

Network Protocol Analysis and Emulation

November 2024

- <u>CAS</u>
- HDLC
- ISDN
- <u>SS7 (C7)</u>
- <u>SS1</u>
- <u>MLPPP</u>
- <u>GPRS</u>
- <u>GSM</u>
- <u>UMTS</u>
- <u>SIGTRAN</u>
- LTE (Long Term Evolution)
- <u>TRAU</u>
- <u>Asynchronous Transfer Mode (ATM)</u>
- Frame Relay protocol analyzer
- <u>CDMA 2000</u>
- Protocol Identifier
- <u>Network Surveillance System</u>

GL Communications Inc.

818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878 Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com

Supported Hardware Platforms



Dual UTA HD



tProbe™ - Portable USB based T1 E1 VF FXO FXS and Serial Datacom Analyzer



USB based T3 E3 Analyzer



Dual T1 E1 Express (PCIe) Board

Quad / Octal T1 E1 PCle Card



VQuad™ Probe HD



SonetExpert™ Analyzer





CAS Protocol Analysis and Emulation

CAS Protocol Analyzer (over T1 E1)

GL's **CAS Protocol Analyzer** supports real-time monitoring and decoding of CAS signaling events over T1 or E1 networks. Supported standards include MFCR2 and R1 protocols. The Real-time CAS Analyzer requires GL's T1 or E1 internal cards or portable USB based T1 or E1 external units, and corresponding software licenses. Users can capture and analyze frames in real -time and record all or filtered traffic into a trace file. The recorded trace file can then be analyzed offline and exported to ASCII file, or printed. For more information, visit <u>CAS</u> <u>Protocol Analysis</u> webpage.

CAS Emulator (over T1 E1)

GL's **CAS Emulator** is a client-side application that works along with the GL's T1/E1 Analyzer cards and Windows Client/Server software. CAS Emulator simulates and analyzes any userdefined CAS protocols by providing signaling bit transitions and forward/backward frequency digits and tones. For more information, visit <u>CAS Protocol Simulation</u> webpage.

MAPS[™] CAS Emulator (over T1 E1)

MAPS[™] CAS Emulator software automates the CAS signaling testing procedure with ready scripts for inbound and outbound calls, and send/receive TDM traffic such as DTMF/ MF digits, Tones, Fax, and Voice. For more information, visit MAPS[™] CAS Emulator.



										Back
CAS Pr	otocol Analysis	MFCR2								<u>_ 0 ×</u>
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$\sqrt{1}$	0	9	17:28:21.067750	28	Digits	DTMF	5	1		
V1	0	10	17:28:21.227750	28	Digits	DTMF	5			
V1	0	11	17:28:21.387750	28	Digits	DTMF	1			
V1	0	12	17:28:21.547750	28	Digits	DTMF	2			
V1	0	13	17:28:21.707750	28	Digits	DTMF	3			
./1	n	14	17-28-21 867750	28	Dinite	DTMF	4			<u>•</u>
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Figure: CAS Analyzer (XX092)



Figure: CAS Simulator (XX625)



Figure: MAPS[™] CAS Emulator (XX651)

CAS Protocol Analysis and Emulation

MAPS™ Central Office Switching Simulator

MAPS[™] Central Office Switching can be used to verify all Wireless, IP and T1/E1 signaling protocols over different transport networks including IP, ATM, and TDM within the network infrastructure. These protocols include variety of GSM/3G, UMTS/3G, T1/E1 CAS, PRI ISDN, SS7, FXO, FXS, No Call Control, and VoIP protocols (SIP, H.323, MEGACO, MGCP, SIGTRAN). It can also simulate a variety of traffic generation such as, digits, tones, voice file, fax, video file, sms, email, and http depending on the.

For more details, visit <u>MAPS[™] Central Office Switching</u> <u>Simulation</u> webpage.



Figure: MAPS[™] Central Office Switching Simulation

VQuad[™] with CAS/ISDN (over T1 E1)

Using the T1/E1 Analyzer, the VQuad[™] can generate and receive up to 12 simultaneous CAS or PRI ISDN or No Call Control (NOCC) calls on T1 or E1 trunks. Once the call is up, sending/recording voice is provided via the VQuad[™] traffic configuration yielding in VQT MOS results.

For more information, visit <u>VQuad™</u> webpage.



Figure: VQuad[™] with CAS Analyzer



HDLC Protocol Analyzer, Record and Playback (over T1 E1, T3 E3, Datacom)

GL's **HDLC Protocol Analysis and Playback** software provides the capability to capture, analyze, record, and transmit HDLC data on a T1/E1, T3/E3, or Datacom lines. The HDLC frames may be contained in single channel (64 or 56kbps), hyper channels (N*64 or N*56kps), or sub channels (n*8kbps). The analyzer is also available as Remote and Offline HDLC analyzer. The HDLC Automated Test System also consists of **Transmitter – Receiver** applications. The Transmitter application generates HDLC test frames, transmits them, or records them to an HDL file for subsequent use with other applications. The Receiver

application can receive frames real-time, or can verify an offline HDL file for correct frame order and data integrity. For more information, visit HDLC Protocol Analyzer webpage.

HDLC Link Impairment Utility

HDLC Impairment Utility impairs HDLC frames on T1 E1 lines, whether they occur on single timeslots at 64/56 kbps rate or as hyper channels. The application is useful in simulating real network conditions, measure the delays, and the impact thereof on protocols. For more information, visit <u>HDLC Link</u> <u>Impairment Utility</u> webpage.

Client-Server HDLC Emulation and Analysis

GL provides client –server based HDLC capture, playback, emulation and analysis modules. The File based HDLC Record/ Playback (**Hdlcfunc**) module allows HDLC Traffic Capture/ Playback. It also allows transmission/reception of *.HDL frames files located on the server and on client. The **HDLCTerr** module performs multi-channel HDLC emulation and analysis. The **HDLCHpio** module performs file–based HDLC record and playback actions. It permits receive / transmit of HDLC streams of various bandwidth (hyper channel, timeslot, and multiple sub-channel streams per timeslot). For more



information, visit <u>HDLC Emulation</u> and Analysis webpage.



Figure: HDLC Protocol Analyzer, Record and Playback Software (XX090)

Figure: Multi Channel HDLC Emulation and Analysis (XX634, XX640, XX641)

Figure: HDLC Link Impairment Utility (XX090)

ISDN Protocol Analysis and Emulation

ISDN Protocol Analyzer (over T1 E1)

GL's **ISDN Protocol Analyzer** can capture and analyze stream of frames on an ISDN PRI link. It decodes LAPD according to Q.921, while, the ISDN information parsing is done based on the user's selection of protocol standards. The analyzer is also available as Remote and Offline ISDN analyzer.

For more information, visit <u>ISDN Protocol Analyzer</u> webpage.

Figure: ISDN Analysis and Emulation Software (XX100)

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Davi	Frank Title Database	N THE THE AND A CONTRACT OF A
Dev	Framew TIME [Freidive]	Len Ellor Froncos IP Packet type Nove Operation -
		IU2 Internet in (in ye)
0030 L	ength	- 55 (x0037)
0032 T	SN	= 8 (x00000008)
0036 5	tream identifier	= 1 (2001)
0038 3	tream sequence sumper	- 5 (XOUSS)
0034 F	ayload Frotocol Identifier	- x0000001 ISDN 0587 Adaptation Layer(10A)
003E Ver	sion	= 00000001 Belease 1 0
0040 Mes	sage Class	= DDDDDDD1 0 921/0 931 Boundary Prinitives Transport (OPTM) Messages
0041 OPT	M Message Type	- 00000010 Data Indication Message
0042 Mes	sage Length	= 39 (x00000027)
0046 Tag		= 1 (x0001)
0048 Len	gth	- 8 (x0008)
004A Int	erface Identifier (integer)	= 0 (x00000000)
004E Ta	g	- 5 (x0005)
0050 Le	ngth	= 8 (x0008)
0052 SA	PI(Service Access Foint Identi:	(ler) = 000000(0)
0053 IE	I(lerminal Endpoint Identifier) = 0000001. (1)
Pro	tocol Data	
0056 1	ag	= 14 (RODE)
0050 L	ength	= 15 (R000F)
n	ingher Layer Data	- X0022004021004E1000301
0054 Pro	tocol Discripinator	= 00001000 0931/T 451 wer-network call control
005B Cal	1 Reference Length	
005C Cal	1 Reference Value	- 4 (.0000000 00000100)
005C Cal	1 Reference Flag	= 1
005E Mes	sage Type	= 00000010 CALL PROCEEDING
005F	IEI Channel Identification	= 00011000 Channel Identification IE Identifier
0060	IE Channel Identification 1	iength = 4 (x04)
0061	Info Channel Selection	01 B1 channel
0061	D-channel Indicator	=0. The channel identified is not the D-channel
0061	Preferred/Exclusive	=0 Indicated channel is preferred
0061	Interface Type	 I Primary Kate Interface
0061	interface identifier Prese	it = .1 interface explicitly identified in one or more octets
0062	Interface identifier	0000000 (U)
0063	Number /War	 Channel is indicated by the number in the following octet
0063	Coding Standard	= 00 ITU f (CIT) standardized ording
0064	Channel number	= 0000001 (1)

Figure: PacketScan[™] ISDN Protocol Analyzer Software (PKV100 and PKV105)

ISDN SIGTRAN Protocol Analyzer (over IP)

GL's <u>PacketScan[™] - All IP Protocol Analyzer</u> supports monitoring all **5G**, **4G**, **3G**, and **2G** wireless communication protocols such as GSM, GPRS, UMTS, ISDN and SS7 SIGTRAN, LTE, and Diameter, in addition to IP protocols such as SIP, MGCP, MEGACO, Skinny, and H.323.

PacketScan[™] cellular protocol analyzers support analyzing signaling across multiple technologies (Mobile, IMS, LTE, SIGTRAN, VoIP, etc.). Monitor calls progressing through advanced 3G or 4G networks from a central location, along with the powerful and customizable reporting tools.

SIGTRAN Analysis over IP by PacketScan[™] permits decoding and analysis of SCTP, and user adaptation (UA) layers such as M2UA, M3UA, M2PA, SUA, IUA, ISUP and GSM MAP. It is used for testing and verification of Signaling Gateways.

For more details, visit ISDN SIGTRAN Protocol Analyzer over IP.

ISDN Protocol Analysis and Emulation (Contd.)

ISDN Protocol Emulator (over T1 E1)

GL's ISDN Emulator provides a user-friendly graphical user interface (GUI), which allows the user to get up and running quickly. From 1 to 4 T1 or E1 trunks can be supported with a mixture of subscriber or switch emulation on different trunks. For more information, visit <u>ISDN Emulator</u> webpage.

MAPS[™] ISDN Protocol Emulator (over T1 E1)

GL's MAPS[™] ISDN Emulator is an advanced protocol emulator/ tester for ISDN simulation over TDM (T1 E1) and generates high volumes of ISDN traffic.

For more information, visit <u>MAPS[™] ISDN Emulator</u> webpage.

MAPS[™] ISDN SIGTRAN Protocol Emulator

GL's MAPS[™] ISDN SIGTRAN Emulator is designed for ISDN

emulation over IP. The tester can simulate a complete ISDN connection SG to MGC, where ISDN signaling is defined by the

For more information, visit MAPS[™] ISDN SIGTRAN Emulator

- Back **ISDN Emulator** _ 🗆 × File Functions View 🔲 🛅 📽 💥 📭 📽 🖭 E, ISDN Setup Protocol Variant Protocol End Stop T1:1 USA AT&T #4ESS Subscriber --• Stop T1:2 USA • AT&T #4ESS -Switch • Start T1:3 USA • AT&T #4ESS • Subscriber • Start T1:4 USA AT&T #4ESS -Subscriber --• Link Up L1 Active Link Down Figure: ISDN Protocol Emulator (XX105)

ITU-T Q.921 / Q.931 standards.

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(over IP)

webpage.

Figure: MAPS[™] ISDN (XX648)

SS7 Protocol Analysis and Emulation

SS7 Protocol Analyzer (over T1 E1)

GL's **SS7 Protocol Analyzer** supports decoding different SS7 layers and many application layer protocols from GSM/GPRS/ UMTS network like MAP, CAMEL (CAP), and so on. The SS7 Analyzer supports decoding of both Low Speed Links (LSL) of 56 kbps or 64 kbps DS0 links or high-speed 1.544 Mbps or 2 Mbps channelized T1 or E1 High Speed Signaling Links (HSL). The analyzer is also available as Remote and Offline SS7 analyzer. For more details, visit <u>SS7 Protocol Analyzer</u> webpage.

ISDN SIGTRAN Protocol Analyzer (over IP)

GL's <u>PacketScan[™] - All IP Protocol Analyzer</u> supports monitoring all **5G**, **4G**, **3G**, and **2G** wireless communication protocols such as GSM, GPRS, UMTS, ISDN and SS7 SIGTRAN, LTE, and Diameter, in addition to IP protocols such as SIP, MGCP, MEGACO, Skinny, and H.323.

PacketScan[™] cellular protocol analyzers support analyzing signaling across multiple technologies (Mobile, IMS, LTE, SIGTRAN, VoIP, etc.). Monitor calls progressing through advanced 3G or 4G networks from a central location, along with the powerful and customizable reporting tools

SIGTRAN Analysis over IP by PacketScan[™] permits decoding and analysis of SCTP, and user adaptation (UA) layers such as M2UA, M3UA, M2PA, SUA, IUA, ISUP and GSM MAP. It is used for testing and verification of Signaling Gateways.

For more details, visit <u>SS7 SIGTRAN Protocol Analyzer over IP</u> webpage.

Figure: SS7 Protocol Analysis (XX120)

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Day	Francett TIME (Delational	sei er an -	Fire	Protocole	IR Packet Tune	NSAP Dependion
1004	4 00.00.04.244419	90	LIIG	Interact (RIP) (1)	II Tacket Type	Now operation
V	4 00:00.04.244410			miterneen (n. 14)		
•						<u>•</u>
018	Header Check Sun	= xAA46				
001A	Source IP Address	= 192.168.	1.85 (x0	COA80155)		
001E	Destination IP Address	= 192.168.	1.201 (1	COA801C9)		
	SCIP Layer	-				
0022	Source Fort Number	= 2905 (x0.	859)			
0024	Destination Port Number	= 2905 (x0.	B59)			
0026	Verification Tag	= 19929279	16 (x/60	(9AAAC)		
JUZA	Checksun	= 15134476	96 (X5A.	356110)		
JUZE	Chunk Type	= 00000000	DATA CE	iunk		
JU2F	Ubit		Ordered	1 DATA chunk		
JUZE	Beginning/Ending Dits	=	Reserve	5G		
0030	Length	= 44 (2002	00011			
1032	Chunge Identifier	- 1 (x0000	0001)			
0036	Stream Identifier	- 1 (X0001	{			
0038	Stream Sequence sumper	= 1 (X0001	A MTDO I	Terror and and a terror	Terrer (Matta)	
	WTP2 Hear Adaptation Tawar a	- X0000000	5 MILS (ser anabrar	ION TRAFT(HION)	
1038	Version	= 00000001	Pelease	1.0		
1040	Meesane Class	= 00000001	Transfe			
0040	Transfer Mercade Tune	- 00000001	Particas	Data		
1042	Meesage Tength	= 28 (¥000	00010			
0042	Protocol Data	=	00010)			
1046	Tag	= 528 (x02	10)			
0048	Length	= 20 (v001	4)			
	Originating Point Code	-	• /			
104C	Point Code	= 0.32.21	000001	00000010)		
	Destination Point Code	=				
0050	Point Code	= 0.32.1(.	.000001	00000001)		
0052	Service Indicator	= 0101	ISDN Us	er Part		
0053	Network Indicator		Nations	1 Network		
0054	Message Priority	=	Priorit	v Code 0		
0055	Signalling Link Selection	=0001	(1)			
	ISUP Laver	-				
0056	Circuit Identification Code	= 00000001		00 (1)		
0058	Message Type	- 00001001	Ansver			
	Mandatory Fixed Parameters					
0059	Pointer to optional parameters	= x00 (0)				
	Mandatory Variable Length Parameters	- None				
	Optional Variable Length Parameters	= None				
	Sector acceleration and acceleration of the provident of the sector of the sector of the sector of the					

Figure: PacketScan[™] SS7 Protocol Analyzer Software (PKV100 and PKV105)

SS7 Protocol Analysis and Emulation (Contd.)

MAPS[™] SS7 Protocol Emulator

The **MAPS[™] SS7 Emulator** is designed tester for ISUP simulation over TDM (T1 or E1). MAPS[™] SS7 can simulate Service Switching Point (SSP). The ISUP signaling specification conforms to ITU-T and ANSI standards. For more details, visit <u>MAPS[™] ISUP Protocol Emulator</u> webpage.

MAPS[™] SIGTRAN Protocol Emulator

MAPS[™] SIGTRAN Emulator is designed for SS7 simulation over IP Networks. It can emulate a Signaling Gateway and Softswitch ISUP signaling specification as defined by ITU-T standards. For more details, visit <u>MAPS[™] SIGTRAN Protocol</u> <u>Emulator</u> webpage.

Figure: MAPS[™] SS7 Emulator (XX649)

Figure: MAPS[™] SIGTRAN Emulator (PKS130)

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SS1 Protocol Analysis and Emulation (*Contd*.)

SS1 Protocol Analyzer (over T1 E1)

The GL's **SS1 protocol analyzer** detects and analyzes tone sequences that make up SS1 dial digits. Sequences of pulse and guard tones are detected, decoded, and assembled into their corresponding dial digits. For more details, visit <u>SS1</u> <u>Protocol Analyzer</u> webpage.

configure new conflect Run Results in	elp								
Setup Load Save Connect	t Disconnec	t View WC	S Ru	n Stop	Real-	Time From	n File	llear	Nelp
#¥ 16:45:44 ' 8' TS=#1:0 dur=1025 (Dia	Seq#	Channel	Time	ID	Freq	Power	Duration	Tot Pwr	S/N ▲
# 16:45:41 '558' TS=#1:0 dur=1027	10-1-01	#1:0	16:45:44	SS1/mark	2601	-8.0	100	-8.0	31
# 16:45:39 '963' T5=#1:0 dur=527	10-1-02	#1:0	+0.100	SS1/space	2401	-7.9	42	-7.9	21
16:45:36 '478' TS=#1:0 dur=1027	10-1-03	#1:0	+0.141	SS1/mark	2601	-8.0	59	-8.0	40
16:45:35 '215' TS=#1:0 dur=726	10-1-04	#1:0	+0.201	SS1/space	2401	-7.9	41	-7.9	23
16,42,16 1 0 TS-#110 dam-1025 (0)	10-1-05	#1:0	+0.241	SS1/mark	2601	-8.0	59	-8.0	40
	10-1-06	#1:0	+0.301	SS1/space	2401	-7.9	41	-7.9	21
H → +0.000 8 15=#1:0 dur=1025	10-1-07	#1:0	+0.341	SS1/mark	2601	-8.0	59	-8.0	40
8-√ 16:42:14 '558' TS=#1:0 dur=1027	10-1-08	#1:0	+0.401	SS1/space	2401	-7.9	41	-7.9	23
	10-1-09	#1:0	+0.441	SS1/mark	2601	-8.0	59	-8.0	40
	10-1-10	#1:0	+0.501	SS1/space	2401	-7.9	41	-7.9	21
e ✓ 16:42:07 '215' TS=#1:0 dur=726	10-1-11	#1:0	+0.541	SS1/mark	2601	-8.0	59	-8.0	40
	10-1-12	#1:0	+0.601	SS1/space	2401	-7.9	41	-7.9	23
	10-1-13	#1:0	+0.641	SS1/mark	2601	-8.0	59	-8.0	40
	10-1-14	#1:0	+0.701	SS1/space	2401	-7.9	41	-7.9	21
	10-1-15	#1:0	+0.741	SS1/mark	2601	-8.0	59	-8.0	40
	10-1-16	#1:0	+0.801	SS1/space	2401	-8.0	224	-8.0	27
	9-1-01	#1:0	16:45:41	SS1/mark	2601	-8.0	100	-8.0	31
	9-1-02	#1:0	+0.100	SS1/space	2401	-7.9	41	-7.9	24
	9-1-03	#1:0	+0.141	SS1/mark	2601	-8.0	59	-8.0	40
	9-1-04	#1:0	+0.201	SS1/space	2401	-7.9	41	-7.9	23
	9-1-05	#1:0	+0.241	SS1/mark	2601	-8.0	59	-8.0	40
	9-1-06	#1:0	+0.301	SS1/space	2401	-7.9	41	-7.9	24
	9-1-07	#1:0	+0.341	SS1/mark	2601	-8.0	59	-8.0	40
	9-1-08	#1:0	+0.401	SS1/space	2401	-7.9	41	-7.9	23
	9-1-09	#1:0	+0.441	SS1/mark	2601	-8.0	59	-8.0	40
	9-1-10	#1:0	+0.501	SS1/space	2401	-8.0	224	-8.0	28
	. 0 2 01	#1.0	10 725	CCI Imade	2601	0.0	100	0.0	24

Back

Figure: SS1 Analyzer Software (XX626)

SS1 Emulator (over T1 E1)

The SS1 Emulator (Dialer) application provides the ability to setup and dial tone sequences that make up SS1 dial digits. The applications' interface includes options to setup Dial Code, and control Mask (pulse) and Space (guard) frequencies and duration, Initial, Nominal, and Final Durations, Timeout definitions, Transmit Channel, and other similar parameters related to the dial code. For more details, visit <u>SS1 Emulator</u> <u>over T1 E1</u> webpage.

Figure: SS1 Emulation Software (XX626)

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MLPPP and PPP Protocol Analyzer (over T1 E1, T3 E3, OC3 OC12, Datacom)

The **MLPPP Protocol Analyzer** can be used to capture and decode a host of PPP, MLPPP, and MC-MLPPP protocols exchanged between pairs of nodes over T1 E1, T3 E3, or OC3 OC12 links. MLPPP analyzer also supports **Packet Data Analysis** module (requires additional license) to perform detail analysis of packets over IP and segregates them into SIP / H.323 / MEGCO / MGCP / T.38 Fax calls. The analyzer is also available as Remote and Offline MLPPP analyzer. For more details, visit PPP Analyzer webpage.

MC-MLPPP Emulator (over T1 E1)

GL's flexible and versatile MC-MLPPP Emulator is GUI based WCS client, which simulates MC-MLPPP and PPP protocols over T1 or E1 links. The unit is capable of generating and receiving MC-MLPPP/PPP traffic (with or without impairments). For more details, visit <u>Mc-MLPPP Emulator over</u> <u>T1 E1</u> webpage.

MAPS[™] MC-MLPPP Conformance Tester (over T1 E1)

GL's **MAPS[™] MC-MLPPP** is an advanced protocol emulator/ tester for MC-MLPPP/MLPPP/PPP protocols over TDM (T1 E1). The tester can simulate a complete PPP/MLPPP link between two peers (Router or a Switch), with MLPPP signaling conforming to IETF specifications. For more details, visit <u>MAPS</u> <u>Mc-MLPPP Conformance Tester</u>.

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1	4		10	00.00.07.430	21	Link Control			Ecko Roguest		2.1
1	1		11	00.00.07.022	59	ML PPP	0	0	Echo-Request		
1	1		12	00:00:07:057	16	ML PPP	1	0	E CHO HOQUEM	Contigure-Bequest	
1	2		13	00:00:08 196	21	Link Control		Ŭ	Echo-Bequest	Compare ricqueer	
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Figure: MLPPP and PPP Protocol Analyzer (XX135)

MC-MLPPP Emulator	
ijle <u>A</u> ction <u>H</u> elp	Simulation
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Class Locally Assigned Address	Address and Control Field Compression Maximum Differential Delay 250 ms
VCP Network Control Protocol IPCP Nep Over MLPPP Options Option type IP Address	
IP Address 0 0 0 IP Per IP Address 0 0 0	

Figure: MC MLPPP Emulator (XX634)

MAPS (Message Automation Protocol Simulation) (MLI	PPP IETF) - [Call Ge	neration - Untitle	ed]				_ D ×					
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	N N	axinum-Receiv	e-Unit				ك.					
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Scripts Message Sequence Event Config & Script F	Flow											

Figure: MAPS[™] MC MLPPP Emulator (XX652)

GPRS Protocol Analysis and Emulation

GPRS Protocol Analyzer (over T1/E1)

The **GPRS Protocol Analyzer** when connected between SGSN and BSS elements of a GPRS network permits the monitoring of Gb interface. Similarly, when connected between SGSN and GGSN elements, permits monitoring of the Gn interface. The analyzer is also available as Remote and Offline GPRS analyzer.

For more details, visit <u>GPRS Protocol Analyzer</u> webpage.

GPRS Protocol Analyzer (over IP)

GL's <u>PacketScan[™] - All IP Protocol Analyzer</u> supports monitoring all **4G**, **3G**, **2G**, and wireless communication protocols such as GSM, GPRS, UMTS, SIGTRAN, LTE, and Diameter, in addition to IP protocols such as SIP, MGCP, MEGACO, Skinny, and H.323.

PacketScan[™] cellular protocol analyzers support analyzing signaling across multiple technologies (Mobile, IMS, LTE, SIGTRAN, VoIP, etc.). Monitor calls progressing through advanced 3G or 4G networks from a central location, along with the powerful and customizable reporting tools

GPRS Analysis over IP by PacketScan[™] permits decoding and analysis of signaling and user data protocols over Gb and Ga/ Gn interfaces.

MAPS[™] GPRS Gb Emulator (over IP)

MAPS[™] GPRS Gb Emulator is designed to simulate GPRS Gb interface between the BSS and the SGSN over IP transmission protocol. MAPS[™] GPRS Gb Emulator supports various procedures including Network Service Control, Identity Check, Combined GPRS / IMSI Attach, and Routing Area Update. It can run pre-defined test scenarios against the interface test objects in a controlled and deterministic manner. For more details, visit MAPS[™] GPRS Gb Emulator webpage.

Figure: GPRS Protocol Analyzer Software (XX155)

Pac	ketScan (All-in-One)				
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002A	PN			.1 Present	
002B	Message Type		= 111111	L11 G-PDU	
082C	Length of GTP }	lessage	= 69 (xC	0045)	
002E	Tunnel Endpoint	Identifier	= 8 (x00	1000008)	
0032	Sequence Number		= 1482 ((NUSCA)	
	No Extension He	ader	= x00		
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0038	Total Length		= 65 (x0	0041)	
003A	Identification		- 26033	(x65B1)	
003C	Reserved		= 0	(0)	
003C	DF		= .0	May Fragment	
003C	HF		=0	Last Fragment	
003C	Fragment Offset		= 0 (00000 00000000)	
003E	Time To Live		= 255 (>	(FF)	
003F	Protocol		= 000100)01 User Datagram	
0040	Header Check Sua		= xE5F5		
0042	Source IP Addres	18	= 192.16	8.2.201 (xCUA802C9)
0046	Destination IP #	ddress	= 125.22	2.47.125 (x7D162F7D)
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Figure: PacketScan[™] GPRS Protocol Analyzer Software (PKV100 and PKV103)

Figure: MAPS[™] GPRS Gb Emulator (PKS133)

GSM Protocol Analyzer (over T1 E1)

GL's **GSM Protocol Analyzer** is used to analyze GSM protocols, a switching and signaling telecommunication protocol between MSC & BSC, BSC & BTS, MSC & SMLC, UMA & MS, and so on. GSM protocol analyzer also supports decoding proprietary 'Mobis' Interface (Motorola equivalent of the GSM A-bis interface) between BSC - BTS and BSC - PCU. Other interfaces supported include Ls / Lb / Lp Interface (Interface between MSC and SMLC), and Up (Interface between UNC (UMA network controller) and MS). The analyzer is also available as Remote and Offline GSM analyzer.

For more details, visit <u>GSM Protocol Analyzer</u> webpage.

GSM Protocol Analyzer (over IP)

GL's <u>PacketScan[™]- All IP Protocol Analyzer</u> supports monitoring all **5G**, **4G**, **3G**, and **2G wireless communication protocols** such as GSM, GPRS, UMTS, SIGTRAN, LTE, and Diameter, in **addition** to **IP protocols** such as SIP, MGCP, MEGACO, Skinny, and H.323.

PacketScan[™] cellular protocol analyzers support analyzing signaling across multiple technologies (Mobile, IMS, LTE, SIGTRAN, VoIP, etc.). Monitor calls progressing through advanced 3G or 4G networks from a central location, along with the powerful and customizable reporting tools.

GSM interfaces supported over IP by **PacketScan™** are:

- A (b/w BSC and MSC)
- A-bis (b/w BSC and BTS)

For more details, visit GSM Protocol Analyzer over IP webpage.

Figure: GSM Protocol Analyzer (XX150)

No. No. <th>(Pac le Vi</th> <th>ketScan iew Capt</th> <th>ure Statis</th> <th>Une) tics Da</th> <th>tabase</th> <th>Call D</th> <th>stail Reco</th> <th>rds Cor</th> <th>figure</th> <th>Help</th> <th></th> <th></th> <th></th> <th></th> <th>JĽ</th>	(Pac le Vi	ketScan iew Capt	ure Statis	Une) tics Da	tabase	Call D	stail Reco	rds Cor	figure	Help					JĽ
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															ġ

Figure: PacketScan[™] GSM Protocol Analyzer (PKV100 and PKV103)

GSM Protocol Analysis and Emulation (*Contd*.)

MAPS[™] GSM A and Abis Emulator (over T1 E1)

GL's **MAPS[™] GSM A Emulator** can emulate A Interface network elements MSC and BSC by generating and receiving BSSMAP and DTAP messages.

For more details, visit <u>MAPS[™] GSM A Emulator over T1 E1</u> webpage

GL's **MAPS[™] GSM Abis Emulator** can simulate Abis interface network elements BTS and BSC by generating and receiving BTSM messages. The signaling specification conforms to ITU-T and 3GPP standards.

For more details, visit <u>MAPS[™] GSM Abis over T1 E1</u> webpage.

MAPS[™] GSM A and Abis Emulator (over IP)

Station Controller), and MSC (Mobile Switching Center) entities on GSM A interface over IP. For more details, visit

MAPS[™] GSM A over IP Emulator webpage.

For more details, visit MAPS[™] webpage.

GL's MAPS[™] GSM A IP is designed for emulating BSC (Base

GL's MAPS[™] GSM Abis IP can emulate BTS and BSC elements

specification conforms to 3GPP standards. The traffic handling

by generating and receiving BTSM messages. The signaling

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Figure: MAPS[™] GSM A IP (PKS137)

capabilities supports RTP traffic.

TRAU Protocol Analyzer and Playback (over T1 E1)

GL's TRAU Protocol Analyzer is used to non-intrusively monitor TRAU frames at the Abis interface (between the BTS (CCU) and the TRAU node at BSC/MSC). The application can automatically detect and capture TRAU frames of half rate (HR -8 kbps) or full rate (FR-16 kbps). The analyzer also supports TRAU Packet Data Analysis which provide detail packet analysis in tabular and graphical formats as well as detailed frame-by-frame information. The analyzer is also available as Remote and Offline TRAU analyzer. For more details, visit TRAU Analyzer webpage. The TRAU Traffic Playback provides the ability to playback the recorded TRAU HDL file(s) on selected/all subchannels of T1 or E1 lines. The application allows the user to transmit a single or multiple files on the desired subchannels at any given time. TRAU frames are timealigned as per the control information in the frame. For more details, visit TRAU Traffic Playback webpage.

TRAU Toolbox[™] Emulator (over T1 E1)

GL's **TRAU Toolbox™** is used to create, monitor, and terminate multiple TRAU/GSM traffic. Once the TRAU session is created, different kinds of audio/voice/digits can be generated and analyzed on GSM call with various codecs. **TRAU Toolbox™** is an ideal tool to test network elements at A-bis and A interface. For more details, visit <u>TRAU Tool</u> webpage.

MAPS[™] GSM Abis Emulator (over T1 E1)

GL's **MAPS[™] GSM Abis** can emulate BTS and BSC elements by generating and receiving BTSM messages. The signaling specification conforms to ITU-T and 3GPP standards. The traffic handling capabilities supports TRAU traffic. The TRAU Traffic commands includes Transmit TRAU DTMF Digits (Send TRAU File, Send TRAU Tones), Monitor TRAU Digits, Rx TRAU File, Monitor TRAU Tones, and Stop Traffic Actions.

For more details, visit <u>MAPS™</u> webpage.

Figure: TRAU Protocol Analyzer and Playback (XX153)

Figure: TRAU Toolbox Emulator (XX153)

Figure: MAPS[™] GSM Abis (XX693)

UMTS Protocol Analysis and Emulation

UMTS Protocol Analyzer (over T1 E1, OC3 OC12)

GL's **UMTS Protocol Analyzer** is capable of capturing, decoding and performing various test measurements across various interfaces i.e. lub, lur, luCS and luPS interfaces of the UMTS network based on ATM transport layer. The analyzer is also available as Remote and Offline UMTS analyzer. It helps in fault diagnosis and troubleshooting of UMTS network on T1/E1 and OC-3 / OC-12 lines. For more details, visit <u>UMTS analyzer</u> webpage.

Figure: MAPS[™] UMTS Analyzer (XX165, LTS206, LTS306)

UMTS Protocol Analyzer (over IP)

GL's <u>PacketScan[™]- All IP Protocol Analyzer</u> supports monitoring all **5G**, **4G**, **3G**, and **2G wireless communication protocols** such as GSM, GPRS, UMTS, SIGTRAN, LTE, and Diameter, in **addition** to **IP protocols** such as SIP, MGCP, MEGACO, Skinny, and H.323.

PacketScan[™] cellular protocol analyzers support analyzing signaling across multiple technologies (Mobile, IMS, LTE, SIGTRAN, VoIP, etc.). Monitor calls progressing through advanced 3G or 4G networks from a central location, along with the powerful and customizable reporting tools.

UMTS IuCS and IuPS supported over IP by **PacketScan™** permits -

- Testing RNC, MSC, Home NodeB (HnB) and Home NodeB Gateway (HN GW) entities.
- Decode and analyze different control plane protocols i.e. NBAP, RNSAP, RANAP and more over IuCS, IuH, and IuPS interfaces

Figure: PacketScan[™] UMTS Analyzer (XX165, LTS206, LTS306)

UMTS Protocol Analysis and Emulation (*Contd*.)

MAPS[™] UMTS luPS Emulator (over IP)

MAPS[™] UMTS luPS can emulate luPS interface with RNC, and 3G SGSN entities by generating RANAP and DTAP signaling messages over IP (SCTP as Transport layer). For more details, visit MAPS[™] UMTS luPS Emulator webpage.

MAPS[™] UMTS luCS luH Emulator (over IP)

MAPS[™] UMTS IuCS Emulator can emulate the RNC and the MSC nodes by generating RANAP and DTAP signaling messages over SCTP as Transport layer. MAPS[™] UMTS IuH Emulator can simulate Femto Home Node B (HnB), and a Femto Home Node Gateway (HnB-GW) by generating RANAP and DTAP signaling messages over SCTP as Transport layer.

For more details, visit <u>MAPS[™] UMTS luCS luH Emulator</u> webpage.

MAPS[™] Gn Gp Interface Emulator

GL's **MAPS[™] Gn Gp Emulator** can emulate GTP messages over Gn, Gp interfaces with signaling specification as per 3GPP TS 29.060 GPRS Tunneling Protocol (GTP) standard. For more details, visit <u>MAPS[™] Gn Gp Emulator</u> webpage.

Figure: MAPS[™] UMTS IuPS Emulator (PKS164)

Figure: MAPS[™] UMTS Gn Gp Interface Emulator (PKS166)

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SIGTRAN Protocol Analyzer

GL's <u>PacketScan[™]- All IP Protocol Analyzer</u> supports monitoring all **2G**, **3G**, **4G**, and **5G wireless communication protocols** such as GSM, GPRS, UMTS, SIGTRAN, LTE, and Diameter, in **addition** to **IP protocols** such as SIP, MGCP, MEGACO, Skinny, and H.323. The analyzer is also available as Remote and Offline PacketScan[™] analyzer.

PacketScan[™] cellular protocol analyzers support analyzing signaling across multiple technologies (Mobile, IMS, LTE, SIGTRAN, VoIP, etc.). Monitor calls progressing through advanced 3G or 4G/5G networks from a central location, along with the powerful and customizable reporting tools.

PacketScan[™] SIGTRAN analyzer supports SCTP, M2UA, M3UA, M2PA, SUA, IUA, SIGTRAN protocols. For more details, visit <u>PacketScan[™] SIGTRAN Analyzer</u> webpage.

MAPS[™] ISDN SIGTRAN Protocol Emulator

MAPS[™] ISDN SIGTRAN is a powerful tool that can be used to perform detailed testing of ISDN protocol messages over IP, and offers a complete solution for testing, troubleshooting, and maintenance of devices and networks implementing PRI ISDN. For more details, visit MAPS[™] ISDN SIGTRAN Emulator webpage.

MAPS[™] SIGTRAN (SS7 IP) Protocol Emulator

GL's **MAPS[™] SIGTRAN** is an advanced protocol emulator/ tester for SS7 emulation over IP Networks. It can simulate a Signaling Gateway and Soft switch ISUP signaling specification as defined by ITU-T standards.

For more details, visit <u>MAPS[™] SIGTRAN (SS7) Protocol</u> <u>Emulator</u> webpage.

Figure: PacketScan[™] SIGTRAN Analyzer (PKV105)

Figure: MAPS[™] SS7 SIGTRAN Emulator (PKS130)

LTE Protocol Analysis and Emulation

LTE Protocol Analyzer

GL's **LTE Protocol Analyzer** is capable of capturing, decoding and performing various test measurements across various interfaces i.e. S1, S3, S4, S5 (or S8), S6a, S10, S11, S13 and X2 interfaces of the LTE network. The analyzer is also available as Remote and Offline LTE analyzer. For more details, visit <u>LTE</u> <u>Analyzer</u> webpage.

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Figure: LTE Protocol Analyzer Software (PKV107)

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Figure: MAPS[™] LTE S1 Emulator (PKS140) and MAPS[™] LTE eGTP-c Emulator (PKS142)

CEMENDE Objectsory Automation produced Considering and an analysis of the second and analysis of the second analysis of the second analysis of the second analysis of the second an

Figure: MAPS[™] LTE for X2 AP Emulator (PKS141)

MAPS[™] LTE S1 Emulator

GL's MAPS[™] designed for testing LTE – S1 interface (any interface excluding Air interface) can emulate eNodeB (Evolved Node B), and MME (Mobility Management Entity). For more details, visit MAPS[™] LTE S1 webpage.

MAPS[™] LTE eGTP-c Emulator

GL's MAPS[™] designed for testing LTE S11, S5/S8 (eGTP) interfaces can emulate MME (Mobility Management Entity), SGW (Serving Gateway), and PGW (Packet Data Network Gateway) network elements. For more details, visit <u>MAPS[™]</u> <u>LTE eGtp</u> webpage.

MAPS[™] LTE X2 Emulator

GL's MAPS[™] X2 Application Protocol (X2-AP) is used to coordinate handovers and perform load management between eNodeB (Evolved Node B) network elements - Source eNodeB and Target eNodeB. For more details, visit <u>LTE X2 Application</u> <u>Protocol Testing</u> webpage.

ATM Protocol Analysis and Emulation

ATM Protocol Analyzer (over T1 E1, T3 E3, OC3 OC12)

GL's **Asynchronous Transfer Mode (ATM) Protocol Analyzer** is used to analyze and decode different ATM protocols like ATM, AAL2 Protocols (CPS-SDU, SSSAR-SDU, and SSCS), AAL5 (CPCS), UNI etc. across U plane and C plane of UNI and NNI interface over T1 E1, T3 E3, OC3 OC12. The analyzer can also decode ATM frames constituting Classical IP over ATM, or CIP based networks, and traditional SS7 Stack (ISUP, SCCP, MAP, CAMEL (CAP) etc.) over ATM. The analyzer is also available as Remote and Offline HDLC analyzer.

For more details, visit <u>ATM Protocol Analyzer</u> webpage.

Client-Server ATM IMA Emulator (over T1 E1)

GL's **ATM IMA (Inverse Multiplexing over ATM) Emulator** is client-server based application with GL's T1 E1 Analysis hardware. The ATM IMA Emulator application can simulate the inverse multiplexing of an ATM cell stream over multiple physical links (up to 16 T1 or E1 ports) and retrieve the original stream at the far-end from these physical links.

For more details, WCS ATM IMA Emulator webpage.

Figure: ATM Analyzer Software (XX160)

MA Group	Status	Link View Acti	on VC Statisti	cs Tx/Rx Verification	n IMA Config & Statistics
Second States	None		1		
	None	Link Name	Action	Status	
		#1:04	Open	Not In Group	
		#1:59	Open	Not In Group	
		#1:1014	Open	Not In Group	
		#1:15.19	Open	Not In Group	

Figure: ATM IMA Emulator Software (XX654)

Frame Relay Protocol Analysis and Emulation

Frame Relay Protocol Analyzer (over T1 E1, T3 E3, Datacom)

GL's **Frame Relay Protocol Analyzer** can be used to analyze and decode frames conforming to Q.921, Q.922, LAPF, Frame Relay Forum standard -FRF.9 and FRF.12, Multiple Protocol Encapsulation, LCP RFC1661, Q.933 SVC and LMI SNAP, PPP, IP, SMTP, POP3 and so on. The analyzer is also available as Remote and Offline Frame Relay analyzer. For more details, visit <u>Frame Relay Analyzer</u> webpage.

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Figure: Frame Relay Analyzer Software (XX130)

Client-Server Multi-link Frame Relay Emulation (over T1 E1)

Multi-Link Frame Relay, or MFR, is similar to Multi-Link PPP, and both are a form of inverse multiplexing. MFR works by bundling multiple T1 circuits into a multilink bundle and fragmenting the individual frame relay frames into fragments. These fragments are then transported in parallel over the multiple T1 circuits.

For more details, visit WCS Frame Relay Emulator webpage.

MFR Emulator - MFR Simulatio Eile Action Simulation Help Server Connection Status	on - Untitled	_
Bundles Status DOWN 2 No Links	Link Wew Action VC:Statistics Tx/Rx:Verification Bundle Config 8:Statistics Link Name Action Status #1:1:10 Open Down #1:1120 Open Down #1:1230 Down	
Bundle ID 3	Add Delete Core Link Config Impairments Statistics Fragmentation Fileps between Hdc frames 100 © Unit Nil Fragmentation © End to End Fragmentation	
Add Delete Open Close		

Figure: Multi-link Frame Relay (MFR) Emulation with Client-Server (XX655)

CDMA, GR-303 Protocol Analysis

CDMA 2000 Protocol Analyzer (over T1 E1)

GL's **CDMA Protocol Analyzer** can be used to analyze and view protocols across A1 (between Base Station Controller and Mobile Switching Centre), A3 and A7 (between two Base Station Controllers), A9 (between Base Station Controller and Packet Control Function), and A11 (between Packet Control Function and PDSN) signaling interfaces. The analyzer is also available as Remote and Offline CDMA analyzer. For more details, visit <u>CDMA 2000 Analyzer</u> webpage.

GR-303 Protocol Analyzer (over T1 E1)

GL's **GR303 Protocol Analyzer** offers testing for all aspects of GR-303 systems: monitoring T1 Line, monitoring the TMC/CSC control channel, monitoring EOC channel, viewing robbed ABCD signaling and dialed digits, listening to voice channels, and thorough tests for the physical layer. GR-303 uses three message-based signaling channels namely, Timeslot Management Channels (TMC), Common Signaling Channels (CSC), and Embedded Operation Channels (EOC). TMCs are used for timeslot allocation and call processing messages between the RDT and the LDS. For more details, visit <u>GR-303</u> <u>Analysis</u> webpage.

Protocol Identifier

The **Protocol Identifier** application can identify various protocols, traffic types at a concentration point, DSX patch panel, or multiplexed facility on T1 or E1 lines. Supported protocols are - ISDN, ATM, HDLC, MTP2, LAPD, SS7, PPP, GSM, GSM Abis, TRAU, and Frame Relay. The timeslots and the subchannels within the timeslots are also identified. Once identified, a detailed protocol analysis can be carried out by individual protocol analyzers. This application is helpful in identifying For more details, visit <u>Protocol Identifier</u> webpage.

Figure: CDMA 2000 A1 Interface (XX142, OLV142)

Figure: Protocol Identifier (XX089)

Network Monitoring Solutions (NMS)

NMS for 3G Networks (over T1 / E1 / IP)

The network monitoring systems facilitate real-time analysis, historical storage, retrieval, querying, and display of **Call Detail Records (CDRs)** by non-intrusively connecting to **TDM**, **Optical**, **or IP networks**.

- Typical application includes Call Detail Records, fraud detection and location, remote protocol analysis and troubleshooting, real-time signaling monitor, traffic optimization engineering, statistics
- NMS features include a central database for historical and near real time data storage, a WebServer for "browser based" access to information
- Records are stored into a relational database (Oracle, DB2, Sybase, Microsoft Access, etc.) using ODBC
- The web-based client NetSurveyor[™] connected to T1 / E1 / IP probes through a web server facilitates result display using a web interface

For more information, visit <u>Network Monitoring and</u> <u>Surveillance System</u> webpage.

