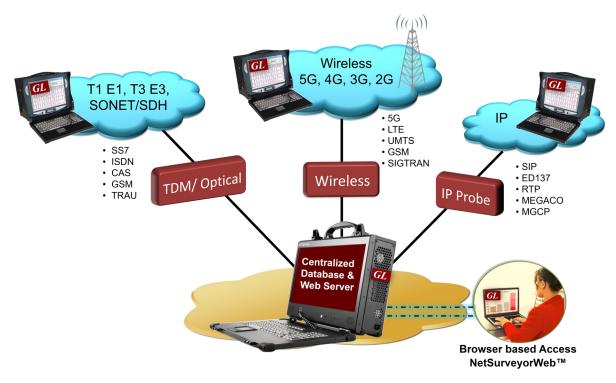
Network Monitoring and Surveillance Solutions

For TDM, VoIP, and Wireless Networks



Overview

GL's Network Monitoring and Surveillance System is web-based application that facilitate display of CDRs by connecting to TDM, Optical, or IP probes through a web server for monitoring physical layer, signaling and traffic at various points in such networks. Supported protocols include SIP, SS7, ISDN, VoIP (SIGTRAN, SIP, H.323), GSM, GSMA TRAU, MAP, IuCS, CAMEL, IuPS, LTE, and so on.

GL provides a variety of solutions for network wide monitoring and surveillance. The solutions consists of:

- Intrusive and non-intrusive 'PC Probes' for TDM, VoIP, and Wireless networks
- Probes deployed at strategic locations in a network transmit and collect voice, data, protocol, statistics, quality measurements, and performance information. These are relayed to a centrally distributed network management system (NMS)
- NMS may be client-server based or Web based system and consists of a database and applications for controlling, collecting, and analyzing the information provided by the various probes

The system can be used for billing verification, remote protocol analysis, traffic engineering, calculating key performance indicators, failure analysis, and call trace functionality. The architecture is uniform across all types of networks, TDM, IP, and Wireless. This results in a reliable, user-friendly and uniform approach to Reports, Administration, and Maintenance.

GL's current NMS solutions for VoIP, Wireless, and TDM networks are:

- <u>Voice, Video, and Data Quality Testing and Monitoring System for any network</u>
- IP Network Monitoring and Surveillance System (passive / non-intrusive) SIP, RTP, H.323, SIGTRAN, MAP
- <u>Wireless Network Monitoring and Surveillance System (passive / non-intrusive)</u> GSM, UMTS, LTE, Diameter, IMS
- TDM and Optical Network Monitoring and Surveillance System (passive / non-intrusive probes) SS7, ISDN, GSM Abis, TRAU
- <u>Digital T1 / E1 Line Monitoring, Test, and Diagnostic System</u>

For more details, refer to <u>Network Monitoring Solutions</u> webpage.

🕼 GL Communications Inc.

818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878, U.S.A (Web) <u>www.gl.com</u> - (V) +1-301-670-4784 (F) +1-301-670-9187 - (E-Mail) <u>info@gl.com</u>

IP Network Monitoring and Surveillance System (VoIP)

Response Time : 0.00300 Seconds Orage view Decode Type : 0 TU ANSI Calified Query Editor Debug Summary (Export as CSV) RATCOCOLIVE FRAMENO TIMESTAMP PROTOCOLSPECIFIC S57 1158 2015-09-14 23:58:49.206500 ISUP Message : Initial address , OPC : 2.2.2, DPC : 3.3.3, CIC : 52, CARD : 7, Timeslot 2: 31, Caling Number : 222997095821, Calied Number S1P 10235 2015-09-14 23:58:49.269309 SIP Method : INVITE , Source IP : 192.168.1.174, Destination IP : 192.168.1.231, UDP Source Port : 54098, UDP Destination Port : 5060 S1P 10236 2015-09-14 23:58:49.270501 SIP Method: SIP/2.0 100 Trying, Source IP : 192.168.1.231, Destination IP : 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 S1P 10238 2015-09-14 23:58:49.27051 SIP Method: SIP/2.0 200 OK, Source IP : 192.168.1.231, Destination IP : 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 S1P 10238 2015-09-14 23:58:49.277529 SIP Method: SIP/2.0 200 OK, Source IP : 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 S1P 10238 2015-09-14 23:58:49.277529 SIP Method: ACK, Source IP : 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 S1P 2222(31) 3.33(31) 192.168.1.174, SP Employee at : 3646616333:	: 8888978675421 , SLS :
557 1158 2015-09-14 23:58(49,206500 ISUP Message : Initial address, OPC : 2.2.2, DPC : 3.3.3, CIC : 52, CARD : 7, Timeslot : 31, Timeslot 2: 31, Calling Number : 2229987095821, Called Number 51P 10235 2015-09-14 23:58(49,26930 SIP Method: INVITE, Source IP : 192.168.1.231, Destination IP : 192.168.1.231, UDP Source Port : 5060, UDP Destination Port : 5060 51P 10236 2015-09-14 23:58(49,26930 SIP Method: SIP/2.0 100 Trying, Source IP : 192.168.1.231, Destination IP : 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 51P 10237 2015-09-14 23:58(49,270760 SIP Method: SIP/2.0 180 Ringing , Source IP : 192.168.1.231, Destination IP : 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 51P 10238 2015-09-14 23:58(49,270760 SIP Method: SIP/2.0 180 Ringing , Source IP : 192.168.1.231, Destination IP : 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 51P 10239 2015-09-14 23:58(49,277529 SIP Method: ACK , Source IP : 192.168.1.174, Destination IP : 192.168.1.231, UDP Source Port : 5060, UDP Destination Port : 5060 537 537 537 S57 S57 S19 540 10249 2015-09-14 23:58(49,277529 SIP Method: ACK , Source IP : 192.168.1.174, Destination IP : 192.168.1.231, UDP Source Port : 5060, UDP Destination Port : 5060 22.2(31) 3.3.3(31) 192.168.1.174 BE <	: 8888978675421 , SLS :
SIP 10235 2015-09-14 23:58:49.269369 SIP Method: INVITE, Source IP: 192.168.1.174, Destination IP: 192.168.1.174, UDP Source Port: 5000, UDP Destination Port: 5000 SIP 10236 2015-09-14 23:58:49.269970 SIP Method: SIP/2.0 100 Trying, Source IP: 192.168.1.231, Destination IP: 192.168.1.174, UDP Source Port: 54098, UDP Destination Port: 5000 SIP 10237 2015-09-14 23:58:49.270261 SIP Method: SIP/2.0 100 Kr, source IP: 192.168.1.231, Destination IP: 192.168.1.174, UDP Source Port: 54098, UDP Destination Port: 5000 SIP 10238 2015-09-14 23:58:49.270740 SIP Method: SIP/2.0 200 OK, Source IP: 192.168.1.231, Destination IP: 192.168.1.174, UDP Source Port: 54098, UDP Destination Port: 5000 SIP 10238 2015-09-14 23:58:49.277529 SIP Method: SIP/2.0 200 OK, Source IP: 192.168.1.174, UDP Source Port: 5000, UDP Destination Port: 5000 SIP 10239 2015-09-14 23:58:49.277529 SIP Method: ACK, Source IP: 192.168.1.174, Destination IP: 192.168.1.231, UDP Source Port: 5000, UDP Destination Port: 5000 SIP 10239 2015-09-14 23:58:49.277529 SIP Method: ACK, Source IP: 192.168.1.174, Destination IP: 192.168.1.231, UDP Source Port: 5000, UDP Destination Port: 5000 SIP 10237 3.3.3(31) 192.168.1.174 BE SIP 2.22(31) 3.3.3(31) 192.168.1.174 BE SIP SIP SIP	: 8888978675421 , SLS :
SIP 10236 2015-09-14 23158/49.269970 SIP Method: SIP/2.0 100 Trying . Source IP : 192.168.1.231 . Destination IP : 192.168.1.174 . UDP Source Port : 54098 . UDP Destination Port : 5060 SIP 10237 2015-09-14 23158/49.270740 SIP Method: SIP/2.0 180 Ringing . Source IP : 192.168.1.231 . Destination IP : 192.168.1.174 . UDP Source Port : 54098 . UDP Destination Port : 5060 SIP 10238 2015-09-14 23158/49.270740 SIP Method: SIP/2.0 200 OK . Source IP : 192.168.1.231 . Destination IP : 192.168.1.174 . UDP Source Port : 54098 . UDP Destination Port : 5060 SIP 10239 2015-09-14 23158/49.277529 SIP Method: SIP /2.0 200 OK . Source IP : 192.168.1.174 . DEStination IP : 192.168.1.231 . UDP Source Port : 5000 . UDP Destination Port : 5060 SIP 10239 2015-09-14 23158/49.277529 SIP Method: SIP /2.0 200 OK . Source IP : 192.168.1.174 . DEStination IP : 192.168.1.231 . UDP Source Port : 5000 . UDP Destination Port : 5060 SIP 10239 2015-09-14 23158/49.277529 SIP Method: SIP /2.0 200 OK . Source IP : 192.168.1.174 . DEStination IP : 192.168.1.231 . UDP Source Port : 5060 . UDP Destination Port : 5060 SIP 3.3.3(31) 192.468.1.174 . SIP SIP Method: SIP /2.0 200 CF . Frame=0 at3646616333:30:47.871567 OK . Len=42 Ethernet Frame Data = .0010811 (43) = .0010811 (43) = .0010811 (43) = .0010811 (43) = .0010811 (43) = .0010811 (43) = .0010811 (43) =	
SIP 10237 2015-09-14 23:58:49:27061 SIP Method: SIP/2.0 180 Ringing , Source IP: 192.168.1.231, Destination IP: 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 SIP 10238 2015-09-14 23:58:49:277529 SIP Method: SIP/2.0 200 OK , Source IP: 192.168.1.231, Destination IP: 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 SIP 10239 2015-09-14 23:58:49:277529 SIP Method: SIP/2.0 200 OK , Source IP: 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 SIP 10239 3.3.3(31) 192.168.1.174, Destination IP: 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 SIP 3.3.3(31) 192.168.1.174, Destination IP: 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 SIP SIP SIP SIP SIP SIP SIP SIP Method: SIP/2.0 200 OK , Source IP: 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 SIP SIP SIP Method: SIP/2.0 200 OK , Source IP: 192.168.1.174, Destination IP: : 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 SIP SIP SIP SIP Method: SIP/2.0 200 OK , Source IP: : 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060 SIP SIP SIP SIP SIP Method: SIP/2.0 200 OK , Source IP: : 192.168.1.231, UDP Source Port : 5000, UDP Destination Port : 5060	
SIP 10238 2015-09-14 23:58:49.270740 SIP Method: SIP/2.0 200 OK, Source IP: 192.168.1.231, Destination IP: 192.168.1.174, UDP Source Port : 54098, UDP Destination Port : 5060 SIP 10239 2015-09-14 23:58:49.277529 SIP Method: SIP/2.0 200 OK, Source IP: 192.168.1.231, UDP Source Port : 5060, UDP Destination Port : 5060 2.2.2(31) 3.3.3(31) 192.168.1.174 Destination IP: 192.168.1.231, UDP Source Port : 5060, UDP Destination Port : 5060 ss7 Ss7 Ss7 Ss7 SiP Initial address Ss7 SiP SiP 2.2.2(>3.3.3 Initial address = .0101011 (43) 1 (1)	
SIP 10239 2015-09-14 23:58:49.277529 SIP Method: ACK , Source IP : 192:168.1.174 , Destination IP : 192:168.1.231 , UDP Source Port : 5060 , UDP Destination Port : 5060 2.2.2(31) 3.3.3(31) 192:168.1.174 SIP Device? Frame=0 at -364661633;30:47.871567 OK Len=42 S57 557 S57 S1P S1P Initial address 2.2.2(>3.3.3 Image: S1P Image: S1P Initial address 2.2.2(>3.3.3 Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P Image: S1P </td <td></td>	
2.2.2(31) 3.3.3(31) 192.168.1.174 SS7 SS7 SS7 Device7 Frame=0 at -364661633;30:47.871567 OK Len=42 Ethernet Frame Data Initial address = 2.2.2(>3.3.3 =	
SS7 SS7 SS7 SP Device? Frame=0 at -364661633:30:47.871567 OK Len=42 Ethernet Frame Data Ethernet Frame Data = .0101011 (43) Initial address = .0011001 (43) = 2.2.2<>3.3.3 = .0011001 (43) = Initial address = .0011001 (43) = Initial address = .0011001 (43) = Initial address = .0011001 (43) = III MTP3 Layer = .0011001 (43)	
SS7 SS7 SS7 SP Device? Frame=0 at -364661633:30:47.871567 OK Len=42 Ethernet Frame Data Ethernet Frame Data = .0101011 (43) Initial address = .0011001 (43) = 2.2.2<>3.3.3 = .0011001 (43) = Initial address = .0011001 (43) = Initial address = .0011001 (43) = Initial address = .0011001 (43) = III MTP3 Layer = .0011001 (43)	
Address complete 3.3.3<	luded

Figure: NetSurveyorWeb[™] CDR View (VoIP)

GL's <u>PacketScan™</u> probes are used to capture, and monitor packet flows in real-time within a IP network. All major IP protocols are supported. PacketScan™ also performs detailed analysis of voice band streams gathering QOS statistics such as MOS (Mean Opinion Score), total packet count, reordered, duplicate and missing packet counts, gap, jitter, and delay. A central database stores the real-time and historic data. The system also facilitates various views using a web interface.

- GL's PacketScan[™] acts as a probe and gathers IP packet information in a non-intrusive fashion, and forwards call detail records (CDRs) as well as statistics to a central database
- A central database stores the real-time and historic data into a relational database (Oracle) using ODBC. A web-server accesses the data and allows clients across WAN to view results. It provides a user friendly interface to query and display database custom records
- <u>NetSurveyorWeb™</u> facilitates result display using a web interface. With this, one can view real-time data, navigate through records, filter the collected VoIP traffic summary, and graphically analyze the Answer Call, MOS, call duration, failed calls, session request delay, PDD, and so on through a simple web browser

For more details, refer to <u>Network Monitoring Solutions</u> webpage.



IP Network Monitoring and Surveillance System (VoIP) (Contd.)

Supported Protocols with PacketScan[™].

- SIP, SIP-I, SIP-T, H323, MEGACO, MGCP
- SCCP (Skinny), SIGTRAN SS7, ISDN
- All traffic Digits, Tones, Voice, Video, T.38 Fax



Figure: NetSurveyorWeb[™] – KPIs in Reports View



Page 4

Wireless Network Monitoring and Surveillance System (over IP or TDM)

letSi	urve	yorWe Real Time Mo	b 5.9.9 nitoring System	Protocol T	/pe TRAU	- Select Sum	mary - M	Hi, Gl		My Accou	int 🔹		
	Statu	us	Data Filt	ers / Views Reports	Alarms	Users	Admin	System St 2015-09-24	atus as of 🔞				
- c	DR Data	Page Co	nfig Default		📑 120 Secs 🍃 🛛 📔	Enable Alarms	Link Filter to Column	View Date Rang Hour Rang	je : 2015-06-05 je : 00:00:00 To	To 2015-09-0 23:59:59	1		_
-	Export	t as PDF X	Export as CSV (Filt	er OFF / No Filters Added) (Query Execution Time : 0.3	9800 Seconds							
0.00	uick Search	Trafficsum	id • 730573	7 60 🗸			View Records Per	Page: 20 V	Sort Expression :	STARTTIME I	DESC		
		umid Probenar			Number #1 Channel Nur	nber ≠1 Start SubCha	nnel #1 End SubChan	nel #1 TotalPackets	=1 CodecType	#1 CrcError	s #1 BadFram	ies ≠1 Dev Num	nber#2 C
			and the second se	2.952 00:11:25.000260 5	28	2	2	34216	AMR	1	0	6	2
		WaveSurfer ()	/lc Downlo	ad wav file : 7305737.wav						nload VLC Pl			
		-++++- -+ + + + + + + + + + +	} \$ = \$ = \$ = \$ +++\$+\$ \$ \$ \$	1044444444444444	***	*	+		444	NUCLOSICOL THE	2.1.3-win64 V		
le -													
	-			H Backward ►Play	/ II Pause Forw	ard 🛛 🖛 Toggle M	lute						
E	730228	86 p1	2015-06-05 10:19:4	K Backward ►Play	/ II Pause NForw	ard Toggle M	lute 5	0	AMR	0	0	6	1
	730228							0	AMR	0	0	6	
		85 p1	2015-06-05 10:19:4	2.822 00:00:00.000000 5	1	5	5						3
	730228	85 p1 97 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.000000 5 2.682 00:00:29.000214 5 2.507 00:00:01.000511 1 2.450 00:00:01.000420 1	1 29 29 1	5 2 3 5	5 2 3 6	1104 0 61	AMR AMR AMR_WB	0	0 0 0	6 2 2	:
	730228 730199 730482 730228	85 p1 97 p1 22 p1 84 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.00000 5 2.682 00:00:29.000214 5 2.507 00:00:01.000511 1 2.450 00:00:01.000420 1 2.450 00:00:46.000256 5	1 29 29 1 13	5 2 3 5 7	5 2 3 6 7	1104 0 61 1979	AMR AMR AMR_WB AMR	0 0 61 0	0 0 0	6 2 2 6	
	730228 730199 730482 730228 730363	85 p1 97 p1 22 p1 84 p1 39 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.000000 5 2.662 00:00:29.000214 5 2.850 00:00:01.000511 1 2.450 00:00:10.00420 1 2.450 00:00:46.000256 5 2.431 00:05:01.000880 3	1 29 29 1 13 21	5 2 3 5 7 6	5 2 3 6 7 6	1104 0 61 1979 15081	AMR AMR AMR_WB AMR AMR	0 0 61 0 0	0 0 0 0	6 2 6 4	
	730228 730199 730482 730228 730363 730244	85 p1 97 p1 22 p1 84 p1 39 p1 49 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.000000 5 2.682 00:00:29.000214 5 2.507 00:00:01.000511 1 2.450 00:00:01.000420 1 2.450 00:00:01.000420 5 2.431 00:05:01.000880 3 2.395 00:00:03.000700 3	1 29 29 1 13 21 21	5 2 3 5 7 6 5	5 2 3 6 7 6 5	1104 0 61 1979 15081 312	AMR AMR AMR_WB AMR AMR AMR	0 0 61 0 0	0 0 0 0	6 2 2 6 4 4	
5	730228 730199 730482 730228 730228 730363 730244 730244	85 p1 97 p1 22 p1 84 p1 39 p1 49 p1 01 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.00000 5 2.682 00:00:29.000214 5 2.507 00:00:01.000511 1 2.450 00:00:46.000256 5 2.431 00:00:46.000256 5 2.431 00:05:01.000880 3 2.395 00:00:00.000453 3	1 29 29 1 13 21 21 21 18	5 2 3 5 7 6 5 2	5 2 3 6 7 6 5 2	1104 0 61 1979 15081 312 21	AMR AMR AMR_WB AMR AMR AMR AMR	0 0 61 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 2 6 4 4 4	
	730228 730199 730482 730228 730363 730244 730244 730450 730563	85 p1 97 p1 22 p1 84 p1 39 p1 49 p1 01 p1 36 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.00000 5 2.682 00:00:29.000214 5 2.507 00:00:01.000511 1 2.450 00:00:04.000254 1 2.451 00:00:05.00.00080 3 2.431 00:05:01.000880 3 2.395 00:00:00.000700 3 2.223 00:00:00.0004043 1	1 29 29 1 13 21 21 18 6	5 2 3 7 6 5 2 4	5 2 3 6 7 6 5 2 4	1104 0 61 1979 15081 312 21 12	AMR AMR_WB AMR_WB AMR AMR AMR AMR AMR	0 0 61 0 0 0 0 0	0 0 0 0 0 0 0	6 2 2 6 4 4 4 2	
	730228 730199 730482 730228 730363 730244 730450 730563 730563	85 p1 97 p1 22 p1 84 p1 39 p1 49 p1 01 p1 36 p1 83 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.000000 5 2.662 00:00:29.000214 5 2.507 00:00:01.000511 1 2.450 00:00:01.000420 1 2.450 00:00:46.000256 5 2.431 00:05:01.00088 3 2.395 00:00:03.000700 3 2.295 00:00:00.000453 3 2.203 00:00:00.00453 3	1 29 29 1 13 21 21 18 6 22	5 2 3 5 7 6 5 2 4 1	5 2 3 6 7 6 5 2 4 1	1104 0 61 1979 15081 312 21 12 551	AMR AMR_WB AMR AMR AMR AMR AMR AMR AMR AMR	0 61 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 2 6 4 4 4 2 2 2	
	730228 730199 730482 730228 730263 730244 730450 730563 730228 730228	85 p1 97 p1 22 p1 84 p1 39 p1 49 p1 01 p1 36 p1 83 p1 94 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.000000 5 2.662 00:00:29.000214 5 2.607 00:00:01.000511 1 2.450 00:00:01.000420 1 2.450 00:00:46.000256 5 2.431 00:05:01.00086 3 2.395 00:00:03.000700 3 2.325 00:00:00.000453 3 2.203 00:00:00.000453 3 1.854 00:00:11.000000 1 1.854 00:00:11.000000 1	1 29 29 1 13 21 21 18 6 22 29	5 2 3 5 7 6 5 2 4 1 4	5 2 3 6 7 6 5 2 4 1 4	1104 0 61 1979 15081 312 21 12 551 631	AMR AMR_WB AMR_WB AMR AMR AMR AMR AMR AMR AMR AMR AMR	0 61 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 2 6 4 4 2 2 2 2 4	2 3 3 3 3 3 4 3 3 3 3 3 3 3 3 3 3 3 3 3
	730228 730199 730482 730228 730363 730244 730450 730563 730563	85 p1 97 p1 22 p1 84 p1 39 p1 49 p1 01 p1 36 p1 83 p1 94 p1 94 p1	2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4 2015-06-05 10:19:4	2.822 00:00:00.000000 5 2.662 00:00:29.000214 5 2.507 00:00:01.000511 1 2.450 00:00:01.000420 1 2.450 00:00:46.000256 5 2.431 00:05:01.00088 3 2.395 00:00:03.000700 3 2.295 00:00:00.000453 3 2.203 00:00:00.00453 3	1 29 29 1 13 21 21 18 6 22	5 2 3 5 7 6 5 2 4 1	5 2 3 6 7 6 5 2 4 1	1104 0 61 1979 15081 312 21 12 551	AMR AMR_WB AMR AMR AMR AMR AMR AMR AMR AMR	0 61 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	6 2 6 4 4 4 2 2 2	1 2 2 1 1 1 2 2 2 2 2 2 2 2 2 2 1 5

Figure: NetSurveyorWeb[™] CDR View (IP/TDM)

GL's PacketScan[™] or T1 E1 / T3 E3 / OC-3 / OC-12 Hardware probes non-intrusively monitor networks for both signaling and data. Almost all the standard protocols on 2G, 3G, and 4G wireless networks are supported.

- These intelligent protocol analyzers extract relevant contents in a non-intrusive fashion, and forwards call detail records (CDRs) as well as statistics to a central DB for storage, display, and control
- A central database stores the real-time and historic data into a relational database (Oracle) using ODBC. A web-server accesses the data and allows clients across WAN to view results. It provides a user friendly interface to query and display database custom records
- <u>NetSurveyorWeb™</u> facilitates result display using a web interface. With this, one can view real-time data, navigate through records, filter the collected traffic summary, and graphically analyze the results through a simple web browser

For more details, refer to <u>Network Monitoring Solutions</u> webpage.



Page 5

Wireless Network Monitoring and Surveillance System (over IP or TDM) (Contd.)

Supported Protocols

- LTE, Diameter, IMS (over IP)
- GSM A, GSM-R (over IP)
- GSM Abis and TRAU (over TDM)
- GPRS Gb and Gn (over IP)
- UMTS IuCS, IuPS, and IuH (over IP)
- All traffic Digits, Tones, Voice, Video, T.38 Fax, Mobile GTP Traffic

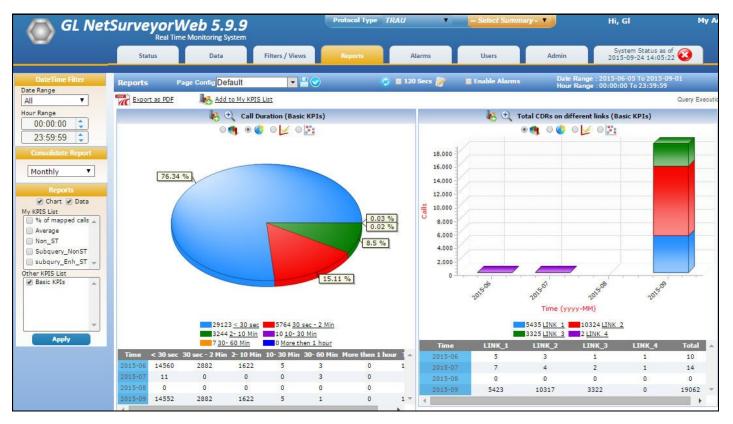


Figure: NetSurveyorWeb[™] – KPIs in Reports View



Page 6

TDM and Optical Networks Monitoring and Surveillance System (T1 E1 T3E3 OC-3/STM-1 OC-12/STM-4)

CDR Data			📕 Enable A	larms		Date Range : 2015-09 Hour Range : 00:00:00	-24 To 2015-09-) To 23:59:59							
ALLID : 12760120	Go Back													
Graph view	Details view	Merge view	Decode Type : ITU ANS	51		Debug Summary (Expo	rt as CSV)							
RAMENO	Timestamp		Probename	Card	Linkname	Linkname Directional	T51	T52	CIC	SLS	OPC	DPC	ISUP Message Type	Calling Numb
3739208	2015-09-24 05:17:1	8.691000	SS7_Probe	1	1.1.1>2.2.2	1.1.1>2.2.2	23	23	1	1	1.1.1	2.2.2	Initial Address	9987095801
3739209	2015-09-24 05:17:1	8.821625	SS7_Probe	1	1.1.1>2.2.2	2.2.2>1.1.1	23	23	1	1	2.2.2	1.1.1	Address Complete	
3739210	2015-09-24 05:17:	8.949000	SS7_Probe	1	1.1.1>2.2.2	2.2.2>1.1.1	23	23	1	1	2.2.2	1.1.1	Release	
53739211	2015-09-24 05:17:1	9.076625	SS7_Probe	1	1.1.1>2.2.2	1.1.1>2.2.2	23	23	1	1	1.1.1	2.2.2	Release Complete	
Ad Re	2 http://docs. 11.14-22.22 dress.Complete 22.22-2-11.11 Release 22.22-2-11.11 Release 22.22-2-11.11 Release 1.1.14-22.22			Ethernet BSN BIB FSN FIB LI Service Priority OPC OPC Signall: Circuit Message Mandato Nature Satel Conti Echo o Forwarn Natio	Frame Data HTP2 Layer = MTP2 Layer = Indicator / Code rice field Link Code Hentification C Type y Fixed Paramete	nde rs ficators Parameter ator Parameter call ind		Format V User Pa prity Coci ional Net 210000 .0001 (25 tial addr satellif tinuity (going ech ated as a	de 0 twork 2010) 20010 57) ress te circu check no no contr a nation	it in th t requir ol devic al call	red te not inc			

Figure: NetSurveyorWeb[™] CDR View (SS7)

GL's provides non-intrusive analyzer probes for a network wide management of T1 E1 / T3 E3 / Optical lines, including line health, non-intrusive diagnostics, and much more. The essential elements of the systems are:

- <u>T1 E1 / T3 E3 / OC-3 / OC-12 Hardware</u> probes non-intrusively monitor networks for both signaling and data, including ISDN, SS7, GSM, TRAU, and others. These intelligent protocol analyzers extract relevant contents, and forwards call detail records (CDRs) and statistics to a central NMS for storage, display, and control.
- A central database stores the real-time and historic data into a relational database (Oracle) using ODBC. A web-server accesses the data and allows clients across WAN to view results. It provides a user friendly interface to query and display database custom records.
- The <u>NetSurveyorWeb[™]</u> is a web-based client connected to T1 E1 / T3 E3 / Optical probes through a web server and facilitates result display using a web interface as shown in the screenshot. The NetSurveyorWeb[™] is driven by non-intrusive T1 E1 / T3 E3 / Optical hardware probes, intelligent software, and a database engine. With this, one can view real-time data (Probe name, Disposition, Calling number, Called number, Duration, and so on), navigate through records, filter the required call records (based on the start time and date of each call) through a simple web browser. Custom Filter option allows users to filter the call records based on various signaling and traffic data.

For more details, refer to Network Monitoring Solutions webpage.



TDM and Optical Networks Monitoring and Surveillance System (T1 E1 T3E3 OC-3/STM-1 OC-12/STM-4) (Contd.)

Supported Protocols

- SS7, ISDN
- GSM A, Abis, GSM-R, TRAU
- UMTS luCS, luH
- All traffic Digits, Tones, Voice, Fax

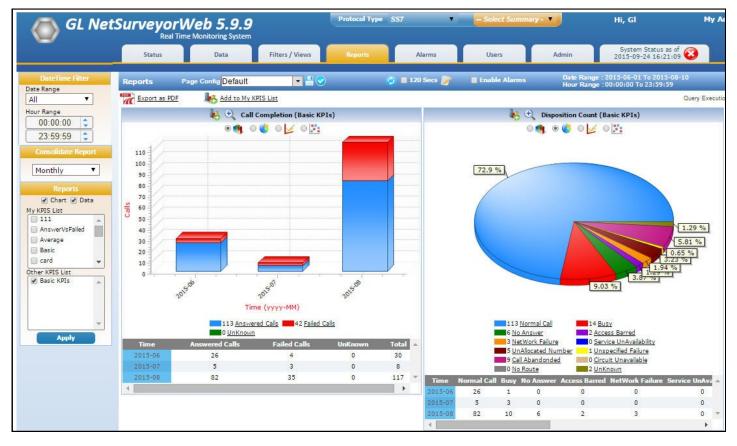


Figure: NetSurveyorWeb[™] – KPIs in Reports View



Digital T1 / E1 Line Monitoring, Test, and Diagnostic System

letSurve	yorWeb 5.9. Real Time Monitoring Syst	.9	Protocol Type 7	1E1 Layer 1 🔹	– Select	Summary – 🔻		Hi, Gl		My Account
Stat		Filters / Views	Reports	Alarms	Users	Admi	in	System Sta 2015-09-14	tus as of 18:21:03 😣	
CDR Dat	a Page Config <mark>Defaul</mark>	it 🔽 📕 📀	🥥 🔲 13	20 Secs 🍃 🔲 E	nable Alarms	📕 Link Filter to	Column View		e: 2015-06-01 T je: 00:00:00 To	
	ort as PDE	as CSV (Filter OFF / No Filte	ers Added) Query	Execution Time : 0,14	701 Seconds					
Quick Sear	ch: #ID	• CO				View Re	cords Per Page	20 🔻	Sort Expression	: DATE_TIME DE
<u>#1D</u>	Probe Name	Datetime		2	Alarm Type	Alarr	n Condition		Port#	Alarm Cour
1312	SS7_Probe	2015-07-16 05:28:27.19	9000		3	2			1	1
1311	SS7_Probe	2015-07-16 05:28:27.19	9000		1	2			1	1
1310	SS7_Probe	2015-07-16 05:28:27.19	9000		3	2			1	1
1309	SS7_Probe	2015-07-16 05-28-27 19	000		3	2			1	1
1308	SS7_Probe	2				Link Status			Enable Ala	ms
1307	SS7_Probe	2								
1306	SS7_Probe	2		define Columns		Reset / Ref				
1305	SS7_Probe	2	Circ	uit Name	**	2° 🗆 s	Secs 🥖 🧾	lear History		
1304	SS7_Probe	2	Circ	ier Name uit ID	Apply	Sort Evo	ression : Probe	Name ASE		
1303	SS7_Probe	2	Usa	ре Туре	8					
1302	SS7_Probe	2						201200 - 20140		
1301	SS7_Probe	2 Erobe Nam			ste Carrier Los		Yellow Alarm			Line Level (dödsx)
1300	SS7_Probe	2	D1:1	(B)	(Here)	v (0)	V (0)	✓(0)	-103	0.5
1299	SS7_Probe	2 SS7Probe_L	ab SS7Probe_Lab:4	V (0)		V (0)	✓(0)	V (0)		0.5
		SS7Probe_M	ND SS7Probe_MD:1	v _0	×(1)	×(1)	🖍 (t)	🖌 (D)		
		SS7Probe_N	1D SS7Probe_MD:2	v _0	√ (0)	V (0)	v (0)	I(0)		
		\$\$7Probe_N	ID SS7Probe_MD:3	* m	100	\$ (7)	v (0)	100		
		a participant of the second carbon		1.0	10	100	1 m	100		

Figure: NetSurveyorWeb[™] for T1 E1 Physical Layer

GL's T1 E1 Network Monitoring System provides network wide management of T1 and E1 lines including line health, intrusive diagnostics, non-intrusive monitoring, and much more. It's a web-based client connected to TDM probes (SS7, ISDN, GSM,...) through a web server that facilitates result display using a web interface.

The essential elements of the systems are:

- PC based <u>T1 and E1 probes</u> that collect physical and line level status and performance information. The Intrusive and Nonintrusive "probes" for TDM networks are deployed at strategic locations in a network. They can transmit and collect voice, data, protocol, statistics, and performance information. These probes can relay information to a central / distributed Network Management System (NMS)
- A "<u>T1 E1 J1 Switch</u>" for non-intrusive monitoring or intrusive diagnostics; The switch is "fail safe" during power disruptions and USB controlled by the PC that houses the probes
- The web-based client <u>NetSurveyorWeb[™] for T1 E1 Physical Layer</u> provides an instant overall graphical view of the health of the TDM network with drill down to individual lines; secure access through WEB; remote monitoring and diagnostics to troubleshoot any T1 E1 line; and a central database and applications for controlling, collecting, and analyzing the information provided by the various probes

Supported Alarms

- MTP Layer Status
- Sync Loss, Carrier Loss
- Yellow Alarm, Blue Alarm, AIS
- Frequency Deviations and Power Level
- Customize Alarm Conditions
- Generate email alerts, visual alerts, audible alerts, and even logs

For more details, refer to <u>Digital T1 E1 Line Monitoring NetSurveyorWeb™</u> webpage.

🌑 GL Communications Inc.

Voice, Video, and Data Quality Monitoring System (Wireless, IP, and TDM Networks)

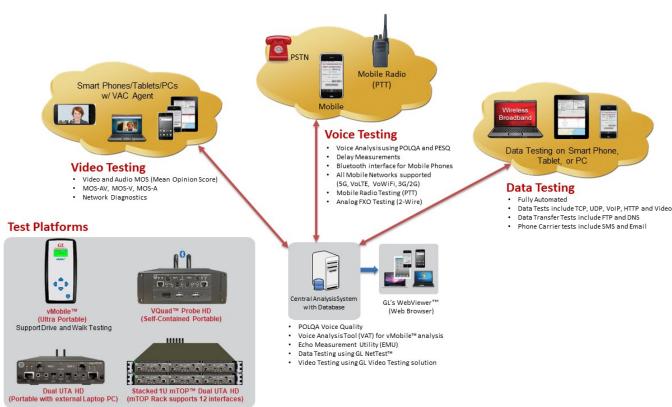


Figure: VQT WebViewer™

GL's WebViewer™ provides real-time voice, video, and data quality measurements across a diverse set of networks. Voice, Data, and Video calls are automatically placed between end points; quality is measured and provided for display at an NMS. Voice Quality Testing (VQT) supports international standard voice quality test methods, including, PESQ, POLQA, MOS (Mean Opinion Score), Round Trip Delay (RTD), Jitter, Clipping, Voice band quality metrics, etc. Video Quality Test Solution provides support for Android, PC and Linux based clients (end points) for active Video Quality Testing. The Data Tests supported includes TCP, UDP, VoIP, Route, HTTP, FTP, DNS, SMS, Email, PhoneInfo, SIMInfo, and UEInfo.

The essential elements of this system are:

- Intrusive VoIP / TDM Nodes GL's VQuad[™], is a low density network probe used for proactive testing of end-to-end voice connections. It is a common probe for Wireless, VoIP and TDM networks
- Controls individual or multiple wireless, landline or VoIP telephony terminals. Various associated applications (Voice Quality, Video Quality, Data tests, Echo and Delay tests, Fax tests, Voice Band Analysis) works with VQuad[™] to provide "end-to-end assessment" with additional test and measuring capabilities. All the results are automatically transferred to the Central Database for access via the GL WebViewer[™]
- Voice Quality Testing (VQT) software for analysis according to widely accepted ITU (International Telecommunications Union) voice comparison algorithms (POLQA, PESQ LQ/LQO/WB). GL also supports mobile device based manual and automated Voice Testing using NetTest VQT app (supported on rooted Android devices) within the network
- The WebViewer[™] uses a simple web browser with facilities to query the results either manually or automatically as well as output the results/statistics. These results include <u>VQuad[™]</u> Call Event, User Defined Events, Bluetooth[®] events, <u>Data Test</u> (NetTest from PC and NetTest from Mobile Device), <u>VQT</u>, <u>VBA</u>, <u>Delay and Echo Measurement</u> results and <u>Fax TxRx Events</u> which can be saved to either text or Excel format. WebViewer[™] includes support for user-defined statistics with both tabular and graphical outputs

For more details, refer to Intrusive Method of Speech Quality Assessment webpage.

🌑 GL Communications Inc.

Buyer's Guide

Item No	Product Description
<u>PKV170</u>	Network Surveillance Software with Centralized Database Engine and Client
<u>PKV175</u>	T1 E1 Physical Line Monitoring Option for Network Surveillance - requires PKV170
<u>PKV172</u>	ISDN Call Detail Record (CDR) Option for Network Surveillance - requires PKV170. requires OLV100 at the central site.
<u>PKV092</u>	CAS Call Detail Records (CDR) Option for Network Surveillance. requires OLV092 at the central site.
<u>PKV173</u>	SS7/SIGTRAN Call Detail Record (CDR) Option for Network Surveillance - requires OLV120 for SS7 and PKV106 for SIGTRAN at the central site.
<u>PKV174</u>	GSM (TDM or IP) and TRAU Call Detail Record (CDR) Option for Network Surveillance - requires OLV150 for GSM and OLV153 for TRAU at the central site.
<u>PKV176</u>	VoIP (SIP, MGCP, MEGACO etc.) Call Detail Record (CDR) Option for Network Surveillance - requires PKV101 at the central site.
Item No	Related Software
<u>PKV169</u>	Network Surveillance Lite Software.
<u>PKV171</u>	Network Surveillance Agent Toolkit
Item No	Related Hardware
<u>PTE001</u>	tProbe™ Dual T1 E1 Laptop Analyzer
<u>XTE001</u>	Dual T1 E1 Express (PCIe) Boards
<u>TTE001</u>	tScan16™ T1 E1 Boards
<u>FTE001</u>	QuadXpress T1 E1 Main Board
<u>ETE001</u>	OctalXpress T1 E1 Main Board plus Daughter Board

For more information, refer to <u>NetSurveyorWeb™</u> webpage.

GL Communications Inc.

818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878, U.S.A (Web) <u>www.gl.com</u> - (V) +1-301-670-4784 (F) +1-301-670-9187 - (E-Mail) <u>info@gl.com</u>