

Carrier VoIP Service Assurance: Comparing the Players

Hands-on review checks out the leading, carrier-oriented, VoIP service-monitoring packages. by Edwin E. Mier

Differences in service quality between the PSTN and VoIP-based services are narrowing. Indeed, some private studies are concluding that audio-quality differences are now largely imperceptible although "ancillary" service issues—dial-tone availability, post-dial delay, and so on—remain.

The ongoing improvement in VoIP service is due in no small part to the specialized class of products that aggressively monitor service providers' networks. We decided to take a closer, hands-on look at these "VoIP service-quality-assurance" packages and see how they compare.

MierConsulting, which closely monitors this market, compiled a review methodology and issued invites to the dozen or so vendors known to us who offer such wares. Time allowed up to six product packages to be reviewed hands-on. Available slots were booked in fairly short order on a first-come, first-served basis.

The author personally conducted these reviews during March and April, in environments set up by the vendors at their locations. Costs of the review were borne by *VON Magazine* and participating vendors, which were:

Agilent Technologies (www.agilent.com): Test & Measurement in Colorado Springs, Colo., 800-829-4444.

Empirix (www.empirix.com): Based in Bedford, Mass., 781-266-3200.

GL Communications Inc. (www.gl.com): Based in Gaithersburg, Md., 301-670-4784.

JDS Uniphase (www.jdsu.com): Based in Milpitas, Calif., 408-546-5000.

RADCOM Inc. (www.radcom.com): With U.S. headquarters in Paramus, N.J., 201-518-0033.

Tektronix Inc. (www.tek.com): Communications business in Richardson, Tex., 469-330-4000.

Figure 1 provides a thumbnail, side-by-side summary comparison of the major components of the packages reviewed.

Comparison Criteria

The packages reviewed all offer impressive, sophisticated monitoring of VoIP services. That said, we observed significant differences in six main areas. We recommend carriers and service providers shopping for service-monitoring packages structure

their product searches with these in mind:

1) Scalability: The two most common metrics are calls per second (cps), and number of concurrent VoIP streams (RTP) that can be tracked per probe. A lot of architectural issues affect how big of a carrier's VoIP network these packages can track. These include:

a) Power of the monitoring probes: Many VoIP carriers need full gigabit/s backbone links full of VoIP traffic monitored. Not all of the probes can handle that. What's more, high-end probes in the near future will need to handle 10-gigabit/s links.

b) Amount of processing done on the probe and the amount of data passed from probes to the central-site server: Typically one call record is passed from the probe to the central server on completion of a VoIP call, at a minimum.

c) Central-site server capacity and the amount of processing done on the server versus the probes: For example, in most cases, but not all, the calculation of voice-quality MOSs (typically R Factor-based) on a call-by-call basis is done out on the probes.

2) Information presentation: Most of these packages offer listings, usually in chronological order, of VoIP calls. Most also offer a number of canned reports. Where they differ is in the presentation of processed "information," not just raw data, in easy-to-understand, high-level views. Another distinguishing factor is the inherent capability for users to readily tailor display graphs and reports and save them for future use, as well as create all new custom reports.

3) Active testing: Nothing provides as accurate an assessment of end-to-end VoIP service quality as simulated VoIP calls exchanged between strategically located active test probes. But how well this aspect of VoIP monitoring is integrated with the system's passive monitoring is a key distinguishing factor.

4) Signaling monitoring: Close tracking of the call-control protocol exchange for VoIP calls—often involving multiple signaling nodes and protocols (SIP and MGCP, for example)—can be the best diagnostic tool for finding and fixing VoIP service problems. A few of the packages reviewed can effectively correlate call signaling from multiple probe points, even including PSTN signaling for the same call, and present

FIGURE 1: CARRIER VOIP SERVICE MONITORING—PRODUCTS REVIEWED

Vendor	Agilent	Empirix	GL Communications	JDSU	RADCOM	Tektronix
Products reviewed, versions. <i>Active test components are shown in italics.</i>	NgN Analysis System v3.11; Quality of Service Manager v6.0.1; Triple Play Analyzer v1.2; & Distrib. Network Analyzer v5.40	Hammer XMS Passive r1.6, and passive probes; Hammer XMS Active v1.0, and active probes	PacketScanWEB, v2.0, PacketScan Probe v4.5.4, VoiceBand Analyzer v2.0, VQuad v4.0, & PacketGen v3.0i	NetComplete v2.1, NetOptimize v16.6 and QT-600 v3.0 probe; NetAnalyst v3.2, & QT-50 v1.0 active test software	Omni-Q v70.60.7, Q-Console, Q-Expert, R-70 and R1000 probes, iProbe, & cProbe	Orion Service Assurance v7.09, APM (Advanced Perf Mon) v3.0, GeoProbe, DirectQuality RT, and PowerProbe series
Passive VoIP Media-Quality Monitoring	✓	✓	✓	✓	✓	✓
Signaling Monitoring	✓	✓	✓	---	✓	✓
Real-time, Call-in-Progress Monitoring	✓, signaling view	✓	---	✓	Currently limited; full support in Q3	✓
Multi-Point Signaling Correlation	✓	✓	---	---	✓	✓
Active VoIP Monitoring (probes generate synthetic VoIP calls)	In partnership w/ Brix Networks; not included in system reviewed	✓, both IP and analog/TDM active probes	✓, both IP and analog/cellular active probes	✓	✓, both IP and analog/TDM active probes	✓, both IP and analog active probes
Active End-to-End, "User Experience" Measure/Monitoring	---	---	✓, plus VoIP content analysis	Yes for IP endpoints; no for analog or PSTN	✓	✓
VoIP Stream Capture, Playback	✓	✓	✓	✓	✓	✓
Historical Reporting—Days, Weeks, Months	✓	✓	Requires third-party report pkg	✓, Cognos-based report engine	✓, Cognos-based report engine	✓, Cognos-based report engine
System Monitoring Capacity, Per Vendor	1,000+ calls/sec network load	Server can handle ~300 calls/sec	"Hundreds" of calls/sec; 100+ probes tested	16,000 concurrent VoIP streams per QT-600 probe	40,000 concurrent calls, 16,000 RTP streams/probe	Thousands of calls/sec; one billion call records/day
Approx U.S. List Price for a 10-Node Passive Monitoring System (1)	\$832,000, with full Gigabit/s-capacity probes	\$450,000, w/mix of Gigabit and 100-Mbps links	\$100,000, with 100-Mbps-capacity probes	\$195,000, with probes monitoring gigabit/s links	\$789,000, with full Gigabits/s capacity probes	\$1,200,000, with full Gigabit/s-capacity probes

(1) List price for a comparable distributed, passive-monitoring deployment including full central-site software and hardware and distributed probes for monitoring 10 high-capacity backbone links or 10 remote sites/locations/subnets.

leg-by-leg drill-down with the call record.

5) Customization: Some customization is applied for each of these monitoring systems. The Agilent and Tektronix packages, for example, are designed to be used largely "as is," without a lot of architectural modification. By comparison, RADCOM undertakes a fair amount of custom tailoring in deployments of its Omni-Q system. And GL Communications, which offers a toolbox of components and subsystems, expects to substantially tailor its wares for each customer and even integrate the subsystems with the user's existing management infrastructure.

6) Price: Carriers and service providers will find an order of magnitude difference in the pricing of these sophisticated packages, as shown in the "approximate U.S. list price" comparison at the bottom of figure 1. We sought a point of comparative reference and asked for the cost of a "passive" monitoring deployment, including central-site server hardware, all the vendor's software reviewed, and sufficient probes for 10 backbone links. Note that the load capacities—of monitored links as well as overall system traffic load—of the packages vary considerably. Also, costs for customization, installation, and training are not included.

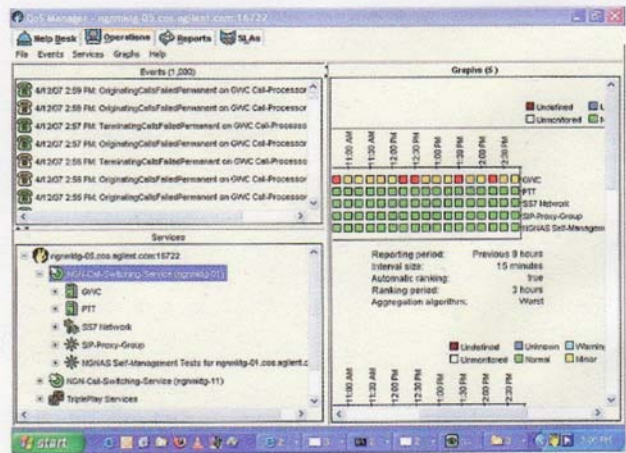
Summary findings for each of the packages reviewed are presented below, listed alphabetically by vendor.

AGILENT

Several discrete software modules, each with a notably different

user interface, comprise the Agilent package. At the highest level is the QoS Manager, running on a high-powered Sun Solaris server, which offers ready access to the other, subordinate modules. These include the NgN Analysis System—Sun-based software that tracks signaling—and Triple-Play Analyzer, or TPA—Windows-based software that monitors only VoIP media streams, in conjunction with the VxWorks-based distributed network analyzer (DNA) series of probes. The signal-monitoring and media-monitoring subsystems feed results separately into the QoS Manager.

For active testing, Agilent partners with Brix Networks. The Brix system operates completely separate from the Agilent package although the Brix can pass some active test results di-



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rectly to the Agilent server. The Brix package was not included in the Agilent system reviewed.

VoIP-quality presentation graphics, as noted, are superb. Two database engines are offered—one for real-time data manipulation and an optional Oracle for mainly historical data repository. Signaling monitoring is also well done, with full protocol support, VoIP as well as SS7/wireless/TDM, and impressive correlation or all of these. High capacity and high performance, this system specializes in monitoring all calls, all the time, in real time.

Agilent's architectural separation of signaling monitoring from voice-stream monitoring does certainly enhance scalability of the overall package. Signaling analyzers are typically placed beside softswitches to collect full call-control details, and a hierarchy of correlation engines is supported.

Empirix

Empirix's Hammer XMS portfolio consists of XMS Passive—Linux-based software offered for a range of VoIP traffic loads—and the newly added XMS Active component, which is a I-U, Windows-based Hammer call generator and analyzer. Both components are consolidated and controlled from the same Linux central server (called the operations server, or OS).

The limiting factor in the Empirix architecture is apparently the OS, which can handle up to about 300 calls per second. It only takes about three or four passive probes to hit this limit.

Most data processing is done on the five-slot, Linux-based,

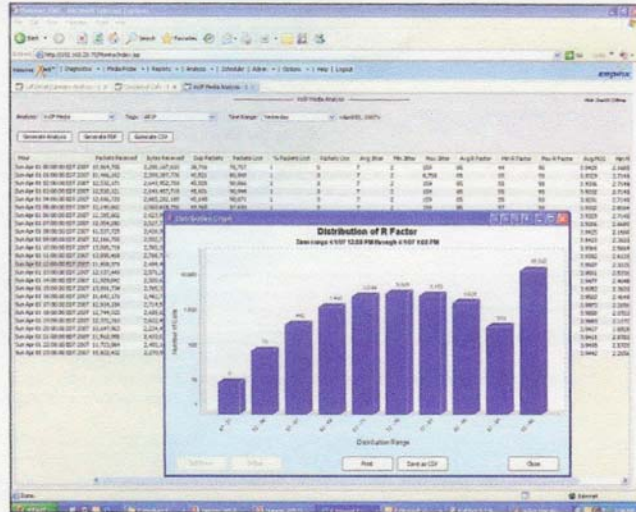


FIGURE 2: CARRIER VOIP MONITORING—HANDS-ON HIGHLIGHTS

<p>Agilent</p> <p>Demonstrated strengths</p> <p>Other notes, observations</p>	<p>QoS Manager, NGN Analysis System, Triple-Play Analyzer, Distributed Network Analyzer</p> <ul style="list-style-type: none"> • Best presentation of VoIP service information. • Health Reports: provide concise, high-level, easy-to-understand, graphical status icons, which reflect one or multiple metrics; can easily expand to see which component is the problem. • Supports convenient right-click drill down from almost any point. • Monitors and displays all metrics, all the time, in real time. • Compatible probes offered for SS7 and cellular environments for fully tracking of VoIP calls across PSTN and wireless. • A passive-monitoring package. Active testing for VoIP quality is separately addressed by Brix Networks in partnership with Agilent. • Signaling and media monitoring are handled separately. This limits some analyses (i.e., MOS by signaling protocol can't be correlated). • There are several discrete and different user interfaces, but access to all can be launched from the same high-level interface.
<p>Empirix</p> <p>Demonstrated strengths</p> <p>Other notes, observations</p>	<p>Hammer XMS Passive and Probes, Hammer XMS Active and Probes</p> <ul style="list-style-type: none"> • Good, clean interface for in-progress or completed calls, easy to maneuver, drill down, and generate summary reports. Consolidated access to both active test setup and passive results. • Active probes can call other active probes, as well as place real VoIP calls as endpoints via various protocols, including cable NCS. • Good reporting of calls in progress, including a real-time BHCA (busy-hour call attempts) summary. • Call records can be "tagged," allowing carrier's customers to access and view just their records and statistics. • The current central-server passive-monitoring capacity of 300 calls per second may be a limiting factor for large carrier networks. • Latency and delay are not measured or factored into call-quality ratings. Vendor is enhancing this in next release. • Reports are fixed and not readily customizable.
<p>GL Communications</p> <p>Demonstrated strengths</p> <p>Other notes, observations</p>	<p>PacketScan and PacketScanWEB, VoiceBand Analyzer, VQuad and PacketGen Active Testers</p> <ul style="list-style-type: none"> • A portfolio of full-featured VoIP service-monitoring components—from Web-based passive monitoring to client-server active testing. • Each installation is broadly customized; vendor assembles components, sets thresholds, defines reports, data flows, customizes interfaces, and integrates with other customer management systems. • Separate VoiceBand Analyzer (VBA) examines full content of passively captured VoIP voice streams, uniquely analyzes "transmission quality"—echo, noise, etc. • Probes and central-site software applications all run on off-the-shelf PCs atop Windows OSs. • Maximum passively monitored link speed currently is 100 Mbps. • Customization is involved in all cases; can add to roll-out time. • No inherent report generation; data is exported to a third-party report package. • Some consolidation of the many different interfaces (to the different subsystems) is needed. Better on-screen help would simplify use.
<p>JDSU</p> <p>Demonstrated strengths</p> <p>Other notes, observations</p>	<p>NetComplete: NetAnalyst NGT, NetOptimize, QT-600, QT-50 Probes</p> <ul style="list-style-type: none"> • Passive NetOptimize focuses on VoIP call-quality monitoring (RTP; media), but does not directly track, record, or analyze signaling. • With test access module (TAM), vendor's probe can interact directly with Cisco IOS platforms for automated switch-port configuration. • Special package for Cable MSOs includes ability to "enrich" database by importing carrier subscriber data, NCS, MTA testing, etc. • Rich array of ancillary "point" analyze products for VoIP troubleshooting, including DA-3400/3600A, PVA-1000 (packet VoIP analyzer). • All monitoring measurements and active testing are via IP connections, so TDM, SS7, or PSTN aspects of VoIP calls are not reflected in MOS ratings. • Some screens need resizing to fit on screen better; on-screen help could be improved. • No event recording/logging; few alarm capabilities.
<p>RADCOM</p> <p>Demonstrated strengths</p> <p>Other notes, observations</p>	<p>Omni-Q (w/ Q-Console, Q-Expert, etc.), R-70, R1000, iProbe and cProbe</p> <ul style="list-style-type: none"> • Best integrated passive and active monitoring. • Other probe interfaces include SS7 and TDM; can effectively correlate signaling of VoIP calls that also traverse the PSTN. • Several special reports and features for cable operators (including NCS protocol support). • About 40 useful canned reports, including SLA monitoring and availability. Rich custom reports can also be readily created. • Excellent threshold/alarm capabilities and the same clean alarm configuration interface is used for both active and passive probes. • Calls-in-progress monitoring is currently limited, as it interrupts passive monitoring. This is expected to be fixed in a Q3 release. • System is very usable as is; rich in functionality, but some amount of customization will be needed in all cases. • Data displays and listings could be cleaned up. There is no column sorting, and on-screen help could be more helpful.
<p>Tektronix</p> <p>Demonstrated strengths</p> <p>Other notes, observations</p>	<p>Orion Service Assurance, APM, GeoProbe, DirectQuality, and PowerProbe</p> <ul style="list-style-type: none"> • Most scalable VoIP service-monitoring system. • Central-server software can be distributed across several servers; GeoProbes are powerful; and data-record streaming from the probes is very adjustable. Installed systems are handling "hundreds of millions" of calls per day, and hundreds of concurrent users. • Great drill down. From the top level a user can drill down into eight layers of technical depth for diagnostics and troubleshooting. • Thresholding and alarm setup is straightforward and clean. • GeoProbe interfaces for TDM, SS7, and ATM let calls be tracked across multiple segments, with all signaling legs correlated. • The Orion system is well defined and fairly fixed; it does not seem as customizable or tailorable as some competitive packages. • The Windows-based active testing package is versatile and flexible but is not integrated to any extent yet with the Linux-based passive Orion monitoring system.

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The graphics and reports are clean and legible although substantial alteration of canned reports is not now supported. Active and passive call records are integrated on the OS, and the drill-down process is the same for either. In-progress call reporting, and busy-hour call attempts (BHCA), by hour, are also noteworthy.

GL Communications

GL Communications offers an assortment of Windows software-based applications, comprising a toolbox, if you will, of full-featured VoIP-monitoring components. What distinguishes this vendor's package is that GL Communications integrates, tailors, and customizes the components—including the user interfaces—to fit in the customer's existing management infrastructure.

On the passive side is the PacketScan probe, a Windows platform that handles a 100-Mbps link, typically on a mirrored switch port. The probe forwards call-detail records and statistics to a "listener/loader" central Windows-based server and database. This works with another Windows platform, a Web server with an Oracle database, which handles information presentation, and multiple Web-console access.

A unique adjunct application is the VoiceBand Analyzer, or

and active-test subsystems, but with a clear focus on VoIP call quality. VoIP RTP streams and RTCP are passively monitored and scrutinized in detail, and multiple MOS quality algorithms deliver rich VoIP-quality assessments. However, the system does not now separately track or analyze signaling activity. The vendor is adding this in a future release.

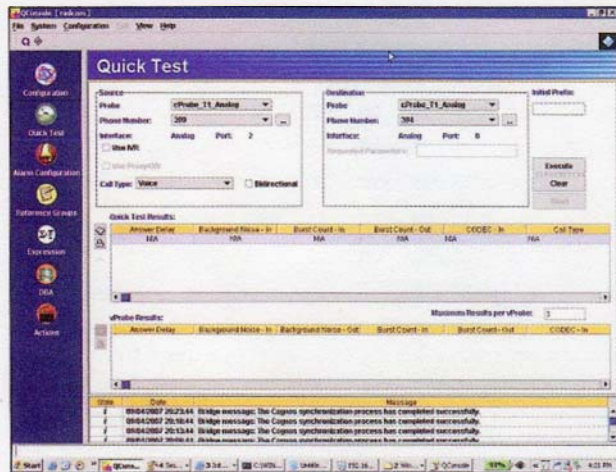
The same Sun Solaris server hosts both the passive monitor-

Originating Party	CD	CC	Terminating Party	Date/Time	Start Time	Last Time	RTP % Pk Loss	RTP % Pk Drop	RTP % Pk Error	RTP % Pk Jitter	RTP Delay (ms)	RTP Delay (ms) T-90
4000-0-0	3.00	4.25	4000-0-0	11/02/06	11/02/06 09:40	11/02/06 09:40	18.64%	1.67%	18.64%	1.67%	3.30	2.60
10.115.94.40	3.00	4.25	10.115.94.40	11/02/06	11/02/06 09:40	11/02/06 09:40	18.64%	1.67%	18.64%	1.67%	3.30	2.60
4000-0-0	3.00	4.25	4000-0-0	11/02/06	11/02/06 09:40	11/02/06 09:40	18.64%	1.67%	18.64%	1.67%	3.30	2.60
10.115.94.34	2.75	4.25	10.115.94.34	11/02/06	11/02/06 09:33	11/02/06 10:02:47	24.86%	2.76%	24.86%	2.76%	6.80	9.00
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10.115.94.34	2.75	4.25	10.115.94.34	11/02/06	11/02/06 09:33	11/02/06 10:02:47	24.86%	2.76%	24.86%	2.76%	6.80	9.00
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10.115.94.34	2.75	4.25	10.115.94.34	11/02/06	11/02/06 09:33	11/02/06 10:02:47	24.86%	2.76%	24.86%	2.76%	6.80	9.00
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10.115.94.34	2.75	4.25	10.115.94.34	11/02/06	11/02/06 09:33	11/02/06 10:02:47	24.86%	2.76%	24.86%	2.76%	6.80	9.00
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4000-0-0	3.00	4.25	4000-0-0	11/02/06	11/02/06 09:33	11/02/06 10:02:47	24.86%	2.76%	24.86%	2.76%	6.80	9.00
10.115.94.34	2.75	4.25	10.115.94.34	11/02/06	11/02/06 09:33	11/02/06 10:02:47	24.86%	2.76%	24.86%	2.76%	6.80	9.00
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10.115.94.34	2.75	4.25	10.115.94.34	11/02/06	11/02/06 09:33	11/02/06 10:02:47	24.86%	2.76%	24.86%	2.76%	6.80	

throughput. The newer R-70 probe handles up to two gigabit/s now (via multiple gigabit/s interfaces), and up to 16,000 monitored VoIP streams. MOS assessment is done on the probes.

Two active test stations include the cProbe, which generates and receives test calls via circuit-switched (analog or TDM) networks, and the iProbe, which launches VoIP calls.

Alarming is also well done. An excellent interface lets the user readily apply thresholds to over 100 performance metrics. Alarms can launch an application or be issued via e-mail or SNMP trap. Still others pluses are SLA monitoring and the ability to selectively capture, playback, and/or analyze actual voice streams for metrics including noise and echo.

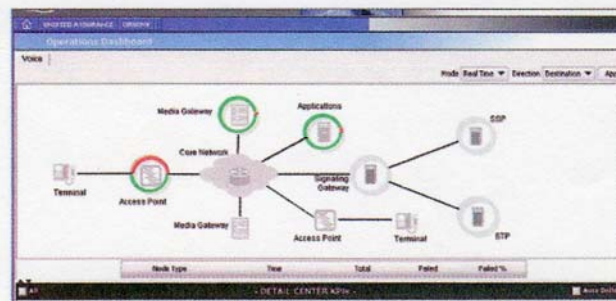


Tektronix

Tektronix's "Unified Assurance" banner covers network assurance, also known as passive monitoring, and Active Assurance, which embodies the excellent active VoIP-testing wares of Montreal-based Minacom, which Tektronix acquired late last year.

The passive package may be better known by the GeoProbe name that refers to the vendor's high-end probes. The vendor refers to its 14-slot probe chassis as a single GeoProbe; even dozens of high-speed, gigabit/s-capacity links are being monitored. There is a smaller, two-slot GeoProbe model, which can still handle eight physical gigabit/s interfaces.

At the central site are two or more Sun Solaris servers, running the Advanced Performance Monitoring, or APM, application, and the top-level Orion Service Assurance software. (Another major software component, called Beamer, handles managed-



service monitoring, what the vendor calls customer assurance. This software was not included in the system reviewed.)

Everything about GeoProbe and Orion equates to high-end, high-power, and high-capacity, which is why we name it the most scalable VoIP service-monitoring system. A high-level dashboard shows subtly color-coded icons of key service nodes and components. But that belies the eight levels of drill down that let an operator get to every level of detail.

Though not yet integrated with the Orion/GeoProbe package, the Active Assurance package (nee Minacom) deserves credit on its own. The Windows-based DirectQuality R7 system offers a clean, highly usable interface and a variety of active test probes.

WELL DONE

Based on this comparative hands-on review, in MierConsulting's opinion, three vendors—Agilent, RADCOM and Tektronix—showed their packages to be a cut above the rest in several key regards. They are:

Best Presentation of VoIP Service Information: Agilent

Unlike several competitors in the review, which include the very effective third-party report-generation engine from Cognos, Agilent developed its own presentation mechanisms for VoIP service monitoring. These include the Health Report Card format, which distills volumes of data into an excellent high-level overview, and which lets users easily drill down for details. Many of Agilent's clear and easily manipulated, real-time graphs are reminiscent of the OpenView SNMP manager, and Agilent acknowledges it has borrowed from this popular legacy system.

Best Integrated Passive and Active Monitoring: RADCOM

There's a lot to like about this vendor's Omni-Q package, but one particularly laudable aspect is the way in which passive monitoring and active monitoring have been neatly brought together. Yes, the passive and active probes are different, but the two VoIP-monitoring subsystems have been cleanly consolidated at the Q-Console. We note a "Quick Test" display, which shows the correlated results of an active test right alongside the passive observation of the same call.

Most Scalable VoIP Service-Monitoring System: Tektronix

Our review did not apply actual call loads to find the breaking point of these monitoring systems. But from all architectural aspects we believe Tektronix's Unified Assurance package, featuring the high-capacity GeoProbe series of passive probes and Orion Service Assurance software running on high-end Sun Solaris servers, can handle the biggest VoIP networks. The key central-site software modules can be split over multiple servers, and the vendor boasts installations handling "hundreds of millions" of call per day. ▽

Ed Mier, VON Magazine's test and measurement columnist, runs MierConsulting, which focuses solely on VoIP and network management, monitoring, and measurement. He has designed and installed dozens of local and worldwide networks and been involved in many VoIP rollouts. He can be reached at: emier@mierconsulting.com.