

# Small IP-PBXs: Another Close Race

Betsy Yocom, Jonathan Taylor and Diane Poletti-Metzel

**Rapidly evolving small IP-PBXs now offer sophisticated features, a variety of endpoints and good voice quality, but SIP is still to come on most systems.**

**S**mall IP-PBXs—supporting 99 or fewer stations—now offer many of the sophisticated features and endpoints available on higher-end products. Voice quality on these systems is good overall, although high latency was an issue on some of the softphones.

As with their higher-end counterparts, the differentiators among products are primarily the advanced features—unified communications and blending voice mail, email and instant messaging and powerful contact-center applications—as well as depth and breadth of endpoints.

One thing did surprise us about this group of IP-PBXs: While SIP-to-H.323 gateway support is widespread on the bigger systems (see *BCR*, January 2004, pp. 26–40 and February 2004, pp. 26–39) it is not on these smaller ones. In fact, only two vendors of the seven in this test support SIP—Interactive Intelligence, whose Enterprise Interaction Center is entirely SIP-based, and Nortel Networks, which supports the MCS 5100 SIP-to-H.323 gateway.

Most vendors had SIP “in the works,” but were not willing to reveal their plans.

The IP-PBXs reviewed here are targeted to smaller networks—branch offices of larger companies, retail stores (large pharmacy chains, “big box” stores, etc.), municipal government, local schools and law offices.

Some of the vendors told us that they are beginning to sell these small IP-PBXs as key system replacements, but that is evolving slowly. Smaller offices are typically not early adopters of new technologies, and the pricing on these systems is probably a tad high for companies with fewer than 25 employees—which is where key systems are still widely deployed.

## The Review

Last December, Miercom invited vendors that offer IP-PBXs supporting fewer than 100 stations


### Correction

In the review of mid-range IP-PBXs in the *BCR* February issue, the architecture of Mitel’s 3300 ICP was incorrectly characterized. The product package does indeed now support a redundant fail-over call controller and a standalone, IP-connected VOIP gateway, the combination of which can substantially bolster the system’s overall survivability and reliability.

We regret the error.

*Betsy Yocom is managing editor at Miercom, a network consultancy and product test center based in Princeton Junction, NJ (www.mier.com). Jonathan Taylor is lead test engineer and Diane Poletti-Metzel is manager of lab testing.*

**TABLE 1 Scorecard: IP PBXs <100 Stations**

	Pct. Weighting	 Avaya IP Office 403	EADS Telecom PortSpan M6501	Interactive Intelligence EIC	Nortel Networks BCM	Siemens HiPath 3500	Swyx SwyxWare	Vertical Networks InstantOffice 3500
Architecture	10	82	78	87	89	86	80	85
Endpoints	15	87	83	81	84	85	81	78
Management and Administration	25	83	78	81	87	85	78	88
Features	30	90	82	85	84	87	81	84
Performance	20	85	80	88	84	82	82	82
<b>The Bottom Line</b>	<b>100</b>	<b>86</b>	<b>80</b>	<b>84</b>	<b>85</b>	<b>85</b>	<b>80</b>	<b>84</b>

to participate in a competitive review (results summarized in Table 1). Seven vendors agreed to compete. An overview of their architectures and basic functions is shown in Table 2, (pp. 38–39) and features are summarized in Table 3, pp. 44–45. The participating vendors were:

■ **Avaya**, which demonstrated its Avaya IP Office 403, v2.04 and IP Office Manager Windows-based management application, v4.0(16). The Avaya 4624 IP Phone was the phone under test; we also evaluated the Avaya iPhoneManager Pro softphone and IP Office SoftConsole and Avaya's 3616 and 3626 wireless phones.

■ **EADS Telecom**, which came in with the PointSpan M6501, firmware version E3FP, and M7425 Enterprise Management System, v3.2. The IP phone under test was the EADS i760; we also evaluated the EADS i2052 Softphone and i2070 Attendant Console.

■ **Interactive Intelligence**, which brought in its SIP-based Enterprise Interaction Center (EIC), v2.3 and Interaction Administration management application, v2.3, which runs on a server or laptop PC. The IP phones under test were the Polycom SoundPoint IP500 and the Cisco 7960 SIP phone; we also reviewed the Interactive Intelligence Interaction Client.

■ **Nortel Networks**, which tested its Business Communications Manager (BCM), v3.6 (1.1, in beta when tested) and BCM Unified Manager, v3.6 Web-based application. We also reviewed Nortel's Network Configuration Manager, v3.6 multisite management application as an advanced feature. The IP phone under test was the Nortel i2004; we also evaluated the Symbol NetVision wireless phone and SpectraLink Wi-Fi phone, which Nortel supports, and the Nortel i2050 Client softphone.

■ **Siemens ICN**, which submitted its HiPath 3500, v4.0 and HiPath 3000/5000 Manager E (for system management) and Manager C (for moves, adds and changes), both version 4.0. The Siemens IP phone under test was the optiPoint 400; we also evaluated the optiPoint 600, optiPoint 130 soft client and the optiPoint Attendant soft console.

■ **Swyx International**, with SwyxWare, a software-based offering that includes SwyxServer and the SwyxGate ISDN gateway, both version 4.21. We also evaluated SwyxWare Administration, v4.2, a Windows-based GUI and the SwyxIT! softphone. The IP phone under test was the Swyx-Phone L420 (a Siemens OEM).

■ **Vertical Networks**, which came in with its InstantOffice 3500, v6.0 (in beta when tested) and the Vertical InstantOffice Remote Management Console, v6.0, a Web-based application. We evaluated Vertical's Multi-Site Management, v1.1 and Multi-Site Reporting, v1.0 application as part of the advanced features evaluation. The IP phone under test was the Polycom SoundPoint IP 500. We also evaluated the SpectraLink NetLink wireless phone.

## The Scorecard

The Avaya IP Office 403 took the "Best-in-Test" award, edging out the Nortel BCM and the Siemens HiPath 3500, which tied for second place.

As with this year's previous IP-PBX reviews, this one was a close race among very well matched contenders. All the products tested had overall scores of 80 or above, an indication of their strong standing competitively.

But in this review, top scorers within each category were more diverse. Avaya had the highest ratings in Endpoints and Features, which resulted in its Best-in-Test win. However, the Nortel Networks BCM was best-ranked for its architecture, the Vertical Networks' InstantOffice 3500 for its impressive management application, and Interactive Intelligence for its performance—notably its outstanding softphone voice quality.

We rated the products in five different categories:

■ **Architecture**, in which we assessed physical attributes, such as redundancy, hot swappability, ease of scalability, etc.

■ **Endpoints**, which included IP phones, softphones, conference phones, wireless phones, etc.

■ **Management and Administration**, incorporating management applications, including integral and extra-priced options. We rated robustness, ease of use, intuitiveness, real-time monitoring and reporting features, etc. Ease of installation was also included in this analysis.

■ **Features**, including the basic features we would expect to find on an IP-PBX (such as call hold, call forward, etc.), other IP-PBX features (such as automated attendant, unified messaging, interactive voice response, etc.), as well as unique features that set the product apart.

■ **Performance**, in which we assessed call quality, latency, call completion rates, ability to fail over quickly, etc. We also assessed the effects that a series of denial of service (DoS) attacks had on the systems.

## Architecture

The Nortel BCM had the best showing in this category, with a score of 89. Chief among its architectural attributes are redundant hard drives and fans, hot swappable power supplies and the ability to upgrade its call controller with processor expansion cards to increase codec capacity.

Also kudos to the Nortel BCM for its support of a SIP-to-H.323 gateway on the MCS 5100. Only one other vendor, Interactive Intelligence, supported the SIP protocol.

In the small IP-PBX market, the ability to offer "all in one" products is a plus, and the Nortel BCM was one of two (the Vertical Networks InstantOffice is the other) that supported a number of other functions integrally, including a firewall, virtual private network (VPN), a DHCP server and router in one unit.

**Only Nortel and Interactive Intelligence supported SIP**

**TABLE 2 Configurations Compared—IP PBXs <100 Stations**

	<b>Avaya Inc. Basking Ridge, NJ www.avaya.com</b>	<b>EADS Telecom Frisco, TX www.eadstelecomna.com</b>	<b>Interactive Intelligence, Inc. Indianapolis, IN www.inin.com</b>
System tested	Avaya IP Office 403, v2.0	PointSpan M6501 IP PBX, firmware version E3FP	Enterprise Interaction Center (EIC), v2.3
Configuration	Standalone unit with integral ACD voice compression modules; Avaya AP connected for wireless	Multi-slot chassis with 14 slots for cards and 1 for CPU	EIC software running on Windows-based server supporting Intel Host Media Processing; Domain Controller runs on Windows 2000 Server
Management application	IP Office Manager, v4.0(16); Windows based; runs on Windows 95, 98, NT, 2000, XP; no CLI	M7425 Enterprise Management System, v3.2 (\$7,274); Windows-based on 2000 and higher; also Web-based (Java client); VT100-based CLI	Interaction Administration, v2.3 (separate application on server or laptop PC); Cisco CLI
Call control/call routing platform	Proprietary hardware based on Motorola PowerQuicc running proprietary OS and Call Processing software	Via Winrmx-based call server on Windows 2000 or via M6501 proprietary OS (IRMXIII)	Windows 2000
Maximum devices supported (1)	98	250	300
Maximum T1/E1 trunks per single system (2)	1; 2 planned (May 2004)	4	5
Maximum analog trunks per single system (2)	56	48	5
Codecs supported	G.711, G.729A; G.723	G.723.1, G.711, G.729A	G.711, G.729A/B, G.723.1; G.726
Gateways (other than PSTN-IP)	None	None	Cisco TAPI to Cisco CallManager via third party
H.323 gatekeeper	Integral	Optional	Not applicable
Native VOIP protocol	H.323/Q.931	MOVACS proprietary	SIP
VOIP protocol to deliver phone features	H.323, H.450, Q.931	MOVACS proprietary	SIP
Integrated firewall, VPN, DHCP server, router, etc.	Firewall, VPN and DHCP	No	Via third party only; must be SIP compliant
IP phone(s) under test	Avaya 4624 IP Phone	EADS i760	Polycom SoundPoint IP500
Station interfaces	IP, analog, digital, wireless	IP, digital, analog	IP, analog via AudioCodes MP-108 FXS gateway (\$1,200), analog wireless
Third-party phone support	None	None	Polycom IP500, IP600; Cisco 7960; any SIP-compliant phone
Softphone(s)	Avaya PhoneManager Pro; IP Office SoftConsole	i2052 Softphone; i2070 Attendant Console	Interactive Intelligence Soft Client; Interaction Client
Audio conference phone(s)	Polycom SoundStation (analog)	Polycom SoundStation (analog)	Analog conference phone supported via AudioCodes MP-108 FXS gateway
Base system price (US list ) (3)	\$33,289	\$65,686	\$35,206
Optional components (4)	\$560 per seat for Compact Contact Center; \$23,722 for Call Center Reporting (50 agents); \$510 for first SoftConsole position (\$255 additional per seat up to five); approximately \$5,000 for Conferencing Center (May GA)	\$73,147 for M7408 Contact Center; \$7,274 for M7425 management application; \$3,000 for PointSpan M6501 Database Administration; \$3,000 for PointSpan Installation and Maintenance; \$24,000 for M6501 Database Admin on site	\$5,000 for upgrade to CIC Server license; \$400 for each External Call Port upgrade (total CIC upgrade for configuration tested was \$19,600); \$5,000 for Advanced SIP Proxy

<b>Nortel Networks Brampton, Ontario www.nortelnetworks.com</b>	<b>Siemens ICN Boca Raton, FL www.icn.siemens.com</b>	<b>Swyx International, Inc. Providence, RI www.swyx.com</b>	<b>Vertical Networks, Inc. Sunnyvale, CA www.vertical.com</b>
Business Communications Manager (BCM) v3.6 (beta when tested)	HiPath 3500, v4.0	SwyxWare, v4.21; includes SwyxServer and SwyxGate (ISDN gateway)	InstantOffice 3500, v6.0 (beta when tested)
Standalone system with optional redundant RAID; expansion chassis supported (on BCM 400) to increase line capacity	Standalone multi-slot chassis with HiPath Gateway 1500 IP card	Completely software-based product that runs on Windows platform	Standalone multi-slot chassis
BCM Unified Manager, v3.6 (Web-based Java application; SSH CLI, also CLI via Telnet (but disabled by default))	HiPath 3000/5000 Manager E; v4.0; HiPath 3000/5000 Manager C (for moves, adds and changes), v4.0; separate application that runs on Windows 98 and higher; CLI via Telnet	SwyxWare Administration, v4.2; Windows-based GUI; no CLI	Vertical InstantOffice Remote Management Console, v6.0; Web-based application; no CLI
Implemented in Media Services Card running pSOS; Windows NT embedded platform for VOIP tasks	Proprietary Cosmos operating system (resides on CPU module in chassis)	Windows Server 2000 and 2003	Windows NT 4.0 server
249	212	600 (based on 2.4 GHz Pentium-4 server)	72
3	1	2	2
80	60	16	30
G.711, G.729A/B, G.723.1	G.711, G.723, G.729, G.722 (on optiPoint 410 series)	G.711, G.729A	G.711, G.729A/B
MCS 5100 SIP to H.323 Gateway	None	H.323 to Siemens CorNetIP	MGCP to H.323
Supports Nortel Networks Succession, CS2000, NetCentrex and RadVision ECS gatekeepers	Optional	Integral	Integral
Unistim proprietary	H.323	H.323	MGCP
Unistim, H.323, 802.11 wireless	CorNet IP for Siemens phones; H.323 for third-party phones	H.323 and Siemens CorNetIP; SIP planned for 2004	MGCP
Firewall, VPN, NAT, DHCP server and router	Firewall	Users firewall integrated with Windows platform	Firewall, VPN, DHCP server and router
Nortel i2004	optiPoint 400	SwyxPhone L420 (Siemens OEM)	Polycom SoundPoint IP 500
IP, digital, analog, wireless	IP, digital, analog	IP, analog (via terminal adapter), wireless	IP, digital, analog, wireless
Symbol 802.11 wireless handsets with proprietary extension to H.323	Polycom IP3000	Symbol and SpectraLink Wi-Fi phones	Polycom SoundPoint IP 500; SpectraLink NetLink i640; SpectraLink NetLink e340
Nortel i2050 Client; Converttec Attendant Console	optiPoint 130 soft client; optiPoint Attendant soft console	SwyxIT!	H.323-compliant
Analog and digital (Polycom); IP planned (RadVision MCU IP)	Polycom Soundstation (analog) and Polycom IP Conference Phone	Polycom IP Conference Phone	Third-party analog phones
\$27,405 (based on optimized i2001 IP phones); \$31,005 based on optimized i2002 IP phones	\$27,126	\$35,089	\$36,977
\$525 for one BCM Network Configuration Manager Software Authorization Code; \$5,000 for four-port IVR; \$1,400 for Console.NET attendant console	\$3,750 for optiClient; \$645 for optiPoint 600 Office Phone; \$450 for Manager C (Manager E free with training course); \$11,700 for OpenScape for 25 users	License charges for SwyxLink range from \$540 for two channels to \$6,000 for 30 channels; \$1,141 for 25-user license for Swyx CTI client for hard phone	\$34,950 for Multi-Site Management and Reporting; \$2,000 for Call Routing and Queuing; \$500 for Fax Manager; \$1,000 for Service Response

Table 2 notes on p. 40

**SwyxWare is an entirely software-based product**

**Notes From TABLE 2 Configurations Compared—IP PBXs <100 Stations**

- 1-Assumes a mix of PC softphones, analog phones, fax, IP phones, etc. supported on a single, discrete, local system.
- 2-Assumes a maximum configuration with 1:1 station-to-trunk ratio supported in a single, discrete, local system (under a common call controller).
- 3-Vendors were asked to provide basic system pricing based on the following: An IP-PBX system with 50 mid-range stations (including 25 IP hard phones and 25 softphones); IP phones should support a secondary switch port, at least six feature buttons and an LCD; greenfield installation assumed. Pricing includes all required cards, call control, station interfaces, power for IP phones and software licenses to support basic services; the system supports one T1 trunk. Included are voice mail licenses and servers for 50 users; all basic PBX functions and basic telephony functions; any chassis required to house the basic system components; cost of management; and any additional services, gateways, etc. required for full VOIP functionality.
- 4-We evaluated up to five advanced features on each product. Pricing for any features that were not included in the base system price are included in this entry.

About the only notable down side for Nortel in this category is its support for a proprietary VOIP protocol (Unistim). As the market moves steadily toward open standards, this could pose an impediment to interoperability.

Second-ranked Interactive Intelligence, with a score of 87, received points for its flexibility. Because the EIC is a software-based product, it can run on a variety of servers. (The vendor said it has a list of “approved” servers that they recommend to customers.)

The vendor claims that EIC will support any SIP-compliant device. In our test configuration, EIC proved seamless interoperability with the Cisco 7960 SIP Phone and the Polycom SoundStation IP 500 and IP 600 phones, but we did not test that claim further.

Redundancy is available through addition of second EIC. Switchover to a backup unit is automatic in the event of failure in the primary system, but load sharing is not supported.

Redundancy is further achieved through the Interactive SIP Proxy, which can take over call control if the EIC call controller is not functioning. A standard SIP Proxy can be downloaded from the vendor for free, and an advanced proxy with additional load-balancing functionality is available for \$5,000.

Among the EIC’s other attributes are hot-swappable hard drives and power supplies and support for four different codecs (G.711, G.729A/B, G.723.1 and G.726), although G.729 was not supported on Interactive’s softphone. EIC also supports network interface card (NIC) teaming, whereby one IP address can be assigned to two

different interfaces. If the primary goes down, the secondary interface takes over.

The Siemens HiPath 3500 took third place in Architecture with a score of 86. Siemens won points for its compact chassis and the ability to increase system capacity by adding HiPath 1500 Gateway IP cards.

The Siemens HiPath 3500 was also cited for its scalability. HiPath 3500s can be clustered via an IP trunk with the vendor’s HiPath 5000 Real-Time IP system (its high-end IP-PBX), which assumes management and control of the cluster that then acts as a single, discrete system.

With its “all-in-one” product, Vertical offers a cost-effective alternative to customers who don’t want a lot of different hardware.

InstantOffice was the only product reviewed that supports the Media Gateway Control Protocol (MGCP). Vertical was an early entrant into the IP-PBX market and chose MGCP when there was still some question about where VOIP standards were headed. Clearly, the standards are not headed in the direction of MGCP, and Vertical might have to address that in the future.

The InstantOffice 3500 had a much larger footprint than most of its competitors—it’s 8.065 inches high, by 17.6 inches wide, and 17 inches deep and weighs 46 pounds. Contrast this to the HiPath, for example, which is in a one-unit enclosure, or a Swyx that runs on a server. InstantOffice’s size could be a negative in some environments.

The Avaya IP Office 403’s score of 82 reflects a couple of notable shortcomings in this category. It supports no hot swapping of drives or power and no SIP-to-H.323 gateway.

And while media encryption isn’t available on any of the other products tested here, its absence on the Avaya IP Office 403 is notable since Avaya’s other IP-PBXs currently support Real-Time Protocol (RTP) media encryption.

On the plus side, the IP Office supports a VPN, firewall and DHCP server, and it comes in three different models: the 403 we tested, which supports one T1 trunk; the IP Office 406, which supports two T1 trunks, and the IP Office 412, which supports 4 T1s.

SwyxWare is an entirely software-based product that is tightly integrated with the Windows platform. Buyers receive a CD with the SwyxWare applications and purchase their own Windows 2000 or 2003 platforms. Swyx won points in this category for this flexibility—users can buy their own hardware and install the system themselves. SwyxWare is very Windows-oriented, and anyone familiar with that OS can probably handle the system without a long learning curve.

Another plus for SwyxWare is the ability to link multiple SwyxServers to form an integrated, distributed IP-PBX.

SwyxWare also supports Siemens CorNetIP protocol for operation with Siemens optiPoint IP phones.

On the down side—while Swyx supports the firewall that comes integrated with the Windows platform, it does not offer any other integral functionality like many of its competitors do. Furthermore, its support of T1 is limited to CAS and PRI; analog FXO support is still planned, and WAN support is IP only.

EADS Telecom's PointSpan M6501 scored a 78 in this category, losing points for its dependence on the proprietary MOVACS VOIP protocol and its very large footprint. The 14-slot chassis takes up quite a bit of real estate, and the need to change dual inline package (DIP) switches to reconfigure a T1 trunk is outmoded.

Also, PointSpan has no hot swappable components, as most of its competitors do.

However, EADS won points for its ability to network several PointSpans via MOVACS over an IP or PRI link to increase capacity.

### Endpoints

The Avaya IP Office 403 was the leader in this category with an 87, awarded chiefly for Avaya's breath of offerings, including five models of Avaya 46XX Series IP phones, seven 44XX and 64XX Series digital phones, Avaya's 3616 and 3626 wireless phones, the Avaya iPhoneManager Pro softphone and the IP Office SoftConsole.

The Avaya phone under test was the Avaya 4624 IP, which supports 24 programmable buttons—the most offered on any of the IP phones we tested. While all the softphones we tested reside on a Windows operating system, Avaya's iPhone Manager Pro softphone works with the widest variety, including Windows XP, 2000, NT4, 98, ME, 2000 Server and NT Server.

The only notable misses for Avaya in this category are lack of support of an IP conference phone (Avaya supports Polycom's analog SoundStation) and support of a hub, rather than a switch, on its phone. (A switch is preferable because it allows support of 802.1P/q prioritization, and separation of data traffic from VOIP traffic in discrete VLANs. With a hub, voice and data are transmitted on the same link and can be seen by both the phone and the PC.)

Siemens had the second highest score in Endpoints (an 85). Its phones were cited for their sleek, attractive design. We tested the optiPoint 400 IP phone and evaluated the optiPoint 600 as an advanced feature (see Features below).

Siemens also supports the optiPoint 130 soft client (evaluated as an advanced feature below) and the optiPoint Attendant (soft console).

While all the vendors supported some kind of audio conference phone (typically Polycom's analog SoundStation), Siemens was one of two (Swyx was the other) that supported the Polycom IP conference phone as well.

Siemens was also one of two vendors (Avaya was the other) that supported a videoconference phone, both from third parties such as Polycom.

Nortel's score of 84, which puts it in third place, also reflects a broad product line, including three IP phones (the i2001, i2002 and i2004); the Symbol NetVision and SpectraLink Wi Fi phones; the Nortel Series of T7XXX digital phones; the Nortel i2050 Client softphone (16 come with the base system); and the Convertec Attendant Console, which the vendor offers under its Nortel Developer Program.

One of the highlights of Nortel's endpoints is support of the same feature codes for both digital and IP sets. This allows those with a large investment in digital sets to migrate to IP with greater ease of use for end users.

Nortel lost points in this category for a couple things. First, its phones had no graphical volume representation. When we hit the volume bar, nothing showed where we were on the volume scale. Second, an evaluation of Nortel's "full-duplex" speakerphone revealed it was half duplex.

EADS Telecom's score of 83 reflects a solid endpoints product line, which includes three IP phones—the i740, i760 and the higher-end i780, which supports a larger display area than the two-line models. A QWERTY (31 keys) keyboard is integrated into all of the phones, providing interactive soft keys.

EADS won points for support of 20 programmable keys, which, depending on the model, can be expanded up to 60 keys through expandable blocks that attach to the phones.

In addition to its IP phones, EADS also supports five models of M7XX digital phones (which can be upgraded to IP phones), but no wireless phones. They also support an i2052 SoftPhone and an i2070 Attendant Console.

"Misses" for EADS in this category include the lack of a volume bar on the phone (although you could adjust the volume via keystrokes). And although the phones support a missed call indicator button, it did not clear properly.

The remaining vendors in this review—Interactive Intelligence, Swyx and Vertical Networks—do not manufacture their own IP phones, but depend on third parties for support. Interactive Intelligence and Vertical Networks support Polycom's SoundStation IP phones, while Swyx's SwyxPhone L420 is an OEM from Siemens. Swyx also offers an L400 handset, which is competitively priced at only \$180.

Highlights of Interactive's endpoints line is support of the Interaction Client softphone, which is part of the EIC system. It can be used with a SIP phone or with a SIP phone and unified messaging, both of which require licenses. (More on Interaction Client in the Features section.)

An AudioCodes MP-108 FXS gateway (priced at \$1,200) is needed for analog support on Interactive's EIC.

Swyx also offers a softphone, called SwyxIt!, which works with a USB headset or with an off-hook table phone, which we really liked. Headsets



**Three of the vendors don't manufacture their own IP phones, but rely on third-party sets**



**Vertical Networks led the management category thanks to its well-designed GUI**

can be annoying to wear and the table unit offers a nice alternative.

Vertical Networks said it can support any H.323-compliant softphone, but we did not test InstantOffice with any in this review. InstantOffice also supports digital phones and the Symbol and SpectraLink wireless phones.

#### **Management And Administration**

The Vertical Networks InstantOffice 3500 led the management category with a score of 88. The InstantOffice Remote Management Console is Web-based and also supports dial-in access for remote management.

InstantOffice's win was due mainly to the product's well-designed, intuitive and highly navigable graphical user interface. Parameters are grouped into three areas: administration (for system management), applications (for setting up general settings, the InstantOffice Contact Center, MultiSite Management, etc.) and diagnostics (which includes ping, ARP table, trunk monitoring, etc.). We could easily find and complete most tasks within no more than three mouse clicks.

A highlight of Vertical's management are powerful Station Monitor and Trunk Monitor applications, which were very effective for assessing phone and network operations and the health of the system.

For example, within two mouse clicks we found a list of extensions in Station Monitor, which we could sort by extension number, phone type, etc. Drilling down into the list provided more statistics, such as jitter, latency, media type, codec in use, etc.

Also good was the chassis view screen, which provided a visual look at the InstantOffice itself, showing cards installed, LED status, hardware levels, firmware revisions, etc.

Vertical also won points for its ability to add users and voice mail accounts in bulk. Another significant plus were the many diagnostics and troubleshooting tools on the system. For example, Trunk Monitor allows a real-time view of the trunks, with options to troubleshoot remote locations from the network operating center.

For all its features, InstantOffice Remote Management is somewhat limited in canned reports compared to its competitors. It also supports no SSL/SSH encrypted access and no audit log.

The Nortel Networks BCM Unified Manager is a highly navigable and intuitive Web-based Java application, which is based on a tree structure with menus. A CLI is also supported, but disabled by default, although we accessed it for troubleshooting through SSH.

A highlight of Nortel's management is the BCM Real-Time Monitor, which provides statistics on CPU utilization, memory, estimated bandwidth per call, jitter, etc. New this year is Live Monitor for viewing stats on outgoing calls; also new is the ability to set variable payload sizes.

Although BCM Monitor is a great tool, it has one deficiency. It doesn't record RTP information on calls between internal phones—only external calls. The BCM Monitor receives information on internal calls, but does not get RTP stats from the phone because the internal calls are peer to peer. The BCM knows that the extensions are on a call, but cannot "see" any statistics about those calls because the call path does not traverse the BCM. Calls to the PSTN or external VOIP destinations travel through the BCM, so it sees and can report those RTP stats.

Security on Unified Manager is provided through encrypted access via SSH/SSL and through the ability to lock out users after a definable number of attempted entries.

Next up in the Management category was Siemens with a score of 85. The HiPath 3500 worked "out of the box" through a wizard that downloaded the system configuration. Unfortunately, there was no wizard to change default settings, which would have eased installation.

Siemens management, which is designed around a directory tree structure, comes in two flavors: HiPath 3000/5000 Manager E for system maintenance and centralized management of multiple systems; and Manager C for moves, adds and changes. These are separate applications that run on Windows 98 and higher platforms. Manager C is an extra-priced option that costs \$450; however, Manager E is free with the training course Siemens requires to use that application. That course, HiPath 3000 Manager E Fundamentals costs \$281 and is required, but it's provided via the Internet, so there are no travel expenses.

Offering a separate application for moves, adds and changes is a good idea as it allows lower-level technical staff to complete these frequent tasks without affecting the system itself. Requiring additional training for system management is also wise, since it's a detailed application that could easily overwhelm the less technical.

Notable on Siemens' management is the rich templating available to set parameters. With a few check box entries and mouse clicks, we set up and activated an E-911 application, for example.

Another asset is the comprehensive diagnostic tool, which allowed us to test down to the channel level. Also noteworthy was the Deployment Tool (part of the Manager E application) that allows batch upgrades and changes to the phones.

One criticism: The Siemens application is light on canned reports for such a rich system. Siemens CDR records are in flat files, and third-party tools, such as IntegraTrak, are necessary for reporting.

Avaya's IP Office Manager is a Windows-based application that runs on Windows 95 and higher platforms. A CLI is not supported.

Office Manager supports offline configuration, which can be done from a laptop PC and then "pushed" down to the system—a plus for this application since it facilitates remote management.



**Avaya had the  
broadest set of  
advanced feature  
offerings**

Currently, Office Manager does not support the ability to make global changes, but this is coming in 4Q04, according to Avaya.

Another plus is the System Monitor application, which allows viewing of statistics in real time and the status of calls in progress.

However, Avaya lost points for what it lacks *vis a vis* its competitors: an integral event viewer, canned management reports (although these are available with Avaya's Compact Contact Center, which we evaluated as an advanced feature) and an audit log.

The Interactive Intelligence Interaction Administration management application is a separate application that runs on a server or laptop PC for remote management. A Cisco CLI was used to manage the Cisco 1760 Gateway to the PSTN. (Note: customers have the option of using Accu-Lab or Dialogic boards installed on the server for T1/E1 access instead of the Cisco gateway, but since we used the Cisco gateway, we had to manage it via the Cisco CLI.)

The Interaction Administration was less intuitive than the other management applications we evaluated. The application supported the typical tree list/menu-based structure, but there was a lot to master, which is one reason why it wasn't as easily navigated as some of its competitors.

Also, some common actions were not straightforward. For example, adding a new phone to the system involved getting its MAC address, setting the phone to DHCP and copying over a configuration file from an existing configuration, copying the file to a TFTP or FTP server, then opening Interaction Administration and going to the station field to add the extension and selected rights. On most other systems, we could perform this function with a few clicks.

Interaction Administration does offer some powerful tools—for example, the ability to customize buttons to manage calls, and an “action” feature that allows pop-ups to occur on certain actions, such as a call coming in. Some on our staff found the pop-ups distracting, others thought they were useful.

Interaction Administration also scored points for its graphical statistics, some of which (CPU utilization, user information longest call etc.) we could view in real time.

For such a detailed application, some omissions stood out. For instance, getting a report of users and extensions was not a canned report (it can be customized, though); most of the IP-PBXs we've reviewed support this as a canned report. We also could not get a count of phones physically connected to the EIC, nor any bandwidth statistics. And there was no onscreen help for alarms.

EADS Telecom's M7425 Enterprise Management System is extra-priced. (\$7,274). It operates on a Windows 2000 and higher platform and also via the Web through a Java client. One M7425 can manage multiple PortSpans.

The system also supports a VT100-based CLI for system, telephony, data and operations management. Six levels of password access are supported for security. Of the vendors tested, EADS seemed more reliant on the CLI. For instance, CLI was required to make an IP address change.

The EADS GUI lacks many of the tools that have been added to IP-PBXs to make them more attractive to IT-oriented staff, including wizards to facilitate certain processes, canned management reports and intuitive processes for setting up parameters. The EADS interface will definitely take some getting used to and will require fairly significant technical expertise to master.

On the plus side, the M7425 can manage multiple sites, and supports an application to add IP users in bulk. It also supports a separate moves, adds and changes module and provides call-accounting and costing records through a charging module, although EADS said most U.S. customers use an external CDR application instead.

Swyx's management application, SwyxWare Administration, is based on the Microsoft Management Console snap-in tool. It provides an application that Windows users will find easy to learn and use. It also supports a good setup wizard for installation and two very good graphical scripting tools for setting up system functions.

But the simplicity of the SwyxWare tool is offset by some limitations. It supports no T1 utilization reports (these are planned, according to the vendor) or real-time bandwidth statistics. It also does not support SNMP, and graphical reporting of CDR information is available only through third-party packages.

### Features

Our features analysis consisted of a review of 16 basic features (call forwarding, call hold, etc.) that users would expect to find on an office phone, and 16 basic PBX system features and add-ons that should reside on an enterprise IP-PBX (Table 3, and for a list of the 16 basic telephony features, see *BCR*, January 2004, pp. 26–40.)

We also asked each vendor to nominate up to five “advanced” features that they believe separate the product from competitors in this market. All the vendors presented many innovative offerings, which are summarized in this section. Some of these features are extra-priced (Table 2).

The Avaya IP Office 403 took the gold in Features with a top score of 90, awarded for its breadth of offerings in this category.

IP Office 403 comes with an integrated VoiceMail Lite application, but the Windows-based VoiceMail Pro (VMPRO) and Integrated Messaging application is offered for more advanced call handling.

The VMPRO GUI provides the ability to create various levels of call flows through a graphical scripting tool. Specific call routing can be defined per user or per group, and a call recording feature

**TABLE 3 Features Compared—IP PBXs <100 Stations**

	<b>Avaya Inc. IP Office 403</b>	<b>EADS Telecom PortSpan</b>	<b>Interactive Intelligence EIC</b>
Percent of basic phone features supported (1)	97 (2)	100	97 (4)
Automated alternate routing	Integral	Integral	Integral
Automatic route selection	Integral	Integral	Integral
Automated attendant	Optional via VoiceMail Pro	Optional	Integral via Interaction Attendant
Billing/accounting	Via third party	Optional	Integral (5)
Call Center/ACD support	Integral	Optional via M7480 contact Center	Integral
Hunt groups	Integral	Integral	Integral
Interactive Voice Response (IVR)	Optional via VoiceMail Pro	Optional via M7480	Integral
Least cost routing	Integral	Optional	Integral
Night service (time of day)	Integral	Integral	Integral via Interaction Attendant
Recorded announcements	Optional via VoiceMail Pro	Optional via daughterboard	Integral
System speed dialing	Integral	Integral	Integral
Unified messaging	Integral with VoiceMail Lite; full integration messaging via optional VoiceMail Pro(3)	Optional	Optional via third-party mail server
User directory	Integral	Integral	Integral
Voice mail	Integral via VoiceMail Lite; advanced features via optional VoiceMail Pro	Via optional card that integrates into M6501	Integral
911/E-911	Integral	Integral	Integral (6)
Advanced features evaluated for this review (11)	Compact Contact Center; Installation and Administration Wizard; IPPhoneManager Pro; IP Office Conferencing Center; IP Office SoftConsole	MOVACS networking; IP/TDM feature transparency, Vital Subscriber/Virtual Subscriber; M7480 Contact Center	SIP proxy, Interaction Client, Presence Manager, Interactive Attendant; license upgrade to Customer Interaction Center

**Notes : 1-** Analysis of basic phone features based on 16 features that Miercom considers necessary to support business environments. For a complete list of the 16 phone features tested, see the sidebar "Basic Telephony Features" p. 36 in "Large IP-PBX's: A Well Matched Quartet," *BCR*, January 2004.

**2-** Avaya lost points for the Missed Call Indicator feature. A missed call count is displayed on PhoneManager, a separate application, but there is no visual indicator in the phone itself.

**3-** VoiceMail Lite offers the ability to deliver voice mail messages via SMTP- or MAPI-based email packages, but it is not synchronized. Synchronization requires an integrated messaging system license, which is offered within VoiceMail Pro. VoiceMail Pro offers integration with Microsoft Exchange for more sophisticated integration.

**4-** We did not observe a successful call park and retrieve on the Polycom phone that was under test, although this feature is supported within the EIC system itself and available via the Interaction Client. Interactive Intelligence, therefore, received half credit for this feature.

**5-** While a billing and accounting feature is integral within EIC, it can also interface with third-party applications for more detailed billing.

**6-** 911 is supported remotely through a SIP proxy or directly from a phone by adding a dial plan for 911.

**7-** The base BCM does not support canned messages, and the caller hears a busy signal on an invalid number. However, incorrectly dialed numbers can be set up to overflow to voice mail, which does have canned messages that will respond to an invalid number.

**8-** Last number redial is supported only for external calls.

**9-** Group-based, DNIS and time of day call routing is integral; skills-based call routing is via optional HiPath ProCenter Suites.

**10-** By default, InstantOffice routes all 911 calls over analog trunks; InstantOffice also supports connection to third-party CAMA boxes for Enhanced 911 support.

**11-** As part of Miercom's evaluation, each vendor is asked to nominate five features that they believe distinguish their product in the marketplace. These are evaluated as advanced features. Nominated features must be generally available at the time the review appears in *BCR*.

<b>Nortel Networks BCM</b>	<b>Siemens HiPath 3500</b>	<b>Swyx Swyxware</b>	<b>Vertical Networks InstantOffice</b>
100	97 (8)	100	100
Integral	Integral	Integral	Integral
Integral	Integral	Not supported; planned	Integral
Integral	Integral	Integral	Optional
Via third party	Via third party	Via third party	Via third party
Integral; requires optional key code to activate	(9)	Not supported; planned	Optional
Integral	Integral	Integral	Integral
Integral; requires optional key code to activate	Via HiPath Xpressions Compact or via third party	Via optional Extended Call Routing	Optional
Integral	Integral	Not supported; planned	Integral
Integral	Integral	Can be defined in optional Extended Call Routing	Integral
(7)	Optional via external device	Integral	Not supported
Integral	Integral	Integral	Integral
Integral within CallPilot; requires optional key code to activate	Optional via HiPath Xpressions software	Integral	Integral
Via third party	Integral	Integral	Optional via OfficeAttendant
Integral in CallPilot; requires optional key code to activate	Optional via Xpressions Compact integrated card; Xpressions external server; PhoneMail server or via third party	Integral	Optional
Integral	Integral	Integral	Integral (10)
Network Configuration Manager, i2050 Mobile Voice Client, Console.NET Network Attendant, IVR	OpenScape on optiClient 130; TAPI personal call management; Xpressions Compact Linux-based voice mail; optiPoint 600 Office phone	SwyxLink; SwyxIt USB handset/headset; Extended Call Routing; one-click applications sharing	MultiSite Manager and MultiSite Reporting; InstantOffice Fax Manager, Service Response, Call Routing and Queuing, Call Assistant

allows creation of announcements, such as late openings or closings, from a remote location.

VMPRO also integrates with Microsoft Exchange, allowing prioritization of email and voice mail messages in one in-box. A text-to-speech application provides the end user with the ability to retrieve voice and email messages through a telephone.


Another of Avaya's outstanding features is Compact Contact Center (CCC), a modular software application that supports 2–75 agents. The CCC server provides up to five supervisor positions, which have a real-time view into what is happening in the call center (idle operators, calls in queue, etc.). Up to 70 canned reports summarize historical data on the many functions reported in the CCC application.

A unique feature on CCC is the use of wallboards—a small area on the screen on which the supervisor can send *ad hoc* messages, make announcements or broadcast information.

Avaya also showed us the IP Office SoftConsole with a centralized operator feature that allows one operator to handle multisite locations. The SoftConsole also supports a conference room function that allows an operator to easily configure up to two conference room calls, including details about the conference.

The iPhone Manager Pro softphone rounds out Avaya's showing in this category. An iPhone Manager Lite softphone comes with the IP Office 403, but adding iPhone Manager Pro provides integration with popular contact management packages, such as Microsoft Outlook, Goldmine, Act! and Maximizer. This integration facilitates screen pop-ups, simple incoming call scripting, voice mail box control and more.

The Siemens HiPath 3500 received the second-highest score in this category (an 87). Siemens showed us perhaps one of the best personal productivity-enhancing tools in the review—its OpenScape presence-aware, real-time communi-



## Siemens earned high marks for its OpenScape application

cations software. We reviewed OpenScape running on the Siemens optiClient 130.

OpenScape is impressive for several reasons: First, it allows multiple workers to view documents at the same time (although on the release we evaluated, it was not yet possible to make changes to the document in real time). With a proper password, someone can retrieve documents left for him/her on someone else's system via voice mail or email. OpenScape also supports a text-to-speech application and a rules wizard for setting up call routing and handling.

Siemens also showed us its optiPoint 600 "universal" phone, which supports both IP and circuit-switched configurations and several Web protocols (such as WAP and HTTP). Its large (8 × 24 characters) backlit, touch-screen display is menu driven.

The optiPoint 600 is designed for applications where a PC is either not appropriate (places, for example in which it could be easily stolen) or too expensive (the optiPoint 600 costs \$645).

The optiPoint 600 supports Internet access, and it can also display customized Web content via a Net6 gateway (which scrapes out banners and other extra content so that only essential information is displayed on the screen.) The optiPoint 600 also supports a USB keyboard and snap-in expansion adapters for added functionality.

Siemens optiPoint phones support TAPI APIs, and to demonstrate some of the TAPI-based features, Siemens showed us two applications: HiPath SimplyPhone personal call management application and HiPath 3000 Concierge.

HiPath SimplyPhone provides the ability to click and dial numbers from a Microsoft Outlook directory or Lotus Notes and initiate and log real-time voice communications from within voice messages, address books, LDAP directories, contact lists and calendars.

The HiPath 3000 Concierge "hot desking" feature was particularly good. From a map of an office provided on a laptop screen, one could drag and drop an extension on to a vacant cubicle from a profile or list of configured extensions on the screen. After 30 seconds the user's profile was loaded on the phone in the selected room.

Siemens also demonstrated its Xpressions Compact, a Linux-based voice mail feature, which is implemented on a card integrated into the HiPath 3500, eliminating the need for a separate voice mail server. This product includes an Auto Attendant and provides an inexpensive way (Xpressions Compact costs \$1,300 list) for companies to get both features in the same system.

Ranking third in this category with an 85, Interactive Intelligence, a relative newcomer, made an impressive showing.

The centerpiece of Interactive's features presentation was the Interaction Client. It provides a host of advanced features, including drag-and-drop calling, speed dialing, integration with

Microsoft Outlook, initiation of chat sessions and accessing real-time call details.

Within Interaction Client are Presence Manager and Find-me/Follow-me features. Presence Manager lets callers know the whereabouts of a called party and a path to locate them—typically beginning with a desktop phone and then "following" the called party to cell phone and home phone numbers.

A notable feature on Interaction Client was the "tear off page" function, which lets the user drag a portion of a screen and drop it into its own "page," which can be separately monitored.

Interactive also showed us its advanced Interaction Attendant function, which provides flexible and complex call routing, easy operator transfers, and night menu and emergency menu support.

Nortel Networks' major advanced feature was actually a management application called Network Configuration Manager (NCM), which provides multisite management, reporting and the ability to make mass configuration changes and patch distributions to multiple sites. NCM costs \$525 for one authorization code.

Available via Web browser (which can be enabled or disabled for security) or as a separate client application, NCM includes a number of powerful applications. Included are BCM Monitor for real-time system and line monitoring; Call Accounting for customized reports and billing, multisite billing and forced account codes; and Call Center Reporting, which offers real-time monitoring and alerting, wallboarding and a host of canned reports that can be printed on schedule (but not emailed, in the current release).

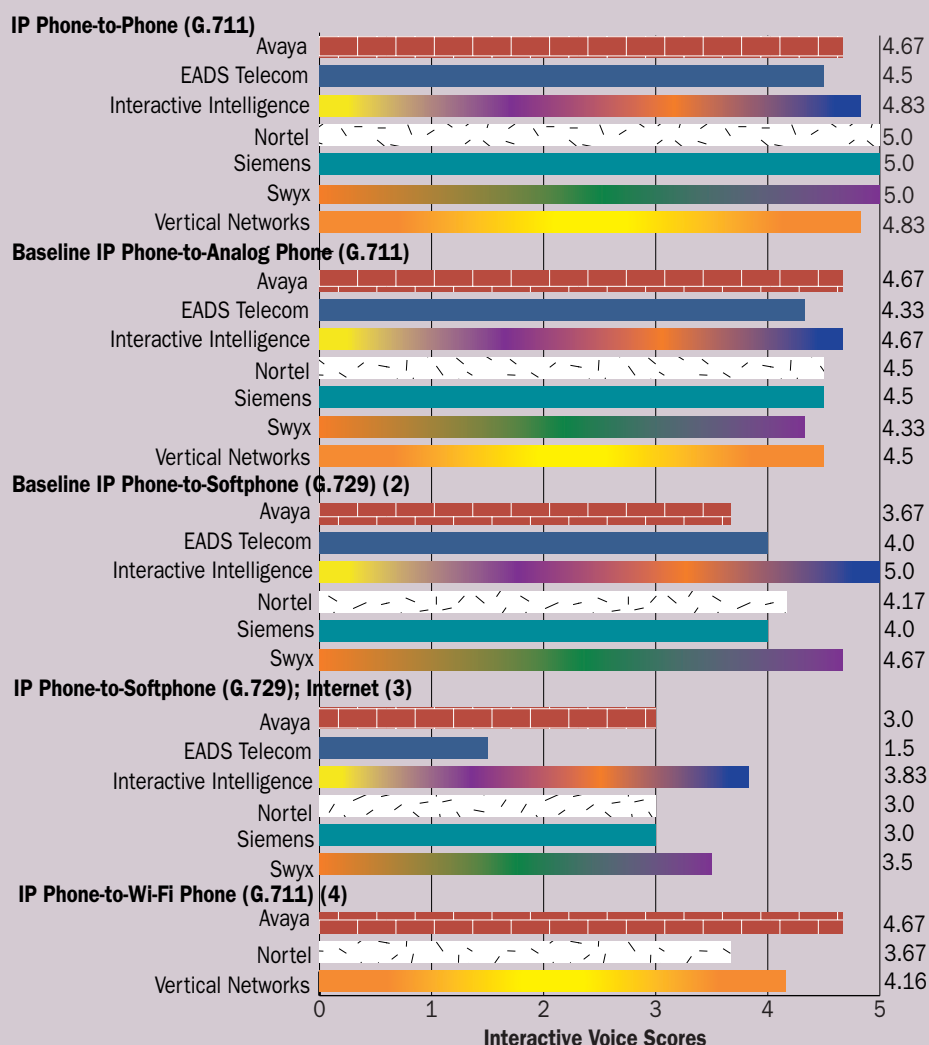
Nortel also showed us its new IVR application, which provides a tight integration with telephony. A distinctive ringing feature was demonstrated in a pharmacy application in which the user could identify what type of customer was calling (doctor, customer, etc.) by the sound of the ring. IVR also can automatically generate faxes based on specific IVR responses and can handle multisite updates and scheduled announcements.

Next in Nortel's lineup was the i2050 Mobile Voice Client, which extends features from an IP hardphone to a PDA.

Finally, Nortel showed its Console.NET application, which is offered by ConverTec Inc. under Nortel's Compatible Products Developer Program. Console.NET provides enhanced attendant features, such as organization of phone extensions by group (sales, marketing, etc.), call ID name and number, extension buttons that change color based upon status (idle, active, etc.) and a built-in database to store contact information.

The highlight of Vertical Networks' advanced features was also a management application, called MultiSite Manager and MultiSite Reporter (MSM and MSR), which augment the basic InstantOffice management application. It costs \$34,950 (U.S. list). We tested MSR in beta; it will

**FIGURE 1 Interactive Voice-Quality Scores (1)**



**EADS Telecom offered a powerful contact center feature**

1-In the Interactive voice-quality tests three lab testers, in rotation, conducted real-time, two-way conversations over separate connections. All tests were conducted over a simulated WAN connection. We performed countdown tests to measure the effects of latency and alphabet tests to examine bidirectionality. We noted any echoes, clipping, background noises or other impairments that affected clarity. Scores were given on a five-point scale with a score of 4.0 and above rated as "toll quality," suitable for all telephony applications.

2-Interactive Intelligence and Swyx did not support G.729 on their softphones and so were tested with G.711 vocoding; we did not test the Vertical Networks' InstantOffice with a softphone.

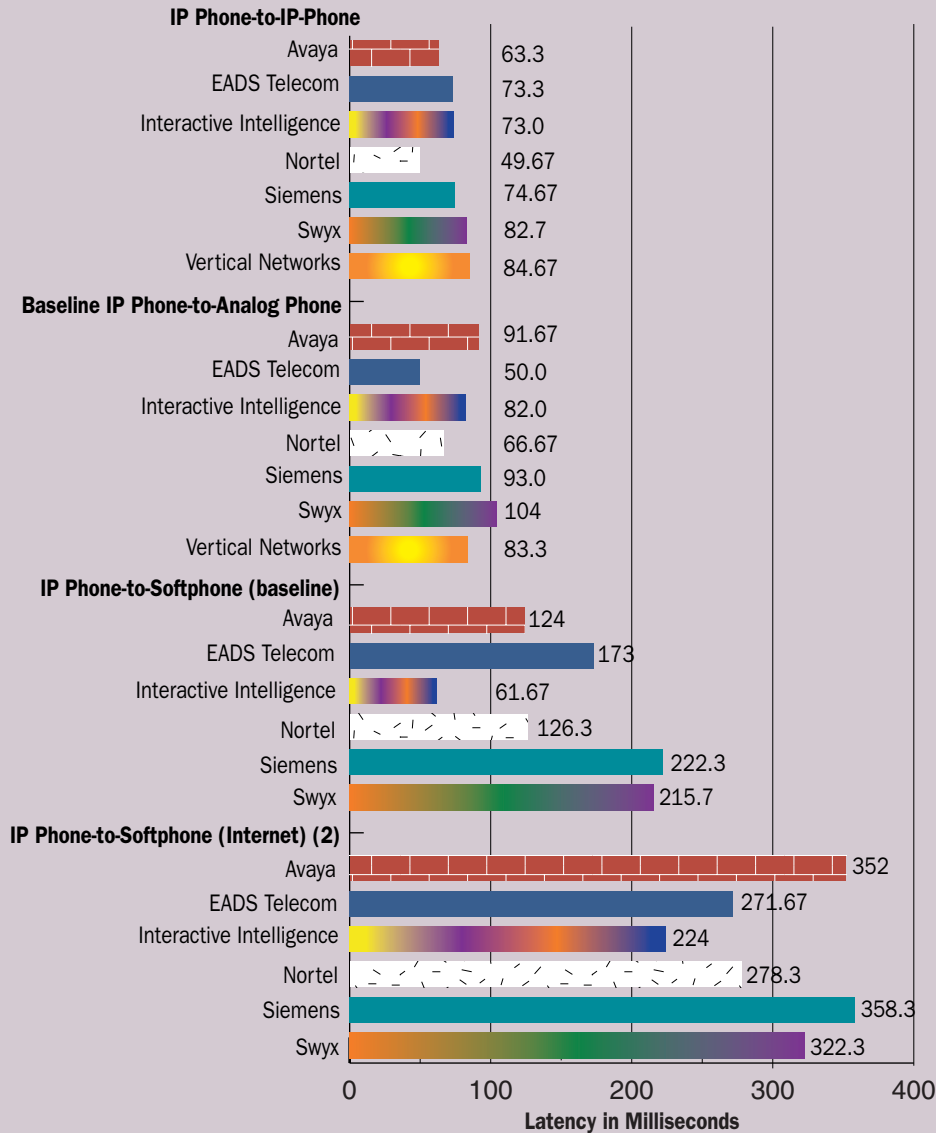
3-These tests were conducted with network impairments, including 100 milliseconds of added latency in each direction, 1-percent packet loss and 20 milliseconds of jitter.

4-Only the three vendors supported Wi-Fi phones.

be released in March. MSM runs on a Windows 2000 server; site information is stored on a SQL database. MSM/MSR provides centralized management of multiple systems and global software upgrades and system backups from a central location. The application offers real-time system monitoring and supports robust scheduling and monitoring of network events, as well as a host of canned reports, which can be run by time period, department or extensions. We also took a look at the InstantOffice Service Response feature, which provides a mecha-

nism for notifying employees of requests for service that are initiated via customer-service call boxes located throughout a store. (Many "big box" hardware stores deploy these systems.) Once a customer requests service, a store employee is notified via overhead or phone paging. InstantOffice tracks and reports how long it took for an employee to respond and also the number of times customers access the system, the options chosen, etc. Service Response actions can be customized for a variety of applications. Vertical also showed us its Call Routing and Queuing feature—designed for smaller offices

**FIGURE 2 One-Way Latency Measurements (1)**



**1-**After placing a VOIP call between two phones, we used a Telephone Handset Audio Tap-2 (THAT-2) adapter to inject a laptop-generated .wav file from the Line Out 1/8 stereo-jack connector of the laptop into the handset connection of the first phone. The left channel of the .wav file was diverted back into the "Line In" stereo-jack connector on the laptop and the right channel of the .wav file was transmitted across the phone connection to another THAT-2 box where the right channel was diverted back to the "Line In" jack.

On the laptop, we ran Syntrillium Software Corp.'s Cool Edit 2000 audio recording, editing and mixing application for capturing and displaying both the left and right channels.

We then measured the change between the two signals.

We measured one-way latency three times and averaged the results.

All calls were placed over a wide area network (WAN).

Impaired calls were run without any quality of service (QOS) enabled on the system under test.

**2-** Impairments included 100 milliseconds of added latency in each direction, 1-percent packet loss (based on eight consecutive bit-error bursts) and 20 milliseconds of jitter.

**Companies Mentioned In This Article**

- |  |  |
|--|--|
| Avaya ( <a href="http://www.avaya.com">www.avaya.com</a> )                             | Polycom ( <a href="http://www.polycom.com">www.polycom.com</a> )             |
| EADS Telecom ( <a href="http://www.eadstelecom-na.com">www.eadstelecom-na.com</a> )    | Siemens ICN ( <a href="http://www.icn.siemens.com">www.icn.siemens.com</a> ) |
| Interactive Intelligence ( <a href="http://www.inin.com">www.inin.com</a> )            | Swyx International ( <a href="http://www.swyx.com">www.swyx.com</a> )        |
| Microsoft ( <a href="http://www.microsoft.com">www.microsoft.com</a> )                 | Symbol ( <a href="http://www.symbol.com">www.symbol.com</a> )                |
| Nortel Networks ( <a href="http://www.nortelnetworks.com">www.nortelnetworks.com</a> ) | SpectraLink ( <a href="http://www.spectralink.com">www.spectralink.com</a> ) |
|  | Vertical Networks ( <a href="http://www.vertical.com">www.vertical.com</a> ) |

that need intelligent call routing, but do not require a sophisticated call center application. We also saw Call Assistant, which provides PC-based call control and integration with Microsoft Outlook, Act! and Goldmine for pop-up notifications and one-click dialing.

The most outstanding feature on the EADS Telecom PortSpan was the powerful M7480 Contact Center—a fully featured, multimedia application that can reside on any M6501 PortSpan in a MOVACS-connected network. (MOVACS is EADS Telecom’s proprietary VOIP protocol.) The ability to link agents across the enterprise allows companies to pool their contact center resources across sites.

M7480 includes a very sharp scripting tool that lets users develop contact routing and IVR applications from a graphical user interface that was logically designed and intuitive. M7480 also supports 20 standard reports, three of which are graphical. Also, because these contact centers can be linked, supervisors can view agents’ status in real time across the network.

EADS advanced features also included a “vital subscriber” application that uses routing algorithms to seamlessly reroute calls to an emergency set (which can be a cellular phone) if the original phone number is unreachable.

EADS also demonstrated its MOVACS networking, which provides the ability to operate over both PRI and IP networks with full feature transparency. EADS’s digital phones may be converted to IP phones via module swap, allowing easy migration from TDM to IP and reducing the need for retraining.

Like many of its competitors, Swyx supports a tight integration with Microsoft Outlook and other Microsoft applications (such as Word, Excel and Internet Explorer.) This integration can be used to effect screen pops for Outlook contacts, swipe-dial from an Outlook contacts list (highlight number and right click to dial) and use SwyxIt! function keys for dialing a selected number from one of the Microsoft applications.

While the SwyxIt! Call Routing Manager (CRM) allows sequential processing of actions through check box selection, an Extended Call Routing (ECR) feature (extra priced at \$2,648) lets users specify how their calls should be routed via a powerful graphic drag-and-drop scripting tool similar to Visual Studio. ECR also supports error checking for incomplete call paths, simple creation of audio prompts and intelligent collection of DTMF details.

Swyx’s advanced features also include SwyxLink, which allows linking of multiple SwyxWare servers across IP connections to form intranet and broadband Internet networks.

Swyx also supports one-click desktop application sharing between two locally connected SwyxIt! clients. Users can not only view the applications in real time, but also make changes.

## Performance

The Performance story for these systems is fairly straightforward: With minor exceptions, all support acceptable voice quality—even on our “Internet” scenarios in which we injected network impairments (Figure 1).

Only three vendors tested wireless phones, but voice quality on those was surprisingly good, especially on Avaya’s phone, which scored an outstanding 4.67 out of 5.

Latency tended to be high on our IP phone-to-softphone tests—for example, up to 222.3 milliseconds (ms) on the Siemens softphone and up to 215.7 ms on the SwyxIt! (which was tested with G.711 rather than G.729 because the softphone did not support the latter). But while latency was noticeable (Figure 2), it was not bad enough to seriously impede call quality, which rated 4.67 on SwyxIt! and 4.0 on Siemens.

On the Internet “impairment” tests, we injected 100 ms of latency in each direction, along with 1-percent packet loss and 20 ms of jitter. As expected, call quality declined noticeably, but it remained at 3.0 or above, except for EADS Telecom, whose softphone rated only a 1.5 due to a noticeable impairment in call clarity and latency.

We ran several denial of service (DoS) attacks to determine what effect they would have if the attacks got through a firewall or other security mechanisms that most of these vendors support.

In previous IP-PBX reviews, we’ve found that all the systems were vulnerable in some way to DoS attacks. However, in this test they had no effect on the Interactive Intelligence server, the Vertical InstantOffice 3500 or the Nortel BCM systems, although the attacks did cause phone resets in most instances.

## Conclusion

As far as IP-PBXs go today, it’s about the features. On all the systems we’ve tested during the past few months, voice quality was good overall, and most vendors have made considerable strides in enhancing their management applications for a more IT-oriented environment, although there is still room for improvement.

All the vendors in this market realize that unless prospective buyers can see some clear ROI for buying into VOIP, customers may be reluctant to replace their older telephony systems just yet. Many of the features we’ve seen in our reviews—the powerful contact centers, presence management, service response and collaboration tools—offer good reasons to take a long hard look at how IP-PBXs can ensure a better bottom line.

Miercom would like to acknowledge the test tools and other equipment used in this review: Adtran Atlas 800, Brix Networks 100, Extreme Networks Summit 48 switches, HP Compaq laptops, the Hammer LoadBlaster from Empirix, Syntrillium Software Corp. Cool Edit 2000, JK Audio THAT-2 and the PacketStorm 1800E□



**These small systems actually stood up to denial-of-service attacks better than their larger cousins**