



VoIP: The Right Call

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By Charlotte Wolter

After years of hype and unfulfilled promises, IP telephony—also known as Voice over IP (VoIP)—has finally evolved as a true option for small and medium-size businesses. The technology of sending voice packets over data pipes has been refined and has matured, offering a number of benefits over traditional phone networks.

Not only do today's VoIP systems match the voice quality of regular phone systems—based on the TDM (time division multiplexing) system—they're adding features that businesses never would have imagined. For example, with VoIP, callers can reach you no matter where you are by dialing your office number. And with a Web browser, you can retrieve your voice mail.

The main benefit, of course, is cost savings. Though initial equipment costs can be considerable, with most implementations of VoIP the distinctions between local and long-distance calls go away almost completely. And when signing up with a hosted service, such as an IP Centrex provider, you can keep up-front costs to a minimum.

VoIP calls made over a private network—for example, from a main office to a branch office—are free. And even if you're calling someone who is not on the network and doesn't have VoIP, you can still realize significant savings. Through deals with broadband service providers or other hosted services your calls are still carried either free via the Internet or at highly discounted flat rates—about 2 to 3 cents a minute.

Today, there is much more to VoIP than the early consumer applications, which involved cumbersome Web interfaces and using PCs with headphones instead of handsets. In the early days of VoIP, there was also a lack of widespread broadband, a problem augmented by poor voice quality and the difficulty in finding people to connect with at the other end. Only over the past five years, since the introduction of the first IP gateways, has the technology been adapted for standard business phone use.

Enterprise customers have firmly grabbed hold of this new technology, and now manufacturers old and new are eyeing small and medium-size business markets. (We define small as having fewer than 100 employees and medium-size as 100 to 500.) The industry is heating up to the point where these businesses can choose from a dozen or more IP PBX (IP private branch exchange) systems and nearly as many service providers offering hosted VoIP solutions.

With so many choices available, business owners need to understand their own requirements, the pros and cons of IP telephony in general, and the distinctions among the various solutions before deciding how to implement VoIP, if at all.

Cost Savings and Other Benefits

VoIP can save small businesses significant amounts of money, averaging about 30 percent on phone costs. This varies tremendously and depends greatly on the type of system a company uses, but some amount of savings is just about guaranteed.

While larger companies have the most to gain by connecting their branch offices via VoIP, small businesses too can save on calls to and from teleworkers or partners—even if they're located in another country—when those calls are placed over the Internet. IP phones can talk over any IP network, including the Internet or a company's data network. The quality may not be perfect if you are depending on the Internet, but companies may be willing to accept that in exchange for free calls around the world.

Most of the time, poor voice quality is caused by Internet congestion, which today is much more of a problem in developing nations. Such nations often have very little bandwidth going in or out, compared with the more advanced networks of Asia and Europe.

As an IP telephony switching system, the IP PBX controls all of the phones in its system via an IP network (which could be the Internet). Thus, just one PBX can control phones at multiple locations, even in other countries. That eliminates the need for multiple PBXs, which many companies have now with traditional PBX systems.

Enterprises can use this capability to provide extended office coverage. For example, calls placed to an East Coast office that has closed for the day can be routed free to a West Coast office. Likewise, IP telephony comes in handy in times of disaster; if an office becomes damaged and unusable for whatever reason, calls can often be forwarded to workers at home over broadband connections.

In the same way that it enables calls from any location, IP telephony can be a godsend for the frequent traveler. A VoIP phone—or for more convenience a VoIP soft phone installed on a laptop—can be used to make and receive calls from any location in the world, as long as there is access to the Internet. In many cases broadband access is not even necessary, though it usually helps considerably with voice quality.

Finally, a VoIP system can mean significant savings in maintenance costs, especially when moving phones. There is no need to call in a technician and spend \$200 every time an employee changes offices, since an IP phone will carry its configuration over to any LAN port it is plugged into. But adding phones or changing a phone's configuration requires logging on to the PBX management console and likely requires an administrator or consultant.

Rich With Features

While the potential cost savings are what usually sells IP telephony, the cool features and the ease with which they can be managed are what keeps users happy.

Voice over IP systems offer features traditional PBXs and key telephone systems either don't offer or offer with a high level of complexity. Such features include unified messaging, in which all voice mail messages are stored as audio files and delivered as attachments to e-mail. This way, traveling employees don't need to make expensive phone calls back to the office to retrieve their messages.

Another feature that is proving to be hot with business is find me/follow me. This is a feature that knows whether a user can be reached and how (desk phone, e-mail, instant message, mobile phone). And though the browser-based interfaces are evolving and differ from one manufacturer to another, you can control what the caller is told. For instance, if a salesperson wants only the boss to know that she is reachable on her cell phone, that can be easily set up.

Surveys have shown that most employees of a company never use the majority of features a traditional PBX affords, because they're not easy to use. With IP systems, many advanced features are more accessible and easier to use.

Many automated applications are also available to run on or in tandem with an IP PBX, such as call-center applications, which assist with routing calls to appropriate employees or physical locations. In addition, auto-attendants—basically automated software-driven replacements for live operators—are becoming common.

If the many features that come with an IP PBX or IP Centrex system are not exactly what a company is looking for, they can be customized much more easily than with traditional telephony. A programmer who knows Java or XML can create custom applications that will run on an IP PBX or IP Centrex system. And some manufacturers are now supplying software development kits for this purpose as well.

Considerations

VoIP for the small office isn't perfect—yet. Most systems and services on the market have had a couple of years to work out the bugs, but there are still occasional performance issues, particularly with networks that are saturated with both voice and data traffic.

One of the often-cited advantages of Voice over IP is that the office telephone system moves onto the local area network (LAN), and you then have just one network to maintain, not two. Whether this is good news depends on how a company feels about its LAN. Local area networks are generally far superior to what they were even a few years ago, but a LAN may need a tune-up—upgrading its switches and making sure its WAN connection can support the bandwidth requirements to carry both its data and voice communications. Most businesses contemplating such a move should contact a consultant or VAR (value-added reseller) to assess their networks and carry out preliminary planning.

Another issue to keep in mind is power. Every VoIP phone has to have a power source, which means one more thing to plug in at each desktop. If the power goes out, so do your IP phones, unless you have power backup for the LAN. The new Power over Ethernet standard is simplifying these issues, but to get that capability a company has to install new LAN equipment, something most businesses are willing to do only when they move to new offices.

Finally, there's the issue of up-front costs. All these nifty new IP phones don't come cheap; they average about

\$300 each, with the highest-end models selling for more than \$600. New models, as from snom technology (www.snom.com), can be had for under \$200, but they remain the exception.

IP phones do provide many extras for their hefty price tags, such as soft keys, which can be programmed for almost any function the user chooses. For instance, a soft key can be set to open your Outlook address book at the touch of a button and then dial a selected number. These advanced features can be managed through the system's Web interface, which can be reached from anywhere in the world. Keep in mind that setting up these features still requires a telephony-savvy administrator.

Standards and Sticking Points

IP and the Internet represent the model for open systems, but the same is not always true for IP phones. Some vendors—notably the big ones, such as Avaya and Nortel—still lock customers into using their brand-name IP phones by relying on proprietary signaling between the PBX and the phones. Although another manufacturer's phones can sometimes be used, you'll be left without any of the fancy proprietary features designed into the end-to-end solution.

Now the acceptance of a new international standard called SIP (Session Initiation Protocol) is putting pressure on manufacturers to be more open. SIP is still developing and has not yet implemented some of the more obscure PBX features. But SIP has a lot of industry momentum, and once it is widely adopted it will undoubtedly help bring down phone prices.

Beyond the battles over protocol adoption, IP telephony has other issues to be resolved. One worth mentioning is the current inability for 911 services to pinpoint the location of VoIP users and dispatch help. Unlike traditional phones, IP phones are not necessarily associated with specific addresses. Many IP phones can be plugged into the Internet anywhere. This is particularly true when a company has several branches, all controlled by one IP PBX. Some of the phones will be in the physical office where the PBX is, and some will be elsewhere, but the PBX will see them all as local.

An organization working to find a solution to this problem by the end of 2004 is the National Emergency Number Association (www.nena.org), which has members from both government and the manufacturer community. Many possible solutions have been discussed, like tying GPS systems to phone locations or requiring hosted services and those with IP PBXs to maintain databases of physical locations tied to IP addresses.

The Flavors of VoIP

If you believe your business is a good candidate for VoIP, you need to ask yourself how far you want to go with it. Much of your answer depends on how much you're willing to spend on new equipment, and how much responsibility you want your business to take on with the deployment and upkeep of the system. There are three ways you can implement VoIP: a hybrid system (which combines old equipment with new technology), an entirely new IP PBX system, or a hosted VoIP service.

Hybrid systems. A hybrid system allows you to stick a toe in the water without getting completely wet. This is best for businesses that are satisfied with their current, traditional PBXs or don't have the budget to buy whole new VoIP systems. Several IP PBXs are designed to begin life as a kind of helper system to the main PBX, enabling low-cost calls between offices and adding some more features.

The big manufacturers, such as Avaya (www.avaya.com), Mitel Networks Corp. (www.mitel.com), and Nortel Networks (www.nortelnetworks.com), offer a number of upgrade scenarios that ease into the new technology. These solutions vary in cost, depending on the original equipment and the number of extensions served, but they start at an average of \$800 per worker.

A small company called Citel Technologies (www.citel.com) makes software that enables some of the most popular analog phones, such as the Nortel Meridian, to talk to an IP PBX from another manufacturer like 3Com (www.3com.com). This can cut the costs associated with buying new IP phones, or at least allow you to purchase and roll them out slowly.

For the kind of business with a few locations that make most of their calls to each other, another strategy is to install gateways at each company location. The gateways then convert only calls within the company to VoIP so they can travel over the Internet. Such small gateways, from companies like Mediatrix Telecom (www.mediatrix.com) or Quintum Technologies (www.quintum.com), can cost less than \$2,000.

Finally, businesses with just a few employees who make the bulk of long-distance calls should consider buying a couple of phones from a consumer Voice over IP service, such as VoicePulse (www.voicepulse.com) or Vonage (www.vonage.com). These services bill at a flat rate, and using one of them can result in significant

savings.

Complete IP PBX systems. Companies that are setting up new offices from scratch or expanding significantly are ideal candidates for a full hardware- and software-based, on-site VoIP system. The key advantages here are that a company owns and has full control over its voice system. In many cases this provides a great deal of flexibility to customize communications applications to meet specific needs. The one potential drawback is handling the complexity of an IP PBX. Either a knowledgeable IT staffer or a VAR or consultant must deploy and manage it.

The initial costs may be 10 to 20 percent higher than for a traditional PBX, but those costs are usually recouped within months if the purchaser can take advantage of the savings on long-distance calls. Those starting from scratch can also save when it comes to wiring their new space. Going with VoIP means installing one set of cables instead of one for voice and another for data.

Choosing a VoIP manufacturer is much like choosing a traditional PBX or key system manufacturer, especially now that most of the traditional players have IP products.

The traditional manufacturers, such as Alcatel (www.alcatel.com), Avaya, Nortel, and Siemens (www.siemensenterprise.com), all now have IP PBXs. And the company that pioneered the idea, Cisco Systems (www.cisco.com), now has some scaled-down models, though it is not yet aiming at very small companies, such as those with fewer than 20 employees. (See the table at the top of page 147 for details on these offerings.)

Among small-system providers, one of the leaders is AltiGen Communications (www.altigen.com), a longtime player in systems for small businesses. Among its several IP PBX offerings is the AltiGen AltiServ1, which is designed for 8 to 50 users and includes voice mail, an auto-attendant, unified messaging, an administration system, call-detail reporting, workgroup support, and analog extensions (\$7,445 list).

Also widely deployed is the ShoreTel solution (www.shoretel.com), from a company that was known until very recently as Shoreline—another organization with a long history in traditional PBXs. One of its offerings is the ShoreTel Single-Site Enterprise Solution (for 100 phone users or fewer), which includes ShoreGear switches in 24-port and 12-port sizes, as well as a T1 interface for trunking. The products include a user Web interface, ShoreWare Personal Call Manager. A system for ten users is available for less than \$10,000.

Other manufacturers offering products in this arena are: Anta Systems (www.antasystems.com), Artisoft (www.artisoft.com), Bizfon (www.bizfon.com), Comdial (www.comdial.com), EADS Telecom (www.eadstelecom-na.com), FacetCorp (www.facetcorp.com), Interactive Intelligence (www.inin.com), Swyx Solutions (www.swyx.com), Toshiba (whose strategy has been to IP-enable existing lines; www.toshiba.com/taistsd/pages/prd_voip_ipctxdk.html), Vertical Networks (www.vertical.com), and Zultys Technologies (www.zultys.com).

[Click here](#) for a comparison of the leading small-business IP PBX Solutions.

Hosted services: IP Centrex solutions. Service providers large and small are offering hosted VoIP services for businesses. Some have a national footprint, while others are regional. Some offer complete PBX replacements, while others offer simply cheap long distance and standard phone features (call hold, caller ID, call waiting), plus a few extras for business (simultaneous ring, call transfer, and fax). The key advantage of a hosted service is that it relieves you of the responsibility of setting up and maintaining the system.

If you choose an IP Centrex provider, your phone system basically consists of software running at your provider's network operations center. It functions just like an on-site PBX, and you probably won't even know the difference; there just won't be any voice equipment in your own wiring closet. Such services are relatively new, having been offered only for the past five years, and failure to get the word out about their availability has been the primary inhibitor to their adoption.

The big national providers of hosted services in the U.S. and Canada include Covad/GoBeam (www.covad.com, www.gobeam.com), International Computer Graphics (www.icg.com), SBC (www.sbc.com), and Telus (www.telus.com). AT&T Wireless (www.att.com) plans to join this group by the end of 2004, as does Verizon Wireless (www.verizon.com).

The new service that Covad/GoBeam offers is typical of these packages. Covad provides T1 and DSL connections nationwide. It just acquired GoBeam, which has been offering a full-featured IP Centrex service. Together they have national sales and support reach—and a highly developed PBX replacement package.

A typical service package from Covad is a full seat license for \$26 to \$32 a month, depending on volume. That license includes all PBX functions. Long distance is from 3 to 5 cents a minute. Factor in the cost of the

broadband connection and the typical Covad customer spends about \$61 per user per month. Auto-attendant and automatic call distribution are extra services, billed monthly.

[Click here](#) for a comparison of IP Centrex providers.

Hosted options for very small businesses. Small companies with fewer than five employees can turn to "consumer" Voice over IP services. For instance, one consumer service provider, Packet8 (www.packet8.com) has just added a new service for small groups, called Virtual Office. It includes features such as auto-attendant, voice mail, call forwarding, call waiting, three-way conferencing, on-hold music, and call park and pickup. The package also includes unlimited local and long-distance calling. The price ranges from \$39.99 to \$79.95 a month with a minimum of three lines. Equipment, including a speakerphone, is a \$99 one-time charge.

VoicePulse, a consumer service that offers flat-rate long distance in the U.S. and Canada, has features such as hunt groups, which will ring several phones simultaneously or in sequence, and distinctive ring, which will change the ring tone based on caller ID information. Whichever phone is answered first gets the call, but calls can also be transferred to other lines in the same group. These features are included in the cost (\$45.99 per month), which also includes unlimited long distance.

A well-known consumer service, Vonage, offers a small-business package that includes a separate fax line, plus unlimited calling and a broad feature package, for \$49.99 a month.

Covad/GoBeam will also be launching a small-office/home-office product this summer with a reduced feature set and, one assumes, lower pricing. Details were still in development at press time.

For small and medium-size businesses, the VoIP options are growing, and that's good news. As competition in this field increases in the coming months, prices will drop even further, making this a viable alternative for even more companies. And who knows, perhaps in another five years we will all be chatting via VoIP.

[Click here](#) for a comparison of hosted VoIP services for small businesses.

Telephony Glossary

June 22, 2004
By Charlotte Wolter

Attendant console The larger, specialized phone an operator or attendant uses to answer incoming calls and route them to the appropriate extension. In an IP PBX, this may be replaced by software running on a PC.

Centrex A traditional business telephone service that a local telephone company offers from a local central office. This is essentially a normal single-line telephone service with advanced business features.

CSU/DSU (channel service unit/data service unit) A device that terminates a digital channel. In this context, the device sits between the voice T1 line and the IP PBX.

Find-me/follow-me A feature that allows calls to find you wherever you are, ringing multiple phones (such as your cell phone, home phone, and work phone) all at once. Such presence features are found in IP PBXs and offered by some hosted services. You activate them by pressing a soft key.

Gateway In VoIP systems, a network device that converts voice and fax calls in real time from a public switched telephone network (PSTN) to an IP network. A gateway can also convert calls between branch offices to VoIP so they can travel over the Internet.

High-availability Refers to devices or deployment strategies designed to provide access to fully functioning systems at all times. One HA strategy is to cluster devices so that the primary device can fail over to the secondary one if necessary.

IP Centrex or hosted voice An IP voice service delivered by an IP service provider or a phone company. On the surface it is like old-fashioned Centrex, but the features are much richer and the price is usually much lower.

IP PBX (Internet Protocol private branch exchange) A private telephone switching system that performs the same basic functions as a traditional PBX but operates using IP, making it easier to add features.

KTS (key telephone system) A system in which the telephones have multiple buttons representing separate phone lines. Users select external phone and intercom lines directly through these buttons. KTS solutions are

less expensive and less flexible than PBX solutions.

PBX (private branch exchange) A private telephone switching system that connects outside phone lines from a telecommunications provider to extensions within a building or office, as well as providing such features as call forwarding and paging. Where older proprietary systems used handsets designed specifically for separate systems, new PBX devices are interoperable.

PoE (Power over Ethernet) A solution in which networking hardware transmits electrical power over Category 5 Ethernet cable or better. This eliminates the need for AC power cords, minimizing cabling and outlet requirements.

POTS (plain old telephone service) The typical, familiar single-phone-line-and-single-phone-number model.

PSTN (public switched telephone network) The combination of local, long-distance, and international carriers that make up the worldwide telephone network.

QoS (quality of service) The ability of a network (including applications, hosts, and infrastructure devices) to deliver traffic with minimum delay and maximum availability.

SIP (Session Initiation Protocol) An Internet Engineering Task Force (IETF) standard for initiating, maintaining, and terminating an interactive user session involving video, voice, chat, gaming, virtual reality, and more.

Soft keys Buttons on a telephone handset that can be programmed to perform various functions—such as speed dialing or conferencing—depending on the interface on the handset's screen.

Soft phone IP telephony software that lets users send and receive calls from nondedicated hardware such as a PC or Pocket PC device. It is typically used with a headset and microphone.

VoIP (Voice over IP) The process of making and receiving voice transmissions over any IP network. IP networks include the Internet, office LANs, and private data networks between corporate offices. The main advantage of VoIP is that users can connect from anywhere and make phone calls without incurring typical analog telephone charges, as for long distance.

The Mitel Example

June 22, 2004

By [Matthew D. Sarrel](#)

Beyond all the theoretical explanations, we at PC Magazine Labs knew that a real-world evaluation would help demonstrate how VoIP really works, so we set up and test-drove a leading hardware manufacturer's IP telephony solution.

For our testing, we installed and maintained an IP-based PBX in a hypothetical small-business setting to evaluate the system's features, management, and ease of use. Market leaders in this space include Avaya, Cisco Systems, Inter-Tel, Mitel, NEC, Nortel, and Siemens. We chose a Mitel solution, because the company has been a strong player in this market space for a number of years and is a recognized leader in IP telephony.

No two manufacturers provide parallel systems; each varies in hardware and software offerings. Also, none of the systems available from major manufacturers is a do-it-yourself project; each requires a VAR or consultant for initial installation and configuration of features. An IT administrator or power user can be trained to perform day-to-day maintenance, but major issues should be handled by a VAR.

The Project

We began by outlining parameters and needs for our hypothetical business, which consisted of 50 employees in a central office, 25 in a branch office, and 2 full-time mobile employees. We gave all employees access to voice mail, and the solution included a speech-enabled auto-attendant. We required high availability, a variety of IP-based phones (some wired, some not), and soft phone licenses. Mitel provided us with two Mitel 3300 ICP (Integrated Communications Platform) telephony servers, a variety of application servers, and an abundance of phones. [The total cost](#), not including installation, was \$62,621.

The Central Units

The 3300 ICP is a full-featured IP-based telecommunications solution that uses a

Web-based GUI for configuration and management. Besides the administrator GUI, there is also a user GUI (Desktop Administrator Tool), which individual employees can use to configure their own phones and soft-function keys.



Desktop application

[ENLARGE](#)

Physical installation of the 3300 ICP was fairly straightforward and took less than an hour. But configuring the auto-attendant, company-wide speed dials, and voice mail options took several hours. Configuring a second 3300 ICP for the branch office and the Mitel 6010 Teleworker Solution added another half a day.



Mitel test system

[ENLARGE](#)

Several features of the 3300 ICP highlight the value an IP telephony solution adds, relative to a traditional PBX. The unit runs a flavor of Unix that allows for simplified control via a Web browser, as well as the ability to transfer configurations via TFTP to other 3300 ICPs for backup. Support for fail-over resiliency is a strong selling point: Once configured, copies of configuration files are automatically exchanged with other 3300 ICPs, which can then serve as warm spares. In our testing, fail-over was not immediate, but within several minutes the branch-office IP phones found the central-office 3300 ICP, obtained its configurations, and were able to send and receive calls.

Also available is the Mitel SX-200 ICP, a less expensive alternative (\$6,500 each) for either new installations or organizations looking to make the transition from a traditional phone system to an IP-based one. While the SX-200 ICP costs less and is easier to install and maintain, the 3300 ICP offers the additional software integration we required for our test business.

The Phones

The Mitel 5200 IP Desktop product line includes many different models, each of which contains a second switched Ethernet port, so a single cable can connect a user's phone and PC, although we recommend isolating voice and data traffic onto separate VLANs and applying QoS rules. Each 5200-series phone comes with an external AC adapter but can be configured to use Power over Ethernet. From the model 5215 up, a soft key works in conjunction with the 3300 ICP to provide access to administrator -configured options such as a company-wide directory, voice mail, and call forwarding with the touch of a single button.

The most popular unit is the Mitel 5220 IP Phone (\$350), a fairly typical desktop handset with support for up to 24 programmable keys. It is well suited for a teleworker and can be enhanced with a programmable module that adds 12 or 48 programmable keys.



IP phones

[ENLARGE](#)

The most interesting unit is the Symbol MiNET Wireless Phone (\$818), a wireless handset that combines Symbol Technologies hardware with Mitel firmware to provide a cost-effective option for in-office roaming. The handset can be installed as a separate extension or twinned with an existing one. Reception on the MiNET phone was clear as long as we stayed within range of our 802.11b access point.

An intriguing option is the Mitel 5230 IP Appliance (\$350), which integrates an HP iPAQ PDA (not included) into an IP-based desktop phone. This lets users take advantage of features that go far beyond a traditional PBX. All telephone settings, including phone book and speed dials, automatically populate any 5230 base station once an iPAQ is docked. Other features include the ability to dial from your Outlook Contacts list, and Visual Voice Mail lets you select a specific message to hear rather than going through all your messages in chronological order.

Mitel 6600 Your Assistant, a soft-phone application (\$95 per user), is extremely powerful and easy to use. A single screen lets users obtain presence information for other users, set up granular call-routing rules, send text messages, share applications, and videoconference (with an added PC camera).

The 6010 Teleworker Solution

The Mitel 6010 Teleworker Solution is easily the coolest feature Mitel has to offer. The 6010 lets remote users harness all the features of the 3300 ICP without being in the office. An administrator must enable a user for telework in OPS Manager and then configure a 5220 with the external IP address of the 3300 ICP. Wherever that 5220 is plugged into a network, it attempts to establish contact with its 3300 ICP master, prompts the user for a PIN, establishes an IPsec VPN connection, and downloads firmware updates in addition to the user's profile.


At that point, a teleworker can send and receive calls (just as if directly attached to the 3300 ICP) and be available for automated call distribution (ACD), which is especially helpful in a customer-support scenario. We connected our 5220 to a Linksys Ethernet 802.11b bridge from the home of one of our PC Magazine Labs staffers, and it immediately found its host. And we were up and running with our full user profile.

What We Learned

In using the Mitel solution, we reached a couple of conclusions. First, purchasing your own system is expensive. Our fictitious small business spent \$813.26 per user. We could have subtracted a few thousand dollars from the total by choosing simpler, lower-end phones rather than the mix of feature-rich and middle-of-the-road models we chose for our testing scenario.

Mitel's Web-based management GUI, Mitel OPS Manager, allows administrators to change a multitude of settings, the most common maneuvers being adds, moves, and changes to phone extensions. A traditional PBX requires a console connection and knowledge of a proprietary command line interface for any such tasks. This procedure is typically daunting enough to cause IT personnel to call back the VAR who installed the system and pay another \$200 an hour.



Even though OPS Manager is a good start, it fails to tame the complexity of the 3300 ICP for the uninitiated. Some of its options are buried in three nondescript menus, and the help system is extremely limited and overly complex. That means you'll need to pay for training at the time of installation or plan on regular maintenance. [ENLARGE](#) 

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