



THE GUIDE TO  
COST-EFFECTIVE BUSINESS:

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# COMMUNICATION CONVERGENCE

INSIGHT RESEARCH CORPORATION

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### The Mid-Level Enterprise Dilemma

The 100-to-1,000 employee business is in something of a bind. These mid-level businesses—especially in banking, finance, and other service industries—operate fairly complex voice and data networks linking multiple sites. The telecom infrastructure of the mid-levels resembles that of the over-1,000-employee firm, but unlike their larger corporate peers, the mid-levels many not have the budgets, staff, or expertise to take advantage of the convergence technologies available to the much larger, heavily capitalized firms. Insight’s research, however, suggests that there are powerful options available to mid-sized companies that can provide many of the advantages of convergence without a radical retooling of the network infrastructure.

Insight’s annual survey of vertical industry telecom expenditures summarized in Table 1 reveals that mid-level banking companies average over 40 data communication lines per office site—obviously with central offices linking in more lines than branch offices. Mid-level firms are also more likely to use their carrier’s sophisticated data services and higher bandwidth T1 access lines. Also, Internet access is ubiquitous among the mid-levels, estimated at nearly 100% penetration. In short, the mid-level firms use telecom like a Fortune 500 company.

**Table 1 Average Number of Data Communication Lines per Site, 2003**

Vertical Market	Avg Lines/Site	
	101-1,000 Employees	1,001+ Employees
Banking	43.8	57.0
Communications	36.1	426.8
Education K-12	15.2	84.3
Education-other	69.1	571.3
Finance	45.4	108.4
Govt-Federal	41.1	206.3
Govt-State	35.0	193.6
Svc-business	10.9	126.4
Svc-IT (EDP)	24.6	106.7

Unfortunately, mid-level companies' use of services and their larger size has not translated into better long distance (LD) calling rates, as we note in Table 2. Insight's data shows that mid-level businesses spend less per employee on LD voice than their smaller associates, but almost 50% more than larger Fortune-sized enterprises.

**Table 2 Average Monthly Long Distance Expenditures per Employee by Size, 2000 vs. 2002 vs. 2003**

Employees	2000	Change (2000-2002)	2002	Change (2002-2003)	2003
One to ten	\$69	-33%	\$46	7%	\$49
11-100	\$34	-21%	\$27	21%	\$33
101-1,000	\$27	-22%	\$21	22%	\$26
1,001	\$18	-17%	\$15	11%	\$17

Mid-levels are less likely than their larger counterparts to have the free capital to transition their voice infrastructure to packet-based (IP PBXs and IP phones) systems and converge all voice services onto their existing internal data networks. Result: They are stuck with a legacy telecom infrastructure from which they cannot attain cost savings or productivity improvements.

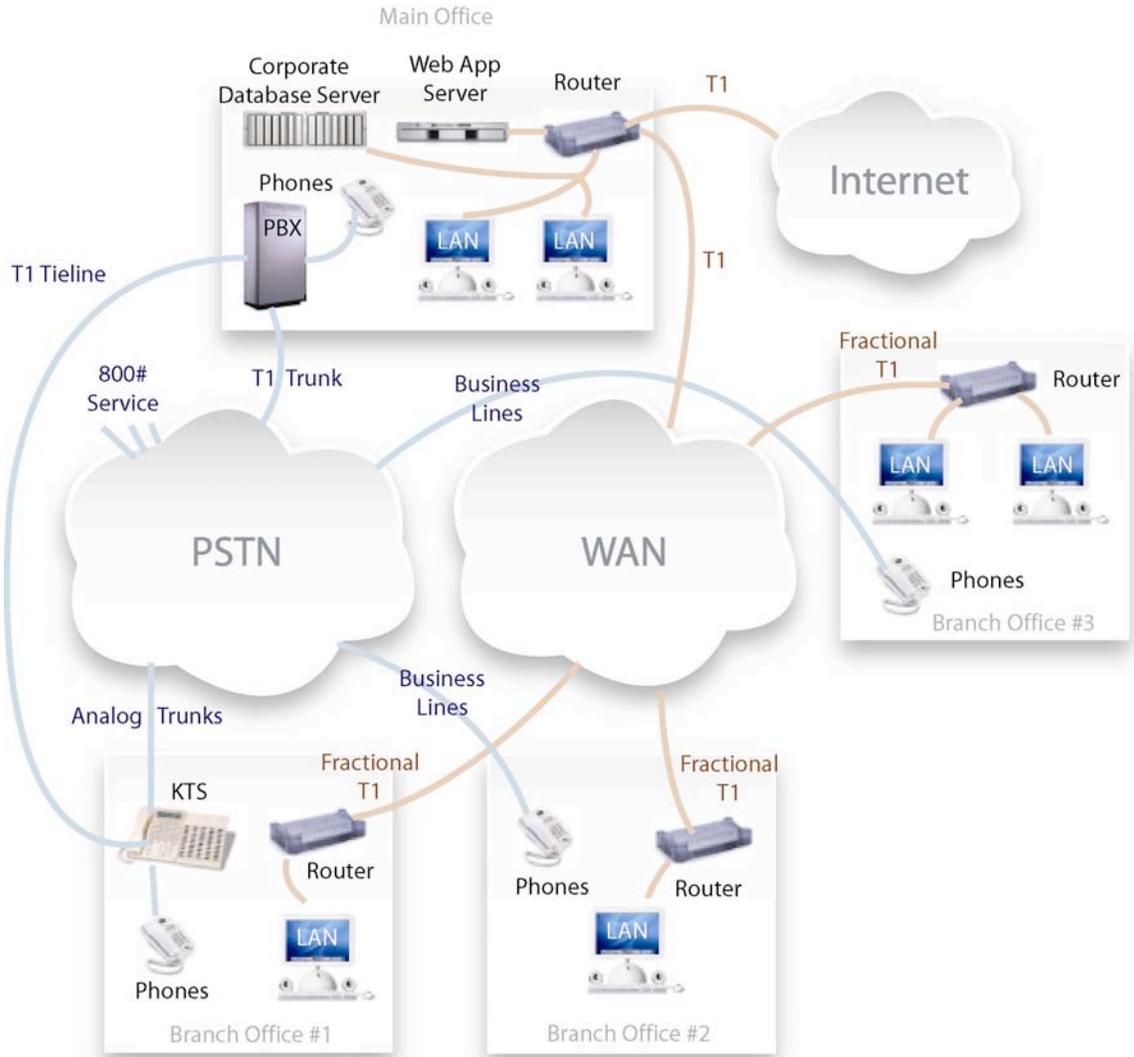
Our survey of telecom managers suggests general agreement with the premise that the costs of implementing a converged network will continue to decline. But without the capital to invest today, are there short-term steps that a mid-level business can take to become more competitive, and thereby free itself from this mid-level trap? Before answering that question, it would be helpful to examine the voice and data network of a representative mid-level business.

### A Mid-Level Business and Its Network

The type of mid-level business we have in mind is a financial services firm. It has a main office and three branch office locations, all within a large

metropolitan area. We refer to our mid-level company as “Median Services.” To link Median’s three smaller branch offices to its main office, the IT department selected fractional T1s from the local carrier. The firm deployed a data networking infrastructure of routers with WAN interfaces and switched Ethernet LANs to create an IP-based corporate Intranet. The network architecture for our fictitious financial services company is illustrated in Figure 1.

**Figure 1 A Mid-Level Enterprise Network Architecture**



On the voice side, the main office’s PBX handles the bulk of its incoming calls, routing external callers to the appropriate internal extension. Median decided that the volume of calls between the public switched telephone network (or PSTN) and its main office justified a T1 trunk, a single physical line that is provisioned with 24 voice channels.

While it may not be the case for smaller mid-levels, Median uses a “private” voice tieline—also a T1—to link its busiest branch office (#1) to the main office. The other branch offices contact the main office by making a local toll call (accruing per-minute charges); branch office #1 avoids toll charges by using the dedicated line for which the company pays a flat monthly fee. But more cost savings were still possible. Taking advantage of its PBX’s “least cost routing” software, Median sends all of branch office #1’s long distance calls over the private line and to the main office’s trunk line. Since carriers typically discount LD per-minute charges for higher call volumes, Median was able to lower its total voice toll charges.

## Analyzing the Current Network

Looking at the Median network from “the 10,000-foot” perspective, we note that the fictitious company—and many mid-sized companies in the real world—have, over time, and on an ad-hoc basis, purchased voice and data access lines to evolve their network. These lines can be divided up into two types, private and public switched.

Median, like many multi-office businesses, uses private lines to reduce the cost of long distance services by tying their largest locations together. Wherever a high volume of call traffic existed between two points, it made sense for large customers to lease private lines from carriers at a flat monthly rate, rather than to pay for service on a per-minute switched basis, as smaller end-users do.

Typical of a service sector company, Median Services also uses private data lines to transfer files, relay emails, and carry client-server transactions from the branch offices to the main office. And Median routes Internet traffic over its private lines to the main office and then out over a separate private line to its Internet Service Provider (ISP).

In addition to the private lines, Median has circuit-switched voice lines linking the main office and branch offices to the public phone network. These lines provide voice services using two different transport technologies. The high-volume trunk line relies on T1 (the same as the private lines); the branch offices, though, are still connected to the carrier’s central office by individual analog lines.

Having reviewed Median's private lines and switched voice circuits, we note that T1 access technology can carry either voice or data. As we will soon see, with the proper customer premises device, a single T1 can be used to deliver *both* voice and data simultaneously.

Table 3 Access Lines to the PSTN and WAN for Median Services

Access Lines	Location	Service
Voice Tie Line	Main office-branch #1	Private voice
T1 trunk	Main office	Switched voice, DID, toll-free
Analog trunk	Each branch	Switched voice
Fractional T1	Each branch	Interoffice data
T1 Internet	Main office	Internet data

## Weighing the Converged Option

Though our financial services company is fictitious, its problems are not. The premises infrastructure and telecom access lines and services we presented are not unusual for a company of this size and class. In our example, the Median network evolved in complexity on an ad-hoc basis—and therein lies the root of a set of problems that many mid-level companies are grappling with. For example:

- The older voice equipment is less integrated than the newer data networking. It is much easier to email, instant message, or transfer files between two desktop computers than it is to place an internal station-to-station call. Without a uniform dial plan, voice calls between locations (except branch office #1) require employees to dial 10-digit numbers, rather than 3- and 4-digit extension numbers that may be available through an updated PBX.
- The main office has 4 separate T1 access lines: one each for PSTN trunk, interoffice tie line, WAN, and Internet access. Taken together, Median incurs a high monthly charge for its telecom usage, probably several thousand dollars.
- The network is difficult to manage. Changing voice and data volumes cannot be accommodated easily and inexpensively. For example, branch office #2 makes more calls to the main office during certain times of the year, but the expense of adding another permanent private line is not justified by the temporary increase in traffic (and long distance charges).

- Multiple service providers for WAN and Internet access has led to difficulties in tracing networking problems.

All of these are issues have been present in Median's network for some time, but they could combine into a "perfect storm" when a new office is added. Median Services would, in fact, like to add a branch office that is close to key customers. An ideal voice solution would be a smaller PBX from the same vendor as the main office's PBX, and tied to it by a separate private line. With this in place, employees at the branch could quickly conference and transfer calls—more than just a convenience when experts from other offices have to be brought into a call. However, the capital expense for the premises switch and the cost of the additional voice access lines make it an unlikely option. Instead, Median will use plain analog business lines.

While it can forgo an integrated voice solution, this new branch office must have a private data line back to the main office. Since the new branch office is outside the local access and transport area (LATA) of the main office, an inter-exchange carrier (IXC) may have to become involved, as we note in Table 4. Crossing LATAs can result in additional charges for leased lines and the introduction of an IXC adds another service provider to an already complex mix.

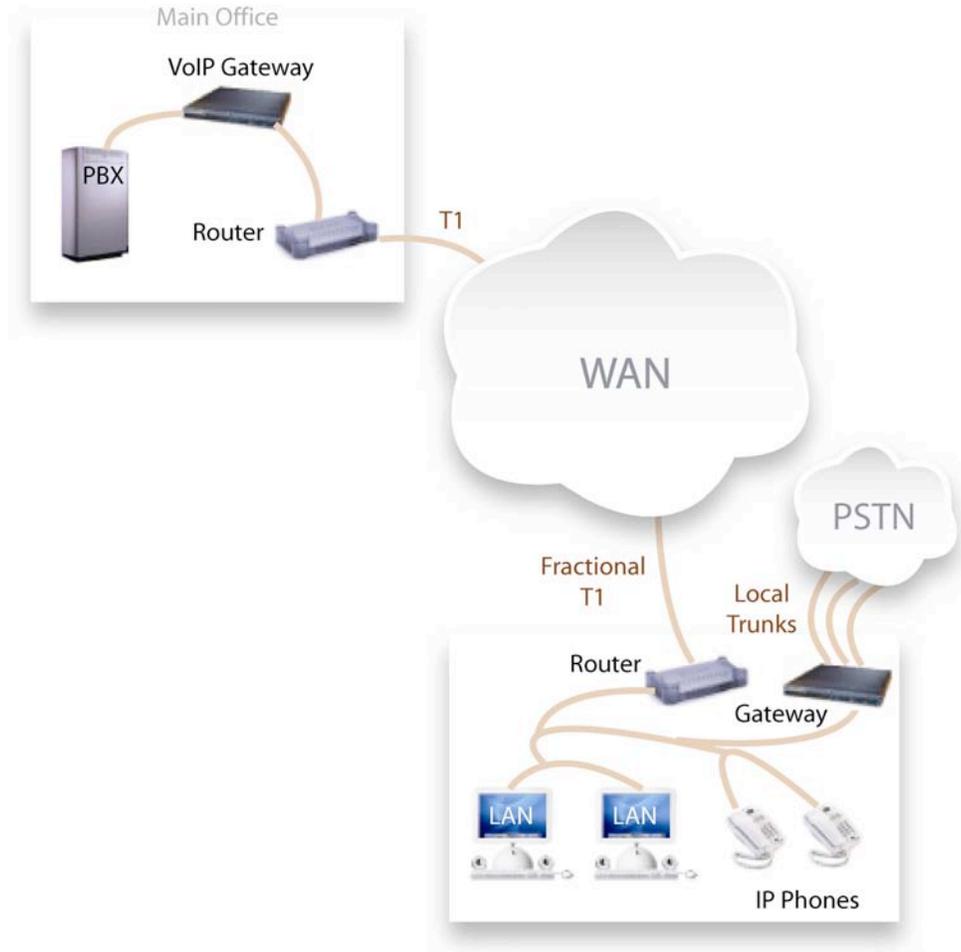
Table 4 Private Line Provisioning

Portion of the Circuit (Coordinated Service)	Customer Orders the Service from:	Carrier Orders from:	Customer is Billed by:	Number of Bills Sent to Customer:
<i>Local Private Line Full Circuit</i>	LEC	LEC	LEC	One
<i>Long Distance Private Line Full Circuit</i>	IXC	LEC & IXC	IXC	One

## VoIP: A Way to Convergence

Median's voice and data departments are familiar with the newest convergence technologies. They have naturally considered Voice over IP (VoIP) as a way to integrate their voice infrastructure and reduce their costs. Their PBX vendor has suggested adding a VoIP gateway to the main office's PBX to bring the new proposed office under a single dial plan. The gateway could carry the PBX's station port signaling and media stream over the company's existing data WAN. The new office would then just link with a single access line, as we illustrate in Figure 2. IP phones connected to the LAN would take the place of analog phones and would offer most of the features of the main office's phone system, including access to PBX voicemail, for which Median had made a significant investment. The company would still need to order trunk lines for local dialing and 911 services, and Median would therefore need to purchase a branch gateway device to convert the trunk's analog signaling and voice stream for the IP phones.

**Figure 2 VoIP Architecture with Branch Office**



This is certainly a feasible solution, and many companies are migrating toward VoIP. Ultimately, VoIP will give businesses all the benefits of convergence: a single premises wiring plant, a unified voice and data network, and a single access line to services. With carriers now offering IP VPNs (virtual private networks), businesses can start eliminating private access lines, especially those that have high tariffs associated with them. Connections to an IP VPN are made through inexpensive public broadband,

like DSL or cable modem. If Median worked with a VPN carrier, the VoIP gateway solution could be used to bring new branches online at a lower operating cost than using the traditional private line method.

But this mid-level financial services firm has little experience with packet switching. They are especially concerned about Quality of Service (QoS) issues arising when voice and data contend for a single WAN connection. While the two VoIP gateways are less than the price of a small PBX, they have discovered that the IP phones are much more expensive than even the PBX vendor's proprietary digital phones at the main office. The cost is now coming close to some of the lower-end key systems that they have also been considering.

## Integrated Access Devices: Convergence without Packets

There is another way to gain the advantages of convergence without gambling on a full-blown VoIP solution—and one that may be better suited to a mid-level enterprise looking to wring all the value out of existing investments. Integrated access devices (IADs) offer a cost-effective, low-administration solution to convergence that many mid-levels are looking for. The basic idea, to use a single carrier access line to transport both voice and data, has been around for many years, but this newer generation of access devices differs from the older T1-muxes in significant ways.

IADs are small and are available in modular or fixed configuration options. They combine voice channel banks, premises-side data interfaces, and a CSU/DSU—typically at a much lower price than these components would

cost separately. They also often include an integrated IP-based router for Internet access. In more advanced IADs, the telecom administrator can plug in optional modules for packet protocols (IP, ATM, or frame relay) and gain the bandwidth efficiencies of multiplexing voice and data. While both IADs and VoIP gateways can interface to existing telecom infrastructure—PBXs, key systems, and plain analog phones—IADs have the benefit of being able to map either traditional TDM or VoIP voice streams directly into the logical channels of the access lines. If VoIP is selected, the IAD can preserve QoS and serve the function of managing both voice and data traffic on a single WAN circuit.

With IADs located at each office, Median's telecom administrators realized they could now create a unified voice network, converged onto their data WAN and meeting their QoS requirements. At each branch office, IADs wired directly to analog phones would carry voice back to the main office, where a central IAD linked to the PBX would make the remote phone connection appear like an in-office extension. Result: Employees at the branch offices are brought under a common dial plan and have access to advanced PBX features. The branch office analog phones may not have all the features of digital phones—which are often proprietary to the phone's vendor and are typically expensive—but as a result of the connection to the central office PBX, calls can be forwarded, transferred, and conferenced. With the voicemail system of the PBX now available companywide, group messages can be broadcast to all employees.

Median also realizes hard cash savings with the IADs. Long distance calls from all the remote offices can now be routed to the main office and over its digital T1 trunk connection to the PSTN. Bringing more LD volume to the carrier allowed them to negotiate even lower LD per-minute charges.

## Convergence from Your Carrier

The IAD approach is a great investment extender for mid-levels since they make it possible to hold on to existing PBXs, key systems, and use existing T1-based access lines from the carrier. To gain further advantages from convergence, eventually Median will have to migrate to VoIP technology. But the IADs make this transition less burdensome, allowing mid-levels like Median to gradually deploy packet technology as they manage their equipment budget. When the telecom managers at our fictitious financial service firm feel the network and corporate budget are ready to support VoIP, they can perform a quick hardware upgrade of selected IADs, enabling voice packetization and compression, without having to bring in new equipment and purchase the new IP phones.

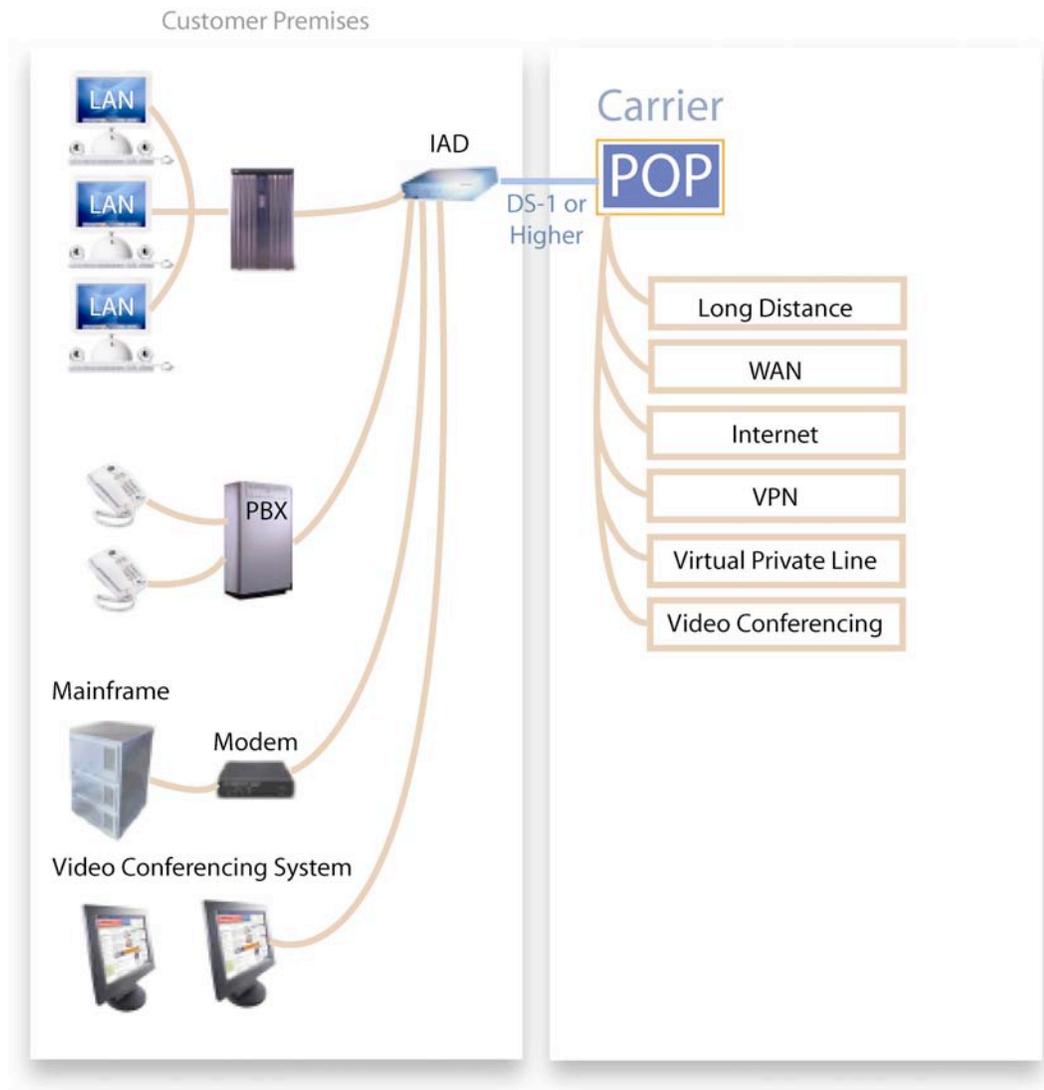
Our telecom managers can leverage other sources to gain still more convergence benefits. Median now turns to its carrier for help.

With the reduction in regulations, the boundaries and definitions of carrier types have changed dramatically. The IXCs have morphed into end-to-end providers of communications services, including both local and LD voice services. The IXCs are no longer constrained to LD services and can provide local services.

This leads to the most converged solution possible, at least on the network side. With the use of an IAD and an accommodating carrier, local, LD, LAN/WAN, VPN, IP, and Internet access can all be integrated onto a single private line. The different services are stripped out at the carrier's point

of presence (POP) and delivered to the appropriate transmission facility. For example, voice services are sent to the PSTN, Internet-bound traffic to the Internet, and LAN/WAN services are connected to the customer's LAN/WAN network provided by the carrier, as we illustrate in Figure 3.

Figure 3 Integrated Services Architecture



For our imaginary company, a carrier offering so-called “bundled” services solves the last piece of the puzzle. A single pipe eliminates contracting with a separate ISP for Internet services and with a local carrier for trunk lines. Each branch office has a single access line, and it is quicker and less expensive to set up a new branch office.

Median may have to purchase a larger/higher speed access pipe for the main office, perhaps a fractional T3 or several T1s bundled together to handle the total converged traffic. However, Median is contracting with a single carrier for all its networking access lines. Now that the FCC has deregulated all IXC services and the state commissions allow flexible pricing, customer are free to choose the best rate that they can negotiate. Median should be able to derive hard cost savings by bringing its total networking to a single provider.

The benefits of a single carrier offering a converged network include:

- With a single access line replacing both private lines and public switched lines, the total fixed monthly cost for telecom access is reduced.
- Managers have a single point of contact when requesting service upgrades and resolving network problems. When both an IXC and LEC are involved in tracing a network fault, there is inevitable “finger pointing.” This disappears when you have a single carrier responsible for all aspects of your voice and data network.
- The carrier issues a single detailed bill for all telecom services. Using this highly granular bill, businesses can charge back total

telecom costs to the appropriate department. The company now can determine who is using resources and calculate departmental P&L more accurately.

- The carrier often discounts or provides the IADs for its customers as part of its bundled service, thus saving businesses a capital expenditure.
- The carrier often backs up its Internet access, as well as other services, with Service Level Agreements (SLAs), committing to certain performance metrics.
- Finally, a carrier that offers VPN services can quickly respond to network growth and enhancements.

As we mentioned earlier, IP VPNs are now a practical alternative. They are the next step for businesses that are growing beyond their WANs' scalability limitations. In the past, these firms would have moved to traditional transport technologies like frame relay. Next-generation IP VPNs offer the same "meshing" capabilities to link branch offices together, but they achieve this at lower per-site costs than frame. Unlike frame relay, IP VPNs are multi-service oriented, handling voice and video as well as plain data. For example, as part of a VPN service bundle, some carriers offer basic and advanced voice features, like hosted PBX and on-net dialing.

Businesses that are reluctant to transition completely from their WAN can use IP VPNs selectively. Working with a carrier, mid-levels can quickly configure and deploy remote teleworking or telecommuting applications.

In this case, rather than being restricted to a T1, employees work from home or at a remote site using whatever IP access technology (DSL, cable modem, or WiFi) happens to be available. It is also possible for the carrier to link individual branch offices to the corporate intranet via the VPN. Mid-levels can confine this packet technology to non-critical operations while they are evaluating it, and with little additional capital expense required. The IADs that were deployed for the private line connection still remain in place, but with the appropriate VoIP module plugged in.

## Conclusion

In recent years, both premises equipment vendors and carriers have focused their business strategies on VoIP, sending out a message that “VoIP is the way to convergence,” but it is not the only way. There is no question that enterprises are migrating to VoIP; Insight’s recent survey of the PBX markets predicts that VoIP will become the predominant form of premises switching, with the total number of IP phone extensions exceeding the older base of Time Division Multiplexed (TDM) phones by the end of this decade. Carriers are also actively exploring hosted IP PBX solutions.

But for mid-level enterprises that wish to gain most of the advantages of convergence here and now, T1-based IADs offer an attractive alternative. This non-VoIP convergence device connects with existing voice (PBXs, key systems, and analog phones) and data (routers and LAN) infrastructure. Mid-levels effectively gain the cost reductions of a shared network without having to make the investment required to upgrade the WAN for VoIP. In many applications, IADs can often take the place of VoIP gateways: It is

convergence without the QoS issues that come with VoIP and its packet-based routing.

The current deregulation of voice and data services presents an opportunity for mid-levels to take fullest advantage of IADs. By purchasing all their data and voice services from a single carrier (either an IXC or LEC) through a bundled package, mid-levels can achieve one of the most important and very practical goals of convergence: a single access line for all telecom services. With this approach, mid-levels attain lower total telecom costs and have the option to quickly add on new services, like VPNs.

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