NETWORK CONVERGENCE FOR ENTERPRISES

The Carrier-Centric Approach
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1. Overview

When the monthly communications bill runs into six figures as it does in many large enterprises, managers are keenly aware of reoccurring expenses and are always on the lookout for ways to lower their network operational costs. One approach to shave expenses is converging voice and data by using voice-over-IP (VoIP), which has proven cost saving benefits, but it also requires significant investment in new premises equipment. Unfortunately, in today’s economic environment, enterprises are faced with more aggressive ROI payback periods that make it difficult to justify the expense of buying large quantities of new VoIP technology.

Rather than invest, enterprises could instead attempt to lower their operational costs by trying to roll-up and rationalize the expenses of running their legacy networks, but there are challenges here too. Telecom is generally considered one of the least understood and worst managed corporate cost centers because collecting expense and billing information for voice (long distance and local), data (Internet and WAN), and enhanced services (video, voice conferencing, and messaging) across multiple systems spread out over many locations and from multiple service providers is a complex process. If cost center information is not available or not granular enough, departmental P&L numbers are only an approximation.

INSIGHT’s ongoing analysis of telecommunications industry trends suggests there is another approach to enterprise convergence—one that is far simpler to implement and comes with measurable bottom-line results. What is being called network or carrier-based convergence has many of the cost saving advantages of internal or premises-based convergence, but unlike VoIP, enterprises are spared from making significant new capital investments. Instead enterprises plug their existing voice and data networking devices into the carrier’s network. Besides immediate hard cost savings derived from lower access charges, a carrier approach strategically positions the enterprise for more advanced network architectures. If the enterprise elects to migrate to an IP-based VPN (virtual private network), the enterprise typically sees additional cost savings and an added bang that comes with new sophisticated service capabilities.
To understand the power of network convergence, we first examine how enterprises use telecom carriers for their voice and data services up until quite recently.

2. Telecom Today: It Could Be Better

The large (above 1000-employee) enterprise is a multiple location organization. To link corporate headquarters, regional offices, branches, supply and manufacturing centers to each other, these large businesses have typically contracted with a variety of service providers, as we note in Table 1.

### Table 1 Numerous Service Requirements, Numerous Carriers

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For regulatory reasons, enterprises have historically turned to IXCs (inter-exchange carriers) for wide area networks. Only IXCs were allowed to provide data services (like frame relay or ATM) that crossed LATA (local access and transport area) boundaries. And IXCs have also been the only provider of long distance voice calling. The IXCs sophisticated voice networks supported other enhanced voice services that have found a large market with enterprises: 800 number, conferencing, corporate dial plan, and intelligent routing for distributed call centers.

With its POPs (points-of-presence) and co-location facilities in key metropolitan areas linked by optical fiber, IXCs have the network capacity and reach to service nationwide enterprises. Enterprises connect into the IXC network using T1/T3 access lines. These lines feed into customer premises equipment, like T1 multiplexers, frame access devices, or ATM switches, which act as a bridge between the local area networks and the carrier’s internal data network.
Until recently, regulations also restricted LECs (local exchange carriers) to intra-LATA data networks and local voice calling. For voice access to the PSTN (public switched telephone network), enterprises have had to link to the LEC’s central office. In this case, they choose between individual analog or digital (T1 or ISDN) trunk lines that lead to either individual phone lines or on-premises switches (PBX or key phone systems).

Enterprises today require access to a third type of network, the Internet. Still another access line to another provider of telecom service, an ISP, must be ordered and linked to the corporate internal network.

The divide between voice and data departments within the enterprise is well documented; but what is even more problematic is the separation between voice and data on the network-side, with multiple providers each specializing in their own services, as we illustrate in Figure 1.

**Figure 1 Islands: Today’s Enterprise Network Architectures**

![Diagram of network architectures](image)

For the enterprise, the consequence of multiple carriers has meant higher costs for telecom connectivity and administrative overhead. With each access line to each
service provider, there are both monthly recurring and one time costs. Recurring T1/T3 access charges are based on distance to the POP or central office, with additional charges depending on the type of service (voice trunk, ISDN, point-to-point, frame relay) that has been purchased.

Discounts on the recurring part of the access charges are available and depend on the length of the contract and total billings from the customer. For example, carriers discount T1 access charges for trunks if the total long distance charges reach certain agreed upon levels. Unfortunately, when multiple service providers are involved, enterprises can’t take optimum advantage of the “total revenue” discounts.

Multiple carriers have also brought about an extra layer of administrative complexity. For example, depending on how the access circuits were ordered, both IXCs and LECs can be involved, with separate bills originating from each. When there is service disruption, network trouble shooting often results in telephone tag or fruitless finger pointing.

With the reduction in regulations brought about by the Telecommunications Act of 1996, 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. They are no longer constrained to LD services and can provide local services as well. This means that for the first time it is possible for a single carrier to handle data and voice, on both a national and local level and with aid of the new convergence technologies, to do so in a cost-effective manner.

3. **External Convergence: A Better Way**

Voice-over-an IP (VoIP) has been touted as the be-all and end-all of convergence—with much of that push coming from the hardware vendor community. To achieve on-site or internal convergence, the enterprise must invest in new customer premises equipment: gateways, LAN switches, IP PBXs, IP phones, and upgraded wiring. The typical vendor argument is that while new VoIP infrastructure is more expensive than TDM-based systems, VoIP offers operating savings in administration (lower costs of moves-adds-changes) and productivity improvements (reduced staffing) for a lower total cost of ownership. Typically, the payback period for a converged voice-data infrastructure is said to be approximately one to two years.
But, the new de-regulated carrier environment offers another approach to convergence—external convergence, where hard cost savings and productivity gains are achieved without significant investment. It’s an approach that lets the enterprise retain its existing voice and data networking access equipment, yet achieve the cost advantages assumed to be only available through VoIP convergence.

The deregulated carrier bundles local and long distance voice, WAN networking, and Internet access, delivering these services over a common access line. Enterprises eliminate separate trunk connections to the LEC and private point-to-point voice lines, consolidating both on an integrated access connection for measurable cost savings.

The only additional premises equipment required to plug into the network is an integrated access devices (IAD). These sophisticated devices offer a cost-effective, low administration solution to convergence. 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, telecom administrators can plug in optional modules for packet protocols (IP, ATM, or Frame Relay) to support access to carrier data networks.

On the premises side, IADs interface to PBXs, key systems, plain analog phones, as well as LANs, routers, and frame relay devices. IADs map the voice and data streams directly into the logical channels of the access line. At the carrier’s central office or co-location facility, a corresponding IAD de-multiplexes the stream, routing each service to the appropriate network: voice to the PSTN, data to the corporate WAN, and Web traffic (email, browsing, etc.) to the Internet, as we illustrate in Figure 2.
4. Evaluating External Convergence

An enterprise that moves to external convergence provided by a single carrier is motivated by cost considerations first, and technical and administrative benefits as a secondary consideration. We summarize the key benefits of external convergence:

**Lower network access cost:** A move to network convergence achieves immediate cost saving because separate voice access lines to the LEC and point-to-point leased lines can be eliminated. Additional cost savings are also possible. As mentioned earlier, service contracts with carriers generally offer discounts based on higher spending levels. Generally these spending levels include total
monthly recurring costs for access lines and per minute charges for long distance voice. When an enterprise brings their total voice, data, and telecom business to a single carrier, they are in a good position to negotiate discounts on their recurring access charge schedules.

**New branch flexibility:** A single carrier approach allows enterprises to connect up new branch offices quickly and inexpensively. Rather than separate WAN and LEC access lines, a single integrated access line provides total telecom service coverage, including 911.

Another significant benefit derives from the IAD positioned at the branch office. Telecom managers can directly connect analog phones to the IAD device, which takes the place of a more expensive phone switch. Though not integrated directly to the corporate PBX, these analog phones can, with the help of a carrier’s network, simulate several PBX features. In this case, the carrier’s intelligent network comes into play with services like corporate dial plans and on-net dialing. If both are available, inter-office calls can be made using 3- or 4-digit extension with no per-minute toll charges accruing.

**Single bill:** A single bill for all corporate telecom services—WAN, internet, voice and even wireless—is another major benefit of external convergence. New technology in the carrier’s back office called “convergent mediation” means carriers can monitor the network elements that collect billing information (the call detail records) from wireline voice switches, network availability data from the WAN, and email and Web statistics from IP devices. The carrier’s back-end servers filter and combine the data which is then rated or priced to produce a single customer bill. This new capability means that the enterprise can request customization of the billing outputs—and it means the carrier can be more flexible in creating flexible pricing plans, such as tiered flat rate billing levels or billing based on average data usage levels

**Web administration:** The ability to view and change service parameters using a web interface is another significant benefit of external convergence. Web-based administrative control has been available from carriers for some time, but with a single carrier handling all the enterprise telecom, the benefits are proportionally greater. From a single administrative screen, the corporate telecom manager can order new circuits or disconnect unused ones, configure enhanced services (voice mail, conferencing, dial plans), monitor data network activity, and view other reports and consolidated billing information—putting all network management activities under a single umbrella.
**Single Provider Efficiencies:** A single provider for all data and voice services across all locations leads to lower corporate overhead. Internally, fewer resources will need to be devoted to managing and monitoring services contracted from a single source. The enterprise’s external telecom services is now streamlined through predictable technical support, one Web portal for all configuration, uniform pricing schedules, and a single point of contact for sales.

5. **Ultimate Network Convergence: IP VPNS**

Virtual private network (VPN) is a term that changes meaning with the technology. If you used the term VPN ten years ago, everyone knew you were talking about enterprise-class voice products from the IXCs. More recently VPNs have been used almost exclusively to describe new IP-based network services offered by the carriers. Today a VPN defines either secure, private data networking over the public Internet or a private, managed-IP network available from the carrier. An IP VPN network facilitates an individual user’s remote access to corporate assets, site-to-site networking within the enterprise, as well as external communications to the wider world.

Today’s IP VPNS inherently support IP applications of which VoIP is the most critical. Packet classification schemes that confer class of service or priority information can be used by the IP VPN to assign voice, data, or video streams to the appropriately conditioned “virtual circuit”—such as a best effort transport, real-time delivery, etc. In a managed VPN network, carriers can more easily and cost-effectively build enhanced services like hosted PBX, collaboration, and messaging. In short: the VPN has morphed into a multi-service, intelligent network that provides a total telecom solution.

IP VPNs are attractive to the enterprise for many of same reasons that first moved corporate networking in the direction of frame relay or ATM VPNS. By the early 90s, enterprises were discovering that as their point-to-point T1/T3 networks grew they became more difficult to manage and more expensive to operate. As new locations were added, the number of circuits per site linking the new office to the rest of the network scaled disproportionately and therefore per-site access costs increased with the complexity of the network. While few enterprise networks were fully meshed—with links to every other node—a rule of thumb was that when the number of T1 circuits reaches 20 percent of full meshing, frame relay networks were deserving of serious consideration.
Many of the same considerations that first prompted the enterprise to consider the earlier versions of VPN are still factors today. The reason for lower per-site cost is that frame relay and ATM support the concept of virtual circuits. Rather than being true “nailed-down” connections, virtual circuits are allocated from shared resources in these packed-based networks. They can simulate many of the features of a real circuit, such at guaranteed bit rates and low latency. To link up a new office in a frame or ATM VPN network, enterprises simply order additional virtual circuits for the other sites in the network. The cost of these virtual circuits was much lower than a point-to-point connection.

The new MPLS-based IP VPNs share the virtual circuit architecture common in these older shared data networks, but have a major advantage in their any-to-any connection capability. In frame and ATM VPNs, enterprises explicitly order additional virtual connections; the carrier then provisioned the appropriate network resources. But with IP VPNs, the network is fully meshed: once a node is linked in, it can establish connections with any other site on the fly. And there are no charges for additional virtual circuits.

The benefits of IP VPNs are overwhelming, and their use has exploded in recent years. IP VPNs duplicate all the shared network features of the legacy data networks, but do so at lower costs. Managed IP VPNs from carriers add other improvements. Unlike the legacy data networks, they are truly multi-service, handling both voice (VoIP) and data. Advanced MPLS technology supports
prioritization of different IP streams and can meet VoIP’s quality of service (QoS) requirements. IP VPN network performance is also backed up by Service Level Agreements (SLAs). These contracts, which require the IP VPN carrier to compensate customers for network failures and glitches, are becoming as competitive and comprehensive as the agreements given for legacy data networks.

Our research has identified several operational benefits to a managed IP VPN from a single carrier:

- **lower meshing costs**: External convergence reduces access costs, but still relies on older data network technology. With their any-to-any capability, IP VPNs allow new offices to be added at minimal costs and without requiring formal networking provisioning for new virtual circuits.

- **bandwidth efficiency**: External convergence uses a single pipe for both voice and data, but the IAD statically assigns channels (and hence bandwidth) to voice and data. IP technology, on the other hand, allocates bandwidth between voice and data dynamically, depending on usage. As traffic grows, IP VPNs allow existing access lines to be used for longer periods before an upgraded line is required.

- **flexible remote access**: Unlike frame or ATM, access to an IP VPN can be made from any location that has an Internet connection (DSL, cable, or dial-up, or wireless). IP VPNs support a mobile, flexible workforce.

External convergence is a natural stepping-stone to VPN convergence. With IADs positioned at each location, it is not a difficult (or expensive) task to upgrade the IADs with new modules to support IP data transfer and VoIP protocols. The carrier then uses the legacy virtual circuit mapping and routing table information in the IAD to configure the enterprises virtual network within the shared IP VPN. Once the transition is made, management of IP edge routing is entirely the task of the carrier.

### 6. 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. Larger enterprises that wish to make the move to convergence without compromising corporate ROI policies should find
external convergence compelling. Using an IAD to connect existing voice (PBXs, key systems, and analog phones) and data (routers and LAN) infrastructure to a carrier, they gain the cost reductions benefits of internal convergence without having to make any significant investment in new infrastructure.

The current deregulation of voice and data services presents an opportunity for enterprises to take fullest advantage of network convergence. By purchasing all their data and voice services from a single carrier (either an IXC or LEC) as part of a bundled package, they can further reduce carrier telecom costs. And enterprises achieve lower administrative overhead through features like a single telecom services bill and one-call network trouble shooting.

Finally, external convergence through a single carrier is logical transition step toward a multi-service IP VPN network. Besides additional costs savings resulting from highly scaleable network, IP VPNs bring to the enterprise intelligent network features at very low costs. Of these enhanced features, hosted PBX based on an IP architecture is the most significant. It will eventually make possible the “premiseless” corporate voice network in which all voice features derive from the carrier. Enterprises that transition to convergence using their carrier may find that they will never again have to make major capital investment in voice infrastructure.

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