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Convergence

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Convergence

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Introduction

In the past, businesses, service providers and individual consumers thought of voice, video and data as separate entities whose paths would never cross. Video arrived via the airwaves and coaxial cable, while voice and data arrived via separate phone lines.

However, with recent advancements in multimedia software, network routing and data cabling technologies, these three lines of communication are closer than ever to traveling on one network infrastructure. The term for this form of single network integration has become known as convergence.

The Impact of Convergence

In the corporate world, convergence will improve the way companies manage their networks. Network and IT managers believe that this marriage of communications and computer systems will provide more efficient and effective business solutions.

Presently, some businesses are hesitant to converge networks, believing "a small cost-savings does not warrant moving a reliable network, like telephony, onto a less reliable data network." These concerns are based on two misconceptions.

The first is that cost savings are the only benefit to convergence. In addition to cost savings, convergence will also give birth to new applications and processes that help to generate revenue. These applications will allow people and departments to communicate more efficiently and share data on a macro level. Ultimately, convergence promises a reduction in operating costs, increased performance and productivity as well as providing entirely new sources of revenue[1].

The second misconception is that data networks are inherently unreliable. Reliability, while certainly not an unwarranted concern, is not an insurmountable problem. Presently, more than fifty percent of data network problems are related to the network infrastructure[2]. While this number could increase substantially as convergence applications demand more bandwidth, it doesn't have to. There are data cabling solutions available that provide sufficient headroom for bandwidth-hungry applications. Taking the time to ensure that the cabling infrastructure can consistently provide the necessary bandwidth, will go a long way to ensure reliability and efficiency.

The key to convergence is the successful utilization of bandwidth.

Cost Analysis

When looking at the impact convergence will have on the bottom line, it is important to take into account costs, savings and profits over the short- and long-term.

Voice Over Internet Protocol (VoIP) Cost Savings

A combined voice/data infrastructure may lead to the elimination of redundant networks and network resources, and simplified network management.[3]

- ***Eliminate Redundant Networks***
  Because typical PBXs (public branch exchanges) are also costly to operate, VoIP would result in substantial savings in infrastructure costs even within a single building or facility.

- ***Bypass Toll Costs***
  The corporate environment anticipates that convergence will result in savings on long-distance toll calls, especially international voice calls where a substantial part of the cost derives from regulatory fees. In most cases, these surcharges don't apply to circuits carrying data traffic. VoIP would result in a much less expensive way to make voice calls.

- ***Eliminate Redundant Circuits***
  Despite very reliable telephone service in this country, large companies often purchase multiple, diverse circuits to the local telephone company's exchange to act as a reserve system. However, these circuits are rarely utilized and ultimately double the cost per month the company must pay for leased-line telephone access circuits. However, with VoIP, if a failure occurs on the primary telephone circuit at one location, the data network could be used to route calls temporarily to PBXs at other company locations. This eliminates the need for a redundant telephone circuit by leveraging the company's data network.

- ***Facilitate Adds/Moves/Changes***
  It's costly for a company to maintain a typical work area that includes data and telephone jacks along with a phone or PC, especially when individuals move from one desk to another. With a DHCP (Dynamic Host Configuration Protocol, which enables dynamic assignment of IP addresses to devices on a network), moving a PC from one LAN to another will become simpler due to auto-configuration functionality. However, moving a phone extension from one desk to another (or to another building) is not as simple, usually requiring reconfiguration of the office PBX systems. With the increased popularity of VoIP, a new type of PBX and IP telephone station has entered the marketplace. An IP Phone can automatically configure itself as a DHCP client. Now a desk requires only a single data jack, and the IP Phone can act as a hub or switch to provide a data port for the user's PC. One or more PCs, or perhaps an IP fax machine, can be directly connected to the IP Phone, and all of them can utilize the local IP network. Moving employees from one desk to another is now less costly.

- ***Falling IP Equipment Costs***
  Packetizing voice puts computing power for data networking equipment near the endpoints of the network, where the packet-switching equipment shows a faster improvement in price/performance than switched equipment. With many companies feverishly developing new features for IP equipment, the price/performance of packet-switching equipment should continue to improve. Packet-switching equipment technology is able to keep pace with the increase in demand for IP.

New Applications and Generating Revenue

Besides cost savings, convergence will also give birth to new applications and processes that either directly or indirectly help to generate revenue. These applications will allow people and departments to communicate more efficiently and share data on a macro level.

- ***Employee Productivity***
  This will increase as the result of integrating voice mail and e-mail, as well as better access to teleconferencing and multimedia training. Corporations already use multimedia on their networks to invigorate corporate training and more easily convey corporate messages. The belief is that interactive media will have as much of an impact on corporate computing applications as client/server computing[4].

- ***Manufacturing Efficiency***
  By integrating the factory floor network with inventory and sales databases, backorders and over-production situations can be avoided.

- ***Enhanced Security***
  Security can increase through the integration of databases that manage network logon IDs and passwords with the programs that manage proximity cards and security cameras.

- ***Customer Service***
  Several applications will bring companies closer to their customers, including: streaming video in call-centers, and databases with text from sales calls.

Data Network Investment

In order for an existing TCP/IP networks to successfully carry streaming video and VoIP traffic, several modifications must be made to ensure that the network infrastructure can support these applications.

Currently, the data cabling industry standards are not very stringent—certainly not stringent enough to ensure that convergent applications won't run into problems.

Fortunately, there are network infrastructure solutions available that do provide the necessary throughput and bandwidth support. If a company does not already have one of these high-end network infrastructures, they need to invest in one.

For many businesses, convergence will save money and open up new revenue opportunities. Though there may not be dramatic cost savings in the short-term, converged networks will pay off in the long run.

Bandwidth Management

The key to convergence is the successful utilization of bandwidth. Eliminating the telephony network will reduce "wasted" bandwidth, while the new multimedia applications will require more of it. The telephony network infrastructure will no longer be needed, but the data network infrastructure will need to be able to handle more bandwidth with greater consistency than ever before.

Fortunately, methods of compressing and routing data, as well as efficient and reliable data cabling solutions are available to help manage bandwidth.

Compressing and Routing Data

Since they are circuit-switched, traditional networks usually waste bandwidth. They use a dedicated communications path for every call, with a constant bit rate of 64 kbps. However, silence consumes more than half of the average telephone call and if no calls are made, this bandwidth remains unavailable for other traffic. Therefore, unused capacity results in inefficient use of bandwidth.[5]

Today, one of the most important design considerations in implementing voice or streaming video is minimizing one-way, end-to-end delay. Retransmission is not an option with voice and video traffic flows. It needs to stream in real-time; if there is too long a delay in packet delivery, the data is unrecognizable.

These factors make data compression and routing crucial.

- ***Compression***
  The bit rate for an uncompressed telephone call approaches 64 Kbps. This degree of bandwidth is considered excessive, and is usually reduced for delivery over a typical data network. Several encoding and compression algorithms are available to reduce the bandwidth consumed by a telephone call. These compression mechanisms are usually found at the VoIP gateways and not within the data network routers or switches.[6]

- ***Network Quality of Service***
  A TCP/IP network must have mechanisms in place to prioritize VoIP traffic above all other traffic on the network (except other real-time application traffic such as video). A protocol called Resource Reservation Protocol (RSVP) has been designed to reserve resources across the network for real-time transmissions. Quality of Service (QoS) mechanisms within TCP/IP have also recently been implemented by a number of TCP/IP router and switch vendors. ATM networks and, to a lesser degree, Frame Relay networks have QoS functionality already built into them. Generally, TCP/IP routers and switches will use a priority queuing system to buffer non-VoIP packets and send them only after all of the VoIP packets have been transferred to the next network element. Large IP packets (non-VoIP) are buffered to the side so that the smaller VoIP packets can be sent on time. Other mechanisms will predict times of congestion over the wide area link and throttle back bandwidth demands from non-real-time applications.[7]

- ***IP Packet Precedence***
  IP precedence bits should be set at the edge of the network, with VoIP traffic given the highest possible precedence. Data networks with protocols other than TCP/IP running on them are not as well suited for VoIP as a purely TCP/IP network because it's more difficult to give traffic priority when it is not a TCP/IP packet. Whenever possible, all bridged traffic should be segregated from the TCP/IP WAN links where VoIP will flow. Bridging of any sort over the wide area will hinder TCP/IP QoS implementations.[8]

- ***Weighted Fair Queuing***
  Weighted fair queuing (WFQ) is a buffering mechanism that will buffer TCP/IP packets, classify them based on a number of different criteria and then de-buffer the packets based on IP precedence or traffic flow. The classifications available are: source and destination address, protocol and session identifier. During the de-queuing procedure, packets are given privilege based on the three IP precedence bits in the packet's IP header.[9]

In order for an existing TCP/IP network to successfully carry streaming video and VoIP traffic, several modifications must be made to make the network infrastructure act like a circuit switched network. Streaming traffic is given priority and, when possible, network resources are reserved exclusively for these packets.[10]

Efficient and Reliable Network Infrastructures

Successful implementation of convergence applications require an efficient and reliable data network infrastructure. Presently, more than fifty percent of data network problems are caused by the infrastructure, and with convergence the data network infrastructure will need to be able to handle more bandwidth consistently than ever before.

Fortunately, efficient and reliable data cabling solutions are available to help manage bandwidth better.

The true gauge of a network's performance is its throughput efficiency. Throughput refers to the amount of data that is transferred from server to user. If the network is supposed to transmit data at 100 Mbps, but it's only transferring data at 60 Mbps, it isn't working at optimum throughput levels, and that network's efficiency is compromised as a result. These delays in data transference are usually the result of a network infrastructure that degrades a signal to the point it can no longer be received. This requires a retransmission of the signal and results in delays and inefficient network performance.

Today, this scenario is relatively common, but with convergence it won't be acceptable. Retransmission is not an option with voice and video traffic flows. It needs to stream in real-time; if there is a significant delay in packet delivery, the data is unrecognizable. While packet prioritizing and routing applications will help, compression programs often make data signals more susceptible to degradation. This issue will be exacerbated by the increased data traffic and bandwidth requirements convergence will bring.

Fortunately, certain network infrastructures are designed to maximize data throughput well beyond minimum standard requirements. These infrastructures are more forgiving of weak data signals, and have enough headroom for spikes in bandwidth. Taking the time to ensure that the cabling infrastructure will consistently provide the necessary bandwidth is crucial to implementing convergence successfully.

- ***Fiber optic cabling***
  Fiber optic cabling is immune to electrical interferences and offers higher data transmission capacity and longer distances than copper. When you consider the cost of fiber and copper, contrary to popular belief, there is very little difference. However, the cost of the fiber optic electronics is more. Fiber optic systems offer many advantages in the backbone because their high data-carrying capacity translates into fewer electronics to achieve higher throughput. Most networks currently run copper in the horizontal.

- ***Copper cabling***
  While cabling that only meets Cat 5e requirements probably will run into severe difficulties with convergence, other high-performance copper cabling solutions are available. Specifically, high performance cabling solutions that are electrically matched and take into account impedance and crosstalk variances.

- ***Wireless***
  Technically, wireless products operate as any wired product would in regards to bandwidth. Any additional overhead is between the wireless products and not between the wireless and wired LAN segments. The only possible technology addition would be for management, but this is also associated with wired hub, switches and routers. However, the convenience of a wireless connection will most likely result in increased data traffic and the need for more bandwidth. There are also associated security concerns with wireless. Data encryption is not the issue. Traditionally, wired network security was viewed as a "closed environment," meaning network administrators knew which wires were connected to what terminals. By introducing wireless LAN devices, the sense of control is no longer "seen" but still needs to be understood.

Implementation

Converging networks is not really a matter of "if "but "when." Not only are there cost savings possibilities, but there are revenue-generating applications businesses will need to implement in order to stay competitive. The network software and infrastructure technologies are available to ensure that networks will use bandwidth efficiently and reliably enough.

Convergence Standards

The widespread deployment of converged networks depend on the availability of standards to ensure interoperability and performance requirements. Standards useful in a converged network, such as International Telecommunications Union (ITU) H.323, Institute of Electrical and Electronics Engineers (IEEE) 802.1p/Q and Real-Time Transport Protocol (RTP), to name a few, were developed over the last several years and are now being implemented in products.

Unfortunately, no data cabling standard adequately addresses the performance requirements associated with convergence. However, there are other sources for information, like Anixter's Levels® Program, which can provide guidance. Anixter's Levels Lab® tests network infrastructures by running real-world applications in real-world networking environments to determine which solutions provide enough data throughput and headroom.

Conclusion

In the corporate world, convergence will improve the way companies manage their networks. Network and IT managers believe that this marriage of communications and computer systems will provide more efficient and effective business solutions.

Presently, some businesses are hesitant to converge networks, believing "a small cost savings does not warrant moving a reliable network, like telephony, onto a less reliable data network." These concerns are based on two misconceptions.

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There are data cabling solutions available that provide sufficient headroom for bandwidth-hungry applications. The key to convergence is the successful utilization of bandwidth.

Migration and Adoption

Some business are integrating networks already. VoIP is of particular interest right now.[11, 12]

Other businesses are now investing in better-performing data network infrastructures in preparation of convergence. They are gradually transitioning sections of their network piece-meal.

The other companies will have to catch up later.

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#227161 5K 01/01–JT

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