Lippis Consulting

White Paper

Wiring Closet Switches Enable New Applications and IT Services

Intelligence Enters Network Access

By

Nicholas John Lippis III
President, Lippis Consulting

April 2008

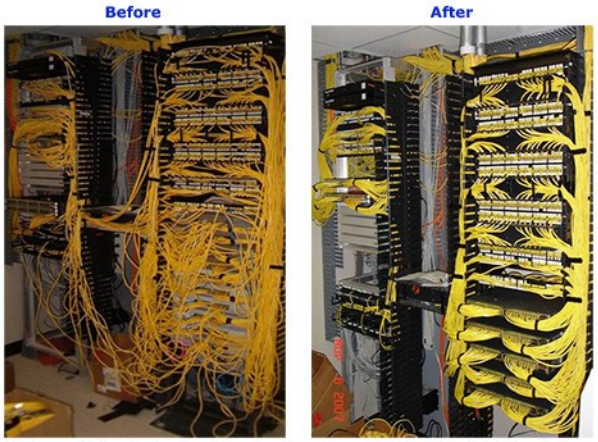
Abstract:

Wiring closet switches are undergoing a renaissance of sorts. Once thought of as commoditized simple network connectivity devices, they are now central to network security, mobility, Power over Ethernet (PoE) distribution, IP phone and UC connection devices, et al. Wiring closet switches are pervasive as they connect all end-points into an enterprise network, distributing network services throughout a corporation. Previously acquisition cost might have been the primary criteria for wiring closet vendor selection. IT leaders are now rethinking their decision criteria as network intelligence and services have shifted toward network access, enabling unified communications, integrated security, wireless LAN access, application delivery, and high availability to support real time applications and much more. Total Cost of Ownership (TCO) of these switches break down as 20%/80% capital/operational spend resulting in switch design, network management plus reliability and serviceability features possessing a demonstrable effect toward lowering TCO. In addition to this network intelligence shift, previous IT purchase decisions, which deployed multiple vendor products for network access, are being reviewed as operational cost has soared thanks to inconsistent management and operations. This white paper documents the dynamics forcing a change in wiring closet switching with recommendations and guidelines for business and IT leaders to assist them in fixed switch vendor selection.

1.0 Introduction: Existing wiring closet deployments

The edge or access of a network connects all end-points into an enterprise network infrastructure. The network edge is made up of wiring closet switches, which are usually fixed Ethernet switching devices. The market for wiring closet switches is evolving.

In the previous decade IT organizations had traditionally pursued an edge network that utilized shared hubs and switches to provide connectivity to end-points. The primary buying criteria was price per port with low price being paramount. These switching devices possessed few network services such as layer 2 forwarding, Virtual Local Area Networking (VLAN), Routing Information Protocol (RIP) and a configuration tool as their primary network management capabilities. In short, the old network access model provided best effort connectivity services with little to no operational control.

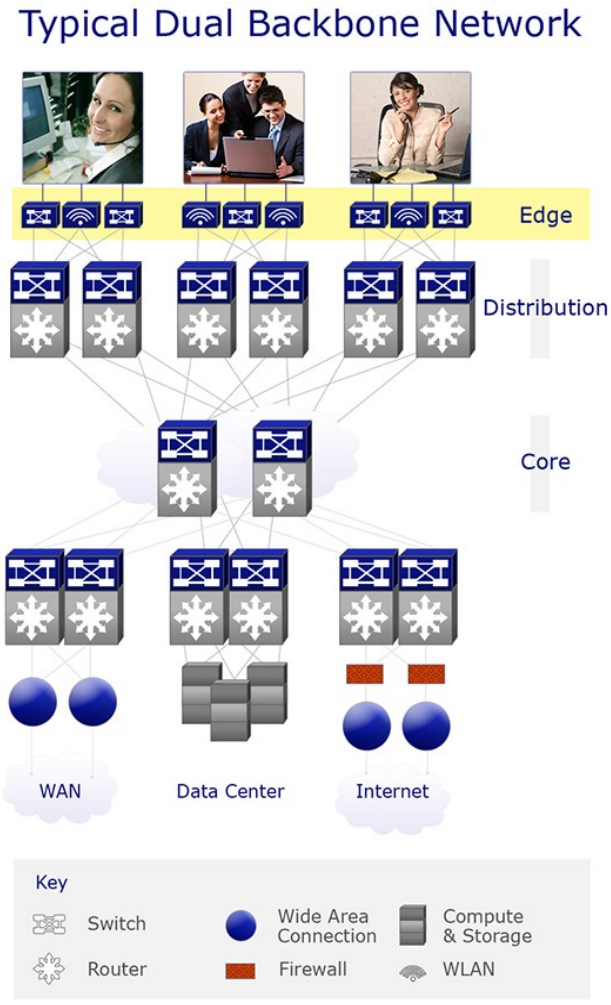


Before and after photos of a wiring closet, courtesy of Sanford Health Network after their upgrade to next generation Cisco wiring closet switches. Notice the wiring closet vendor consistency and organization which hastens troubleshooting in the after photo.

As a result of these past decisions, edge/access security was limited, with layer 2 security measures often implemented haphazardly. Multiple VLANs were relied upon to maintain separation of user traffic and provided limited access control. Most switches relied on RIP as an interior gateway routing protocol but limitations in its algorithm could lead to sporadic outages that would render the network unusable. Wiring of switches is often disorganized after years of physical troubleshooting; additionally, adds, moves and changes without good network management systems contribute to a lack of availability, reliability and extended time to resolve faults (see before and after photos).

IT departments viewed wiring closet switches as commoditized networking equipment, with little differentiation between vendors. As a result, purchasing decisions were typically made solely on the basis of upfront acquisition cost with little regard for the increased lifecycle costs these purchases incurred on operations. Large organizations that focused their decisions on acquisition costs had soon assembled an enterprise network made up of equipment from different vendors throughout their wiring closets, which may have been different than distribution and core switch suppliers. Equipment from multiple vendors made effective management difficult and the multiple management systems necessitated that these organizations keep a large staff with diverse skills to maintain network functionality.

Wiring closet switch manufacturers have been driven to deliver increased network services in their products due to changing enterprise network demands, discussed below. As a result wiring closet switches and the network edge in particular have transitioned from being a commodity connectivity service to a strategic enabler of new IT applications and services while being the first level of defense to mitigate against internal network threats and attacks. This is a fundamental change in enterprise network design upon which business and IT leaders need to take action; see recommendations section.

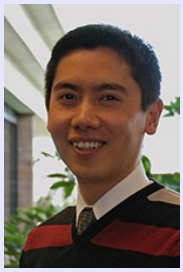


A new category of wiring closet switches has recently begun to appear on the market. These switches offer a host of new features that allow vendors to compete on multiple different fronts beyond traditional price per port metrics. It is important for executives responsible for purchasing decisions to understand this new basis of competition and to take into account not just their organization's current needs but also heretofore unconsidered future needs before selecting wiring closet switches and designing the next generation edge network. The podcast link below is a discussion with Mr. Thuan Nguyen, Director of IT at Kent School District, about his options, decisions and results of a new state-of-the-art network edge. The Kent School District is the fourth largest school in the state of WA, comprising four high schools, six middle schools, 28 elementary schools and two academies. In 2006, the school district employed 3200 and enrolled nearly 27,000 students plus an additional 301 students were enrolled in offsite programs such as Running Start (college).

The start of the fiscal year brought with it a district-wide network refresh, where the IT team sought to replace the current edge network that included products from ProCurve Networking by HP and 3Com. The existing equipment was aging and very basic with only layer 2 support. The school district's IT team wanted to:

- Deliver to students and staff new applications such as voice, video, wireless networking and virtualized applications.
- Improve network availability and reliability.
- Enhance network flexibility to support new tools and applications as needed.

Kent's IT staff were challenged to support a doubling of networked computers, new IT service requirements including virtualized desktops, smart boards, video surveillance and unified communications all while keeping their operational budget constant. Mr. Nguyen explains how a new network edge allowed Kent School District to deliver on its goals.



Related Podcast:

Kent School District Deploys New Wiring Closet Switches And Gets New IT Services While Keeping Operational Cost Constant

Listen to the podcast »

1.1 Enterprise Trends

A new set of enterprise trends is forcing IT executives to review projects, programs and priorities as they seek to drive down Total Cost of Ownership (TCO) while extracting additional value from their enterprise network. Business executives expect their IT departments to meet continually growing demands for increased number of networked applications and associated performance without significant year over year network expenditures. To manage this requirement, IT leaders seek to purchase network switches that possess more forward-looking designs and significant upgradeability than what was provided by the previous generation of equipment.

IT Application Infrastructure Changes

There are fundamental changes taking place with IT applications and communications, which are forcing new network edge requirements into the market. From an IT application perspective many IT leaders are experimenting with and deploying Web 2.0 technologies which enable social networking and local content creation such as blogs, podcasts, vidcast, etc., which are consumed throughout an organization and between partners, suppliers and at times customers. Data center consolidation and virtualization projects are growing in popularity across all market segments, changing traffic patterns and increasing bandwidth requirements. Virtualized desktop deployments are on the rise, which downloads a user's profile after log in and creates their unique application environment. Video is also becoming mainstream; it is the foundation of real-time collaboration. In addition high-def end-point camera pricing has plummeted or is packaged within new computing systems while unified communication providers integrate click-to-conference capabilities into their unified communications soft end-points. All of the above plus unforeseen developments point to a new dynamic in mixed traffic patterns with increased desktop bandwidth and service requirements.

A New Era in Communications Has Emerged

IP telephony and now unified communications (UC) offer strong economic advantages, prompting business and IT leaders to adopt this technology. To support UC, wiring closet switches need to distribute power over Ethernet and provide unique configuration profiles for these end-points. In addition to UC, mobility, in particular Wireless LANs (WLANs) adoption has become mainstream as IT leaders start to implement the latest high speed WLAN option in 802.11n. As WLAN technology continues on its high adoption trajectory, wiring closet switches must be able to support mobility through the ever-increasing value offered by WLANs with power and management capabilities. The rise of laptop adoption in the enterprise has provided the ability for employees to be nomadic, allowing them to take their computing platform anywhere in the enterprise. This has introduced a need for the network to deploy policy for the user based on its current point of attachment, as this is no longer static or wired. Wiring closet switches need the intelligence to: 1) negotiate PoE levels as opposed to using the non-granular IEEE 802.3af classes; 2) negotiate end-point policies based on identity and/or equipment type; and 3) provide for automatic VLAN assignment for UC and other applications.

Power Over Ethernet (PoE) Distribution

The demands on the network continue to grow as additional devices are deployed throughout the enterprise. WLAN access points, video surveillance, IP phones, specialty devices such as health care instrumentation, point of sale devices and soon even laptops will require power distribution from the edge of the network. PoE is not only an efficient and Green Power distribution mechanism which facilitates Uninterruptible Power Supply (UPS) deployments but a low cost alternative to supplying power to devices which are located away from existing power outlets and infrastructure. PoE also provides central control of power distribution, which simplifies rebooting and powering down a device when necessary thus reducing the threat of brownouts.

The Network Edge Is The First Level of Defense

As executive management has become aware of the real and brand tarnishing cost associated with an insecure network, network security initiatives have increased in their priority and Board of Directory visibility. All prior generations of wiring closet switches are less secure than today's devices. Network security approaches to the mitigation of internal threats and attacks are table stakes in the building of a secure and intelligent network edge. Previous wiring closet switches relied upon layer 2-based VLANs as their main defense. This level of security is wholly inadequate as a defense strategy and even worse, many organizations did not implement VLAN-based security consistently across the entire organization. With the myriad of threats facing IT organizations, including an ever-growing population of spy-ware, espionage, mal-ware and unauthorized network access, Network Access Control (NAC) and application policing has increased in importance for organizations committed to protecting the integrity of their network, the privacy of their data and providing compliance to various government and industry regulations. This new generation of wiring closet switches is powerful enough to deliver security features without compromising network performance or employee productivity.

Total Cost of Ownership

The network edge and wiring closet switches in particular have a total cost of ownership break down of 20 percent capital and 80 percent operational spend respectively, according to Gartner Group. This TCO model which heavily weighted operational cost is a direct consequence of IT leaders purchasing wiring closet switches based upon lowest acquisition cost without attention to its operational impact. Purchasing wiring closet switches from multiple vendors based primarily on a low acquisition cost cause an IT organization to incur significant costs going forward for the following reasons:

1. Additional personnel are required to support multiple vendor systems
2. Additional purchases are usually needed to add capability and sparing
3. The lack of upgradeability necessitated a faster replacement cycle
4. Lost opportunity to take advantage of synergies provided by an end-to-end integrated solution
5. Missed or delayed business opportunities due to network downtime
6. Lack of service and connectivity consistency across employees and devices due to a mixed vendor network edge

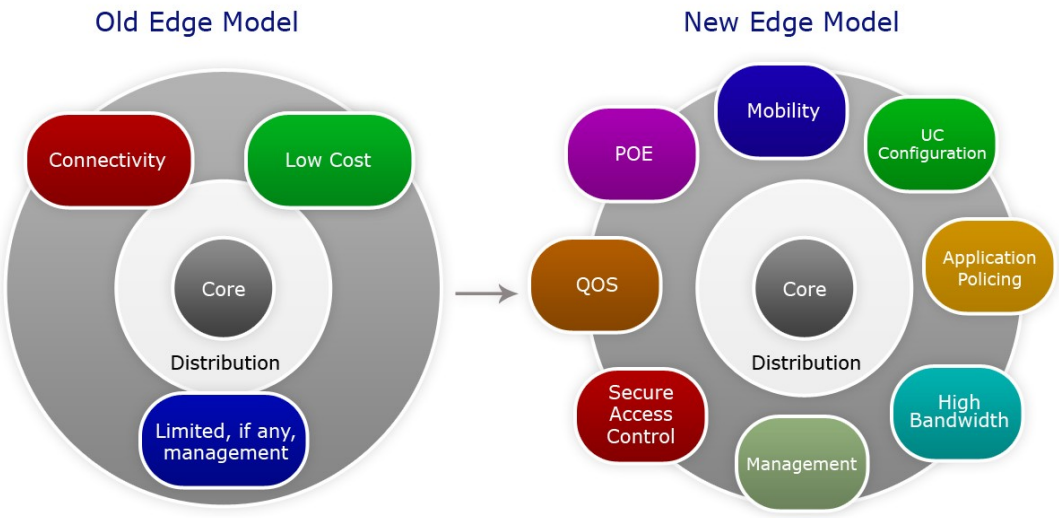
What is alarming about the TCO characteristics of the old network edge is that IT organizations are paying much more than they need to as operational cost, which includes salaries and fringe benefits, are a larger burden upon a corporation's expense

while capital expenditure is amortized over some number of years. While new wiring closet switches may be more expensive from a capital acquisition point of view, their operational cost will be lower and the total dollar spend over a three-year period will also be lower while delivering increased value to the enterprise.

Remember that 80% of the cost of wiring closet switching is incurred over the course of its operational lifecycle as troubleshooting, maintenance, skilled technical staff, facilities and lost productivity. In the next section we review the new class of wiring closet switches and discuss how new designs are addressing both the above changes in enterprise IT and reducing TCO.

2.0 A New Class of Wiring Closet Switches Emerges

Wiring closet switch suppliers have recognized the above enterprise trends and responded to the growing needs of their customers with a new type of wiring closet switch that adds significant functionality over and above previous switch generations. These suppliers are succeeding at delivering increased value to IT organizations and in the process transforming the commoditized network edge into a strategic IT asset. These new switches build upon the capabilities of the previous generation and enable a host of new applications such as UC, Telepresence, enterprise-wide mobility and enhanced security features that provide a new degree of protection against internal security threats.



Intelligence and network services are being distributed to the network edge or access, allowing wiring closet switches to support enterprise transitions in IT application infrastructure and communications adding business value in the process. This new class of wiring closet switches includes the following characteristics:

1. Quality of Service: New wiring closet switches tag applications at access to guarantee priority throughout an internal network and active monitoring.
2. Power over Ethernet (PoE): Power is efficiently distributed over Ethernet cables, enabling new classes of devices to emerge and operate in environments that lack electrical infrastructure.
3. Integrated Security: Both integrated security features and the support of security appliances implement strong access control and application-policing, bolstering internal threat defenses.
4. Wireless Local Area Networking: WLAN integration, which includes access point PoE and controller support, increases WLAN coverage. Further common network management interfaces streamline operational support for both wired and wireless networks.
5. Unified Communication (UC): UC support via PoE to power IP phones and UC end-points plus unique UC configuration profiles to ensure reliable and stable UC operation.
6. Application Intelligence: Application intelligence or the categorizing of applications as they enter the wiring closet and either mark them with QoS or discard the application, affording application policing at the network edge.
7. Layer 3: Full layer 3 forwarding enabling all the value associating with routing including high availability, segmentation and simpler troubleshooting are now included in some wiring closet switches.

In addition to the above network services, wiring closet switches have become more powerful from a performance point of view, while engineers have increased switch reliability, availability and manageability designs. Power supplies are more efficient and serviceable, reducing power consumption and service outage. Bandwidth and packet processing performance have increased to support higher densities of 1 and 10 Gbps Ethernet while offering clever approaches to ease the transition to higher LAN speeds.

2.1 The New Basis of Competition Emerges

This new category of switches has redefined the basis of competition among switch vendors. These advanced features allow for a degree of differentiation that was not possible for the previous generation. Organizations must assess their needs and begin making decisions based on a host of new factors besides initial acquisition cost. The following nine items are the new basis of competition among wiring closet switch suppliers.

Future Proofing

Future proofing is found in backward and forward migration strategies to utilize past investment as part of upgrades. Another aspect of future proofing is acquiring wiring closet switches with more than enough packet processing performance to meet existing requirements and those unforeseen demands. In short future proofing means having enough headroom for growth in terms of raw performance and network service intelligence. For example, Cisco's "source specific multicast" feature which improves the reliability of video multicast is an example of products which anticipate future customer requirements and include them within its wiring closet switches.

Transitioning From 1Gb Ethernet to 10Gbps Ethernet

10Gbps Ethernet is the future of networking, with more than 1 million 10Gbps-capable ports shipped in 2007. If the past is a guide to the future, then over time more and more 1Gb Ethernet ports will upgrade to 10 Gbps, placing strain on wiring closet packet processing performance while driving up 10Gbps port density requirements plus upstream distribution and core switch capabilities. This increased bandwidth will enable organizations to collaborate in new and dynamic ways, e.g., enterprise-wide video conferencing, social networking, etc. Another innovation example from Cisco is its TwinGig technology which enables a quick and painless transition from 1 to 10 Gbps Ethernet within their Catalyst 6500, 4500, 3750-E and 3560-E wiring closet switches.

Power over Ethernet (PoE)

PoE is increasingly becoming a standard wiring closet requirement as it enables a wide range of devices to exist in areas that are not wired for electrical power, in addition to being convenient and an efficient power distribution method. The current standard, IEEE 802.3af, provides only up to 15.4W over Ethernet cables. The next generation of this technology, high powered PoE + will likely emerge within the next few years. The details of its implementation, known as 802.3at, have yet to be agreed upon by the IEEE while a number of implementations are viable candidates. Flexibility in this area is highly desirable when selecting a wiring closet switch. Indeed, the upcoming WiFi standard, 802.11n, will almost certainly require higher power than 15.4W, which is the maximum power supported with current IEEE 802.3af. Cisco introduced Enhanced PoE support across Catalyst portfolio, which is an enhanced power capability for such requirements. Wiring closet switches should support 802.3af with the flexibility to provision 802.11n access points, with intelligent power monitoring to actively manage PoE ports by enabling alarms and shut down of PoE ports when faulty. Wiring closet switches should support full class 3 802.3af PoE as a requirement. Note that most products only support a fixed power budget of 370 watts for 24- or 48-port fixed configured switches, which may limit the availability of power to all ports.

High Reliability and Availability

High availability switch features ensure that the network edge does not suffer downtime. Some wiring closet switches implement a stacking feature to increase port density when needed, avoiding larger than needed capital acquisitions. This is an effective approach to scale and in some cases availability; however care must be applied when researching the stacking mechanism. Seek out those stacking approaches that utilize dual rotating rings as this provides redundancy with auto-healing in the case of failure, thus assuring uptime.

Power supply systems can either add or subtract from high availability. Many suppliers have equipped their wiring closet switches with redundant power supply modules which are hot swappable or with field replaceable power supply and fans that do not disrupt power flowing to the switch. Cisco's Catalyst 6500, 4500, 3750-E, 3560-E and Juniper's new EX series of switches are examples of advantaged power supply systems.

Most if not all network managers seek to eliminate spanning tree from their networks as it is a source of troubleshooting difficulties, link downtime and inefficiency. To meet this end some wiring closet switch suppliers such as Cisco's FlexLinks, Nortel's Multi-Link Trunking, Juniper's Redundant Trunk Group (RTG), and ProCurve's switch meshing have implemented technology to decrease convergence time of link failure to the 100 to 50 millisecond range. Some approaches such as Cisco's FlexLinks and Etherchannel support provide load balancing between links too.

High Performance

As an ever-increasing amount of traffic is placed upon the network, performance remains an important differentiator between switches. The ability of this latest generation of switches to handle the load imposed by voice and video traffic in addition to the standard application demands is critical. The best switches can determine the nature of the packets being sent to them and dynamically adapt to ensure that additional latency is not added to communication which is occurring in real time. Wiring closet switches equipped with 24 or 48 10/100/1000 port densities plus dual 10 Gigabit Ethernet uplinks connected via a non-blocking packet switching capacity across all ports and traffic types including unicast and multicast flows define high performance devices.

Reduced / Contained Operational Costs

To reduce the largest and most expensive component of the network edge's TCO, switch features that minimize operational impact should be exploited. Most features which reduce or maintain operational spend are found in network management. Proactive automated management features such as run-time checking the health of switch hardware components and verifying proper operation of systems data and control are built into some switches and reduce operational time spent troubleshooting. Self-provisioning capabilities such as image upgrades and auto configuration install reduce operational spend on switch deployment time; they also enable reduction of switch replacement which increases overall up time. Other bases of competition will contribute to lower operational cost as well, such as high availability, the level of unified communications, security and mobility integration as well as troubleshooting tools and overall network monitoring.

Consistent Network Management

Consistent network management means leveraging the same supplier for the network edge, distribution and core. By standardizing on a supplier a consistent network management environment will be realized with the benefits of either lower operational cost or the ability to increase the level of services to employees with the same operational head count. In addition to switch configuration, troubleshooting and network monitoring, there are vendor specific features, which add value to operational efficiency. Some of these features include the ability to stack wiring closet switches with auto-configuration and auto-upgrade tools such as with Cisco's Catalyst 3750-E and 3750 series and remote traffic mirroring which sends traffic to operational staff's physical locations even if they are in different subnets. Wiring closet switches that deliver real-time diagnostics, which communicate the health of their internal operations are both rare and highly valuable to lowering time spent troubleshooting network and application faults. All of the above are currently unique features of Cisco Catalyst switches. While most suppliers adhere to standardized MIBs and an IT organization can deploy a vendor-independent management layer, it has been our experience that this approach does not deliver the economic and operational efficiency most IT leaders seek. MIBs reflect the most common features/functions supported on switches. As switches have increased in functionality, and deliver more services at the access layer, standards bodies have not reacted quickly enough to adapt the MIB. Therefore, using the MIB as the basis for network management in a multi-vendor network requires IT to utilize the least common denominator of features across vendors.

True Layer 3 Support

To support all the above-mentioned trends and yet unforeseen applications, wiring closet switches are required to support full layer 3 forwarding. This generation of wiring closet switches will support both layer 2 services such as VLANs while replacing RIP with more advanced routing protocols such as EIRGP. Note that static routing is not full layer 3 support and will not deliver the advantages mentioned above. Full layer 3 support contributes to improved network reliability, availability and manageability. Cisco's Catalyst switches and Juniper's new EX series of switches offer full layer 3 and 2 support.

Support of UC, Mobility and Security

This basis of competition is one of the most important attributes to the new network edge. Wiring closet switches need to both support standard interfaces and services for UC, mobility and security so that mixed vendor solutions may occur. There is value and large operational efficiency gained when a single supplier provides UC, mobility and security solutions along with the network infrastructure. The level of integration of these important services into the wiring closet switch is a choice every IT department will make depending upon their constraints, vendor relationships and risk tolerance.

For network security, wiring closet switches are required to enforce post-NAC decisions, that is after an end-point's posture has been assessed. Other key attributes are the support of 802.1x for AAA (authentication, authorization, and accounting) services and identity-based networking. To mitigate man-in-the-middle and Denial of Service (DoS) attacks, DHCP snooping, dynamic ARP inspection, IP source guard and port security are important feature sets. To mitigate disruption of service due to broadcast, multicast and unicast storms, some switches offer storm control.

For mobility, some switch suppliers offer an integrated WLAN controller module, but the most important aspect of unified networking is common network management and PoE to support 802.11a, b, g and now n access points. For unified communications VLANs are important, while PoE is paramount. Some switch suppliers go further by easing IP phone configuration with templates while making the configuration file portable across the network, so that users may plug in their IP phones to different network ports which prompts the wiring closet switch to download its unique configuration file.

The new basis of competition among wiring closet switch suppliers is based upon switch attributes, scale, and features which reduce operational requirements and spend plus possess the ability to not only support but add value to UC, mobility and security. In the next section we review various suppliers.

3.0 Wiring Closet Fixed Switch Vendor Profiles

In this section we profile and review the following fixed switch wiring closet switch suppliers:

1. Cisco Systems 3750-E, 3560-E, and 2960 series
2. ProCurve 3500yl and 2610 series
3. 3Com 5500 Series
4. Nortel 4500 Series
5. Juniper EX 3200 and 4200 series

Each of the five suppliers will be briefly profiled including their associated fixed switch wiring closet product(s) and corporate standing. Included in the analysis is a strength and weakness assessment versus the basis of competition among those listed above. We provide list pricing examples for each supplier, but not detailed common configuration pricing comparisons. We contend that price/port is essentially meaningless in today's competitive fixed switch market as pricing changes often and list price is usually reduced during competitive bidding. Further, the network edge pricing is but one consideration during acquisition and should not be the only or deciding factor in vendor selection.

Cisco Systems

Cisco Systems is the world leader in enterprise networking with over 60% market share in Ethernet switching and 92% percent of the enterprise router market according to data from the NPD Group/Distributor Track for the six-month period ending June 2007. Its Catalyst Ethernet switch product line is the broadest and most widely deployed in the industry. Cisco leverages its market share by gathering customer needs over a broad base to provide end-to-end solutions and to develop new features, packaging options and network services. During the past eighteen months Cisco has been delivering on its Campus Communications Fabric and Empowered Branch initiatives, which included Application Intelligence to maximize user experience, Non-Stop Communications to ensure business continuity, Unified Network Services for wired and wireless LAN integration and Integrated Security to ensure protection, privacy and compliance and network virtualization to improve performance while easing operational requirements.

It recently upgraded its wiring closet fixed switch family to the "E" series of switches, which increased performance, investment protection and added new network services to the network edge. We review Cisco's Catalyst 3750-E and 3560-E services of wiring closet switches.

Related Podcast:

Cisco Redefines Intelligence in Wiring Closet Switches - A Must For UC, Integrated Security and Mobility

Listen to the podcast »

Cisco Catalyst 3750-E Series

The Catalyst 3750-E series of switches stands out as the best-in-class fixed wiring closet 24- and 48-port 10/100/1000 with 10 GbE ready switches on the market today. It combines 1Gb Ethernet with PoE and every switch includes multiple small Form-Factor Pluggable (SFPs) and 10GbE ports for enhanced connectivity. These switches are built with field replaceable power supplies and cooling fans. This family of switches is available with a choice of software packages. The IP Base package provides QoS, rate-limiting and ACLs plus RIP routing. The IP Services package includes advanced hardware-based unicast and multicast routing built on advanced routing protocols, including EIGRP, OPSF and BGP. IPv6 support is also available as a separate add-on software package. Prices range from $10,295 for a 24-port switch with PoE enabled on every port to $20,495 for a 48-port switch with PoE enabled on every port.

Cisco Catalyst 3560-E Series

The Catalyst 3560-E series offers enterprise level performance and a robust feature set, including 10Gbps Ethernet, swappable 1 and 10 GbE components and redundant power supplies on some models and fans, plus high performance optical SFPs. The 3560E-12D offers 12-10 GbE links, which may be equipped with Cisco's TwinGig converter for mixed 1 and 10 GbE requirements. Like the 3750-E series, this line of switches is available with a choice of software packages. The IP Base package provides QoS, rate-limiting and ACLs plus RIP routing. The IP Services package includes advanced hardware-based unicast and multicast routing built on advanced routing protocols, including EIGRP, OPSF and BGP. The Advanced IP Services includes IP Services and enables IPv6 routing functionality. Prices range from $5,995 for a 24-port low-end configuration to $18,990 for the highest end 48-port switch.

Cisco Catalyst 3750-E/3560-E Series Switches Strengths

Future Proofing: The 3750-E/3560-E Series switches are backward compatible with the 3750 and 3560 switches, which also allows integration with ISR 2800 and 3800 for branch office solutions. Catalyst 3750-E StackWise Plus technology provides inter-switch bandwidth of up to 64 Gbps.

Transitioning From 1Gb Ethernet to 10Gbps Ethernet: Cisco's TwinGig converter technology enables netops to transition between two 1GbE or one 10 GbE uplinks, in-service, literally with the snap of a connector.

Power over Ethernet (PoE): The 3750-E/3560-E Series are both available in PoE configurations. In addition to standard 802.3af PoE, these switches support Cisco's enhanced PoE which delivers PoE beyond 15.4W per port to support 802.11n access points (AP) as well as an intelligent dynamic power allocation which distributes the right amount of power required to various end-points rather than deliver 15.4W to every end-point independent of power requirement. These switches support full class 3 802.af PoE on all 48-port configurations without the need for an additional power shelf or injector as is common for most other competitors.

High Reliability and Availability: Cisco supports field replaceable power supplies and fans, which are hot swappable and offer a redundant external power option. Cisco's StackWise Plus technology utilizes a dual rotating ring, which provides redundancy with auto-healing in the case of failure, ensuring uptime. Its FlexLink provides link redundancy and convergence within 100 to 50 ms ensuring that UC connections are not interrupted or fail.

High Performance: The 3750-E/3560-E Series Switches support 128-Gbps switching fabric.

Reduced/Contained Operational Costs: There are a wide range of features built into the 3750-E/3560-E series switches which reduce or maintain operational cost. These include its StackWise/StackWise plus technology which provides auto-configuration, auto-upgrade and failed unit replacement capabilities, all of which lower operational expenses. Also Cisco's General On-line Diagnostics (GOLD) is unique in that it provides run-time checking of hardware components health and verifying proper operation of systems data and control, minimizing troubleshooting time.

Consistent Network Management: The 3750-E/3560-E series switches are equipped with a host of management features; in particular for experts CLI is available for quick and detailed configuration. These switches can also be managed via CiscoWorks LAN Management Solution (LMS) providing a consistent management experience between edge, distribution and core switching.

True Layer 3 Support: There are three software licenses available: IP Base, IP Services, and Advanced IP Services. IP Base enables layer 2 forwarding, IPv6 management, and basic layer 3 routing, including Enhanced Interior Gateway Routing Protocol (EIGRP) stub and Protocol Independent Multicast (PIM) stub mode. IP Services includes IP Base and enables advanced layer 3 routing such as EIGRP, Open Shortest Path First (OSPF), and multicast routing. Advanced IP Services includes IP Services and enables IPv6 routing functionality.

Support of UC, Mobility and Security: The 3750-E/3560-E series switches supports UC and wireless LAN services via QoS, security, PoE, intelligent power management, Smartports technology which stores IP phone configurations via LLDP-MED and/or CDP plus field replaceable power supply and fans. The switches also support Source Specific Multicast (SSM) for one-to-many video communications. There is a wide range of standard and advanced security options including 802.1x for

identity-based networking, NAC enforcement, hardware ACL, DHCP snooping, dynamic ARP inspection (DAI), IP Source Guard (IPSG) and port security to mitigate against man-in-the-middle plus DoS attacks. Storm control is also unique which prevents LAN traffic from being disrupted by broadcast, multicast and unicast storms. Note that the integrated wireless controller is only supported on the 3750G.

Cisco Catalyst 3750-E/3560-E Series Switches Weaknesses

It's hard to find an engineering or product feature weakness in these switches. The biggest Cisco weakness is that it tends to be more expensive than others, which opens the market for competitors. From a product completeness point of view the 3750-E/3560-E series switches are best of class and most feature complete.

ProCurve Networking By HP

ProCurve Networking by HP has been a major Ethernet switch provider since its inception in the mid 1990s. ProCurve is the second largest Ethernet switch manufacturer, larger than Foundry Networks and Extreme Networks combined. Their value proposition is rooted in price advantage, life-time warranty, and financial stability thanks to the HP brand and products that perform as advertised. ProCurve was one of the first switching firms to focus on the edge of the network, providing more value per price/port than others. While ProCurve has filled out its core and distribution switching product line in recent months, it maintains a strong emphasis on what it calls the adaptive or intelligent edge by incorporating security, mobility and convergence features. All of its recent switches are built upon the ProVision ASICs.

ProCurve offers its 3500yl Series of switches and its recently announced 2610 PoE series of switches.

ProCurve 3500yl Series

The ProCurve 3500yl Series is targeted at the upper end of the wiring switch closet. It provides QoS and security features that are scalable yet granular. Layer 3 services are available, though layer 3 routing is available with an additional premium license purchase. As one would expect, ProCurve's layer 3 services are not as deep as Cisco's by a large margin with Cisco offering over 40 more additional layer 3 routing features than ProCurve. The 3500yl is packaged in 24- and 48-port units, are pileable versus stackable and support PoE. There is no separate stacking port for the 3500yl, limiting its scale to the provisioning of Ethernet uplink ports for inter-switch connectivity, which is why we say pileable versus stackable. Redundant power supplies and hot swappable components are available as external options. All ports are 10/100/1000 Mbs while a four-port 10Gbps Ethernet module is available for additional purchase. PoE is included on every port; however the switch can deliver only 398W, which would power 25 class 3 devices in the 48-port configuration. An external PoE power supply is available for additional purchase to provide full 48-port class 3 power. Certain aspects of IPv6 are supported. List prices range from $3,899 for a 24-port switch to $7,119 for a 48-port switch. Note pricing excludes the 4-port 10Gbps Ethernet module.

ProCurve 2610 Series

The ProCurve 2610 Series are 10/100 switches with two mini-GBIC slots for gigabit uplink connectivity plus two additional RJ-45 gigabit uplinks, for a total of four uplink ports that all work simultaneously. The 2610 series are 24- and 48-port fixed switches. The 2610 series is priced aggressively but does not include many of the other switch features reviewed here. ProCurve has hit the mark with this series of switches, as demand is high. 10Gbps Ethernet is not available. PoE is available on three of the five 2610 switches. The management software, ProCurve Manager Plus is included and provides both a command line and web-based interface. IPv6 is not supported. Street prices range from a low end of $450 for a 24-port switch with no PoE and $752 for a 24-port switch with 12 PoE ports to $2,025 for a 48-port switch in which all ports are powered.

We focus the following strength and weakness analysis on the ProCurve 3500yl series. To gain the most compelling features customers are required to purchase its premium license.

ProCurve 3500yl Series Strengths

High Performance: ProCurve reports 3500yl switch fabric speeds between 115 Gbps and 173 Gbps for 24- and 48-port switches respectively. These fabric speeds support full non-blocking 24/48 Gig ports plus up to 2 10G ports at wire speed.

True Layer 3 Support: The 3500yl supports IPv4/IPv6 forwarding plus OSPF, VRRP, PIM (dense and sparse mode) and QnQ with the purchase of an additional premium license. Note that the depth of layer 3 support between suppliers is different.

Reduced/Contained Operational Costs: The 3500yl does provide some proactive automated management features such as run-time checking the health of switch hardware components and verifying that proper operation of systems data and control are built into the switches. The ProVision ASIC in the 3500yl automatically monitors health of switch hardware components in the background, and if there is an anomaly an error message and statistics are logged for the netops. It provides mirroring of selected ingress/egress across subnets and it also provides independent primary and secondary OS files for backup, while upgrading as well as multiple configuration files may be stored in flash image.

Support of UC, Mobility and Security: There are a wide range of security and UC features embedded within the 3500yl. It offers all of the standard security features as well as integration into its identity management, enforcement for its NAC appliance and virus throttling technology. In addition to PoE for UC it also offers Radius VLAN for voice, IP multicast routing and snooping as well as LLDP-MED to ease IP phone configurations. WLAN support in the 3500yl is via PoE for APs.

Consistent Network Management: ProCurve offers its ProCurve Manager Plus with Network Immunity plug-in that provides a toolset to manage internal network threat detection and response which is in essence an Network Behavior Anomaly Detection service for its switches based upon sFlow and Virus Throttle technology. The ProCurve Manager Plus provides configuration, monitoring and management of a ProCurve infrastructure. The combination of ProCurve's Manager Plus with Network Immunity Manager and Identity Driven Manager provide a full tool set for netops to monitor the security of network and troubleshoot faults.

ProCurve 3500yl Series Weaknesses

Future Proofing: The 3500yl offers a range of features within its premium license such as bandwidth shaping, traffic prioritization, IP multicast routing and router redundancy. It also supports LLDP-MED (Media End-point Discovery), which is a standard extension of LLDP that stores values for parameters such as QoS and VLAN to automatically configure network devices such as IP phones. The 3500yl is limited in its aggregate switching performance by inter-switch Ethernet uplink speeds. This lack of stacking feature in the 3500yls may force an upgrade to its 5400zl modular switches as performance requirements grow.

Power over Ethernet (PoE): ProCurve does not offer an interim PoE option in its 3500yl series of switches making the switches unable to deliver power to most 802.11n access points. Nor does it support full class 3 PoE on the 48-port configuration without purchasing a power shelf or injector.

Transitioning From 1Gb Ethernet to 10Gbps Ethernet: The 3500yl provides a max of 4-10GbE uplink port via mini-GBIC module option, but Cisco's TwinGig converter is more flexible and offers the option of either two 1 GbE or one 10 GbE uplinks with a converter change. The 3500yl 10GbE requires a separate module that plugs into the back of the switch.

High Reliability and Availability: While the 3500yl may be provisioned with a single IP address to manage a virtual stack of 16 switches, there is no high speed stacking technology as with Cisco, 3Com, Juniper and Nortel switches. Redundant power is provided via an external device at additional cost. There is no support for hot swappable field-replaceable/upgradeable power supply or fan modules.

3Com

3Com has been a switched LAN supplier since the market was developed in the mid 1990s. It offered the first approach to stacking switches and was a major player in all industry advances. But 3Com lost its way with a large string of mishaps and wrong technology bets. It currently is battling with Bain Capital Partners as Bain ended an agreement with China's biggest network equipment maker, Huawei Technologies, to buy 3Com, citing plans by a United States security panel to block the deal. 3Com's dubious corporate and financial status weighs heavy on the minds of IT leaders as they select vendors. Note that 3Com has had six consecutive quarters of operating profit and in their Q3 2008, generated $44M in cash. However, 3Com is not yet net profitable.

Today, 3Com's strength is outside the U.S. 3Com worldwide is the number two vendor of Ethernet switch ports, thanks in part to its number one position in the China market through its H3C (Huawei/3Com) operation. 3Com has a full range of edge products for SMB and enterprise needs. For enterprises, 3Com offers a "good / better / best" lineup in both Fast Ethernet and Gigabit Ethernet, from the Switch 4210/4200G with layer 2 switching, Switch 4500/4500G with dynamic layer 3, and the Switch 5500/5500G for advanced layer 3, to meet different price/performance requirements. Gigabit switches all have available 10-Gigabit uplinks. 3Com's top Gigabit edge offering is its Switch 5500G line.

We focus on 3Com's 5500G series edge products in this report.

5500G Series

3Com offers five models in their 5500G Series product line ranging from a 48-port switch where all ports support PoE to a 24-port switch with no PoE. 3Com's software sets it apart, offering layers 2-4 QoS on all models and promising "five 9s" network uptime. High-end models support 10Gbps Ethernet and all ports on all models are 1Gb compatible. US list prices range from $4,495 for a 24-port switch without PoE to $9,995 for a 48-port gigabit switch with full PoE. The 3Com Switch 5500G models use a built-in stacking technology 3Com calls eXpandable Resilient Networking (XRN) for simplified management of multiple Switch 5500G units, as well as a more basic clustering approach for single IP management of Switch 5500G with other non-5500G 3Com stackables.

3Com 5500G Series Strengths

High Performance: The 5500G series of switches boasts 107 Gbps to 240 Gbps of packet switching capability based upon configuration. Included in this is built-in unit-to-unit stacking bandwidth of 96 Gbps, based on dual redundant connections running 24 Gbps x 2 for full duplex.

3Com's XRN technology provides for high-resiliency stacking that includes single IP management and cross-stack virtual-chassis capabilities such as distributed link aggregation. Its unique distributed routing feature avoids centralized routing of a traditional master / slave stack, delivering high performance and fast recovery to stack or network issues.

Consistent Network Management: All 3Com Switch 5500G products share the same operating system as its modular switches and routers. This allows netops to manage an entire switching and routing infrastructure from a single CLI or SNMP management platform such as its 3Com Enterprise Management Suite or 3Com Network Director.

3Com 5500G Series Weaknesses

Future Proofing: While 3Com's 5500G series offers performance headroom plus forward and backward migration, it has not provided features such as source specific multicast which anticipate video distribution.

Also 3Com's forward and backward migration strategy is based upon stacking technology while others allow previous investment protection by upgrading a chassis while supporting previous modules. The chassis upgrade option has advantages in some environments as it would allow IT leaders to repurpose a chassis in the event that their fixed switches needed connectivity beyond a fully stacked configuration.

High Reliability and Availability: 3Com clustering allows up to 32 devices to be managed with a single IP address, but there is no redundant master so there is no self-healing if the master fails. Also the 5500G series units do not offer dual power supplies, nor do they offer hot swapping a power supply or field replaceable / hot swappable fans, although 3Com does offer a redundant DC power option.

Power over Ethernet (PoE): 3Com does not offer an extended PoE option in its 5500G series of switches making the switches unable to deliver greater than the IEEE 802.3af standard 15.4 Watts of power as required to run some vendor's 802.11n access points. Nor does it support full class 3 PoE simultaneously across all ports on a 48-port configuration without purchasing a separate redundant power system or DC injector.

Transitioning From 1Gb Ethernet to 10Gbps Ethernet: While 3Com offers an upgrade path from 1 to 10Gbps uplinks it is arguably less elegant when compared to Cisco's TwinGig option. 10GbE requires a separate module that plugs in the back of the switch.

Reduced/Contained Operational Costs: While 3Com has a full range of start-up diagnostics, no proactive automated management features such as run-time checking the health of switch hardware components and verifying proper operation of systems data and control are built into its switches.

Support of UC, Mobility and Security: 3Com does a good job of supporting security in the 5500G series but falls short on UC and mobility. It is able to interact with its IPS (Intrusion Protection System), SMS (Security Management System), EMS (Enterprise Management Suite) and NAC products to enforce quarantine commends. Its UC support is limited to PoE with an 8 queues per port QoS implementation and auto-voice VLAN capabilities. Mobility or WLANs support is limited to PoE as the switches have no native wireless controller capabilities.

True Layer 3 Support: The 5500G supports OSPF, Virtual Router Redundancy Protocol (VRRP) and multicast routing but does not support IPv6 or IPv6 routing protocols such as OSPFv3.

Nortel Networks

Nortel Networks has been a supplier of Ethernet switching since its acquisition of Bay Networks back in the late 1990s. Much like 3Com, Nortel lost its way in enterprise networking by investing heavily in the optical networking boom during the late 1990s which was followed by a harsh bust which forced Nortel to shed some 60,000 employees out of a total of 90,000. Nortel is a $10B concern with 33,000 employees stretched over the service provider, mobile operator and enterprise networks and communications markets. It struggles to prioritize investments across these markets with Enterprise networking representing some 20% of revenues.

For wiring closet switching Nortel offers its 4500 Series of switches.

Ethernet Routing Switch 4500 Series

The Nortel Ethernet Routing Switch (ERS) 4500 Series is a stackable switching product. Nortel's ERS 4500 series offers many options for wire closet switches and is packaged in 24- and 48-port form factors. All devices are equipped with either 2 or 4 SFP ports for optical fiber linkages at gigabit speeds as well as 2 10Gbps ports on the ERS 4526GTX and 4526GTX-PWR. High-end models include PoE, integrated security, advanced QoS and intelligent ports that simplify deployment of IP phone and UC devices. Prices range from $1,455 for a 24-port switch with no PoE to $6,995 for a 50-port switch with 48 1Gb ports and 4 SFP ports and 2 10Gbps, PoE and integrated QoS, security and port intelligence.

Nortel Ethernet Routing Switch 4500 Strengths

High Performance: The 4500 delivers stack performance up to 320 Gbps of switching capacity in an eight-unit stack.

Support of UC, Mobility and Security: Nortel does provide auto-configuration of ports with IP phones, QoS and PoE for UC deployments. Its security features are standard DHCP snooping, ARP Inspection and BPDU filtering. The ERS 4500 contributes to end-user device posture assessment, quarantine and remediation through the use of Nortel Secure Network Access. Its mobility support is limited to PoE.

Nortel Ethernet Routing Switch 4500 Weaknesses

Future Proofing: Nortel has not invested in features such as source specific multicast, which anticipates video distribution. Also Nortel's forward and backward migration strategy is based upon stacking technology while others allow previous investment protection by upgrading chassis which support previously purchased modules. This is an advantage for those corporations who have invested in both fixed configuration and chassis-based Ethernet switches allowing chassis to replace fixed switches as needs grow.

Transitioning From 1Gb Ethernet to 10Gbps Ethernet: 10 Gbps is not offered in the ERS 4500 Switch series.

Power over Ethernet (PoE): Nortel does not offer a pre-standard extended PoE option in its ERS 4500 ERS series of switches making the switches unable to deliver power to most 802.11n access points. Nor does it support full class 3 PoE on the 48-port configuration without purchasing a power shelf or injector. Nortel argues that this PoE approach allow IT departments who use the ERS 4500 to deploy a more cost effective solution as there is no embedded cost to the customer who might never need to support full class 3 PoE ports.

High Reliability and Availability: The ERS 4500 series does not offer field replaceable hot swappable power supplies or fans; however redundant power is supported. Nortel offers its HiStack stacking technology allowing eight units to be stacked with resilient stacking in the event of a unit failure; however, all desktop connectivity for end-points connected to the failed unit is disrupted. Other schemes offer connectivity for the failed unit if the stacking model is at fault.

Reduced/Contained Operational Costs: No proactive automated management features such as run-time checking the health of switch hardware components and verifying proper operation of systems data and control are built into its switches. Nortel does provide its Auto Unit Replacement features which provide automatic configuration upgrade and automatic software image upgrade.

True Layer 3 Support: There is no layer 3 support in the ERS 4500 series of switches; however Nortel plans to incorporate layer 3 support in a future release.

Consistent Network Management: All Nortel ERS 4500 switch products share the same operating system; however they are not managed by Nortel's Enterprise Switch Manager, creating a discontinuity in managing edge, distribution, core and WLAN networks. The Nortel 4500 series lacks true stack management features such as auto-upgrade and auto-configuration.

Juniper Networks

In late January 2008, Juniper Networks launched a series of Ethernet switches. While it is too early to assess their success, as Juniper has no market share and limited customers providing testimonials, we include them here as they do represent an option to IT leaders who seek to build a new network edge. Juniper's challenges in LAN switching are that its switches do not possess advantages or the feature depth over incumbents nor does it have a direct channel to the enterprise market for sales and support.

For edge products Juniper offers its EX-3200 and EX-4200 series of switches.

EX 3200 series

The EX3200 Series offers many of the same features as the EX-4200 series of switches and attempts to make minimal compromises for the sake of affordability. 1GbE and 10GbE uplink ports are included in limited numbers for connections to distribution or core level switches. Note that Juniper's core switch, which promises to be a competitive enterprise core switch, will not be available until year-end 2008. For aggregation requirements, Juniper recommends the EX 4200-24F which is a 24 port all fiber 1GbE switch that is available now. PoE is available on a subset or all ports. The power supply and fan is field replaceable. Juniper claims to support a redundancy option via an external power supply which is not yet available. These switches include the same JUNOS software package as the EX4200 series, and include layer 3 in the base license. There is also integration with Juniper's Unified Access Control solution through 802.1X. The EX3200 Series are pileable versus stackable switches. Prices are on the high side with a range from $4,000 for a 24-port switch with PoE available on 8 ports to $8,800 for a 48-port switch with PoE included on all ports. Note that uplinks pricing is not included and would be an additional charge.

EX 4200 series

This series of switches seeks to be competitive with the high-end offerings of Cisco, ProCurve, et al. The EX 4200 switches feature PoE on every port and a full suite of layer 2 and layer 3 capabilities as part of the included software. 10GbE ports are included for connection to distribution or core layer switches. Hot swappable redundant power supplies and fans are included on all models to minimize mean time to repair. JUNOS software is included on all models and is designed to work seamlessly with other Juniper network infrastructure products deployed throughout the enterprise. QoS and DHCP snooping are built into this software to ensure performance and security. Just like the EX 3200, the EX 4200 offers integration with Juniper's Unified Access Control solution through 802.1X. Prices range from $6,000 for a 24-port switch with PoE available on only 8 ports to $12,400 for a 48-port model with full PoE capabilities.

Juniper Networks EX series Strengths

High Performance: Juniper's EX-series of switches boast high performance packet switching capabilities in the 88 Gbps to 136 Gbps range, the highest in the industry.

High Reliability and Availability: Juniper supports field replaceable power supplies and fans, which are hot swappable and offer a redundant external power option which is not yet available. While Juniper does offer a stacking option called virtual chassis it is unclear as to the stacking technology deployed and its ability to self heal.

True Layer 3 Support: Its LAN switches borrow layer 3 forwarding software from its JUNOS routing software, which was designed for service provider environments, but needs to be proven to support Enterprise requirements.

Juniper Networks EX series Weaknesses

Future Proofing: As the Juniper EX-series of switches do not offer a forward or backward migration strategy they fall short on this topic. Installations would either be a displacement of an incumbent or a new deployment. In the case of the former, Juniper's success hinges upon who they are displacing as many switch providers offer upgrade paths. In addition the Juniper EX series lacks complete multicast support, which is critical for video and financial services applications, et al. The EX series only supports IGMP.

Transitioning from 1G to 10Gbps: While Juniper offers an upgrade path from 1GbE to 10GbE uplinks, it is cumbersome when compared to Cisco's TwinGig option. 10GbE requires a separate module.

Reduced/Contained Operational Cost: No proactive automated management features such as run-time checking the health of switch hardware components and verifying proper operation of systems data and control are built into its switches ASIC and firmware. Juniper does claim that JUNOS checks for hardware faults and monitors software modules, which can independently restart any module, should a failure occur. Juniper argues that the biggest operational cost savings comes from the fact that the EX series switches run the same software as Juniper routers, reducing the cost burden of maintaining multiple releases.

Power over Ethernet: These switches support PoE 802.3af either on the first eight ports or throughout all ports. There is no support of PoE greater than 15.4W per port, limiting its support of 802.11n access ports, which typically require more than the 15.4W offered in 802.3af implementations.

Support of UC, Mobility and Security: Juniper's EX series offer PoE as its basis for UC and mobility support. It does a much better job at security by offering an extensive set of security features.

Layer 2 Support: Given that JUNOS software was designed for service providers, its layer 2 feature set is basic and incomplete for enterprise deployments.

Consistent Network Management: Juniper provides the Network and Security Manager application to manager switches, routers, and security devices from a single console. While the CLI commands in JUNOS are the same in switches and routers, they differ greatly compared with others in the industry, thus requiring additional extensive IT staff training.

3.1 Cross Vendor Comparison based on Basis of Competition

The following table compares the various vendors based upon the basis of competition. All vendors offer high-speed solutions with plenty of security features while nearly all offer layer 3 services. Differentiation is found in all other next generation wiring closet fixed switch attributes including future proofing, intelligent PoE implementations, transition from 1 and 10 GbE strategies and availability, operational cost containment, high reliability and availability plus consistent management between edge, distribution and core switching. The level of UC, mobility and security integration also differs among suppliers.

Basis Of Comparison	Cisco	HP	3Com	Nortel	Juniper[1]
Future Proofing	+	+/-	-	-	-
Transition From 1Gb to 10Gbps	+	-/+	-/+	-	-/+
PoE	+	-/+	-/+	-/+	+/-
> 15.4W/port PoE	+	-	-	-	-
Reliability / Availability	+	-/+	-	-	-/+
Performance	+/-	-/+	+/-	+/-	+/-
Operational Cost Controls	+	-/+	-	-/+	-
Consistent Management	+	+/-	+/-	-	-
Layer 3 Support	+	-/+	-/+	-	-/+
UC support	+/-	+/-	-	+/-	-
Mobility support	+/-	-/+	-/+	-/+	-
Security support	+	-/+	+/-	+/-	-/+

+ indicates an advantage; - indicates a disadvantage;

+/- indicates attribute offered at no advantage or disadvantage; -/+ indicates attribute offered at disadvantage

[1] As Juniper's new LAN switches are not proven in the market, its entries are anticipated and may very well be over or under estimated.

From the above it's clear that the largest number of advantages go to Cisco's Catalyst 3750-E/3560-E Series Switches, followed by HP ProCurve's 3500yl, then to 3Com's 5500G Series of Switches with Nortel's ERS 4500 Series and Juniper's EX series trailing behind. It is not too surprising to find that Juniper is far behind its competitors as it recently entered the market competing against firms with over twelve years of market experience. In terms of the new basis of competition Cisco and ProCurve are best positioned with Cisco's 3750-E/3560-E Series Switches demonstrating considerable advantages.

4.0 Industry Recommendations

The choice of wiring closet switches depends upon the current and projected needs of the organization, incumbent suppliers and budget availability. It is important to consider TCO during vendor and switch selection. Items which tend to increase operational cost, the largest TCO cost component in the network edge, are: hardware diversity, configuration and support complexity, security and regulatory demands, conflicting performance criteria, higher costs for incremental services, higher recurring expenses, minimal opportunities for automation, multiple maintenance contracts, minimal synergies between applications, lack of business agility and high upgrade costs.

When selecting suppliers it's important to verify the exact meaning of feature attributes when comparing switching solutions. For example, "stackability" is a desirable feature in many switches at this level and each vendor may define this feature differently. Some will use terms such as stackabiity when their switches are pileable which reduces performance, reliability and availability. Further care should be applied to PoE, in particular to terms such as "all ports support PoE". IT buyers should look at the total power available to be distributed to ensure that all ports can be powered with 15.4W for class 3 devices. Layer 3 support is another attribute which suppliers claim but all offer different levels of support. For example, Cisco offers a deeper level of layer 3 support than all others.

When choosing between the many options for wiring closet switches available on the market today, a number of factors should be considered. These factors can be grouped into four broad categories, each of which can then be further broken down into sub-factors presented in the framework below:

Factors to Consider When Selecting a Wiring Closet Switch

Organizational Costs: Remember that initial acquisition cost is typically 20% of TCO while operational spend consumes approximately 80% of cost over a 3 year period. If TCO reduction is important to your organization look to standardize on suppliers and place a large weight on operational cost reduction attributes identified above.

Current Organization Requirements: Monitor and when possible model network edge performance, traffic flows and bandwidth requirements. In short, IT leaders need to make a judgment on how important network uptime, applications and workflow are to their organization for the network edge. Are real-time applications such as UC, click-to-conference, Web 2.0, and Telepresense supported in the IT application infrastructure, on top of existing office productivity and workflow applications, etc? If so then attributes of redundant power supplies, hot swappable components, layer 3 support, high reliability and availability are important in the vendor selection process. If security and vulnerability reduction is important due to regularity conformance and/or executive mandate then strong integrated management and security tools are required, such as network access control and threat mitigation options as outlined in section 2.1.

Future Organizational Needs: It's always easier to gather current organizational requirements than to anticipate future demands. Here industry initiatives are usually helpful in charting future and unexpected requirements. For example, the IT industry is shifting toward Web 2.0-based application delivery which includes locally generated real-time media such as podcast, blogs, vidcast, etc. Real-time communication such as UC, Telepresence, click-to-conference and IP video are entering a business cycle where massive consumption and deployment will occur due to strong industry and cultural trends. Some of the network edge suppliers profiled above have anticipated these demands and build attributes into their fixed switches to enable their deployment without the need for new equipment. Some of these attributes include upgradability via new software versions instead of new hardware, easy and low cost transitions from 1Gb to 10Gbps, PoE with flexibility to support 802.11n and efficient power distribution, WLAN integration, unified communications and video distribution support.

Incumbents: Another important factor when selecting a wiring closet switch is the status of existing network suppliers which the organization already supports. In short, many network operations personnel will need compelling reasons to switch away from incumbent vendors. Not supporting the above outlined new basis of competition is a strong compelling reason. Most IT organizations will seek to leverage skill sets and experience currently present within the organization. Another factor, often not discussed but very much prevalent in the vendor selection process is maintaining the largest career opportunities available which is usually equated to gaining experience with the vendor who possesses the largest market share, affording these executives a wide range of future employment options. Incumbent inertia is gained by IT management's resistance to an increase in operational and training cost if additional personnel must be hired to support new wiring closet switch suppliers.

Organizations must determine the proper value to place on each of these factors when making a purchasing decision regarding a wiring closet switch. Obviously, different organizations will have different needs both now and going forward and not every factor should bear equal weight for each organization. In fact, we recommend that weights be placed on the basis of comparison attributes that reflect organization needs. Then IT leaders may assign a number to the "+", "-", +/-", -/+" such as 4, 3, 2, 1 respectively for each supplier's entry into the basis of comparison matrix. Once this is completed IT leaders can cross multiply the rows and numbers which will identify the importance of the attribute to the organization and the ability of the vendors to support this requirement. By adding the columns the IT leader will gain a numeric fit of the supplier to their organization. The larger the number the better the supplier fit. In addition to the above, and to assist organizations in making their decisions, below we offer Lippis Consulting's top five recommendations for these types of purchasing decisions:

1. Think of Wiring Closet Switches As Strategic IT Assets

Wiring closet switches are strategic IT assets, which enable a host of new applications and communication options. No longer do these devices simply offer a connectivity service, but rather a wide range of network services that enable mobility, unified communications and provide internal threat defense.

2. Consolidate Wiring Closet Devices To A Single Supplier Who Meets The Basis Of Competition

Wiring closet switches are no longer commodity items purchased based upon lowest cost. It is recommended that IT organizations consolidate their wiring closet switch purchases to a single supplier to increase operational expense efficiency by providing consistency in the network edge.

3. Only Procure PoE Wiring Closet Switches as Most Networking Devices Will Require Network-Based Power

It is inevitable that WLANs and UC, both of which require PoE, will be pervasively deployed. Also there is a plethora of new devices which derive their power from PoE, such as security surveillance, point of sale devices, health care instrumentation, in the near future laptops and many other devices. IT organizations should consider replacing their wiring closet switches with PoE supported wiring closet switches pervasively throughout their organization.

4. Consider Supplier Consistencies Between Wiring Closet, Aggregation And Core To Streamline Operational Expense

Significant synergies can be achieved by selecting a single vendor to provide switching capabilities across wiring closet, distribution and the network core. Operational expense can be contained and minimized, as fewer personnel are required to support a single vendor solution versus multiple platforms. Expertise in a single vendor's products can then be developed reducing troubleshoot time, increasing availability and network reliability all at a lower TCO. Every switch supplier has a broad portfolio of products that span edge, distribution and core, be it Cisco, Nortel, Juniper, 3Com, ProCurve, or Extreme and Foundry who are not covered in this report.

5. Consider the Basis Of Competition As Required Features To Support Both Existing & Unforeseen Future Applications

The basis of competition described above provides a useful guide to the new features available in wiring closet switches. For most organizations looking to purchase new switching hardware, it makes sense to consider these features as required since buying hardware that lacks these attributes has the potential to severely limit the organization's capabilities going forward. The needs of business are constantly changing with unforeseen new applications; IT organizations need to have a network to support the future. As a result, selecting a switch that does not support advanced features like PoE or 10Gbps Ethernet will significantly increase total ownership cost as these switches will more than likely have to be replaced in the near term.

About Nick Lippis

Nicholas J. Lippis III is a world-renowned authority on advanced IP networks, communications and their benefits to business objectives. He is the publisher of the Lippis Report, a resource for network and IT business decision leaders to which over 40,000 business and IT executive leaders subscribe. Its Lippis Report podcasts have been downloaded over 35,000 times; i-Tunes reports that listeners also download the Wall Street Journal's Money Matters, Business Week's Climbing the Ladder, The Economist and The Harvard Business Review's IdeaCast. Mr. Lippis is currently working with clients to transform their converged networks into a business platform.

He has advised numerous Global 2000 firms on network architecture, design, implementation, vendor selection and budgeting, with clients including Barclays Bank, Microsoft, Kaiser Permanente, Sprint, Worldcom, Cigitel, Cisco Systems, Nortel Networks, Lucent Technologies, 3Com, Avaya, Eastman Kodak Company, Federal Deposit Insurance Corporation (FDIC), Hughes Aerospace, Liberty Mutual, Schering-Plough, Camp Dresser McKee and many others. He works exclusively with CIOs and their direct reports. Mr. Lippis possesses a unique perspective of market forces and trends occurring within the computer networking industry derived from his experience with both supply and demand side clients.

He has advised numerous Global 2000 firms on network architecture, design, implementation, vendor selection and budgeting, with clients including Barclays Bank, Microsoft, Kaiser Permanente, Sprint, Worldcom, Cigitel, Cisco Systems, Nortel Networks, Lucent Technologies, 3Com, Avaya, Eastman Kodak Company, Federal Deposit Insurance Corporation (FDIC), Hughes Aerospace, Liberty Mutual, Schering-Plough, Camp Dresser McKee and many others. He works exclusively with CIOs and their direct reports. Mr. Lippis possesses a unique perspective of market forces and trends occurring within the computer networking industry derived from his experience with both supply and demand side clients.

He has advised numerous Global 2000 firms on network architecture, design, implementation, vendor selection and budgeting, with clients including Barclays Bank, Microsoft, Kaiser Permanente, Sprint, Worldcom, Cigitel, Cisco Systems, Nortel Networks, Lucent Technologies, 3Com, Avaya, Eastman Kodak Company, Federal Deposit Insurance Corporation (FDIC), Hughes Aerospace, Liberty Mutual, Schering-Plough, Camp Dresser McKee and many others. He works exclusively with CIOs and their direct reports. Mr. Lippis possesses a unique perspective of market forces and trends occurring within the computer networking industry derived from his experience with both supply and demand side clients.

He has advised numerous Global 2000 firms on network architecture, design, implementation, vendor selection and budgeting, with clients including Barclays Bank, Microsoft, Kaiser Permanente, Sprint, Worldcom, Cigitel, Cisco Systems, Nortel Networks, Lucent Technologies, 3Com, Avaya, Eastman Kodak Company, Federal Deposit Insurance Corporation (FDIC), Hughes Aerospace, Liberty Mutual, Schering-Plough, Camp Dresser McKee and many others. He works exclusively with CIOs and their direct reports. Mr. Lippis possesses a unique perspective of market forces and trends occurring within the computer networking industry derived from his experience with both supply and demand side clients.