November 4, 2010 | Updated: November 12, 2010

Q&A: Networking Landscape, Q4 2010

Collapsed Tiers, Converged Infrastructure, And Virtualization Are Turning Networking On Its Head

by Andre Kindness
with Lauren E. Nelson and Robert Whiteley

EXECUTIVE SUMMARY

Landing on the moon or the Jonas Brothers' debut doesn't hold a candle to the awesome state of today's networking landscape. Customers couldn't be in a better position to have true networking choices. Hewlett-Packard acquired 3Com, Brocade spiced up Foundry with its Brocade One initiative, and Juniper entered the high-end switch market with a bang. Meanwhile, Cisco Systems has left the gate with its Nexus and UCS solutions. Regardless of the platform, we believe Ethernet is the future of all data center networking, especially as solutions emerge that bridge the gap from high-performance options like InfiniBand and Fibre Channel (FC) — which will be around for a long time. So what's next? Infrastructure managers should: 1) leave behind the traditional three-tiered data center and move toward the promised land of a two-tiered LAN architecture; 2) make the change to a converged Ethernet slowly with FCoE and avoid major overhauls until SANs are phased out in 10 years; and 3) save money on data center networking by evaluating all vendors and being open to a multivendor network.

QUESTIONS

1. Which vendors should I consider for my data center LAN and why?

2. Should we collapse our three-tier architecture to one tier?

3. What is the impact of server virtualization on data center switch architecture?

4. Should we start to invest in Fibre Channel over Ethernet (FCoE) equipment?

5. Is it sensible to introduce a second vendor into the LAN infrastructure?

6. Which vendor has the best green credentials?

SINGLE-TIER DATA CENTER SWITCHES ARE THE FUTURE — THE ONLY QUESTION IS WHEN

IT infrastructure and operations (I&O) spending is starting to grow again. Currently, networking consumes 14% of the enterprise infrastructure budget, but 30% of enterprises indicate they will grow their network budget heading into 2011.[1] And the network is front and center as organizations return to their previous roots of consolidating and virtualizing to reduce the footprint of hardware and wasteful operations that were thrown at issues over the past 15 years. So it's no surprise that Forrester has experienced a steady increase from I&O managers inquiring about the future of data center networks and lessons learned from early adopters. What are we hearing?

"Our core data center switches will need to be replaced over the next 12 months. We are looking at the market for 10 gigabit Ethernet (10 GbE) switches, and would like some help in understanding how the market is changing." (I&O director, US-based enterprise)

"We have a large installed base of Fibre Channel SANs. Should we start to invest in FCoE equipment? Have all the relevant standards been ratified? If not, what are the risks if we install prestandard systems now?" (VP operations, UK-based financial services company)

These types of inquiries suggest that many enterprises are confused by:

- **The effects of virtualization, consolidation, and convergence on your data center network.** We believe that Ethernet will become a single, unified interconnected fabric for the data center due to its ubiquity, familiarity, cost, and speed advances. Although Ethernet-based storage is the likely future, the global slowdown has cut IT budgets substantially, and many users have major investments in existing FC SANs.[2]

- **How quickly you can move to new versions of Ethernet.** You'll need a strategy to upgrade your data center network infrastructure during the current economic climate and determine whether an evolutionary approach is possible. Tight IT budgets also mean you'll need to explore multiple network options for different speed and traffic requirements to ensure that you're spending the minimum amount needed without going down dead-end paths.

- **Vendor viability moving forward.** Choosing a strategic vendor for data center switching is a major decision that will affect performance and operations for the next five years or more. However, there are significant savings to be made by adopting the latest technology from the challengers in the market — both in the acquisition of equipment and, increasingly, data center operations.

Forrester recommends that you not make vendor and product decisions for either greenfield data centers or for upgrades without a full technical and commercial evaluation of the alternative vendors and their product ranges. We've compiled some of our more frequently asked questions below to provide you with insight into the key decisions you will need to make when embarking on a new implementation or an upgrade to an existing switch infrastructure.

1. Which vendors should I consider for my data center LAN and why?

Cisco Systems dominates the data center LAN market. Estimates vary, but it probably has about three-quarters of the market in North America and Europe, way ahead of the other data center contenders of HP Networking (ProCurve/3Com), Juniper, and Brocade. Even though others players — like Force10, Extreme, Avaya, Alcatel — are attacking the data center market, we see HP, Brocade, Cisco, and Juniper as farthest ahead in their vision, resources, and product depth/maturity. As a result, you should consider four vendors:

- **Cisco, if you're revamping and virtualizing your data center in the next six to 12 months.**
  To Cisco's credit, it saw the data center evolution way before any other networking vendor and
  started to build a set of products and solutions directed at a converged and virtual world. With
  a series of launches over this past year, it offers the largest collection of tools, services, and
  support to enable a networking platform to support virtualization and convergence. It's difficult
  to foresee any solution coming out within the year that will be on par with flattening the
  network, having policies automatically follow a virtual machine, or working with legacy servers
  and storage. Only consider Cisco's Nexus line for the data center.

- **Brocade, if you're looking for storage pedigreed vendor and can help with your convergence.**
  Second to Cisco, Brocade offers one of the broadest and most tested sets of networking solutions
  and management applications for local-, metro-, and wide-area networks (LANs/MANs/WANs),
  as well as storage-area networks (SANs). Most of its traditional business focused on providing
  ports for data center SANs, but Brocade purchased Foundry, which opened the door to the rest
  of the network and positions it well for supplying converged networks. Foundry has a very loyal
  and sophisticated set of high-computing customers. Even though it took Brocade two years
  to launch Brocade One, its vision and strategy for a next-generation network, the company
  is rolling out converged hardware and a converged management platform for LAN and SAN
  that can integrate into larger IT management solutions, a missing component in other vendors'
  portfolios. Brocade is proving its ability to execute by creating an end-to-end solution so quickly
  after announcing Brocade's One networking vision in June of 2010.

- **HP, if you're heavily invested in HP BladeSystem Matrix.** Until recently, HP's commitment
  to networking was half-hearted — it was a leading reseller of Cisco switches and disregarded
  its homegrown line, ProCurve. That has now all changed, with its networking division placed
  firmly in the center of HP's enterprise servers and storage, along with its acquisition of
  3Com; 3Com has been winning a major share of the data center LAN switch business in Asia,
  especially in China.[3] 3Com's core products combined with Intelligent Resilient Framework (IRF)
  technology from H3C, Matrix, and HP's FlexFabric create a solid data center solution. HP has
  been consolidating its 64 data centers down to four and refreshing them with ProCurve and
  H3C products. Moreover, its networking solutions are backed by the strength of the global HP
  brand in servers, storage, and systems integration.[4] Perhaps most impressive, though, is that HP
  gets access to more than 2,000 software engineers in China to help accelerate integration with
  more innovative data center solutions like HP's Matrix.[5]

- **Juniper, if you need a lower-cost clustering technology to support VM portability.** Juniper
  has a very strong business in telecom carrier network routers, a market where it competes with
  Cisco on a level basis. Many leading carriers have chosen Juniper as their sole supplier. Using
  this business as a springboard, Juniper is now contending for the data center LAN switch
  market, and it has won a few significant logos like NYSE Euronext to prove that it's a serious

contender.[6] It uses a single operating system, Junos, across its entire switching, routing, and security range, which enables it to use a single management platform to simplify network management and reduce support costs. Juniper has been very successful at building network gear to aid machine portability. It has architected its switches for convergence using virtual chassis and MPLS technologies to extend Layer 2 capabilities across physically separate data centers, thus enabling vMotion across sites. Juniper plans to extend this vision and build a converged fabric — codenamed Stratus — but very few details have been released to date.

2. Should we collapse our three-tier architecture to one tier?

It has been the conventional wisdom for many years to split data networks into three layers: core, distribution (or aggregation), and access (see Figure 1). The stated aim of this approach was to maximize scalability, management, performance, and control while trying to minimize cost. But benefits were quickly eroded by the limitations of the switch bandwidth and Layer 2 redundancy issues. As a result, core routers were needed for high-speed and low-latency transport; policy enforcement was carried out in the distribution layer; and the access layer was essentially a collision domain. Network architects had to build increasingly complex Layer 3 and Layer 4 architectures, resulting in high end-to-end latency and forcing the implementation of specialized, parallel Fibre Channel networks for latency-sensitive storage.

Figure 1 Network Topologies

Tree hierarchal   Distributed
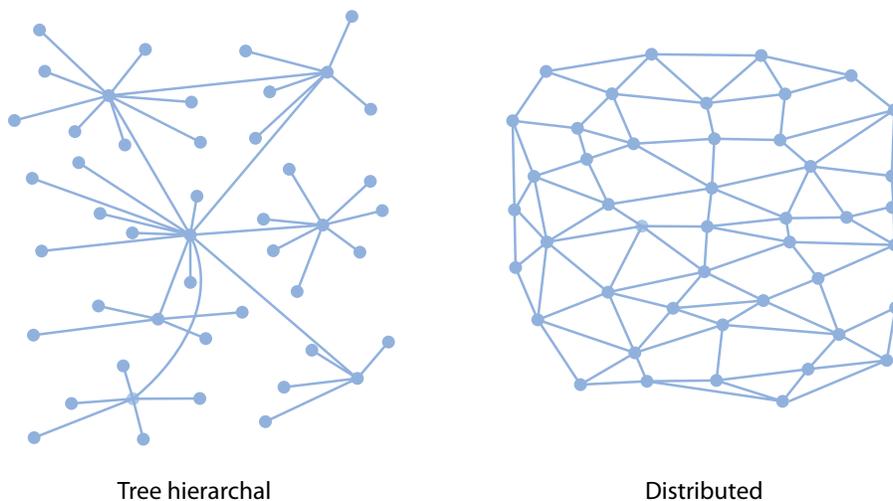
48404   Source: Forrester Research, Inc.

Fast forward to today where the goal is to build a single, flat network. Why? Because:

- **New virtual infrastructure and storage loads require higher performance.** Enterprises will need to flatten their networks for virtual machines (VMs) fluidity across the data center network. There will also be more bandwidth and less latency for intensive applications like real-time communications and transportation of Fibre Channel over Ethernet (FCoE) and iSCSI.

- **Converged fabrics consolidate redundant operations and hardware.** The data center of the future will require an extremely high-performance, lossless, nonblocking, low-latency switch if the infrastructure is to be serviced by one protocol: Ethernet. Architecturally, the major vendors all share the same vision — not just of a single-tier architecture but of all the data center switching equipment acting as a matrix of switches, dramatically reducing the latency across the network by eliminating Layer 3 protocols and inefficient links found in spanning tree protocol.

The end result is a less complex topology, which has lower latency and is easier to manage. To enable this to happen, a band of companies are working together in the IEEE on 802.1aq — referred to as Data Center Bridging (DCB) — to do this in a standards-based way. IETF is also coming up with a very similar method, called transparent interconnection of lots of links (TRILL).

Most vendors support a proprietary implementation of this design. Juniper has its virtual chasing clustering technology, Cisco has VPC, HP has IRF, and Brocade has Virtual Cluster Switching (VCS). Each vendor's pseudo-DCB and TRILL technology is limited to a few choices in hardware and, typically, doesn't allow intermixing among switch series. Implementations are often restrictive. We recommend that you adopt a one-tier structure when vendors start supporting TRILL or 802.1aq.

3. What is the impact of server virtualization on data center switch architecture?

Virtualization is the driver behind the evolution of data center networking. It will result in three major impacts on your switch architecture. Virtualization:

- **Causes increased network utilization.** In a traditional siloed data center, the utilization of servers and storage is typically no better than 20%. Virtualization of servers and storage solves this, reducing both the cost of the electronics and the amount of raised floor space, power, and air conditioning. For the network, however, a fully virtualized data center represents a big challenge. Instead of most traffic staying local, with an area of the data center associated with each application, putting both compute and storage resources in large pools means that traffic is completely random; this means that the same performance is required from the network whether a server is accessing storage near to it or at the far end of the data center, perhaps on a different floor or in a different building altogether. Additionally, the utilization of the network ports on each server increases in line with the utilization of the server.

- **Creates a "virtual air gap" between your physical and virtual network.** Each physical server will host multiple virtual machines with multiple virtual network addresses. This results in a new network layer emerging with inter- and intra-VM connectivity. VM mobility, scalability, security, and resiliency are important factors in the virtualized and physical worlds. VMs can freely migrate between hosts or be partitioned on the same or different hosts. Data centers can host hundreds of instances. Nothing prevents VMs from talking to each other on the same host, yet there is no visibility of these VMs as they share information from different hosts. Ultimately, this virtualized world doesn't line up to the physical world and drives an I/O disconnect.

- **Requires a new set of software interfaces to extend network capabilities.** Network traffic in a virtualized data center needs to have the same capabilities in the virtual world, including quality of service (QoS), rate limits, continuous data protection, port analyzers, access control lists, port-level security, and port channels. Policies should automatically follow the VM as it is moved around. If you're implementing today, we recommend leveraging networking vendors that have software to interface with the default virtual switch, or the networking vendor provides their own virtual switch like Cisco's 1000v. For deployments that can wait till next year, the DCB specification will put the finishing touches on Virtual Ethernet Port Aggregator (VEPA) — an open standard resolving issues with network visibility, end-to-end policy enforcement, and management scalability at the virtualized server-to-network edge. More tools and options will be created for automation and control in the network outside the proprietary ones being sold today.

4. Should we start to invest in Fibre Channel over Ethernet (FCoE) equipment?

FC was designed to solve Ethernet design issues that were not compatible with the high-speed transfer of large blocks of data. Traditional Ethernet is based on the concept of packets colliding and being re-sent, which can cause performance problems with time-sensitive traffic. As described above, organizations strive to unify multiple transport protocols over the same media. FC requires very low-latency and large-block connections. As a result, there are two things I&O managers need to know:

- **There's an emerging "standards" war . . .** The need for low-latency and large-block connections is the driver behind the emerging converged enhanced Ethernet (CEE). Note that this is more or less the same as the IEEE's DCB and Cisco's push for data center Ethernet (DCE) standards.[7] While lossless Ethernet itself is not a standard, many of the underlying elements, such as priority-based flow control, enhanced transmission selection, and congestion notification, are. The major vendors have not yet announced release dates for their CEE-compatible switches, but we expect them to be shipping product in 2011. The next generation of Ethernet switches will employ a set of standards for converged Ethernet. These new switches implement a number of standards that will deliver lossless Ethernet. In the longer term we expect FC SANs to be superseded by network-attached storage (NAS) using standards like iSCSI, as well as more directly attached storage. In fact, we think that in the next 10 years certain workload mixes may not require you to have a SAN at all.[8]

- **. . . but you should hold off investments until a winner emerges.** However, many organizations have invested heavily in FC SANs, and this expensive storage will be used for the rest of its economic life. In the medium term, standards like CEE allow FC to be encapsulated within Ethernet frames, using a standard called FCoE. This eliminates the need for duplicate LAN and SAN switches and is a great way to cut costs when upgrading or building a new LAN infrastructure. Even though Cisco, Brocade, and 3Com (H3C) are shipping FCoE interface cards now for use with their 10 GbE top-end switches, Forrester recommends that customers wait till standards are ratified and the products are shipping with conformity. This will ensure you aren't charged for software upgrades or forced to change out hardware.

5. Is it sensible to introduce a second vendor into the LAN infrastructure?

Directors and C-level executives often ask us about the financial benefits and operational risks of introducing a second vendor into their LAN environments. Fear and uncertainty force pushback from network administrators who were born and raised on a particular vendor. Everything from poor feature sets to the high cost of retraining is thrown at anyone looking to bring in another vendor. Most of these are Cisco shops looking for ways to reduce costs.

Forrester recommends decoupling the data center network from the core/distribution and access switching outside the data center. In lieu of single-sourcing the entire network, consider adding a second vendor by taking a traditional multivendor approach, using one vendor for the networking foundation for the data center and, potentially, another networking vendor for access and distribution/core outside the data center. This ensures there are not more than two networking vendors within the entire networking infrastructure — otherwise, any cost savings of having a multivendor environment could be diluted by inefficiencies of adding three or more vendors to the network (see Figure 2).

Figure 2 Dual-Vendor Network
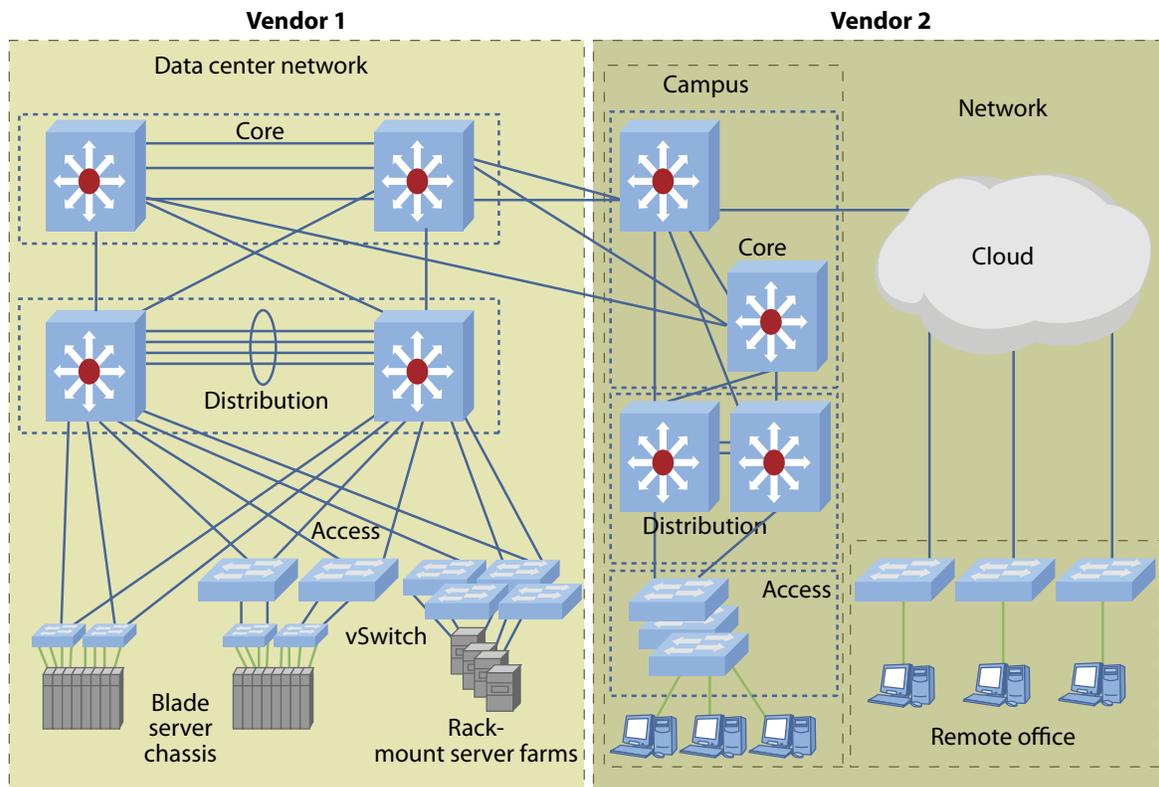
48404   Source: Forrester Research, Inc.

Whether two different vendors are introduced into the networking fabric is dependent on the vendors' abilities to meet your business needs. It's ultimately in the best interest of the organization to do its due diligence. Forrester believes IT needs to examine all the options for its customers and business, and that's because:

- **The financial benefits can be considerable.** First, competing vendors' switch equipment can be considerably cheaper to buy and run. HP's switches are 30% less costly than Cisco's, and apart from lower acquisition costs, its lifetime warranty promises significantly lower support costs. Second, having two vendors introduces a competitive situation into the purchase of equipment. Knowing you have a choice will sharpen your suppliers' pencils when responding to your tender request.

- **The operational risks are minimal.** An amazing number of networks have been bound by proprietary protocols. At one time or another most of them were very useful and provided solutions, such as increased throughput from trunking, automatic setup and discovery, and load-balancing of underutilized links. However, the standards bodies have caught up, and networks can be standardized. There's no better catalyst to moving from restrictive architecture to open-based platform than introduction of a second networking vendor. This provides the greatest flexibility and choice for network improvements and future deployment of advance services and applications. More importantly, you'll dramatically decrease the amount of science projects and specialized personnel — thus increasing the overall efficiencies within the organization.

- **Initial "switching" costs are dissipating.** Initially, there are some additional costs — in particular, training staff on the new vendor's equipment. But most vendors have very similar interfaces and command lines. Forrester has found the uptake is minimal for network operations staff. Networking personnel are trained on standards-based methods before they move to vendor-specific features. This additional cost is small compared with the potential savings and flexibility an organization retains.

- **New management tools ease insertion of a second vendor.** As for management tools, multivendor network management tools, which are widely available, are often at lower cost than switch vendors' proprietary tools, simpler to deploy, easier to use, and have richer feature sets. Bottom line? The black art of networking is a thing of the past, and advances in standards and interoperability ensure that you can phase in a second vendor without disrupting end-to-end operations.

- **There is a wrong way to introduce a second vendor — a systematic approach is essential.** You need to leverage Lean Thinking principles.[9] The flow of each application should be streamlined to eliminate waste and make sure that value is optimized. Forrester recommends installing control and management systems to automate and embed security. At this point in data center technology, be wary of bundled server, app, and networking solutions that promise more integration and higher operation efficiency. With limited hardware choices and lack of standards, these solutions will be too restrictive for networks that need to be flexible with today's ever-changing business needs and tectonic shifts in data center technology. Ultimately, this is the right direction to go in. This also gives you a chance to question the conventional approach of buying servers, storage, and switches separately and to see if there are benefits for you in an integrated approach such as Cisco's Unified Computing System (UCS) or HP's BladeSystem Matrix, which is at the heart of HP's virtual data center (VDC) concept.[10]

6. Which vendor has the best green credentials?

It ought to be possible to answer this question, but it isn't that easy. HP, Avaya/Nortel, and Alcatel-Lucent all claim that their switches use less power than Cisco's kit in equivalent configurations, making them greener. They often cite independent test labs results to "prove" their case. However, these findings are disputable, with results from other independent labs contradicting the findings of the first. The truth is that the results depend considerably on the particular configuration chosen. Some of the calculations are based on published power consumption specs that are worst case rather than actual measured figures. The real wins are in dramatically changing your architecture and collapsing tiers, which removes the need for switches altogether. As you compare vendors:

- **Don't take any of the claims at face value.** Ask for copies of the test reports, and ask your incumbent vendor to comment on them. Look for measurements that are based on the configurations that you would need in your own environment. Keep an open mind.

- **Look at the design age of the equipment being compared.** Remember that every new generation of switch or card will be more power-efficient than the previous generation, so the vendors are constantly playing leapfrog. None of them can afford to be left behind in the escalating "green wars" game for long.

ENDNOTES

[1] I&O execs will spend a lot of money on server, storage, and networks. In fact, 36% of budget holders told us they were going to increase both storage and server spend by 5% or more, and 33% indicated they'd increase network spend by 5% or more. See the July 16, 2010, "Focus Your I&O Budget On Three Key Initiatives" report.

[2] It's been the conventional wisdom of the past 10 years that to provide the best performance, protection, and capacity utilization for applications and databases, you need a robust storage array in a storage area network (SAN). But with low capacity utilization, the inability to prioritize application performance, long provisioning times, and soaring costs, SANs haven't lived up to their promise. SANs also leave application, database, and system administrators at the mercy of storage administrators for all their storage-related needs, such as capacity, data copies, and backups. To regain control and get better results, application vendors are starting to subsume more storage functionality into the application itself, giving IT buyers the option to spend less on commodity storage and get their high-value features from the application. The time has come for buyers to question the value of their SAN and consider simpler options that fit better with the applications they truly care about. See the December 4, 2008, "Do You Really Need A SAN Anymore?" report.

[3] 3Com also includes brands such as H3C and TippingPoint. The H3C brand comes from the assets it acquired from the joint venture of the same name with Huawei. 3Com acquired the remaining 49% of the joint venture for $882 million in November 2006.

[4] 3Com's H3C delivers full access to China with a list of marquee customers and a massive market. It also gets new and inexpensive talent through H3C's China R&D center. Sure, 3Com was also working on expanding out of China, which HP can take advantage of as well. See the November 12, 2009, "3Com Gives HP Core Networking — And Amps Up Cisco Competition" report.

[5] HP BladeSystem Matrix — like most converged infrastructure solutions — includes network, server, and storage in a single hardware chassis.

[6] NYSE Euronext and Juniper Networks have announced that the companies are working together to design a state-of-the-art, ultra-low latency core network for NYSE Euronext's new consolidated global data centers. Located in the greater New York and London metropolitan areas, NYSE Euronext's two new data centers will be the primary operational infrastructure supporting several billion daily transactions and quotes across diverse asset classes and geographies and will be instrumental in NYSE Euronext's effort to consolidate the total number of its global data centers from 10 to four. Expected to be operational in 2010, the new facilities will provide much greater network scale and efficiency, with plans to utilize Juniper's data center infrastructure solutions and advanced data center fabric technology to support an unprecedented internal latency of 50 microseconds roundtrip. Source: "NYSE Euronext and Juniper Networks Announce Plans for Ultra-Low Latency Network for Global Trading Data Centers," Juniper press release, June 24, 2009 (http://www.juniper.net/us/en/company/press-center/press-releases/2009/pr_2009_06_24-16_00.html).

[7] All three initiatives are more accurately described as a collection of standards, including: Priority-Based Flow Control (P802.1Qbb), Enhanced Transmission Selection (P802.1Qaz), Congestion Notification (P802.1Qau), and Data Center Bridging Exchange Protocol (not formalized yet).

[8] It's been the conventional wisdom of the past 10 years that to provide the best performance, protection, and capacity utilization for applications and databases, you need a robust storage array in a storage area network (SAN). See the December 4, 2008, "Do You Really Need A SAN Anymore?" report.

[9] The five principles of Lean Thinking, as articulated by Jim Womack and Dan Jones, set the foundation for Lean. Chief information officers (CIOs) who are serious about implementing Lean make sure that everyone in the organization knows and acts according to them. See the October 29, 2009, "What Vendor Strategists Need To Know About Lean — The Hot Topic For CIOs Right Now" report.

[10] On November 4, 2009, HP announced the HP Converged Infrastructure architecture, which delivers a technology environment that rapidly adjusts to meet organizations' changing needs. HP Converged Infrastructure addresses IT sprawl, the main cause of technology spend being focused on maintenance instead of innovation. HP Converged Infrastructure enables: the ability to more easily deploy application environments through orchestrated, shared service management; lower network costs and reduced complexity through a flexible network fabric; optimized use through virtual resource pools; and improved energy integration and effectiveness across the data center through data center smart grid technology. Source: "HP Helps Organizations Thrive in Unpredictability," HP press release, November 4, 2009 (http://www.hp.com/hpinfo/newsroom/press/2009/091104xa.html).