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The Effortless Network: HyperEdge Architecture for the Campus Network

The Effortless Network, enabled by the Brocade HyperEdge Architecture, seamlessly integrates new innovations with legacy technologies, improving network flexibility and reducing management complexity, application deployment time, and operational costs.

Today's campus network is critical for business connectivity to customers, vendors, partners, and growth. At the same time, to ensure business agility and competitiveness, the campus network must support new applications, cloud-based services, and mobile users. However, after decades of limited innovation, legacy campus networks remain rigid, complex, and costly to maintain. Organizations are learning the hard way that these networks were not built to meet today's business challenges and user demands.

Introduction

The campus network for today and tomorrow should be flexible, easy to manage, and cost-effective. The Effortless Network™ is the Brocade vision to meet these objectives, enabled by the Brocade® HyperEdge® Architecture as the cornerstone of delivering on that vision. HyperEdge Architecture seamlessly integrates new innovations with legacy technologies to improve network flexibility and reduce management complexity, allowing organizations to deploy applications quickly and cost-efficiently.

New Applications and New Devices Add New Stresses

Applications and devices continue to increase in sophistication. They provide greater services, a rich multimedia user experience, and increased mobility. But these new applications and devices also place immense pressure on the network—a network that was not originally designed to handle such technology.

Applications: Video, Unified Communications (UC), and Virtual Desktop Infrastructure (VDI) all create a significant impact in user productivity, as well as the campus network.

Video: As end-user devices increase performance at the speed of Moore's Law, user expectations increase just as fast. Nowhere is the expectation gap more evident than with video. Today, users expect real-time access to streaming video for corporate training, executive briefings, and even when conducting meetings with remote customers. This "video-on-demand" expectation requires the campus network to deliver high bandwidth with low latency and jitter.

UC: Enterprises are experiencing a historic transition in how employees communicate. Previously, voice, e-mail, instant messaging, and video conferencing were deployed with separate applications, used different devices, and often had independent networks. Today, UC brings all forms of communication to a single device—a desktop/laptop computer, tablet, iPad, or smartphone—delivering real-time collaboration. Human collaboration is becoming more and more dynamic. For example, a low-bandwidth text message can instantly transform into a shared desktop with joint editing of documents and—with a mouse click—can expand to a video chat before disappearing again at the end of the collaboration. The campus network has to scale, better support peer-to-peer (in other words, East-West) traffic patterns, ensure consistent security policies, and provide low latency and jitter while maintaining continuous uptime.

VDI: VDI leverages server virtualization to reduce the cost and complexity of desktop application support, application upgrades, data management, and data security. While VDI addresses desktop application problems including upgrades, patching, and the security of desktop data, VDI also creates new challenges for the campus network. User mouse clicks, typing, and screen refreshes have to move from the local device to the virtual machine that hosts the desktop from the data center, and back again.

New devices: The explosion of smartphones, tablet computers, and iPads sets an expectation that access to the data, applications, and social networks users rely on in their personal lives will be available when they are at work. Bring Your Own Device (BYOD) has a positive impact on IT budgets when users purchase and maintain their own devices, yet it creates concerns about securing access to sensitive corporate data. User expectations of high-quality anywhere, anytime access require consistently applied security policies across both wired and wireless segments and corporate or consumer-owned devices.

The impact of these applications and devices on the campus network creates a need for higher bandwidth, lower latency, pervasive access, and always-up availability. Incremental improvement to networking protocols such as Quality-of-Service (QoS), rate limiting, and traffic prioritization helps to maintain the quality experience but also adds additional layers of complexity, which impedes an organization's ability to deploy new applications or maintain current applications.

Friction Points: Business Expectations Confront Campus Realities

Every network in the enterprise, whether it is the cloud, data center, or campus, must be designed to meet business expectations that are balanced with technology choices. This is not an easy task, when IT budgets and personnel remain flat or shrink while applications, data, and user devices continue to grow rapidly.

The cost of running the campus network is out of control in many organizations. Gartner found that companies who had a single vendor procurement strategy for the campus incurred a 25 percent premium in Total Cost of Ownership (TCO) over a five-year period.[1] This adds up to an average cost of $1,400 per person per year for campus networks—clearly a major investment. For this reason, focused actions that reduce the cost of the campus LAN are a top strategic objective at many companies.

A survey from TheInfoPro of Fortune 1000 enterprise network administrators identified the following top five pain points for companies operating a campus network:[2]

1. Managing growth
2. Proper capacity forecasting
3. Managing costs
4. Administrative management
5. Managing complexity

The root cause of this pain is complexity caused by years of stagnant innovation and patchwork improvements. Campus networks originally provided a connection from desktop computers to file or print servers or application servers hosting back-office applications in the data center. This traffic flow is commonly referred to as North-South traffic flow, with servers at the top and user devices at the bottom. For decades, legacy campus network architectures have been used to support this usage model. Today, UC, virtual desktop infrastructure, streaming video, and Web 2.0 applications create complex multidirectional traffic flows that put unplanned stresses on these legacy architectures. In addition to traffic moving North-South, accessing server and cloud-based applications, traffic flow to support communication and video-centric applications now travels peer-to-peer, or East-West.

Increasingly, work happens at any time and any place an employee chooses. It is common for employees to use several devices during the day: a desktop or laptop computer, a tablet computer or iPad, and a smartphone. Employees expect the freedom to choose the device that best meets their needs, with unfettered access to applications and data and a consistent high-quality user experience. Also, because most of these devices lack the ability to connect a network cable, their increased use is causing an explosion in wireless traffic in the campus.

[1] Fabbi, Mark, and Debra Curtis, "Debunking the Myth of the Single-Vendor Network," Gartner Research Note G00208758, Nov. 17, 2010.

[2] TheInfoPro, Inc., "Deduplication: A Paradigm Shift in Backup," January, 2011.

Where is the Innovation?

For organizations to remain competitive, they must be agile—able to adapt to changing conditions quickly. The legacy campus network is a barrier to that agility. New bandwidth-intensive and QoS-sensitive applications, new sophisticated devices, and evolving usage patterns and traffic flow put immense stresses on IT and the campus network, while legacy network architectures make it extremely difficult to quickly roll out new technologies. Clearly, there is a need for innovation in the campus network.

As a Gartner report points out, however, for the past 20 years there has been little innovation in the enterprise network.[3] Combined with the fact that the leaders in campus networking, both at the high and low end of the market, have not made significant investments beyond incremental "speed and feed" enhancements, it becomes clear why innovation in the campus network has stalled.

Traditional legacy campus networks have been through years of incremental improvements and patchworks that have turned what should be a coherent network into a complex and fragmented collection of loosely coupled devices.

Costly to manage: Legacy campus networks are managed one switch at time. Network administrators are required to connect to each individual network device to apply configuration changes and provision resources. The burden is on the network team to keep the network coherent and all network devices configurations in sync.

Fragmented services: A typical legacy campus network includes multiple network layers running inefficient legacy protocols such as spanning tree, with many different network devices running various network OS platforms and versions. Each network device offers different levels of Layer 2 and Layer 3 (L2/L3) network services based on the capability of each device and the type of software licenses activated.

Rigid scalability: Traditional three-tier network design with "big-box" chassis at the aggregation and core layers require a significant up-front investment and offer limited deployment flexibility and future-proofing. Often this requires a "fork-lift" upgrade to move up to the next capacity level.

[3] Fabbi, Mark, "Rethinking LAN Switching Architectures," Gartner Research Note G00210808, Feb. 25, 2011.

"There have been few substantial changes to the [enterprise] networking vendors' approaches in the last 20 years."

— Gartner

Building the Effortless Network With Brocade HyperEdge Architecture

As Brocade considers today's campus network and the impact of new applications and business demands, it is clear that attempting to solve emerging problems using old assumptions is an inadequate approach. To achieve the required flexibility, automation, and dramatic reductions in cost of ownership requires a new vision. Brocade calls this vision The Effortless Network, and it is built from the innovations found in the HyperEdge Architecture.

The Brocade HyperEdge Architecture increases organizational agility by bringing the campus network into the modern era. This evolutionary architecture collapses unnecessary network layers of legacy campus architectures to radically simplify networks and eliminate legacy protocols such as spanning tree. HyperEdge Architecture integrates innovative new wired and wireless features with existing network technologies to streamline application deployment, simplify management, and reduce operational costs.

HyperEdge Architecture key Design Principles

Brocade employs three key design principles to influence the development of the HyperEdge Architecture solution for modernizing and simplifying the network to achieve better business agility and productivity.

1. **Consolidated management:** Reduces unnecessary network layers to create large HyperEdge management domains that eliminate individual switch touchpoints to ease maintenance time and costs.
2. **Shared network services:** Allows premium and entry-level switches that share a common HyperEdge management domain to share advanced L2/L3 services to achieve lower price-per-port functionality.
3. **Scale-out networking:** Integrates high-performance fixed form factor switches to create a single logical device independent of physical location by scaling ports when and where needed across the campus.

[4] Ibid.

HyperEdge Architecture Implementation Options

Brocade has developed unique enabling technologies, called Mixed Stack and Switch Port Extender, to achieve the benefits of the HyperEdge Architecture design principles (see Figure 1). The Brocade ICX® series of high-performance fixed switches embodies these enabling technologies with flexible distributed chassis configuration deployment options. These powerful deployments deliver equivalent or better functionality than large rigid modular chassis systems, but with significantly lower costs and carbon footprints.

- The **Mixed Stack** enabling technology, offered for the Brocade ICX 6xxx Switches, integrates premium Brocade ICX 6610 and entry-level Brocade ICX 6450 Switches, which collapse the network access and aggregation layers into a single HyperEdge domain that shares services while reducing management touch points and network hops across fewer network layers as compared to legacy three-tier designs.
- The **Switch Port Extender*** enabling technology, offered for the Brocade ICX 7xxx Switches, integrates premium Brocade ICX 7750, midrange Brocade ICX 7450, and entry-level Brocade ICX 7250 Switches, which collapse the network access, aggregation, and core layers into a single HyperEdge domain. Similar to Mixed Stacks, Switch Port Extender shares services across multiple levels of switches while reducing management touch points and network hops in a single-layer design across the entire campus network.

These implementation options can also be integrated into an existing legacy network for incremental adoption. As Brocade continues to further develop the HyperEdge architecture, new implementation options will be available, delivering the benefits of the key HyperEdge design principles of single-point management, shared services, and scale-out networking across an ever increasing number of network ports.

* Switch Port Extender support will be available in a future release.

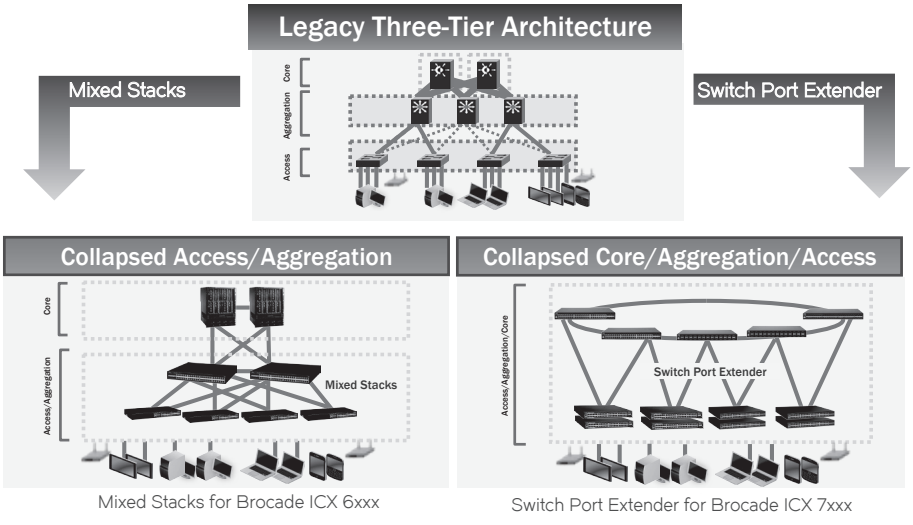

Figure 1: The Brocade HyperEdge Architecture offers multiple implementation options.

Brocade HyperEdige Mixed Stack for Campus Access and Aggregation

Mixed stacking is the ability to combine premium and entry-level switches in the same stack. Mixed stacking provides all the benefits of traditional stacking—in which all switch members are alike, all links within the stack are active (no Spanning-Tree Protocol [STP]), and where all the components can be spread across the entire campus, due to the use of long-distance optical links—yet, the whole system can be managed from a single IP address. However, when HyperEdge shared services is used, a mixed stack becomes unique and powerful. HyperEdge shared services enables premium switch services to be extended to all ports of all members of the stack, including entry-level switches. This capability provides two distinct advantages: significant per-port cost reduction and long-term investment protection.

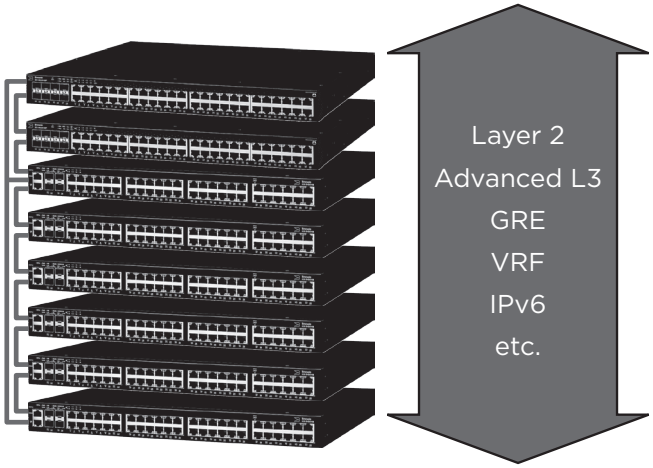

Figure 2: Mixed stacking with HyperEdge shared services.

Per-port cost reduction: With premium services available to all switches and ports within a mixed stack, organizations no longer need to buy an entire stack of premium switches to provide these services. Adding just one Brocade ICX 6610 Switch to a stack of Brocade ICX 6450 Switches reduces the aggregate per-port acquisition costs by nearly 50 percent, as compared to an equivalent stack of Cisco premium switches. (For a more detailed cost comparison, go to www.brocade.com/CampusTCO.)

Long-term investment protection: With mixed stacking enabling HyperEdge shared services, organizations no longer need to rip-and-replace entire stacks of switches to meet new service demands. Using Brocade mixed stacking and shared services, organizations can initially deploy a stack of Brocade ICX 6450s to inexpensively provide Layer 2 and some Layer 3 services. As the need for more comprehensive advanced Layer 3 services increases, organizations can simply add one Brocade ICX 6610 (or two, for high availability) to the stack of Brocade ICX 6450s, and HyperEdge shared services extends the premium services to all switches in the stack—eliminating the need to replace the entire stack of switches, as is the case with competitive switches.

Brocade Switch Port Extender fro Campus Access Aggregation and Core

The Switch Port Extender enabling technology for Brocade ICX 7xxx switches expands upon Mixed Stacks to include access, aggregation, and core. Switch Port Extender technology integrates premium, midrange, and entry-level switches to create a distributed chassis that collapses the network access, aggregation, and core layers into a single HyperEdge domain that shares services while reducing management touch points and network hops across the entire campus network.

The premium Brocade ICX 7750 Switch acts as a master controller that can be combined with midrange Brocade ICX 7450 Switches and entry-level Brocade ICX 7250 Switches. HyperEdge shared services enables the premium switch services of the Brocade ICX 7750 to be extended to all ports of all members of the stack. This capability provides distinct advantages:

- **Simplicity and automation:** Collapsed access, aggregation, and core layers reduce the network to a single tier and offer a single point of management across the campus.
- **Per-port cost reduction:** With premium services available to all switches and ports within Switch Port Extender, organizations no longer need to buy an entire stack of premium switches to provide these services. Adding just one Brocade ICX 7750 Switch to a stack of Brocade ICX 7450 or Brocade ICX 7250 Switches reduces the aggregate per-port acquisition costs by over 75 percent, as compared to an equivalent stack of Cisco premium switches.
- **Long-term investment protection:** With HyperEdge shared services, organizations no longer need to rip-and-replace entire stacks of switches to meet new service demands. Using Brocade Switch Port Extender, organizations can initially deploy a stack of Brocade ICX 7250s to inexpensively provide Layer 2 and some Layer 3 services. As the need for more comprehensive advanced Layer 3 services increases, organizations can simply add one Brocade ICX 7750 (or two, for high availability) to the stack of Brocade ICX 7250s, and HyperEdge shared services extends the premium services to all switches in the stack—eliminating the need to replace the entire stack of switches, as is the case with competitive switches.
- **Highly flexible and scalable:** The distributed chassis scale-out model enables network architects to add capacity exactly where it is needed in the network, unlike a "big-box" chassis approach with all ports located in the same closet.

Switch Port Extender requires a fraction of the cost of a traditional chassis-based access, aggregation, and core solution, with about 75 percent savings on total cost of acquisition, power and cooling, and vendor service fees.

For maximum flexibility, multiple topologies are supported. Figure 3 shows a campus ring where all aggregation switches are interconnected across the campus in a ring configuration. With this topology, it is actually possible to eliminate the need for a separate core layer on a medium-size campus. This greatly simplifies the management and troubleshooting of the entire campus network, with a single point of management and the elimination of spanning tree for the campus aggregation/core. Switch Port Extender allows Brocade ICX 7250 or ICX 7450 Switches to be included, adding the access layer to the single HyperEdge domain.

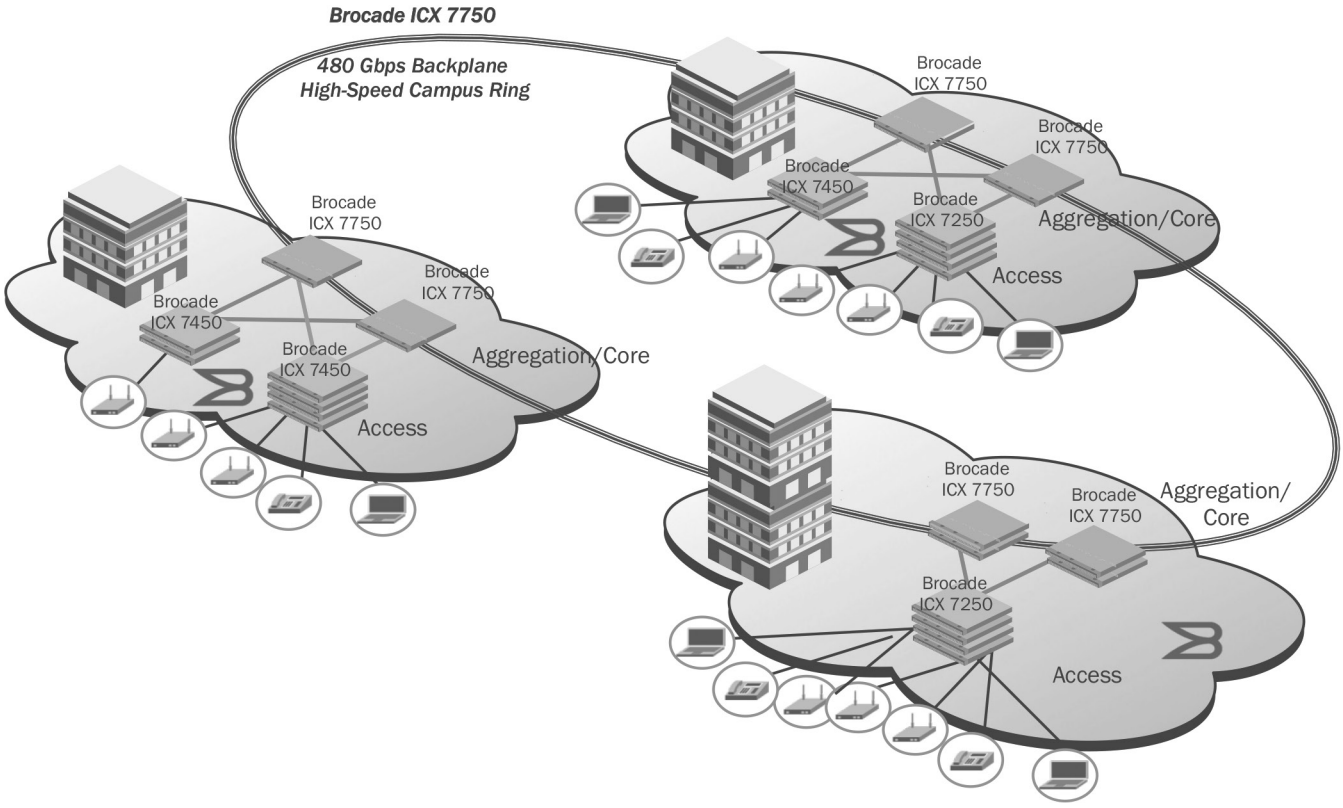

Figure 3: Switch Port Extender deployment combining access, aggregation and core.

HyperEdge Architecture Delivers the Effortless Network

These powerful deployments deliver equivalent or better functionality than large rigid modular chassis systems, but with significantly lower costs and carbon footprints. Both the Switch Port Extender and Mixed Stacks technologies offer a level of flexibility, ease of deployment, and TCO unmatched by traditional access, aggregation, and small-core chassis solutions.

The innovative Brocade ICX® Series of switches implements Distributed Chassis design deployments using standards-based optics and cabling interface connections, ensuring maximum distance between campus switches (up to 80 km) and minimum cabling costs—up to 50 percent lower than incumbent solutions. This cabling flexibility delivers ports to locations where they are needed on the campus at a fraction of the cost. The Distributed Chassis future-proofs campus networks by allowing networks to easily and cost-effectively expand in scale and in capabilities.

Campus networks built with HyperEdge Architecture technologies are ready to take on the challenges of streaming video, UC, VDI, and cloud-based applications, as well as demanding mobile users, by offering flexible, application-centric, automated, and cost-effective network solutions. With innovations such as shared services and consolidated management, combined with existing technologies such as Multi-Chassis Trunking (MCT), HyperEdge Architecture improves organizational agility by reducing network complexity, application deployment time, and operational costs. With Brocade, owning and maintaining your entire campus network is one step closer to being effortless.

To learn more about The Effortless Network, Brocade HyperEdge Architecture, the Brocade ICX campus switch family and Brocade mobility solutions, visit www.brocade.com/campus.

About Brocade

Brocade networking solutions help organizations achieve their critical business initiatives as they transition to a world where applications and information reside anywhere. Today, Brocade is extending its proven data center expertise across the entire network with open, virtual, and efficient solutions built for consolidation, virtualization, and cloud computing. Learn more at www.brocade.com.

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