DATA CENTER FABRIC

Technical Brief: Optimizing Data Center Consolidation with Server Virtualization and the Brocade Data Center Fabric (DCF) Architecture

Building an adaptive data center infrastructure means consolidating existing IT assets and integrating new technologies, including virtualization, to help streamline IT operations. To be successful, new technologies should leverage existing components while further enhancing the productivity of data center operations as a whole.

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INTRODUCTION

Data centers are evolving from places that house disparate IT operations into strategic fortifications for achieving vital corporate objectives. This shift from simply hosting business applications to aligning the data center infrastructure with broader business needs reflects fundamental changes in the nature of IT processes. Applications and data are now the lifeblood of every enterprise and institution. Loss of access to data can quickly lead to loss of revenue, loss of customers, and potentially loss of the enterprise itself. Whereas formerly a data center outage was an inconvenience, today's businesses are at risk whenever an unscheduled outage occurs. In addition to high data availability, modern business processes also require much greater flexibility to respond to changing requirements. The old data center model of static IT processes and slow incremental growth has been displaced by a new paradigm that demands rapid response to changing needs and the ability to quickly accommodate growth of new applications and data.

Due to budget, environmental, or power constraints, however, it is often not possible to simply expand the data center real estate or introduce additional servers and storage to satisfy new application needs. For most companies, building an adaptive data center infrastructure means consolidating existing IT assets and integrating new technologies to help streamline IT operations. Consolidating servers, infrastructure, and storage, for example, enables greater processing power, streamlined connectivity, and larger storage volumes in a smaller footprint. By reducing the number of IT elements, consolidation can also simplify data center management. These benefits are amplified when a data center consolidation project integrates new technologies that leverage existing components, while further enhancing the productivity of data center operations as a whole.

Blade servers, for example, dramatically reduce the real estate required to support applications and offer economies in terms of reduced components, connectivity, and power consumption. Multi-processor blade servers provide factors of increased processing power in a compact form factor. The efficiencies of consolidated blade server technology, though, are increased exponentially when combined with server virtualization software. By enabling multiple instances of an operating system to be hosted on one hardware blade, server virtualization maximizes utilization of available CPU power. This reduces both the footprint and the power draw required to drive multiple business applications. Consequently, these two distinct technologies are often conceptually bound together in regard to the concept of server consolidation.

The natural complement to server consolidation is storage consolidation. Storage consolidation typically involves replacing multiple smaller storage arrays with more efficient and larger centralized arrays. To maximize the benefit of physical consolidation, storage consolidation can be combined with storage pooling to virtualize physical storage systems and enable more efficient utilization of all available storage capacity. In addition, storage efficiencies can also be enhanced through tiered storage for Information Lifecycle Management (ILM). ILM technology helps align the business value of any given data set to the cost and performance of the storage container used to house it.

The third major element in data center consolidation is the fabric connectivity that binds servers and storage together and facilitates high availability and high performance. For large data centers in particular, the fabric is both the backbone of connectivity and the extensible infrastructure to accommodate flexibility and growth. Formerly, fabric consolidation was achieved by replacing fabric switches with large, high-port-count, centralized directors to enhance availability and streamline the cable plant. Today, however, the fabric must extend its role to facilitate new server and storage virtualization solutions and to optimize the performance and availability of upper-layer business applications and data. A data-centric and application-aware approach helps ensure that the entire matrix of data center servers, fabric, and storage leverages advanced technologies to optimize transactions and safeguard application data. This is the strategic goal of the Brocade® Data Center Fabric (DCF) architecture.

THE BROCADE DATA CENTER FABRIC ARCHITECTURE

The pressures of mergers and consolidation, global competition, and regulatory compliance demand more flexibility and agility in both enterprise operations and the supporting IT data center infrastructure. The Brocade DCF architecture and supporting products are designed to fulfill these new requirements of business operations, as companies adopt more dynamic practices. For both server platforms and storage, rigid physical connections between applications and data are being replaced with more flexible virtual relationships and shared resource pools. Enhanced data mobility, protection, and security are now key to preserving data integrity and fulfilling regulatory requirements. By combining enhanced connectivity with advanced storage and application-aware services, the Brocade DCF architecture is centrally positioned to coordinate new capabilities in both server and storage platforms and thus to maximize data center productivity.

To minimize disruption and cost, the Brocade DCF architecture is designed to interoperate with existing storage and fabric elements, while providing enhanced services where needed. The Brocade DCX™ Backbone platform, for example, integrates with existing Brocade fabrics and extends their value by providing multiprotocol connectivity, data migration services, storage virtualization, scalability, Quality of Service (QoS), Continuous Data Protection (CDP), data encryption, and other advanced services throughout the data center fabric. To simplify administration, these advanced services can be automated via policy-based rules aligned with upper-layer application requirements.

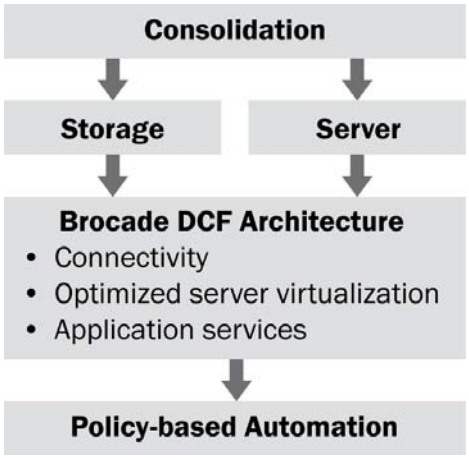

Figure 1. The Brocade DCF architecture provides the infrastructure to optimize the performance and availability of upper-layer business applications.

Reducing the Server Footprint

Large server farms have become an impediment to data center operations for a number of reasons. Each server requires its own chassis, power supplies, fans, motherboard, bus, and I/O connectivity—as well as an operating system and application licenses. Physically, hundreds or thousands of servers in a data center occupy a significant portion of the data center real estate and place a considerable burden on the Heating, Ventilation, and Air Conditioning (HVAC) in the data center. Replacing standard servers with more powerful standalone servers may not be a sustainable strategy, since incremental growth in application support often results in larger populations of power platforms. Consequently, the current trend in data center consolidation typically involves replacing server farms with blade server enclosures. This not only reduces the footprint to support processing power, but can significantly reduce auxiliary elements, such as cabling and fabric connectivity.

Replacing the standalone servers with blade servers greatly reduces the physical footprint. It enables the equivalent processing power, but in 5 blade server chassis instead of 70 individual servers. In addition, server-to-storage connectivity is simplified by deploying 2 external switches and 12 integrated blades (on the right in Figure 2) to replace the 14 external switches required in the standalone model (on the left in Figure 2). The reduction in optical elements and fiber cables reduces cost and streamlines deployment and connectivity.

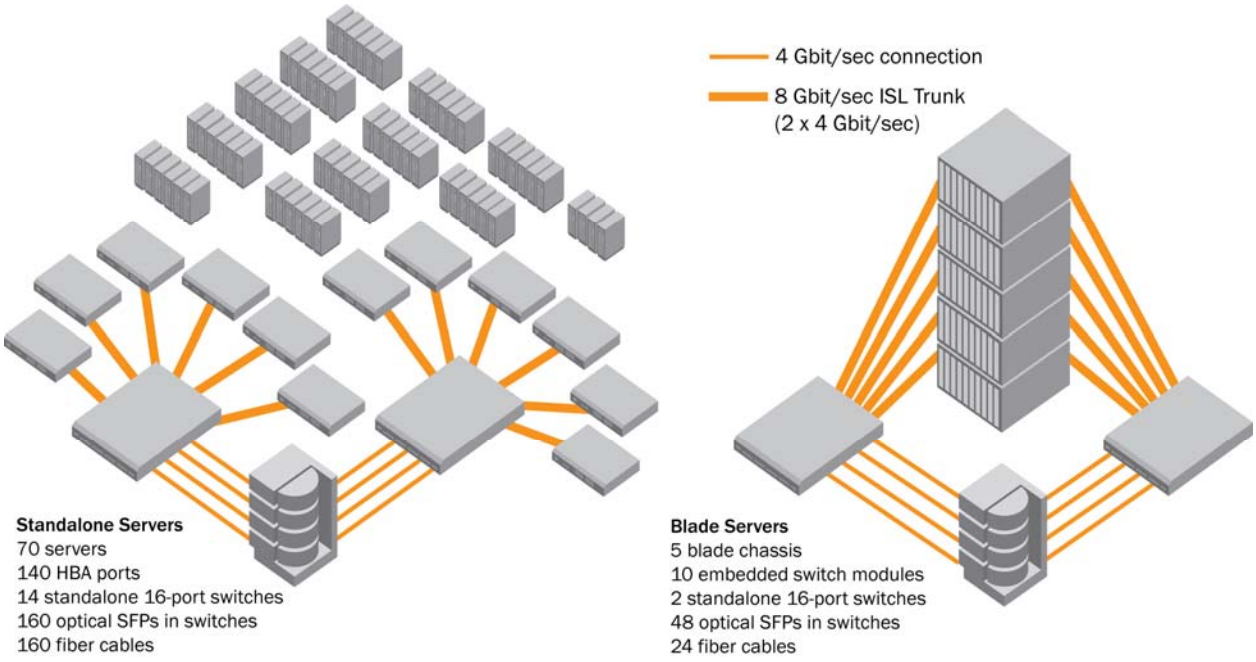

Figure 2. Deploying blade servers significantly reduces both hardware and connectivity components.

The blade configuration (on the right) requires fewer hardware units and fewer connections, consumes less power, and centralizes server management via consolidation. These benefits are compounded when server virtualization is implemented. In this example, the 5-blade chassis configuration could perform the work of 490 standalone servers if 7 operating system instances were supported on each blade. In addition, server virtualization vendors may provide enhanced utilities for non-disruptively migrating operating system instances from one blade platform to another, thus offering far greater flexibility in deployment of processing power compared to conventional server farm configurations.

Consolidating processing power with blade servers and server virtualization poses significant implications for the supporting SAN infrastructure, however. The fabric must provide much higher performance to accommodate the increase in virtual server I/Os, more flexibility in providing connectivity between blade server frames and storage, and QoS to enable prioritization of the different applications driven from virtualized environments. The Brocade DCF architecture and the Brocade DCX platform are designed to optimize these demanding configurations and further streamline both Fibre Channel and future Fibre Channel over Ethernet (FCoE) connectivity to enhance services for application data on virtualized platforms.

Simplifying Server Virtualization Connectivity to Fibre Channel Fabrics

The combination of blade servers and server virtualization software concentrates processing power and productivity in a minimal footprint and power cost. This consolidation benefit, however, is augmented by the greater flexibility server virtualization provides for selectively applying processing power where needed and for non-disruptively migrating operating system instances from one hardware platform to another.

For storage connectivity, blade servers support integrated dual-port Fibre Channel Host Bus Adapters (HBAs) that attach through the backplane of the blade server enclosure. In a conventional configuration, a Fibre Channel blade switch inserted in the blade server chassis would provide connectivity to the external storage network. While this accomplishes the task of storage access, each blade switch requires a unique Domain ID. As more blade servers are deployed over time, Domain ID management may become problematic.

The Brocade Access Gateway feature in Brocade Fabric OS® on a bladed platform resolves this issue by using N_Port ID Virtualization (NPIV) to eliminate the need for separate Domain IDs. NPIV is a Fibre Channel standard that allows multiple logical host connections through a single physical device connection (N_Port). In a Brocade Access Gateway configuration, the operating system instances running on blade servers have fabric connectivity to storage through virtual IDs. But because the blade in Access Gateway mode does not appear as a conventional Fibre Channel switch, there is no Domain ID or fabric rebuild traffic. Instead, the Domain ID and conventional switch fabric services are hosted by the external Fibre Channel switch or director to which the blade in Access Gateway mode is attached, as shown in Figure 3.

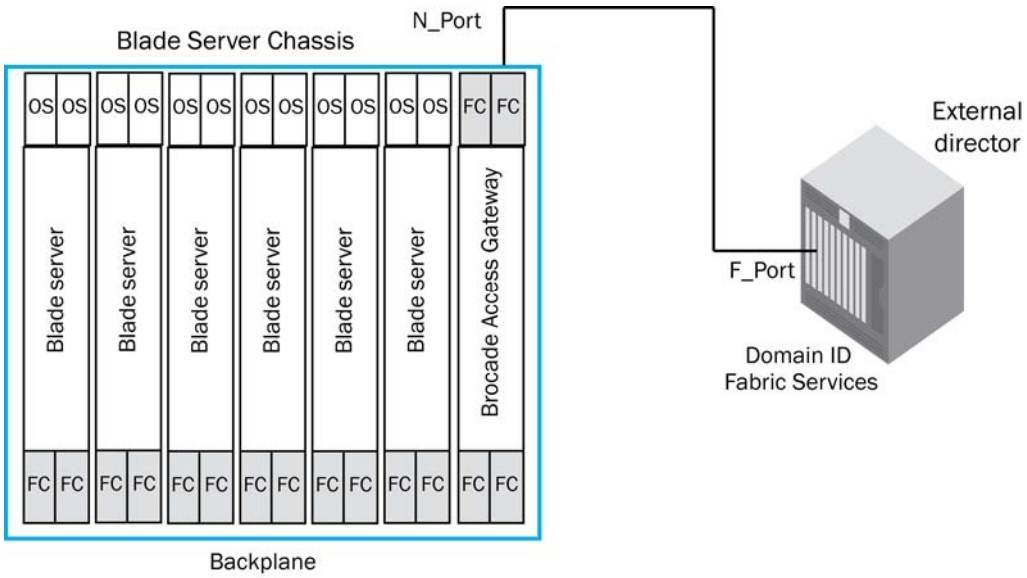

Figure 3. The Brocade Access Gateway simplifies deployment and management of blade servers for Fibre Channel connectivity to storage.

The Access Gateway feature simplifies both deployment of blade servers and ongoing fabric management. For the data center SAN designer, each Access Gateway connection appears as a single device attachment, even though dozens of virtual IDs are supported on the link.

Facilitating Server Virtualization Mobility

In addition to streamlined fabric connectivity, the Brocade DCF architecture provides higher-level functions for virtualized server environments to facilitate mobility of virtual servers. Once physical server platforms have been virtualized, companies can leverage Virtual Machine (VM) mobility to optimize compute resources and respond quickly to changing business priorities while adding resiliency against IT disruptions. This approach combines server virtualization and shared storage in the data center fabric.

Aligning Business Application Priorities to QoS Delivery

The Brocade DCF architecture also supports QoS for different applications running on virtualized servers. This level of adaptive networking is achieved through virtual channels, which can prioritize delivery based on the business value of particular applications. A high-workload application, such as tape backup, may actually have a lower business priority than a less-intensive online transaction application. To prevent lower-priority applications from dominating bandwidth, adaptive networking helps ensure priority delivery of the more mission-critical data. This application-centric approach aligns fabric resource utilization with higher-level business requirements so that the infrastructure aligns with application needs.

Simplifying Server Virtualization Connectivity with DCE (Future)

The Brocade DCF architecture is engineered to support existing storage protocols such as Fibre Channel, Fibre Channel over IP (FCIP), and iSCSI—as well as new storage protocols such as Fibre Channel over Ethernet (FCoE), which are still undergoing standardization. For data center storage applications, FCoE requires enhancements to conventional Ethernet to make it more robust and deterministic. This new Data Center Ethernet (DCE) protocol will provide a 10 Gbit/sec transport with reliable delivery and multipathing capability. The Brocade DCX Backbone platform is designed to support DCE and associated protocols, such as FCoE, and thus offers an additional way to streamline blade server and server virtualization connectivity.

The primary advantage of FCoE for server virtualization is that it leverages proven Fibre Channel protocols and technology and existing Fibre Channel storage assets, while further reducing server connectivity requirements. Blade servers with 10 Gbit/sec DCE connections will be able to transport block storage data, file data, server clustering traffic, and IP-based protocols over a single high-performance link. The Brocade DCX, in turn, provides the multiprotocol conversion to interface virtualized operating system transactions to the data center fabric infrastructure. Consequently, simplified server connectivity is possible without disruptively "forklifting" the data center storage network.

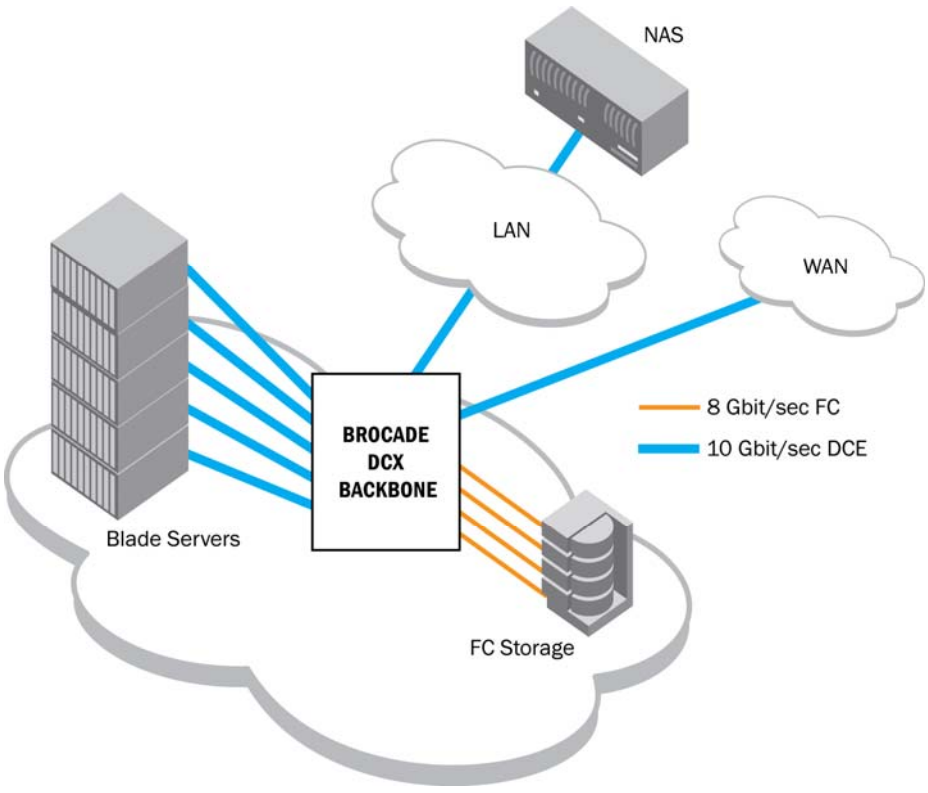

Figure 4. The Brocade DCX supports multiple protocols to integrate DCE and existing Fibre Channel data center storage assets.

Unifying Virtual Servers and Virtual Storage with the Brocade DCF Architecture

Because different server and storage vendors are incorporating advanced services in their own products, the Brocade DCF architecture cannot assume that all advanced storage or application services will be vested in the network. Storage virtualization, for example, can be implemented in storage systems as well as in the Brocade 48000 Director and Brocade DCX Backbone platforms. The Brocade DCF architecture is therefore designed to apply intelligent services where it makes sense and to coordinate with other server and storage-based advanced services as needed. The determining factor is not *where advanced services reside*, but *what is needed to best serve the upper-layer business applications and data*.

Data center consolidation is enabled by blade servers and server virtualization on the compute side, by storage consolidation and storage virtualization on the data repository side, and by the consolidation of the fabric and advanced application services in the middle. In addition to providing high port density and high performance for centralized connectivity, the Brocade DCX offers advanced services for data migration, data encryption, data protection, block and file access, and adaptive networking to provide QoS to designated applications. These integrated services reduce the need to deploy auxiliary components to solve storage problems and so help to minimize the hardware footprint. Because the Brocade 48000 Director and Brocade DCX Backbone consume less than half the power of competing platforms, higher-level functionality can also support applications without further burdening the data center power or cooling plant.

SUMMARY

The Brocade DCF architecture and Brocade DCX Backbone platform provide the foundation for maximizing the value of new server and storage virtualization technologies for today's data center consolidation projects. Working together, they have the ability to handle thousands of virtual machines to provide the requisite scalability for a virtualized environment. For server virtualization, Brocade Access Gateway technology simplifies deployment and support of large blade server configurations, while advanced application services on the Brocade DCX help ensure that applications and data receive the highest level of security and data protection. Just as server virtualization software amplifies the benefits of blade server technology, the Brocade DCF architecture and supporting products amplify the benefits of the consolidated data center infrastructure as a whole.

For more information on the Brocade Access Gateway feature in Fabric OS, visit:
www.brocade.com > Products > Software > Access Gateway

For more information on the Brocade Data Center Fabric architecture, visit:
www.brocade.com > Resources > SAN Resources > White Papers