

INTRODUCING THE BROCADE DATA CENTER FABRIC ARCHITECTURE

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Abstract

Enterprise data centers are undergoing a transformation driven by the need to reduce costs and increase performance. The evolving data center fabric exploits developing virtualization technologies for a data- and application-driven solution that reduces complexity and enables end-to-end management on a common framework.

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Challenges in the Enterprise Data Center

Today, business organizations are challenged by conflicting requirements—to become more efficient and do more with less—while at the same time increasing their ability to adapt to rapid market changes. Many CIOs understand that they need to replace the application-centric infrastructure that relies on storage islands isolated by data type, file or block data, with a shared infrastructure that delivers application-defined levels of service using a common fabric that consolidates file and block access.

Infrastructure scalability, performance, and availability are essential—and the explosive growth of digital data, applications, and regulatory compliance means that tradeoffs of one for the other are no longer tolerated. Because complexity increases expense and risk, new technology deployments in the data center must integrate smoothly, be simple to manage, and incur low operational risk.

The need to access, protect, move, and store data efficiently is central to the data center, as more businesses make data a strategic asset. To control costs, meet growth requirements, and implement security efficiently, managers must consolidate physical assets and geographical locations, maintain and improve application availability, and manage the environment as a homogenous entity—all key elements of enterprise IT strategy.

For management

What keeps the Chief Information Officer and data center management up at night?

The need to:

- Meet corporate financial, customer retention, data security, and profitability goals
- Retain reliable staff and reduce overall head count
- Support Business Continuity (BC), “always on” applications, data recoverability, and Disaster Recovery (DR) initiatives
- Apply the resources that incur the lowest management and risk for cost-effective operations
- Keep up with an evolving business environment, which includes changing goals, merger and acquisition activities, and infrastructure challenges
- Increase customer satisfaction and reduce capital expenditures across disparate group and application needs

For data center administrators

A different set of challenges face storage, network, and server/application administrators:

- Coordinate data center consolidation and relocation
- Perform non-disruptive maintenance and upgrades for equipment, OS, and applications
- Deploy server consolidation and application virtualization, and storage consolidation and emerging data virtualization technology

- Ensure data security via encryption for data in flight and at rest and reduction of human errors
- Provide Continuous Data Protection (CDP), and centralize data storage and DR
- Implement policy-based management and service for repetitive tasks such as data migration, Information Lifecycle Management (ILM), data security, and network management
- Manage branch office IT, including efficient deployment of equipment, data, and Wide Area Network (WAN) resources
- Simplify management, while scaling the environment and increasing performance between the user, application, and data

The Evolutionary Transformation

In response to these challenges, data centers are undergoing a transformation. They are evolving from static stovepipes of dedicated servers and storage hosting fixed applications into "virtual data centers," in which applications run on virtual servers, sharing compute resources while storing their data in virtual storage pools. The term "evolving data center" accurately conveys the ongoing and relentless nature of the transformation.

To keep up with growth, data centers have to dramatically increase the utilization of physical server and storage assets, while simplifying infrastructure provisioning, management, and fault isolation. Two innovative technologies, virtual servers and virtual storage, are key to this transformation. A compelling benefit of increased virtualization is reduction in power, cooling, and floor space—all of which are becoming scarcer and more expensive.

A new architecture is required for data centers that will address the joint issues of cost and increased complexity. What will this new architecture look like? It will require high levels of availability, bandwidth, and scalability—while delivering consistent, end-to-end latency. Infrastructure upgrades and configuration changes must be non-disruptive, and application outages will be unacceptable. Deploying virtual servers and storage, applications and their data will be dynamically moved across the physical infrastructure. This will entail deeper network intelligence to ensure network resources are efficiently allocated as workloads shift. An evolving data center requires innovative technology in the fabrics that connect server to server, server to storage, and storage to storage.

The new architecture will encompass four interlocking principles to reduce cost, simplify management, and increase the agility of the physical infrastructure:

- Consolidate (pool) physical resources
- Deploy virtual partitions to subdivide management
- Use virtual connections to access shared pools of physical resources
- Use application service levels (policies) to provide efficient resource allocation and agile provisioning

The transformation is likely to proceed in stages, as illustrated in Figure 1:

- Consolidate technology onto a common fabric.
- Align management of the infrastructure with business requirements, logically separating management of applications and their data according to criticality and data policies.
- Integrate the fabric using virtual connections that overlay the physical infrastructure to connect virtual machines with virtual storage. As workloads move across physical servers and storage, consistent performance requires application-aware Quality of Service (QoS) to follow the application. As data migrates between storage tiers, data mobility policies ensure efficient use of physical storage.

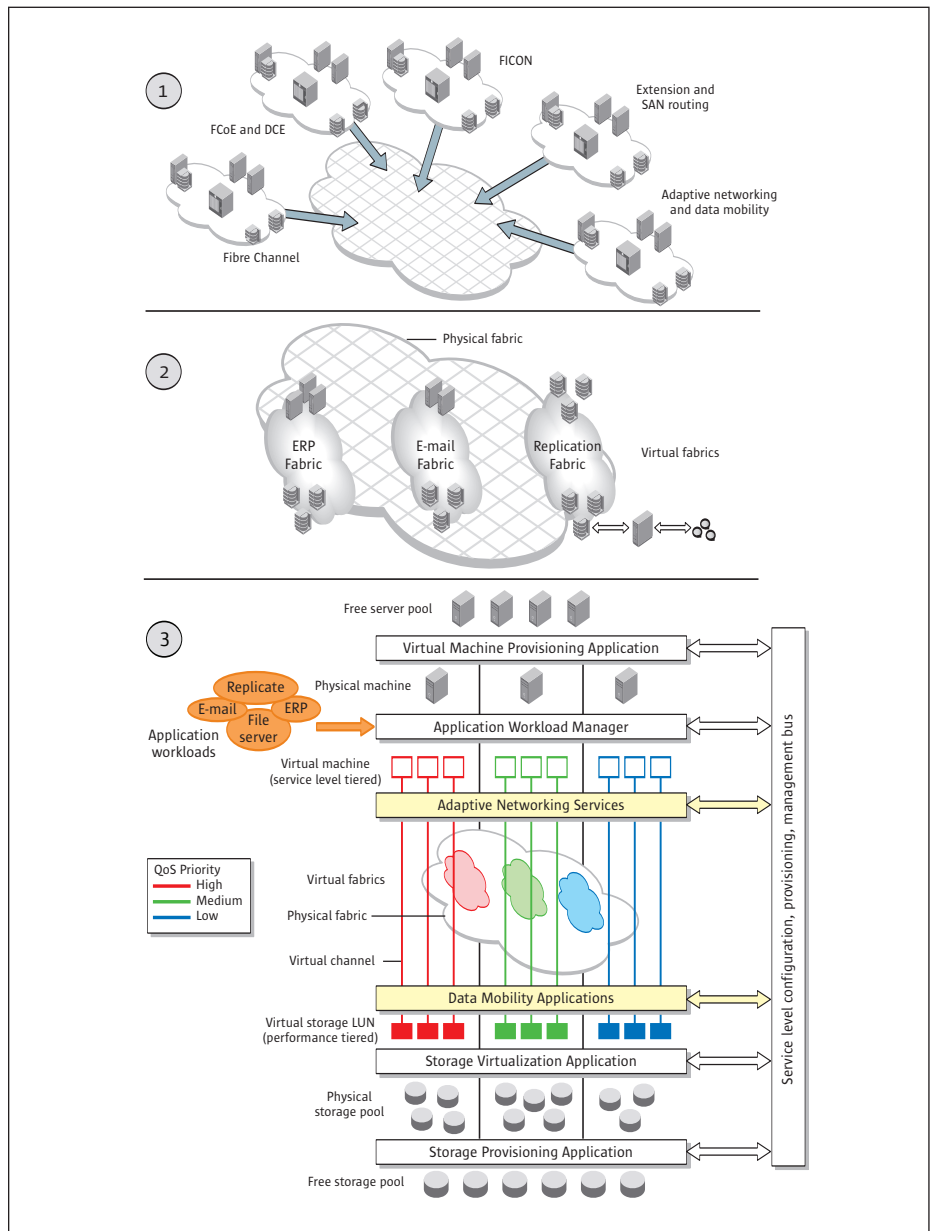


Figure 1. Data center fabric technology aligns with evolving data center strategy

The data center fabric

The data center fabric is an architecture for transforming existing Storage Area Network (SAN) fabrics into data center fabrics, transparently connecting virtual servers and virtual storage with support for both file and block data access. The architecture encompasses multiple storage protocols between applications and their data, integrates SAN and File Area Network (FAN) components, connects virtual server and storage pools, integrates distance connectivity over xWDM and WANs, as well as supporting mainframe requirements. It facilitates the consolidation of resources, while enabling management to be logically segmented to meet business and application requirements.

NOTE: There are two types of Wave Division Multiplexing (WDM), Dense and Coarse; “xWDM” implies both DWDM and CWDM.

A data center fabric delivers high-performance, constant availability, and non-disruptive scalability, onto a uniform, consolidated fabric at low cost and low risk. It provides end-to-end data center connectivity (server to server, server to storage, and storage to storage) with integrated management of both the physical and virtual infrastructure. Its overarching goal is to reduce the complexity of storing, accessing, protecting, and moving data — which are the core functions of the data center.

The Brocade DCF Architecture

The Brocade Data Center Fabric (DCF) Architecture transforms Brocade’s current technology and product portfolio into a unified fabric that integrates physical and virtual connectivity with block and file data access. The management layer exploits deeply integrated device and fabric intelligence to communicate with workload management, provisioning, and capacity-planning tools provided by our storage and server virtualization partners. This in turn extends application service levels and data management policies into the fabric. The benefits of this approach are clear: simple management, lower operating cost, and dynamic infrastructure.

Physical resource consolidation in the data center is inevitable, but it has a number of impacts. As resources are concentrated, the demands on infrastructure performance increase as multiple application workloads share the same physical resources. Continuous availability, backbone-class bandwidth, consistent end-to-end latency, and non-disruptive scalability are essential qualities and key attributes of the Brocade DCF Architecture.

The data center fabric consolidates essential technologies onto a single, extensible fabric, as shown in Figure 2. Adaptive networking technology simplifies the configuration, provisioning, and management of the fabric’s resources. Application-aware technology simplifies basic data management operations in a virtualized data center environment and can extend them to remote offices and recovery sites.

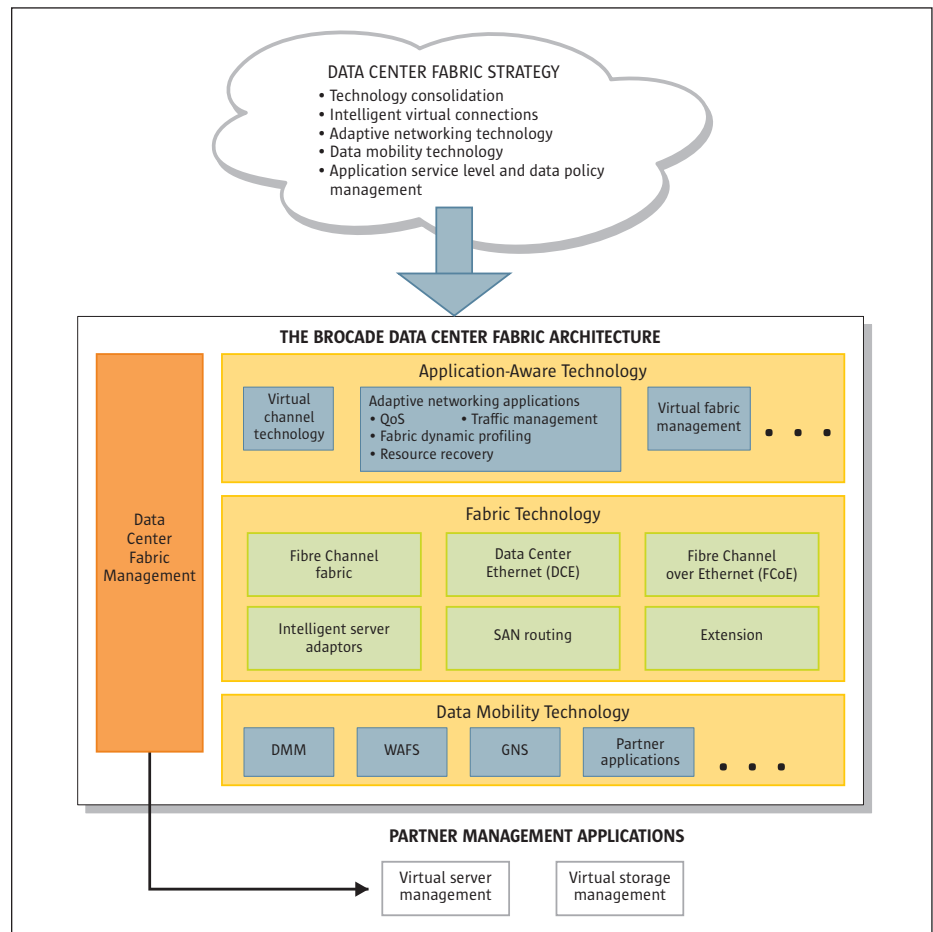


Figure 2. The Brocade Data Center Fabric (DCF) architecture

Consolidating with fabric technology

The Brocade DCF Architecture uses proven fabric network technology to consolidate multiple physical data center networks. Enterprises deploy and manage many physical networks in the data center; and merging networks onto a single, open platform is attractive from a cost perspective. Look at a rack of servers in a data center that are connected to separate SANs, and client/server and server cluster networks. There are Fibre Channel (FC) adaptors, Ethernet Network Interface Cards (NICs), and a growing number of server-to-server cluster adaptors. The complexity is immediately evident, and associated facilities requirements can exhaust scarce data center physical plant. In addition, this complexity greatly complicates moving, adding, or changing physical components—all of which makes root cause problem analysis time consuming and expensive.

The technology chosen for integrating data center networks must deliver the highest performance levels of bandwidth, availability, scalability, and consistent latency.

Data center fabric performance must support the most demanding application workloads. If not, the network cannot ensure that applications meet their service levels, a situation that is unacceptable. Fabric network technology has always delivered the highest performance levels because server-to-storage traffic has the highest performance requirements. “Best-effort” network technologies, such as TCP/IP, cannot deliver the consistent latency and extreme performance levels required.

Investment protection

A key goal during the architecting of data center consolidation is the decrease of Total Cost of Ownership (TCO) for the IT infrastructure. The Brocade DCF Architecture provides the ability to manage server and storage connectivity for block and file data under a common fabric management framework. Increased performance and faster deployment, implementation, and recovery, combined with decreased power and cooling resources, drive operational costs down. Decrease of capital expenditures can be gained by reducing footprint while leveraging the new infrastructure (equipment, cabling, and management tools).

Adding virtual connections with intelligence

Seamlessly integrating virtual fabrics and virtual channels with physical fabrics simplifies the end-to-end management of the data center. Virtual fabrics partition a physical fabric into independent management domains. Virtual channels connect virtual servers to virtual storage, and together they can extend application-aware service levels into the data center fabric.

Each virtual channel is assigned a Quality of Service priority (high, medium, or low). Applications are connected to the virtual channel via a QoS priority, extending the service level into the fabric.

Extending fabric intelligent with adaptive networking

Adaptive networking services manage virtual channels. These services can provision and adjust resource allocation to a virtual channel based on the assigned QoS priority. The same QoS can span Fiber Channel, iSCSI, and Data Center Ethernet (DCE) networks, so that data flows receive the appropriate service level as they move across different network technologies. Adaptive networking also provides traffic management and shaping applications with automated congestion detection and congestion avoidance technology.

Deep fabric intelligence about resource utilization, integrated at the data center fabric management layer, is deployed end-to-end along the data path, not isolated to a single network device or protocol. This intelligence is essential for simplifying fabric management, configuration, and fault isolation in a virtual environment.

FCoE and DCE

Recently, a new Fibre Channel standards initiative was created for running the Fibre Channel protocol over Ethernet (FCoE). FCoE is of the encapsulation of Fibre Channel within a different link layer transport, Data Center Ethernet (DCE). The DCE initiative utilizes new Ethernet extensions that will enable convergence of applications in the data center (LAN, SAN, and High Performance Computing (HPC)) onto a single interconnect technology. FCoE encapsulates the proven Fiber Channel protocol in DCE frames to replicate the reliability and efficiency that Fibre Channel has already demonstrated for data center applications. These new Ethernet enhancements are predicated on 10-Gb/s performance and are sometimes referred to as Converged Enhanced Ethernet or Data Center Ethernet. The value of FCoE is that it provides the option of maintaining separate logical networks for storage and messaging LANs or of melding storage, messaging traffic, Voice over IP (VoIP), streaming video, and other data on the same network infrastructure. Today data centers deploy different networks based on distinct interconnect technologies to transport different traffic from different applications. With recent advances in speed—10 Gb/s already standard and 40 Gb/s and 100 Gb/s around the corner—Ethernet is a compelling choice as the technology of convergence in the data center.

Using application-aware service levels to simplify management

As application workloads shift among virtual servers, it becomes important for the fabric to monitor resource use and to predict congestion anywhere along the data path. Fabric resource exhaustion causes fabric congestion. When the fabric intelligence predicts that congestion seems likely, QoS service levels help the fabric dynamically allocate resources, so that critical applications can avoid network congestion. The fabric invokes traffic management applications (for example, ingress rate limiting and traffic shaping) at network entry points to ensure that bandwidth for lower-priority applications is throttled and congestion avoided.

The Brocade DCF Architecture includes a point of presence in the server, the Intelligent Server Adapter (ISA). Applications use the ISA to access adaptive networking services when requesting fabric service levels. This evolves the physical fabric connection into a logical one used to communicate with adaptive networking applications. The fabric uses its intelligence to ensure it can deliver the service level requested by the application. Additionally, more knowledge about application requirements improves fabric resource utilization and capacity planning, while simplifying provisioning, configuration, and fault isolation.

Support for non-disruptive transformation

The Brocade DCF Architecture creates a common logical fabric, which converges multi-protocol physical networks, so that existing SAN fabrics can non-disruptively connect to the data center fabric. Advanced network technology protocols currently in development, such as Fiber Channel over Ethernet and DCE, can be integrated into the data center fabric when they become available. Data center fabric management can connect to application workload managers and virtual storage applications, so that resources are seamlessly allocated in this dynamic environment. The Brocade DCF Architecture delivers a dynamic, scalable, secure, and cost-effective fabric—connecting virtual servers with virtual storage and Virtual Tape Library (VTL) technology.

The Brocade DCX Backbone

It is well known that Brocade develops industry-leading solutions for servers, storage, applications, and data. Our solutions help organizations improve and scale application performance, and keep applications connected to data throughout enterprise data centers. The Brocade DCF Architecture extends these solutions to meet the requirements of the virtual data center:

- To ensure continual, non-disruptive data access
- To protect data both in movement and at rest
- To move and migrate applications and data as needed
- To manage the storage of data based on relevance and specific requirements

At the core of this architecture is the Brocade DCX Backbone. The Brocade DCX extends our 25 years of data center and platform leadership, integrating technology innovations such as adaptive networking, for evolving data centers. The Brocade DCX enables massive consolidation, multi-protocol integration, and simplified management to dramatically reduce operational and capital costs. With the industry's first "backbone" level of performance, it combines unprecedented scalability and bandwidth with leading innovations in power, cooling, and port density. It provides true interoperability with existing SANs.

The Brocade DCX technology innovation, shown in Figure 3, anticipates the changes in infrastructure capabilities created by virtual servers and storage. Adaptive networking services extend the application service level into the fabric. As applications traverse virtual servers, the fabric resources follow, thus avoiding fabric congestion.

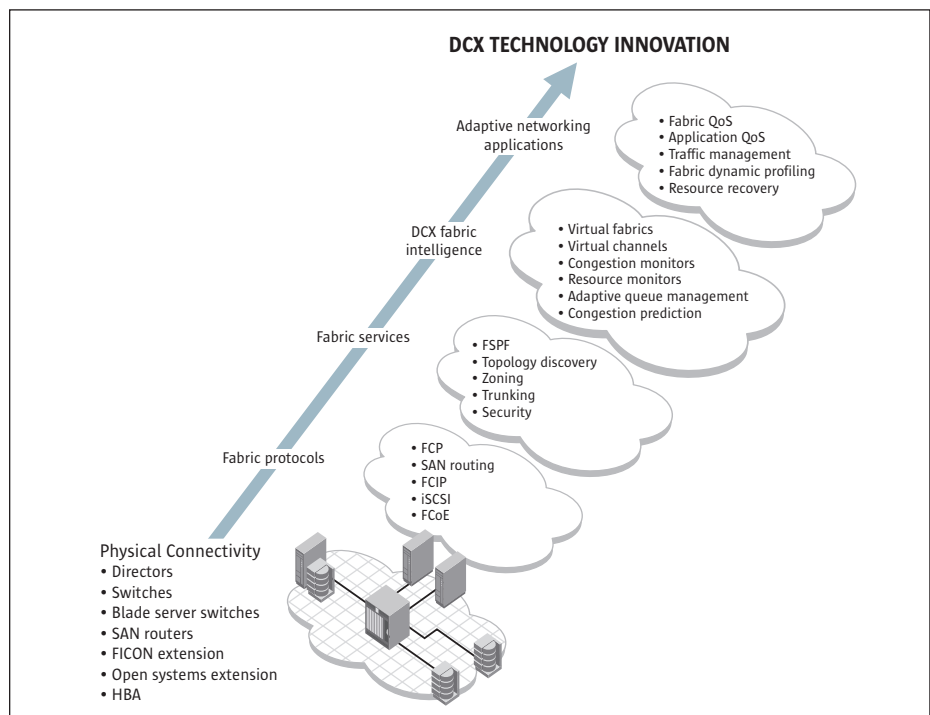


Figure 3. Evolving data center technology innovation

The Brocade DCX Backbone is the building block for converging server-to-server, server-to-storage, and storage-to-storage connectivity, which integrates with virtual server and virtual storage technology to simplify infrastructure management. Adding the Brocade DCX to existing SAN fabrics, shown in Figure 4, is non-disruptive, making it a stepping stone in the transformation of existing SAN fabrics to data center fabrics. It provides forward and backward compatibility with classic Brocade platforms; it is an interoperable platform for all SAN environments, ensuring vendor-independent investment protection.

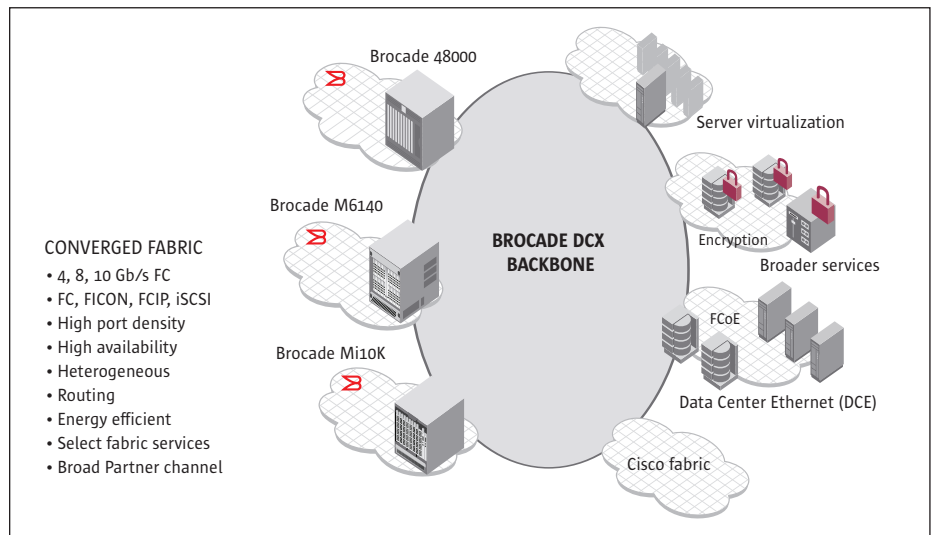


Figure 4. Data center fabric architecture and its characteristics

Summary

Data center evolution is fueled by the demand to consolidate assets. This requires re-architecting of data center infrastructure and physical plants and automation of management and functionality. The Brocade DCF Architecture is a key resource for organizations to meet these evolving business goals. Customers rely on us because of our history and commitment to be the first data center fabric solution that allows them to increase application efficiency and speed, deliver quality product and service, reduce IT cost of ownership and management, and help control and reduce risk during growth and change.

We designed this architecture working hand-in-hand with our customers and leveraging our proven leadership in technology innovation:

- Brocade has a large (in fact, the largest) installed base in the core of strategic data centers worldwide. We are in every major customer environment and understand their application and storage needs.
- The approach acknowledges that applications manage data, not the network. Fabric intelligence should simplify data access and management, end-to-end across the fabric.
- Policy-based services are applied where and when they are needed in the network to meet the needs of the applications and data they handle.
- The data center fabric is managed by a common framework that leverages existing Brocade and third-party data center management tools.
- We offer investment protection and extension of your current SANs and FANs. Brocade does not expect nor advise you to rip and replace your existing infrastructure.
- We are first to market and longest in market; we have the largest test and interoperability environment and a sixth-generation ASIC that provides the most efficient processor and equipment performance for bandwidth delivered per Watt consumed.
- Broad partnerships provide choice and best-of-breed integrated solutions. Proven technology partners let you build your own environment with the broadest selection of solutions and purchasing options.
- We have a range of services with proven expertise to help you evaluate, design, build, and manage your data center transformation.

The Brocade DCF Architecture is unique—it simplifies how applications connect to and manage their data without the confusion of the network competing for control. It extends application service levels and data management policies into the fabric. Fabric services such as data protection, security, and adaptive networking are used as required by the application, not as dictated by the network.

