White Paper

How to Build a Better Cloud:
Leveraging Unified, Virtualized Storage and Data Center Fabrics

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Cloud Services Becoming Pervasive

Although much of the talk about cloud infrastructures in the recent years was centered around marketing hype, the cloud landscape today is very real. The offerings available have matured, helping to define what the public and private cloud infrastructures can be. In addition, there is clear evidence that organizations are increasing their investments in cloud computing.

First, let’s take a step back and remember how we got to where we are today, starting with some ESG cloud definitions. Cloud computing is an IT service delivery model that is based on a dynamic infrastructure that is highly virtualized, self-service, and that offers elastic scalability to accommodate a varied and changing workload environment. Cloud infrastructures are centrally managed on shared resources and offer usage-based tracking. Public clouds offer software, infrastructure, and platforms as a service (SaaS, IaaS, and Paas) to customers who access them generally over the Internet. Private clouds offer this same type of dynamic IT infrastructure with all of these core features, but used solely for the benefit of the organization that builds and operates it.¹

The enterprise push to the cloud has clearly gained momentum. Recent ESG research indicates a growing data center consolidation trend. In a 2012 research survey, 63% of respondents reported that they were consolidating data centers, and of those, 48% reported that they were building out multitenant environments.² Data center consolidation has also moved into the top ten most important IT spending priorities chosen by research respondents, reaching number seven in ESG’s 2012 annual spending intentions survey (see Figure 1).³ Consolidation can deliver significant cost benefits by reducing the equipment and management effort required, but it also results in corporate data centers looking and acting a lot like service providers.

This consolidation is primarily enabled by increasing server virtualization, which has remained the top reported most important IT priority in ESG’s IT spending intentions survey for the past three years. Also notable is the emergence of private cloud into the tenth spot (see Figure 1).⁴

![Figure 1. Top Ten Most Important IT Priorities for 2012](image)

Which of the following would you consider to be your organization’s most important IT priorities over the next 12-18 months? (Percent of respondents, N=614, ten responses accepted)

- Improve data backup and recovery: 30%
- Increased use of server virtualization: 30%
- Major application deployments or upgrades: 29%
- Manage data growth: 27%
- Information security initiatives: 27%
- Business continuity/disaster recovery programs: 25%
- Data center consolidation: 24%
- Desktop virtualization: 23%
- Mobile workforce enablement: 22%
- Deploying a "private cloud" infrastructure: 22%

Source: ESG Research Brief, Private Cloud Usage Trends, August 2012.
² Source: ESG Research Report, Data Center Networking Trends, January 2012.
⁴ Source: Ibid.
Server virtualization deployments have been maturing, and as they do, they reach beyond the initial benefits of consolidation. Organizations are beginning to use virtualization to create a more agile IT environment to satisfy business needs. Cloud infrastructures provide the flexibility to scale up and back as needed, to provision new applications quickly, and to make applications and data available to a wider range of end-users; these advantages have increased in importance. This is also borne out in ESG research—when we asked IT professionals how they justify IT projects to business managers, for the first time in several years, the top justification they reported was business process improvement rather than reduction in operational expense.\(^5\) Today, infrastructure investments that make an organization more agile and more responsive to end-users are more likely to be funded.

**Challenges Facing IT**

A seemingly never-ending challenge for IT is finding a way to manage data and storage growth. Look at Figure 1 again, and you’ll find managing data growth number four on the hit parade of IT priorities. Block-based application data continues to grow. In addition, today’s technologies help to make file-based data growth a huge burden. With every laptop, smartphone, and tablet used to both create and consume content, it’s become an avalanche. Video streaming, web applications, photo sharing, and social media are certainly a large part of the challenge, but garden-variety file shares also contribute mightily. What’s the problem with all this data growth? Finding sufficient storage capacity and network bandwidth that can be managed effectively without breaking the bank. Most organizations have large—and growing—silos of separately managed block and file storage that are severely underutilized and cannot be shared. This scenario results in extremely inefficient, expensive, segregated storage and network domains that make agility, flexibility, and responsiveness almost impossible.

The value that virtualization adds can be somewhat diminished by its impact on networked storage environments, making it critical that networks and storage work well together. Running multiple virtual machines (VMs) on each physical server has the effect of aggregating workloads. As a result, I/O and throughput capabilities become of paramount importance—if the network can’t handle the consolidated workloads, application and storage performance will suffer. In addition, the virtual environment adds mobility to the mix—VMs can move among servers and clusters, and traditional networks were simply not built for this type of movement. These challenges can cause performance and availability problems that don’t sit well with users. This can lead to the problem of “shadow IT”—departments doing an end run around internal IT, buying application and data services from public cloud providers using a credit card. IT has to compete against this, and as a result must become more responsive. Private cloud, here we come.

**The Cloud is For Real**

Cloud service providers are also proliferating, and customers are gaining confidence that they can obtain reliable storage, software, infrastructure, and platform services from these providers. There is clear evidence that organizations are increasing spending on cloud environments. In ESG research, 74% of respondents stated that their IT departments would increase spending on public cloud computing services in 2012, with 46% of respondents reporting that they were already using SaaS and 27% reporting that they were already using IaaS—63% cited server virtualization and building private clouds as areas of increased spending in 20-12, as well (see Figure 2).\(^6\) These were significant increases from 2011, and clearly indicate that cloud computing is entering the mainstream.

\(^5\) Source: Ibid.
\(^6\) Source: Ibid.
Requirements for Success

The clear trends of greater data center consolidation and virtualization paint a picture of larger, more complex, multitenant environments for both private and public clouds. In the cloud, costs are based not on asset purchases, but on resource consumption. This enables customers to “pay as you grow,” paying only for what they use. Therefore, cloud environments must be able to track usage by customer. So whether you are in enterprise IT or a service provider, you need an infrastructure that offers a particular set of capabilities. Today’s cloud-focused infrastructures should be capable of:

- **Rapid provisioning.** Virtualization has made it possible to spin up a new application or add resources in just minutes. End-users are coming to expect this type of service, and have a diminishing tolerance for lengthy provisioning times. When there is a market opportunity (or threat), waiting weeks to request, purchase, provision, and configure infrastructure resources just doesn’t cut it anymore.

- **Multi-tenancy.** Whether your customers are internal or external, cloud infrastructures must be able to securely partition infrastructure resources. If every organization or customer you are serving has its own servers, networks, and storage, it is impossible to be efficient and responsive—it takes too much equipment and too many people. Multi-tenancy makes the best possible use of your equipment, keeping utilization rates high and spending low.

- **Service agility.** Customers require different service levels, but those service levels must be predictable and consistent. Service providers are paid according to SLAs, so they must meet them consistently or face fines, and private clouds face similar demands. The cloud infrastructure must be able to handle different data types, provide a variety of performance levels, and leverage a variety of network protocols. This type of agility answers the needs of users, IT, and the business. Mission critical databases might need very fast performance, while file shares may not, and a mix of network protocols can deliver different performance
and cost benefits. A single-flavor infrastructure will either waste money by providing high-level services where they are not needed, or under-serve users.

- **Operational simplicity.** Common management is extremely important for this type of infrastructure. Having to separately manage different storage types, physical and virtual servers, and network protocols is difficult and subtracts from the benefits that cloud infrastructures provide. In addition, automated features should be available to handle certain tasks such as automated storage tiering, array-based replication, and network load balancing. Of course, you can only manage what you can measure—making effective infrastructure monitoring and reporting absolutely critical to meeting service level objectives. Centralized, simple monitoring and management with high levels of task automation will enable greater efficiency and agility.

- **High degrees of virtualization.** Server virtualization enables multiple application workloads to be consolidated on physical machines. But that’s not the only type of virtualization that makes a cloud infrastructure beneficial. The ability to virtualize storage will not only make the most of current storage investments, but will also help to centralize storage management, and even network services can be managed and delivered virtually. Virtualization is an essential component for efficient delivery of IT as a service.

- **Fabric-based connectivity.** Networks today must carry traffic for a diverse set of applications, storage, and communications. Infrastructures built with pools of server and storage resources, and stringent user demands require low latency, high-bandwidth, and consistent performance. In addition, networks must be scalable, flexible, highly resilient, and virtualization-aware. The standard hierarchical network architecture is insufficient for this type of environment; growth and workload consolidation add processing latency as well as management complexity. Instead, fabric-based networks offer higher performance, fault tolerance, and guaranteed service delivery. Fabrics are more flexible, can more easily scale up and down, simplify and automate network configuration and management, and reduce errors and bottlenecks. Finally, fabrics may offer converged protocols and multiprotocol adapters to bridge LAN and SAN traffic, and add consolidation benefits.

- **Cloud scale.** Clouds provide on-demand access to shared pools of infrastructure resources, and often include self-service portals. As a result, they must be able to quickly increase resources on demand—without impacting performance. Compute power, storage capacity, and network bandwidth must be able to scale to great heights, and to easily scale back down with minimal intervention. The keys to cloud scalability are virtualized resources, consolidated management, and the ability to know what’s going on where, with advanced infrastructure monitoring and proactive alerting.

- **High availability.** Built for dynamic, 24x7 IT service delivery, cloud infrastructures must provide high availability of applications and data. That means components must be fault tolerant and redundant; provisioning and maintenance must be done without downtime; and data must be protected and available in the event of a failure or corruption.

Taken together, this is a hefty list of requirements—and one that is likely to grow in the future. Increasing cloud usage will no doubt escalate workload variations as well as the size of deployments. It seems fair to say that the foundation on which you choose to build your cloud infrastructure is not a trivial decision.

**Hitachi Data Systems and Brocade Enable Cloud Environments**

Deciding how to put together your cloud infrastructure can be a daunting task. Many organizations count on industry leaders Hitachi Data Systems (HDS) for storage and Brocade for network infrastructure, and as long-time partners, they have thousands of joint installations. Each company offers innovative solutions to the underlying challenges of the cloud—and they complement each other, making each other better together.
HDS Storage Solutions

HDS cloud storage solutions come from a long line of industry-leading products. The HDS Agile Cloud portfolio simplifies the adoption of cloud computing, helping organizations consolidate and dynamically automate IT resource delivery. Elastic scalability, security, reliability, and cost-effectiveness have been hallmarks of HDS solutions for SAN, NAS, and object storage—the portfolio includes Hitachi Virtual Storage Platform (VSP), Hitachi Unified Storage solutions, Hitachi NAS Platform, powered by BlueArc, and Hitachi Content Platform.

Hitachi Unified Storage

The most recent addition to the portfolio is Hitachi Unified Storage (HUS), which combines block, file, and object storage in a unified platform—including HUS VM, which combines enterprise virtualization with unified storage features for small and medium enterprises. HDS calls HUS VM “entry-level enterprise,” and it offers a mid-point in cache, capacity, ports, bandwidth, and functionality between the midrange HUS 150 and the high-end VSP. ESG believes this is an important slot to fill, as enterprises and service providers of all sizes are building out their clouds. For storage management, Hitachi Command Suite now offers a unified dashboard view of block, file, and object storage, so that administrators have a complete view across their environment from a single screen. This simplifies operations and reduces operational costs. In addition, protection applications such as Hitachi Universal Replicator and efficient, flexible provisioning with Hitachi Dynamic Provisioning, as well as both block and file software bundles to add functionality.

HUS VM is the type of storage environment that cloud deployments really benefit from, and that makes it easier to handle data growth. Storage for all types of data is consolidated in a single platform with integrated functionality and centralized management. HUS VM and Command Suite make it simpler and less costly to provision and manage storage for any application and eliminate the parallel silos for block, file, and object data. This unified platform also makes it easier to ensure data protection and compliance across applications and data types. For a cloud provider, whether public or private, this means that HUS VM can provide for every need: databases and home directories, active data and archives, high IOPS for transactional applications and high throughput for streaming media, all stored, managed, and protected centrally. Applications run on data stored in the infrastructure—if that storage begins to looks like a reservoir from which applications can grab what they need and return what they don’t, the concept of utility, service-based IT begins to come to life.

In addition, with external storage virtualization, HUS VM brings various vendor storage arrays under a single umbrella, making capacity from any storage investment available to multiple applications with consolidated management. Petabytes of capacity can be combined into a single, central storage pool. With consolidated, heterogeneous storage in a single, managed set of tiered pools, enterprise storage service levels become available at any time, to any application. Cloud providers gain additional return on previous storage investments, essentially upgrading them with HDS advanced capabilities.

These advanced capabilities have significant impacts—and among them, increased capacity efficiency so cloud providers can improve service levels while reducing management effort. IT gains more control over storage assets, but eliminates the complexity of multiple interfaces and management applications. Arrays without built-in advanced functionality can suddenly gain features such as automated tiering, advanced replication, and logical partitioning. Automated tiering optimizes both performance and cost by application, making a better environment for end-users, and can leverage HDS flash drives. HUS VM also extends the automated tiering feature to external storage, which is something most unified platforms cannot do. This additional tiering expands both performance and cost-efficiency. Adding advanced replication ensures that data will be available and recoverable when needed, reducing risk and minimizing downtime—essential in consolidated cloud environments. In addition, logical partitioning makes it easier for cloud providers to consolidate applications with secure segregation. Finally, this efficient environment reduces data center floor space, power, and cooling costs, as well as reducing (or eliminating) tape backup processes.
With HDS, private and public cloud providers can offer storage as an infrastructure service easier, faster, and with higher availability and reliability. All of these, combined with the ability to consistently meet service levels, bring a comfort level to customers that their cloud infrastructure will perform as needed.

**Brocade Cloud-optimized Networking**

So what impact do virtualization, data center consolidation, and workload aggregation have on the network? The increased demand for fast access to IT services, rapid scalability, and continuous uptime for various applications with various performance and availability requirements can create a significant strain on network resources. Networks must be able to handle high I/O and throughput with low latency—the diversity of workloads as well as their aggregation requires high performance so that the network doesn’t become a bottleneck. The network architecture must also be highly scalable to handle not just data growth, but also the unpredictable demand of self-service cloud portals. In addition, there must be minimal downtime, since the consolidated cloud infrastructure is likely to be fully in use at all times. That means not just greater automation of network tasks, but management across the domain instead of by individual device. Automation enables the network to be more flexible and agile as clouds demand, simplifies administration, and reduces costs. All these capabilities are necessary for private clouds to operate effectively—and for public clouds if they expect to generate revenue. Imagine a cloud service whose network can’t accommodate demand spikes—that’s a cloud about to burst.

The cloud-optimized network must be able to seamlessly connect physical and virtual components, creating a flatter network that can operate effectively through constant change. The network has a huge impact on service delivery, so it must be simple to manage, intelligent, scalable, and efficient to consistently meet SLAs. One cloud challenge is that virtual machines can be moved around between physical devices—so port configurations, VLAN membership, client access connections, and network policies must be portable and travel with the VMs, while also retaining security and load balancing. With so many moving parts, network traffic management and congestion must be managed without manual reconfiguration.

So in this more complex environment, how do you deliver lossless, deterministic network services that are virtualization-aware, simple to manage, that keep latency low, scale rapidly, remain agile, are highly available, and are not exorbitantly expensive? Brocade Fibre Channel (FC) and Ethernet fabrics fit the bill. Brocade fabric-based switches and adapters are built for virtualization and the cloud, offering high performance and resiliency for FC, iSCSI, and NAS storage environments enabled by HUS, and delivering the simplicity, high level of features, and virtualization awareness that clouds demand. Fabrics are different from standard hierarchical networks; they include properties such as self-aggregation, self-healing, transparent internal topology, and Layer 2 multi-pathing, which all help to minimize manual intervention. With their distributed intelligence, network policies and devices are known at every port. In addition, the Brocade Automatic Migration of Port Profiles (AMPP) feature is hypervisor-agnostic and provides the ability to automatically apply policies and networking parameters when Virtual Machines are provisioned dynamically anywhere in the VM infrastructure that is connected to the Brocade Virtual Cluster Switching (VCS) network. Traffic is not restricted to the standard “north-south” movement; fabrics also manage “east-west” traffic to span multiple server racks, reducing latency and minimizing inter-switch link congestion.

**Fibre Channel Fabric**

Brocade DCX 8510 Backbones and enterprise-class Fibre Channel switches are easy to deploy and simplify scale-out network design, reducing complexity, management, and costs. With “pay-as-you-grow” scalability and 16 or 8Gb/sec FC line-rate connectivity on all ports, Brocade Fibre Channel fabrics provide the flexibility and performance that clouds need. Consolidation of legacy SANs can optimize port density and space utilization, saving money as multiple environments combine into a single fabric. Brocade’s industry-leading and data center proven reliability meets the needs of dynamic cloud environments, offering enhanced diagnostics and reliability, availability, and serviceability (RAS) functionality to minimize disruption and maintain uptime.

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**Ethernet Fabric**

Brocade Virtual Cluster Switching (VCS) fabric technology provides a flatter, more reliable Ethernet network. By eliminating the Spanning Tree Protocol, it delivers active-active server connections, doubling network utilization and improving resilience. This flat, multi-path, deterministic mesh network is ideal for unified storage environments like HUS, virtualized data centers, and cloud computing. It supports a flexible topology so that it can handle changing application demands, and seamlessly interoperates with all industry-standard Layer 2 switches. In addition, it offers elastic scalability—switches can be added and removed without manual configuration. It scales out in a modular fashion with consistent performance and latency, and IP storage traffic can be configured for transmission over lossless Ethernet channels for optimal performance.

**Fabric Adapters**

Featuring Brocade AnyIO technology, Brocade fabric adapters support native 16Gb/sec Fibre Channel and 10Gb/sec Ethernet Data Center Bridging (DCB) connectivity, offering a single fabric adapter to meet all the connectivity needs of highly virtualized, cloud-enabled data centers. Brocade fabric adapters extend Fibre Channel and Ethernet fabric services to the server and applications, delivering unmatched performance, application-aware services, and reduced cost and complexity.

**Centralized Management**

Brocade Network Advisor unifies the management of adapter, Fibre Channel, and Ethernet fabric resources, reducing management complexity and costs. With “at-a-glance” health and performance dashboards, Brocade Network Advisor provides advanced monitoring, diagnosing, and troubleshooting capabilities that avoid problems and minimize downtime. In addition, Brocade Network Advisor is integrated with leading hypervisors and virtualization management solutions to enable a single point of data center management.
The Bigger Truth

As private and public cloud services continue to gain popularity, enterprises and service providers need flexible IT environments that support varying applications and service levels. Virtualization has made so much possible—that is the good news, but also the bad news, because a byproduct of virtualization is that user expectations are through the roof. Performance, availability, and scalability will make or break a cloud infrastructure—end-users expect immediate IT services that deliver the performance they need and remain up and running no matter what. A multi-tiered infrastructure that appears as a single, easy-to-manage, unified environment will become a critical foundation; consolidated data centers, unified storage environments, and network fabrics will likely be part of the solution. Success will depend on the ability to rapidly provision highly available, shared infrastructures that deliver consistent service levels.

Whether your customers are internal or external, Hitachi Unified Storage and Brocade Fabrics are proven, tightly integrated solutions that accelerate cloud deployments. The right infrastructure is a requirement—and while HDS and Brocade separately deliver extremely valuable assets, they are in fact better together. Both companies understand what their customers face in setting up and operating cloud environments, and as a result their solutions are built on the concept of consolidated resource pools that can be provisioned quickly, distributed to a variety of applications, and managed centrally. Virtualization of only part of the infrastructure stack gets only part of the job done; implementing cloud-optimized storage without a cloud-optimized network (or vice versa) will ensure that applications encounter bottlenecks, causing end-user dissatisfaction. Together, HDS and Brocade help you create a flexible, agile, resilient infrastructure that is operationally simple—a “better together” solution for public and private clouds.