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Strategic Snapshot

IBM Blade Storage Strategies
Diskless Blade Architecture

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ABSTRACT

Demands for increased efficiency in the datacenter have led systems vendors to develop a variety of more efficient and flexible servers. At the same time, consolidation initiatives combined with the growing demand for information of all types now has organizations facing the challenge of managing a rapidly growing data pool. This has become a very real concern for most organizations as they struggle to adopt industry best practices and comply with various regulatory initiatives. This challenge is further complicated by the varying workloads and historic server deployment practices that shaped the IT infrastructure within the datacenter.

IBM BladeCenter offers organizations the opportunity to rethink their approach to storage, serving a latent need for a new approach to blade server storage that helps deliver efficient deployment, streamlined operational management, and competitive acquisition cost, to support the growing needs of organizations through a choice of storage solutions.

In this paper we review the storage needs of blade server environments. In particular, we review the storage options afforded IBM BladeCenter users and how these capabilities can deliver a new approach to server and storage environments within organization of most any size. By taking a diskless blade server approach combined with remote booting of servers, organizations are in a good position to help reduce the upfront costs and operational and maintenance expense, as well as the complexity of their blade server environments. In addition, the diskless architecture is consistent with storage and server consolidation initiatives as all data and applications are retrieved from a centralized location.

IBM Blade Storage Strategies

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What Does the Future Hold for BladeCenter Storage?

Demands for increased efficiency in the datacenter have led systems vendors to develop a variety of more efficient and flexible servers, and blade servers are among the most notable new platforms. The efficiencies afforded in space, wiring, flexibility, and ease of maintenance and operation of bladed solutions such as IBM BladeCenter have resulted in a growing popularity and acceptance of the architecture. At the same time, consolidation initiatives combined with the growing demand for information of all types now has organizations facing the challenge of managing a rapidly growing data pool. This has become a very real concern for most organizations as they struggle to adopt industry best practices and comply with various regulatory initiatives.

This challenge is further complicated by the varying workloads and historic server deployment practices that shaped the IT infrastructure within the datacenter. Disk-based storage has often been deployed in silos, just as organizations have typically deployed their server operating systems on local storage while locating the applications and data either locally or on a network resource such as a NAS- or SAN-based storage pool. Although this customary approach is familiar to most organizations, it is not necessarily the most efficient solution for storage, especially in light of today's blade-based environments.

IBM BladeCenter offers organizations the opportunity to rethink their approach to storage. With proper consideration and planning, organizations can transition to a simplified, consolidated approach that will support their blade servers. In addition, organizations can achieve a state-of-the-art best practice approach to deliver virtualized server environments on the blade infrastructure with virtual workloads having equal and streamlined access to all stored data, applications, system boot environments, and other IT resources. This solution serves a latent need for a new approach to blade server storage that helps deliver efficient deployment, streamlined operational management, and competitive acquisition cost, to support the growing needs of organizations through a choice of storage solutions.

The Diskless Blade Approach

By taking a diskless blade server approach combined with remote booting of servers, organizations can help reduce the upfront costs and operational and maintenance expense, as well as the complexity of their blade server environments. This approach removes all moving media from server blades, which can lead to increased availability, manageability, and simplicity of the storage infrastructure as well as reducing the number of blade components that might fail. Blade servers boot from remote disks; however, "remote" can actually be very close by, as the drives can be attached to the BladeCenter via a simple switch. Besides addressing one of the more common blade component failures, this approach is also consistent with storage consolidation initiatives.

The diskless blade strategy also simplifies support for virtualized server environments as virtual workloads have equal access to all stored data, applications, system boot environments, and so forth. This helps enable organizations to deploy additional resources at a significantly lower rate of administrative overhead, due in large part to shared or virtualized CPUs, storage, and management software.

Nevertheless, for most organizations a sudden change to a diskless strategy might be disruptive to operations as the changes would impact not only the topology of the servers, but also potentially the network resources, especially if the system files, applications, and data were suddenly relocated across the organizations in disparate locations. For those organizations that cannot afford to make a rapid change to a diskless environment, IBM

offers transitional paths that support the strategic changeover to a diskless blade server in a more measured, incremental, and minimally disruptive fashion.

Given the consolidated nature of IBM BladeCenter, close-by centralized storage can be achieved through high-performance yet low-cost Serial Attached SCSI (SAS) drives. These modern drives can be attached within the BladeCenter chassis to yield an optimal price/performance solution for many workloads without mandating the deployment of a SAN, NAS, or other external storage solution. Alternatively, solid state/flash memory disks can also be deployed on the server blade as a transitional step. These non-moving storage devices deliver many of the same benefits as the diskless blade approach while maintaining the existing on-blade boot approach. IBM has made considerable progress in solid-state disk technology and the company views it as an integral part of simplifying and enhancing the reliability of blade server environments.

IBM BladeCenter Background

IBM's vision for BladeCenter as both an architecture and strategy to integrate and simplify server environments dates back to the introduction of this architecture in 2002. More than just a fancy new rack; BladeCenter's consolidated and integrated design inherently reduces customer acquisition, deployment, and management costs over that of traditional rack- and tower-based servers.

IBM BladeCenter offers the flexibility to build up as well as logically build out in order to meet the workload needs of customers. Computing, memory, operating systems, storage, and other resources can be quickly deployed and made available to applications while helping reduce the traditional expenditures to acquire, integrate, and manage hardware resources.

By taking a diskless blade server approach combined with remote booting of servers, organizations can help reduce the upfront costs and operational and maintenance expense, as well as the complexity of their blade server environments. Deployment, operations, and maintenance costs can be significantly reduced by the elimination of extensive cabling, and unnecessary redundant external components such as power delivery systems or switches, etcetera. Efficient resource management can result in improved asset and cost management in most any business environment. In addition, through consolidation and integration, BladeCenter helps to reduce potential points of failure and increases system availability.

Beyond simply creating a new form factor for servers, BladeCenter was an early integration platform for a variety of interconnection methods. The platform was first to market with many innovations including:

- The first integrated Fibre Channel switch module for a blade, delivered in 2003. This option integrated the storage fabric into the blade server architecture;
- The first iSCSI adapter for blade environments, released in 2005.

IBM recognizes that organizations have varying storage requirements and that a one-size-fits-all approach will not meet all BladeCenter customers' storage needs. IBM BladeCenter is a very flexible architecture that supports a variety of storage approaches and technologies including:

- Storage Area Networks (SAN),
- Network Attached Storage (NAS),
- Direct Attached Storage (DAS) options affixed inside the blade server,
- Direct Attached Storage (DAS) via an option attached to the blade server.

BladeCenter Storage Strategy: Enabling the Future of Enterprise Storage

Although there are many means by which one can connect BladeCenter to storage, a well considered strategic approach is in the best interest of any organization. Even if the current storage footprint is an amalgamation of disparate solutions, a transitional roadmap can be defined with the goal of an eventual rationalization and simplification of the storage resources.

High-Level Strategy

IBM has a strategic view for BladeCenter storage that offers customer choice in storage systems for their BladeCenter while simultaneously offering best practices in deployment and operations. This is demonstrated by the broad range of storage and interconnect offerings for BladeCenter including Direct Attached or Local Disk Storage, Fibre Channel SAN, iSCSI SAN, and NAS. In each case, the driving consideration is to provide the flexibility and simplicity required for organizations of almost any size to align the value of their data and information stores with the most cost-effective and appropriate storage solution.

IBM recommends blades as the best practice for any datacenter, not just bladed environments. IBM offers a simplified and consolidated storage solution for organizations that have made a strategic commitment to IBM BladeCenter platform. For organizations that are not in a position to undertake a potential disruption in service to embrace this practice, there are transitional storage technologies such as SAS drives and Solid State or USB flash memory drives that can help.

Detailed Strategy

IBM's strategy is to deliver a comprehensive set of application-optimized storage solutions for BladeCenter environments. Although the technologies function well across a variety of applications, the company has invested in the creation of specific solutions that target specific application workloads ranging from infrastructure applications such as Web serving to industry-focused line-of-business applications, including FlashCopy and many ISV backup and recovery applications.

As part of its overall storage strategy, IBM has delivered enhanced storage management integration and automation for BladeCenter. This helps to simplify the management of BladeCenter overall, but it also provides an opportunity for organizations to leverage and broaden the skills of their existing IT personnel to overcome a common bifurcation in IT support skills between servers and storage.

Diskless Blades

IBM promotes the diskless blade and remote boot for blade servers as the preferred storage solution. The company is a strong supporter of diskless blades given their ability to help deliver consolidated simplicity, decreased operational cost, increased availability and improvement of the overall value derived from BladeCenter environments.

Organizations that select the diskless blade approach can potentially derive the following benefits:

- Increased reliability of the blade server due to the removal of all moving parts,
- Increased storage efficiency as redundant copies of system boot and configuration files as well applications and associated data are consolidated on the SAN or other external (to the blade) storage,

- Decreased acquisition costs for server blades since there are no onboard disk drives,
- Reduced operating and managements costs as a result of fewer parts and a centralized approach to data storage,
- Potential for reduced heat generation as the total number of disks is reduced in a consolidated approach.

In addition, the diskless architecture is consistent with storage and server consolidation initiatives as all data and applications are retrieved from a centralized location. This has the advantage of simplifying the addition of other physical or virtual servers as no local disk setup or system and applications installation is required, which can substantially help reduce deployment times.

SAS and Solid State Drives

Although the advantages of the diskless approach are numerous, IBM recognizes that not every organization can make an instantaneous migration to this architecture. In addition, there are customers that for well founded reasons would not choose to embrace this approach as their own. To meet the needs of these organizations, IBM is committed to providing a transitional path to a diskless BladeCenter environment and alternatively offer a disk-based solution that helps deliver initial acquisition and long-term operational cost reductions over traditional solutions.

SAS drives are a relatively new storage technology providing a favorable balance between low cost and high performance for DAS on a BladeCenter server blade. These small form factor drives do not necessitate changes to the server environment and offer moderately large amounts of onboard data storage with favorable performance characteristics.

Solid state or flash memory drives offer onboard DAS on the blade server; however, this storage technology addresses many of the shortcomings of traditional drives such as operational/moving part failure, heat generation, and current draw. As a result, organizations can maintain a local boot device on the server blade as well as support a modest degree of local storage, while simultaneously benefiting from enhanced reliability, reduced operational expense, decreased heat generation, and a lower blade acquisition cost.

Commitment to Technology Flexibility

As part of its commitment to customer choice and flexibility in technology, IBM supports numerous storage and interconnect technologies including:

- FC N Port ID Virtualization (NPIV) switch modules
- SAS technologies including I/O Expansion Card, and Connectivity Module
- BladeCenter S Chassis that features integrated SAS or SATA disk-based storage
- SATA solid state drives with mirroring in one drive bay (available on the Hs21 XM)
- 10Gb Ethernet-based unified fabric support
- Support for iSCSI using SW and HW iSCSI initiators

BladeCenter Storage Flexibility and Options

There are many ways to implement storage for BladeCenter. Centralized approaches can raise the average utilization of storage through centralized management and allocation of resources. The majority of approaches involve external storage, i.e., storage that is accessed through a switch in the BladeCenter chassis to a network resource.

Depending upon customer workload scenarios, storage can be directly attached to the BladeCenter. If workloads dictate that servers outside of the BladeCenter chassis have direct access to storage resources, then external interconnections across a SAN through FC, iSCSI, or Infiniband or NAS through Ethernet can be deployed to maintain a centralized but universally accessible storage pool for all required servers. What follows is an overview of the various interconnection options that IBM BladeCenter supports and some of the recommended scenarios for said options.

Direct Attached Storage (DAS)

DAS is the most prevalent method by which to attach storage. Traditionally, this has been achieved by attaching disk drives to the server blade, which provides storage for the specific blade only. While the storage is available for boot and local application purposes, it is not an optimal approach for leveraging the storage capacity as the storage mounted to an individual blade cannot be directly shared among the blades inside the chassis.

Another approach to DAS is to attach SAS disks via a Storage and I/O Expansion Blade directly to the blade itself. The Expansion Blade includes disks that are hot-swappable and is available with optional advanced RAID and additional I/O bandwidth on select blade servers.

In addition, with the BladeCenter S chassis, one can attach SAS disks directly to the blade chassis midplane to make storage directly accessible by all blades in the chassis. These disks are hot-swappable and accessed via the integrated Disk Storage Module in the BladeCenter S chassis. This approach permits treating all the storage as a pool that is available to all blades without incurring most of the overhead inherent in sharing files resident on a drive that is directly attached to the server blade.

Common scenarios where this approach is recommended include branch offices or other smaller remote settings, supporting infrastructure applications such as file, print, and security as well content or document management solutions.

DAS with Solid State Storage

For some organizations, storage that is directly attached to the blade server may be appealing for local boot purposes or storage of frequently accessed files but there is still a desire for the bulk of files to be stored and accessed off the blade. In this approach, directly attached solid state drives, which contain no moving parts, are a new option for balancing the need for local boot scenarios with overall efficiency. This provides for local storage to handle certain workload characteristics but encourages centralization of most storage.

In addition, these drives share many of the characteristics of a diskless approach as there is minimal heat generated, no moving parts, and quick and simple installation/removal. As a result, this approach can be part of a transition to a diskless blade environment or to comply with corporate policies that discourage the remote boot scenario inherent in a network-only storage solution while maintaining a centralized storage architecture.

Recommended usage scenarios include distributed environments with large amounts of networked storage, such as Web servers or other workloads that are dynamic and often call upon additional servers for peak load balancing

SAS Adapters, SAS Connection Modules, and SAS Storage Systems

Advances in SAS storage technology have elevated its capability to be comparable with traditional higher-cost approaches. A consolidated pool of external storage based upon SAS drives, adapters, and switches offers a higher performance solution compared with

1GB iSCSI implementations and is competitive with Fibre Channel-based solutions for many organizations. One example of this is IBM's System Storage DS3200, which can scale to 14.4TB with hot swappable 300GB SAS drives.

SAS-based solutions are well suited for workgroup applications, security solutions, remote boot scenarios, and applications with medium-bandwidth requirements.

Fibre Channel SANs

SANs are commonly found in organizations with large storage requirements that are spread across multiple applications/workloads. The decision to deploy a SAN is largely driven by the desire or need for sharing of storage resources throughout the enterprise. SANs permit a mixture of storage technologies that are most appropriate for a given workload or price/performance consideration without limiting access to the storage pool to a given server or cluster of servers.

IBM BladeCenter provides access for Fibre Channel SANs using FC Host Bus Adapters from QLogic and Emulex and FC switches from Brocade (McDATA), Cisco, and QLogic; FC HBA NPIV switch modules; and Optical Pass-through Modules. All these options are supported on IBM System Storage N series, DS3000, DS4000, DS6000, and DS8000 as well as most non-IBM FC SAN attached storage systems.

Recommended usage scenarios for FC SANs include enterprise applications including database, analytics, and data warehousing; email; ERP; and other high-bandwidth applications. SANs also support remote boot server environments for diskless servers.

InfiniBand

InfiniBand is a very high-performance switched fabric that is generally deployed in environments where low latency and the highest performance are of paramount concern. InfiniBand is typically used in clusters where scalability of workload is important while maintaining high performance characteristics overall. Connectivity to the fabric from a server is achieved through an InfiniBand Host Channel Adapter and storage connectivity is achieved through the InfiniBand Target Control Adapter such as an FC bridge or Ethernet bridge. Fibre Channel bridges are supported with IBM System Storage N series, DS3000, DS4000, DS6000, and DS8000; Ethernet bridges are supported with the IBM System Storage N series.

Given its inherent high performance characteristic, common InfiniBand usage scenarios include large-scale enterprise applications, high-performance clusters (HPC), grid computing and other highly distributed high-bandwidth, low-latency applications such as multimedia, scientific modeling, and business intelligence.

iSCSI

iSCSI offers organizations a relatively simple way by which to create a storage network that only requires an Ethernet interface supporting standard TCP/IP networking. With the general availability of low-cost Gigabit Ethernet components, iSCSI has found a place in delivering storage connectivity with a favorable price/performance ratio. iSCSI connections are made through a hardware adapter and Ethernet Switch, or iSCSI software initiator (BIOS-based) and Ethernet Switch. Both of these approaches are supported with the IBM System Storage N series.

Common usage scenarios for iSCSI include small business applications, email, and other applications. For environments with storage that can support 10GB speeds, 10GB iSCSI combined with a 10GB Ethernet switch module can deliver a very high performance solution. iSCSI also supports remote boot environments.

Network Attached Storage

NAS is commonly found in organizations with storage requirements that are spread across multiple applications/workloads. Growing organizations have often turned to NAS deployments as a way to combat storage silos by providing a centralized pool of storage that can be accessed throughout the organization. One reason for the popularity of NAS is its ability to share storage across multiple servers but often at a lower entry price point than SANs. NAS is supported with IBM System Storage N series.

NAS implementations are generally well suited for workgroup applications and file-based applications. However, in fully 10GB Ethernet environments NAS can provide a high-speed solution. Unlike FC SAN, native block based I/O is not supported, so its deployment to support database or other block based applications is not recommended.

There are low-cost alternative methods by which to connect iSCSI and NAS storage solutions to the network. These are typically through an embedded Ethernet adapter or Ethernet switch with speeds of 1GB or less. These interfaces are supported with IBM System Storage N series.

Standard Ethernet connectivity is ubiquitous, so it is easy to provide access throughout an organization; however, the performance characteristics are often limited compared with other networked storage solutions including much faster Ethernet solutions such as 4GB or 10GB. As result, for all but the most transitory or tactical uses, such interconnections are not recommended.

What Does It All Mean?

The efficiencies afforded in space, wiring, flexibility, and ease of maintenance and operation by IBM BladeCenter has resulted in a growing popularity and acceptance of the platform architecture. IBM BladeCenter allows enterprises to consolidate various applications, networks, and supporting storage into a simplified and consolidated solution. In addition, it helps enable organizations to deploy additional resources at significantly lower administrative overhead while maintaining higher overall utilization of storage as well as servers through virtualization. BladeCenter can support build up or build out environments, whichever is the best approach to meet the customer's needs.

Enterprise storage has been an under leveraged IT resource, given its history using discretely deployed silos often to support specific applications. Interconnecting these storage systems has been a daunting, if not impractical undertaking as the server and storage volumes were discreetly deployed, owned, and managed. Consolidated storage offers greater virtualization and operational efficiency for organizations that have made a strategic commitment to the blade server architecture. The BladeCenter supports all common standard interconnect methods including DAS, SAN, and NAS.

Managing a rapidly growing pool of data has become a very real concern for most customers as they struggle to achieve industry best practices and comply with various regulatory initiatives. Diskless blades support a remote boot environment that can help further enhance operational efficiency, reduce powering and cooling impact, and simplify the deployment and redeployment of server blades. In scenarios where customer needs dictate a local storage solution, solid-state storage offers many of the same benefits as the diskless approach.

By taking a diskless blade server approach, enterprises can reduce the complexity of their blade server environments. In addition, this simplifies support for virtualized server environments on the blade infrastructure as virtual workloads have equal access to all stored data, applications, system boot environments, and so forth. Organizations taking

this approach are in a good position to deploy additional resources with greater administrative flexibility, due in large part to shared or virtualized CPUs, storage, and management software.

IBM has made considerable progress in Solid State drives and views them as a preferred best practice when requirements dictate a local boot capability on a server blade. IBM has a breadth of technology, products, and service that can meet the needs of organizations that have invested in a blade centric strategy. Further, IBM has a strategy to address the latent need for a new approach to blade server storage that helps deliver efficient deployment, manageability, and reduced costs to support the growing storage need through a variety of storage alternatives.

Organizations that have made investments in blade server environments are well advised to consider their strategic needs for storage across their entire IT infrastructure and weigh the cost and benefits of consolidating their storage solutions. For those seeking to build upon the simplified, consolidated, and flexible infrastructure afforded by their BladeCenter investments, the move towards diskless blades and consolidated storage should be given thorough consideration.