Intel IT Center

MARCH 2012

Vendor Round Table

Cloud Storage

Vendors Answer IT's Questions about Storage Technologies for Tomorrow's Cloud

Why you should read this document:

This guide is designed to help you better evaluate different cloud storage technology offerings based on the answers to a series of questions posed to four vendors about six storage solutions. This document compiles their responses, including:

- Descriptions of the architecture and components of the cloud storage solutions
- How the current offerings integrate with data center infrastructure
- Information about storage allocation, file types, and storage network protocols
- How return on investment is demonstrated

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Introduction

Compare answers from vendors to common IT questions to help you evaluate storage technologies for the next-generation data center.

Scale-out storage may be one of the most important improvements you can make as you evolve your next-generation data center. The volume of digital content—most of it unstructured—continues to increase, putting heightened pressure on data center networks and storage capacity. More efficient storage is an imperative, as data must be available to meet business, regulatory, and compliance needs.

Highly virtualized environments actually worsen existing storage inefficiencies. Capacity may be provisioned to handle worst-case scenarios, but is underutilized. Redundant data is copied and archived, while unused space may be backed up. The cost of adding more storage capacity is compounded by performance degradation.

Intelligent storage solutions offer compelling benefits and a way for the next-generation data center to address three major storage challenges: increasing volume, inefficient management, and cost. While traditional approaches to storage are often built around extremely powerful, costly, and in some cases proprietary hardware, intelligent storage solutions combine software and industry-standard converged storage servers to deliver high-speed access in a much more modular and scalable solution.

There's no one-size-fits-all solution for scale-out storage. We created this guide to help you better evaluate different storage vendors and their offerings as applied to your specific data center initiatives.

We asked four companies to answer a standard set of questions about six storage solution offerings. This document compiles their responses.

Next-Generation Data Center Resources from Intel

Vendor Round Table: Cloud Storage is part of a series of documents produced by Intel to help IT professionals prepare the next-generation data center to take full advantage of the benefits of cloud computing. Other documents include:

- *Planning Guide: Technology for Tomorrow's Cloud.* Describes how IT managers can prepare their virtualized data centers for the cloud in three key areas with unified networking, scale-out storage, trusted server pools, and policy-based power management
- *Peer Research: Cloud Computing Research for IT Strategic Planning.* Survey of IT professionals describing the business and technology drivers for evolving networking and storage technologies to support cloud environments

Participating Vendors

Throughout this guide, vendors are listed in alphabetical order.

Vendor	Product	For More Information
AMPLIDATA	AmpliStor	www.amplidata.com
DataDirect NETWORKS	Web Object Scaler* (WOS*)	www.datadirectnet.com/products/web-object-scaler-wos
EMC²	EMC* Atmos*	www.emc.com/storage/atmos/atmos.htm
	EMC Isilon*	www.isilon.com
	EMC Symmetrix*	www.emc.com/products/storage/symmetrix/symmetrix.htm
NetApp	NetApp cloud storage solutions	http://www.netapp.com/cloud

Intel Guidance on Vendor Selection

Choosing a next-generation storage vendor is complicated on many levels. Your existing network and storage architecture, as well as the usage model you want to support, define the scope of the implementation. In addition, the vendor landscape is characterized by countless interdependencies and relationships, both technological and business related, among vendors. And some companies offer not only software, but also hardware and services.

General considerations for selecting a vendor include:

- Which usage model do you want to support: application data store, large object store, or backup and archiving?
- Is the solution robust enough to support organizational growth? Is it modular and scalable?
- Is it built on open standards with minimal proprietary or customized hardware and software?
- What benchmarks does the vendor provide for performance and reliability? Can they be replicated independently?
- Is the solution compatible with other next-generation data center technologies, such as unified or converged networking? Will it run with newer technologies and protocols, such as 10 or 40 gigabit Ethernet (GbE), Fibre Channel over Ethernet (FCoE), or Internet Small Computer System Interface (iSCSI)?
- What specific capabilities are you looking for? How does the solution:
  - Maximize capacity and minimize overallocation and underutilization?
  - Handle duplicate or redundant data?
  - Provide tiered access to stored data based on demand?
  - Maximize reliability and minimize data traffic errors?
- Does the solution enable you to meet industry or regulatory compliance requirements?
  - How is data protected? Encryption?
  - What are the compliance issues that affect storage? For example, is data distribution across geographies OK? Does your industry impose specific storage and access requirements?

In addition, considerations related to costs, vendor relationship, and long-term product viability include:

- What is the total cost of ownership? Make sure to include licensing fees, upgrade charges, support, and maintenance fees over time.
- Is your engagement based on a trusted advisor relationship? If so, you can be more confident that your vendor will help you avoid costly mistakes by helping you understand what you need to know for a successful deployment.
- What is the long-term strategy for the product?
- Is the vendor financially stable?

Evolving the Data Center at Intel

In 2009, Intel IT began moving the Intel enterprise to a private cloud and exploring the use of external cloud services for certain applications.

Underlying Intel's private cloud strategy is a plan to implement the right technology to support these efforts, including upgraded network architecture, intelligent storage solutions, and trusted server pools that build security into the hardware while enhancing security software.

Vendor Responses to IT Questions

Vendors responded to the following standard set of questions. Please note that many answers include acronyms. You can find these spelled out in the Acronym List.

1. Please briefly describe the components of your storage solution.
2. What is your solution architecture, and how does it support cloud implementations?
3. What does your solution offer IT managers looking for a storage fabric that supports a cloud environment?
4. How does your storage solution reduce IT complexity in the data center? How does it make an IT manager's life easier?
5. How does your solution integrate with data center infrastructure?
6. Does your solution use FCoE, 10 GbE, or iSCSI? Please describe.
7. What hardware configuration do you recommend to take full advantage of the capabilities of your offering?
8. How does your solution allocate storage? (DAS, NAS, or SAN?)
9. What file types is your solution best suited for?
10. What sort of tools do you offer to minimize data duplication in the network? How does your solution work with other providers' solutions to protect data in motion, in transit, or at rest?
11. Why should I select your solution over the others?
12. Do you have a method for demonstrating ROI for your offering?
13. Are there networking or storage concerns that your solution doesn't address that you think the industry still needs to solve?
14. I'm just beginning to investigate innovative technologies that will support my future plans for cloud implementations. What advice can you give me, and what steps should I take to make sure I'm covering all my bases?

Q1: Please briefly describe the components of your storage solution.

AMPLIDATA

AmpliStor is designed to tackle the problems of traditional storage systems, which provide high reliability by storing multiple data copies across storage nodes. Instead of copying data, AmpliStor encodes and distributes data using BitSpread, a high-performance implementation of "erasure coding," to achieve high reliability at low overhead. The technology comes preinstalled on a dedicated AmpliStor appliance.

AmpliStor software components include:

- **BitSpread:** BitSpread Codec uses online codes to distribute and store data reliably across a large number of AmpliStor storage appliances. Stored data objects are divided into data blocks and then encoded into check blocks. Original data objects are accessed by decoding a subset of check blocks as soon as a minimum number have been retrieved. This provides fault tolerance by allowing a set of disks or storage nodes to be unavailable as per user-set policies while still preserving data access.
- **BitDynamics:** Automates out-of-band storage management functions such as data integrity verification, self-monitoring, automatic data healing, scrubbing, and garbage collection. A BitDynamics agent on each AmpliStor storage node provides scalable and parallel processing of repair and maintenance tasks.

AmpliStor hardware components include:

- **Storage node:** The AmpliStor node is an integrated and preconfigured appliance containing disk storage, processor, and BitDynamics software.
- **Controller node:** An AmpliStor environment requires three or more controller nodes, which provide redundant data access (read and write) and run the BitSpread software.

DataDirect NETWORKS

DataDirect* Networks Web Object Scaler (WOS) is the industry's leading scale-out cloud storage hardware and software appliance solution. WOS provides high-speed access to hyperscale-sized data in the cloud from anywhere in the world. WOS radically simplifies and improves how data in the cloud is stored, distributed, and accessed across multiple geographically dispersed sites. From a single, easy-to-use management interface, you can build a global storage cloud that scales simply and limitlessly.

EMC²

EMC Atmos

EMC Atmos is a cloud storage platform that lets enterprises and service providers store, manage, and protect globally distributed, unstructured content at scale. Atmos provides the essential building blocks to implement a private, public, or hybrid cloud storage environment.

Q1) Continued

EMC Isilon

EMC provides proven scale-out NAS solutions powered through these high-level technology components:

- **EMC Isilon's OneFS* operating system:** Providing the intelligence behind all Isilon scale-out storage solutions, the OneFS operating system combines the three layers of traditional storage architectures—file system, volume manager, and RAID—to create a single intelligent file system that spans all nodes within a cluster. This makes the Isilon system easy to scale, manage, and protect.

  Isilon's OneFS enables:

  - Independent or linear scalability of performance and capacity to over 85 GB per second of throughput and more than 15.5 PB of capacity
  - A single point of management for large and rapidly growing data repositories
  - Mission-critical reliability and high availability with state-of-the-art data protection
  - An integrated, automated tiering environment within a single file system to ensure data is efficiently located on the correct price and performance tier

- **The Isilon hardware platforms:** Three flexible product lines for a broad range of business needs:
  - S-series for storage built for high-transactional and IOPS-intensive applications
  - X-series for providing a right balance between high performance and large capacity
  - NL-series for providing cost-effective, highly scalable nearline storage

- **Scale-out NAS software:** A software suite for the enterprise in the areas of data protection, management, access, and availability.

EMC Symmetrix

Virtual Matrix Architecture (VMAX) delivers the highest levels of automation, performance, scalability, availability, and security in the industry.

The EMC Symmetrix family includes the following products:

- EMC Symmetrix VMAXe: The entry-point series into the EMC Symmetrix family, the VMAXe engine includes the latest Intel® processors, cache, front-end connectivity, and back-end connectivity. This multicontroller architecture delivers the highest performance, availability, and consolidation at a price point that fits today's limited IT budget. The scale-out architecture of the EMC Symmetrix VMAXe system provides the foundation to scale to more than 1.3 PB of usable capacity, supporting thousands of servers and millions of IOPS.
- EMC Symmetrix VMAX: Delivering the highest levels of scalability, availability, integration, and reliability for mission-critical Tier-1 virtual environments, the EMC Symmetrix VMAX scales from one to eight VMAX engines and can scale to support 2.1 PB of usable capacity, supporting thousands of servers and millions of IOPS.

Q1) Continued

NetApp helps enable the delivery of IT as a service through a flexible, scalable, virtualized shared IT infrastructure; automation; and service efficiencies.

NetApp advanced storage and data management technologies provide the foundation for a private cloud, including these core capabilities:

- Unified architecture with the NetApp Data ONTAP virtualized storage operating system, which supports multiple workloads
- Storage efficiency that can reduce capacity requirements and help reduce costs by up to 50 percent or more
- Secure multitenancy to segment, isolate, and deliver shared server, storage, and network resources to different groups, users, departments, or applications
- Service automation and analytics for automated storage provisioning, comprehensive visibility, monitoring, and proactive alerts of availability, performance, and policy compliance
- Nonstop operations to enable transparent, continuous data availability for shared storage resources
- Integrated data protection to meet backup, disaster recovery, archiving, compliance, and security SLAs
- The ability to scale up, down, and out in multiple dimensions: performance, capacity, and operations
- Intelligent caching built in to meet performance SLAs

In addition, NetApp OnCommand* data management software offers effective, cost-efficient management of shared storage infrastructure.

Q2: What is your solution architecture, and how does it support cloud implementations?

AMPLIDATA

The AmpliStor system consists of multiple storage nodes, which provide back-end storage capacity. Application data access is through controller nodes, which are connected to storage nodes through 10 and 1 GbE networks.

BitSpread distributes data across nodes according to policies with the following parameters:

- The number of disks to be included in the data spread
- The number of simultaneous failures to survive
- The geographical spread rules

The system then selects which disks across storage nodes store the data. This minimizes the impact of a component failure. In the event of a failure, the system automatically reconfigures itself to store new incoming data according to an alternative spread of available disks, as defined by policy, while missing data is repaired by BitDynamics agents on other available disks.

Controllers provide native object interfaces for object storage services such as public or private storage clouds. The system provides an http/REST API (with PUT-, GET-, and DELETE-style access semantics) that is similar to APIs from existing online storage services. Controllers provide high-throughput access for large object and file storage and retrieval. Throughput is scalable with multiple controllers, with fully shared access to the back-end storage pool even for concurrent writers.

DataDirect NETWORKS

WOS is a fully distributed system, meaning there are absolutely no single points of failure or bottlenecks. This enables the system to scale, with each new cloud building block (called a node) linearly adding to the system's performance capabilities and storage capacity. WOS nodes are self-contained appliances configured with disk storage and CPU and memory resources. Each node is preconfigured with the WOS software and gigabit Ethernet network interfaces. A cloud can be created out of any nodes that have IP connectivity to each other, regardless of their physical location. Various capacities and performance configurations of WOS nodes are available. A WOS cloud can be geographically dispersed, yet it creates a common pool for content ingest, storage, and delivery. The cloud is centrally managed, and content distribution within the cloud is automated.

EMC²

EMC Atmos

EMC Atmos is object storage with HTTP-based connectivity. Its global architecture enables it to operate as one system across multiple sites and tenants with limitless scale. The software also enables management of large amounts of content with granular policies that can be triggered with user or system metadata. Atmos can be accessed and controlled over local networks or the Internet, and it supports multiple tenants with individualized SLAs, all within a shared infrastructure.

Q2) Continued

EMC Isilon

EMC Isilon's scale-out storage solutions provide cloud implementers with an architecture built from the ground up to be easy to scale in a linear and nondisruptive manner. Isilon offers ease of management, performance, and industry-leading availability—from terabytes to petabytes.

The foundation for Isilon's storage infrastructure used to enable private and public cloud deployments is the OneFS operating system, a fully symmetric file system with no single point of failure. OneFS takes advantage of clustering, not just to scale performance and capacity, but also to enable any-to-any failover and multiple levels of redundancy that go far beyond the capabilities of RAID. The OneFS file system abstracts the underlying physical storage from the user and stripes data across multiple nodes in the cluster underneath. As nodes are added to the cluster, OneFS spreads the data across the newly added nodes for immediate and seamless expansion.

Hardware nodes within the cluster consist of industry-standard, cost-effective components and are available in 2U and 4U form factors connected at the back end through high-speed, low-latency InfiniBand. Leveraging standards-based components and providing intelligent software enables cloud implementers to benefit from the combined research and development of the industry's leading firms.

EMC Symmetrix

EMC Symmetrix products deliver these key architectural benefits to support cloud implementations:

- **Rapid, elastic, and on-demand resource allocation** – EMC Symmetrix architecture enables storage to be rapidly and simply provisioned and deallocated from applications or clusters of servers at any given time. Additionally, virtual provisioning ("thin provisioning") provides the ability to pool resources and share across the entire virtual data center. Virtual pools can be expanded, automatically rebalanced, and reclaimed as storage capacity requirements change.
- **End-to-end management and monitoring of the cloud implementatio**n – The ability to provision, manage, and view storage from host to array level is provided as follows:
  - **Automatically monitor and improve performance levels at lower costs:** Fully Automated Storage Tiering for Virtual Pools (FAST VP) automatically improves performance in consolidated and tiered cloud environments where applications have dynamically changing performance requirements
  - **Advanced security and multitenancy capabilities, including:**
    - Secure audit and tamper-proof logs with RSA* enVision integration
    - Secure access, two-factor authentication, and access controls
    - Data at rest encryption (DARE)
    - The ability to create separate storage pools for different VMware* ESX* servers and virtual machines
- **Monitoring and chargeback:** The ability to monitor the consumption of virtual resources to provide chargeback in cloud implementations

Q2) Continued

NetApp storage solutions for cloud computing are built on the foundation of our Unified Storage Architecture and Data ONTAP operating environment, as well as our OnCommand management software products, with integration to cloud management partner software for full-stack data automation and orchestration.

For multitenant cloud environments, NetApp MultiStore* software lets you create multiple separate private virtual storage controllers (vFiler* units) on a single storage system, so you can share storage with minimum impact on privacy or data security. The result is secure multitenant cloud storage with increased storage utilization.

In addition, NetApp, Cisco, and VMware have created the industry's first secure multitenancy capability that includes all the server, storage, and networking hardware and software necessary to facilitate sharing, reuse, and dynamic resource allocation in a multitenant cloud environment. This purpose-built capability has been carefully tested, integrated, and documented via a Cisco Validated Design.

Q3: What does your solution offer IT managers looking for a storage fabric that supports a cloud environment?

AMPLIDATA

- The AmpliStor system is a scalable and reliable storage grid with an object interface.
- Online applications in the IT manager's cloud environment can be easily connected through the http/REST object interface.
- AmpliStor scales in throughput by adding controller nodes. Objects written through one of the controller nodes can be retrieved immediately, and after that, through another controller node as objects are stored in a global namespace. The load can be balanced easily across controller nodes to scale aggregate performance of the system. In case of a controller node failure, any other controller node in the system can serve the same data, making this an inherent redundant storage cluster.
- Unlike typical cloud storage systems that store three or more copies of data, AmpliStor encodes the data through BitSpread. This enables the IT manager to define higher durability policies, even though BitSpread consumes far less raw disk capacity than data copy–based systems. Furthermore, the BitSpread durability policy can be defined per global namespace, which enables the IT manager to define different durability levels within the same AmpliStor storage system to differentiate durability of data stored for specific users or data types.

DataDirect NETWORKS

WOS provides IT managers a single global namespace so they will never have to manage multiple file systems, RAIDs, LUNs, or SANs. With WOS, all objects are in a single namespace that spans all storage nodes and zones. WOS defines policies that govern which locations or tiers of the WOS cloud each file should be stored on to easily get content close to users for low-latency delivery, generate multiple copies of popular files for performance, and create automated backup and disaster-recovery processes.

WOS allows IT managers to start with just a few terabytes of capacity, yet easily and nondisruptively grow storage capacity to multiple petabytes in a cost-effective, pay-as-you-grow fashion. WOS is fully distributed with no single points of failure or bottlenecks. Data is always online and available, and all failure conditions are automatically handled by the WOS cloud without interrupting data access.

EMC²

EMC Atmos

EMC Atmos is the only cloud storage that offers easy deployment via hardware appliance or software for a virtualized environment. Atmos provides out-of-the-box storage-as-a-service enablement through the Atmos Cloud Delivery Platform software. Atmos itself offers nearly infinite scalability in terms of capacity, location, and tenants, all in a cost-effective and easy-to-manage platform.

Q3) Continued

EMC Isilon

EMC Isilon offers scalability for a cloud environment, both in terms of performance and capacity. IT managers can expand capacity by simply adding extra nodes to the cluster through the highly expandable InfiniBand-based storage cluster fabric. This ease of expansion aligns naturally with a pay-as-you-grow model for the cloud.

EMC Isilon solutions are designed to be simple. The deployment and provisioning of a cluster can be done in minutes. Therefore, it saves significant cost and time.

All data in a cluster is made redundant within the cluster, making it highly available even if there are node or disk failures within the cluster. For additional levels of high availability and disaster recovery, SyncIQ* can replicate the data onto another cluster in the cloud.

For ease of management, Isilon solutions are integrated with VMware vCenter* through a plug-in called Isilon for vCenter for managing heterogeneous cloud environments. Additionally, Isilon's InsightIQ* helps you maximize the performance of your Isilon scale-out storage system with advanced analytics to optimize applications, correlate work flow and network events, and accurately forecast future storage needs.

EMC Symmetrix

The EMC Symmetrix family of products is purpose-built for virtual data centers to provide scalability, performance, availability, and functionality at reduced cost. It is tightly integrated with VMware functionality at every level, including support for VAAI and EMC's virtual storage interface (VSI) functionality. FAST VP automates the movement and placement of data in dynamic virtual environments, and auto-provisioning groups combine tasks by device, port, and initiator to reduce time and complexity of provisioning storage in virtual environments by 95 percent. Virtual LUN technology enables users to nondisruptively migrate storage within the array.

NetApp

NetApp storage and data management capabilities are built on the Data ONTAP platform, which is the foundation of the NetApp Unified Storage Architecture, and include:

- **Multiprotocol storage:** Support for 4 Gb and 8 Gb FC, 10 GbE FCoE, 1 Gb and 10 GbE iSCSI, NFS, and CIFS with the same management and software tools.
- **Storage efficiency:** Technologies inherent to NetApp Data ONTAP that improve storage efficiency, including thin provisioning, deduplication, cloning, and Snapshot* copies.
- **Scale up and scale out:** Elastic scalability to meet dynamic demands of a shared IT infrastructure.
- **Nonstop operations:** For moving data to balance workloads and perform maintenance, hardware and software upgrades, and refreshes. DataMotion* for vFiler migrates and moves data across storage systems without disrupting users or applications. It also can move data off a storage system and then back after maintenance tasks.
- **Secure multitenancy:** MultiStore combined in an SMT architecture with Cisco* and VMware software to segment, isolate, and deliver shared server, storage, and network resources to different users, groups, departments, or applications.

Q3) Continued

- **Integrated data protection:** Built in to NetApp storage for high availability, disaster recovery, backup, and compliance without additional software and hardware.
- **Service automation and analytics:** Automated storage provisioning, comprehensive visibility, monitoring, and proactive alerts.

Q4: How does your network or storage solution reduce IT complexity in the data center? How does it make an IT manager's life easier?

AMPLIDATA

The AmpliStor system comes preinstalled on appliances and requires very limited manual intervention:

- **New storage nodes can be seamlessly added at any time without system disruption.** As soon as new storage nodes have been added to the storage pool, the BitDynamics agents can start using the added capacity to store newly incoming data in the global namespace. This is fully policy driven and does not require end-user or application reconfiguration.
- **BitDynamics agents monitor and perform maintenance tasks on every storage node.** In case of a disk or node failure, BitDynamics agents across all storage nodes will generate additional data blocks on available disks to substitute the lost data and to restore data availability as configured in the policy. Because this repair is performed before defective disks or nodes are replaced, no immediate manual intervention is required in the data center to replace the components.
- **BitDynamics agents perform frequent background integrity checks on the stored data.** This includes data scrubbing, data-integrity verification, and assurance tasks. Data that may have been corrupted due to write errors, bit rot, or tampering will be detected and proactively corrected.
- **The system provides a scriptable command-line interface.** This can be used for administrative tasks, management tasks, and system monitoring.

DataDirect NETWORKS

DataDirect WOS is a sophisticated, cloud-based file storage technology that radically simplifies and improves how content is stored, distributed, and accessed across multiple geographically dispersed sites. From a single, easy-to-use management interface, IT managers can build a global storage cloud that scales simply and limitlessly. Users can collaborate, and content can be accessed from any device, anywhere in the world.

EMC²

EMC Atmos

With Atmos policies, customers can set a data-management scheme in minutes and never have to touch it again. This reduces the burden and cost of separate replication, backup, and archiving for every application as well as the storage silos that typically exist today. Atmos also greatly eases storage provisioning. Administrators can create access credentials in minutes. Customers can take this one step further with the Atmos Cloud Delivery Platform and enable complete self-service storage provisioning. When IT administrators need more capacity, they can simply add more Atmos infrastructure, and the capacity is automatically available.

Q4) Continued

EMC Isilon

EMC Isilon designs its systems to reflect a "smart is simple" philosophy. OneFS combines the three layers of traditional storage architectures—file, volume manager, and RAID—into one unified software layer. The traditional issues related to LUN and volume management do not exist in an Isilon environment, which saves tremendous cost and effort for the IT manager. This provides a sufficient advantage over SAN systems.

In traditional storage systems, adding or removing nodes may incur downtime and numerous operational steps to complete. With Isilon clusters, nodes are simply added. OneFS easily recognizes the new nodes and automatically redistributes and rebalances the storage across the new nodes without operator intervention. In addition, Isilon nodes can be removed transparently—absolutely critical for 24-7 uptime—through technology refresh or maintenance operations.

Isilon solutions can be easily managed through InsightIQ enterprise application software or through the VMware vCenter plug-in for Isilon. The management features provide functions to optimize performance of applications and forecast storage needs.

EMC Symmetrix

The following are ease-of-management capabilities of the EMC Symmetrix product:

- **Virtual Storage Integrator (VSI) –** VSI is a VMware vCenter plug-in that will discover EMC Symmetrix storage in a cloud implementation and enable the VMware administrator to provision storage as a resource in VMware environments.
- **EMC Symmetrix Management Console (SMC) and EMC Symmetrix Performance Analyzer (SPA) –** SMC provides ease-of-management capabilities in cloud implementations and has wizards that streamline the process of provisioning and expanding storage to virtual machines. SPA provides advanced, real-time monitoring and the ability to quickly diagnose performance issues.
- **EMC ProSphere* –** EMC ProSphere is cloud-storage management software to monitor and analyze storage service levels across a virtual infrastructure. Built to meet the demands of the cloud environment, ProSphere enables enterprises to enhance performance and improve storage utilization.

Q4) Continued

NetApp

NetApp focuses on the following areas critical to achieving maximum efficiency in data center environments and driving more value from IT investments: utilization; power, space, and cooling; availability; performance; capacity optimization; management; and ROI.

The same areas apply to building an efficient storage foundation. Our customers:

- Often realize payback windows of as little as six to nine months
- Use half the storage of traditional approaches in many cases
- Cut infrastructure and data storage costs

See the case study for Suncorp showing improved storage efficiency and 30 percent savings of its total IT budget, which could be applied to new projects.

Our comprehensive portfolios of sustained efficiency solutions, technologies, and features provide a more efficient storage environment even for existing storage systems, including improved storage utilization and optimization for more data with fewer systems, use of less space and power, and lowered operational costs.

Q5: How does your solution integrate with data center infrastructure?

AMPLIDATA

The AmpliStor solution comes preinstalled on dedicated hardware. The AmpliStor AS20 storage node has a standard 1U rack-mount form factor and hosts ten 2 TB SATA disks for high density. Each appliance has two 1 GbE connections. Storage nodes are built for power efficiency, with a power consumption of 140 watts peak, 65-watt average utilization. Environmental specifications include:

AC power	100 to 240 VAC, 1 A/1.4 A max @ 100 VAC 1 internal power supply with standard power plugs
Height	1.75 in
Width	19-in IEC rack-compliant
Operating temp and relative humidity	10°C to 40°C (50°F to 104°F) <2,100 m (<7,000 ft) elevation 20% to 80% relative humidity, noncondensing
Nonoperating temp and relative humidity	-20°C to 65°C (-4°F to 149°F) 8% to 95% relative humidity, noncondensing
Minimum service clearances	30 in (front); 30 in (rear)

DataDirect NETWORKS

WOS integrates with a data center infrastructure though standard gigabit Ethernet network connections with the assignment of a unique network address to each WOS node. IT managers then create zones in the WOS cluster, assign node(s) in each, and create the policies that they will use to manage the cloud storage cluster as they prefer. If more storage is needed, another WOS node can be seamlessly added to the network for added capacity at any time.

EMC²

EMC Atmos

The EMC Atmos solution integrates with applications over IP via REST and SOAP APIs or NFS, CIFS, and CAS/XAM. It provides an installable file system for Linux-based applications. Our IP connectivity enables easy network connectivity, management, and security via IP-enabled switches, load balancers, DNS, and firewalls.

Q5) Continued

EMC Isilon

With multiprotocol support and support for multiple client types and virtualized environments, EMC Isilon scale-out NAS solutions integrate seamlessly with any data center infrastructure environment.

The support of common networking communication protocols, such as NFS, CIFS, and iSCSI, enable these solutions to interface with industry-standard compute systems and technologies. Isilon supports Windows*, Mac*, Linux*, UNIX*, and VMware along with directory services such as Microsoft* Active Directory* and UNIX-based LDAP servers. Additionally, Isilon has a broad range of certifications from and partnerships with Atempo, BakBone*, CommVault*, EMC NetWorker*, Front Porch Digital, Symantec, and many others.

Isilon scale-out NAS solutions work naturally within virtualized environments and eliminate storage sprawl that is often associated with virtualization. Isilon is certified VMware Ready for vSphere* 4.1 and is also a Citrix Ready* partner.

EMC Symmetrix

EMC Symmetrix supports all networking protocols in the data center and is qualified and integrated with leading data center technologies from other vendors.

NetApp

NetApp technology improves data center infrastructures with pretested, prevalidated solutions that improve storage efficiency.

NetApp-Cisco FlexPod* solution: Built on shared infrastructure from Cisco Unified Computing System servers, Cisco Nexus* switches, and NetApp unified storage systems that run on Data ONTAP, FlexPod components are integrated and standardized to achieve timely, repeatable deployments. FlexPod is optimized with mixed-application workloads and design configurations in various environments, including virtual desktop infrastructure and secure multitenancy environments. Validated designs and workloads include:

- VMware vSphere built on FlexPod
- Microsoft SharePoint* 2010 validated on FlexPod
- SAP* applications built on FlexPod
- Citrix* XenDesktop* built on FlexPod
- Enhanced Secure Multi-Tenancy Design Guide

Q6: Does your solution use FCoE, 10 GbE, or iSCSI? Please describe.

AMPLIDATA

The AmpliStor controller provides two or more 10 GbE interfaces. User or application data is transmitted over these interfaces using an http/REST protocol over TCP/IP. Encoded data is transmitted to the AmpliStor storage nodes using TCP/IP over the GbE interface.

For customers needing a block interface such as FC, FcoE, or iSCSI, Amplidata can provide solutions through its OEM and gateway partners.

DataDirect NETWORKS

These interfaces are currently not supported.

EMC²

EMC Atmos

EMC Atmos supports 1 GbE or 10 GbE connection links.

EMC Isilon

EMC Isilon clusters support iSCSI, NFS, and CIFS network communication protocols. They support 10 GbE connectivity per node, for linear scaling when adding new ports.

EMC Symmetrix

EMC Symmetrix supports FCoE, 10 GbE, and iSCSI connection links on all makes and models in the Symmetrix family.

NetApp

NetApp storage systems support 4 GB and 8 GB FC, 10 GbE FCoE, 1 GB and 10 GbE iSCSI, NFS, and CIFS. NetApp was the first vendor to support unified storage in 2001, and the first vendor in 2010 to support FCoE, iSCSI, NFS, and CIFS on the same 10 GbE connection. The application and customer environment drives which protocol is best to use, and NetApp supports all protocols with the same platform, same software, and same management.

Q7: What hardware configuration do you recommend to take full advantage of the capabilities of your offering?

AMPLIDATA

The system comes preinstalled on the AmpliStor storage node and controller hardware. The smallest configuration, providing 160 TB of raw storage (100 TB usable), would include eight 20 TB storage nodes and three controller nodes. The storage capacity is increased by simply adding AmpliStor storage nodes to the pool. Aggregate throughput of the system is increased by adding controller nodes and storage nodes to the pool.

DataDirect NETWORKS

WOS nodes are self-contained appliances configured with disk storage and CPU and memory resources. Each node is preconfigured with the WOS Object Clustering System (OCS) software and GbE network interfaces. A cloud can be created out of any nodes that have IP connectivity to each other, regardless of their physical location. Various capacities and performance configurations of WOS nodes are available. WOS nodes come in two form factors. The WOS 1600 is a 3U chassis with 16 drives for 32 TB capacity and 4x GbE network connections. The high-density WOS 6000 is a 4U chassis with 60 drives for 180 TB capacity and 8x GbE network connections. Clouds support heterogeneous node types, allowing tailoring of performance and scale to the needs of the environment.

EMC²

EMC Atmos

The EMC Atmos platform has multiple physical form factors that can be tailored for greater capacity density or more robust content services. It also offers a Virtual Edition to enable support of any VMware vSphere–certified hardware.

EMC Isilon

The EMC Isilon family delivers flexibility to configure the storage solution to the needs of the environment. The Isilon components enable customers to scale from 18 TB to over 15 PB. Isilon's software system provides the greatest I/O throughput in the industry with over one million IOPS as measured by the SPECsfs* test suite. Isilon provides platforms designed to mix and match within a single file system to provide the performance and capacity requirements unique to each customer's environment:

- **S-Series:** For IOPS-intensive applications with SAS drives and SSD for the utmost in performance to over one millions IOPS
- **X-Series:** For high-concurrent and sequential throughput work flows with SATA and SSD drives for a balance between performance and capacity
- **NL-Series:** High-capacity, near-primary accessibility with SATA drives for the highest levels of scalability to over 15 PB

Specialty add-on nodes:

- **Performance Accelerator:** Scale IOPS without scaling capacity
- **Backup Accelerator Node:** High-speed and scalable NDMP backup and restore solution

Q7) Continued

EMC Symmetrix

The EMC Symmetrix family supports a number of configuration offers that can be tailored to ensure an optimal configuration based on a customer's unique compute environment. Key to the configuration is the EMC Enginuity operation environment. A few key features are:

- FAST VP automates the movement and placement of data across storage resources, including enterprise flash drives, Fibre Channel drives, and SATA drives. FAST VP enables customers to realize the benefits of tiered storage with less time and effort spent on performance tuning, management, and monitoring. While manual assignment of applications and data to separate tiers can be (and is today) used to deliver the benefits of tiered storage, FAST VP will automate the allocation and relocation of data across these tiers as needed to maximize the utilization, efficiency, and performance of the overall system.
- Vblock* converged infrastructure platforms from VCE virtually eliminate the complexity inherent in traditional data center setups. Vblock platforms are preconfigured solutions with world-class compute, network, storage, management, and virtualization capabilities, so customers can quickly deploy a high-performance, scalable, and secure cloud implementation. EMC Symmetrix is integrated into Vblock.

NetApp

NetApp storage solutions for cloud computing are built on the foundation of our Unified Storage Architecture and Data ONTAP operating environment. Data ONTAP is the foundation for all of our storage systems and provides unified storage through multiprotocol support on every platform, storage efficiency technologies, integrated data protection, and a single management interface. This gives you a single platform that can scale and grow with your needs as you move to a cloud environment.

Q8: How does your solution allocate storage? (DAS, NAS, or SAN?)

AMPLIDATA

The AmpliStor system is an object-based storage system accessible over standard IP protocols: All storage is available in one large pool in which one or multiple global namespaces are created per user or per application. Data access is provided through an http/REST object API. For customers needing legacy DAS, NAS, or SAN interfaces, Amplidata can provide solutions through its OEM and gateway partners.

DataDirect NETWORKS

WOS is a revolutionary new object-based cloud storage system that addresses the needs of content scale out and global distribution. At its core is intelligent software that allows a massively scalable content-delivery platform to be created out of small building blocks (nodes) that enable the system to start small and easily grow to a multipetabyte scale. WOS is a fully distributed system, meaning there are absolutely no single points of failure or bottlenecks. This allows the system to scale, with each new cloud building block linearly adding to the system's performance capabilities and storage capacity.

Data is stored in WOS as "objects." While it is easiest to think of an object as a file, it is more appropriately defined as a container. For example, more than one file can be stored and retrieved as a single object if the files are always used together or have some other relationship to each other. In addition to the file data itself, WOS objects may also contain user-defined metadata, which can be any key/value pair information related to the object. Finally, WOS objects contain the object's policy, which determines content placement within the cloud.

EMC²

EMC Atmos

EMC Atmos utilizes REST and SOAP storage APIs over HTTP. It also supports protocols such as NFS, CIFS, and CAS/XAM.

EMC Isilon

Isilon offers scale-out NAS storage solutions. Isilon's OneFS operating system is truly distributed and intelligently stripes data across all nodes in a cluster to create a single shared pool of storage.

EMC Symmetrix

EMC Symmetrix supports SAN, DAS, or NAS via gateway functionality.

Q8) Continued

The NetApp Unified Storage Architecture supports multiple protocols, a single management interface, integrated data protection, support for multiple tiers of storage (primary, secondary, archive, and compliance), QoS, and the ability to act as a front end for legacy storage systems. NetApp combines these features into a single platform capable of meeting end-to-end storage needs, while demonstrating significant performance and cost-of-ownership advantages. NetApp sets the standard by which any storage solution that claims to be unified should be measured.

Q9: What file types is your solution best suited for?

AMPLIDATA

Amplidata was specifically designed for large, unstructured data. In practice that means larger than 1 MB files, preferably a lot larger, that are not stored in a database. The system can store virtually unlimited numbers of objects, with expectations of billions of objects per system. Application categories include:

- Application data store (for example, Web 2.0, web applications, and online applications)
- Large object store (for example, document, picture, and videos)
- Backup/archive store (for example, typically application driven)

DataDirect NETWORKS

- Application data store (for example, Web 2.0 and web applications)
- Large object store (for example, document, picture, and videos)
- Backup/archive store (for example, typically application driven)

WOS is best suited for all of the above, especially for data that grows quickly, both in terms of outright size, as well as in total number of files. WOS also shines as access to the storage cloud grows quickly as more and more users seek data within it. Good examples are social-networking and photo-sharing web sites. As their user base grows, the total number of files they store also grows, and the file requests per second go up as more users take advantage of the service. Another WOS characteristic is that once files enter the content store, they tend to stay there and are generally not changed or deleted. Good examples are bank-check imaging applications, fingerprint databases, and medical-image archiving systems. WOS is also best suited for when the access rate to any particular file tends to go down over time. For example, a file that has been recently stored is accessed frequently, but over time its use decreases. However, any file may be accessed at any time, necessitating that it be kept online.

EMC²

EMC Atmos

- Application data store
- Large object store
- Backup/archive store

Q9) Continued

EMC Isilon

Isilon scale-out NAS is a complete, end-to-end storage platform for both large-scale enterprise applications and data-intensive vertical work flows. It natively supports industry-standard protocols such as NFS and CIFS to address a wide range of workloads and file types run on Linux, UNIX, and Windows-based applications.

Isilon is a leading IT solution in the following horizontal application areas: archiving, backup and recovery, cloud storage, eDiscovery, disaster recovery and business continuance, high-performance computing, home directories and file sharing, unified scale-out storage, and virtualization.

Isilon also supports applications in the following vertical markets: energy, finance, geospatial imaging, government, higher education, integrated circuit design and electronic design automation, Internet and cloud services, life sciences, and media and entertainment.

The broad application of Isilon solutions to a variety of environments and industries makes it an ideal solution well suited for different file types, work flows, and data sets, including the fast-growing opportunities in Big Data.

EMC Symmetrix

- Application data store
- Large object store
- Backup/archive store

NetApp

The NetApp solution is well suited for all the environments below. Because the NetApp common platform is built on Data ONTAP, NetApp offers truly unified storage architecture capable of meeting all storage needs—NAS and SAN: primary, secondary, and archive—from a single platform with a single architecture. With NetApp, you can implement a single set of processes for all data management functions, including backup and disaster recovery, and delegate important storage tasks to other functions with policy-based management.

- Application data store (for example, Web 2.0 and web applications)
- Large object store (for example, document, picture, and videos)
- Backup/archive store (for example, typically application driven)
- Mission critical

Q10: What sort of tools do you offer to minimize data duplication in the network? How does your solution work with other providers' solutions to protect data in motion, in transit, or at rest?

AMPLIDATA

AmpliStor provides local caching to avoid having to send the same data multiple times. Amplidata provides high availability, self-monitoring and healing, continuous integrity checking, and data optimization. Additional solutions can be integrated through the Amplidata partners.

DataDirect NETWORKS

In WOS, data is purposely duplicated globally across the wide area network to provide for built-in disaster recovery and locally cached data for high-performance access no matter where in the world you are accessing the cloud.

The intelligence of WOS protects data far better than traditional storage systems. In a traditional RAID storage system, when a disk drive fails, a RAID rebuild to a hot spare disk drive can happen only as fast as the write speed of the hot spare drive. With today's large drive sizes, this can take hours under ideal circumstances. In reality, the process will be slowed considerably by other tasks the storage system must contend with, such as user I/O requests.

With WOS, when a disk drive fails, the cloud immediately knows which objects resided on that drive, as well as the location of copies of those objects (per the policy-based replication) elsewhere in the cloud. WOS uses this information to perform a fully distributed rebuild operation, using copies of objects from all over the cloud to create new copies of the missing objects. Because this process employs multiple cloud nodes and disk spindles, it initiates a many-to-many rebuild process that is much faster than the one-to-one rebuild process of a traditional storage array. Similar distributed recovery operations are employed to handle other failure modes, such as the loss of a cloud node.

EMC²

EMC Atmos

EMC Atmos supports single instancing natively. We also have multiple ISV partners that deduplicate data at the application level before storing the content.

Atmos supports SSL encryption for in-flight content from application to Atmos and within the Atmos private network. We also have multiple ISV partners that encrypt the data at the application level, retaining the keys, before storing the content. Atmos has native at-rest encryption on the product roadmap.

EMC Isilon

Isilon offers data-reduction technologies such as thin provisioning through its SmartQuotas software. However, the biggest contribution comes from the OneFS operating system. Isilon's unified scale-out NAS with OneFS simplifies storage administrative tasks and guarantees greater than 80 percent storage efficiency. This supports large-scale application consolidation and virtualized data centers. With such high storage utilization, Isilon solutions compare quite favorably to other architectures that use data deduplication and compression. For environments that may benefit further from deduplication and compression services, Isilon provides software solutions from EMC and other ISVs.

Q10) Continued

To protect data, Isilon integrates natively with common authentication and directory services such as Network Information Services, LDAP, Kerberos, and Microsoft Active Directory. It supports strong file system authentication and granular access controls with POSIX/*NIX semantics, Windows ACL semantics, and a combination of both. Data integrity is provided by granular file system and component checksums, powerful and scalable erasure encoding, and replication capabilities with SyncIQ. In addition, Isilon has strong partnerships with various solution providers for industry-standard data protection.

For backups, Isilon uses the NDMP, NFS, and CIFS protocols supported widely by major backup vendors. Major vendors and their products offering support to back up OneFS include: Symantec* NetBackup*, EMC NetWorker, IBM* Tivoli* Storage Manager, FastBack, CommVault Simpana*, BakBone NetVault*, and Atempo Time Navigator*.

For encryption, Isilon leverages partners such as Vormetric for host-based techniques—providing end-to-end security from the host, through the network, and to the storage media. Isilon also partners with network infrastructure providers such as Aspera and Riverbed, providing not only end-to-end encryption but also WAN optimization and work-flow automation.

EMC Symmetrix

EMC Symmetrix includes a number of built-in technologies that make effective use of network bandwidth. One feature includes native compression with Symmetrix Remote Data Facility (SRDF) replication to optimize network resources and reduce the infrastructure costs for deploying advanced disaster recovery and business continuity. In addition, using SRDF "track change" technology when replicating data provides the ability to incrementally resync data between sites, minimizing the amount of data that needs to be copied, which reduces bandwidth requirements and improves RPOs and RTOs.

For data at rest, EMC Symmetrix supports DARE. For data in transit, EMC Symmetrix supports IPsec.

NetApp

These features are part of NetApp's Data ONTAP operating system that ships with all FAS and V-Series storage systems:

FlexClone*: Instantly replicates data volumes and data sets as space-saving virtual clones.

Deduplication and compression: NetApp data deduplication and data compression can be used in either SAN or NAS environments, provide benefits throughout the data life cycle, and are application and storage-tier agnostic.

Snapshot: Enables you to create point-in-time copies of file systems using very little space, which you can use to protect data—from a single file to a complete disaster recovery solution.

RAID-DP*: Makes lower-cost SATA disk an option for your enterprise storage without worrying about data loss.

SnapMirror*: SnapMirror thin replication protects your business-critical data while minimizing storage capacity requirements.

SnapVault*: SnapVault thin replication enables backups to run more frequently and utilize less capacity because no redundant data is moved or stored.

Q10) Continued

Flash Cache (PAM II): Optimizes performance of your storage system without adding high-performance disk drives.

V-Series: Makes the storage you already own (from any major storage vendor) more efficient and flexible.

Provisioning Manager: Policy-based automation to provision your entire NetApp SAN and NAS infrastructure from a single console.

Q11: Why should I select your solution over the others?

AMPLIDATA

Unbreakable storage: AmpliStor solves the problem of high reliability on multiterabyte disk drives. AmpliStor stores data 10,000 to 100,000 times more reliably than alternative RAID and replication-based solutions, and does so without incurring the storage overhead of mirroring or replication.

Storage efficiency: The system requires 50 to 70 percent less raw disk capacity while still providing the highest levels of reliability. This provides lower power and cooling requirements: Storage appliances require less than 7 watts per TB. With AmpliStor, system administrators can manage 10 times more storage than with alternative solutions.

Scalable capacity and performance: The system scales out to support tens of petabytes of capacity and tens of gigabytes per second of throughput. There are no limits on object sizes or on numbers of objects that can be stored and managed—making it possible to efficiently store *billions* of objects. Scale out AmpliStor by adding AmpliStor storage nodes. No user reconfiguration is required. The system automatically includes added capacity in the storage pool.

DataDirect NETWORKS

The changing world of cloud storage dictates new approaches to storage systems design. With DataDirect Networks' WOS, the pitfalls and complications surrounding multisite scalable cloud storage and delivery have been resolved. WOS provides a single global namespace for billions of files; industry-leading file read-and-write performance; and fast, efficient data access anywhere in the world. WOS can grow nondisruptively in small increments to massive scale with leading energy and space efficiency. WOS features a single management interface for all data in the cloud, no matter where it is within its globally distributed and self-healing cloud storage infrastructure, without bottlenecks or single points of failure.

This enables organizations to focus on their core business, instead of the tedious tasks associated with storage engineering and management. With WOS, DataDirect Networks is ushering in a new era of storage systems design, one where storage clouds can be quickly and easily set up, yet scale to service the needs of millions of users accessing multiple PB of information spread around the world.

EMC²

EMC Atmos

The EMC Atmos platform provides a best-in-class solution for customers to deploy business-critical content-rich applications, cloud storage services, and archives. Atmos has proven scalability and efficiency, serving customers with billions of objects and petabytes of content across multiple sites, all while saving up to 80 percent on storage costs.

Q11) Continued

EMC Isilon

The top five reasons to choose Isilon over other solutions are:

- **Simplicity:** Isilon's easy-to-manage scale-out NAS is simple to buy, build, maintain, and grow. It significantly reduces TCO. One person can now manage petabytes of data, keeping your staff focused on managing data—not storage.
- **Scalability:** With Isilon scale-out NAS solutions, you can nondisruptively scale performance and capacity in the right combination—up to 15.5 PB and over 1.6 million CIFS IOPS and 1.1 million NFS IOPS with over 85 GB per second of aggregate throughput, all from a single file system.
- **Efficiency:** Isilon's industry-leading solutions deliver greater than 80 percent storage utilization for your mission-critical applications. By taking advantage of our industry-leading ease of use and unique "pay-as-you-grow" model, you can reduce operating expenses and capital expenditures.
- **Availability:** Isilon offers the industry's highest level of end-to-end data protection. By offering up to quadruple failure protection, Isilon ensures that even if up to five nodes or drives fail simultaneously, 100 percent of your data is still available.
- **Commitment:** Isilon is committed to removing the barriers that exist between businesses and their data. Over 1,600 leading organizations worldwide rely on Isilon's scale-out NAS solutions.

EMC Symmetrix

With tens of thousands of systems deployed, EMC Symmetrix is the world's most trusted, powerful, and smart storage. EMC Symmetrix has proven its reputation as the gold standard for high-end storage, and it continues to lead the industry in providing highly available, high-performance storage for the world's mission-critical virtualized Tier-1 applications. The EMC Symmetrix architecture is designed to break the physical boundaries of data center storage. Built on the revolutionary EMC Virtual Matrix Architecture*, EMC Symmetrix offers a lower TCO, with performance and scale, unmatched application availability, and complete security.

NetApp

Only NetApp provides a common operating system, running across common storage systems and managed with common management tools. Only NetApp supports:

- **Unified storage:** Supports multiple protocols (FC, NFS, CIFS, iSCSI, FCoE, and pNFS).
- **Integrated data protection:** Delivers a single platform for high availability, business continuance, backup and recovery, and compliance directly from the storage system.
- **Multidimensional scaling:** Performance scaling, capacity scaling, spatial (operational) scaling, and "clustering."
- **Storage efficiency:** Supports primary and secondary deduplication, compression, dual-parity RAID and SATA, intelligent caching, space-efficient snapshots, virtual cloning, thin provisioning, thin replication, and remote caching—the same way, on every platform.
- **Continuous data availability:** Upgrades, capacity and performance expansion, load balancing and testing without business disruption.

Q11) Continued

- **Secure multitenancy:** Architecture meets compute, network, and storage requirements of high availability, fault tolerance, and redundancy; enables separation across tenants; and delivers service assurance and management of shared resources.
- **Intelligent caching:** Self-managing, data-driven service layer provides real-time assessment of workload-based priorities and ensures that I/O data requests are optimized for cost and performance without data classification.
- **Service automation and analytics:** Automated chargeback and metering; common and open APIs; proactively managed multivendor environments; and measured IT costs, efficiency, and value.

Q12: Do you have a method for demonstrating ROI for your offering?

AMPLIDATA

Our TCO calculator will demonstrate your savings over three years compared to other systems.

To perform a TCO calculation, we need some information about your current storage infrastructure characteristics (hardware, RAID configuration, cost per TB, power consumption, maintenance cost, collocation cost, and so on). Our TCO report gives you insights such as cost savings for total usable capacity, savings in raw capacity, the electricity and rack space savings over three years, and management savings.

DataDirect NETWORKS

We have compared WOS cloud storage TCO to conventional storage "islands" and have demonstrated 33 percent reduced acquisition and deployment costs along with 30 to 50 percent reduction in total TCO in cloud storage environments.

EMC²

EMC Atmos

Atmos serves a number of different use cases and has proven ROI for each of them.

EMC Isilon

In addition to the TCO and ROI calculator tools Isilon uses in our customer engagements, IDC recently published a report assessing the business value of scale-out NAS solutions. IDC used an extensive research database of several thousand organizations to quantify the benefits and found that, on average, companies achieved annual benefits of $8,200 per TB from deploying scale-out NAS solutions.

IDC looked at improvements in key metrics, such as time spent provisioning, utilization percentage, and backup schedule, and grouped benefits into three major categories: cost savings, increased IT staff productivity, and improved end-user productivity.

The results: On average, companies with scale-out NAS solutions reduced provisioning time by 60 percent and the time needed for backup by 76 percent. Utilization increased by an average of 30 percent, while storage capacity was managed 27 percent more efficiently—which when converted into dollar terms added up to $8,200 per TB annually.

EMC Symmetrix

ROI and TCO tools for the Symmetrix platform are available, as well as the Tier Advisor tool for virtual environments.

Q12) Continued

Yes, NetApp starts with the number-one line item in most IT budgets: storage. We help customers analyze the efficiency of their IT environment and calculate their storage efficiency so they can optimize their environment and boost their bottom line. Our customers use half the storage of traditional approaches and can reinvest their savings in revenue-generating opportunities. Try our online ROI tools.

Q13: Are there networking or storage concerns that your solution doesn't address that you think the industry still needs to solve?

AMPLIDATA

Storage needs will keep evolving. AmpliStor is one of the most innovative approaches to storing massive amounts of large, unstructured data.

DataDirect NETWORKS

WOS cloud storage is Tier-2 storage and does not address typical Tier-1 storage workload requirements. These Tier-1 requirements are already solved by locally attached conventional storage solutions.

EMC²

EMC Atmos

Control over QoS is still primarily a function of the network—this is an important area of innovation in the future. Cloud gateways, technologies that enable easy access into the cloud, are still emerging and need additional work. We think these will have a big impact in the cloud storage market in the future.

EMC Isilon

Looking beyond storage infrastructure, the next major area for industry innovation lies within data asset management, classification, and analytics—areas in which Isilon with its key partners such as Documentum and Greenplum are leading in innovation and delivery.

EMC Symmetrix

EMC maintains a close relationship with customers and provides numerous feedback channels to take user input to develop and shape our strategy and product roadmaps. As a result, EMC often leads the industry in developing new technologies that address our customers' evolving set of challenges.

NetApp

NetApp has repeatedly set the industry standard with game-changing innovations, including storage efficiency; Unified Storage Architecture; and isolated, end-to-end, multitenant IT infrastructure with the NetApp, Cisco, and VMware secure multitenant solution, to name a few. We will continue to work on innovations that will help our customers with their most critical challenges in storage and data management.

Q14: I'm just beginning to investigate innovative technologies that will support my future plans for cloud implementations. What advice can you give me, and what steps should I take to make sure I'm covering all my bases?

AMPLIDATA

Customers should find out the answers to these questions:

- Will the solution you are looking at support your growth over several years?
- Does the solution enable data migration?
- What is the true power cost?
- What is the efficiency?
- Can you integrate with existing applications?
- Will your budget keep supporting the management cost that comes with the solution?

DataDirect NETWORKS

Traditional storage and file systems were not designed with the needs of large-scale, global cloud storage in mind. When storage needs grow to billions of files consuming petabytes of capacity, all of which must be quickly and efficiently shared between multiple data centers, traditional solutions become complex to deploy, hard to manage, difficult to scale, and overly expensive. It is important to consider innovative technologies designed from the ground up to specifically support cloud storage. Sophisticated cloud-based file-storage technology found in DataDirect WOS radically simplifies and improves how data is stored, distributed, and accessed across multiple geographically dispersed sites. From a single, easy-to-use management interface, you can build a global storage cloud that scales simply, cost-effectively, and limitlessly—where users can powerfully collaborate, and content can be accessed from any device, anywhere in the world.

EMC²

EMC Atmos

One key to cloud is to understand what you want to get out of the technology before you buy it. It is not a panacea, and you may have to make changes to your overall architecture and process, but there are very real benefits. If you want to start a cloud storage service, figure out what your customers want before you buy, or at least have a strong plan to test the market. We can help with this process. If you want to build or rearchitect an application, talk to us first. We can help you think through the optimal solution.

EMC Isilon

Cloud computing is a new paradigm quickly sweeping across the IT industry. It demands unique and innovative but proven solutions that can deliver massive scalability, performance, high availability, data protection, and management.

Q14) Continued

Cloud implementation can get immensely complex and costly if not done properly. For your cloud, here are a few suggestions to help you get it right.

- **Keep it simple:** Forming a cloud and providing cloud services can become a gigantic undertaking. By keeping it simple, you help make issues solvable and affordable to address. Therefore, align with solutions that emphasize simplicity.
- **Strive to be scalable:** The demand for compute and storage resources will change in a highly unpredictable fashion. So choose solutions that will help you achieve scalability instantaneously and predictably.
- **Protect your data:** Cloud users will demand that their data in the cloud has the highest level of protection. Therefore, rely on solutions that promise and demonstrate high levels of data protection. There is no compromise, especially in this regard.
- **Choose solutions like Isilon:** Look at solutions that are unique and innovative, but are already proven at numerous customer cloud deployments.

EMC Symmetrix

Automation and self-management are key capabilities that provide the cornerstone to deploying highly scalable cloud infrastructures with minimal administrative overhead. As a result, technologies such as fully automated storage tiering, virtual provisioning, and advanced virtual server integration are quickly becoming core capabilities for building out next-generation cloud environments.

NetApp

NetApp has helped many enterprises and service providers evolve to a service delivery model using our storage solutions as the foundation for their clouds. Based on our experience, we've identified four fundamental elements that should be incorporated when evolving to a private cloud:

- **Service catalog:** Define your services with well-defined policies that automatically map service levels to storage attributes.
- **Service analytics:** Optimize your services with centralized monitoring, metering, and showback or chargeback capabilities to enhance visibility and management of costs and SLAs.
- **Automation:** Rapidly deploy your services by integrating and automating provisioning, protection, and operational processes.
- **Self-service:** Empower IT and your end users by enabling service requests to be fulfilled through a self-service portal.

We provide these capabilities with our storage and data management technologies, OnCommand management software products, and partner cloud management products. These capabilities are documented with best practices in a series of technical white papers.

Acronym List

ACL	access control list
APIs	application program interfaces
CAS/XAM	content addressable storage/eXtensible access method
CIFS	Common Internet File System
CLI	command-line interface
DARE	data at rest encryption
DAS	direct attached storage
DNS	Domain Name System
FC	Fibre Channel
FCoE	Fibre Channel over Ethernet
IOPS	input/output operations per second
GbE	gigabit Ethernet
IP	Internet Protocol
IPsec	Internet Protocol Security
iSCSI	Internet Small Computer System Interface
LDAP	Lightweight Directory Access Protocol
LUN	logical unit number
NAS	network attached storage
NDMP	Network Data Management Protocol
NFS	Network File System
*NIX	Unix-like operating system
PB	petabyte
pNFS	Parallel NFS

POSIX	Portable Operating System Interface for UNIX
QoS	Quality of Service
REST	representational state transfer
ROI	return on investment
RPO	recovery point objective
RTO	recovery time objective
SAN	storage area network
SAS	Serial Attached Small Computer System Interface (SCSI)
SATA	Serial Advanced Technology Attachment
SLAs	service level agreements
SMP	symmetric multiprocessing
SMT	surface mount technology
SOAP	Simple Object Access Protocol
SPECsfs	Standard Performance Evaluation Corporation System File Server
SSD	solid state drive
SSL	secure socket layer
TB	terabyte
TCO	total cost of ownership
TCP/IP	Transmission Control Protocol/Internet Protocol
U	rack unit
VAAI	vStorage APIs for Array Integration
VDI	virtual desktop infrastructure
VSI	virtual storage interface

Intel Resources for Learning More

For more information about Intel and next-generation data center storage technologies, see the following:

Understanding Optimized Storage

Implementing Cloud Storage Metrics to Improve IT Efficiency and Capacity Management

As part of Intel's migration to the cloud, Intel IT is working on optimizing the efficiency of the SAN environment by increasing storage capacity utilization. This white paper describes a storage metrics methodology that spans both new private cloud and traditional enterprise environments. The metrics focus on efficiency, capacity management, and risk management.
intel.com/content/www/us/en/it-management/intel-it/intel-it-implementing-cloud-storage-metrics-paper.html

Intel IT's Data Center Storage Strategy

A video describing data center storage strategy, design computing manufacturing, and office and enterprise environments. (Length: 4:03 min.)
intel.com/content/www/us/en/data-center-efficiency/intel-it-data-center-efficiency-data-center-storage-strategy-brief.html

Intel Scale-Out Storage Technologies: Powering Tomorrow's Cloud

Animated video about the benefits and capabilities of scale-out storage based on Intel Xeon® processors. (Length: 2:04 min)
intel.com/content/www/us/en/cloud-computing/cloud-computing-scale-out-storage-animation.html

Ready for Cloud Storage? Key Considerations & Lessons Learned

This webcast featuring a panel of end users discussing their experiences with cloud storage first presents data on a recent research report looking at adoption trends among IT shops and then hosts a discussion focused on overcoming barriers to adoption and key considerations. (Length: 57 min.)
brighttalk.com/webcast/679/27865

About Next-Generation Data Center Technology

Peer Research: Cloud Computing Research for IT Strategic Planning

Survey of IT professionals describing the business and technology drivers for evolving networking and storage technologies to support cloud environments.
http://www.intel.com/content/www/us/en/cloud-computing/next-generation-cloud-networking-storage-peer-research-report.html

Inside Intel IT on Technology for Tomorrow's Cloud

In this podcast, Ajay Chandramouly, Intel's cloud computing and data center industry engagement manager, and Terry Yoshii, enterprise architect for Intel IT Research, look at the business case for developing a private cloud, and outline the basics of building a cloud for the future. (Length: 7:10 min.)
intel.com/content/www/us/en/it-management/intel-it/inside-it-building-private-cloud-best-practices-podcast.html

Planning Guide: Technology for Tomorrow's Cloud

Describes how IT managers can prepare their virtualized data centers for the cloud in three key areas with unified networking, scale-out storage, trusted server pools, and policy-based power management.
intel.com/content/www/us/en/cloud-computing/cloud-computing-technology-for-tomorrows-cloud-planning-guide.html

Intel Cloud Builders Initiative

Intel Cloud Builders Program

Get guidance from this cross-industry initiative to build more simplified, secure, and efficient cloud infrastructure. Intel Cloud Builders provides information and advice designed to simplify, secure, and increase the efficiency of cloud infrastructures.
intel.com/content/www/us/en/cloud-computing/cloud-builders-provide-proven-advice.html

Intel® Cloud Builders Guide: Cloud Design and Deployment on Intel® Platforms; NetApp Unified Networking and Storage: 10 GbE FCoE and iSCSI*

Design and deployment guide for building cloud data centers with architectural details and step-by-step instructions to set up and evaluate the two most common block-level storage protocols, FCoE and iSCSI, run over 10 GbE from end to end.
intel.com/content/www/us/en/cloud-computing/cloud-computing-netapp-unified-networking-guide.html

Intel® Cloud Builders Guide: Cloud Design and Deployment on Intel® Platforms; Scale-out Storage with EMC Atmos**

A reference architecture based on EMC Atmos cloud-optimized storage, including cloud topology, hardware and software deployment, installation and configuration steps, and tests for real-world use cases.
intel.com/content/www/us/en/cloud-computing/cloud-computing-scale-out-storage-with-emc-atmos-architecture.html

More from the Intel IT Center

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