EMC ISILON AND VMWARE VSPHERE 5

EMC Isilon Storage Solutions

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Revision Summary

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Reference Architecture Overview

Document Purpose
This Reference Architecture document is intended to serve as a basis for planning a VMware vSphere infrastructure built on a foundation of Isilon scale-out storage. The solution described in this document is meant to ensure that a complete vSphere infrastructure—including hosts, network and storage components—is sufficiently scaled and configured to support the availability, performance, and capacity needs of most environments.

The information provided in this reference architecture is based on real-world infrastructure designs and use cases.

The architecture of this solution comprises the following components:

- An EMC-Isilon storage array consisting of S-series, X-series, and NL-series storage nodes, and running the OneFS 6.5.4.x operating system
- VMware vSphere 5
- Several dedicated network segments, comprised of 1Gb and 10Gb Ethernet infrastructure

Introduction to EMC Isilon

Based on an architectural model that differs from traditional storage platforms, Isilon storage solutions enable efficient storage at large scales. An Isilon cluster can scale to over 15 petabytes in size, all in one file-system space. Organizations with virtualized infrastructures can optimize their investments by simplifying the underlying storage infrastructure, and, in keeping with the dynamic nature of virtualization, making it vastly more scalable.

By combining file and folder hierarchy, volume management and data protection within a single file system, Isilon changes the storage paradigm while delivering much greater storage scalability with much simpler management.

Isilon Architecture

An Isilon array is comprised of storage nodes—which themselves include processor, memory, network and disk resources—and the overlying software components and modules that enable the full functionality of the Isilon platform.

Storage Nodes

EMC Isilon nodes are segmented into several classes, based on their functionality and performance characteristics:

- **S-Series**: IOPS-intensive applications and workloads
- **X-Series**: High-concurrency and throughput-driven workloads
- **NL-Series**: Near-primary accessibility, with near-tape value.

An Isilon array starts with as few as three nodes and can scale up to 144 nodes. All node types can be aggregated into a single cluster in which different node types provide discrete ratios of capacity to performance. An internal Infiniband network between all nodes in the cluster is used for intra-node communication, cache synchronization, data movement and workload management.
More detailed information about Isilon product families is provided in the EMC Isilon Storage Nodes section below.

Additional Software Modules
Specific licensed software modules can be enabled in response to specific customer needs. The following list is a brief description of some of these available modules and their functionality.

- **SmartConnect Advanced®** – Provides for policy-based network access and load balancing with failover for high availability.
- **SmartPools®** – Data management using different disk tiers, applying Information Lifecycle Management (ILM) policies based on standard file attributes.
- **InsightIQ®** – Powerful yet simple analytics platform to identify storage cluster performance trends, hot spots, and key statistics and information.
- **Isilon Plugin for vSphere®** – Integrates backup and restore tasks through the vCenter client.

More detailed descriptions of select software modules can be found in the Licensed Features and Functionality section of this document.

Please refer to specific product documentation for additional details on all of the above licensed features.

**Solution Purpose**
Combined with VMware vSphere 5, an EMC-Isilon storage array can simplify your infrastructure while maintaining a highly scalable platform to support future growth. It is also intended to build and demonstrate the functionality, performance, and scalability of virtualized infrastructures hosted on Isilon storage with VMware vSphere 5. The solution described in this guide is built on an EMC Isilon storage cluster using NFS-based datastores.

This reference architecture serves as a general model for building a vSphere infrastructure on Isilon storage. It is not intended to be a comprehensive guide to every aspect of a vSphere solution.

**Business Challenge**
One of the primary data center challenges faced by organizations today is dealing with the mixed performance characteristics that multiple disparate workloads—including analytics, back-office applications and server virtualization—may present to the storage infrastructure. In many instances IT professionals are faced with having to use a combination of multiple storage solutions and platforms in order to accommodate all the varied requirements of these different workloads. This increases the complexity of their environment, as well as the administrative overhead associated with managing these platforms.

For customers whose workflows include multiple data tiers and workloads, the Isilon scale-out storage architecture enables the use of a single file-system volume across all workloads. It provides ease of management while at the same time delivering on the multi-tiered performance requirements for those same workloads.

**Technology Solution**
This solution demonstrates how to apply the functionality of the EMC Isilon platform to a vSphere-based virtualized infrastructure. It configures storage hardware, network connectivity, and available features to provide high-availability, high-performance storage resources for a robust vSphere environment. It is suitable for use in most...
mixed-workload environments, in which an Isilon storage array provides storage services to multiple concurrent workloads in addition to a vSphere infrastructure.

**Solution Benefits**

The solution as described and validated in this guide balances the performance requirements of vSphere virtual infrastructure against the cost pressures of expanding data requirements. The Isilon file-system-based approach to storage enables greater utilization rates of an organization's existing capacity. At the same time, its ease of management means that administrative costs remain relatively flat regardless of the size or scale of the storage cluster. Coupled with the native NFS support of vSphere datastores, Isilon create cost-effective storage that can be rapidly provisioned and expanded to continually satisfy an organization's growing storage needs.

The design offers the following benefits in a mixed-workload environment:

- More efficient use of server hardware and data-center infrastructure resources through consolidation and virtualization of multiple workloads, as enabled by VMware vSphere 5.
- Reduced overall vSphere storage footprint by using thin-provisioned NFS datastores and OneFS data-protection mechanisms.
- Flexible, highly available virtual infrastructure.
Solution Architecture

The overall component architecture of the solution is described in this section. Additional details of the constituent elements are provided in Key Components. Specific configuration settings are described in Component Hardware and Software.

Figure 1 depicts the overall physical architecture of the solution.

Figure 1: EMC Isilon Virtual Data Center Infrastructure Solution

The Reference Architecture consists of the following infrastructure components:

- **EMC Isilon mixed-node storage cluster** – Composed of three S-Series nodes, three X-Series nodes, and three NL-series nodes, the Isilon storage platform in this solution provides storage using NAS-based storage capacity via NFS-mounted datastores for vSphere virtualized workloads.

  Specific node hardware information for this solution is provided in Isilon Storage Configuration below.

- **VMware ESXi 5 hosts** – A three-node VMware vSphere 5 cluster hosts the virtualized servers in this solution. Details regarding specific host hardware information can be found in VMware ESXi Host Hardware Configuration below.

- **VMware vCenter Server 5** – Used to provide a scalable, extensible platform that forms the foundation for management of the VMware vSphere 5 virtual data center.

- **Internal Infiniband network** – Redundant Infiniband (IB) adapters provide a high-speed, back-end cluster interconnect—essentially a virtual backplane connecting all nodes in the storage array.

- **10-Gigabit VMkernel IP network** – The Ethernet network infrastructure that provides IP-based connectivity to the Isilon storage nodes.
1-Gigabit VM network – There are three 1Gb networks in the architecture: one providing dedicated network bandwidth for VMotion functions and data, another for ESXi host management, and the third for VM network traffic.

This section describes the settings as configured in this solution to enable storage connectivity and data access between the Isilon storage nodes and the vSphere cluster.

**NFS Configuration**

Using the Isilon OneFS web-based administrative console, three NFS exports are created. One export is established for hosting data on the S-Series storage nodes, another for data on the X-Series nodes, and the final export is for data on the NL-Series nodes, as shown below in Figure 2.

The process of enabling the hosting of data on the nodes that correspond to the NFS export directories is explained in [SmartPools Policy Settings](#) below.

**NFS > Summary**

![NFS exports configured on Isilon cluster](image)

Figure 2: NFS exports configured on Isilon cluster
**Isilon SmartPools**

Three SmartPools disk pools are configured in the cluster, corresponding to the node types provisioned in the Isilon storage cluster, as shown in Table I below:

**Table I: SmartPools Disk Pools**

<table>
<thead>
<tr>
<th>SmartPools Pool Name</th>
<th>Resources in Pool</th>
<th>HDD Size</th>
<th>Default Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>iq_36NL</td>
<td>Nodes 1-3</td>
<td>95.2TB</td>
<td>+2:1</td>
</tr>
<tr>
<td>x200_11tb_200gb-ssd_24gb-ram</td>
<td>Nodes 4-6</td>
<td>28.3TB</td>
<td>+2:1</td>
</tr>
<tr>
<td>s200_6.9tb_200gb-ssd_48gb-ram</td>
<td>Nodes 7-9</td>
<td>5.01TB</td>
<td>+2:1</td>
</tr>
</tbody>
</table>

Each individual NFS export highlighted in Figure 2 above is mapped to one of the available disk pools in the cluster using SmartPools policies. The folder name and the description field of the NFS export designate the pool to which it is assigned. This simplifies the tiering of VM data to the appropriate storage pool, as determined by the value and performance requirements of the data.

**SmartPools Policy Settings**

Once a VM has been created in its designated datastore cluster, SmartPools will automatically manage VM data storage according to the policies shown in Figure 3 below.

![SmartPools File Pool Policies](image)

**Figure 3: SmartPools File Pool Policies**

In this solution, disk pool assignment is delineated by folder path: all data on the Isilon array under the `/ifs/RefArchNL` directory is automatically mapped to the 36NL pool via the SmartPools policy named ‘36NL’. A second path-based policy, named ‘s200’, ensures that all data under the `/ifs/RefArchS` directory is stored on the s200 disk pool. Finally, when no explicit policy is defined to filter data into a specific disk pool, SmartPools will store the data as defined in the ‘Default’ policy—in this case the
x200 disk pool. Using this filtering sequence, all data under the /ifs/RefArchX directory would default to the X200 pool.

Finally, the ‘VMware Files’ policy at the top of the SmartPools list in this solution automatically sets the data-access pattern to ‘Random’ for all VMDK files, regardless of path. This optimizes the performance of VM data reads and writes in SmartCache, per Isilon best practices for optimal performance.

Isilon is primarily a NAS-based storage platform, so all vSphere datastores in this solution are accessed via Ethernet network connections. This section describes the networking settings on both the vSphere cluster and the Isilon storage array.

**Storage Node Networking**

The Isilon storage nodes are each configured with two 1Gb network interface connections, labeled ext1 and ext2, and two 10Gb connections, labeled 10gige-1 and 10gige-2. NFS-based datastores in this solution are accessed via the 10gige-1 interface on each node in the cluster.

**Isilon Array Subnet Settings**

The Isilon array is configured with three available external subnets, as shown in Figure 4 below.

Subnet1 is configured to provide storage connectivity for the NFS-based vSphere datastores in this solution. VMkernel storage traffic has been isolated to a dedicated subnet for optimal throughput, per EMC and VMware best practices. To optimize throughput between hosts and storage, Jumbo frames (MTU=9000) have been enabled and validated on the vSphere hosts, the storage nodes, and the Ethernet equipment.

---

**SmartConnect and FQDN-Based NFS Datastores**

While vSphere 4.x limited NFS datastores to IP addresses only, VMware introduced support for NFS datastores mapped to Fully Qualified Domain Names (FQDNs) in vSphere 5. This reference architecture makes use of that new functionality by mounting all NFS-based datastores to FQDNs.

Within vSphere, each NFS datastore constitutes a separate NFS mount. Since the NFS protocol restricts each mount to a single physical path, more datastores mean more available paths, and therefore more available bandwidth for storage traffic.

Six SmartConnect IP address pools have been created and designated for NFS access from the vSphere 5 hosts. Each unique FQDN used in this solution corresponds to a separate SmartConnect pool, or zone. With six separate SmartConnect network pools,
and three NFS exports for vSphere data configured on the storage array, the maximum number of possible datastores per ESXi host in this solution is 18. Since all connections between hosts and storage utilize 10Gb Ethernet connections, however, eight datastores are sufficient to provide the necessary bandwidth.

**SmartConnect Pool Settings**

For network connectivity, each of the three pools of nodes—S, X, and NL—has been allocated two discrete SmartConnect network pools. Each SmartConnect pool has a range of dynamic IP addresses allocated to it, and is assigned a unique DNS alias. The primary 10Gb Ethernet interface from each of the three nodes has been joined to the pool, resulting in each pool having 3 x 10Gb interfaces presented to the vSphere cluster. Table II below summarizes the SmartConnect pools configuration.

**Table II: Allocated SmartConnect Pools**

<table>
<thead>
<tr>
<th>Subnet Pool</th>
<th>Allocated Nodes/Type</th>
<th>Node network interface</th>
<th>IP address range</th>
<th>Pool alias name (FQDN)</th>
<th>Allocation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool1</td>
<td>Node4-6/X200</td>
<td>10gige-1</td>
<td>192.168.10.88-192.168.10.90</td>
<td>nfs-x10.sc-isi-a.alliances.isilon.com</td>
<td>Dynamic</td>
</tr>
<tr>
<td>Pool3</td>
<td>Node7-9/S200</td>
<td>10gige-1</td>
<td>192.168.10.91-192.168.10.93</td>
<td>nfs-s10.sc-isi-a.alliances.isilon.com</td>
<td>Dynamic</td>
</tr>
<tr>
<td>Pool6</td>
<td>Node4-6/X200</td>
<td>10gige-1</td>
<td>192.168.10.14-192.168.10.16</td>
<td>vsphere-x10.sc-isi-a.alliances.isilon.com</td>
<td>Dynamic</td>
</tr>
</tbody>
</table>

Note: Additional SmartConnect pools are created and used for other workloads on the Isilon storage cluster. They are not used in this solution, and are therefore not included in Table II above. They are only mentioned to account for the discontinuous numbering sequence of the pools as given in the table.

SmartConnect network pools in this solution use dynamic IP address allocation to ensure that all available IP addresses are distributed among all nodes assigned to the pool. If a storage node fails, or a network interface on an Isilon storage node becomes unavailable, its IP addresses are automatically reallocated to the remaining available node interfaces in its dynamic SmartConnect pool. NFS failover ensures that the hosted vSphere datastores remain online. The configuration of all SmartConnect network pools as used in this solution is depicted visually in Figure 5 below.
Figure 5: SmartConnect pool settings

**Domain Name System (DNS) Configuration**

In order to provide support for FQDN-based datastores, the DNS namespace that services this solution is configured per SmartConnect best practices. In this case, SmartConnect requires that a new Name Server (NS) record be added to the existing authoritative DNS zone that contains the storage cluster.

A DNS delegation is created on the primary DNS server for this environment, corresponding to the configured name of the Isilon storage array, as shown in Figure 6 below.

Figure 6: Isilon cluster DNS delegation in Windows
If DNS and SmartConnect are properly implemented, the Isilon storage array name effectively functions as a subdomain within the larger DNS namespace. When a client—in this case, an ESXi host—queries its DNS server for the FQDN that corresponds to a SmartConnect address pool, the DNS server forwards the query to the Isilon cluster, which responds with an IP address from the appropriate pool. Connections from multiple ESXi hosts are balanced using the default round-robin policy that was applied when the SmartConnect pool was created.

This section describes the vSphere network settings necessary to establish connectivity between the ESXi hosts, the vCenter server, and the NFS mounts on the Isilon storage array. It also describes the vSwitch setup for connecting the VMs to the production network.

**Host Network Configuration**

All vSphere ESXi hosts in this solution are identically configured with four 1Gb Ethernet adapters and two 10Gb Ethernet adapters. One 10Gb interface per host is configured for NFS access by assigning it to a VMkernel switch. The other 10Gb NIC is configured as a standby in the event of a failure event on the primary interface. Two 1Gb adapters on each host provide connectivity to the larger enterprise for VM traffic through a dedicated vSwitch. NIC teaming is enabled on that vSwitch, with traffic balanced across both adapters using the originating virtual port ID.

Of the remaining two Ethernet adapters, one is configured for VMotion traffic within the vSphere cluster. The other is used as the management interface between the vSphere host and the vCenter server, as shown in Figure 7.

All vSphere hosts are configured to use the DNS servers on which the Isilon cluster's SmartConnect DNS delegation has been created. This enables the use of FQDN-based...
Guest VM Network Configuration

Guest VMs are all connected via vSwitch0 to the production-facing 1Gb network, and use either static or DHCP-assigned IP addresses depending on the VM's assigned role.

Eight datastores per ESXi host are created within the vSphere cluster for the purpose of hosting virtual machine data. This solution balances workloads by distributing datastore traffic between all node types, mounting six of the eight datastores to the SmartConnect pools hosted on the same nodes as the underlying data. Two additional datastores, although hosted on the X200 disk pool, are mounted through the S-node SmartConnect pools due to their ability to host higher traffic volumes overall.

The default configuration of ESXi restricts the number of NFS datastores per host to a maximum of eight, but this limit can be increased to as many as 256. In order to allow for the addition of more NFS datastores to satisfy changing capacity or performance demands, the NFS.MaxVolumes setting on each host has been increased to 24. Per the VMware best-practices recommendation, the Net.TcpipHeapSize setting on each host has been increased to 8MB, and the Net.TcpipHeapMax has been set at 64MB.

Datastore Planning

SmartConnect allows clients to mount NFS exports through any of the available network pools. For full inter-host functionality, however, including Storage VMotion, HA and DRS, vSphere 5 requires all hosts using a particular datastore as a shared resource to mount that datastore using the same method. If an NFS datastore connection is mounted using a specific IP address, then all hosts using that datastore must mount the datastore using the same IP address. If the datastore is mounted via FQDN, then all hosts must use the same FQDN.

vSphere limits the number of datastores mounted through a single NFS export to the number of IP addresses through which the NFS export is presented. By using FQDN-based NFS mounts, this Reference Architecture further limits the number of available network connections in order to preserve additional connectivity and bandwidth for other workloads running concurrently against the Isilon storage array. Larger virtualized infrastructures, and virtualized infrastructures with more disk-intensive workloads, may benefit from more connections between hosts and storage.

Datastore Names

In order to provide sufficiently descriptive names for the datastores used in this solution, the following naming standard is applied to all NFS datastores in the vSphere cluster:

NFS.<SmartConnectAlias>.<DirectoryName>

This standard provides for unique naming across all datastores while also providing path information for planning or troubleshooting purposes.
Datastore Mapping

To ensure consistency across the vSphere cluster, datastores on all hosts were mapped via command line on each host, using the following sequence:

```
esxcfg-nas -a NFS.nfs-nl10.RefArchNL -o nfs-nl10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchNL

esxcfg-nas -a NFS.vsphere-nl10.RefArchNL -o vsphere-nl10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchNL

esxcfg-nas -a NFS.nfs-s10.RefArchX -o nfs-s10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchX

esxcfg-nas -a NFS.nfs-x10.RefArchX -o nfs-x10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchX

esxcfg-nas -a NFS.vsphere-s10.RefArchX -o vsphere-s10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchX

esxcfg-nas -a NFS.vsphere-x10.RefArchX -o vsphere-x10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchX

esxcfg-nas -a NFS.nfs-s10.RefArchS -o nfs-s10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchS

esxcfg-nas -a NFS.vsphere-s10.RefArchS -o vsphere-s10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchS

esxcfg-nas -a NFS.vsphere-x10.RefArchS -o vsphere-x10.sc-isi-a.alliances.isilon.com -s /ifs/RefArchS
```

The resulting datastore configuration on each ESXi host is shown in Figure 8 below.

![Datastore Configuration](image)

**Figure 8: vCenter Datastore Configuration**

Datastore Usage

A small number of virtual servers in the vSphere cluster require the throughput and performance levels provided by the S-series storage pool. To support this workload, two datastores provide sufficient throughput for the bandwidth requirements of those VMs.

Similarly, a few VMs, hosting archive data and near-line backups, have capacity-to-performance requirement ratios that allow them to be hosted on the NL-series storage pool. The cluster also has a number of archived VMs, VM templates, and ISO files to support the day-to-day operations on the cluster. A pair of NL-based datastores is created on the vSphere hosts to store this data.
The remainder of the virtual servers is hosted on the X-Series storage nodes. In order to maintain sufficient network bandwidth between all hosts and the storage—and per Isilon best practices for vSphere 5—multiple datastores are mounted from each host to the NFS export created on the X-series storage nodes.

**Datastore Clusters and Storage Distributed Resource Scheduler**

To ensure optimal availability and load balancing across all datastores mapped from each disk pool, three separate datastore clusters are configured. Using a mesh topology (as illustrated below in Figure 9) enables the balancing of loads across multiple network paths. Storage DRS is enabled for each datastore cluster and set to Fully Automated, using default settings for each datastore cluster, as shown in Figure 10 below.

![Figure 9: NFS Datastore clusters in vSphere 5.0](image)

Each datastore cluster corresponds to a different SmartPools disk pool on the Isilon storage array: VMs on the S-nodes are presented to the vSphere hosts through the RefArchS.10Gb datastore cluster in this solution. Similarly, X-node-based VMs are accessed via the RefArchX.10Gb datastore cluster, and NL-based VMs and templates through the RefArchNL.10Gb datastore cluster, as shown in Figure 10 below.
Figure 10: vSphere datastore clusters, with DRS enabled

**Storage I/O Control**

When SDRS is configured, vSphere enables Storage I/O Control® automatically, as shown in Figure 11 below. As with SDRS, the default settings for SIOC on each datastore cluster are left intact in this solution.

Figure 11: Storage I/O Control settings
Key Components

This section describes the key infrastructure hardware and software components of the solution in more detail:

- **EMC Isilon Storage Nodes**
- **Standard Features and Functionality**
- **Licensed Features and Functionality**
- **VMware vSphere 5**

The *Component Hardware and Software* section provides the specifications of the hardware and software that comprise this solution.

**EMC Isilon Storage Nodes**

EMC offers three different models of Isilon storage nodes, each targeted to meet specific performance and capacity requirements. All node classes are configured with 2 x 1Gb Ethernet interfaces, and can be configured with 2 x 10Gb Ethernet network interfaces as well, as is the case in this solution.

**S-Series**

The Isilon S-Series product line is optimized for high-performance enterprise workloads for mission-critical, transaction-based, or file-based applications and workloads. Each node can be configured with a mix of 24 Serial-Attached SCSI (SAS) hard disk drives (HDD) and/or solid-state drives (SSD) to deliver very high throughput while minimizing latency. Each S-Series node can be configured with up to 96GB of cache memory.

**X-Series**

The Isilon X-Series product line is designed to provide a cost-effective balance of performance and capacity. These nodes function well in high-concurrent and sequential-throughput workloads such as most virtualized environments. X-Series nodes can be configured with 12 Serial ATA (SATA) disks (SSDs can be added as well), up to 48GB of cache memory.

**NL-Series**

Designed and optimized for reliability and economy, the NL-Series typically functions as an archiving repository, a disk-to-disk backup solution, and/or a disaster recovery platform. Each NL-Series node can be configured with either 24 or 36 SATA HDD spindles—for a storage capacity of up to 108TB—as well as up to 16GB of cache per node.

**Standard Features and Functionality**

In addition to NFS-based file-system access, the following features and functions are included as standard components within the OneFS operating system, and are functional on all node types.

**SmartCache**

OneFS SmartCache is globally-coherent across the entire Isilon storage cluster, and provides faster read and write access to data. Like other resources in the cluster, SmartCache scales in size as more nodes are added. The shared cache is used to pre-fetch both metadata and file data to optimize access based on the actual workflows.
Data Protection

OneFS is designed to withstand multiple simultaneous component failures—up to four, including entire node failures—while still affording unimpeded access to the entire file system and dataset. Data protection is implemented at the file level, and therefore is not dependent on any hardware RAID controllers or dedicated parity drives. Unlike most traditional storage platforms, protection settings for individual files or entire directories can be changed on-the-fly, with no downtime. Additionally, changing the protection level does not change the file-system path of the impacted data, so not only does the data remain available throughout the process of changing protection levels, but it also remains accessible through the same access path. No client-side reconfiguration or remount is necessary.

SmartConnect Basic

SmartConnect Basic manages client connection balancing using a simple round robin balancing policy. Its functionality is limited to using static IP addresses, and to one IP address pool per external network subnet. The basic version is included with OneFS as a standard feature, and provides simple DNS round-robin client connection balancing, but does not include failover capabilities or the more advanced load-balancing mechanisms of SmartConnect Advanced.

Licensed Features and Functionality

The following features and functions are optional, licensed components. They have been included in this solution because of their relevance and utility within a virtualized environment, and are functional on all node types.

SmartPools

With SmartPools, multiple tiers of Isilon storage nodes—including S-Series, X-Series, and NL-Series—can exist within a single file system, with a single point of management. Performance, capacity, and data protection can be optimized by automatically and transparently moving less-active and inactive data to more cost-effective storage, or highly active file and transactional data to a pool of higher-performance storage, or move business-critical data to a higher tier of protection within its designated disk pool.

Using SmartPools, different nodes of different performance and capacity characteristics can be mixed to meet different workload requirements with the same single point of management. The use of SmartPools also enables the mixing of older and newer node hardware within a single array, allowing for investment protection across multiple product generations.

The use of SmartPools enables the subdivision of a large cluster into discrete disk pools without requiring a corresponding restructure of the logical file system. Different data-protection policies can be applied to either single files or entire directories, enabling very granular data protection levels to match the criticality of different datasets.

SmartPools is policy-driven, enabling the definition of the relative capacity, resiliency, and performance values of various workloads. Once these policies are defined and created, SmartPools will transparently and automatically align vSphere data to the appropriate price-performance tier.
**SmartConnect Advanced**

Through a single DNS delegation and host name, SmartConnect Advanced enables automated client-connection load balancing, dynamic NFS failover and failback of client connections across storage nodes, and provides optimal utilization of available cluster resources without requiring extensive configuration by administrators. SmartConnect ensures that in the event of a path failure between vSphere host(s) and storage node(s), datastore stability and availability are maintained.

**InsightIQ**

EMC Isilon InsightIQ is a licensed virtual appliance that enables detailed monitoring of the long-term usage statistics of all components of the Isilon storage cluster. InsightIQ can assist in identifying and correcting potential performance bottlenecks and limitations within the storage cluster. It also provides detailed tracking of the storage and network overhead associated with each workload on the cluster to ensure optimal placement and protection of all hosted applications.

**Plugin for vCenter**

The Isilon Plugin for vCenter is a licensed virtual appliance that runs on the vSphere cluster, and is accessed and administered via a plugin WebUI for vCenter. It uses the Isilon Platform API to communicate with the cluster in order to orchestrate backups and restores across Isilon storage environments.

VMware vSphere is the market-leading virtualization platform that is used in thousands of IT environments around the world. vSphere can transform or virtualize computer hardware resources, including CPU, RAM, hard disk, and network controller, to create a fully functional virtual machine that runs its own operating systems and applications just like a physical computer. The latest version of vSphere builds on the features and functionality of vSphere 4 to enable a dynamic, agile data center environment.

The high availability features of VMware vSphere 5.0, including VMotion, Distributed Resource Scheduler (DRS), Storage VMotion, and Storage DRS, enable seamless migration and management of virtual machines between hosts and datastores with minimal or no disruption to customers. vSphere also offers resource protection mechanisms, such as SIOC, to ensure that system resources are maintained to support critical servers and applications, even under peak workloads.

This section lists the hardware used to validate the solution.

**Storage Configuration**

The storage configuration as described in this solution is intended to include a full representation of the available node types in a typical Isilon storage array. Table III describes the hardware and network specifications for each node type. The Isilon storage array in this solution consists of a total of nine nodes.
### Table III: Storage Node Hardware Specifications

<table>
<thead>
<tr>
<th>Node #</th>
<th>Node Type</th>
<th>Quantity</th>
<th>Capacity per Node</th>
<th>RAM</th>
<th>Network Interfaces per Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>36NL</td>
<td>3</td>
<td>33,256 GB HDD</td>
<td>4GB</td>
<td>2x1Gb/s Ethernet 2x10Gb/s Ethernet</td>
</tr>
<tr>
<td>4-6</td>
<td>X200</td>
<td>3</td>
<td>184 GB SSD 9,626 GB HDD</td>
<td>24GB</td>
<td>2x1Gb/s Ethernet 2x10Gb/s Ethernet</td>
</tr>
<tr>
<td>7-9</td>
<td>S200</td>
<td>3</td>
<td>184 GB SSD 7,066 GB HDD</td>
<td>48GB</td>
<td>2x1Gb/s Ethernet 2x10Gb/s Ethernet</td>
</tr>
</tbody>
</table>

### VMware ESXi Host Hardware Configuration

The vSphere cluster consists of three identically configured host servers. Table IV describes the specific hardware configuration of each server. The host count and configuration were selected based on the workload profile, and on the expected CPU and memory resource requirements. The host count and configuration are also based on the need to maintain sufficient vSphere cluster capacity in the event of a host hardware failure.

### Table IV: Host Hardware Specifications

<table>
<thead>
<tr>
<th>Host Hardware</th>
<th>Hardware Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Count</td>
<td>3</td>
</tr>
<tr>
<td>CPUs per host</td>
<td>2</td>
</tr>
<tr>
<td>Number of cores per CPU</td>
<td>6</td>
</tr>
<tr>
<td>Number of cores per host</td>
<td>12</td>
</tr>
<tr>
<td>CPU type</td>
<td>Intel® Xeon® E5645</td>
</tr>
<tr>
<td>CPU speed</td>
<td>2.4GHz</td>
</tr>
<tr>
<td>Memory per host</td>
<td>48GB</td>
</tr>
<tr>
<td>Network connections</td>
<td></td>
</tr>
<tr>
<td>1Gb/s Ethernet interfaces, per host</td>
<td>4</td>
</tr>
<tr>
<td>Model</td>
<td>Broadcom NetXtreme II BCM5709</td>
</tr>
<tr>
<td>10Gb/s Ethernet interfaces, per host</td>
<td>2</td>
</tr>
<tr>
<td>Model</td>
<td>Intel 82599EB</td>
</tr>
</tbody>
</table>
### Software Resources and Configurations

Table V lists the component software, software versions, and configuration settings used in this solution.

**Table V: Software Components and Configurations**

<table>
<thead>
<tr>
<th>Software</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isilon Array (including shared storage, file systems, vSphere integration and management)</td>
<td></td>
</tr>
<tr>
<td>OneFS operating system</td>
<td>v6.5.4.13</td>
</tr>
<tr>
<td>NFS Service</td>
<td>Enabled</td>
</tr>
<tr>
<td>NFS compatibility</td>
<td>NFS v3</td>
</tr>
<tr>
<td>Lock protection level</td>
<td>+2</td>
</tr>
<tr>
<td>SmartConnect Networking</td>
<td>Dynamic</td>
</tr>
<tr>
<td>MTU size</td>
<td>9000</td>
</tr>
<tr>
<td>VLAN tagging</td>
<td>Disabled</td>
</tr>
<tr>
<td>IP connection policy</td>
<td>Round Robin</td>
</tr>
<tr>
<td>IP allocation method</td>
<td>Dynamic</td>
</tr>
<tr>
<td>Rebalance policy</td>
<td>Automatic failback</td>
</tr>
<tr>
<td>IP failover policy</td>
<td>Round Robin</td>
</tr>
<tr>
<td>SmartPools Settings</td>
<td></td>
</tr>
<tr>
<td>Directory protection</td>
<td>Protect directories at one level higher</td>
</tr>
<tr>
<td>Global namespace acceleration</td>
<td>Disabled</td>
</tr>
<tr>
<td>Protection settings</td>
<td>Managed by SmartPools</td>
</tr>
<tr>
<td>I/O optimization</td>
<td>Managed by SmartPools</td>
</tr>
<tr>
<td>Default disk pool protection level</td>
<td>+2:1 (all pools)</td>
</tr>
<tr>
<td>InsightIQ</td>
<td>v1.5.2.0002</td>
</tr>
<tr>
<td>Isilon for vCenter</td>
<td>v1.0.1.0003</td>
</tr>
<tr>
<td>vSphere Cluster</td>
<td></td>
</tr>
<tr>
<td>VMware vSphere hosts</td>
<td>ESXi 5.0</td>
</tr>
<tr>
<td>Datastores</td>
<td>NFS</td>
</tr>
<tr>
<td>VMkernel (storage) network MTU size</td>
<td>9000</td>
</tr>
<tr>
<td>NFS.MaxVolumes per host</td>
<td>24</td>
</tr>
<tr>
<td>Net.TcpipHeapSize</td>
<td>8MB</td>
</tr>
<tr>
<td>Net.TcpipHeapMax</td>
<td>64MB</td>
</tr>
</tbody>
</table>
**Software**                  | **Configuration**  
---|---
VMware vCenter server | VMware vCenter Server 5.0  
Additional vSphere features |  
  vSphere High Availability (HA) | Enabled with default settings  
  vSphere Distributed Resource Scheduler® (DRS) | Enabled, fully automated, with default settings  
  Storage Distributed Resource Scheduler® (SDRS) | Enabled, fully automated, with default settings  
  Number of SDRS-enabled datastore clusters | 3  
  Storage I/O Control® (SIoC) | Enabled, fully automated, with default settings  
Microsoft guest VMs |  
  Number of virtual machines | 36  
  CPU | 1-4 vCPU per guest  
  Memory | 2-8GB per guest  
  SCSI Controller | LSI Logic SAS  
  Disk | 40-120GB per guest  
  Disk provisioning type | Thin  
  VMware Tools for Windows | v8.6.0, build-515842  
  VMware Hardware Version | 8  

**Virtualized Components and Workloads**

- **Microsoft Windows 2008 R2 Active Directory Domain and DNS services** – The Windows 2008 R2 domain controllers provide Active Directory Domain Services that serve as the basis for identity and security management for Windows environments. The (DNS) component of the Windows network infrastructure is also installed on these servers, which are hosted as virtual machines on the vSphere 5 host servers within the cluster.

- **Microsoft Active Directory Certificate Services** – Provides customizable services for issuing and managing public key certificates used on software security systems that employ public key technologies.

- **Microsoft Windows 2008 R2 Dynamic Host Configuration Protocol (DHCP)** – The Microsoft Windows DHCP server provides a platform for the centralized management of IP address provisioning. This service is hosted on the same virtual machine as one of the domain controllers and DNS servers within the vSphere cluster.
• **Microsoft Internet Information Services (IIS) 7.5** – A unified web platform that enables information sharing with users and applications on the Internet, an intranet or an extranet. Version 7.5 is bundled with Windows Server 2008 R2, and delivers a completely modular, extensible web server with expanded application hosting.

• **Microsoft Print and Document Services** – Enables the sharing of printers on a network, as well as the centralization of print server and network print management tasks.

• **Isilon for vCenter Plugin** – A plugin that connects with vCenter and provides a single management point for integrating backups, restores and snapshots between vCenter and Isilon.

• **Isilon InsightIQ** – Provides detailed analytical capabilities for capturing and analyzing Isilon storage array performance metrics across all component areas.
Conclusion

The flexibility and features offered by the Isilon storage platform in a virtualized vSphere environment enable higher levels of storage consolidation and utilization than is possible using traditional RAID- and LUN-based storage models. The Isilon web-based administrative interface provides a much simpler management model than as well, allowing for rapid, linear storage capacity scaling without simultaneously increasing administrative overhead. By combining these benefits in support of a virtualized Microsoft data-center infrastructure, organizations that deploy Isilon storage can significantly reduce both their capital and operational costs while improving performance, flexibility and service levels for their customers.

Together with VMware vSphere 5, the EMC Isilon storage platform provides a scalable, dynamic data center infrastructure that grows and adapts to meet the ever-changing demands of the modern IT enterprise.

This Reference Architecture provides a validated blueprint for hosting a virtualized solution for workload and server consolidation. Use the configuration guidelines and recommendations in this document, as well as those provided in the EMC Isilon Storage and VMware vSphere 5 Best Practices Guide and the EMC Isilon Scale-Out Storage and VMware vSphere Sizing Guide, to ensure a reliable and predictable outcome.

Next Steps

EMC can help accelerate assessment, design and implementation of an Isilon-based vSphere solution in your organization while lowering the implementation risks.

To learn more about this and other solutions, contact an EMC representative.
References

The following documents provide additional and relevant information. Access to these documents may depend on your login credentials. If you do not have access to a document, contact your EMC representative.

VMware vSphere documentation:
- VMware Compatibility Guide
- vSphere Installation and Setup
- vSphere Networking
- What’s New in VMware vSphere 5.0 – Storage
- VMware vSphere Resource Management Guide

EMC Isilon Storage Configuration documentation:
- Isilon Scale-out Storage for Virtualization
- Solution Brief: EMC-Isilon Virtualization at Scale
- Insight from Isilon: Understanding the Role Storage Plays in Virtual Environments
- EMC-Isilon InsightIQ: Customizable Analytics Platform to Accelerate Workflows and Applications
- SmartConnect: Optimize Scale-out Storage Performance and Availability
- Next Generation Storage Tiering with EMC Isilon SmartPools

EMC Isilon and vSphere Documentation:
- EMC Isilon Storage and VMware vSphere 5: Best Practices Guide
- EMC Isilon Scale-Out Storage and VMware vSphere 5: Deployment Guide
- EMC Isilon Scale-Out Storage and VMware vSphere: Sizing Guide
About EMC Isilon

EMC Isilon is the global leader in scale-out NAS. We provide powerful yet simple solutions for enterprises that want to manage their data, not their storage. Isilon products are simple to install, manage and scale, at any size and, unlike traditional enterprise storage, Isilon stays simple no matter how much storage is added, how much performance is required, or how business needs change in the future. We’re challenging enterprises to think differently about their storage, because when they do, they’ll recognize there’s a better, simpler way. Learn what we mean at www.emc.com/isilon.
