

Utilizing IBM XIV Storage System snapshot technology in SAP environments

IBM SAP International Competence Center



... combining our strengths

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1. Abstract

This paper describes a proof of concept conducted to demonstrate utilization of IBM XIV Storage System snapshot technology to backup and provision SAP systems in virtualized SAP environments.

2. Executive summary

As companies drive more and more of their business processes with SAP applications, supporting infrastructure environments are growing and increasing in complexity. These companies require their operations to be available 24/7 as they increasingly globalize and centralize their IT environment. At the same time, they are demanding more and more efficient and secure backups to further protect their data.

Customers also look for ways to efficiently provision new SAP systems and clone existing systems according to SAP best practice requirements. Companies also consolidate and virtualize their server environments, to increase server efficiency and manage their SAP environments more easily.

In order to meet these demands of ensuring SAP environments are available and protected all the time, an efficient, storage-based database backup technology is used to achieve high SAP availability.

In traditional, non-virtualized environments, SAP backups or installing new SAP instances can take many hours and consumes additional space on a storage system, the same amount of space as the source. Customers are looking for solutions that require less storage space and less time to operate and manage.

In order to address these requirements for SAP storage environments, the virtualized IBM® XIV® Storage System helps customers maintain backups and provision new systems through its enhanced snapshot capabilities. The system supports up to 16,000 snapshots per Logical Unit (LUN). Each snapshot is space efficient and quick, taking just milliseconds to generate.

3. Exercising IBM XIV Storage System snapshot technology proof of concept

The IBM XIV Storage System is designed to generate up to 16,000 space-efficient snapshots per LUN. Space-efficient means that only changes of the source LUN and snapshot are physically written on the hard disks. The IO performance of an IBM XIV Storage System is virtually independent of the number of snapshots taken. A customer can generate practically an unlimited number of snapshots, using them for backups, clones, or other sandbox environments without impacting storage performance.

IBM and SAP together conducted a proof of concept project to highlight the advantages of XIV snapshot technology in SAP environments. The proof of concept successfully demonstrated that taking 100 snapshots of an SAP application, creating several SAP clones from the snapshots, and using the SAP clones, that the additional storage space consumption was minimal and there was no degradation in SAP application performance.

4. System environment

This section provides an overview of the test environment, the hardware and software requirements, and the SAP lab environment setup.

4.1 Description of the environment

The PoC environment consists of an IBM XIV Storage System connected to two IBM System x servers through a SAN switch:

- One IBM System x3950 M2 to host the source environment:
SAP data and operating system binaries reside on the IBM XIV Storage System LUNs.
- One IBM BladeCenter HS22 to host the cloned environment
Cloned SAP data and operating system binaries reside on XIV snapshots.

Clients and the IBM System x hosts reside in a private physical network and connect to each other through a network switch.

Figure 1 provides a graphical overview of the system landscape.

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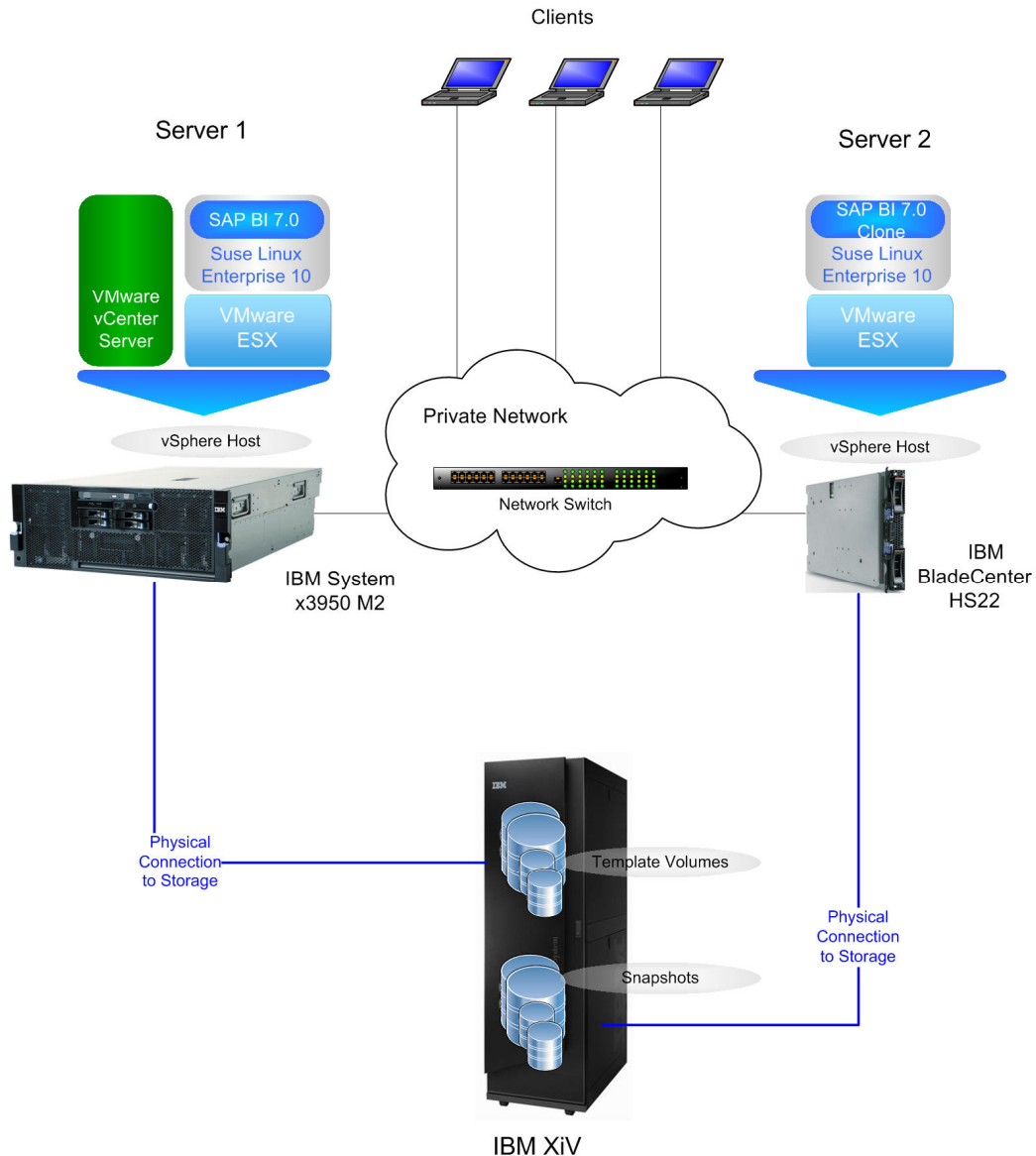


Figure 1: Graphical overview of the system environment

4.2 Proof of concept test setup

The following points briefly describe the SAP lab environment setup steps:

1. Run VMware vSphere 4.0 host on the IBM System x3950 M2.
2. Within the x3950 M2 VMware vSphere host create 2 virtual machines:
 - one virtual machine containing the VMware vCenter server on Microsoft Windows 2003
 - one virtual machine containing the SAP System on SuSE Linux Enterprise version 10
3. On the IBM XiV Storage System, take a snapshot of the LUN containing the SAP system.

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4. Unlock the Snapshot on the XIV and attach it to the IBM BladeCenter HS22.
5. Also run VMware vSphere on the IBM BladeCenter HS22 host.
6. Within the BladeCenter HS22 VMware vSphere host create 2 virtual machines:
 - one virtual machine containing the VMware vCenter server on Microsoft Windows 2003
 - one virtual machine containing the SAP System clone on SuSE Linux Enterprise version 10

4.3 Hardware

Hardware used in the proof of concept includes:

Machines (vSphere Host):

IBM BladeCenter® HS22
IBM System x3950 M2

Storage:

IBM XIV Storage System, Controller Firmware Version: 10.2.1

More detail on hardware components and features is provided in Section 6.

4.4 Software

Software used in the proof of concept includes:

VMware:

VMware Infrastructure 4:

- VMware vSphere 4.0
- VMware vCenter Server 4.0

Storage manager:

IBM XIV Storage System GUI version 2.4.3

ERP system:

SAP Business Intelligence (BI), based on SAP Netweaver 7.0 SR3, SAP Kernel 7.0

Virtual machine guest operating system:

Suse Linux® Enterprise 10

Database:

IBM DB2® V9.7

4.5 Proof of concept test execution

For this PoC the team first allocated the X86 storage pool. While hardware resources within the XIV Storage System are virtualized globally, the available capacity in the system can be administratively apportioned into separate and independent storage pools. Essentially, storage pools function as a means to effectively manage a related group of similarly provisioned logical volumes and their snapshots, facilitating the administration of relationships among LUNs, snapshots, and consistency groups.

The following principles govern relationships between entities within the storage pool:

- A logical volume can have multiple independent snapshots. This logical volume is also known as a *master volume*.
- A *master volume* and all of its associated snapshots are always a part of only one storage pool.
- A volume can only be part of a single consistency group.
- All volumes of a consistency group must belong to the same storage pool.

Furthermore, snapshot reserve capacity is defined within each storage pool and is effectively maintained separately from logical, or master volume capacity.

In our PoC we created a storage pool named X86 as shown in *Figure 2*. The storage pool also includes 3 TB for snapshot reserve within its virtually allocated 11 TB. This means that 3 TB (this figure is variable based on XIV storage management settings) is set as the upper capacity limit used for all snapshots in the storage pool.

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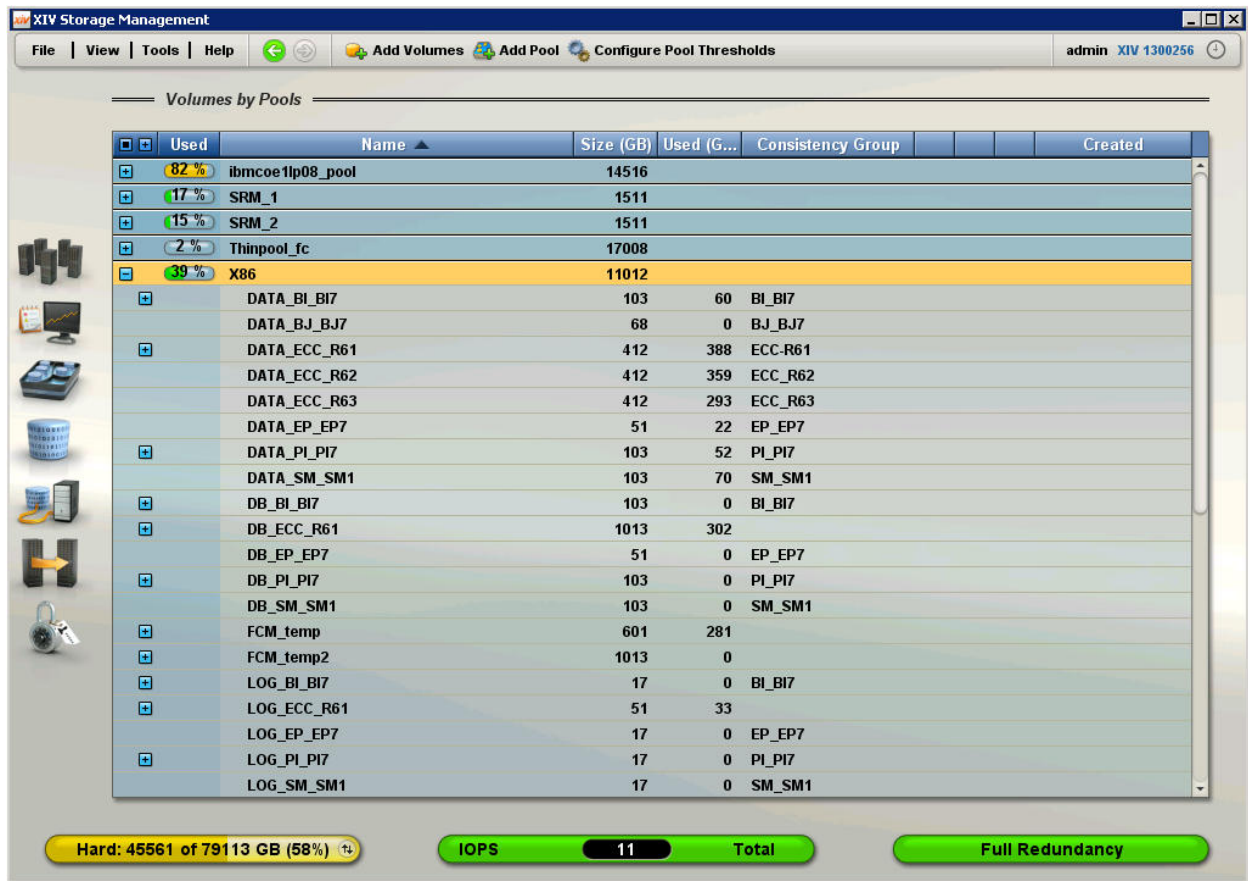


Figure 2: LUNs residing in the storage pool X86

As XIV can support 16,000 snapshots per LUN that space-efficiently use little storage capacity and cause little or no XIV performance degradation, 3 TB is a large reserve. However, if the limit is approached, XIV warns a user with an alert (starting at a configured threshold level, e.g. 2.5 TB) before XIV stops saving snapshots at the 3 TB limit. Thus, XIV demonstrates flexible as well as reliable space-efficient technology that protects customer SAP data. Figure 3 shows how to configure thresholds.

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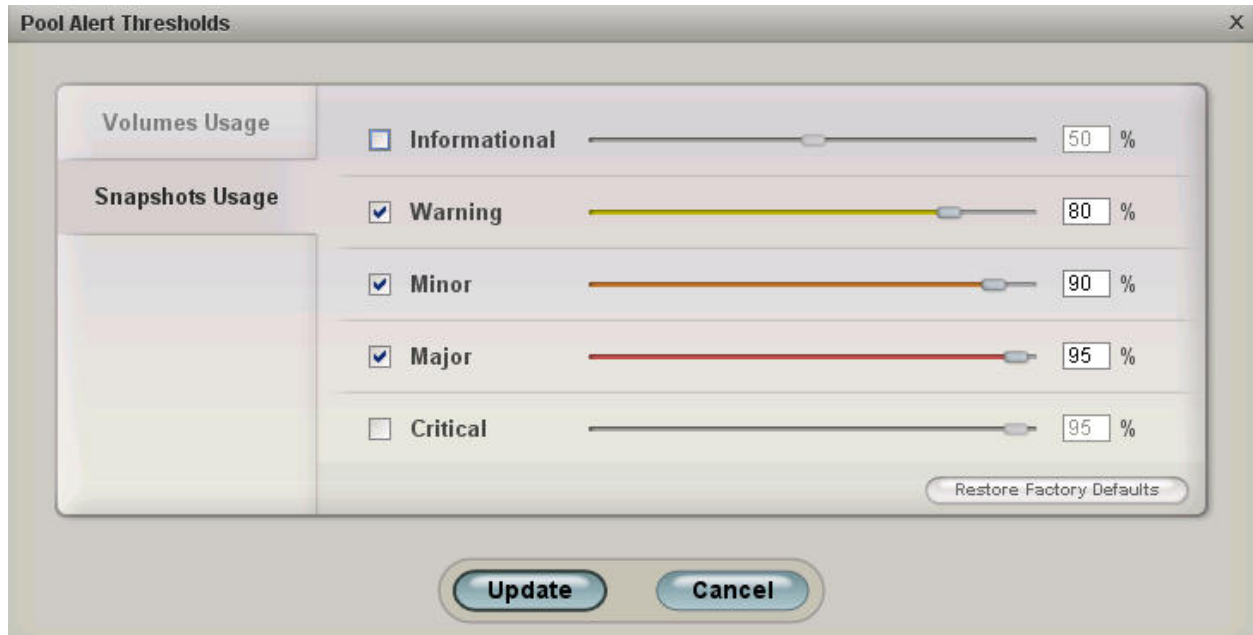


Figure 3: Threshold configuration

The team used the IBM System x3950 M2 server to host the VMware vCenter and create the template virtual machine containing the SAP BI system.

After creating the template, the team stopped the template virtual machine and created 100 snapshot groups of the LUNs belonging to the template virtual machine on the IBM XIV Storage System. As all LUNs belonging to the template were part of a consistency group, the snapshot group automatically contained all the required snapshots of the LUNs belonging to the consistency group. *Figure 4* shows the snapshot groups and the snapshots of the SAP BI system.

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Name	Size (GB)	Master	Pool	Created
BI_BI7.snap_group_00083				
BI_BI7.snap_group_00084				
BI_BI7.snap_group_00085				
BI_BI7.snap_group_00086				
BI_BI7.snap_group_00087				
BI_BI7.snap_group_00088				
BI_BI7.snap_group_00089				
BI_BI7.snap_group_00090				
BI_BI7.snap_group_00091				
BI_BI7.snap_group_00092				
BI_BI7.snap_group_00093				
BI_BI7.snap_group_00094				
BI_BI7.snap_group_00095				
BI_BI7.snap_group_00096				
BI_BI7.snap_group_00097				
BI_BI7.snap_group_00098				
BI_BI7.snap_group_00099				
BI_BI7.snap_group_00100				
BI_BI7.snap_group_00101				
BI_BI7.snap_group_00101.DATA_BI_BI7	103	DATA_BI_BI7	X86	2010-07-05 13:48
BI_BI7.snap_group_00101.DB_BI_BI7	103	DB_BI_BI7	X86	2010-07-05 13:48
BI_BI7.snap_group_00101.LOG_BI_BI7	17	LOG_BI_BI7	X86	2010-07-05 13:48
BI_BI7.snap_group_00101.OS_BI_BI7	51	OS_BI_BI7	X86	2010-07-05 13:48
BI_BI7.snap_group_1				
BJ_BJ7			X86	
ECC_R61			X86	
ECC_R62			X86	
ECC_R63			X86	
EP_EP7			X86	
ibmcoe1lp01_datavg			Thinpool_fc	
ibmcoe1lp01_rootvg			Thinpool_fc	
ibmcoe1lp02_rootvg			Thinpool_fc	
ibmcoe1lp09_rootvg			Thinpool_fc	
PI_PI7			X86	
SM_SM1			X86	
SRM_1			SRM_1	
vmware_mgmt			Thinpool_fc	

Figure 4: Snapshot groups and snapshots of the SAP BI system

All snapshots on the IBM XIV Storage System are thinly provisioned; this means only the changes relative to the target LUN are physically written to disk and require storage space.

During this PoC, the team created 100 snapshots. These snapshots were taken from four LUNs that together used about 250 GB of storage space. If the same snapshots had been created with non-space-efficient methods, the storage space consumed would be 100 snapshots x 250 GB = 25 TB. As shown in *Figure 4*, the four LUNs and snapshots are part of the 11 TB XIV X86 storage pool. All snapshots in X86 storage pool together took actually only 498 GB, see *Figure 5*. Snapshots consume no space until they are actually updated. Only changes consume additional disk space. Using space-efficient snapshot technology, the PoC pool X86 is nearly 2.5 times over-provisioned, effectively reducing a 25 TB "non-space efficient" pool size to an 11 TB hard pool size. Additionally, as *Figure 2* shows, many other LUNs and snapshots reside in the X86 pool as well, further demonstrating XIV space-efficient storage space savings.

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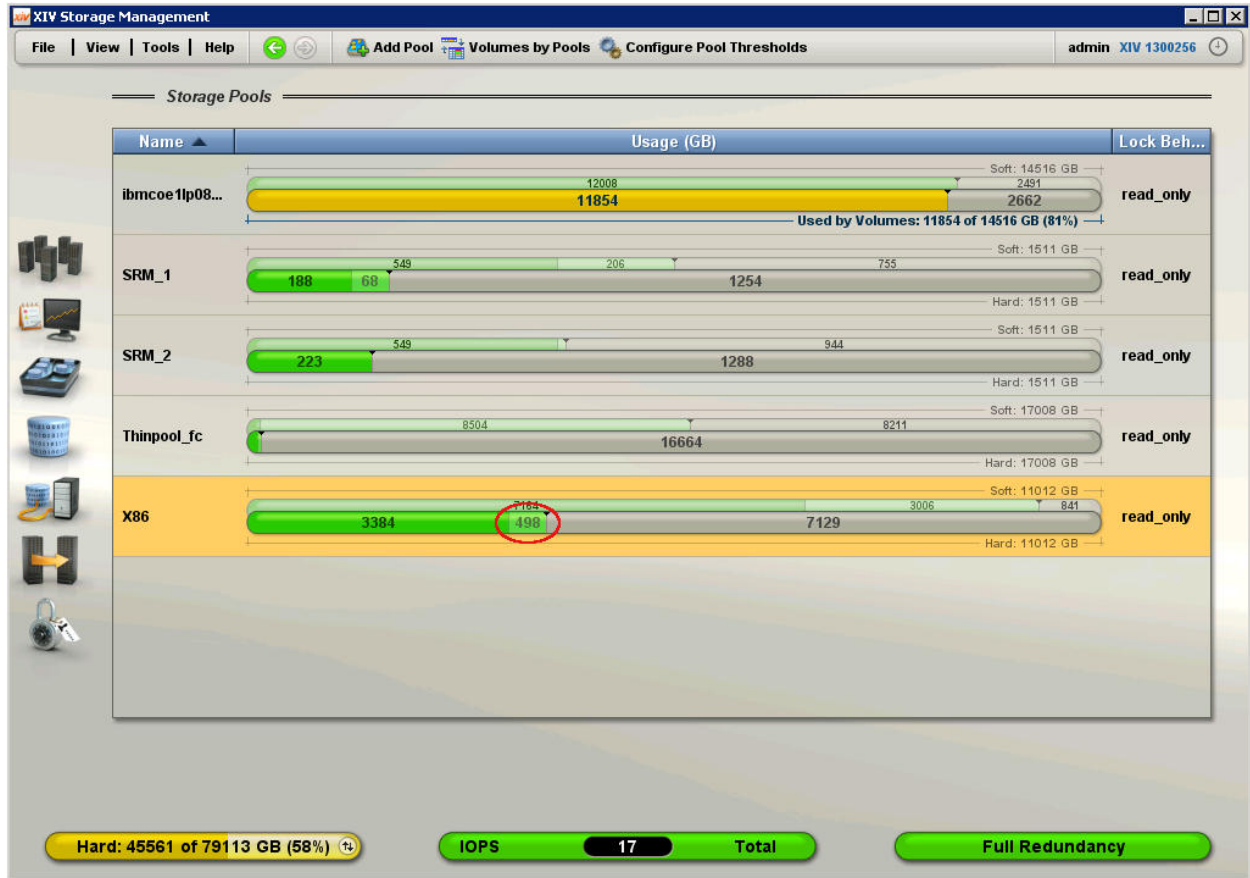


Figure 5: Space actually consumed by snapshots

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Next, the team unlocked one of the snapshot groups and mapped the LUNs to the IBM BladeCenter HS22 host.

Figure 6 shows the host mappings.

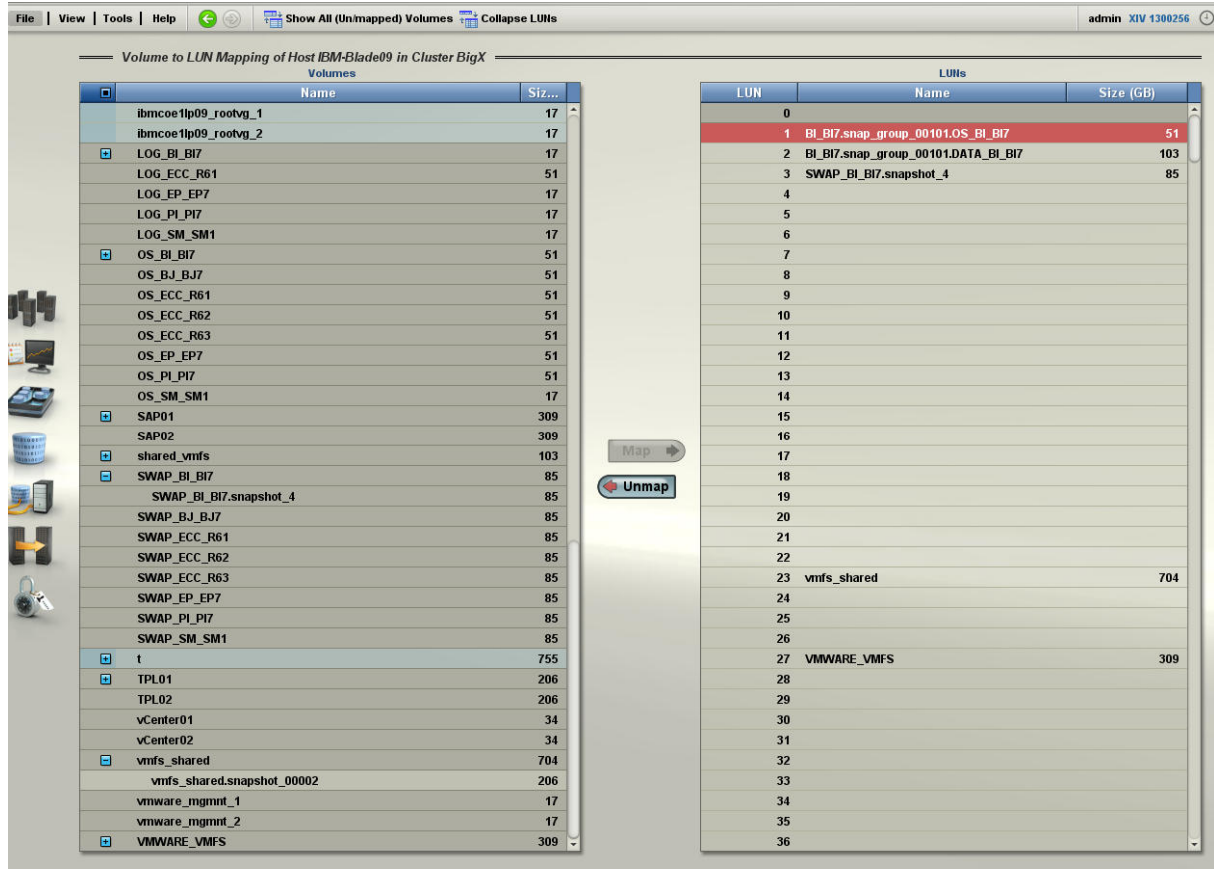


Figure 6: Host mappings of the snapshots

After completing this, the team created a new virtual machine in the VMware vSphere running on the IBM BladeCenter HS22 host and mapped the snapshot LUNs (belonging to the snapshot group) to the new virtual machine. Figure 7 shows the final step and the settings of the new virtual machine that hosted the cloned SAP BI system. Figure 8 shows the IBM XIV Storage System LUNs mapped to the IBM BladeCenter HS22 host.

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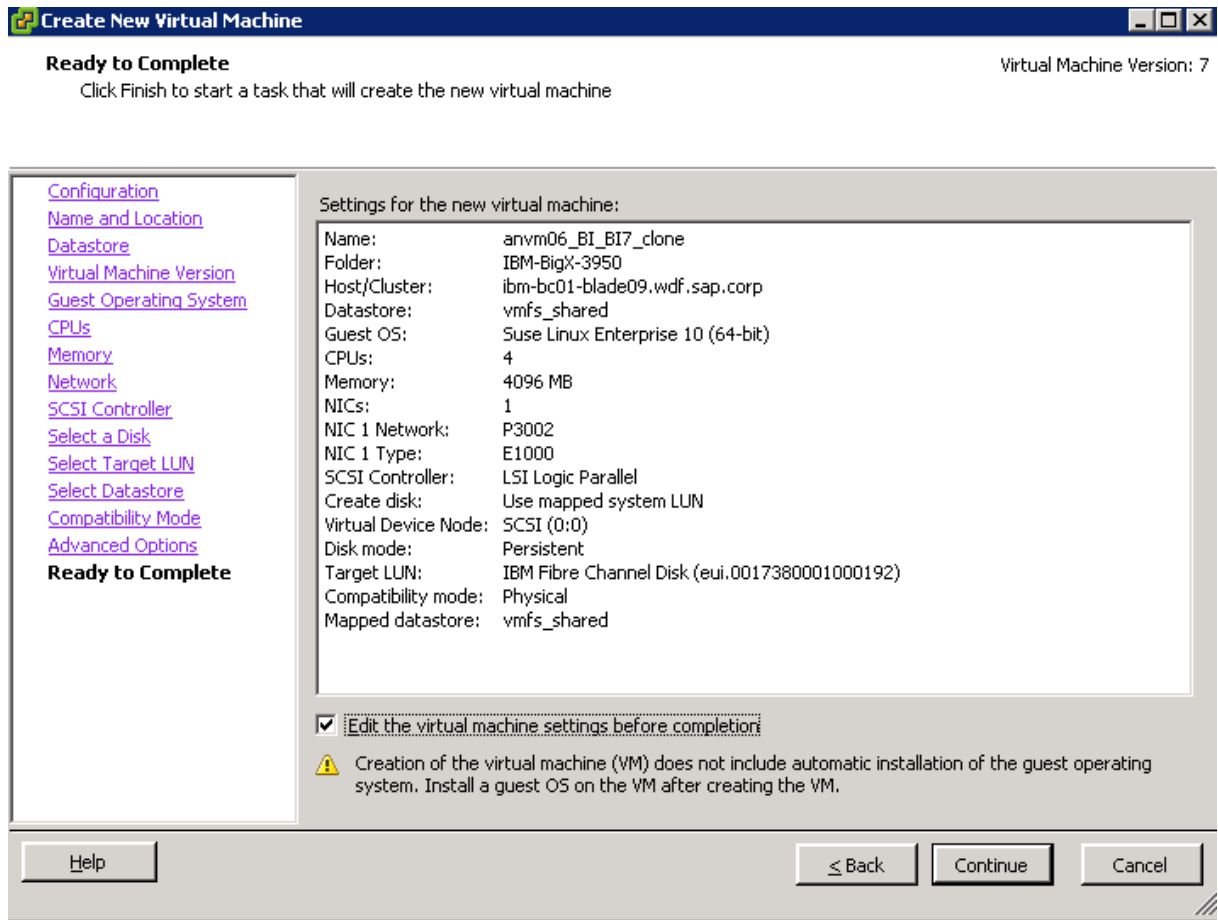


Figure 7: New virtual machine hosting the cloned SAP BI system

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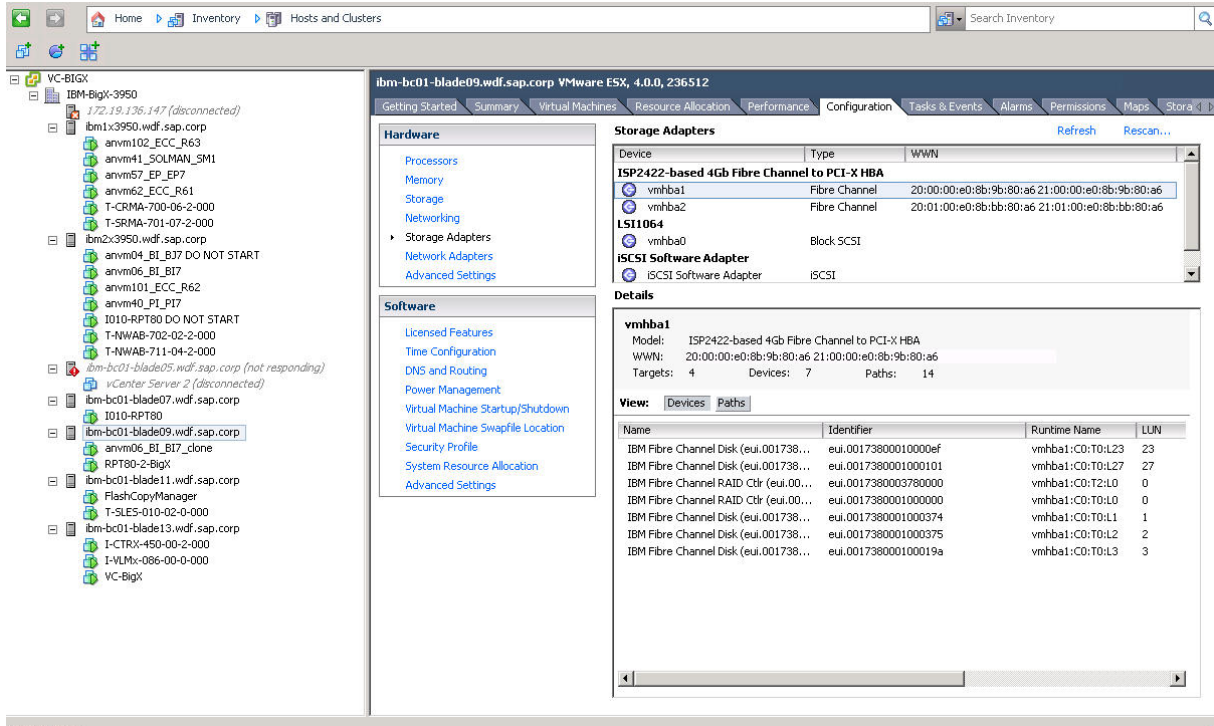


Figure 8: IBM BladeCenter HS22 host running VMware vSphere and the attached IBM XIV Storage System LUNs

5. Testing the new virtual machine

In order to test the cloned SAP BI system, the team switched on the new virtual machine and started the SAP BI system. *Figure 9* shows the successful start of the cloned SAP BI system.

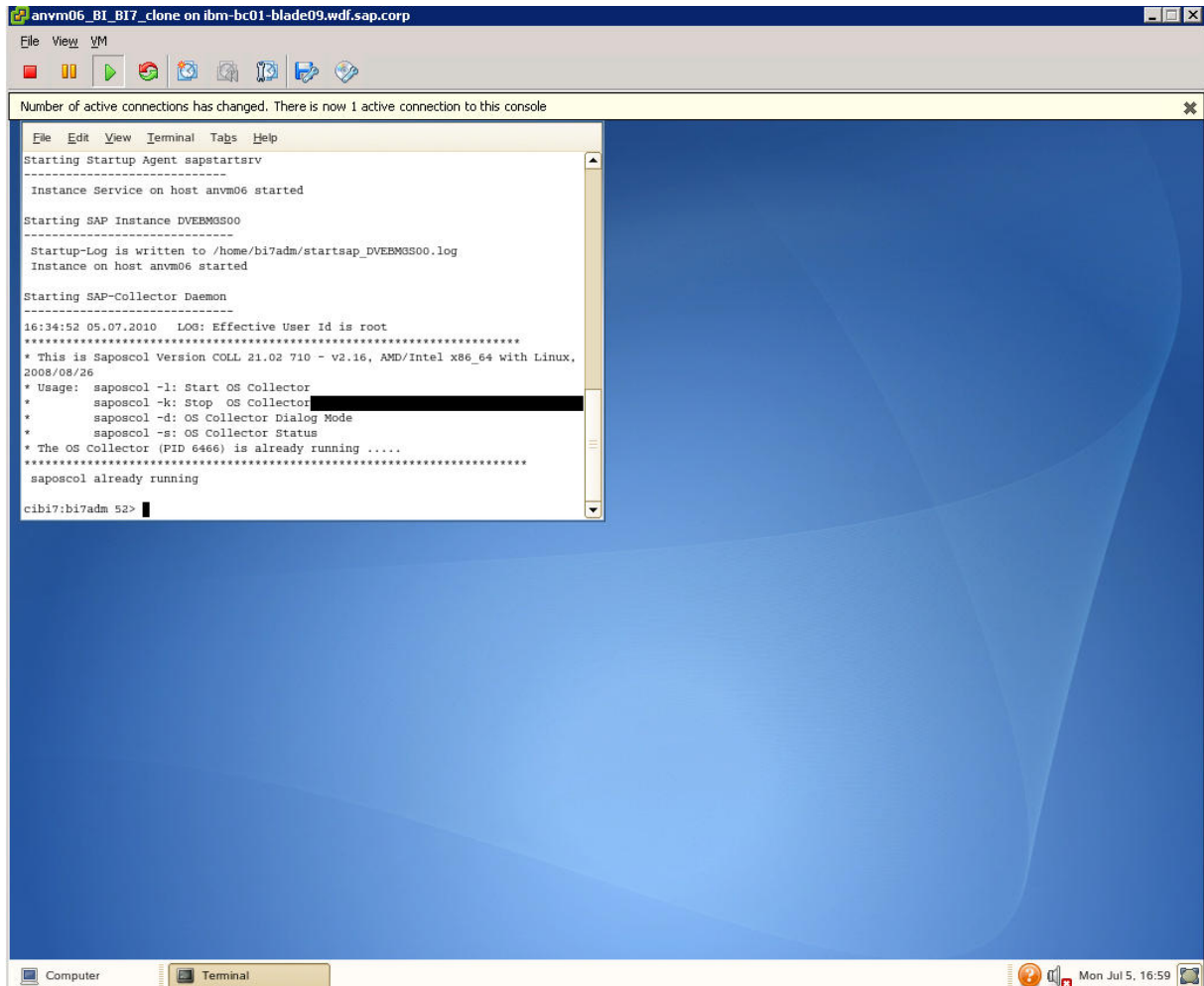


Figure 9: Cloned SAP BI system started in the new virtual machine

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Figure 10 shows the IOs per second (IOPS) of the snapshots of the SAP BI system on the IBM XIV Storage System at the time when the SAP system was started.

The snapshot names are:

- BI_BI7.snap_group_00101.DATA_BI_BI7
- BI_BI7.snap_group_00101.DB_BI_BI7
- BI_BI7.snap_group_00101.LOG_BI_BI7
- BI_BI7.snap_group_00101.OS_BI_BI7

See Figure 4 for further details on the snapshots and their names.

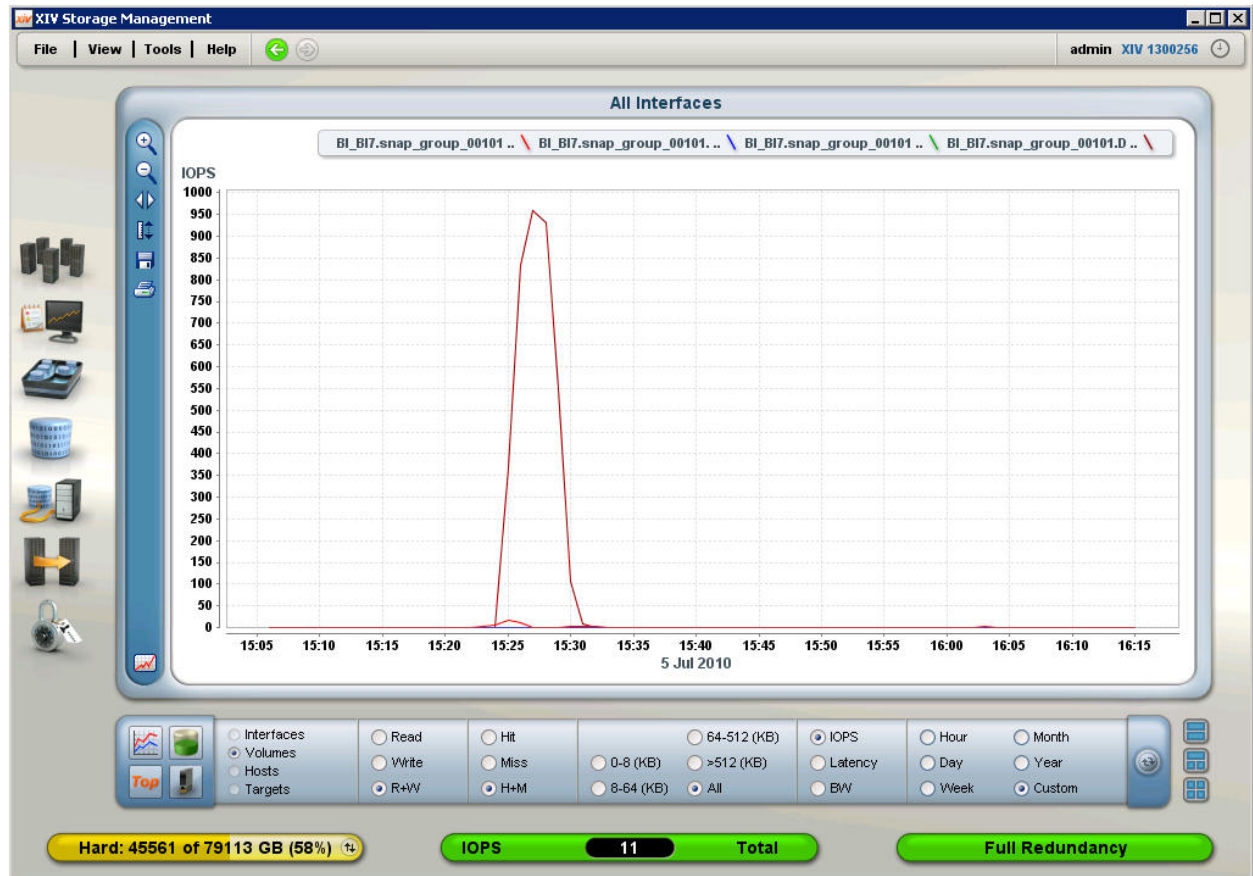


Figure 10: IOPS of BI7 snapshots during SAP system startup

6. Description of the hardware

The following sections describe the individual hardware components and features used in this PoC in more detail.

6.1 IBM BladeCenter

IBM BladeCenter offers flexible options to support a broad range of workloads, including virtualization and enterprise applications. IBM BladeCenter can be customized and deployed quickly while reliability features help keep customers up and running.

Built for performance

IBM BladeCenter provides outstanding performance with support for the latest processors, high-speed I/O, and support for high memory capacity and fast memory throughput. IBM BladeCenter can run applications up to two times faster when compared to previous generation blade servers.

The IBM BladeCenter HS22 provides the following features:

- High performance, energy efficiency, and low cost to run the most demanding applications
- Exceptional power management with integrated tools such as IBM Systems Director Active Energy Manager™ and Blue Path Cooling blade design
- Optional embedded hypervisor with instant virtualization
- IBM Integrated Management Module (IMM) for complete control and remote presence
- Light path diagnostics and Predictive Failure Analysis to detect component failure before the failure occurs—helping to maximize availability

Find more detail on IBM BladeCenter at:

ibm.com/systems/bladecenter/hardware/servers/hs22

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6.2 IBM System x3950 M2

Engineered with the needs of enterprise organizations in mind, the IBM System x3950 M2 provides a scalable, efficient, and highly reliable server solution. This fourth-generation IBM X-Architecture® enterprise server combines 64-bit performance in a balanced design. The x3950 M2 server can help organizations meet business demands with confidence, and as many organizations require servers that expand as business grows, the x3950 M2 server provides the flexibility to run more applications on the same piece of hardware. These features deliver an optimized solution for large database enterprise application and virtualization services.

The IBM System x3950 M2 provides the following features:

- Innovation with fourth-generation IBM X-Architecture chipset enhancements to deliver performance, balanced design, and proven reliability
- Manage growth and risk with IBM Active Memory™ and features such as Memory ProteXion, hot-add / hot-swap memory, and Chipkill to provide a level of reliability and availability that helps reduce downtime and maintain data integrity
- Improve responsiveness with double the memory availability over previous generations with 32 Dual in-line Memory Module (DIMM) slots
- Maximize return on IT investment with extraordinary scalability that delivers the ability to add more processing power, memory, or I/O required in virtualized environments

Find more detail on the IBM System x3950 M2 at:
ibm.com/systems/x/hardware/enterprise/x3950m2

6.3 IBM XIV Storage System: Innovative grid-based storage system with “built-in” virtualization

The IBM XIV Storage System is a next-generation high-end open-disk storage system. An integral part of IBM's broad spectrum of system storage and system area network (SAN) offerings, the IBM XIV Storage System is designed to deliver the highest levels of reliability, performance, scalability, and functionality at low overall cost, while providing unprecedented ease of management.

The IBM XIV Storage System provides the following features:

- A disk storage system designed to eliminate the complexity of administration and management of tiered storage.
- Fully virtualized grid architecture, supporting mission-critical workloads and designed innovatively to simplify storage
- High reliability and data availability through active-active N+1 redundancy of all key components, partition mirroring, unique self-healing, rapid rebuild times, and non-disruptive upgrades
- Unmatched total cost of ownership and environment-friendly attributes with breakthrough ease of management, full system virtualization, and dramatic efficiencies in capacity, power, and space
- Consistent performance at an enterprise-level through massive parallelism, disk utilization, and unique caching mechanisms
- Open and integrated system, offering strong integration with the IBM portfolio and diverse interoperability with open-system servers and technologies
- Transparent, no-impact scalability, in on-demand increments, without the need for manual data migration or performance tuning, providing automatic online capacity growth
- Rich, enterprise-class function set bundled with the system software including virtually unlimited, near-instant differential snapshots, thin provisioning, data migration, asynchronous and synchronous mirroring, as well as an intuitive management console

Find more detailed information on the IBM XIV Storage System at:

ibm.com/systems/storage/disk/xiv

Figure 11 shows an overview of the IBM XIV Storage System architecture.

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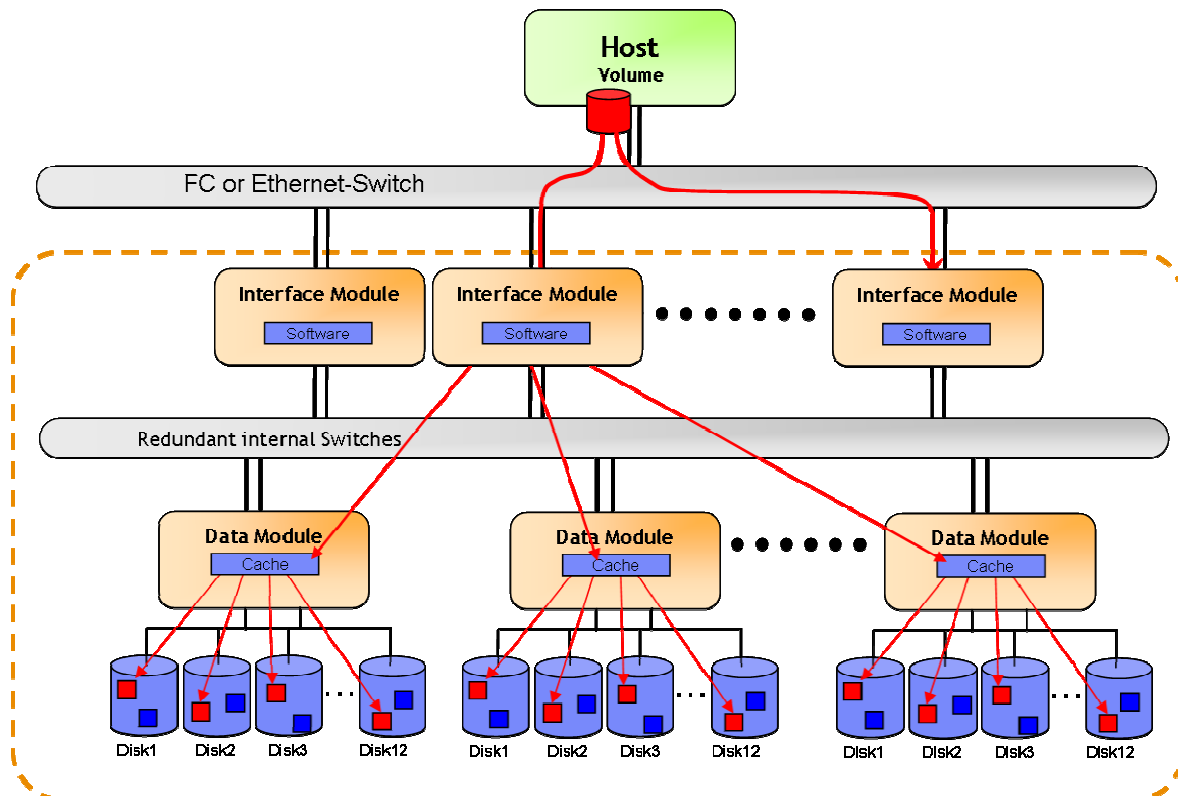


Figure 11: IBM XIV Storage System architecture overview

The IBM XIV Storage System consists of interface and data modules which are connected through redundant switches. Each data module handles a set of 12 hard disks. Per the IBM XIV Storage System design, the modules work in a grid-like architecture, that is, with automatic load balancing and redundant maintenance.

As a result, the IBM XIV Storage System's architecture provides the following advantages:

- Equal data distribution to all disks in 1MB partitions
- All resources are utilized equally: Paths, CPUs, Caches, Disks
- Hot spots not possible

7. Conclusions and best practices

As described in the Executive summary, the joint IBM SAP PoC demonstrated the following proof points:

1. Many XIV snapshots can be taken very easily with little or no performance degradation
2. XIV Snapshots can be attached to a host after being unlocked to be available for writing
3. XIV snapshots are space efficient; only the space for incremental changes is allocated requiring little incremental space as new snapshots are created.

With XIV's ability to automatically create a snapshot group from a consistency group, allowing creation of consistent snapshots of LUNs belonging to that consistency group, the team easily created consistent snapshots from a set of LUNs belonging to the same SAP BI system.

Also, snapshots attached to the vSphere host were successfully used to start the SAP BI system, showing that snapshots or clones can be used as like normal LUNs.

Additionally, snapshot sizes were still much lower than the size of the original LUNs.

Hence, this proof of concept demonstrates that it is easy to clone an existing SAP system using the IBM XIV System Storage featuring space-efficient snapshots.

The following section lists best practice recommendations for leveraging snapshot and virtualization capabilities of the IBM XIV Storage System in virtualized environments. Not all of the best practice recommendations were applied in the PoC because the environment was static, and only few systems were part of the PoC. However, the recommendations apply to more complex production environments as they help to ease the LUN management on the IBM XIV Storage System. Best practice recommendations not applied in this PoC are marked.

- On the IBM XIV Storage System, create the following storage pools:
 - Golden template (not applied in this PoC)
 - Separate pools for different landscapes

Separate storage pools help organize the LUNs on the storage system.

- Create and strictly apply naming conventions for all storage pools, LUNs and snapshots, host names etc. on the IBM XIV Storage System. Names should be self explaining.
Deploying descriptive naming conventions helps keep an overview of allocated resources on the IBM XIV Storage System.
- Create separate template LUNs for operating systems, SAP executables, database, and database log files on the IBM XIV Storage System. Place these LUNs in the **Golden template** pool. Golden templates were not used in this PoC. Creating separate template LUNs allows easy creation of new combinations of operating system, SAP, and database versions. These LUNs should not be mapped to any host.

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- Copy these separate template LUNs to a storage pool which contains a system or even a system landscape. Start the systems and configure the landscape. After this, shutdown the systems, so that no changes can be written on the template LUNs any longer and the systems and databases are in a consistent state.
These template LUNs act as source LUNs to create snapshots for new SAP systems.
- Place the LUNs of each SAP system into a separate consistency group.
Using consistency groups allows easy creation of consistent snapshots of all LUNs belonging to one system. This is done by creating a so called snapshot group from a consistency group. When this is completed, unmap these LUNs from the hosts.
Now, the LUNs can be used as templates for complete systems. Note that these templates should not be mapped to any host in read/write mode. Changing data by writing on the template LUNs can make the templates unusable.
- Create a snapshot group from one or more systems and map the snapshots to hosts.
The snapshots act as the LUNs for new SAP systems or even SAP system landscapes.
- Create separate VLANs for each SAP system landscape.
VLANs help separate SAP systems or SAP system landscapes from each other.

7.1 Feedback

We are interested in any feedback you have. Please send your comments to isicc@de.ibm.com.

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