



Virtualize More, Manage Less:

IBM System Storage
SAN Volume Controller
Update SVC 4.3 + TPC

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IBM System Storage SAN Volume Controller

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What is Virtualization?

Logical representation of resources not constrained by physical limitations

- Create many virtual resources within single physical device
- Reach beyond the box – see and manage many virtual resources as one
- Dynamically change and adjust across the infrastructure



IBM Virtualization Engine

**A comprehensive platform to
help virtualize the infrastructure**

2 | IBM System Storage SAN Volume Controller

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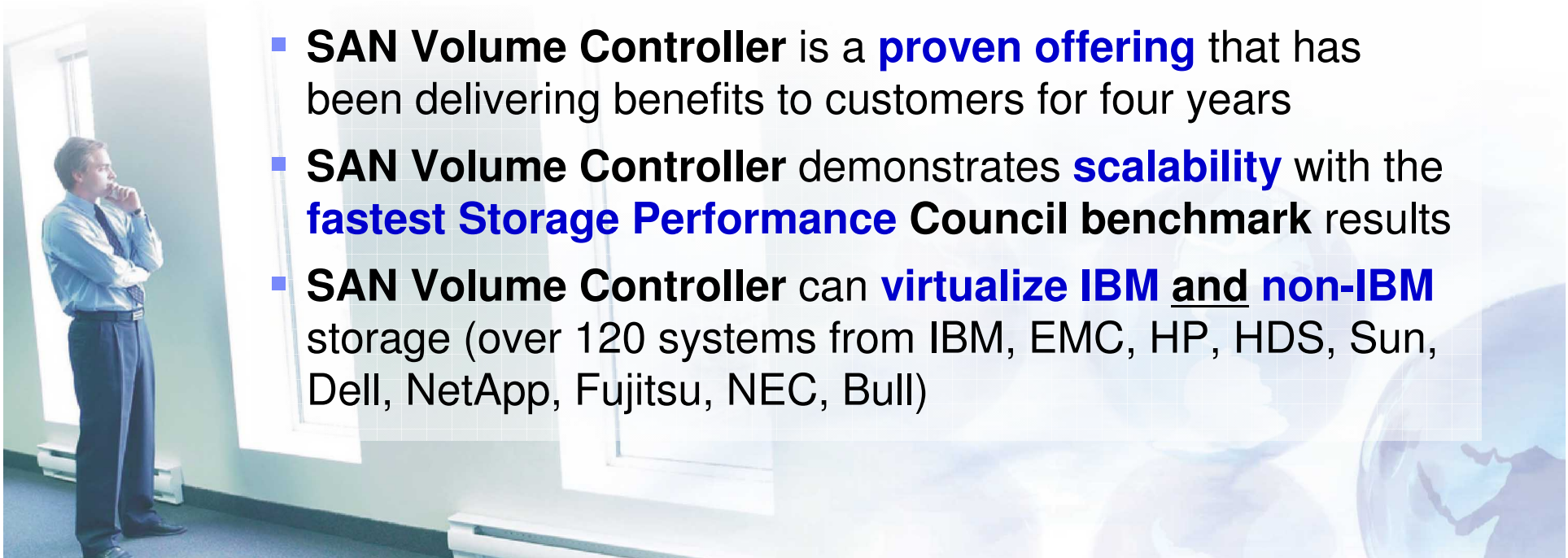
Why Storage Virtualization?

- Not “just another way of helping manage SANs”
- **Storage virtualization complements server virtualization**
 - Both technologies help increase flexibility and speed responsiveness
- Storage management used to be manually intensive, time-consuming and disruptive to the business
- Storage virtualization with SVC can help **change** that to automatic, **time-saving** and **non-disruptive** to the business
- Radically changes the way you think about and work with storage to make it fundamentally more flexible than just disk boxes alone



SAN Volume Controller Facts

- IBM has **40 years experience** in virtualization technologies
- IBM has shipped **over 10 000 SVC engines** (SVC nodes) running in more than **4 000 SVC systems** (SVC Clusters)
- There are more than **130 customer references** and **24 customer case studies** for **SAN Volume Controller**
- **SAN Volume Controller** is a **proven offering** that has been delivering benefits to customers for four years
- **SAN Volume Controller** demonstrates **scalability** with the **fastest Storage Performance Council benchmark** results
- **SAN Volume Controller** can **virtualize IBM and non-IBM** storage (over 120 systems from IBM, EMC, HP, HDS, Sun, Dell, NetApp, Fujitsu, NEC, Bull)





SAN Volume Controller :

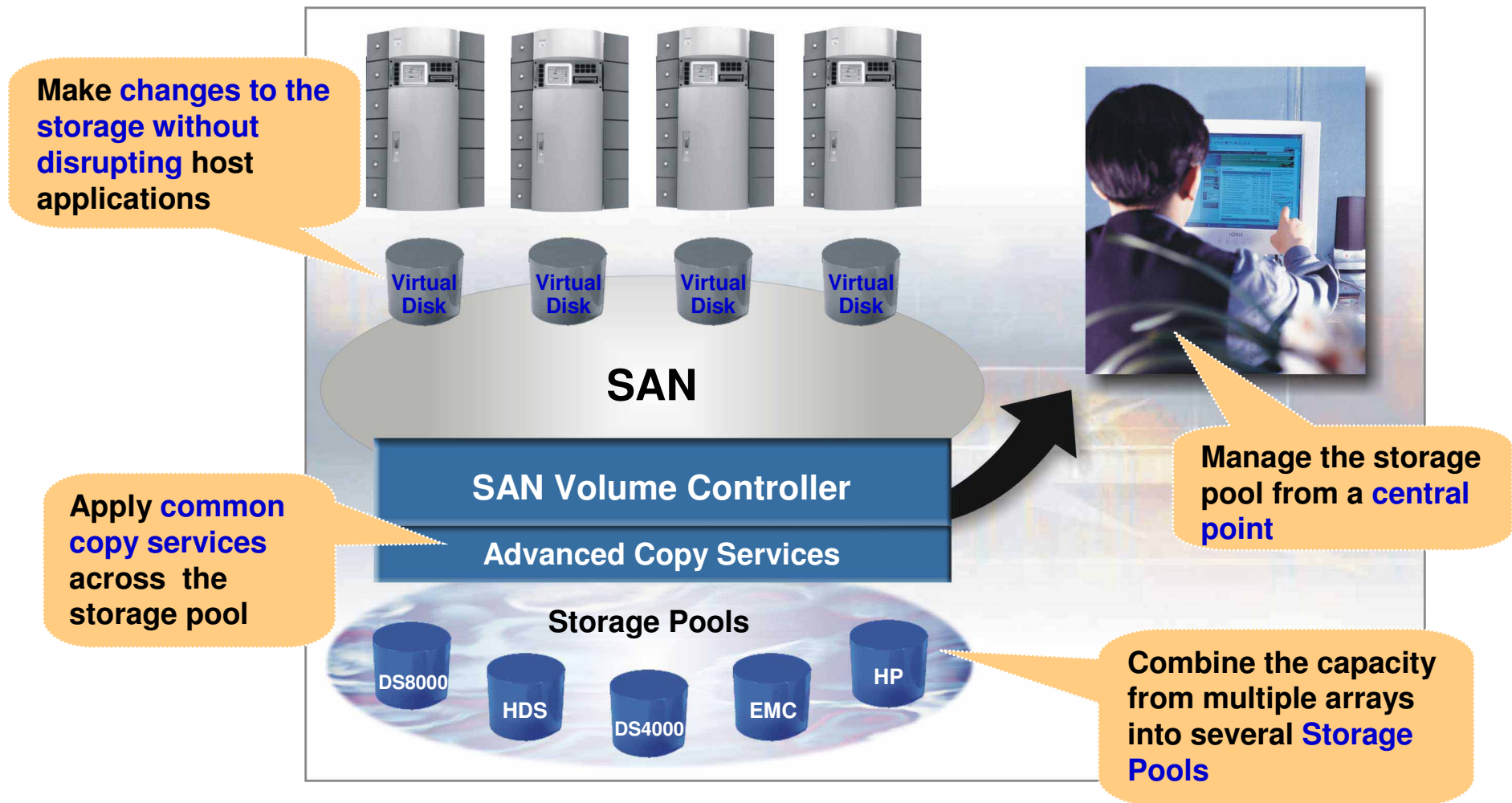
Concepts & Features

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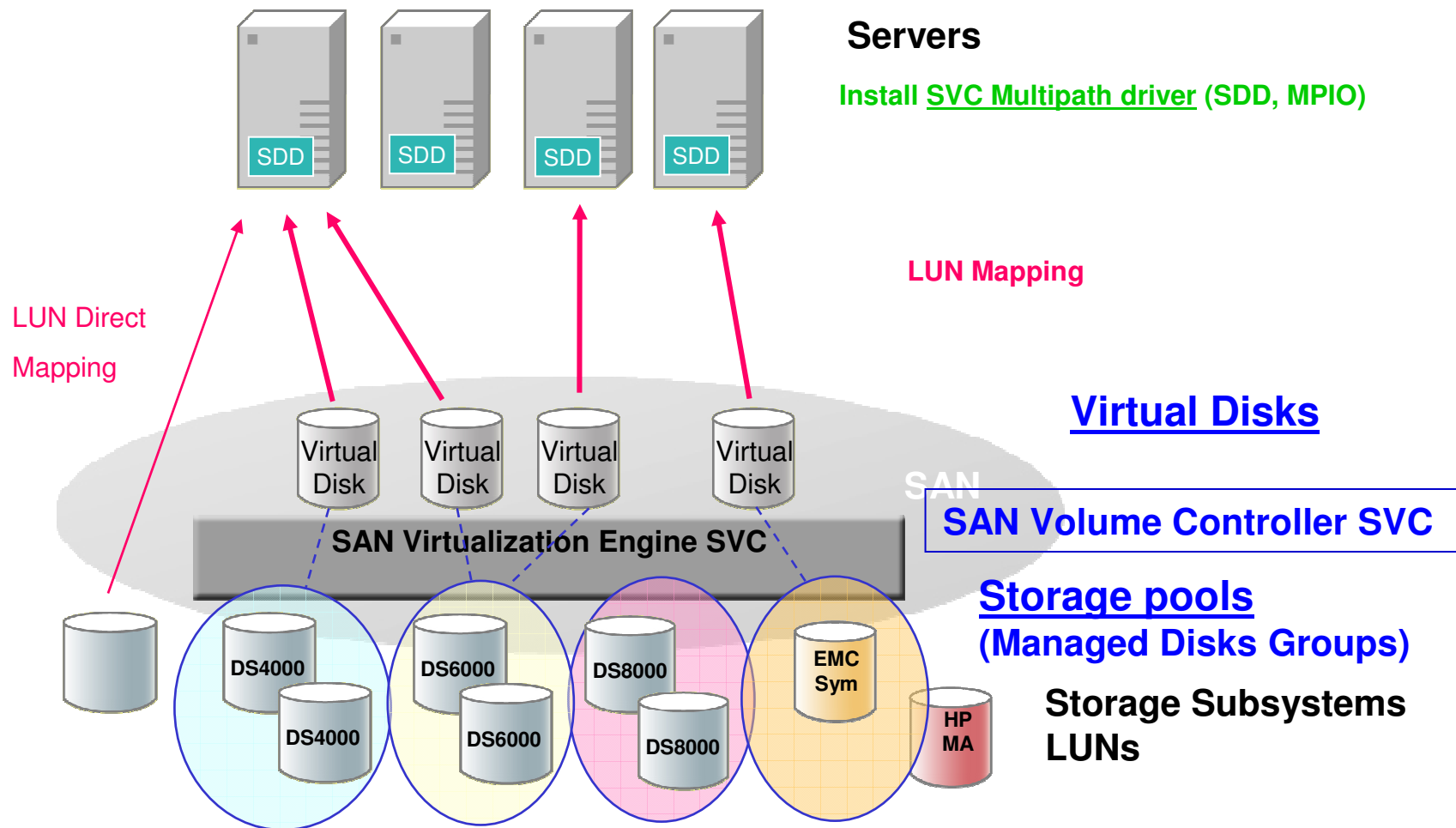
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SAN Volume Controller Concepts



SVC : Disk block virtualization concepts



SAN Volume Controller Delivers Value



Reduces the cost and complexity of managing storage

- Creates tiers of storage
- Enables multi-vendor strategies

Improves business continuity

- Supports data movement without interrupting applications
- Allocate more storage to applications automatically

Improves storage utilization

- Combines storage capacity into a single resource – from multiple vendors
- Manage storage as a business resource, not as separate boxes

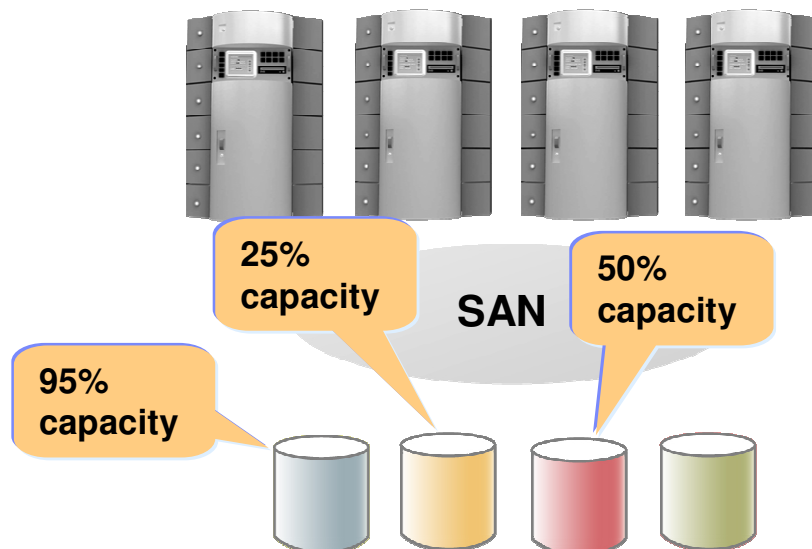
Improves personnel productivity

- Manage a single storage resource from a central point

Infrastructure Simplification with SAN Volume Controller

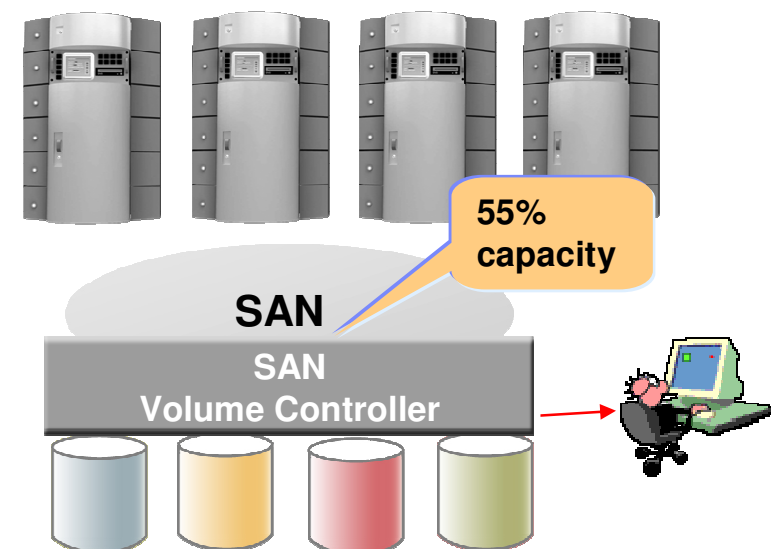
Traditional SAN

- Capacity is isolated in SAN islands
- Multiple management points
- Poor capacity utilization
- Capacity is purchased for, and owned by individual processors



SAN Volume Controller

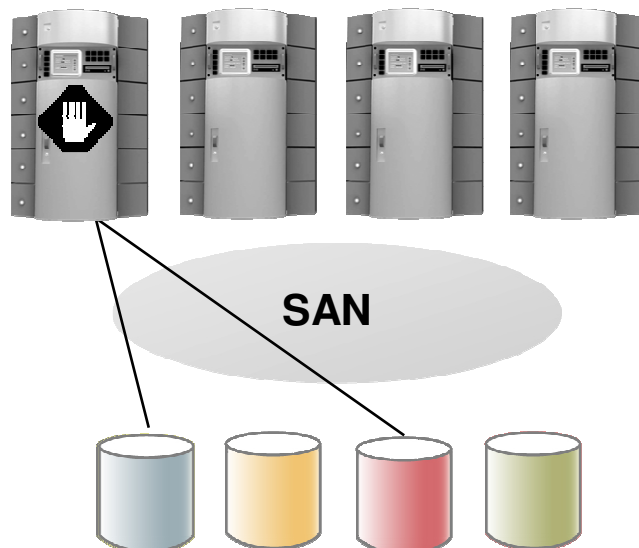
- Combines capacity into a **single pool**
- Uses storage assets more efficiently
- **Single management point**
- Capacity purchases can be deferred until the physical capacity of the SAN reaches a trigger point.



Non-disruptive Data Migration with SAN Volume Controller

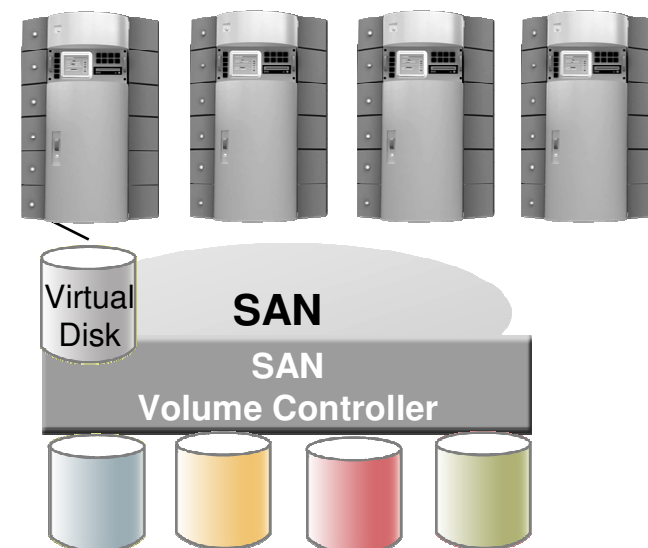
Traditional SAN

1. Stop applications
2. Move data
3. Re-establish host connections
4. Restart applications



SAN Volume Controller

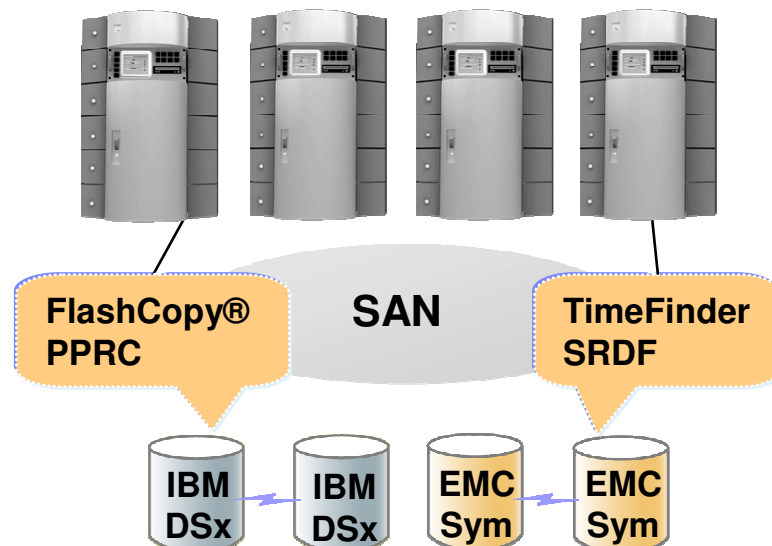
1. Move data
- Host systems and applications are **not affected**.



Business Continuity with SAN Volume Controller

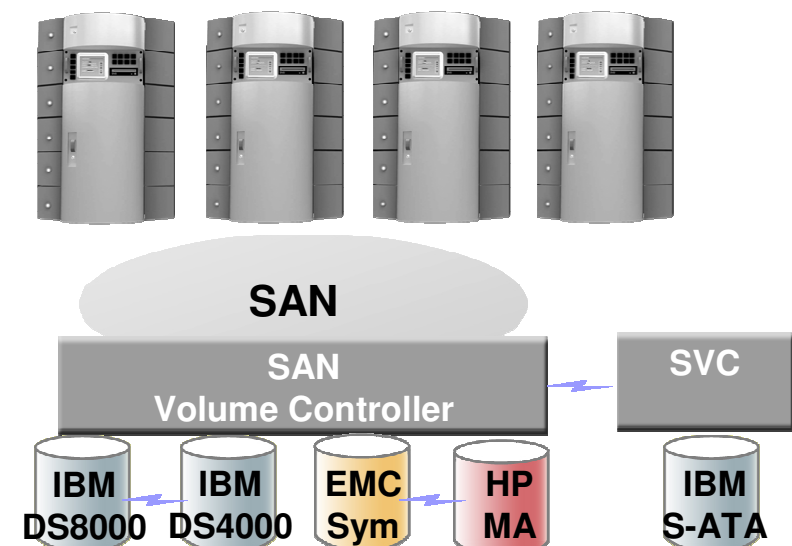
Traditional SAN

- Replication APIs differ by vendor
- Replication destination must be the same as the source
- Different multipath drivers for each array
- Lower-cost disks offer primitive, or no replication services



SAN Volume Controller

- **Common replication API**, SAN-wide, that does not change as storage hardware changes
- **Common multipath driver** for all arrays
- Replication targets can be on lower-cost disks, reducing the overall cost of exploiting replication services





SAN Volume Controller : **Hardware**

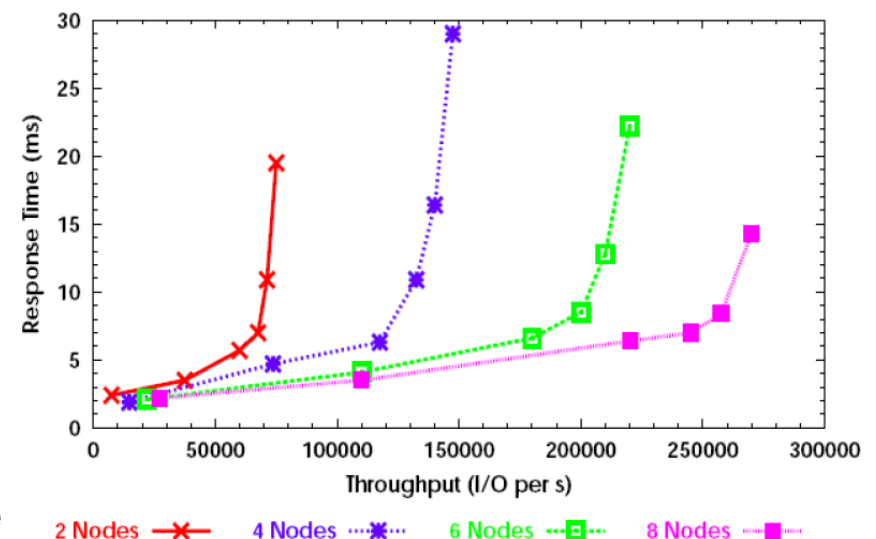
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SVC Elementary modules (Hardware nodes)

- SVC is a mix of **IBM Storage Software** and **IBM hardware** (SVC nodes)
- **SVC nodes** are based on IBM System x3550 servers which have following characteristics :
 - **Two dual-core Intel Xeon 5160 processors at 2.33GHz** (Dramatically improved throughput compared with previous generation of nodes)
 - **8GB of cache**
 - **Four 4Gbps FC ports**
 - **Fully mirrored cache between pairs of nodes**
- Designed to provide **high performance**
- **Scalable solution** :
 - Minimum configuration : **2 nodes**
 - Upgradable up to **8 nodes** (by adding pairs of nodes)
- New engines may be **intermixed in pairs** with older engines in SVC clusters (Helps protect investments and offers enhanced growth capability)
- **Cluster nondisruptive upgrade capability** may be used to *replace* older nodes with new 8G4 nodes.





SAN Volume Controller :

Copy Services

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SVC Advanced Copy Services

▪ FlashCopy :

- Designed to create copies for backup, parallel processing or test purpose which are available almost immediately for use
- FlashCopies across heterogeneous SVC supported disks
- Incremental, **Cascaded** FlashCopy capabilities
- Up to 256 copies of a single source volume (new with SVC 4.3)
- Space-Efficient Flash Copy (new with SVC 4.3)

Note : SVC is one of the few products to support cascaded copies (copies of copies at later points in time)

▪ Metro Mirror :

- Metropolitan” distance synchronous remote mirroring function
- Up to **300km** between sites for business continuity

▪ Global Mirror :

- Long distance asynchronous remote mirroring function
- Up to **8000km** distance between sites for business continuity

SVC Metro Mirror Function

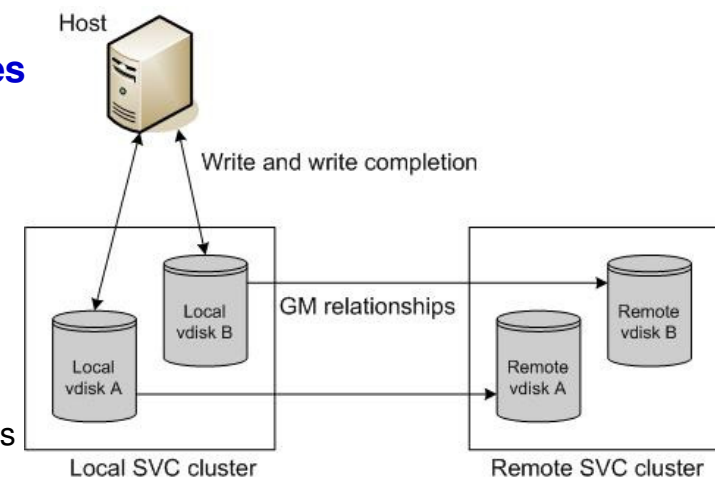


- “Metropolitan” distance **synchronous remote mirroring** function
- **Up to 300km** between sites for business continuity
 - As with any synchronous remote replication, performance requirements may limit usable distance
- **Host I/O completed only when data stored at both locations**
- **Designed to maintain fully synchronized copies at both sites**
 - Once initial copy has completed
- **Metro and Global Mirror delivered as single feature**
 - Offers great implementation flexibility
- **Operates between SVC clusters at each site**
 - Local and remote volumes may be on any SVC supported disk systems

SVC Global Mirror Function



- **Long distance asynchronous** remote mirroring function
- **Up to 8000km** distance between sites for business continuity
- **Does not wait for secondary I/O before completing host I/O**
 - Helps reduce performance impact to applications
- **Designed to maintain consistent secondary copy at all times**
 - Once initial copy has completed
- **Built on Metro Mirror code base**
- **Metro and Global Mirror delivered as single feature**
 - Offers great implementation flexibility
- **Operates between SVC clusters at each site**
 - Local and remote volumes may be on any SVC supported disk systems





SAN Volume Controller :

V4.3 New features

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SVC 4.3 Major new features

- Space Efficient Vdisks (SEV)
 - Can be used for **thin provisioning** (also referred as storage **over-allocation**)
 - Can be used for **Space Efficient Flash Copy (SEFC)**
 - Can configure Vdisks to hosts in such a way that the sum of the configured vdisk capacity within a cluster is greater than the physical disk capacity in the managed Storage Pools within that cluster.
- Space Efficient FlashCopy
 - SEFC is the capability to have a target of an SVC FlashCopy to only consume the minimum required disk capacity for the changed bits, and not consume capacity equal to the source.
- Vdisk mirroring (RAID1)
 - A given vdisk has **two complete copies** of mdisk where the data is saved within the cluster.
 - mdisks can come **from different mdisk groups** and have **different mdisk extent sizes**
 - Improves high availability configurations by allowing vdisks to be mirrored across mdisks, and therefore stay online, when an mdisk group goes offline.
 - **Mirrored Vdisks can be Space Efficient & used in SVC Copy Services**

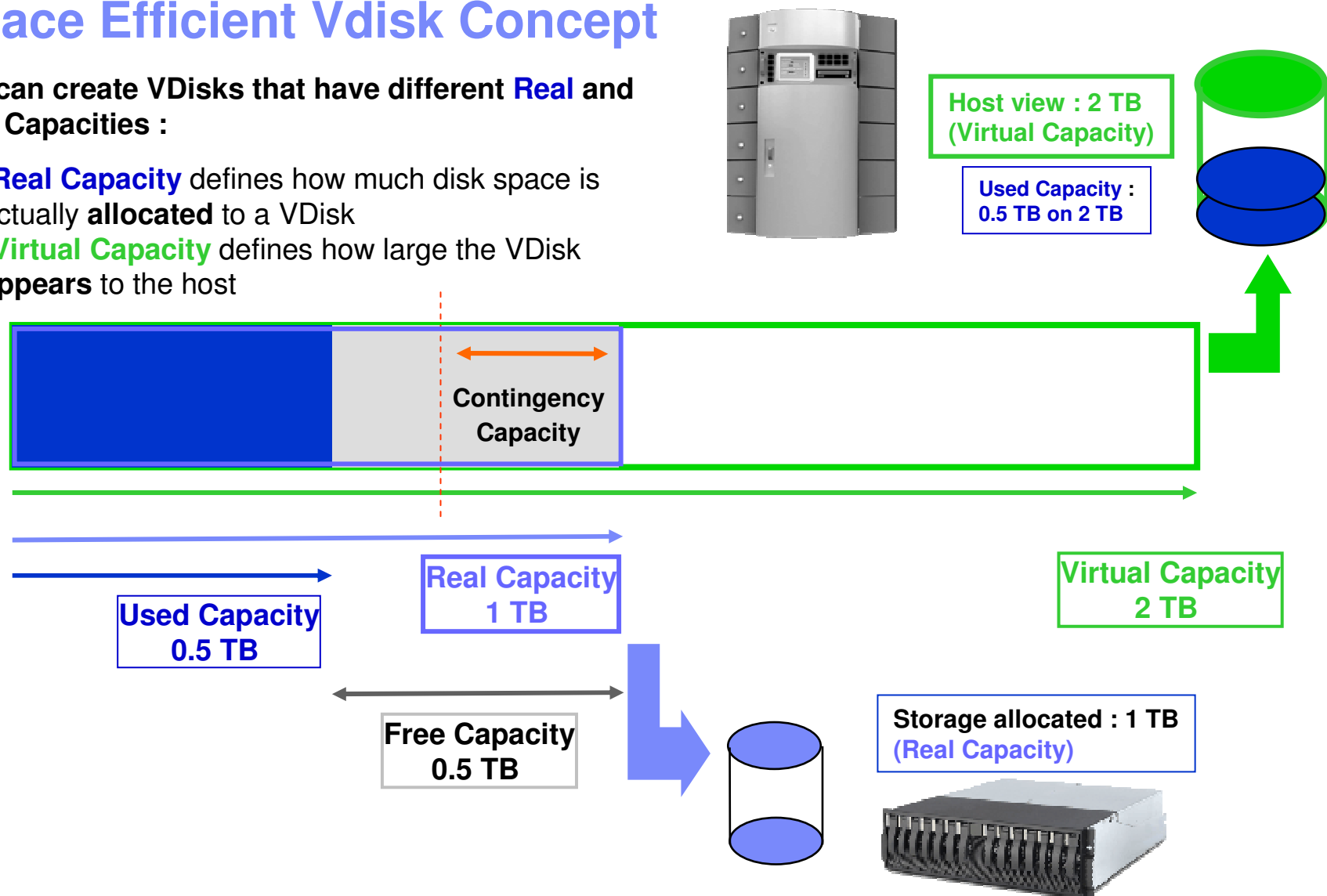
1) Space Efficient Vdisk SEV – Terminology

- **Virtual Capacity**
 - The full capacity of the VDisk and **what the host sees**.
 - For a fully allocated VDisk, this is the only capacity term that applies.
- **Real Capacity**
 - The **actual physical storage** (MDisk extents) **pre-assigned to the VDisk**. At VDisk creation this value is specified by “-rsize”.
 - For a fully allocated VDisk virtual and real capacity are the same.
- **Used Capacity**
 - The **subset of Real Capacity** allocated to grains for storing actual customer data
- **Free Capacity**
 - The difference between Real Capacity and Used Capacity available to be assigned to grains
- **Contingency Capacity**
 - The difference between Real and Used Capacity that SVC tries to maintain as Real Capacity is used. **Comes in to play when Auto-Expand is enabled**

Space Efficient Vdisk Concept

Users can create VDisks that have different **Real** and **Virtual** Capacities :

- **Real Capacity** defines how much disk space is actually **allocated** to a VDisk
- **Virtual Capacity** defines how large the VDisk **appears** to the host



Space Efficient Vdisk - details

- If the **Used Capacity reaches the Real Capacity** then the VDisk will go **offline** and application I/Os will fail
- **Auto-Expand option** to have SVC automatically add Real Capacity to the Vdisk when needed
- SVC helps you to avoid exhausting the Real Capacity allowing for **alerts** to be sent to admins to provide space or by increasing Real Capacity automatically
- User can choose the granularity (**Grain**) at which space is allocated - 32, 64, 128 or 256K Bytes
- **!! Space is never de-allocated** even when host deletes files.

Space Efficient Vdisk – Out Of Space

- **If a Space-Efficient VDisk runs out of space it goes **offline**, not read-only**
 - An error is logged indicating the VDisk has been taken offline
 - Can be configured to generate an email or SNMP trap
 - For non Auto-Expand VDisks the user must manually increase the real capacity
 - For Auto-Expand VDisks the user must add capacity to the Managed Disk Group or migrate the VDisk
- **Use the **warning** thresholds to give advance notice of out of space conditions**

Space Efficient Vdisk – When To Use

- Many open system applications typically run at no more than 50% storage capacity utilization :
- Traditional techniques are also to **provision as large a disk as maybe needed next year, or the year after.**
 - > **In all cases, this generates a lot of wasted disk space.**
- With Space Efficient Vdisk, you can start by allocating a small base size and let SVC adding more space but only when really required by the application.
- **Warning : Space-Efficient VDisks only save capacity if the host server or application does not write to the whole VDisk**
 - Some filesystems (e.g. NTFS) will **write to the whole VDisk before overwriting deleted files**, others will reuse space in preference to allocating new space
 - Filesystem problems may be mitigated by tools such as “defrag” or by managing storage using host LVMs
 - Some applications **only delete log** files when the filesystem is nearly full
- So, it is recommended to test this new feature with the applications before using it :
 - **IBM Montpellier PSSC can help you to do such validation tests.**

Space Efficient FlashCopy

- SVC 4.3 **Space Efficient FlashCopy** is based on Space Efficient Vdisk feature.
- In many customer environments, there can be **multiple copies (“clones”) of production** systems being used for various purposes such as development, test, QA and training.
 - > **With traditional replication techniques, each copy occupies as much disk space as the original.**
- Using **Space Efficient FlashCopy** could significantly reduce the amount of space required because **capacity would be used only to store differences between the copies and the original data.**

Example

- A customer have a production database of 1TB and needs to create 2 FlashCopy images of this DB
 - With **traditional FlashCopy**, he would need to allocate **2x 1TB of physical space** to create its 2 FlashCopy images
 - With **Space Efficient FlashCopy**, only physical space required to store **modifications** between the production DB and the 2 FlashCopy images will be really allocated, which is just a percentage of the production DB space (and not twice its size).

Space Efficient FlashCopy : technical details

Two distinct meanings

- **1 : Space-Efficient Source to Space-Efficient Target**
 - Background copy process does not copy unallocated regions
 - Can use incremental feature to refresh mapping (once a full copy of the actually allocated regions is complete)
- **2 : Fully-Allocated Source to Space-Efficient Target**
 - Must have zero copy rate to avoid fully allocating the Space-Efficient target
 - Provides CDP like function, but no reverse FlashCopy yet
- **Try to use same grain size for FC mappings and SEV if possible**
 - Beware that defaults are different, 32KB for Space-Efficient VDisks and 256KB for FC mappings

VDisk Mirroring

- VDisk Mirroring allows creation of VDisk with **two copies**
- **The 2 copies can be in different Storage Pools (MDisk groups)**
- Anything that can be done today with a VDisk can be done with a mirrored VDisk
- **You can combine Space Efficiency and Mirrored Vdisk features**
- **Other available options of Vdisk Mirroring :**
 - **Add a copy** to an existing VDisk
 - Copy added can be of any structure
 - No provision for combining two VDIs into a single mirrored VDisk.
 - **Remove a copy** from mirrored VDisk
 - Add and remove together can be used for migrations not currently allowed
 - **Split a copy** from a mirrored VDisk and **create a new VDisk**
 - Only allowed when copies are synchronized unless use –force

VDisk Mirroring – Using For Migration

- **Can be used to migrate VDisk between MDisk Groups with different extent sizes** (Vdisk migration restriction)
 - Add a copy in the new MDisk Group
 - Wait for synchronization to complete
 - Remove copy in original MDisk Group
- **Migrate from space-efficient to fully-allocated VDisk**
- **Migrate from image/striped/sequential mode to a sequential VDisk**
- **Can control copy rate of migration and even suspend/cancel migration**
 - Same controls as FlashCopy
 - Default copy rate setting is 50 which is 2MB/s

Others new features in SVC 4.3

- **IPV6 support**

- Can have both IPv4 and IPv6 addresses for a cluster and both can be used at once

- **8K Vdisks :**

- Simple doubling of the VDisk maximum
- 2048 VDisks per IO Group (node pair)
 - 8192 VDisks per 8-node cluster

- **New Flash Copy Features**

- 256 FlashCopy targets
 - In any combination of multiple targets or cascaded mappings from one source
- Auto-delete consistency group
 - Can delete consistency group when last mapping is deleted or moved out
- New maximum of 4096 mappings

SVC 4.3 Licensing changes

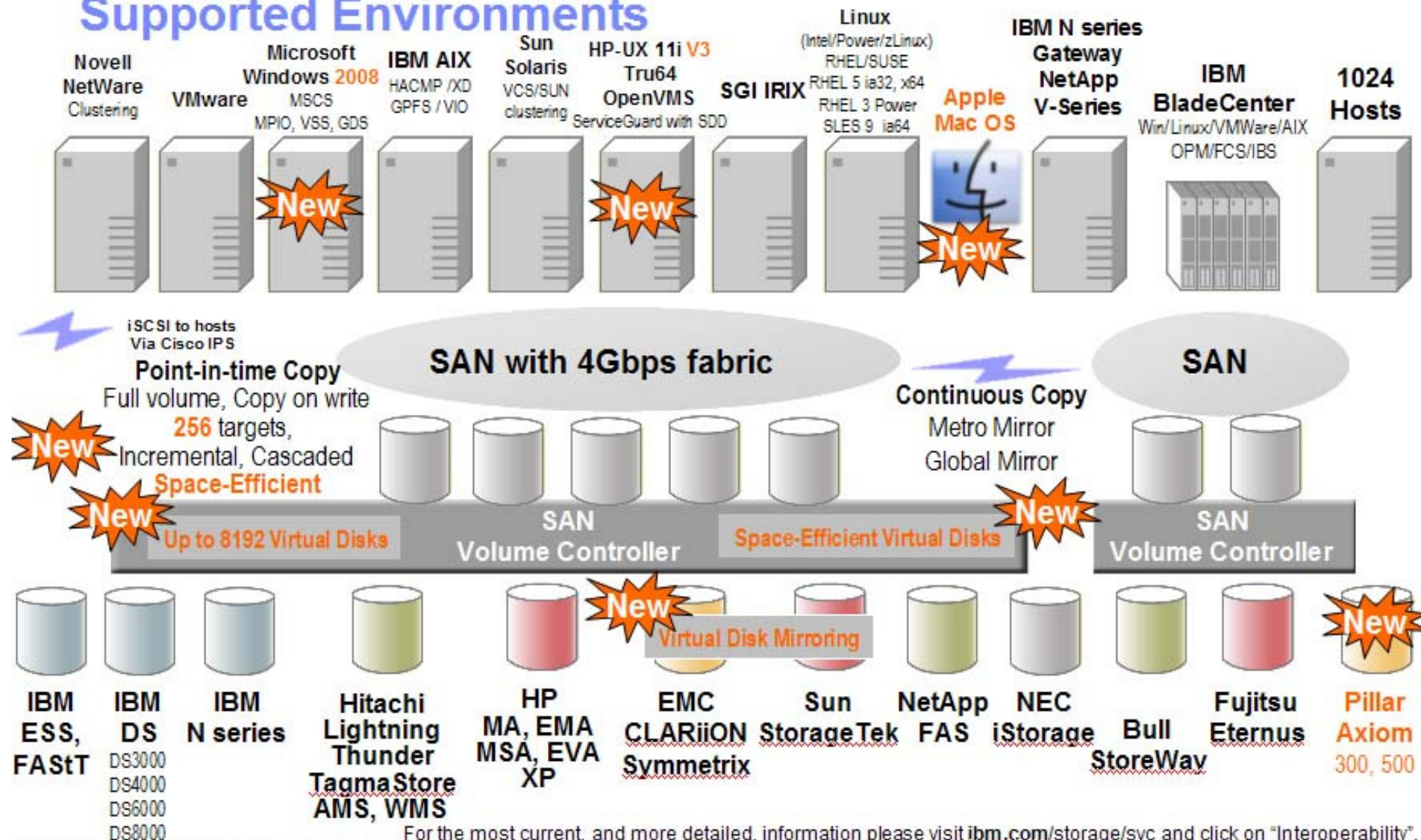
- **Space-Efficient VDisks and Mirrored VDisks are not licensed features**
- **FlashCopy licensed now by source VDisk capacity only (and no longer on source + target capacity)**

SVC Concurrent Code Upgrade

- **Non-disruptive upgrade to new SVC code 4.3 :**
 - Download SVC and SVC Console codes from web site ([free](#))
 - Upgrade SVC Console first,
 - Then, upgrade SVC cluster ([non-disruptive upgrade](#))
- **Can upgrade directly from any post-3.1.0.5 level to 4.3**
- **For pre-3.1.0.5 levels, upgrade to 3.1.0.5 first**

SVC 2008 & 2009 Roadmap

SAN Volume Controller Version 4.3 Supported Environments



For the most current, and more detailed, information please visit ibm.com/storage/svc and click on "Interoperability".

SVC Roadmap

■ 2008 :

- Support of DS5000, XiV and other storage subsystems,
- Support of IBM i / VIOS
- New entry-price nodes

■ 2009 (2 releases) :

- iSCSI support
- Copy Services improvements
- Non disruptive Vdisks move between I/O groups
- New High End nodes : 12-48 GB cache, 8x 8GBps FC ports



SAN Volume Controller : References

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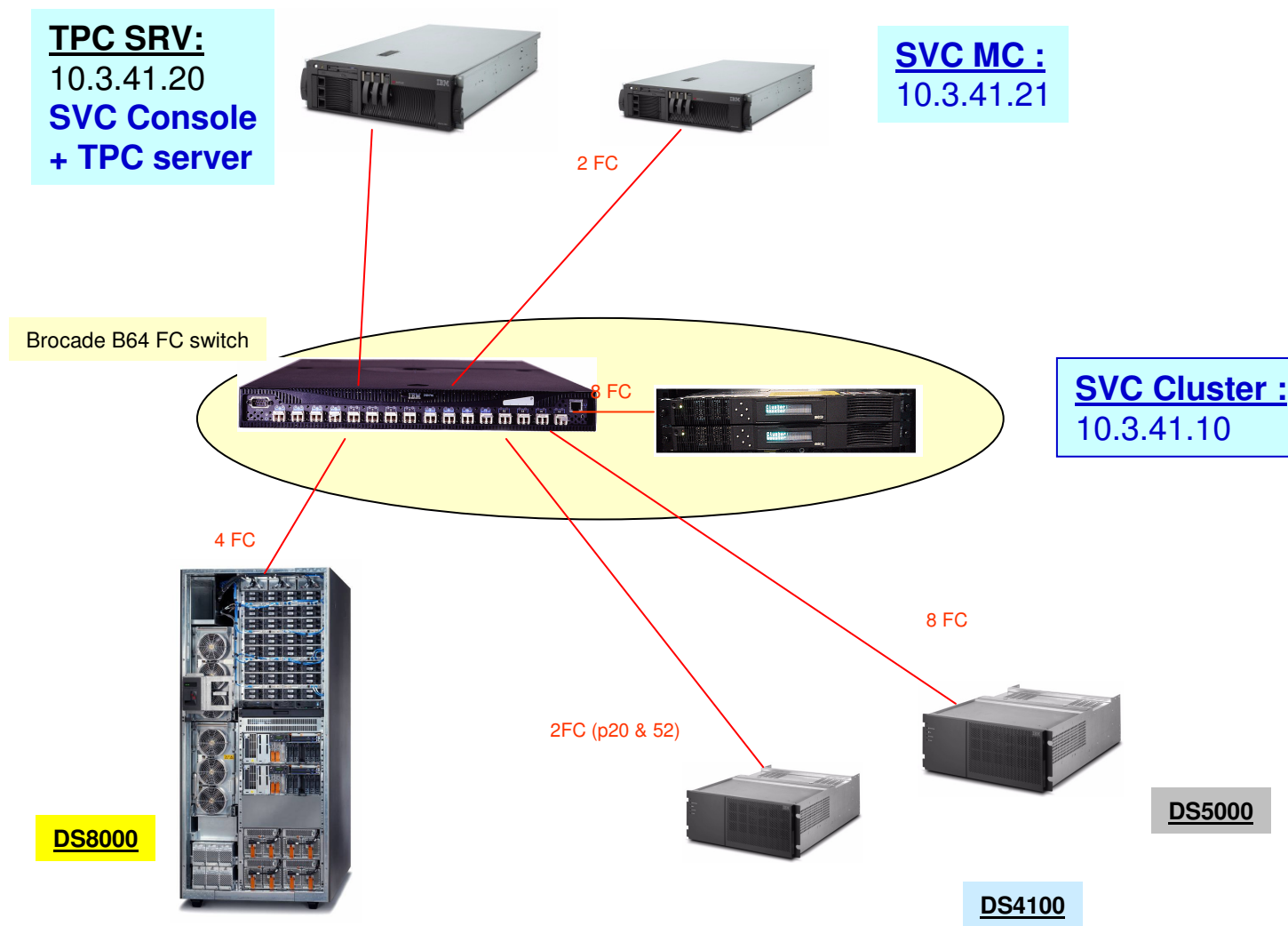
SVC References

- New SVC case study document
- SVC web site

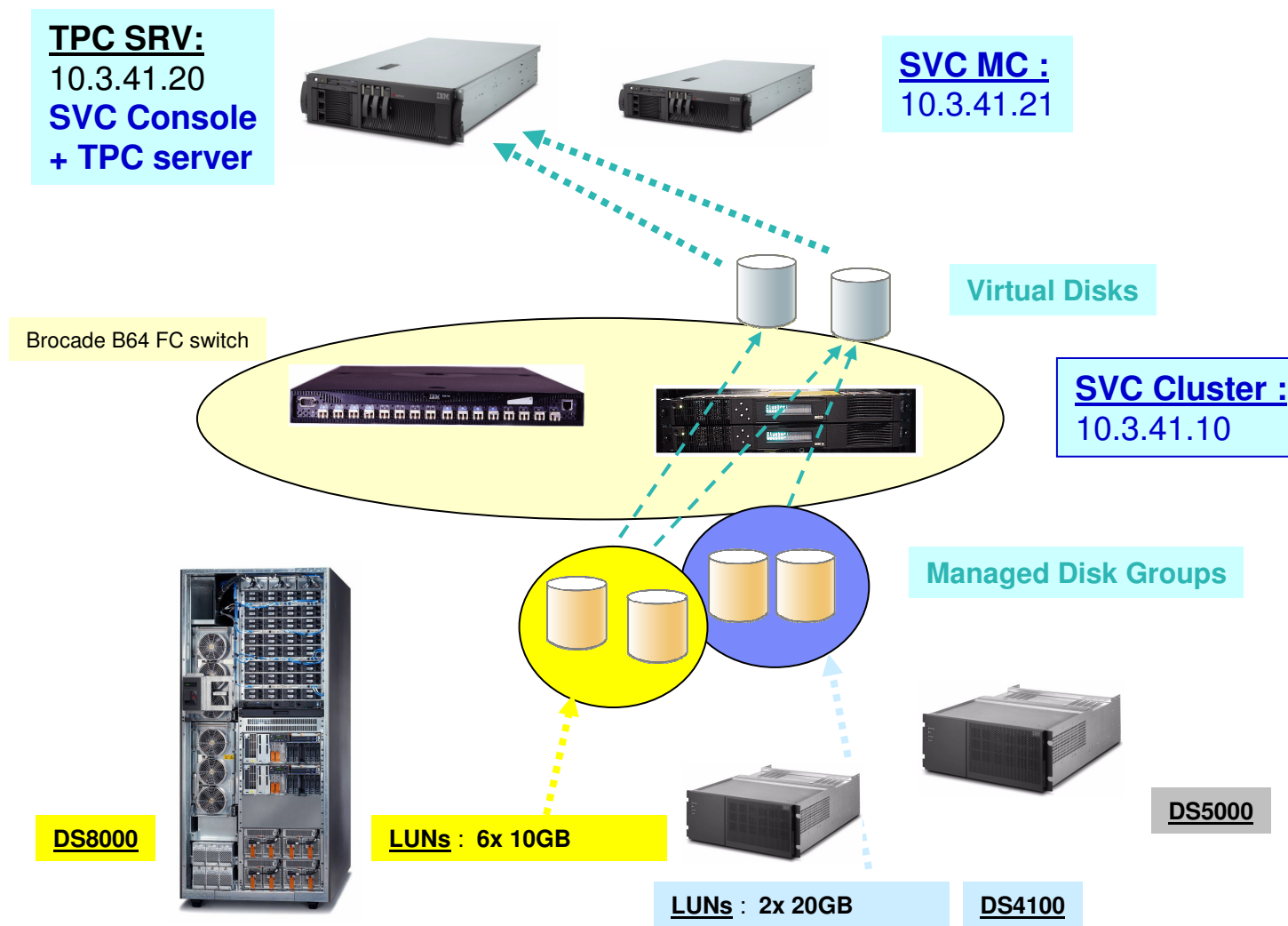
SAN Volume Controller demonstration



SVC 4.3 Demo : Physical Configuration



SVC 4.3 Demo : Logical Configuration



SVC 4.3 Demo : Test Scenario

Will be demonstrated during the demonstration :

- **Creation of Space Efficient Vdisk without Auto-Expand first :**
 - Write on the Vdisk and observe he goes Offline,
 - Change it to Auto-Expand and observe he goes back Online automatically and have Real size automatically allocated,
- **Create a Mirrored Vdisk**
 - Show the 2 copies details and how they are automatically synchronized,
- **Create a Mirrored and Space Efficient Vdisk**
 - Show how to split one copy,
- **To finish, show how to create a Space Efficient FlashCopy.**



SAN Volume Controller Management with TotalStorage Productivity Center - TPC

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Storage Infrastructure Management

■ The Problem

- **Heterogeneous storage infrastructures**, driven by growth in file and database data, are consuming increasing amounts of administrative time. IT managers are looking for ways to make their storage administrators more efficient.

■ The Solution

- Empower administrators with automated tools for managing heterogeneous storage infrastructures

Four Major TPC Components

TotalStorage Productivity Center for Data

- Data collection and analysis, file systems and databases
- Reporting, chargeback and quotas
- Automated actions
- Support for heterogeneous disk (IBM, EMC, HDS, HP, Engenio)
- IBM 3584 Tape Asset Reporting

TotalStorage Productivity Center for Disk

- Disk subsystem management
- Performance management—IBM and heterogeneous storage
- Storage provisioning—IBM and heterogeneous storage

TotalStorage Productivity Center for Fabric

- SAN topology display and management
- Event reporting, performance reporting
- Security enforcement via zone control
- Heterogeneous fabric support (Brocade, Cisco, McData)

TotalStorage Productivity Center for Replication

- Single point of control for point-in-time and remote volume replication services
- Automated source-target matching
- Cross-device consistency groups, DS8000/ESS and SVC FlashCopy and Metro Mirror

Standard Edition Bundle

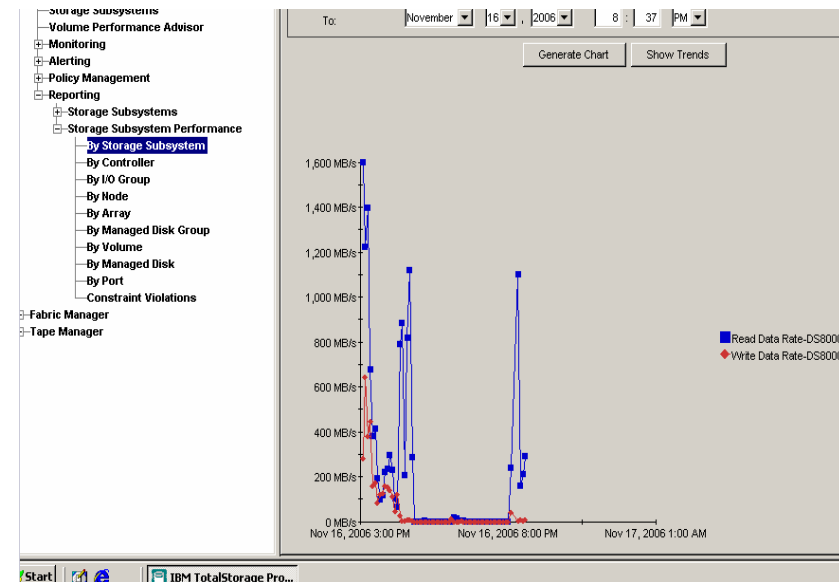
TotalStorage Productivity Center for Disk

Key Capabilities

- **Configures** multiple storage devices from a single console to improve productivity
- **Monitors** and tracks the performance of storage devices to optimize the SAN performance

Performance Management

- **Collects, stores, alert on** performance metrics
- **Recommends optimized storage allocation**
- **Monitors and tunes storage**
- **Includes Integrated Device Management**



TPC Enhances SAN Volume Controller



Asset and Capacity Reporting

- Physical characteristics such as the manufacturer, model, serial number, capacity, etc.
- Show the allocated and free capacity of every SVC on the network

Configuration Reporting and Management

- Reports on SVC's storage allocated to logical host volumes (which appear to hosts as disk drives) and the managed disks being used on the backside
- Display the physical managed disks behind what the host sees as a disk drive
- List all SVC volumes which have been allocated but aren't in use
- Show which hosts have access to a given SVC volume
- Show which hosts have access to a given disk drive (within the SVC)
- Show which SVC volume (and managed disks) a host has access to
- Discovery, Show the Storage Controllers (ex., ESS/DS4000) that provide volumes to SVC

Performance Management

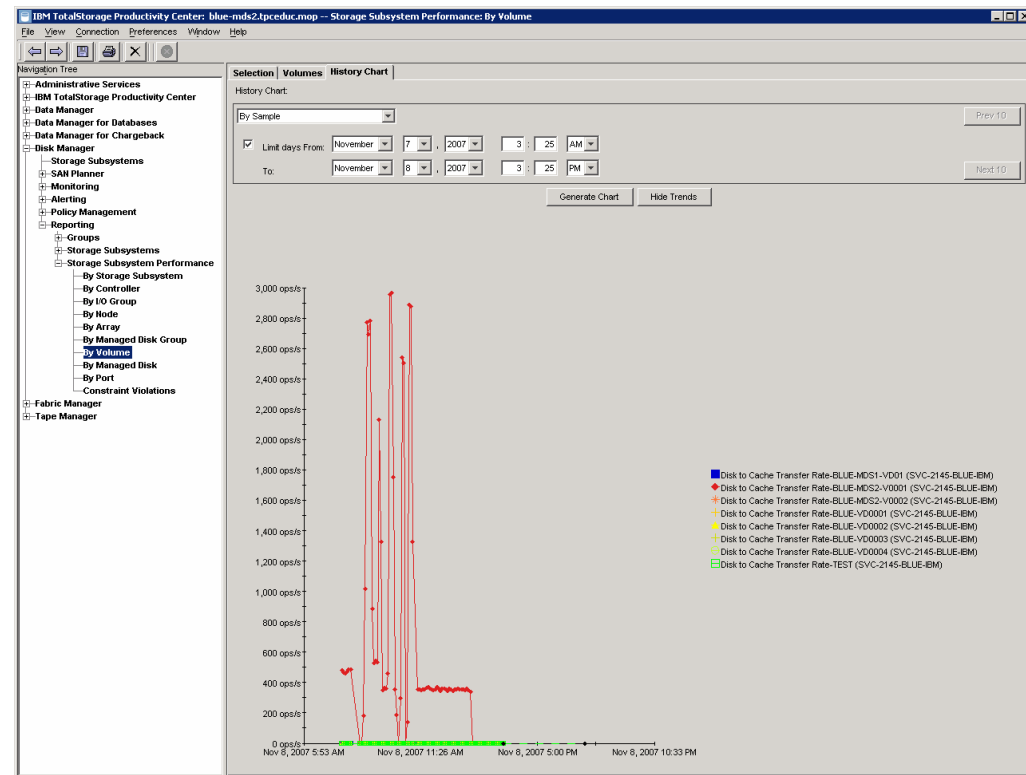
Basic and Automated Provisioning

- Information collection, display, thresholding, alerting
- Integration with Tivoli Provisioning Manager

TPC Disk Manager Functions for SVC

■ Performance Graphing - SVC

- By subsystem
- By controller
- By I/O Group
- By array
- By Managed Disk Group
- By Volume (aka vdisk)
- By Managed Disk
- By Node
- By Port
- Constraint Violations



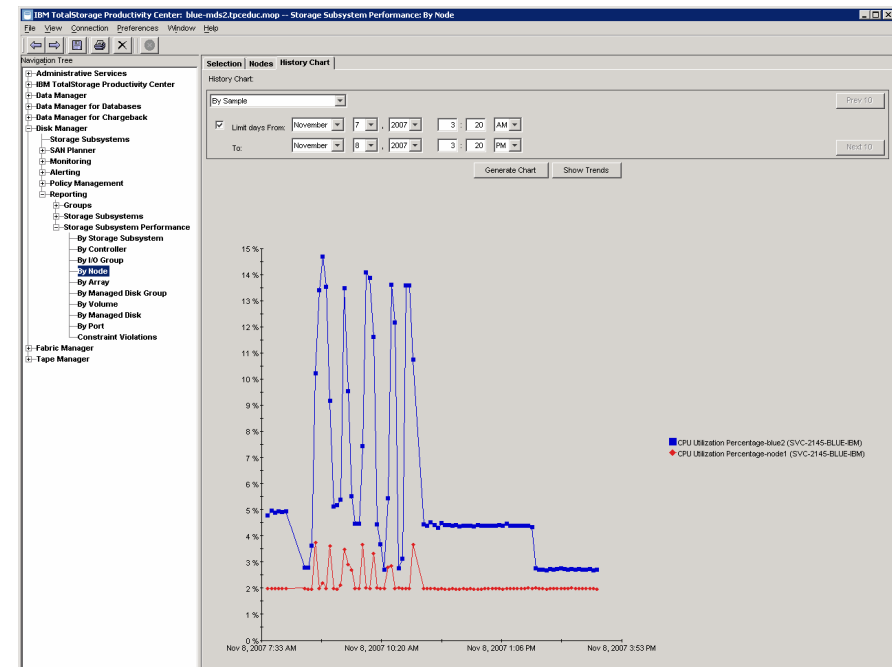
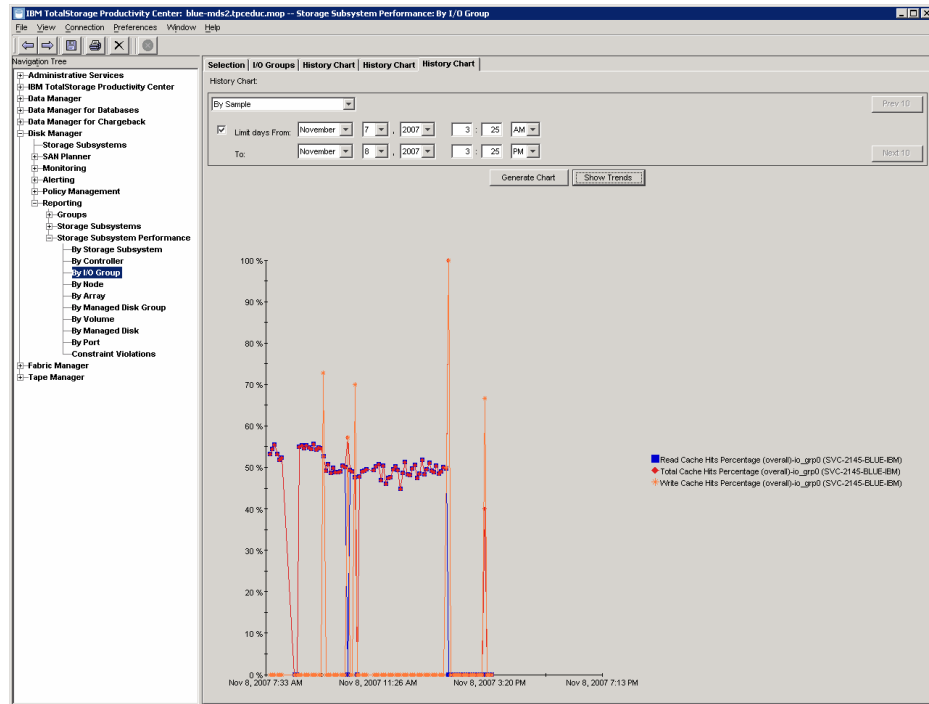
Example : SVC Performance Monitoring by Volume

TPC Disk Manager Functions - Thresholds

- **Threshold types – various subsystems**

- Overall Port response time (ms)
- Total port data rate (MB/sec)
- Total port IO rate (ops/sec)
- Cache holding time (sec)
- NVS Full Percentage (%)
- Total Data Rate (MB/sec)
- Total IO Rate (ops/sec)
- Disk Utilization Percentage (%)
- Overall Backend Response time (ms)
- Total Backend Data Rate (MB/sec)
- Total Backend IO Rate (ops/sec)

TPC : SVC Performance monitoring examples





Conclusion

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SVC: The Benefits are Real

Key Areas of Cost Saving Observed by Forrester in SVC Customers

- **Reduction in storage management and administration cost**
 - Allowing a core group of administrators to control multiple assets across a distributed storage environment (*50% efficiency improvement*)
- **Improved storage utilization**
 - Improve capacity utilization of existing storage assets
 - Control the growth of future spending (*improved utilization by 30%*)
- **Reduced cost of storage**
 - Capitalize on being able to purchase the lowest cost storage resources (*controlled growth on average by 20%*)
- **Improved customer and end user availability to data-driven applications**
 - Minimize downtime associated with migrating data between storage assets (*\$240,000 in annual savings*)



Source: *The Total Economic Impact™ Of IBM® System Storage™ SAN Volume Controller*

Find Out More

SVC on ibm.com

ibm.com/storage/svc

Virtualization NewsCenter

ibm.com/systems/storage/news/center/virtualization/

SVC Support

ibm.com/servers/storage/support/software/sanvc/index.html

Storage Virtualization Blog

ibm.com/developerworks/blogs/page/storagevirtualization

SVC Sales Kit

IBM System Sales

tinyurl.com/ozhs3

PartnerWorld

tinyurl.com/z5u23

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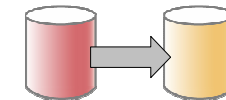
Backup slides

Incremental FlashCopy



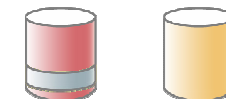
- New FlashCopy capability where only changes from either source or target data since last FlashCopy operation are re-copied during a target refresh
- Up to 256 incremental and non-incremental targets can exist for same source
- Consistency groups can include both incremental and non-incremental FlashCopy targets
- Helps increase efficiency of FlashCopy operations and can reduce time to refresh copies
- Designed to allow completion of point-in-time online backups much more quickly, thus the impact of using FlashCopy is reduced
 - May enable more frequent backups so enabling faster recovery
 - More frequent backups could be used as a form of “near-CDP”

Start incremental FlashCopy



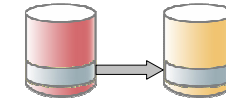
Data copied as normal

Later ...



Some data changed by apps

Start incremental FlashCopy



Only changed data copied by background copy

Cascaded FlashCopy



- **New FlashCopy capability to create “copies of copies”**
 - Mappings can be incremental or non-incremental
- **Allows a vdisk to be both source and target in concurrent FlashCopy mappings**
- **Maximum number of targets dependent on a single source disk is 16. The example shows 4 targets from source disk 0**
- **Enables backup of target disks to be made without having to disrupt existing FlashCopy relationships with original source**
- **Helps reduce time to establish copies of targets, since there is no need to await copy complete of target disk before triggering cascaded copy**
- **Designed to increase flexibility in use of FlashCopy**

