Storage Area Networks

Introduction to SAN

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DFSORT	HyperSwap	System z	z/VM*
DFSMS	IBM*	System z9	z/VSE
DS6000	IBM eServer	System z10	zSeries*
DS8000	IBM logo*	System z10 Business Class	z9
Enterprise Storage Server*	IMS	Tivoli	z10
ESCON*	MQSeries*	TotalStorage*	z10 BC
FICON*	OMEGAMON*	VSE/ESA	z10 EC

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Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.
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Introduction to Storage Area Networks (SAN)

§ **What are the building blocks of a SAN**

§ **Optimizing storage for business continuity**

§ **Storage virtualization**

§ **SAN Volume Controller**

§ **z/VSE SCSI support**

Storage Architectures/Topologies

§ **DAS – Direct Attached Storage**
  – Server-centered storage architecture
  – Storage devices are linked directly to a server via a direct physical connection

§ **NAS – Network Attached Storage**
  – Server dedicated to file sharing (NAS Appliance)
  – Shared connection to data and ist storage using a file system
  – Uses network file system protocols such as NFS or CIFS

§ **SAN – Storage Area Network**
  – Storage-network-centered
  – Storage devices and storage users are attached to a separate network
  – SCSI commands and data pass over fiber channel (FC)

§ **FICON**
  – Same as SAN but mainframe channel commands and data pass over FC

IBM Enterprise Disk Positioning – Feature/Function Map

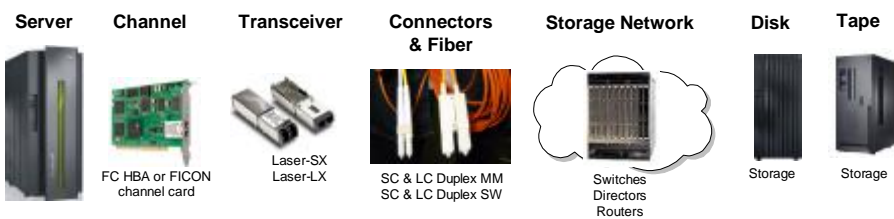| Mainframe, System i	Open Systems		Heterogeneous	NAS
High-end				
DS8000 Mainframe & Open Systems Zero or near zero downtime Advanced Disaster Recovery: 3-Way Mirroring Online Transaction Processing (OLTP) Encryption Dedicated rack-based storage	**XIV** SIMPLE management Thin provisioning Excellent TCO Dedicated rack-based storage		**SVC** Multi-vendor open storage Data migration Space Efficient Replication Thin Provisioning	**Scale-Out File Services SoFS –** massive scalability **N series** Combined file and block support in one system NAS/iSCSI storage
Mid-range				
DS6000 Mainframe and System i Compatible copy services w/DS8K Modular drawer based storage	**DS4700/DS5000** Modular, scalable disk storage (start small and grow incrementally) High Performance and Low Cost Per TB Basic snapshot and mirroring capabilities Typical configurations <50TB			

Components of a SAN Connection

Server   Channel   Transceiver   Connectors & Fiber   Storage Network   Disk   Tape

FC HBA or FICON channel card

Laser-SX
Laser-LX

SC & LC Duplex MM
SC & LC Duplex SW

Switches
Directors
Routers

Storage

Storage

§ Many different combinations of components
§ Connectors
  – SC is the older style 1 Gbps connector
  – LC is the newer style 2/4/8 Gbps connector
§ Fiber
  – Single-mode provides long distance connection (~10 to 80 km +)
  – Multi-mode provides local distance connection (~75 to 500 m)

Fibre Channel Protocol
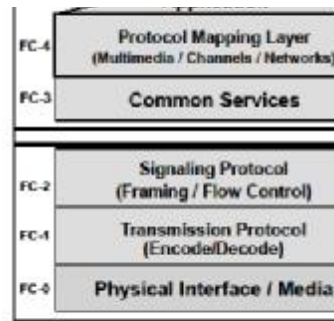
Fibre Channel (FC) provides high speed transport for upper level (i.e. FICON or SCSI) payloads

§ Some confusing terms
  – "Fiber" is the glass cable
  – "Fibre" is the protocol/architecture
§ FC is the "protocol" for a Storage Network
§ Attributes are:
  – Highly scalable – addressing for up to 16 million nodes
  – Various switched topologies
  – High speeds – up to 10 Gbps
  – Segments of up to 100 km between switches
  – Support for multiple protocols like FICON and OPEN (SAN)
 – Support for security via **Zoning** and Prohibit/Allow Matrix

FC-4	Protocol Mapping Layer (Multimedia / Channels / Networks)
FC-3	Common Services
FC-2	Signaling Protocol (Framing / Flow Control)
FC-1	Transmission Protocol (Encode/Decode)
FC-0	Physical Interface / Media

Zoning

§ **A logical grouping of fabric connected devices within a SAN (or virtual fabric)**
§ Zoning establishes access control
  – Devices within a zone can access each othe
§ Zoning increases security
  – Limited access prevents unauthorized acces
§ Zone membership might be defined by:
  – Port World Wide Name (pWWN) – device
  – Fabric World Wide Name (fWWN) – fabric
  – Fibre Channel Identifier (FCID)
  – Fibre Channel Alias (FC_Alias)
  – IP address
  – Domain ID/Port number
  – Interface

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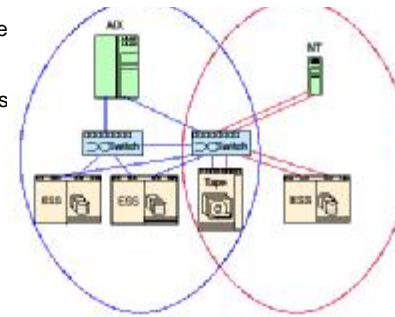
Storage Network Components

§ Multiple infrastructure vendors (e.g., Brocade, McData, Cisco)

§ Several components required to build a SAN

  – Servers with Host Bus Adapters (HBA)

  – Mainframes with FICON/FICON Express Channels

  – Storage systems

    Ø RAID

    Ø JBOD (Just a Bunch Of Disks)

    Ø Tape

    Ø VTS/VSM (virtual tape)

  – Fibre Channel / FICON switches or directors

  – Ethernet Switches (iSCSI)

  – SAN management software

Direct Attached Storage or SAN?

3390 eCKD

SCSI

Storage Virtualization

Disk Drives

DS6000 or DS8000

host adapter chipset — Controller card 0
Power PC chipset
Volatile memory
device adapter chipset
Persistent memory

Controller card 1
Volatile memory
Persistent memory
host adapter chipset
Power PC chipset
device adapter chipset

Server enclosure →
20 port fibre channel switch
20 port fibre channel switch

← First expansion enclosure (if present)
20 port fibre channel switch
20 port fibre channel switch
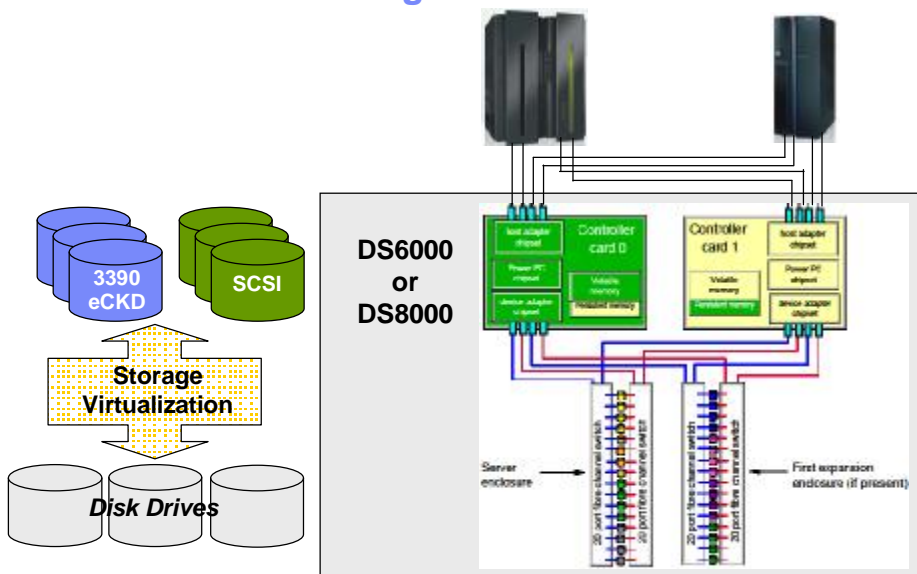
Introduction to Storage Area Networks (SAN)

§ **What are the building blocks of a SAN**

§ **Optimizing storage for business continuity**

§ **Storage virtualization**
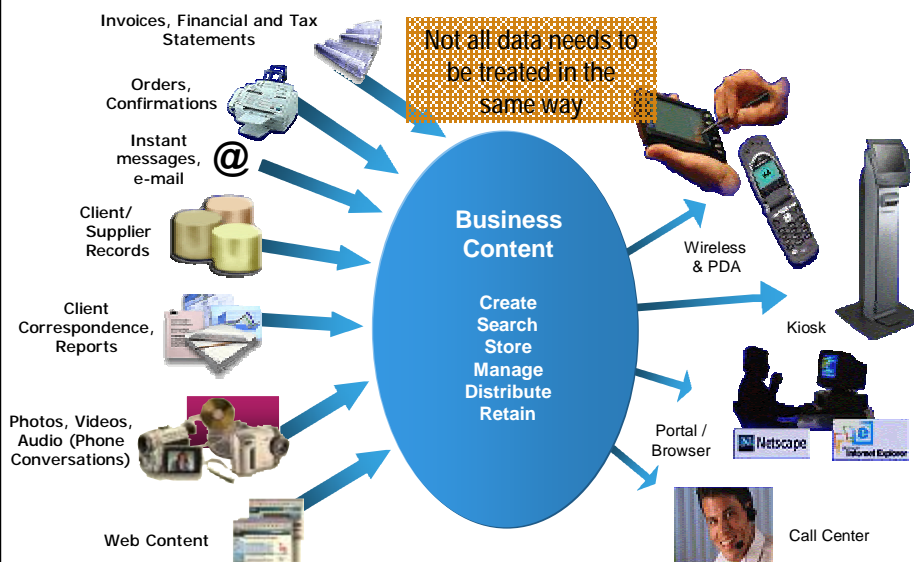
§ **SAN Volume Controller**

§ **z/VSE SCSI support**

Do You Have This Kind of Information?

Invoices, Financial and Tax Statements

Orders, Confirmations

Instant messages, e-mail
@

Client/ Supplier Records

Client Correspondence, Reports

Photos, Videos, Audio (Phone Conversations)

Web Content

Not all data needs to be treated in the same way

Business Content

Create
Search
Store
Manage
Distribute
Retain

Wireless & PDA

Kiosk

Portal / Browser

Netscape

Call Center

Tiers of Business Continuity

Recovery from a disk image   Recovery from tape copy

Value (Cost)

Continuous Availability

Rapid Recovery

Backup/Restore

Recovery Time Objective
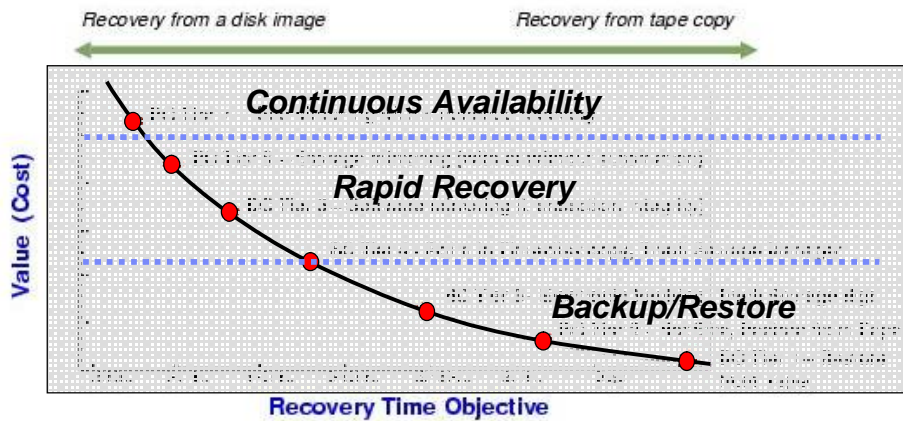
Technology changes as tiers increase

Storage Virtualization is . . .

Logical
Representation

Virtualization

Physical
Resources
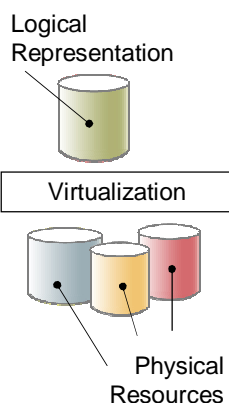
Technology that makes one set of resources look and feel like another set of resources, preferably with more desirable characteristics…

A logical representation of resources not constrained by physical limitations

– Hides some of the complexity

– Adds or integrates new function with existing services

– Can be nested or applied to multiple layers of a system

What is Virtualization?

Logical representation of resources not constrained by physical limitations

– Enables user flexibility

– Centrally manage many resources as one

– Dynamically change and adjust across the infrastructure

– Create many virtual resources within single physical device

– Eliminates trapped capacities

IBM Virtualization

A comprehensive platform to
help virtualize the infrastructure

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System Storage SAN Volume Controller

IBM Information Infrastructure for Storage Virtualization
IBM System Storage SAN Volume Controller for Linux on z

§ Improves storage utilization and reduces storage growth

§ Reduces power and cooling requirements helping make data centers more "green"

§ Boosts performance and simplifies storage management for IBM and non-IBM disk

– Improve storage administration productivity by up to 2x

§ Redundant architecture supports enterprise-class availability

– Non-disruptive upgrades of both hardware and software

§ Supports non-disruptive data movement

§ Advanced functionality:

– Space-Efficient Virtual Disks
– Space-Efficient FlashCopy - reduces storage needed for backup copies by as much as 75% or more
– Virtual Disk Mirroring

Outstanding performance, flexibility, and high availability while controlling storage TCO
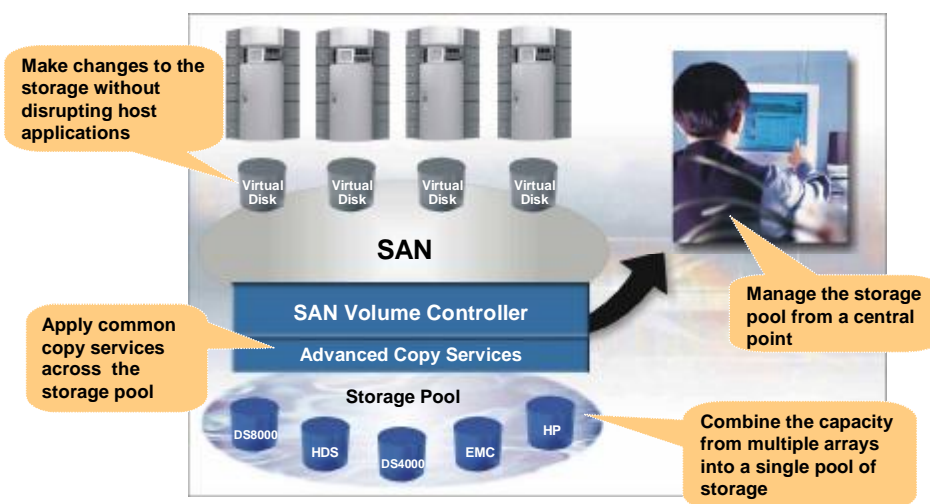
Information Availability
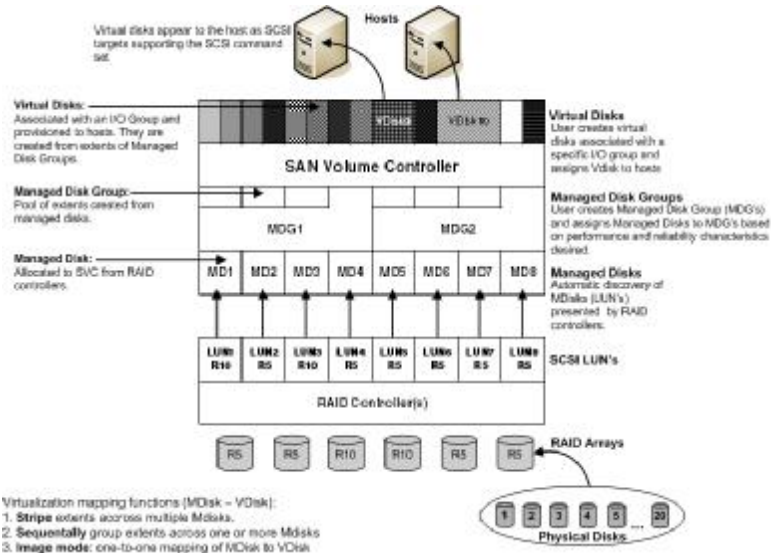
SVC 2145-CF8 Storage Engine

- § New SVC engine based on IBM System x3550M2 server
  - **Intel® Core™ i7 2.4 GHz quad-core processor**
  - **24GB of cache (with future growth possibilities)**
  - **Four 8Gbps FC ports**
  - **IBM® Systems Director Active Energy Manager enabled**
- § Bandwidth twice that of the Model 8G4
  - **Expect 2x MB/s and 1.5x IOPS of Model 8G4**
- § Support for Solid State Drives (up to four per SVC node) enabling scale-out high performance SSD support with SVC
- § New engines may be intermixed in pairs with other engines in SVC clusters
  - **Mixing engine types in a cluster results in VDisk throughput characteristics of the engine type in that I/O group**
- § Cluster non-disruptive upgrade capability may be used to replace older engines with new CF8 engines
- § Replaces the SVC 2145-8G4 engine as premier offering; 2145-8A4 Entry Storage Engine also available

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Flexible Storage Infrastructure with SAN Volume Controller

Make changes to the storage without disrupting host applications

Manage the storage pool from a central point

Apply common copy services across the storage pool

Combine the capacity from multiple arrays into a single pool of storage

Virtual Disk

SAN

SAN Volume Controller

Advanced Copy Services

Storage Pool

DS8000   HDS   DS4000   EMC   HP

SVC – Relationship between physical and logical disks

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.
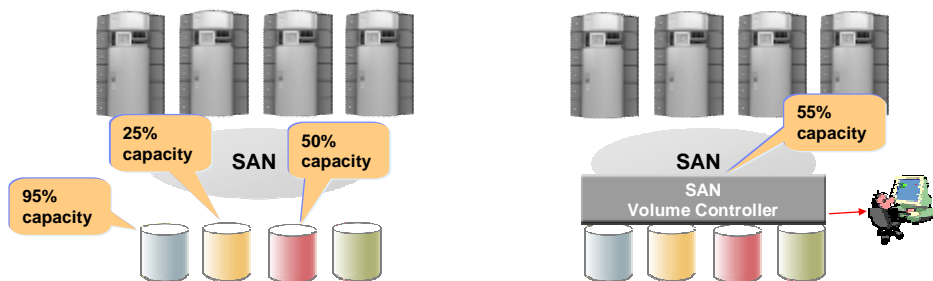
Non-disruptive Data Migration with SAN Volume Controller

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.

SAN
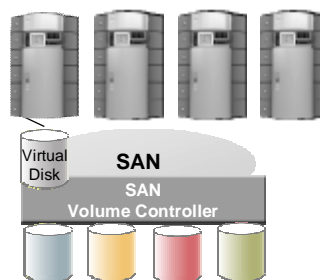
Virtual Disk | SAN
SAN Volume Controller

Space-Efficient Virtual Disks (SEV)

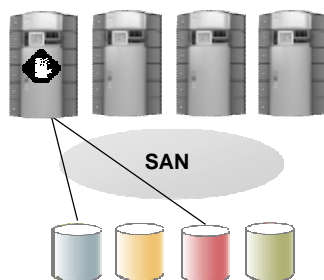§ Space-Efficient Virtual Disks function is the SVC implementation of "thin provisioning"

§ Traditional ("fully allocated") virtual disks use physical disk capacity for the entire capacity of a virtual disk even if it is not used

  – Just like traditional disk systems

§ With SEV, SVC allocates and uses physical disk capacity *when data is written*

  – Can significantly reduce amount of physical disk capacity needed

§ Available at *no additional charge* with SVC base virtualization license

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**SAN Volume Controller Version 4.3.1
Supported Environments**

IBM z/VSE	Novell NetWare	VMware	Microsoft Windows Hyper-V	IBM AIX IBM i 6.1	Sun Solaris	HP-UX 11i Tru64 OpenVMS	SGI IRIX	Linux (Intel/Power/zLinux) RHEL SUSE	Apple Mac OS	IBM N series Gateway NetApp V-Series IBM TS7650G	IBM BladeCenter	1024 Hosts

New **New** **New** **New**

iSCSI to hosts Via Cisco IPS

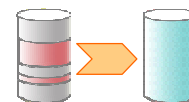**SAN with 4Gbps fabric**

SAN

Point-in-time Copy
Full volume, Copy on write
256 targets,
Incremental, Cascaded
Space-Efficient

Continuous Copy
Metro Mirror
Global Mirror

New

Entry Edition software

SAN Volume Controller

Space-Efficient Virtual Disks

SAN Volume Controller

New **New** **New** **New**

Virtual Disk Mirroring

IBM ESS, FAStT	IBM DS DS3400 DS4000 DS5000 DS6000 DS8000	IBM XIV	IBM N series	Hitachi Lightning Thunder TagmaStore AMS, WMS, USP	HP MA, EMA MSA, EVA 4400 XP 24000/20000	EMC CLARiiON Symmetrix	Sun StorageTek	NetApp FAS	NEC iStorage	Bull StoreWay	Fujitsu Eternus	Pillar Axiom 300, 500

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

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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*

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z/VSE – SCSI Support

§ SCSI disks are widely used in 'open' systems

§ SCSI disks supporting the FCP (Fibre Channel Protocol) can be attached to IBM System z servers

§ z/VSE 3.1 and later supports FCP-attached SCSI disks

§ SAN Volume Controller is qualified to be used with z/VSE 4.2

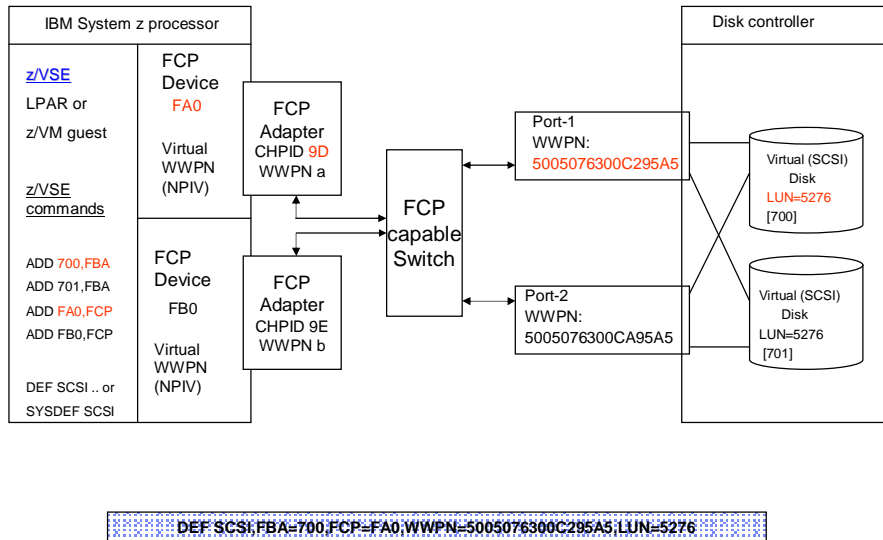 – Through the SVC, disk controllers supported by the SVC can be used

z/VSE SCSI Configuration using a Disk Controller - Example

IBM System z processor	
z/VSE	FCP Device
LPAR or	FA0
z/VM guest	
	Virtual WWPN (NPIV)
z/VSE commands	
ADD 700,FBA	FCP Device
ADD 701,FBA	FB0
ADD FA0,FCP	
ADD FB0,FCP	Virtual WWPN (NPIV)
DEF SCSI .. or	
SYSDEF SCSI	

FCP Adapter CHPID 9D WWPN a

FCP Adapter CHPID 9E WWPN b

FCP capable Switch

Disk controller

Port-1 WWPN: 5005076300C295A5

Port-2 WWPN: 5005076300CA95A5

Virtual (SCSI) Disk LUN=5276 [700]

Virtual (SCSI) Disk LUN=5276 [701]

DEF SCSI,FBA=700,FCP=FA0,WWPN=5005076300C295A5,LUN=5276

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z/VSE SCSI Configuration using SVC - Example

IBM System z processor	
z/VSE	FCP Device
LPAR or	FA0
z/VM guest	
	Virtual WWPN (NPIV)
z/VSE commands	
ADD 700,FBA	FCP Device
ADD 701,FBA	FB0
ADD FA0,FCP	
ADD FB0,FCP	Virtual WWPN (NPIV)
DEF SCSI .. or	
SYSDEF SCSI	

FCP Adapter CHPID 9D WWPN a

FCP Adapter CHPID 9E WWPN b

FCP capable Switch

SAN Volume Controller

Managed disk

Port-1 WWPN: 5005076300C295A5

Port-2 WWPN: 5005076300CA95A5

Virtual (SCSI) Disk LUN=1 [700]

Virtual (SCSI) Disk LUN=2 [701]

A Disk Controller supported by SVC

Disk (storage) managed by the SVC

DEF SCSI,FBA=700,FCP=FA0,WWPN=5005076300C295A5,LUN=0001

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SAN Summary

A Storage Area Network -

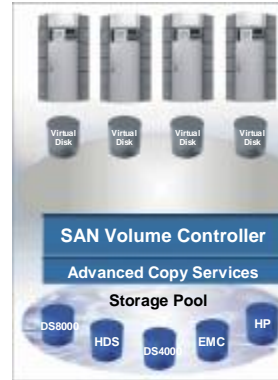§ is a specialized, high-speed network attaching servers and storage devices

§ Enables one server or many heterogeneous servers to share a common storage utility

§ Can be used to bypass traditional network bottlenecks

IBM SAN Volume Controller –

§ Designed to combine storage capacity

Consolidation and virtualization can help to achieve a simpler, more scalable, more cost-effective IT infrastructure that aligns more flexibly with business goals

managed more effectively

Virtual Disk | Virtual Disk | Virtual Disk | Virtual Disk

SAN Volume Controller

Advanced Copy Services

Storage Pool

DS8000 | HDS | DS4000 | EMC | HP

IBM Storage Systems and System z Together

IMPROVE SERVICE

REDUCE COST

MANAGE RISK

Virtualization

Security

Energy Efficiency

Service Management

Business Resiliency

Asset Management

Information Infrastructure

Thank You