G15

IBM System Storage Overview for the System z Environment

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Abstract

G15 IBM System Storage Overview for the System z Environment

Curtis Neal, IBM

In the current IBM Disk System product line, one size does not fit all. There are several families of IBM System Storage products that are designed to meet the needs of the System z series. This session will review the various families and provide an overview and introduction to the sessions on specific products.

Level: Standard

Top Business Needs for 2006

1. Streamline or improve efficiency of business processes
2. Maintain continuity of business operations
3. Better understand and meet their customer expectations
4. Secure business operations, IT infrastructure and privacy
5. Increase employee productivity
6. Ensure regulatory compliance and business controls
7. Improve utilization and management of IT resources
8. Manage business risk – financial, operational, and IT
9. Organize, analyze and use vast amount of information
10. Increase flexibility of business processes
11. Attract, motivate and retain talented employees
12. Work efficiently with suppliers, partners, and customers
13. Anticipate/respond quickly to marketing opportunities/threats
14. Expand existing markets and/or enter new markets
15. Address increasing or intensifying competition
16. Focus on innovation in business, processes, products and services.

People

Productivity, business risk, employees, suppliers, partners and customers

Information

Understand, secure, privacy, compliance, analyze, anticipate, respond, intensifying, innovation

IT environment

Efficiency, continuity, utilization, flexibility, expand

Source: IBM Business Needs Study 2006

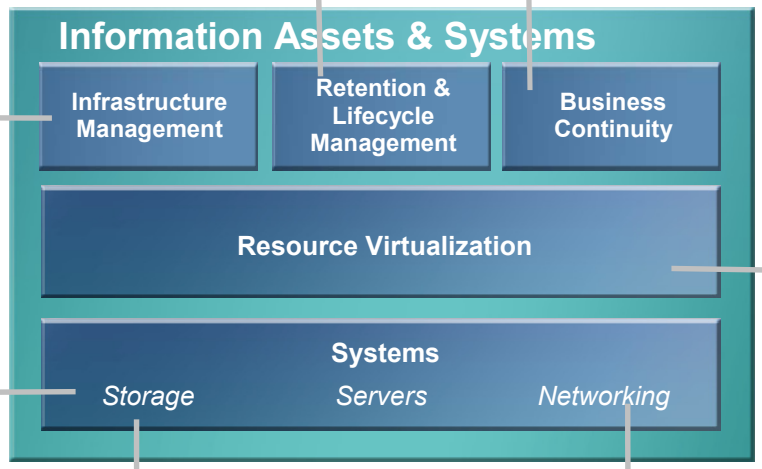
IBM System Storage™ – Offering Matrix

Lifecycle and Retention

- DR550, DR550 Express
- TSM Space Manager, HSM for Windows
- GPFS, DFSMS and SAN File System

Business Continuity

- TotalStorage Productivity Center for Replication
- **Tivoli Storage Manager**
- Tivoli Continuous Data Protection (CDP) for Files
- XRC, GDPS



Infrastructure Management

- **TotalStorage Productivity Center**
- Tivoli Provisioning Manager

Storage Virtualization

- **SAN Volume Controller**
- Virtualization Engine

Disk Systems

- **DS family**
- **FlashCopy, Metro Mirror, Global Mirror**
- N series

Tape Systems

- **TS family**
- **Virtual Tape Server**
- **Peer-to-Peer**

Storage Networking

- Switches
- Directors
- Routers

*** IBM System Storage Offerings for zSeries**

IBM System Storage SAN: Supports FICON Express4

Enterprise SAN Switch Continuum

Midrange pricing with 4 Gbps performance

SAN Switches

- Affordable pricing with the capabilities of traditional enterprise directors
- Portfolio of 4 Gbps support for performance in a small form factor package
- Scalability features enable a "buy-and-grow" strategy
- Great entry to midrange solutions
- 16, 24, 32 FICON/FC port options
- Range of products supporting cascading with enterprise directors for tiered storage networks

- **Supports major types of servers including IBM System z, IBM System i™, Linux, UNIX®, Microsoft® Windows®, . . .**
- **Industry-leading SAN fabric interoperability**
- **Advanced automated management software**
- **Designed for enterprise class reliability to help support continuous operations**
- **Metro and global distance capability to support business continuity solutions**

Enterprise availability and scalability with 4 Gbps performance

SAN Directors

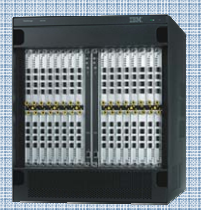
- Enterprise class availability with built-in redundancy
- Support for SAN consolidation platform
- Scalability with support for nondisruptive upgrades
- 4 Gbps field upgrade options can help protect director investment
- Up to 256 FICON/FC ports
- 10 Gbps metropolitan links over optical networks
- Gigabit Ethernet global links over IP networks

4 Gbps Enabled IBM Director Portfolio

Designed to provide:

- High availability, scalability, and intelligent software to help simplify management of complex, integrated enterprise SANs
- Support for heterogeneous Windows®, Linux®, System i, UNIX and mainframe servers

IBM SAN256M (planned 2006)
64-256 FC/FICON 2, 4 Gbps ports
10Gbps ISL ports
ibm.com/totalstorage/san/m-type



IBM SAN140M (2027-140)
16-140 FC/FICON 2, 4[1] Gbps ports
10Gbps ISL ports
ibm.com/totalstorage/san/m-type

Cisco 9513
24-528 FC/FICON 4 Gb ports
10 Gbps ISL ports
www.**ibm.com**/storage/cisco

Cisco 9506
12-192 FC/FICON 2, 4 Gbps ports
10 Gbps ISL ports
www.**ibm.com**/storage/cisco

IBM SAN256B
256 FCP 2, 4 Gbps
FI CON planned 2Q06
ibm.com/totalstorage/san/b-type

4 Gbps Enabled Switch Portfolio

Designed to offer:

- Integrated, scalable, high availability IBM Virtualization family solutions
- Heterogeneous Windows, Linux, System I, UNIX, and z9 mainframe servers
- IBM DS6000, DS8000, LTO™ and ETS storage

IBM TotalStorage b-type (Brocade) switches

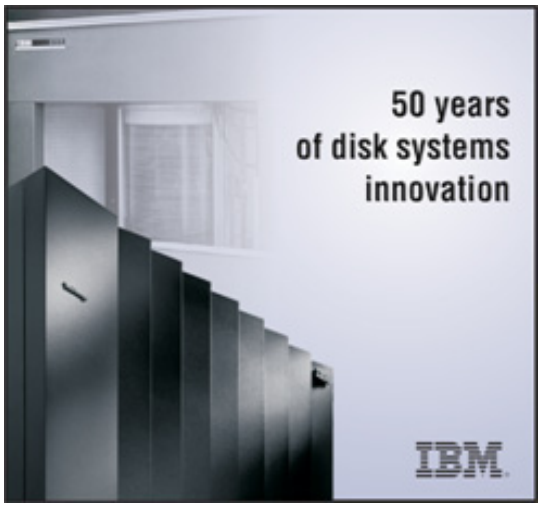
IBM SAN32B-2
(2005-B32 PN 200532B)
16, 24, 32 ports FCP 2,4 Gbps, FICON Planned 2Q06
ibm.com/totalstorage/san/b-type

IBM TotalStorage m-type (McDATA) switches

IBM SAN32M-2
(2026-432 PN 202632E)
16, 24, 32 ports,
FICON,FCP 2,4 Gbps
ibm.com/totalstorage/san/m-type

Cisco 9216i/A
(2062-D1A/D1H)
14 FC + 2 IP/16 FC ports,
2 Gbps FICON
12 – 48 FCP ports,
2, 4 Gbps,
14 FCP +2 IP; 8 GbE IP storage ports
www.**ibm.com**/storage/cisco

IBM Has A Long History in Disk Systems



IBM has over 50 years experience in disk, tape and software solutions

On September 13, 1956, IBM introduced the industry's first disk system, the IBM 350 disk storage unit for the IBM RAMAC 305.

- **5 million 7-bit characters (approximately 5MB)**
- **Across 50 disk platters (61cm diameter)**
- **Was leased for $3,320 USD per month, or purchased outright for just under $50,000 USD.**

This year, IBM celebrates the 50th anniversary of the disk system, and continues its leadership in disk systems innovation.

IBM System Storage DS8000 series

New opportunities to help increase ROI and decrease long-term costs

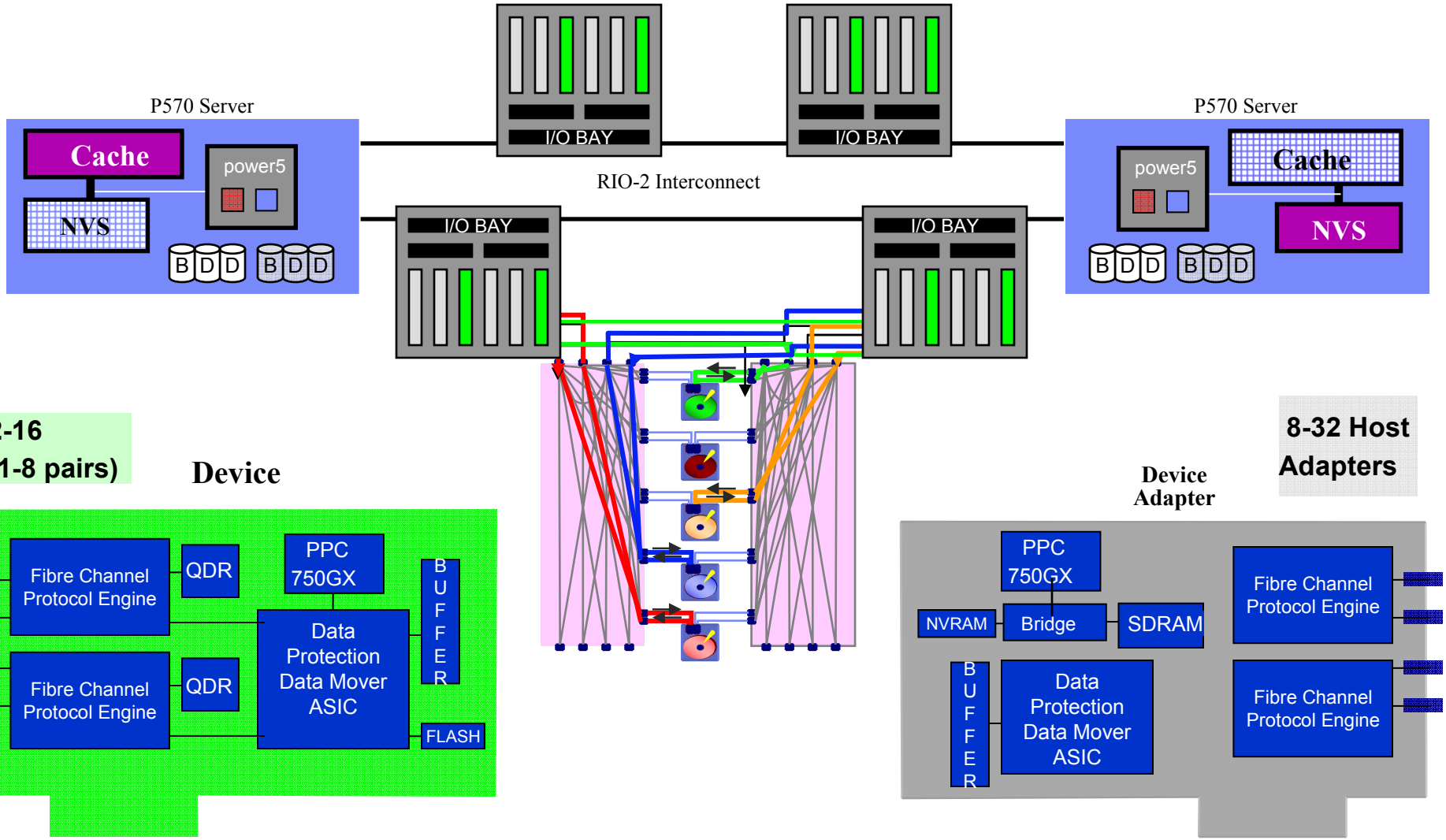
- **Setting a New Standard in Cost Effectiveness**
  - ***Performance*** – Up to 7X ESS Model 800
  - ***Scalability*** – Up to 320TB physical capacity
  - ***Virtualization*** – Storage System LPARs
  - ***Flexibility*** – FC and FATA disks fit cost/access
  - ***Extendibility*** – Extended addressing capability
  - *Storage Management* –Full set of interfaces/tools
  - ***Availability*** – Designed for 24x7 environments
  - ***Resiliency*** – Industry leading advanced functions
  - ***Long Term Cost*** – Four year warranty, model upgrades
- **Delivered through**
  - Server/Storage Integration – POWER5™ Technology
  - Exploitation of IBM Virtualization Engine™ Technology
  - IBM technology leadership and innovation

DS8000 Enhancements Over ESS

- **Hardware – new "everything"**
  - Processors, adapters, internal paths, frames…
- **Increased management flexibility via storage system LPARS**
- **Enhanced Performance**
  - Faster or more of almost "everything"
  - New patented cache algorithms
- **Extended logical device addressing**
- **Even more attractive Total Cost of Ownership**
  - Longer standard warranty period
  - Larger capacity volumes supported
  - Increased opportunities for consolidation

- **Improved volume management**
  - Nondisruptive volume add and delete
  - Up to 64K logical volumes assigned to up to 256 Logical Subsystems (LSSs); an array can contain volumes for multiple LSSs
  - Larger LUNs (over 2 TB)
  - 64,000 cylinder (55.6 GB) zSeries volumes
- **Improved Administration**
  - Online and offline configuration capability using a Web-based graphical user interface (GUI)
  - Ease-of-use improvements (compared to the ESS Specialist)
  - Command line interface (CLI) supports control of copy services without dependencies on GUI-created tasks
- **Extended Connectivity**
  - Up to 128 host ports
  - Up to 510 FCP logins per port and 8,192 per Storage LPAR
  - Up to 512 FICON logical paths per logical control unit image and 128,000 per storage facility image
  - Up to 256 FICON logical path groups per control unit image
  - Up to 2,048 FICON logical paths per port

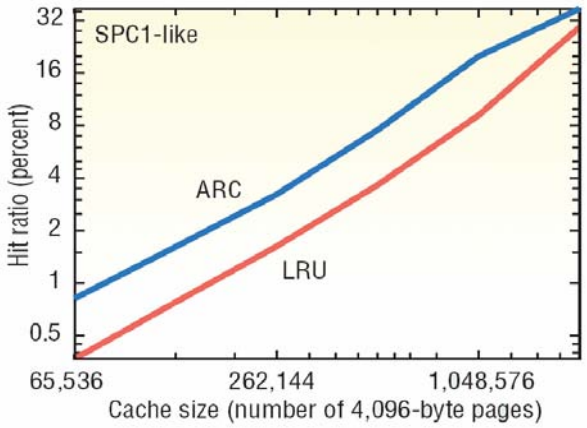
DS8000 High Availability Design Architecture



Patent Number: US20040098541A1

System and method for implementing an adaptive replacement cache policy

- **Best caching algorithms in industry**
- **Over 20 years experience**
- **Simplified Adaptive Replacement Cache (SARC)**
  - *Self-Learning algorithms*
    - ✓ Adaptively and dynamically learn what data should be stored in Cache based upon the recent access and frequency needs of the Hosts
  - *Adaptive Replacement Cache*
    - ✓ Most advanced and sophisticated algorithms to determine what data in Cache is removed to accommodate newer data
  - *Pre-fetching*
    - ✓ Predictive algorithm to anticipate data prior to a host request and loads it into Cache



- **Benefits**
  - ***Leading performance***
    - ✓ Been proven to improve Cache hit by up to 100% over previous IBM caching algorithms and improve I/O response time by 25%
  - ***More efficient use of Cache***
    - ✓ Intelligent caching algorithm profiles Host access patterns to determine what data is stored
    - ✓ Need less Cache than competitors

Nimrod Megiddo and Dharmendra S. Modha, "Outperforming LRU with an Adaptive Replacement Cache Algorithm," *IEEE Computer*, pp. 4-11, April 2004.

IBM DS8000 Standby Capacity on Demand

Highlights:

- Flexible offering for IBM System Storage DS8000 series
- Offers additional capacity ready to use when needed
- Supports use of FC or FATA disk drives
- Allows up to 50% more capacity on standby

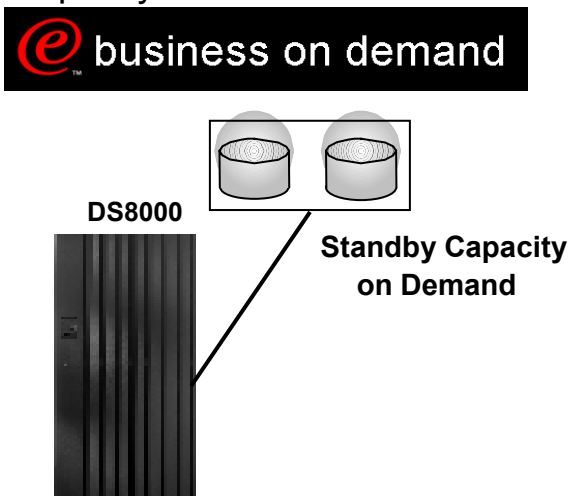
Intended Benefits

- **Convenience**
  - Ready to use excess capacity whenever it's needed
  - Pay small percentage up front and the rest not until activation of extra capacity
  - Available for up to 12 months
  - Customer activation - no vendor intervention or key is required
- **Efficiency**
  - Helps avoid employee time for planning, selecting, and ordering
  - Non-disruptive to normal operations, no downtime for activation
  - Simplifies advance capacity planning
- **Flexibility**
  - The more the base capacity, the higher the extra capacity allowed
  - Featured worldwide for new or previously installed DS8000s

Capacity Options

Base DS8000 with:

- 2 sixteen packs ==> qualifies for 1 sixteen pack of Extra Capacity
- 4 sixteen packs ==> qualifies for 2 or 3 sixteen packs of Extra Capacity
- 8 sixteen packs ==> qualifies for 4 sixteen packs of Extra Capacity



DS8000 Specification

	DS8100	DS8300
DDMs	16-384	16-640
DDM Interface	FC-AL	FC-AL
DDM Types	73,146,300,500 GB	73,146,300,500 GB
RAID Types	RAID 5,10	RAID 5,10
Max Capacity w/146 GB DDM	56 TB	93.4 TB
Max Capacity w/500 GB DDM	192 TB	320 TB
Max Sequential Bandwidth	2 GB/s	4 GB/s
LUNs/CKDs	64K Total	64K Total
Max N-Port Logins/Port	510	510
Max Process Logins	2K	2K
Max Logical Paths / CU	512	512
Max LUN Size	2 TB	2 TB
Dynamic Provisioning	Add/Del	Add/Del
Cache // NVS	16-128 GB // 1-4 GB	32-256 GB // 1-8GB
Processor	DS8000 ML (SMT) 2 Way	DS8000 ML (SMT) 4 Way
Host Adapters	ESCON x2 FC(4 Gb/s)x4	ESCON x2 FC(4 Gb/s)x4
Host Adapter Slots	16	32
Max Host Adapter Ports	64	128
Interface Protocols	SCSI-4GB or 2 Gb FCP/FICON	SCSI- 4Gb or 2 Gb FCP/FICON
PPRC Fabric	FCP	FCP
DA Slots	8	16

DS8000 Exploitation of Storage System LPARs

The Storage System LPAR Advantage!

- **Reduction in**
  - Floor space, power requirements and cooling requirements, through consolidation of multiple stand-alone storage functions
  - Systems management effort
  - Implementation effort through LPAR integration, test, pre- installation and self-configuration
  - Storage infrastructure complexity through integration
- **Hardware based implementation ensures data integrity**
- **Heterogeneous workload support**
- **Efficient use and sharing of system resources through exploitation of dynamic LPAR**
- **Ability to leverage Storage Subsystem LPARs for the purpose of testing**
- **Reduction in physical asset management through consolidation into DS8000 LPARs**

DS8300 with LPARs

DS8000 – R2 Announcement Summary

Announcing new models - Turbo Models 931, 932, and 9B2

- Supports previously announced features / functions, as well as all new R2 features / functions

Announcing new features for ALL models:

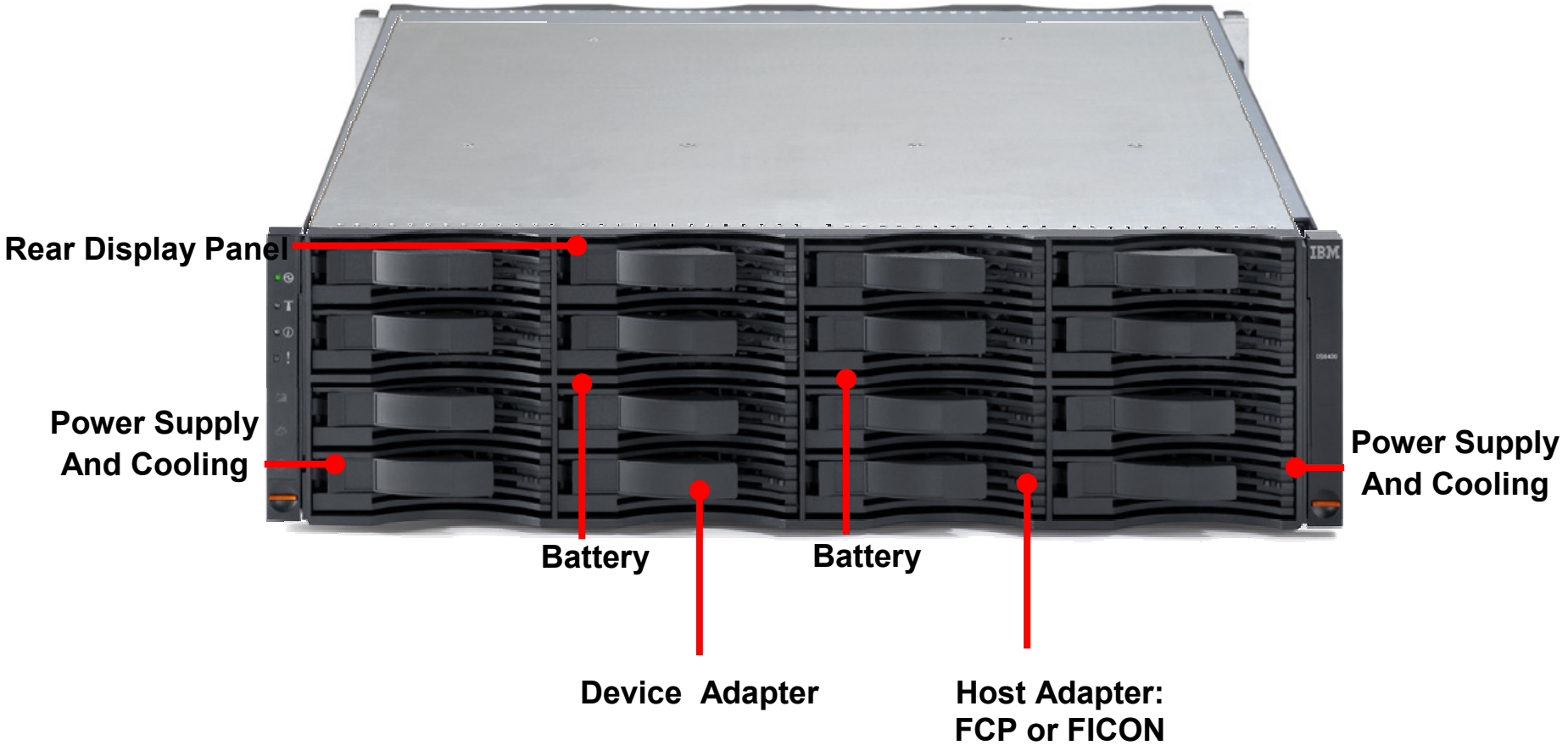
- ***IBM POWER5+ processor – standard on Turbo models***
  - Compared to the current IBM POWER5 processor, the POWER5+ processor may enable up to 15% performance improvement in I/O operations per second in transaction processing workload environments
- ***4Gb FCP / FICON adapter***
  - Designed to offer up to 50% improvement in a single port MB/second throughput performance, helping to enable cost savings with potential reduction in the number of host ports needed.
- ***500GB 7,200 rpm FATA drives***
  - Drives can be added to DS8000 series models to support various fixed content, data archival, reference data, and near-line applications that require large amounts of storage capacity at lower cost per MB
- ***3-site Metro / Global Mirror***
  - Provides fast failover / failback to any site, fast re-establishment of 3-site recovery (without production outages), and quick resynchronization to any site with incremental changes only (incremental resyncing)
- ***Earthquake resistance kit***
  - Seismic kit for stabilizing the storage unit rack, Feature needed on each frame
- ***Ethernet adapter pair (for TPC RM support)***
  - TPC for Replication provides management of DS8000 series business continuance solutions, including FlashCopy and Remote Mirror and Copy functions.
- ***Performance Accelerator (Models 932, and 92E only)***

Low-end Mainframe Attach with the DS6800

- **Value Proposition:**
  - Affordable zSeries storage solution
  - Save customers money in scenarios where the DS6000 fits
  - Customers can now afford new technology instead of purchasing older used equipment
    - - Leverage new technology instead of purchasing or retaining older, used hardware
  - Affordable zSeries solution that fits in standard 19" rack
  - Outstanding TCO for customers' whose specific capacity and performance needs are met

- **DS6000 Models - 522/EX2**
  - 3U package for controllers and 7 disk expansion units
  - High storage density footprint -16 drives per 3U package
  - Maximum of 1024 host and 8192 LUNs (2TB max)
  - **One year, same-day, 24x7 IBM onsite repair (IOR) warranty**
  - **500 GB 7,200 rpm FATA disk drives**
    - Provide additional price, and capacity flexibility to help address specific application and business requirements
    - Intermix is at the drawer level
  - **TPC Replication Manager Support**
  - **CALL HOME SUPPORT VIA TELEPHONE LINE**
    - Provides the ability to E-Mail a customer at Call Home

DS6800 High Availability Design

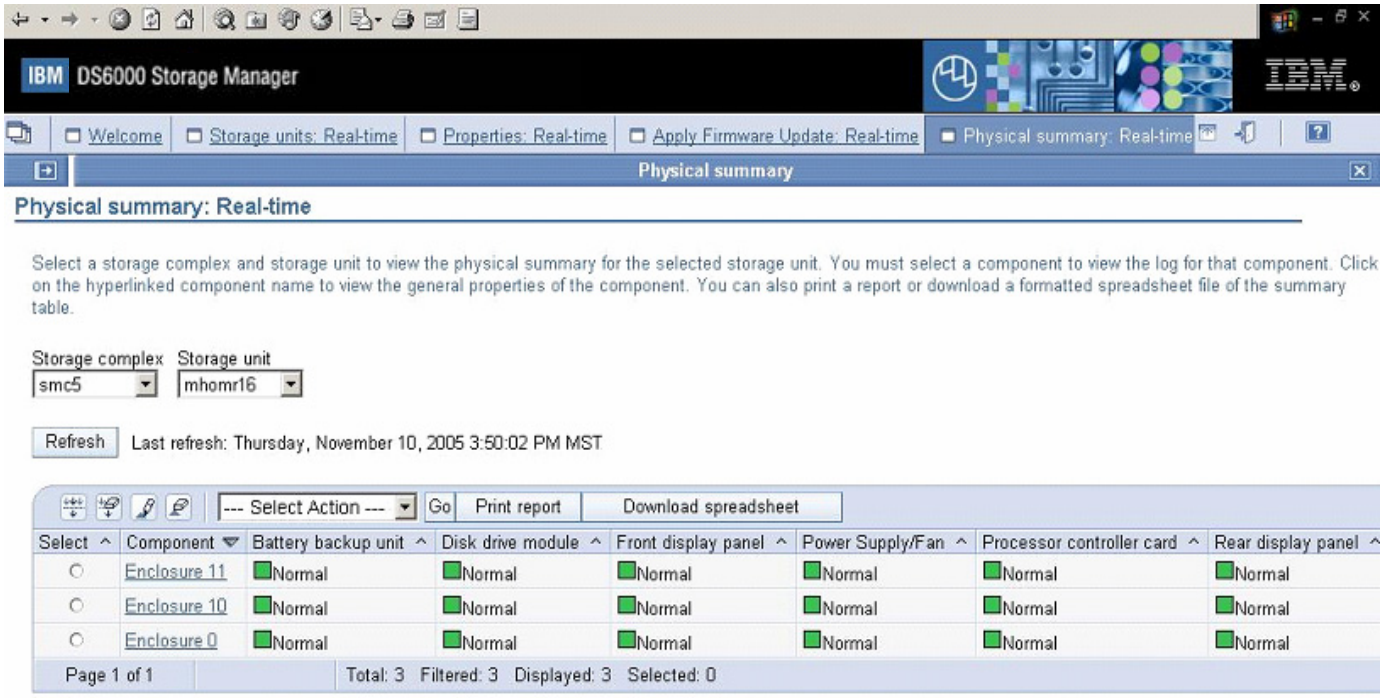


DS Storage Manager Interface

– *Provides centralized management*
  - Provides enterprise view of all managed systems
  - Automatic and manual device discovery
  - Consistent interface across all platforms

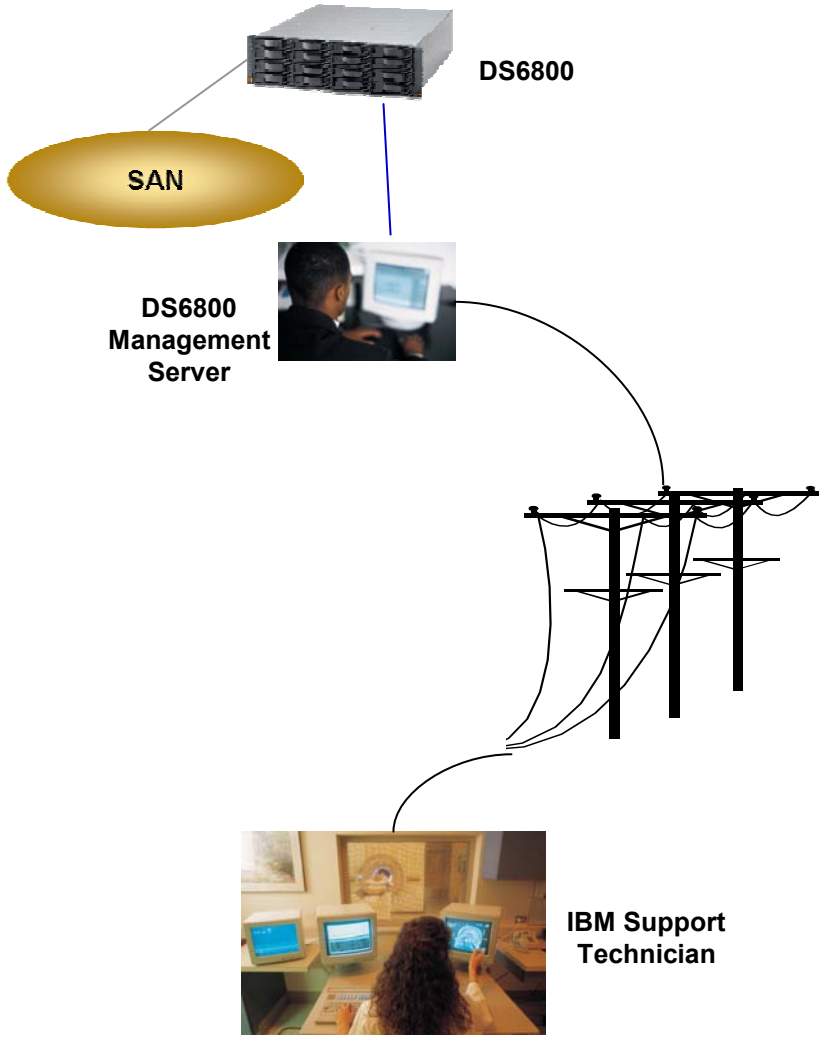
– *Intuitive GUI enables*
  - Easy to navigate and administer interface
  - Express configuration through wizards
  - Management of all hardware and software components

– *Comprehensive Online help and documentation*



Modem: Call Home and Remote Support

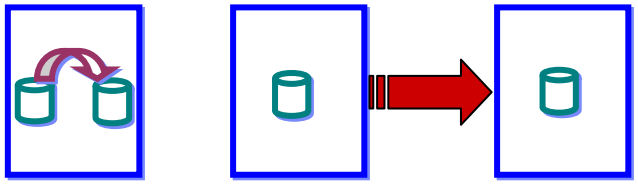
- **Modem connection provides robust support capabilities**
- **Alerts sent to IBM via modem enhances customer's experience**
  - Problem notification
  - Enables IBM to have accurate system configuration information
    - Weekly heartbeat
    - Configuration data stored for support assistance
- **Modem can provide interactive remote support capability**
  - Interactive problem assistance
  - Diagnosis of system issues
  - Secure connection between IBM and customer site



DS6800 Specifications

Controllers	**Dual Active**
Max Cache	**4 GB**
Max Host Ports	**8-Ports; 2Gb FC/FICON**
Max Hosts	**1024**
Max Storage / Disks	**Up to 64TB / 128 drives**
Disk Drives	**FC 10K rpm: 146 GB, 300 GB** **FC 15K rpm: 73, 146 GB** **FATA 7.2K rpm: 500 GB**
Max Expansion Mod	**7**
Max Disk Loops	**4 (2 dual redundant)**
Max LUNs	**8192**
RAID Levels	**5, 10**
RAID Array Sizes	**4 or 8 drives**
Operating Systems	**z/OS, z/VM, i5/OS, OS/400, AIX, SUN Solaris, HP UX, VMWare, UNIX, Microsoft Windows, Linux**
Packaging	**3U – Controller & Expansion Drawers** *Height: 5¼ inches, Width: 18.8 inches, Depth: 24 inches*
Power consumption	**Controller: 0.69 kVA** **Expansion drawer: 0.48 kVA**

DS6000 and DS8000 Data Replication Technologies

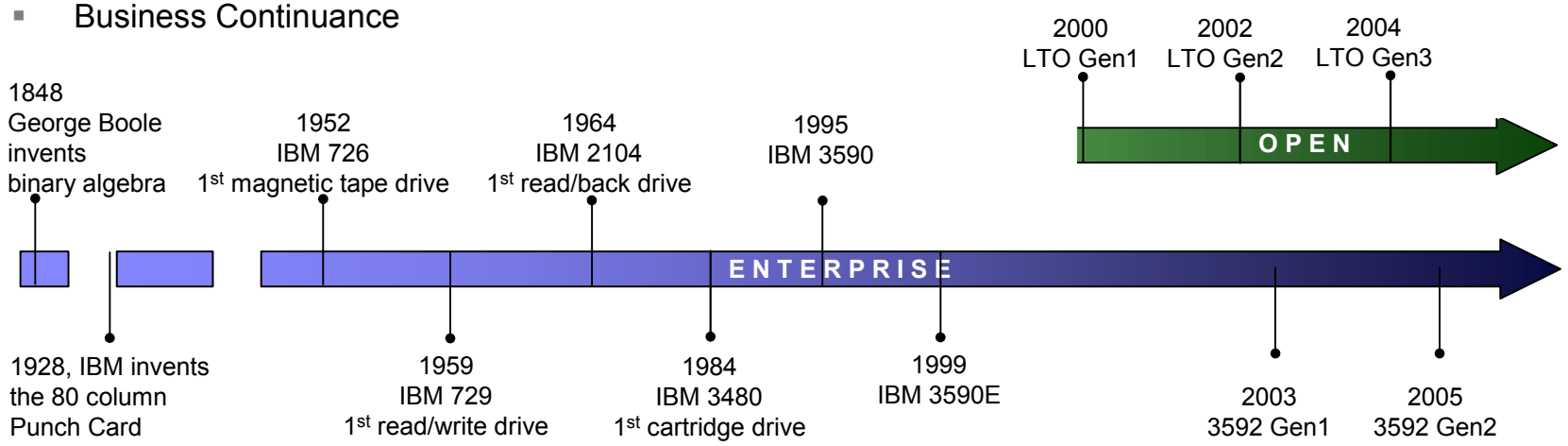


- **FlashCopy – internal replication**
- **Remote Mirroring – external replication**
  - ***Metro Mirror***
    - Synchronous protocol, remote site data currency, 303 km, consistency groups
  - ***Global Mirror***
    - Asynchronous protocol, remote site near-data currency, unlimited distance, consistency groups
  - ***Global Copy***
    - Asynchronous protocol, period point-in-time currency, unlimited distance
  - ***Metro/Global Mirror***
    - 3-site with A-to-B synchronous + B-to-C asynchronous)
  - ***z/OS Global Mirror (XRC)***
    - Optimized for z/OS, asynchronous, remote site near-data currency, unlimited distance, high scalability, open architecture, no DS6000 primary site support
  - ***z/OS Metro/Global Mirror***
    - Three site solution using Metro Mirror + zSeries Global Mirror (XRC)

Over 50 Years of Tape Innovation

- **Tape is an integral part of the storage hierarchy**
- **Tape is low cost**
- **Tape is intrinsically "On-Demand"**
- **Tape is removable and portable**
- **Tape provides high volumetric efficiency**
- **Tape media has a long life**
- **Tape is ideally suited for:**
  - Information Lifecycle Management
  - Infrastructure Simplification
  - Business Continuance

Starting in 1952 - IBM 726



IBM System Storage Tape: Supports FICON Express4

Enterprise Tape Continuum


LTO Gen 3


TS1120


TS3310


3494


3584


TS7510


TS7700

Tape Drives

- LTO Gen 3 tape drive[1,2]
  - Supports up to 400 GB cartridge capacity[4]
  - Up to 80 MB/sec throughput[4]
- TS1120 tape drive/controller
  - Second generation tape drive
  - Controller supports ESCON & FICON
  - Tape drive data encryption in plan[3]
  - 100 & 500 GB cartridge capacity[4]

Tape Libraries

- TS3310 tape library[1,2]
  - Stackable modular design
  - LTO Gen 3 only
- 3584 tape library
  - Linear scalable design
  - LTO Gen 3[1,2] & TS1120 tape drive
  - Advanced management function
- 3494 tape library
  - Investment protection
  - TS1120 and 3590 Tape drive support

Virtualization

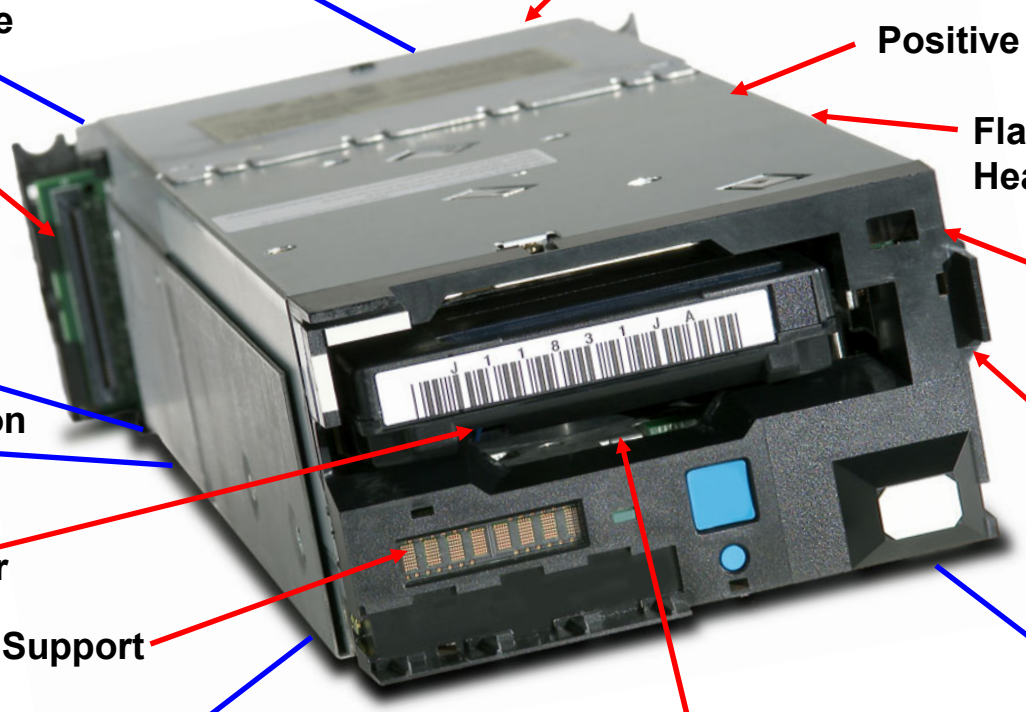
- TS7510 Virtualization Engine[1,2]
  - Up to 600 MB/sec throughput[4]
  - Up to 46 TB cartridge capacity[4]
- TS7700[2]
  - Standalone or PtP deployment
  - Advanced function
  - GDPS support

[1]Linux on System z support only; [2] 2 Gbps/sec only; [3]Statement of Direction included in June 27. 2005 announcement; [4]Uncompressed Capacity

TS1120 Tape Drive Overview

- **2nd Generation of 3592 enterprise tape drive roadmap**
  - 104 MB/sec performance (up to 260 MB/s at 3:1 compression)
  - 100 / 500 GB native capacity (up to 300 GB / 1.5 TB at 3:1 compression)
    - Re-Writable and Write Once Read Many (WORM) cartridges
  - Supports data encryption and key management
- **Attaches to**
  - All IBM eServers (IBM System z™ via TS1120 Controller)
  - Selected HP and Sun Microsystems servers
  - Selected versions of Microsoft Windows™
  - Selected Linux editions
- **Supported in**
  - IBM 3494 and TS3500 tape libraries
  - IBM 3592 C20 silo compatible frame
  - IBM 7014 Rack

TS1120 Highlights



Drive status LED's
Fan Speed detection
Dual FC ports

100 mounts - SARS drive performance

40K lines of 3590 *u*code

Positive Pin Retention

Vital Product Data -VPD

Flat Contour Low Wrap Head

128 MB Buffer

Surface Control Guiding Rollers

Dual scheme compression

Separate Thread & Load Motors allows tape removal

Harden cartridge Loader

Vol ID Manual Mode Support

Dedicated Servo Control ASIC and Speed Matching circuits

Long Life Brushless Spindle Motor

Enhanced R/W data channel w/auto calibration

TS1120 / 3592 Cartridge Media

- **Cartridges are in rewritable and WORM**
- **Cartridges are available in two lengths**
  - JJ and JR cartridges provide rapid access to data
  - JA and JW cartridges provide fast access to data or high capacity
- **Cartridges can be formatted to either Gen 1 or Gen 2 formats[1]**
  - TS1120 tape drives can read or write Gen 1 or Gen 2 formats
  - 3592 J1A tape drives can read or write the Gen 1 format

3592 Cartridge Media		TS1120 Tape Drive		3592 J1A Tape Drive	
Type	Format	Capacity	Performance	Capacity	Performance
JJ / JR	**Gen 1**	**60 GB**	**50 MB/sec**	**60**	**40 MB/sec**
	Gen 2	**100 GB**	**100 MB/sec**		
JA / JW	**Gen 1**	**300 GB**	**50 MB/sec**	**300**	**40 MB/sec**
	Gen 2	**500 GB**	**100 MB/sec**		

* iSeries only supports writing cartridges native 3592 Gen 2 format

Supports Lightning Fast Performance

- **Includes two 4 Gbit FC / FC-AL interfaces**
- **Uses existing 3592 cartridge media**
  - JJ/JR cartridge media supports fast access
  - JA/JW cartridge media supports high capacity
    - The capacity scaling function can also be used to support fast access

Average Tape Drive Performance Metrics

	Machine Model	TS1120		3592 J1A		3590 H1A	LTO Gen 3
	Cartridge Type	JJ	JA	JJ	JA	K	Gen 3
A:	Load	16	16	20	20	42	15
B:	Initial Search	11	33	12	40	62	46
C:	Average Access (A+B)	27	49	32	60	104	56
D:	Rewind	11	33	12	40	56	46
E:	Unload	19	19	19	19	18	15
F:	Mount / Demount (A+B+D+E)	57	101	63	119	178	123

Tape Encryption with Key Management on System z

Why z/OS centralized key management?

- Can help to protect and manage keys
  - Highly secure and available key data store
  - Long term key management
  - Disaster recovery capabilities
- Single point of control
- Over a decade of production use

OVP130

Encryption Facility for z/OS, V1.1

Data Encryption in the Server

- Flexible options for business partner exchange
- Partners can encrypt and decrypt using no-charge Java client
- Supports public key or password based exchange
- Plans to support OpenPGP standard*

Protected Encryption Keys

Data Encryption in TS1120*

Enterprise scope

- Highly secure tape library
- High performance archive encryption
- Transparent to existing processes and applications
- Can help provide audit compliance

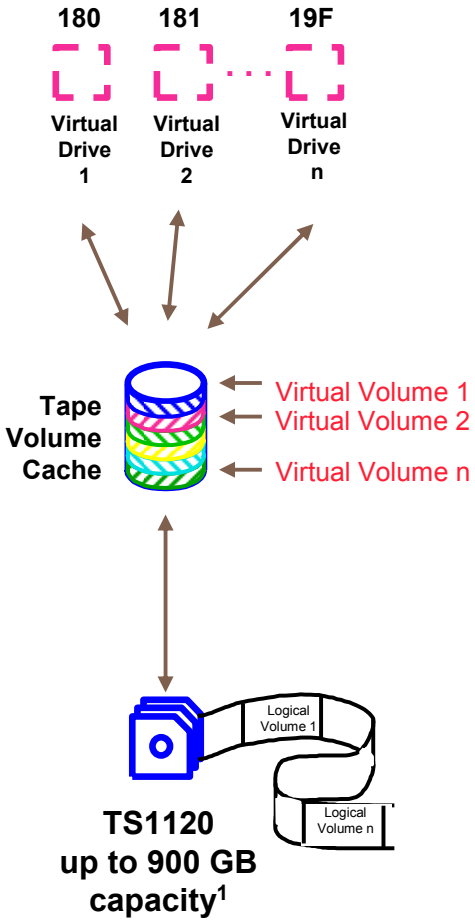
TS7700 Virtualization Engine Components

Develop a subsystem that exploits the storage hierarchy

- Addresses the fact that data written to tape is either
  - required to address business continuity in the event of an outage
  - required to address long term archival or regulatory legislation
- Matches the data to its access requirements
  - Fast access to data on 'virtual volumes' on the disk buffer
  - Cost effective storage by migrating 'virtual volumes' to tape

Virtual Tape Concepts

- *Virtual Tape Drives*
  - Appear as multiple 3490E tape drives
  - Shared / partitioned like real tape drives
  - Requires fewer real tape drives
- *Tape Volume Caching*
  - Designed to eliminate many physical tape delays
  - Supports read hits from cache / recalls from cartridge
  - Supports 100 % write hits
- *Volume Stacking*
  - Designed to fully utilize cartridge and library capacity
  - Stacks multiple logical volumes onto stacked cartridges
  - Supports TS1120[1] and/or 3592 J1A tape drives



TS7700 Virtualization Engine Components

- **One TS7740 node[1]**
  - High performance IBM System p server
    - Two dual-core, 64-bit, 1.9-GHz processors
    - 8 GB
    - Two or four 4 Gbps FICON host interfaces
    - Two 1 Gbps replication links
    - Additional adapters
      - Physical library and drive attachments (fiber)
      - Management interface (Ethernet)
      - Service interface (Ethernet)
- **Three TS7740 cache drawers[1]**
  - High performance RAID 5 disk
    - Attaches to the TS7740 cache controller
    - Provide 1.5 TB of usable cache capacity
    - Includes 16 15k rpm 146GB FC HDDs
- **One TS7740 cache controller[1]**
  - Provides high performance RAID 5 disk tape volume cache
    - Attach to one TS7740 Virtualization Engine node
    - Provide up to 1.5 TB of usable cache capacity
    - Includes 16 15k rpm 146GB FC HDDs
    - Includes four 4 Gbps FC interfaces

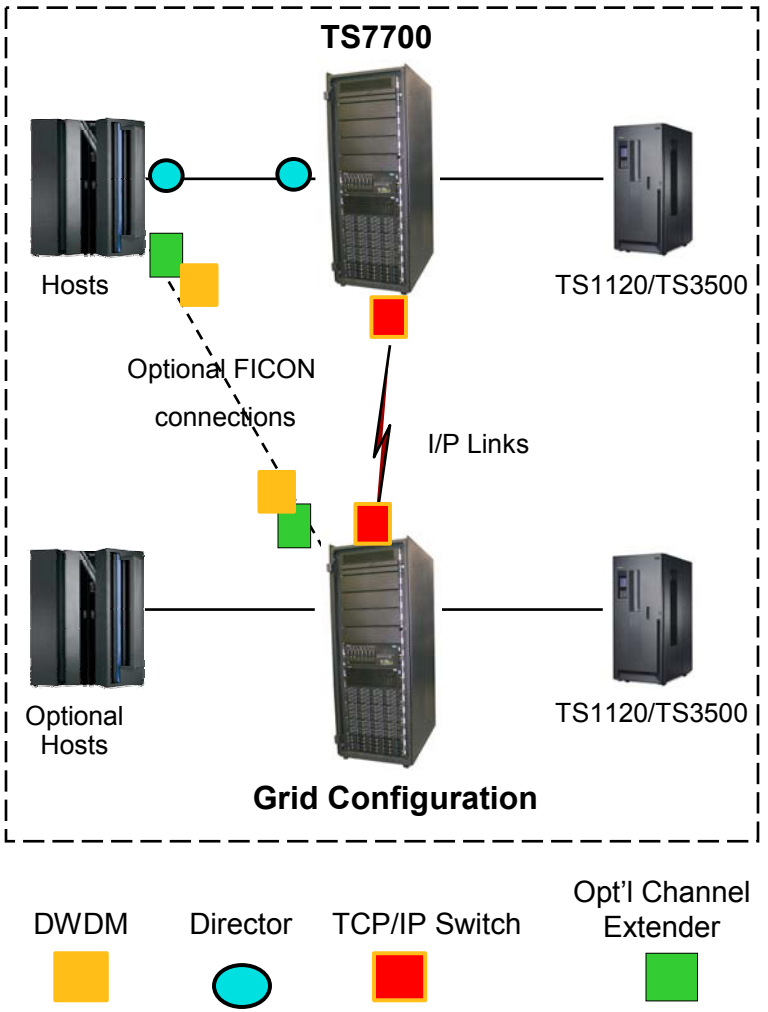
Specification	TS7740
Number of Virtual Devices	**128**
Usable Cache Capacity	**6 TB**
Compressed Cache Capacity (3:1)	**18 TB**
FICON	**4**
ESCON Channels	
TS1120/3592 Tape Drive Attachment	**4 - 16**
3590 Tape Drive Attachment	
Number of Virtual Volumes	**500,000**

[1] Machine Type 3957 Model V06

TS7700 Grid Configuration

for Disaster Recovery & Availability

- **Couples two TS7700 Clusters together to form a Grid configuration**
  - VTCs have been eliminated
  - Hosts attach directly to the TS7700 Clusters
- **Any volume accessible through either TS7700 cluster in the Grid configuration**
- **I/P based replication**
  - Two 1 Gbps Ethernet links
  - RJ45 Copper (Cat 6)
  - Standard TCP/IP
- **Policy-based replication management**
- **Can be configured for disaster recovery or higher availability environments**



LTO Gen 3 Meets Customer Requirements

- **The IBM LTO Gen 3 tape drive delivers**
  - A tape drive that adheres to the LTO specification yet provides
    - Performance that is equal to or better than competitive products
      - 80 MB/sec performance (up to 160 MB/s at 2:1 compression)
      - 400 GB capacity (up to 800 GB at 2:1 compression)
    - Digital Speed matching that best matches server throughput
    - Adaptive compression that maximizes storage capacity
  - A platform that serves as the anchor for business continuance
    - By incorporating unique or leading edge IBM technology to provide higher capacity and performance as well as higher levels of data integrity
    - By using high quality metal materials (e.g. aluminum, steel, etc) for key components as opposed to plastic

- **Supported in Linux for zSeries**
  - TS3100 tape library (desktop/rack-mount)
  - TS3200 tape library (desktop/rack-mount)
  - TS3310 tape library
  - TS3500 tape library

LTO Tape Library Overview

- **TS3100 single drive tape library**
  - Models: L2U; L3S, F3S for HVEC
  - LVD SCSI or new 4Gb Fibre Channel attach IBM LTO Ultrium 3 tape drives
  - Completely new robotics and operational design
- **Capacity**
  - 22 data cartridge slots, 1 dedicated I/O slot vs. 8 on 3581
  - 8.8 TB of native storage capacity (17.6 with 2:1 compression)

- **TS3200 Two Tape drive library**
  - 4U Rack mount or desktop
  - Drives will be feature code options, with both LVD SCSI and 4Gb Fibre Channel available
- **Capacity:**
  - Provides 17.6TB of native physical or 35.2TB compressed (typical) storage capability
  - 44 data-cartridge IBM LTO Ultrium 3

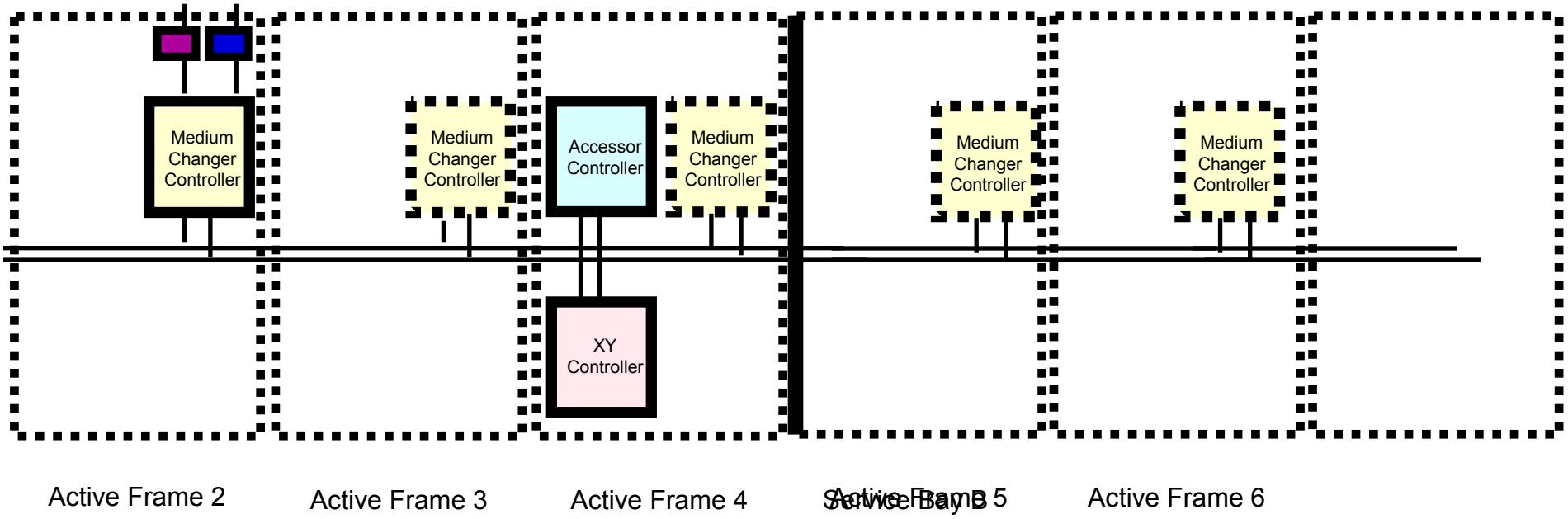
- **TS3310 tape library**
  - 12 TB native capacity (30 slots)
  - 37 TB native capacity (92 slots)
  - Up to two LTO Gen 3 drives (FC/SCSI) – Base
  - Up to four LTO Gen 3 drives (FC/SCSI) -- Expansion
  - Six fixed slot cartridge I/O
  - Contains robotics and control logic
  - Barcode Reader is standard
  - Remote management Unit
  - Native SMI-S support

TS3500 Tape Library Overview

- **1 - 16 frames (plus two service frames)**
- **1 - 192 tape drives**
  - Up to 192 System z attached TS1120 tape drives
  - Up to 192 open system attached tape drives
    - TS1030 or TS1120/3592 J1A tape drives are supported
    - Tape drives types and associated media require unique frames
- **Storage Capacity of over 9.3 Petabytes***
- **1 - 8 TS7700 Virtualization Engines**
  - Up to 2,048 virtual drives
  - Up to 2 million virtual volumes
- **1 – 8 Virtual Tape Servers**
  - Up to 2,048 virtual drives
  - Up to 4 million virtual volumes
- **Supports Peer-to-Peer VTS configurations**
  - Second PtP must be in a separate TS3500 or 3494 tape library

* Using TS1120 tape drive with 3592 JA cartridge at a 3:1 compression

Expansion of a TS3500 with High Availability Option is designed to be performed with a downtime of less than 60 minutes.



Why less than 60 minutes?

- Because no frame is removed and, most of the work required to expand the library can be performed with the safety barrier in place.

IBM Tape Drives
What determines Best of Breed?

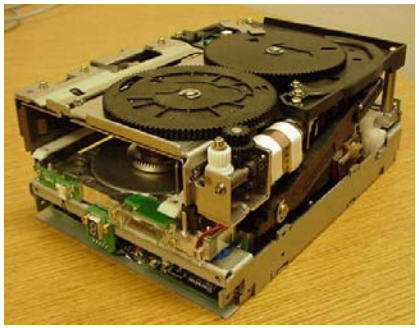
Technology Competencies

MR Heads
Media
Mechanics
Electronics / Servo
Recording Technology
Error Correction
Dynamic Compression Look Ahead
Speed Matching
Attach Interface Architecture
Dynamic Load Balancing
Native Fibre Channel

SARS (**S**tatistical **A**nalysis **R**eporting **S**ystem)

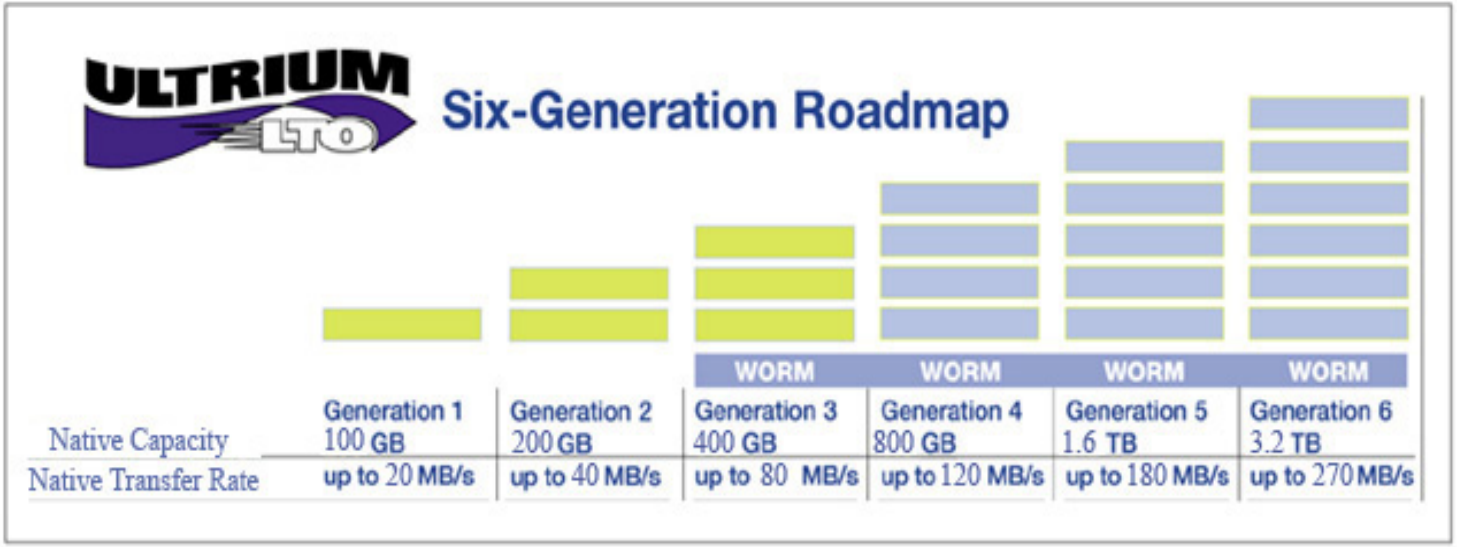
50 Years of Tape Technology

IBM LTO Drives



LTO Cartridge Interchangeability

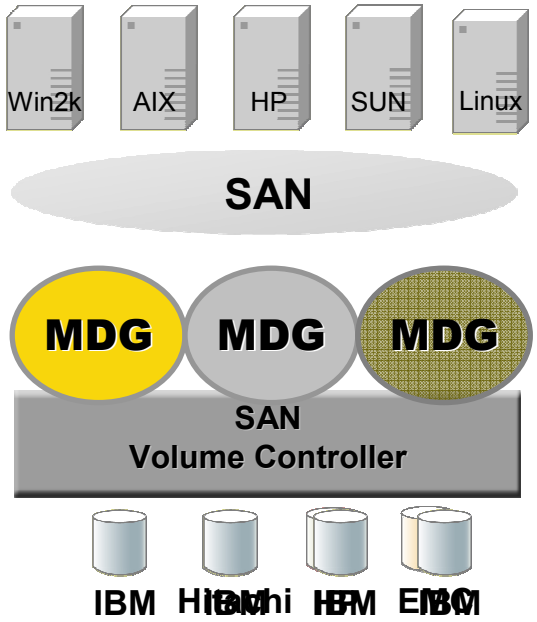
LTO Cartridge		LTO Tape Drive Generation Datarate [2]			
Generation	Native Capacity	Datarate	Gen 1	Gen 2	Gen 3
Gen 1 	**100 GB**	**Read**	**15 MB/sec**	**20 MB/sec**	**20 MB/sec**
		Write	**15 MB/sec**	**20 MB/sec**	
Gen 2 	**200 GB**	**Read**		**35 MB/sec**	**35 MB/sec**
		Write			
Gen 3 [1] 	**400 GB**	**Read**			**80 MB/sec**
		Write			



1. Rewritable Cartridge illustrated, WORM Available
2. Native sustained data rate, native physical capacity

SAN Volume Controller Delivers Value

- **Reduces the cost & complexity of managing storage**
  - Creates tiers of storage
  - Enables multi-vendor strategies
  - Cineca (Italy) established tiered storage and is set to grow 6X in 2006
- **Improves Business Continuity**
  - Change storage without interrupting applications
  - Allocate more storage to applications automatically
  - Bell Canada uses SVC for 24 X 7 emergency call center
- **Improves Storage Utilization**
  - Combines storage capacity into a single resource – from multiple vendors
  - City of Richmond increased utilization by 45%
- **Improves Personnel Productivity**
  - Manage a single storage resource from a central point
  - Yurion, Inc. uses SVC in a grid for its online music service
- **Improved application availability**
  - Eliminate many of the causes of storage-related downtime



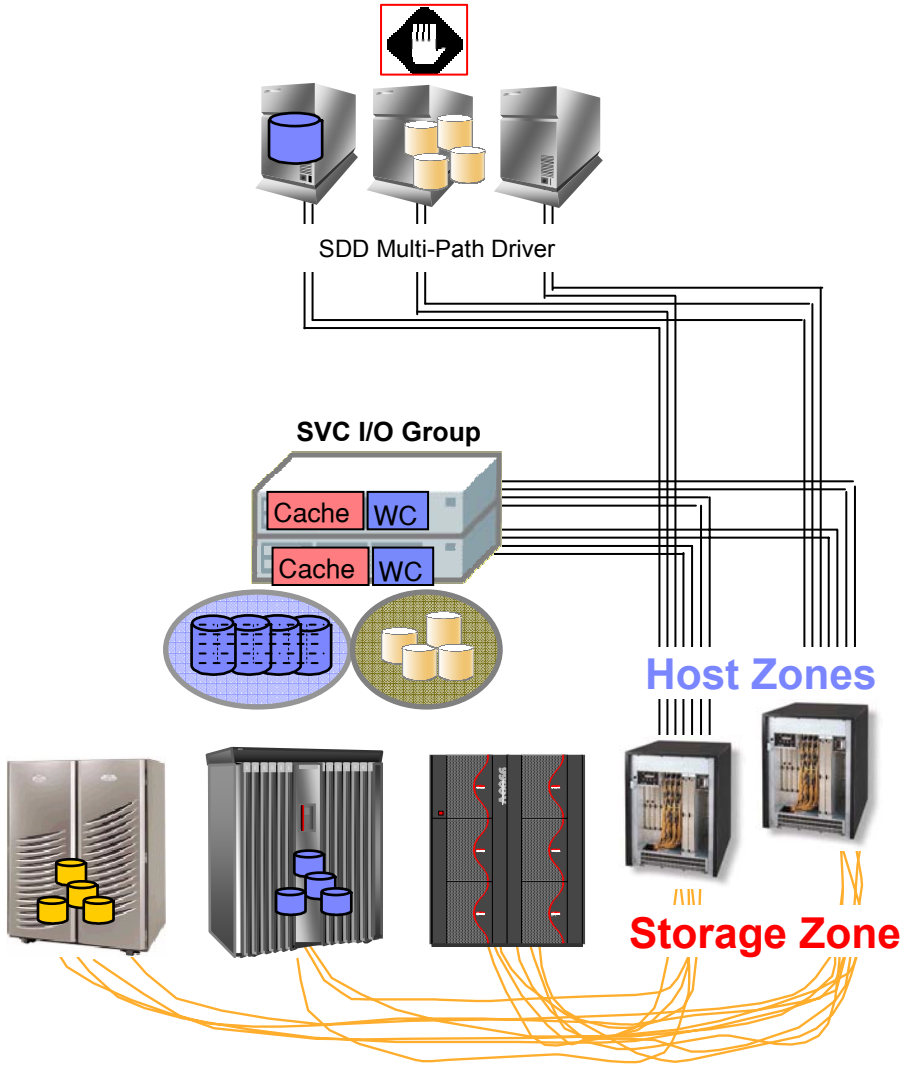
SAN Volume Controller Infrastructure

It's Resilient and Available

We designed and built SVC with the resiliency of a storage controller

SVC supports **non-disruptive** firmware updates **and** hardware maintenance on the disk arrays to further increase its availability

SVC is running at **5 nines** availability in the field !



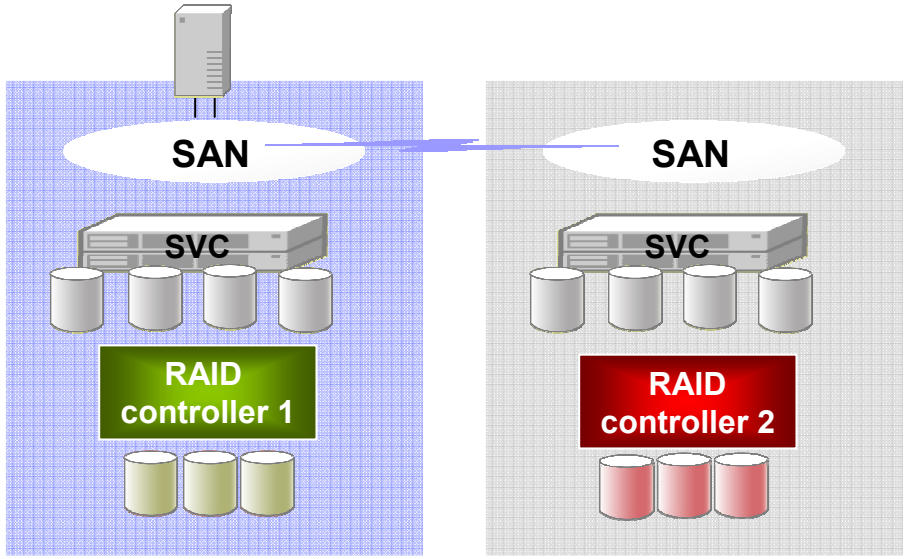
IBM SVC Version 4.1 Copy Servies

METRO MIRROR:

- Synchronous remote copy between virtual disks geographically dispersed on two SVC clusters
- **Inter-cluster** remote copy is supported when one virtual disk comes from each of two clusters
- **Intra-cluster** remote copy is supported when virtual disks are within the same I/O Group)
- SVC supports Consistency Group at the level of the **cluster**
  - Implements an internal Freeze/Thaw to assure data consistency

GLOBAL MIRROR:

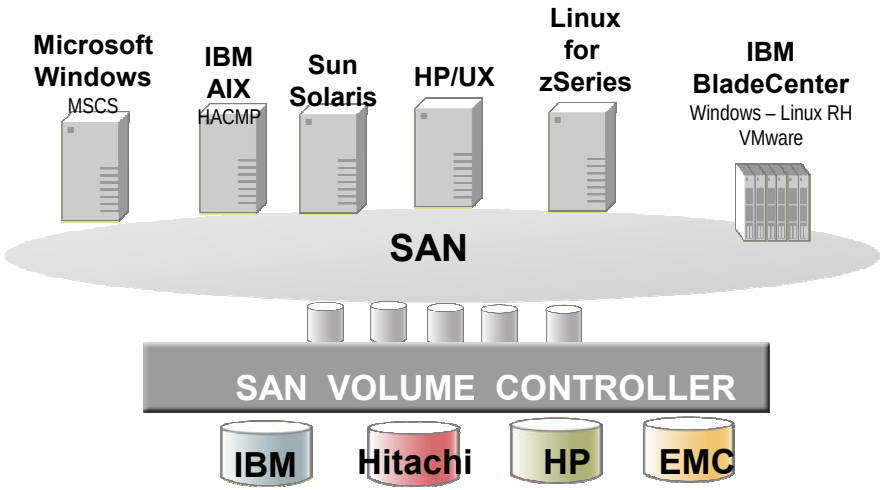
- Long distance asynchronous remote mirroring function
- Practically unlimited distances for business continuity
- Does not wait for secondary I/O before completing host I/O
  - ✓ Minimizes performance impact to applications
  - ✓ Supports consistency groups which span IO groups within a cluster
- Designed to maintain consistent secondary copy at all times



The IBM TotalStorage SVC ROI Benefits

DISK Savings

- Offsite storage moved to less expensive disks
- FlashCopy moved to less expensive disk
- Higher high performance disk utilization
- More efficient low-cost FlashCopy
- More efficient low-cost PPRC Onsite/Offsite
- Less reserved capacity for high performance
- Slower high performance data growth



TIME Lost Savings:

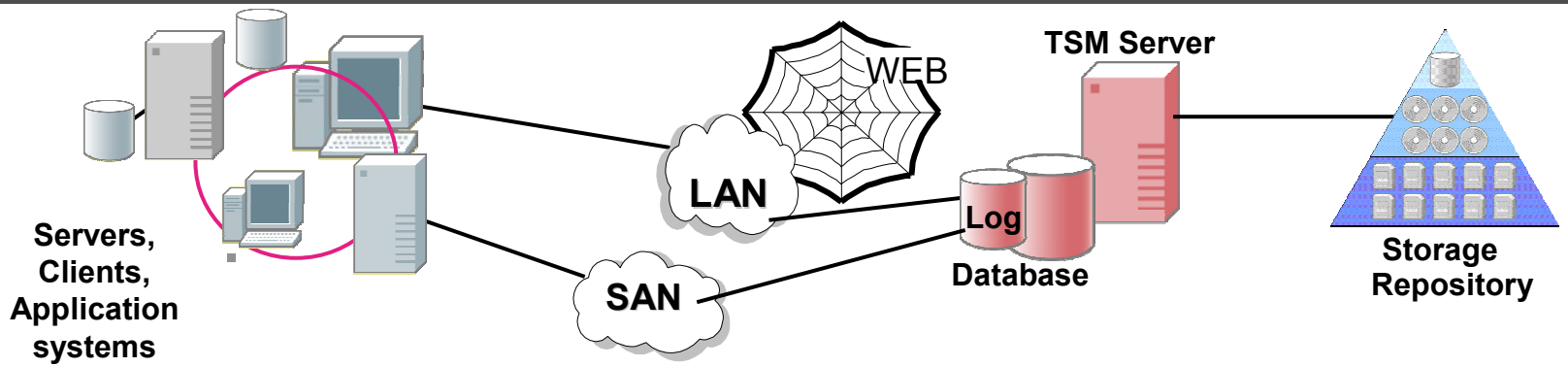
- Time lost during scheduled maintenance
- Time lost from freezing applications while IT adds storage
- Time lost from freezing applications while IT moves storage

PERSONNEL Savings:

- Moving or migrating data
- Planning or creating new storage
- Planning or performing copy services
- General storage infrastructure management

The IBM Tivoli Storage Manager

Complete Storage Management



Backup/Restore	Data Retention	Disaster Recovery	Space Management	Archive / Retrieve

Database and Application Protection	Bare Machine Recovery

- **There is no native TSM zOS client**
- **zOS datasets are backed up thru DFSMS**
- **Linux on zSeries files are backed up thru the TSM Linux on zSeries client**
- **USS (Unix System Services) files are backup up thru the TSM USS client**

- Utilizes powerful relational database to track meta data
- Only needs to back up new and changed files – progressive bkup
- Policy changes retroactively applied to previously backed up data
- Archived files are retained for long term storage based on policy
- DR planning built in and automated
- Flexibility to move data from one type of media to another

z/OS Requirements

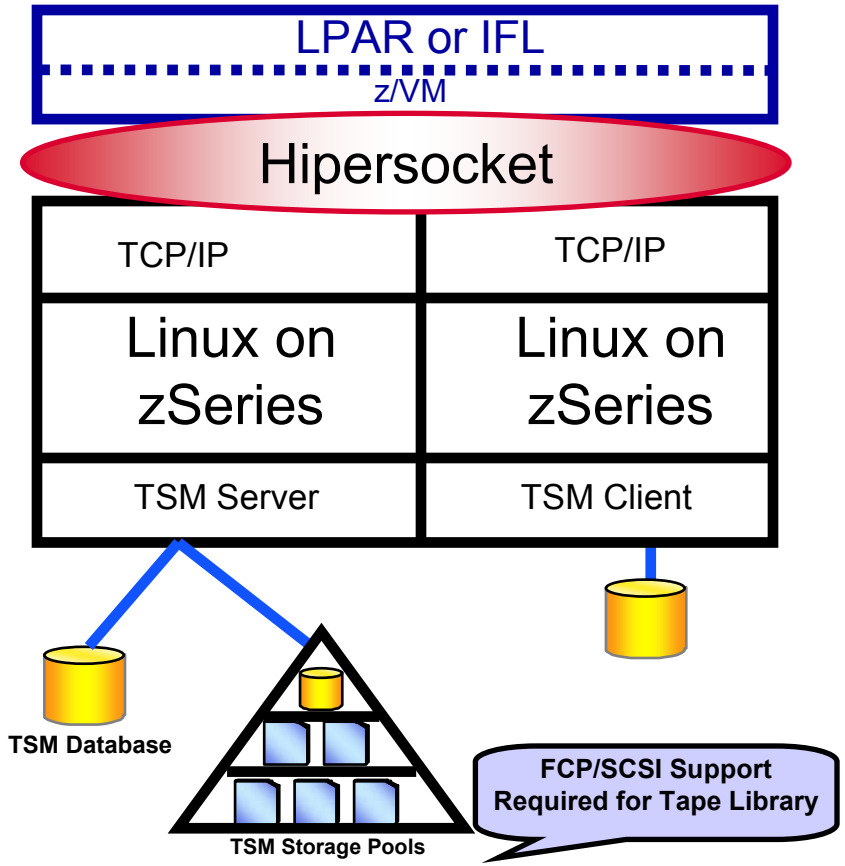
- **Hardware**
  - Any S/390 or zSeries architecture CPU
- **Operating System**
  - z/OS V1R1 or OS/390 V2R10
- **Communications**
  - LU6.2 (APPC) and LU2 (3270 Extended Data Stream)
  - TCP/IP
    - IBM TCP/IP Communications Server
    - (CS) for OS/390 or z/OS Communications Server
- **Additional Software**
  - SMP/E
  - IBM Language Environment

Linux for zSeries Requirements

- **Hardware**
  - A zSeries 900 or 800 server with either native LPARS or VM guests. 31-bit and 64-bit LPARs and guests are supported
- **Operating System**
  - SUSE Enterprise Linux 8/UnitedLinux 1.0
- **Environments**
  - IFL (Integrated Facility for Linux)
  - LPAR
  - z/VM
- **Device Support**
  - Native Linux Filesystem for DB, Log, and Stgpool volumes
  - FCP/SCSI Support Required for Tape Storage

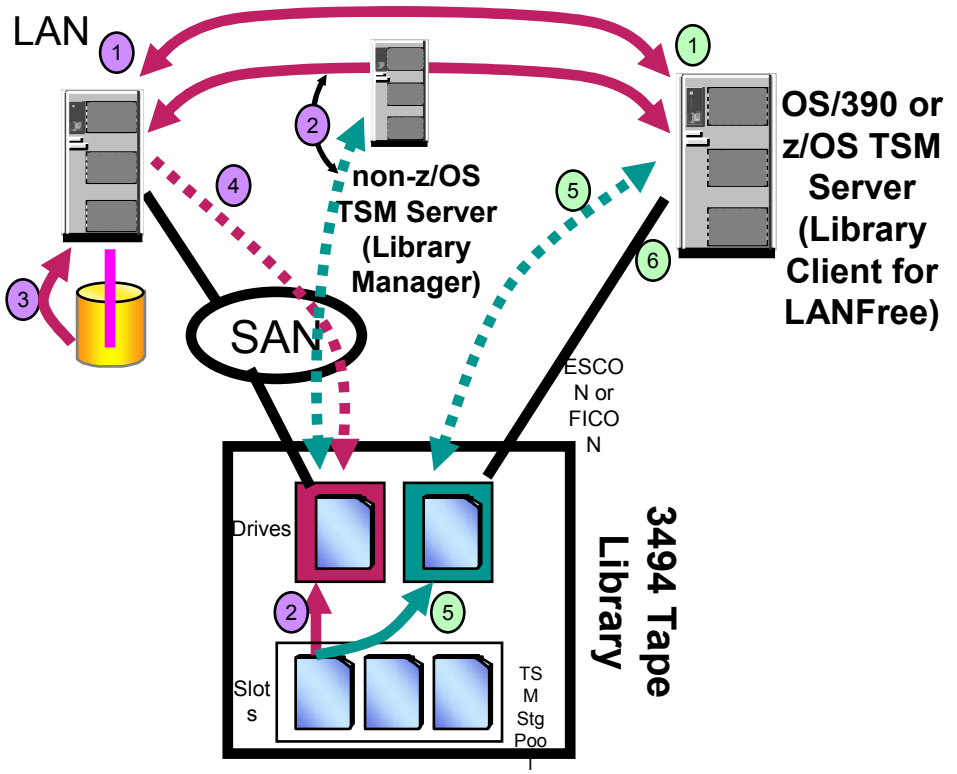
TSM Server on zSeries Linux

- **TSM on zLinux is more like TSM on Open Systems**
  - TSM on zLinux leverages the zSeries hardware
  - Must use SCSI-attached tape drives
    - Tape drives on traditional zOS systems are ESCON/FICON, not SCSI
  - Tape libraries which must perform work on both zOS and zLinux must be partitioned
    - Adds complexity over dedicated tape libraries
  - Tape drives within library must be dedicated to either zOS (ESCON) or zLinux (SCSI)
    - Tape drive sharing between zLinux and zOS not possible
  - Migration of TSM from zOS to zLinux is no easier than migration to other platforms



zOS LANFree Implementation and Benefits

- **Improve storage resource utilization**
- **Minimizes LAN disruption**
  - Offload LAN Traffic
  - More flexible backup window
- **Scheduling and policy management to optimize shared resource**
- **Better performance over slow LAN**
- **Can improve performance and scalability of certain applications**
- **Communication intensive applications may improve due to less communication contention on LAN**
- **TSM server scalability:**
  - Can handle more simultaneous client sessions
  - CPU utilization down
  - Server performance gated by TSM database activity



A Unified IBM System Storage and System z Approach

Take back control of your infrastructure

- **Lower costs with tiered storage offerings for effective information lifecycle management**
  - **Leverage IBM's enterprise continuum of disk storage, SAN and tape technology to best fit the accessibility needs and value of your data**
- **Support data security, business continuity, regulatory compliance**
  - **IBM Systems support data security and end-to-end world class business continuity solutions encompassing SAN, disk, tape, server, software and services**
- **Reduce costs and complexity through infrastructure simplification and consolidation**
  - **High performance, highly scalable systems that include features like 4 Gb FICON/FCP connectivity can enable you to unify your infrastructure to help lower costs, simplify management**

Resilient, cost effective, world-class solutions. IBM's integrated infrastructure for On Demand Business.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- ESCON
- eServer
- FICON
- FlashCopy
- GDPS
- Geographically Dispersed Parallel Sysplex
- HiperSockets
- i5/OS
- IBM
- IBM eServer
- IBM logo
- iSeries
- Lotus
- ON (button device)
- On demand business
- OnForever
- OpenPower
- OS/390
- OS/400
- Parallel Sysplex
- POWER
- POWER5
- Predictive Failure Analysis
- pSeries
- S/390
- Seascape
- ServerProven
- System z9
- System p5
- Tivoli
- TotalStorage
- TotalStorage Proven
- TPF
- Virtualization Engine
- X-Architecture
- xSeries
- z/OS
- z/VM
- zSeries

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