IBM® TotalStorage®

zSeries Conference G22 - IBM TotalStorage® Portfolio Part 1

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Agenda

Part 1 - Session G22

- Overview
- Strategy
- DS Family
- Tape Solutions (3590, 3592, LTO, 3494, 3584 and VTS)

Part 2 - Session G23

- Storage Networking
- DFSMS
- Virtualization
- Storage Management

Grand Challenges of Storage (by Jai Menon)

- 1. Managing Complexity
- 2. Building bulletproof storage
- 3. Creating maintenance-free storage
- 4. Bringing business continuity to the masses
- 5. Securing storage
- 6. Finding or searching for information
- 7. Guaranteeing the authenticity of data
- 8. Long-term presentation of data
- 9. Creating an information grid
- 10. Replacing disk drives as the primary storage medium

Data Size!

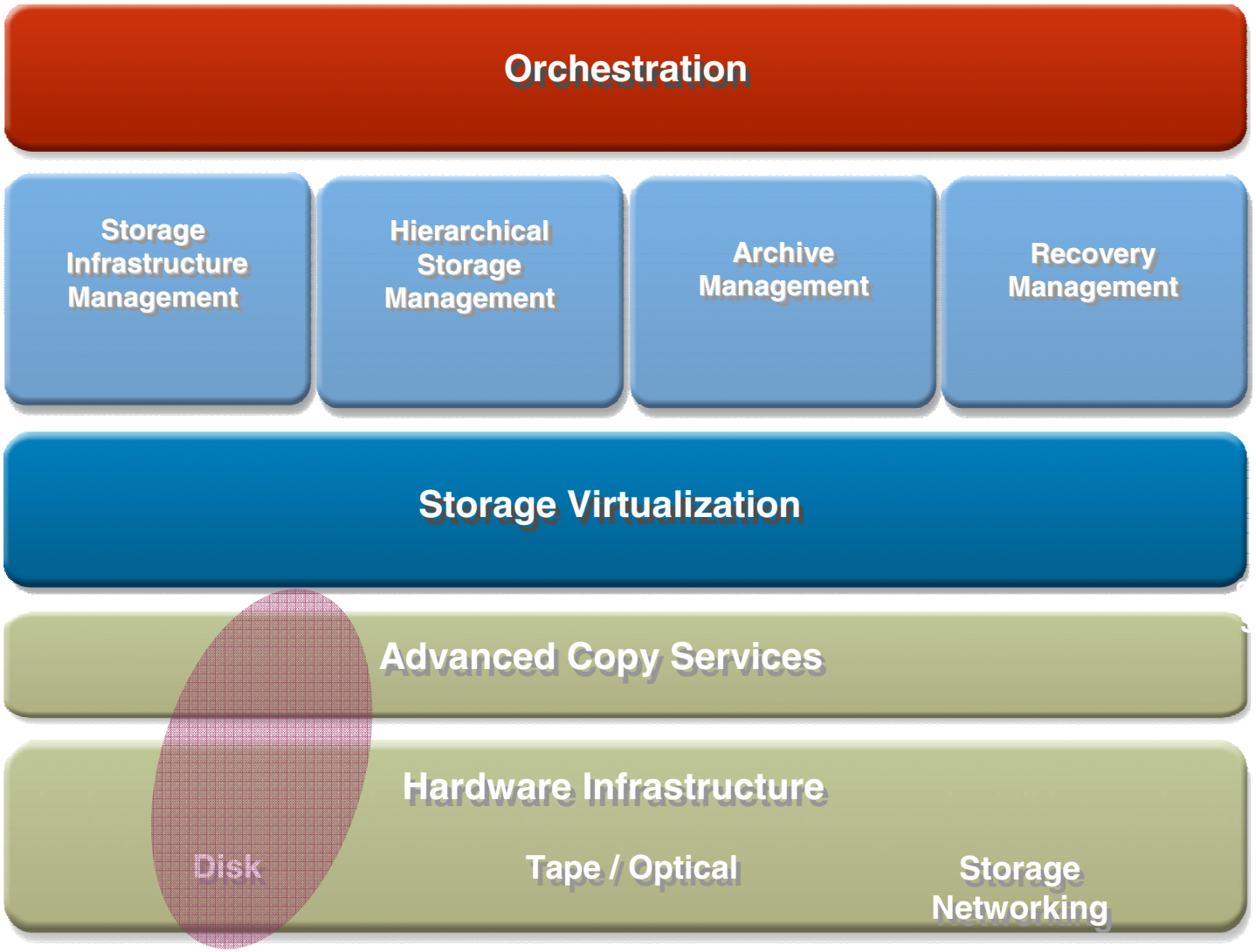
- **Gigabytes** (10*9) (Billion) of disk storage - small customers
- **Terabytes** (10*12) (Trillion) of disk storage - most customers and many individuals
- **Petabytes** (10*15) (Quadrillion) of disk storage - several customers today!
- **Petabytes** (10*15) (Quadrillion) of tape storage - large customers
- **Exabytes** (10*18) (Quintillion) of tape storage - a few accounts by 2004
- **Zettabytes** (10*21) (Sextillion) WW digital data by 2004 - IDC
- **Yottabytes** (10*24) (Septillion) - How Long will it take?

ON DEMAND BUSINESS *can respond with flexibility and speed to any customer requirement, market opportunity, or external threat*

Getting there involves:

1. **Simplification of the underlying IT infrastructure and its management are required to support the changes in the business and lower cost and complexity**
2. **Assuring business continuity, security and data durability**
3. **Efficiently managing information over its lifecycle**

IBM TotalStorage Portfolio



Introducing the IBM TotalStorage DS Family

- Common management platform
- Common suite of copy services
- Virtualization
- Compelling price points
- Industry leading service and support

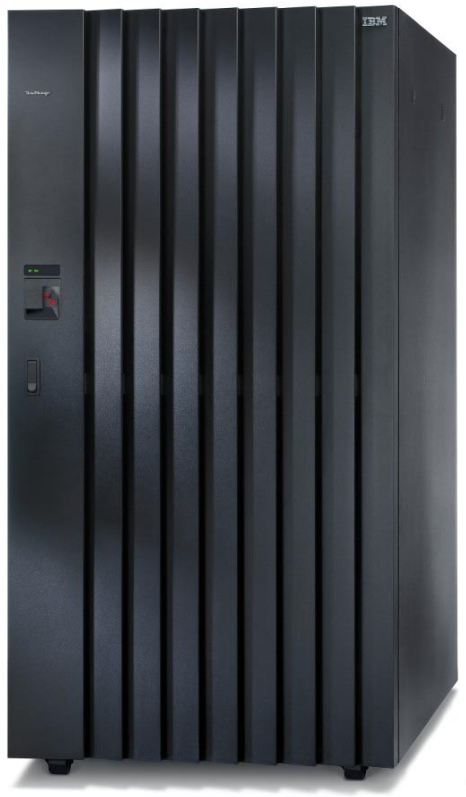
Enterprise Storage Continuum

IBM TotalStorage DS Family innovations help you:

- **Simplify** the underlying IT infrastructure of storage and its management to lower cost and complexity while increasing the ability to respond to changing needs.
- Assure **business continuity**, security and data durability.
- Efficiently manage information **throughout its lifecycle**, relative to its business value.

DS8000 Design Point

- Fastest storage controller
- Best reliability
  - –Projected 99.999+
- Competitive prices
- LPAR capabilities
  - –Multiple images today
  - –Storage applications in future



DS8000 Models

DS8100

Model 921

2 x 2-way P5 570 engines

Non-LPAR only

1 base frame, 1 optional expansion frame

DS8300

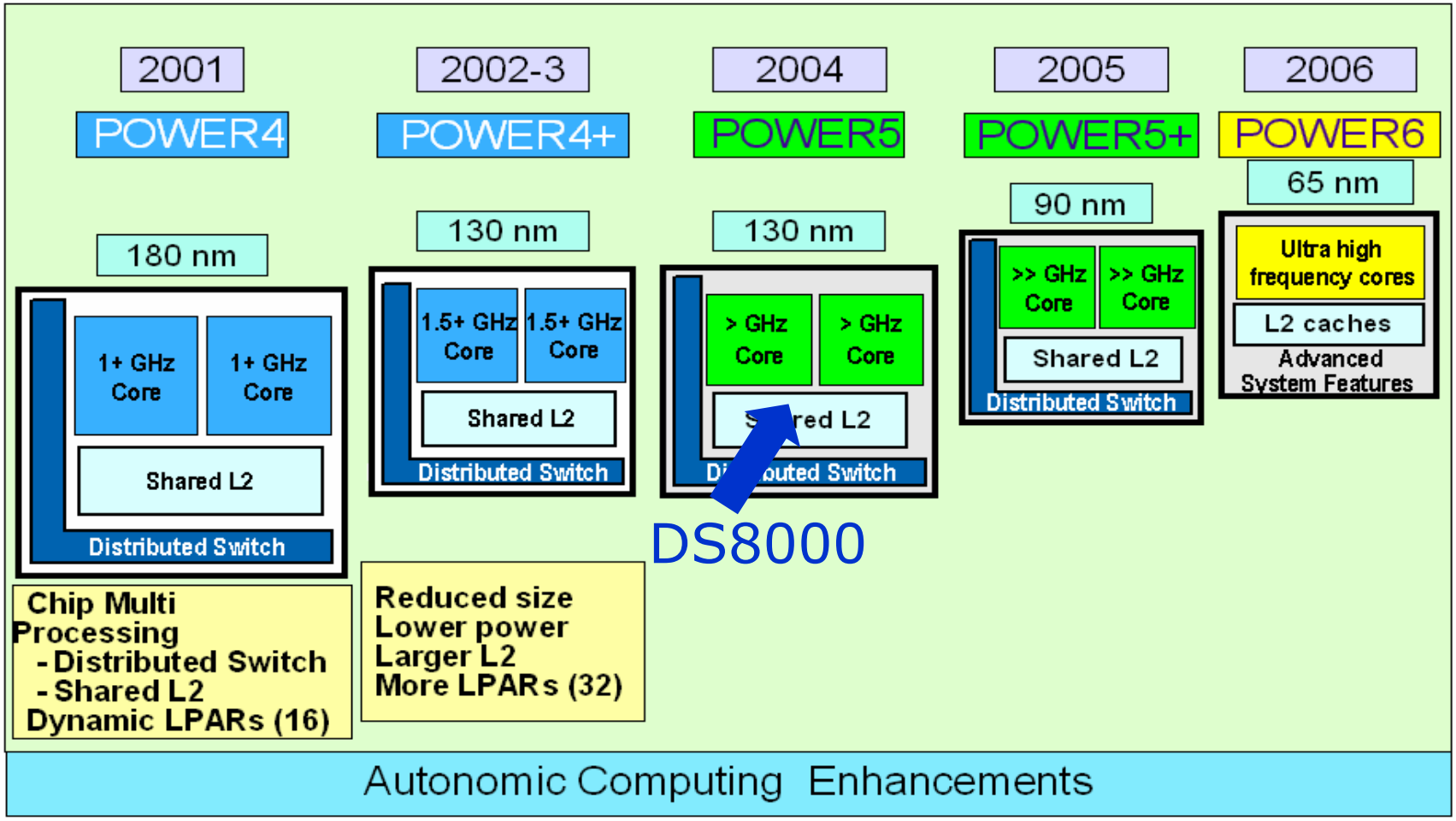
Model 922/9A2

2 x 4-way P5 570 engines

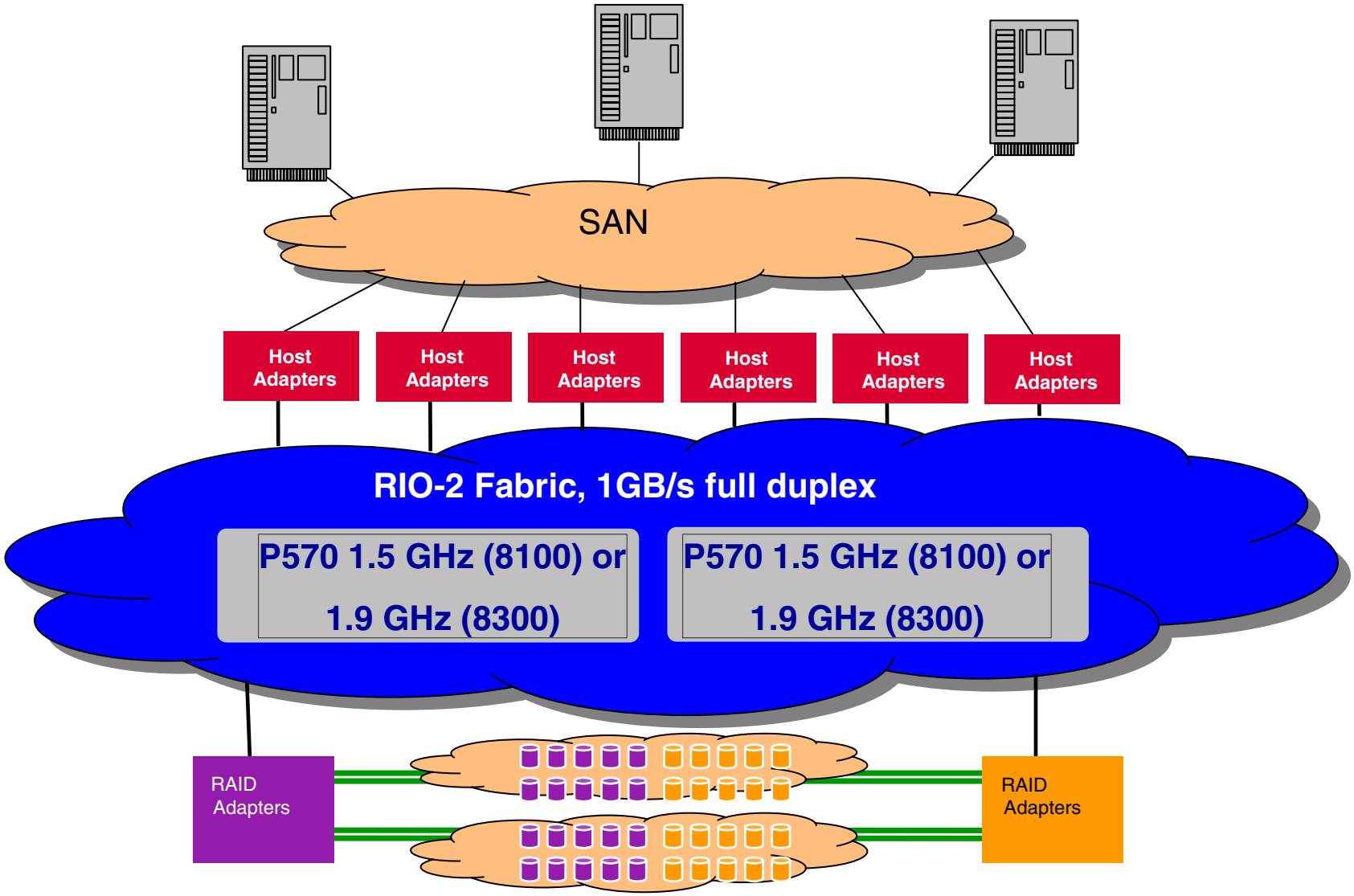
LPAR and Non-LPAR

1 base frame, 1 or 2 optional expansion frames

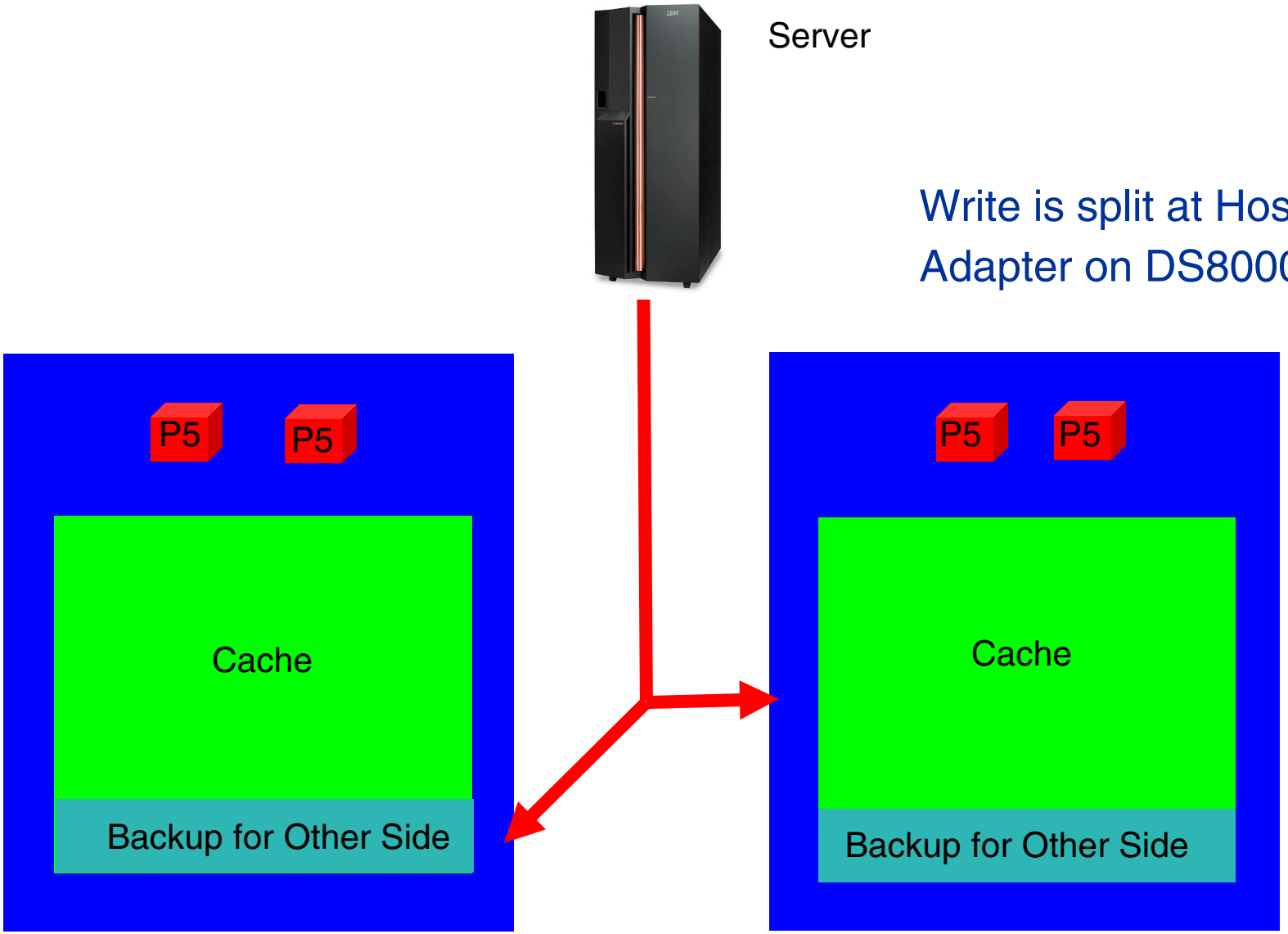
PowerPC™ Server Based Technology



General Topology – DS8000



Write Into DS8100-921 (two 2-way processors)



Dual Partition Customer Exploitation

- LPAR Available on DS8300 only
- Static Split At General Availability ("GA")
  - DS8300 is split 50-50 into two logical images
- Service providers can use to give separate image to
  - Customers
  - Business Units inside same company
- Dedicated partition resources to meet Service Level Agreements for critical applications

LPAR Future : Storage-Related Functionality

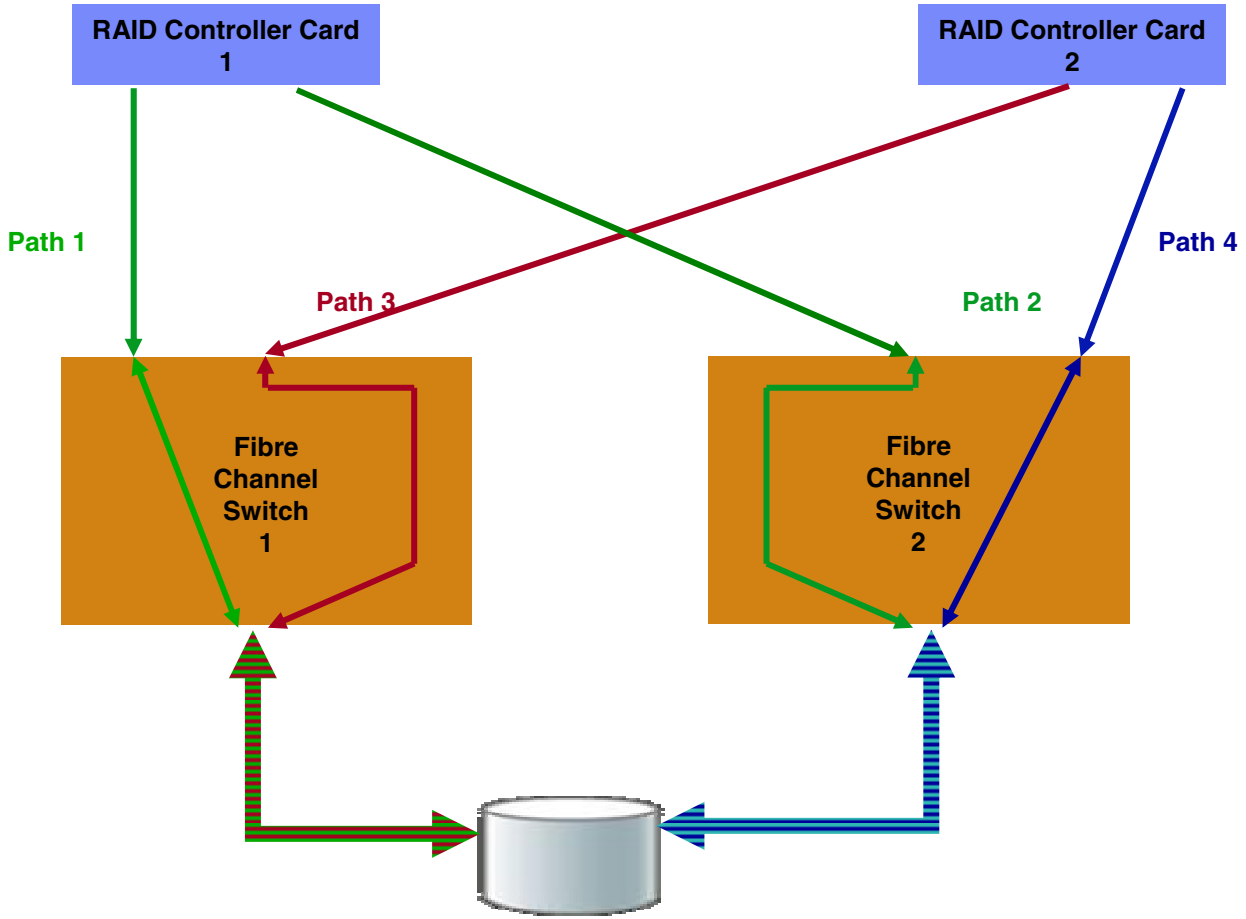
- Technology Demonstration – 26 JUL 2005
  - IBM Almaden Research Lab
  - Prashant Pandey and team
  - DB2 Running in DS8000 Application LPAR
- Customer Benefit
  - Economies of Scale (DS8100 -> DS8300)
  - Floor Space Reduction
  - Performance (under investigation)
- Customer Feedback Wanted
  - Applications
  - Size of partitions
- Field Release No Earlier Than 2H2006

Ficon vs ESCON - Characteristics

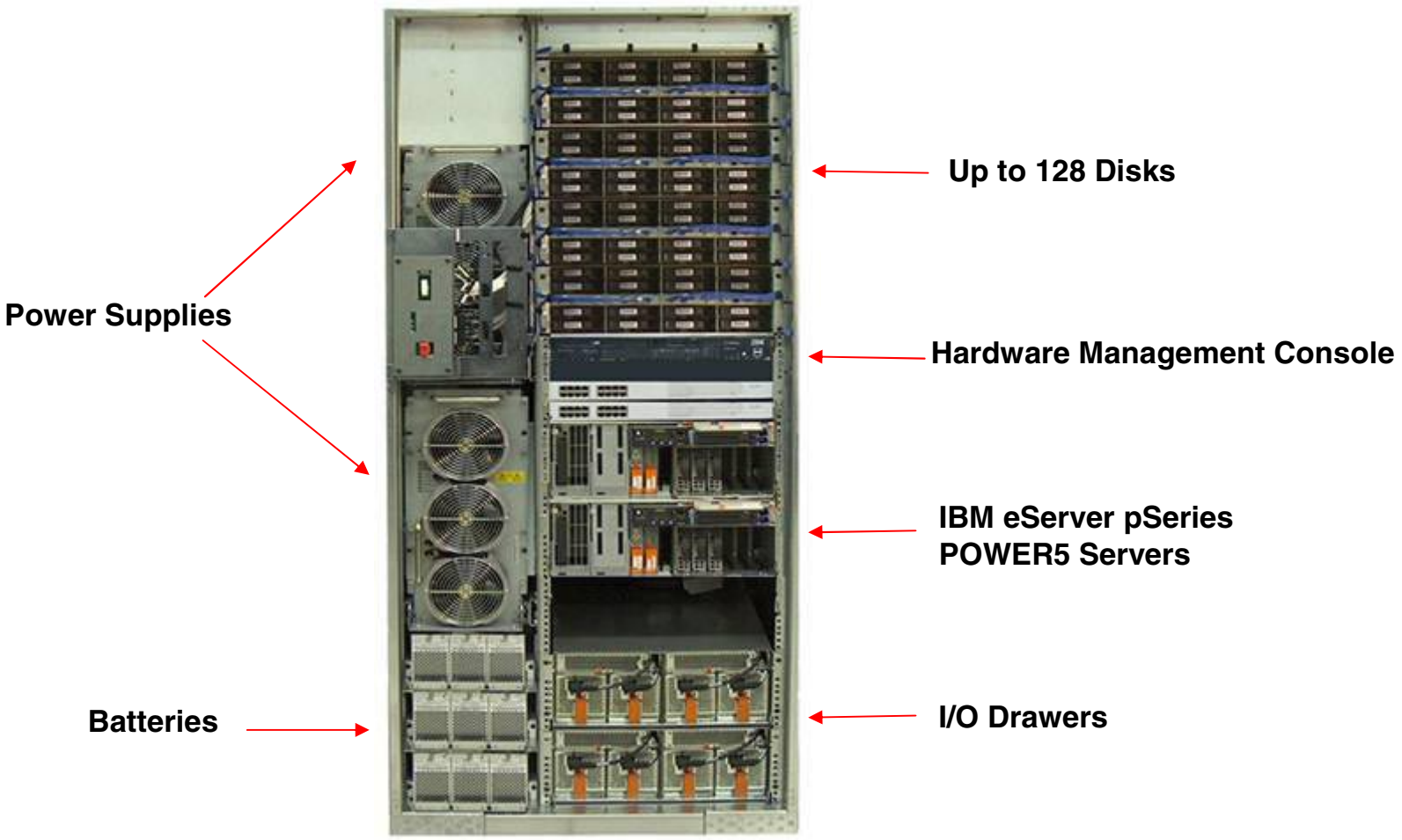
	FICON Express 2Gb-800	FICON Express 1Gb-800	FICON Express 1Gb-F20	FICON Classic 1Gb-F20	ESCON
Link data rate	200MB/s	100MB/s	100MB/s	100 MB/s	20 MB/s
Effective data rate	135MB/s	90+MB/s	UP to 70MB/s	Up to 70MB/s	Up to 17MB/sec
Max I/O Throughput	6500/s	6500/s	4800/s	4000/s	1100/s
Distance (no repeaters)	10 km	No data	10 km (20 w/RPQ)	10 km (20 w/RPQ)	3 km
Repeated Distance (no degradation)	100 km	No data	100 km	100 km	9 km

Four Data Paths To Every Disk

Drives are Fibre protocol, and all connections are Fibre



IBM TotalStorage DS8100 (2-Way)



Primary Frame – DS8000 (rear)

Hard Drives

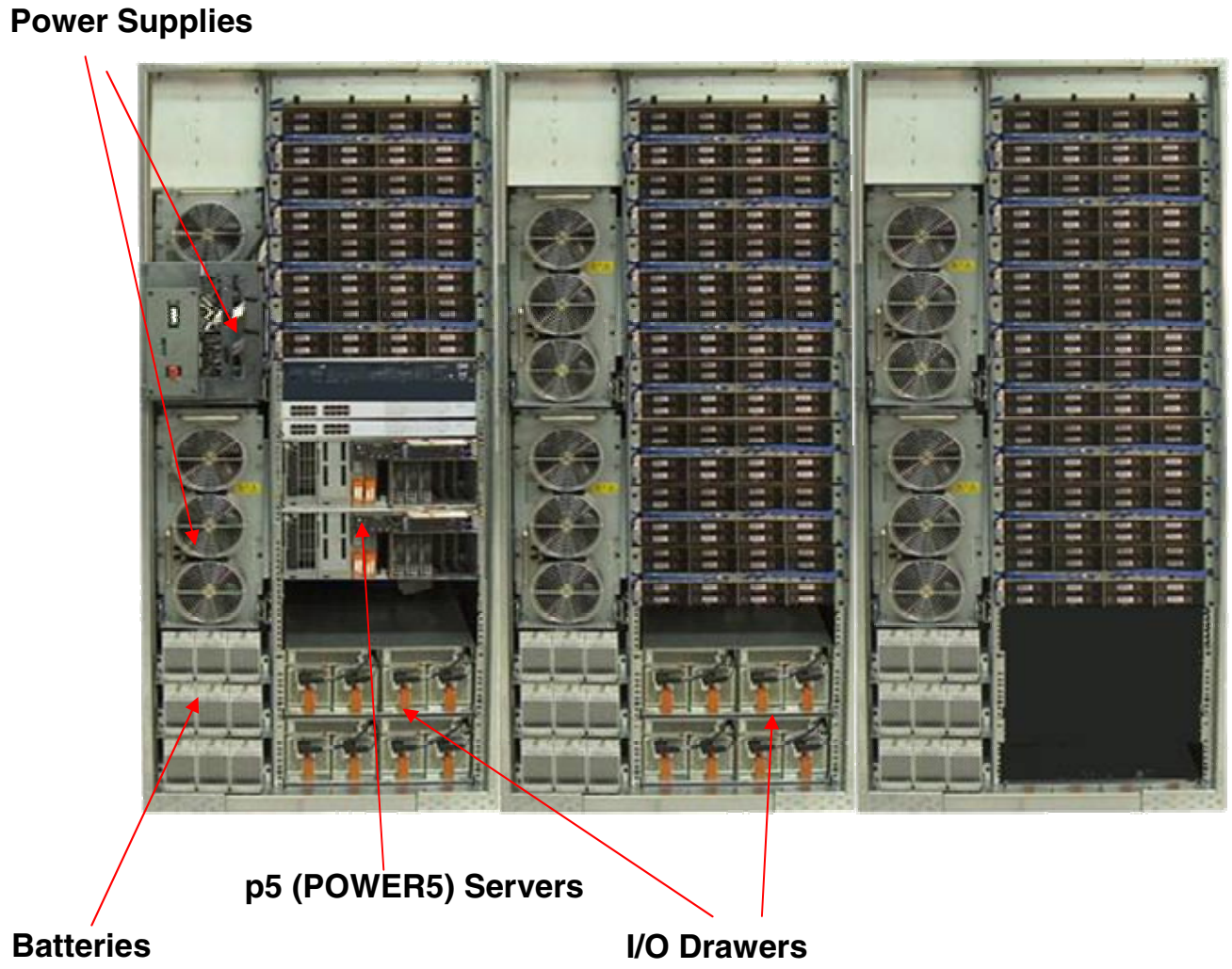
Fibre Channel Switches

4 I/O Bays

Host Adapter

Device Adapter

DS8300 (4-way with two expansion frames)



DS8000 – Model 8100

	2-Way	+92E expansion
Server Processors	2-way POWER5	
Cache	16 to 128GB	
Host Ports		
FICON® (2Gb/s) (4 ports per adapter) Fibre Channel (2Gb/s) (4 ports per adapter) ESCON® (2 ports per adapter)	8 to 64 8 to 64 4 to 32	
Device Ports (2 ports per adapter)	8 to 32	
Drives 72.8 GB (15K RPM) 145.6 GB (10K RPM) 291.2 GB (10K RPM)	16 to 128	16 to 384
Physical Capacity	1.2 to 38.4TB (usable 29.4TB)*	max 115TB (usable 90.5TB)*
Number of Frames	1	2

* = RAID-5, 300GB, open systems

DS8000 – Model 8300

	4-Way	+ one 92E or 9AE expansion	+ two 92E or 9AE expansion
Server Processors	4-way POWER5		
Cache	32 to 256 GB		
Host Ports			
FICON® (2Gb/s) (4 ports per adapter) Fibre Channel (2Gb/s) (4 ports per adapter) ESCON® (2 ports per adapter)	8 to 128 8 to 128 4 to 64		
Device Ports (2 ports per adapter)	8 to 64		
Drives 72.8 GB (15K RPM) 145.6 GB (10K RPM) 291.2 GB (10K RPM)	16 to 128	144 to 384	400 to 640
Physical Capacity	1.2 to 38.4TB (usable 29.4TB)*	max 115TB (usable 90.5TB)*	max 192TB (usable 149.3TB)*
Number of Frames	1	2	3

* = RAID-5, 300GB, open systems

DS8000 (compared to model 800)

	ESS 800	2-Way	4-way
Server Processors	2, 4, 6-way RS64-4	2-way POWER5	4-way POWER5
Cache	8 to 64GB	16 to 128 GB	32 to 256 GB
Write Cache	2GB	1-4GB	1-8GB
Host Ports			
FICON® (2Gb/s) (4 ports per adapter)	1 to 16	8 to 64	8 to 128
Fibre Channel (2Gb/s) (4 ports per adapter)	1 to 16	8 to 64	8 to 128
ESCON® (2 ports per adapter)	2 to 32	4 to 32	8 to 64
Drives	16 to 384	16 to 384	16 to 640
Physical Capacity	0.5 to 55.9TB (44.8TB)*	1.2 to 115TB (90.5TB)*	1.2 to 192TB (149.3TB)*
Number of Frames	1 to 2	1 to 2	1 to 3

* = RAID-5, largest drives, open systems

Capacity of 3390 Volumes

Real devices circa 1989
and defined to z/OS today

- 3390-3
  - –Bytes per track = 56,664
  - –Tracks per cylinder = 15
  - –Cylinders per device = 3,339
  - –Capacity = 2.8 GB
- 3390-9
  - –Bytes per track = 56,664
  - –Tracks per cylinder = 15
  - –Cylinders per device = 10,017
  - –Capacity = 8.5 GB

Fictitious devices, reported to z/OS
operating system as 3390-9

- 3390-27
  - – Bytes per track = 56,664
  - – Tracks per cylinder = 15
  - – Cylinders per device = 32,760
  - – Capacity = 27.8 GB
- 3390-54 (new 64K cylinder volumes!)
  - – Bytes per track = 56,664
  - – Tracks per cylinder = 15
  - – Cylinders per device = 65,520
  - – Capacity = 55.6 GB

Consider using 63441 cylinders (multiple of 3390-3)

Exploitation of Larger Volumes

Data can be migrated to/from larger volumes on a data set basis

DFSMSdss COPY DATASET

- DFSMSdss will use FlashCopy to migrate the data very quickly when volumes are on same storage subsystem

DFSMShsm MIGRATE/RECALL

- Also be used to migrate data to/from the larger volumes on a data set basis

Industry Leading Warranty Period

Purchase

End of warranty

2005…2006…2007…2008…2009

Hardware and Software!

Four years!

DS8300 Helps Set SAP Performance Record

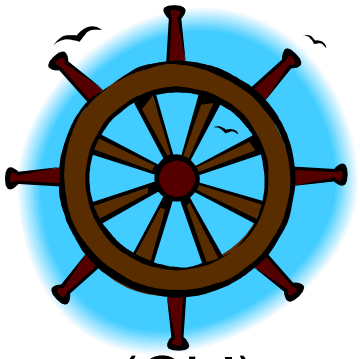
- IBM eServer® p5 595
- IBM DB2® Universal Database™
- IBM TotalStorage® DS8300
- Record result on three-tier SAP® Sales and Distribution (SD) Standard Application Benchmark

"Today's announcement demonstrates the leading performance and scalability of three of IBM's most advanced products – the p5-595 system, IBM TotalStorage DS8300 system and DB2 database software.

The POWER5 processor's overwhelming performance against the competition's fastest processors combined with the scalability of a DB2 version that is optimized for SAP applications make this system an unbeatable platform for SAP customers."

Volker Loehr, General Manager, Global IBM/SAP Alliance

Management of DS8000



Tools Shipped with DS8000

IBM TotalStorage DS Storage Manager

IBM TotalStorage DS Command Line Interface (CLI)

Note: CLI on DS8000 is slightly different from ESS 800

IBM TotalStorage DS Open API

Optional Tools

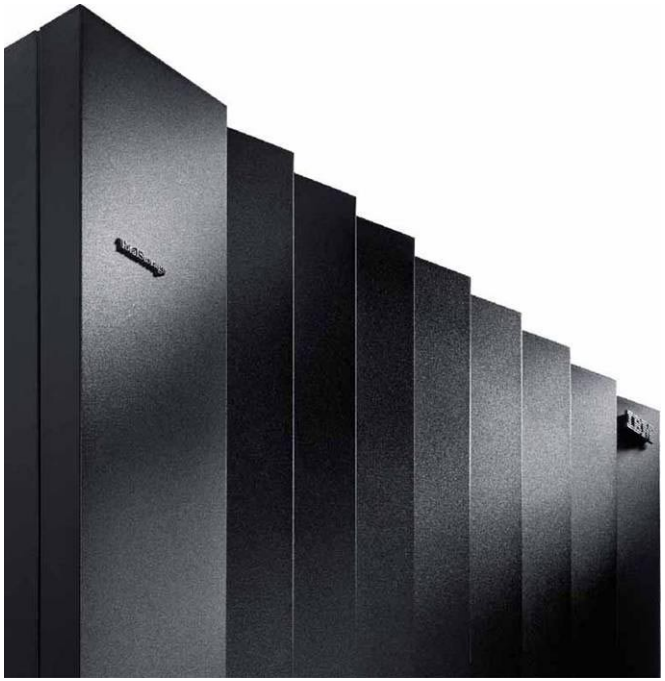
IBM TotalStorage Productivity Center Standard Edition

IBM TotalStorage Productivity Center for Replication

Any SMI-S compliant software

Function Licensing

- Sub-capacity licensing option for:
  - Point-in-time copy
  - Remote replication
- If the DS8000 is partially FB, and partially CKD, and function will be used only on one or the other
  - A license is required for the portion being replicated
- If machine is LPARed, then it's on a per-image basis



DS8000

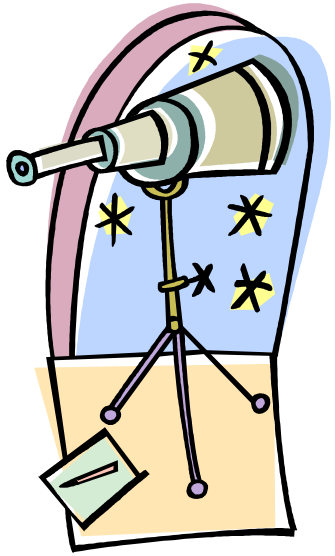
Standby Capacity on Demand

- For customers who want to do near-instantaneous capacity upgrade
- Order 1-4 sets of disks (16 disks in a set)
- Pay 1/10 of charge up front, agree to activate within a year
- To activate, download software key
- Pay remaining 9/10 (or less if price decrease)

Copy Services Decoder Ring

Industry Term	DS8000 Equivalent
Point in Time Copy	FlashCopy
Synchronous	Metro Mirror (PPRC)
Asynchronous	Global Copy (PPRC-XD)
Asynchronous with consistency	Global Mirror (open) or XRC (zSeries)

DS8000 Roadmap



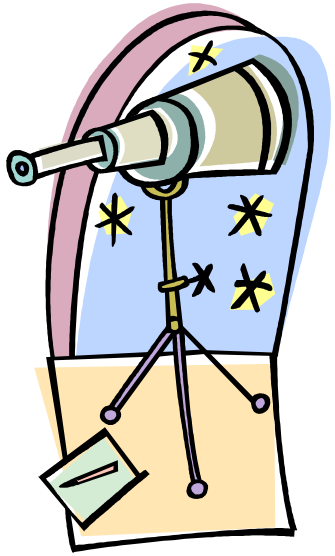
Following slides represent current outlook as of July 2005. Plans are subject to change…

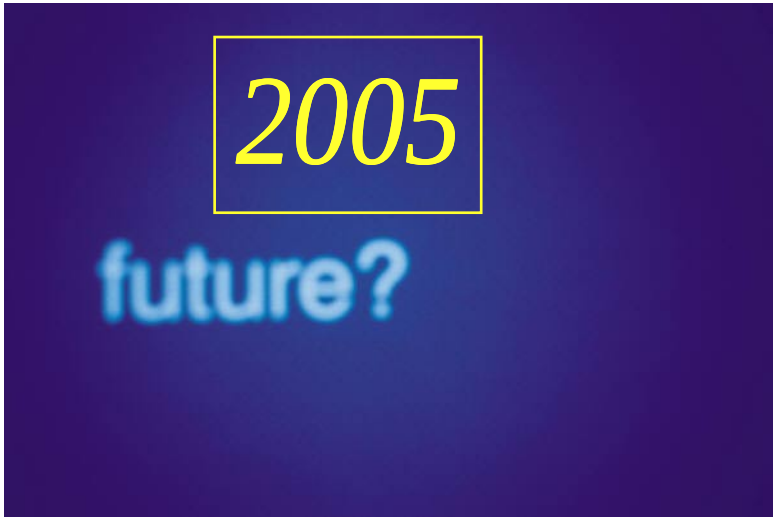
STATEMENT OF DIRECTION:

These statements represent IBM's current intentions. IBM development plans are subject to change or withdrawal without further notice. Any reliance on this Statement of Direction is at the relying party's sole risk and will not create any liability or obligation for IBM. Typically satisfied within 2 years.

All statements regarding IBM's plans, directions, and intent are subject to change or withdrawal without notice. Availability, prices, ordering information, and terms and conditions will be provided when the product is announced for general availability.

DS8000 Roadmap





- Refinement of installation process
- Three site business continuance solution (RPQ)
- 146GB 15,000 RPM Drives

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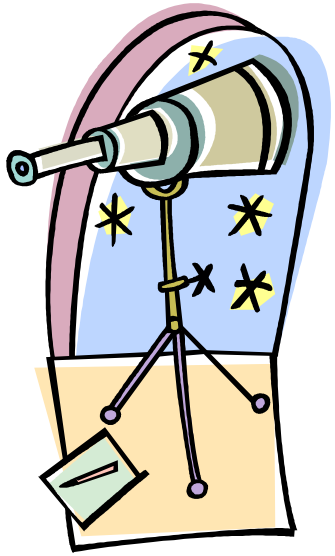
DS8000 Roadmap



2006

future?

- 8-way machine – additional capacity and performance
- LUN/Volume dynamic expansion
- Online data relocation
- Virtual capacity (over-provisioning)
- Space-efficient FlashCopy
- LPAR: Flexibility, storage applications in LPARs

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8-way System, currently in development

* Statement of Direction

DS8000 8-way

	8-way*
Server Processors	8-way POWER5
Cache	64 to 512 GB
Host Ports	
FICON® (2Gb/s) (4 ports per adapter) Fibre Channel (2Gb/s) (4 ports per adapter) ESCON® (2 ports per adapter)	up to 256 up to 256 up to 128
Device Ports (4 ports per adapter)	8 to 128
Drives 73 GB (15K RPM) 146 GB (10K RPM) 146 GB (15K RPM) 300 GB (10K RPM)	up to 1280
Physical Capacity	up to 384 TB
Number of Frames	2 to 6

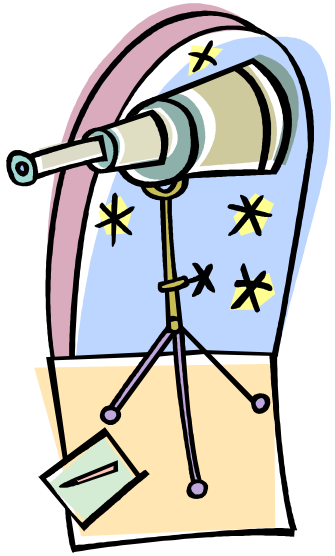
* Statement of Direction

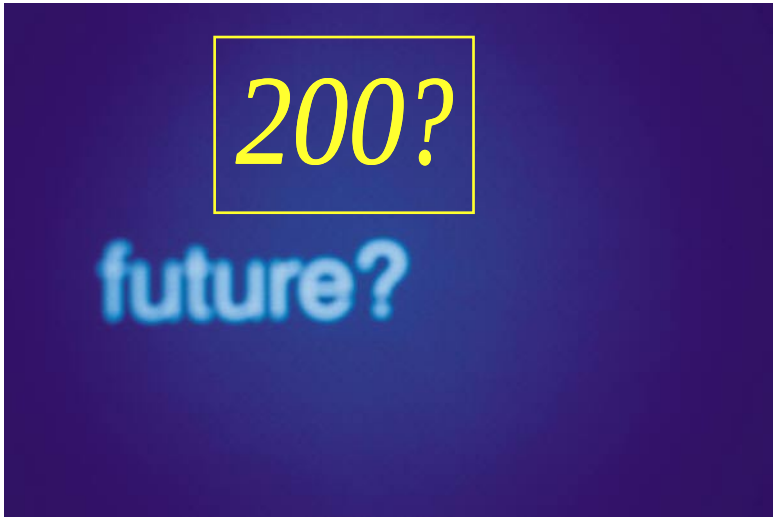
Single footprint scaling (Architecturally possible)

4096 Disks
1.2PB of 300GB disks

Architecture and addressing supports in excess of 96 PB

DS8000 Roadmap





4 Gb adapters	2006 most likely
ATA drives	2006 likely
10 Gb Ethernet adapters	Needs customer input
iSCSI adapters	Needs lots of customer input

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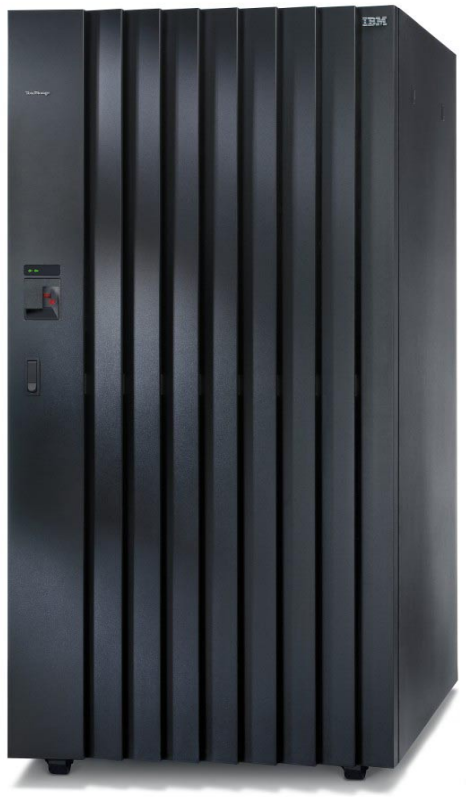
Conclusion

- Best storage controller on the planet
- Near 1000 sold to date
- Most in production
- Performance, already the best, will get better



Backup Charts for DS8000

Systems Attachment to DS8000 for Mainframes/Other

Non-IBM	IBM
Apple® OS X 10.3	z/OS V1 R4, R5, R6 z/OS.e V1 R4, R5, R6 z/VM V4 R4, V5 R1 z/VSE V2 R7, V3 R1 z/TPF V4 R1 z/SuSE SLES 8 “Submarine” OS/400 V5R2 i5/OS V5R3 i5/Red Hat RHEL 3.0 U3

Systems Attachment to DS8000 for RISC

Non-IBM

HP-UX
- 11i, 11iv2

HP-OpenVMS
- 7.3, 7.3-1, 7.3-2

HP-Tru64 Unix
- 5.0A, 5.1, 5.1A, 5.1B

Sun Solaris
- 8, 9, 10 (end of June 2005)

SGI IRIX
- 6.5.13/14/15/16/17

IBM

AIX
- V5.0, V5.1, V5.2,V5.3

HACMP
- V5.1.0/5.2.0

SUSE SLES 8,9

RHEL 3.0 U3

Systems Attachment to DS8000 for Intel

Non-IBM	IBM
RHEL 2.1, 3.0, 4.0 SuSE SLES 8, 9 Asianux •Red Flag Linux V4.1 •Red Flag Linux Advanced Novell NetWare 5.1, 6.0, 6.5 VMWare ESX 2.5.0/2.5.1 Windows 2000 (all) Windows 2003 (all)	Sorry, no OS/2

Disruptive Activities

Data May Not Be Preserved

- Model Conversions
- (2-way 8100 -> 4-way 8300, or 922 -> 9A2)

  *Customer action: move data off DS8000, or **purchase DS8300***

Data Is Preserved

- Attaching first expansion unit to DS8300 base unit

  *Customer action: consider **ordering empty expansion unit***

DS6000 Introduction

- Significantly smaller footprint than ESS 800 and competition
- 3.38 TB (FB, RAID5) in 3U height
- Ease of install and service use from IBM xSeries™
- Rack-mountable – excellent storage choice for IBM Bladecenter
- Replication to DS8000, ESS 800, ESS 750

DS6000 Series

- Currently only one member of the series - DS6800
- Machine type 1750, model 511 (control unit)
- Machine type 1750, model EX1 (expansion enclosures)
- Up to **5 expansion units** may currently be attached to a single control unit

Modular Architecture – Code Reuse

90%

ESS F20

ESS 800

75%

ESS 800

DS6000

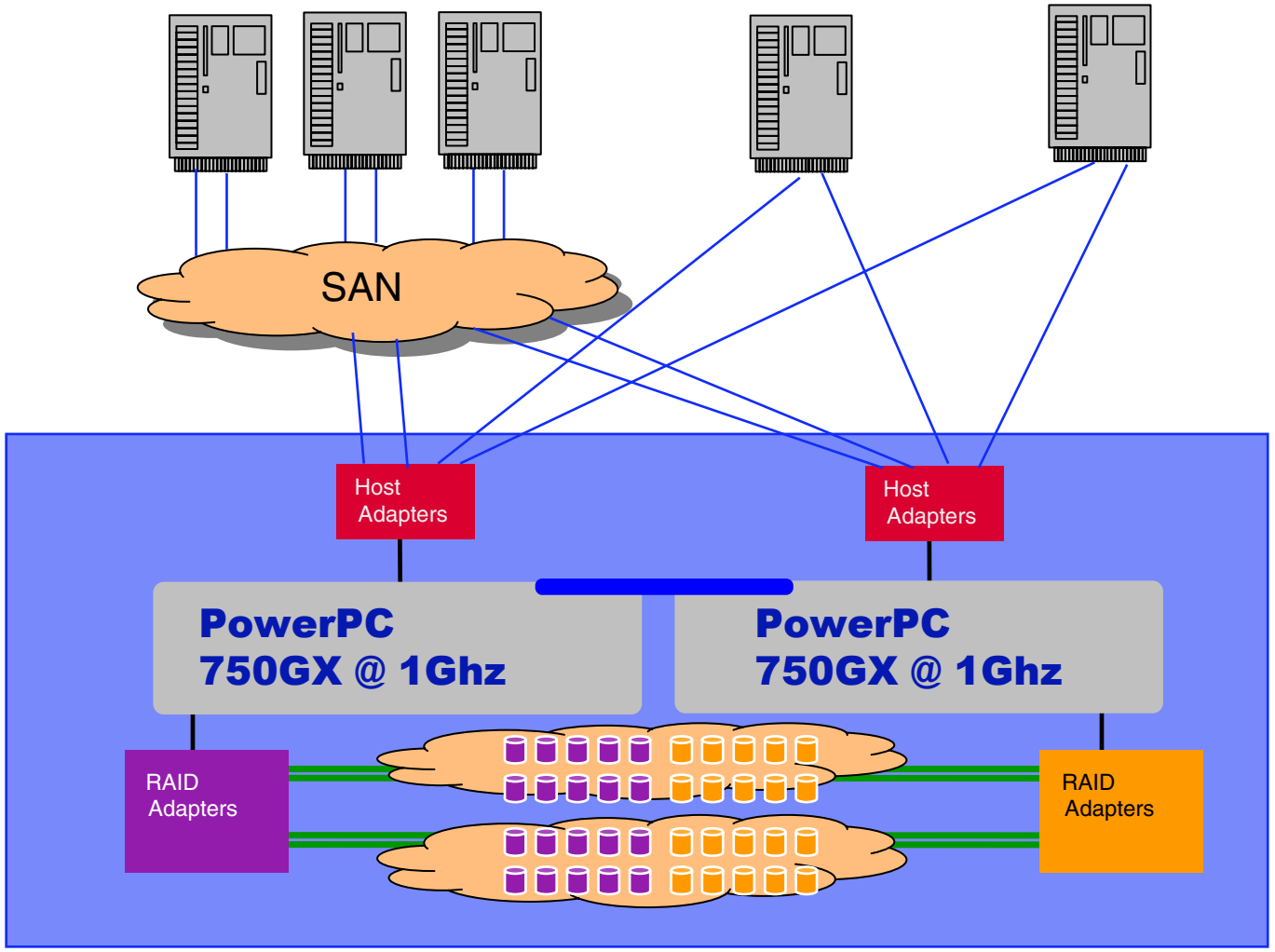
DS8000

Code Commonality

DS8000 **DS6800**

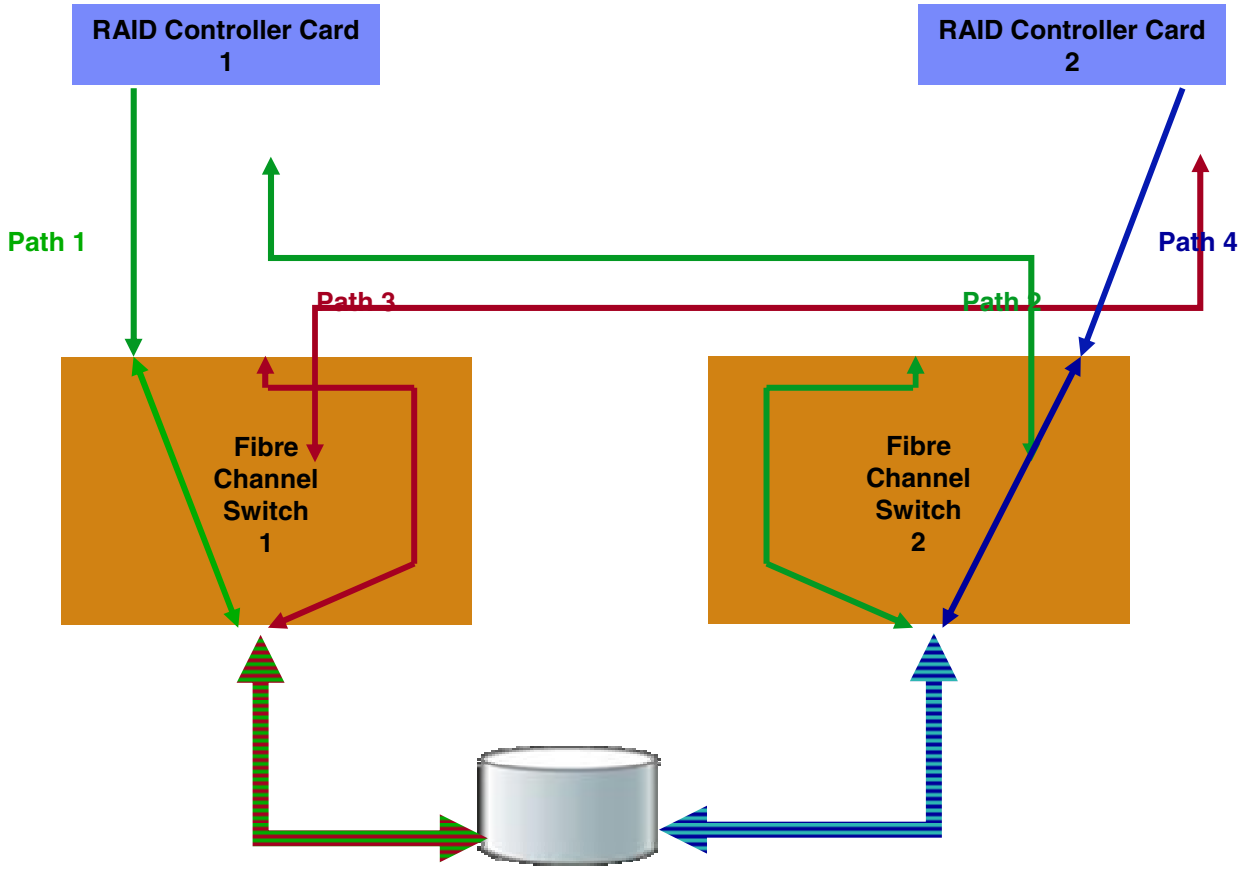
It's not merely compatible – it's the same

General Topology



Four Data Paths To Every Disk

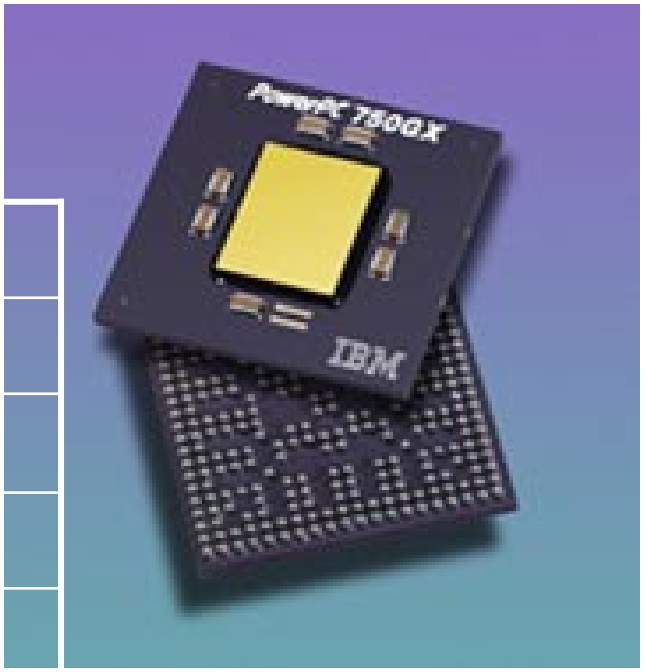
- Protections against single or multiple failures



DS6000 Processor

PowerPC 750GX at 1.0 GHz

Process	0.13 micron
Die Size	51.9 mm²
L3 Cache	4 MB
Power usage	~ 9.0W, 1.45V
Instruction size	32 bit



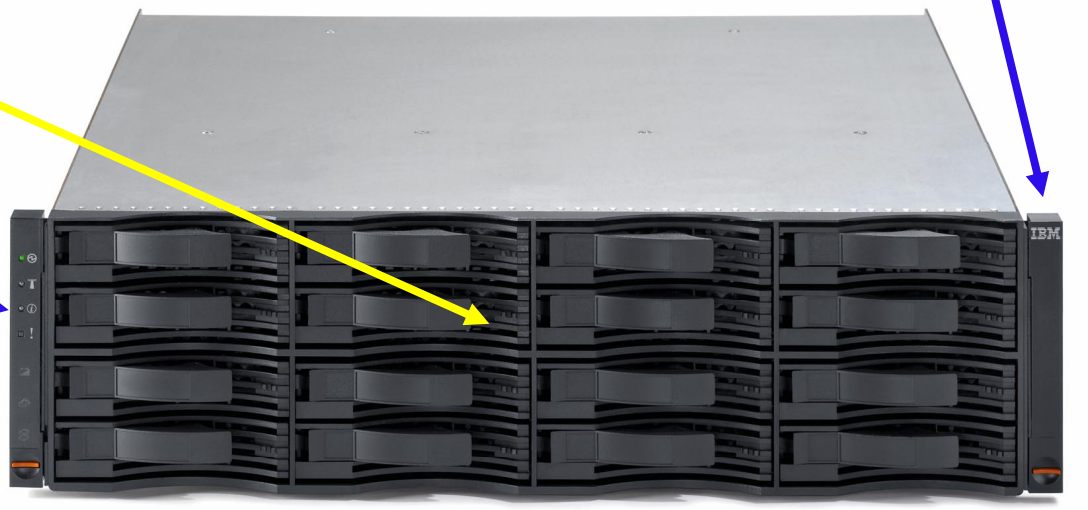
DS6000 Performance Considerations

- DS6800 performs very well in 7 – 14 TB configurations
  - Beats ESS 800 in many – but not all - performance metrics
  - Roughly equivalent to 800 for open
  - Use with caution in zOS environments
- Host Adapter
  - 206 MB/Second – Single Port
  - 778 MB/Second – 4 Ports
  - 155,000 I/O's/Second – 4 Ports
- Bus Interconnect
  - PCI-X Bus
  - Preferred Path to minimize interconnect bus traffic (Reads only, Writes always traverse cross-cluster)

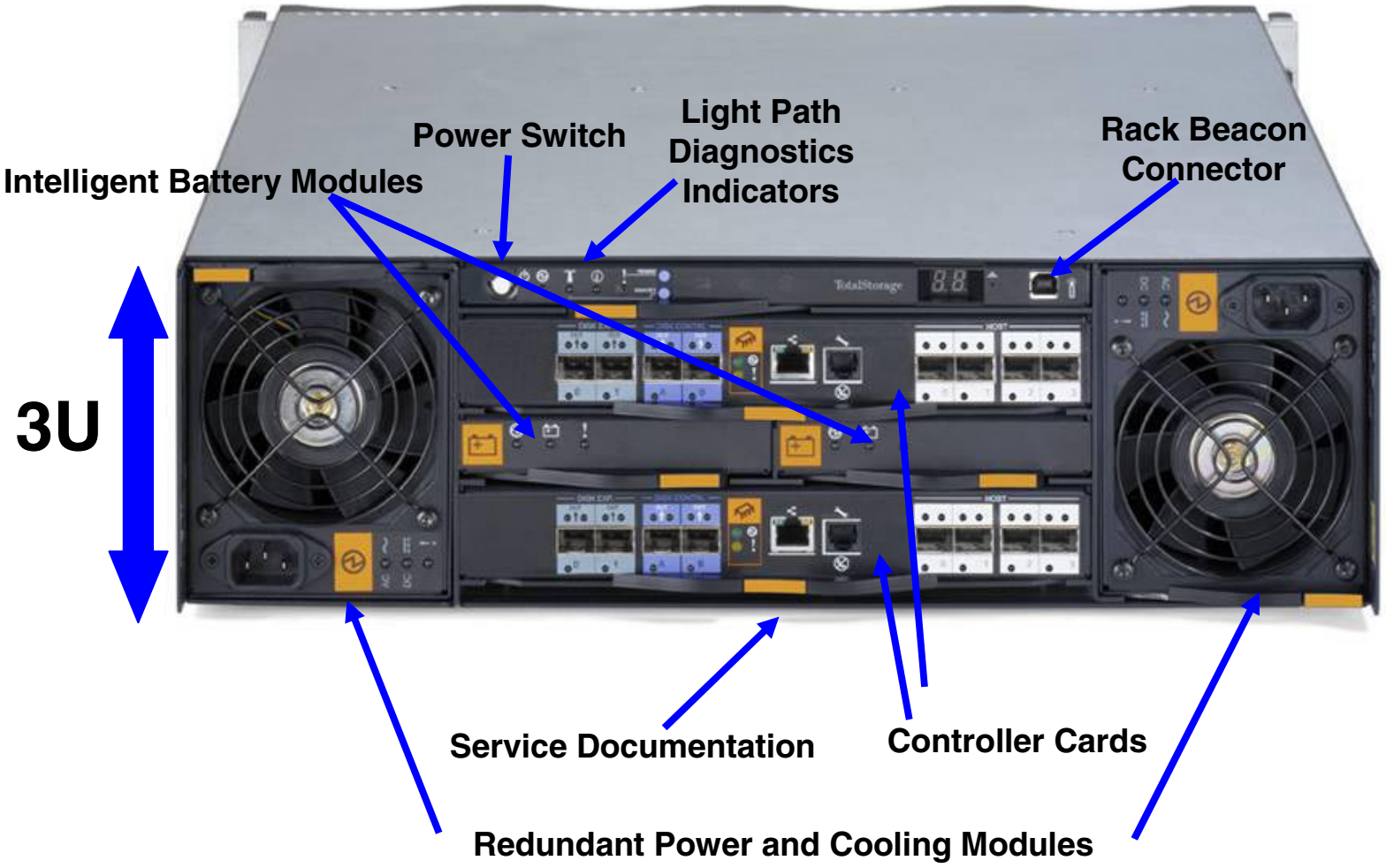
DS6000 - Front

145.6 and 291.2 GB 10K
72.8 GB 15K disks

Indicator panel



Rear View of the DS6000 Controller



DS6000 – Connectivity

8 Host Ports

FCP or FICON

- Short-wave (up to 300m)
- Long-wave (up to 10km)
- Auto-negotiate 1 or 2 Gbps
- FCP and FICON intermix

No ESCON

No SCSI

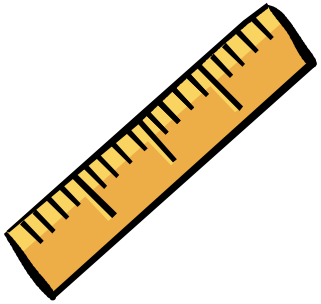
Mix FCP & FICON: 0/8, 2/6, 4/4

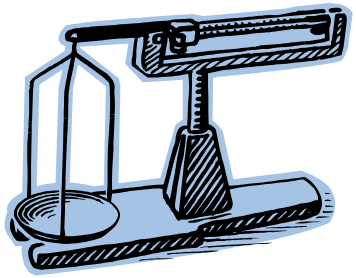
DS6000 – Addressing

	DS6000	DS8000
Hosts	128 per port (1024 max)	509 per port (unlimited max)
LSS	32	255
Volumes	8,192	65,280
Volume groups	1,040	8,320

DS6000 – Physical Specifications

Width: 478 mm (18.8 in)
Depth: 610 mm (24.0 in)
Height: 134 mm (5.25 in)
Weight (empty): approx 18kg (40lb)
Weight: 56.4 kg (124 lb)





Supported rack: IBM TotalStorage 2101-200 System Rack
- Also supported:
  - IBM 7014 RS/6000 Rack
  - IBM 9308 3 Netfinity Enterprise Rack
  - Any EIA 310-D Type A 19 inch rack

Industry Leading Warranty Period

Purchase

End of warranty

2005…2006…2007…2008 …2009

Four years!

Hardware and Software!

Standard Service Terms and Conditions

- CRU = Customer Replaceable Unit
- Replacement all parts is customer responsibility, with exception of midplane (which will be done by IBM at no extra charge)
- CRU shipment is next-day, where available
- Some defective CRUs must be returned within 30 days
- On-site Service for midplane:
  - 9 hours per day, Next Business Day, Monday – Friday (excluding holidays)

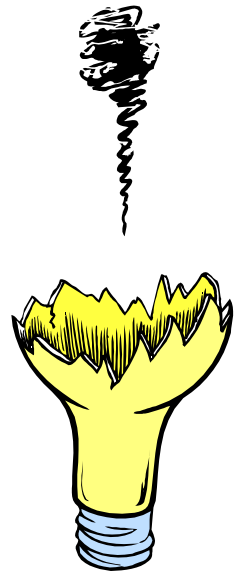
Other Service Options

- Service upgrades are available from IBM
- Business partners can provide additional services

Service Upgrades from IBM

Hours	Days	Average Onsite within
9x5 IOR	M-F	4 hours
24x7x4 IOR	All	4 hours
24x7x2 IOR	All	2 hours

Customer-replaceable Parts



- Battery Backup Unit + blanks
- Power supplies
- SFPs (Small Form Factor Pluggable)
- Display & Operator panel
- Processor cards
- Disk drive modules + blanks
- Fiber optic & Ethernet cables
- Serial communications cable
- Power cords

DS Manager Console

Currently is Windows based, customer supplied PC

- At least 1.4 GHz Pentium 4
- Minimum 256 MB Memory
- Serial connectivity to your storage unit
- Code comes on CD

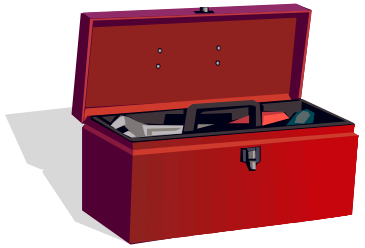
Operating Environments Supported

- Microsoft Windows 2000
- Microsoft Windows XP Professional
- Microsoft Windows 2000/2003 Server

Full range of ESS Copy Services

Industry Term	"IBM-speak"	DS8000	DS6000
Point-in-Time	FlashCopy	Yes	Yes
Synchronous	Metro Mirror	Yes	Yes
Asynchronous	Global Copy	Yes	Yes
Asynchronous w/consistency	Global Mirror	Yes	Yes
XRC	Global Mirror for z/Series	Yes	No
Synchronous + XRC	Metro/ Global Mirror for z/Series	Yes	Sync yes, XRC No

Product Tools



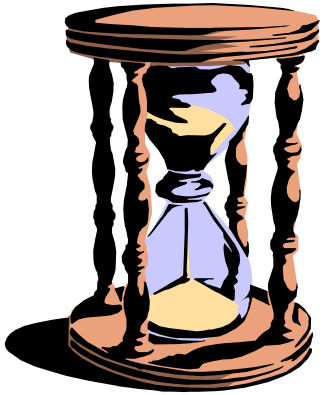
- IBM TotalStorage DS Storage Manager
- Command Line Script
- API

Optional Management Software

- Total Productivity Center's Replication Manager
- GDPS/RCMF (zOS and soon to be hetero z/OS-Open)
- PPRC Migration Manager (z/OS only)
- eRCMF (open and z/OS)

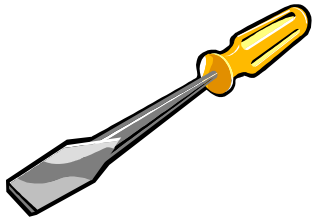
Customer Installation Time

- Targeted for 1 hour or less



Tools Needed for Installation

- 1 flathead screwdriver



DS6000 Service and Support

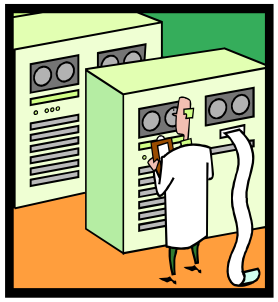
- Should problem occur, DS6000 has multiple ways to signal

SNMP alert

E-mail

Call home

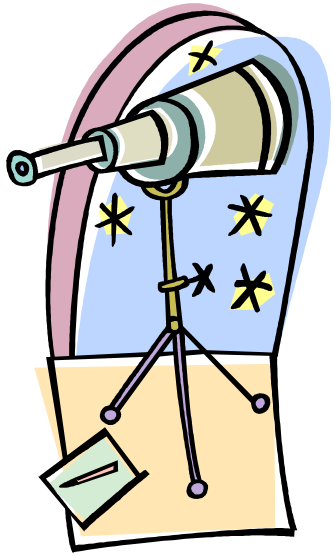
Announced 10 MAY 2005,
Available 30 JUN 2005

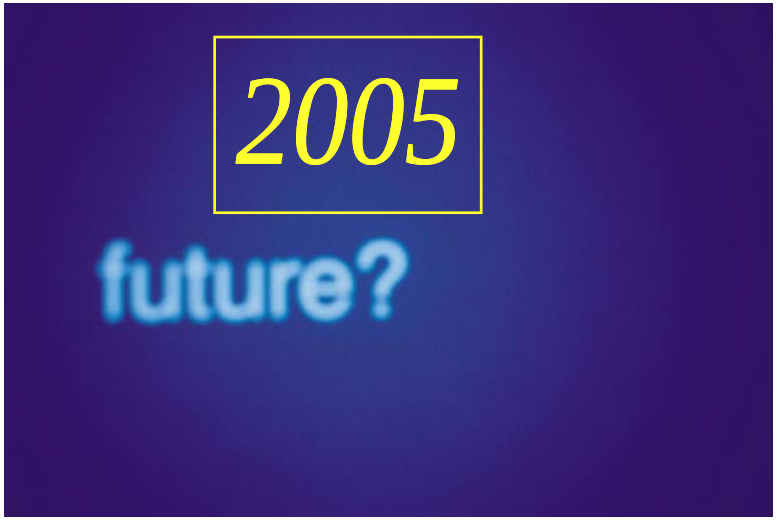


EREP (zSeries)

DS6000 Roadmap

Following slides represent current outlook as of July 2005. Plans are subject to change…

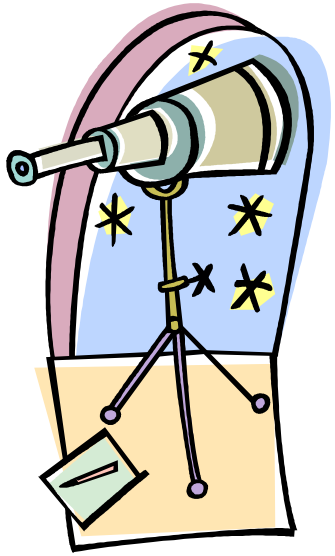




- Refinement of installation process
- Three site business continuance solution (RPQ)
- 146GB 15,000 RPM Drives

All statements regarding IBM's plans, directions, and intent are subject to change or withdrawal without notice. Availability, prices, ordering information, and terms and conditions will be provided when the product is announced for general availability.

DS6000 Roadmap



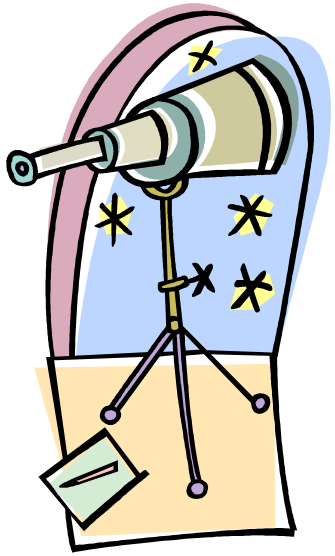
2006

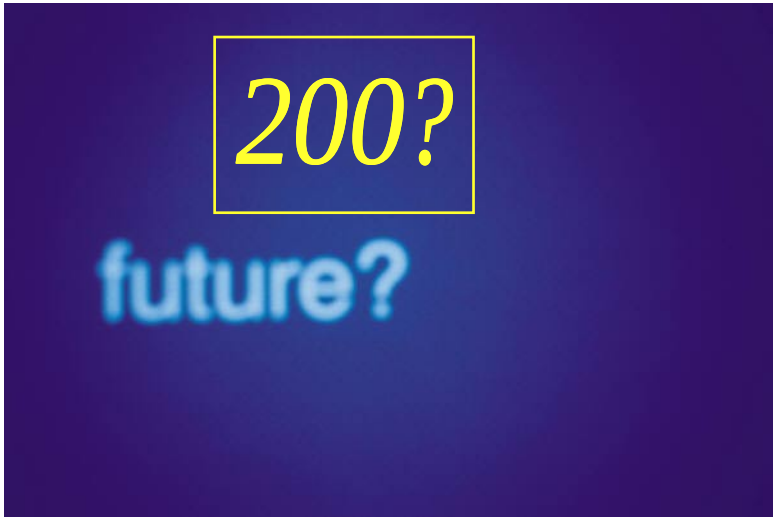
future?

- Performance boost
- ATA disk drives
- LUN/Volume dynamic expansion
- Space-efficient FlashCopy

All statements regarding IBM's plans, directions, and intent are subject to change or withdrawal without notice. Availability, prices, ordering information, and terms and conditions will be provided when the product is announced for general availability.

DS6000 Roadmap





- 4 Gb adapters
- 10 Gb Ethernet adapters
- iSCSI adapters
- RAID 6
- Online Data Relocation

general availability.

Information on the Web

- http://www.storage.ibm.com/
  - Click on “Disk Storage Systems”
  - Click on “DS6000”
- http://www.redbooks.ibm.com/
  - Search on “DS6000”

zSeries Attachment

z/OS V1R4,5,6

z/VM V4R4, V5R1

Linux for IBM @server zSeries SuSE SLES 8

TPF V4R1

z/VSE 40 YEARS VSE/ESA V2R7 & V3R1

pSeries Attachment

AIX V5R1,V5.2,V5.3

HACMP .1.0,5.2.0

Linux for IBM @server pSeries

SuSE SLES 8,
RHEL 3.0 U3

iSeries Attachment

i5OS V5R3

RHEL 3.0 U3

OS/400 V5R2

xSeries Attachment

Rack-optimised servers

HS20 Blade

Windows 2000/2003
RHEL 2.1, 3.0
SuSE SLES 8
Novell NetWare 5.0, 6.1,6.5
VMware ESX 2.1.1

Other Attachments

Windows 2000/2003
NetWare 5.0, 6.1,6.5
VMware ESX 2.1.1
Apple OS X 10.3

HP-UX 11i, 11iv2
HP OpenVMS 7.3,-1,-2
HP Tru64 UNIX V5.0A-5.1B
Sun Solaris 8,9, 10 (as of 30 Jun 2005)
RHEL 2.1, 3.0 on Intel
SuSE SLES 8 on Intel

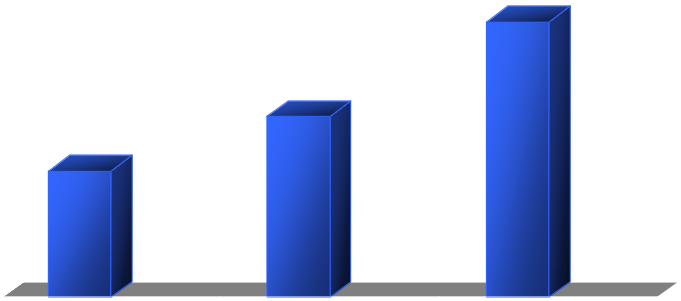
Summary of DS6000/DS8000

- Single Storage Model for the Enterprise Storage Continuum
- Reuse of Innovative Technology and Intellectual Property
  - POWER™
  - Calibrated Vector Cooling™, Light path diagnostics, etc.
- Massive Improvement in Performance/Addressability
- Scalability
- Moving into the sixth 9
- New capabilities e.g. LPAR, Integrated Controller
- While maintaining existing, mature and stable code.

Tape Marketplace Milestones

Gartner Dataquest 2001 – 2003 LTO Out Shipped DLT 2:1

IDC 2004 1st half - LTO Out Shipped DLT 3:1



Over 480,000 Shipped

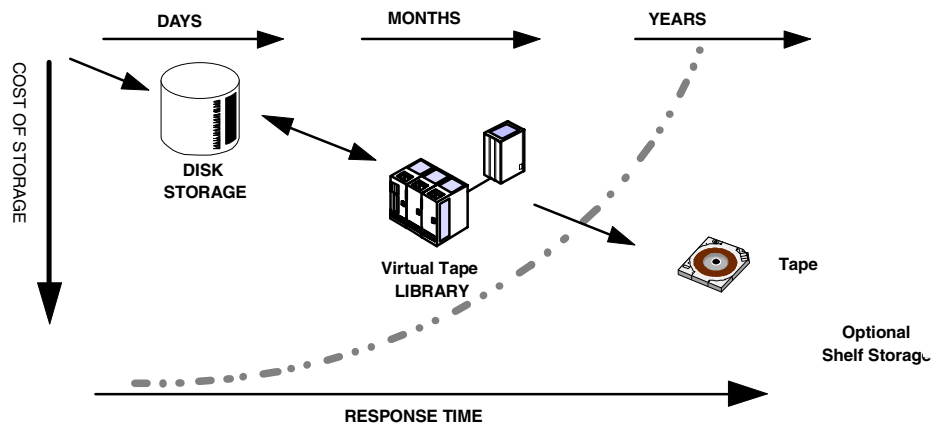
Over 110,000 Shipped

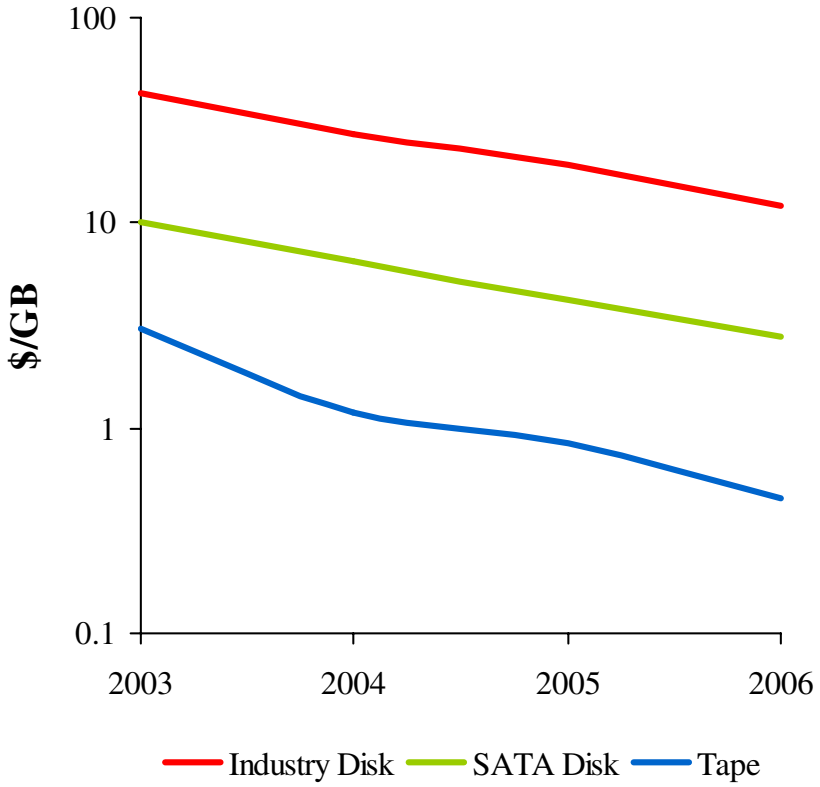
Over 16,000 Shipped

Over 3400 VTS
960 PtP
Shipped

Role of Tape in Storage Consolidation

- Typically not economically practical to store all data on disk
- Tape has "Infinite capacity"
- Removable
- Portability
- The lowest cost storage solution for the foreseeable future
- Long-term achievability
- Emerging Reference Data Applications





The right data at the right place at the right time

Based on IBM list prices of disk expected price declines and tape today, and

Drive Design Criteria

- LTO
  - Format and cartridge standard not a drive standard

    Drive specification written by LTO Technology Provider Companies (TPC)

    LTO TPC includes HP, IBM, Certance (Seagate)

    Drive specifications designed by committee
  - LTO compliant media from any vendor can be read in LTO compliant drives from any vendor
- 10/21/2004 - Quantum acquire Certance
- 10/25/2004 - LTO 3 WORM specifications defined
  - IBM GA 5/27/05
- 03/14/2005 - Tandberg acquired LTO drive manufacturer Info Stor
- 3592
  - IBM exclusive design

IBM Drive Basics

- LTO 3
  - –80 MB/sec
  - –280 MB/s with max compression
  - –400 GB native capacity
  - –Single port
  - –LUN 0 and LUN 1
  - –Ultra SCSI - LVD adapter
  - –FC fabric will auto negotiate to FC arbitrated loop
  - –2 Gbit will auto negotiate to 1 Gbit
  - –Supported in existing automation
- 3592
  - –40 MB/sec
  - –110 MB/sec with max compression
  - –300 or 60 GB native capacity
  - –Dual port
  - –LUN 0 and LUN 1
  - –No SCSI adapter
  - –FC fabric will auto negotiate to FC arbitrated loop
  - –2 Gbit will auto negotiate to 1 Gbit
  - –Supported in existing automation

Tape Drive Selection Criteria

- LTO
  - –Open system attachment
  - – High capacity
  - –Data streaming applications
  - –Write Intensive applications
  - –WORM
- 3592
  - –zSeries and Open attachment
  - –High capacity and fast access
  - –Start stop applications
  - –High recall rate
  - –WORM
  - –Silo attach

IBM Drive Common Features

- LTO 3 and 3592
  - Separate loading and threading motors with positive pin retention
  - Graceful dynamic braking
  - 128 MB buffer
  - WORM
  - Statistical Analysis and Reporting System (SARS)
  - Error correction code (ECC)
  - Auto channel calibration
  - Speed matching
  - Dynamic compressing
  - Flat lapped head
  - Surface control guiding

WORM cartridge media

- 3592 -Two new platinum colored WORM cartridges
  - 60 GB JR cartridge
  - 300 GB JW cartridge
- LTO 3 - New silver bottom cartridge
  - 400 GB capacity
  - Gen 3 only
- Designed to provide a non-alterable, non-rewriteable media

  Manufacturing imbeds WORM flags in SERVO tracks

  Low level encoding is written to the Cartridge Memory (CM)

  Low level encoding is written to the tape media {Wordwide Name}

  Unique Worldwide Name allows applications to track and validate subsequent access to records stored on the WORM cartridges

  - Allows appending

  to labeled or unlabeled files

  new labeled or unlabeled files

Drive Differences

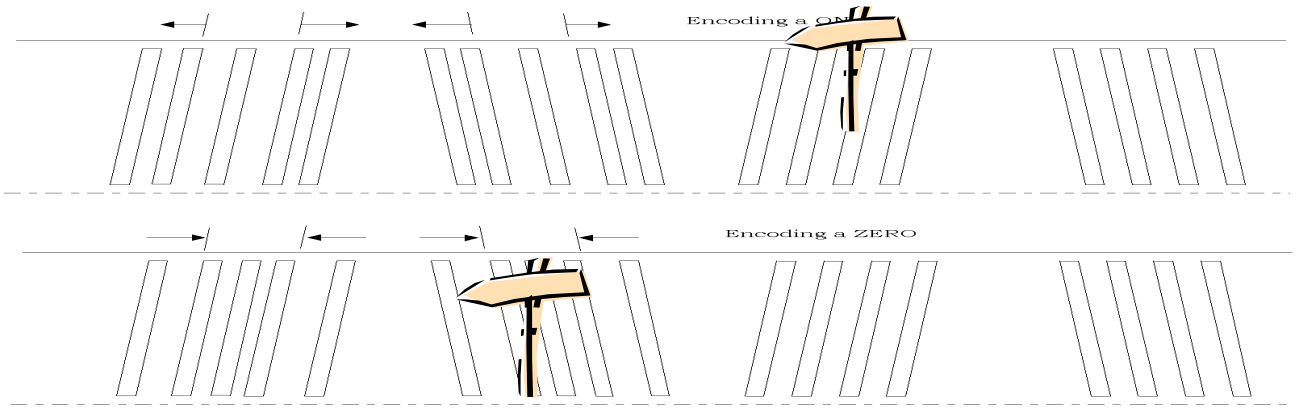
- Cartridge media
- Decreased locate time
- Scaling and Segmentation
- Cartridge Interchange
- Non-volatile caching (Virtual backhitch)

Cartridge Media

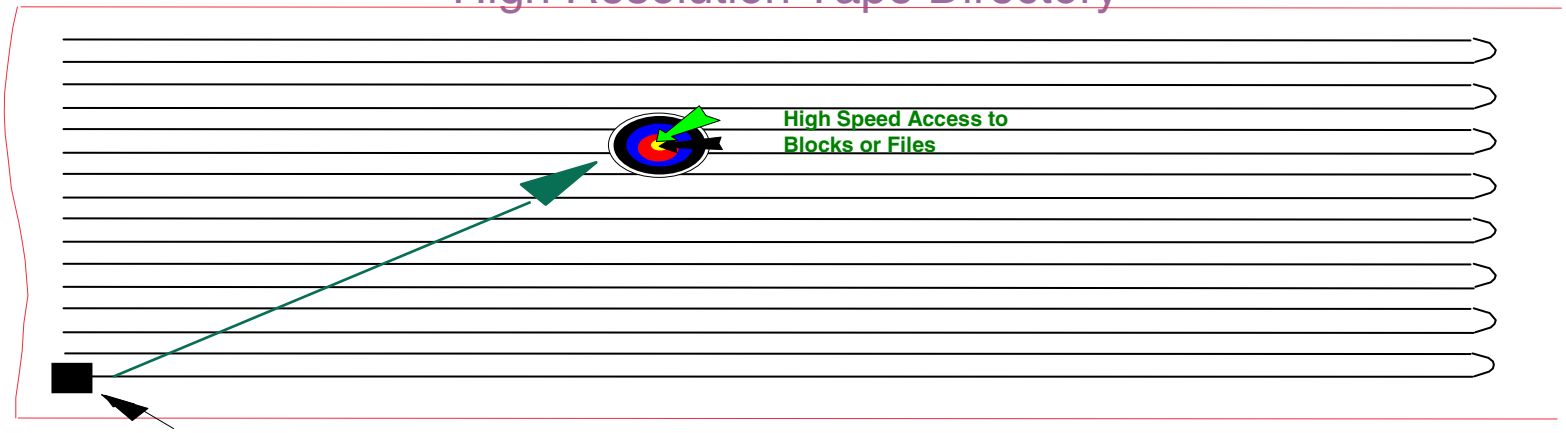
- LTO 3
  - Dual coated metal particle
  - 5 servo bands
  - Cartridge memory chip
  - Estimated 30 year archive life
  - 260 full file passes(11,440 single file)
  - 20,000 short length durability
  - 5000 load, unload
  - Warranty 5 years
- 3592
  - Dual coated metal particle
  - 5 servo bands
  - Cartridge memory chip
  - Estimated 30 year archive life
  - 300 full file passes(19,200 single file)
  - 40,000 short length durability
  - 20,000 load, unload
  - Warranty 10 years
  - WORM cartridge
  - Capacity scaling/segmentation
  - Designed to survive 1 meter drop

3592 - Decreased Locate Time

Longitudinal Position (LPOS)



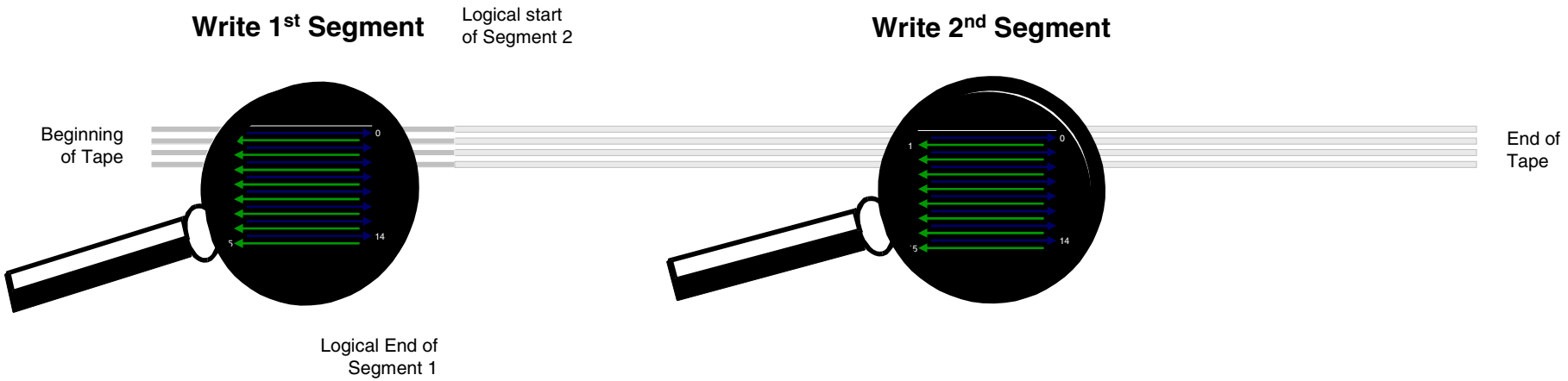
High Resolution Tape Directory



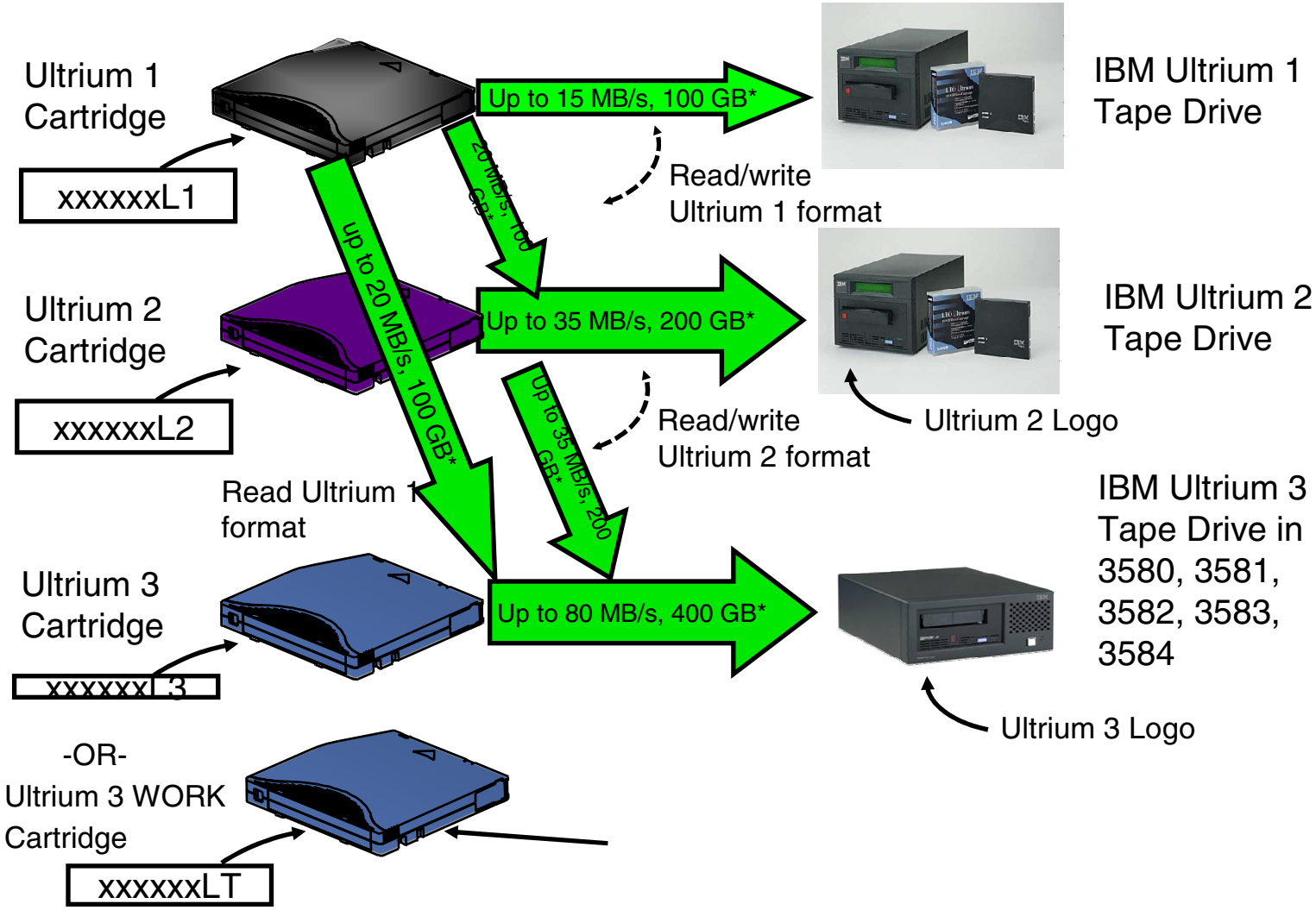
Volume Control Region
Device Block ID Map

3592 – Scaling and Cartridge Segmentation

- Invoked by Capacity Scaling settings
  - Dynamic support is planned for z/OS DFSMS
  - Support for open system environments requires ISV support
- The tape is initialized to create two segments
  - A fast access 60 GB segment
  - A high capacity 200 GB segment



IBM Ultrium 1,2, 3 and 3 WORM Compatibility



* Native sustained data rate, native physical capacity

3592 - Media Interchange

300 GB
40 MB/s

Gen 1

500-600GB

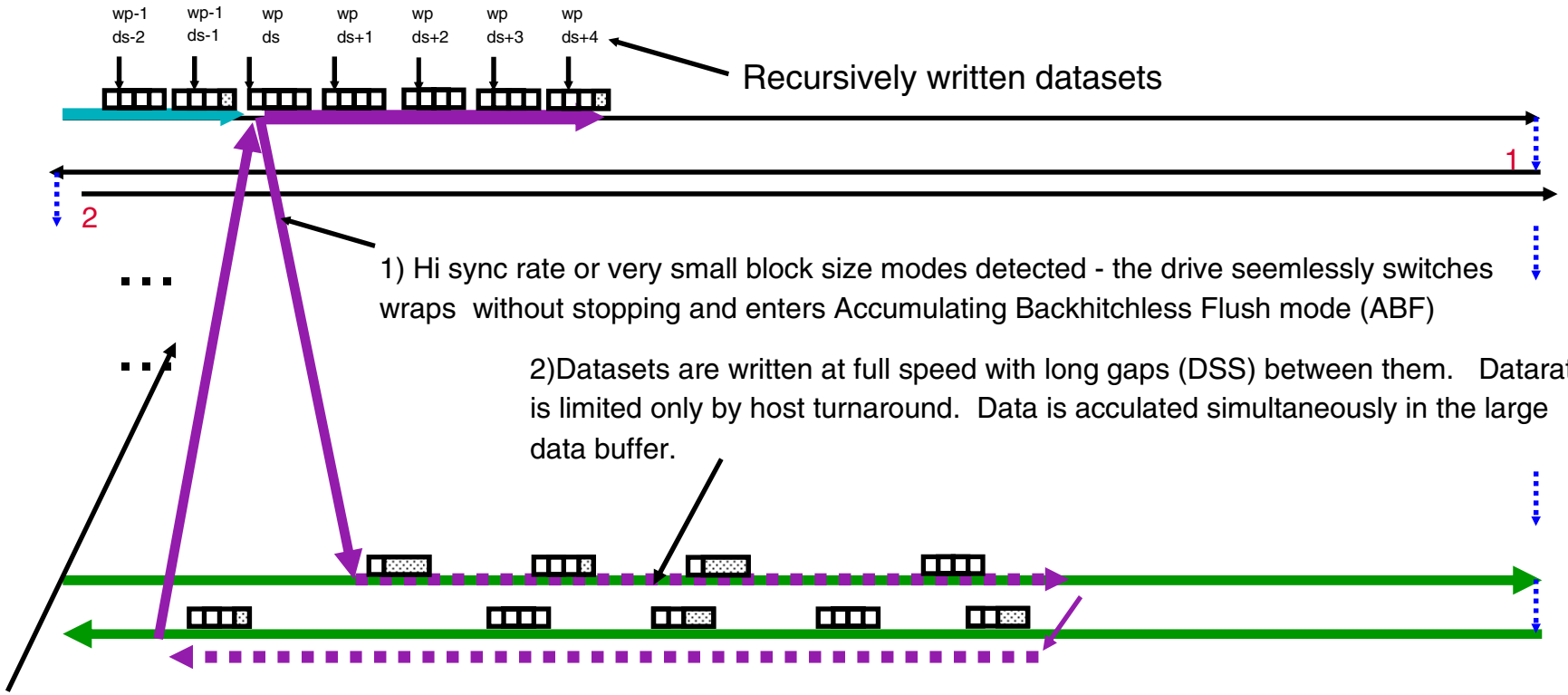
80–100 MB

Gen 2

Gen 3

* Product Road Map: These statements represent IBM's current intent, are subject to change or withdrawal, and represent only goals and objectives.

Non-volatile caching (Virtual backhitch)



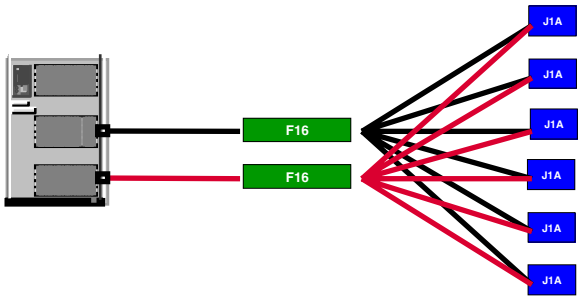
3) Drive returns to current active wrap and recursively writes accumulated datasets from buffer. Depending on host behavoir it may immediately re-enter ABF mode or stay in standard mode on the active wrap

Connectivity - Open System Attachment

- The LTO/3592 tape drive can be attached to FC-AL or FABRIC SANs

- Supported FC-AL and Fabric switches
  - Includes selected models from IBM, Brocade, McData, and others
  - Listed at
- Supported Operating Systems
  - Includes platform support for IBM, SUN, HP, Microsoft Windows and Linux
  - Listed at http://www.storage.ibm.com/tape/drives/3592/3592opn.pdf
  - Listed at http://

- SAN Support
  - Reduces resource requirements
  - Provides redundant paths
  - Supports extended distances



Connectivity - zSeries J70 Overview

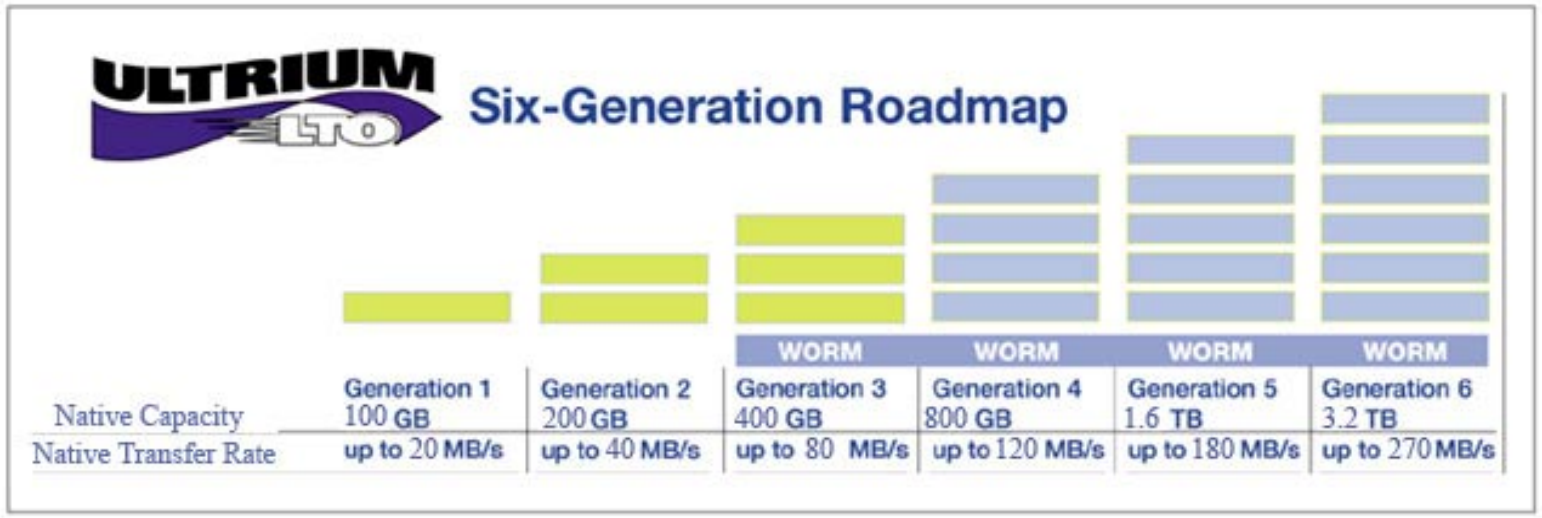
- Increased Performance
  - 2 X A60 write performance (400MB/sec)
  - 1.7 X A60 Read Performance (340MB/sec)
- Redundant Components
  - AC power
  - Power supplies
  - Fans
  - Mirrored HDDS
- Host Attachment- Non disruptive replacement
  - Max 8 ESCON attachments
  - Max 4 FICON attachments
  - Mix of ESCON FICON
- J70 Supports 3590 and 3592 fibre drive and SCSI 3590
- 3494 Drive Attachment
  - Max 16 3592 or 10 3590 drives to J70
  - Max 12 3592 drives to A60
- J70 supported in the same frames types as A60
  - 3494 D14, 3494 D24, 3590 C10, 3590 A14, and standalone rack
- No intermix of 3592, 3590 B, 3590 E, or 3590 H on the same J70

Connectivity - Support for SILO

- Silo attached 3592 J1A tape drive
- 20 drives in a 3592 C20 frame
- Same 3592 drive for 3494
- C10 A60/J70 Controller Attachment
- High Availability Power
- 1.8 Petabytes/silo

- Over 250 3592 installed WW
- Over 4000 3590 installed WW

LTO Tape Drive Roadmap



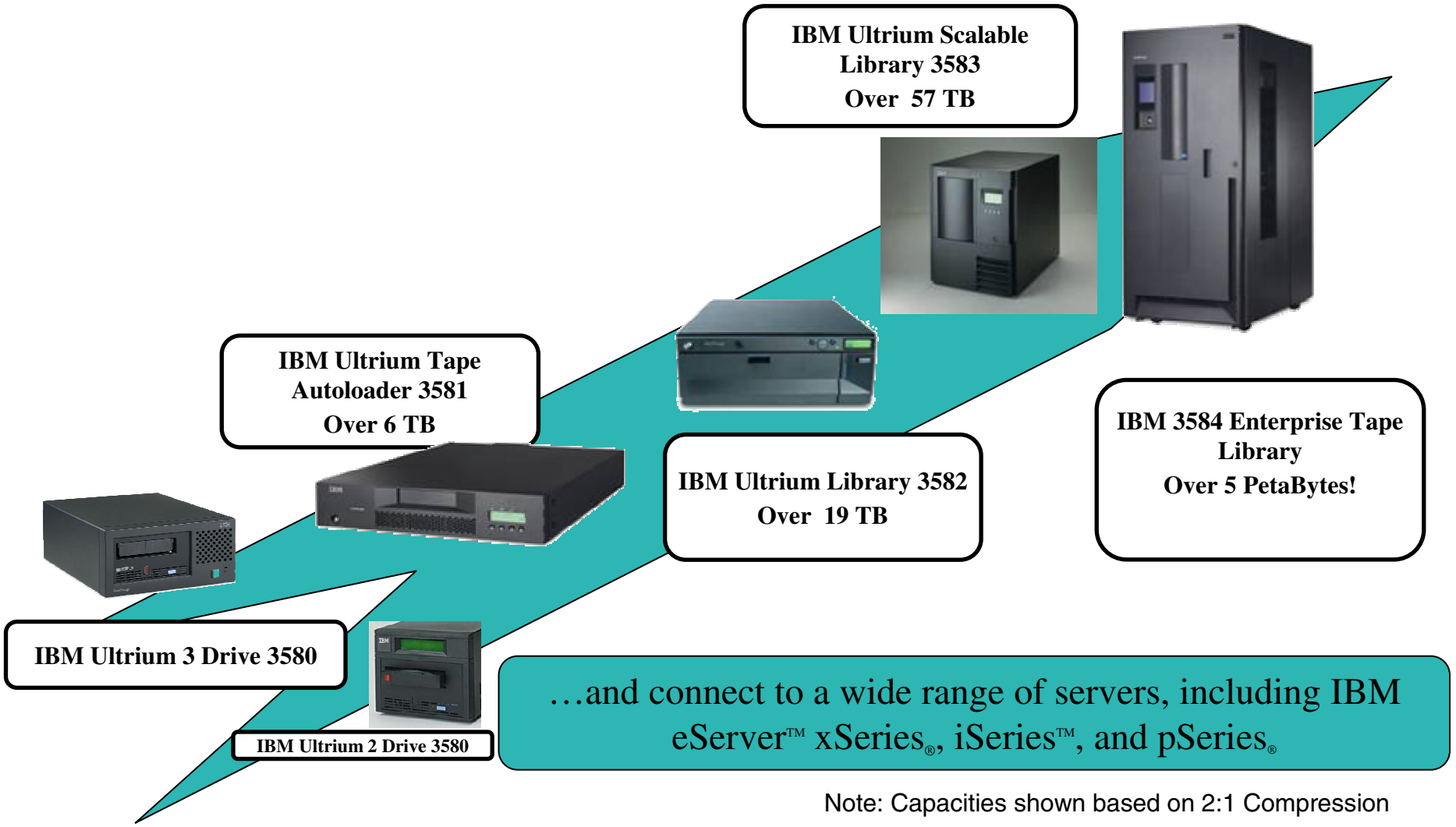
Product Road Map: These statements represent IBM's current intent, are subject to change or withdrawal, and represent only goals and objectives.

3592 Drive Roadmap

3592 Generation	1(J1A)	2	3
Supported Media Types	JA	JA	JA
Native Format	Jag-1	Jag-2	Jag-3
WORM	Yes	Yes	Yes
Scaling and Short cart support	Yes	Yes	Yes
Target Capacity Native format	300GB JA (Jag-1 fmt)	300GB JA (Jag-1 fmt) 500 - 700 GB JA (Jag-2 fmt)	300GB JA (Jag-1 fmt) 500 - 700 GB JA (Jag-2 fmt) 900GB-1.1TB JB (Jag-3 fmt)
R/W compatibility behaviors	Cannot R/W 3590 cartridges R/W Jag-1 format	R/W Jag-1 format R/W Jag-2 format	R/W Jag-1 format R/W Jag-2 format R/W Jag-3 format
Target Native streaming data rate	40MB/s	80-100 MB/s	120-160 MB/s
Host Attachment	Dual active FC-2 200 MB/s N and NL PORT	Dual active FC-4 400 MB/s N and NL PORT	Dual active FC ? ? MB/s N and NL PORT

Product Road Map: These statements represent IBM's current intent, are subject to change or withdrawal, and represent only goals and objectives.

IBM Family of Tape Products



Note: Capacities shown based on 2:1 Compression

3584 Tape Library Overview

L22 or L52 Frame

D22 and or D52

VTS
Models B10 or B20

Required for zSeries Attachment
Native 3592 or VTS

3953
Models F05 (up to 6 frames

HA1 Frame
(service Bay 'A')

1-16 frames +
HA1 frames

HA1 Frame
(service Bay 'B')

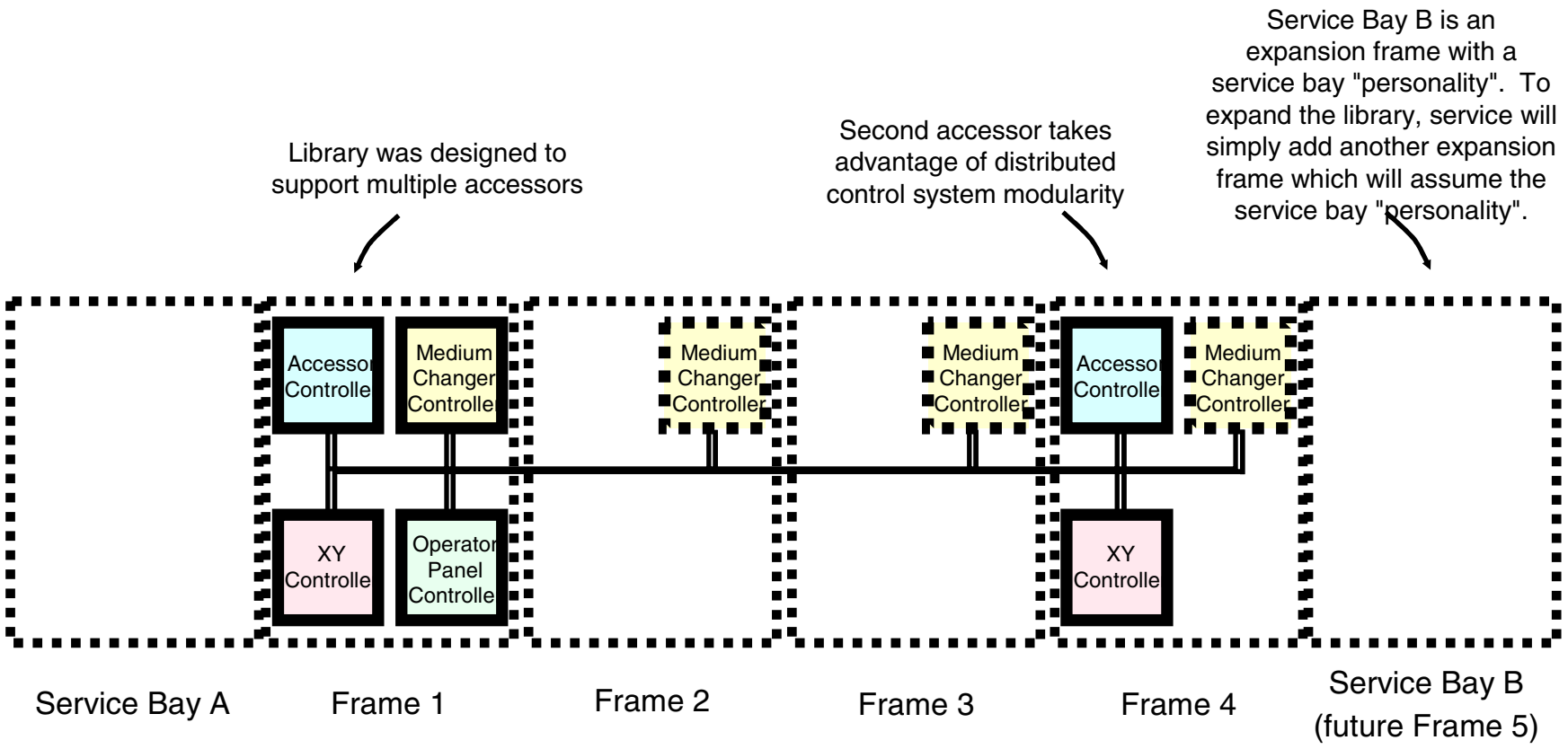
3584 Overview

- Third Generation Automation
- Open Systems Attached Library
  - Standard SCSI Medium Changer (SMC) commands
- zSeries Attached Library
  - Responds to PLF commands
- Open Systems and zSeries Attached Library
  - Can be partitioned to accept Open Systems SMC commands and zSeries PLF commands

IBM 3584 Tape Library

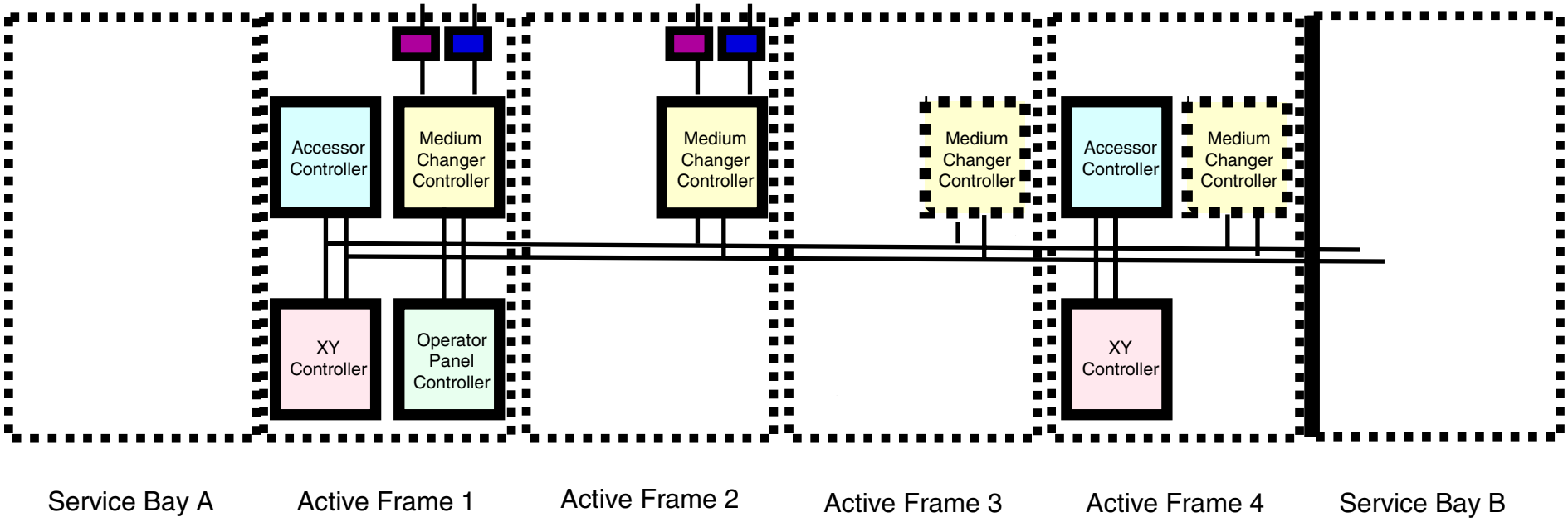
- **1- 18 Frames (16 for drives and cartridges 2 for High Availability)**
- **Up to 192 IBM LTO, *3592 R/W&WORM, intermix of both***
- ***4 New Frames – 20% Smaller L22,D22/3592 and L52,D52/LTO***
  - **Over 6880 Cartridges - over *2 PB native capacity***
  - **Attach: FCP and FC-AL; Ultra-SCSI LVD; Ultra-SCSI HVD**
- **Multi-path Architecture supports up to 192 logical libraries**
- ***Multi-path Advanced Library Management System***
- **Designed for Concurrent Maintenance**
  - **Dual AC power option 110V or 220V**
  - **Hot swappable power supplies/Hot swappable drives**
  - **Remote Management- Multiple simultaneous web clients- 2 access levels**
- **RAS**
  - **Control path failover**
  - **Data path failover and load balancing**
  - **Dual grippers**
- **Persistent World Wide Names**
- **Automatic backup/restore vital products data**
- **Mixed media and drive support**
- **Automatic inventory and calibration**

3584 Distributed Control System with Dual Accessor



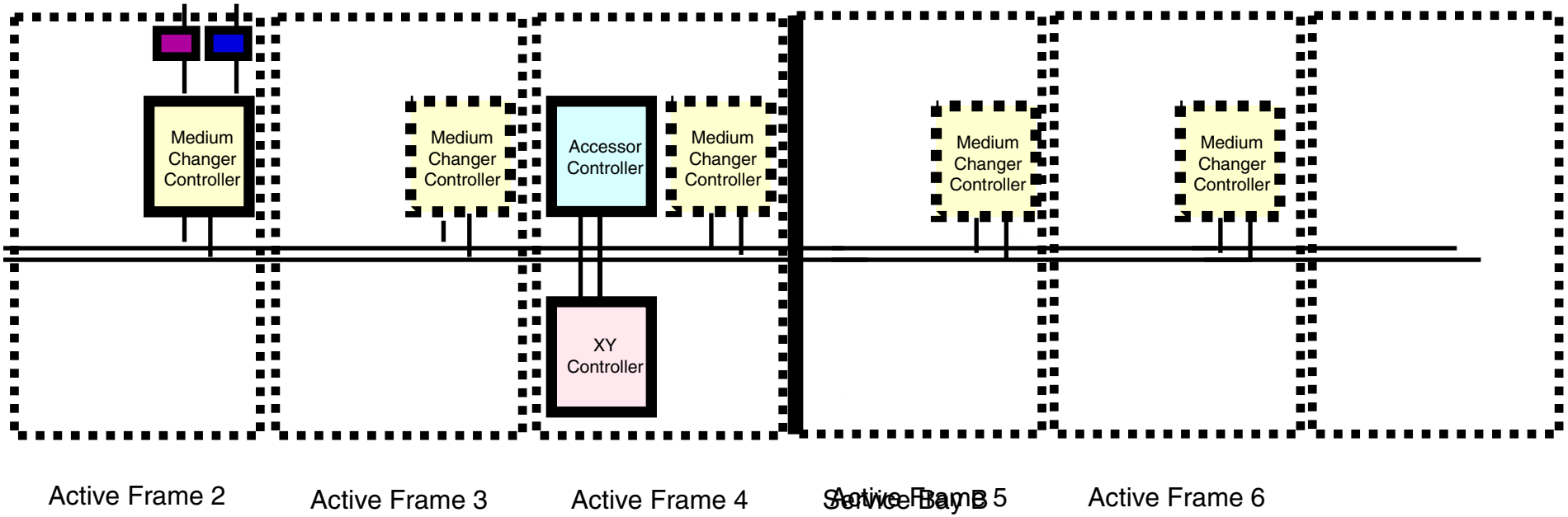
The HA 3584 is designed such that a faulty accessor (including its associated controllers) will either move itself or be moved by the other accessor to its respective service bay.

The active accessor takes over all work requests including any in progress when the fault occurred.



When the Service Bay door is opened to install or remove a safety barrier, the library continues to queue commands. When the safety barrier door is in place, the active accessor is designed to resume operation without loss of any commands.

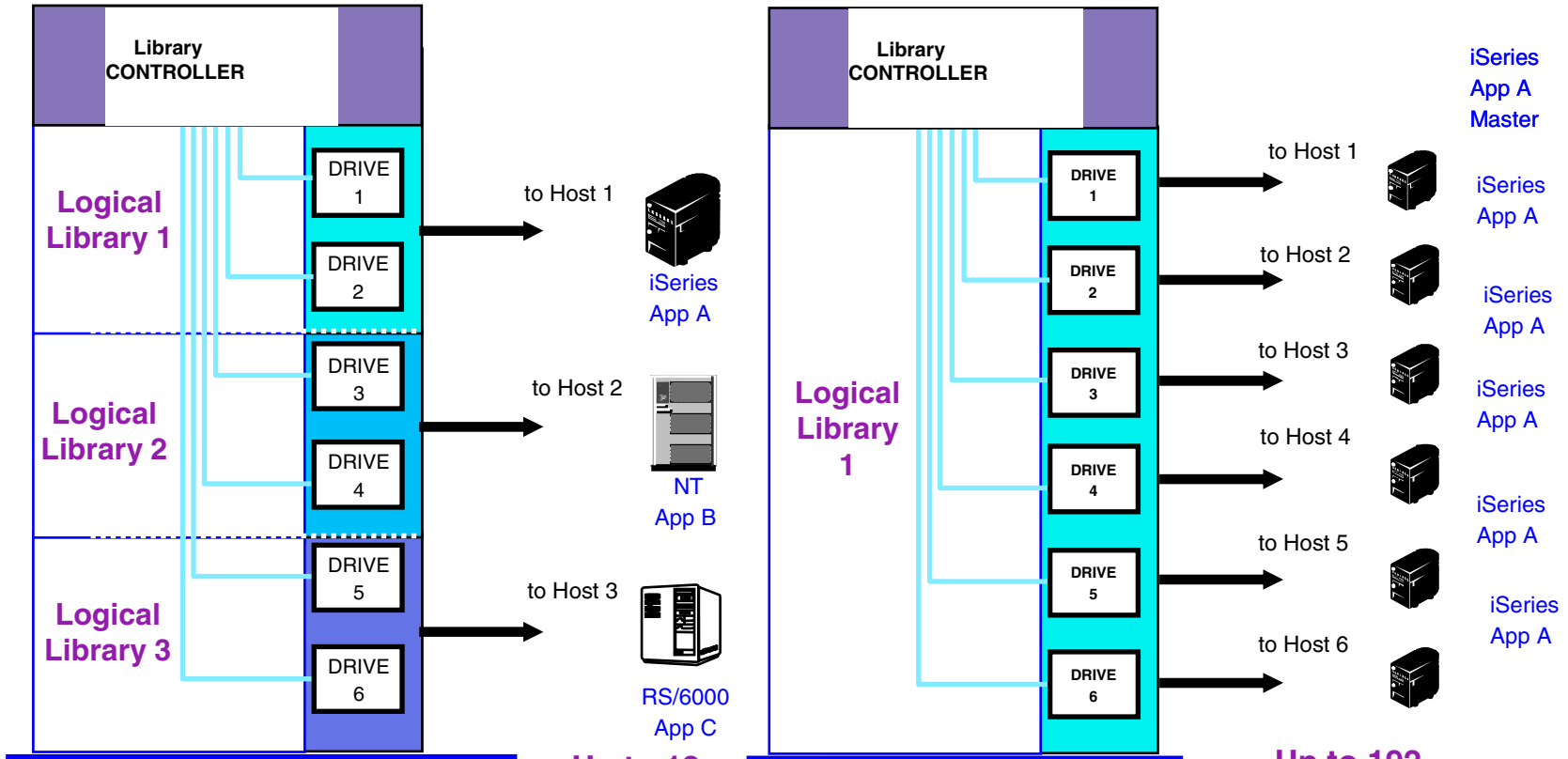
Expansion of an HA 3584 is designed to be performed with a downtime of less than 60 minutes.



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.

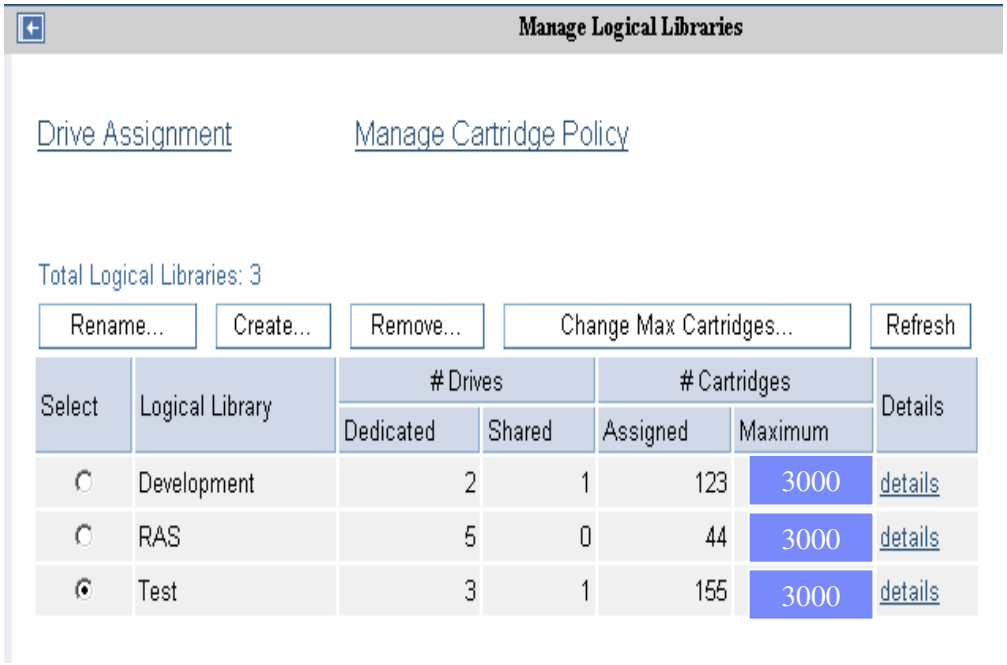
Multi-Path Logical Libraries - Standard For All Automation



Enables hardware partitioning for heterogeneous server and application attachment to separate logical tape library

Advanced Library Management System -3584 only

- Variety of ways to assign cartridges
  - Cartridge Assignment Policy
  - User-defined (manual)
  - backup software import
- Operator feedback
- Logical library set-up non- disruptive to the system
  - Element address not associated with storage slots
  - storage slots are given on a first-come-first-served to each logical library based on cartridge insert operations
  - Indications of a full, nearly full library will be provided via the operator panel, web UI, and SNMP traps.

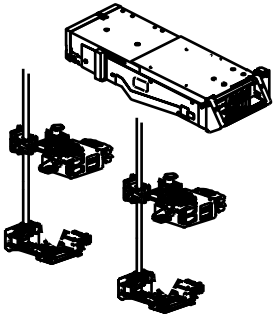


3584 Tape Library Roadmap

- ✓Advanced Library Management System

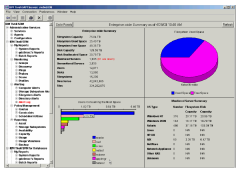
August 2004

- ✓Dual Accessor
- ✓Add Dxx with Reduced Downtime
- ✓LTO Gen 3 Integration



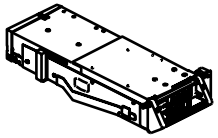
March 2005

- ✓zSeries/zOS Attachment
- ✓LTO Gen 3 WORM
- ✓SMI-S API
- ✓CPF for Windows & HP-UX



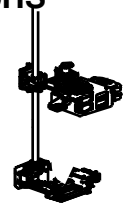
May 2005

- Virtual I/O Slots
- 3592 Gen 2 Integration
- Non-disruptive Firmware Update
- Enhanced Data Gathering/Reporting



2H05

- 4 Gb LTO Gen 3
- Additional I/O Slots
- Dual Enet for TSMC
- Enhanced power
- RoHS



1H06

Availability Dates

Product Road Map: These statements represent IBM's current intent, are subject to change or withdrawal, and represent only goals and objectives.

IBM TotalSolutions 3494 Tape Library

3494 Tape Library- Overview

- Linear Solution 1 to 16 Frames (5.6 PB*)
  - LXX Frames
  - DXX Frames
  - S10 Frames
- High Availability Models (2 Additional Frames)
  - HA1
  - HA1 & Dual Active Accessor
- Drive Support
  - 512 3490E Virtual Drives
  - 164 Max 3592 Tape Drives
    - 1 - 124 3592 zSeries
    - 1 - 128 3592 Open Systems
  - 92 ESCON/FICON 3590 B/E/H
  - 76 SCSI/Fibre 3590 B/E/H
  - 32 3490E
- Virtual Tape Servers
  - Two VTS Supported
  - Shared Between zOS and Open
- Open System Native Attachment
  - RS, AS, HP, SUN, Cray, Convex, NT, Windows 2000, SGI, SEQUENT,Linux, TRU64

* 3:1 compression

3494 Enhancements

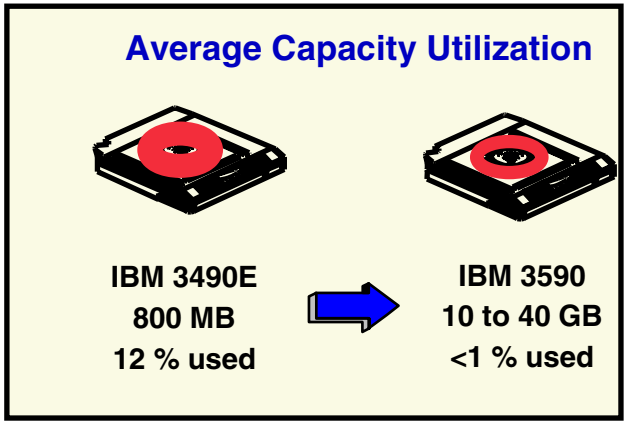
2004

- 3592
  - **WORM Support** **GA 04/04**
  - **New Capacity Cartridge** **GA 04/04**
- ***J70***
  - ***16 drive support*** ***GA 10/04***
  - ***Redundant switches*** ***GA 10/04***
  - ***External switch*** ***GA 10/04***
- ***Support for 128 Open System drives GA 10/04***
- ***Support for 64 LAN attached host GA 10/04***
- ***Dual Power*** ***GA 10/04***
- **Online Shutdown** **GA 04/04**
- **Reduce Teach Time** **GA 04/04**
- **TotalStorage Master Console Integration**
  - **Call Home** **GA 04/04**

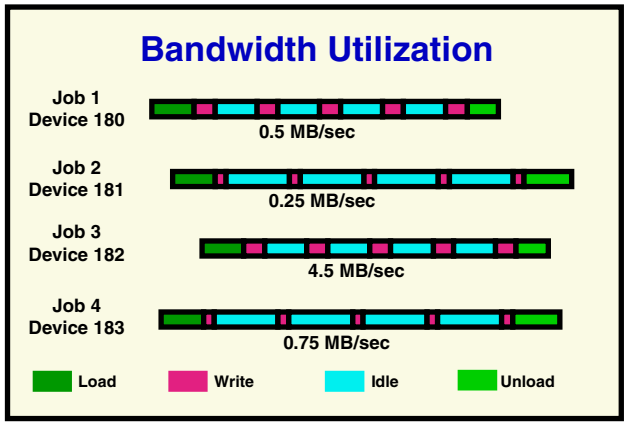
- **2005**
  - Support next generation 3592
  - Download 3592 Drive Code from TotalStorage Web Specialist to LM
  - 10x Improvement for downloading 3592 code from LM to drive
  - Improve database backup/restore
  - Improve Peer-to-Peer migration times
  - Master Console Enhancements
    - Download 3592 Drive Code to LM
    - Automatic Collection of Logs from LM
    - Automatic Transmission of LM Logs to Support Center
    - LM Web Accessible from Master Console
- **2006 and Beyond**
  - SMI-S
  - Support next generation VTS
  - Improve Teach Time
  - Master Console Enhancements

IBM TotalStorage Virtual Tape Solutions

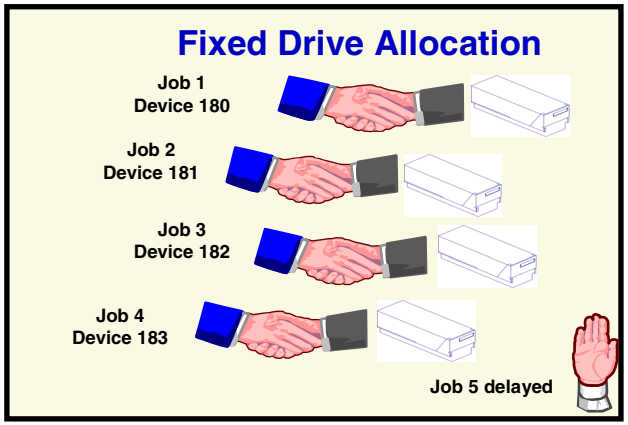
What problems does the VTS address?



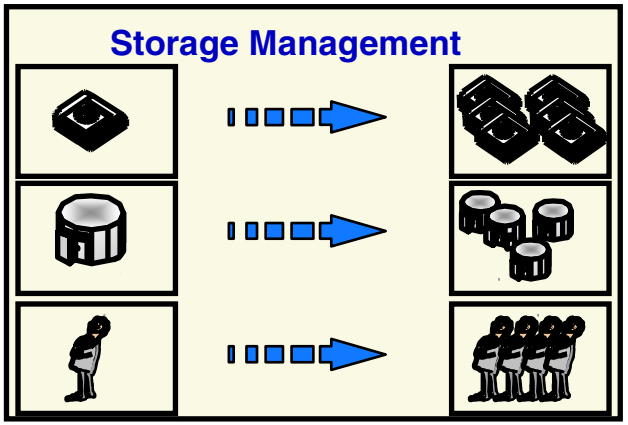
1,000s of cartridges to manage !



Underutilized bandwidth and extended batch window!

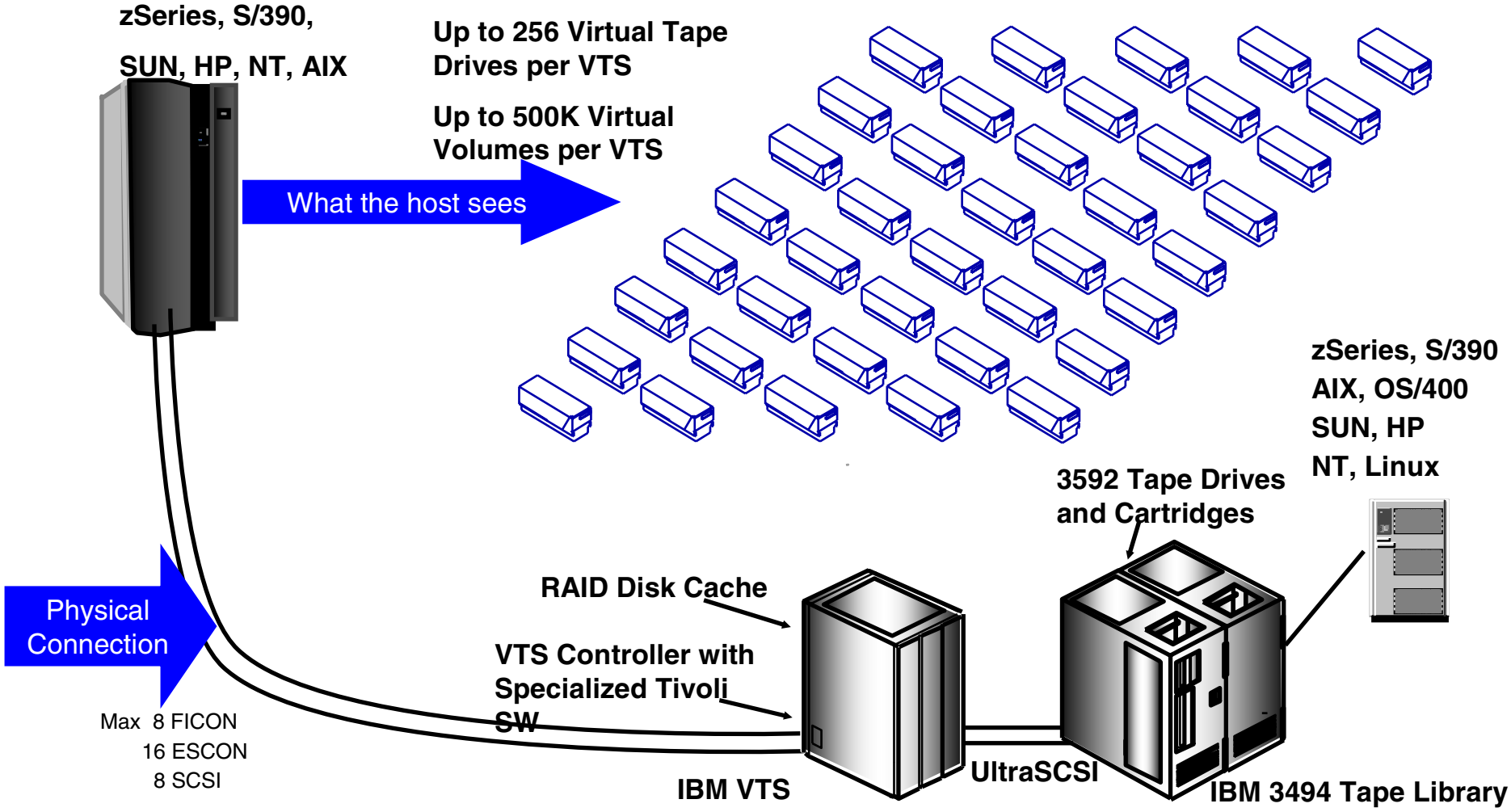


Unavailable resource!



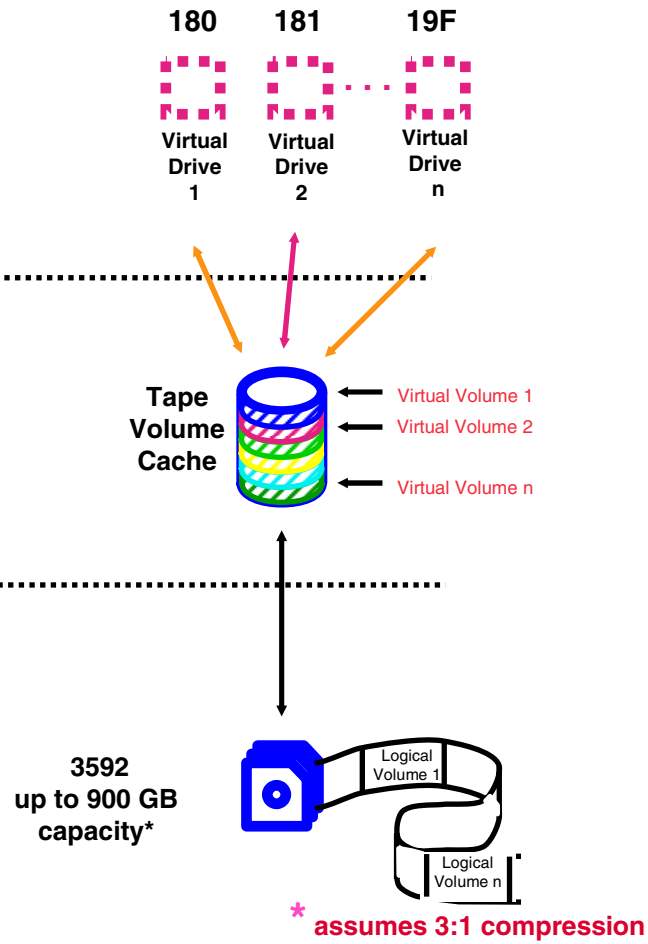
Growing pain$

IBM Virtual Tape Server -Configuration Overview

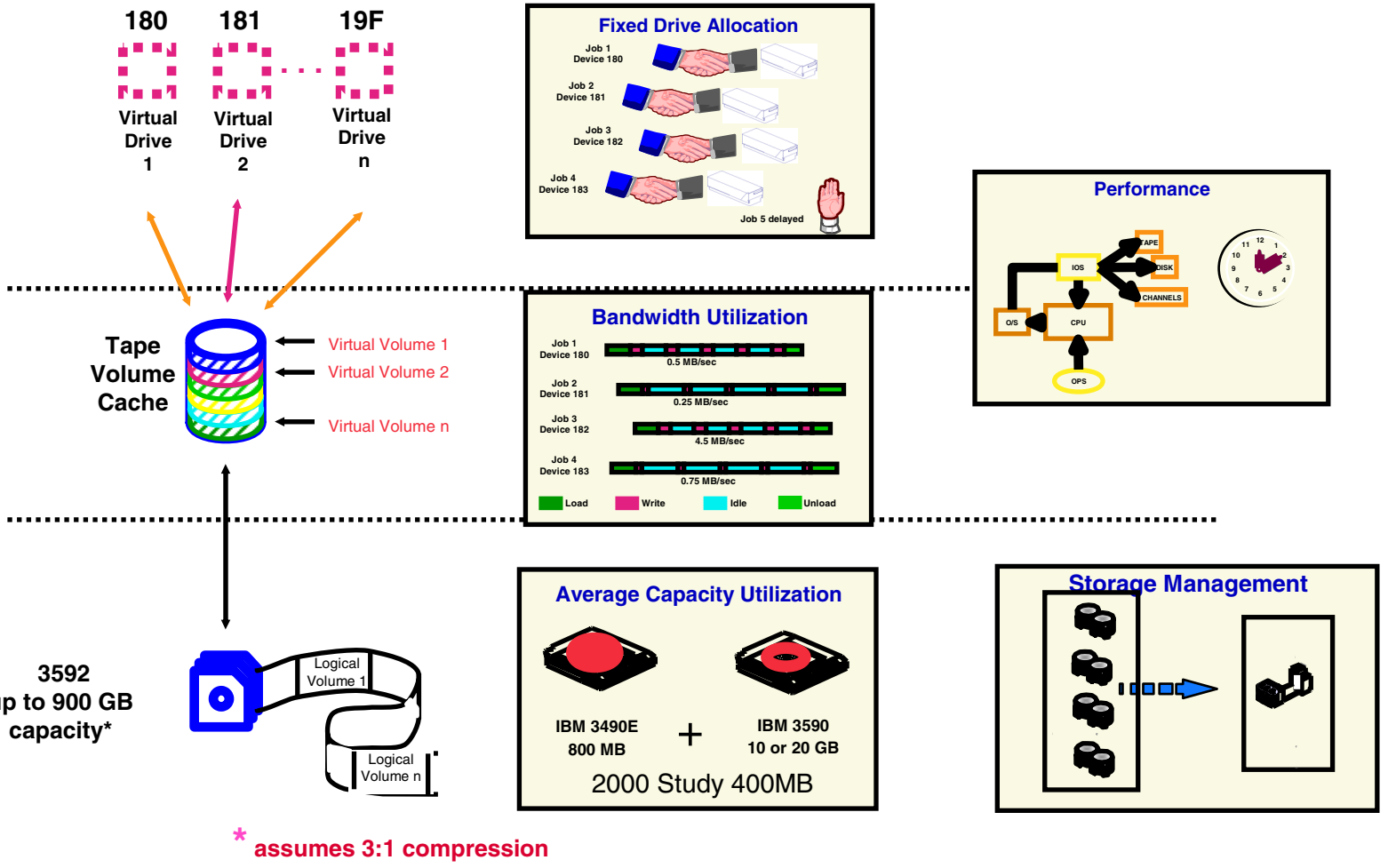


Virtual Tape Concepts

- Virtual tape drives
  - Appear as multiple 3490E tape drives
  - Shared / partitioned like real tape drives
  - Designed to provide enhanced job parallelism
  - Requires fewer real tape drives
  - VTS offers up to 256 virtual drives
- Tape volume caching
  - All data access is to disk cache
  - Removes common tape physical delays
  - Fast mount, positioning, load, demount
  - Up to 5.2 TBytes of cache*
  - VTS offers up to 95% cache hit capability
- Volume stacking
  - Designed to fully utilizes cartridge capacity
  - Helps reduces cartridge requirement
  - Helps reduces footprint requirement
  - VTS provides up to 375:1 cart reduction
  - Supports 3592 and 3590 B,E and H drives



Virtual Tape Benefits



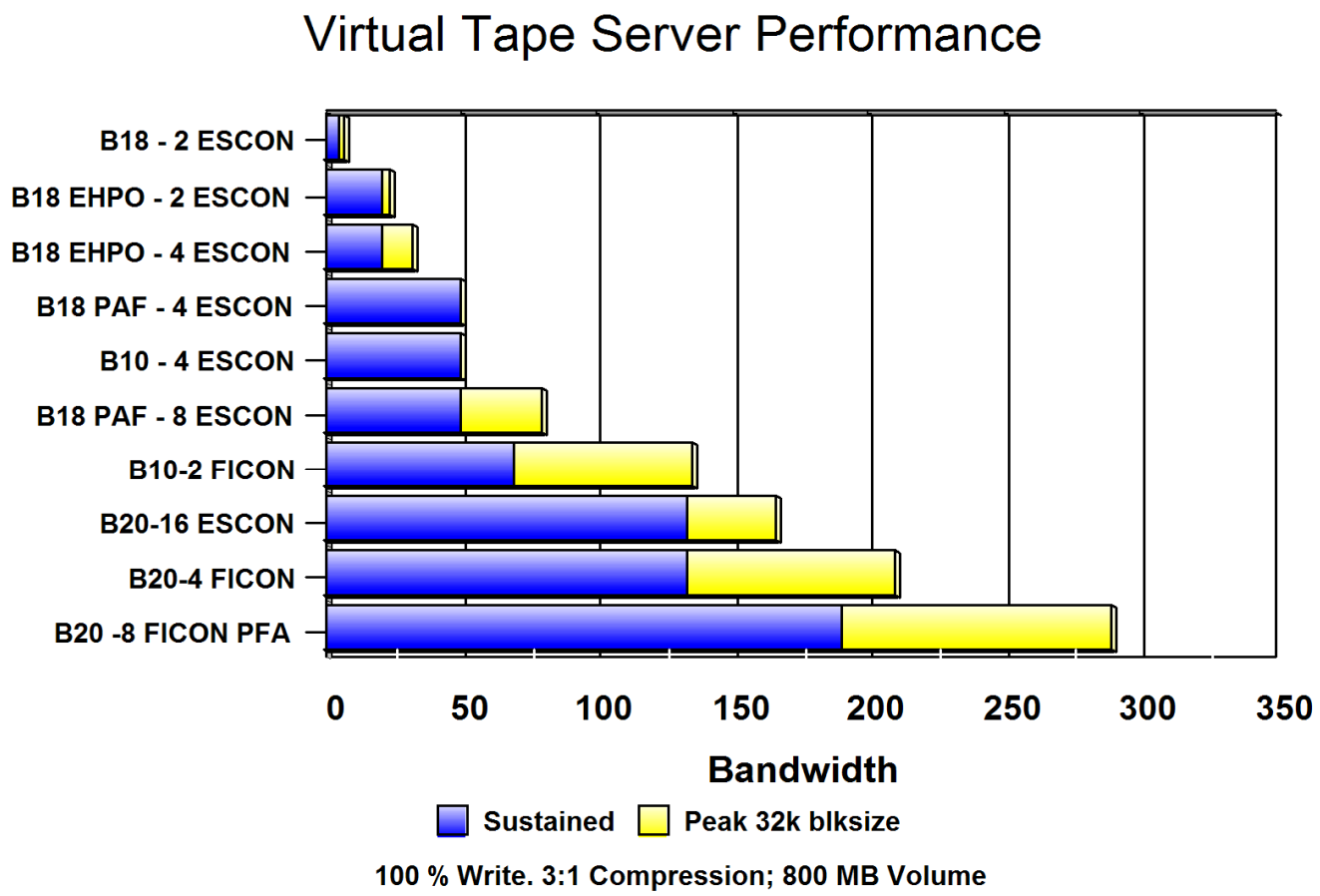
* assumes 3:1 compression

Advanced Policy Management

Enables customer control of data management and placement in a VTS

- Physical Volume Pooling
  - Associates logical volumes with a set of physical volumes
  - Controlled through the Storage Group construct
- Selective Dual Copy
  - Two copies of a logical volume on different physical volume pools
  - Controlled through the Management Class construct
- Tape Volume Cache Management
  - Dynamic Control of logical volumes to be kept in cache
  - Controlled through the Storage Class construct
  - Enhanced cache statistics
- PTP Copy Mode Control
  - Control of how the copy of a logical volume between VTSs is performed
  - Controlled through the Management Class construct

Performance Growth



100% Cache Hits 390 MB

Peer-to-Peer VTS : Overview

Attributes

- Local or Remote Dual Copy of Data
  - Extended distance with channel extenders
- Selectable Copy Operation Modes
  - Immediate/Deferred
- Selectable I/O Workload Options
  - Balanced/Preferred)
- Application Transparency
- Investment Protection

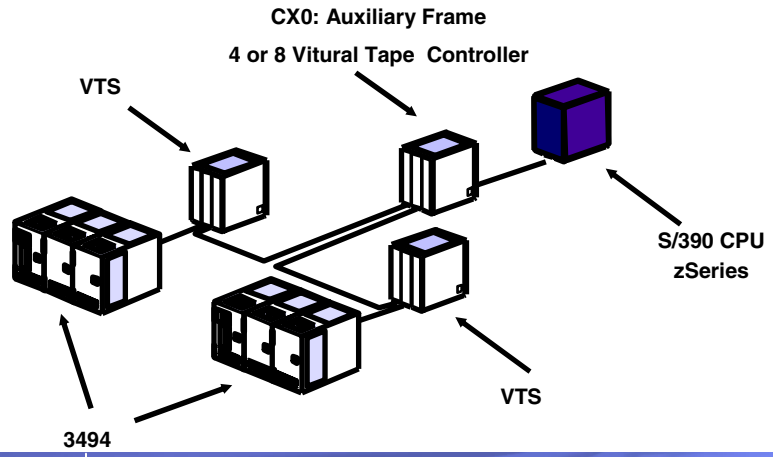
Applications

- Remote Backup
- Business Continuance
- Electronic Vaulting
- GDPS

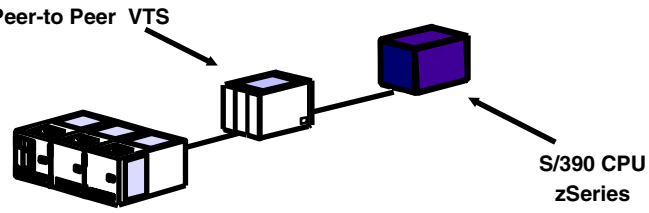
Availability Characteristics

- No single points of failure and protection against many multiple points of failure
- Concurrent maintenance/upgrades
- DDR Recovery for Read errors

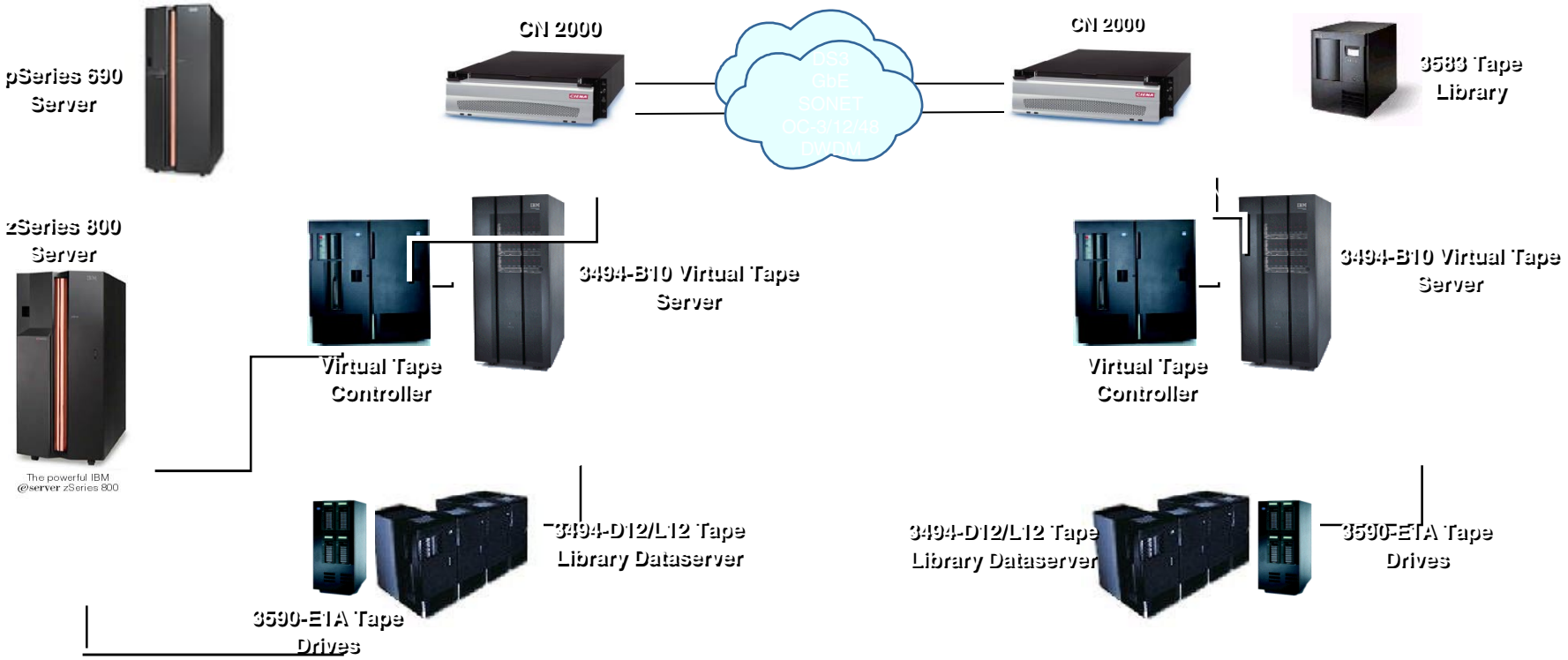
Physical View



Logical View



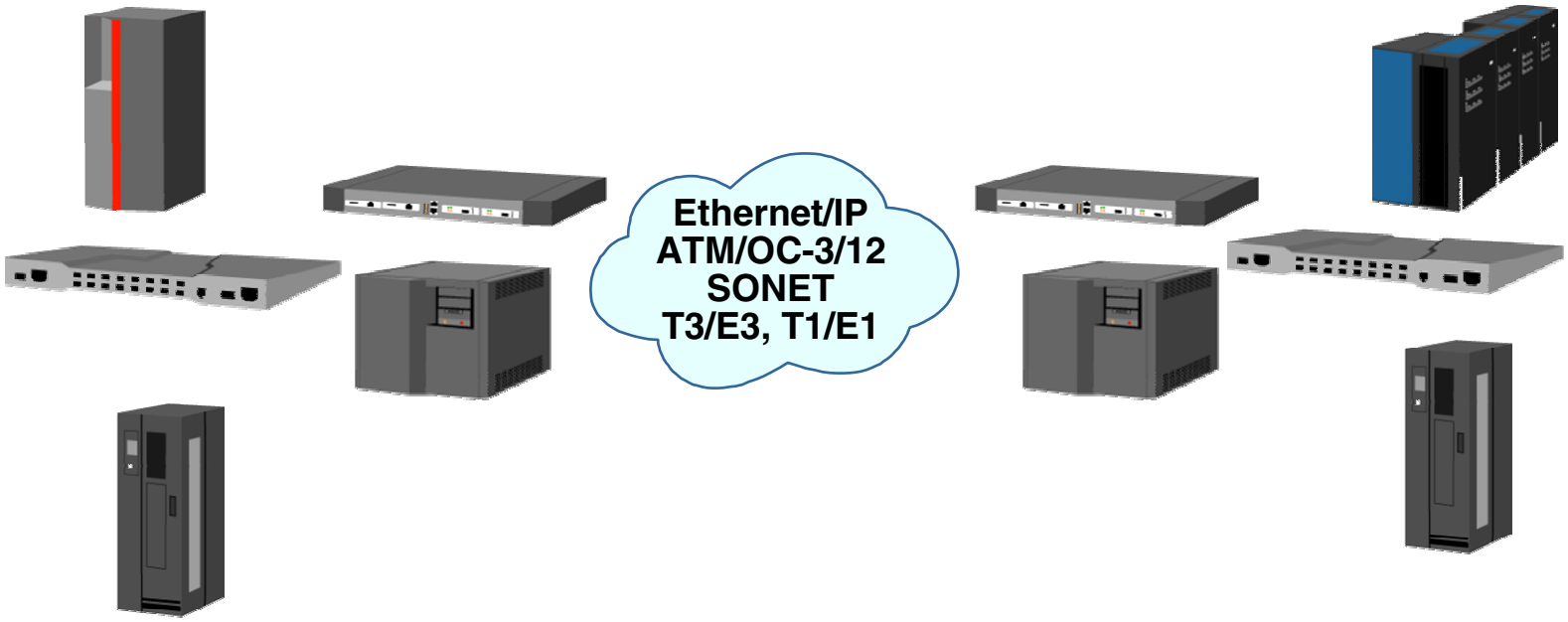
CIENA IBM Tape Management



- Supports FICON VTS, PtP VTS or FICON/FC Tape Extension
- Supports Metro or Wide Area Networks
- Provides lowest Latency – 5 Microseconds
- Individual Hardware Compression on all Client Ports
- Dynamic Bandwidth Allocation
- Policy Based Management

Open Systems Remote Tape – Platforms & Configs

- McData UltraNet Edge Storage Router
  - FC (FICON in future)
  - 10/100, GigE, ATM-OC3/12, SONET
  - Mixed applications, higher throughput, lower cost and greater ease of use
- McData UltraNet Storage Director-eXtended
  - FICON and FC (also ESCON)
  - 10/100, GigE, ATM-OC3/12, SONET, T1/E1, T3/E3
  - Mixed applications and larger environments



Virtual Tape Server Roadmap

- **Information provided represents a statement of IBM future plans and directions. Plans and direction are subject to change without notice**

2005 GA 6/3/05

- **500,000 Logical Volumes**
- **Large capacity logical volumes**
- **8 VTC to 4 VTC conversion**
- **Customer control of VTC modes**
- **Secure data erase**
- **Attachment to 3584**
- **High capacity cache for optical replacement only**

Virtual Tape Server Roadmap

- **Includes development initiatives that are designed to**
  - **incorporate the latest IBM technology**
    - **– Robust high-performance IBM pSeries designed for mission-critical environments**
    - **– Modular high-capacity IBM disk systems to support ILM initiatives**
  - **protect your investment in IBM tape technology**
    - **– Support co-existence with, and an upgrade path to future VTS generations**
    - **– Support future 3592 tape drive generations in 3494 or 3584 tape libraries**
  - **improve business continuity**
    - **– Extend the PtP VTS solution to offer additional deployment options**
    - **– Increase import/export performance to improve interchange / vaulting**
  - **support high availability**
    - **– Standby on demand cache capacity and performance increments**
    - **– A 'n+1' cluster design to support non-disruptive maintenance**

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