Danijel Paulin, Systems Architect, IBM SEE

IBM VTL - Virtual Tape Library za mainframe okolinu

Agenda

- Uvod
- IBM Virtual Tape TS7700
  - Virtual Tape koncepti
  - Model TS7720
  - Model TS7740
- TS7700 Grid konfiguracija
- Integracija sa GDPS rješenjem

IBM Tape 60 years of data protection and retention innovations

In tape drive technology and software

1952 IBM 726 1st magnetic tape drive

1959 IBM 729 1st read/write drive

1964 IBM 2104 1st read/back drive

1984 IBM 3480 1st cartridge drive

1995 IBM 3590

1999 IBM 3590E

2000 LTO Gen1

2002 LTO Gen2

2003 3592 Gen1

2004 LTO Gen3

2005 TS1120 (3592 G2)

2007 LTO-4

2008 TS1130 (3592 G3)

2010 LTO-5

2010 LTFS SDE

2011 TS1140 (3592 G4)

2011 LTFS LE

2012 LTFS SM

2012 LTO Gen6

In tape automation and virtualization

1962 IBM Tractor System

1974 3850 MSS

1992 IBM 3495

1994 IBM 3494

1997 VTS G1

1999 VTS G2

2000 TS3500

2001 VTS G3

2005 TS3200 TS3300

2005 TS7510 VTL

2006 TS7740 (VTS Gen 4)

2007 TS3400

2007 TS7520

2007 TS7530

2008 TS2900 TS3500 High Density

2008 TS7650G

2008 TS7720

2009 TS7650 Appliance

2010 TS7610 TS7680

2011 TS3500 Connector &shuttle

2011 TS7740 TS7720

2012 IBM TSLM software

Why tape is an integral part of an efficient backup process and long term retention

Designed for data

Over 56% of businesses surveyed

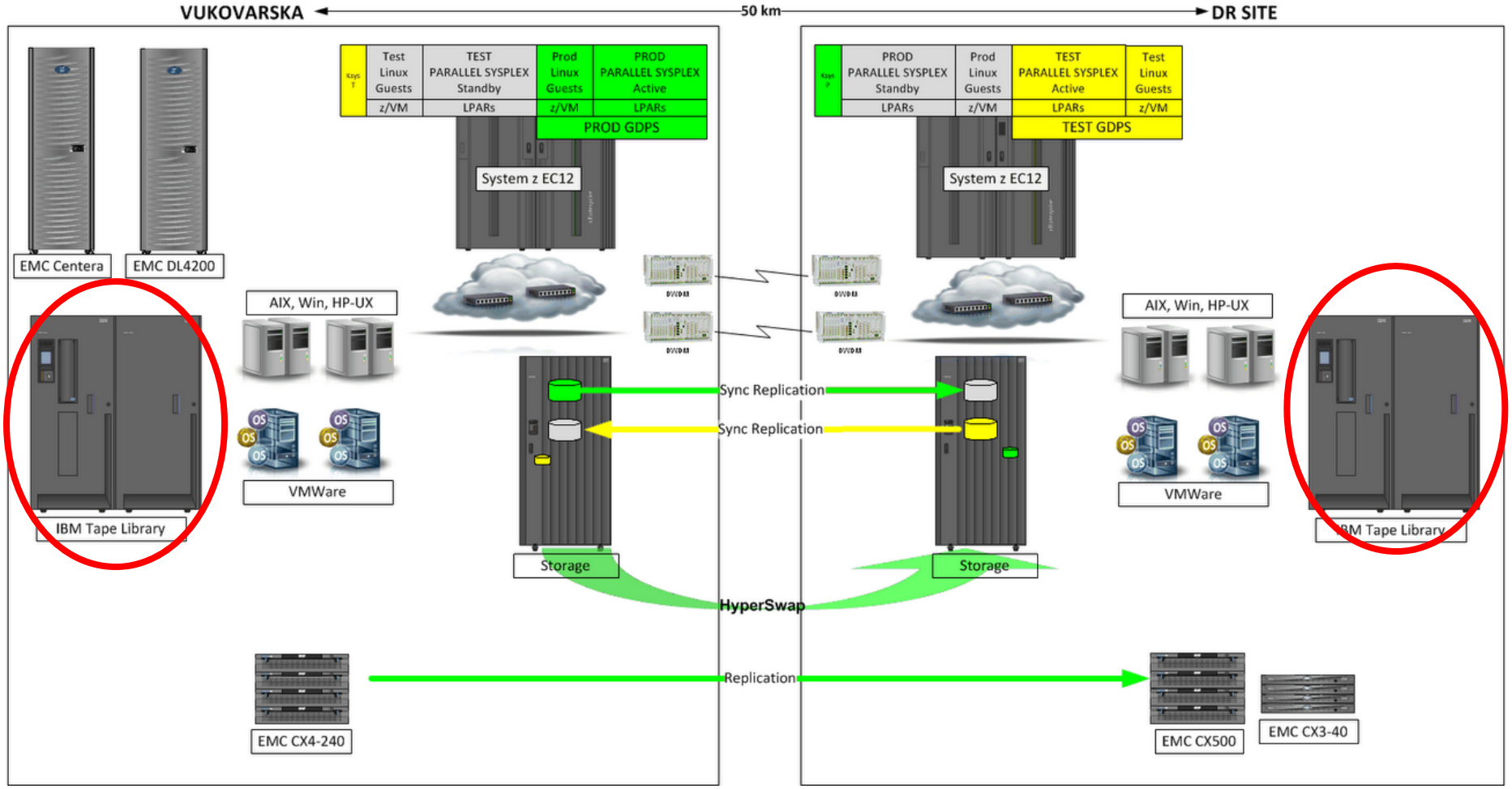
Use tape as a tier at some point in their backup process

Source: Enterprise Strategy Group, Trends in Data Protection Modernization, August 2012

- Tape provides another line of **defense against data loss**
- Saves money
  - Price per TB is about 10% of Tier 2 disk[1]
  - **Power consumption is about 1%**, compared to hard disk[2]
- Transportable
  - Light weight, compact, crash-proof
- Preserve data for up to **30 years** on the same media
- Significantly reduced power, cooling, and space requirements
- Provides **investment protection** with scalability and media compatibility

Sources:
1. "Top 10 Strategies for Surviving Unconstrained Data Growth," Gartner Symposium Presentation, October 2010, slide 21
2 "In Search of the Long Term Archiving Solution – Tape Delivers Significant TCO Advantage over Disk", The Clipper Group, Inc., December 2010.

FINA – buduće okruženje



IBM Virtual Tape TS7700

What is the IBM Virtualization Engine TS7700*?

- The IBM Virtualization Engine TS770 family is virtual tape storage for System z data with interconnection for up to 6 geographically placed systems called “clusters” in a redundant network configuration called a “Grid” which provides enhanced availability and simplified business continuance.

- The IBM TS7700 and its Grid architecture is unique, offering automated failover, replication and intermix of tapeless virtual tape (model TS7720) as well as a model with tape (model TS7740) for enhanced data protection and automated hierarchal storage management.

*Note: throughout this presentation, when “TS7700” is used, it implies the model used can be either a TS7720 or TS7740

IBM Virtualization Engine TS7700 Overview

- Advanced architecture
  - Architecture designed to facilitate future enhancements
  - Advanced IBM technology to increase performance and capacity
  - Grid business continuity option to increase flexibility and reduce cost

- Two models provide high performance and capacity
  - Both can achieve 900 MBps for typical workloads

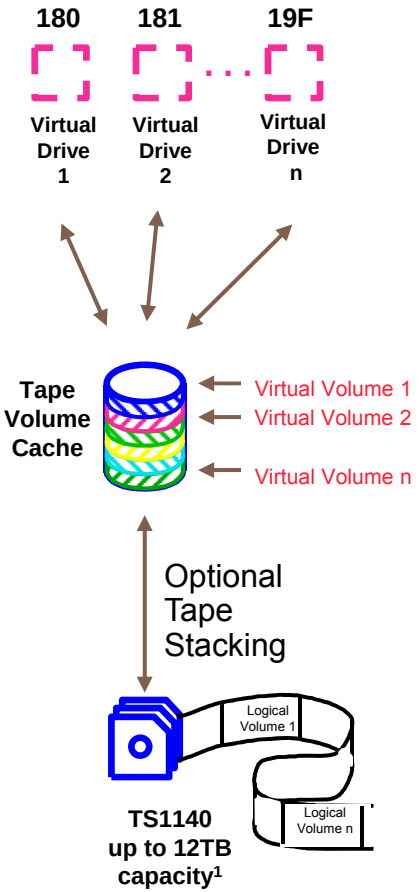
  - **TS7720** provides ~ 1.87 PB of native cache capacity (3:1 compression)
    - No attachment to back end tape except via Grid attachment to a TS7740

  - **TS7740** provides over 84TB of native cache capacity (3:1 compression)
    - Supports attachment to IBM TS1140, TS1130, TS1120 or 3592 J1A tape drives
    - Supports tape drives in an IBM TS3500 tape library
    - Supports TS1140/TS1130/TS1120 data encryption

[1] Belongs to the R2.1 code

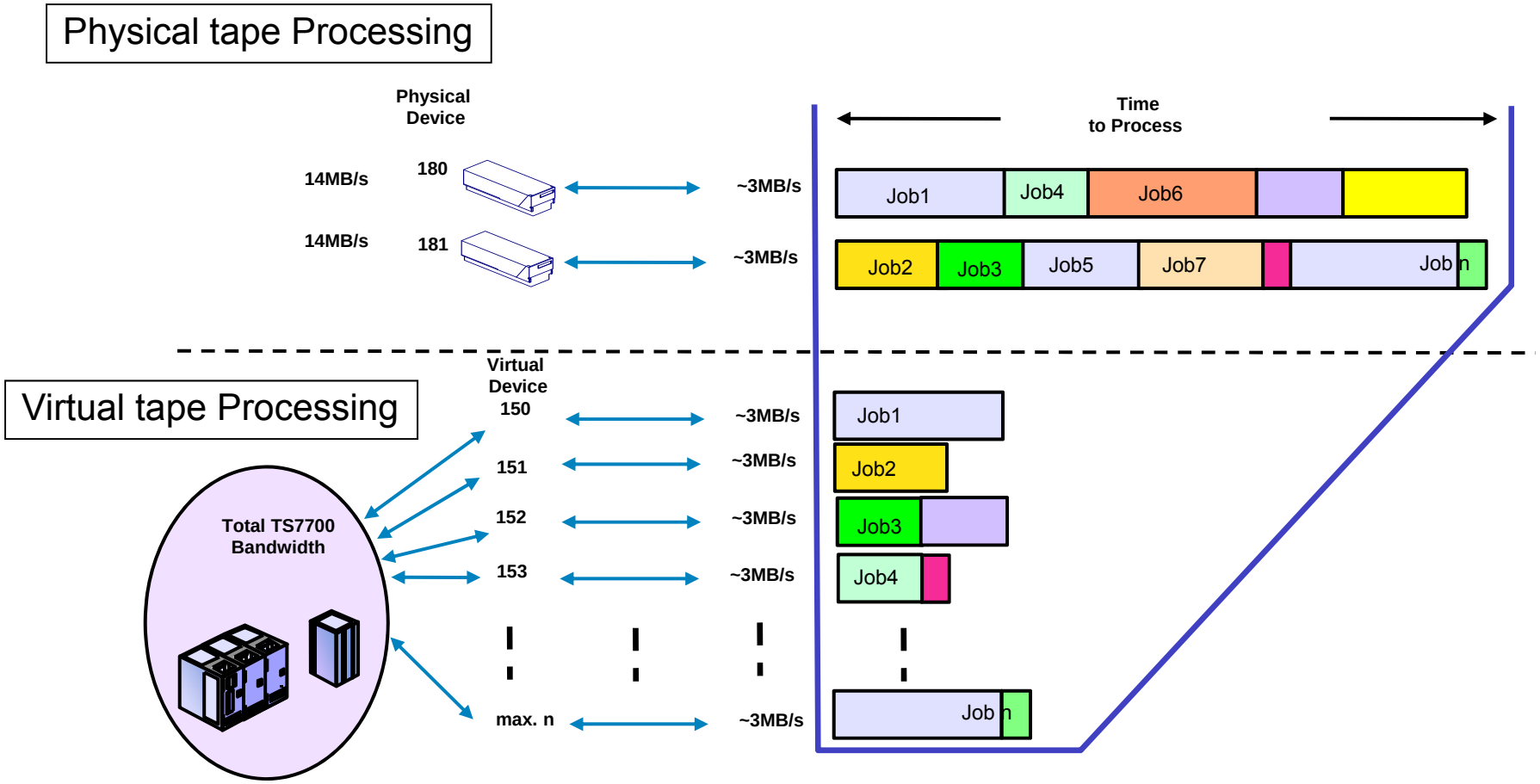
Virtual Tape Concepts

- Virtual Tape Drives
  - Appear as multiple 3490E tape drives
  - Can be shared / partitioned like real tape drives
  - Requires fewer or can eliminate real tape drives
- Tape Volume Caching
  - Designed to eliminate all or many physical tape delays
  - Supports read hits from cache / recalls from cartridge
  - Supports 100 % cache write hits
  - Can be configured to support 100% cache read hits
- Optional Volume Stacking to Physical Tape (model TS7740)
  - Designed to fully utilize cartridge and library capacity
  - Stacks multiple logical volumes onto stacked cartridges
  - Supports TS1140/TS1130/TS1120 and/or 3592 J1A tape drives



[1]assumes 3:1 compression

Virtual tape processing benefits



Helps insure the total processing time allocations are met

Model TS7720 Components (slide 1 of 3)

- The frame[1]
  - up to 36u of rack space dedicated to TS7720 components
    - The TS7720 Virtualization Engine
    - One TS7720 cache controller
    - Up to six TS7720 cache drawers
    - Redundant power supplies for improved availability
    - Two power feeds for improved availability

- The "Cluster"[1]
  - High performance IBM Power 7 server
    - One 8-way processor card
    - Up to 900 MBps of data throughput
  - Performance enablement features (FC5268)
    - Up to nine additional 100MBps increments
    - First increment is enabled with the server
  - Hardware for continuous availability
    - 2x1Gb, 4x1Gb (SW optical or Copper) or 2x10Gb LW Optical Grid Ports
    - 5-way and 6-way grids via iRPQ

[1] Machine Type 3957 Model VEB

Model TS7720 Components (slide 2 of 3)

- Up to three TS7720 cache controllers[1]
  - Base frame supports one controller
  - Optional expansion frame (3592 F05) supports up to two additional controllers
    - Base frame must be fully populated before adding expansion frame
  - Provide high performance RAID 6 disk tape volume cache
    - Attach to one TS7720 Virtualization Engine node
    - Provides up to 24TB of usable cache capacity per drawer
    - Includes 3TB SAS HDDs
    - Includes four 8Gbps FC interfaces
  - Supports high availability
    - Dual power
    - Automatic HDD hot sparing and rebuild
    - Redundant hot-swap components
      - Raid Controllers
      - Power Supplies
      - Enclosure fans
      - Hard disks

[1] Machine Type 3956 Model CS8

Model TS7720 Components (slide 3 of 3)

- Base frame supports two to six XS7 cache drawers[1]
  - –Provide high performance RAID 6 disk arrays
  - –Maximum base frame capacity ~ 162TB (pre-compression)
- Optional expansion frame supports up to ten additional XS7 expansion drawers[1]
  - –Maximum TS7720 configuration capacity ~624TB (pre-compression)
- Each TS7720 cache drawer
  - –High performance RAID 6 disk
    - Attaches to the TS7720 cache controller
    - Provides up to 24TB of usable cache capacity
    - Includes 3TB SAS HDDs
  - –Supports high availability
    - Dual power
    - Automatic hot sparing/rebuild
    - Redundant hot-swap components
      - Power Supplies
      - Enclosure fans
      - Hard disks

[1] Machine Type 3956 Model XS7

Model TS7740 Components (slide 1 of 3)

- The frame[1]
  - Up to 36u of rack space dedicated to TS7740 components
    - A TS7740 Virtualization Engine
    - One TS7740 cache controller
    - Zero, one or three TS7740 cache drawers
    - Redundant power supplies for improved availability
    - Two power feeds for improved availability

- The "Cluster"[1]
  - High performance IBM Power 7 server
    - One 8-way processor card
    - Up to 900 MBps
    - New I/O drawers
  - Cache enablement features (FC5267)
    - Offered in one to 28 1TB increments
  - Performance enablement features (FC5268)
    - Up to ten, 100MBps increments
  - Number of cache and performance increment features are not required to be equal
  - Enhanced continuous availability
    - 2x1Gb, 4x1Gb (SW optical or Copper) or 2x10Gb LW Optical Grid Ports
    - 5-way and 6-way grids via iRPQ

[1] Machine Type 3957 Model V07

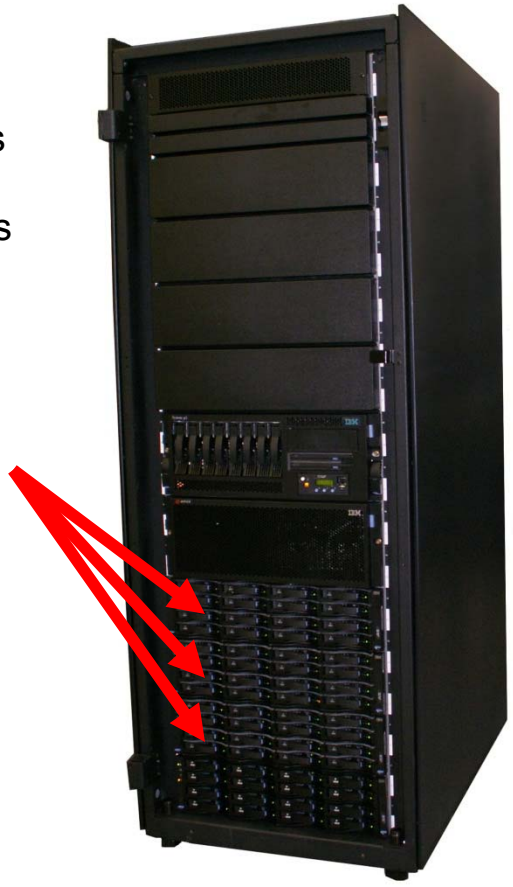
Model TS7740 Components (slide 2 of 3)

- One TS7740 cache controller[1]
  - –Provides high performance RAID 5 disk tape volume cache
    - Attach to one TS7740 Virtualization Engine node
    - Provides up to 7TB of usable cache capacity
    - Includes 600GB FC HDDs
    - Includes four 8Gbps FC interfaces
  - –Supports high availability
    - Dual power
    - Automatic HDD hot sparing and rebuild
    - Redundant hot-swap components
      - Raid Controllers
      - Power Supplies
      - Enclosure fans
      - Hard disks

[1] Machine Type 3956 Model CC8

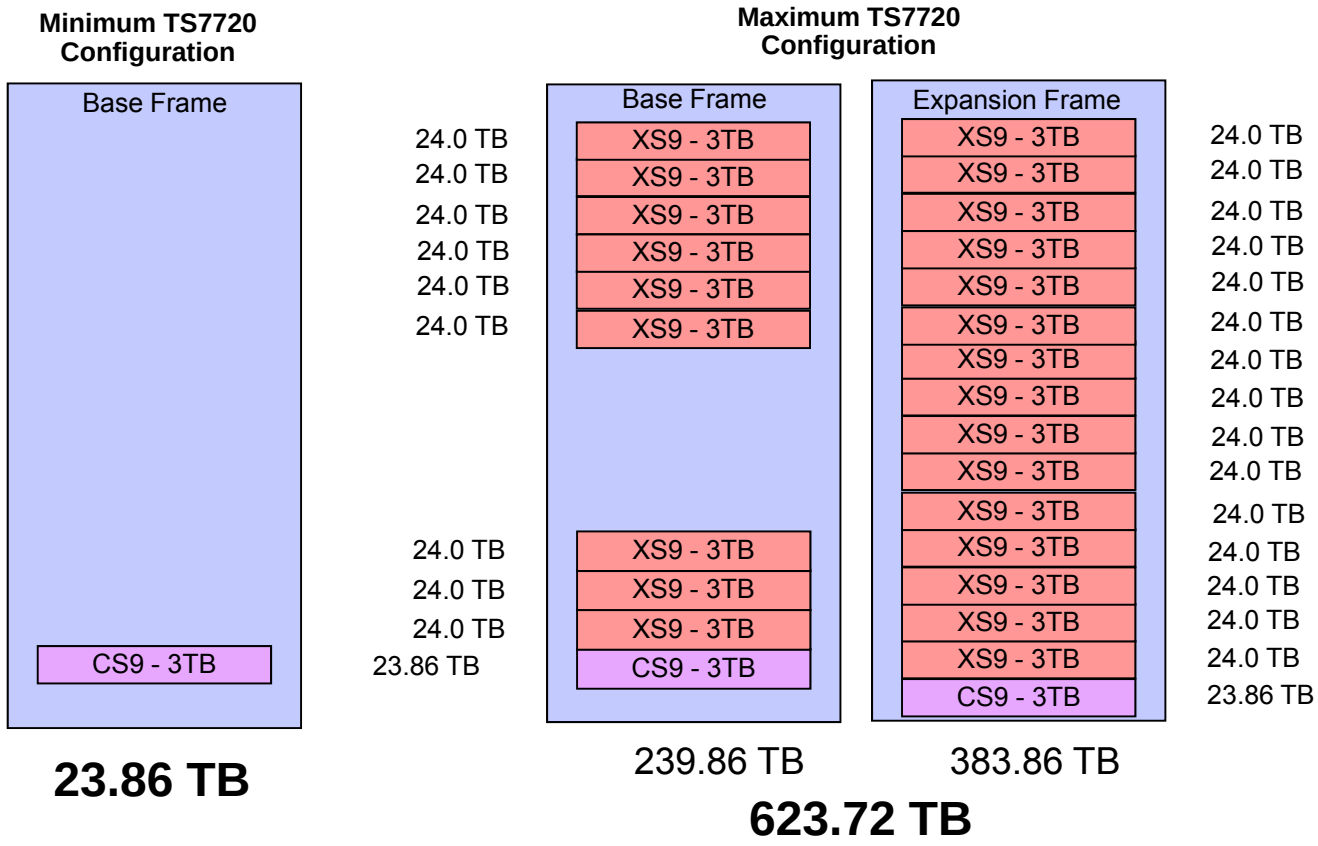
Model TS7740 Components (slide 3 of 3)

- Up to three TS7740 cache drawers[1]
  - –Provide high performance RAID 5 disk arrays
  - –One, two or four drawer cache configurations
    - One drawer with up to 7TB capacity – cache controller
    - Two drawer with up to 14TB capacity – cache controller plus one cache drawer
    - Four drawer with up to 28TB capacity – cache controller plus three cache drawers
- Each TS7740 cache drawer
  - –High performance RAID 5 disk
    - Attaches to the TS7740 cache controller
    - Provides up to 7TB of usable cache capacity
    - Includes 600GB FC HDDs
  - –Supports high availability
    - Dual power
    - Automatic hot sparing/rebuild
    - Redundant hot-swap components
      - Power Supplies
      - Enclosure fans
      - Hard disks



[1] Machine Type 3956 Model CX7

R3.0: TS7720 Virtualization Engine Configurations



- Base frame minimum is one CS9 Cache Controller
  - Up to nine XS9 Cache Drawers can be added to the base frame - single drawer increment
- Expansion frame minimum is one CS9 Cache Controller
  - Up to fifteen XS9 Cache Drawers can be added to the expansion frame - single drawer increment

Summary of key specifications R3.0

Specifications per cluster	TS7740	TS7720
Number of Virtual Devices	256	256
Usable Cache	1TB to 28TB	Up to 624TB
Compressed Cache Capacity (3:1)	3TB to 84TB	Up to 1.872 PB
Number of Virtual Volumes	4,000,000	4,000,000
TS1140/1130/1120/3592 Tape Drives	4 – 16	NA
FICON channels	2 or 4	2 or 4
Logical paths per FICON channel	256	256

IBM Virtualization Engine TS7700 Release 3.0

- What's New?
  - IBM is introducing an even smarter solution for using and storing your data with enhanced features that allows you to secure your data and protect your investment.
    - Increased security, with **hardware encryption**, against a data breach for customer data being stored in the disk cache of the system (TS7720 and TS7740) as well as on tape (TS7740 systems)
    - Increased security against a data breach for customer data transferred between systems via **IPsec**
    - Twice as many **virtual volumes (up to 4 Million)** for your storage applications (TS7720 & TS7740) and **40% more physical capacity for the model TS7720**
    - **A New XIV-like operator Graphical User interface**

Note: throughout this presentation, this color font indicates features or specification new to release 3.0

R3.0: TS7720 Encryption - Details

- **TS7720 –– 2Q12**
  - **Latest generation cache controller**
    - CS9/XS9 Technology
    - 3TB 7.2K 3.5” NL-SAS Encryption Capable Drives
  - **Limited capacities**
    - Single frame - 240TB
    - R3.0 4Q12 - one expansion - 624TB
  - **Internal key AES 128bit encryption**
    - All encryption key management occurs internally within the TS7720 and the disk cache controller
      - Three redundant keys stored in internal persistent storage
      - An option is available to export a wrapped copy of the key on DVD for additional redundancy
    - External key management available in R3.X
      - TKLM & ISKLM
      - Move between internal/external as needed without rewriting data
  - **Retroactive Encryption Enablement**
    - All R3.0 TS7720 configurations will ship with encryption support
    - If not ordered at the time of install, encryption can be enabled in the field and all existing content at rest will automatically be retroactively encrypted.

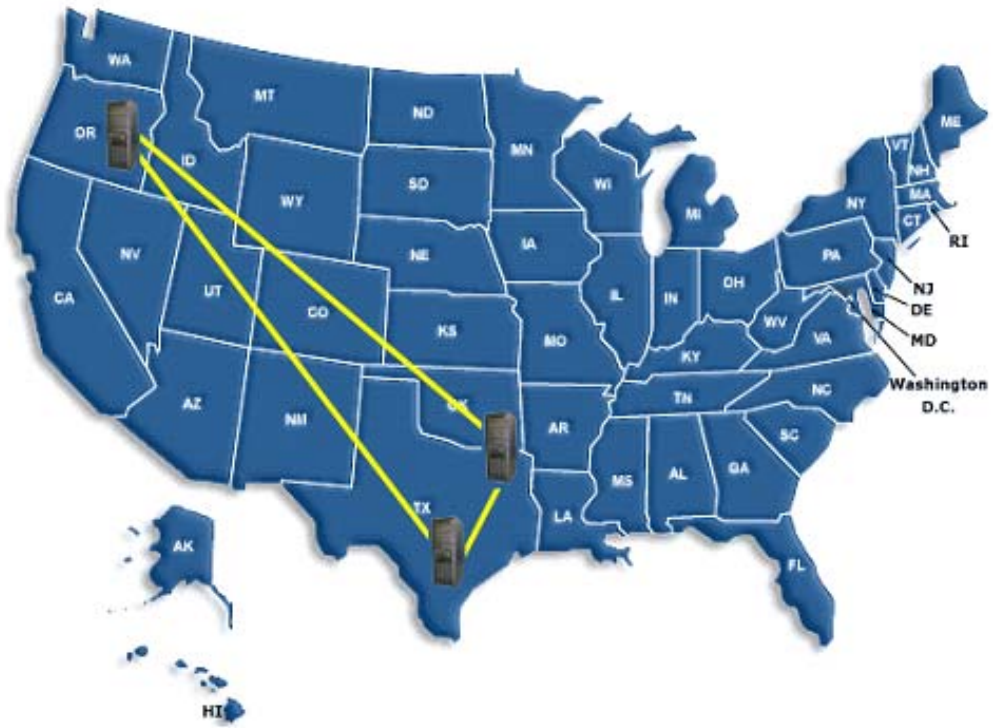
R3.0: Other Enhancements

- Unified GUI
  - V7000 and XIV look and feel
  - Usability is the primary goal
  - Unification across storage
- TS7700 Direct Connect LDAP
  - Direct connect to LDAP server versus a proxy
  - TPC Storage Authentication Service not required
- TSSC Remote Access Security
  - Remote support access optionally protected through LDAP allowing customers to restrict access to the hardware
- Limited IPv6 & IPsec
  - IPv6 on MI, LDAP, Encryption network
  - IPsec on Grid network

TS7700 Grid konfiguracija

What is a TS7700 Grid?

WAN interconnected TS7700s clusters form a Grid configuration

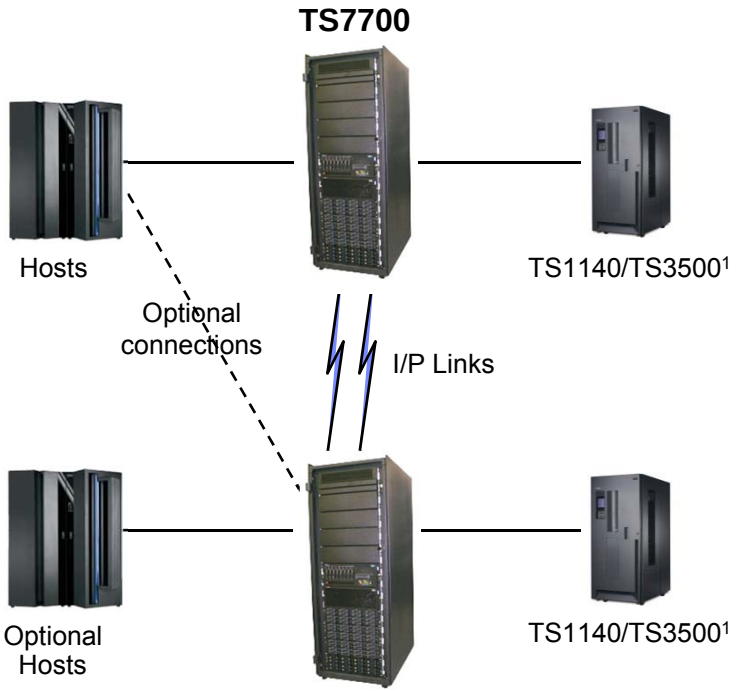


Optimized for Recoverability and Automatic Failback

- All clusters are peers to each other
- The Grid forms one large composite library
- Interconnect is standard TCP/IP using dual 1Gb links
  - Supporting 1000s of miles separation
- Data written to one is transparently replicated to the other
  - Policy control for location of copies and how copies are made
- A volume's data can be accessed through any TS7700
- Can be configured for disaster recovery and/or higher availability environments
  - One to six site configurations
- Each TS7700 Cluster provides
  - 256 virtual devices
  - 4 - 4Gb FICON Channels
  - Up to 84TB of Cache (3:1 C/R) TS7740
  - Up to 1.87PB of Cache (3:1 C/R) TS7720
  - 4,000,000 logical volumes

TS7700 Grid Specifics

- Requires feature code 4015 - Grid Enablement
- Couples up to six TS7700 clusters together to form a Grid configuration
  - Hosts attach directly to the TS7700 clusters
- Clusters in a Grid can be any combination of TS7740s and TS7720s
  - TS7720s in the same Grid are not required to have the same cache size
- Any volume is accessible through any TS7700 cluster in the Grid configuration
- I/P based replication
  - Two 1Gbps Ethernet links
    - Dual-port copper RJ45 FC1032
    - Dual port shortwave optical fibre FC1033
  - Option to have 4 x 1G (SW optical or Copper) or 2x 10Gb (LW Optical Grid Ports)
  - Dynamic Grid network load balancing
  - Standard TCP/IP
- Policy-based replication management
- Can be configured for disaster recovery and/or higher availability environments
- Grid Merge[1]
  - Merge two existing multi-cluster grids to form a single larger grid

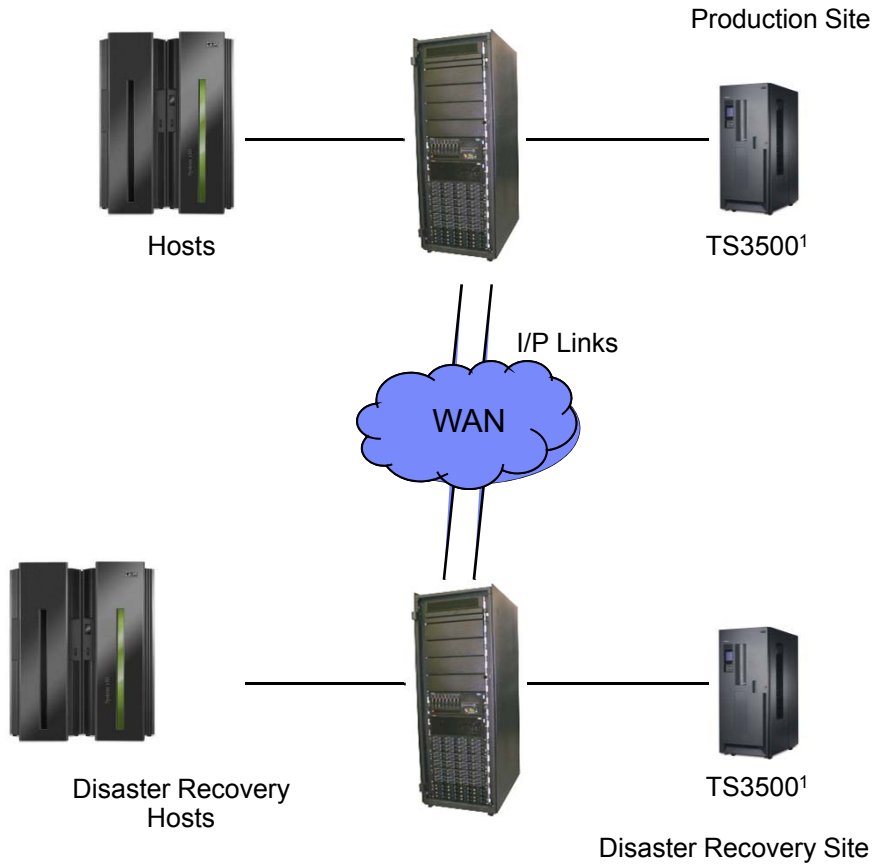


Grid Configuration

[1] Introduced in Release 2.1

Example Architecture: Two Cluster Grid Configuration for Disaster Recovery

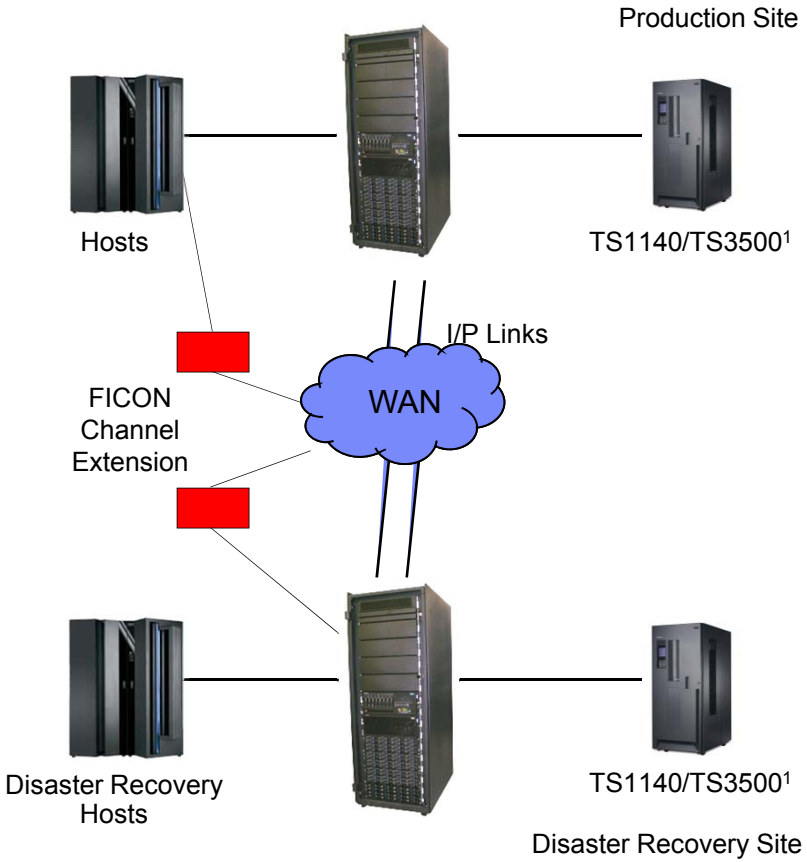
- Two TS7700s are located at two sites geographically separated
- Interconnected through a Wide Area Network
- Only the disaster recovery host is connected to the remote TS7700
- If local TS7700 is unavailable, data is only available at remote TS7700
  - Ownership Takeover Manager enabled automatically when one of the TS7700 fails



[1]Supported by TS7740 Model only

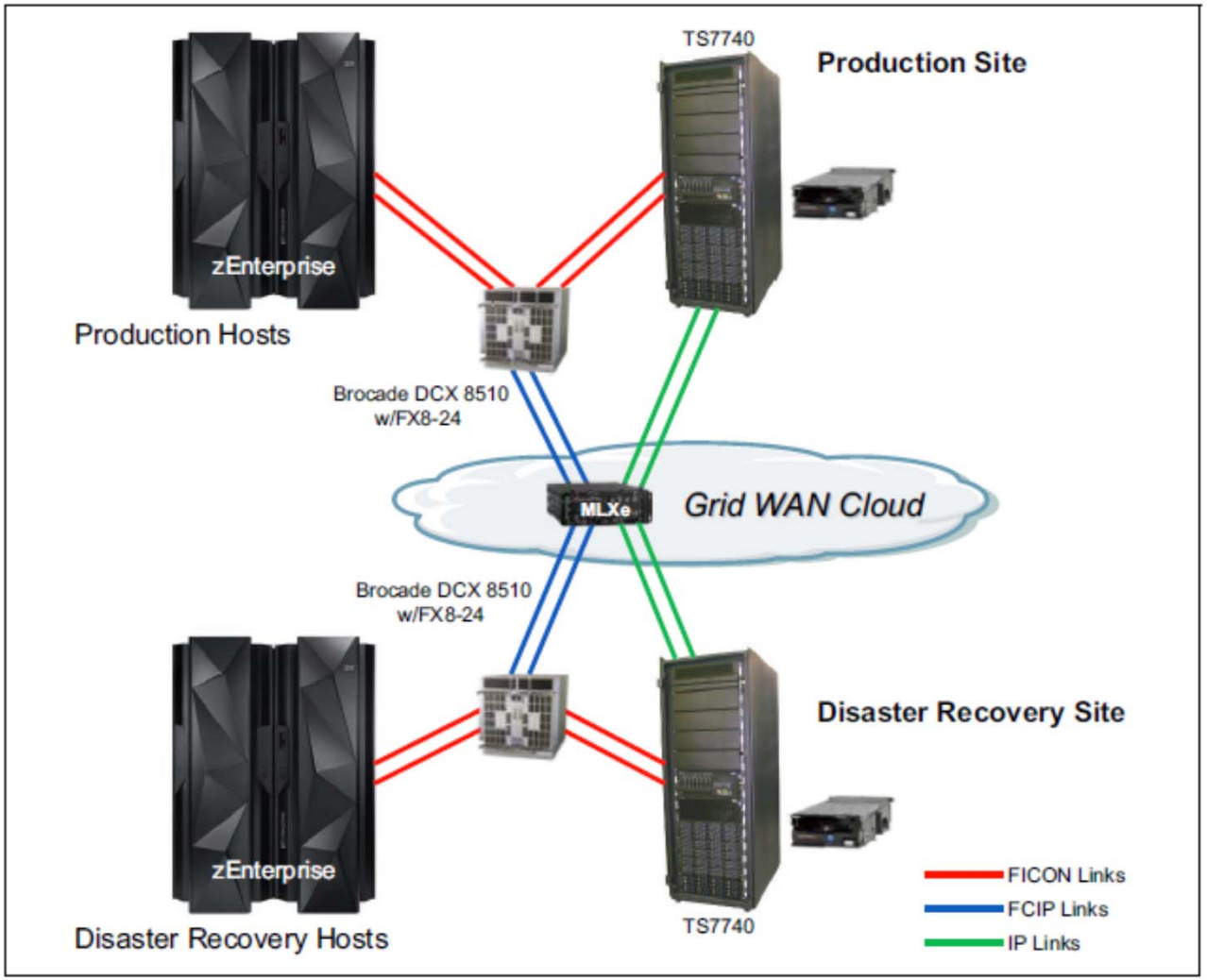
Example Architecture: Two Cluster Grid Configuration for Disaster Recovery & Availability

- The two TS7700s are located at two sites geographically separated
- Interconnected through a Wide Area Network
- The local host connects to the remote TS7700 through channel extended FICON interfaces making data available through either TS7700
  - Vary devices online when needed
  - Ownership Takeover Manager enabled automatically when one of the TS7700 fails



[1]Supported by TS7740 Model only

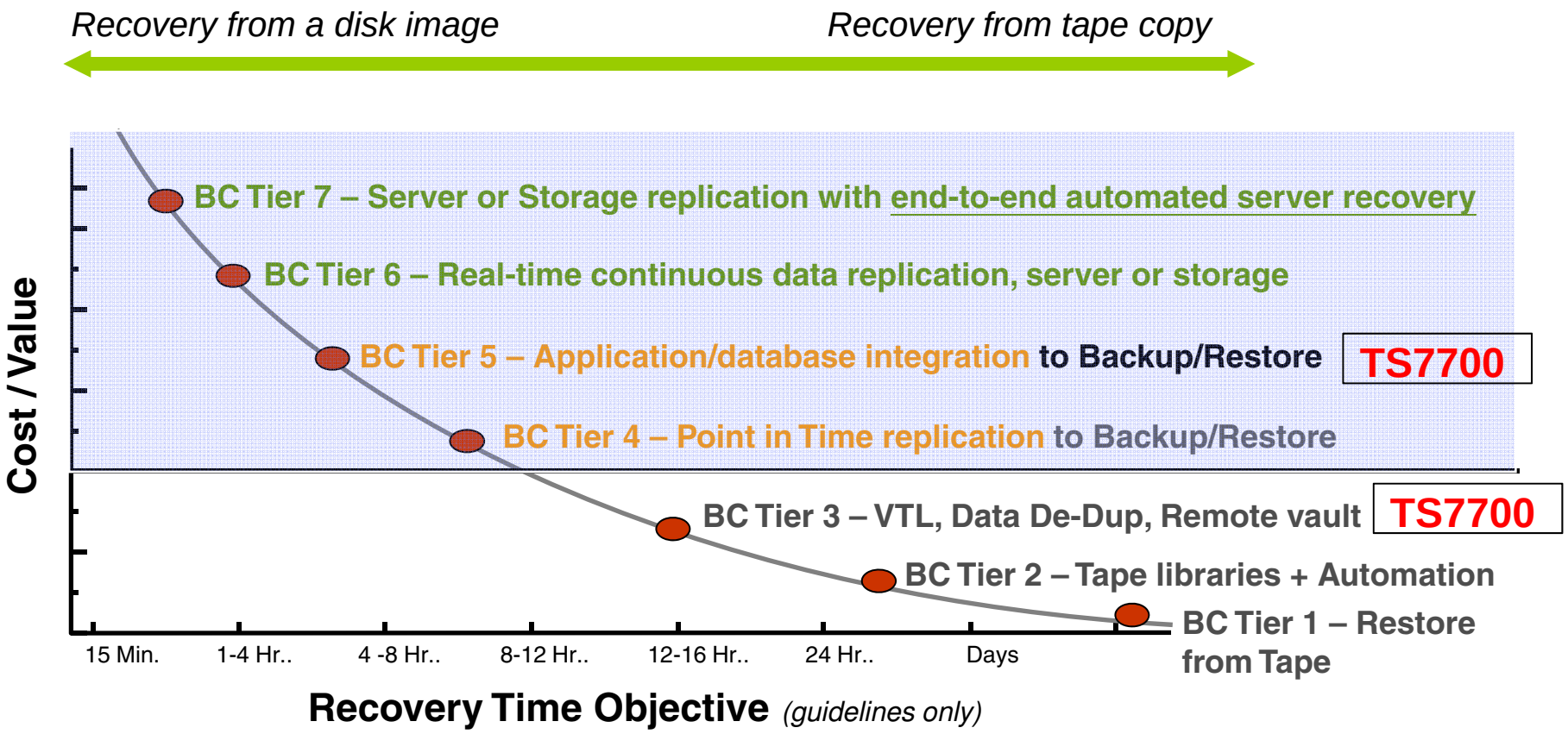
Example: IBM and Brocade integrated TS7700 Grid Network



Integracija sa GDPS rješenjem

Business Continuity Tiered Solutions

Balancing Recovery Time Objective with cost and value



Disk Replication participates in BC Tiers 4, 5, 6, and 7

Integracija sa GDPS rješenjem

- GDPS 3.9 adds support for TS7700 grids.
- GDPS delivers functions related to monitoring and controlling the volume copy capabilities of a TS7700 grid.
- The GDPS Tape Remote Copy functions display the TS7700 clusters that have been defined to GDPS (both the grid configuration and the status of the clusters in the grid are displayed). You can also enable and disable copy operations for a single library, a single grid, or for all libraries in a given site.
- The NetView Status Display Facility (SDF) panels can be used to monitor for problems related to delays in copy processing, or to detect if copy processing is disabled. When the problems are resolved, the SDF alerts will automatically be removed.
- Additionally, new GDPS script commands have been added specifically to allow you to control TS7700 copy processing from GDPS scripts.

Integracija sa GDPS rješenjem – „connectivity”

Supported configurations include:

- A TS7700 in every site that contains a GDPS Control system.
- A TS7700 in a subset of the sites that contain a GDPS Control system.
- TS7700s in one or more sites that contain GDPS Control systems *and* TS7700s in sites that do not contain a GDPS Control system.
- All GDPS Control systems require FICON attachment to all TS7700s that are within the supported distance. This connectivity is required in order for GDPS to be able to communicate with the TS7700 grid if the locally-attached TS7700 is unavailable for some reason.
- Note that FICON channels can be shared between multiple partitions in the TS7700.

Potential Business Benefits

Potential Customer Benefits

- ✓ **Find your data faster and put it to work sooner**
  - Restore backups up to 30% faster with new POWER7 processors in the TS7700 Virtual Tape Library
  - Fast access to data on 'virtual volumes' on the disk buffer
  - Continuous operation thru Automated failover capabilities
- ✓ **Store more data in less space**
  - Store 4 million virtual volumes regardless of the number of clusters in the gird and reduce both hardware and floor space requirements
  - Store 40% more data with the TS7720
- ✓ **Protect your investment**
  - Cost effective storage by optionally migrating 'virtual volumes' to physical tape
  - Makes lower TCO possible for data protection and long term retention
  - Protects customer investment by providing upgrade path for current installations and legacy read media on previous generation (JJ/JA when using TS1140 Tape Drive)
- ✓ **Secure your data**
  - Hardens business continuance environment
  - Increased security with end to end encryption of customer data to help meet regulatory guidelines

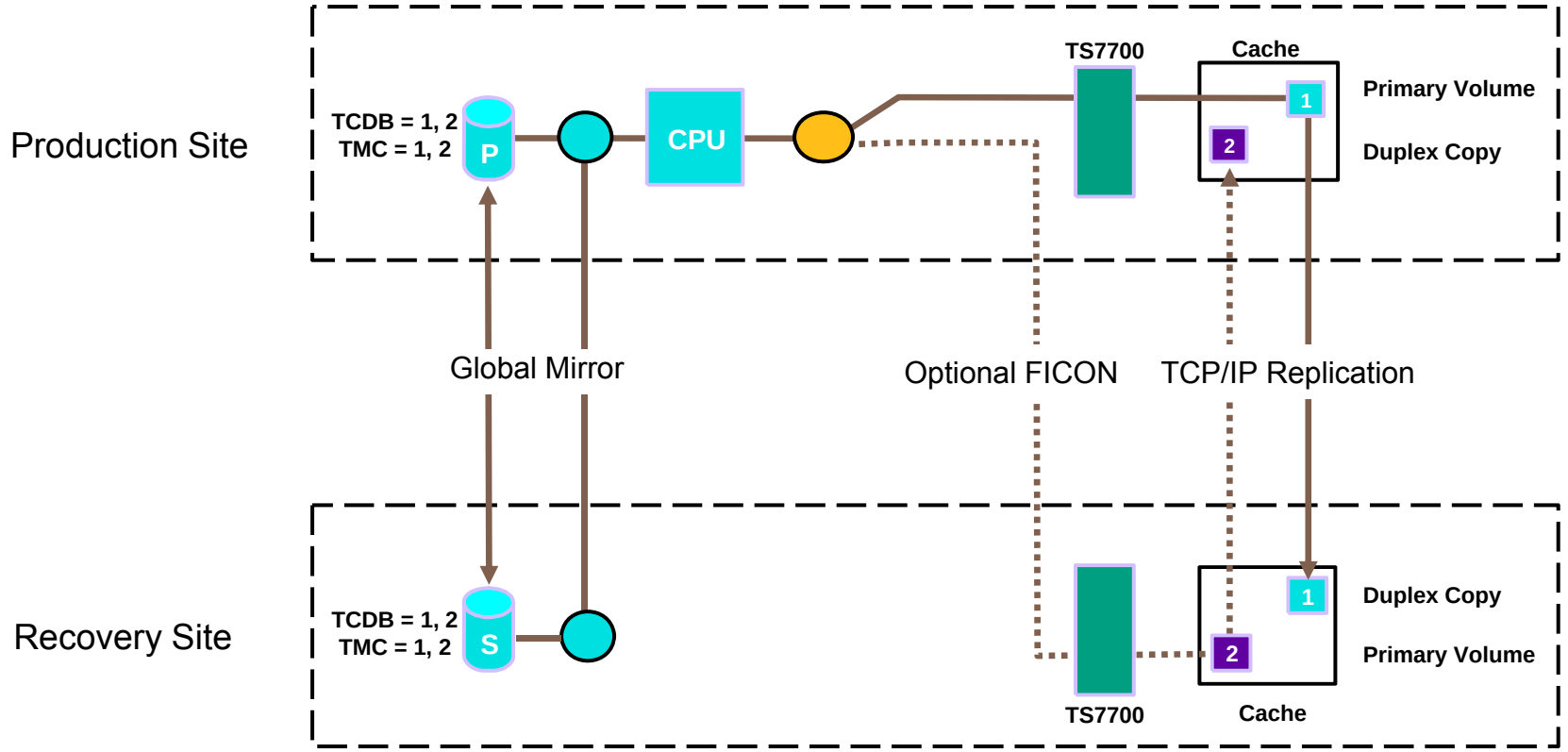
Why choose the IBM TS7700 Virtualization Engine?

- IBM provides technology that matters
  - The 1st generation Virtual Tape Servers (VTS) completely changed tape processing
  - The 2nd and 3rd generation VTS increased performance and capacity
  - The PtP VTS hardened business continuance and reduced recovery time
  - Only IBM provides an entire solution spectrum from disk only virtual tape, to hybrid disk and tape to mostly physical tape
- IBM continues to invest in tape technologies
  - Acknowledged in the industry as a leader in tape drive technology
  - Offers a full range of tape drives, libraries and virtual tape subsystems
  - Offers the full complement of software and services to maximize your ROI
  - Offers data protection via tape drive encryption support
- The TS7700 supports a further reduction in cost by
  - Virtualizing more of your data at a lower cost on fewer resources
  - Automating storage management through full DFSMS support
  - Reducing configuration and environmental requirements
  - Providing high performance and cache capacity

*DFMS= Data Facility Storage Management System

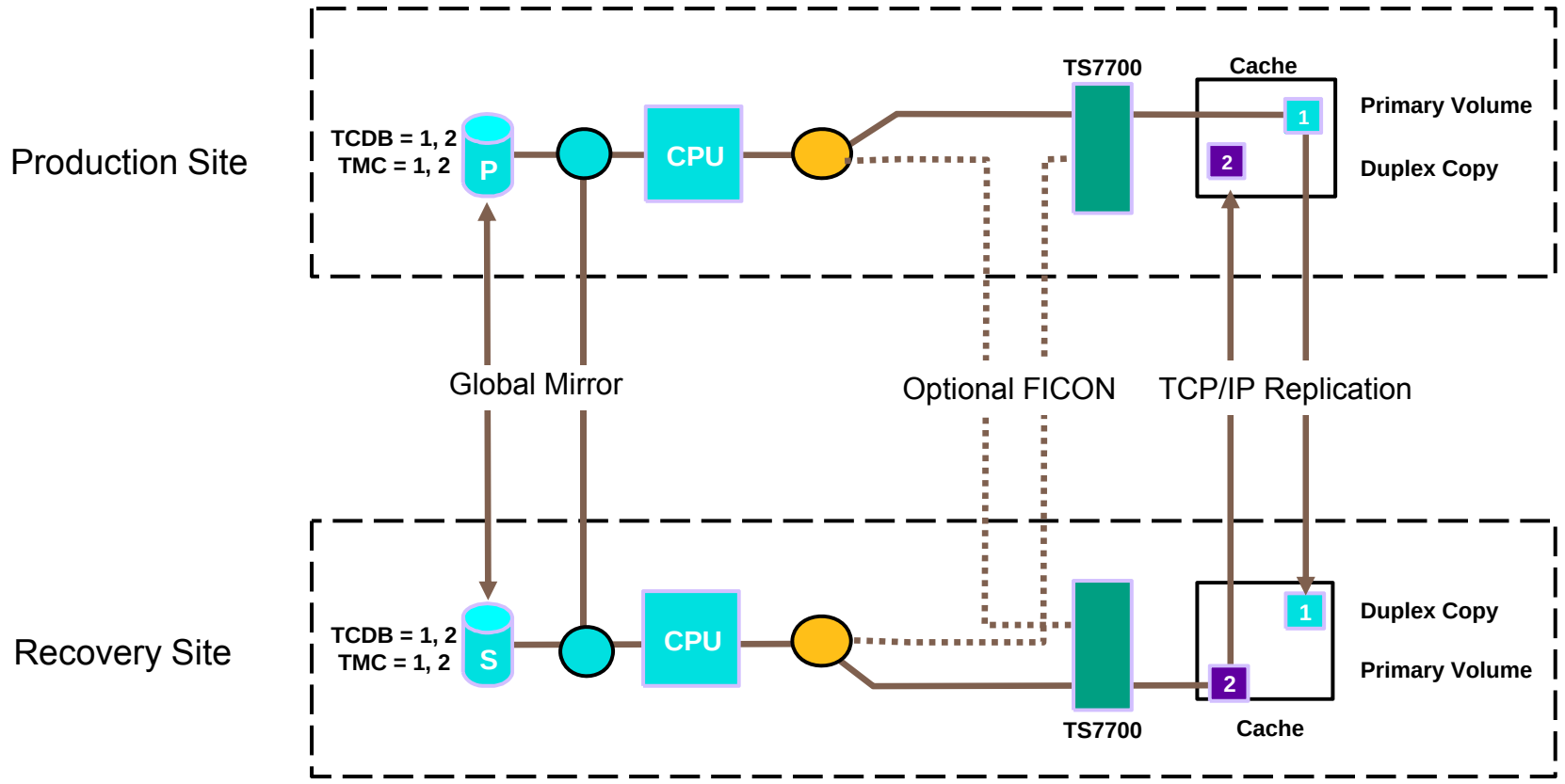
Hvala!

Example: TS7700 supporting Tier 3 Business Continuity



This diagram is meant to illustrate the logical process of the primary and secondary virtual volume copy creation, and does not include all steps in the process.

TS7700 supporting Tier 5 Business Continuity



This diagram is meant to illustrate the logical process of the primary and secondary virtual volume copy creation, and does not include all steps in the process.

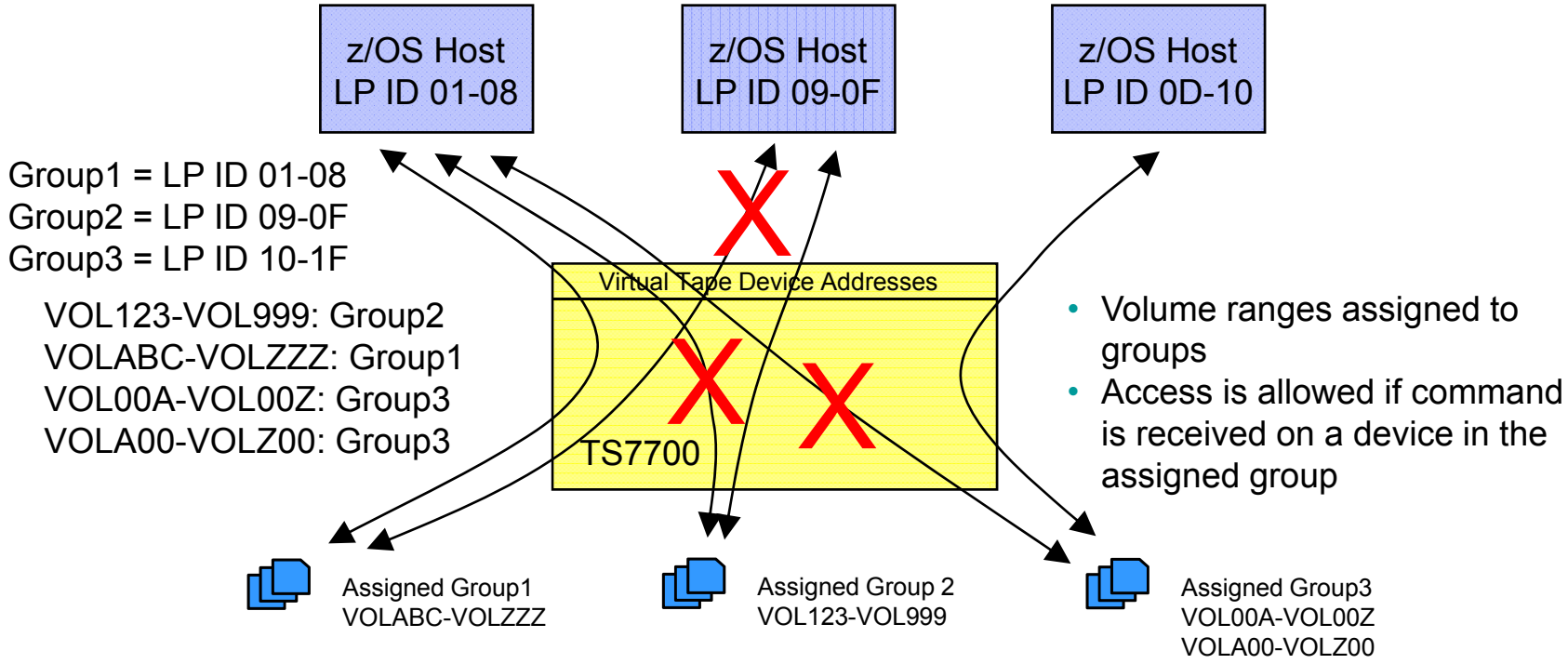
R3.0: New Disk Cache Controller

- TS7720
  - RAID6 (3 TB 3.5” NL-SAS Drives, 12 drive 2U drawers)
  - Up to 240 TB usable capacity within base frame (690TB @ 3:1 comp)
  - Optional 2nd frame with up to 384 TB additional capacity
  - Maximum TS7720 usable capacity of **624 TB** (1.86 PB @ 3:1 comp)
  - Existing TS7720 Upgrade
    - Add 2nd frame to existing TS7720 single frame systems
  - Single drawer increment expansion (~24TB per drawer)
- TS7740
  - **RAID6** (600 GB 2.5” SAS Drives, 24 drive 2U drawers)
  - 28TB (84TB @ 3:1 comp)
  - 1,2 and 3 drawer configurations
- AES 128 bit Encryption
  - All drives in both the 7720 and 7740 are encryption ready. Zero impact to performance.
  - Once encryption feature installed, all existing content and new content is encrypted
  - Internal key management
  - Secure data erase across entire cache even if encryption is not enabled

Multi-tenancy – Selective Device Access Control

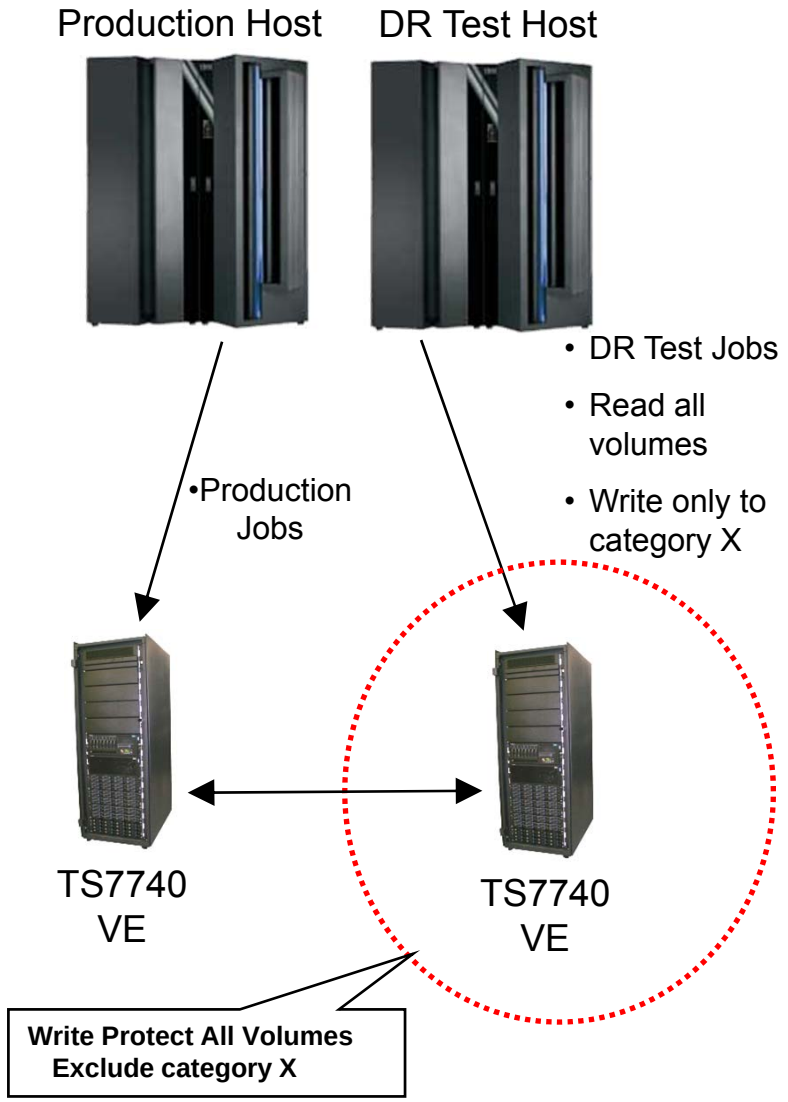
Enables hard partitioning of a TS7700 between several hosts

- Blocks access and control of volumes created by one host from the other hosts
- Separated by tape management systems, independent volume ranges and scratch pools
- Access is allowed through specific Library Port IDs (virtual device addresses)



Selective Write Protect for Disaster Recovery

- Management interface extension of cluster write protect
  - Allows certain categories to be excluded from cluster scope write protection
- Used for DR testing
  - Allows customer to simulate a DR scenario
  - Allows DR test site to read production data while still being able to write DR test volumes within pre-configured categories
  - Prevents DR test from modifying production volumes



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