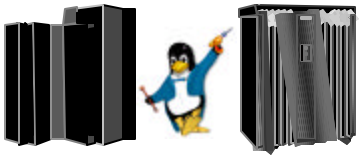
IBM Systems Group

Linux on zSeries™ and IBM TotalStorage™



Curtis Neal
San Jose, Ca

IBM TotalStorage ™ Executive Briefing Center in San Jose

- IBM TotalStorage Demos on multiple server platforms including; IBM... zSeries, pSeries, xSeries, iSeries, SUN & HPQ all connected via a SAN infrastructure
- Demos include:
  - ESS & FAStT Storage Systems
    - Availability & Failover
    - Management & Configuration
    - FlashCopy
    - PPRC
  - SAN Volume Controller
  - SAN Management & Configuration
    - CISCO, Brocade & McData
  - NAS Gateway
    - Management, Configuration, Availability
  - LTO & VTS
  - Tivoli Storage Products
    - TSM, SRM, HSM, LAN Free Backup to LTO

- **Customer Briefing Demonstrations**
- **Outbound Sametime Web Customer Briefing Demonstrations**
- **On-Site Outbound Customer Briefing Demonstrations**

Today's Computing Paradigm

Early

From access,
to publishing
static marketing materials
online
and enabling transactions
via standalone
point solutions

Integrating

Linking internal systems
and extending them to
partners

On Demand

Evaluating business
models
that combine people,
applications and
infrastructure
in new ways

Distributed Computing:
Grid
(Globus -> OGSA)

Applications:
Web Services
(SOAP, WSDL, UDDI)

Operating System:
Linux

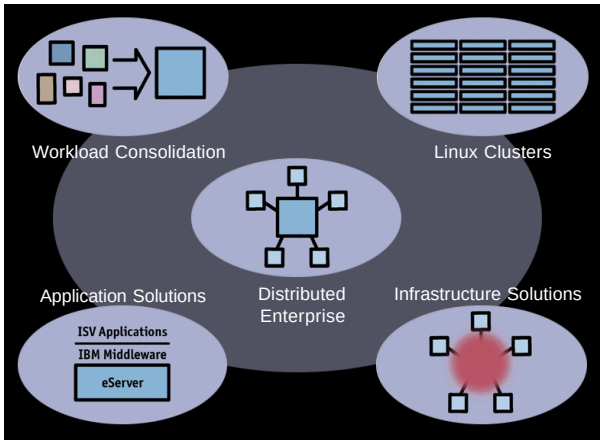
Information:
World-wide Web
(html, http, j2ee, xml)

Communications:
e-mail
(pop3,SMTP,Mime)

Networking:
The Internet
(TCP/IP)

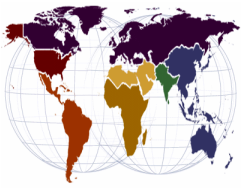
e-business

How Customers are using Linux



IBM Industry Leadership Supporting Linux

- **$1 Billion total investment**
- **Creation of Linux Solution Porting Centers**
  - **Centers located in:**
    Paris and Montpellier, France;
    Greenock and Hursley, UK;
    Boeblingen, Germany;
    Warsaw, Poland;
    Budapest, Hungary;
    Tokyo, Shanghai, Beijing, Taipei, Seoul, Bangalore.
  - **U.S. centers in San Mateo, CA, Chicago, and Waltham, MA**
- **Linux Technology Center**
  - Center of Linux competence across IBM
  - Enterprise enable Linux operating system through development and contribution of utilities, tools, and code - "make Linux better"
  - 200+ developers worldwide
- **Open Source Development Lab**
  - Independent, non-profit lab for Open Source developers adding enterprise capabilities to Linux to share development ideas and innovations
- **IBM Global Services Consulting and Support**
- **IBM Research Contributions**
- **Linux support across IBM**
  - Growing Linux availability across ***entire*** ^ product line
  - Growing Linux support across TotalStorage disk and tape line
  - Middleware solutions
    - DB2®, Websphere®, Lotus Domino, MQ Series, Tivoli Storage Manager, etc.
- **Working Closely with Distributers**



redhat SuSE Linux turbolinux.

UNITEDLINUX

Linux available today for zSeries:

- S/390 and zSeries family
- World's most scalable server
- z800 and z900 models supported
- S/390 G5, G6, Multiprise 3000
- Bullet-proof reliability
- Dynamic workload management
- DB2, WebSphere, MQ, Java, Tivoli
- Linux Distributions
- Linux for S/390 for 32-bit architecture
- Linux for zSeries for 64-bit architecture
- Linux distributions from: Red Hat, SuSE, and Turbolinux
- Variety of Operational Modes
- Logical Partition (LPAR)
- Integrated Facility for Linux (IFL) engines
- Guests under VM/ESA, z/VM
- z/VM v4 can run on IFL engines

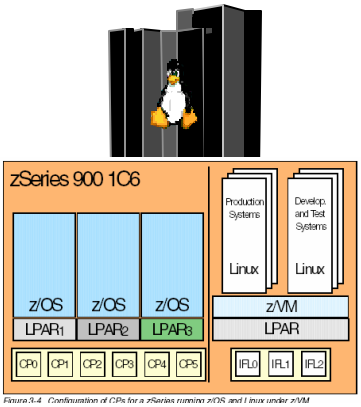


Figure 3-4 Configuration of CPs for a zSeries running z/OS and Linux under z/VM

IBM®

Why IBM Storage for Linux?

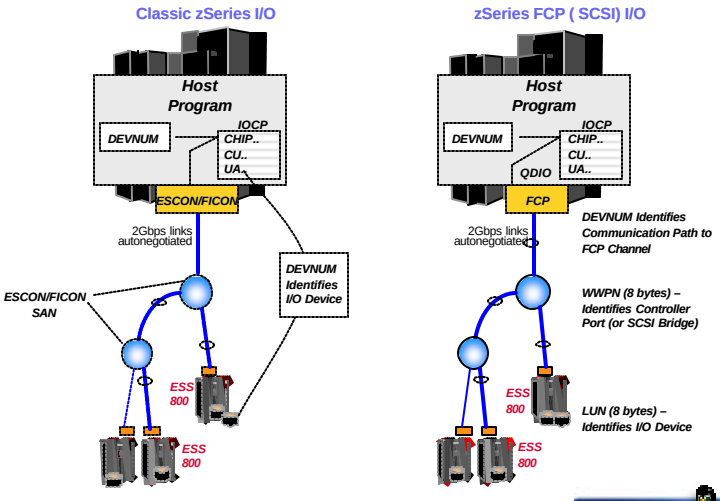
Value proposition

IBM provides a comprehensive Linux strategy that includes all elements, hardware, software and management tools to provide complete infrastructure for the major IT workloads.

IBM storage on Linux provides

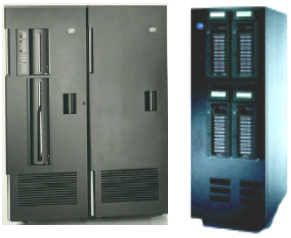
- Pre-tested combinations of disk (high-end and mid-range), tape and networked storage and the major Linux distributions
- A clear strategy of deploying Linux in storage (from attachment to enablement and exploitation)
- Alignment with IBM eServer and software to offer the most appropriate combinations to serve a wide variety of customer needs, all exploiting the benefits of open source and heterogeneous environments made possible by Linux

Traditional vs FCP-based Storage



Linux on zSeries Storage Portfolio Support

Enterprise Storage Server



Magstar Enterprise Tape

Linear Tape Open

Enterprise Storage Server

Host Attachments available:

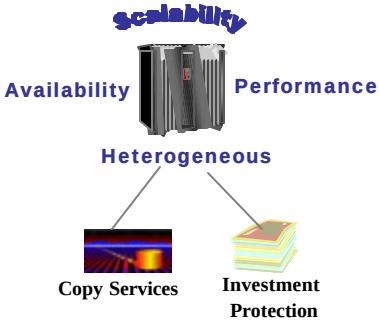
- UltraSCSI
- FC-AL and Switched Fibre Channel (FC-SW)
- ESCON and FICON

Powerful Features:

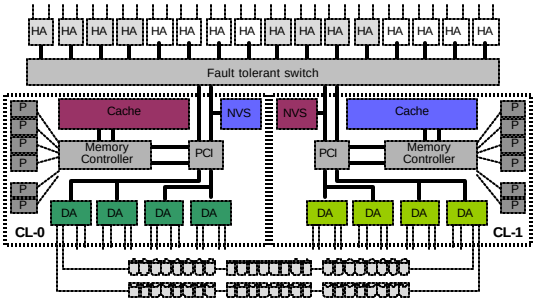
- ESS Fxx JBOD, RAID5 levels supported
- ESS 800: RAID5 and RAID10 levels supported
- Subsystem Device Driver (SDD) dynamic multi-pathing
- Peer-to-Peer Remote Copy (PPRC)V2, FlashCopy V2
- Scalable from 420GB to 55TB useable capacity
- Full fault tolerance and redundancy
- IBM Standby Capacity on Demand for ESS
- Shipped over 14,000 ESS's and 35,000 Petabytes

Linux Support:

- **zSeries**: 2.2.x kernel: SuSE Enterprise Server, TurboLinux 6, ESCON
- zSeries: 2.4.x kernel: SLES 8, UnitedLinux1.0 FICON, UnitedLinux 1.0 SP2 FCP
- **xSeries:** Linux-Intel Red Hat 7.1 7.2 7.3, RHAS 2.1 SuSe 7.2 7.3 SLES 7 UnitedLInux 1.0 FC on F10/F20/800 models, see Interoperability Matrix for Linux kernel levels
- **iSeries:** SuSE Enterprose Server 7 for iSeries 2.4.13, UnitedLinux 1.0 ppc64-2.4.19-186 (SP1)
- **pSeries:** UnitedLinux 1.0 ppc64-2.4.19-186 (SP1)



ESS Architecture



RISC Processors: Storage Management Software

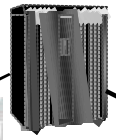
Host Adapter Interface: SCSI, FICON, Fibre Channel, ESCON

Device Adapters: Stuff Done Here

RAID-5 and RAID10 Intermix: 10k RPM - 18GB, 36GB, 72GB, 145GB
15k RPM - 18GB, 36GB, 72GB

ESS Advanced Management

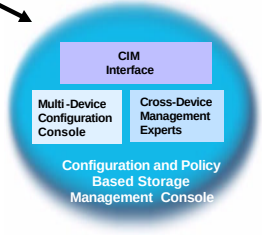
- **ESS Specialist - built-in**
  - Status, configuration, authorization
  - Notification (e-mail, pager, SNMP)
  - Capacity reassignment
  - Copy Services initiation
  - Web-based management
  - One or more ESS's - any location



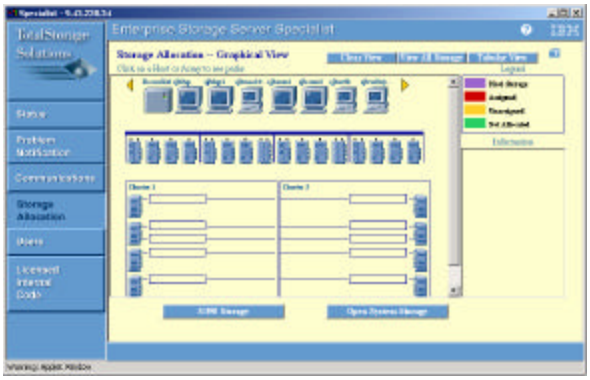
ESS CLI

Automates Routine configuration/management tasks

- Asset Management
- LUN Masking
- Space Management
- Volume Identification
- Host Connections
- Audit Log
- Parallel Access Volumes (PAV)
- Copy Services

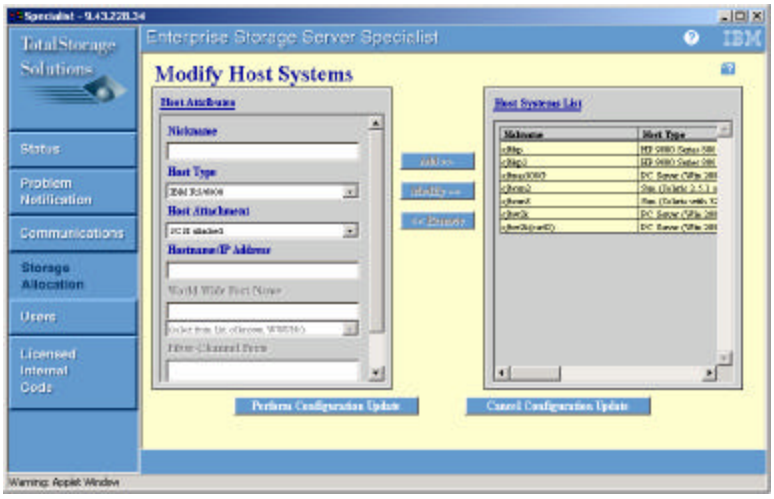


ESS Specialist

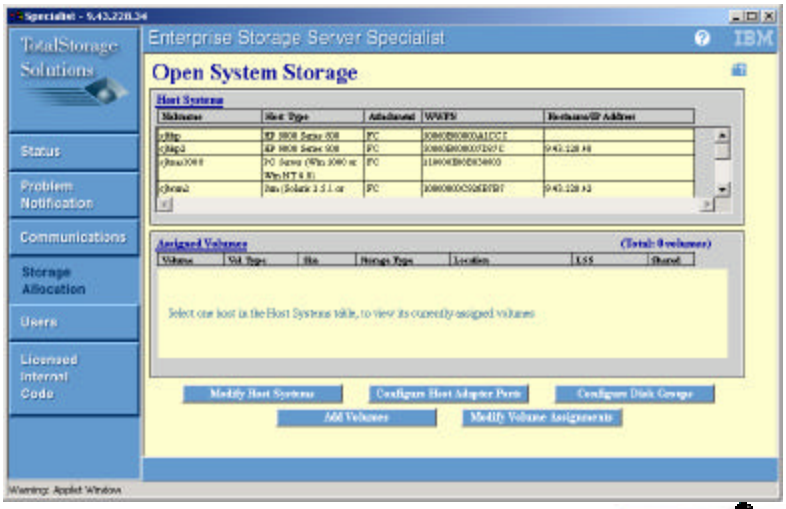


Example 1 IOCP definitions
RESOURCE PARTITION=((A1,1),(A2,2),(A3,3),(A4,9),(A5,A),(A6,B), *
(C1,4),(C2,5),(C3,C),(C4,D),(LINUX1,6),(LINUX2,7),(ZOSE1,8))
CHPID PATH=(**14**),**SHARED**, *
PARTITION=((LINUX1,LINUX2),(LINUX1,LINUX2)),TYPE=**FCP**
CNTLUNIT CUNUMBR=0600,PATH=(14),UNIT=FCP
IODEVICE ADDRESS=(600,**064**),CUNUMBR=(0600),UNIT=**FCP**

Linux on zSeries FCP Definition



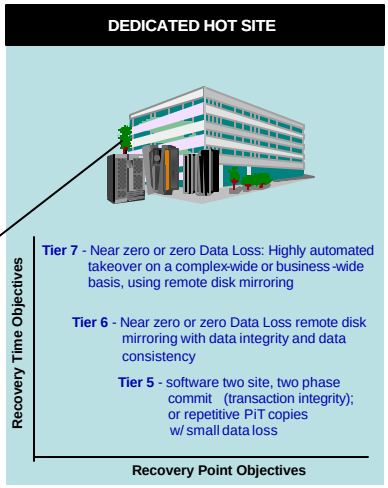
Linux on zSeries FCP LUN Definition



On Demand raises expectations

- **Business continuity**
  - Requires storage that supports data availability so that employees, customers and trading partners can access data 24×7 through reliable, disaster-tolerant systems.
- **Business efficiency**
  - Where storage is concerned, is the need for investment protection, reduced total cost of ownership and high performance and manageability.

Comprehensive *solution* to Disaster Recovery
1. Server
2. Storage
3. Software and Automation
4. Networking



Many kinds of unplanned outages

A/C Failure
Acid Leak
Asbestos
Bomb Threat
Bomb Blast
Brown Out
Burst Pipe
Cable Cut
Chemical Spill
CO Fire
Condensation
Construction
Coolant Leak
Cooling Tower Leak
Corrupted Data
Diesel Generator
Earthquake
Electrical Short
Epidemic
Evacuation
Explosion
Fire
Flood
Fraud
Frozen Pipes
Hacker
Hail Storm
Halon Discharge
Human Error
Humidity
Hurricane
HVAC Failure
H/W Error
Ice Storm
Insects
Lighting
Logic Bomb
Lost Data
Low Voltage
Microwave Fade
Network Failure
PCB Contamination
Plane Crash
Power Outage
Power Spike
Power Surge
Programmer Error
Raw Sewage
Relocation Delay
Rodents
Roof Cave In
Sabotage
Shotgun Blast
Shredded Data
Sick building
Smoke Damage
Snow Storm
Sprinkler Discharge
Static Electricity
Strike Action
S/W Error
S/W Ransom
Terrorism
Theft
Toilet Overflow
Tornado
Train Derailment
Transformer File
UPS Failure
Vandalism
Vehicle Crash
Virus
Water (Various)
Wind Storm
Volcano

Source: Contingency Planning Research, Inc.., 1/30/95

ESS Disaster Tolerance over distance

- Continuous synchronous protection
  - **Peer to Peer Remote Copy (PPRC)**
- Point-in-time asynchronous protection
  - **Extended Distance (PPRC-XD)**
- Continuous asynchronous protection for z/OS
  - **Extended Remote Copy (XRC)**

Distance, Flexibility, Integrity and Automation

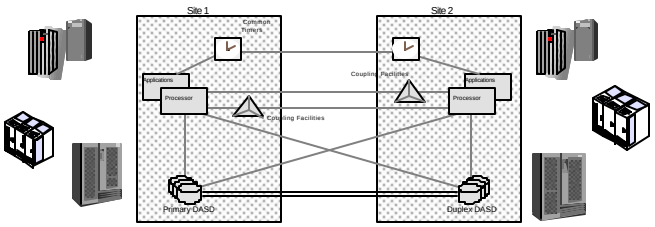
Channel Extension Technologies

- Ongoing effort for joint testing to allow IBM Business Partners to certify their support of OC3/T1/T3/E1/E3/ATM/IP channel extension of PPRC-SYNC and PPRC-XD

Lucent Technologies
INRANGE
CNT
AUSPEX
NORTEL NETWORKS
CISCO SYSTEMS

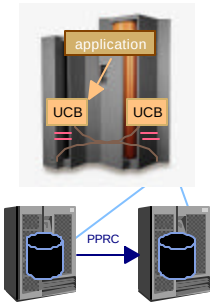
TotalStorage Proven vendors, including *(but not limited to)*

GDPS system-wide HW & SW Solution



- Available today: S/390 Geographically Dispersed Parallel Sysplex
  - directions: eGDPS for centralized control of zSeries and Open
- Open Systems hardware and software:
  - *ESS PPRC software manager* for addressing Open Systems and Clustering
- TotalStorage server software to manage *all* system events
  - Disk, tape, virtual tape servers, inter-system coupling facilities, timers
  - Open, non-proprietary

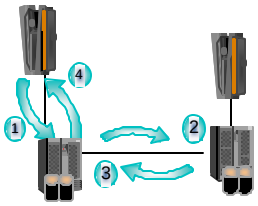
GDPS/PPRC and Hiperswap function



- **Preview: New zSeries GDPS 2.7 capability**
  - Integration of GDPS, z/OS, and ESS microcode
- **Stage 1 of GDPS/PPRC hyperswap function will provide:**
  - Application continuous availability during swap of GDPS/PPRC primary/secondary disk subsystems
    - Disk configuration maintenance
    - Planned site maintenance
  - Significantly shortened GDPS/PPRC site switch time
  - Very scalable - can swap large number of disk devices quickly
  - Ability to re-synchronize incremental changes in both directions between primary / secondary PPRC disks
- **GDPS exploitation will be progressively enhanced**
  - In subsequent GDPS releases, GDPS/PPRC hyperswap function will provide unplanned outage support with non-disruptive failover to secondary disk subsystem(s)

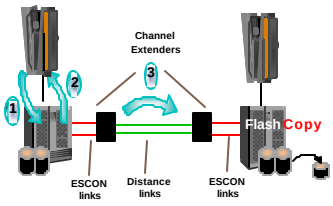
Integrates IBM eServer and TotalStorage technologies together to provide a comprehensive application and data availability solution

ESS Peer to Peer Remote Copy V1



Industry leading initial copy time, performance, and scalability for disk mirroring

- Volume/LUN level copy, S/390 and Open data. Two modes:
  - ***Fully synchronous mode (PPRC-SYNC)***
    - **standard distance 103km**
    - **slightly longer distance possible via RPQ**
- Very fast initial copy, resync, performance
  - **More efficient PPRC protocols than previous technologies**
  - **PPRC dynamically spreads all workload across all paths between volume/LUN**
- z/OS PAV masks PPRC write impact up to 75 KM
  - *Significant differentiation*
- Ability to FlashCopy from PPRC Primary or Secondary

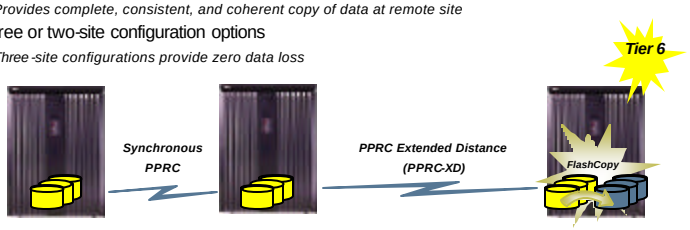


PPRC-XD is a powerful tool for ESS disk mirroring

- Non-synchronous ESS disk mirroring at continental distances
- Minimal write impact, high performance regardless of distance
- Open and zSeries data
- Ideal for long distance data copy, data migration, transmission of log files
- Powerful **'Catchup'** methodology' to provide data consistency

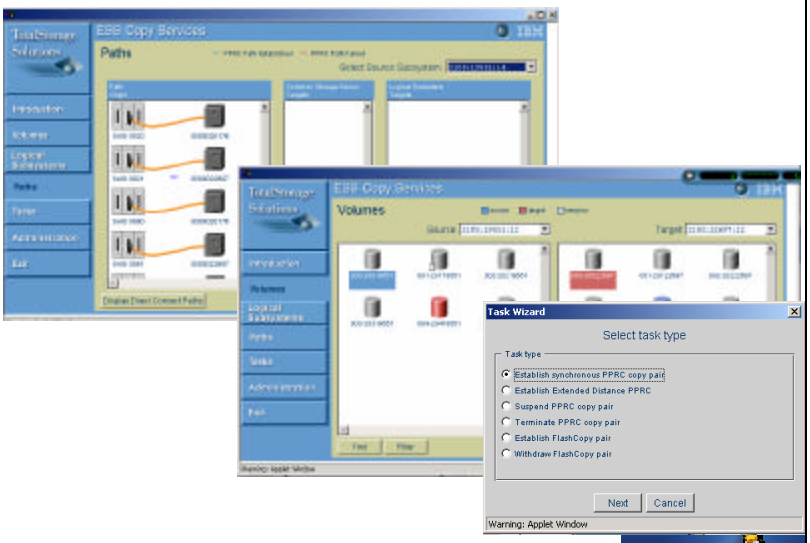
ESS Asynchronous Cascading PPRC

- **Concept**
  - PPRC secondary volume serves as PPRC primary volume for another PPRC relationship (same volume serves as both)
- **Intended benefits**
  - Long distance remote copy solution for zSeries and open systems data
    - *Provides complete, consistent, and coherent copy of data at remote site*
  - Three or two-site configuration options
    - *Three-site configurations provide zero data loss*



***An enhanced Tool* for Continuous Availability, Disaster Recovery, Unlimited Distance**

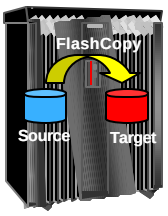
ESS Peer to Peer



ESS FlashCopy V1

- **Fast (T0) Point in Time disk copy**
  - Volume level
  - Target and source immediately available for r/w access as soon as microcode initialization complete
- **Industry leading Point in Time initialization speed, performance, and scalability**
  - ESS Model 800 FlashCopy has significant performance and scalability enhancements over ESS F model
  - Sample reduction for 720 GB:
    - •ESS F20: 26.1 seconds elapsed time
    - •ESS M800: 7.6 seconds elapsed time

FlashCopy is installed on one out of every two ESS's



I/Os to data already copied handled as normal

Writes to data not yet copied *on either volume* cause "copy on demand" then handled as normal

Reads to data not yet copied redirected to source volume

ESS FlashCopy with Databases

Consistent Backups **- speed of Flash Copy permits offline backups where not previously possible**

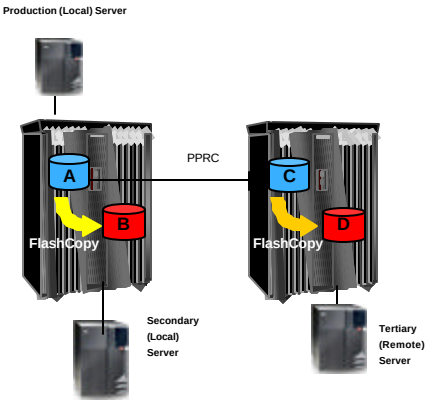
Shutdown Oracle

- **Perform FlashCopy Backup from (A) to (B) or (C) to (D)**
  Start Oracle

Online ("Fuzzy") Backups **- no downtime with minimal impact to production system**

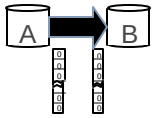
Both reads and writes can continue

- **Begin backup mode for each tablespace**
- **FlashCopy volumes containing data/indexes**
- **End backup mode for each tablespace**
- **Create backup control file**
- **Archive all online redo log files**
- **FlashCopy volumes containing backup control file and archived redo logs**

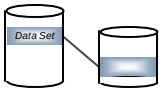


ESS FlashCopy Advantages

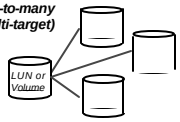
Incremental FlashCopy
(Copies only changed data)



Data Set FlashCopy
between volumes of different size
(with different location in the volumes)



One-to-many
(multi-target)

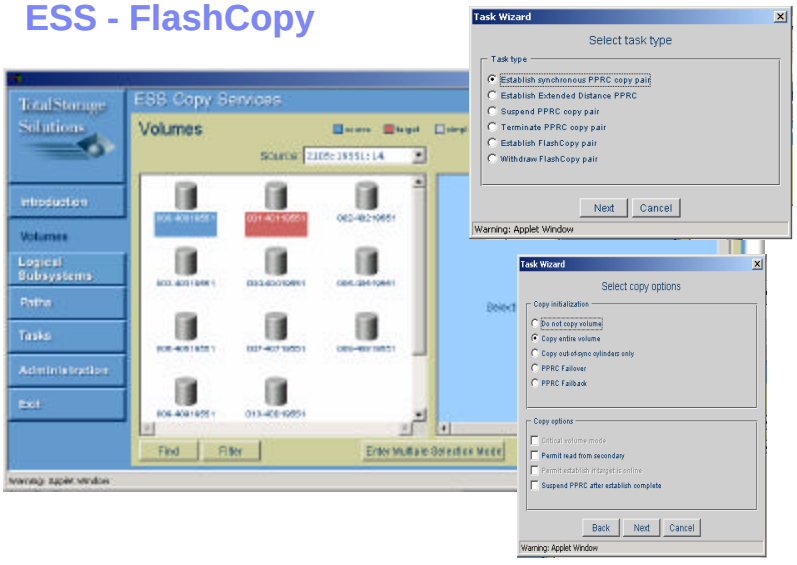


- **FlashCopy provides best-of-breed T0 performance and scalability for all Point in Time copies**
  - Faster: All FlashCopys are T0 including new Data Set FlashCopy
    - competitive EMC DS TimeFinder is not T0
  - Performance and scalability: at large scale for Point in Time copy
- **FlashCopy eBusiness Efficiency**
  - **Faster:** Significant performance improvements enable new applications for FlashCopy
  - **Easier to Manage:** FlashCopy Consistency Group enables ease of implementation and use at application level, scalable as can span multiple ESS's
  - **Performance, Scalability, increased utility / applicability:** Incremental FlashCopy enables additional scalability and performance, bidirectional capability enables additional user application capabilities
  - **Easier to Manage:** InBand FlashCopy - control remote FlashCopys via PPRC link
  - **Performance, Scalability:** FlashCopy continues with NOCOPY option for z/OS and Open Systems - minimizes controller overhead for 'write to tape' backup

Additional FlashCopy Enhancements

- **Consistency groups**
  - Concept
    - *Hold off initiation / completion of write I/O to the source volumes until FlashCopy establish is completed for all volumes in the consistency group*
  - Intended benefits
    - *Enables creation of a consistent point-in-time copy across multiple volumes with minimum host impact and no operator intervention required*
- **Elimination of Logical Subsystem (LSS) constraint**
  - Concept
    - *FlashCopy source and target may reside in different LSSs within a single ESS*
  - Intended benefits
    - *Improved flexibility*
    - *Simplifies capacity management and administration*
- **Establish time reduction**
  - Concept
    - *Reduce FlashCopy establish time to one second or less*
  - Intended benefits
    - *Improved performance, reducing application impact*
    - *Enables new FlashCopy applications (environments requiring rapid or numerous, repetitive establishes)*

ESS - FlashCopy



Linear Tape Open (LTO) Ultrium

New standard in tape jointly developed between IBM, Hewlett-Packard and Seagate

New LTO Ultrium 2 Features

- **200 GB Native Capacity (400 GB compressed)**
- **35 MB/s native (70 MB/s compressed)**
- **Native Switched Fabric 2Gb Fibre Channel Interface**
- **Speed Matching**
- **Channel Calibration**
- **Power Management (Sleep Mode)**
- **New IBM TotalStorage LTO Ultrium 2 Data Cartridge**
- **Backward Read/Write with Ultrium 1 Cartridge**
- **512 Tracks, 64 MB Buffer**
- **Surface Control Guiding Mechanism**
- **Magnetoresistive Flat Lap Head Design**
- **Servo Tracks**
- **Statistical Analysis and Reporting System and ECC**

S/390 and zSeries
UnitedLinux 1.0 FCP

May 21, 1952

Enterprise Tape Drive

3590 B11/B1A tape drive

- 10 or 20 GB native capacity cartridge
- 9 MB/sec native data rate
- Connectivity
  - ✓ **Ultra SCSI with dual data ports**
  - ✓ **San Data Gateway**
  - ✓ **ESCON**

3590 E and H tape drives

- 3590E: 20 or 40 GB native capacity cartridge
- 3590H: 30 or 60 GB native capacity cartridge
- 14 MB/sec native data rate
- Investment Protection
  - ✓ **Field upgradable from B1X Models**
  - ✓ **Media Reuse**
- Connectivity
  - ✓ **Native FC-AL with dual ports**
  - ✓ **ESCON**

Enterprise Tape

- High reliability
- Virtual tape servers with disk cache and volume stacking for zSeries
- Attaches to zSeries, pSeries, xSeries, Linux
- 60 GB per cartridge

zSeries support
SLES 8 for FCP
United Linux 1.0 FCP attached

IBM 3592 Tape Drive

Small form factor drive designed for automation

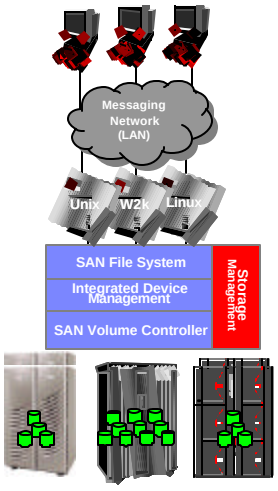
- The 3592 is an Enterprise Class tape drive that
- Increases performance to 40 MB/sec
- Increases capacity to 300 GB per cartridge
- Reduces time to first byte of data to 33 seconds
- Reduces average search time to 12 seconds
- Reduces rewind time to 20 seconds

- Uses a new IBM cartridge that can be initialized as a
- **60 GB cartridge to provide fast access to data or**
- **300 GB cartridge to provide high capacity**
- **The 3592 is supported in three 3494 frames**
  - **L22 library control frame (open and mainframe)**
    1 - 4 drives, 216 - 240 cartridges
  - **D22 drive frame (open)**
    1 -12 tape drives, 230 - 305 cartridges
  - **D24 drive frame (mainframe)**
    IBM 3592-J70 or 3590-A60, 275 - 345 cartridges

Includes a dual-ported 2 Gbit FC / FC-AL interface
- Auto-negotiate to 1 Gbit or 2 Gbit

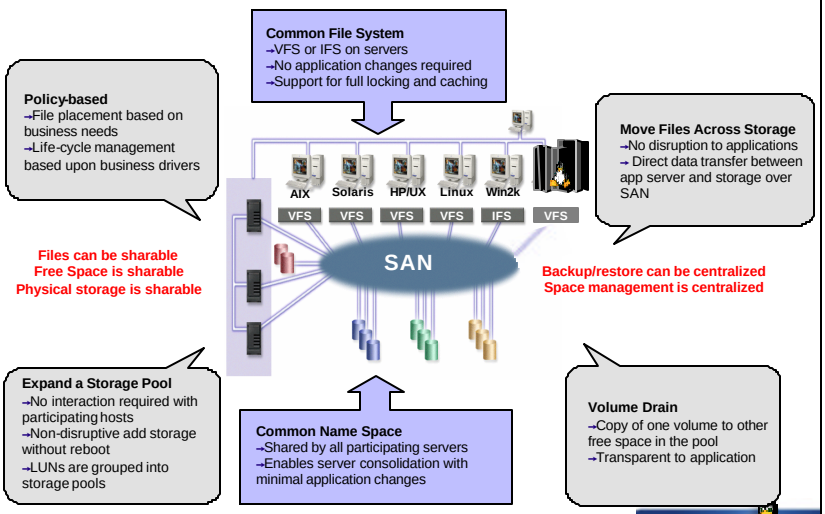
zSeries servers
using supported FICON features
with FC protocol support
SuSE Linux Enterprise Server 8.0

TotalStorage™ Virtualization



- Better management of SAN attached physical storage
  - **IBM SAN Volume Controller**
  - **IBM SAN Integration Server**
- Better management for files and databases on a SAN
  - **IBM SAN File System**
- Increased administrator productivity, flexibility and choice via open standards
  - **Integrated Device Management**
- Consistent management of storage as an enterprise IT asset
  - **Tivoli Storage Resource Management**
  - **Tivoli Storage Manager**
  - **Tivoli SAN Manager**

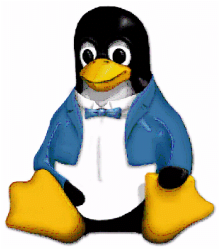
SAN File System Architecture



Linux in Summary

- **IBM continues to support LINUX across its eServer and Storage platforms including Tape, Disk, San and NAS**
- **IBM leads the industry in storage networking based on open, industry standards**
- **IBM delivers world-class disk and tape storage hardware, storage management software, and integrated solutions**

- Reduces customer costs
- Increases freedom of choice
- Fosters innovation
- Promotes a culture of open standards
- Rewrites the rules for operating systems



Questions ?

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