Session T05

IBM® TotalStorage® SAN Volume Controller Overview

Chris Saul

IBM @server xSeries Technical Conference

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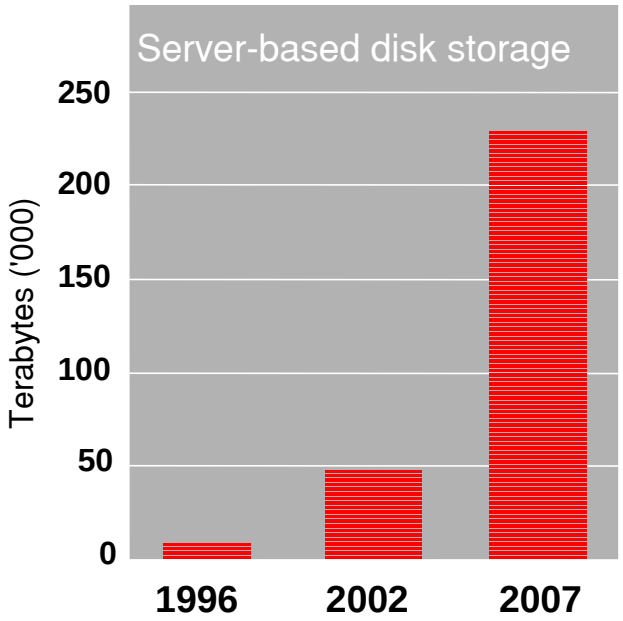
RETURN TO INDEX

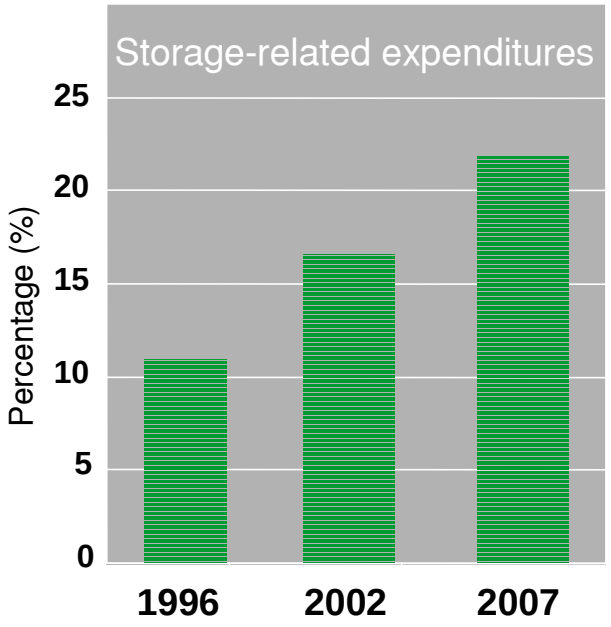
Storage Management Challenges - Real and Growing

In a typical Fortune 500 corporation…

Disk storage is growing rapidly



Storage-related expenditures*, as a % of IT budgets, is also growing rapidly

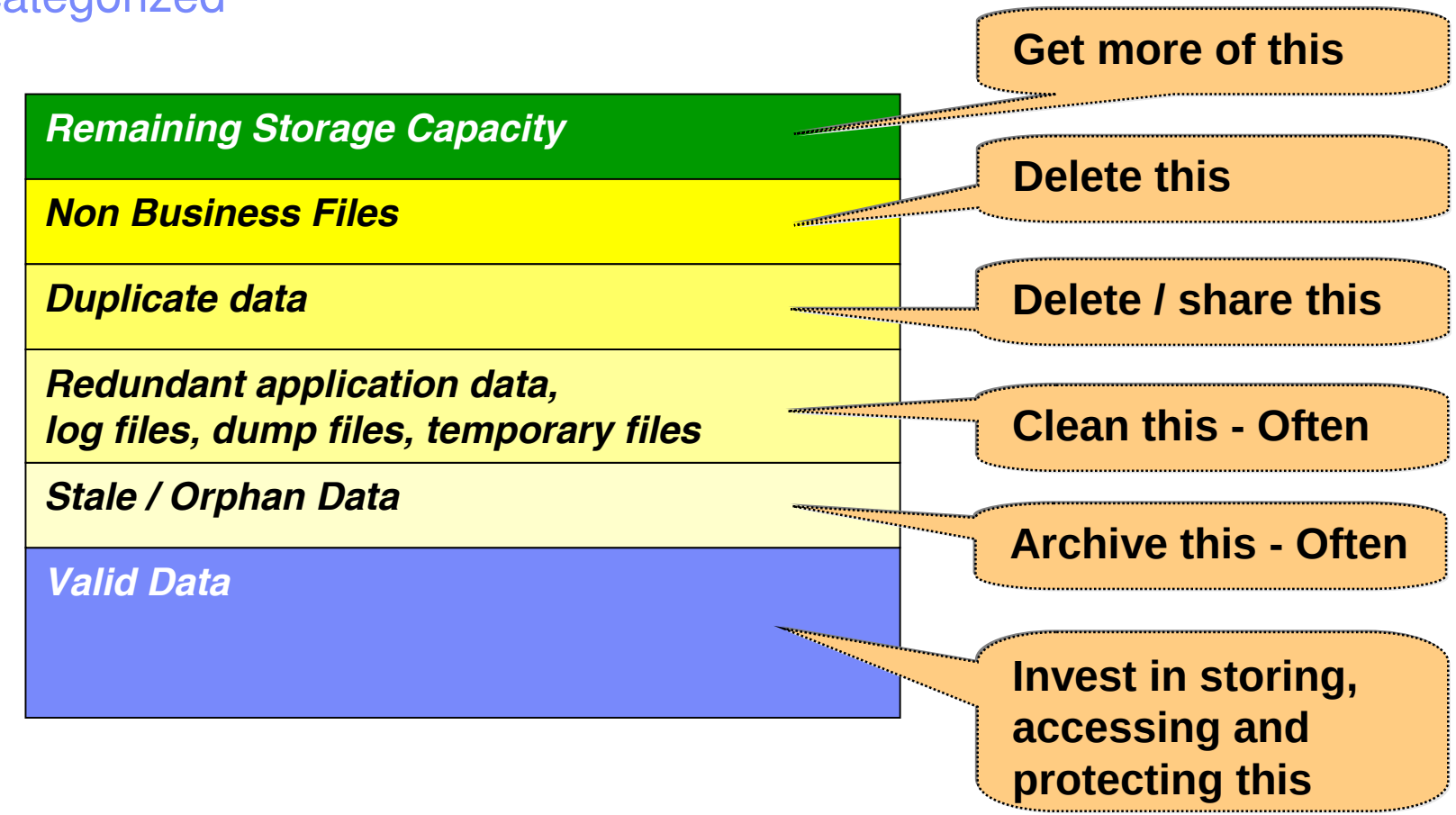


Source: International Technology Group, Sept 2003

* hardware, software, storage networking, personnel, backup operations, recovery, security

With an On Demand Storage Environment…

Data is categorized

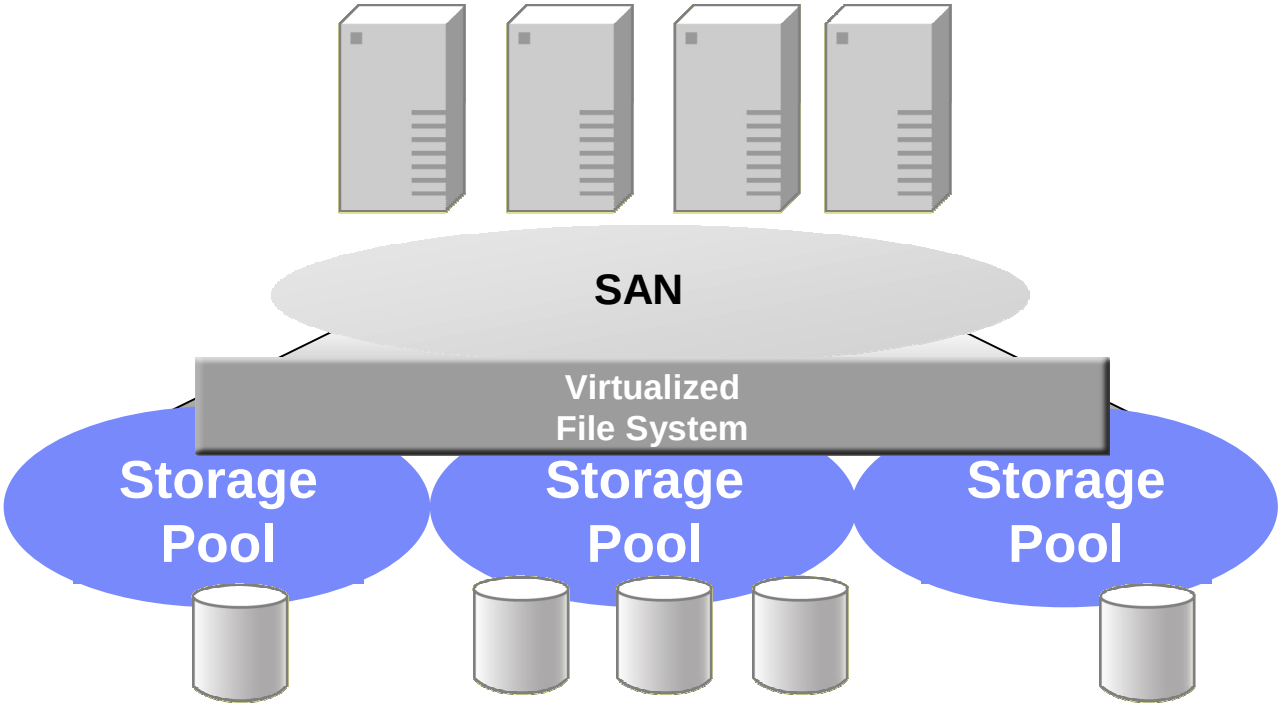


Source: International Technology Group, Sept 2003

* hardware, software, storage networking, personnel, backup operations, recovery, security

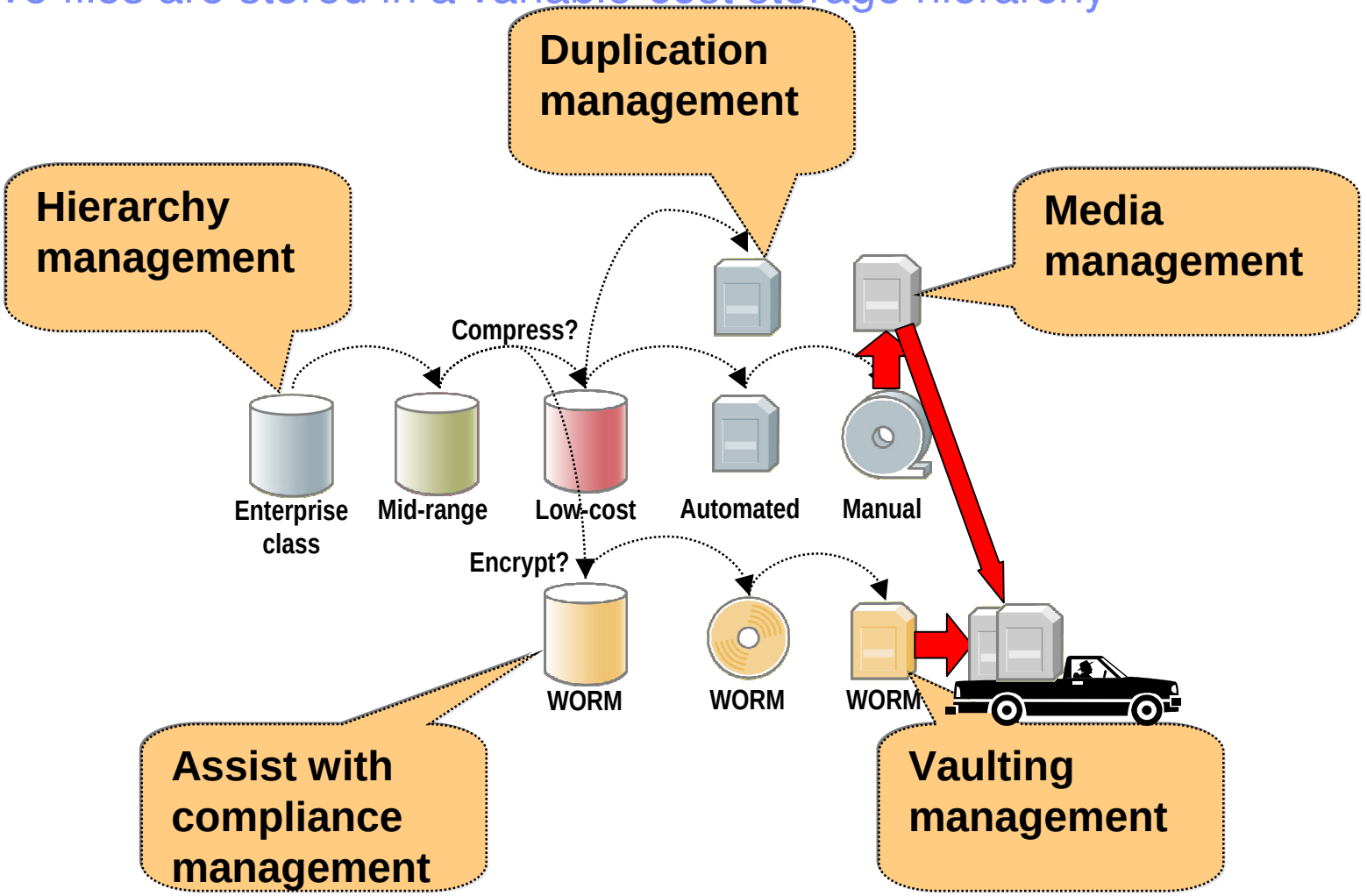
With an On Demand Storage Environment…

Active files are pooled



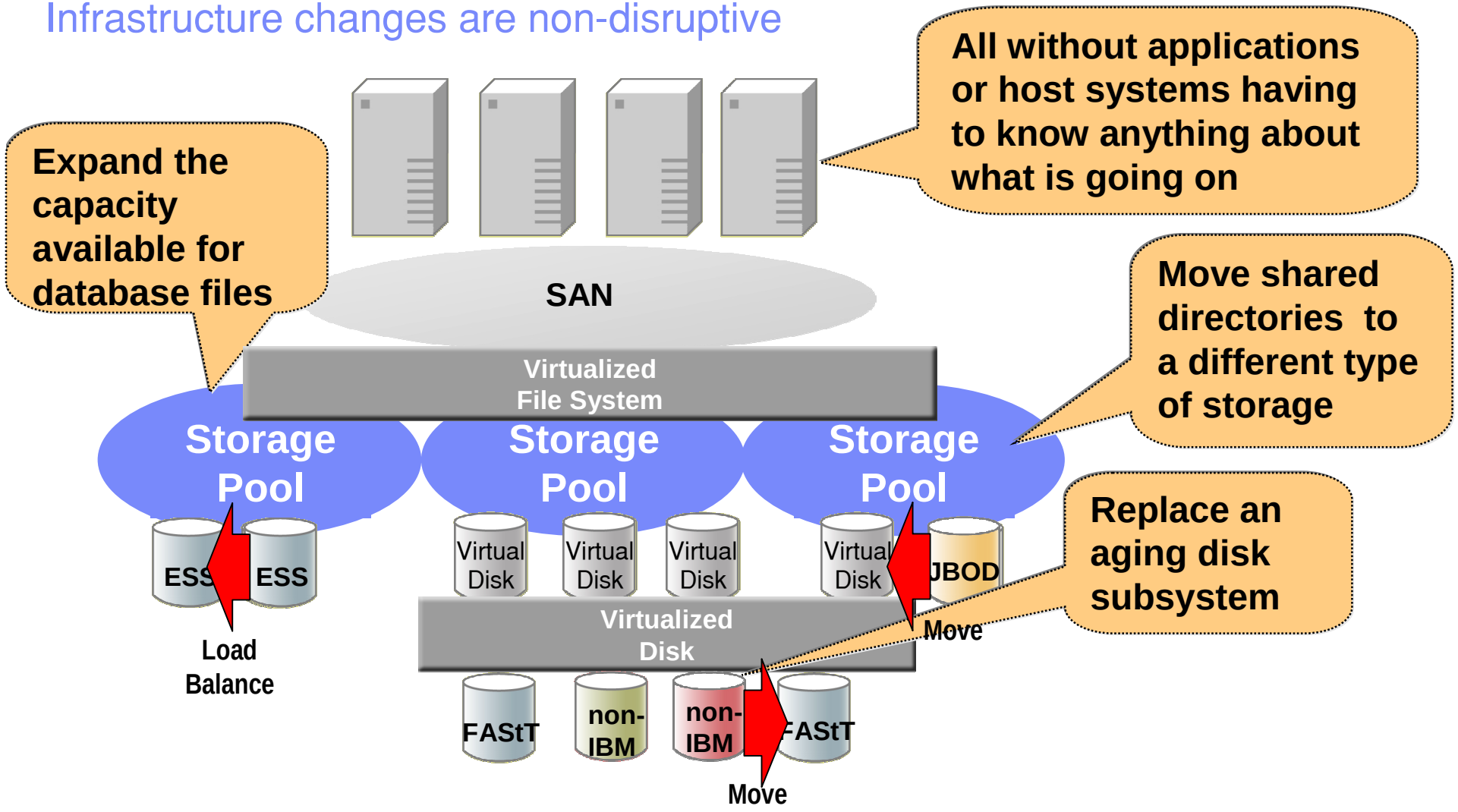
With an On Demand Storage Environment…

Inactive files are stored in a variable-cost storage hierarchy



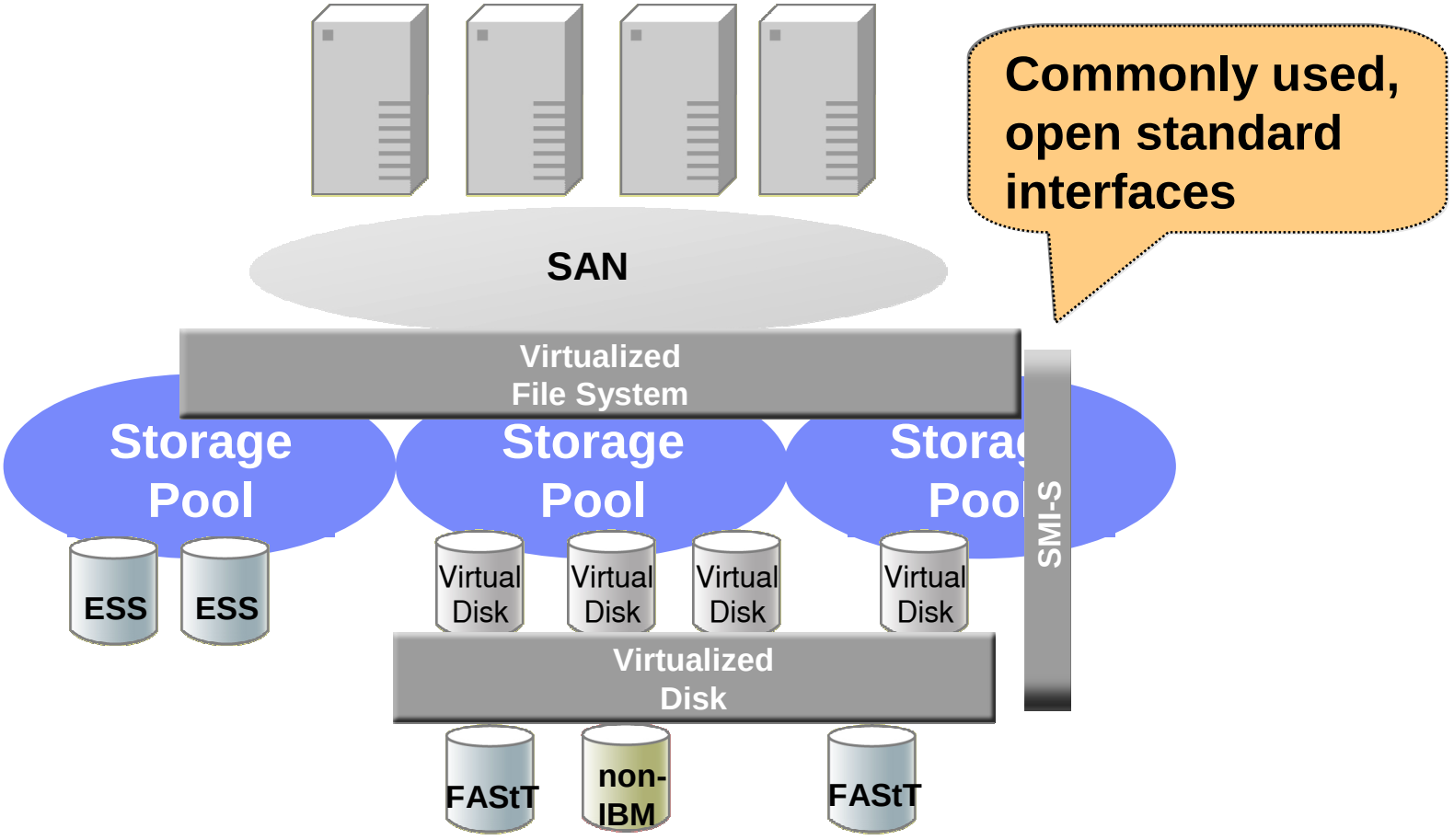
With an On Demand Storage Environment…

Infrastructure changes are non-disruptive



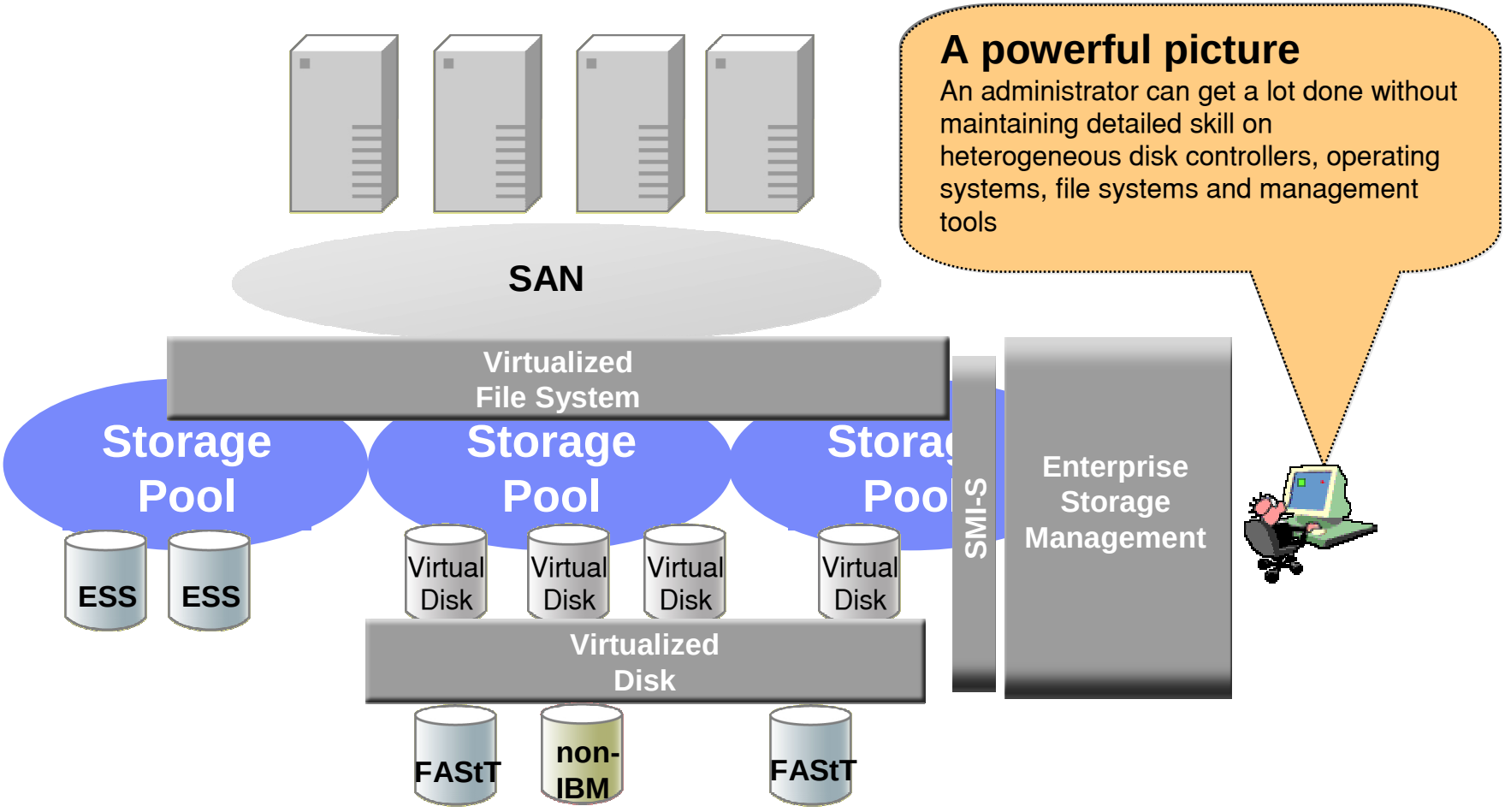
With an On Demand Storage Environment…

Management interfaces are common and open



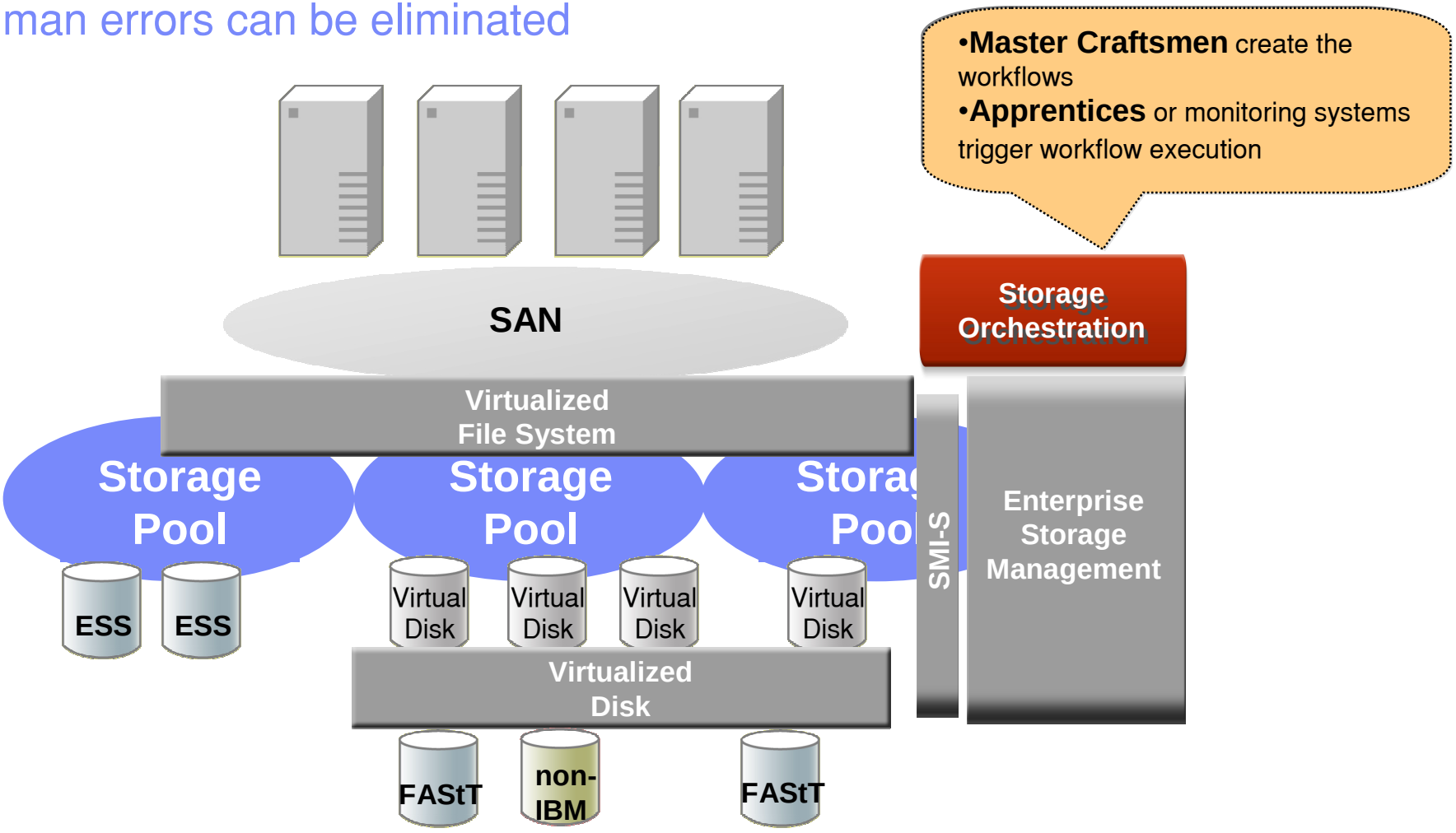
With an On Demand Storage Environment…

Administrators are more productive



With an On Demand Storage Environment…

Human errors can be eliminated



IBM TotalStorage

- Take steps toward evolving to an On Demand storage environment
  - **Enable variable cost** in the storage infrastructure so you can better match the value of information to the cost of storage.
  - **Reduce business risk** by integrating applications and systems with advanced copy services.
  - **Improve flexibility** in the storage infrastructure with virtualization.
  - **Empower administrators** with automated tools for managing heterogeneous storage infrastructures.
  - **Control storage growth** with automated identification and movement of low-activity or inactive data to a hierarchy of lower-cost storage.
  - **Manage cost** associated with capturing point-in-time copies of important data for regulatory or bookkeeping requirements by maintaining this inactive data in a hierarchy of lower-cost storage.
  - **Ensure recoverability** through the automated creation, tracking and vaulting of reliable recovery points for all enterprise data.
  - **Eliminate human errors** by preparing for Infrastructure Orchestration software that can be used to automate workflows

- Results

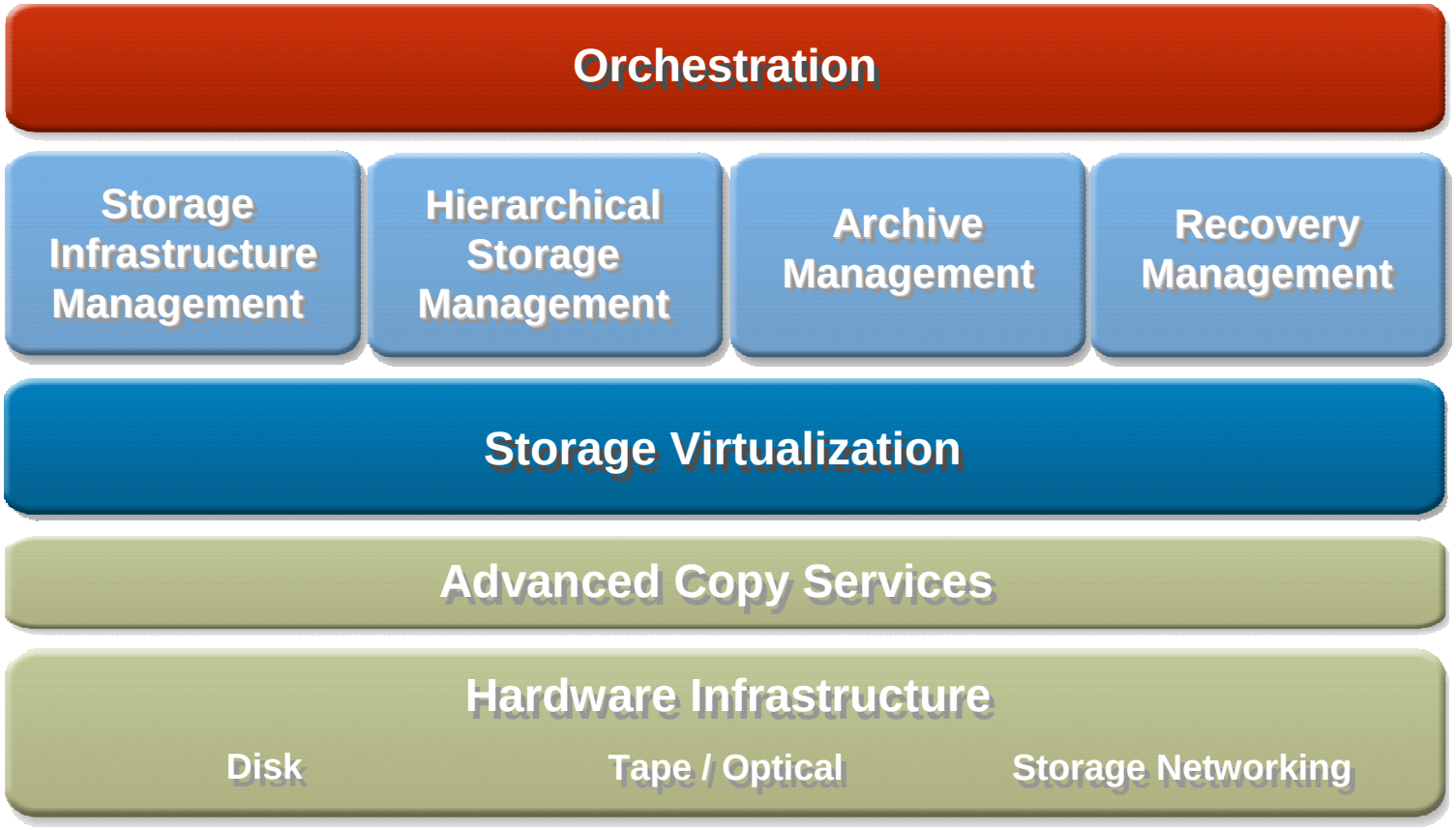
  Improved Application Availability

  Optimized Storage Resource Utilization

  Enhanced Storage Personnel Productivity

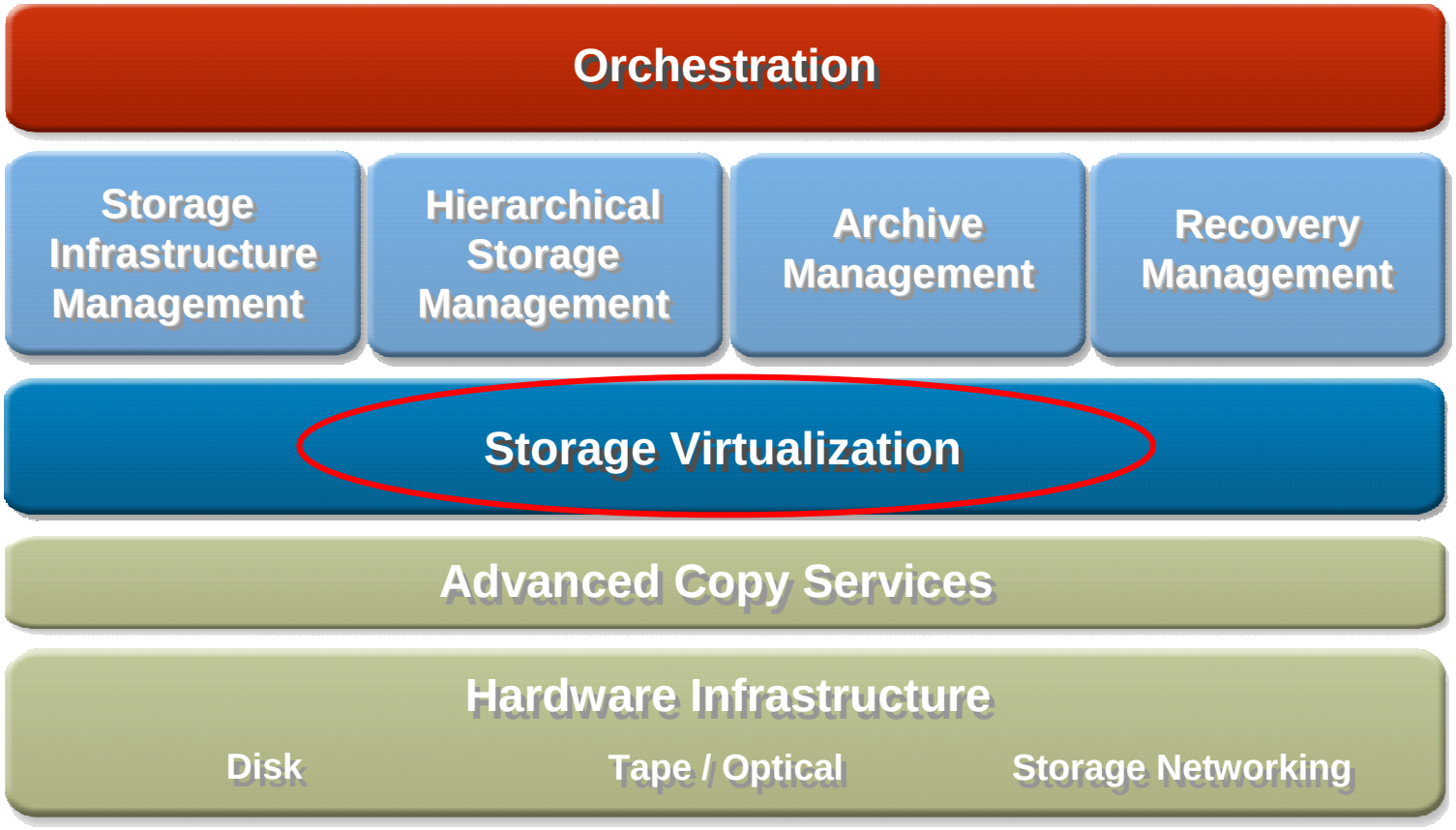
IBM TotalStorage

Taking steps toward an On Demand storage environment



IBM TotalStorage

Taking steps toward an On Demand storage environment



Why Virtualization?
Improve Flexibility

- The Problem

  The flexibility with which changes can be carried out in the storage infrastructure is limited by traditional technologies

- The Solution

  Improve flexibility in the storage infrastructure with virtualization.

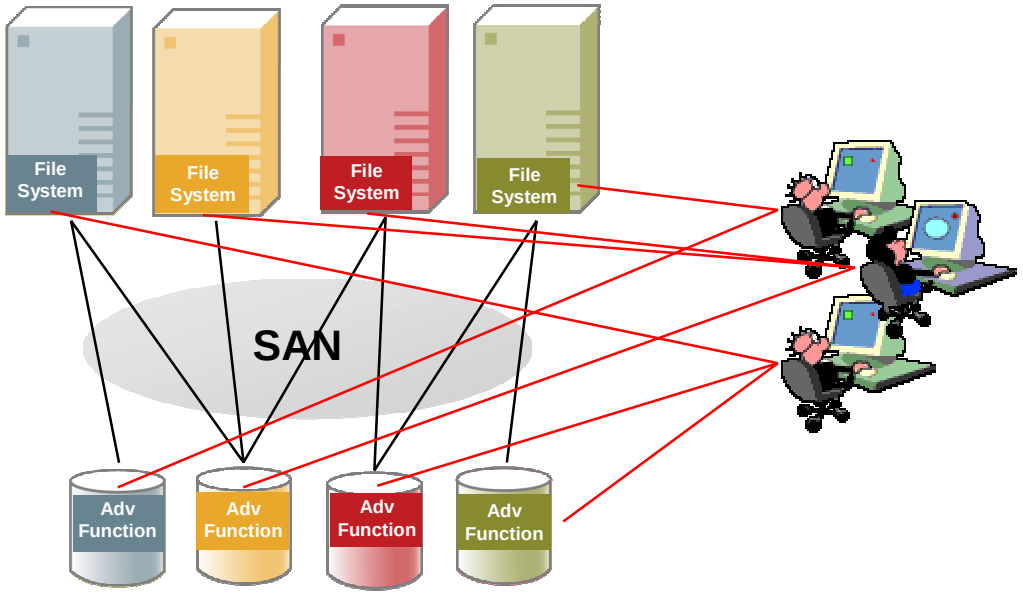
The Problem: SANs today are not flexible

Volume, Storage Management Issues

- Server to storage logical connections are static
- Server Downtime required to manage LUNs, migrate volumes
- Copy services are unique to each device
- Difficult to pool volumes

File, Data Management Issues

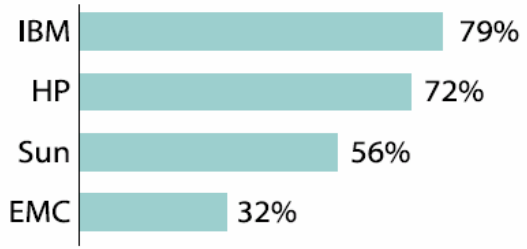
- File tasks must be done on each server
- Difficult to migrate applications to other servers
- Application Downtime required for FS changes
- No single view/access to files or data
- Cannot pool files based on Quality of Service



Forrester: “Firms embark on virtualization in 2003”, (June, 2003)

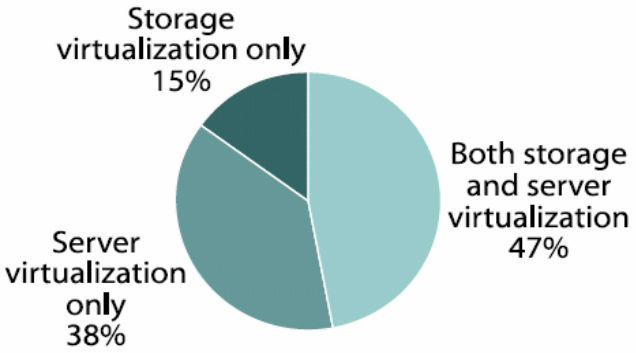
62% of customers surveyed plan to undertake a storage virtualization project in the next 12 months

Companies planning storage virtualization projects

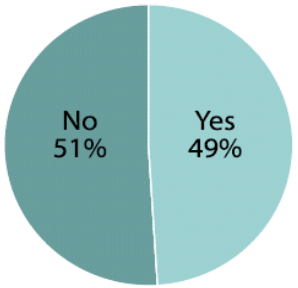


Base: infrastructure decision-makers at North American companies that will undergo a virtualization project during the next 12 months (multiple responses accepted)

“Which of the following infrastructure projects will your company likely undertake in the next 12 months?”



“Will your company likely undertake a virtualization project in the next 12 months?”

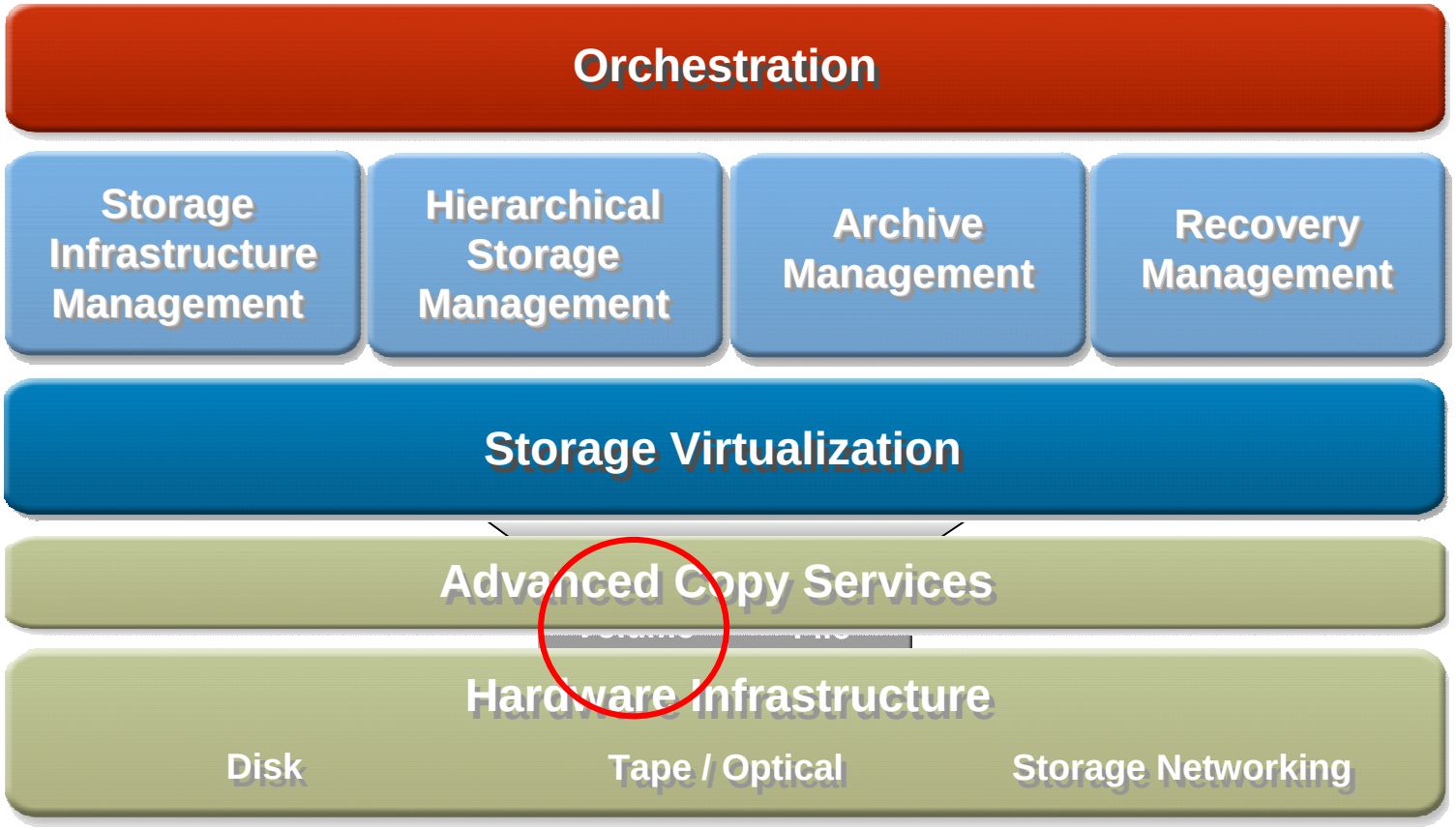


Customers indicate focus on Storage Software to improve efficiencies in 2003

Base: infrastructure decision-makers at North American companies

IBM TotalStorage

Taking steps toward an On Demand storage environment



Value of the TotalStorage SAN Volume Controller

- Improve the flexibility of the disk storage infrastructure
- Results

Improved Application Availability

- Eliminate many of the causes of storage-related downtime
- Create a common platform and API for volume Point-in-time and Remote copy services

Optimized Storage Resource Utilization

- Aggregate smaller islands of spare disk capacity and transparently reallocate to new servers or applications

Enhanced Storage Personnel Productivity

- Create a single point of control, administration and security for disk volumes
- Move, add or change physical disks without requiring application outages

IBM TotalStorage SAN Volume Controller

Addresses volume management issues

Volume, Storage Management Issues

- Server to storage logical connections are static
- Server Downtime required to manage LUNs, migrate volumes
- Copy services are unique to each device
- Difficult to pool volumes

File, Data Management Issues

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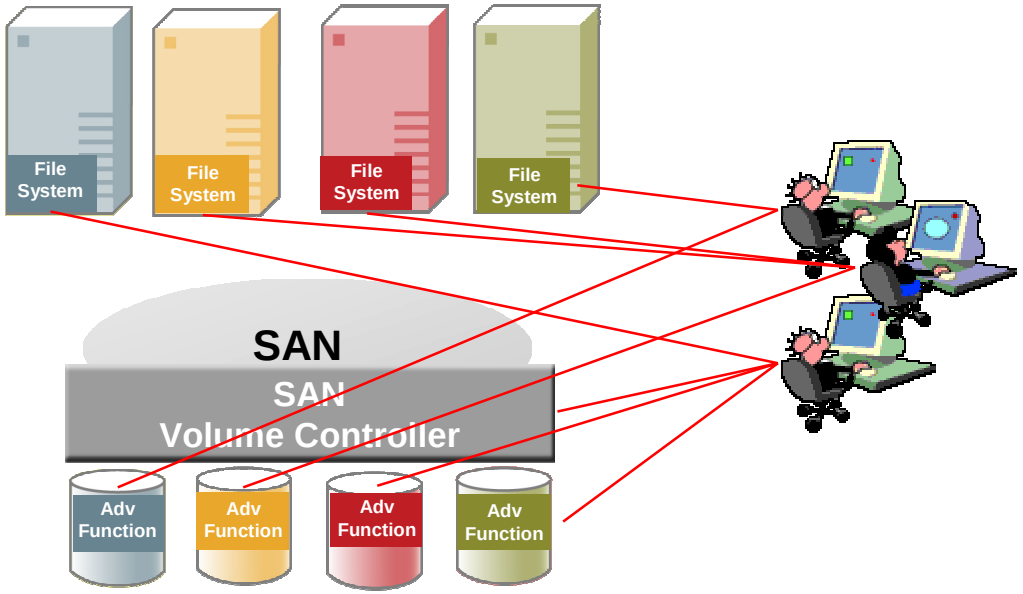
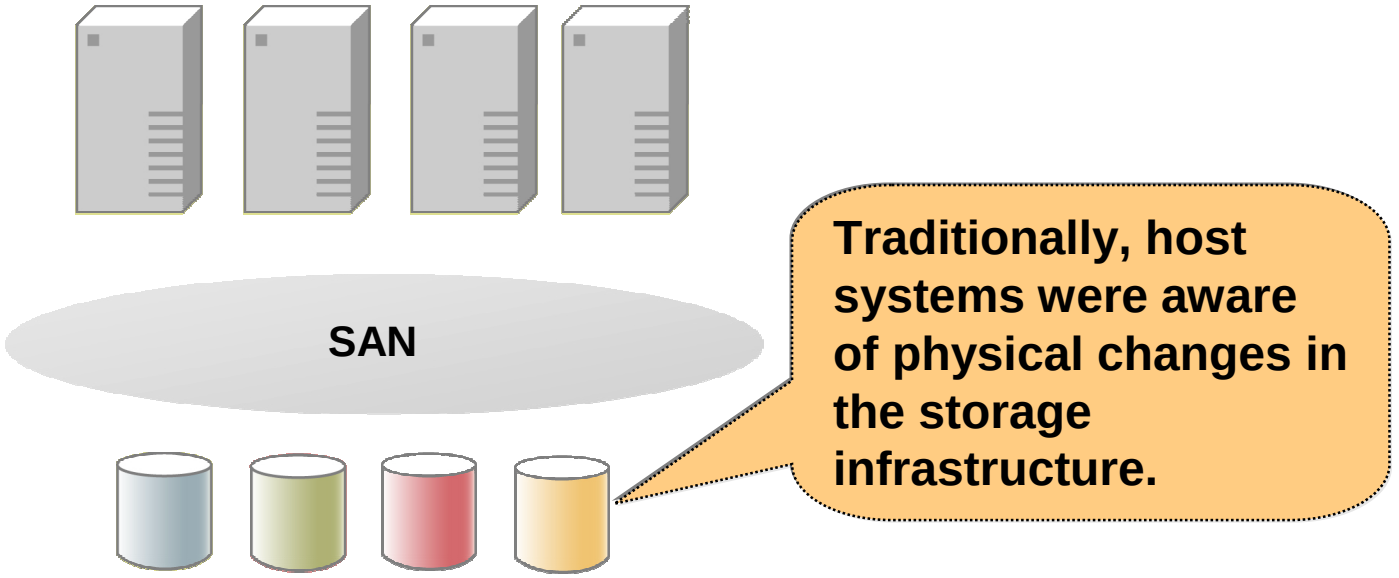
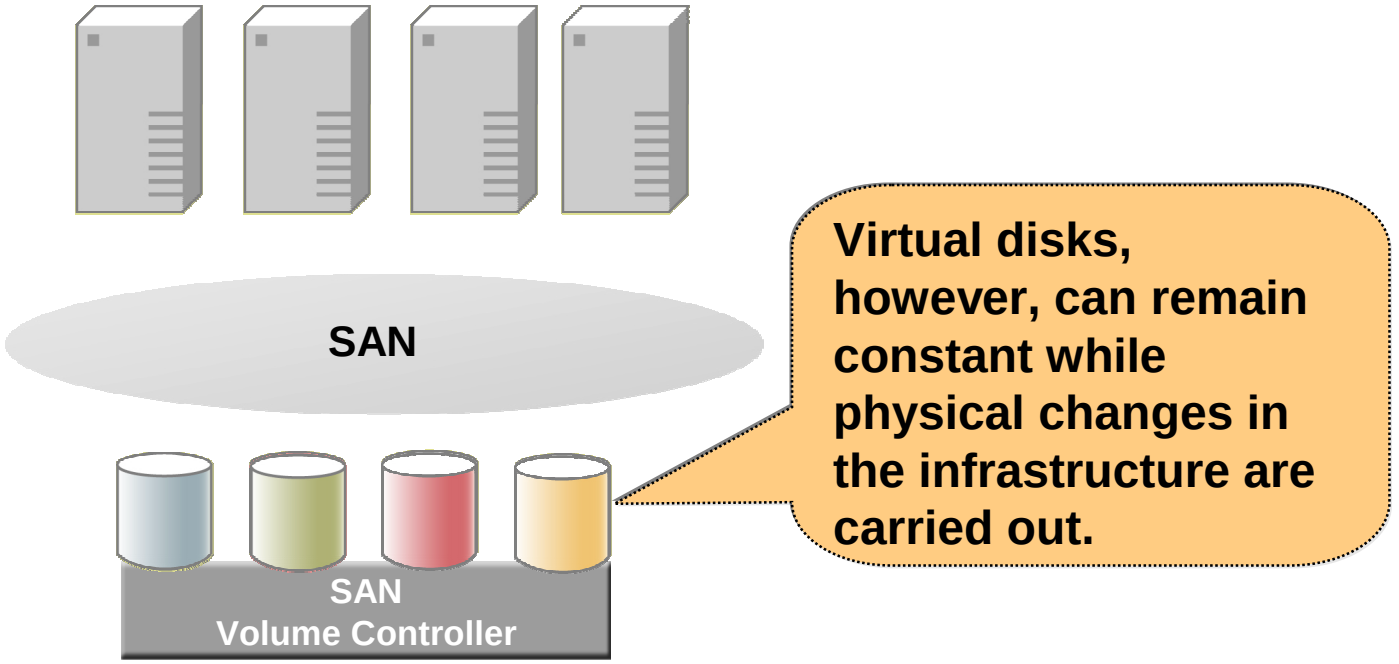


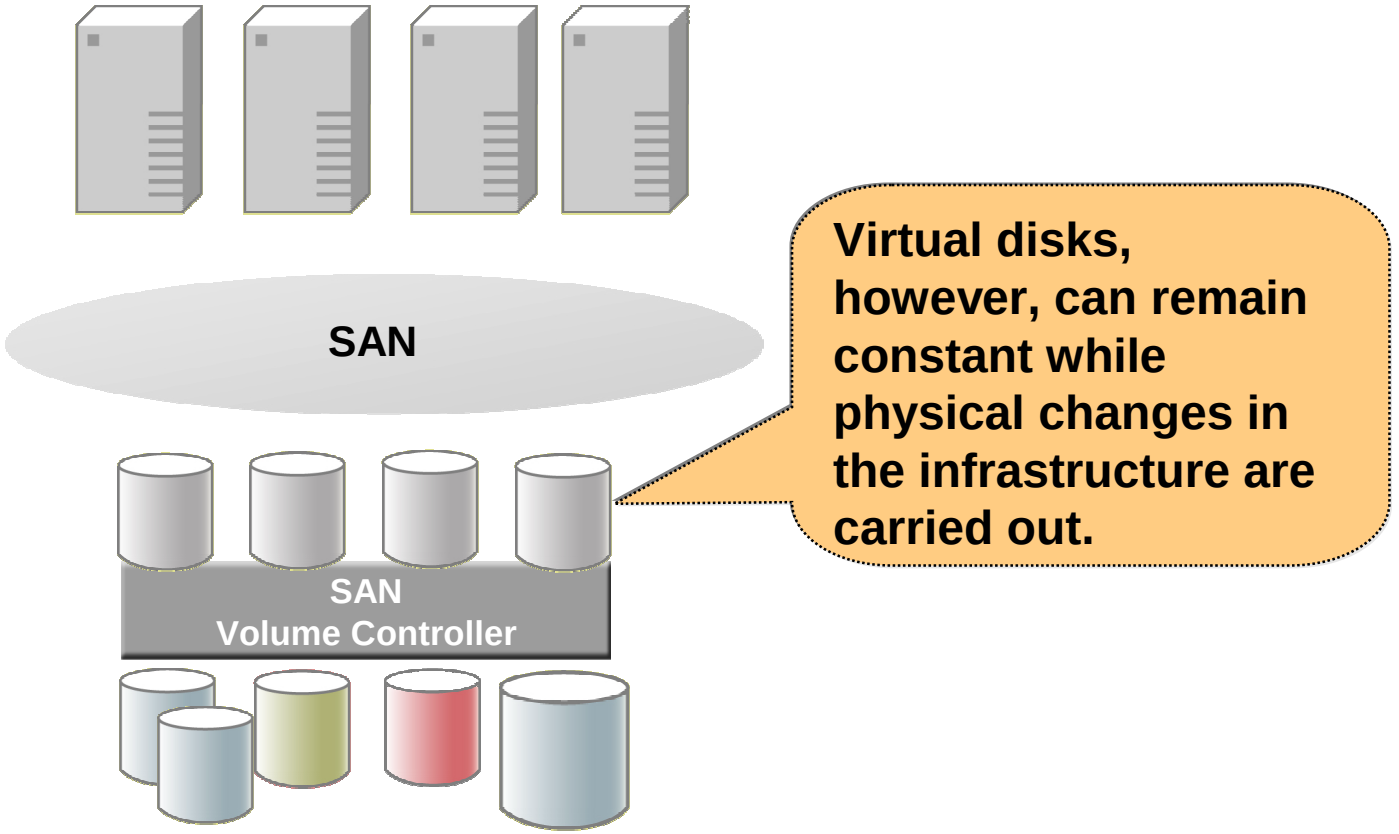
Virtualize the Disks



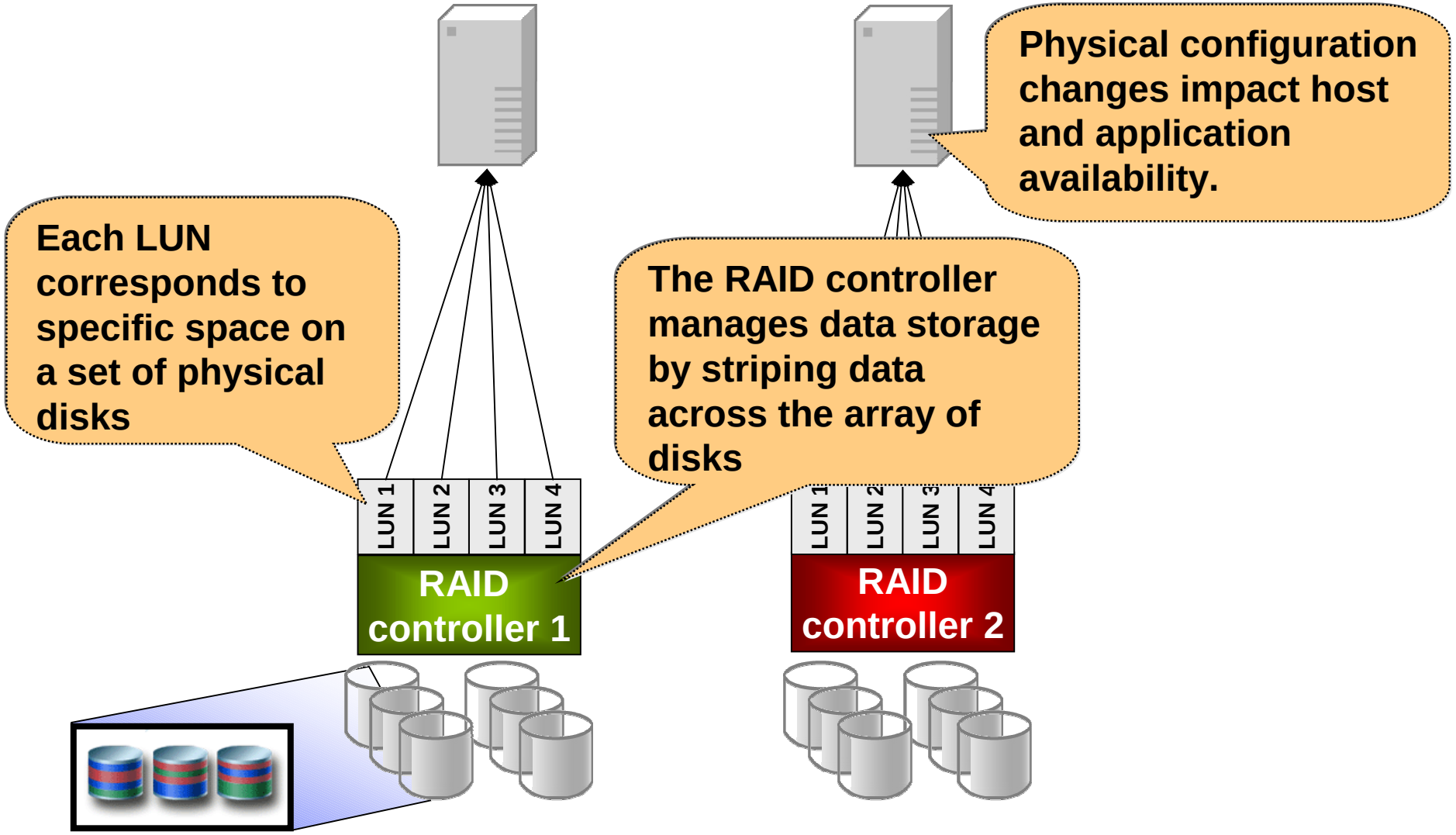
Virtualize the Disks



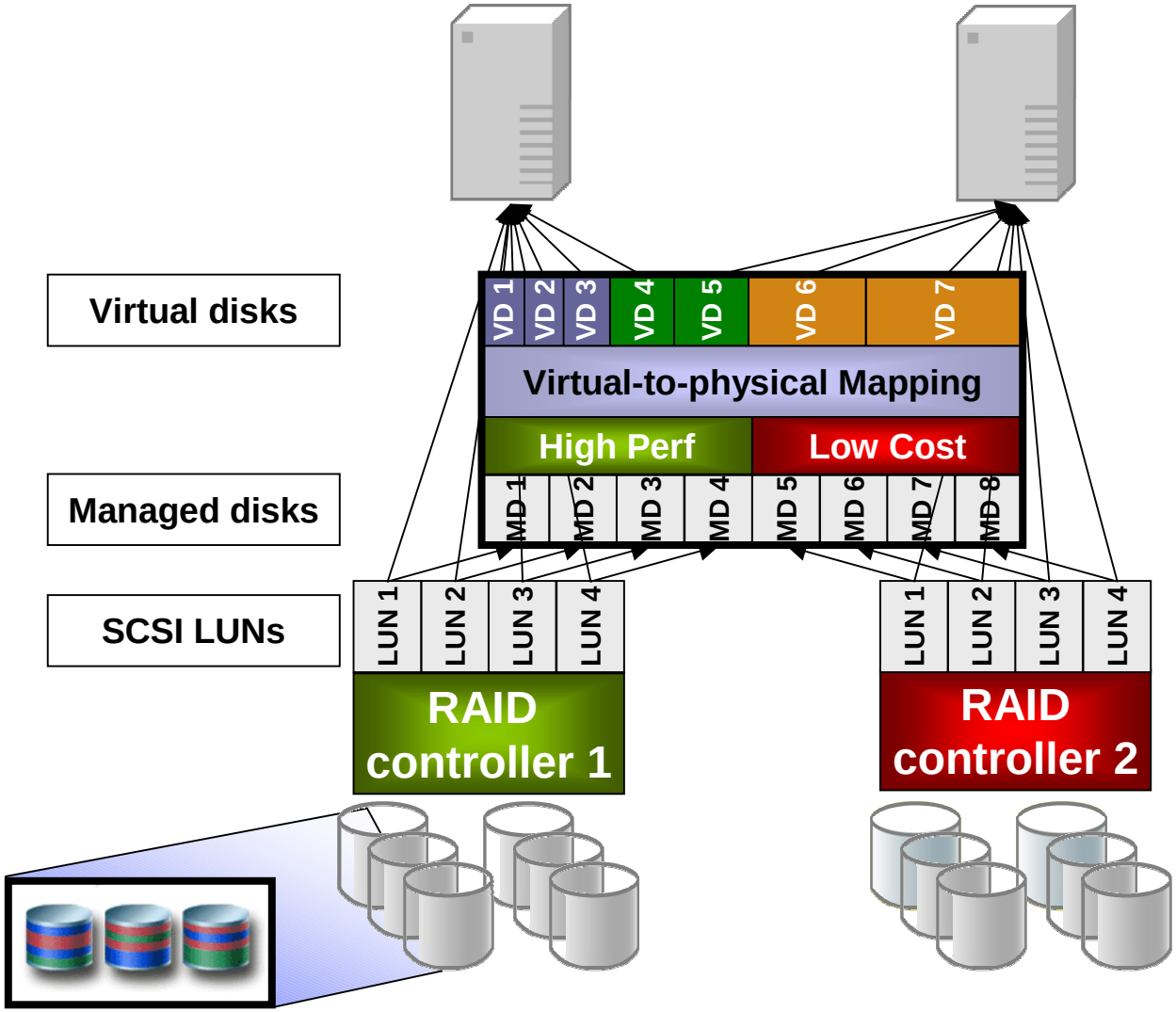
Virtualize the Disks



Traditional RAID Controllers

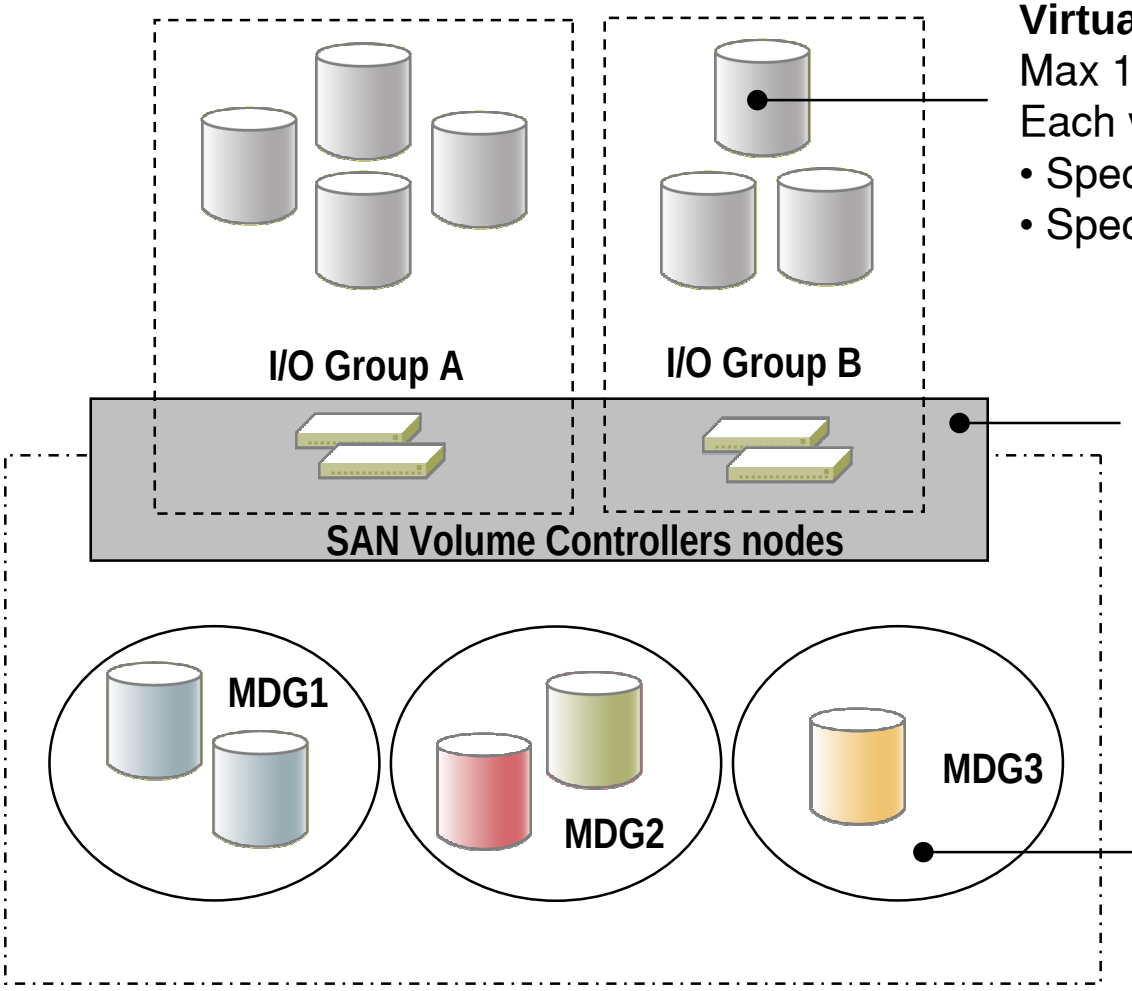


IBM TotalStorage SAN Volume Controller



Mapping options
- **Stripe extents across multiple Managed disks**
- **Sequentially group across one or more Managed disk**
- **Image mode - One to One mapping**

SAN Volume Controller - Terminology



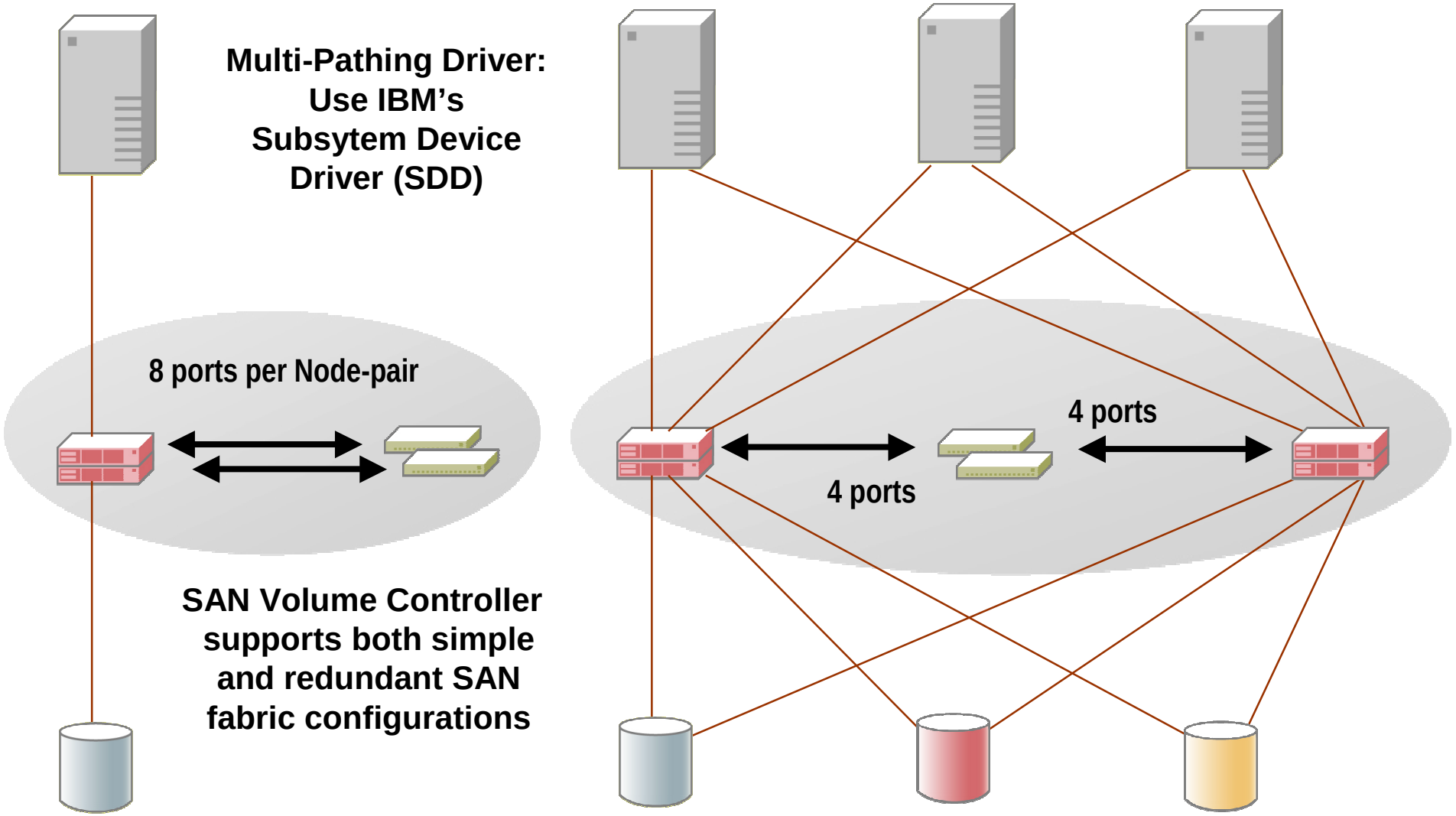
Virtual Disks:
Max 1024 disks total (16MB – 2TB)
Each virtual disk assigned to:
- Specific Node-pair
- Specific Managed Disk Group

Cluster:
- One or Two Node-pairs

Managed Disks:
- Select LUNs from up to 64 physical disk subsystems
- Max 128 Managed Disk Groups
- Max 128 LUNs per group

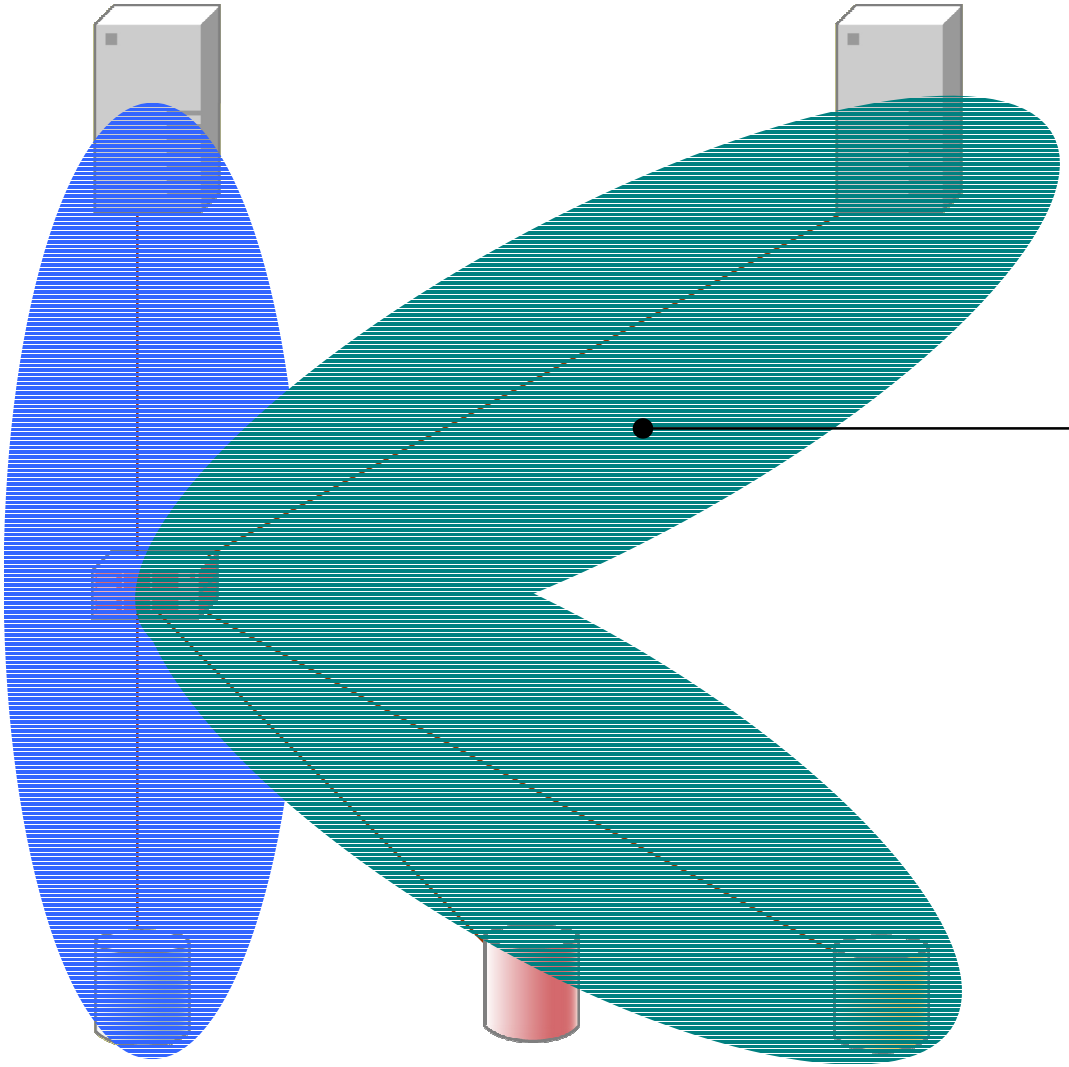
SAN Volume Controller - Connections

Multi-Pathing Driver: Use IBM's Subsytem Device Driver (SDD)



SAN Volume Controller supports both simple and redundant SAN fabric configurations

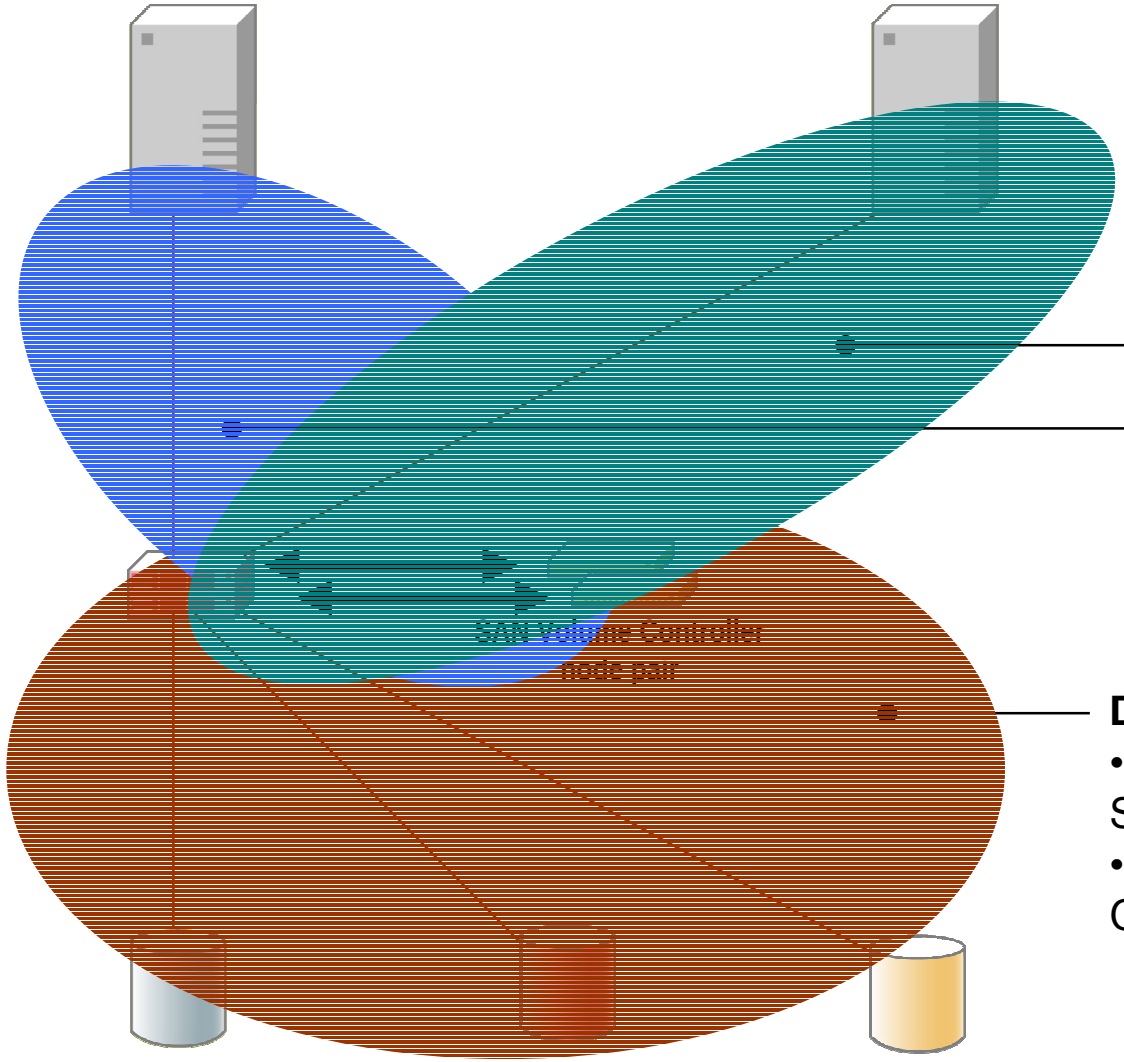
SAN Volume Controller - Zoning



Traditionally, host systems are zoned to the disks they are allowed to talk to.

But with the SAN Volume Controller…

SAN Volume Controller - Zoning



Host Zones:
•Hosts are zoned only to SAN Volume Controller.

•They see only the Virtual Disks they are allowed to talk to.

Device Zone:
•Devices are zoned only to the SAN Volume Controller.
•They see the SAN Volume Controller as their connected host.

SAN Volume Controller – Virtual Disk Modes

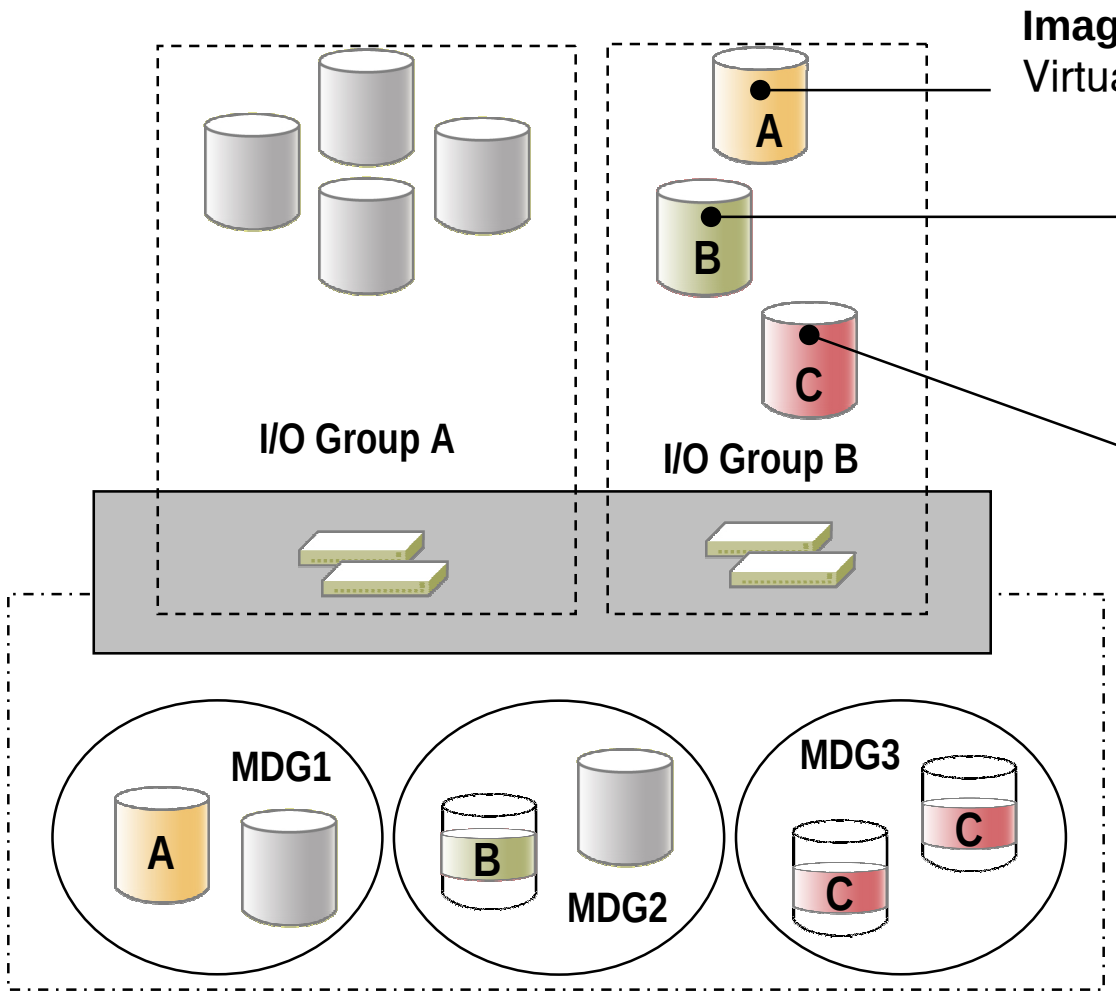


Image Mode:
Virtual Disk = Physical LUN

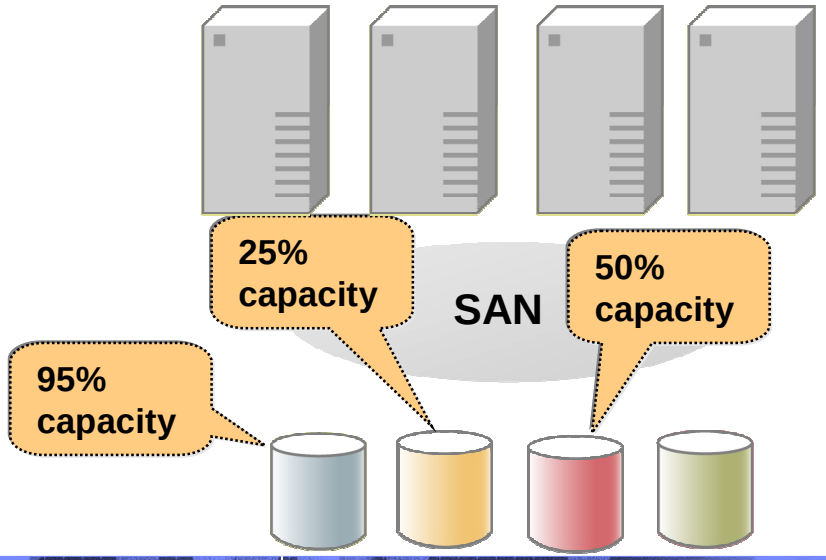
Sequential Mode:
Virtual Disk mapped sequentially to a portion of a managed disk

Striped Mode:
Virtual Disk striped across multiple managed disks

Optimized Storage Resource Utilization

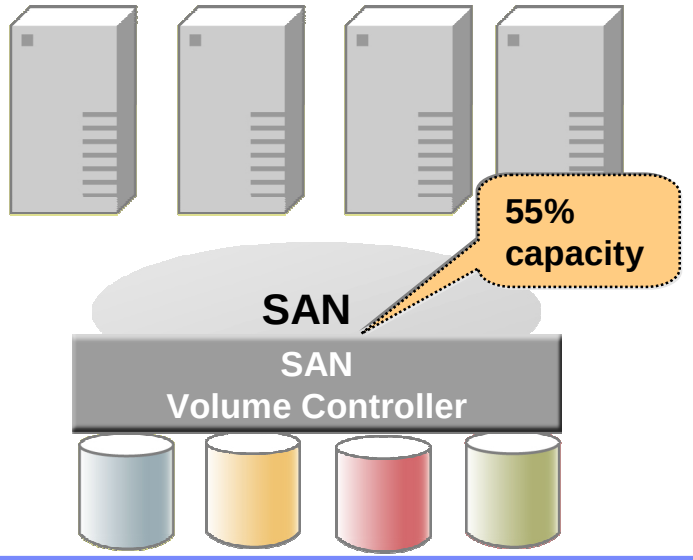
Traditional SAN

- Shared physical network
- Limited capacity sharing
- Capacity purchased for, and owned by individual processors
- Poor capacity utilization



SAN Volume Controller

- Hosts own “virtual” disks
- Capacity can be more easily reallocated
- Capacity purchases can be deferred until the physical capacity of the SAN reaches a trigger point.



Improved Application Availability

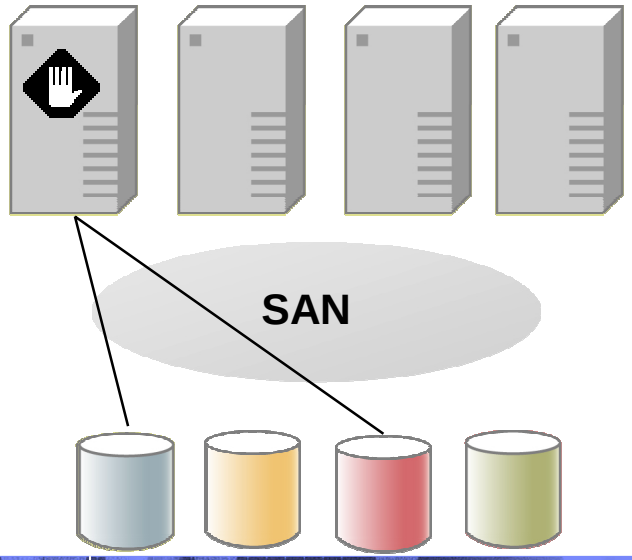
Traditional SAN

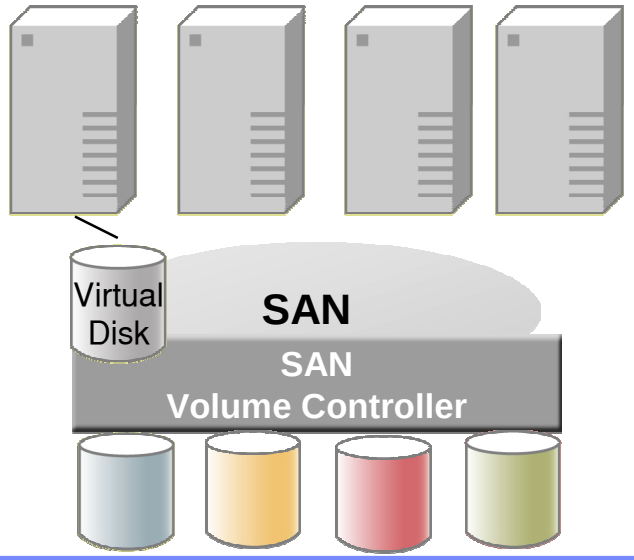
1. Stop the application
2. Move data
3. Re-establish host connections
4. Start application

SAN Volume Controller

1. Move data

- Host systems and applications are not affected.

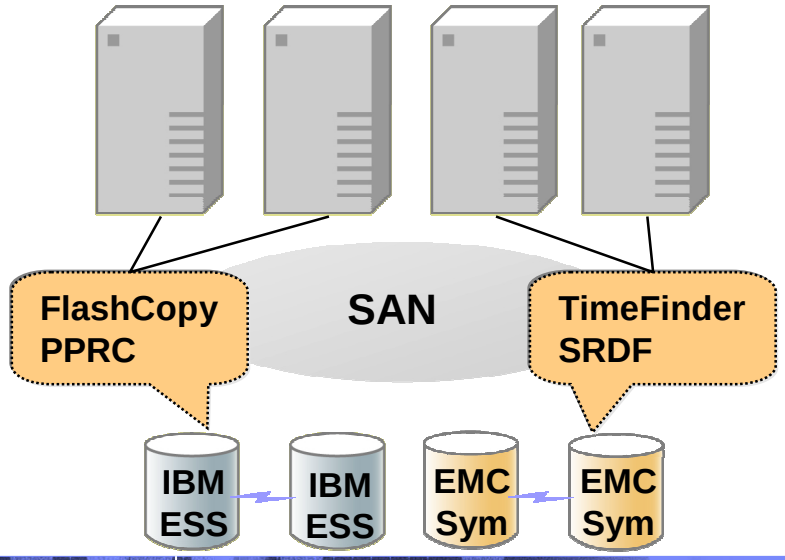




Reduced Cost and Improved Flexibility for Replication Services

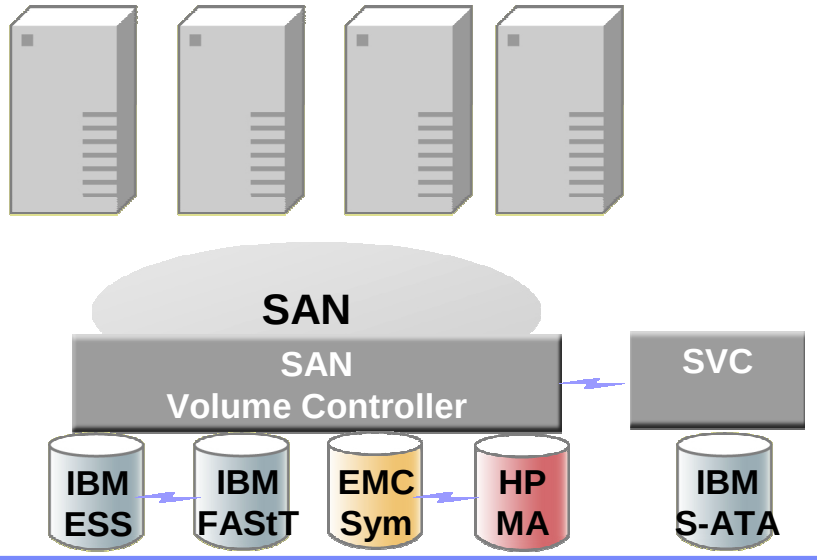
Traditional SAN

- Replication service API's differ by vendor, making it difficult to integrate applications
- Replication targets must be the same expensive disk as the source
- Lower-cost disks offer primitive, or no replication services

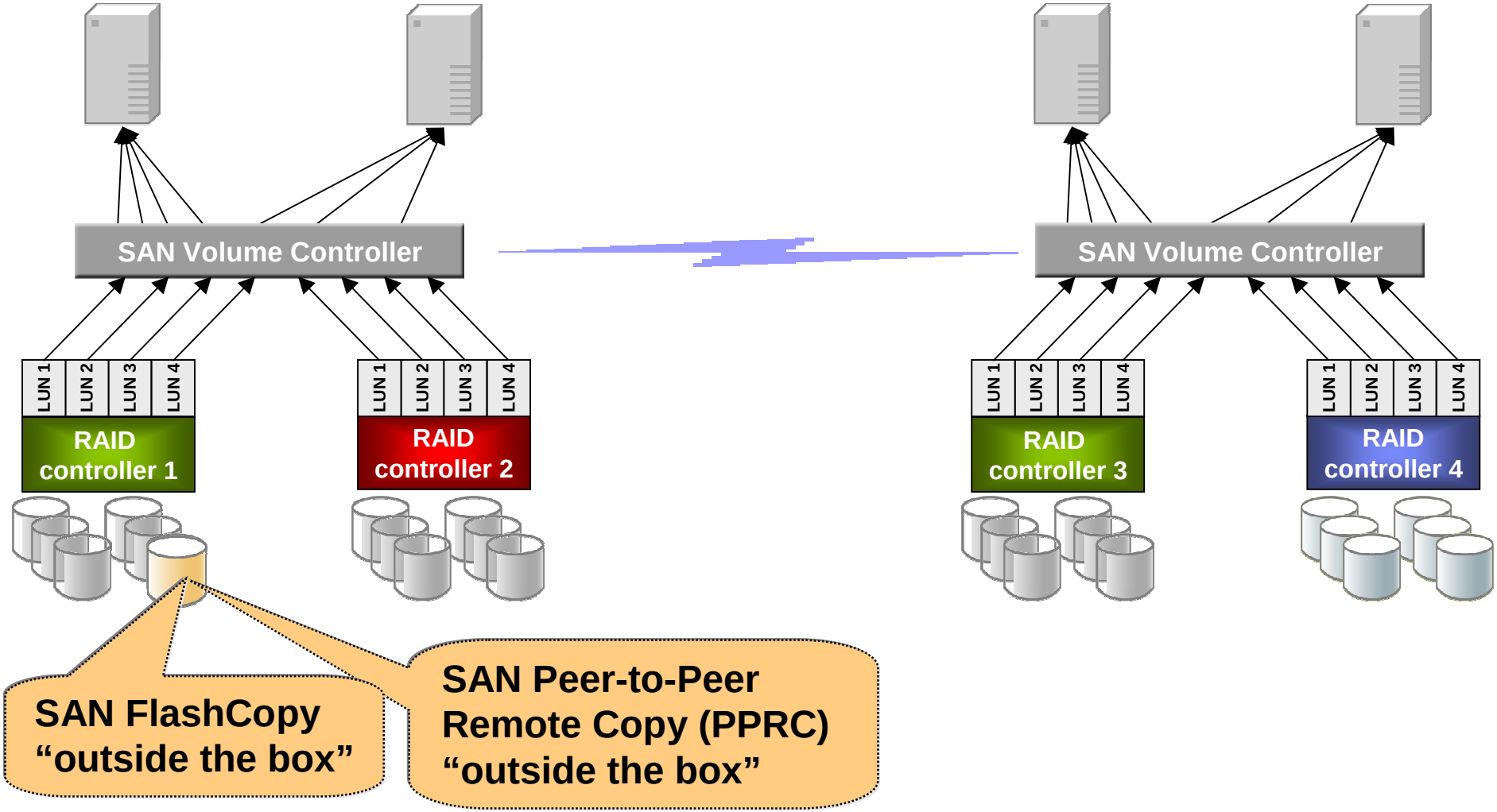


SAN Volume Controller

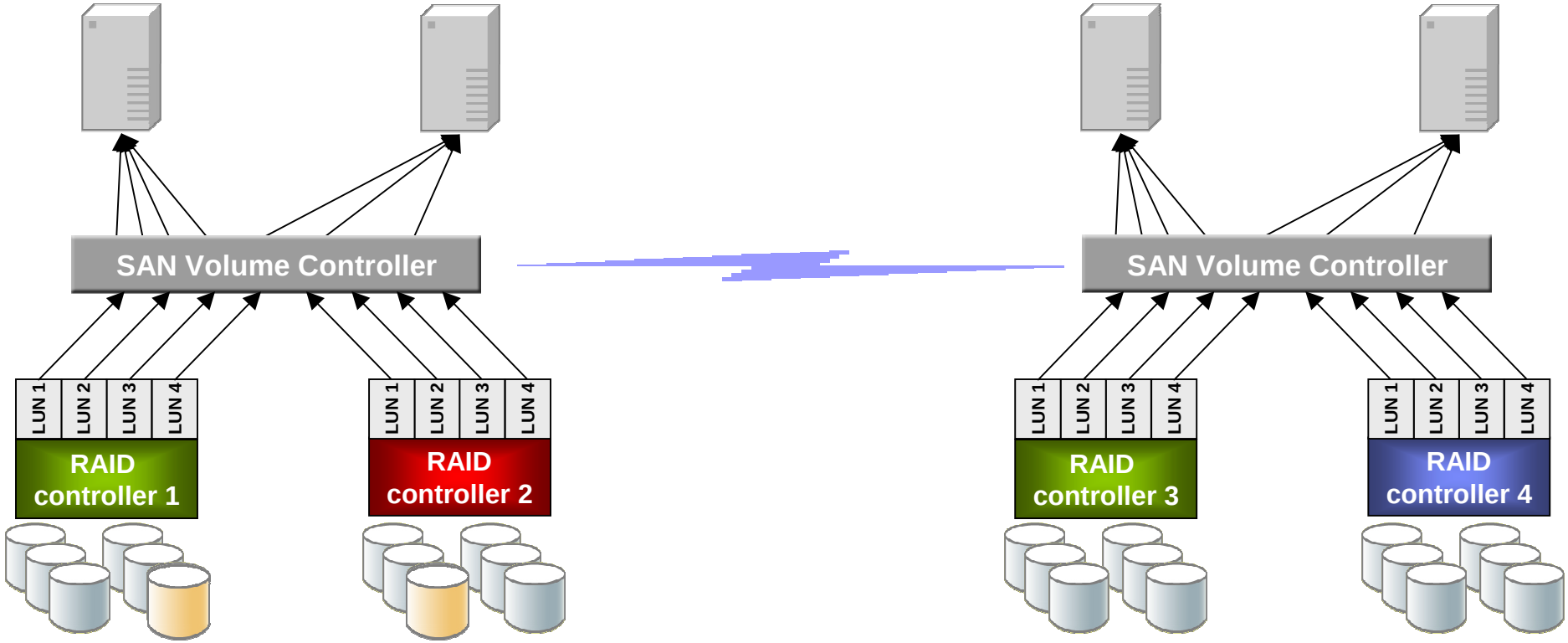
- Common replication API, SAN-wide, that does not change as storage hardware changes
- Replication targets can be on lower-cost disks, reducing the overall cost of exploiting replication services



TotalStorage SAN Volume Controller Copy Services



TotalStorage SAN Volume Controller Copy Services



Cross-device consistency groups

SAN Volume Controller – Performance
What Are These Workloads?

- **Read Hit:** All I/Os are reads, all I/Os are cache hits, all 4KB transfers
  - Exercises "front end" cache performance for transfers out of cache
- **Write Hit:** All I/Os are writes, all I/Os are cache hits, all 4KB transfers
  - Exercises "front end" cache performance for transfers into cache
  - Very few destages from cache to disk
- **Read Miss:** All I/Os are reads, all I/Os are cache misses, all 4KB transfers
  - Exercises ability to read data from back-end disk
- **Write Miss:** All I/Os are writes, all I/Os are cache misses, all 4KB transfers
  - Exercises ability to destage data from cache to disk
  - Most "front end" write operations result in a destage operation

➢ These four workloads are **not** similar to any customer workloads
  - Use for performance characterization only

- **70/30/50:** 70% read, 30% write I/Os; 50% of I/Os are cache hits, 4KB transfers
  - Mixture of I/O types
  - Similar to some online transaction processing workloads

Measured Performance Comparison
Maximum Throughput

Ops/Sec	2-node SAN.VC	FAStT600	FAStT900	ESS F20	ESS 800
Read Hit	141,000	40,600	81,800	46,100	105,000
Read Miss	49,800	6,300	21,600	12,600	25,600
Write Hit	30,100	23,140	49,200	12,300	33,900
Write Miss	14,000	3,700	11,400	8,600	19,800
70/30/50	51,500	9,600	29,900	17,400	41,900

Configurations:
SAN.VC: One 2-node SAN.VC cluster with 12 FAStT600, total of 336 15K RPM 36GB drives, RAID-5, cache mirroring ON
FAStT600: One FAStT600, 42 15K RPM 18GB drives, RAID-10, cache mirroring OFF, two HAs
FAStT900: One FAStT900, 96 15K RPM 18GB drives, RAID-10, cache mirroring OFF, four HAs
ESS: One ESS, 256 15K RPM 18GB drives, RAID-5, sixteen HAs

SAN Volume Controller – Migration

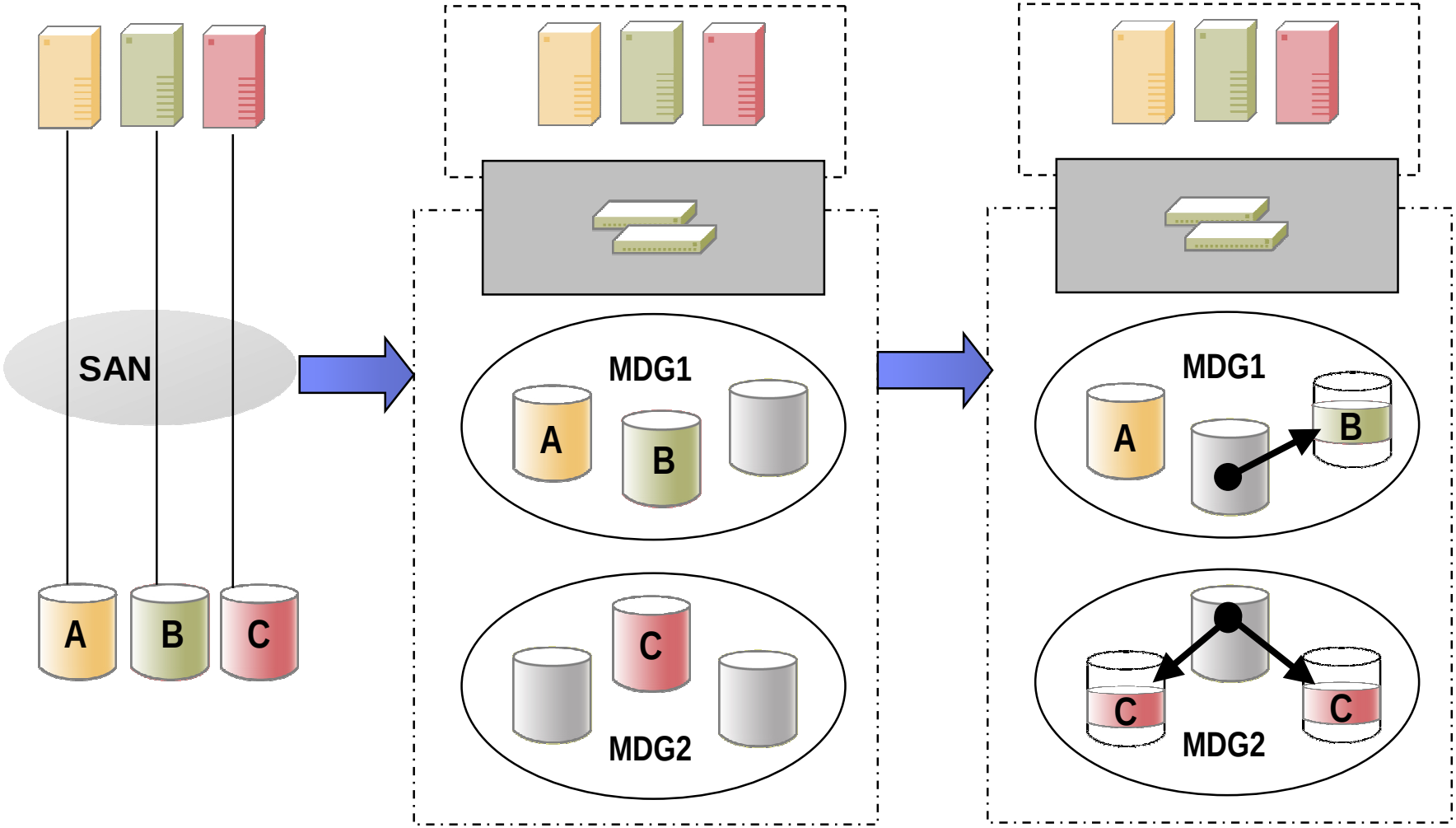


Image Mode versus Managed Disk Mode

Feature or Function	Image Mode	Managed Disk Mode	
		Sequential	Striped
Access as Raw Logical Volume	Yes	Yes	Yes
Access using any File System	Yes	Yes	Yes
Benefit from Cache	Yes	Yes	Yes
FlashCopy/PPRC to another Virtual Disk	Yes	Yes	Yes
Migration to Managed Disk Mode	Yes	Yes	Yes
Reduce Virtual Disk Size dynamically	No	Yes	Yes
Expand Virtual Disk Size dynamically	No	Yes, becomes striped	Yes
Migration to Image Mode	No	No	No

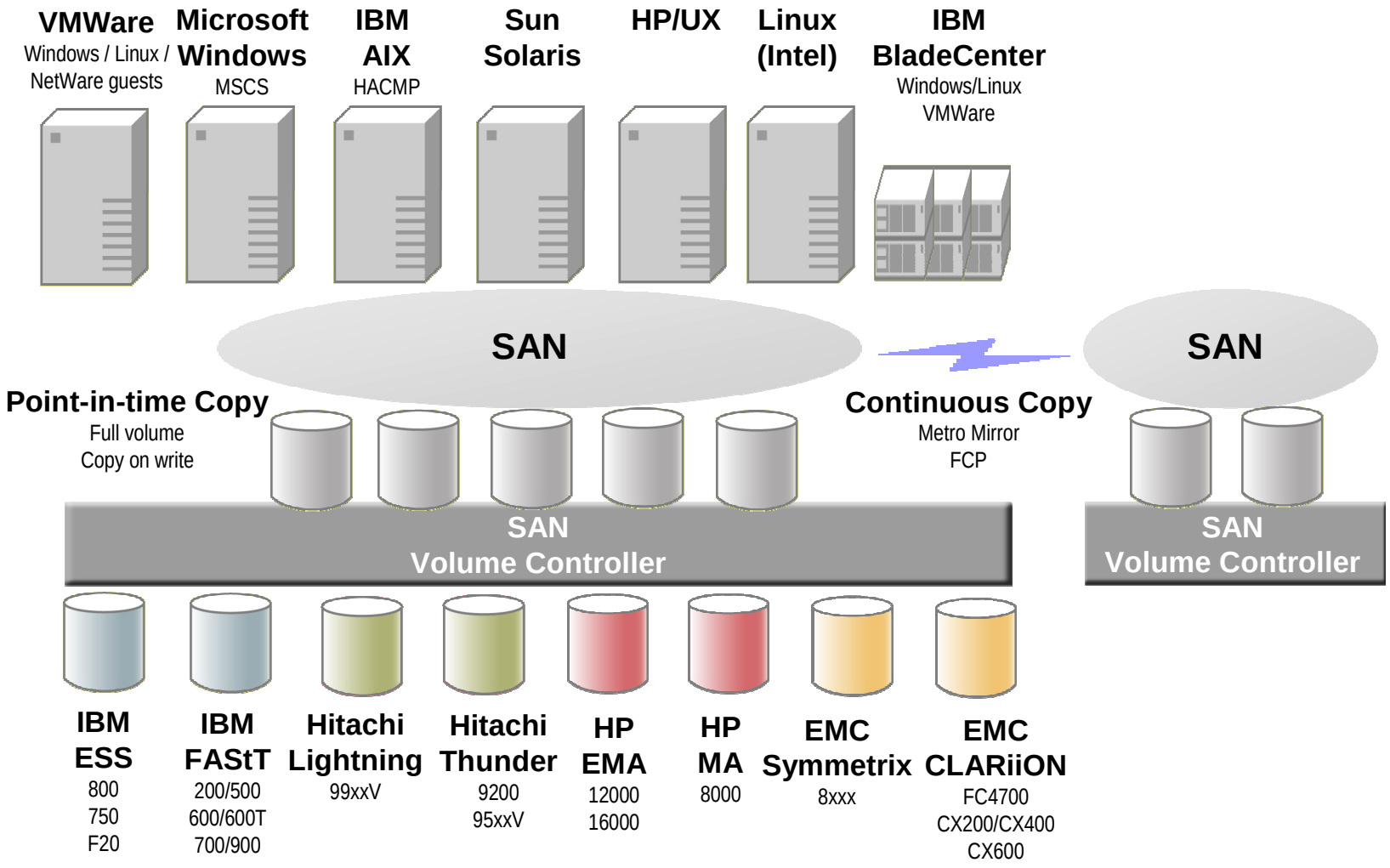
IBM TotalStorage SAN Volume Controller Packages

- For existing SANs
  - SAN Volume Controller
- For new SANs
  - SAN Integration Server
- For Cisco-based SAN infrastructures
  - SAN Volume Controller Storage Software for Cisco MDS 9000

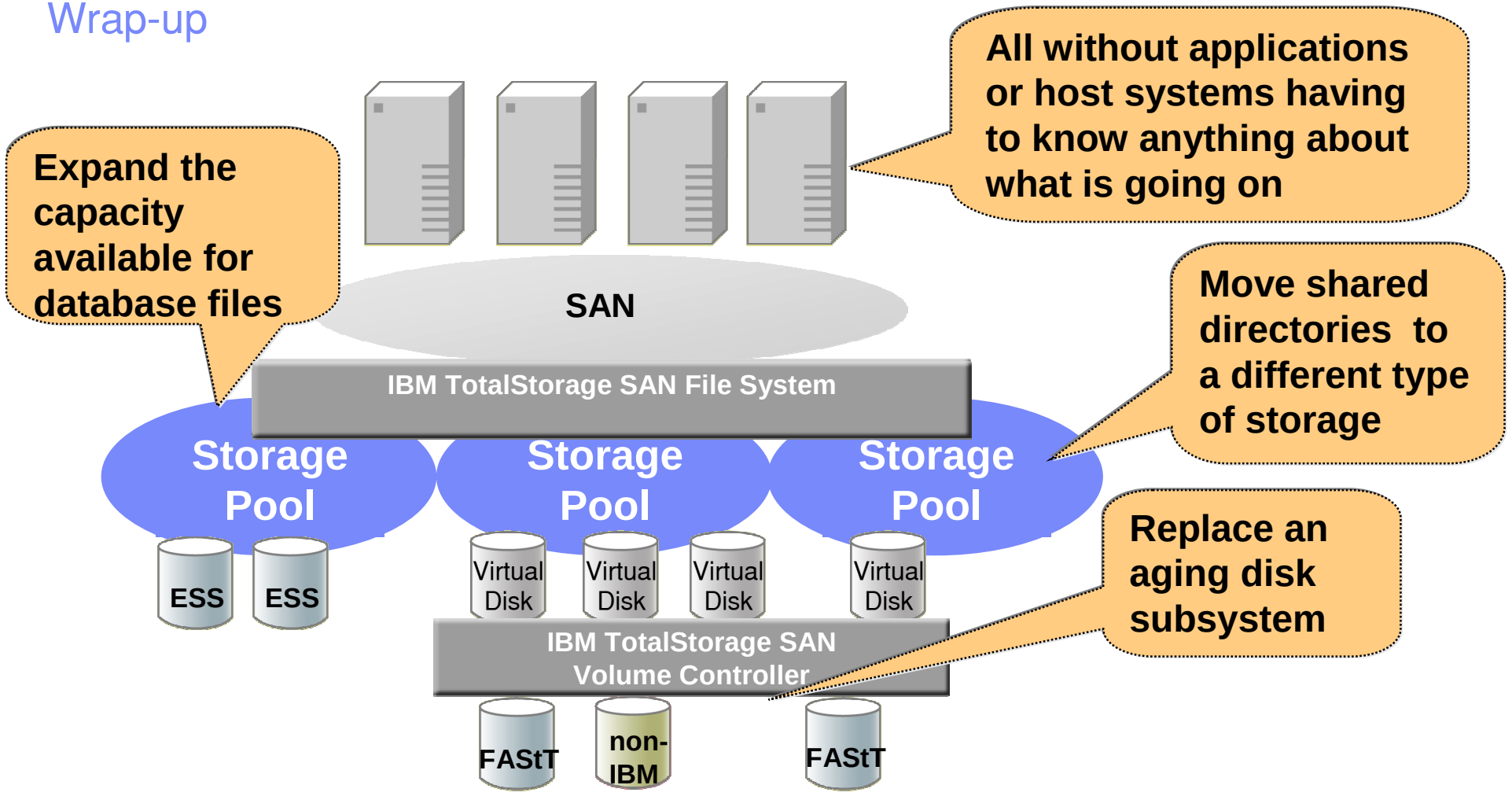
TotalStorage SAN Volume Controller

Supported Environments

Intended as an overview only.
For the most complete information, visit **ibm.com**/storage/software



A Virtualized Storage Infrastructure
Wrap-up



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RETURN TO INDEX