



Education

Storage Virtualization II

Effective Use of Virtualization

- focusing on block virtualization -

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Agenda

- *Virtualization Checklist – Background info*
- **Implementing Virtualization Step-by-Step**
- **Achieving Through Virtualization**
 - ◆ Capacity
 - ◆ Performance
 - ◆ High Availability
- **Storage Virtualization and the SNIA SMI-S**
- **Policy-based Service Level Management**
- **Q&A**

- Before purchasing and implementing any product the user should be aware that Storage Virtualization is an enabling technology and is a part of the solution
- Storage Virtualization is a tool for the IT administrator to simplify the management of the storage resources and reduce the complexity of the overall IT infrastructure

What's the Problem?

- ▶ Storage problems in specific areas, such as:
 - ◆ Capacity
 - ◆ Availability
 - ◆ Performance
 - ◆ Flexibility/Change of Attributes
 - ◆ Manageability

- ▶ Goals to achieve through adoption of virtualization
 - ◆ Align the storage infrastructure with the Business and IT Objectives of the end user
 - ◆ Measure with Service Level Agreements (SLAs)
 - › internally and externally defined
 - ◆ Implement business plans such as D/R, B/C and strategic plans

Implementing Storage Virtualization step-by-step

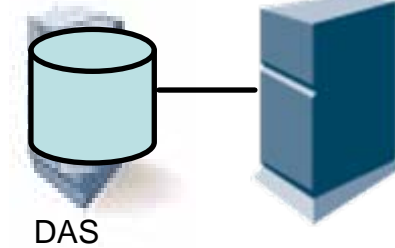
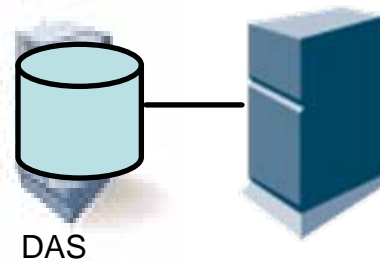
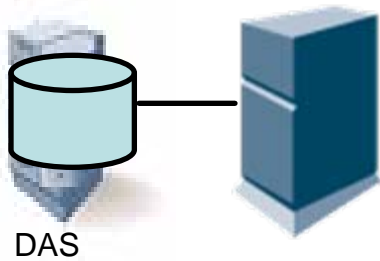
- Step 1: Starting from a DAS environment
- Step 2: Add SAN infrastructure
- Step 3: Add Virtualization infrastructure
 - Out-of-Band example
 - In-Band example
- Step 4: Move DAS volumes to SAN
- Step 5: Change Primary/Secondary relationship
- Step 6: Establish HA environment
- Step 7: Create and Use Single Storage Pool
- Step 8: Establish Load Balancing/Multi-pathing

- *Sequence may change from project to project*

Implementing Storage Virtualization

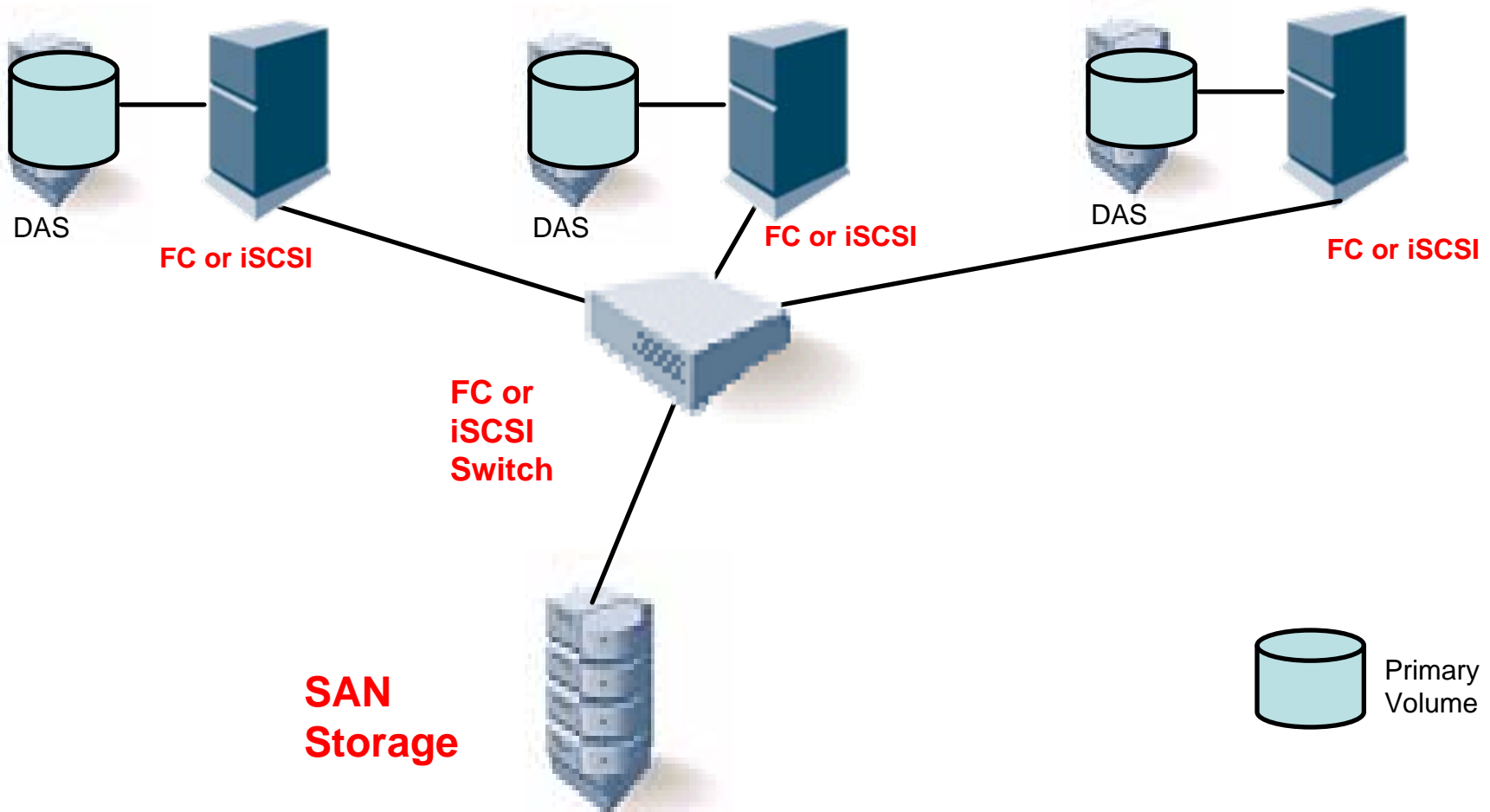
1. Start - DAS environment

DAS = either internal or external direct connect storage devices



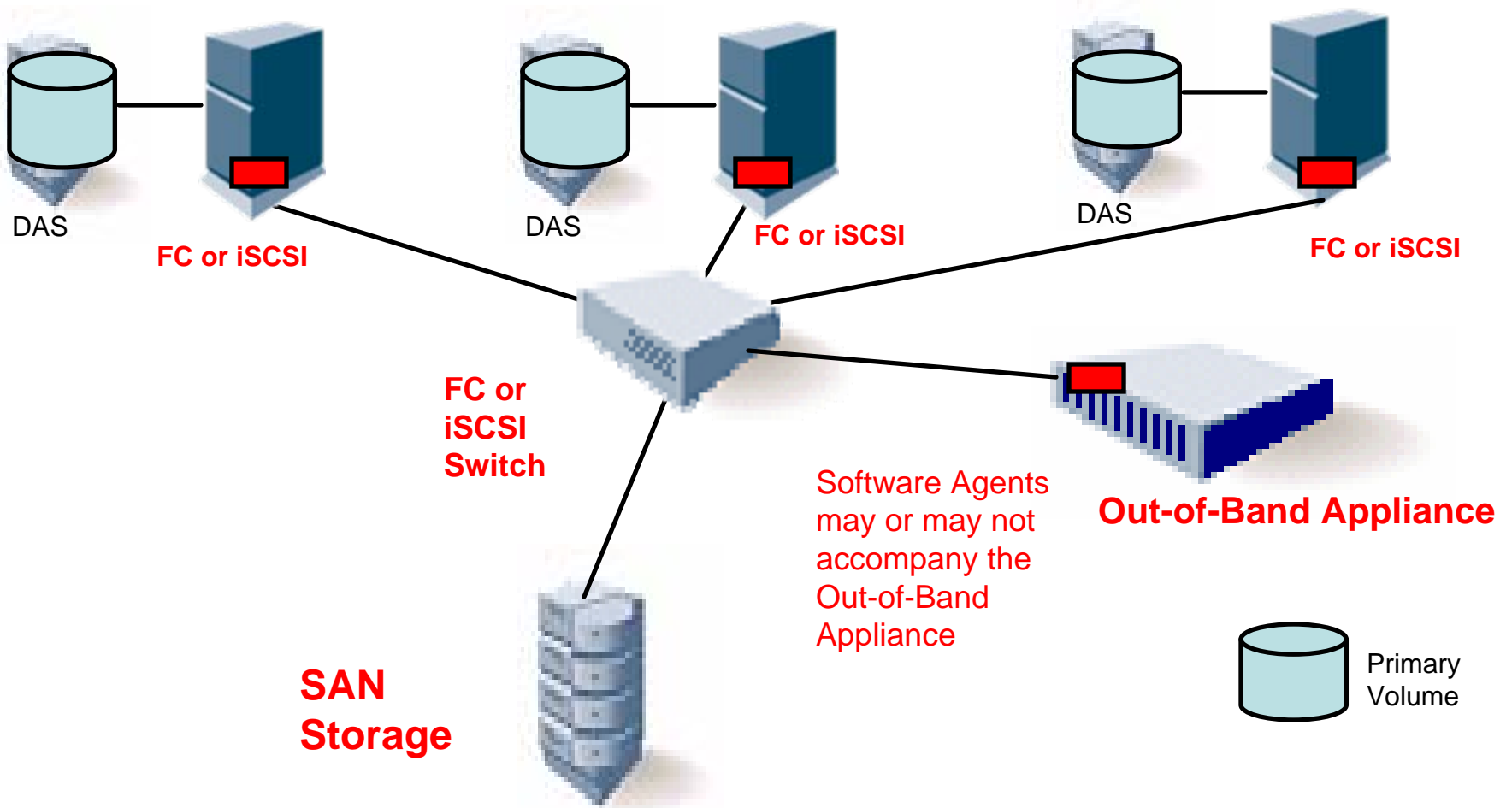
Implementing Storage Virtualization

2. Create SAN infrastructure



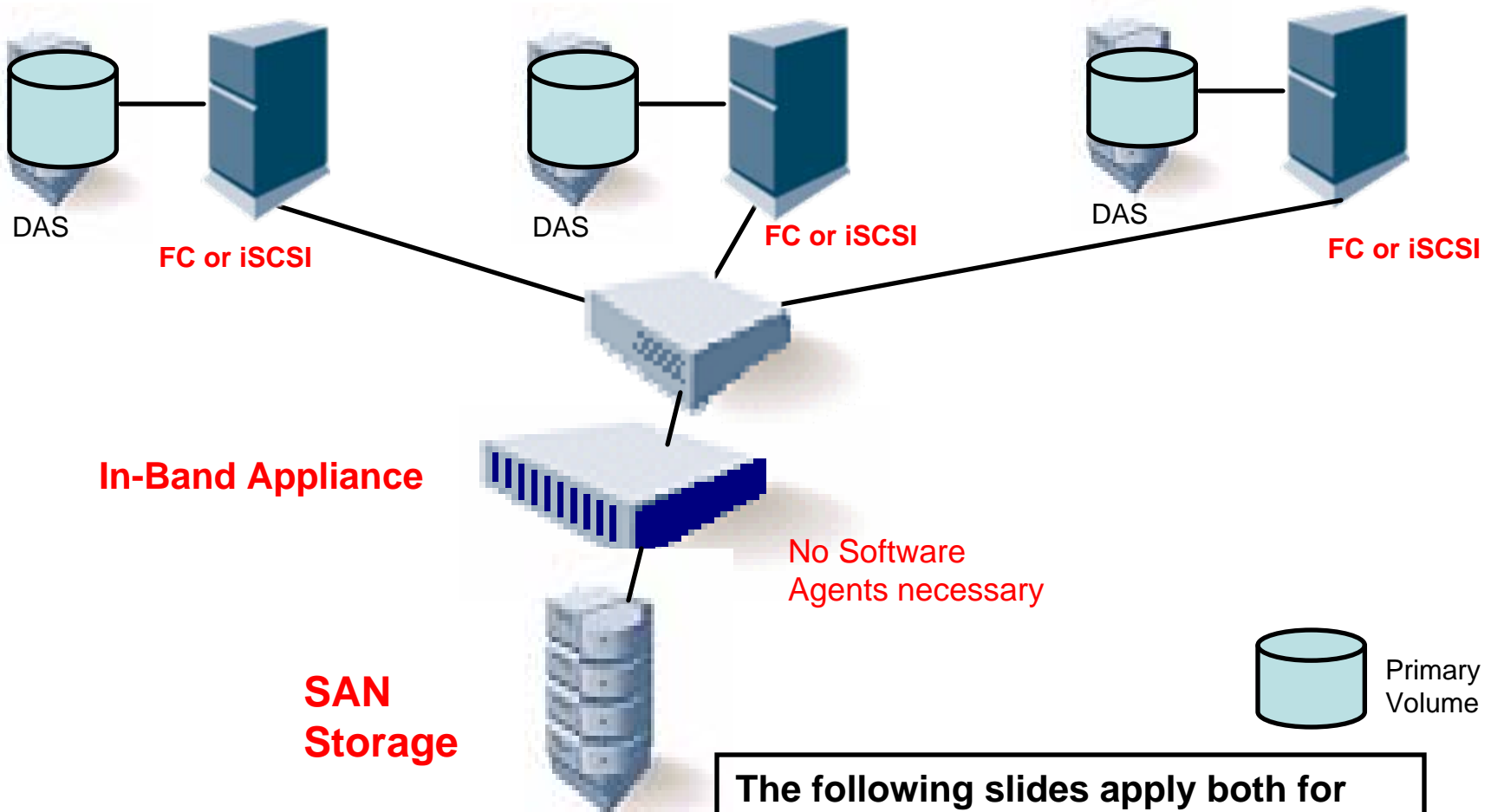
Implementing Storage Virtualization

3a. Add Virtualization – Network OOB



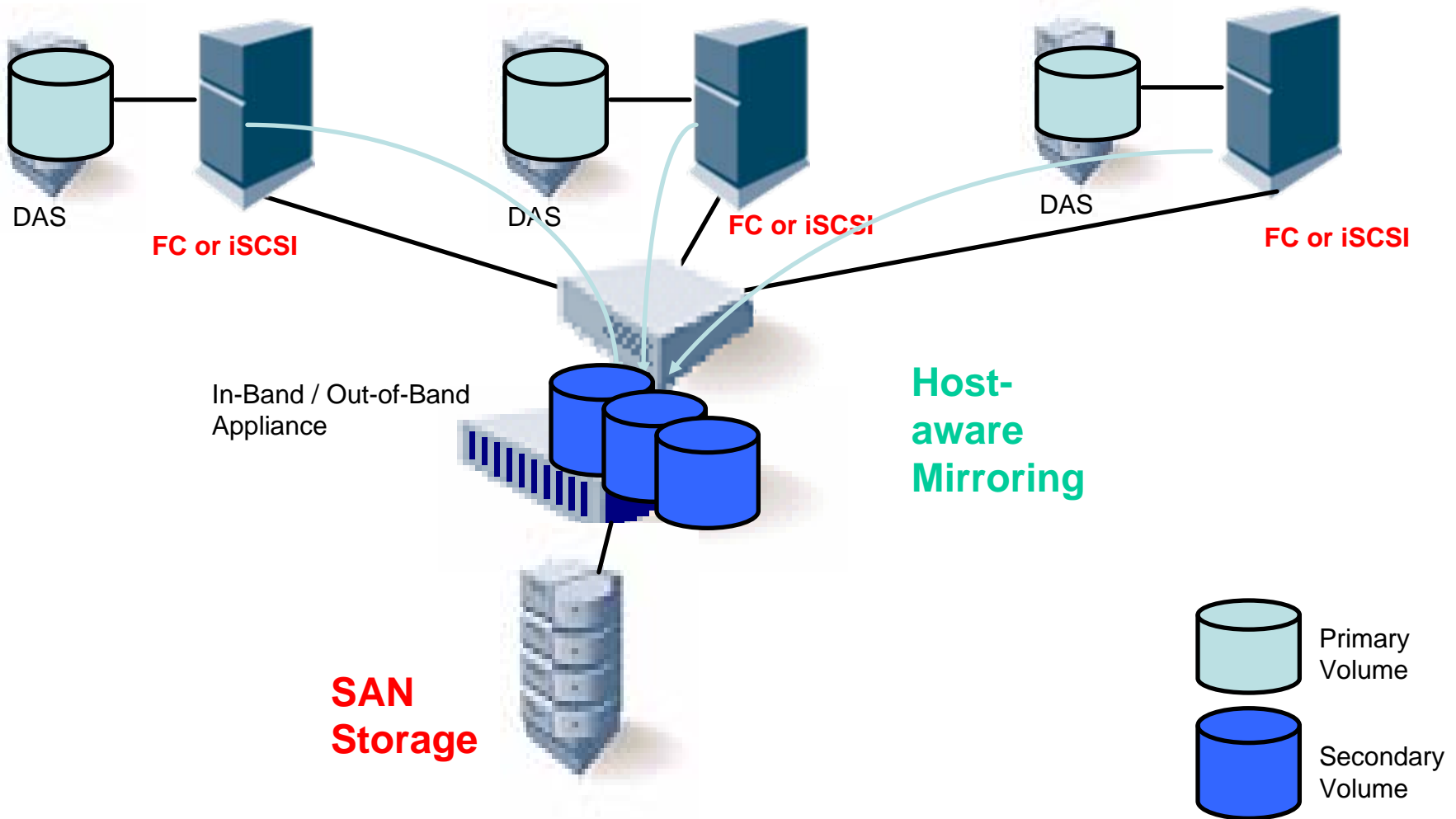
Implementing Storage Virtualization

3b. Add Virtualization – Network InBand



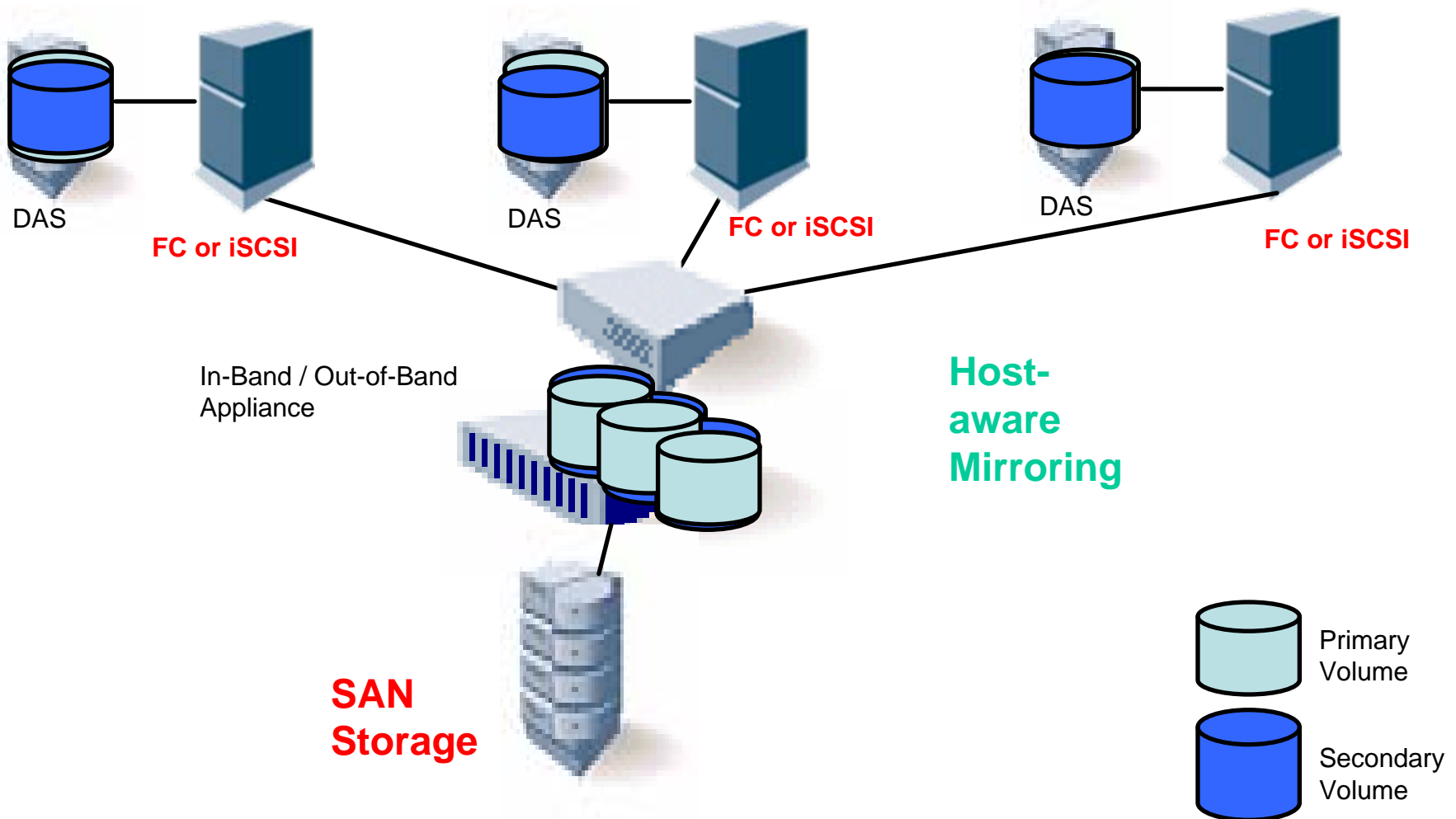
Implementing Storage Virtualization

4. Mirror DAS volumes to SAN



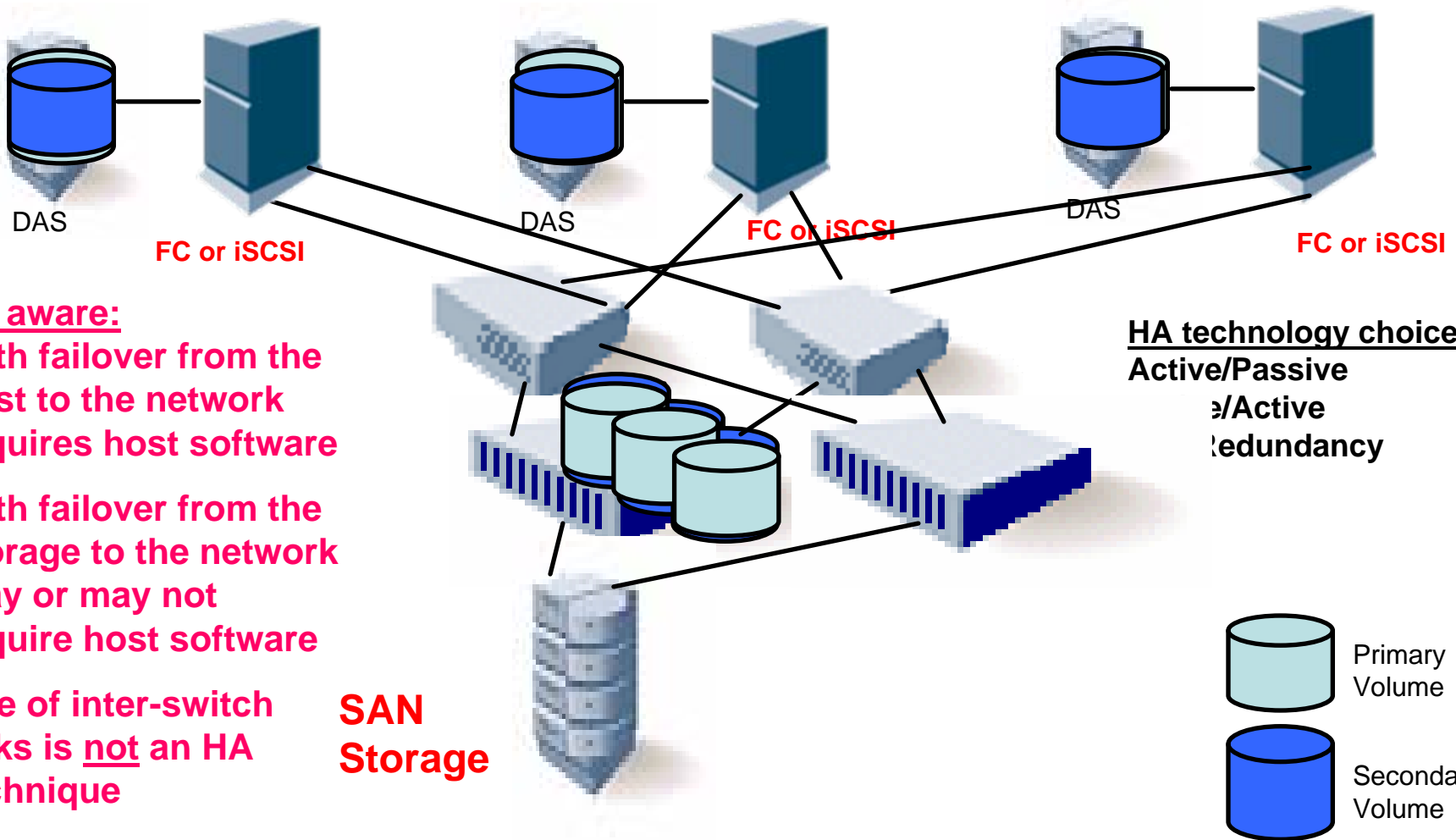
Implementing Storage Virtualization

5. Change Primary/Secondary



Implementing Storage Virtualization

6. Establish HA Environment



Be aware:
Path failover from the host to the network requires host software

Path failover from the storage to the network may or may not require host software

Use of inter-switch links is not an HA technique

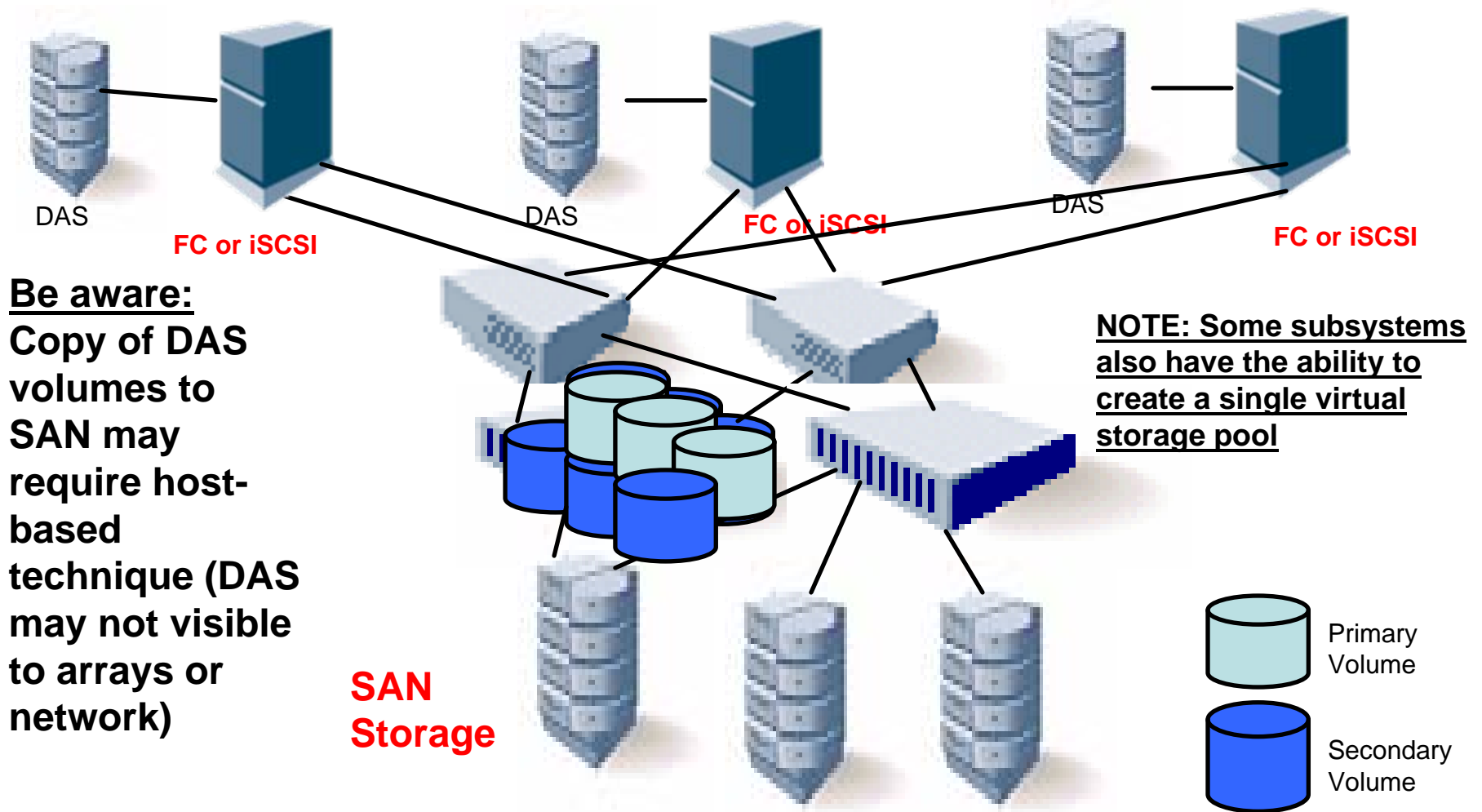
HA technology choices:
Active/Passive
↔/Active
Redundancy

SAN Storage

Primary Volume
Secondary Volume

Implementing Storage Virtualization

7. Create Single Storage Pool

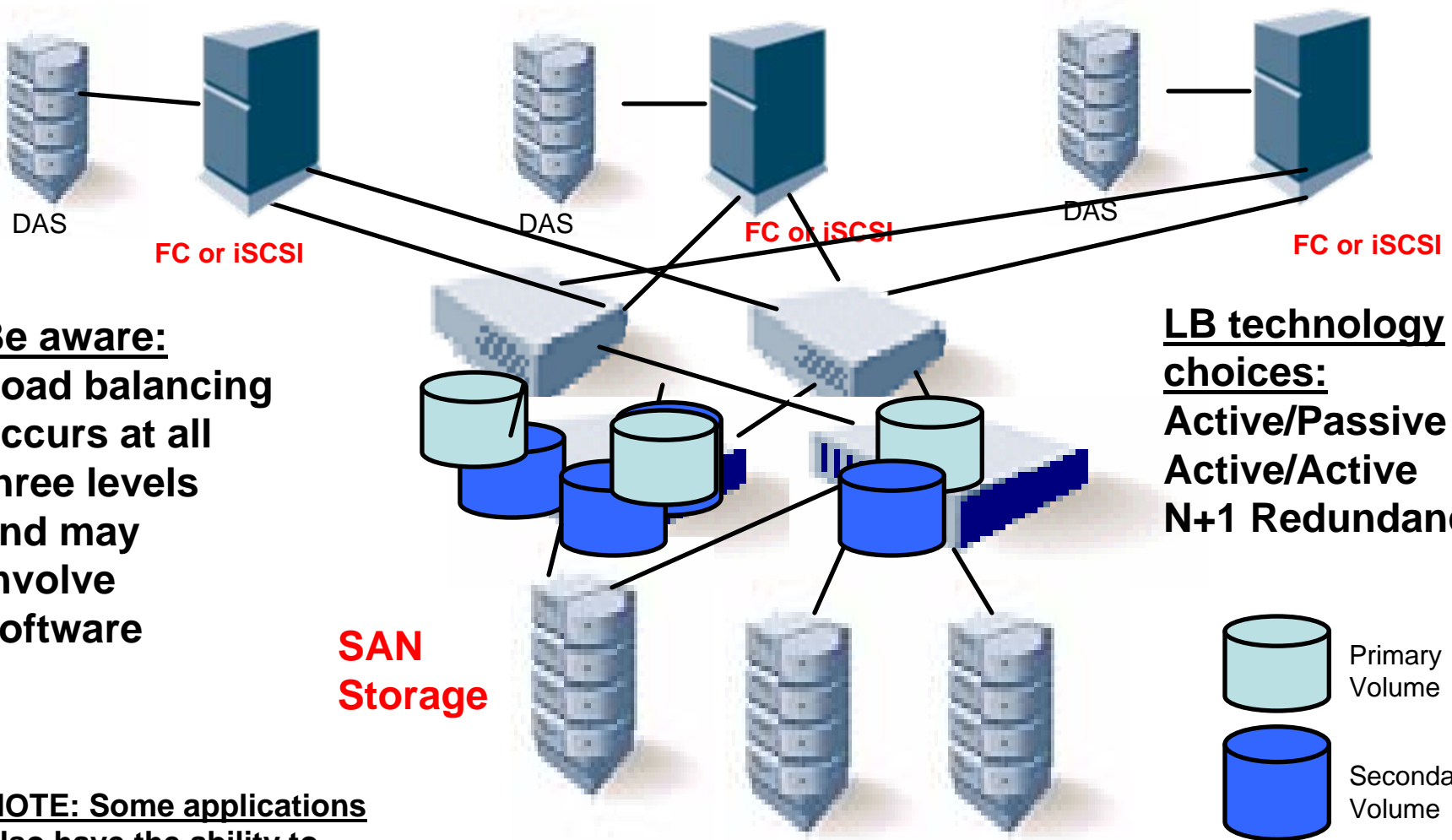


Be aware:
Copy of DAS
volumes to
SAN may
require host-
based
technique (DAS
may not visible
to arrays or
network)

**NOTE: Some subsystems
also have the ability to
create a single virtual
storage pool**

Implementing Storage Virtualization

8. Create Load Balancing



Be aware:
Load balancing occurs at all three levels and may involve software

LB technology choices:
Active/Passive
Active/Active
N+1 Redundancy

NOTE: Some applications also have the ability to load balance amongst their own nodes

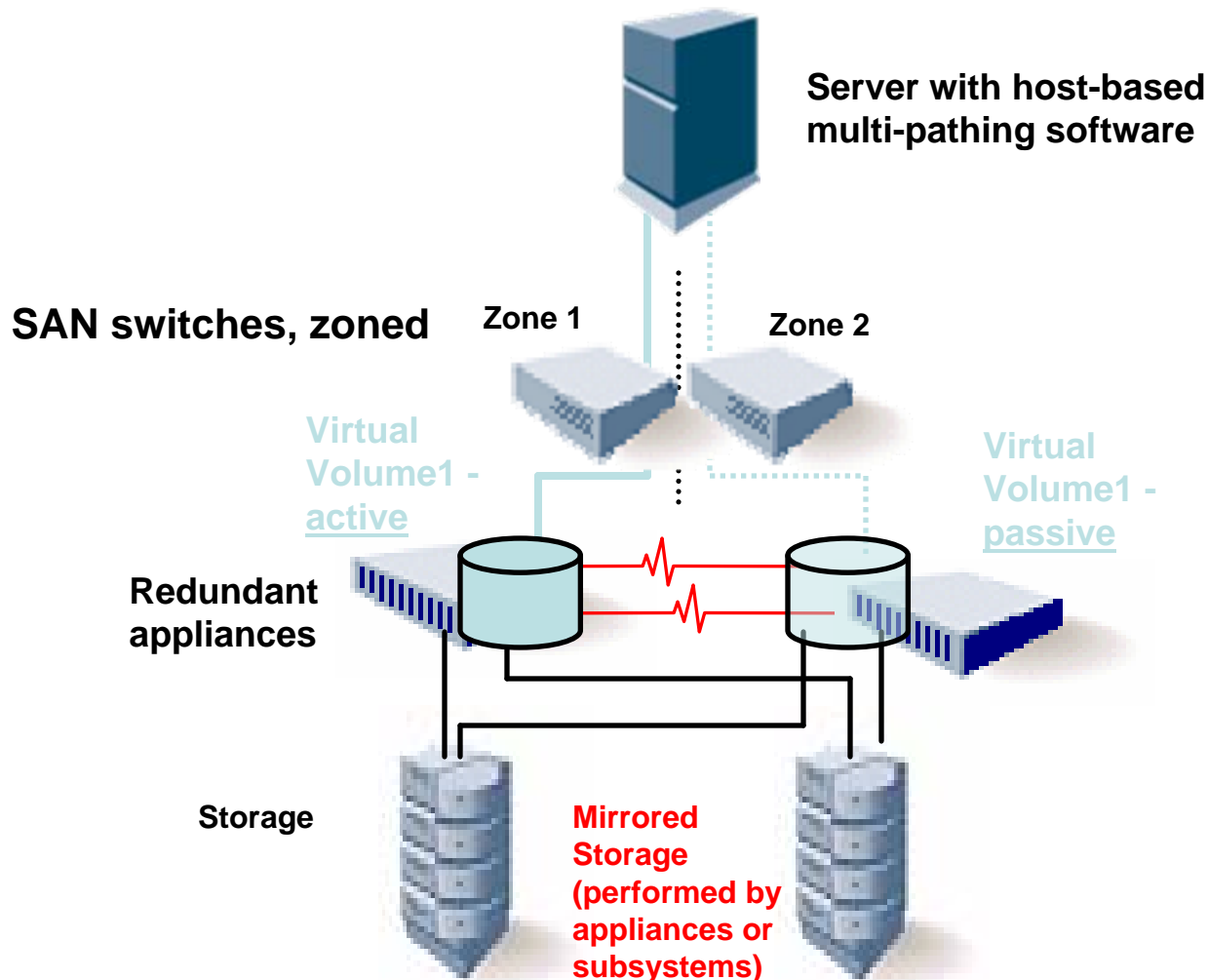
Achieving High Availability in a Virtual environment

Network-based Virtualization

- Do not rely on only one network-based appliance or intelligent switch only
 - ◆ Same rule for in-band as for out-of-band
- There are different methods to protect the engines
 - ◆ Active / Passive
 - ◆ Active / Active
 - ◆ N+1 redundancy
 - ◆ N-way distributed clustering
- The technique used is vendor-specific

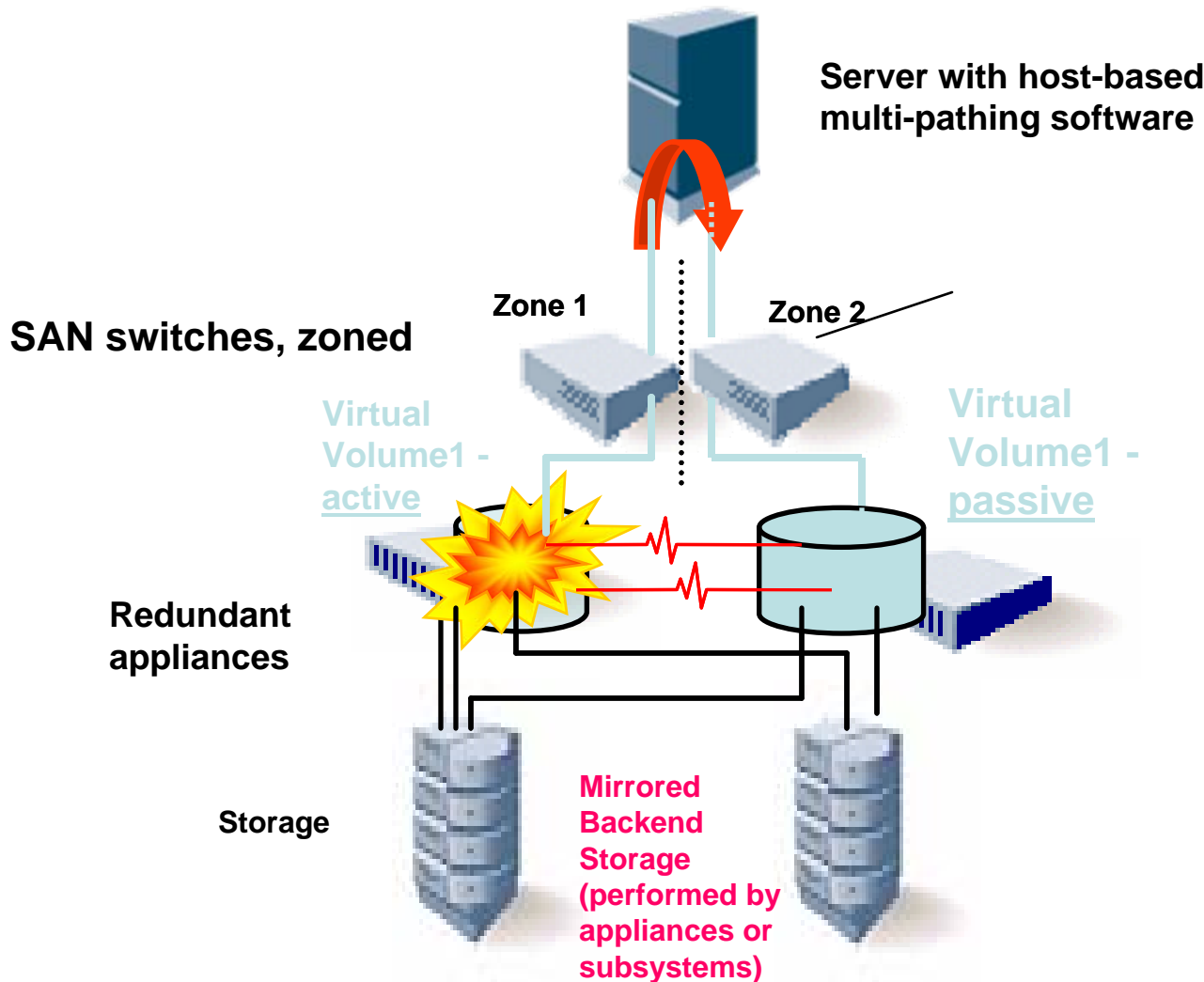
Achieving High Availability

Example: active/passive appliances or subsystems



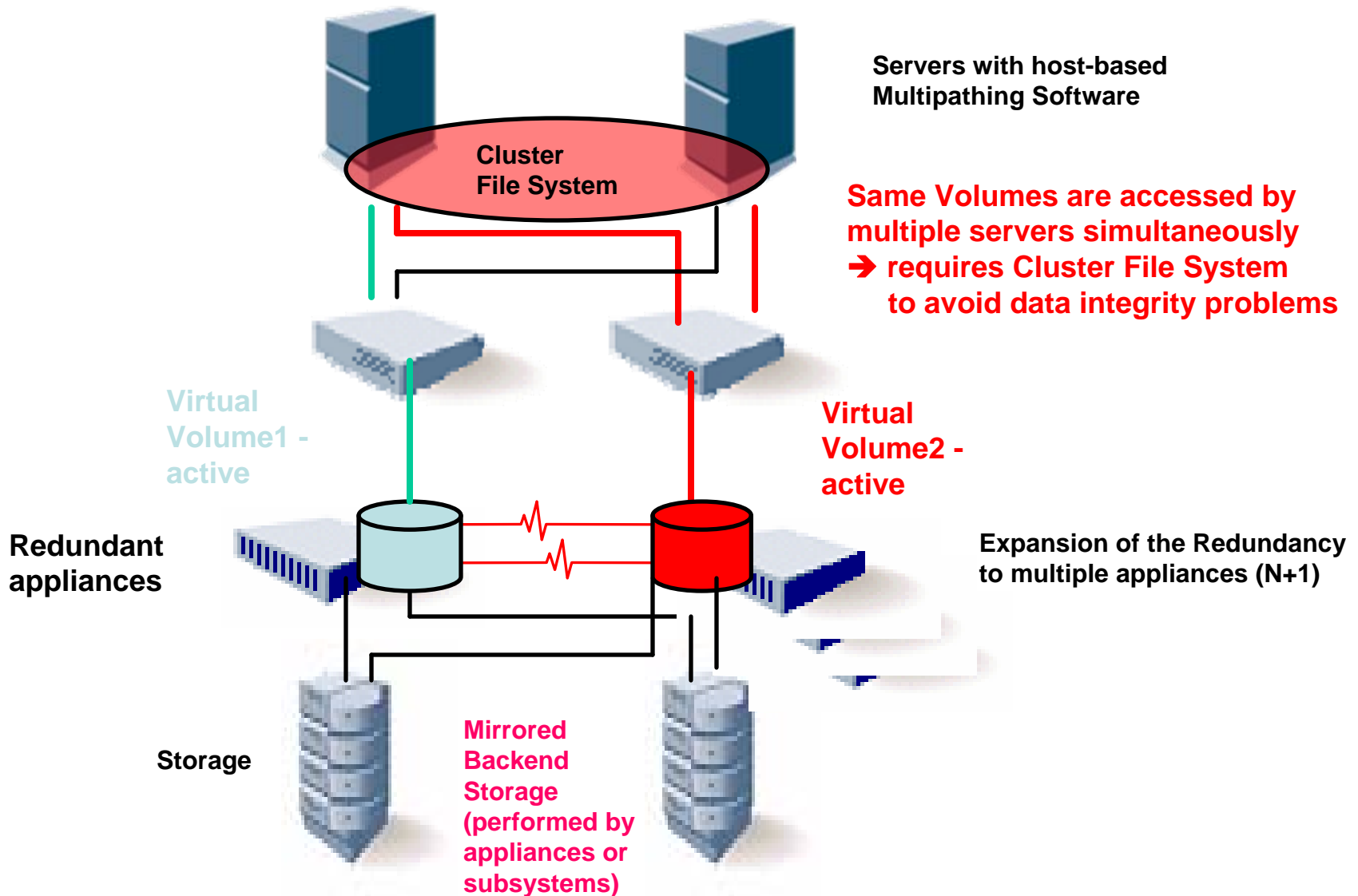
Achieving High Availability

Example: active/passive appliances or subsystems



Achieving High Availability

Example: Multiple access of same volume



High Availability Considerations for 'intelligent' switches

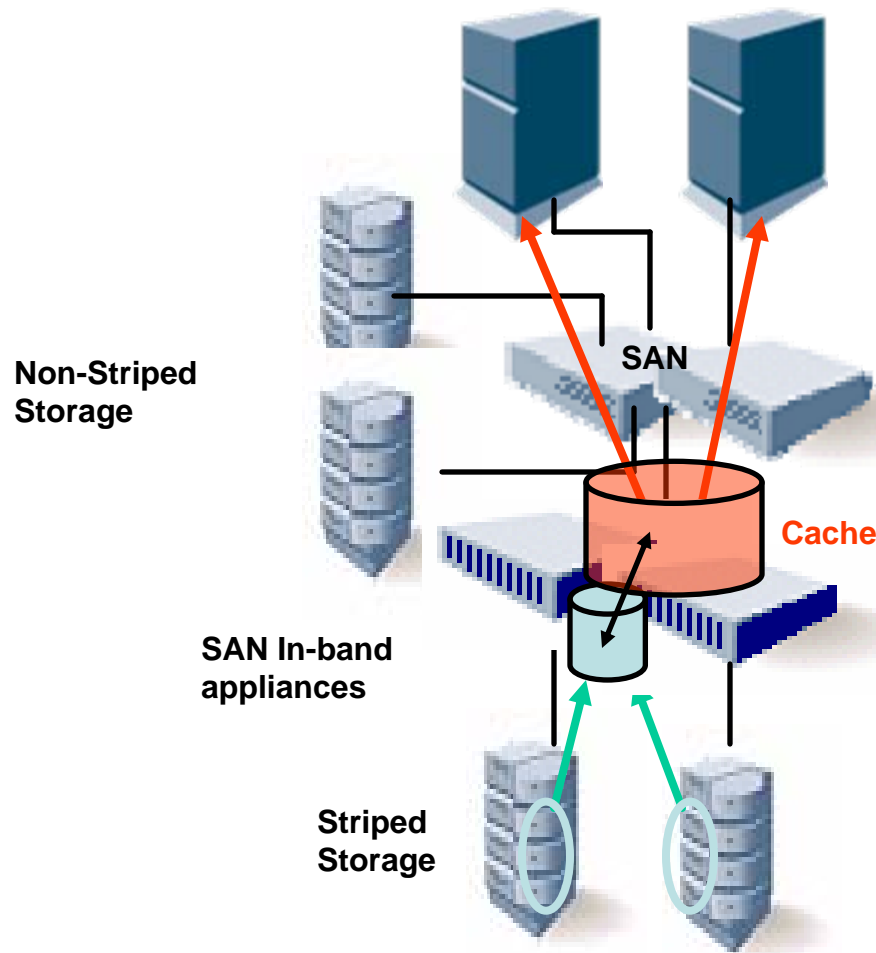
- To support high-availability configurations, virtual storage management must be distributed across two or more switches.
 - ◆ The switches present a virtual volume/LUN to the host(s) for a given LUN presented by the storage array(s) – and that LUN may be a virtual disk
 - ◆ Host-based multi-pathing software allows active-passive or active-active access to the virtual volumes presented to the host(s)
 - ◆ Allows hosts to access virtual volumes in the presence of a switch failure

Achieving Performance in a Virtual environment

- **Striping / Mirroring**
 - ◆ Simultaneous reads and/or writes
- **Load Sharing**
- **Load Balancing**
- **Off-loading host systems**
- **Caching (where possible)**

Achieving Performance

Example: In-band appliance

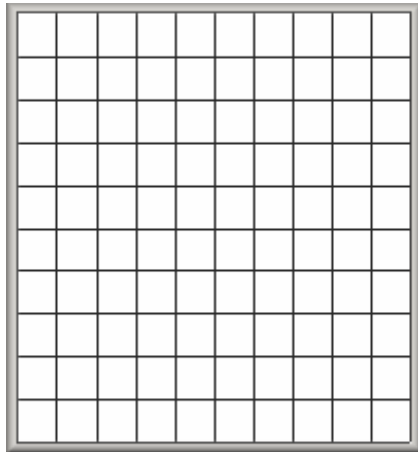


Performance Improvement:

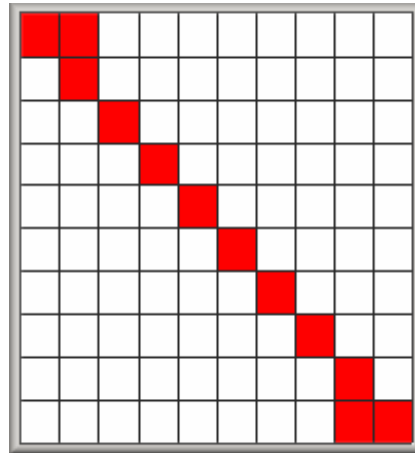
1. Striping across multiple disk arrays
2. Caching Technology in the In-Band SAN appliance

- Eliminate fixed-size LUNs
- Create dynamic virtual LUNs and expand the LUNs as necessary
 - ◆ Requires dynamic volume support on the host(s)
- Create large virtual LUNs and pools and assign backing (physical) storage to it as the host writes data (Sparse Allocation)
- Dynamic growth of Volumes and File Systems simultaneously

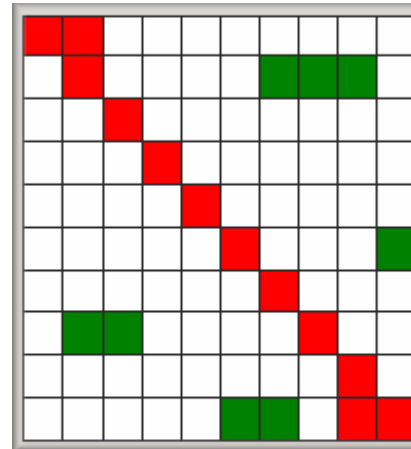
Sparse Allocation a.k.a. Thin Provisioning



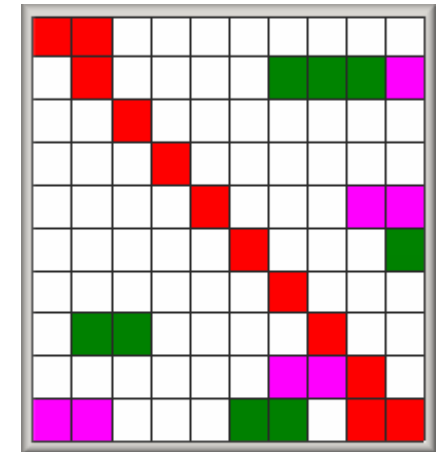
1. New Volume



2. Initial Filesystem allocation



3. Data Written



3. More Data Written

□ Unallocated Logical Block

■ Filesystem Metadata



■ Application Data



Considerations for Thin Provisioning

- Beware of Thin “runaway” (array over-subscription)
- Economic advantage varies - reserved space %
- Large thin LUN versus small growing LUN
- Read thin LUN may present problems
 - ◆ Backup, Copy, Duplicate, Replica
 - ◆ Vendor-specific treatment when reading unwritten blocks
- Over-allocate LUN versus over-subscribe system
- Be careful what you ask for – you may get it!

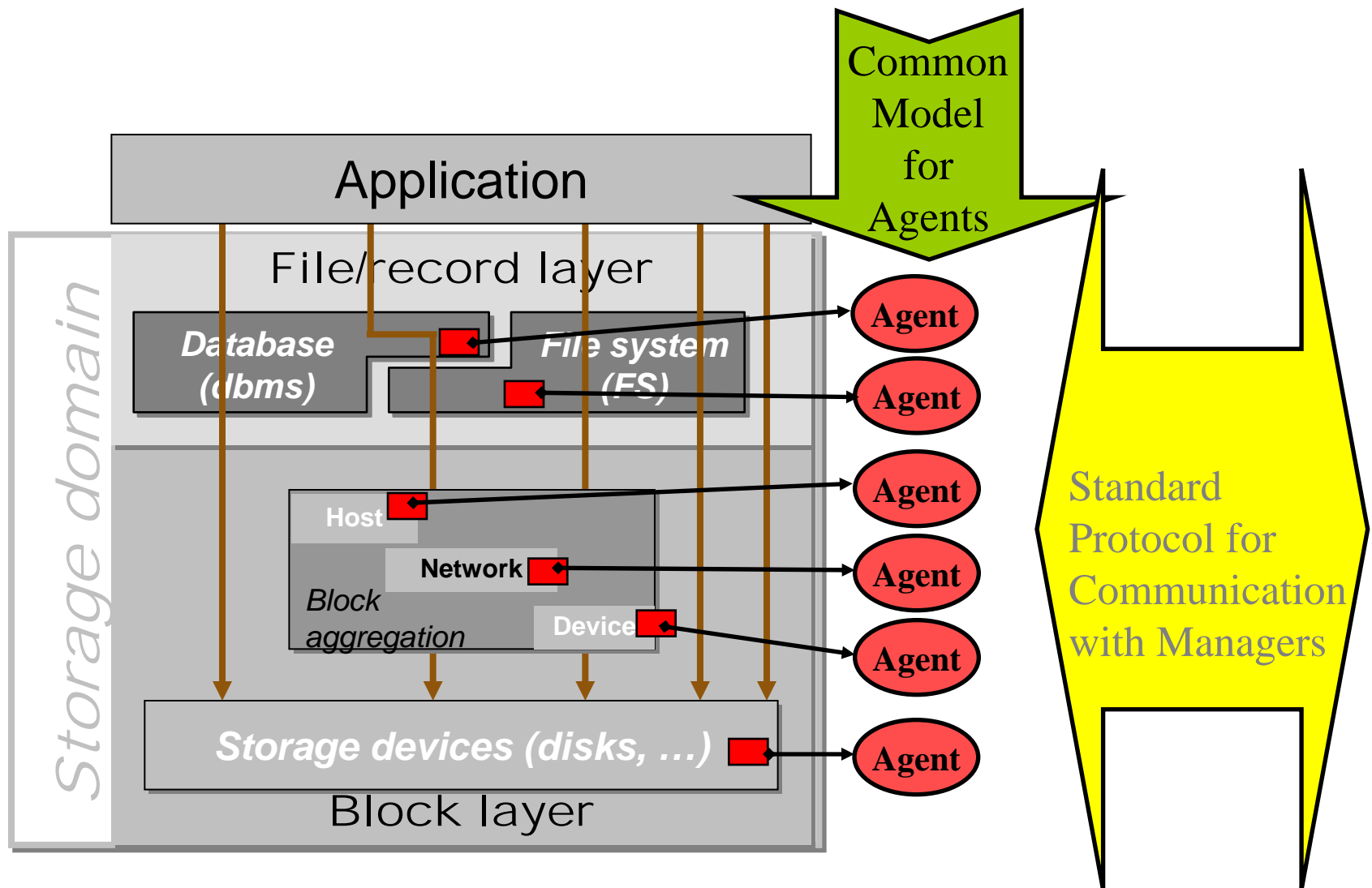
Storage Virtualization and SNIA's Storage Management Initiative (SMI)

The following material corresponds with the SNIA SMI-S 1.1.x

A Brief Introduction to SMI-S

- **SNIA's strategic initiative to solve end-user operational challenges for Storage Management**
 - ◆ Passive (Discovery and Monitoring)
 - ◆ Active (Storage Configuration; manually and policy-based)
- **Based on Standards**
 - ◆ WBEM (Web Based Enterprise Management)
 - ◆ CIM (Common Management Model)
- **Includes Block Virtualization in its first version**

Control Path in SNIA Shared Storage Model



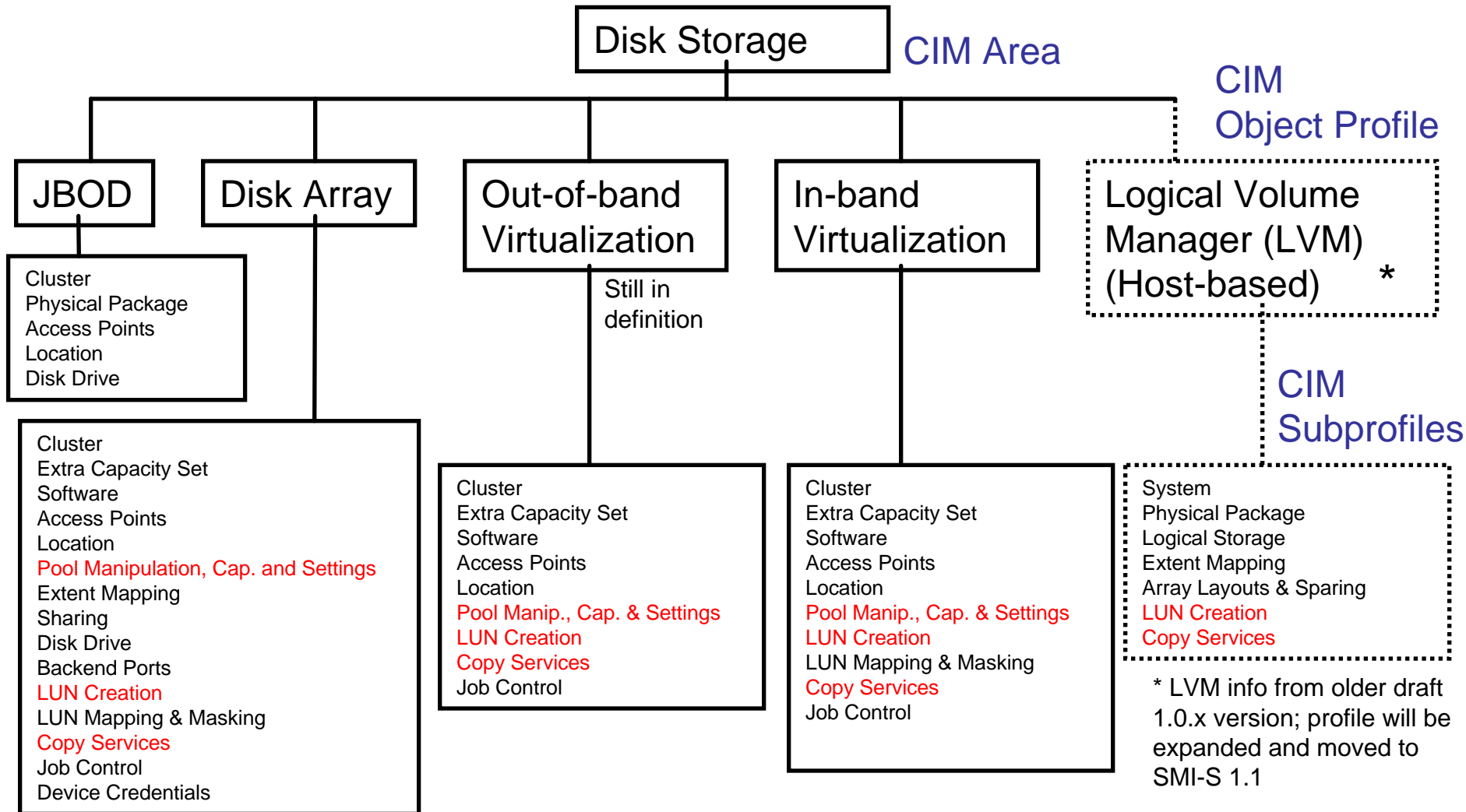
SMI-S V1.1.x Capabilities

1. Identify key resources in a SAN
2. Identify interconnects between key resources in a SAN
3. Receive asynchronous notification that the configuration in a SAN has changed
4. Identify the health of key resources in a SAN
5. Receive asynchronous notification that the health of a SAN has changed
6. Identify the available performance of interconnects in a SAN
7. Receive asynchronous notification that the performance of a SAN interconnect has changed
8. Identify the zones being forced in as SAN
9. Create/Delete and enable/disable zones in a SAN
10. Identify the storage volumes in a SAN
11. Create/delete/modify storage volumes in a SAN
12. Identify the connectivity and access rights to Storage Volumes in a SAN
13. Create/delete and enable/disable connectivity and access rights to Storage Volumes in a SAN
14. Allow a site to require the use of authenticated clients

Block Virtualization

SMI-S V1.1.x

Disk Storage in the SMI-S



SMI-S and Storage Virtualization

- SMI-S is not a virtualization of storage per se
- It is a “virtualization” of the management APIs for the different vendor’s components.
- The long term impact of SMI-S on virtualization products is profound!
 - ◆ Eliminates the need for proprietary APIs to perform common management tasks such as creating LUNs, manage snapshots or data replication
 - ◆ Avoids reverse engineering and its corresponding problems
- SNIA SMI-S VI.1.x already delivers standard interfaces that use virtualization technologies
- Will help to establish Policy-based Service Level Management and Automated Storage Resource Management (SRM)

Policy-based Service Level Management

What's the role of storage virtualization?

Policy-based Service Level Management

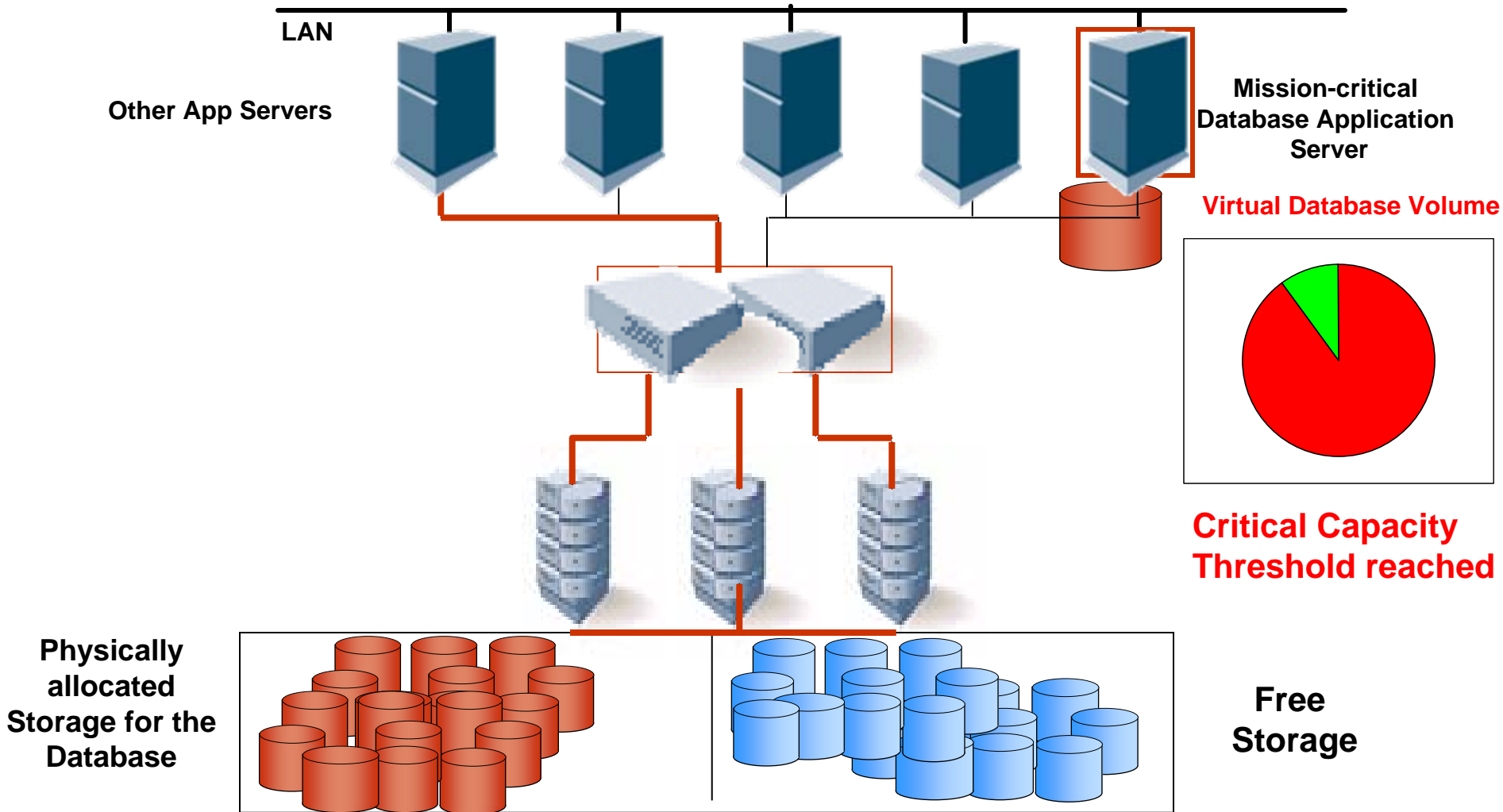
- Handles error-prone administrator tasks (such as storage provisioning) automatically

- Pre-defined rules (policies) must be set

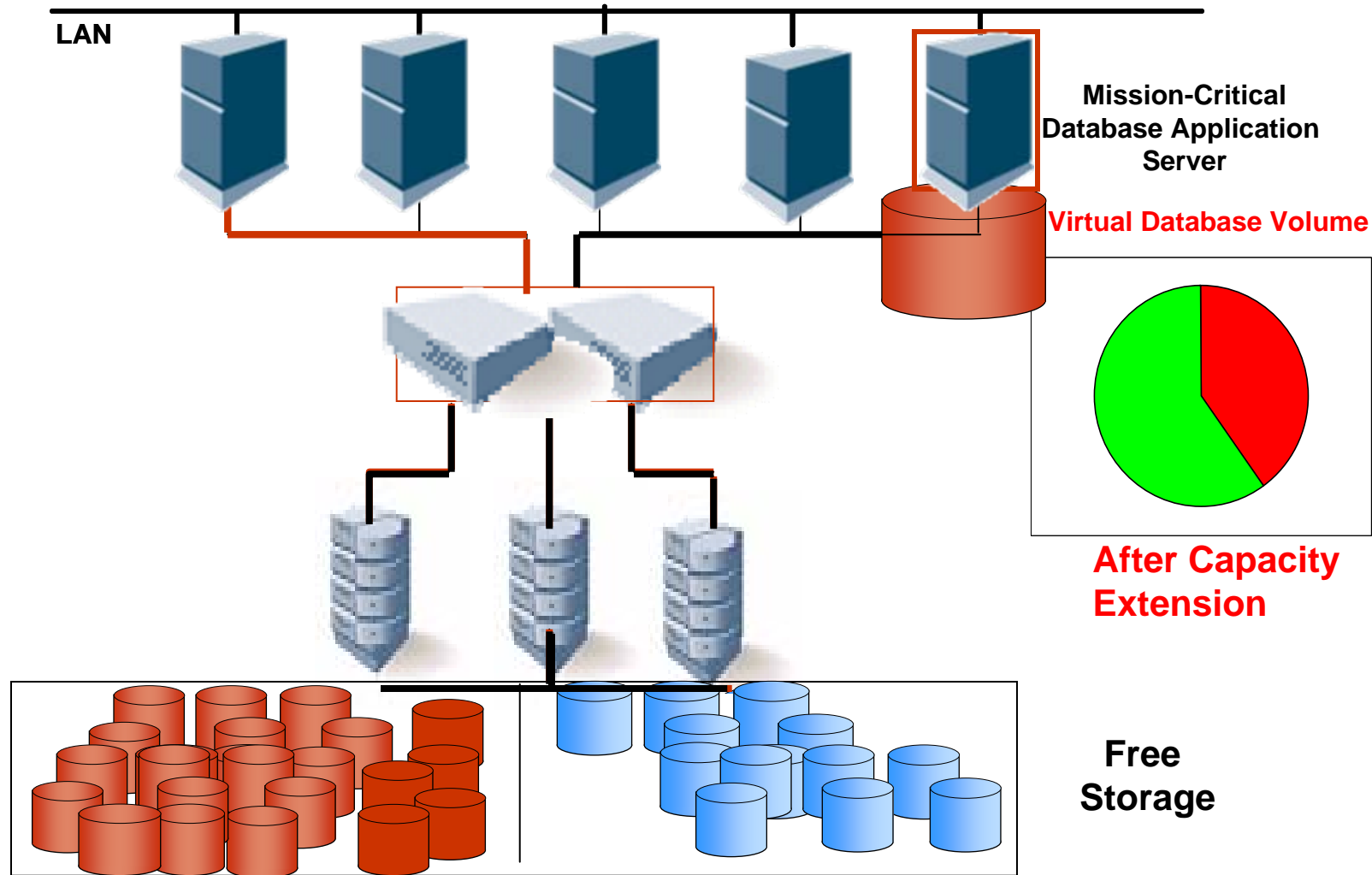
- One critical Service Level Management outcome is efficient Storage Capacity Planning
 - ◆ Dynamic Provisioning
 - ◆ Automated Capacity Plan Execution

- **Monitoring of Storage Capacity**
 - ◆ Application-centric – but can be done in fabric or subsystem
- **Threshold Management**
 - ◆ Definition of rules: What to do, when, to whom...
- **Discover free capacity with desired storage attributes**
- **Assign new storage into the server zone(s)**
 - ◆ Switch zoning via vendor-specific APIs or SNIA SMI-S
- **Grant specific server(s) access to the storage**
 - ◆ LUN Masking via vendor-specific APIs or SNIA SMI-S
- **Map storage to the server volume(s) (Online !!)**
 - ◆ Resize / Re-layout the volume (vendor APIs or SNIA SMI-S)
- **Make larger volume aware to the application**
 - ◆ For example:
 - sparse allocation(thin provisioning) or
 - automatic, dynamic growth of file system

Policy-based Service Level Management - big picture (I)



Policy-based Service Level Management - big picture



- Policy-based Service Level Management must be performed (executed) without any user interaction
- Once new free storage capacity is discovered, the existing volumes must be resized online without any impact to the application
- Only Storage Virtualization techniques can assure these requirements – coupled with OS involvement

- ▶ Please send any questions or comments on this presentation to the SNIA:
trackvirtualization@snia.org

**Many thanks to the following individuals
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