



Education

# **Storage Virtualization II**

## **Effective Use of Virtualization**

- focusing on block virtualization -

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- *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**

# Virtualization Checklist

- 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

# So, What's the Problem?

- Storage problems in specific areas, such as:
  - ◆ Capacity/Provisioning
  - ◆ 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 H/A

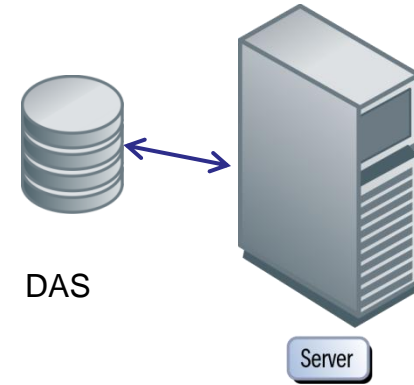
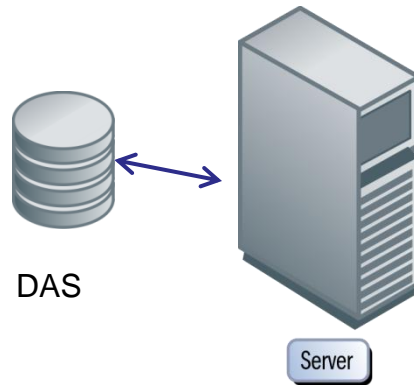
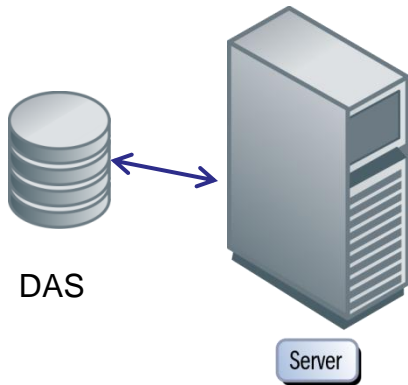
# Implementing Storage Virtualization step-by-step

- 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

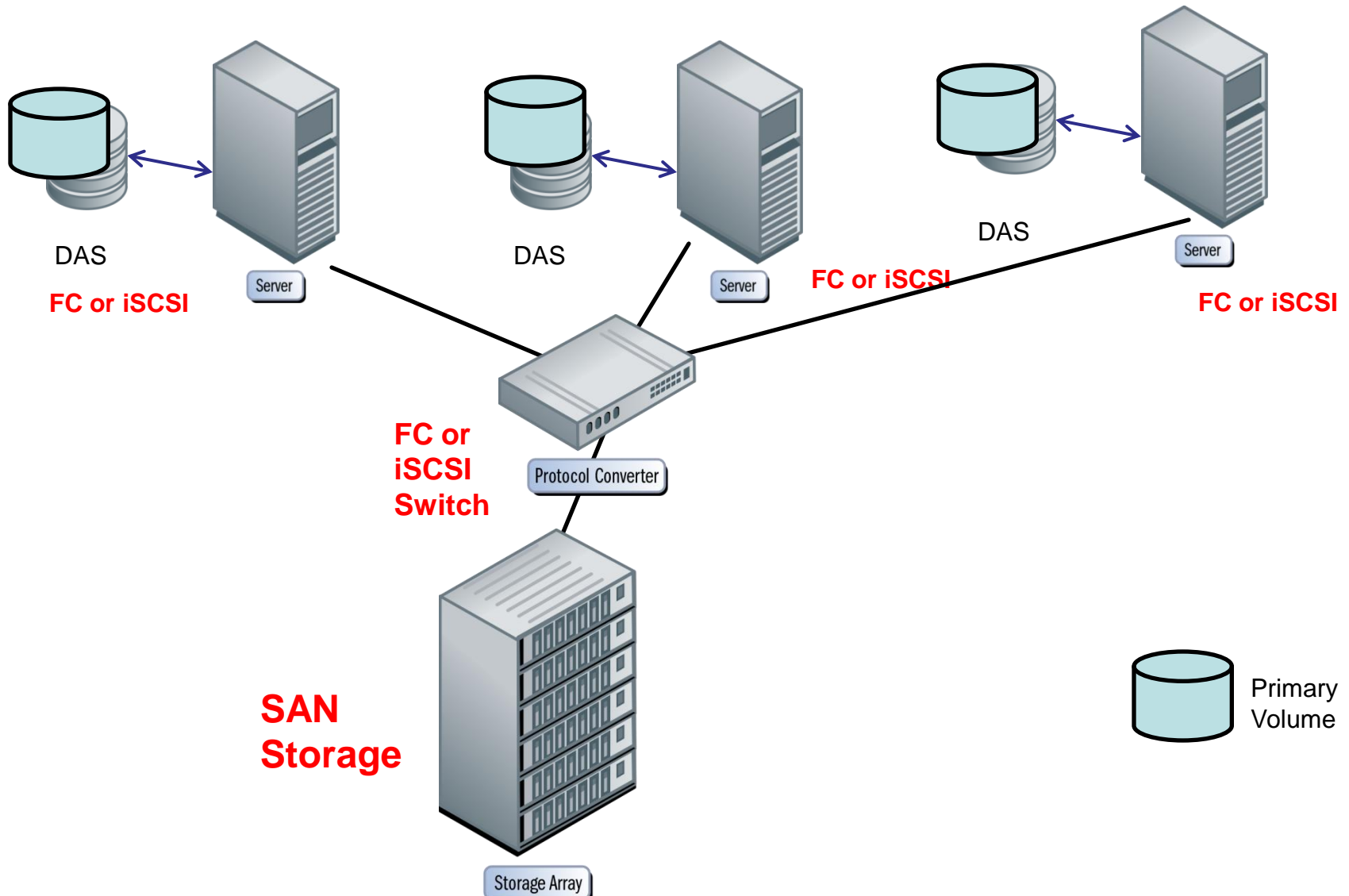
DAS = either internally or externally direct connected storage devices



Primary  
Volume

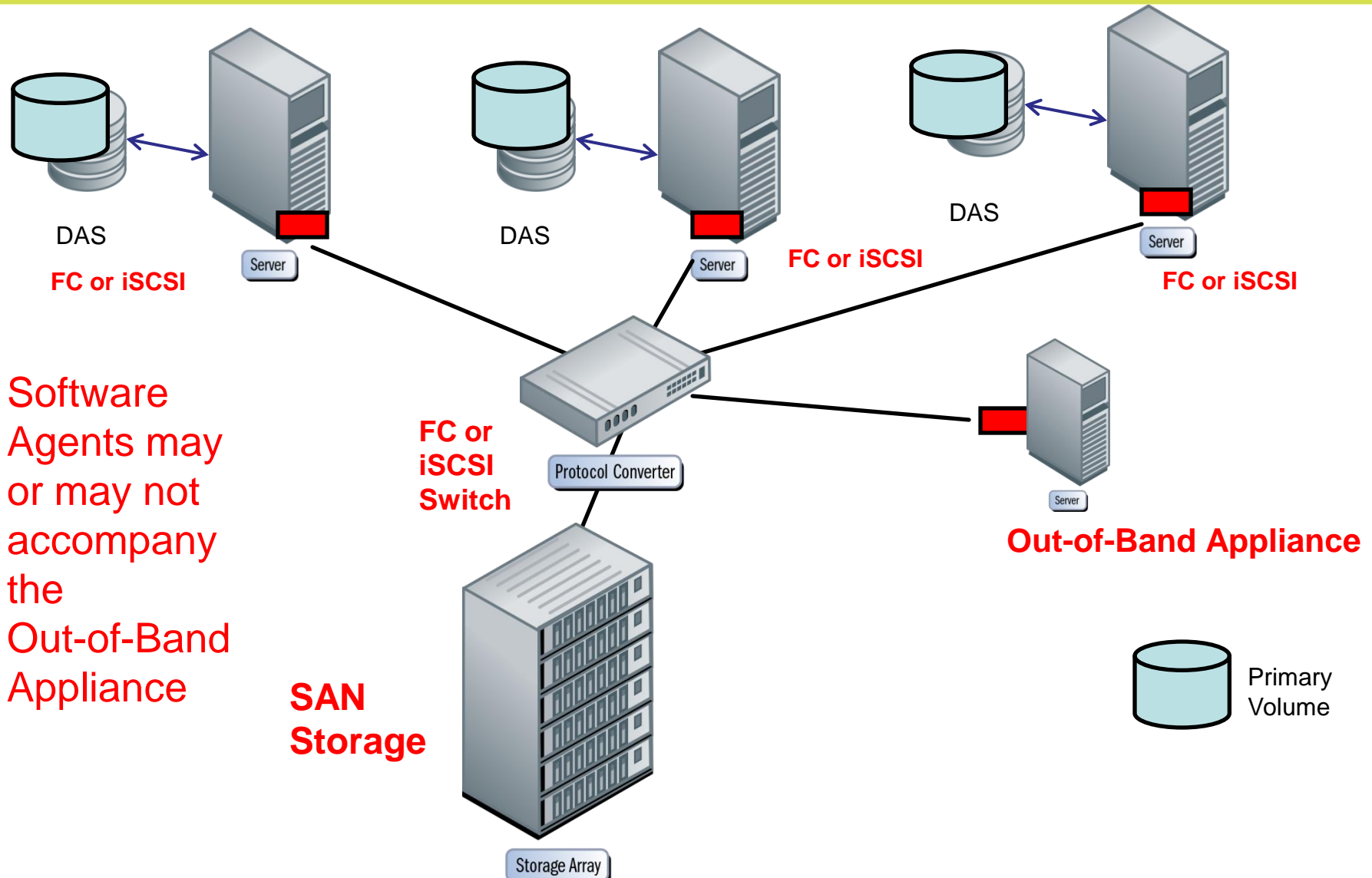
# Implementing Storage Virtualization

## 2. Create SAN infrastructure



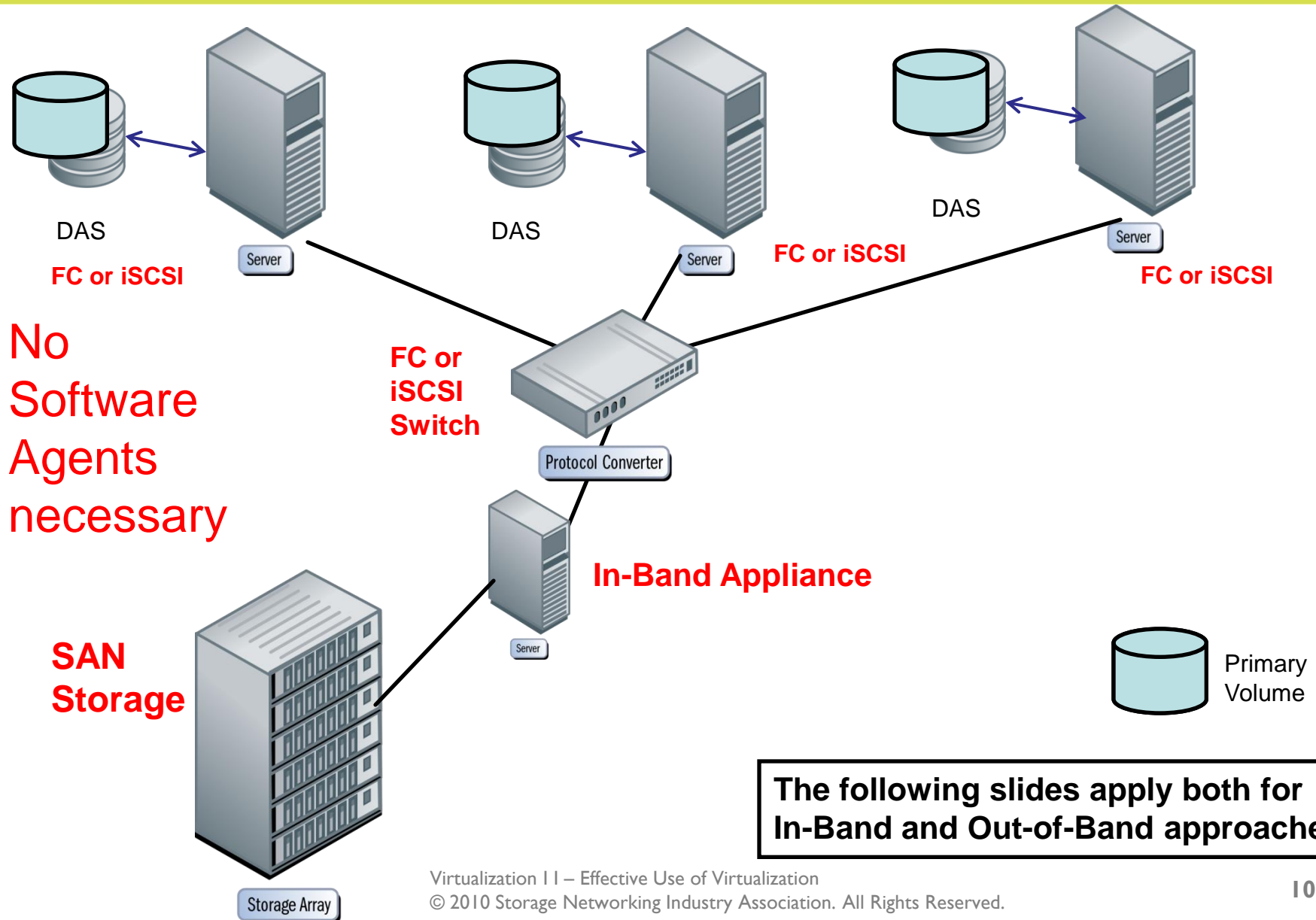
# Implementing Storage Virtualization

## 3a. Add Virtualization – Network OOB



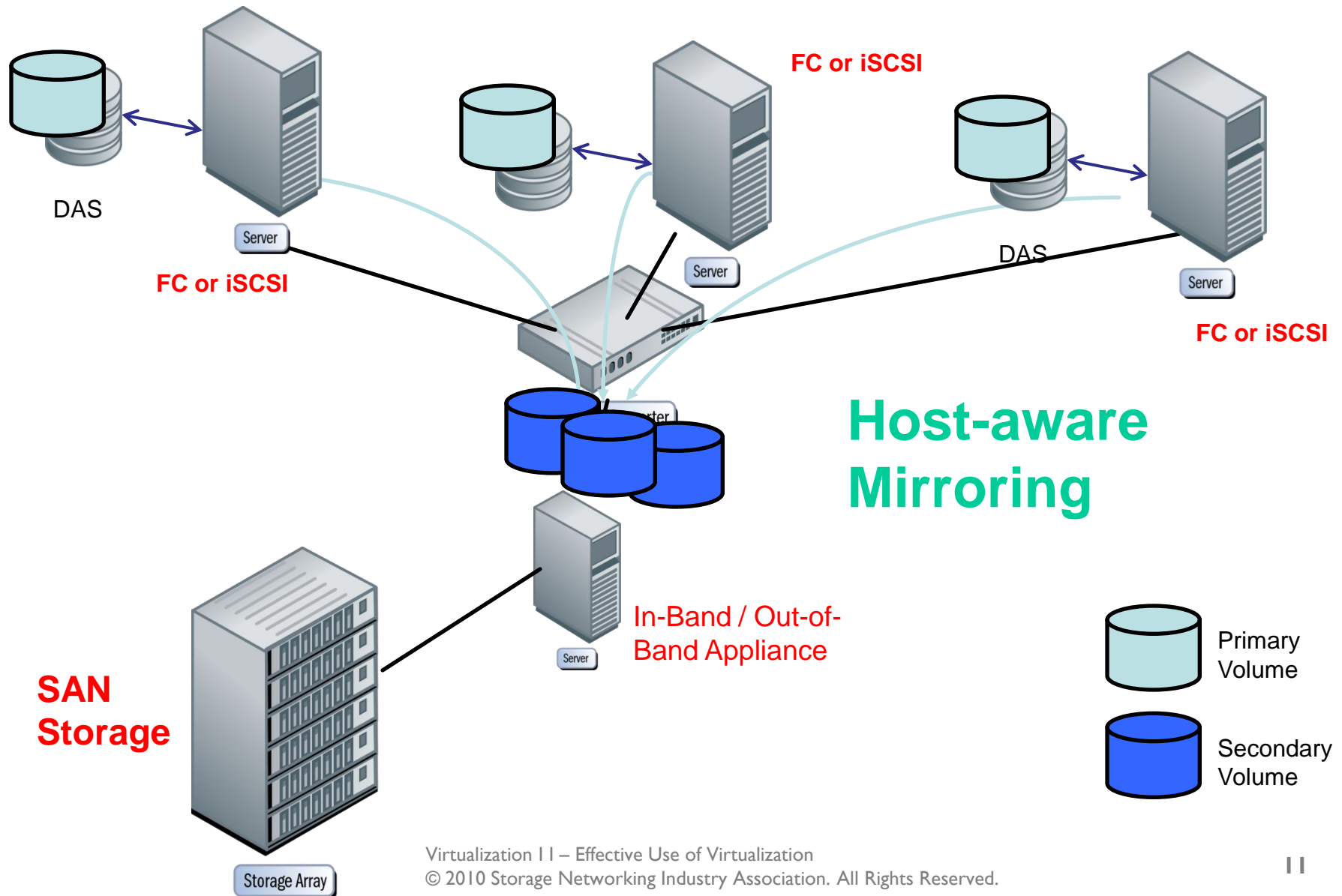
# Implementing Storage Virtualization

## 3b. Add Virtualization – Network InBand



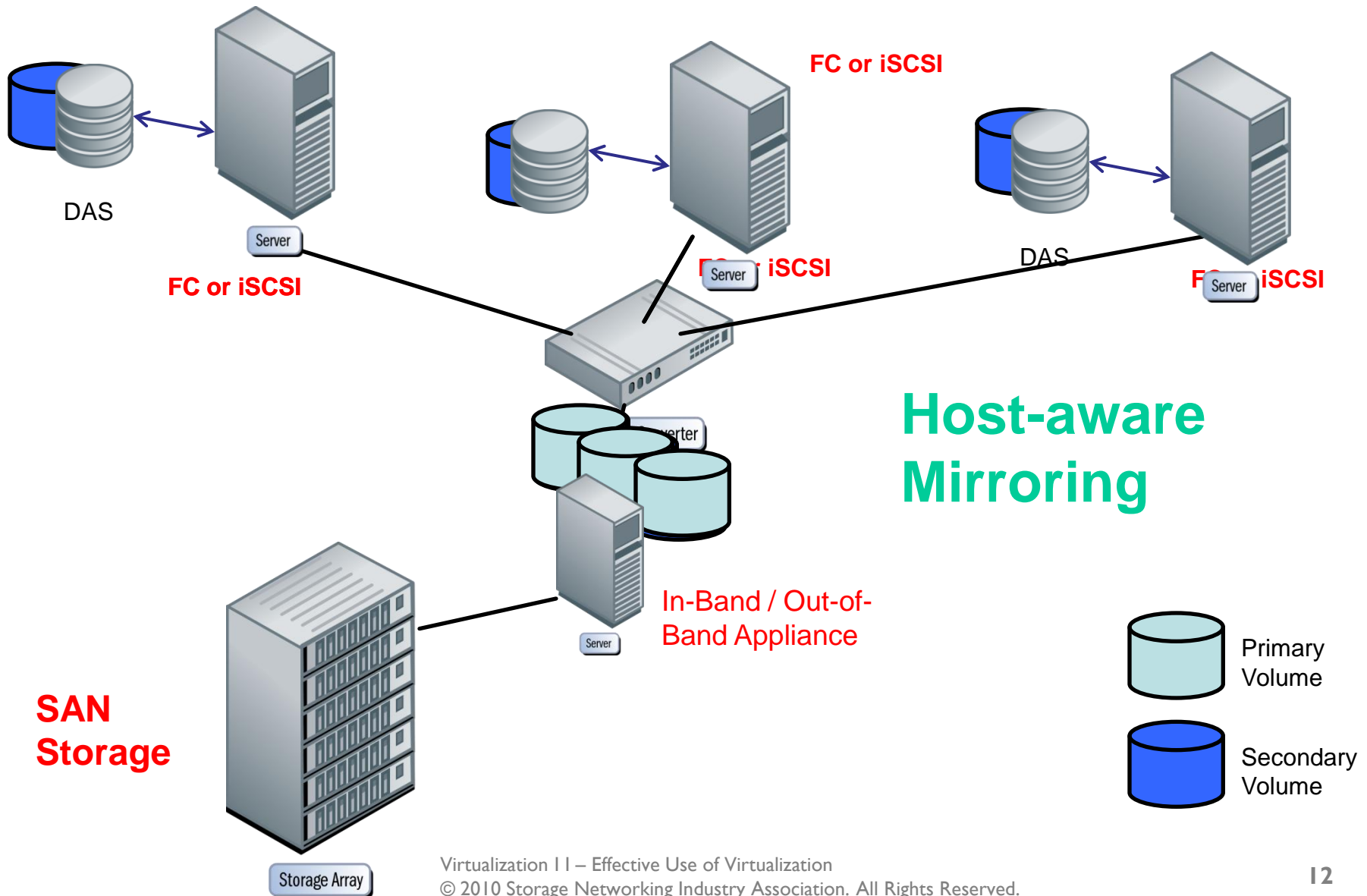
# Implementing Storage Virtualization

## 4. Mirror DAS volumes to SAN



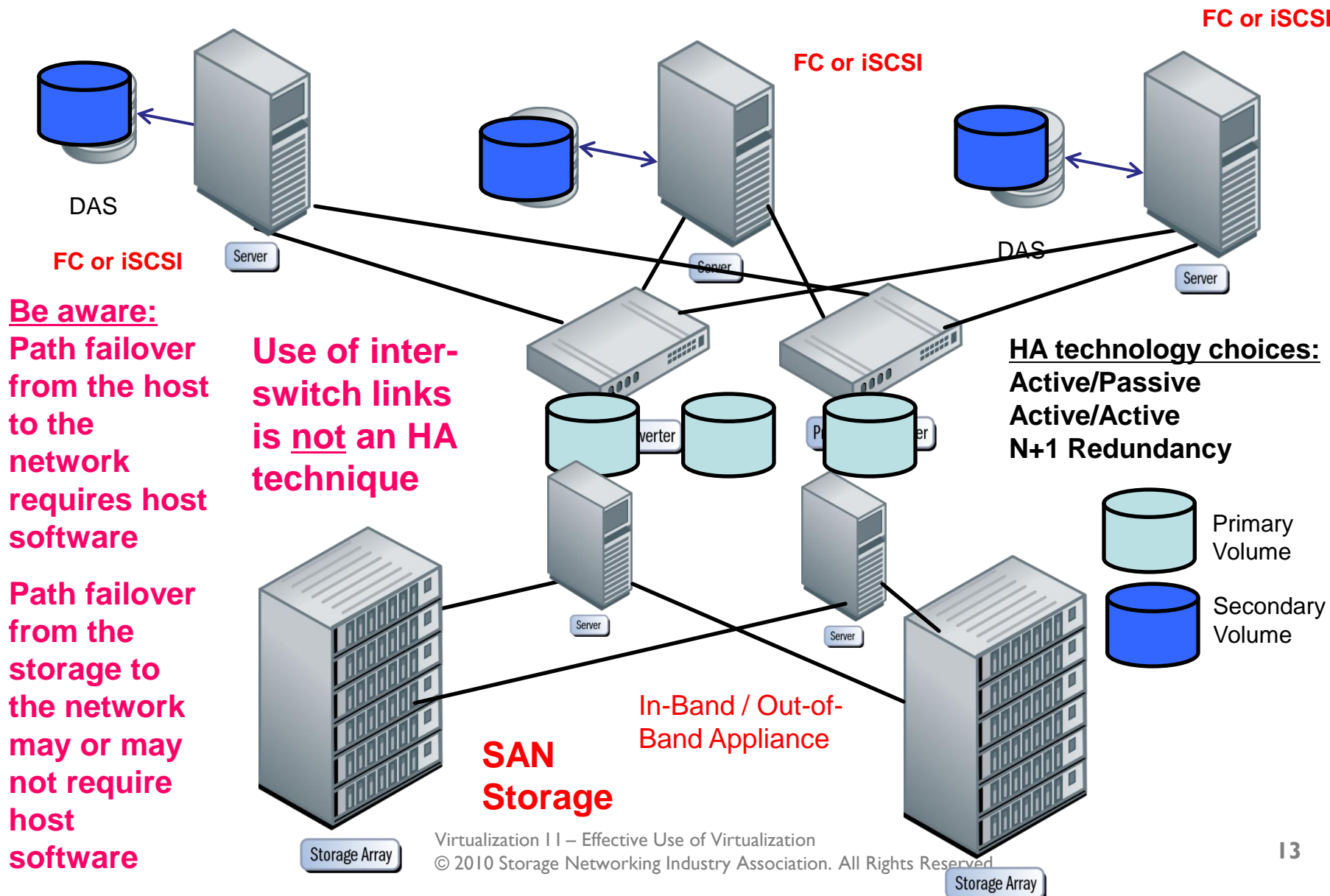
# Implementing Storage Virtualization

## 5. Change Primary/Secondary



# Implementing Storage Virtualization

## 6. Establish HA Environment



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

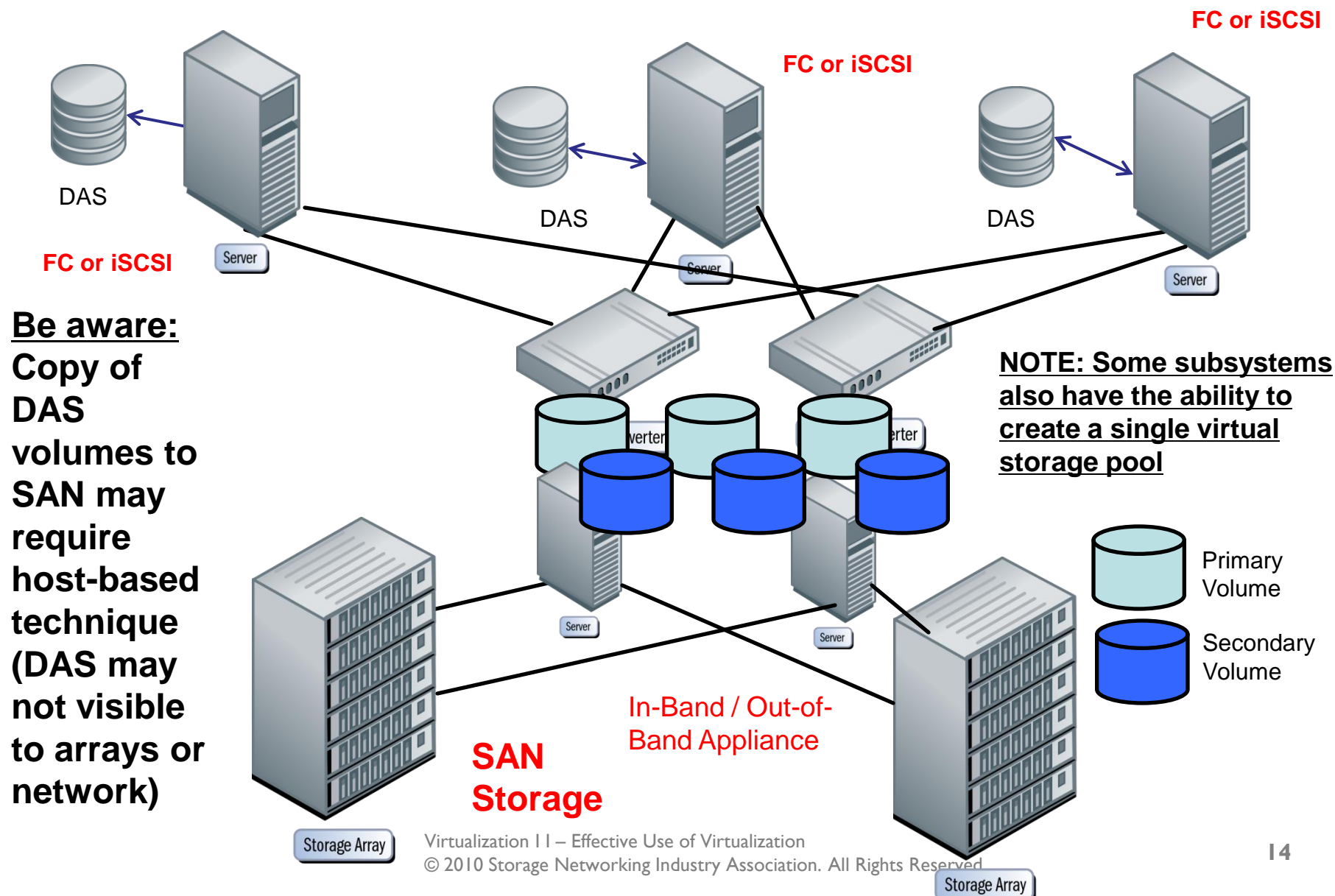
Path failover from the storage to the network may or may not require host software

Use of inter-switch links is not an HA technique

**HA technology choices:**  
Active/Passive  
Active/Active  
N+1 Redundancy

# Implementing Storage Virtualization

## 7. Create Single Storage Pool



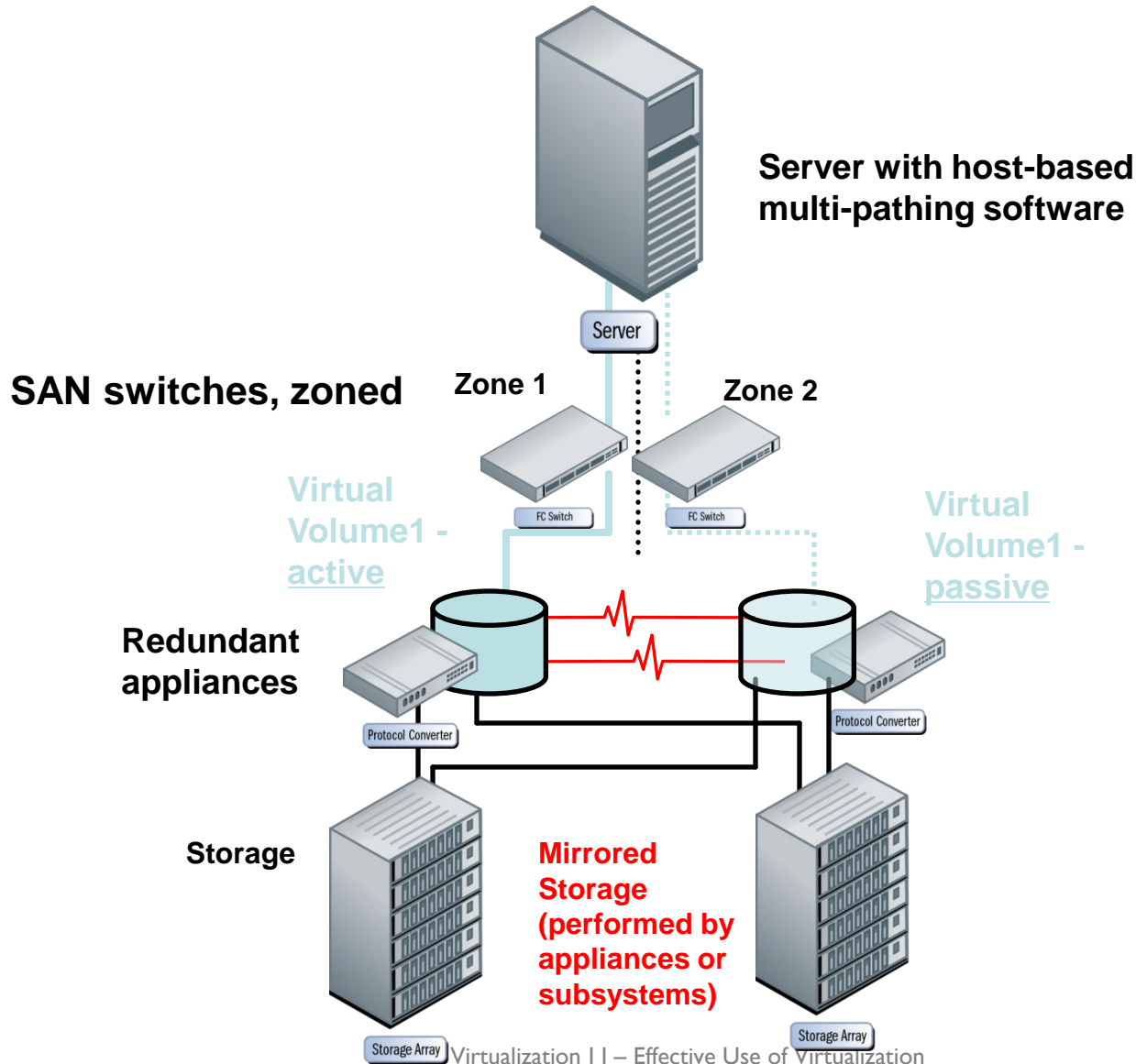


## Network-based Virtualization

- 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

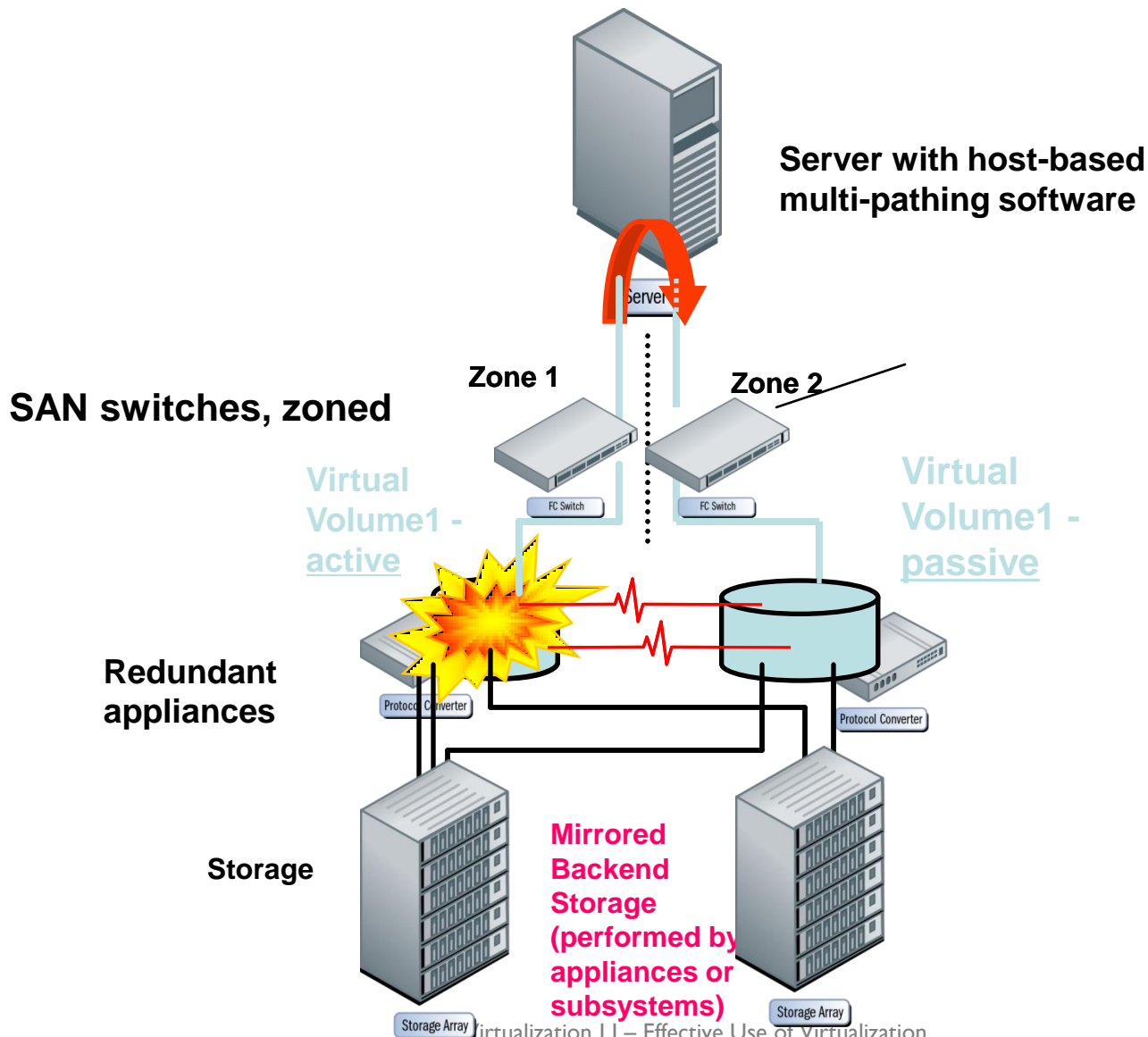
# Achieving High Availability

Example: active/passive appliances or subsystems



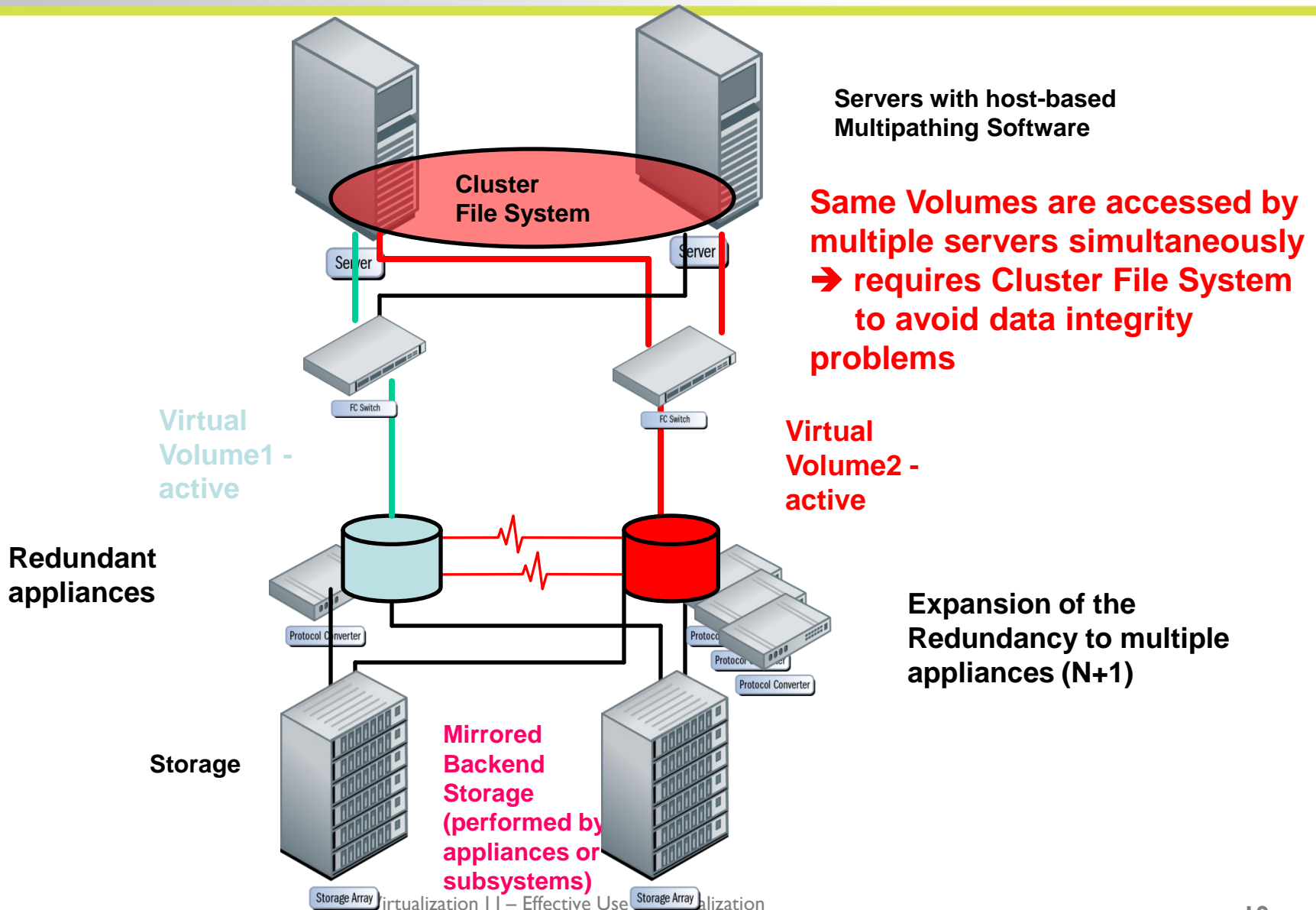
# Achieving High Availability

Example: active/passive appliances or subsystems



# Achieving High Availability

Example: Multiple access of same volume



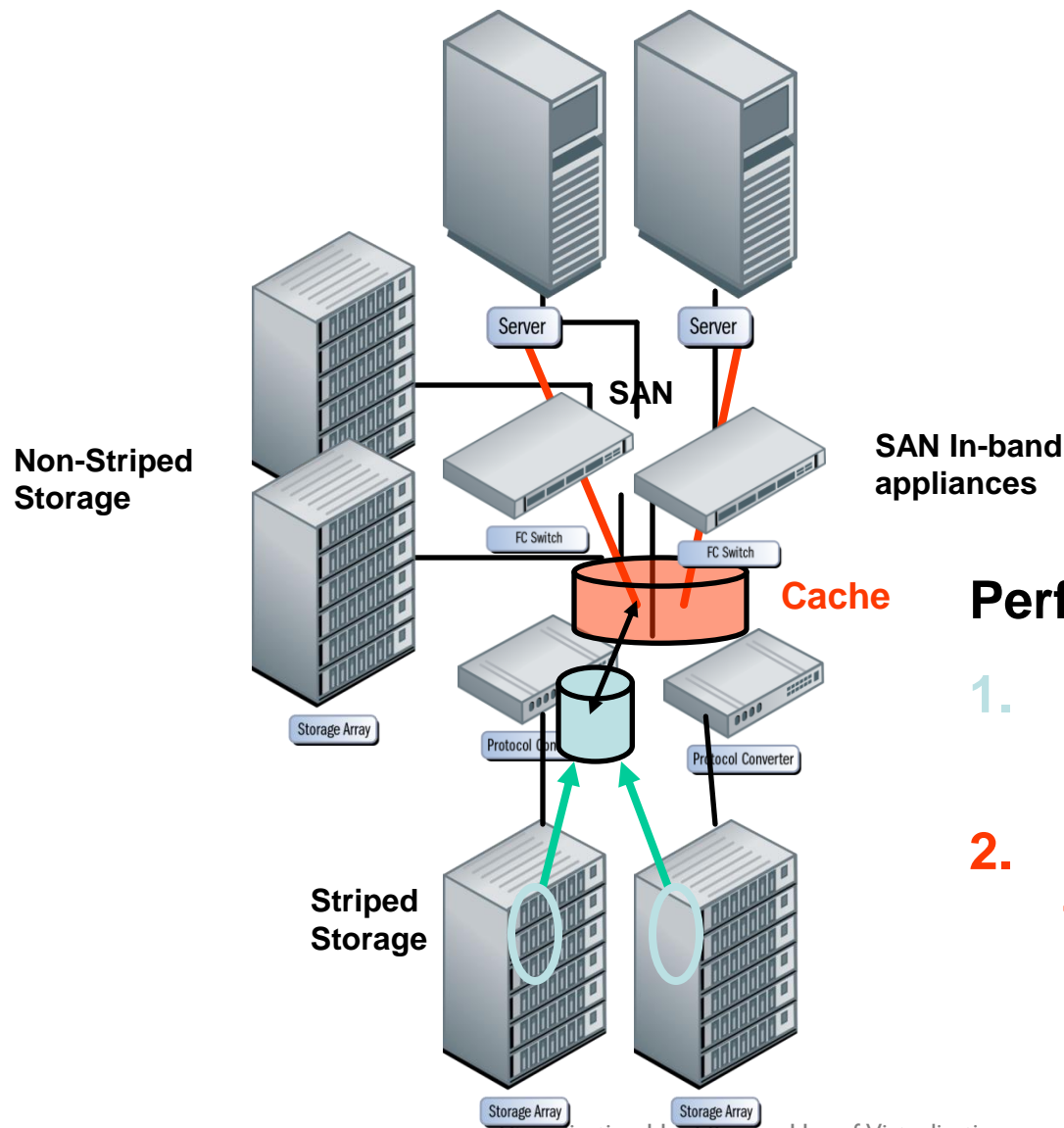
# High Availability Considerations for 'intelligent' switches

- 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

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

# Achieving Performance

## Example: In-band appliance

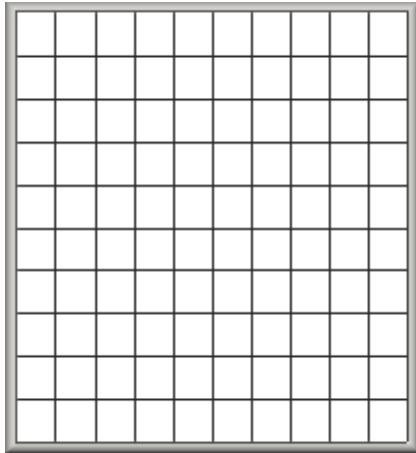


### Performance Improvement:

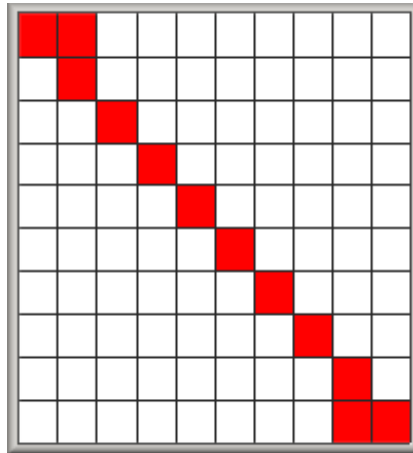
1. Striping across multiple disk arrays
2. Caching Technology in the In-Band SAN appliance

- Eliminate fixed-size LUNs
- Create dynamic virtual LUNs and expand/shrink the LUNs as necessary
  - ◆ Requires dynamic volume /LVM on the host(s)
- Create large virtual LUNs and pools and assign backing (physical) storage to it as the host writes data (Sparse Allocation)
- Data reduction techniques (dedup, compress, incrementalize)
- Dynamic growth of Volumes and File Systems simultaneously

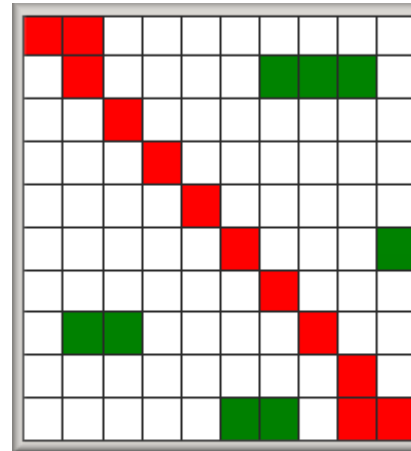
# Sparse Allocation a.k.a. Thin Provisioning



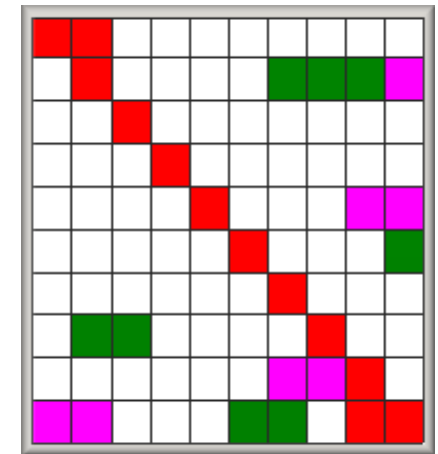
1. New Volume



2. Initial Filesystem allocation



3. Data Written



3. More Data Written

□ Unallocated Logical Block

■ Filesystem Metadata



■ Application Data

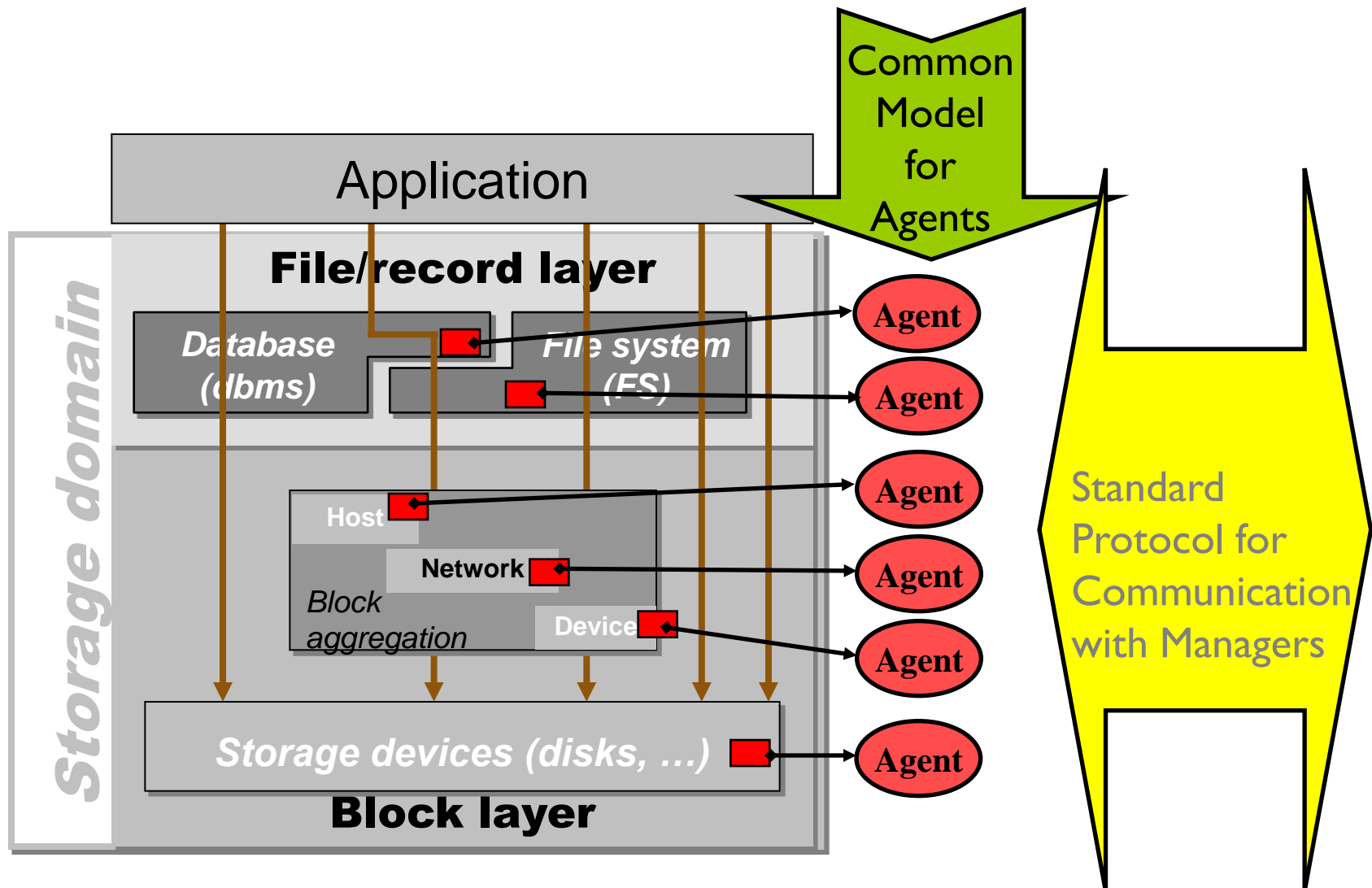


- Beware of Thin “runaway” (array over-subscription)
- Economic advantage varies - reserved space %
- Large thin LUN versus small growing LUN
- Read thin LUN may present problems
  - ◆ Backup, Copy, Duplicate, Replica
  - ◆ Vendor-specific treatment when reading unwritten blocks
- Over-allocate LUN versus over-subscribe system
- Consider data reduction instead of thin provisioning
- Consider using app/OS/HV thin instead of array thin
- 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*

- 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
- Now up to version 1.5

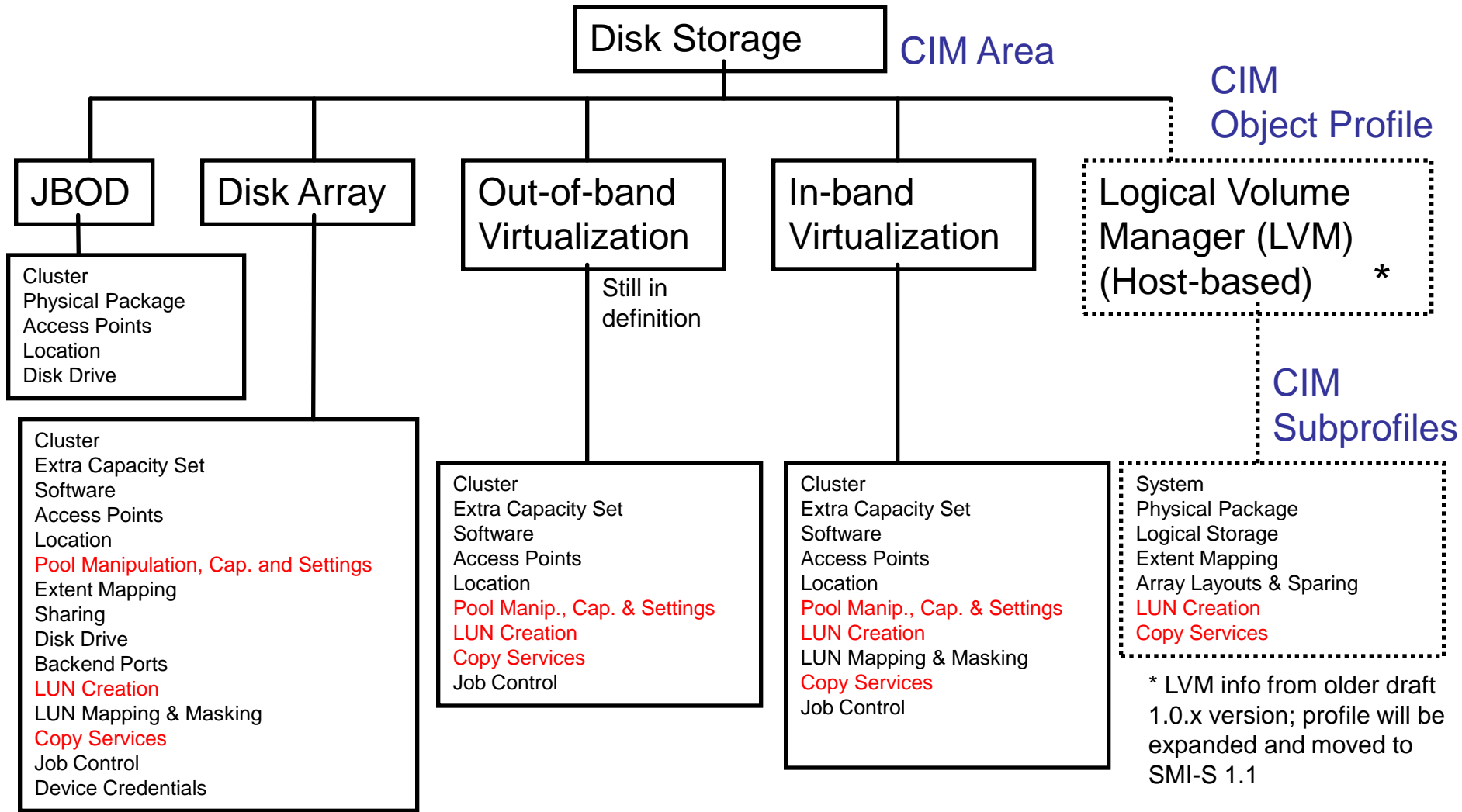


# Some SMI-S Capabilities

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**

# Disk Storage in the SMI-S



- 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)

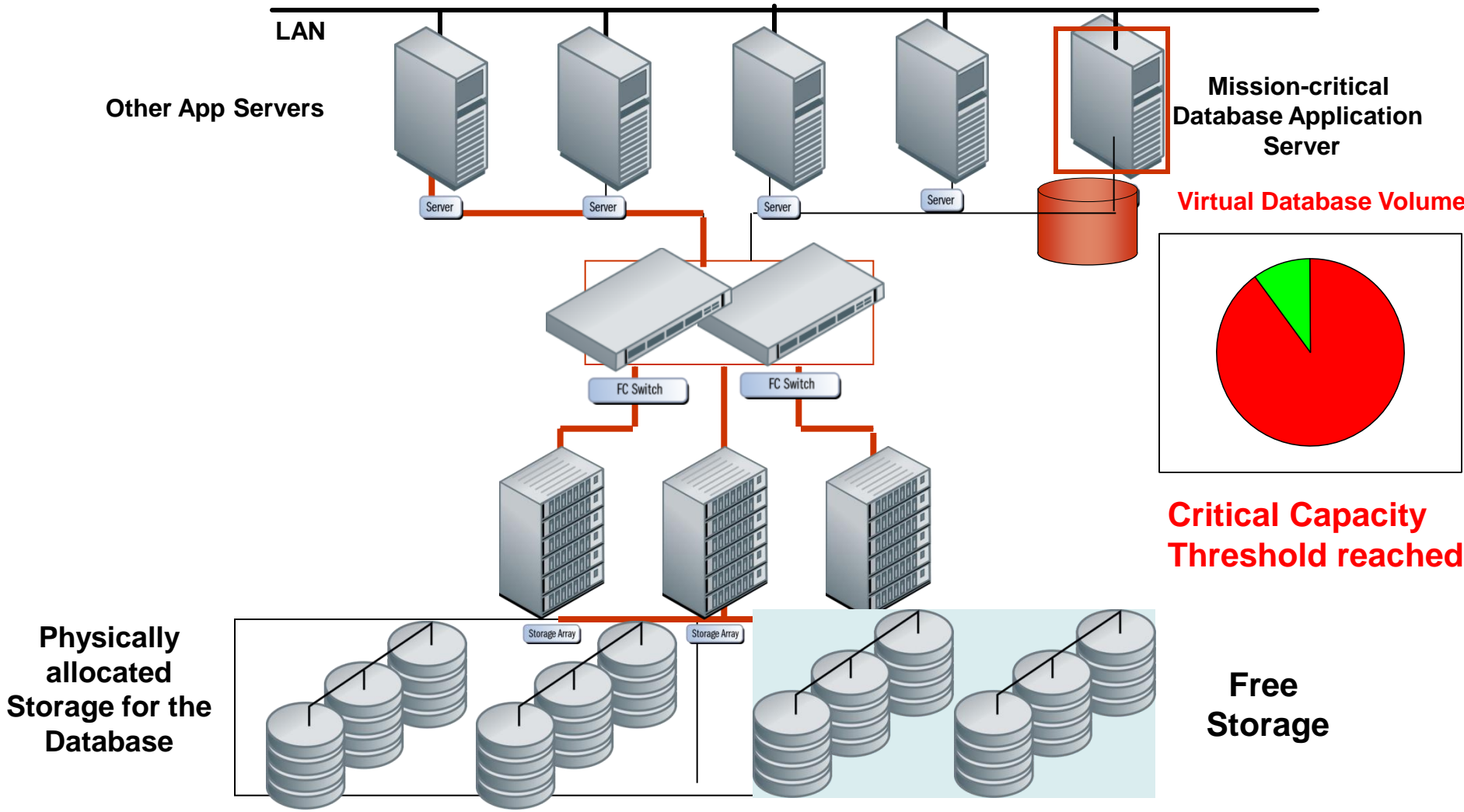
# Policy-based Service Level Management

What's the role of storage virtualization?

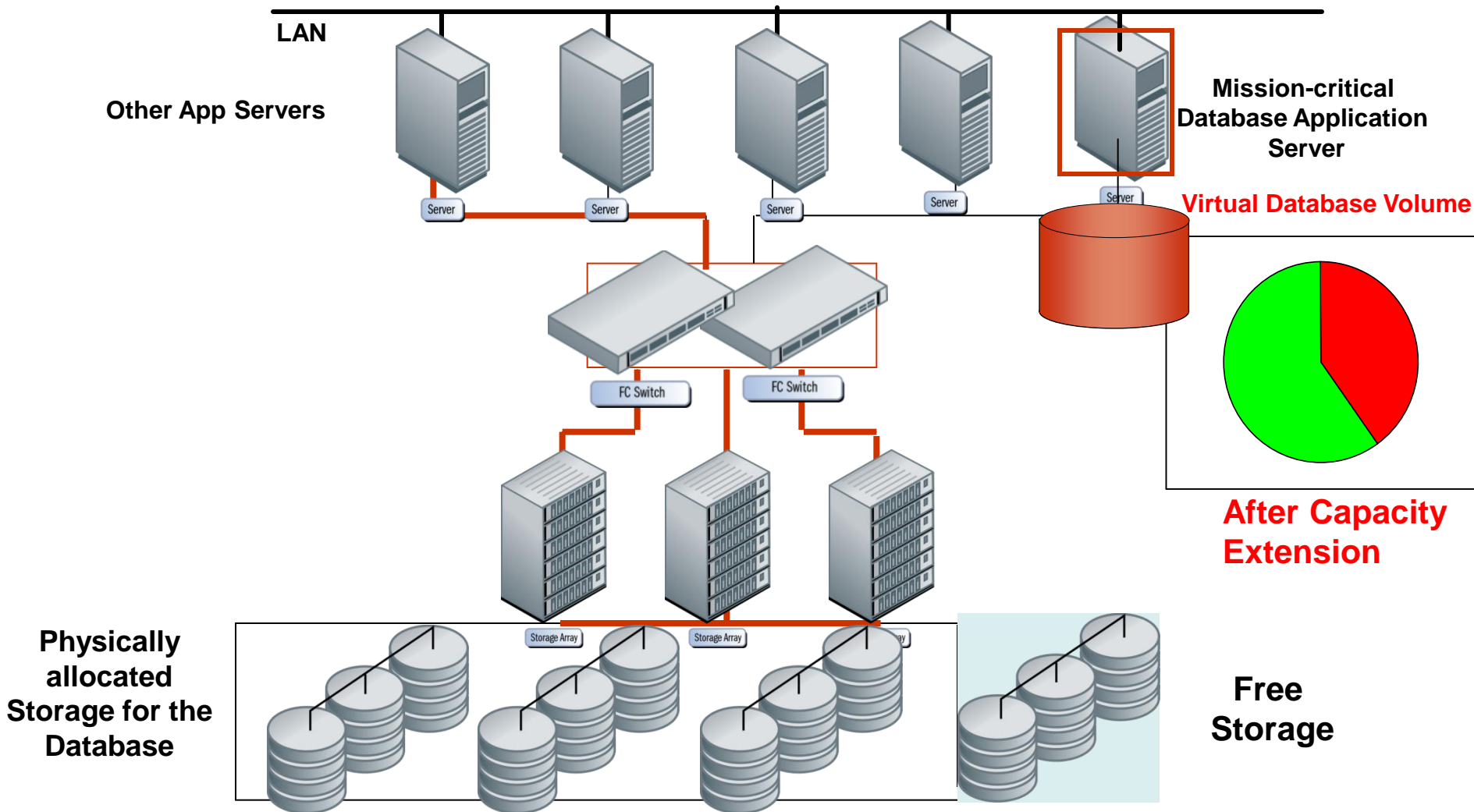
- Handles error-prone administrator tasks (such as storage provisioning) automatically
- Use of Web Services or REST to communicate
  
- Pre-defined rules (policies) must be set
- One critical Service Level Management outcome is efficient Storage Capacity Planning
  - ◆ Dynamic Provisioning
  - ◆ Automated 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 REST or Web Services or SNIA SMI-S
- **Grant specific server(s) access to the storage**
  - ◆ LUN Masking via REST or Web Services or SNIA SMI-S
- **Map storage to the server volume(s) (Online !!)**
  - ◆ Resize / Re-layout the volume (Web Services or SNIA SMI-S)
- **Make larger volume aware to the application**
  - ◆ Including automatic, dynamic growth of file system

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



# Policy-based Service Level Management - big picture (II)



- 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

# Q&A / Feedback

- Please send any questions or comments on this presentation to the SNIA:  
[trackvirtualizationapplications@snia.org](mailto:trackvirtualizationapplications@snia.org)

**Many thanks to the  
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