



Education

Storage Virtualization II Effective Use of 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

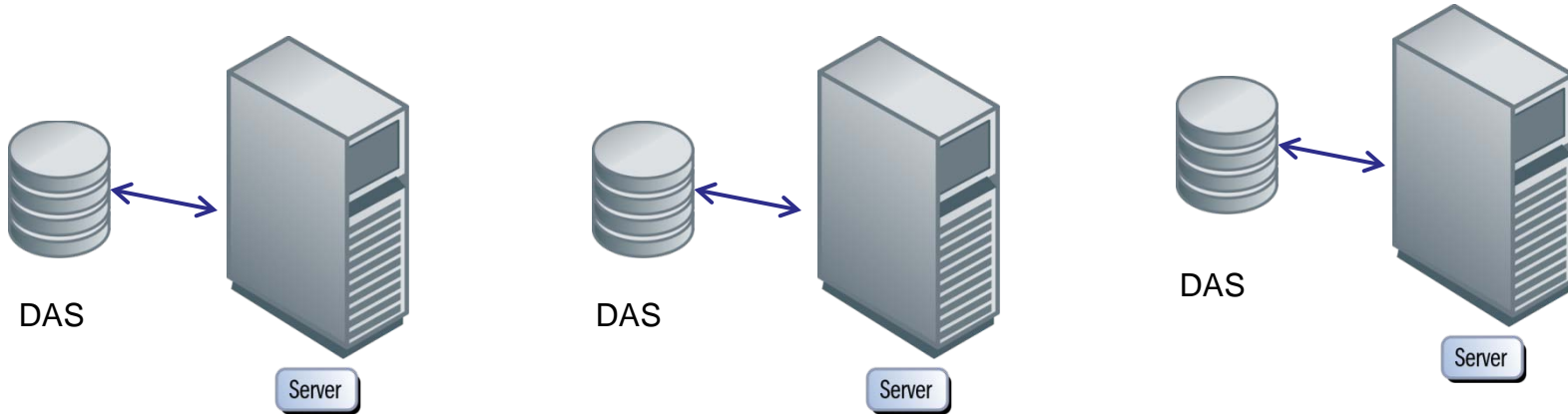
- Step 1: Plan and Start
- Step 2: Add SAN infrastructure
- Step 3: Add Virtualization infrastructure
 - » Out-of-Band example
 - » In-Band example
- Step 4: Move DAS volumes to SAN
- Step 5: Change Primary/Secondary relationship
- Step 6: Establish HA environment
- Step 7: Create and Use Single Storage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

- *Sequence may change from project to project*

Implementing Storage Virtualization

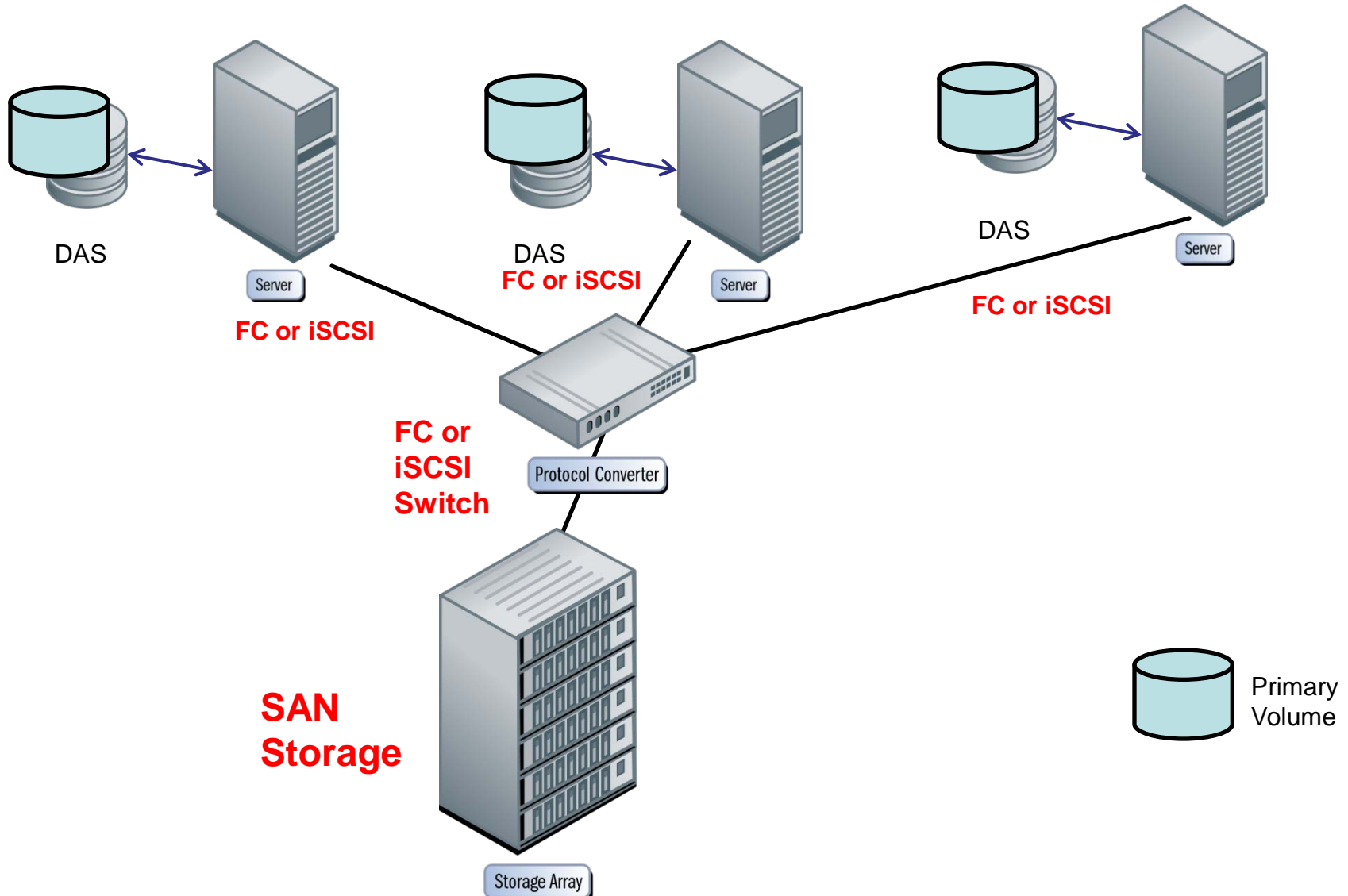
1. Start - DAS environment

DAS = either internally or externally direct connected storage devices



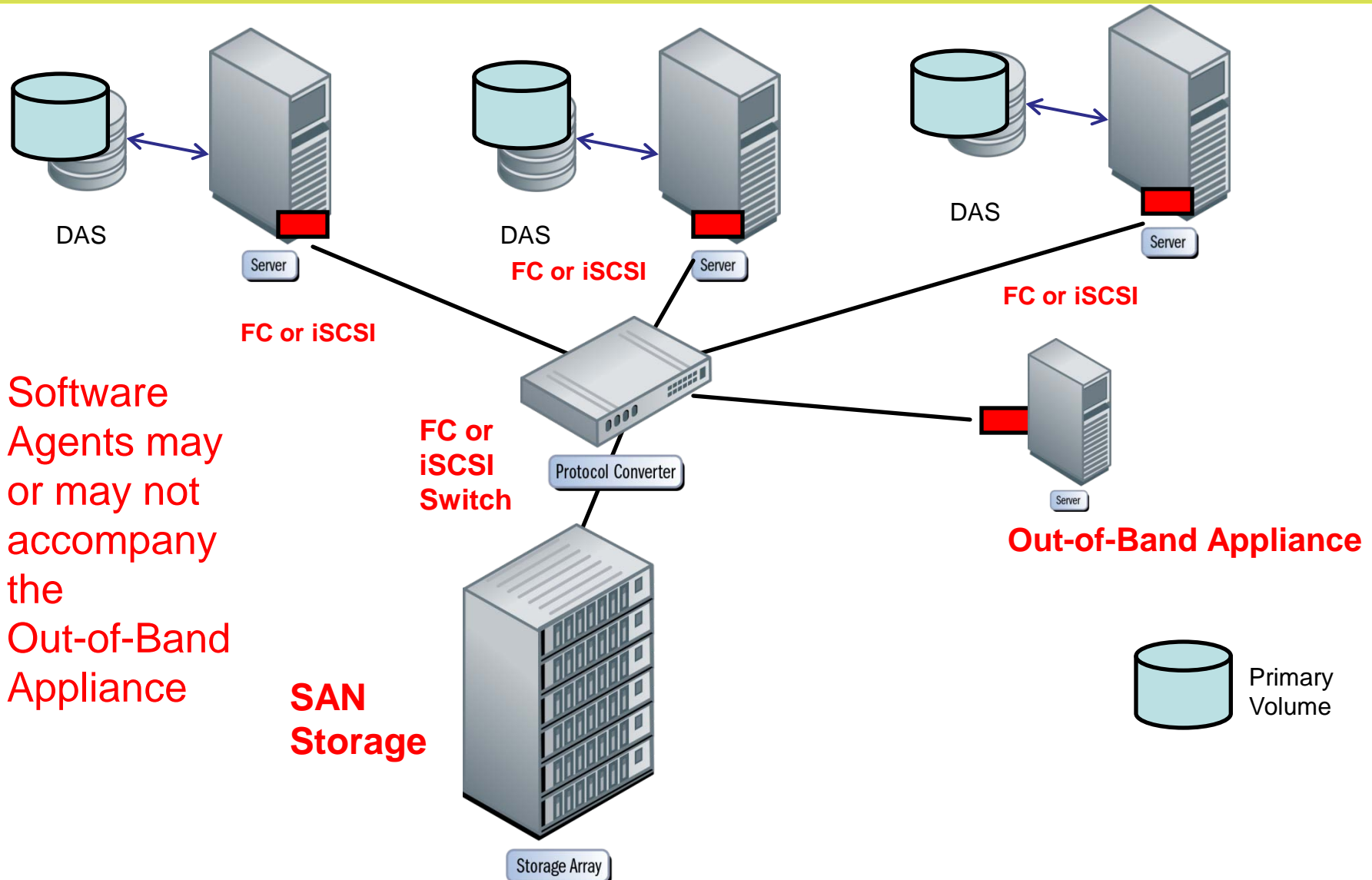
Implementing Storage Virtualization

2. Create SAN infrastructure



Implementing Storage Virtualization

3a. Add Virtualization – Network OOB

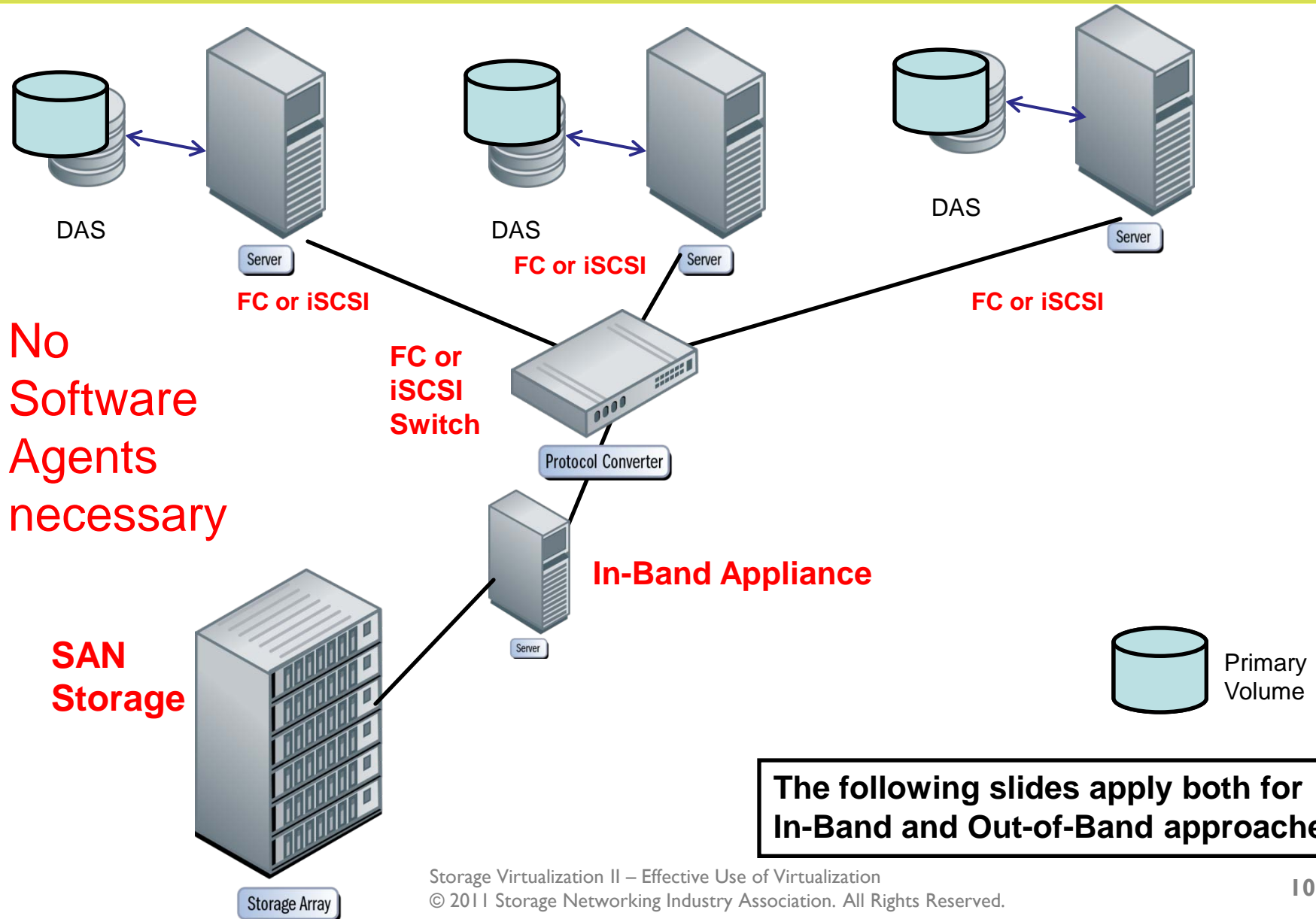


Software Agents may or may not accompany the Out-of-Band Appliance

SAN Storage

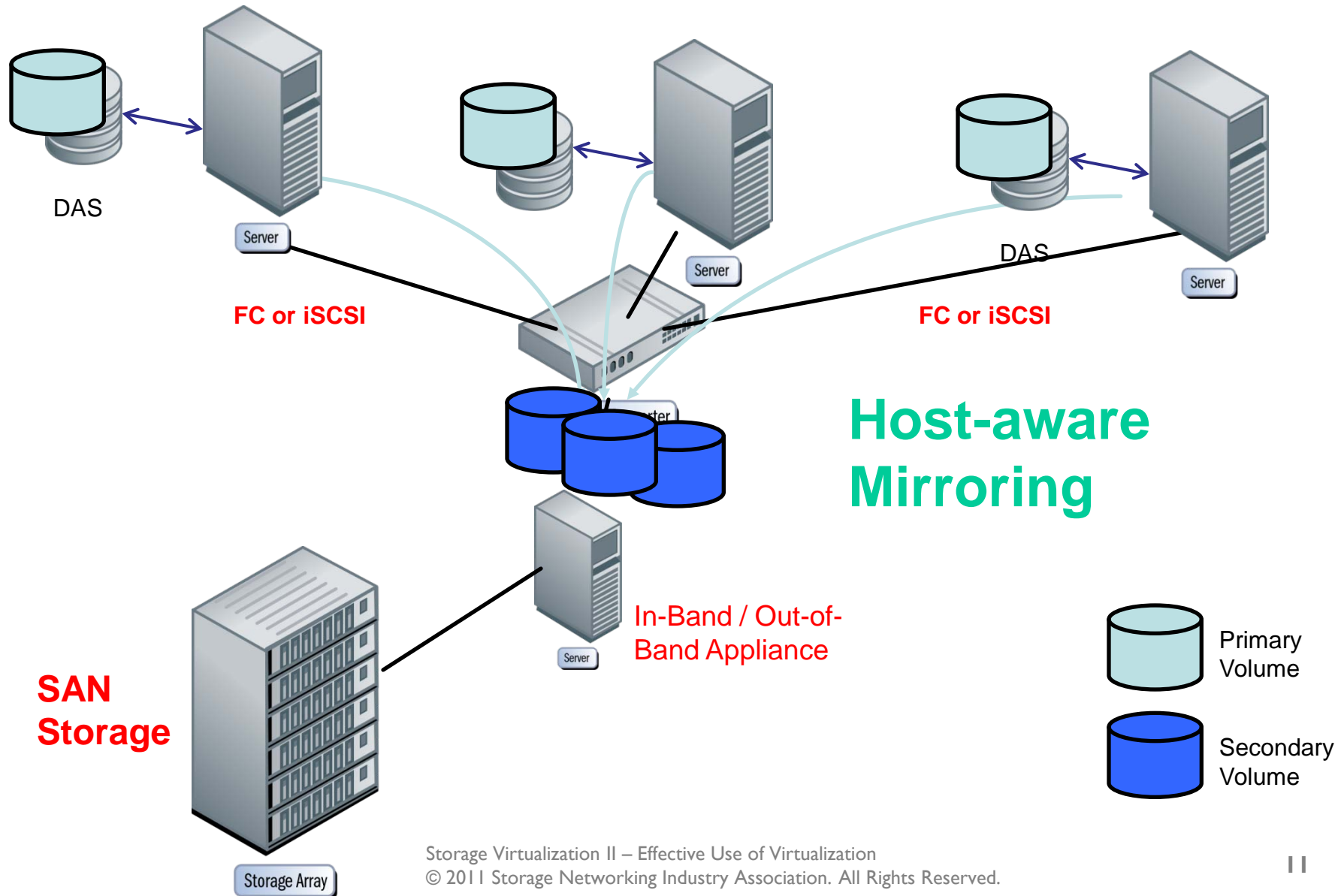
Implementing Storage Virtualization

3b. Add Virtualization – Network InBand



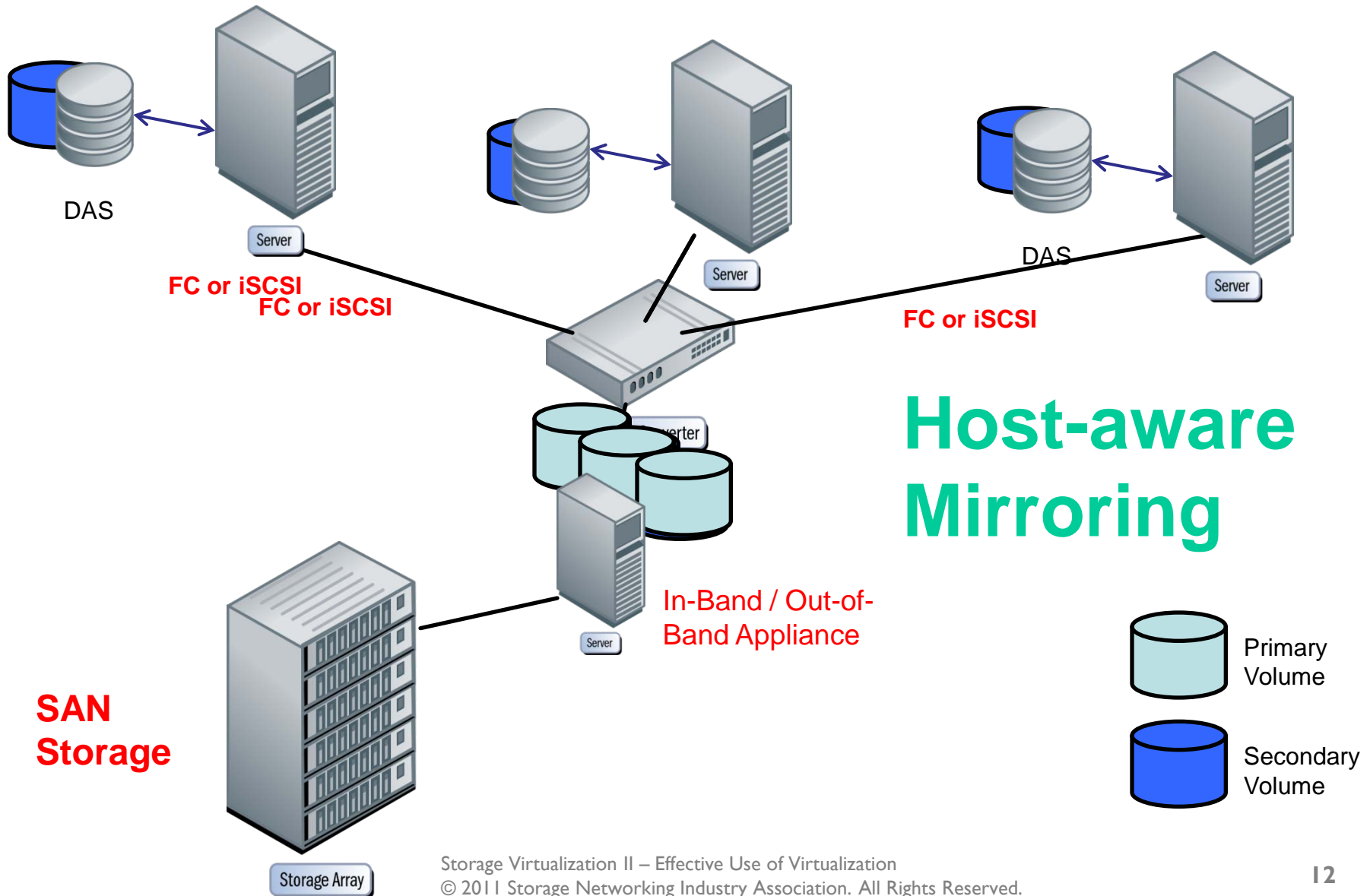
Implementing Storage Virtualization

4. Mirror DAS volumes to SAN



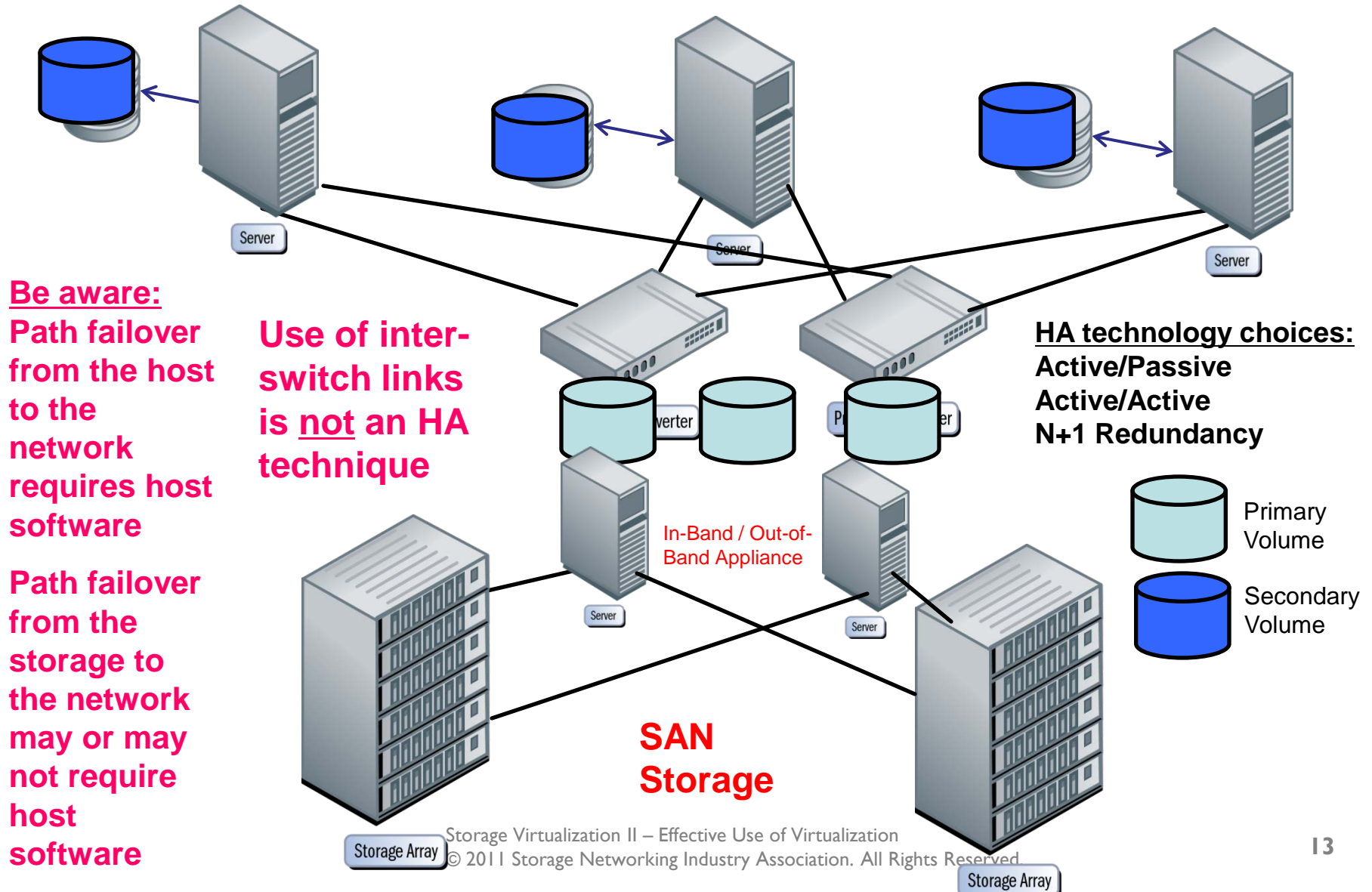
Implementing Storage Virtualization

5. Change Primary/Secondary



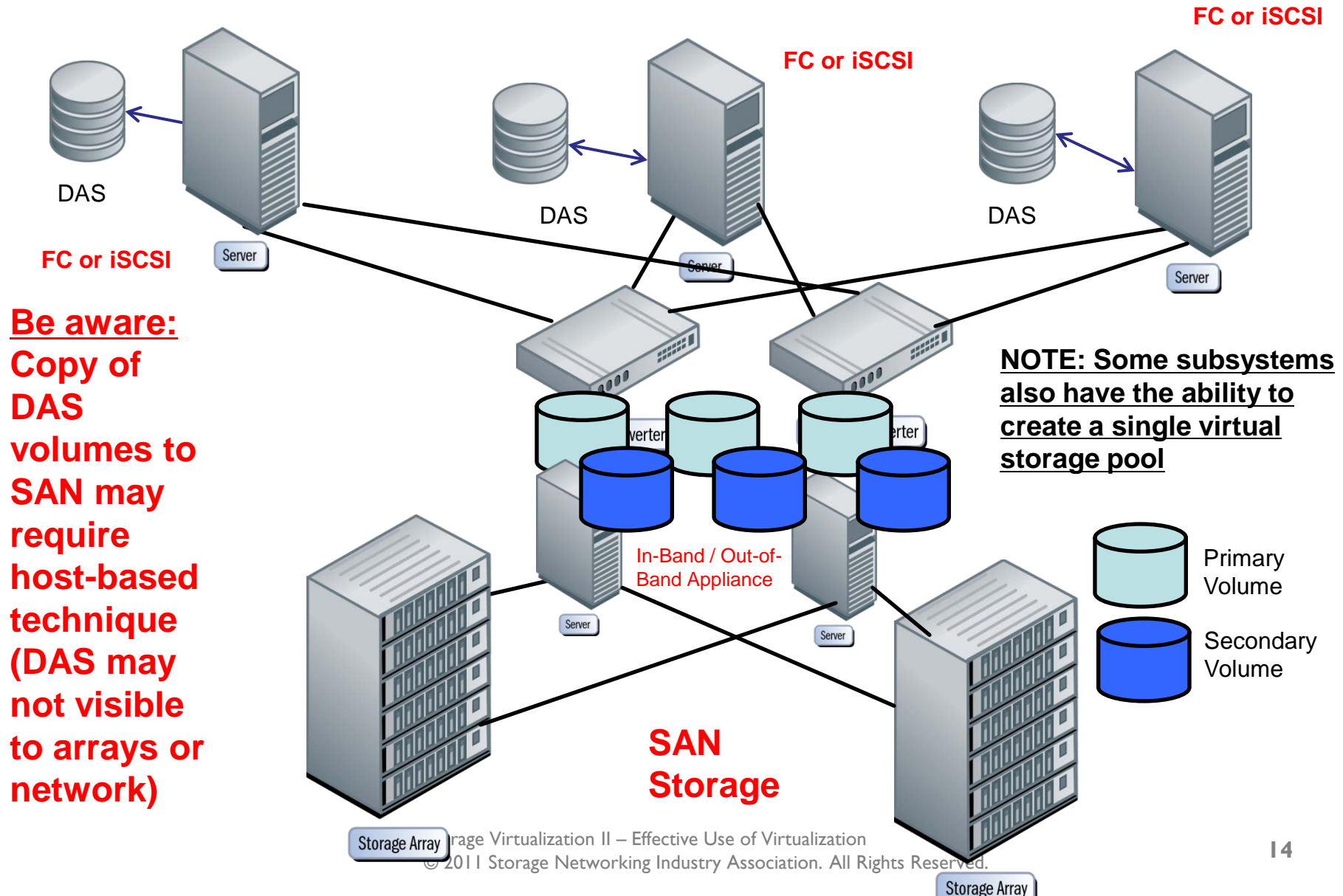
Implementing Storage Virtualization

6. Establish HA Environment



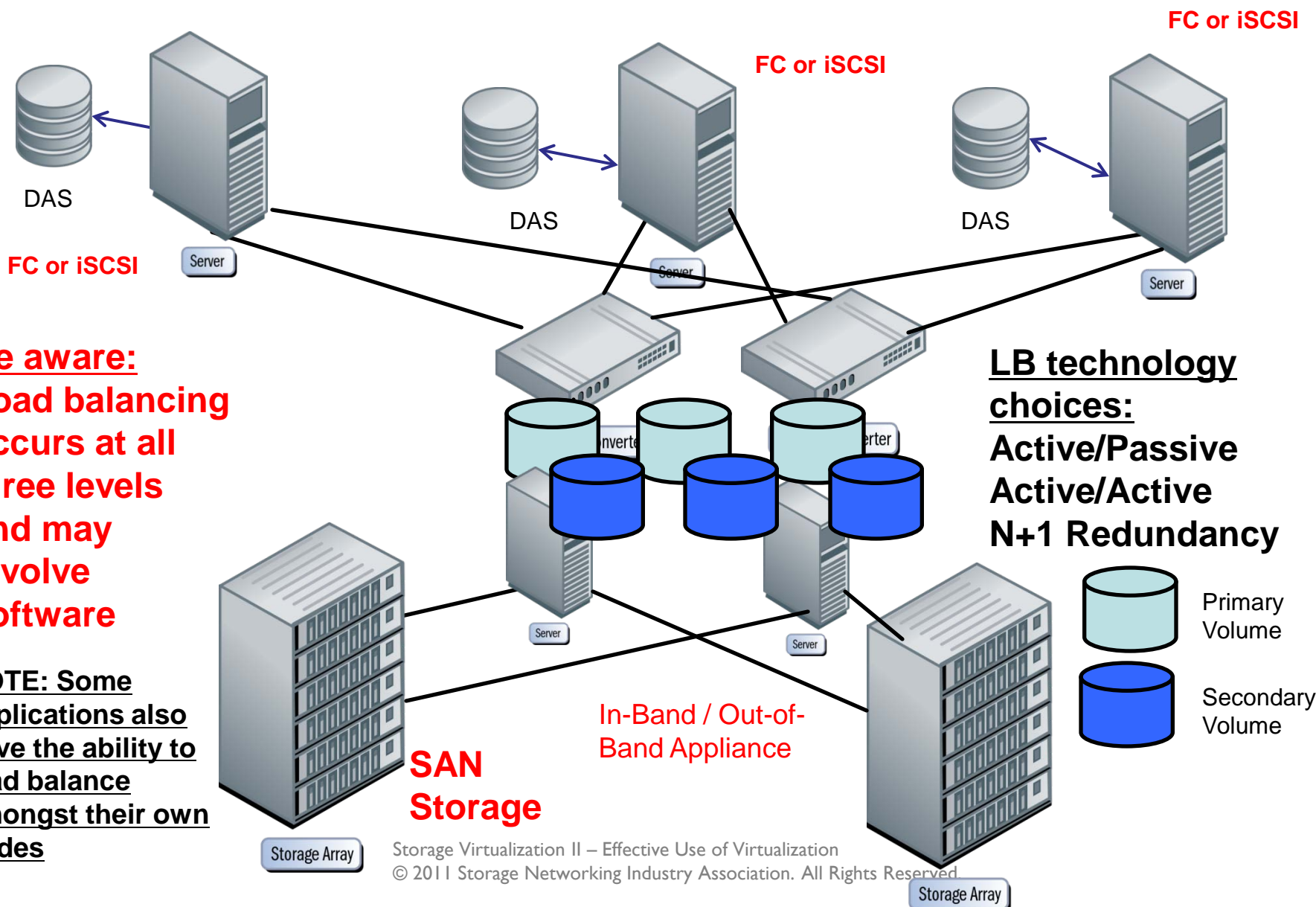
Implementing Storage Virtualization

7. Create Single Storage Pool



Implementing Storage Virtualization

8. Create Load Balancing

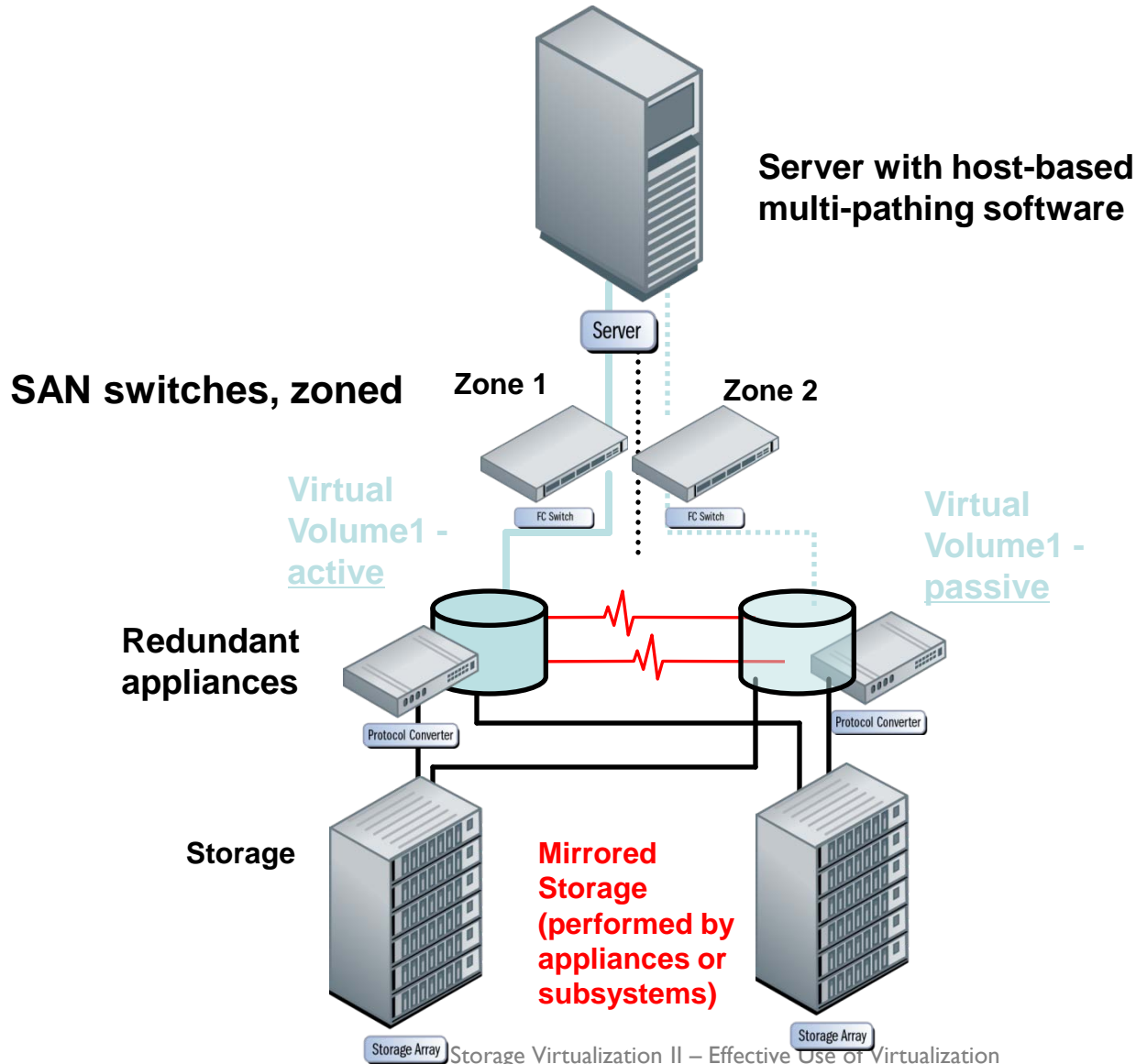


Network-based Virtualization

- 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

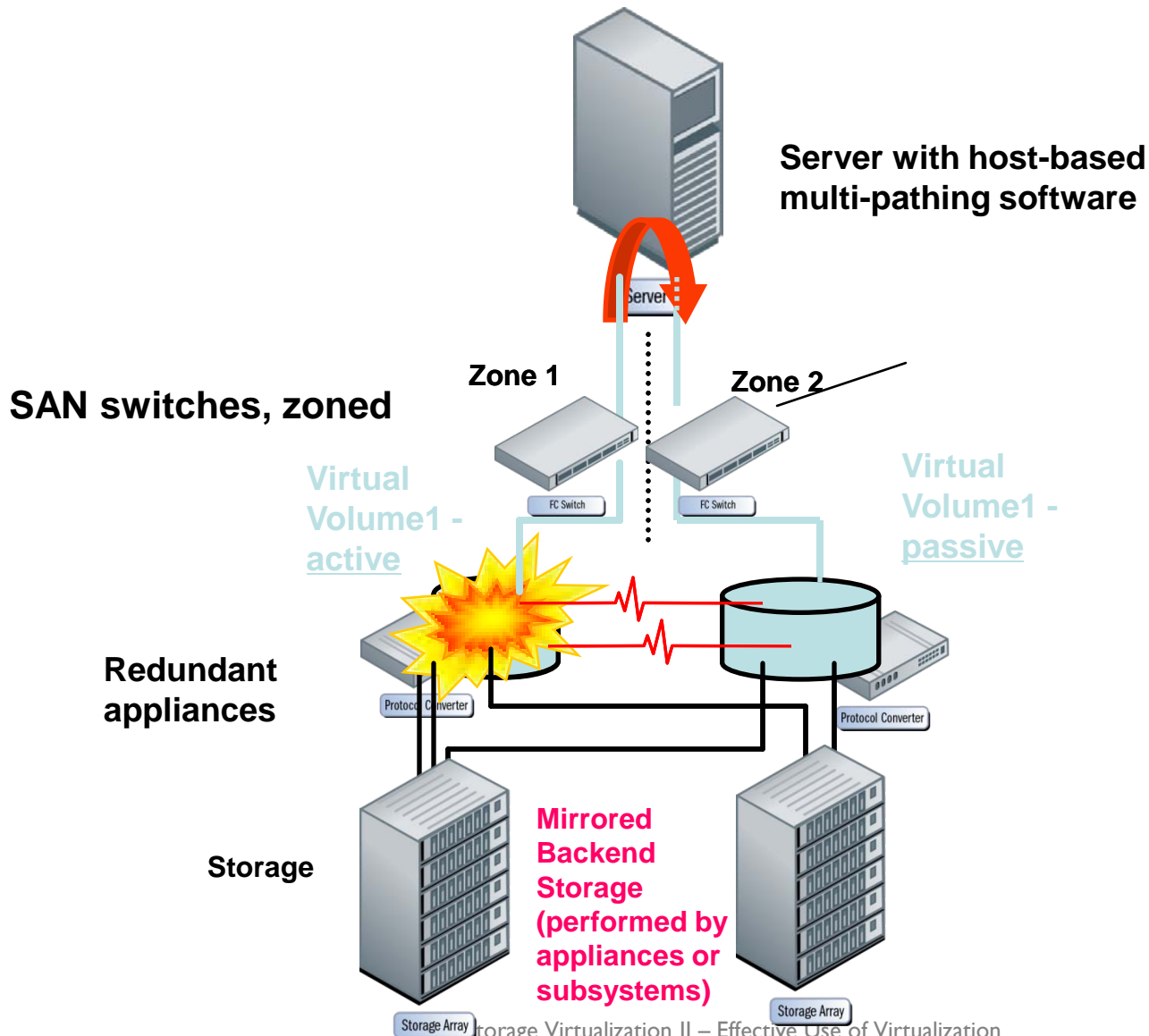
Achieving High Availability

Example: active/passive appliances or subsystems



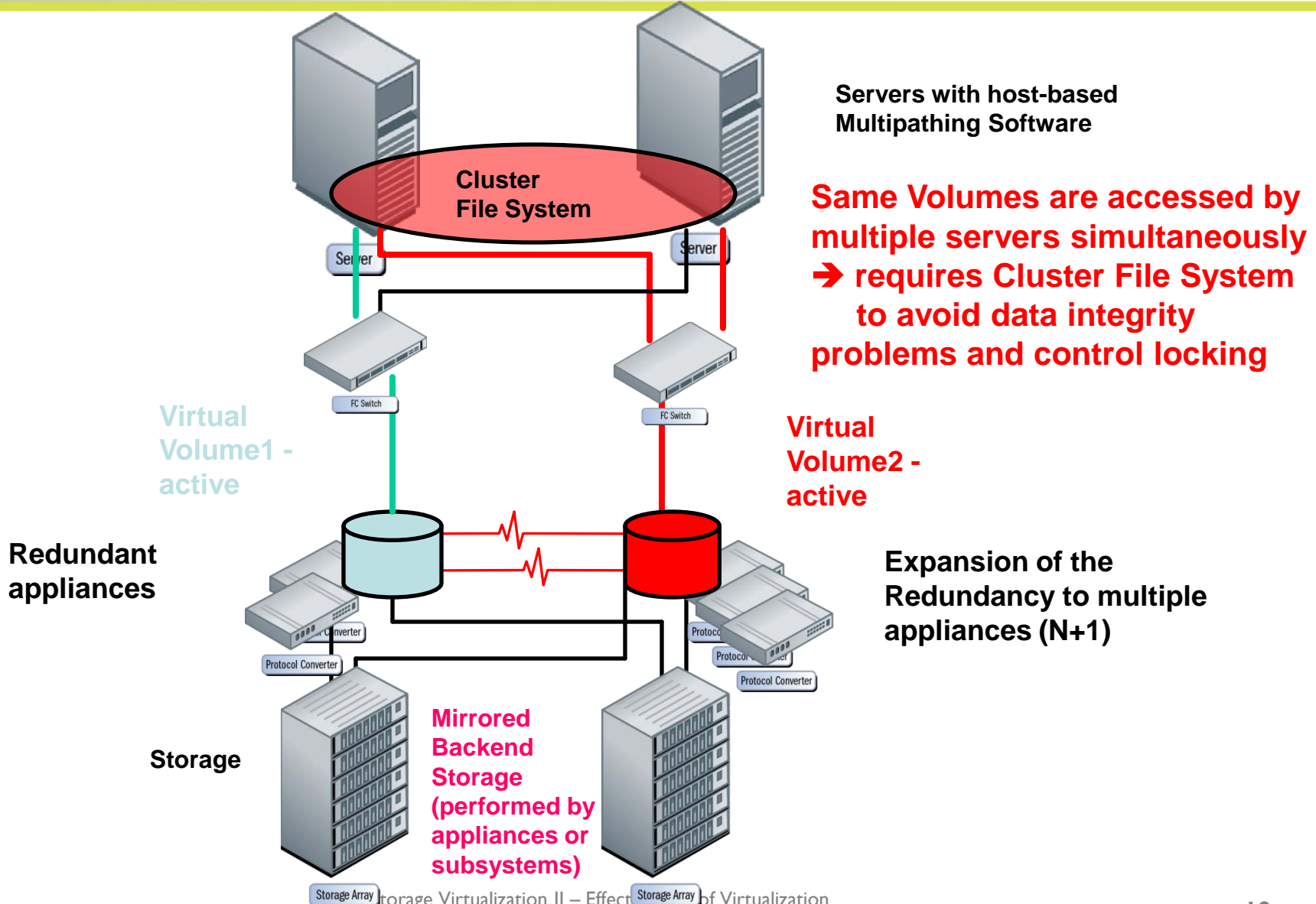
Achieving High Availability

Example: active/passive appliances or subsystems



Achieving High Availability

Example: Multiple access of same volume



Servers with host-based Multipathing Software

Same Volumes are accessed by multiple servers simultaneously → requires Cluster File System to avoid data integrity problems and control locking

Virtual Volume2 - active

Redundant appliances

Expansion of the Redundancy to multiple appliances (N+1)

Storage

Mirrored Backend Storage (performed by appliances or subsystems)

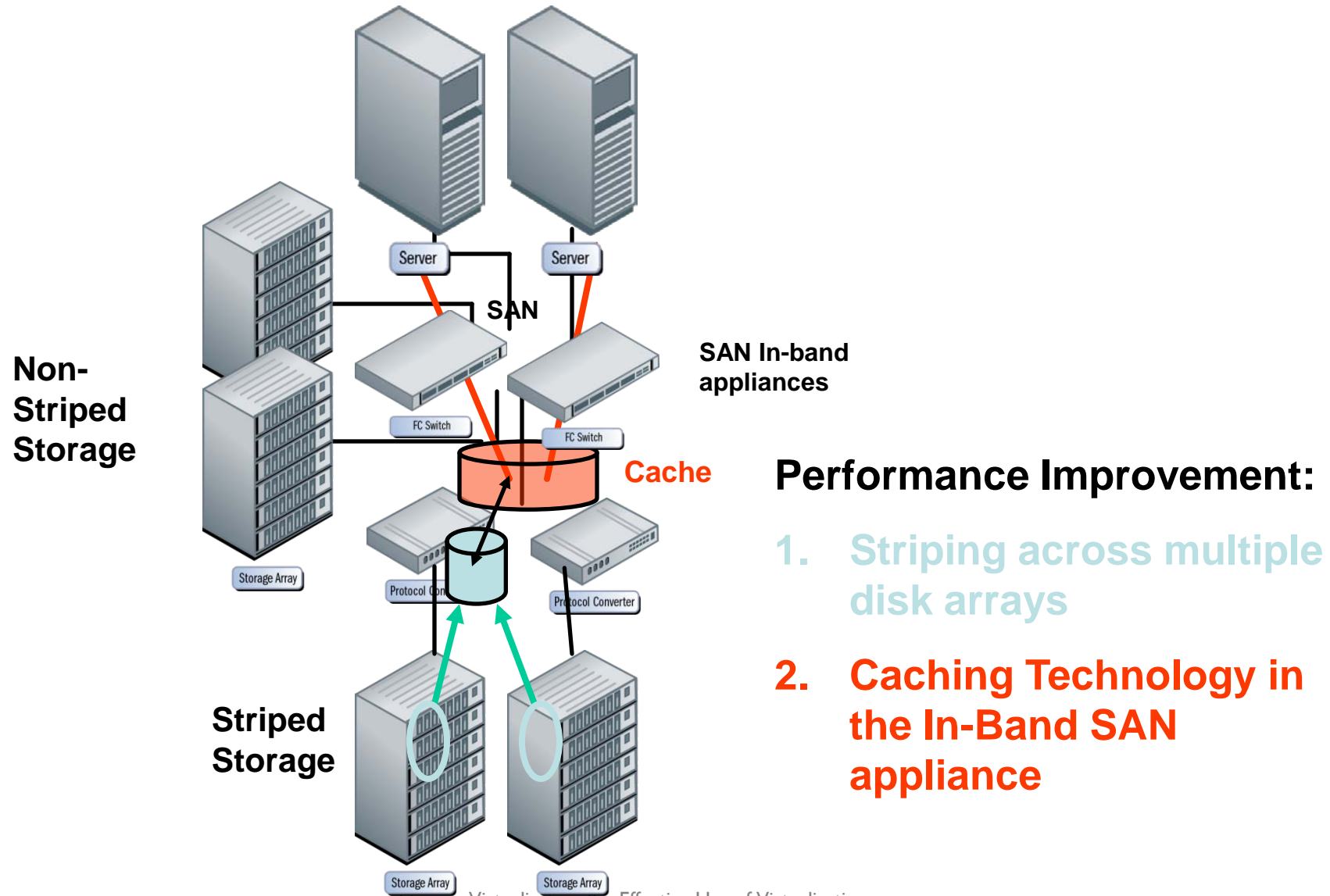
High Availability Considerations for 'intelligent' switches

- 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
- Multipathing
- Off-loading host systems
- Caching (where possible)

Achieving Performance

Example: In-band appliance

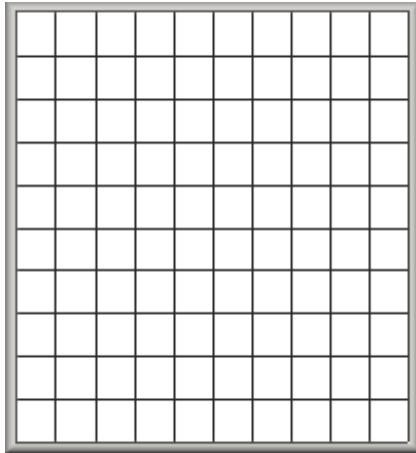


Performance Improvement:

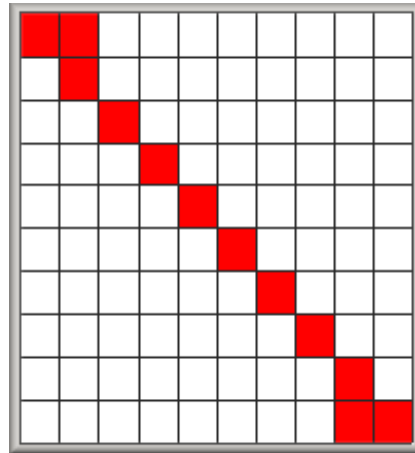
1. Striping across multiple disk arrays
2. Caching Technology in the In-Band SAN appliance

- 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

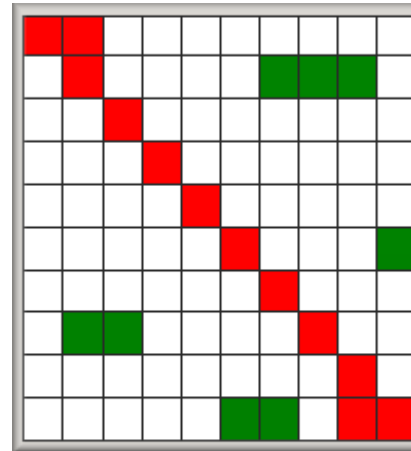
Sparse Allocation a.k.a. Thin Provisioning



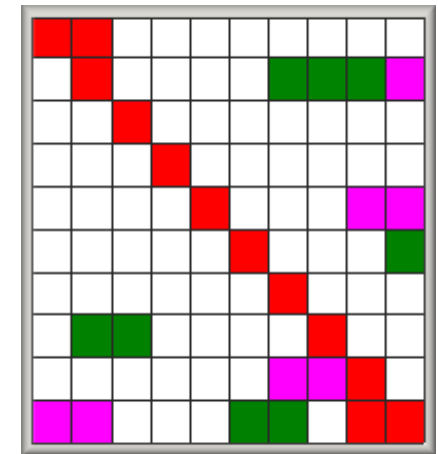
1. New Volume



2. Initial Filesystem allocation



3. Data Written



3. More Data Written

□ Unallocated Logical Block
■ Filesystem Metadata

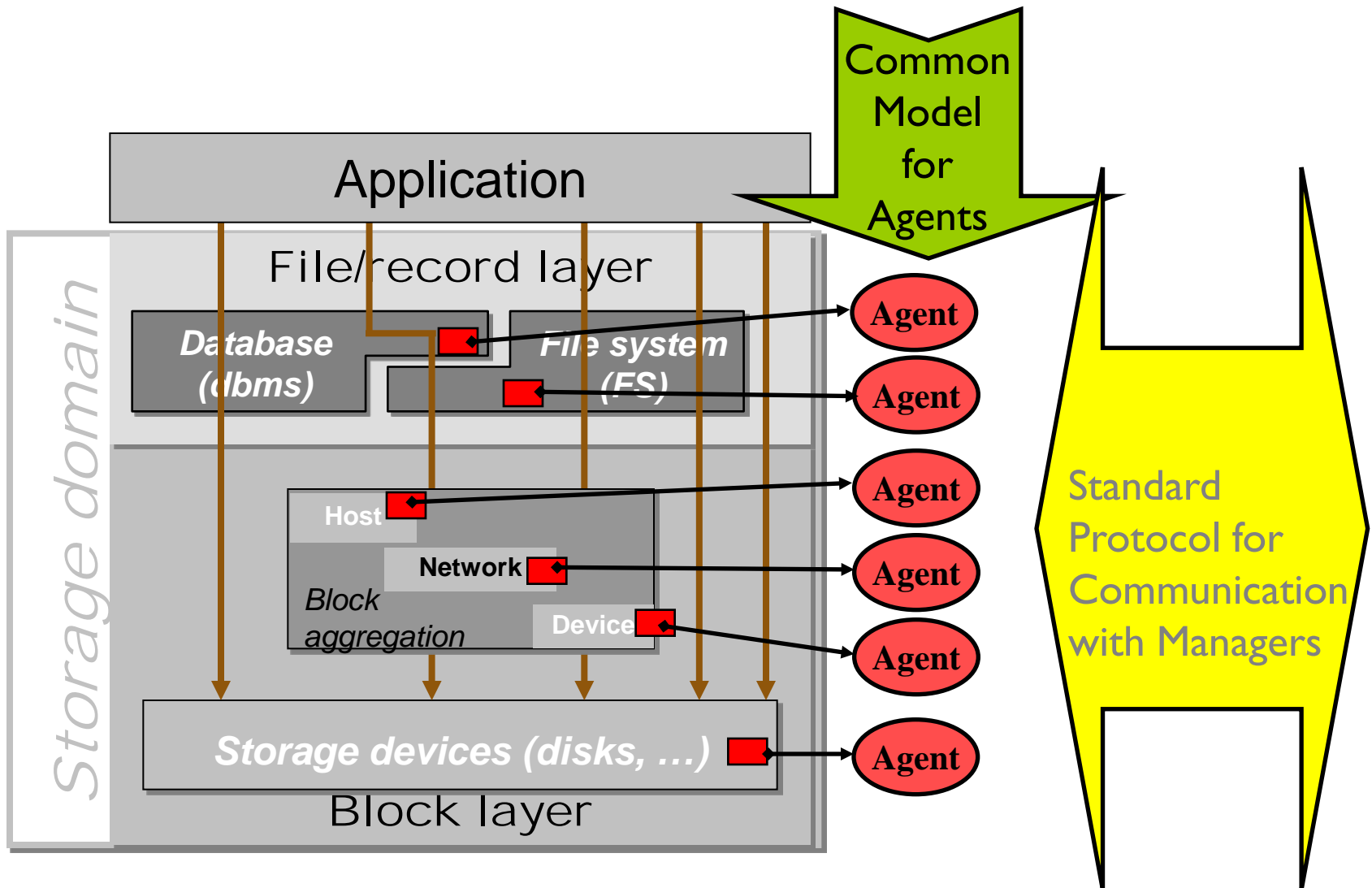
■ Application Data
■ Application Data

Saves space – BUT...

- 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!

- 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; 1.6 in the works

Control Path: SNIA Shared Storage Model

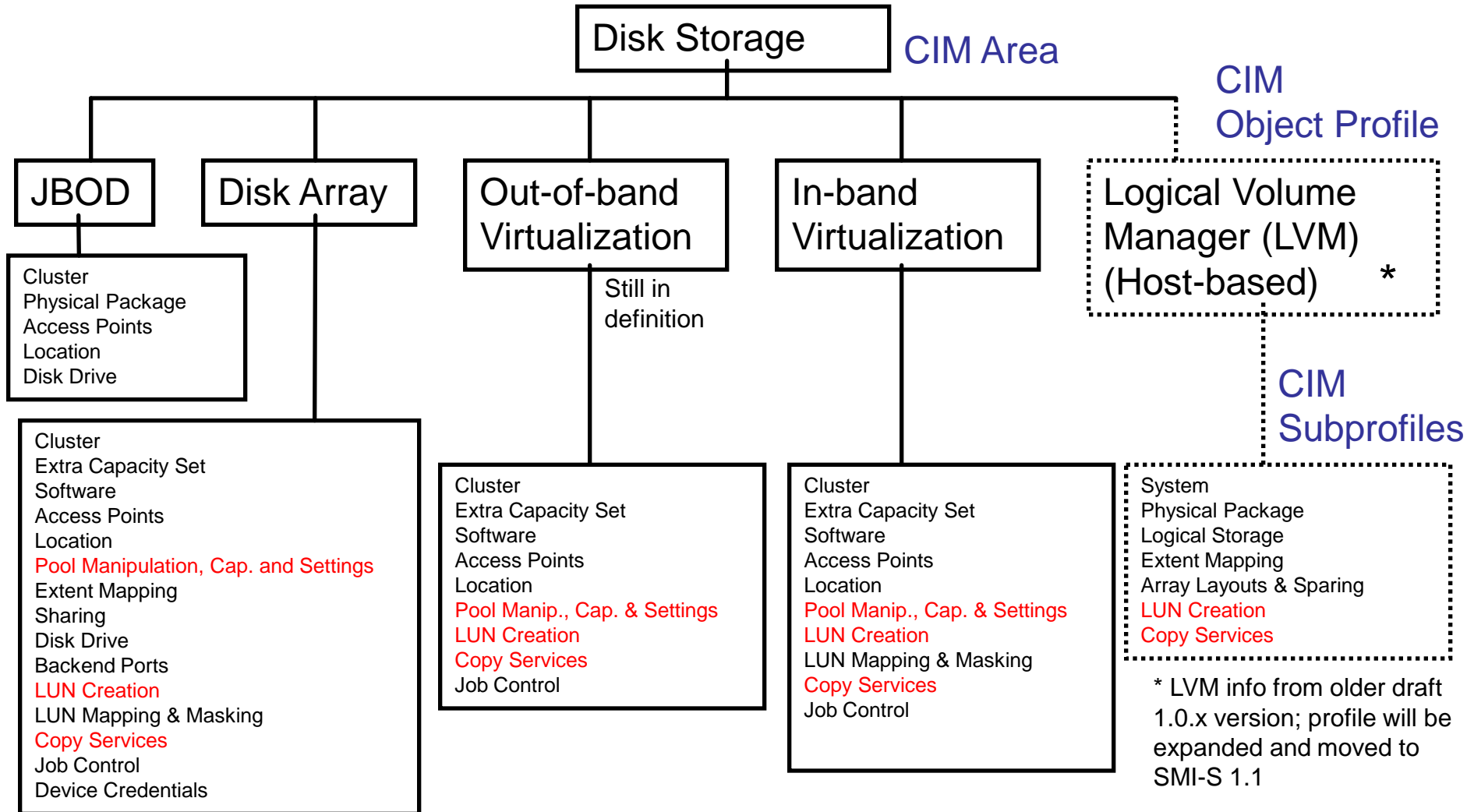


Some SMI-S Capabilities

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)

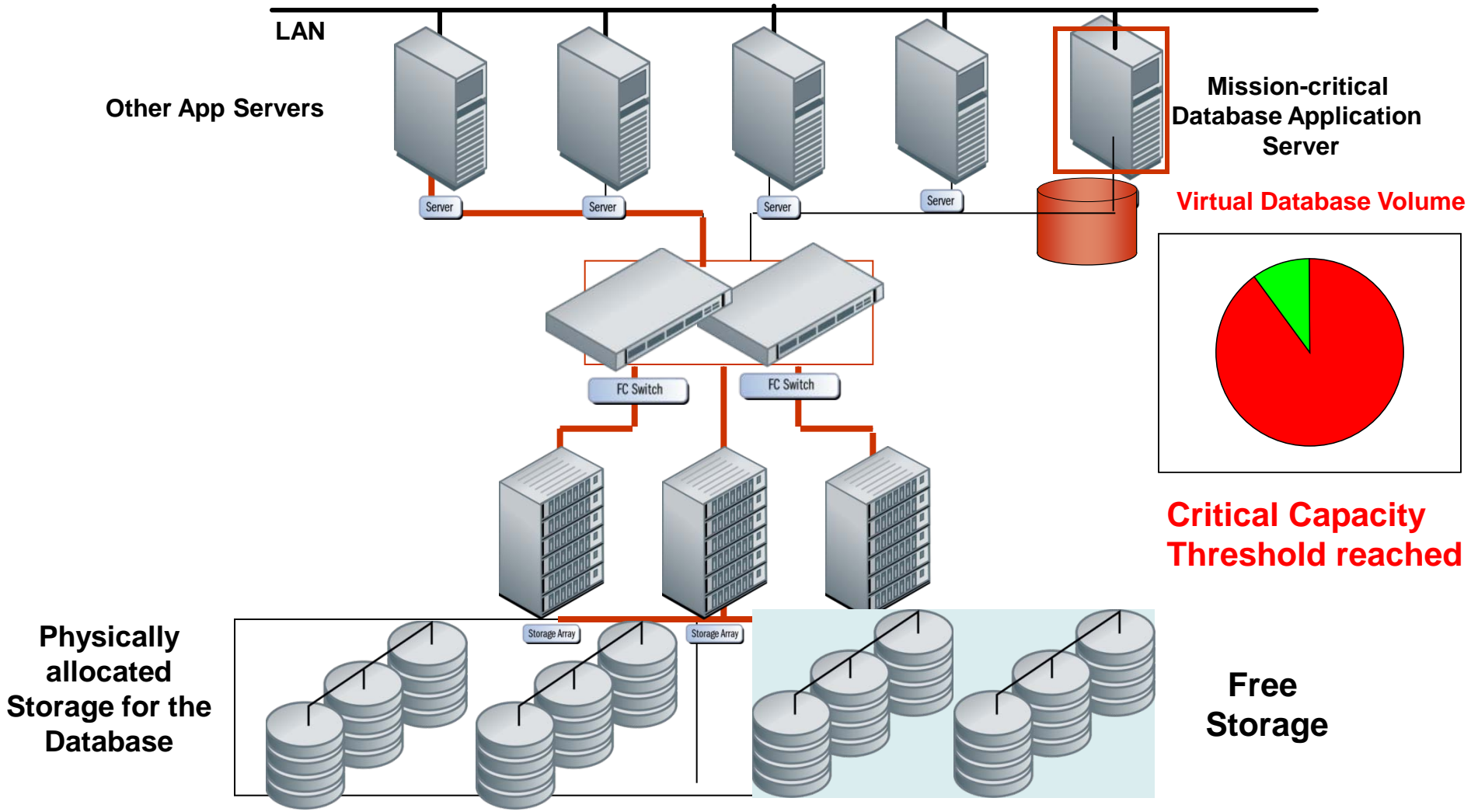
Policy-based Service Level Management

What's the role of storage virtualization?

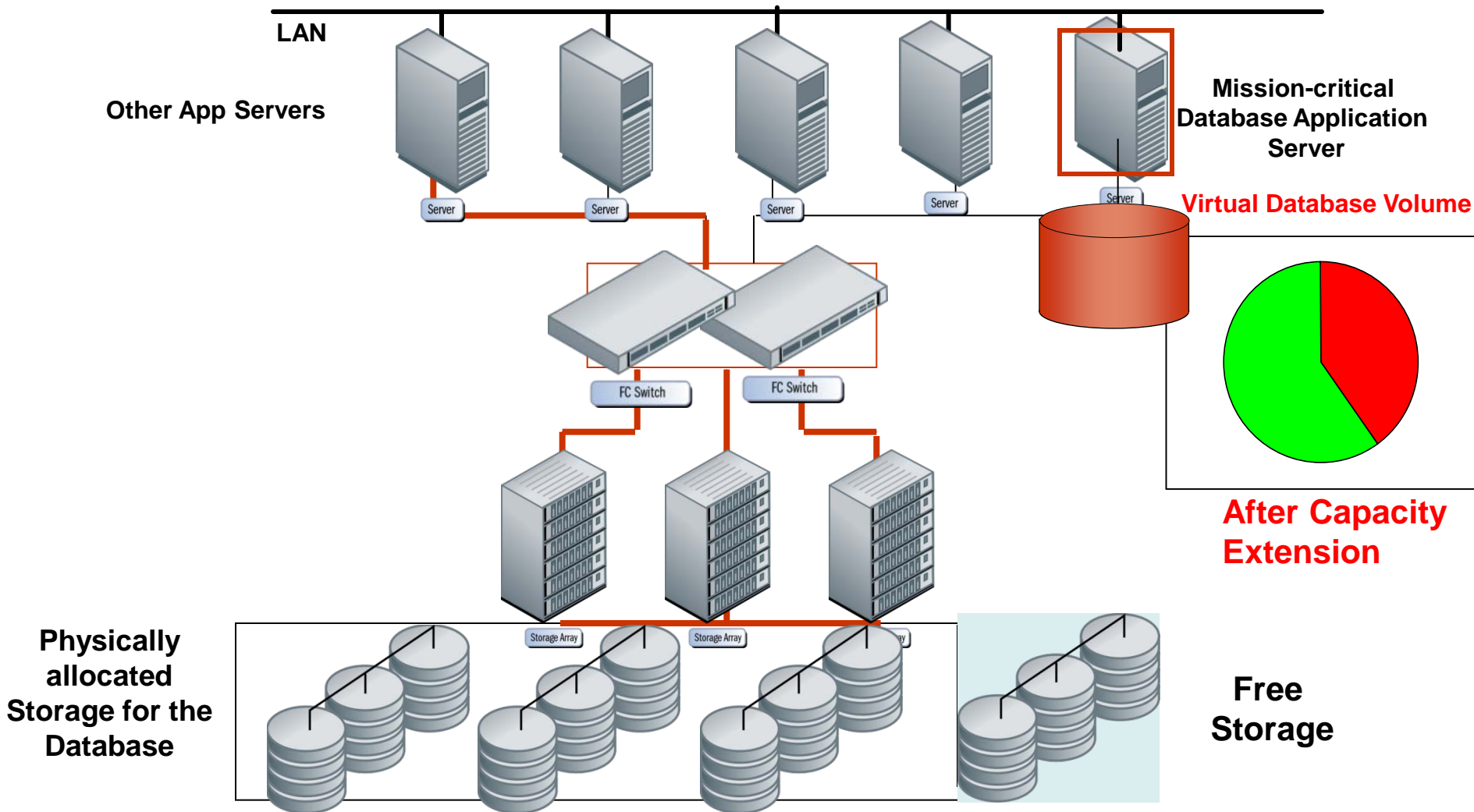
- Handles error-prone administrator tasks (such as storage provisioning) automatically
- Use of Web Services or REST to communicate
- Cloud Data Management Interface (CDMI)
 - ◆ Management especially for Cloud Storage
- Pre-defined rules (policies) must be set
- One critical Service Level Management 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 SNIA SMI-S
- **Grant specific server(s) access to the storage**
 - ◆ LUN Masking via REST or SNIA SMI-S
- **Map storage to the server volume(s) (Online !!)**
 - ◆ Resize / Re-layout the volume (REST 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

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

**Many thanks to the
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SNIA Education Committee

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For More Information, See the *Storage Virtualization
Hands-On Lab*