Module Overview

• Overview of Storage
• Managing Disks and Volumes
• Implementing Storage Spaces
Lesson 1: Overview of Storage

- Disk Types and Performance
- What Is Direct Attached Storage?
- What Is Network Attached Storage?
- What Is a SAN?
- What Is RAID?
- RAID Levels
- Windows Server 2012 and Windows Server 2012 R2 Storage Features
As performance increases, so does cost.

- **EIDE**: Slow
- **SATA**: ~150 IOPS
- **SCSI**: ~210 IOPS
- **SAS**: Fast: 1.5mio IOPS
- **SSD**: Cost
What Is Direct Attached Storage?

DAS is physically attached to the server

**Advantages:**
- Easy to configure
- Inexpensive solution

**Disadvantages:**
- Slower
- Isolated because the disks are attached to a single server
NAS is storage that is attached to a dedicated storage device and accessed through network shares.

**Advantages:**
- Relatively inexpensive, NAS offers centralized storage at an affordable price
- Easy to configure

**Disadvantages:**
- Slower access times
- Not an enterprise solution
What Is a SAN?

SANs offers higher availability with the most flexibility

Advantages:
- Fastest access times
- Easily expandable
- Centralized storage
- High level of redundancy

Disadvantages:
- More expensive
- Requires specialized skills

SANs can be implemented using Fibre Channel or iSCSI
What Is RAID?

**RAID:**
- Combines multiple disks into a single logical unit to provide fault tolerance and performance
- Provides fault tolerance by using:
  - Disk mirroring
  - Parity information
- Can provide performance benefits by spreading disk I/O across multiple disks
- Can be configured using several different levels
- Should not replace server backups
RAID Levels

RAID 0
Striped set without parity or mirroring

Disk 0
A1
A3
A5
A7

Disk 1
A2
A4
A6
A8
RAID Levels

RAID 1

Mirrored drives

Disk 0

Disk 1
RAID 5

Block level striped set with parity distributed across all disks
RAID Levels

RAID 6

Block level striped set with parity distributed across all disks
RAID Levels

RAID 1 + 0

Each pair of disks is mirrored, then the mirrored disks are striped.
Windows Server 2012 and Windows Server 2012 R2 provide several file and storage services enhancements including:

- Storage Spaces
- Data deduplication
- iSCSI Target Server
- Management enhancements
- Work Folders
- DFS enhancements
Lesson 2: Managing Disks and Volumes

• Selecting a Partition Table Format
• Selecting a Disk Type
• Selecting a File System
• What Is ReFS?
• What Are Mount Points and Links?
• Demonstration: Creating Mount Points and Links
• Extending and Shrinking Volumes
• Managing Virtual Hard Disks
• Demonstration: Managing Virtual Hard Disks
Selecting a Partition Table Format

MBR
- Standard Partition table format since early 1980s
- Supports a maximum of 4 primary partitions per drive
- Can partition a disk up to 2 TB

GPT
- GPT is the successor of MBR partition table format
- Supports a maximum of 128 partitions per drive
- Can partition a disk up to 18 EB

✓ Use MBR for disks smaller than 2 TB
✓ Use GPT for disks larger than 2 TB
Selecting a Disk Type

Basic disks are:

- Disks initialized for basic storage
- The default storage for Windows operating system

Dynamic disks can:

- Be modified without restarting Windows
- Provide several options for configuring volumes

Disk volume requirements include:

- A system volume for hardware-specific files that are required to start the server
- A boot volume for the Windows operating system files
When selecting a file system, consider the differences between FAT, NTFS, and ReFS

FAT provides:
- Basic file system
- Partition size limitations
- FAT32 to enable larger disks
- exFAT developed for flash drives

NTFS provides:
- Metadata
- Auditing and journaling
- Security (ACLs and encryption)

ReFS provides:
- Backward compatibility support for NTFS
- Enhanced data verification and error correction
- Support for larger files, directories, volumes, and so on
ReFS is a new file system that is built into Windows Server 2012. Advantages include:

- Metadata integrity with checksums
- Integrity streams with user data integrity
- Allocation on write transactional model
- Large volume, file, and directory sizes (2^78 bytes with 16-KB cluster size)
- Storage pooling and virtualization
- Data striping for performance and redundancy
- Disk scrubbing for protection against latent disk errors
- Resiliency to corruptions with recovery
- Shared storage pools across machines
What Are Mount Points and Links?

A mount point is a reference to a location on a disk that enables Windows operating system access to disk resources.

Use volume mount points:
- To mount volumes or disks as folders instead of using drive letters
- When you do not have drive letters available for creating new volumes
- To add disk space without changing the folder structure

A link file contains a reference to another file or directory.

Link options:
- Symbolic file link (or, soft link)
- Symbolic directory link (or, directory junctions)
In this demonstration, you will see how to:

• Create a mount point
• Create a directory junction for a folder
• Create a hard link for a file
You can resize NTFS volumes from the Windows operating system, beginning with Windows Vista and Windows Server 2008

When you want to resize a disk, consider the following:

- You can extend or shrink NTFS volumes
- ReFS volumes can only be extended
- FAT/FAT32/exFAT cannot be resized
- You can shrink a volume only up to immovable files
- Bad clusters on a disk prevent you from shrinking a volume
Managing Virtual Hard Disks

Virtual hard disks are files that can be managed just like physical hard disks

You can:

• Create and manage virtual hard disks using Disk Management and Diskpart
• Configure .vhd or .vhdx files
• Configure computers to start from the virtual hard disk
• Transfer virtual hard disks from Hyper-V servers and start computers from the virtual hard disk
• Use virtual hard disks as a deployment technology
Demonstration: Managing Virtual Hard Disks

In this demonstration, you will see how to:

• Create a virtual hard disk
• Manage a virtual hard disk
Lesson 3: Implementing Storage Spaces

- What Is the Storage Spaces Feature?
- Virtual Disk Configuration Options
- Advanced Management Options for Storage Spaces
- Demonstration: Configuring Storage Spaces
- Discussion: Comparing Storage Spaces with Other Storage Solutions
What Is the Storage Spaces Feature?

- Use storage spaces to add physical disks of any type and size to a storage pool, and then create highly-available virtual disks from the storage pool.

- To create a virtual disk, you need the following:
  - One or more physical disks
  - Storage pool that includes the disks
  - Virtual disk that are created with disks from the storage pool
  - Disk drives that are based on virtual drives

- Virtual disks are not virtual hard disks; they should be considered a drive in Disk Manager.

- Windows Server 2012 R2 enables Storage Space tiering and write-back caching.
## Virtual Disk Configuration Options

<table>
<thead>
<tr>
<th>Feature</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Layout</td>
<td>• Simple</td>
</tr>
<tr>
<td></td>
<td>• Two-way or three-way mirror</td>
</tr>
<tr>
<td></td>
<td>• Parity</td>
</tr>
<tr>
<td>Disk sector size</td>
<td>• 512 or 512e</td>
</tr>
<tr>
<td>Drive allocation</td>
<td>• Automatic</td>
</tr>
<tr>
<td></td>
<td>• Manual</td>
</tr>
<tr>
<td></td>
<td>• Hot Spare</td>
</tr>
<tr>
<td>Provisioning schemes</td>
<td>• Thin vs. fixed provisioning</td>
</tr>
</tbody>
</table>
Advanced Management Options for Storage Spaces

- Basic Management for Storage Spaces is available in Server Manager
- For disk failure:
  - Do not use chkdsk or scan disk
  - Remove the drive and add a new one
- Advanced management requires Windows PowerShell
## Advanced Management Options for Storage Spaces

<table>
<thead>
<tr>
<th>Windows PowerShell cmdlet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get-StoragePool</td>
<td>List storage pools</td>
</tr>
<tr>
<td>Repair-VirtualDisk</td>
<td>Repair a virtual disk</td>
</tr>
<tr>
<td>Get-PhysicalDisk</td>
<td>List unhealthy physical disks</td>
</tr>
<tr>
<td>Get-VirtualDisk</td>
<td>Remove a physical disk from a storage pool</td>
</tr>
<tr>
<td>Get-VirtualDisk</td>
<td>List physical disks used for a virtual disk</td>
</tr>
</tbody>
</table>
In this demonstration, you will see how to:

- Create a storage pool
- Create a virtual disk and a volume
Discussion: Comparing Storage Spaces with Other Storage Solutions

1. Does your organization currently use SANs or NAS?

2. What are the advantages of using Storage Spaces compared to using SANs or NAS?

3. What are the disadvantages of using Storage Spaces compared to using SANs or NAS?

4. In what scenarios would you recommend each option?

10 minutes
Exercise 1: Installing and Configuring a New Disk
Exercise 2: Resizing Volumes
Exercise 3: Configuring a Redundant Storage Space

Logon Information
Virtual machines 20410C-LON-DC1
20410C-LON-SVR1
User name Adatum\Administrator
Password Pa$$w0rd

Estimated Time: 30 minutes
Lab Scenario

Your manager has asked to add disk space to a file server.

After creating volumes, your manager has also asked you to resize those volumes based on updated information he has been given.

Finally, you need to make data storage redundant by creating a three-way mirrored virtual disk.
Lab Review

• At a minimum, how many disks must you add to a storage pool to create a three-way mirrored virtual disk?
• You have a USB-attached disk, four SAS disks, and one SATA disk that are attached to a Windows Server 2012 server. You want to provide a single volume to your users that they can use for file storage. What would you use?
Module Review and Takeaways

• Review Questions
• Best Practices
• Tools