

# NOS 04

Enterprise Storage Solutions

# Module Overview

- Managing disks in Windows Server
- Managing volumes in Windows Server
- Overview of DAS, NAS, and SANs
- Comparing Fibre Channel, iSCSI, and Fibre Channel over Ethernet
- Configuring sharing in Windows Server

# Lesson 1: Managing disks in Windows Server

- Selecting a partition table format
- Selecting a disk type
- Selecting a file system
- Implementing ReFS
- Using .vhd and .vhdx file types
- Selecting a disk type

# Selecting a partition table format

## MBR

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

## GPT

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

✓ **Use MBR for disks smaller than 2 TB**

✓ **Use GPT for disks larger than 2 TB**

# Selecting a disk type

Basic disks are:

- Initialized for basic storage
- The default storage for the Windows operating system

Dynamic disks can:

- Be modified without restarting the Windows system
- 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

# Selecting a file system

## **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, and volumes

# Implementing ReFS

## **ReFS has a number of advantages over NTFS:**

- Metadata integrity with checksums
- Expanded protection against data corruption
- Maximizes reliability
- Large volume, file, and directory sizes
- Storage pooling and virtualization
- Redundancy for fault tolerance
- Disk scrubbing for protection against latent disk errors
- Resiliency to corruptions
- Shared storage pools across machines

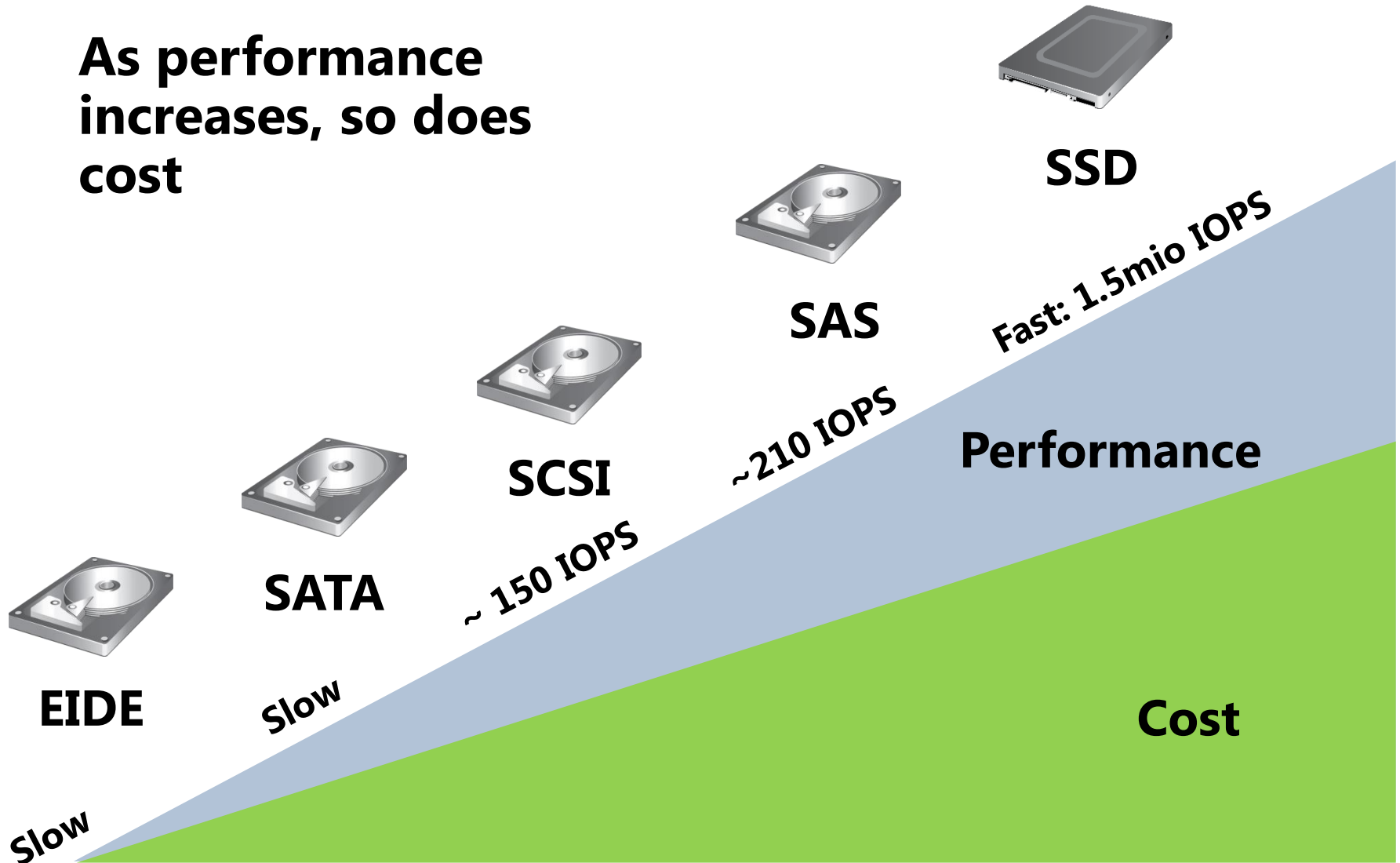
# Using .vhd and .vhdx file types

- Virtual hard disks are files that you can use the same way as physical hard disks
- You can:
  - Create and manage virtual hard disks by using Disk Management and Diskpart.exe
  - 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



# Selecting a disk type

**As performance increases, so does cost**



# Lesson 2: Managing volumes in Windows Server

- What are disk volumes?
- Options for managing volumes
- Extending and shrinking a volume
- What is RAID?
- RAID levels

# What are disk volumes?

Windows Server supports the following volume types:

- Simple
- Spanned
- Striped
- Mirrored
- RAID-5

# Options for managing volumes

Server Manager

Navigation: Servers, Volumes, **Disks**, Storage Pools, Shares, iSCSI, Work Folders

DISKS  
All disks | 11 total

Filter

| Number        | Virtual Disk | Status  | Capacity | Unallocated | Partition | Read Only | Clustered | Size |
|---------------|--------------|---------|----------|-------------|-----------|-----------|-----------|------|
| LON-SVR1 (11) |              |         |          |             |           |           |           |      |
| 0             |              | Online  | 127 GB   | 0.00 B      | MBR       |           |           |      |
| 1             |              | Online  | 127 GB   | 1.00 MB     | MBR       |           |           |      |
| 2             |              | Online  | 32.0 GB  | 1.00 MB     | MBR       |           |           |      |
| 3             |              | Online  | 32.0 GB  | 32.0 GB     | MBR       |           |           |      |
| 4             |              | Online  | 32.0 GB  | 32.0 GB     | MBR       |           |           |      |
| 5             |              | Offline | 32.0 GB  | 32.0 GB     | Unknown   | ✓         |           |      |
| 6             |              | Offline | 32.0 GB  | 32.0 GB     | Unknown   | ✓         |           |      |

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VOLUMES  
Related Volumes | 2 total

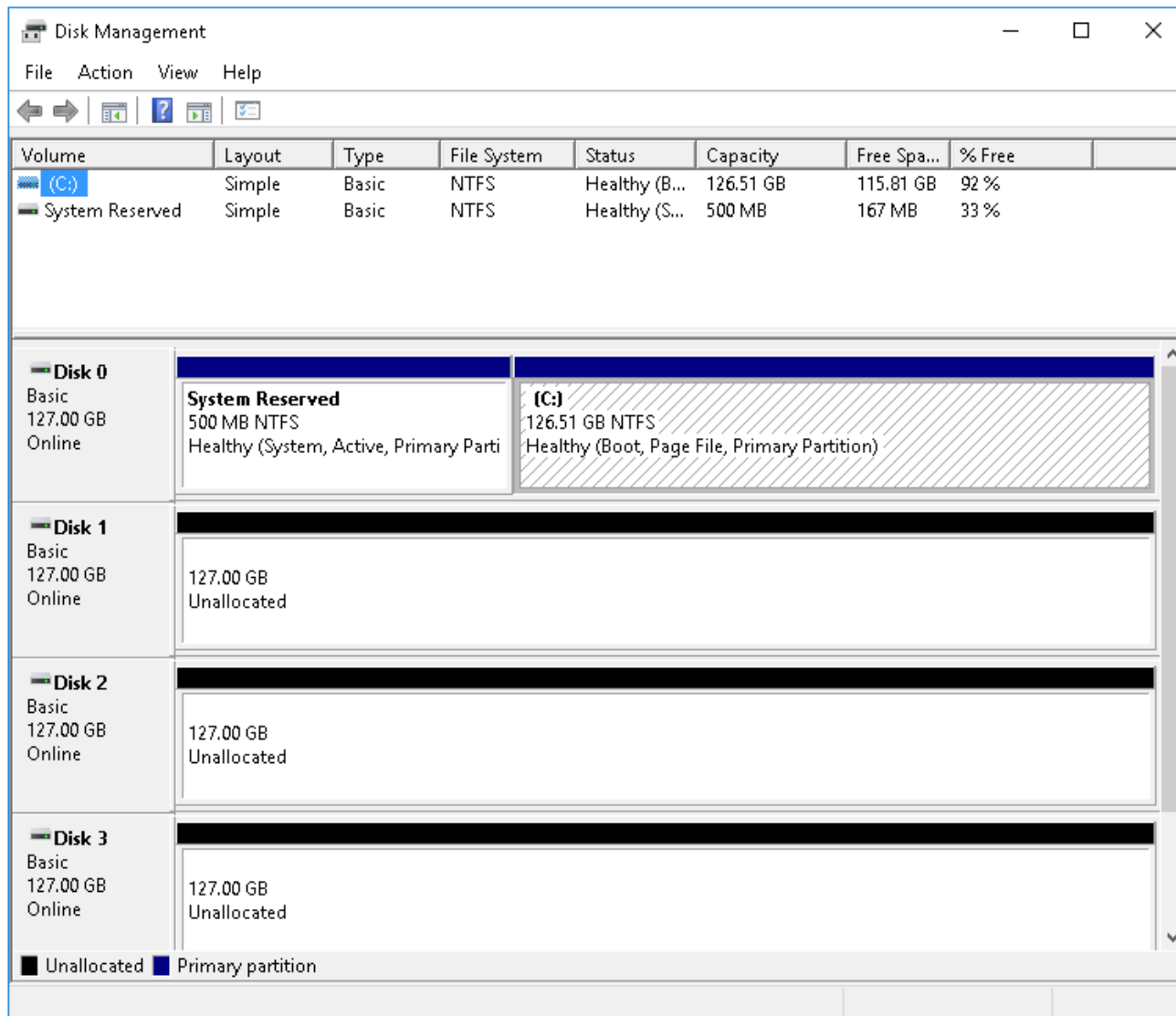
Filter

STORAGE POOL  
Virtual HD on LON-SVR1

No related storage pool exists.



# Options for managing volumes



# Extending and shrinking a volume

- You can resize volumes with Windows Server
- When you want to resize a disk, consider the following:
  - You can extend or shrink NTFS volumes
  - You can only extend ReFS volumes
  - You cannot resize FAT, FAT32, and exFAT volumes
  - You can shrink a volume only up to immovable files
  - You cannot shrink a volume with bad clusters

# What is RAID?

## **RAID:**

- Combines multiple disks into a single logical unit to provide fault tolerance and performance benefits
- 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 0

**Striped set without parity or mirroring**



**Disk 0**



**Disk 1**





## RAID 1

**Mirrored drives**



**Disk 0**

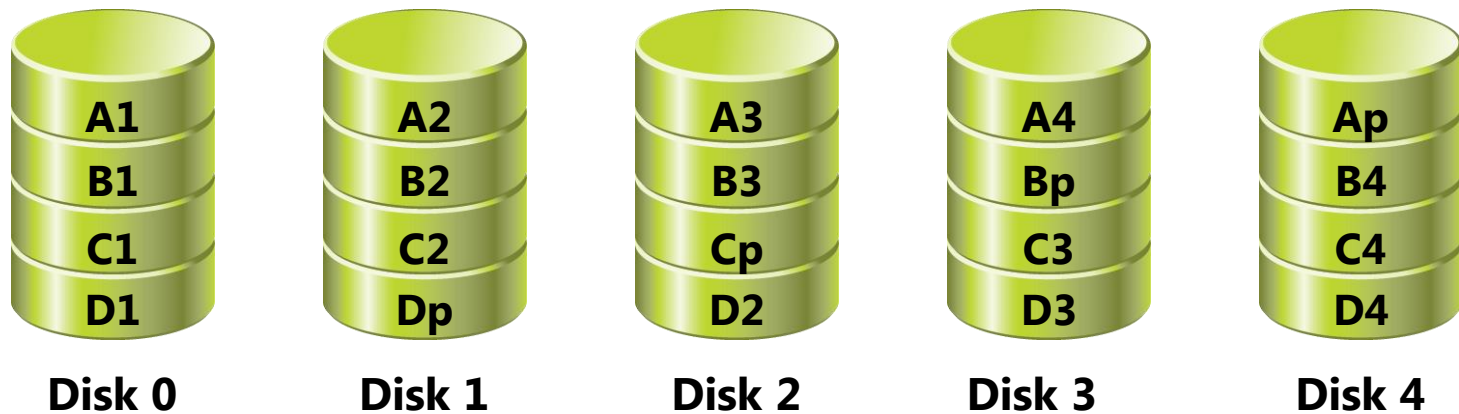


**Disk 1**



## RAID 5

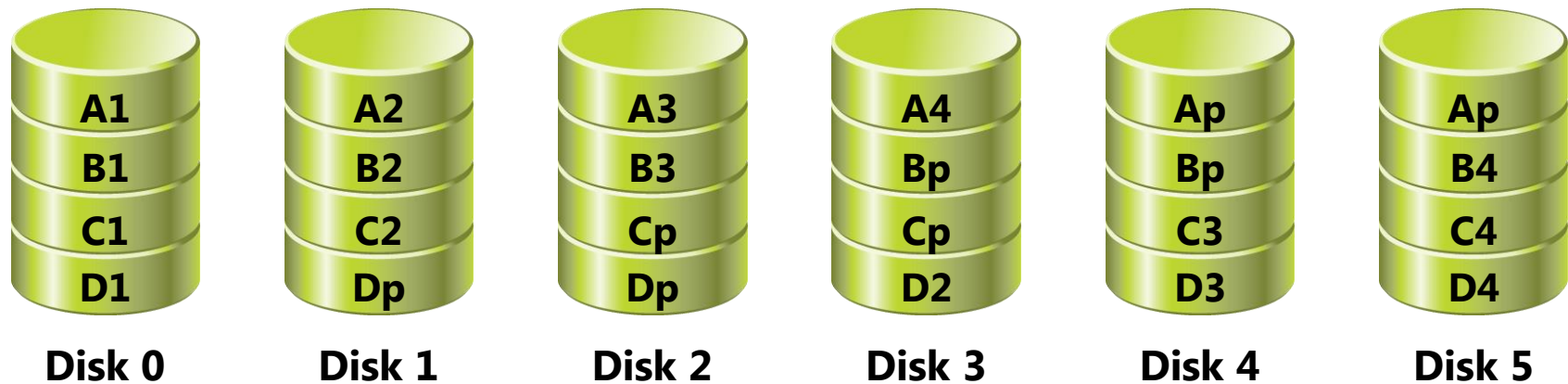
**Block-level striped set with parity distributed across all disks**



# RAID levels

## RAID 6

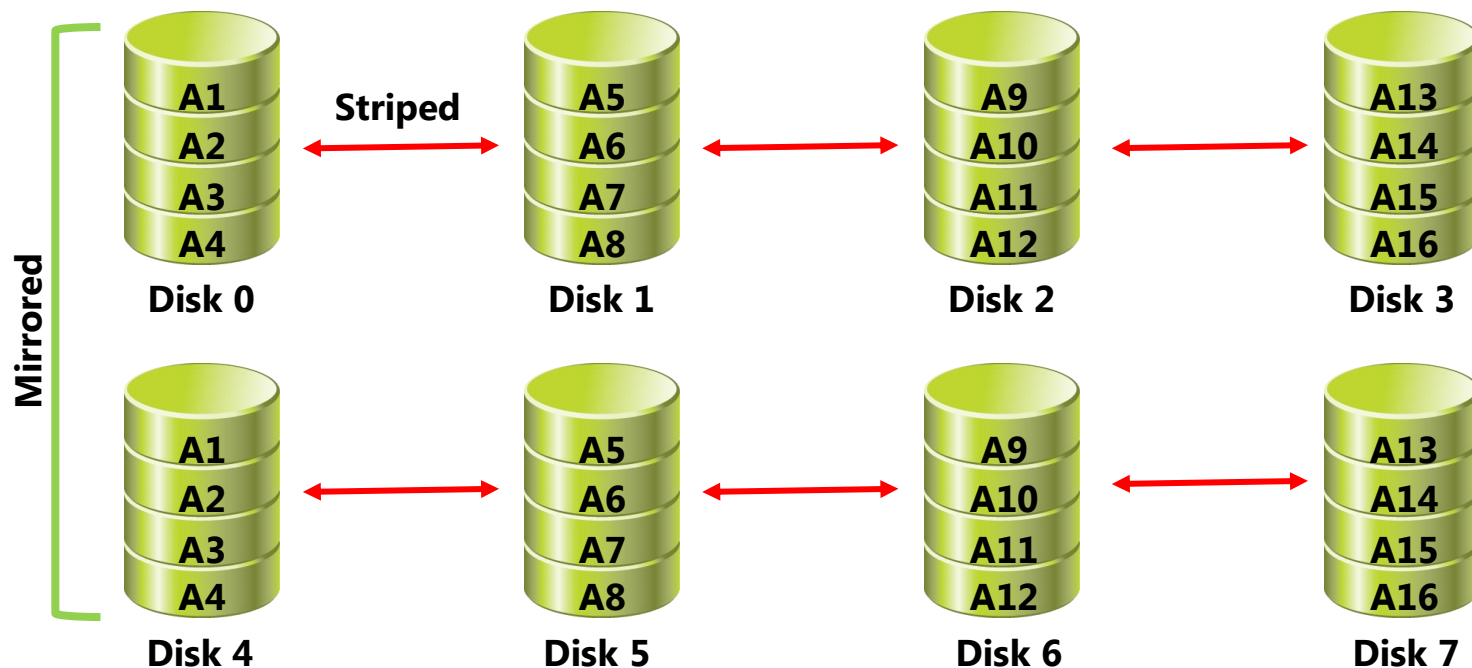
**Block-level striped set with parity distributed across all disks**



# RAID levels

## RAID 1 + 0

Each pair of disks is mirrored, then the mirrored disks are striped



# Lesson 3: Overview of DAS, NAS, and SANs

What is DAS?

What is NAS?

What is a SAN?

Comparison and scenarios for usage

Block-level storage vs. file-level storage

# What is DAS?

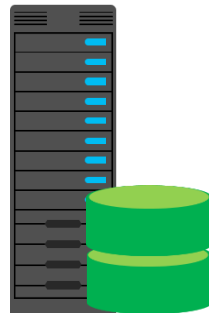
DAS is physically attached to the server

## Advantages:

- Easy to configure
- Inexpensive solution

## Disadvantages:

- Isolated, because the disks are attached to a single server
- Less flexible for allocation



Server with attached disks

# What is NAS?

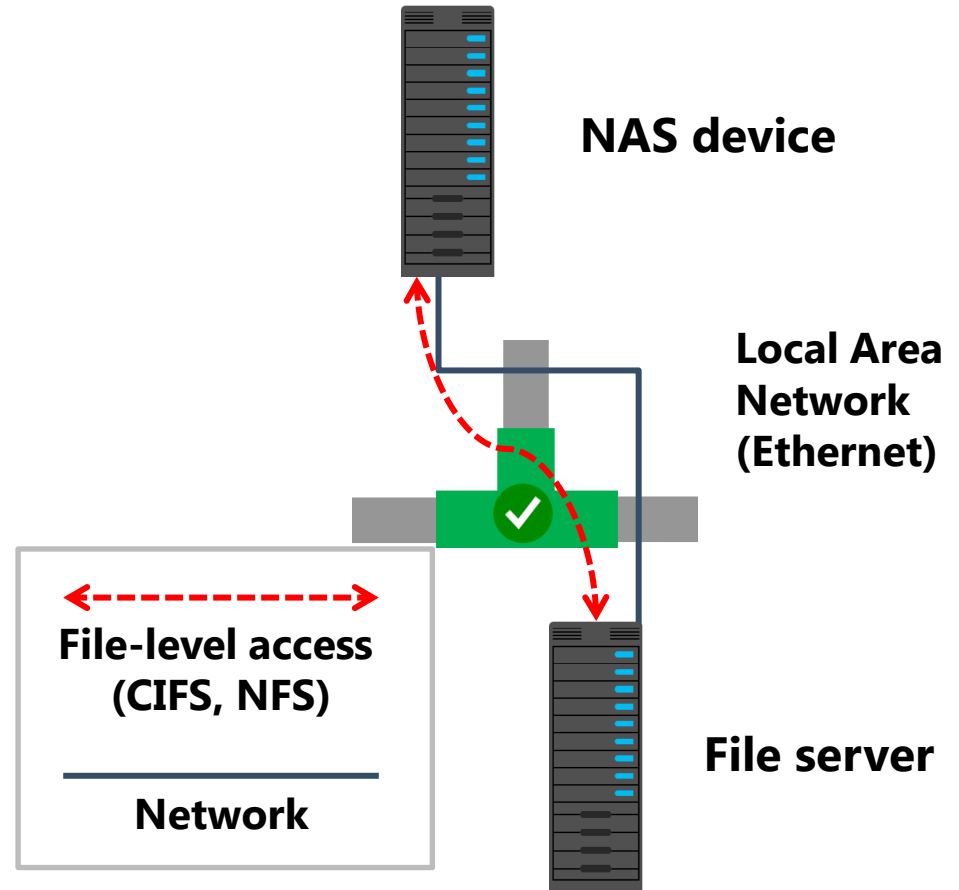
NAS is storage that is attached to a dedicated storage device and accessed through network shares

Advantages:

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

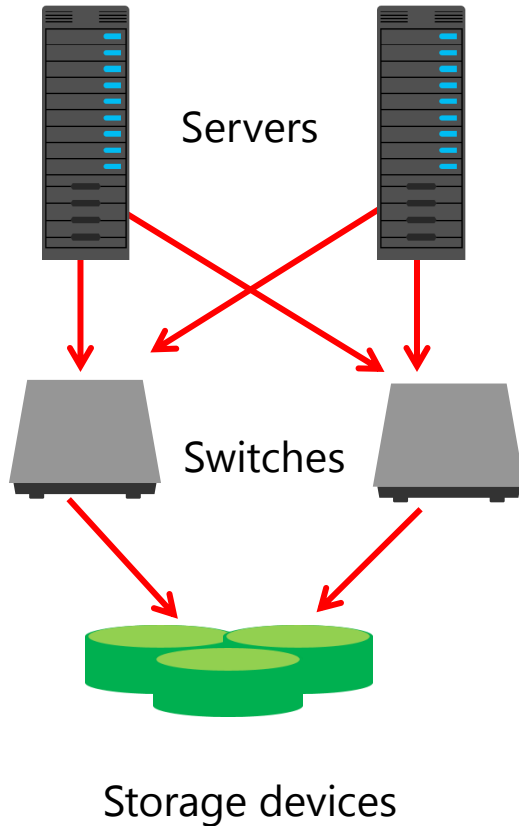
Disadvantages:

- 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

Implement SANs by using Fibre Channel or iSCSI



# Comparison and scenarios for usage

- DAS:
  - Least complex
  - Lowest setup costs
- NAS:
  - Best solution for specific situations
  - Complementary to DAS and SAN
- SAN:
  - Highest performing
  - Has the most features
- Future trends:
  - Windows Server storage features are expanding to improve capabilities when using DAS

# Block-level storage vs. file-level storage

## Block-level storage:

- Is high-performing
- Is often SAN-based
- Presents LUNs to servers
- Is not the most cost-effective

## File-level storage:

- Is delivered via NAS, a storage server, or a file server
- Uses CIFS/SMB (shared folders) or NFS (exports)
- Uses block-level storage on the storage backend

# Lesson 4: Comparing Fibre Channel, iSCSI, and Fibre Channel over Ethernet

What is iSCSI?

iSCSI components

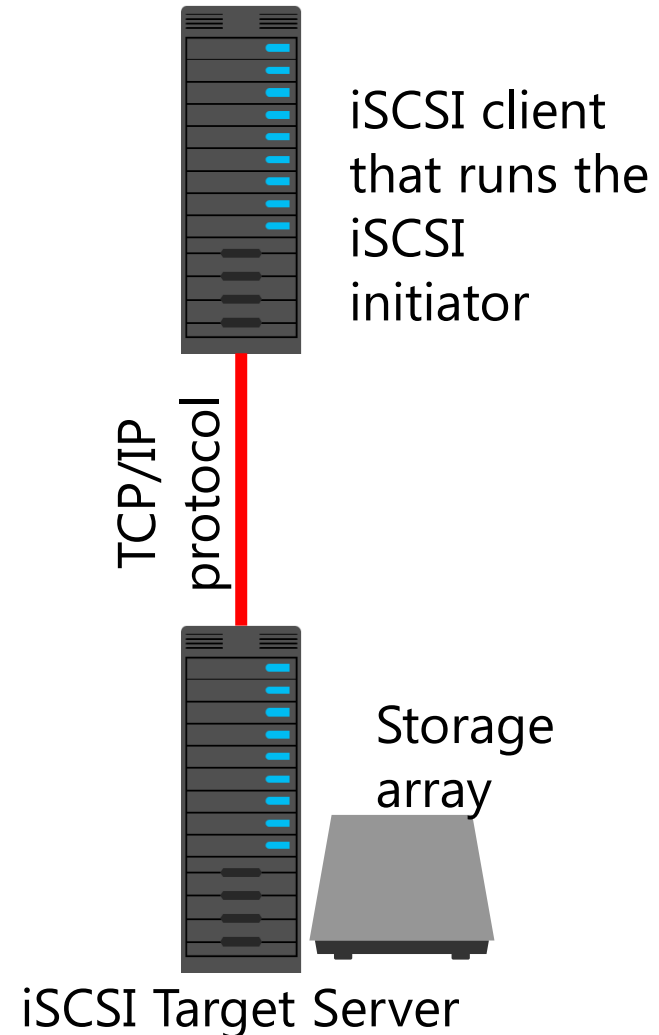
Considerations for implementing iSCSI

Core storage components

# What is iSCSI?

iSCSI transmits SCSI commands over IP networks

| Component        | Description  |
|------------------|--|
| IP network       | Network that provides high performance and redundancy  |
| iSCSI targets    | Servers that run on the storage device and enable access to the disks                            |
| iSCSI initiators | Software component or host adapter on the server that provides access to iSCSI targets           |
| iSCSI IQN        | Globally unique identifier that iSCSI uses to address initiators and targets on an iSCSI network |



# iSCSI components

## The iSCSI Target Server:

- Is available as a role service in Windows Server
- Provides the following functionality:
  - Network or diskless boot
  - Server application storage
  - Heterogeneous storage
  - Lab environments
- Has the following features:
  - Authentication
  - Query initiator computer for ID
  - Virtual hard drives
  - Scalability
  - Manageability

## The iSCSI initiator:

- Runs as a service in the operating system
- Is installed by default on Windows Vista and Windows Server 2008 and newer operating systems
- Requires only to be started and configured to connect the computer to the iSCSI target

# Considerations for implementing iSCSI

The primary factors to consider when planning on using iSCSI are:

- Network speeds and performance
- High availability
- Security
- Vendor information
- Infrastructure staff
- Application teams

Alternative solutions to iSCSI are Fibre Channel, Fibre Channel over Ethernet, and InfiniBand

# Core storage components

- Network adapters are usually used on Ethernet networks
- HBAs are usually used on storage networks such as SAN
- Converged network adapters can be used on Ethernet networks or SANs
- InfiniBand host channel adapters are used on InfiniBand networks
- Disk controllers facilitate communication between disk drives and a CPU

# Lesson 5: Configuring sharing in Windows Server

- What is SMB?
- Configuring SMB shares
- What is NFS?
- Configuring NFS shares



# What is SMB?

- SMB is the file-sharing protocol that Windows client and server operating systems use
- Each new version has additional features
- SMB 3.0 introduced large performance benefits
- SMB 3.0.2 added:
  - Scale-Out File Server
  - Removable SMB 1.x
- SMB 3.1.1 added:
  - Pre-authentication integrity
  - SMB encryption improvements
  - Cluster dialect fencing

# What is NFS?

- NFS is a file system based on open standards
- Current version is 4.1
- Windows NFS components include:
  - Client for NFS
  - Server for NFS
- Support for Kerberos v5 authentication
- The primary uses for NFS are:
  - Storage for VMware virtual machines
  - Sharing data across multiple operating systems
  - Sharing data across different IT infrastructures after a company merger

# Configuring NFS shares

- Install the Server for NFS server role
- Two options for NFS share profile:
  - NFS Share – Quick
  - NFS Share – Advanced
- Authentication options:
  - Kerberos v5 authentication
  - No server authentication
- Share permissions define allowed and denied hosts
- Follow best practices