Lesson 3: Configuring Local Storage

MOAC 70-410: Installing and Configuring Windows Server 2012

Microsoft Official Academic Course

WILEY

Overview

- Exam Objective 1.3: Configure Local Storage
- Planning Server Storage
- Understanding Windows Disk Settings
- Working with Disks

Planning Server Storage

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Planning Server Storage

When planning storage solutions for a server, you must consider many factors:

- The amount of storage the server needs
- The number of users that will be accessing the server at the same time
- The sensitivity of the data to be stored on the server
- The importance of the data to the organization

How Many Servers Do I Need?

When is one big file server preferable to several smaller ones?

Consider the storage limitations of Windows Server 2012 ReFS.

Attribute	***Limit based on the on-disk format***
Maximum size of a single file	2^{64}-1 bytes
Maximum size of a single volume	Format supports 2^{78} bytes with 16KB cluster size. Windows stack addressing allows 2^{64} bytes
Maximum number of files in a directory	2^{64}
Maximum number of directories in a volume	2^{64}
Maximum file name length	32K unicode characters
Maximum path length	32K
Maximum size of any storage pool	4 petabytes
Maximum number of storage pools in a system	No limit
Maximum number of spaces in a storage pool	No limit

Estimating Storage Requirements

The amount of space you need in a server depends on a variety of factors, not just the requirements of your applications and users:

- **Operating system:** Depends on roles and features chosen
- **Paging file:** Depends on RAM and number of VMs
- **Memory dump:** Space to hold the contents of memory + 1MB
- **Log files:** From Event Viewer
- **Shadow copies:** Can utilize up to 10% of space
- **Fault tolerance:** Disk mirroring versus parity

Selecting a Storage Technology

- Designing a server storage subsystem encompasses both hardware and software elements.
- You need to consider many factors, including:
  - How much storage space you need
  - How much and what type of fault tolerance

Selecting a Physical Disk Technology

- Direct-attached storage or external storage
- Review specifications of hard disks:
  - Capacity
  - Rotational speed (10,000 rpm +)
  - Disk interface (to handle large numbers of disk I/O requests)
    - ATA, SATA, SCSI

Using External Drive Arrays

- Hard drives in a separate housing with their own disk controller, power supply, cooling fans, and cache memory.
- Connects to computer using:
  - SCSI (Small Computer System Interface)
  - IEEE 1394 (Fire Wire)
  - External SATA (eSATA)
  - USB (Universal Serial Bus)
  - Network Interface (iSCSI or Fibre Channel)

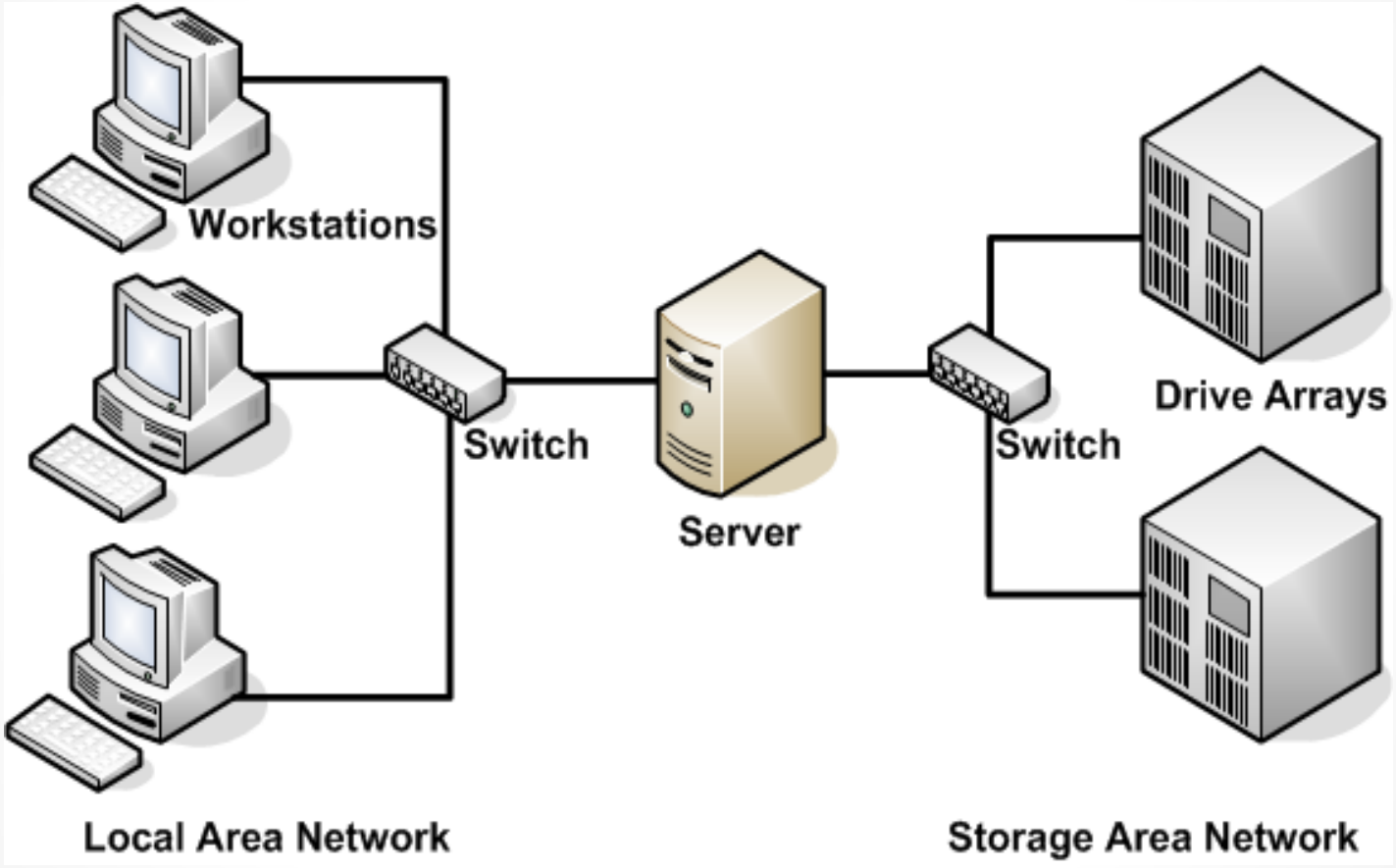
Using External Drive Arrays

- Enable a server to host more physical hard drives and often include fault-tolerance features, such as:
  - Hot-swappable drives
  - Redundant power supplies
  - Hardware-based RAID
- The more features the array has, the more drives it can hold and the higher the cost.

External Drive Array Configurations

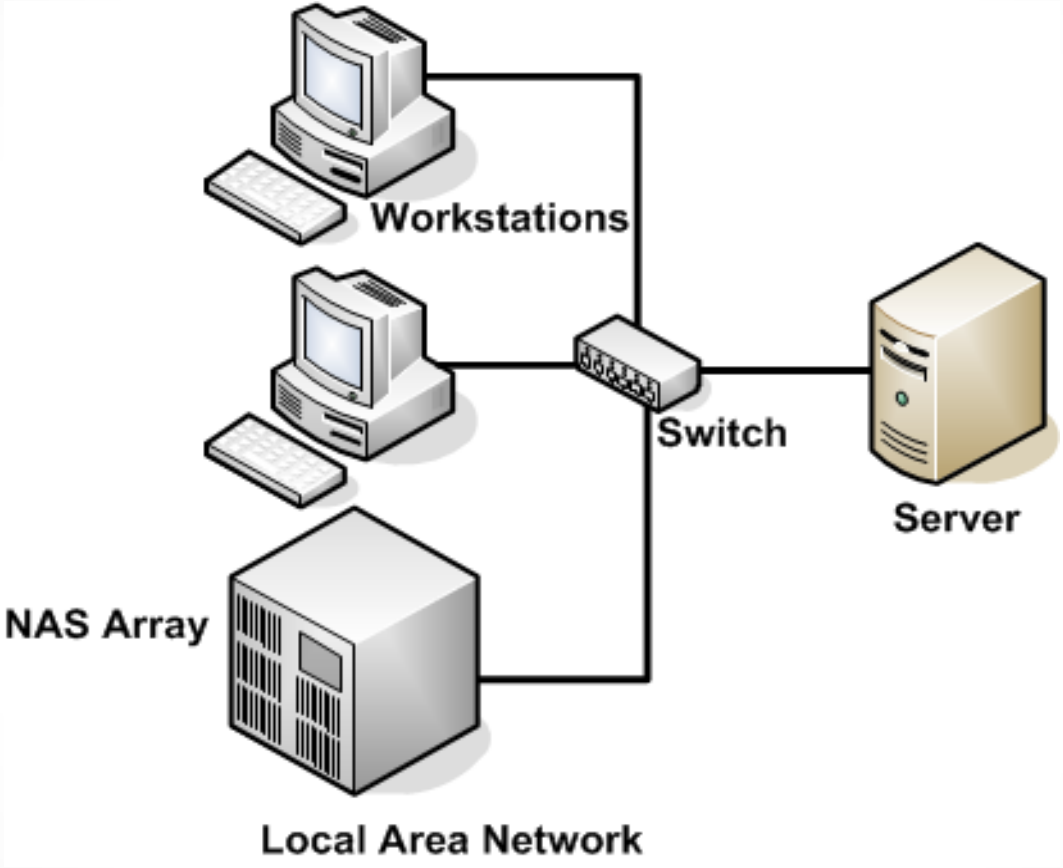
- **Storage Area Network (SAN)**
  - Separate network dedicated to storage devices, using high-speed technologies.
- **Network Attached Storage (NAS)**
  - Essentially a designated file server providing file-based storage directly to clients.
  - Connects to a LAN using standard ethernet hardware.
- **Just a Bunch of Disks (JBOD)**
  - Simplest and least expensive, but it is just extra storage space.

External Drive Arrays



Storage Area Network (SAN)

External Drive Arrays



Network Attached Storage (NAS)

Planning for Storage Fault Tolerance

- Fault tolerance is immediate redundancy.
- Variety of fault tolerance mechanisms:
  - Redundant blocks
  - Redundant files
  - Redundant volumes
  - Redundant drives
  - Redundant servers
- It is a tradeoff between performance and expense.

Fault Tolerance Technologies

- **Disk mirroring/Disk duplexing**
  - A computer writes the same data to identical volumes on two different disks.
  - Disk duplexing also uses duplicate host adapters.
- **RAID with Windows Server 2012**
  - RAID 0: Stripe set without parity
  - RAID 1: Mirror set without parity
  - RAID 5: Stripe set with distributed parity

Parity is a mathematical algorithm that is used to provide redundancy, so that data from a failed drive or volume can be reconstructed.

Using Storage Spaces

- Enables a server to concatenate storage space from individual physical disks to create virtual disks of any size.
- Storage pools can span multiple drives invisibly that can be expanded or reduced as needed.
- Virtual disks of any size can be created.
    - Once created, they behave just like a physical disk, and you can create volumes.

Understanding Windows Disk Settings

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Windows Disk Settings

The Windows Setup program automatically prepares the primary hard disk for the system, but when you add new hard disks, you must:

- Select a partitioning style.
- Select a disk type.
- Divide the disk into partitions or volumes.
- Format the partitions or volumes with a file system.

Selecting a Partition Style

- **Master Boot Record (MBR)**
  - Common partition style for x86- and x64-based computers
- **GUID Partition Table (GPT)**
  - New since the late '90s
  - Most operating systems now support GPT

GPT and MBR

- Supports up to 128 primary partitions
- Supports volumes up to 18 exabytes
- Partitions store data critical to platform operation
- Replication and CRC protection of the partition table provide increased reliability

- Supports up to 4 primary partitions or 3 primary partitions and 1 extended partition, with unlimited logical drives on the extended partition
- Supports volumes up to 2 terabytes
- Hidden (unpartitioned) sectors store data critical to platform operation
- Replication and cyclical redundancy checks (CRCs) are not features of MBR's partition table

Disk Types

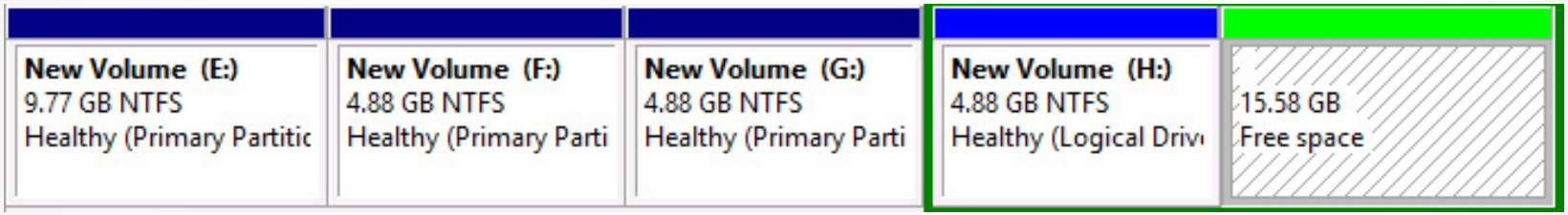
Basic Disk

- Compatible with older OS
- Consists of primary and extended partitions
- Supports up to 4 partitions (per single hard drive)
- Basic disks also can be configured for any of 3 RAID levels:
  - Disk striping (RAID 0)
  - Disk mirroring (RAID 1)
  - Disk striping with parity (RAID 5)

Dynamic Disk

- Supported by Windows 2000 and up
- Does not use traditional partitioning
- Dynamic disks can combine two or more physical disks into one dynamic disk
- Dynamic disks divided into volumes

Primary and Extended Partitions with MBR

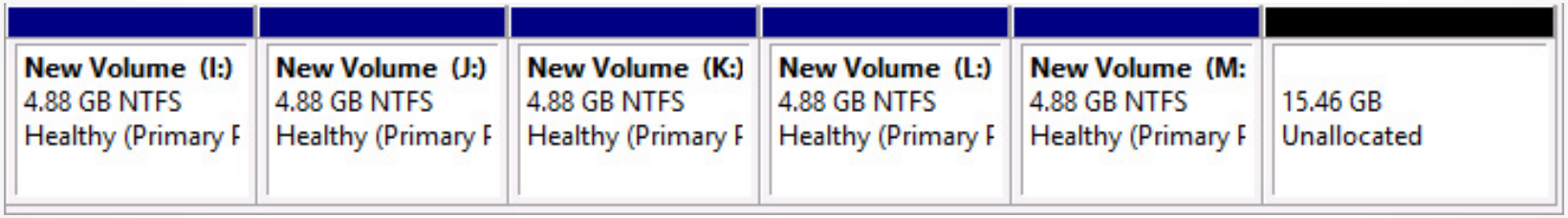


Primary and extended partitions on a basic disk using MBR

Partitions Compared: Primary versus Extended

- A primary partition functions as though it is a physically separate disk and can host an operating system.
- It can be marked as an active partition.
- On a basic disk using MBR, you can create up to 4 primary partitions or 3 primary partitions and 1 extended partition.
- You format each primary partition and assign a unique drive letter.
- Extended partitions cannot host an operating system.
- You cannot mark an extended partition as an active partition.
- A basic disk using MBR can contain only 1 extended partition, but unlimited logical drives.
- You do not format the extended partition itself, but the logical drives it contains. You assign a unique drive letter to each logical drive.

Primary Partitions with GPT



Primary partitions on a basic disk using GPT

Volume Types

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

Simple Volume

- A portion of a disk or an entire disk that is set up as a dynamic disk.
- Can be extended onto multiple sections of the same disk.
- Can be extended to multiple disks to be a part of a spanned or striped volume.

Spanned Volume

- Combines space from multiple dynamic disks to a singe large volume.
- Can contain space on 2 to 32 dynamic disks.
- As new disks are added, the spanned volume can be extended to include new disks.
- One disk is filled before moving onto the space of another disk.
- It does not increase performance.
- It does not provide fault tolerance.

Striped Volume

- Combines space from multiple dynamic disks to a singe large volume.
- Can contain space on 2 to 32 dynamic disks.
- You cannot extend it after creation.
- Data is written equally across all disks.
- Increases disk performance.
- No fault tolerance.
- Referred to as RAID-0.

Mirrored Volume

- Consists of an identical amount of space on 2 physical disks, which must be dynamic.
- The system performs read/write operations on both disks simultaneously.
- One of the most guaranteed forms of disk fault tolerance.
- Referred to as RAID-1.

RAID-5 Volume

- Requires a minimum of 3 disk drives.
- Parity information is distributed on each disk.
  - If one disk fails, the information on that disk can be reconstructed.
- Improved read performance because of disk striping.
- Slower write performance because of the parity calculations.

Choosing a Volume Size

- Server 2012 supports volumes larger than 1 exabyte (over 1,000,000 terabytes).
- Split volumes into manageable sizes.
- Match volume size to the capacity of your backup solution to facilitate easier recovery.
- Larger volumes take longer to repair in the event of an error or failure.
- Many small volumes can create other administrative problems.

File Systems

- A file system is the underlying disk drive structure that enables you to store information.
- A file system is installed by formatting a partition or volume.
- Server 2012 supports 5 file systems:
  - NTFS, FAT32, exFAT, FAT (FAT16), and ReFS

File Systems—FAT

- No security
- Disk size limitations
  - FAT16 max 4GB partition and 2GB file
  - FAT32 max 32GB partition and 4GB file
- Only reason to use is for compatibility when dual-booting with previous versions of Windows that do not support NTFS

File Systems—NTFS

- Preferred file system for Windows Server
- Large volume support
- File and folder security
- File compression
- Encrypted File System (EFS)
- Disk quotas

File Systems—ReFS

- New file system with Windows Server 2012
- Only supported by Windows Server 2012 and Windows 8
- Unlimited file and directory sizes
- Increased resiliency—no need for error-checking tools
- Does not support file compression, EFS, or quotas

Working with Disks

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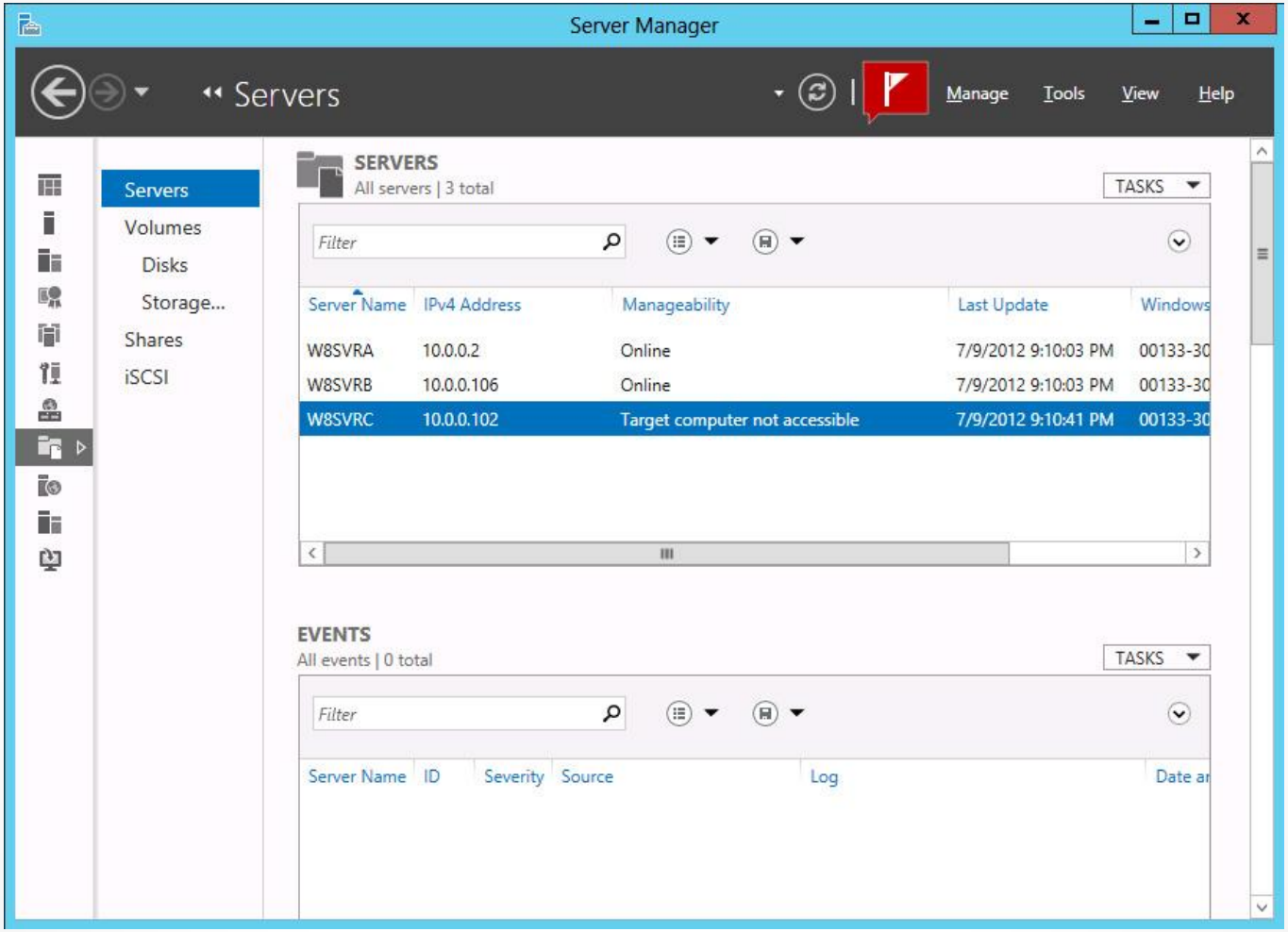
Working with Disks

- Disks can be managed from the command line or through graphical tools.
- Server Manager contains a File and Storage Services submenu to manage storage pools, create virtual disks, and perform some standard disk and volume management tasks.

Working with Disks



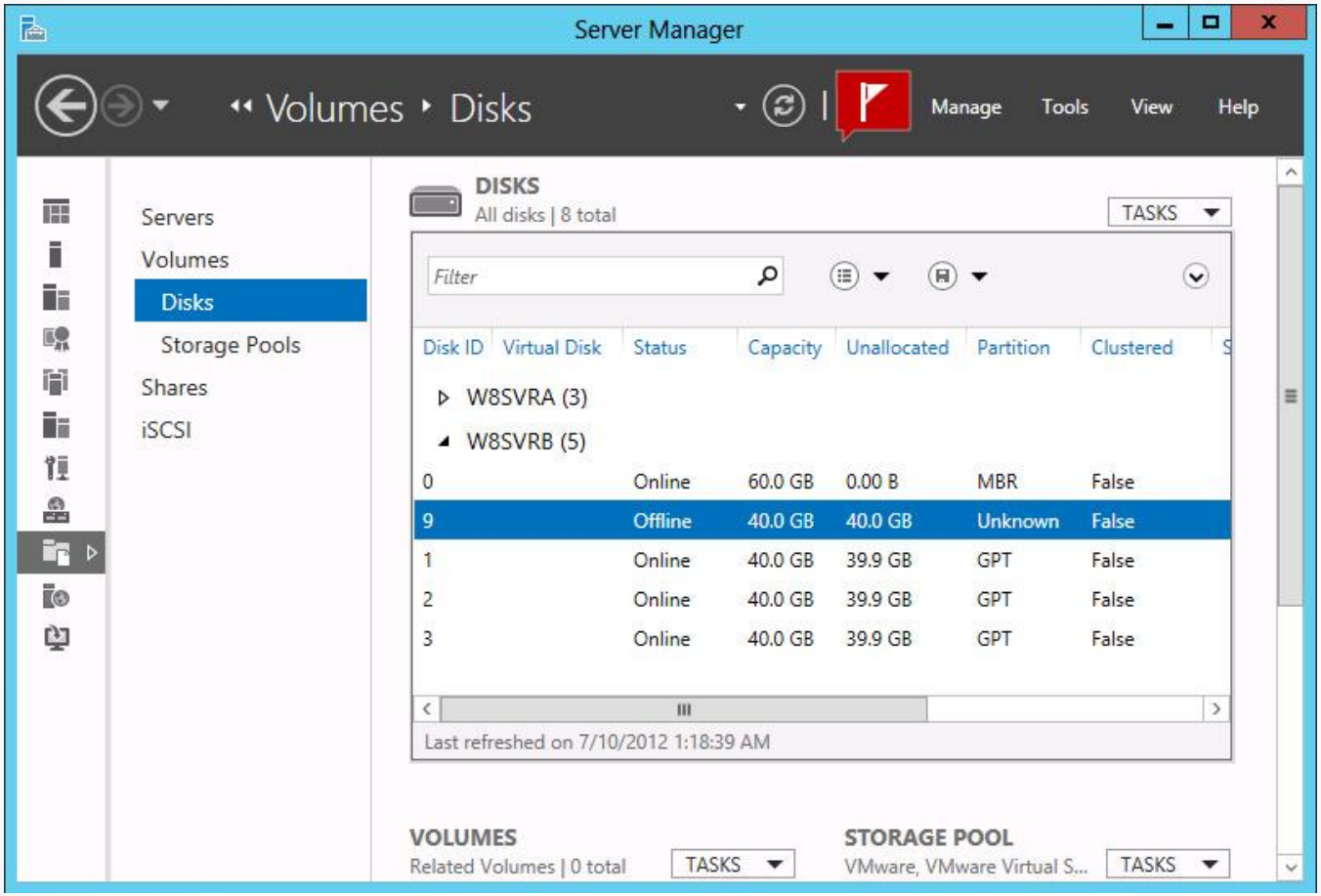
The File and Storage Services submenu in Server Manager

Working with Disks

Disk Management MMC snap-in is the traditional tool for performing disk-related tasks:

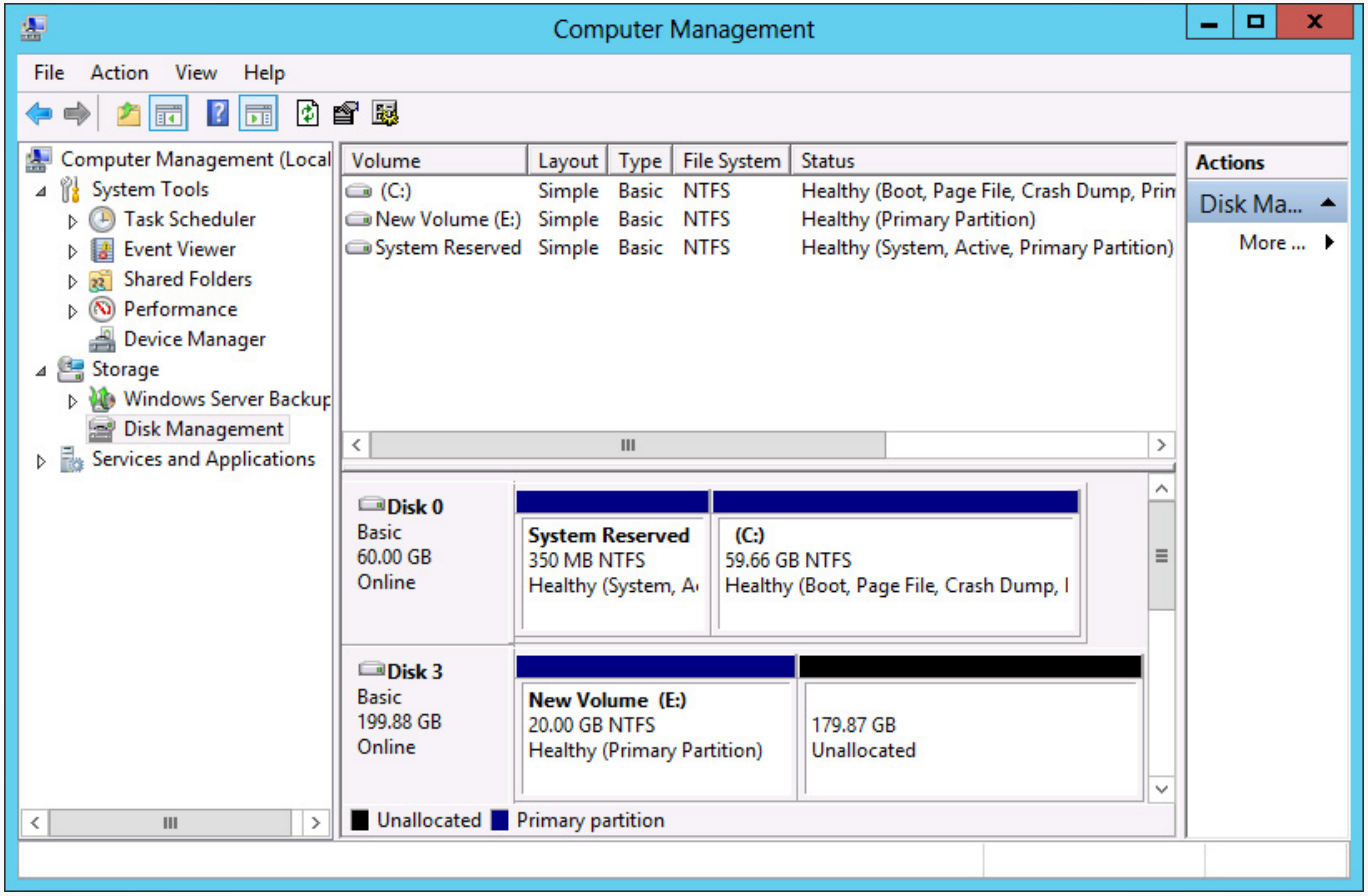
- Initializing disks
- Selecting a partition style
- Converting basic disks to dynamic disks
- Creating partitions and volumes
- Extending, shrinking, and deleting volumes
- Formatting partitions and volumes
- Assigning and changing driver letters and paths
- Examining and managing physical disk properties, such as disk quotas, folder sharing, and error checking

Adding a New Physical Disk



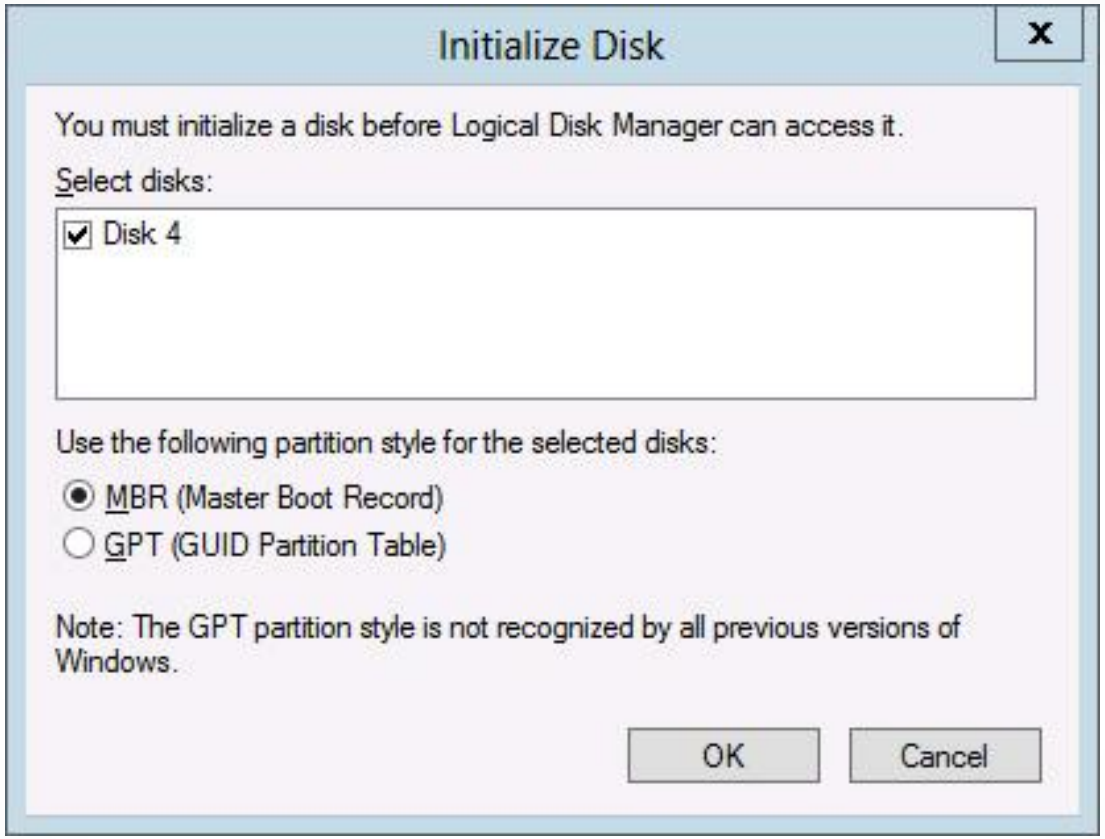
A new physical disk in Server Manager

Adding a New Physical Disk



The Disk Management snap-in

Adding a New Physical Disk

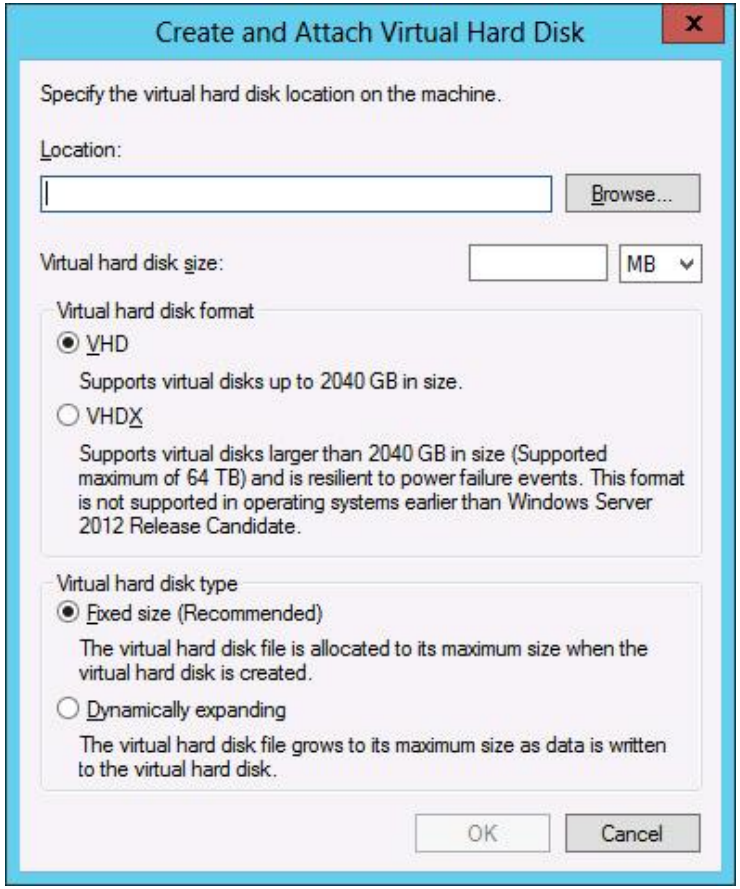


The Initialize Disk dialog box

Creating and Mounting VHDs

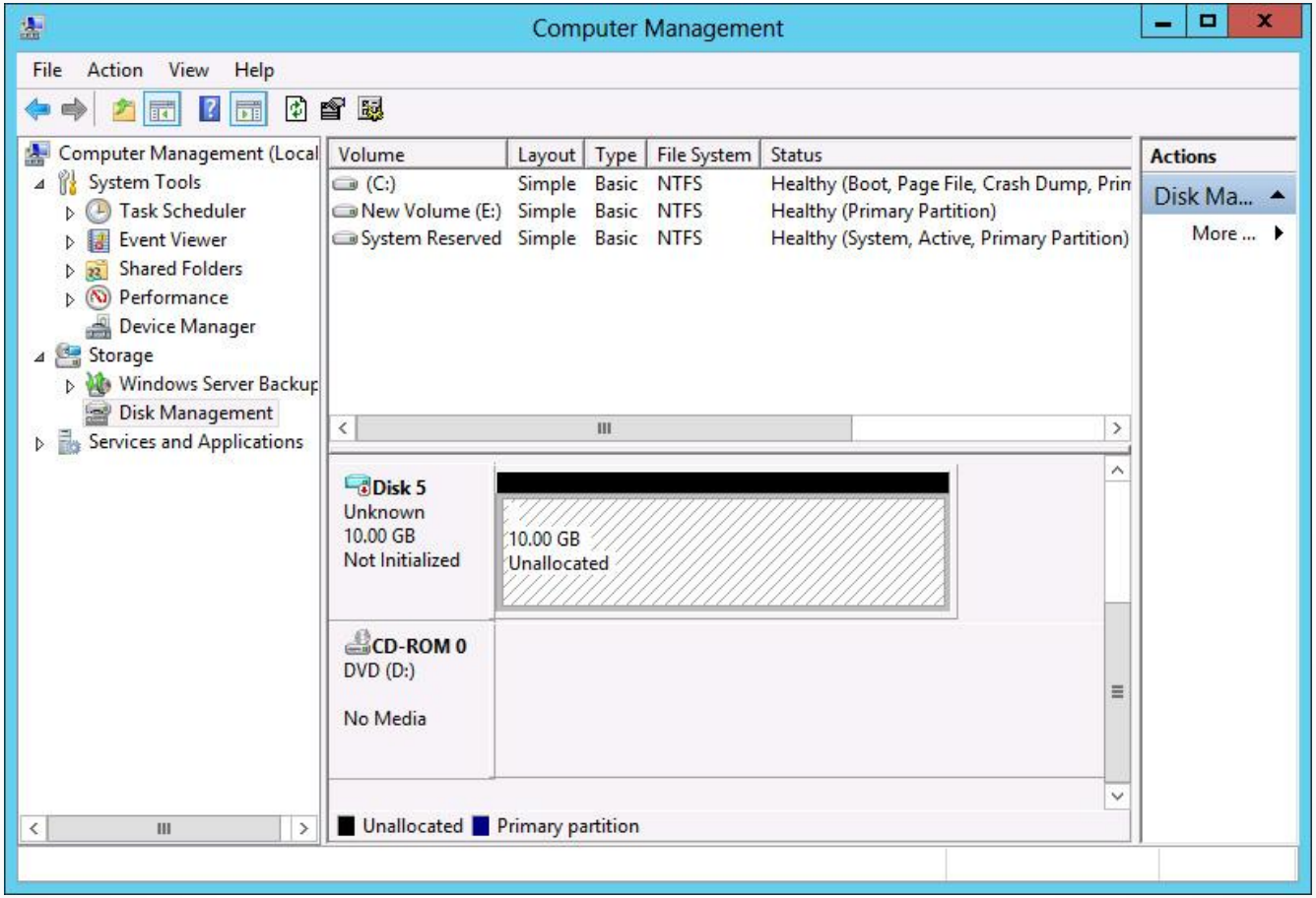
- Hyper-V relies on the **Virtual Hard Disk (VHD)** format to store virtual disk data in files that can easily be transferred from one computer to another.
- The Disk Management snap-in in Windows Server 2012 enables you to create VHD files and mount them on the computer.
- A dismounted VHD can be moved or copied as needed.

Create a VHD



The Create and Attach Virtual Hard Disk dialog box

Create a VHD

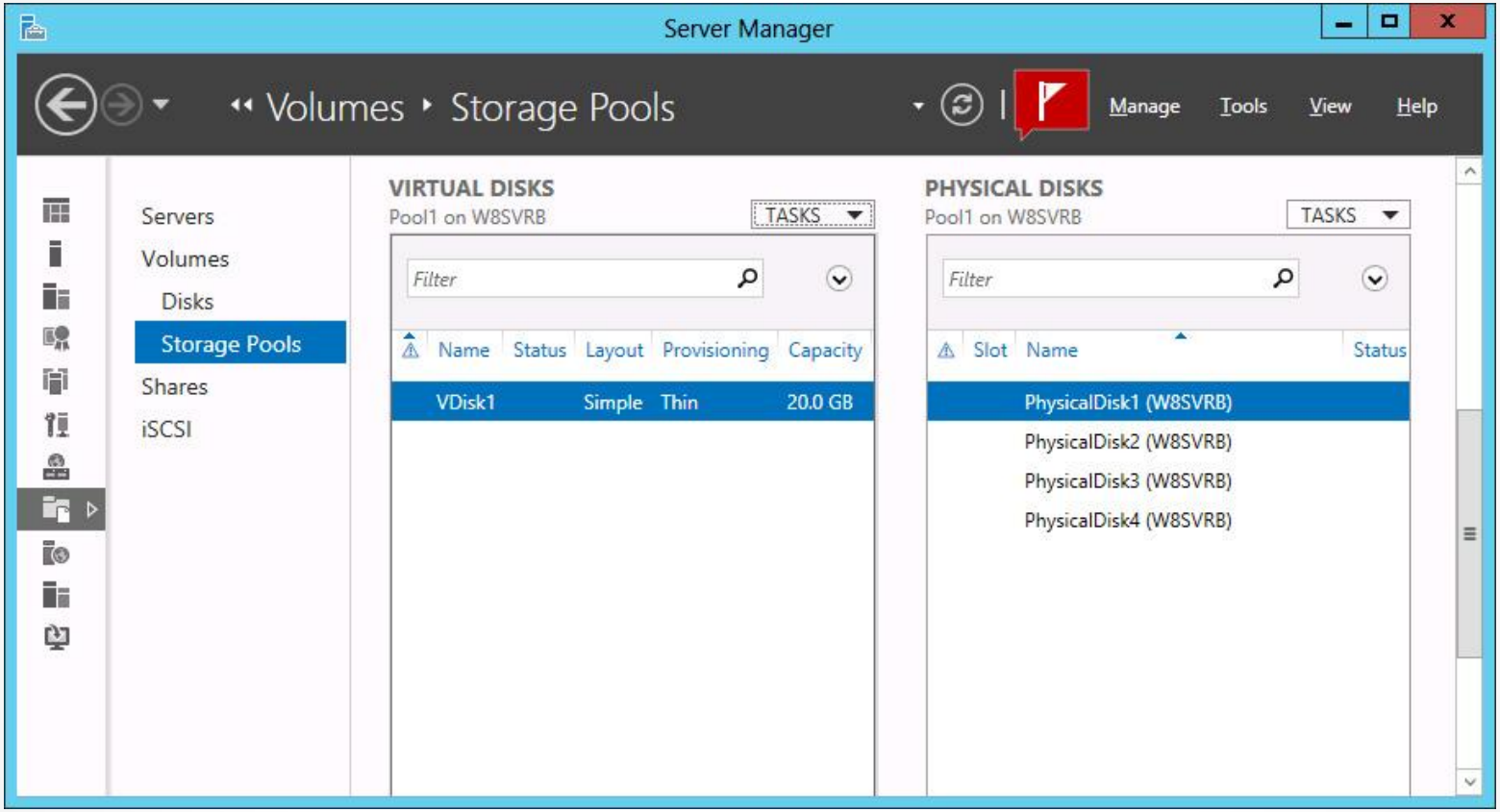


A newly created and attached VHD

Creating a Storage Pool

Once you have installed your physical disks, you can concatenate their space into a storage pool, from which you can create virtual disks of any size.

Storage Pools and Virtual Disks



A new disk in the Virtual Disks tile in Server Manager

Lesson Summary

- Windows Server 2012 supports two hard disk partition types: MBR and GPT; two disk types: basic and dynamic; five volume types: simple, striped, spanned, mirrored, and RAID-5; and three file systems: ReFS, NTFS, and FAT.
- The Disk Management snap-in can initialize, partition, and format disks on the local machine. Server Manager can perform many of the same tasks for servers all over the network.
- A Windows server can conceivably perform its tasks using the same type of storage as a workstation. However, the I/O burdens of a server are quite different from those of a workstation, and a standard storage subsystem can easily be overwhelmed by file requests from dozens or hundreds of users. In addition, standard hard disks offer no fault tolerance and are limited in their scalability.

Lesson Summary

- Windows Server 2012 includes a new disk virtualization technology called Storage Spaces, which enables a server to concatenate storage space from individual physical disks and allocate that space to create virtual disks of any size supported by the hardware.
- All Windows Server 2012 installations include the File and Storage Services role, which causes Server Manager to display a submenu when you click the icon in the navigational pane. This submenu provides access to homepages that enable administrators to manage volumes, disks, storage pools, shares, and iSCSI devices.
- The Disk Management snap-in in Windows Server 2012 enables you to create VHD files and mount them on the computer.
- Once you have installed your physical disks, you can concatenate their space into a storage pool, from which you can create virtual disks of any size. Once you have created a storage pool, you can use the space to create as many virtual disks as you need.