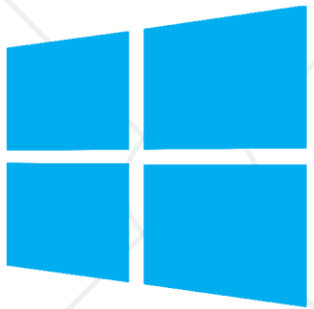


# Connectivity. Software. Storage

Basic Networking. Software and Services. Storage



Windows  
Server

SoftUni Team  
Technical Trainers



**SoftUni**



Software University

<https://softuni.bg>

# Have a Question?

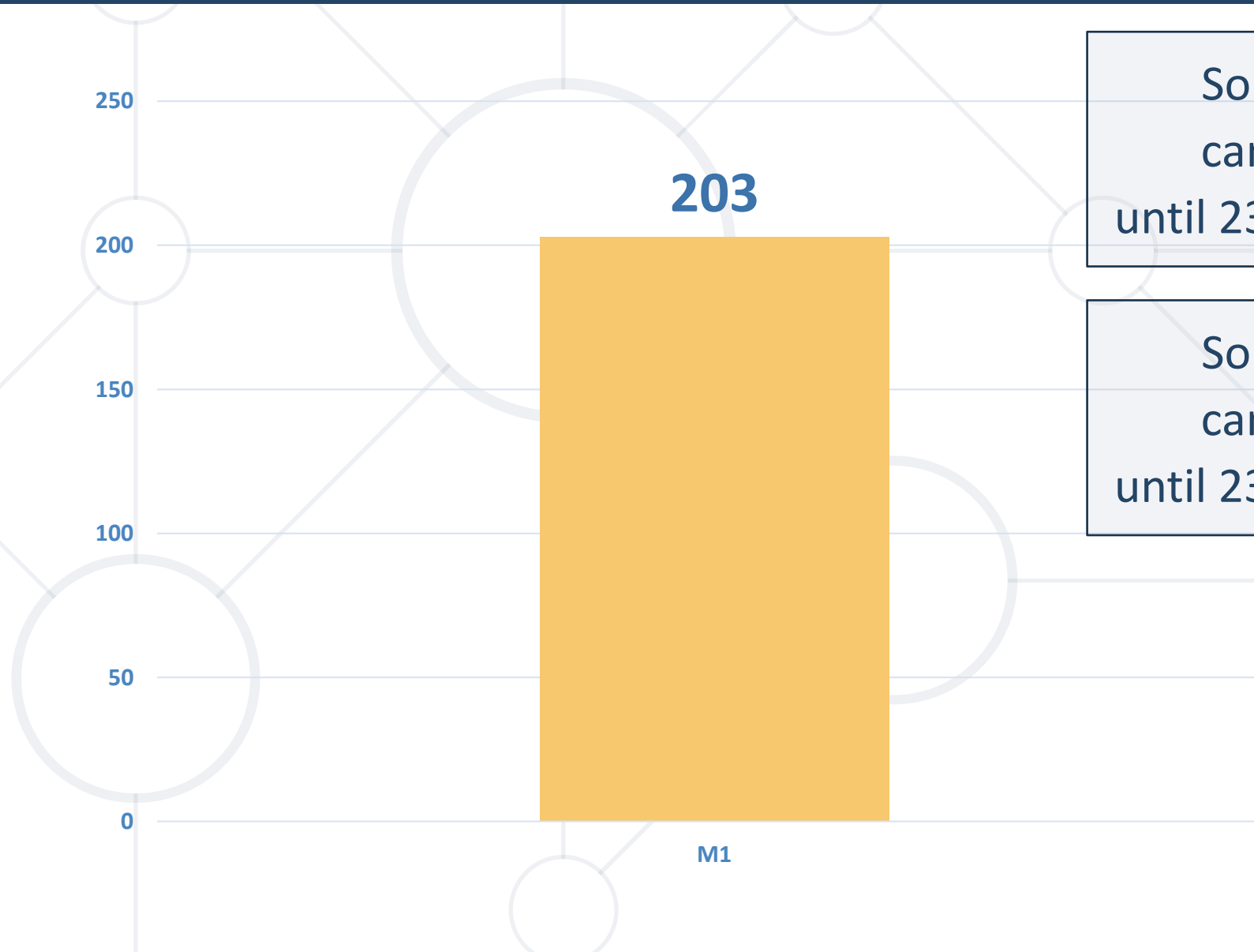
**sli.do**

**#WSA**

**facebook.com/groups/**

**WindowsSystemAdministrationMarch2023/**

# Homework Progress



Solutions for M1  
can be uploaded  
until 23:59 on 07.04.2023

Solutions for M2  
can be uploaded  
until 23:59 on 14.04.2023

**Next Lecture Will Be On**  
**13.04.2023**  
**(Thursday)**



# **Previous Module (M1)**

## **Quick overview**

# What We Covered

- Windows history
- Windows architecture
- Windows editions and features
- Install options
- Basic administrative tasks



# **This Module (M2)**

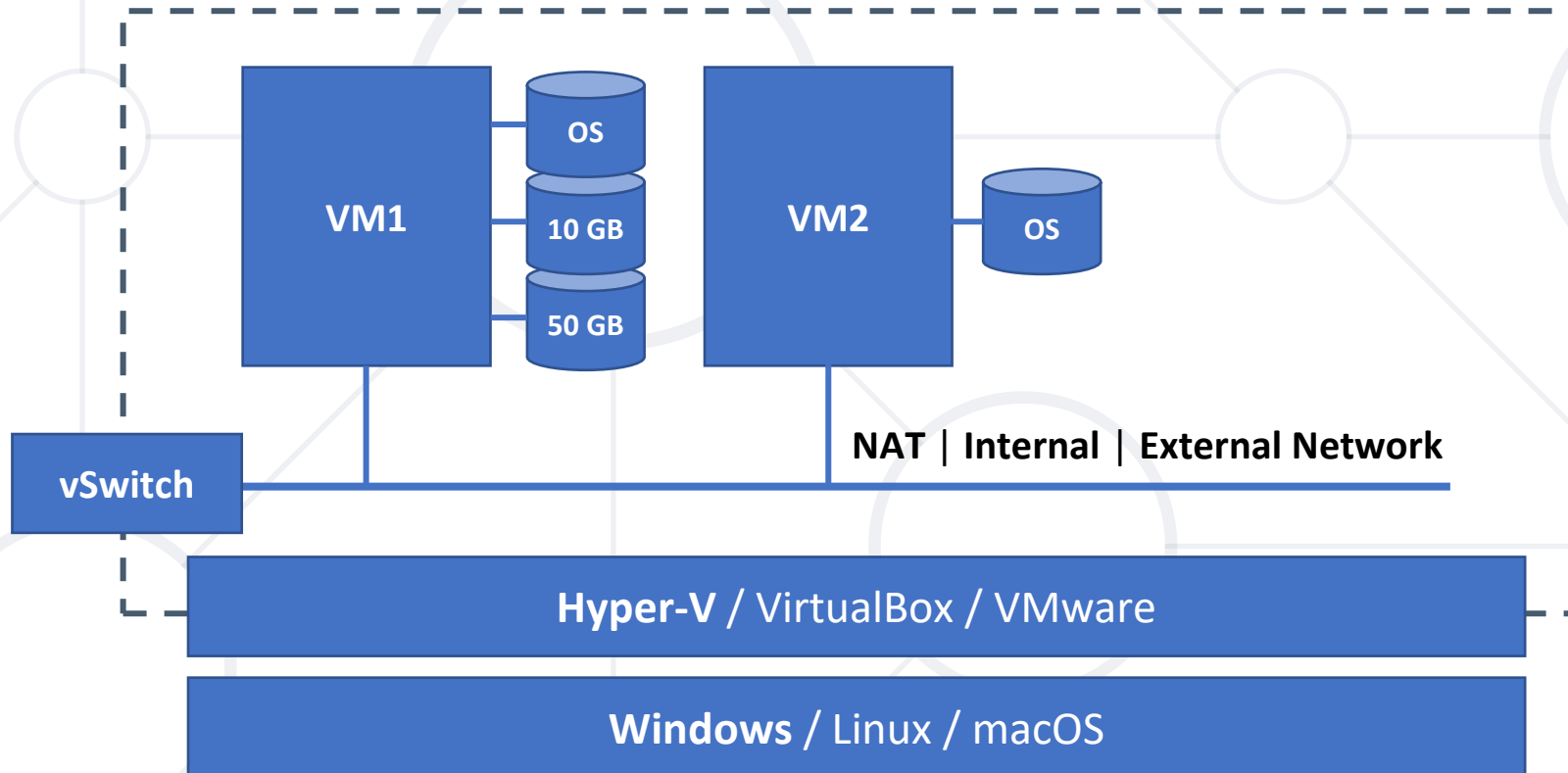
## **Topics**

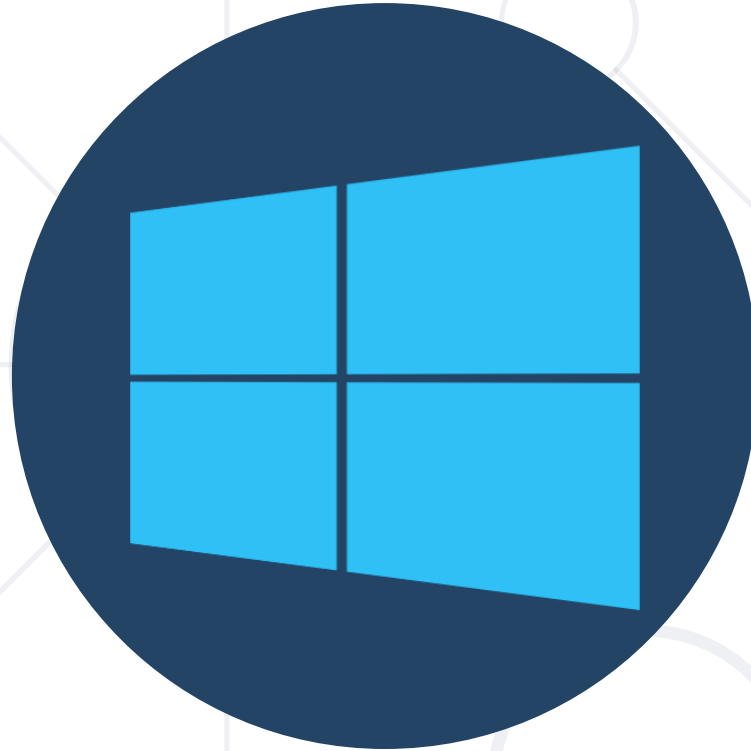
# Table of Contents

1. Basic networking and Firewall management
2. Server roles and features
3. Software management
4. Services management
5. Disk management
  - Storage Basics. RAID and Disk Types
  - File Systems. Management Tools









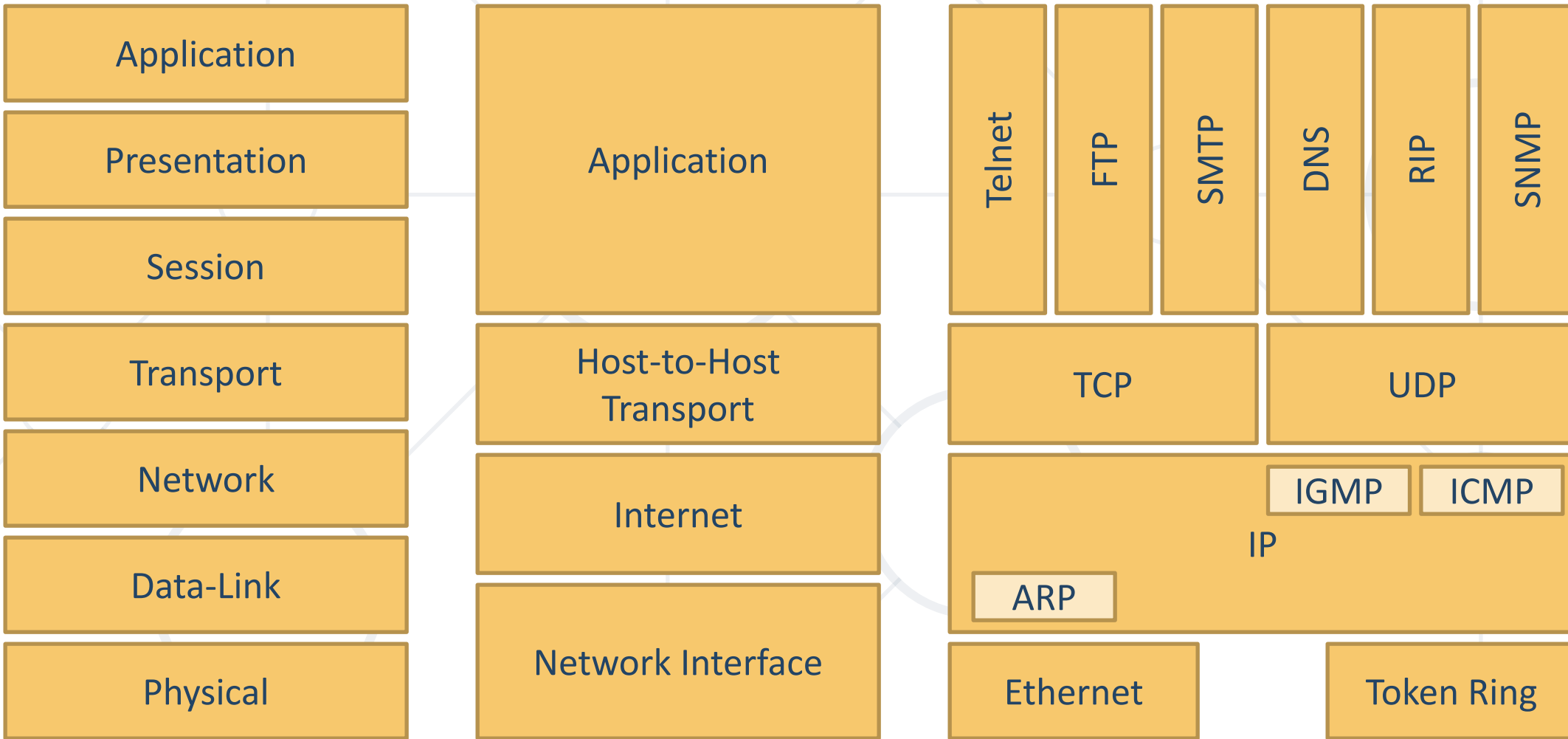
# **Network Basics**

## **Models. Addressing Schemes**

# Network (Switch) Types in the Virtual World

- **External connection**
  - Allows **VM ↔ VM**, **VM ↔ Host**, and **VM ↔ LAN** communication
  - Hyper-V (External Switch), VirtualBox (Bridged), VMware (Bridged)
- **Shared connection with NAT**
  - Allows **VM ↔ VM**, **VM ↔ Host**, and **VM ↔ LAN\*** communication
  - Hyper-V (Internal Switch)\*, VirtualBox (NAT Network), VMware (NAT)
- **Shared connection**
  - Allows **VM ↔ VM** and **VM ↔ Host** communication
  - Hyper-V (Internal Switch), VirtualBox (Host-only Adapter), VMware (Host Only)
- **Isolated connection**
  - Allows only **VM ↔ VM** communication
  - Hyper-V (Private Switch), VirtualBox (Internal Network), VMware (Host Only)\*

# Reference Network Models



OSI Model  
Layers

TCP/IP Protocol  
Architecture Layers

Protocols

- **IP** (Internet Protocol)
  - Handles addressing and communication between devices
- **TCP** (Transmission Control Protocol)
  - It complements IP and focuses on the transport of data packages
- **UDP** (User Datagram Protocol)
  - It is like TCP, but it is connectionless, no error checking
- **ICMP** (Internet Control Message Protocol)
  - Networking devices such as routers are using it

- Groups - **well-known** (<1024), **registered** (<49152), and **dynamic**
- Some well-known ports

22  
(SSH)

53  
(DNS)

80  
(HTTP)

110  
(POP3)

123  
(NTP)


143  
(IMAP)

- Main terms
  - **IP address** - either **static** or **dynamic**
  - **Network mask** - also known as **subnet mask**, it marks the border between two networks or subnets
  - **Gateway address** - it connects **two networks**
  - **Broadcast address** - used for communication to **all hosts** on a network. It is the **last address** of a subnet and it is same for all
- Two versions - **IPv4 (4,3 Billion)** and **IPv6 (340 Undecillion)**


- **32 bits** grouped in **4 octets** of **8 bits**, which is equal to **4 Bytes**
- Written in binary or decimal format, separated by dots
- Ranging from **0.0.0.0** to **255.255.255.255**
- Divided in two – **network** and **host part**
- Calculation can be made **bin-to-dec** and **dec-to-bin**

192.168.200.156

11000000.10101000.11001000.10011100



Value	128	64	32	16	8	4	2	1
Bit #	8	7	6	5	4	3	2	1
Weight	7	6	5	4	3	2	1	0





# IPv4 Address Classes and Ranges

- Five address classes

Class	Leading Bits	Start	End	Default mask	CIDR Notation	Network Bytes	Host Bytes
Class A	0	0.0.0.0	127.255.255.255	255.0.0.0	/8	1	3
Class B	10	128.0.0.0	191.255.255.255	255.255.0.0	/16	2	2
Class C	110	192.0.0.0	223.255.255.255	255.255.255.0	/24	3	1
Class D	1110	224.0.0.0	239.255.255.255	n/a	n/a	n/a	n/a
Class E	1111	240.0.0.0	255.255.255.255	n/a	n/a	n/a	n/a

- Class D and E are reserved and are not for public usage
- CIDR = Classless Inter-Domain Routing, a method for allocating IP addresses

# Special IPv4 Addresses

- Three **private addresses** ranges

- Private addresses are usually used with custom masks

Block	Start	End	Default mask	Notation	Addresses
24 bit	10.0.0.0	10.255.255.255	255.0.0.0	/8	16 777 216
20 bit	172.16.0.0	172.31.255.255	255.240.0.0	/12	1 048 576
16 bit	192.168.0.0	192.168.255.255	255.255.0.0	/16	65 536

- **127.0.0.0/8** is reserved for loopback
- **APIPA** (Automatic Private IP Addressing) when a DHCP server is not available
  - IP address range is 169.254.0.1 through 169.254.255.254 with class B mask (16)
- **Network address** (all host bits set to 0), can not be assigned
  - For 192.168.1.100/24 it is 192.168.1.0
- **Broadcast address** (all host bits set to 1), can not be assigned
  - For 192.168.1.100/24 it is 192.168.1.255

# IPv4 Address Exercise (Standard Mask)

- Class C address
  - IP 192.168.23.48/24
- Result
  - Network mask: **255.255.255.0**
  - Network: **192.168.23.0**
  - Broadcast: **192.168.23.255**
  - Hosts: **254** ( $2^{(32-24)} - 2 \Rightarrow 2^8 - 2 \Rightarrow 256 - 2$ )

# IPv4 Address Exercise (Non-Standard Mask)

- Class C address
  - IP 192.168.23.48/27
- Result
  - Network mask: **255.255.255.224**
  - Network: **192.168.23.32**
  - Broadcast: **192.168.23.63**
  - Hosts: **30** ( $2^{(32-27)} - 2 \Rightarrow 2^5 - 2 \Rightarrow 32 - 2$ )

- Three main definitions
  - Network **Adapter** – physical device
  - Network **Connection** – each adapter is mapped to a firewall profile
  - Network **Address** – each adapter can have one or more IP addresses
- Management means
  - GUI (various tools)
  - CMD Shell
  - PowerShell (**NetAdapter**, **NetConnection**, and **NetTCPIP** modules)

# NetAdapter (1)

# List network adapters

```
PS C:\> Get-NetAdapter
```

...

# Rename network adapter

```
PS C:\> Rename-NetAdapter -Name "Ethernet 2" -NewName "LAN-Internal"
```

...

# Disable network adapter

```
PS C:\> Disable-NetAdapter -Name "Lan-Internal"
```

...

# Enable network adapter

```
PS C:\> Enable-NetAdapter -Name "lan-internal"
```

...

# NetAdapter (2)

# Disable and enable network adapter

```
PS C:\> Restart-NetAdapter "LAN-INTERNAL"
```

...

# Change network adapter VLAN ID

```
PS C:\> Set-NetAdapter -Name "Ethernet" -VLanID 10
```

...

# Change network adapter MAC address

```
PS C:\> Set-NetAdapter -Name "Ethernet 1" -MacAddress "00-10-18-57-1B-0D"
```

...

## # List connection profiles

```
PS C:\> Get-NetConnectionProfile  
...
```

## # Display custom list of connection profile properties

```
PS C:\> Get-NetConnectionProfile |  
    Format-Table -Property InterfaceAlias, Name, NetworkCategory  
...
```

## # Change connection profile of an interface by alias

```
PS C:\> Set-NetConnectionProfile -InterfaceAlias "Ethernet 2"  
    -NetworkCategory Private  
...
```

## # Change connection profile of an interface by index

```
PS C:\> Set-NetConnectionProfile -InterfaceIndex 9  
    -NetworkCategory Public
```



# List all network addresses

```
PS C:\> Get-NetIPAddress
```

...

# List only IPv4 addresses

```
PS C:\> Get-NetIPAddress |  
    Where-Object -Property AddressFamily -Eq IPv4 |  
    Format-Table -Property InterfaceIndex, InterfaceAlias, IPAddress  
    -AutoSize
```

...

# List all properties of a network address

```
PS C:\> Get-NetIPAddress -InterfaceIndex 9 | Format-List *
```

...

## # Create and configure an IP address

```
PS C:\> New-NetIPAddress -InterfaceIndex 9 -IPAddress 192.168.200.1  
-PrefixLength 24 -DefaultGateway 192.168.200.10
```

...

## # Remove an IP address and its configuration

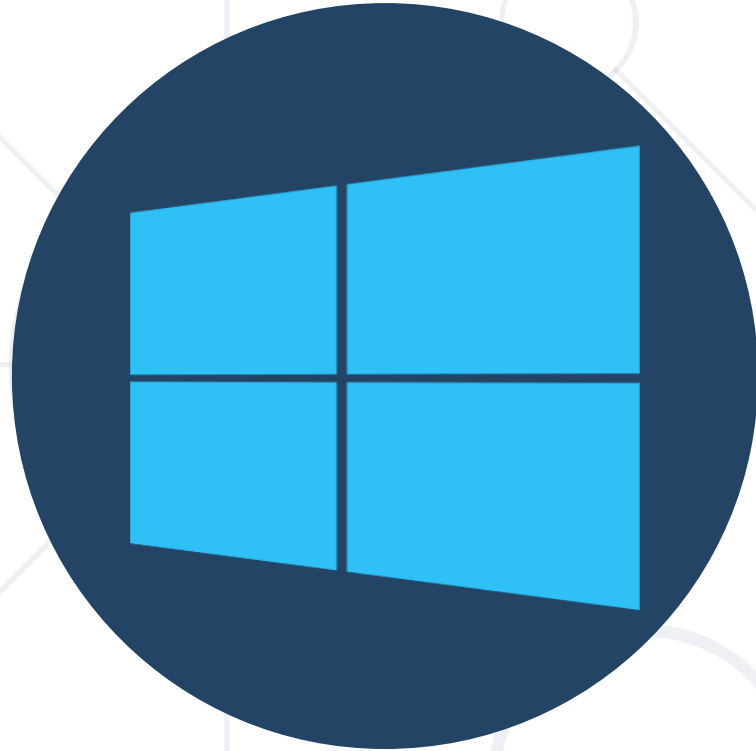
```
PS C:\> Remove-NetIPAddress -InterfaceIndex 9 -IPAddress  
192.168.200.1
```

...

## # Modify the configuration of an IP address

```
PS C:\> Set-NetIPAddress -InterfaceIndex 9 -IPAddress 192.168.200.1  
-PrefixLength 24
```

...



**Windows Firewall**

- Not a perimeter firewall, but a **hosted** solution
- Filters (**allows** or **blocks**) network traffic by applying set of rules
- Rules are **inbound** or **outbound**
- Settings are grouped in **profiles** (**Domain**, **Private**, and **Public**)
- Management Tools
  - GUI (**WF.msc**)
  - CMD Shell (**netsh.exe**)
  - PowerShell (**NetSecurity** module)

- Display all dynamic inbound rules

```
C:\> netsh advfirewall firewall show rule name=all  
dir=in type=dynamic
```

- Show information about rule

```
C:\> netsh advfirewall firewall show rule name="File  
and Printer Sharing (Echo Request - ICMPv4-In)"
```

- Enable rule

```
C:\> netsh advfirewall firewall set rule name="File and  
Printer Sharing (Echo Request - ICMPv4-In)" new  
enable=yes
```

## # List firewall profiles

```
PS C:\> Get-NetFirewallProfile
```

...

## # List all firewall rules matching a pattern

```
PS C:\> Get-NetFirewallRule *icmp4*
```

...

## # Enable predefined firewall rule

```
PS C:\> Enable-NetFirewallRule -DisplayName "File and Printer Sharing (Echo Request - ICMPv4-In)"
```

...

## # Disable predefined firewall rule

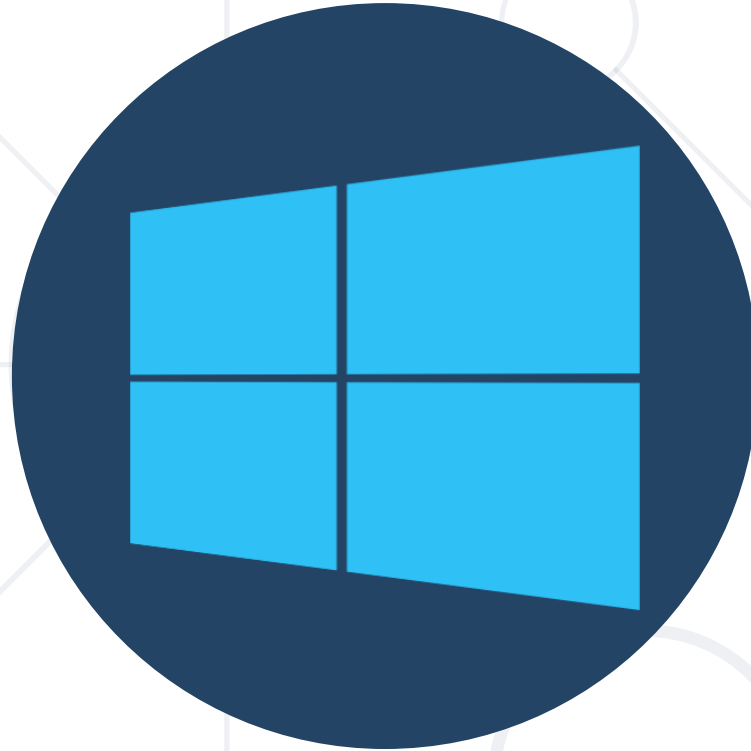
```
PS C:\> Disable-NetFirewallRule -DisplayName "File and Printer Sharing (Echo Request - ICMPv4-In)"
```

...



# **Practice: Basic Networking**

## **Live Demonstration in Class**



# **Software Management**

## **Roles. Role Services. Features**



- **Servers**
  - Dedicated physical or virtual machines
  - Provide services to clients
- **Server Role**
  - Collection of responsibilities provided to clients by a server
- **Role Service**
  - Software programs that provide the functionality of a role
- **Feature**
  - Software programs that support or add to the role functionalities

- Origin
  - Windows Server integrated software
  - Microsoft supplementary software
  - Provided by other vendors
- Installation method
  - Graphical interface
  - Classic installer system
  - PowerShell (**ServerManager** and **PackageManagement** modules)

- Description
  - List all roles and features
- Example

**# List all roles and features**

```
PS C:\> Get-WindowsFeature
```

...

**# Search for role or feature that matches pattern**

```
PS C:\> Get-WindowsFeature *dhcp*
```

...

- Description
  - Install a role or feature
- Example

**# Cmdlet approach**

```
PS C:\> Install-WindowsFeature XPS-Viewer
```

...

**# Alias approach**

```
PS C:\> Add-WindowsFeature XPS-Viewer
```

...

- Description
  - Uninstall a role or feature
- Example

**# Cmdlet approach (it removes the feature)**

```
PS C:\> Uninstall-WindowsFeature XPS-Viewer
```

...

**# Alias approach (it deactivates the feature)**

```
PS C:\> Remove-WindowsFeature XPS-Viewer
```

...

- Description
  - Get package provider
- Example

```
# Get all loaded package providers
```

```
PS C:\> Get-PackageProvider
```

```
...
```

```
# List all available package providers
```

```
PS C:\> Get-PackageProvider -ListAvailable
```

```
...
```

```
# List all available package providers
```

```
PS C:\> Get-PackageProvider -Name "Chocolatey" -ForceBootstrap
```

```
...
```

- Description
  - List available package providers
- Example

# List all available package providers

```
PS C:\> Find-PackageProvider
```

...

# List all versions of a package provider

```
PS C:\> Find-PackageProvider -Name "Nuget" -AllVersions
```

...

- Description
  - List available packages from installed providers
- Example

```
# List all available package providers
```

```
PS C:\> Find-Package
```

```
...
```

```
# Search for a package
```

```
PS C:\> Find-Package zoomit
```

```
...
```

```
# List all available packages that match the given pattern
```

```
PS C:\> Find-Package *notepad*
```

```
...
```



- Description
  - Install package
- Example

```
# Install specific package
```

```
PS C:\> Install-Package XmlNotepad
```

```
...
```

```
# Install package from a particular provider
```

```
PS C:\> Install-Package zoomit -ProviderName "Chocolatey"
```

```
...
```

```
# Find and install package
```

```
PS C:\> Find-Package zoomit | Install-Package
```

```
...
```

- Description
  - Remove installed package
- Example

```
# Uninstall specific package  
PS C:\> Uninstall-Package zoomit  
...
```



# **Windows Services Management**

- Windows Services
  - Specialized programs that operate in the background
  - Conform to the interface and protocol of **Service Control Manager**
  - Started and managed by the **Service Controller (services.exe)**
- Means of management
  - Graphical interface (**services.msc**)
  - CMD Shell (**net.exe** or **sc.exe**)
  - PowerShell (**Microsoft.PowerShell.Management** module)

- Description
  - Can be used for basic local services management
- Example

**:: List all started services**

```
C:\> net start
```

**:: Stop running service**

```
C:\> net stop "Windows Firewall"
```

**:: Start stopped service**

```
C:\> net start "Windows Firewall"
```

- Description
  - Can be used for local and remote services management
- Example

**:: List all objects of type service that are active**

```
C:\> sc query type= service
```

**:: List all inactive services**

```
C:\> sc query type= service state= inactive
```

**:: Get service name by its display name**

```
C:\> sc GetKeyName "Windows Firewall"
```

:: Get service display name by its internal name

```
C:\> sc GetDisplayName MpsSvc
```

:: Show service information

```
C:\> sc query MpsSvc
```

:: Show service configuration information

```
C:\> sc qc MpsSvc
```

:: Reconfigure service

```
C:\> sc config MpsSvc start= disabled
```

:: Stop service

```
C:\> sc stop MpsSvc
```

:: Start service

```
C:\> sc start MpsSvc
```

- Description
  - Display service-related information
- Example

# List all services

```
PS C:\> Get-Service
```

...

# Get all properties of a service

```
PS C:\> Get-Service MpsSvc | Format-List -Property *
```

...

# List all running services

```
PS C:\> Get-Service | Where-Object -Property Status -Eq "Running"
```

...



- Description
  - Start service
- Example

```
# Start service  
PS C:\> Start-Service Winmgmt  
...
```

- Description
  - Stop service
- Example

```
# Stop service  
PS C:\> Stop-Service Winmgmt  
...
```

- Description
  - Restart service
- Example

```
# Force service restart
```

```
PS C:\> Restart-Service -Name Winmgmt -Force
```

```
...
```

- Description
  - Pause service
- Example

# Pause service

```
PS C:\> Suspend-Service Winmgmt
```

...

# List all services that can be suspended (paused)

```
PS C:\> Get-Service | Where-Object -Property CanPauseAndContinue -Eq "True"
```

...

- Description
  - Resume paused service
- Example

```
# Resume paused service
```

```
PS C:\> Resume-Service Winmgmt
```

```
...
```

- Description
  - Change service settings
- Example

```
# Change service startup mode
```

```
PS C:\> Set-Service MpsSvc -StartupType Disabled
```

```
...
```

```
# Change service startup mode
```

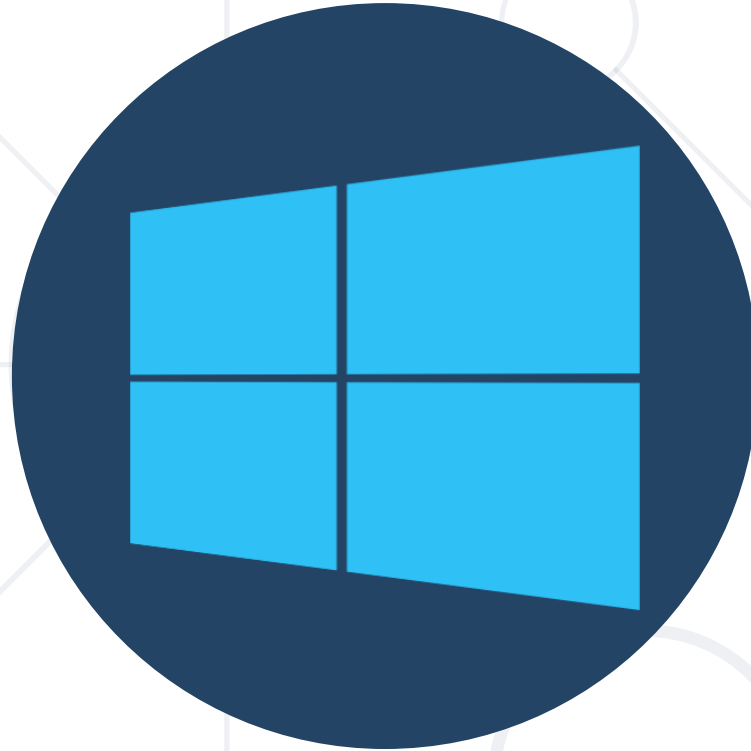
```
PS C:\> Set-Service -Name Winmgmt -Description "System management."
```

```
...
```



# **Practice: Software Management**

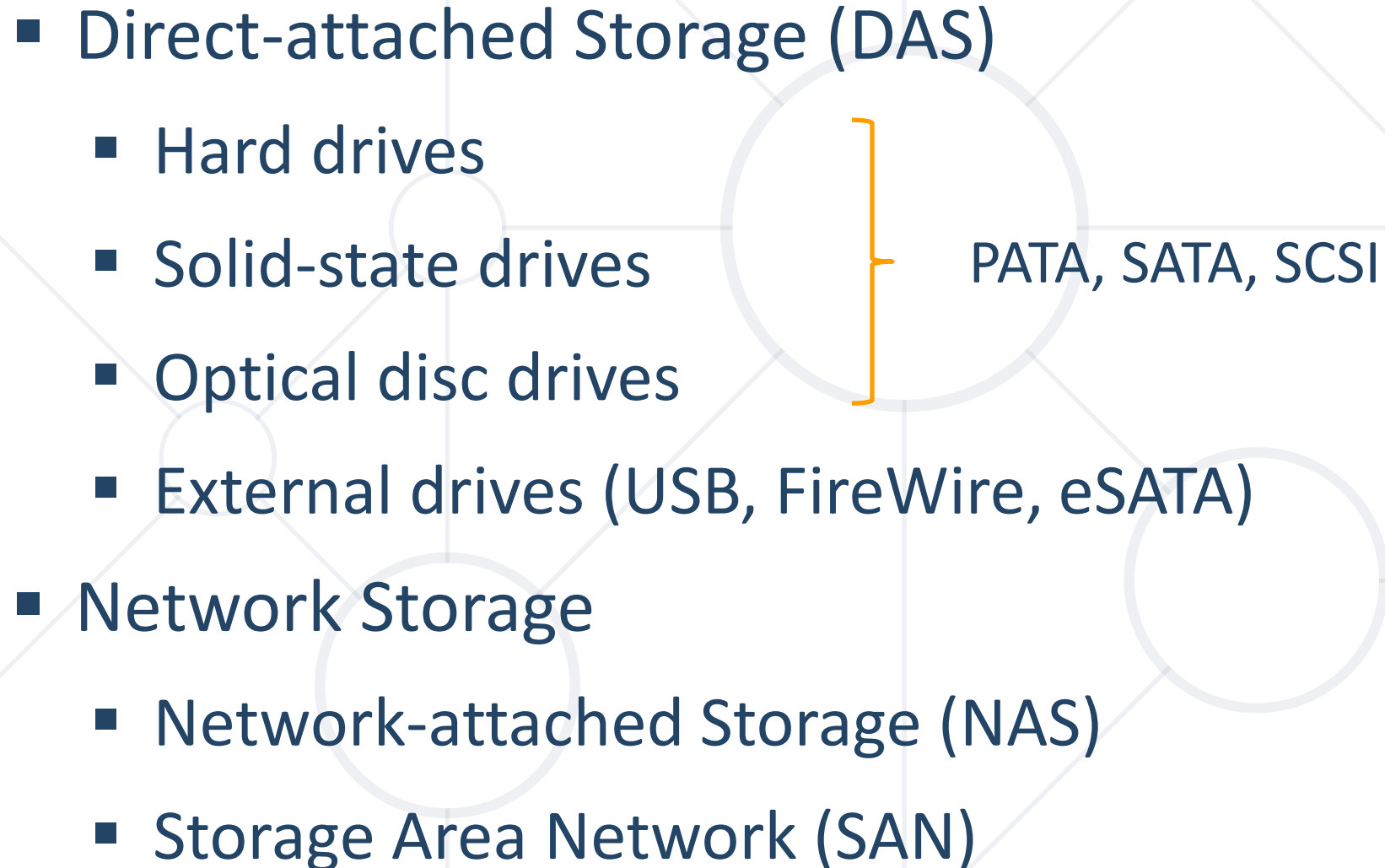
## **Live Demonstration in Class**



# **Storage Basics**

## **Storage Media Options. Partitioning**



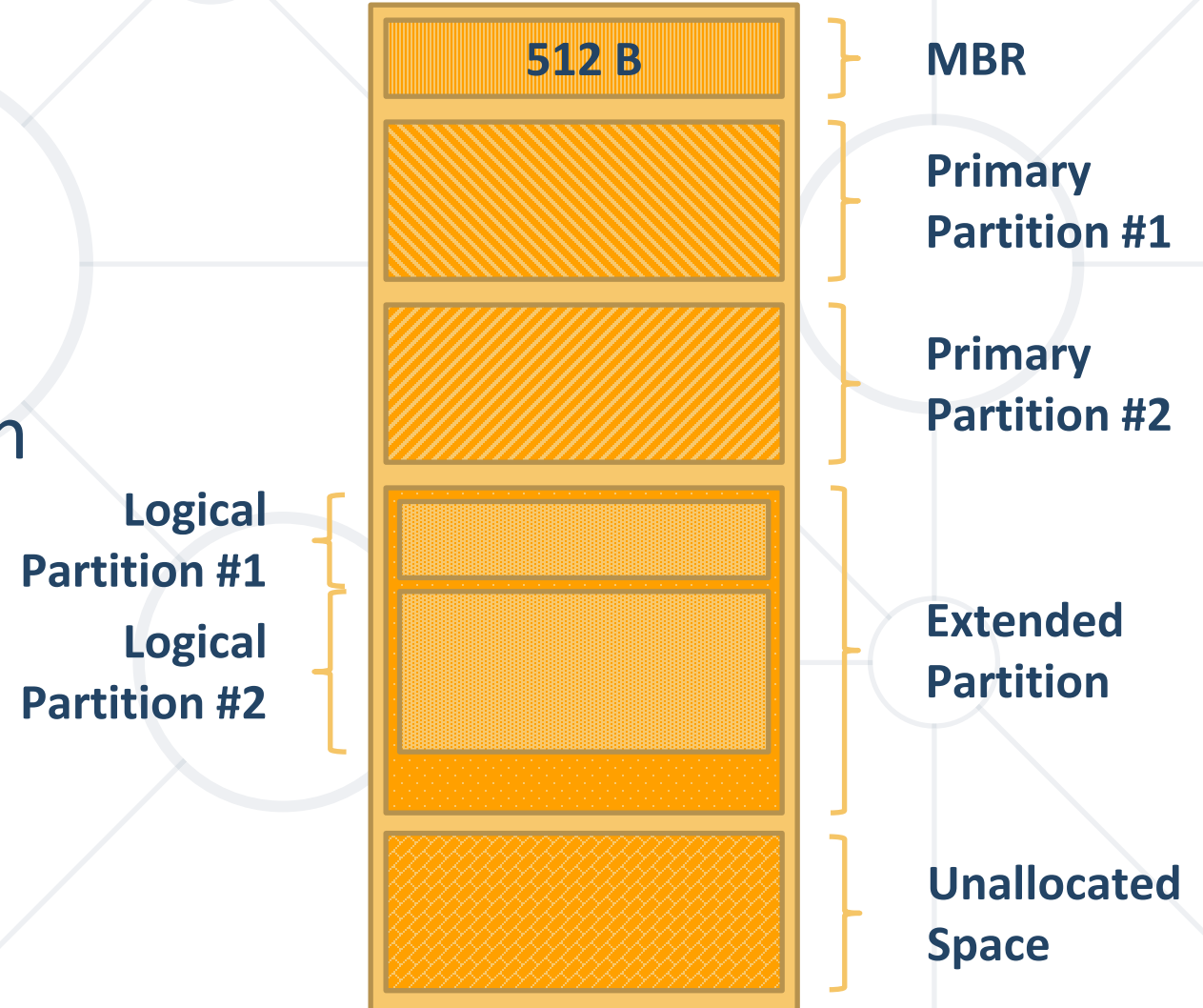
- Direct-attached Storage (DAS)
    - Hard drives
    - Solid-state drives
    - Optical disc drives
    - External drives (USB, FireWire, eSATA)
  - Network Storage
    - Network-attached Storage (NAS)
    - Storage Area Network (SAN)
- PATA, SATA, SCSI
- 

- Multiple OS Support
- Filesystem Choice
- Disk Space Management
- Disk Error Protection
- Security
- Backup



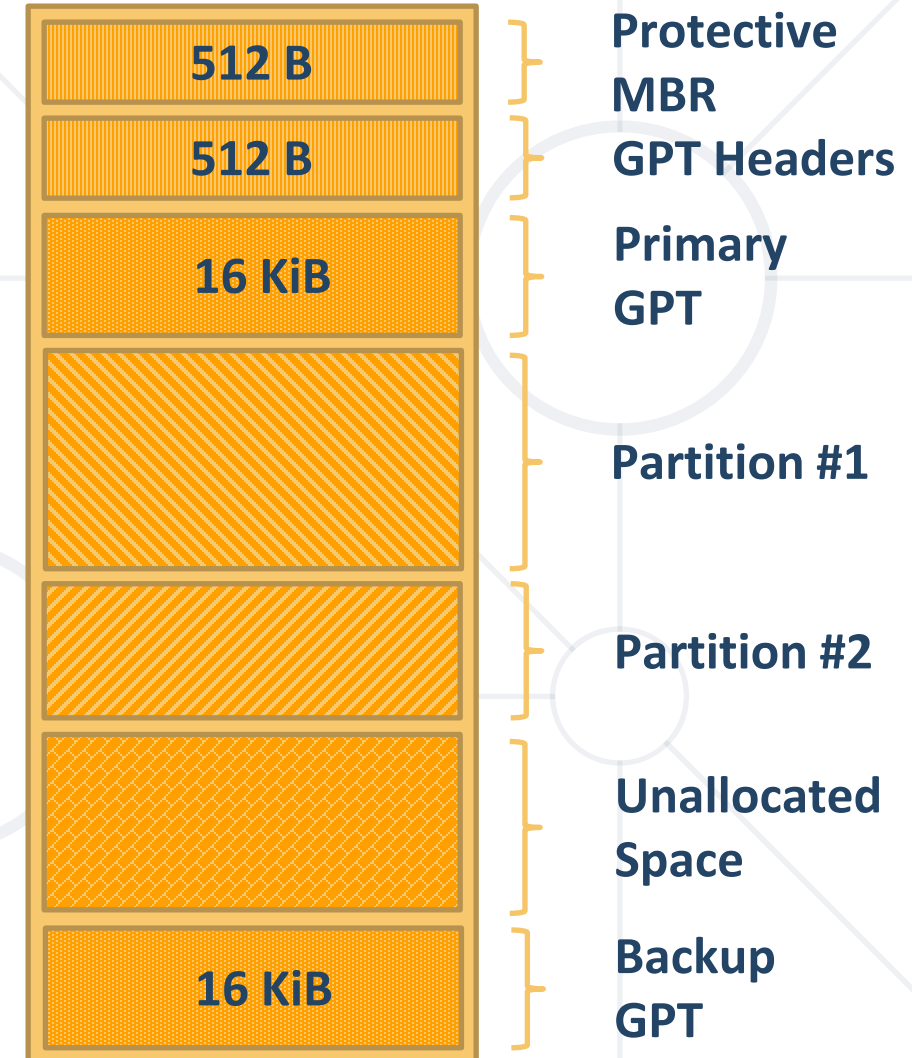
# Master Boot Record (MBR)

- Characteristics
  - Occupies first 512 Bytes
  - 4 partitions
  - Maximum size 2 TB / partition
- Partition types
  - Primary
  - Extended
  - Logical



# GUID Partition Table (GPT)

- Characteristics
  - Part of the EFI specification
  - Has protective MBR
  - Two copies of the partition table
  - 128 partitions
  - Maximum size 8 ZB / partition

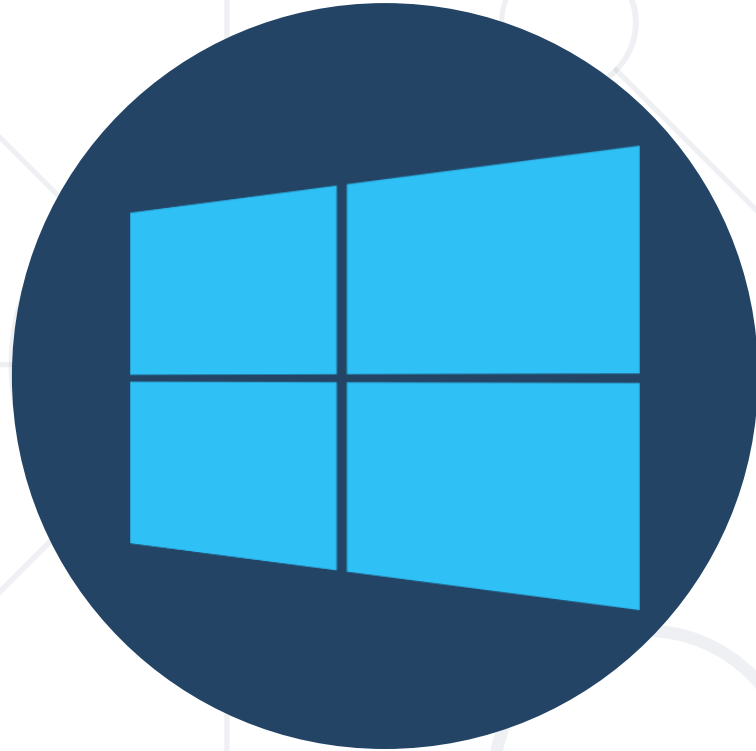




# **RAID and Disk Types**

- Redundant array of independent (inexpensive) disks
- Options
  - Hardware or Software
- Implementations (levels)
  - **Striped (RAID 0)** - Minimum 2, Fault Tolerance 0
  - **Mirrored (RAID 1)** - Minimum 2, Fault Tolerance n-1
  - **Striped with Parity (RAID 5)** - Minimum 3, Fault Tolerance 1
  - Nested levels (RAID 0+1, 1+0, 5+0)

- **Basic disks**
  - Suitable for most storage tasks
  - Contain partitions and volumes (formatted partitions)
- **Dynamic disks**
  - Used for software-based RAID
  - Contain volumes (Simple, Spanned, Striped, Mirrored, RAID-5)
- **Virtual disks**
  - Files emulating hard drives (VHD or VHDX)
  - Space policy (Fixed or Dynamically expanding)



**File Systems**



- File Allocation Table 16 (**FAT16**)
  - Volume size: **2 GB** or **4 GB**, File size: **2 GB**, Number of files: **65 K**
- File Allocation Table 32 (**FAT32**)
  - Volume size: **32 GB** or **2 TB**, File size: **4 GB**, Number of files: **4 M**
- Extended FAT (**exFAT**)
  - Volume size: **128 PB**, File size: **16 EB**, Number of files: **Unlimited?**
- NT File System (**NTFS**)
  - Volume size: **256 TB**, File size: **16 TB**, Number of files: **4 B**
- Resilient File System (**ReFS**)
  - Volume size: **4.7 ZB**, File size: **18 EB**, Number of files: **Unknown?**



**Management Tools**

- GUI
  - Disk Management Snap-in (**diskmgmt.msc**)
- CMD Shell
  - DISKPART.EXE
  - FORMAT.COM
  - LABEL.EXE
- PowerShell
  - **Storage** Module

- Description
  - Disk management utility. Supports interactive and scripted mode
- Example

**:: List all disks**

```
DISKPART> LIST DISK
```

**:: Select disk**

```
DISKPART> SELECT DISK 2
```

**:: Create partition on a selected disk, size in MB**

```
DISKPART> CREATE PARTITION PRIMARY SIZE=1000
```

- Description
  - Format volume or partition
- Example

**:: Quick format of a volume or partition**

```
C:\> FORMAT E: /Q
```

...

**:: Format volume to NTFS with compression**

```
C:\> FORMAT E: /V:New-Volume /FS:NTFS /C
```

- Description
  - Change label of a volume or partition
- Example

**:: Set label**

**C:\> LABEL E:New Label**

**...**

- Description
  - List all disks
- Example

```
# List all disks  
PS C:\> Get-Disk  
...
```

- Description
  - Initialize a disk
- Example

# Initialize disk with MBR partitioning style

```
PS C:\> Initialize-Disk -Number 2 -PartitionStyle MBR
```

...

# Initialize disk with GPT partitioning style

```
PS C:\> Initialize-Disk -Number 1 -PartitionStyle GPT
```

...



- Description
  - Update disk attributes
- Example

**# Convert from MBR to GPT**

```
PS C:\> Set-Disk -Number 2 -PartitionStyle GPT
```

```
...
```

- Description
  - Clear disk by removing partition and volume information
- Example

```
# Remove partition and volume information
```

```
PS C:\> Clear-Disk -Number 2
```

```
...
```

```
# Clear disk with active data volume
```

```
PS C:\> Clear-Disk -Number 2 -RemoveData
```

```
...
```

- Description
  - List partition related information
- Example

```
# List all partitions of all disks
```

```
PS C:\> Get-Partition
```

```
...
```

```
# List partitions of a disk
```

```
PS C:\> Get-Partition -DiskNumber 2
```

```
...
```

- Description
  - Create new partition on a disk
- Example

# Create new partition on a disk

```
PS C:\> New-Partition -DiskNumber 1 -UseMaximumSize -AssignDriveLetter  
...
```

# Create new partition with a specific size

```
PS C:\> New-Partition -DiskNumber 2 -AssignDriveLetter -Size 20GB  
...
```

# Create new partition with a specific size and drive letter

```
PS C:\> New-Partition -DiskNumber 2 -DriveLetter Z -Size 2GB  
...
```

- Description
  - Modify partition attributes
- Example

# Set a MBR partition to active

```
PS C:\> Set-Partition -DriveLetter Y -IsActive $True
```

...

# Change assigned drive letter

```
PS C:\> Set-Partition -DriveLetter Y -NewDriveLetter Z
```

...

- Description
  - Resize partition and underlying file system
- Example

```
# Resize partition
```

```
PS C:\> Resize-Partition -DiskNumber 1 -PartitionNumber 2 -Size (20GB)
```

```
...
```

- Description
  - Delete partition and underlying volume
- Example

# Remove partition by drive letter

```
PS C:\> Remove-Partition -DriveLetter Z
```

...

# Remove partition by disk and partition number

```
PS C:\> Remove-Partition -DiskNumber 2 -PartitionNumber 2
```

...

- Description
  - Display information about volumes
- Example

```
# List all volumes
```

```
PS C:\> Get-Volume
```

```
...
```

```
# Get details about a volume
```

```
PS C:\> Get-Volume -DriveLetter E | Format-List *
```

```
...
```



- Description
  - Display list of supported file systems by a volume
- Example

```
# List all supported file systems
```

```
PS C:\> Get-SupportedFileSystems -DriveLetter E
```

```
...
```

- Description
  - Format existing volume, or a new volume on an existing partition
- Example

# Quick format volume to NTFS

```
PS C:\> Format-Volume -DriveLetter E
```

...

# Quick format with explicit file system

```
PS C:\> Format-Volume -DriveLetter E -FileSystem FAT32
```

...

# Full format with explicit file system

```
PS C:\> Format-Volume -DriveLetter E -FileSystem FAT32 -FullFormat -Force
```

...

- Description
  - Create volume with specified file system
- Example

# Create volume with specific parameters

```
PS C:\> New-Volume -DiskNumber 2 -FriendlyName "New Drive  
Volume" -DriveLetter H -FileSystem NTFS
```

...

- Description
  - Set or change the file system label of an existing volume
- Example

```
# Set volume label
```

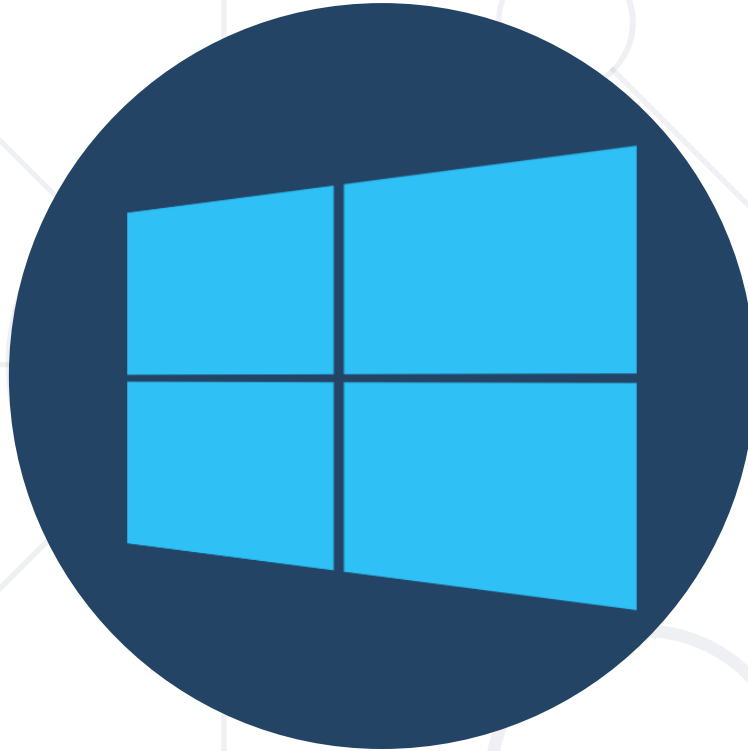
```
PS C:\> Set-Volume -NewFileSystemLabel "Data" -DriveLetter E
```

```
...
```

```
# Change volume label
```

```
PS C:\> Set-Volume -FileSystemLabel "Test" -NewFileSystemLabel "Test Data"
```

```
...
```



# **Practice: Disk Management**

## **Live Demonstration in Class**

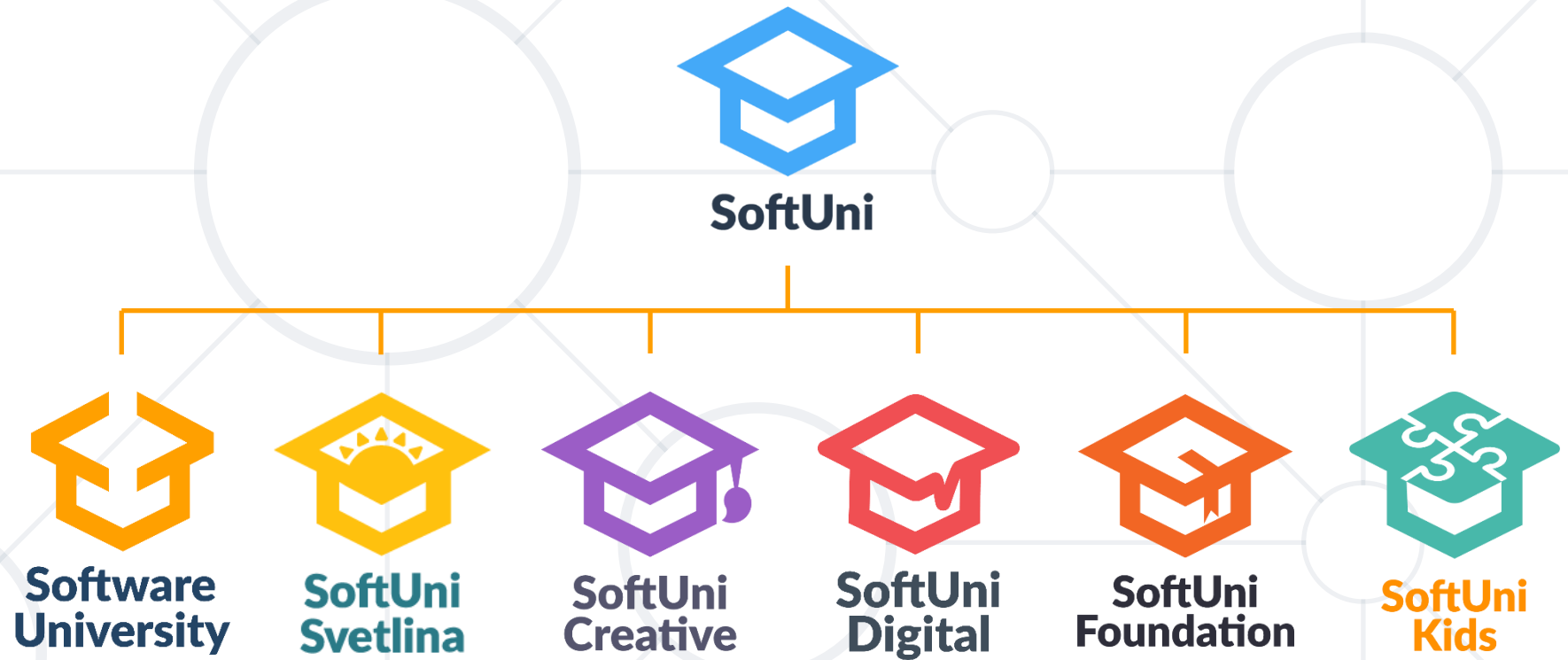
- Servers can be configured through
  - Roles, Role Services, and Features
- Additional software can be installed
  - Classical approach or Package Management Routines
- Services can be managed
  - Either from GUI, CMD Shell, or PowerShell
- Partitioning Styles - MBR and GPT
- File Systems - FAT, FAT32, exFAT, NTFS, and ReFS
- Disk and FS Tools - GUI, CMD Shell, and PowerShell
- Network stack is configured on three levels
  - Adapter, Connection, Address
- Windows Server can act as DHCP server and Router
- Windows Server comes with Firewall



- Storage Module  
<https://docs.microsoft.com/enus/powershell/module/storage>
- NetAdapter Module  
<https://docs.microsoft.com/enus/powershell/module/netadapter>
- NetTCPIP Module  
<https://docs.microsoft.com/enus/powershell/module/nettcpip>



# Questions?





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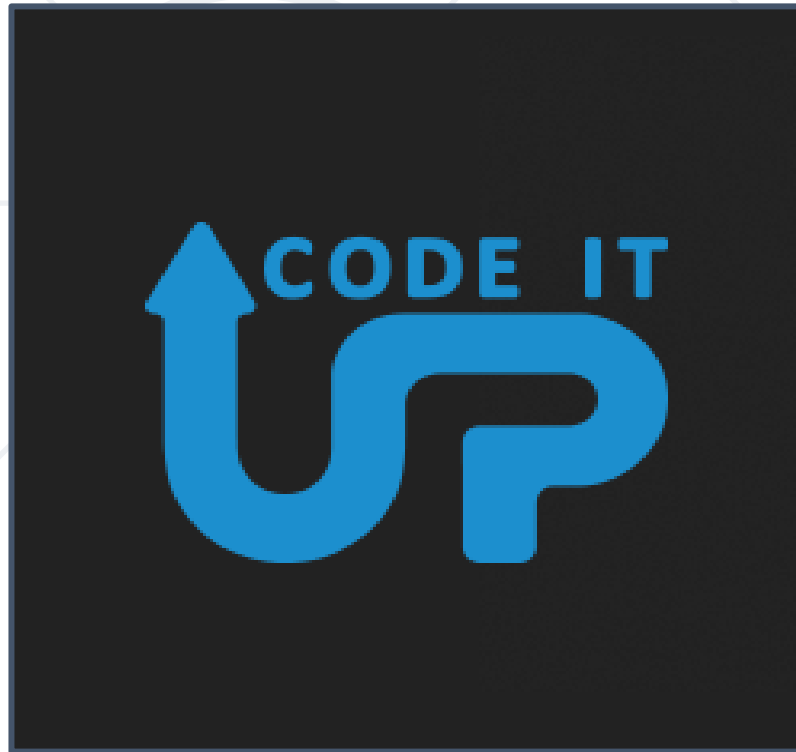
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