Cisco Switch:

o Switch is a device, which is used to connect multiple computers inside LAN.

o Switches are used to connect multiple devices on the same network.

o Switches which operate at Data Link Layer of OSI model called Layer 2 Switches.

o Switches which operate at Network Layer 3 called Layer 3 or multilayer switches.

o Basic Function of a Cisco Network Switch is to forward Layer 2 packets.

o Switch forward Ethernet Frames from source device to destination device.

o Switches are a key component of many business networks now a day.

o Switches connect multiple PCs, laptops, Printers, APs, Phones, Servers etc.

o Switches allow to send and receive information in the Computer Network.

o Switches access-shared resources in a smooth, efficient, highly secure manner.

o Cisco Layer 2 or Layer 3 switches can be managed both locally and remotely.

o Cisco IOS is proprietary Operating System that Cisco routers & switches run on.
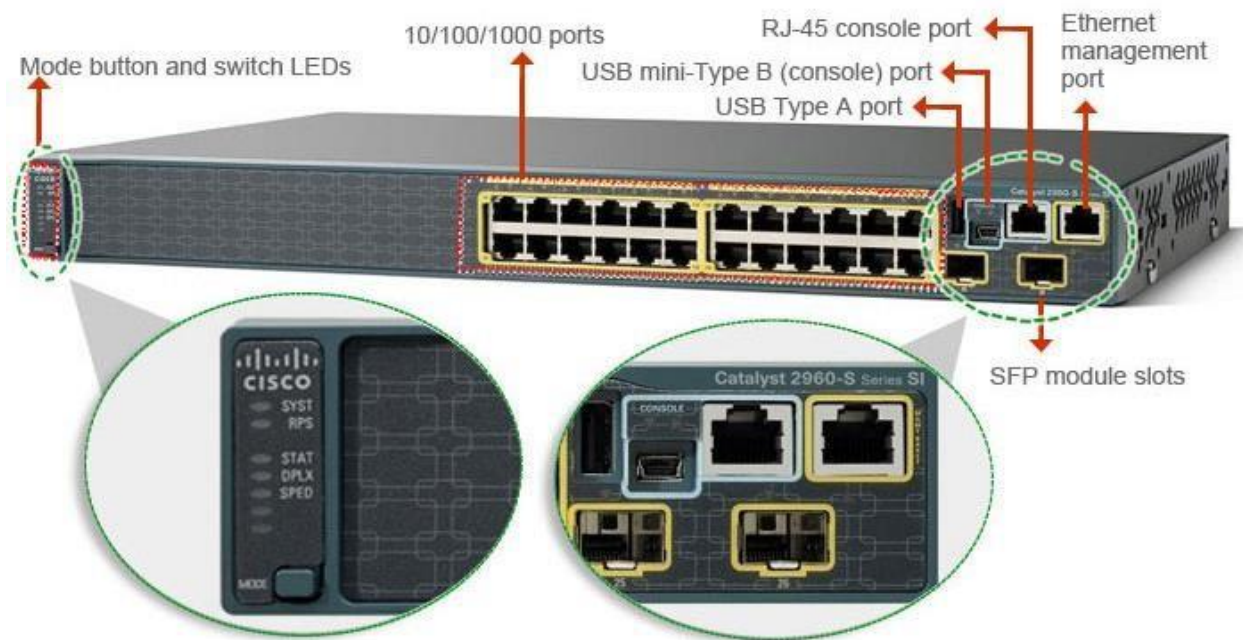
Cisco Operating Systems:

IOS (Internetwork Operating System):

o Cisco IOS (Originally Internetwork Operating System) is a family of software.

o IOS is an Operating System used on Cisco devices, such as routers and switches.

o Multitasking OS that implements and controls logic and functions of a Cisco device.

o Cisco IOS runs as a single image and all processes share the same memory space.

o To configure a Cisco device running IOS, the Command-Line Interface (CLI) is used.

o CLI comes with predefined number of commands to configure routing & switching.

o The CLI is usually accessed from local or remote Computer running Telnet or SSH.

o The IOS is usually stored as a system image within a router or switch flash memory.

o Not all Cisco products routers or switches run IOS (Internetwork Operating System).

```
SW1#show version
Cisco IOS Software, Linux Software (I86BI_LINUXL2-ADVIPSERVICESK9-M), Version 15.2(
DEPLOYMENT DEVELOPMENT BUILD, synced to  FLO_DSGS7_POSTCOLLAPSE_TEAM_TRACK_DSGS_PI5
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2015 by Cisco Systems, Inc.
Compiled Wed 04-Nov-15 02:31 by mmen
```

NX-OS (Nexus Operating System)

o   The Cisco NX-OS Software is a Data Center-Class OS (Operating System).

o   NX-OS is a network operating system for the Nexus-series Ethernet switches.

o   NX-OS is for Fabric Channel storage area network switches made by Cisco Systems.

o   Originally named SAN-OS where the SAN acronym stood for Storage Area Network.

o   NX-OS doesn't share a single memory space and it support symmetric multiprocessing.

o   The Command-Line Interface of Nexus Operating System is similar to that of Cisco IOS.

o   Nexus feature offers capability to partition Nexus switch into multiple logical switches.

o   Other Operating System are CatOS, Cisco IOS XR, Cisco IOS-XE and Cisco IOS-SX etc.

```
switch# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac


Router#show ver
Cisco IOS XE Software, Version 16.07.01
Cisco IOS Software [Fuji], Virtual XE Software
```

Catalyst Switch:

o   Catalyst was a company which produced switches & which was bought by Cisco.

o   Cisco sold that series of switches by company named catalyst as catalyst switches.

o   Catalyst switches are switches belonging to that old series of Cisco switches.

o   for example, Catalyst 2960 series, Catalyst 4500 series, Catalyst 6500 series etc.

o   For Catalyst switches, CatOS (Catalyst Operating System) and IOS are available.

o   Catalyst switches are mainly designed for distribution & core layers in the network.

Nexus Switches:

o   Nexus switches have a different architecture different then Catalyst Switches.

o   The Operating System of Nexus Switches is not IOS anymore, it is NX-OS.

o   All switches in Nexus range run the modular NX-OS firmware & operating system.

o   Cisco Nexus switches are mainly used for DC (Data Centers) in many organization.

o   Catalyst Switches uses IOS Operating System where Nexus Switches use NX-OS.

Nexus 9500 Cloud Scale   Nexus 9500-EX

Nexus 9200   Nexus 9300-EX   Nexus 9300
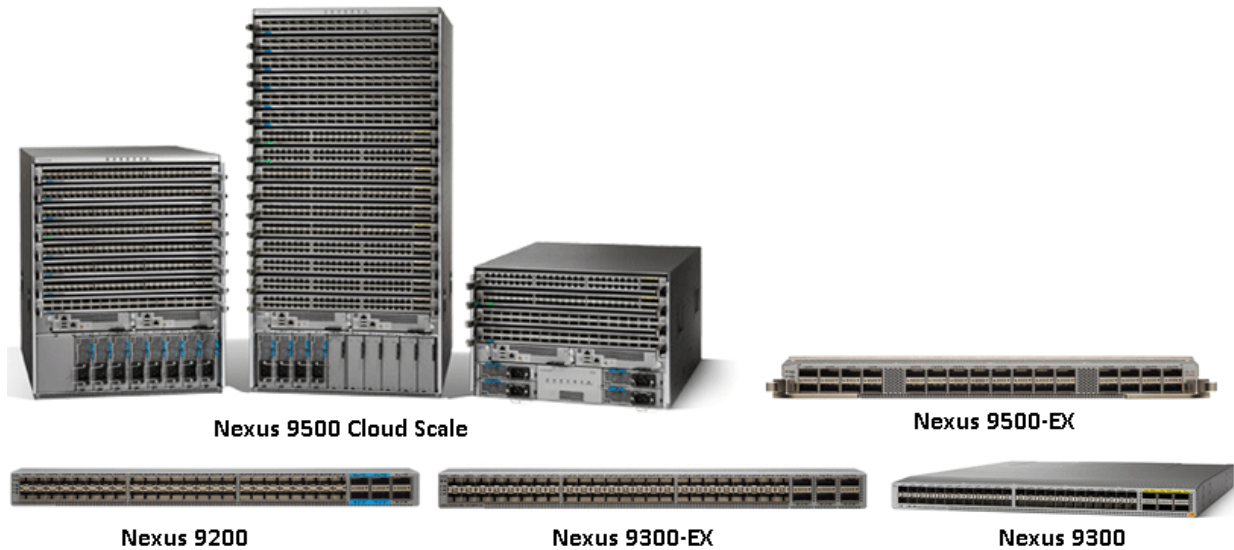
Modular Switches:

o   These switches let you add expansion modules into the switches as needed.

o   Modular Switches giving you the flexibility if your network needs change.

o   These types of switches offer more flexibility in their configuration.

o   Such as expansion modules for additional interfaces, power supplies, or cooling fans.

o   Cisco Catalyst 9400 & Catalyst 6500 and 6800 are good examples of modular switches.

Fixed Switch:

o These switches are switches with fixed number of ports & are typically not expandable.

o Fixed Configuration Switches are types of switches are fixed in their configuration.

o Cannot add features or options to switch beyond those that originally came with switch.

o The particular model you purchase determines the features and options available.

o Cisco Catalyst 2000, 9300, 9500 and the Cisco 110-550X series are good examples.

Standalone Switch:

o Standalone switches need to be configured and managed individually.

o Standalone switches troubleshooting needs to be handled on individual basis.

Stackable Switch:

o Switch stacking technology make stack of physical switches act like one switch.

o The stacking cables together make a ring between the switches.

o The switches connect in series, with the last switch connecting again to the first.

o Switch stacking, STP, CDP & VTP run on one switch, not multiple switches.

o Switch Stacking is one logical switch the port density is increase very much.

o Switch stacking is a feature of certain Cisco access layer switches.

o Stackable switches logically become one switch.

o The stacked switches effectively operate as a single larger switch.

Layer 2 Switch:

o   Terms Layers 2 & 3 are adopted from the Open System Interconnect (OSI) model.

o   The Layer 2 provides direct data transfer between two devices within a LAN.

o   Layer 2 switch functions by keeping a table of media access control (MAC) addresses.

o   Switching operates at the Layer 2 of the OSI Reference Model.

o   Uses MAC addresses to facilitate communication within devices from same network.

o   Layer 2 Network devices can only communicate within the same network.

o   Send packet to destination on the basis of MAC address, work with MAC address only.

o   Switching at Layer 2 is quite fast as they do not look at the Layer 3 portion.

o   Devices in the same layer 2 segment do not need routing to reach local peers.

Layer 3 or Multilayer Switch:

o   Operate on Layer 3 (Network Layer) of OSI model.

o   Layer 3 switch also called Multilayer Switch as well.

o   Can perform functioning of both 2 Layer and 3-Layer switch.

o   Perform the routing of data packets using IP addresses.

o   Layer 3 switches are the fast routers for Layer 3 forwarding in hardware.

o   Layer 3 handles packet routing by logical addressing and subnet control.

o   Layer 3, checks the source and destination IP addresses of every packet.

o   Functions of Layer 3 switch combine some of a Layer 2 switch and some of a router.

o   The main difference between Layer 2 and Layer 3 is the routing function.

o   A Layer 3 or Multilayer switch can do all the job that a Layer 2 switch does.

Unmanaged Switch:

o Unmanaged network switch is designed simply plug them in and they work.

o Unmanaged Switch allows Ethernet devices to communicate with one another.

o They are shipped with fixed configuration & do not allow changes to configuration.

o Unmanaged Network switch require no configuration and management.

o Unmanaged network switches are typically for basic connectivity.

o Often used in home networks, desk, in a lab, or in a conference room etc.

o Key difference between Managed & Unmanaged Switches is the ability to configure.

Managed Switch:

o Managed Network switches give greater security and more features.

o Managed Switches provide all the features of an Unmanaged Switch.

o Managed Switches provide the ability to configure, manage & monitor LAN.

o Provide more control over LAN traffic & offers advanced features to control traffic.

o Provide flexibility because you can configure them to custom-fit your network.

o With greater control, protect the network & improve the quality of service.

Unmanaged Switches: no configuration options, "brainless"... for home use? Or for small Business?

Managed Switches: CLI, SNMP, IP, QoS... for data centers? For enterprise network?
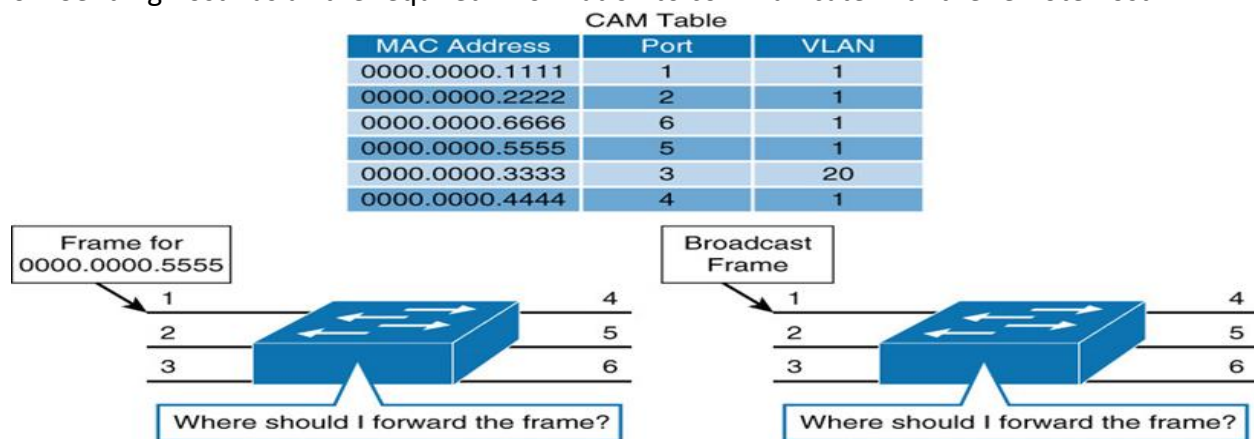
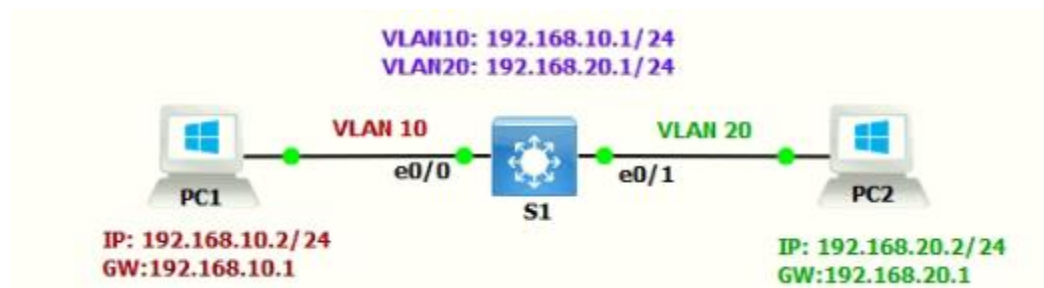No=Unmanaged Switches

Yes=Managed Switches

How Switches Work:

o Each network card has a unique identifier called Media Access Control address.

o This address is used in LANs for communication between devices on same network.

o Devices that want to communicate need to know each other MAC address.

o Use process called ARP to find out the MAC address of another device in LAN.

o When the hardware address (MAC Address) of the destination host is known.

o Sending host has all the required information to communicate with the remote host.

CAM Table

MAC Address	Port	VLAN
0000.0000.1111	1	1
0000.0000.2222	2	1
0000.0000.6666	6	1
0000.0000.5555	5	1
0000.0000.3333	3	20
0000.0000.4444	4	1

Frame for 0000.0000.5555

1 2 3 4 5 6

Where should I forward the frame?

Broadcast Frame

1 2 3 4 5 6

Where should I forward the frame?

Switch Virtual Interface (SVI):

o Switch Virtual Interface is a logical interface on Layer 2 or Layer 3 switches.

o Switch Virtual Interface is normally found on Layer 2 and Layer 3 switches.

o SVI cannot be activated unless VLAN is created & at least 1 physical port is associated.

o Switch Virtual Interface (SVI) is used in Layer 2 switch only for management purpose.

o The Switch Virtual Interface on Layer 2 switches are used for management and testing.

o Any layer 2 switch can only have one SVI, to have more you will need a Layer 3 switch.

o Layer 3 Switches use the SVI for Inter-VLAN communication without need of Router.

o SVI for Layer 3 or Multilayer switch provides both management & routing services.

Interface vlan 10	Interface vlan 20
Ip address 192.168.10.1 255.255.255.0	Ip address 192.168.20.1 255.255.255.0
No shutdown	No shutdown

VLAN10: 192.168.10.1/24
VLAN20: 192.168.20.1/24

VLAN 10   VLAN 20

e0/0   e0/1

PC1   S1   PC2

IP: 192.168.10.2/24
GW:192.168.10.1

IP: 192.168.20.2/24
GW:192.168.20.1

Switch Memory:

ROM (Read-Only Memory):

o   ROM stand for Read Only Memory also called Permanent Memory.

o   ROM used to store Bootstrap Programs, Mini IOS & Diagnostic Applications.

o   Bootstrap program is loaded when the device first powers on.

o   it is used to find IOS image & manage the process of loading the IOS into RAM.

RAM (Random Access Memory):

o   RAM stand for Random Access Memory also called Volatile Memory.

o   Routing table, ARP Cache, Running Configuration File & IOS loaded in RAM.

o   This type of memory loses its content when the device loses power.

NVRAM (Nonvolatile RAM):

o   NVRAM stand for Non Volatile Random Access Memory.

o   NVRAM is Permanent Memory used to store startup configuration file.

o   This type of memory retains its content even after the device loses power.

Flash Memory:

o   Flash Memory is also Permanent Memory like NVRAM.

o   Flash Memory stored Cisco Operating System IOS in compress format.

o   Flash Memory also store IOS software images and other files.

o   This type of memory retains its content even after the device loses power.

o   Flash Memory normal size are 32MB, 64MB, 128 MB, 256 MB & 512 MB.

o   Flash Memory can be upgraded as per environment requirements.

Switch#show version
Cisco IOS Software, vios_l2 Software (vios_l2-ADVENTERPRISEK9-M), Version 15.2(4.0.55)E, TEST

ROM: Bootstrap program is IOSv

System Image Version

Switch uptime is 9 minutes — System Uptime
System returned to ROM by reload
System image file is "flash0:/vios_l2-adventerprisek9-m" — Image Location Flash
Last reload reason: Unknown reason — Cause of Restart

Cisco IOSv () processor (revision 1.0) with 574721K/209920K bytes of memory. — RAM
Processor board ID 9L7J9UWJDI1
16 Gigabit Ethernet interfaces — Interfaces Type
DRAM configuration is 72 bits wide with parity disabled.
256K bytes of non-volatile configuration memory. — NVRAM
2097152K bytes of ATA System CompactFlash 0 (Read/Write)
Configuration register is 0x0 — Flash Memory

Auto-MDIX Feature:

o Certain cable types straight through or crossover required when connecting devices.
o Automatic Medium Dependent Interface Crossover feature eliminates this problem.
o When auto-MDIX is enabled, the interface automatically detects & configures connection.
o When using auto-MDIX on an interface, the interface speed and duplex must be set to auto.

SW(config)# interface f0/0	SW(config-if)# speed auto
SW(config-if)# duplex auto	SW(config-if)# mdix auto

Basic Switch Hardening:

Configuring Console Authentication	
SW(config-)≠ line console 0	SW(config-)≠ username admin password cisco
SW(config-line)≠ password cisco	SW(config-)≠ line console 0
SW(config-line)≠ login	SW(config-line)≠ login local

Configuring Enable Mode Password	
SW(config)≠ enable password 123	SW(config)≠ enable secret cisco

Configuring Telnet Authentication	
SW(config)≠ line vty 0 4	SW(config-)≠ username admin password cisco
SW(config-line)≠ password cisco	SW(config)≠ line vty 0 4
SW(config-line)≠ login	SW(config-line)≠ login local

Configuring SSH Authentication	
SW(config)≠ username ali password 123	SW(config)≠ line vty 0 4
SW(config)≠ ip domain-name ksa.com	SW(config-line)≠ transport input ssh
SW(config)≠ crypto key generate RSA	SW(config-line)≠ login local

Password Encryption	
SW(config)≠ service password-encryption	
SW(config)≠ enable password cisco	SW(config)≠ no service password-encryption

Configure IP Address & Default Gateway on Switch	
SW(config)# interface vlan 1 SW(config-if)# ip address 192.168.1.100 255.255.255.0 SW(config-if)# no shutdown	Switch(config)# ip default-gateway 192.168.1.1