Cyberpatriot Session VI

Internet Operating System (IOS) Fundamentals
Agenda

• IOS
• Cisco Networking Devices
• Interfaces
• Switching 101
• VLANs
• Routing 101
• Basic IOS Commands
Agenda

IOS
Cisco IOS® Software is the world's leading network infrastructure software, delivering a seamless integration of technology innovation, business-critical services, and hardware platform support. Currently operating on millions of active systems, ranging from the small home office router to the core systems of the world's largest service provider networks, Cisco IOS Software is the most widely leveraged network infrastructure software in the world.

Cisco IOS (originally Internetwork Operating System) is software used on Cisco Systems routers and current Cisco network switches. IOS is a software package of routing, switching, internetworking and telecommunications functions integrated into a multitasking operating system.
Cisco Networking Devices
Cisco Networking Devices (Icons)

Laptop – PC, Mac

Desktop – PC, iMac

Smart Device – iPad, iPhone, Galaxy, Etc

Server – Education Application, Facebook,
Network Switch – Street with Mailboxes

Wireless Access Point – Same as a switch, just no wires!

Network Router = Post Office
Interfaces
A hardware interface is described by the mechanical, electrical and logical signals at the interface and the protocol for sequencing them (sometimes called signaling).
Interface Examples

RJ-45

Color Standard
EIA/TIA 568B

<table>
<thead>
<tr>
<th>RJ45 Pin#</th>
<th>RJ45 Pin#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange/White Tracer 1</td>
<td>Orange/White Tracer 1</td>
</tr>
<tr>
<td>Orange 2</td>
<td>Orange 2</td>
</tr>
<tr>
<td>Green/White Tracer 3</td>
<td>Green/White Tracer 3</td>
</tr>
<tr>
<td>Green 6</td>
<td>Green 6</td>
</tr>
<tr>
<td>Blue/White Tracer 5</td>
<td>Blue/White Tracer 5</td>
</tr>
<tr>
<td>Blue 4</td>
<td>Blue 4</td>
</tr>
<tr>
<td>Brown/White Tracer 7</td>
<td>Brown/White Tracer 7</td>
</tr>
<tr>
<td>Brown 8</td>
<td>Brown 8</td>
</tr>
</tbody>
</table>

Optical

Serial

Ethernet Patch Cable

Ethernet Crossover Cable

Common Ethernet Crossover Cables may only cross connect the Orange & Green pairs

**B** is most recent

T1 crossover cable

T568B

RJ-45 Plug

C5UMB3FOR-CROSS
C5UMB7FOR-CROSS

Pins 4 & 5 and 7 & 8 connect without crossing for PoE devices using these for Power Over Ethernet

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## Interfaces – Speeds and Feeds

<table>
<thead>
<tr>
<th>Standard</th>
<th>Speed</th>
<th>Segment Length</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>10Base5</td>
<td>10Mbps</td>
<td>500m / 164ft.</td>
<td>RG-8 or RG-11 coaxial</td>
</tr>
<tr>
<td>10Base2</td>
<td>10Mbps</td>
<td>185m / 606ft.</td>
<td>RG 58 A/U or RG 58 C/U coaxial</td>
</tr>
<tr>
<td>10Base-T</td>
<td>10Mbps</td>
<td>100m / 328ft.</td>
<td>Category 3 or better UTP</td>
</tr>
<tr>
<td>100Base-T</td>
<td>100Mbps</td>
<td>100m / 328ft.</td>
<td>Cat 5 UTP or STP</td>
</tr>
<tr>
<td>100Base-TX</td>
<td>100Mbps</td>
<td>100m / 328ft.</td>
<td>Cat 5 UTP or STP</td>
</tr>
<tr>
<td>100Base-FX</td>
<td>100Mbps</td>
<td>2 km</td>
<td>2-pair 850 nm multimode optic fibers</td>
</tr>
<tr>
<td>1000Base-T</td>
<td>1Gbps</td>
<td>100m / 328ft.</td>
<td>4-pair, CAT5 or CAT5e</td>
</tr>
<tr>
<td>1000Base-SX</td>
<td>1Gbps</td>
<td>550m (multimode)</td>
<td>2-pair fiber optic</td>
</tr>
</tbody>
</table>
Agenda

Switching 101
Layer 2 switching uses the media access control address (MAC address) from the host's network interface cards (NICs) to decide where to forward frames. Layer 2 switching is hardware based, which means switches use special chips called application-specific integrated circuit (ASICs) to build and maintain filter tables (also known as MAC address tables or Content Addressable Memory or CAM tables).
Switching 101

Switch

Printer
IP Phone
Router
Server Farm

Mac
PC

Access Point

Blackberry
Galaxy
iPad
iPhone
Switching 101

Network Switch – Neighborhood with Streets and Mailboxes

<table>
<thead>
<tr>
<th>Port</th>
<th>Link</th>
<th>IP Address</th>
<th>IPv6 Address</th>
<th>Gateway: 10.1.2.1</th>
<th>DNS Server: &lt;not set&gt;</th>
<th>Line Number: &lt;not set&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>FastEthernet0</td>
<td>Up</td>
<td>10.1.2.2/24</td>
<td>&lt;not set&gt;</td>
<td>10.1.2.1</td>
<td>&lt;not set&gt;</td>
<td>&lt;not set&gt;</td>
</tr>
<tr>
<td>FastEthernet0/1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FastEthernet0/2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Physical Location: Intercity, Home City, Corporate Office, Main Wiring Closet

MFHS Laptop1

ARP Table for MFHS Laptop1

<table>
<thead>
<tr>
<th>IP Address</th>
<th>Hardware Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1.2.1</td>
<td>0001.C785.0901</td>
<td>FastEthernet</td>
</tr>
<tr>
<td>10.1.2.2</td>
<td>0001.42D7.320B</td>
<td>FastEthernet</td>
</tr>
</tbody>
</table>

MAC Address: 0001.42D7.320B

MFHS Laptop2

ARP Table for MFHS Laptop2

<table>
<thead>
<tr>
<th>IP Address</th>
<th>Hardware Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1.2.1</td>
<td>0001.C785.0901</td>
<td>FastEthernet</td>
</tr>
<tr>
<td>10.1.2.2</td>
<td>0001.42D7.320B</td>
<td>FastEthernet</td>
</tr>
</tbody>
</table>

MAC Address: 0001.63D1.014C

MAC Table for MFHS Core Switch

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Mac Address</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0001.C785.0901</td>
<td>GigabitEthernet1/1</td>
</tr>
<tr>
<td>2</td>
<td>0001.42D7.320B</td>
<td>FastEthernet0/1</td>
</tr>
<tr>
<td>2</td>
<td>0001.63D1.014C</td>
<td>FastEthernet0/2</td>
</tr>
<tr>
<td>3</td>
<td>0001.C785.0901</td>
<td>GigabitEthernet1/1</td>
</tr>
<tr>
<td>3</td>
<td>0001.C785.0901</td>
<td>GigabitEthernet1/1</td>
</tr>
<tr>
<td>3</td>
<td>003D.F296.91EC</td>
<td>FastEthernet0/24</td>
</tr>
</tbody>
</table>
VLANs
Virtual Local Area Network (VLAN)

A single layer-2 network which is partitioned to create multiple distinct broadcast domains, which are mutually isolated so that packets can only pass between them via one or more routers; such a domain is referred to as a virtual local area network, virtual LAN or VLAN.
Virtual Local Area Network

LAN

VLAN 1

VLAN 2
Routing 101
A router is a device that forwards data packets between computer networks. It is connected to two or more data lines from different networks and when a data packet comes in one of the lines, the router reads the address information in the packet to determine its ultimate destination. Then, using information in its routing table, it directs the packet to the next network on its journey. Routers perform the "traffic directing" functions on the Internet.
Routing 101

Network Router – Connect the Neighborhoods

MFHS

HSH

Starbucks

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Routing 101

MFHS

10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks

C 10.1.1.0/24 is directly connected, GigabitEthernet0/0.1
L 10.1.1.0/32 is directly connected, GigabitEthernet0/0.1
C 10.1.2.0/24 is directly connected, GigabitEthernet0/0.2
L 10.1.2.0/32 is directly connected, GigabitEthernet0/0.2

HSH

10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks

R 10.1.1.0/24 [120/1] via 10.1.100.1, 00:00:35, GigabitEthernet0/0
R 10.1.2.0/24 [120/1] via 10.1.100.1, 00:00:35, GigabitEthernet0/0
C 10.1.4.0/24 is directly connected, GigabitEthernet0/0
L 10.1.4.1/32 is directly connected, GigabitEthernet0/0
C 10.1.100.0/24 is directly connected, GigabitEthernet0/0
L 10.1.100.2/32 is directly connected, GigabitEthernet0/0
Agenda

Basic IOS Commands & Configuration
Basic IOS Modes and Commands

- **User EXEC Mode**
  The default command mode for the CLI is user EXEC mode. The EXEC commands available at the user EXEC level are a subset of those available at the privileged EXEC level. In general, the user EXEC commands allow you to connect to remote devices, change terminal settings on a temporary basis, perform basic tests, and list system information. The prompt for user EXEC mode is the name of the device followed by an angle bracket: Router>.

- **Privileged EXEC Mode**
  Privileged EXEC mode is password protected, and allows the use of all EXEC mode commands available on the system. To enter privileged EXEC mode from user EXEC mode, use the `enable` command. Privileged EXEC mode allows access to global configuration mode through the use of the enable command. The privileged EXEC mode prompt consists of the device's host name followed by the pound sign: Router#.

- **Global Configuration Mode**
  Global configuration commands generally apply to features that affect the system as a whole, rather than just one protocol or interface. You can also enter any of the specific configuration modes listed in the following section from global configuration mode.

  To enter global configuration mode, use the `configure terminal` privileged EXEC command. The router prompt for global configuration mode is indicated by the term config in parenthesis: Router(config)#

- **?** – View available commands
- **enable** – Privileged EXEC Mode
- **configure terminal** – Global Configuration Mode
- **enable password** – Set privileged password
- **show** – View information about specific things on router
- **exit** – Back up one level
- **end** – Exit back to global command line
- **write memory** – Save your configurations
- **logout**
Switch Configuration

- **enable** Privileged EXEC Mode
- **configure terminal**
- **enable password** (ex. Cisco)
- **hostname** (ex. MFHS_Switch) no spaces allowed in hostname
- **interface** (ex. fastethernet 0/1)
- **description** (ex. Connection MFHS Laptop1) any description you wish
- **ip address** (ex. 10.1.2.2 255.255.255.0) ip address and subnet mask
- **switchport access vlan 2** (ex. Sets port to access only vlan 2) or…
- **switchport mode trunk** (ex. Sets port to trunk all Vlans)
- **end**
- **write memory** *(ALAWAYS, ALWAYS, ALWAYS SAVE YOUR WORK)*
Router Configuration

- **enable** Privileged EXEC Mode
- **configure terminal**
- **hostname** (ex. MFHS_Router) no spaces allowed in hostname
- **interface** (ex. gigabit 0/0) and/or…
- **interface** (ex. gigabit 0/0.2 when setting up VLAN Trunk)
- **description** (ex. Connection HSH Router) any description you wish
- **ip address** (10.1.100.1 255.255.255.0) ip address and subnet mask
- **encapsulation dot1q 2** (ex. Set when trunking vlan 2)
- **end**
- **write memory** (ALWAYS, ALWAYS, ALWAYS SAVE YOUR WORK)
End-Point Configuration

- Name Your Device (ex. HSH iPad)
- IP Address (ex. 10.1.4.100)
- Subnet Mask (ex. 255.255.255.0)
- Default Gateway (ex. 10.1.4.1)
Thank you.