

# Basic Router Configuration

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Cisco | Networking Academy<sup>®</sup>  
Mind Wide Open<sup>™</sup>

## Network Addressing

Protocols

Port Address

IPv4 Address

MAC Address

Message Delivery

## Basic Router Configuration

Cisco IOS

Accessing a Cisco IOS Device

Navigating the IOS

The Command Structure

Getting Basic

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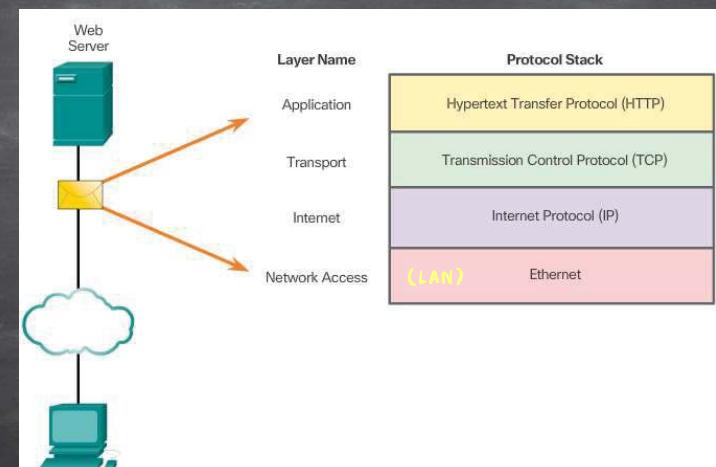
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## Network Protocols

- 1 • The role of protocols
- 2 • How the message is formatted or structured
- 3 • The process by which networking devices share information about pathways with other networks
- 4 • How and when error and system messages are passed between devices
- 5 • The setup and termination of data transfer sessions

## Protocol Interaction

- Interaction of protocols in communication between a web server and web client.



# Protocol Suites and Industry Standards

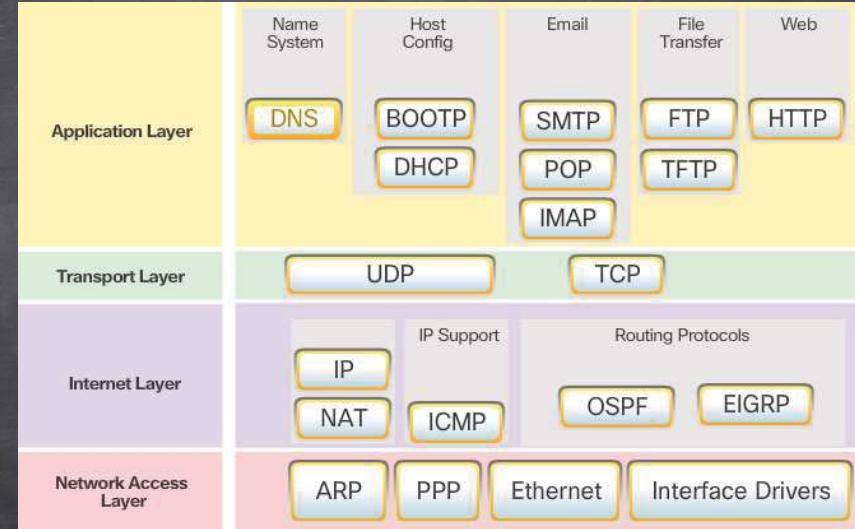


Layer Name	TCP/IP	ISO	AppleTalk	Novell Netware
Application	HTTP DNS DHCP FTP	ACSE ROSE TRSE SESE	AFP	NDS
Transport	TCP UDP	TP0 TP1 TP2 TP3 TP4	ATP AEP NBP RTMP	SPX
Internet	IPv4 IPv6 ICMPv4 ICMPv6	CONP/CMNS CLNP/CLNS	AARP	IPX
Network Access	Ethernet  PPP  Frame Relay  ATM  WLAN			

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# TCP/IP Protocol Suite



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## Port Address

- Handy way for computers and users to keep track of which port belongs to what program
- Ports are numbered from 0 to 65,535
  - The Internet Assigned Numbers Authority (IANA) decided to reserve the first 1024 port numbers (i.e., 0 to 1023) for requesting entities.
  - Ports 1024 - 49,151 : registered port numbers
  - Ports 49,152 - 65,535 : dynamic or private port numbers
- General ways to use port number for source and destination
  - Well-known port numbers -> usually for destination port
  - Randomly generate -> for source port

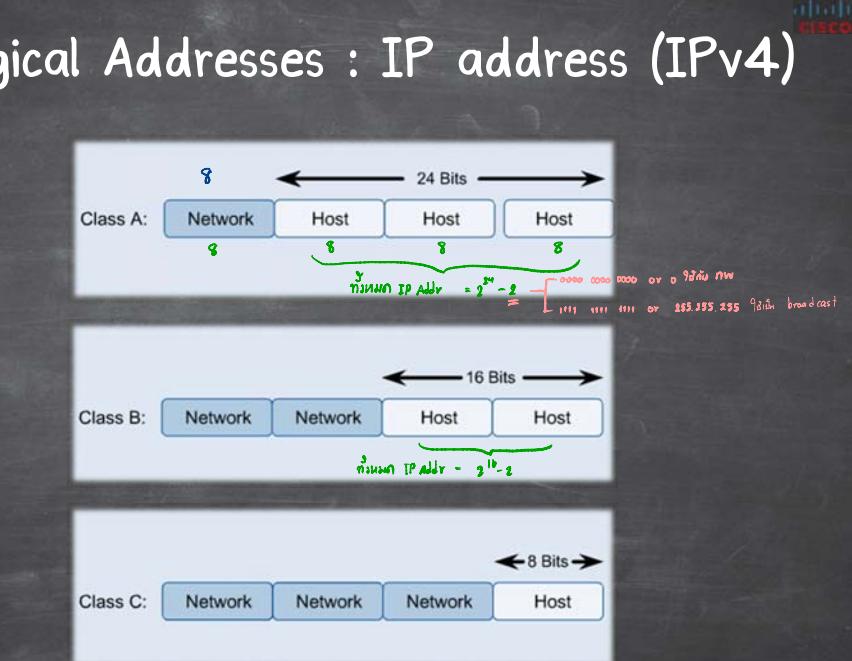
well known Ports

well known Ports

0	top Reserved	51	top DNP Logical Address Maintenance	95	top NET ML Device	121	top Encore Equipped Remote Pro.CELL	162	top Background File Transfer Program
1	top Reserved	52	top XBS Tel Protocol	96	top Micro Focus Colab	122	top Encore Equipped Remote Pro.CELL	163	top Background File Transfer Program
2	top AF Port Service Multiplexer	53	top XBS File Protocol	97	top my private terminal link	123	top SHARKNET	164	top CDP
3	top Network Utility	54	top XBS Device Server	98	top my private terminal link	124	top SHARKNET	165	top METC
4	top Connectionless Forwarding	55	top XBS Diagnostic Server	99	top Kali	125	top Kali	166	top METSC
5	top Remote Job Entry	56	top XBS Directories	100	top SU MIT Telnet Gateway	126	top Network Basic Protocol	167	top METSC
6	top Echo	57	top XBS Directories	101	top MIT Telnet Gateway	127	top ANSA REX Trader	168	top METSC
7	top Echo	58	top XBS Directories	102	top DRSIX Secret Attribute Token Key	128	top ANSA REX Trader	169	top METSC
8	top Discard	59	top XIS Graphics Language	103	top Network Printing Protocol	129	top Local PC-Extrema Net Map Ser	170	top KNET VM Command
9	top Discard	60	top XIS Graphics Language	104	top Network Printing Protocol	130	top Local PC-Extrema Net Map Ser	171	top KNET VM Command
10	top Administer	61	top XIS Graphics Language	105	top Network Control Protocol	131	top Local PC-Extrema Net Map Ser	172	top KNET VM Command
11	top Administer	62	top XIS Graphics Language	106	top Network Control Protocol	132	top Local PC-Extrema Net Map Ser	173	top KNET VM Command
12	top Administer	63	top XIS Graphics Language	107	top Telnet Object Dispatcher	133	top Local PC-Extrema Net Map Ser	174	top KNET VM Command
13	top DCHP	64	top XIS Graphics Language	108	top Telnet Object Dispatcher	134	top Local PC-Extrema Net Map Ser	175	top KNET VM Command
14	top DCHP	65	top XIS Graphics Language	109	top SUPDUP	135	top Local PC-Extrema Net Map Ser	176	top KNET VM Command
15	top DCHP	66	top XIS Graphics Language	110	top SUPDUP	136	top Local PC-Extrema Net Map Ser	177	top KNET VM Command
16	top DCHP	67	top XIS Graphics Language	111	top DCEX Protocol Specification	137	top Local PC-Extrema Net Map Ser	178	top KNET VM Command
17	top DCHP	68	top XIS Graphics Language	112	top Soft Remote Virtual File Protocol	138	top Local PC-Extrema Net Map Ser	179	top KNET VM Command
18	top DCHP	69	top XIS Graphics Language	113	top Soft Remote Virtual File Protocol	139	top Local PC-Extrema Net Map Ser	180	top KNET VM Command
19	top DCHP	70	top XIS Graphics Language	114	top TCP	140	top Local PC-Extrema Net Map Ser	181	top KNET VM Command
20	top File Transfer: Dodge Data...	71	top XIS Graphics Language	115	top TAC Ima...	141	top Local PC-Extrema Net Map Ser	182	top KNET VM Command
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## Logical Addresses : IP address (IPv4)

- IP Classes:  
— class A, B, C, D, E →  
host number 8 bits  
(256 hosts available)  
Multi-class
  - Class selection
    - Max. number of workstations required
  - Each network  
— Must have a **unique logical name** (domain name)  
— Ex. www.ce.kmitl.ac.th is 161.246.4.119
  - Each node or computer
    - Must have a unique host part of IP address



# Logical Addresses : IP address (IPv4)

IP Address Class	High-Order Bits	First Octet Address Range	Number of Bits in the Network Address
Class A	0	0 - 127*	8
Class B	10	128 - 191	16
Class C	110	192 - 223	24
Class D	1110	224 - 239	28

Address Class	Number of Networks	Number of Hosts per Network
A	126*	16,777,216
B	16,384	65,535
C	2,097,152	254
D (Multicast)	N/A	N/A

# Logical Addresses : IP address (IPv4)

IP Address Classes					
Address Class	1st octet range (decimal)	1st octet bits (green bits do not change)	Network(N) and Host(H) parts of address	Default subnet mask (decimal and binary)	Number of possible networks and hosts per network
A	1-127**		N.H.H.H	255.0.0.0	128 nets ( $2^7$ ) 16,777,214 hosts per net ( $2^{24}-2$ )
B	128-191		N.N.H.H	255.255.0.0	16,384 nets ( $2^{14}$ ) 65,534 hosts per net ( $2^{16}-2$ )
C	192-223		N.N.N.H	255.255.255.0	2,097,152 nets ( $2^{21}$ ) 254 hosts per net ( $2^8-2$ )
D	224-239		NA (multicast)		
E	240-255		NA (experimental)		

\*\* All zeros (0) and all ones (1) are invalid hosts addresses.

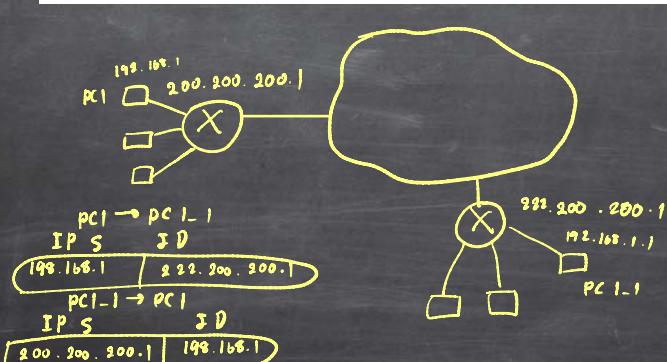
# Logical Addresses : IP address (IPv4)

## • Private addressing

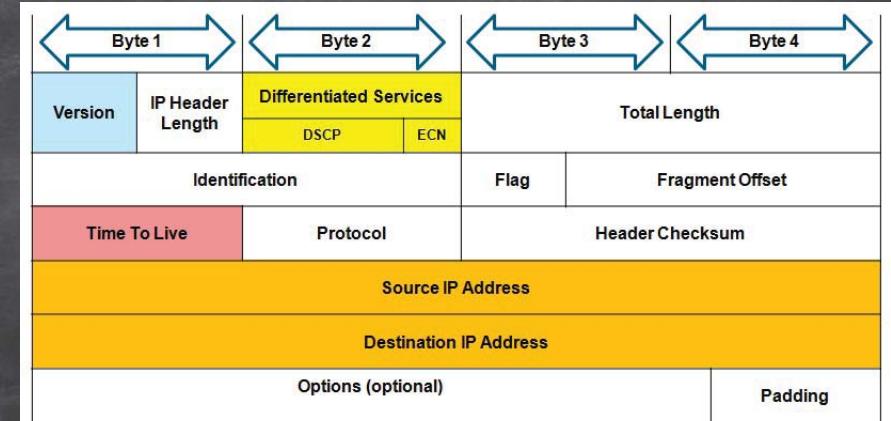
public addr ຕົວ IP ທີ່ໄປຢູ່ສັນນະກົດ

ໃຊ້ຢູ່ໃຫຍ່ເຮັດວຽກ

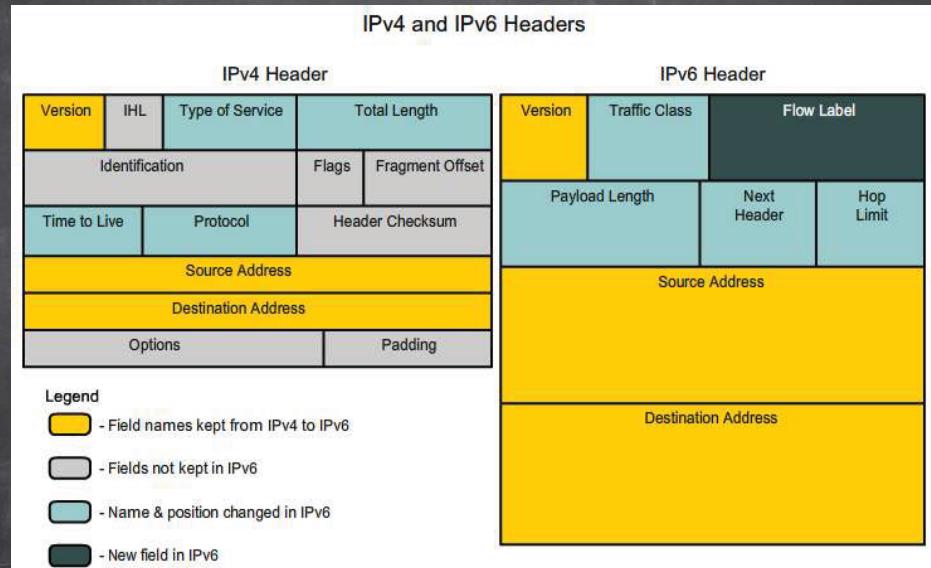
Class	RFC 1918 Internal Address Range	CIDR Prefix
A	10.0.0.0 - 10.255.255.255	10.0.0.0/8
B	172.16.0.0 - 172.31.255.255	172.16.0.0/12
C	192.168.0.0 - 192.168.255.255	192.168.0.0/16



# Logical Addresses : IP address (IPv4)



# Logical Addresses : IP address



6 byte

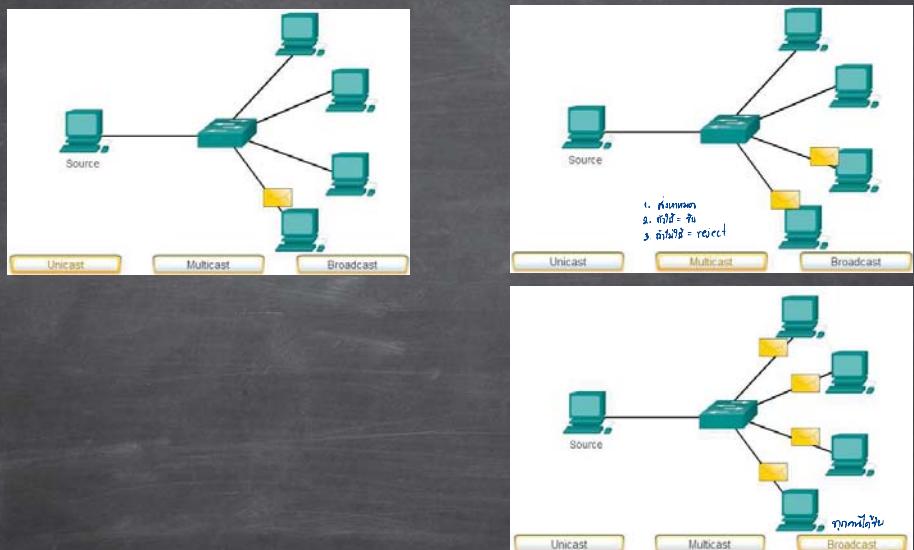
# Physical Addresses : MAC Address

- An Ethernet MAC address is a **48-bit binary** value expressed as **12 hexadecimal digits** (4 bits per hexadecimal digit).
- Hexadecimal is used to represent Ethernet MAC addresses and IP Version 6 addresses.
  - Hexadecimal is a base sixteen system using the numbers 0 to 9 and the letters A to F.
  - It is easier to express a value as a single hexadecimal digit than as four binary bits.
  - Hexadecimal is usually represented in text by the value preceded by 0x (E.g., 0x73).

# Physical Addresses : MAC Address

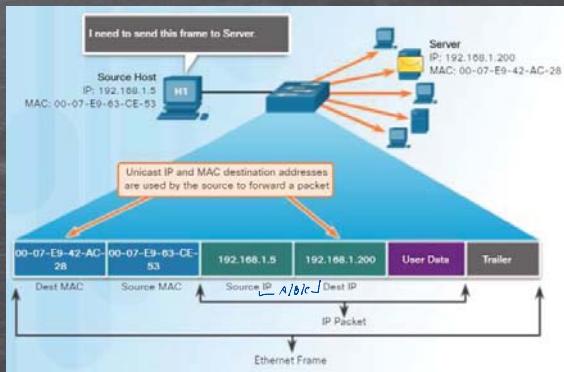
- MAC addresses were created to identify the actual source and destination.
  - The MAC address rules are established by IEEE.
  - The IEEE assigns the vendor a **3-byte** (24-bit) code, called the Organizational Unique Identifier (OUI).
- IEEE requires a vendor to follow two simple rules:
  - All MAC addresses assigned to a NIC or other Ethernet device must use that vendor's assigned OUI as the first **3 bytes**.
  - All MAC addresses with the same OUI must be assigned a unique value in the last **3 bytes**.

# Message Delivery



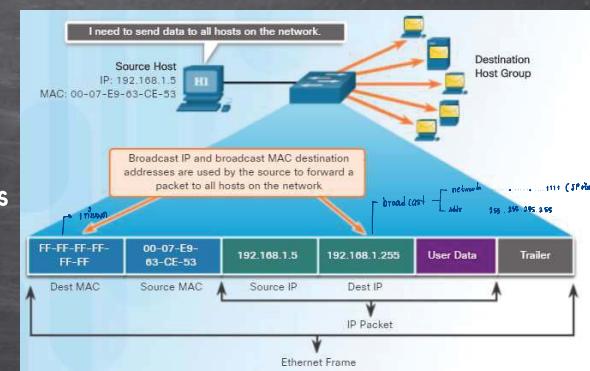
## Unicast MAC Address

- A unicast MAC address is the unique address used when a frame is sent from a single transmitting device to a single destination device.
- For a unicast packet to be sent and received, a destination IP address must be in the IP packet header and a corresponding destination MAC address must also be present in the Ethernet frame header.



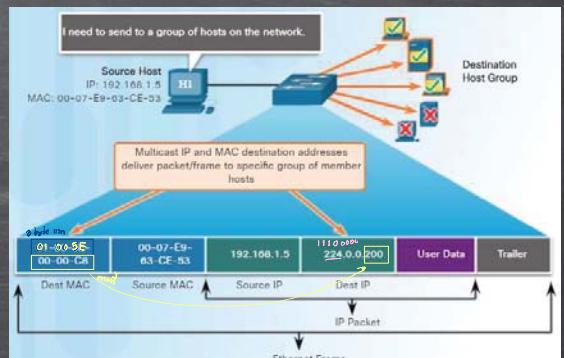
## Broadcast MAC Address

- Many network protocols, such as DHCP and ARP, use broadcasts.
- A broadcast packet contains a destination IPv4 address that has all ones (1s) in the host portion indicating that all hosts on that local network will receive and process the packet.
- When the IPv4 broadcast packet is encapsulated in the Ethernet frame, the destination MAC address is the broadcast MAC address of FF-FF-FF-FF-FF-FF in hexadecimal (48 ones in binary).



## Multicast MAC Address

- Multicast addresses allow a source device to send a packet to a group of devices.
- Devices in a multicast group are assigned a multicast group IP address in the range of 224.0.0.0 to 239.255.255.255 (IPv6 multicast addresses begin with FF00::/8).
- The multicast IP address requires a corresponding multicast MAC address that begins with 01-00-5E in hexadecimal.

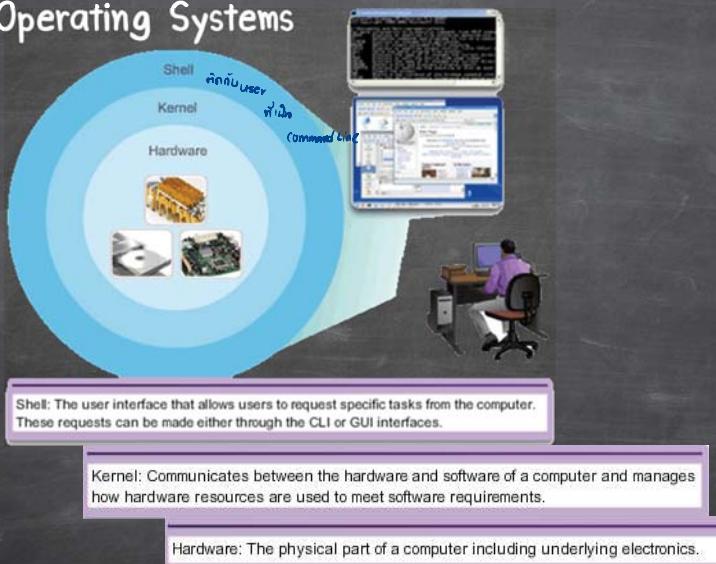


## MAC Address Representations

- Use the `ipconfig /all` command on a Windows host to identify the MAC address of an Ethernet adapter. On a MAC or Linux host, the `ifconfig` command is used.
- Depending on the device and the operating system, you will see various representations of MAC addresses.

# Cisco IOS

- Operating Systems



# Cisco IOS

- Purpose of OS

- PC operating systems enable a user to:

- Use a mouse to make selections and run programs.
- Enter text and text-based commands.
- View output on a monitor.

- Cisco IOS enables a network technician to:

- Use a keyboard to run **CLI-based** network programs.  
Command Line Interface  
from keyboard
- Use a keyboard to enter text and text-based commands.
- View output on a monitor.

- All networking devices come with a default IOS.

- It is possible to upgrade the IOS version or feature set.

# Cisco IOS

- Cisco Internetwork Operating System (IOS)

- Collection of network operating systems used on Cisco devices

- Location of the Cisco IOS

- IOS Functions



# Cisco IOS

- Router & Switch Boot Sequence

- POST

เมื่อดูปกรณ์ไฟ

ก็ boot กัน

software

- Run boot loader software

เมื่อต้องการ

boot

ก็ run

boot loader

- Boot loader does low-level CPU initialization

- Boot loader initializes the flash filesystem

- Boot loader locates and loads a default IOS operating system software image into memory and hands control of the switch over to the IOS.

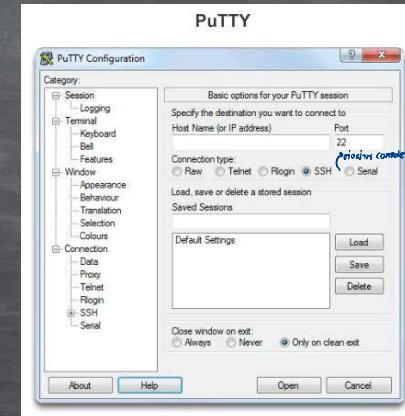
# Accessing a Cisco IOS Device

- Console port
- Telnet (from terminal window)
- Secure Shell (SSH) (from terminal window less security)
- Aux Port



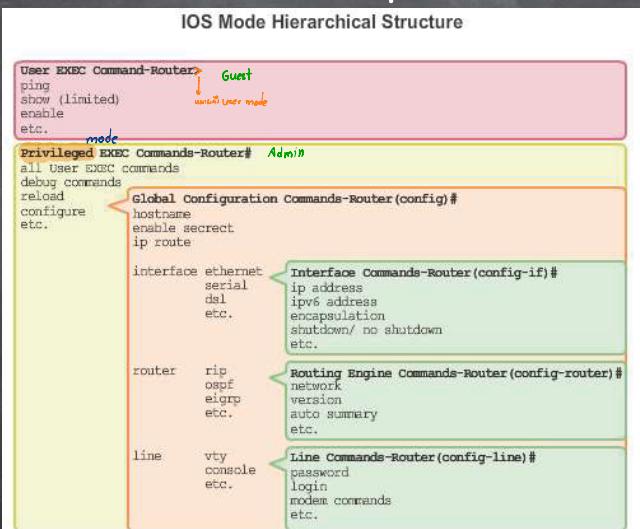
# Accessing a Cisco IOS Device

- Terminal Emulation Programs
  - Software available for connecting to a networking device
- PuTTY
- Tera Term
- SecureCRT
- HyperTerminal
- OS X Terminal



# Navigating the IOS

- Cisco IOS Modes of Operation



# Navigating the IOS

- Primary Modes

## User EXEC Mode

Limited examination of router. Remote access.

```
switch>
Router>
```

The User EXEC mode allows only a limited number of basic monitoring commands and is often referred to as view-only mode.

ใช้ดูเท่านั้น

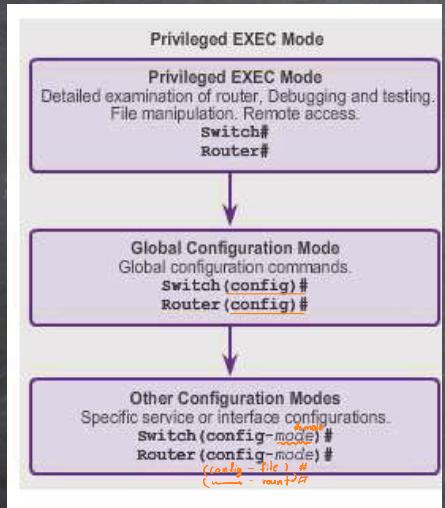
## Privileged EXEC Mode มีสิทธิ์ enable

The Privileged EXEC mode, by default, allows all monitoring commands, as well as execution of configuration and management commands.

```
Switch#
Router#
```

# Navigating the IOS

- Global Configuration Mode and Submodes



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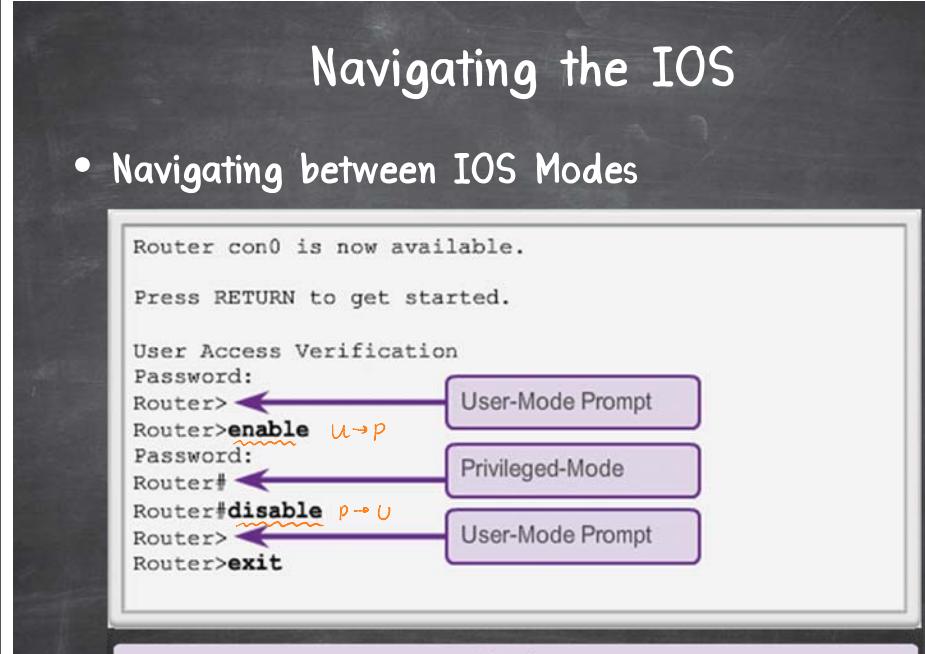
**IOS Prompt Structure**

```

Router>ping 192.168.10.5
Router#show running-config
Router(config)#Interface FastEthernet 0/0
Router(config-if)#ip address 192.168.10.1 255.255.255.0

The prompt changes to denote the current CLI mode.

Switch>ping 192.168.10.9
Switch#show running-config
Switch(config)#Interface FastEthernet 0/1
Switch(config-if)#Description connection to WEST LAN4
    
```



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# Navigating the IOS

- Navigating between IOS Modes

```

Switch>enable /en (continues from: enable mode)
Switch#configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)#interface vlan 1
Switch(config-if)#exit
Switch(config)#exit
Switch#
    
```

*enable ?* *continues from: enable mode*

*clo ?* *continues from: configuration mode*

*clo ?* *continues from: configuration mode*

*clock ?* *continues from: configuration mode*

```

Switch#configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)#vlan 1
Switch(config-vlan)#end
Switch#
    
```

*configure terminal ?* *continues from: configuration mode*

*vlan ?* *continues from: configuration mode*

*line vty 0 4* *continues from: configuration mode*

*interface fastethernet 0/1* *continues from: configuration mode*

*end* *continues from: configuration mode*

*switch#*

```

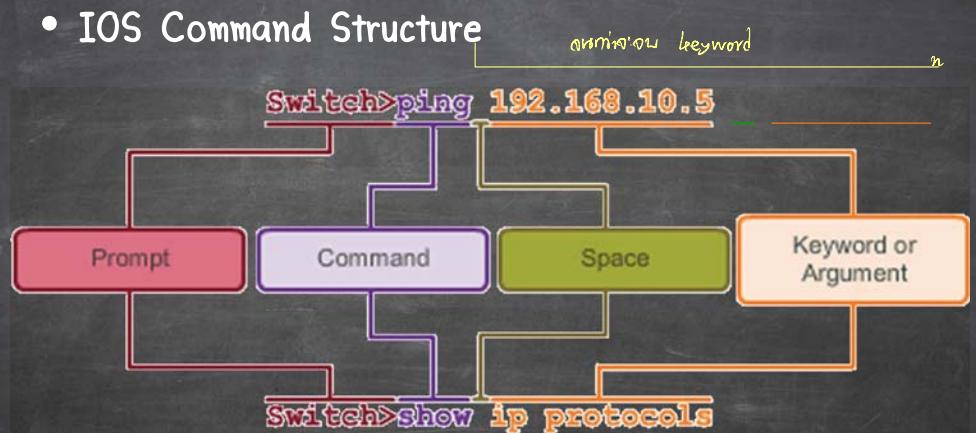
Switch#configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)#line vty 0 4
Switch(config-line)#interface fastethernet 0/1
switch(config-if)#end
switch#
    
```

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# The Command Structure

- IOS Command Structure

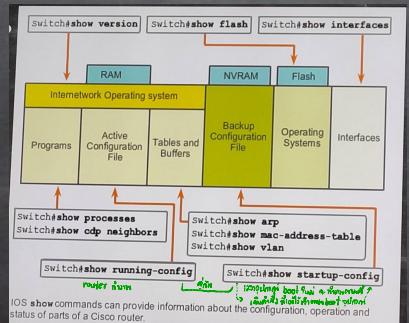


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# The Command Structure

- Context Sensitive Help
- Command Syntax Check within command area
- Hot Keys and Shortcuts TAB CTR, C-A, C-Z, ↑, ↓, C-S-B, C-C-H
- IOS Examination Commands ( ? )



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# The Command Structure

- The show version Command

```
Router#show version
Cisco IOS Software, C1900 Software (C1900-UNIVERSALK9-M), Version
15.2(4)M1, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thu 26-Jul-12 19:34 by prod_rel_team

ROM: System Bootstrap, Version 15.0(1r)M15, RELEASE SOFTWARE (fc1)

cisco1941 uptime is 41 minutes
System returned to ROM by power-on
System image file is "flash0:c1900-universalk9-mz.SPA.152-
4.M1.bin"
Last reload type: Normal Reload
Last reload reason: power-on

This product contains cryptographic features and is subject to
United
States and local country laws governing import, export, transfer
and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use
encryption.

Router#show version
```

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## Getting Basic

- Hostnames from user / password
- Limiting Access to Device Configurations using addr
- Addressing Devices
- Verifying Connectivity from config area, config on network interface Reboot
- Saving Configurations

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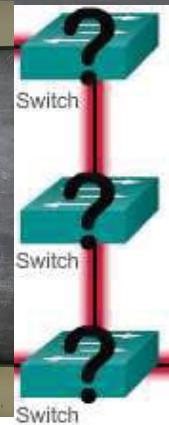
## Getting Basic

- Hostnames

Getting Basic

- Hostnames
  - Device Names : Some guidelines for naming conventions are that names should
    - Start with a letter
    - Contain no spaces
    - End with a letter or digit
    - Use only letters, digits, and dashes
    - Be less than 64 characters in length

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Without names, network devices are difficult to identify for configuration purposes.



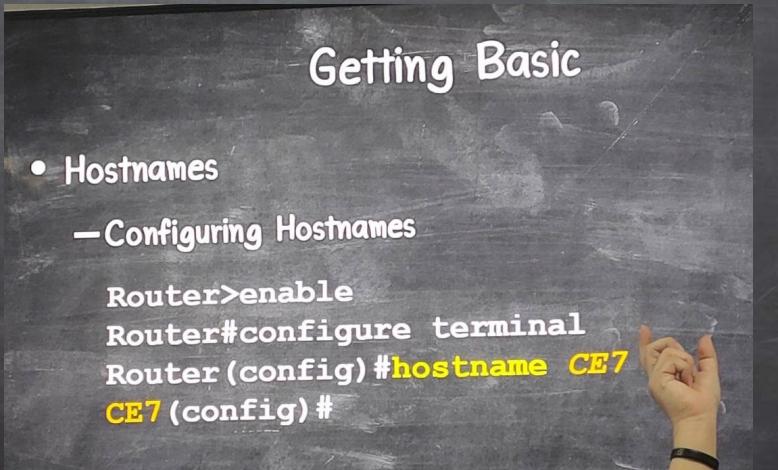
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# Getting Basic

- Hostnames

- Configuring Hostnames



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# Getting Basic

- Limiting Access to Device Configurations

- Banner Messages

- Securing Device Access

- Enable password
    - Enable secret
    - Console password → รหัส console
    - VTY password สำหรับ remote login
    - Encrypting Password Display

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# Getting Basic

- Limiting Access to Device Configurations

- Banner Messages

- important part of the legal process in the event that someone is prosecuted for breaking into a device
      - wording that implies that a login is "welcome" or "invited" is not appropriate
      - often used for legal notification because it is displayed to all connected terminals
- คำสั่ง banner motd mode
- ```
CE-floor-7(config)#banner motd # This is a secure system.
Authorized Access ONLY!!! #
CE-floor-7(config)#exit
CE-floor-7#disable
CE-floor-7>exit
```

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# Getting Basic

- Limiting Access to Device Configurations

- Enable password

Getting Basic

- Limiting Access to Device Configurations
  - Enable password

```
CE-floor-7>enable
CE-floor-7#configure terminal
CE-floor-7(config)#enable password ccna
CE-floor-7(config)#exit
CE-floor-7#disable
CE-floor-7>enable
Password:
CE-floor-7#
```

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# Getting Basic

- Limiting Access to Device Configurations

—Enable secret

## Getting Basic

- Limiting Access to Device Configurations

—Enable secret

```
CE-floor-7>enable  
CE-floor-7#configure terminal  
CE-floor-7(config)#enable secret class  
CE-floor-7(config)#exit  
CE-floor-7#disable  
CE-floor-7>enable  
Password:  
CE-floor-7#
```



# Getting Basic

- Limiting Access to Device Configurations

—Console password & VTY password

## Getting Basic

- Limiting Access to Device Configurations

—Console password & VTY password

```
CE-floor-7#configure terminal  
CE-floor-7(config)#line console 0  
CE-floor-7(config-line)#password kmitl  
CE-floor-7(config-line)#login  
CE-floor-7(config-line)#exit  
CE-floor-7(config)#line vty 0 15  
CE-floor-7(config-line)#password cisco  
CE-floor-7(config-line)#login  
CE-floor-7(config-line)#exit
```



# Getting Basic

- Limiting Access to Device Configurations

—Encrypting Password Display

- prevents passwords from showing up as plain text when viewing the configuration
- purpose of this command is to keep unauthorized individuals from viewing passwords in the configuration file
- once applied, removing the encryption service does not reverse the encryption



ກົດອຳນວຍໃນ password

```
CE-floor-7(config)#service password-encryption  
CE-floor-7(config)#exit
```

```
CE-floor-7#show running-config  
Building configuration...  
...  
no service password-encryption  
!  
hostname CE-floor-7!  
!  
!  
!  
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCil  
enable password ccna  
!  
!  
!
```

```
line con 0
```

```
password kmitl
```

```
login
```

```
!
```

```
line aux 0
```

```
!
```

```
line vty 0 4
```

```
password cisco
```

```
login
```

```
line vty 5 15
```

```
password cisco
```

```
login
```

```
!
```

```
!
```

```
!
```

```
end
```



# Getting Basic

- Addressing Devices

- Select an interface to configure

- Physical interfaces / Loopback interfaces

```
Router(config)#interface type port  
Router(config)#interface type slot/port  
Router(config)#interface type slot/subslot/port
```

IP address

Interface

- Switch virtual interfaces (SVIs)

```
Switch(config)#interface vlan number
```

Interface

- Set the IP address of an interface

```
Router(config-if)#ip address ip_address subnet_mask  
Router(config-if)#no shutdown  
# no IP ADD ဆារែរ IP
```

Interface មិនបាន

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# Getting Basic

- Saving Configurations

```
Router#copy running-config startup-config
```

IOS Command Line Interface

Press RETURN to get started.

This is a secure system. Authorized Access ONLY!!!

User Access Verification

Password:

CE-floer>enable

Password:

CE-floer>?show startup-config

startup-config is not present

CE-floer>?copy running-config startup-config

Destination filename [startup-config]? Building configuration...

[OK]

CE-floer>

IOS Command Line Interface

```
CE-floer>?show startup-config  
startup-config is not present  
CE-floer>?copy running-config startup-config  
Destination filename [startup-config]?  
Building configuration...  
[OK]  
CE-floer>
```

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# Getting Basic

- Verifying Connectivity

```
Router#show running-config
```

```
Router#show startup-config
```

```
Router#show ip route
```

show inter router

```
Router#show interfaces
```

```
Router#show ip interface
```

```
Router#show ip interface brief
```

```
Router#traceroute
```

តាមលម្អិតមុន និងនៅទីនេះ

```
Router#ping
```

តាមពីរលាក់អាជីវកម្ម

```
PC>ping
```

t តាមលម្អិតដែលមានលាក់សាន្ត (តាមចំណាំគ្រប់នូវលើកឡើង)

```
PC>traceroute
```

តាមលម្អិតដែលមានលាក់សាន្ត (តាមចំណាំគ្រប់នូវលើកឡើង)

```
PC>route print
```

ផ្តល់ routing នៃ pc

```
PC>nslookup
```

ទិន្នន័យ request Domain name

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# Questions and Answers



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