



# Basic Router Configuration

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# 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

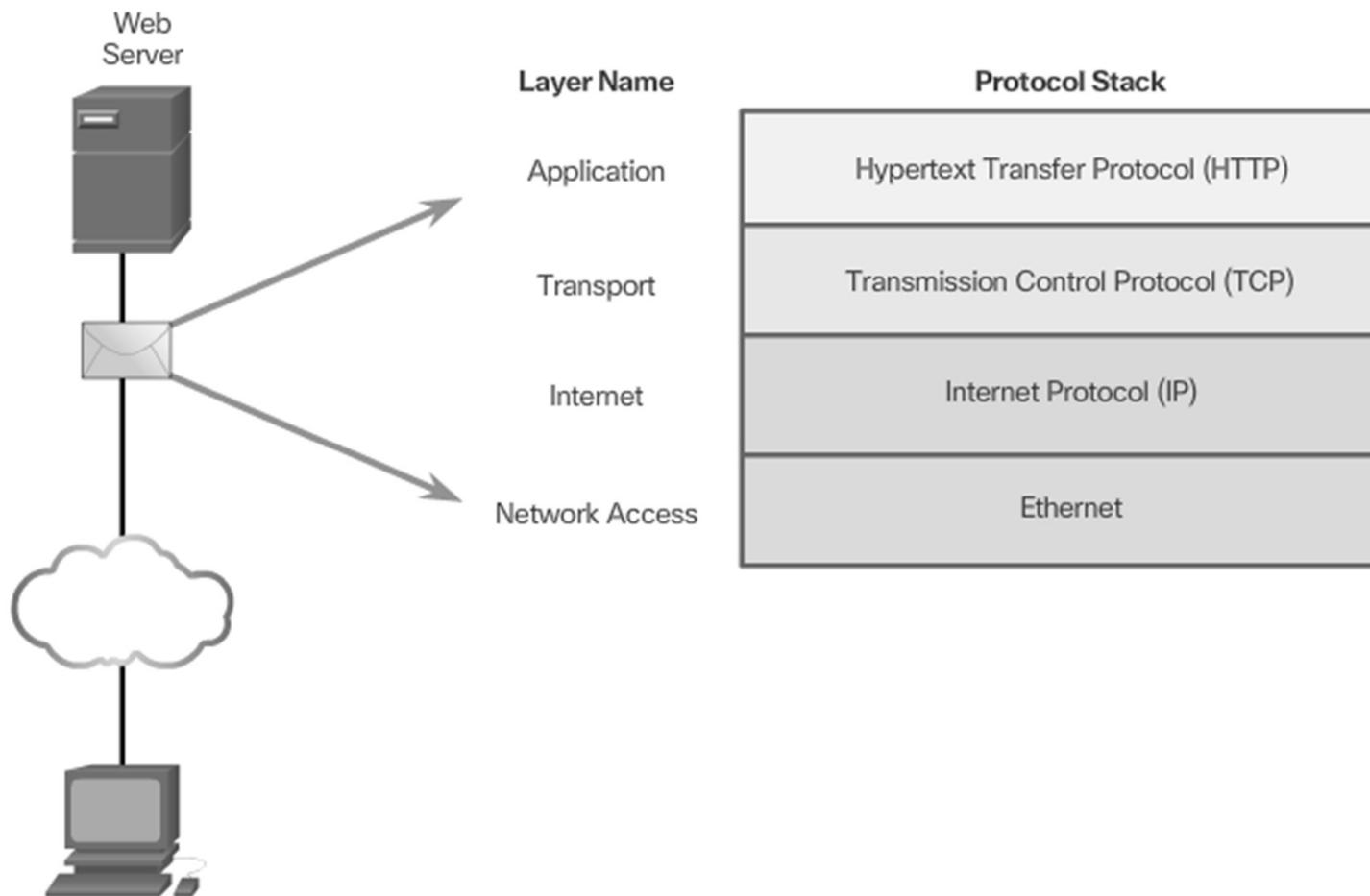
Getting Basic

# Network Protocols

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

# Protocol Interaction

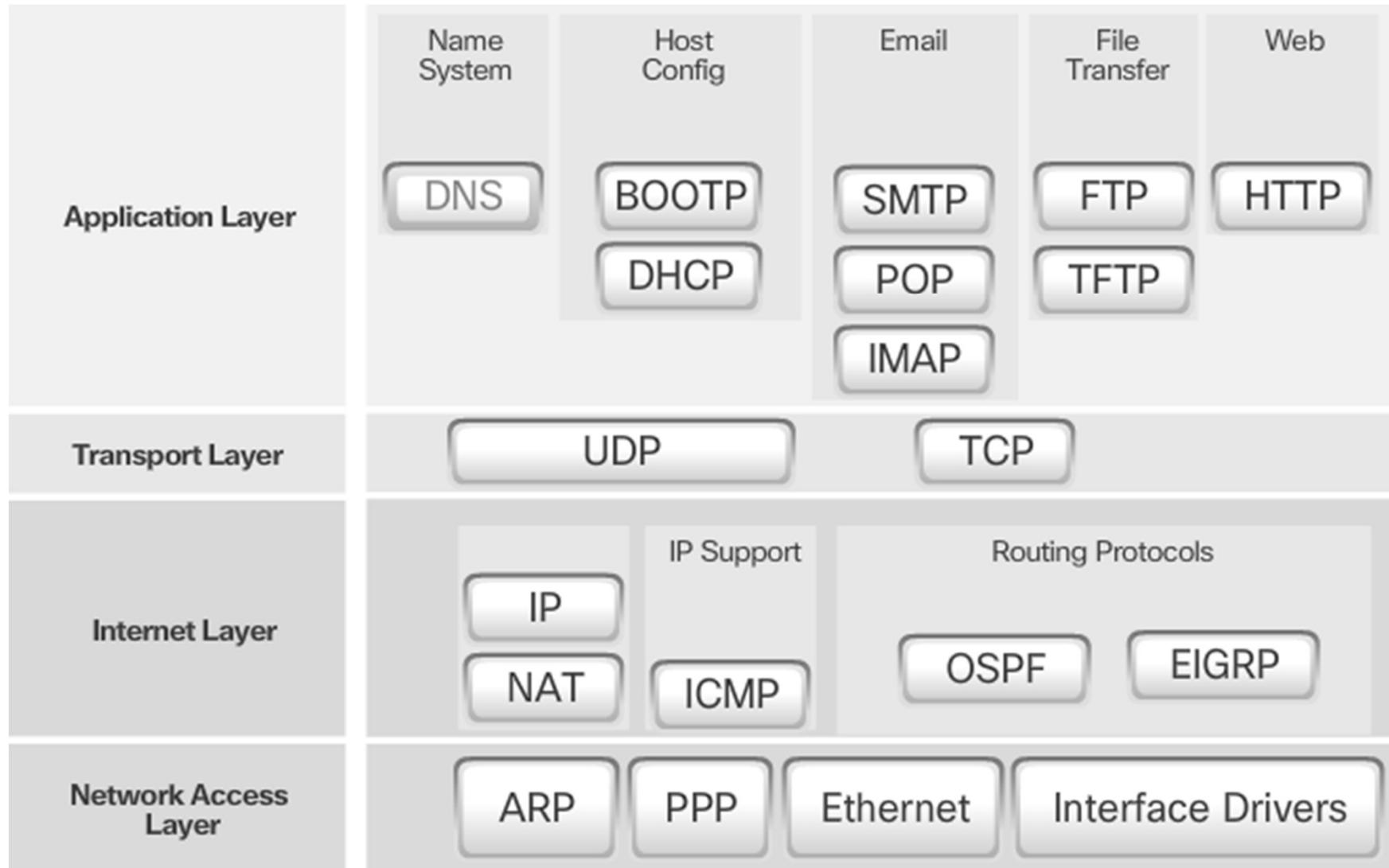
- Interaction of protocols in communication between a web server and web client.



# 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			

# TCP/IP Protocol Suite



# 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

0	tcp Reserved	51	tcp IMP Logical Address Maintenance	95	tcp MIT ML Device	121	tcp Encore Expedited Remote Pro.CELL	152	tcp Background File Transfer Program
0	tcp Reserved	52	tcp XNS Time Protocol	96	tcp Micro Focus Cobol	121	udp Encore Expedited Remote Pro.CELL	152	udp Background File Transfer Program
1	tcp TCP Port Service Multiplexer	52	udp XNS Time Protocol	97	tcp any private terminal link	122	tcp SMAKYNET	153	tcp SGMP
2	tcp Management Utility	53	tcp Domain Name Server	97	udp any private terminal link	122	udp SMAKYNET	153	udp SGMP
3	tcp Compression Process	54	tcp XNS Clearinghouse	98	tcp Kerberos	123	tcp Network Time Protocol	154	tcp NETSC
5	tcp Remote Job Entry	54	udp XNS Clearinghouse	99	tcp SU MIT Telnet Gateway	123	udp Network Time Protocol	154	udp NETSC
7	tcp Echo	55	tcp ISI Graphics Language	100	tcp DNSIX Secure Attribute Token Map	124	tcp ANSA REX Trader	155	tcp NETSC
7	udp Echo	55	udp ISI Graphics Language	11	tcp MIT Dover Spoofer	124	udp ANSA REX Trader	155	udp NETSC
9	tcp Discard	56	tcp XNS Authentication	12	tcp Network Printing Protocol	125	tcp Locus PC-Interface Net Map Ser	156	tcp SQL Service
9	udp Discard	56	udp XNS Authentication	12	udp Network Printing Protocol	126	tcp Unixsys Utility Logon	157	tcp KINET VM Command Message
11	tcp Active Users	57	tcp any private terminal access	13	tcp Device Control Protocol	126	udp Unixsys Utility Logon	157	Protocol
11	udp Active Users	57	udp any private terminal access	13	udp Device Control Protocol	127	tcp Locus PC-Interface Comm Server	158	tcp PCMail Server
13	tcp Daytime	58	tcp XNS Mail	14	tcp Troll Object Dispatcher	128	tcp GSS X License Verification	159	tcp NSS-Routing
13	udp Daytime	58	udp XNS Mail	14	udp Troll Object Dispatcher	129	udp GSS X License Verification	159	udp NSS-Routing
17	tcp Quote of the Day	59	tcp any private file service	15	tcp SUPDUP	130	tcp Password Generator Protocol	160	tcp SGMP-TRAPS
17	udp Quote of the Day	59	udp any private file service	15	udp SUPDUP	131	udp Password Generator Protocol	160	udp SGMP-TRAPS
18	tcp RWT rwrite	60	tcp Unsigned	16	tcp DIXIE Protocol Specification	130	tcp cisco FMATIVE	161	tcp SNMP
18	udp Message Send Protocol	60	udp Unsigned	17	tcp Swift Remote Virtual File Protocol	130	udp cisco FMATIVE	162	udp SMNTRAP
19	tcp Message Send Protocol	61	tcp KI MAIL	17	udp Swift Remote Virtual File Protocol	131	tcp cisco TMATIVE	163	tcp CMIP TCP Manager
19	udp Message Send Protocol	61	udp KI MAIL	18	tcp TAC News	131	udp cisco TMATIVE	163	udp CMIP TCP Manager
11	tcp Character Generator	62	tcp ACA Services	19	tcp TAC News	cisco-eye 132	tcp cisco SYSMAINT	164	tcp CMIP TCP Agent
11	udp Character Generator	64	tcp Communications Integrator (CI)	19	tcp Metagram Relay	cisco-eye 132	udp cisco SYSMAINT	164	udp CMIP TCP Agent
20	tcp File Transfer [Default Data]	65	tcp TACACS-Database Service	20	tcp Metagram Relay	132	tcp Statistics Service	165	tcp Xerox
21	tcp File Transfer [Control]	66	tcp Oracle SQL-NET	100	tcp [unauthorized use]	133	udp Statistics Service	165	udp Xerox
22	tcp Telnet	67	tcp Bootstrap Protocol Server	101	tcp KIC Host Name Server	134	tcp INGRES-NET Service	166	tcp Status Systems
24	tcp any private mail system	68	udp Bootstrap Protocol Client	101	udp KIC Host Name Server	135	tcp Location Service	166	udp Status Systems
25	tcp Simple Mail Transfer	69	tcp Trivial File Transfer	102	tcp ISO-TSAP Class 0	135	udp Location Service	167	tcp KAMP
27	tcp NSW User System FE	70	tcp Gopher	102	udp ISO-TSAP Class 0	136	tcp PROFILE Hosting System	167	tcp KAMP
27	udp NSW User System FE	71	tcp Remote Job Service	103	tcp Genesis Point-to-Point Trans Net	137	tcp NETBIOS Name Service	168	tcp RSVD
21	tcp MSG ICP	71	udp Remote Job Service	103	udp Genesis Point-to-Point Trans Net	137	udp NETBIOS Name Service	168	tcp Network PostScript
21	udp MSG ICP	72	tcp Remote Job Service	104	tcp ACR-NEVA Digital Imag. & Comm.	138	tcp NETBIOS Datagram Service	169	tcp Network PostScript
31	tcp MSG Authentication	72	udp Remote Job Service	300	tcp Mailbox Name NameServer	138	udp NETBIOS Datagram Service	170	tcp Network Innovations Multiplex
31	udp MSG Authentication	73	tcp Remote Job Service	105	udp Mailbox Name NameServer	139	tcp NETBIOS Session Service	171	tcp Network Innovations Multiplex
38	tcp Display Support Protocol	73	udp Remote Job Service	105	tcp SCOM-TSMUX	140	tcp EMFIS Data Service	172	tcp Network Innovations CL 1
38	udp Display Support Protocol	74	tcp Remote Job Service	106	udp SCOM-TSMUX	140	udp EMFIS Data Service	172	tcp Network Innovations CL 1
35	tcp any private printer server	74	udp Remote Job Service	106	tcp Password Server	141	tcp EMFIS Control Service	173	tcp Xyplex
35	udp any private printer server	75	tcp any private dial out service	107	tcp Remote Telnet Service	141	udp EMFIS Control Service	173	udp Xyplex
37	tcp Time	75	udp any private dial out service	108	tcp SMA Gateway Access Server	142	tcp Britton-Lee IDM	174	tcp MAILQ
37	udp Time	76	tcp Distributed External Object Store	109	tcp Post Office Protocol - Version 2	142	udp Britton-Lee IDM	174	udp MAILQ
38	tcp Route Access Protocol	76	udp Distributed External Object Store	110	tcp Post Office Protocol - Version 3	143	tcp Interactive Mail Access Protocol	175	tcp VMNET
38	udp Route Access Protocol	77	tcp any private RJE service	111	tcp SUN Remote Procedure Call	v2	175	tcp VMNET	
31	tcp Resource Location Protocol	77	udp any private RJE service	111	udp SUN Remote Procedure Call	144	tcp News	176	tcp GENRAD-MUX
41	tcp Graphics	78	tcp vettcp	112	tcp McIDAS Data Transmission Protocol	144	udp News	176	tcp GENRAD-MUX
41	udp Graphics	78	udp vettcp	113	tcp Authentication Service	145	tcp UAAC Protocol	177	tcp X Display Manager Control
42	tcp Host Name Server	79	tcp Finger	114	tcp Audio News Multicast	145	udp UAAC Protocol	177	Protocol
43	tcp Who Is	80	tcp World Wide Web HTTP	114	udp Audio News Multicast	146	tcp ISO-IP0	178	tcp Novell Window Server
44	tcp MPM FLAGS Protocol	80	tcp World Wide Web HTTP	115	tcp Simple File Transfer Protocol	146	udp ISO-IP0	178	tcp Novell Window Server
45	tcp Message Processing Module [recv]	91	tcp HOSTS2 Name Server	115	udp Simple File Transfer Protocol	147	tcp ISO-IP	179	tcp Border Gateway Protocol
46	tcp MPM [default send]	91	udp HOSTS2 Name Server	116	tcp ANSA REX Notify	147	udp ISO-IP	179	tcp Intergraph
47	tcp KI FTP	92	tcp XFER Utility	116	udp ANSA REX Notify	148	tcp CRONUS-SUPPORT	180	tcp Intergraph
47	udp KI FTP	92	udp XFER Utility	117	tcp UUCP Path Service	148	udp CRONUS-SUPPORT	180	tcp Intergraph
48	tcp Digital Audit Daemon	93	tcp MIT ML Device	118	tcp SQL Services	149	tcp AED 512 Emulation Service	181	tcp HEMS
48	udp Digital Audit Daemon	93	udp MIT ML Device	118	udp SQL Services	149	udp AED 512 Emulation Service	181	tcp HEMS
49	tcp Login Host Protocol	94	tcp Common Trace Facility	119	tcp Network News Transfer Protocol	150	tcp SQL-NET	181	tcp HEMS
50	tcp Remote Mail Checking Protocol	94	udp Common Trace Facility	120	tcp CFDP/TKT	150	udp SQL-NET	181	tcp HEMS
50	udp Remote Mail Checking Protocol	95	tcp MIT ML Device	120	udp CFDP/TKT	151	tcp CFDP/TKT	181	tcp HEMS

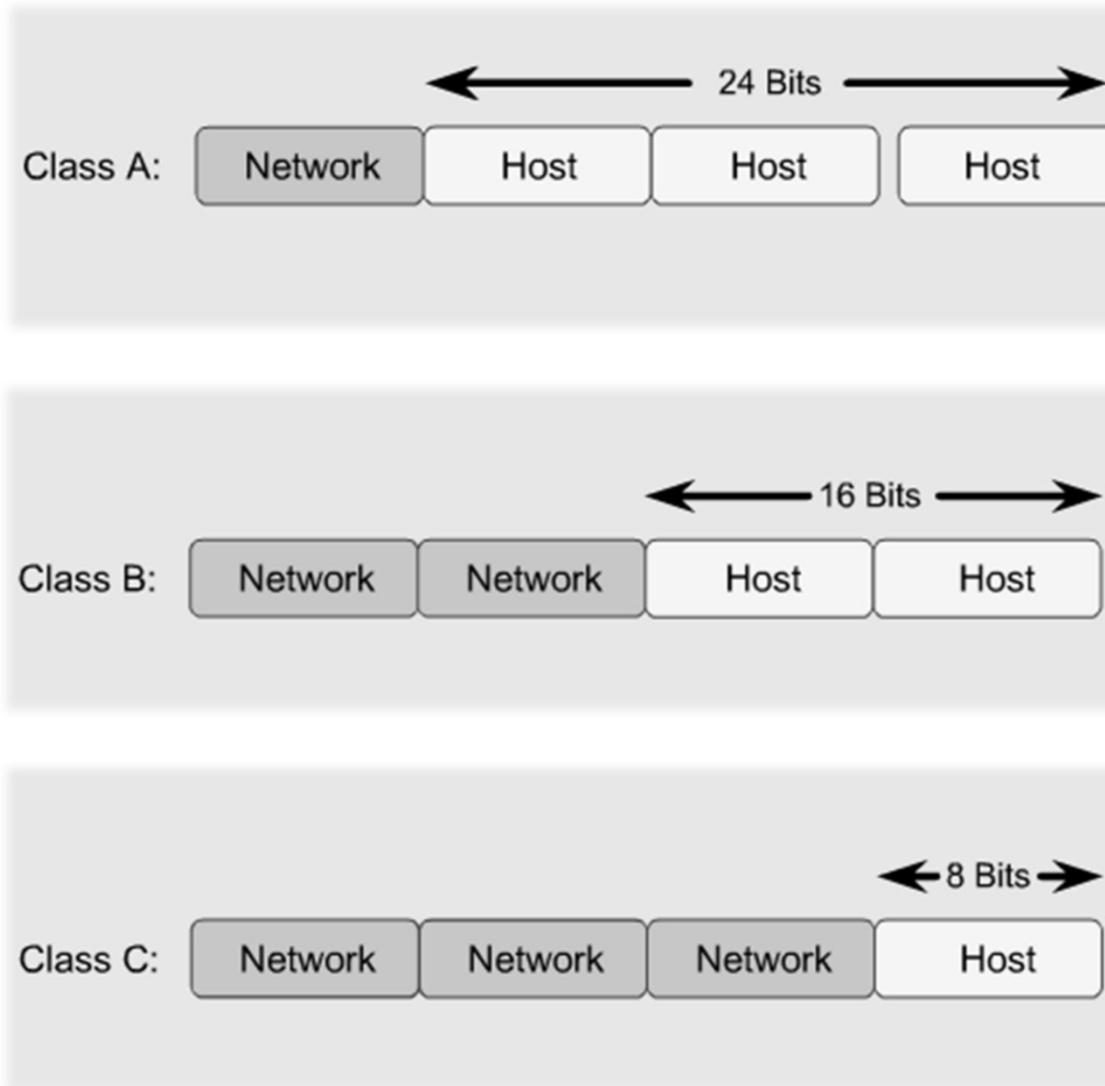
101	tcp Unify	206	tcp AppleTalk Unused	Proto	402	tcp Genie Protocol	433	udp KNSP
101	udp Unify	207	tcp TRivial Authenticated Mail Protocol	377	tcp NEC Corporation	402	udp Genie Protocol	434
102	tcp Unify Audit SITP	207	tcp TRivial Authenticated Mail Protocol	377	udp NEC Corporation	403	tcp decap	435
102	udp Unify Audit SITP	210	tcp ANSI Z39.50	379	tcp NEC Corporation	403	udp decap	436
103	tcp OCBlaster	210	tcp ANSI Z39.50	379	udp NEC Corporation	404	tcp nload	436
103	udp OCBlaster	211	tcp Texas Instruments 914C G Terminal	371	tcp TIA EIA IS-91 nodes client	404	udp nload	437
104	tcp OCServer	211	tcp Texas Instruments 914C G Terminal	371	tcp TIA EIA IS-91 nodes server	405	tcp nload	437
104	udp OCServer	212	tcp ATEXSSTR	380	tcp TIA EIA IS-91 nodes server	405	udp nload	438
105	tcp Remote-KIS	213	tcp IPX	381	tcp hp performance data collector	406	tcp Interactive Mail Support Protocol	438
105	udp Remote-KIS 196	213	udp IPX	381	udp hp performance data collector	406	udp Interactive Mail Support Protocol	439
Protocol	106	tcp KIS Protocol	214	tcp VM PWSCS	382	tcp hp performance data manager	407	tcp Tiburtku
107	tcp Application Communication Interface	214	udp VM PWSCS	382	udp hp performance data manager	408	tcp Prospero Resource Manager Sys.	
107	udp Application Communication Interface	215	tcp Insignia Solutions	382	tcp hp performance data manager	409	tcp Prospero Resource Manager Node	
108	tcp Plus Five's MUMPS	215	tcp Insignia Solutions	383	tcp hp performance data alarm	410	udp DECLadbug Remote Debug	
108	udp Plus Five's MUMPS	217	tcp dBASE Unix	383	udp hp performance data alarm	411	tcp Remote MT Protocol	
109	tcp Queued File Transport	217	tcp dBASE Unix	384	tcp A Remote Network Server System	411	udp Remote MT Protocol	
110	tcp Gateway Access Control Protocol	218	tcp Netik Message Posting Protocol	384	tcp A Remote Network Server System	412	tcp Trap Convention Port	
110	udp Gateway Access Control Protocol	218	udp Netik Message Posting Protocol	385	tcp IBM Application	412	udp Trap Convention Port	
111	tcp Prospero Directory Service	219	tcp Unixys ARPs	385	tcp IBM Application	413	tcp SNSP	
112	tcp OSU Network Monitoring System	219	tcp Unixys ARPs	386	tcp ASA Message Router Object Def.	413	udp SNSP	
112	udp OSU Network Monitoring System	220	tcp Interactive Mail Access Protocol	386	udp ASA Message Router Object Def.	414	tcp InfoSeek	
113	tcp Spider Remote Monitoring Protocol	220	tcp Berkeley rlogind with SPX auth	387	tcp Appletalk Update-Based Routing	414	udp InfoSeek	
113	udp Spider Remote Monitoring Protocol	221	udp Berkeley rlogind with SPX auth	387	tcp Appletalk Update-Based Routing	415	tcp Blket	
Protocol	222	tcp Berkeley rlogind with SPX auth	387	tcp Appletalk Update-Based Routing	415	udp Blket		
114	tcp Internet Relay Chat Protocol	222	tcp Berkeley rlogind with SPX auth	388	tcp Unidata LDM Version 4	416	tcp Silverplatter	
115	tcp DNSIX Network Level Module Audit	223	tcp Certificate Distribution Center	388	tcp Unidata LDM Version 4	416	udp Silverplatter	
Audit	223	tcp Certificate Distribution Center	389	tcp Lightweight Directory Access Protocol	417	tcp Ormax		
116	tcp DNSIX Session Mgt Module Audit	243	tcp Survey Measurement	389	tcp Lightweight Directory Access Protocol	417	udp Ormax	
Realt	243	tcp Survey Measurement	390	tcp UIIS	418	tcp Hyper-G		
117	tcp Directory Location Service	245	tcp UIIS	390	udp UIIS	419	tcp Arild	
117	udp Directory Location Service	245	tcp SynOptics SNMP Relay Port	391	tcp SynOptics SNMP Relay Port	420	udp SMPTIE	
118	tcp Directory Location Service Monitor	246	tcp Display Systems Protocol 3270	391	udp SynOptics SNMP Relay Port	421	tcp Arild	
118	udp Directory Location Service	246	udp Display Systems Protocol 3270	392	tcp SynOptics Port Broker Port	422	tcp Arild	
Monitor	344	tcp Display Systems Protocol 3270	392	udp SynOptics Port Broker Port	423	tcp IBM Operations Planning and Control Start		
119	tcp SMUX	345	tcp Prospero Data Access Protocol	393	tcp Data Interpretation System	424	tcp IBM Operations Planning and Control Track	
119	udp SMUX	345	tcp Perf Analysis Workbench	393	udp Data Interpretation System	425	tcp ICAD	
200	tcp IBM System Resource Controller	346	tcp Perf Analysis Workbench	394	tcp EMBL Nucleic Data Transfer	426	tcp smrtdup	
200	udp IBM System Resource Controller	347	tcp Zebra server	394	udp EMBL Nucleic Data Transfer	426	udp smrtdup	
201	tcp AppleTalk Routing Maintenance	348	tcp Fatman Server	395	tcp NETcout Control Protocol	427	tcp Server Location	
201	udp AppleTalk Routing Maintenance	348	tcp Cabletron Management Protocol	395	udp NETcout Control Protocol	427	udp Server Location	
202	tcp AppleTalk Name Binding	371	tcp Cabletron Management Protocol	396	tcp Novell Netware over IP	428	tcp OCS_CMU	
202	udp AppleTalk Name Binding	371	tcp Clearcase	396	udp Novell Netware over IP	428	udp OCS_CMU	
203	tcp AppleTalk Unused	372	tcp Unik Listserv	397	tcp Multi Protocol Trans. Net.	429	tcp OCS_AMU	
203	udp AppleTalk Unused	372	udp Unik Listserv	397	udp Multi Protocol Trans. Net.	429	udp OCS_AMU	
204	tcp AppleTalk Echo	373	tcp Legent Corporation	398	tcp Kryptolan	430	tcp UTMPSD	
204	udp AppleTalk Echo	373	udp Legent Corporation	398	udp Kryptolan	430	udp UTMPSD	
205	tcp AppleTalk Unused	374	tcp Legent Corporation	399	tcp ISO-TSAP Class 2	431	tcp UTMPCD	
205	udp AppleTalk Unused	374	udp Legent Corporation	399	tcp ISO-TSAP Class 2	431	udp UTMPCD	
206	tcp AppleTalk Zone Information	375	tcp Heska	400	tcp Workstation Solutions	432	tcp IASD	
206	udp AppleTalk Zone Information	375	udp Heska	400	udp Workstation Solutions	432	udp IASD	
207	tcp AppleTalk Unused	376	tcp Aniga Envoy Network Inquiry	401	tcp Uninterruptible Power Supply	433	tcp KNSP	
207	udp AppleTalk Unused	376	Proto	401	udp Aniga Envoy Network Inquiry	433	tcp KNSP	
208	tcp AppleTalk Unused	376	tcp Aniga Envoy Network Inquiry	401	udp Aniga Envoy Network Inquiry	433	tcp KNSP	

	Server	Client	
451 top Cray Network Semaphore server	544 top krcmd-kshell	730 tcp IBM NetView DM 6000	773 top submit
451 udp Cray Network Semaphore server	544 udp krcmd-kshell	730 udp IBM NetView DM 6000	773 udp notify
452 top Cray SFS config server	545 top appletcavr	730 send tcp	774 top password
452 udp Cray SFS config server	545 udp appletcavr	730 udp IBM NetView DM 6000	774 udp account_dbd
453 top CreativeServer	550 top nov-who	730 send tcp	775 top extadb
453 udp CreativeServer	550 udp nov-who 545 udp appletcavr	731 top IBM NetView DM 6000	775 udp account_trusted
454 top ContentServer	550 top nov-who	731 receive top	776 top npages
454 udp ContentServer	550 udp nov-who	731 udp IBM NetView DM 6000	776 udp npages
455 top CreativePartner	555 top def	731 receive top	780 top wpgs
455 udp CreativePartner	555 udp def	741 top netGW	780 udp wpgs
456 top nacos-tcp	556 top rfc server	741 udp netGW	786 top Concert
456 udp nacos-udp	556 udp rfc server	742 top Network based Rev. Cont. Sys.	786 udp Concert
457 top scdelp	557 top openvms-syspc	742 udp Network based Rev. Cont. Sys.	800 top nidle_daemon
458 top apple quick time	557 udp openvms-syspc	744 top Flexible License Manager	800 udp nidle_daemon
458 udp apple quick time	558 top SDNSKMP	744 udp Flexible License Manager	901 top device
459 top aprt-read	559 top SDNSKMP	747 top Fujitsu Device Control	901 udp device
459 udp aprt-read	559 udp TEEDTAP	747 udp Fujitsu Device Control	908 top AccessBuilder
460 top sktron	559 udp TEEDTAP	748 top Russell Info Sci Calendar	908 udp AccessBuilder
460 udp sktron	560 top monitorfd	Manager	916 top Central Point Software-xtrinsic
512 top remote process execution;	560 top monitorfd 561 udp monitor	748 udp Russell Info Sci Calendar	916 udp Central Point Software-xtrinsic
512 udp used by nsl system to notify	562 top chroot-chshell	Manager	917 top waitrd
users	562 udp chroot-chshell	749 top kerberos administration	917 udp waitrd
513 top remote login a la telnet;	564 top plan 9 file service	750 top rfile	918 top busboy
513 udp maintains data bases showing	564 udp plan 9 file service	750 udp loadav	918 udp piparp
who's	565 top whoami	751 top pmp	919 top garcon
514 top like exec, but automatic	565 udp whoami	751 udp pmp 752 udp qrh	919 udp Applik ec
514 udp cydog	570 top demon-meter	753 top rth	919 udp piprouter
515 top spooler	570 udp demon-meter	753 udp rth	919 udp piprouter
517 top talk	571 top daemon-meter	754 top tail-send	1000 top cadlock
518 top talk	571 udp daemon-meter	754 udp tail-send	1000 udp cadlock
511 top unclines	600 top Sun IPC server	758 top nlogin	
511 udp unclines	600 udp Sun IPC server	758 udp nlogin	
520 top extended file name server	607 top nps	759 top con	
520 udp local routing process (on site);	607 udp nps	760 top ns	
525 top theserver	608 top Cray Unified Resource Manager	760 udp ns	
525 udp theserver	608 udp Cray Unified Resource Manager	761 top nra	
526 top novdate	608 top Sender-Initiated Unsolicited File Transfer	761 udp nra	
526 udp novdate	609 top quoted	762 top quoted	
530 top rpc	609 udp quoted	763 top cyclesserv	
530 udp rpc	610 top nprop-local	763 udp cyclesserv	
531 top chat	610 udp nprop-local	764 top ovarv	
531 udp chat	611 top nprop-grid	764 udp ovarv	
532 top readnews	611 udp nprop-grid	765 top webster	
532 udp readnews	614 top gload	765 udp webster	
533 top for emergency broadcasts	614 udp gload	767 top phonebook	
533 udp for emergency broadcasts	616 top vid	767 udp phonebook	
534 top Apertus Technologies Load Determination	616 udp vid	769 top vid	
534 udp Apertus Technologies Load Determination	666 top docon Id Software	769 udp vid	
540 top wscpd	704 top erilog copy server daemon	770 top cadlock	
541 top wscp-logn	704 udp erilog copy server daemon	770 udp cadlock	
541 udp wscp-logn	701 top EnttrustManager	771 top rip	
543 top klogn	721 top IBM NetView DM 6000	771 udp rip	
543 udp klogn	Server Client	772 top cyclesserv2	
	721 udp IBM NetView DM 6000	772 udp cyclesserv2	

# Logical Addresses : IP address (IPv4)

- IP Classes:
  - class A, B, C
- 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)



# 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**	00000000-01111111	N.H.H.H	255.0.0.0	128 nets ( $2^7$ ) 16,777,214 hosts per net ( $2^{24}-2$ )
B	128-191	10000000-10111111	N.N.H.H	255.255.0.0	16,384 nets ( $2^{14}$ ) 65,534 hosts per net ( $2^{16}-2$ )
C	192-223	11000000-11011111	N.N.N.H	255.255.255.0	2,097,150 nets ( $2^{21}$ ) 254 hosts per net ( $2^{8}-2$ )
D	224-239	11100000-11101111	NA (multicast)		
E	240-255	11110000-11111111	NA (experimental)		

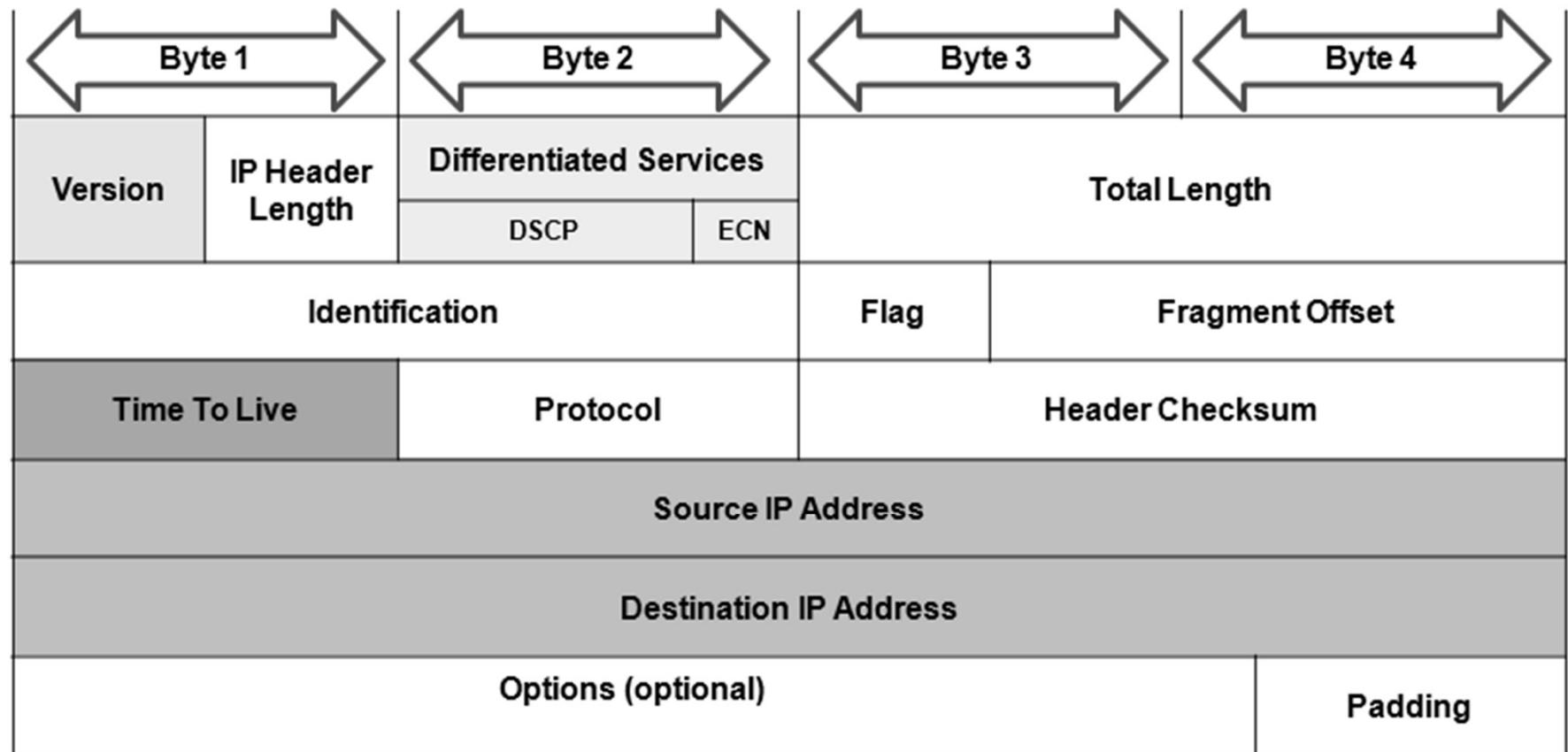
\*\* All zeros (0) and all ones (1) are invalid hosts addresses.

# Logical Addresses : IP address (IPv4)

- Private addressing

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

## IPv4 and IPv6 Headers

IPv4 Header

Version	IHL	Type of Service	Total Length	
Identification		Flags	Fragment Offset	
Time to Live	Protocol	Header Checksum		
Source Address				
Destination Address				
Options		Padding		

IPv6 Header

Version	Traffic Class	Flow Label	
	Payload Length	Next Header	Hop Limit
Source Address			
Destination Address			

Legend

- Field names kept from IPv4 to IPv6
- Fields not kept in IPv6
- Name & position changed in IPv6
- New field in IPv6

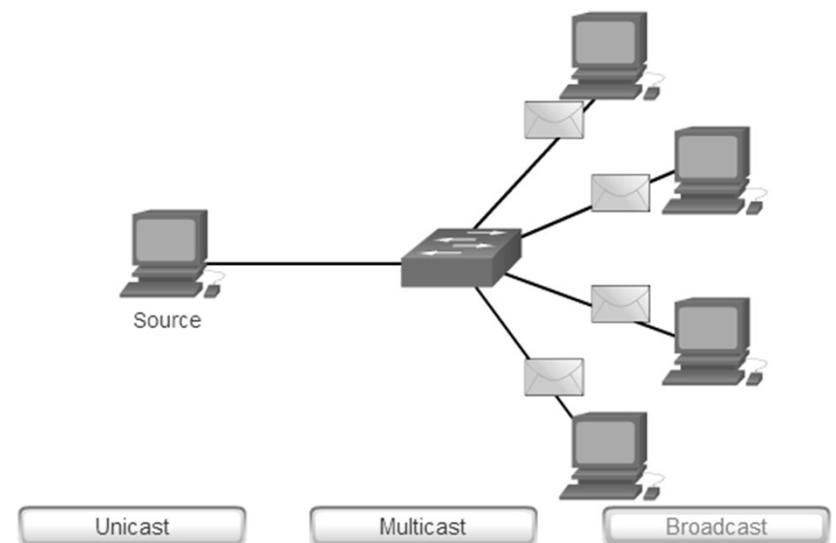
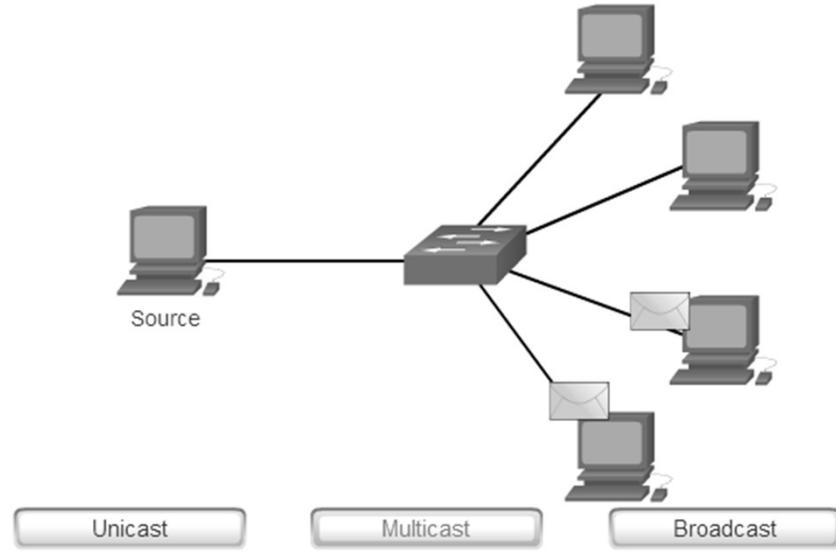
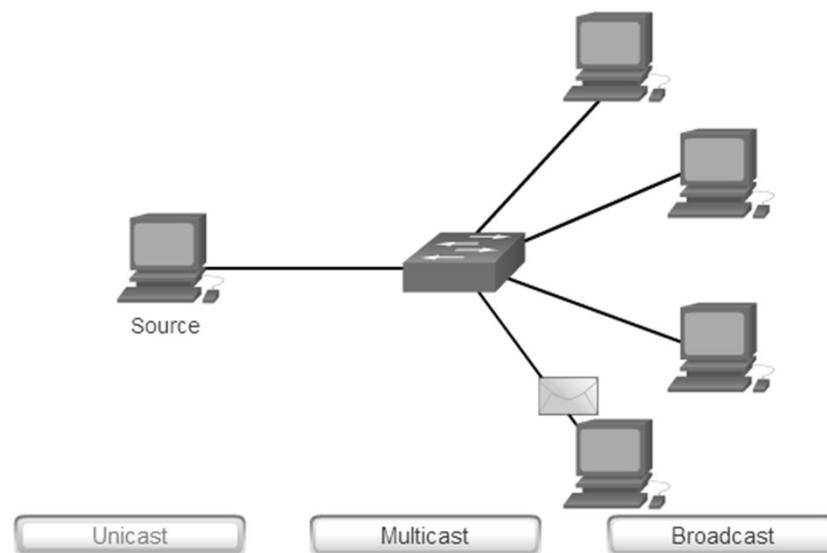
# Physical Addresses : MAC Address

- 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

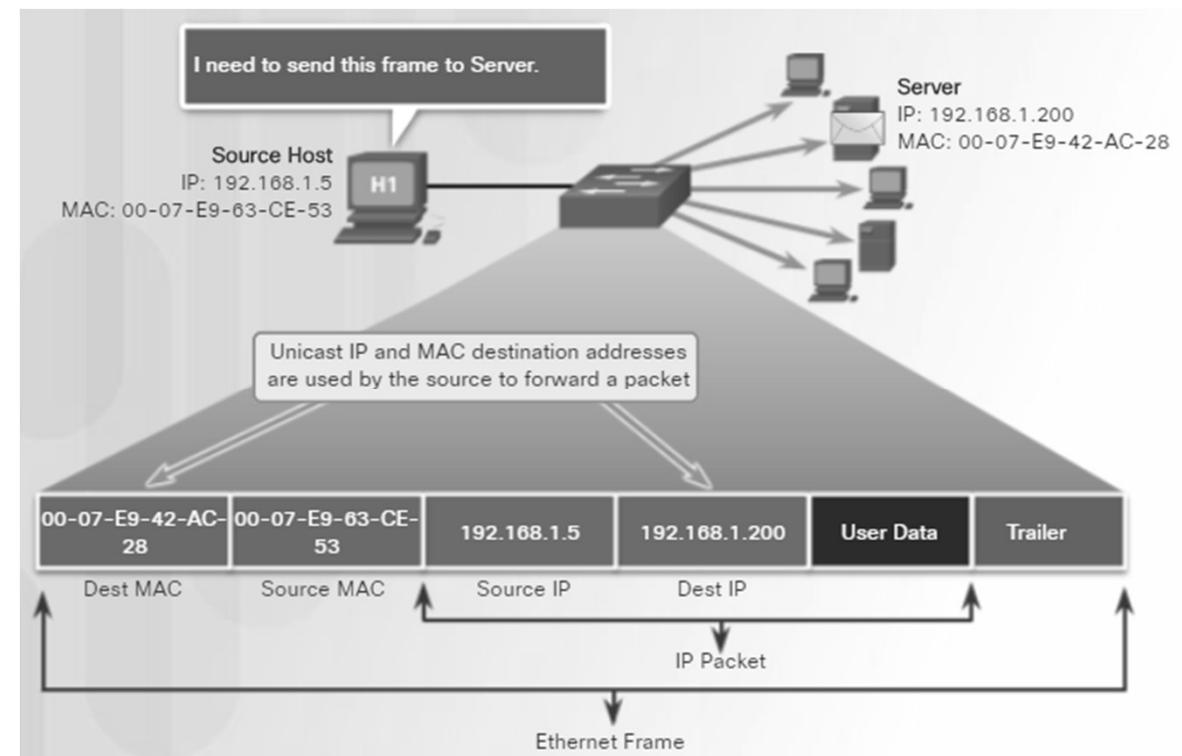
- MAC addresses were created to identify the actual source and destination.
  - The MAC address rules are established by IEEE.
  - The IEEE assigns the vendor a 3-byte (24-bit) code, called the Organizationally Unique Identifier (OUI).
- IEEE requires a vendor to follow two simple rules:
  - All MAC 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



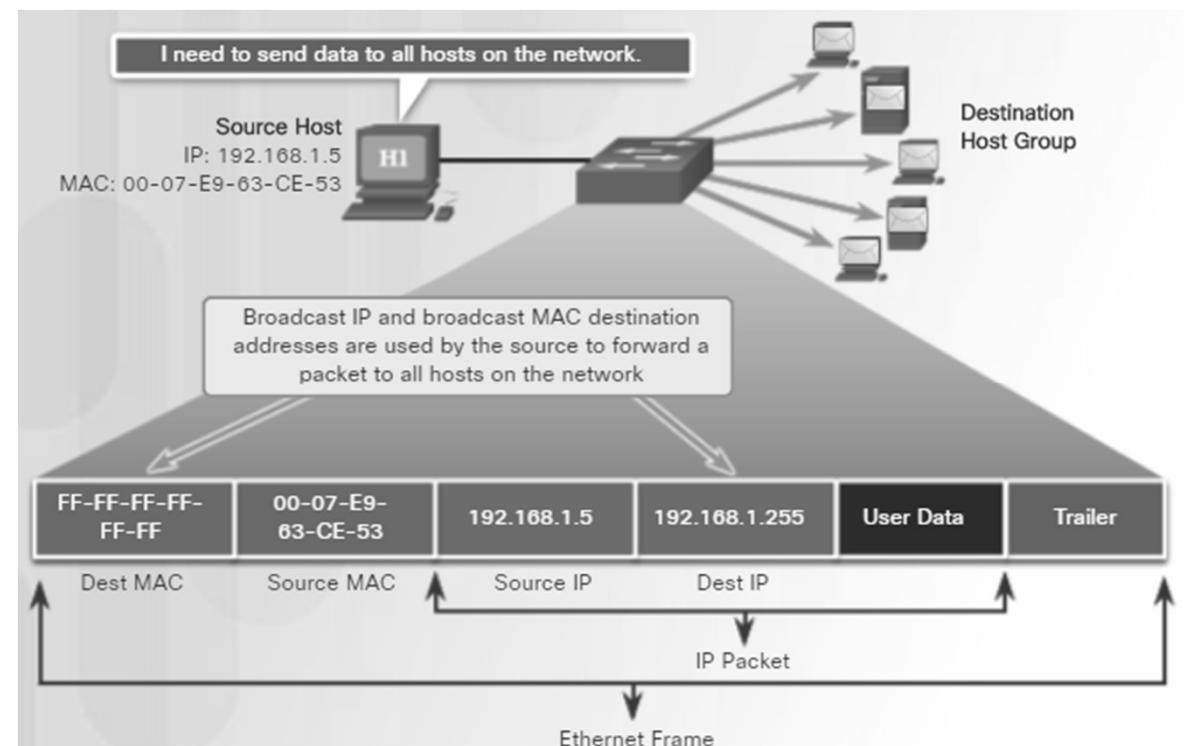
# Unicast MAC Address

- 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.



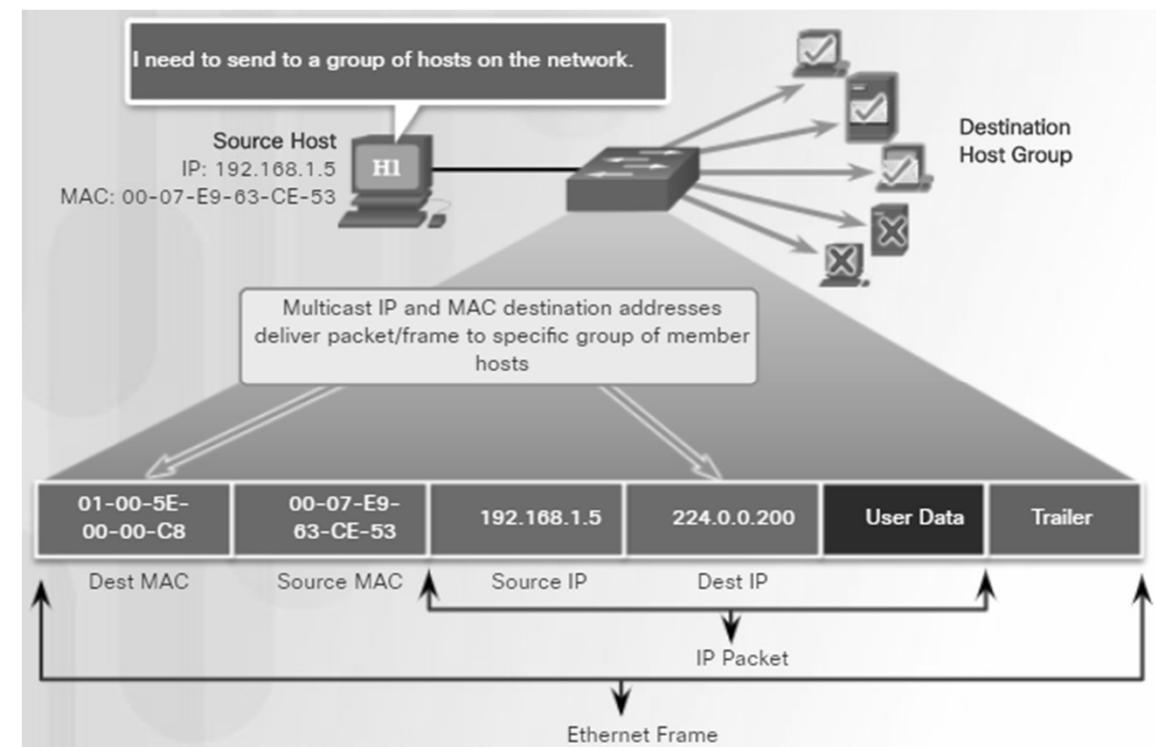
# Broadcast MAC Address

- 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.

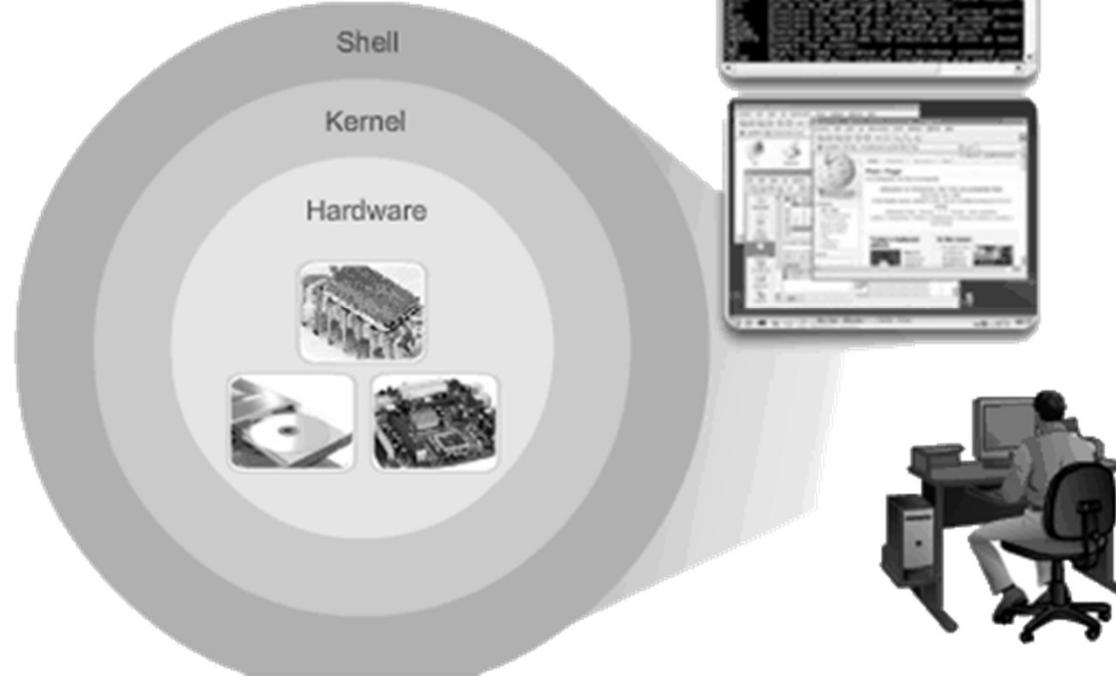


# MAC Address Representations

- 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



**Shell:** The user interface that allows users to request specific tasks from the computer. These requests can be made either through the CLI or GUI interfaces.

**Kernel:** Communicates between the hardware and software of a computer and manages how hardware resources are used to meet software requirements.

**Hardware:** The physical part of a computer including underlying electronics.

# 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.
    - 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
  - Run boot loader software
  - 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.

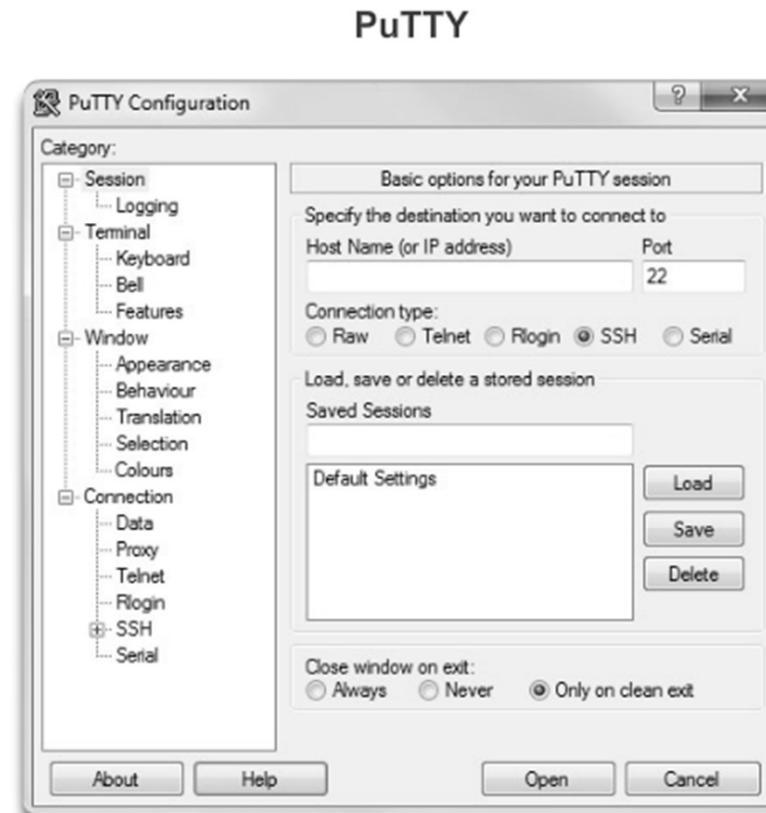
# Accessing a Cisco IOS Device

- Console port
- Telnet
- Secure Shell (SSH)
- Aux Port



# Accessing a Cisco IOS Device

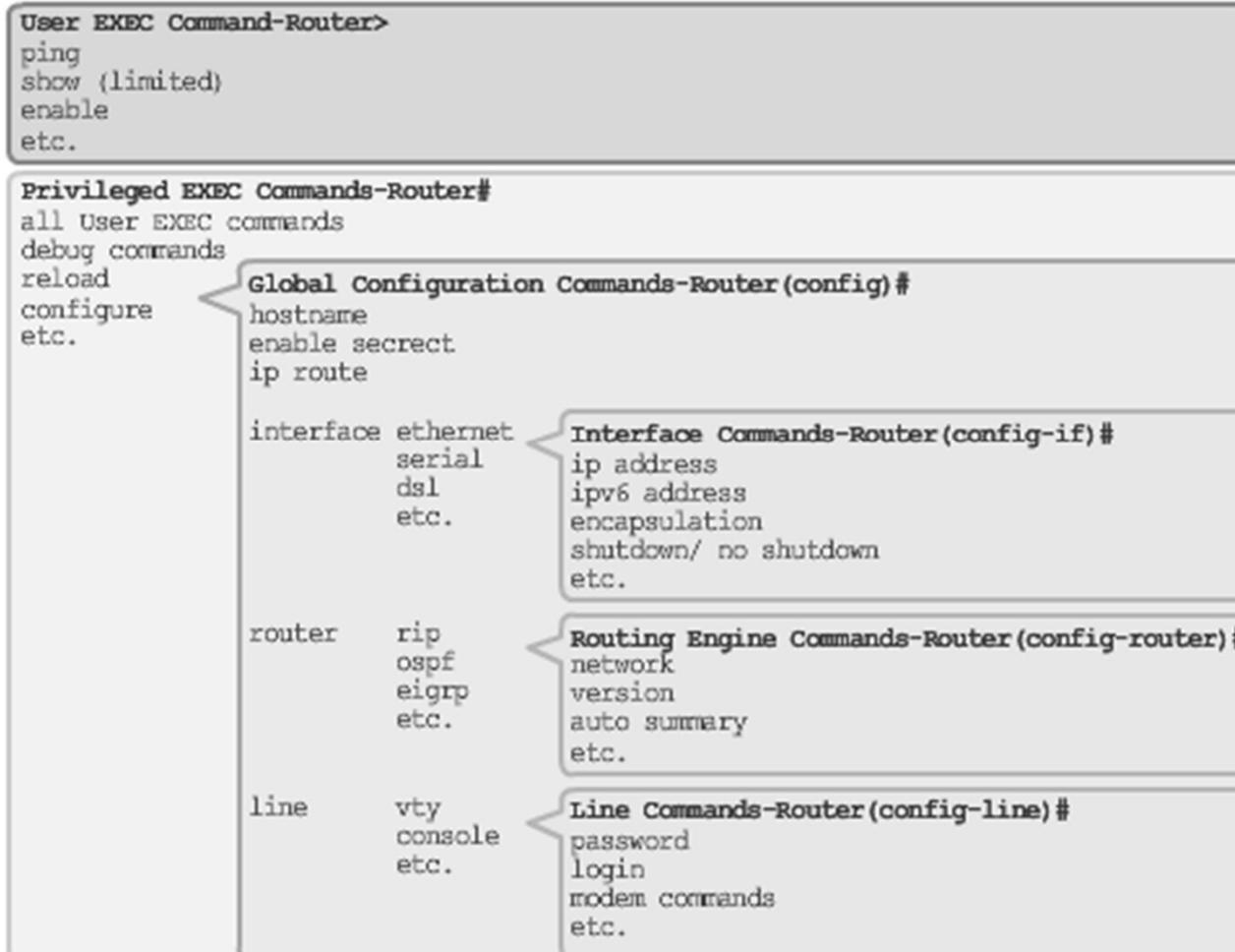
- Terminal Emulation Programs
  - Software available for connecting to a networking device
    - PuTTY
    - Tera Term
    - SecureCRT
    - HyperTerminal
    - OS X Terminal



# Navigating the IOS

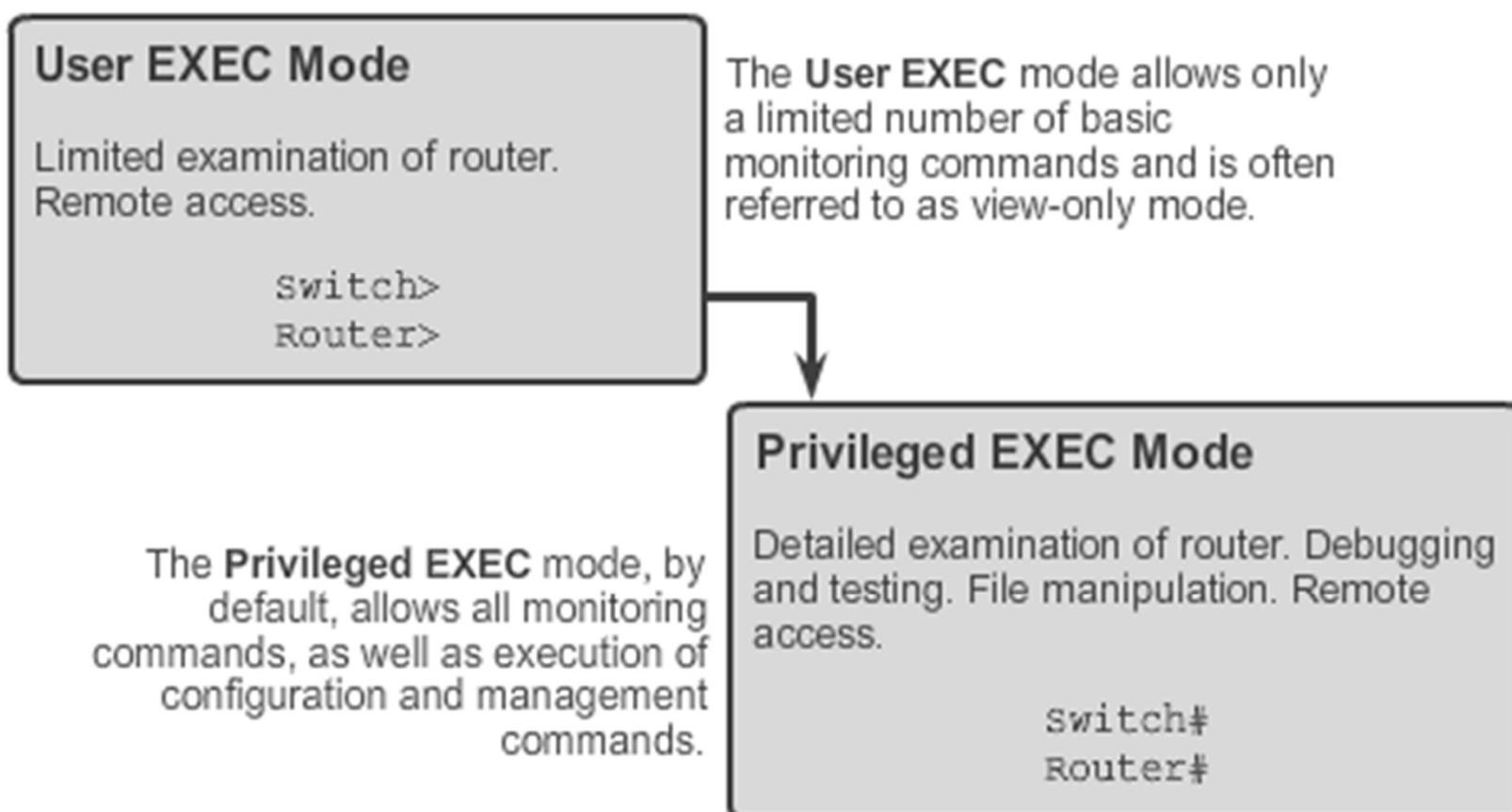
- Cisco IOS Modes of Operation

## IOS Mode Hierarchical Structure



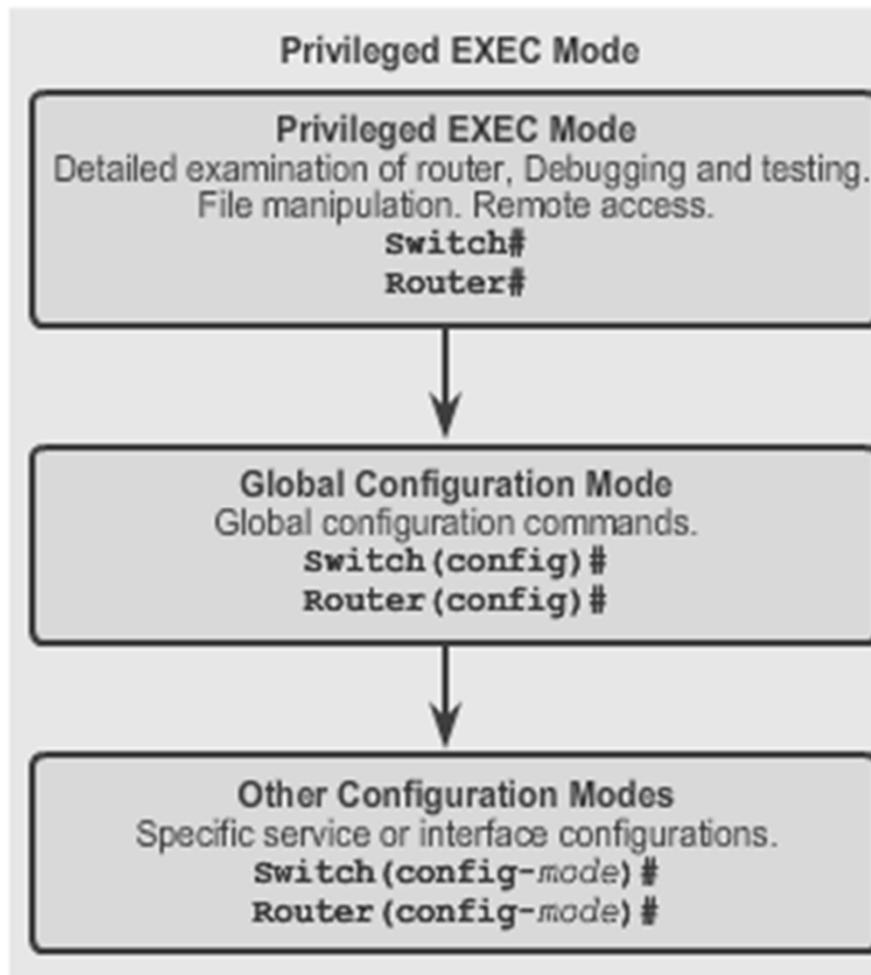
# Navigating the IOS

- Primary Modes



# Navigating the IOS

- Global Configuration Mode and Submodes



## IOS Prompt Structure

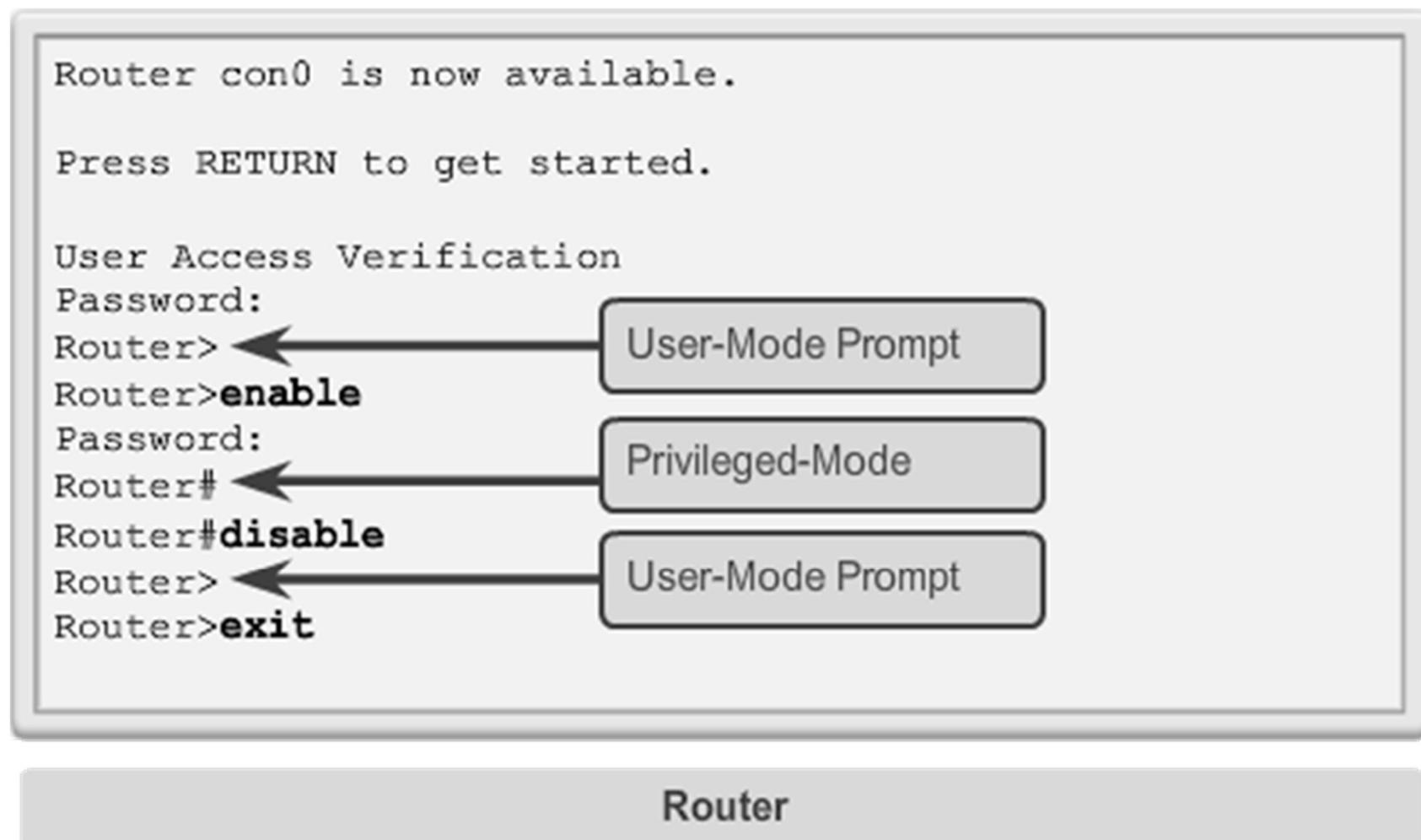
```
Router>ping 192.168.10.5  
Router#show running-config  
Router(config)#Interface FastEthernet 0/0  
Router(config-if)#ip address 192.168.10.1 255.255.255.0
```

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
```

# Navigating the IOS

- Navigating between IOS Modes



# Navigating the IOS

- Navigating between IOS Modes

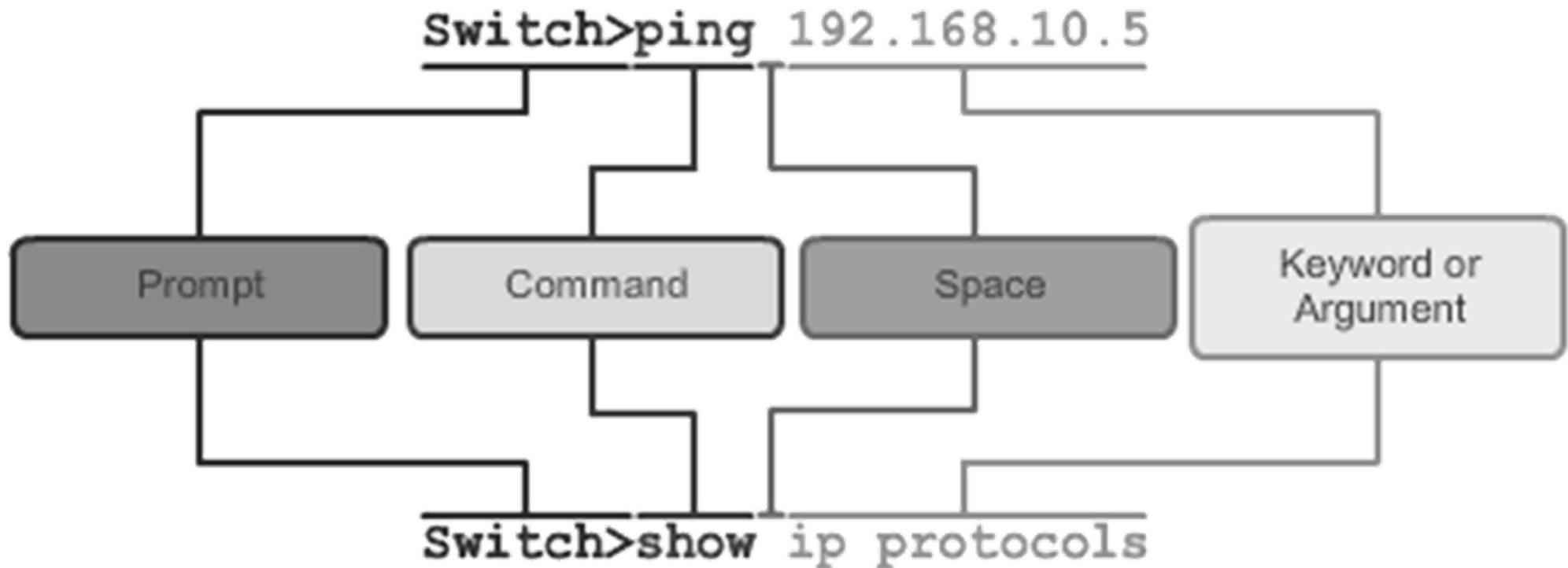
```
Switch>enable  
Switch#configure terminal  
Enter configuration commands, one per line.  
End with CNTL/Z.  
Switch(config)#interface vlan 1  
Switch(config-if)#exit  
Switch(config)#exit  
Switch#
```

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

# The Command Structure

- IOS Command Structure



# The Command Structure

- Context Sensitive Help
- Command Syntax Check
- Hot Keys and Shortcuts
- IOS Examination Commands

# 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.
```

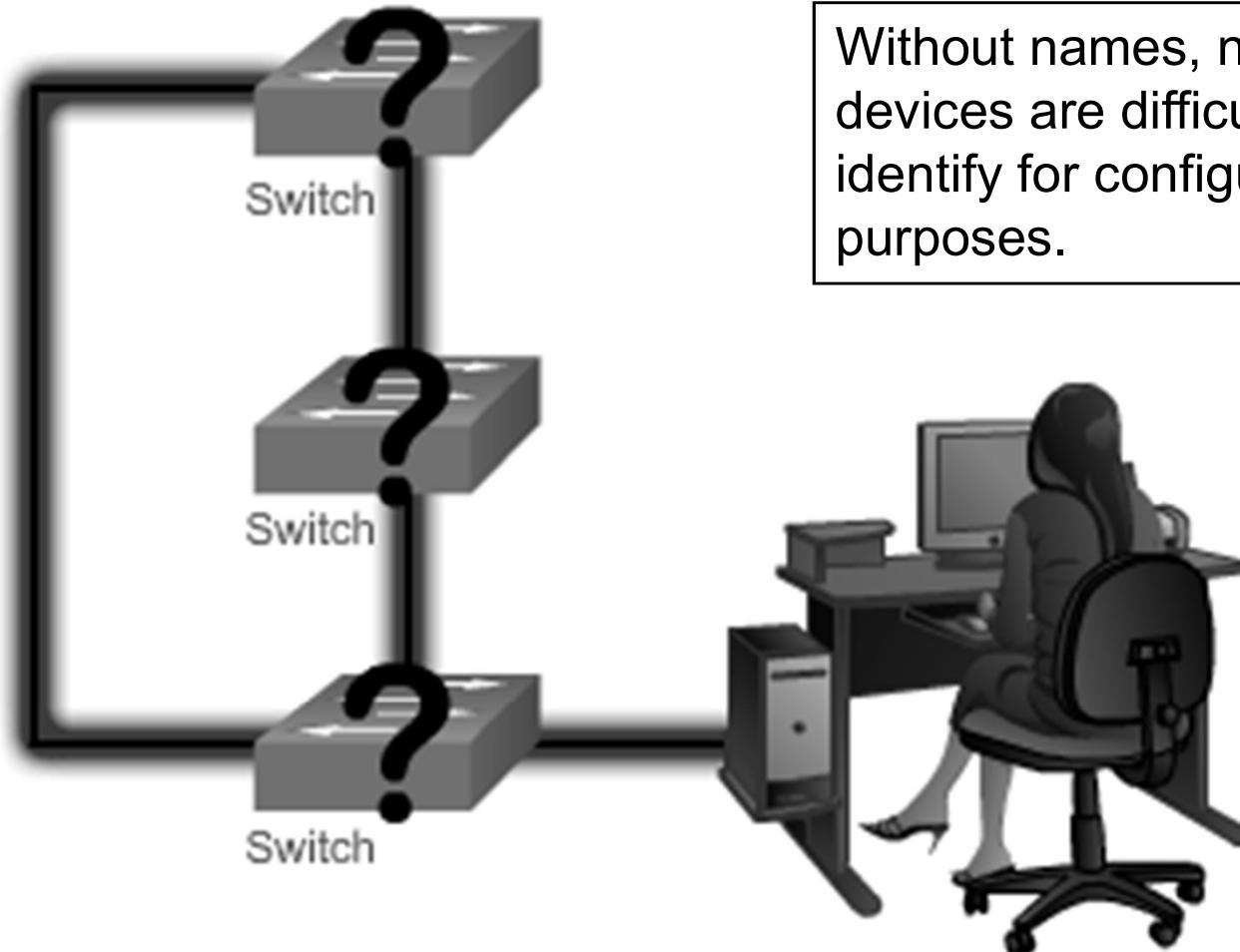
```
Router#show version
```

# Getting Basic

- Hostnames
- Limiting Access to Device Configurations
- Addressing Devices
- Verifying Connectivity
- Saving Configurations

# Getting Basic

- **Hostnames**



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

# Getting Basic

- **Hostnames**
  - Configuring Hostnames

# Getting Basic

- Limiting Access to Device Configurations
  - Banner Messages
  - Securing Device Access
    - Enable password
    - Enable secret
    - Console password
    - VTY password
    - Encrypting Password Display

# 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

```
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
```

# Getting Basic

- Limiting Access to Device Configurations
  - Enable password

# Getting Basic

- Limiting Access to Device Configurations
  - Enable secret

# Getting Basic

- Limiting Access to Device Configurations
  - Console password & VTY password

# 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

```

CE-floor-7#show running-config
Building configuration...
...
no service password-encryption
!
hostname CE-floor-7
!
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1
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
CE-floor-7(config)#service password-encryption
CE-floor-7(config)#exit

CE-floor-7#show running-config
Building configuration...
...
service password-encryption
!
hostname CE-floor-7
!
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCi1
enable password 7 08224F4008
!
!
!
line con 0
password 7 082A41471D15
login
!
line aux 0
!
line vty 0 4
password 7 0822455D0A16
login
line vty 5 15
password 7 0822455D0A16
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/sublot/port
```

- Switch virtual interfaces (SVIs)

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

- Set the IP address of an interface

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

# Getting Basic

- **Verifying Connectivity**

**Router#show running-config**

**Router#show startup-config**

**Router#show ip route**

**Router#show interfaces**

**Router#show ip interface**

**Router#show ip interface brief**

**Router#traceroute**

**Router#ping**

**PC>ping**

**PC>tracercere**

**PC>route print**

**PC>nslookup**

# 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-floor-7>enable
Password:
CE-floor-7#show startup-config
startup-config is not present
CE-floor-7#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
CE-floor-7#
```

IOS Command Line Interface

```
CE-floor-7#show startup-config
startup-config is not present
CE-floor-7#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
CE-floor-7#show startup-config
Using 733 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname CE-floor-7
!
!
!
enable secret 5 $1$mERr$9cTjUIEqNGurQiFU.ZeCiI
enable password 7 08224F4008
!
!
!
!
ip cef
no ipv6 cef
!
--More--
```

# Questions and Answers

