I341 TCP/IP Protocol and Addressing

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Application			Telnet	FTP	SMTP	DNS	SNMP

OSI Model	TCP/IP Protocol Suite
Application / **Presentation** / **Session**	Telnet, FTP, SMTP, DNS, SNMP
Transport	(TCP) Transmission Control Protocol / (UDP) User Datagram Protocol
Network	(IP) Internet Protocol / ARP
Data Link Control (Logical Link Control) / MAC Media Access Contol	Ethernet IEEE 802.3 / Token Bus IEEE 802.4 / Token Ring IEEE 802.5 / Wireless IEEE 802.11
Physical	

TCP Header

Source Port	Destination Port

Sequence Number

Acknowledgement Number

Misc Flags	Window (Flow Cntl)

Checksum	Urgent

Options

TCP/IP User Application Protocols

FTP (File Transfer Protocol) - allows the user to send or retrieve entire files interactively. The user can remove files, list directories, get the status of the file transfer and rename files. FTP follows a client/server mode; a client send commands and interacts with the user, a server receives and responds to the commands.

SMTP (Simple Mail Transfer Protocol) is an electronic mail protocol which uses a TCP virtual circuit to transmit and relay mail. SMTP implementations usually return undeliverable mail automatically. SMTP is address oriented, rather than route oriented so the user does not need to specify a particular path to the receive (although he has that option).

TELNET (Remote Access Protocol) is an interactive, remote access, terminal protocol, allowing the user to log in and use a remote computer system on the network as though your terminal were directly connected to the remote machine. TELNET options permit negotiation of terminal and data characteristics (i.e. 3720, VT100...).

Domain Name Services (DNS) enables a device to be referenced by a special name (as opposed to a TCP/IP number). In this manner a computer such as homer (homer@u.washington.edu) can be accessed by a common naming system.
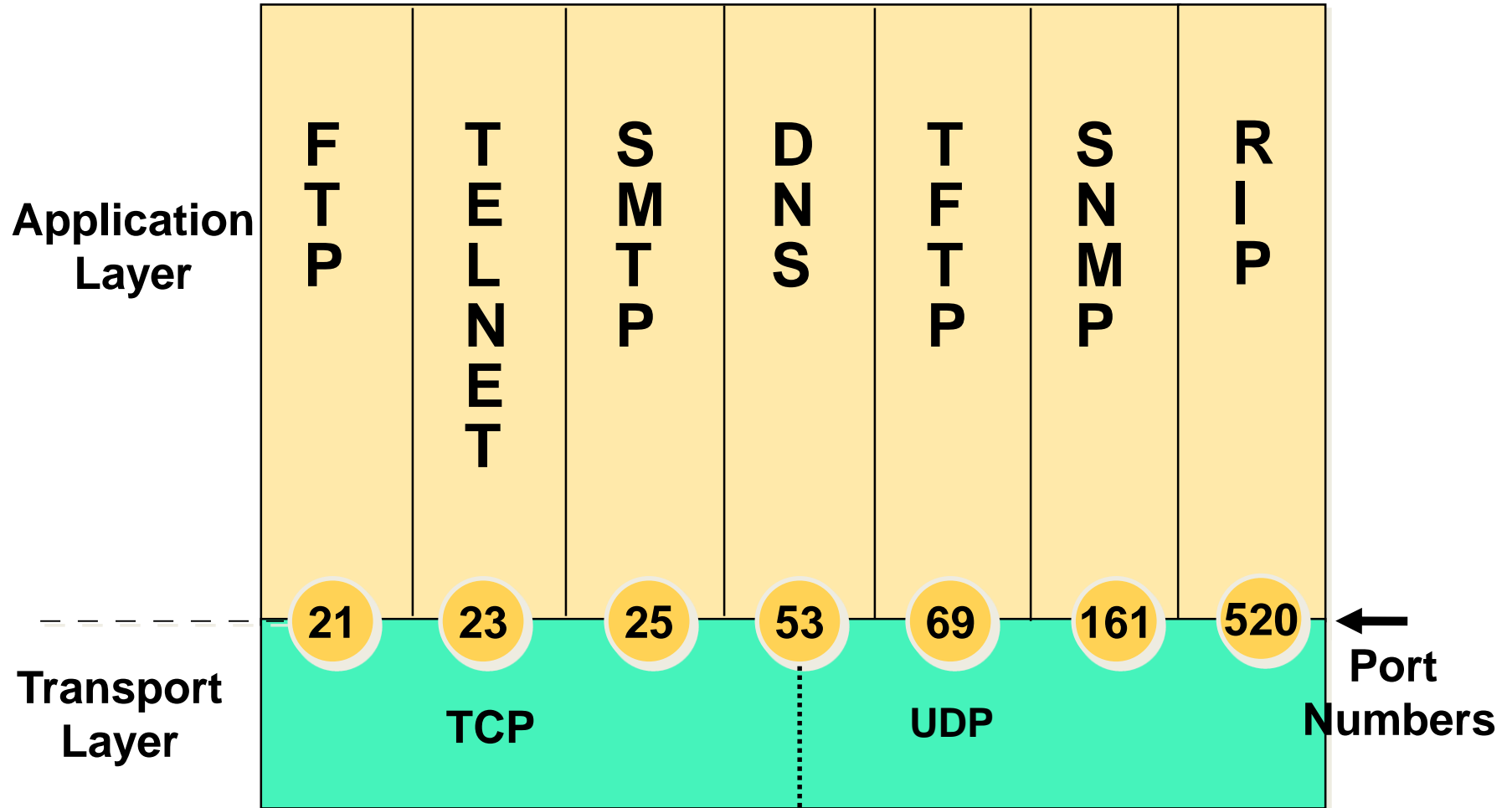
Simple Network Management Protocol (SNMP) uses SNMP agents that reside in network devices (concentrators, bridges, routers, servers) and collects data (statistics) that are transported back over UDP to a SNMP Manager.

Network File Server (NFS) is a set of protocols developed by Sun Micorsystems to allow multiple devices to access each others directories (the interconnected devices files/directories appear as if they are locally attached). This is accomplished by using a distributed filesystem scheme. NFS is commonly used by larger UNIX workstations and typically places extremely large bandwidth requirements on the network supporting it. Extremely difficult to support well over a WAN (Wide Area Network) environment.
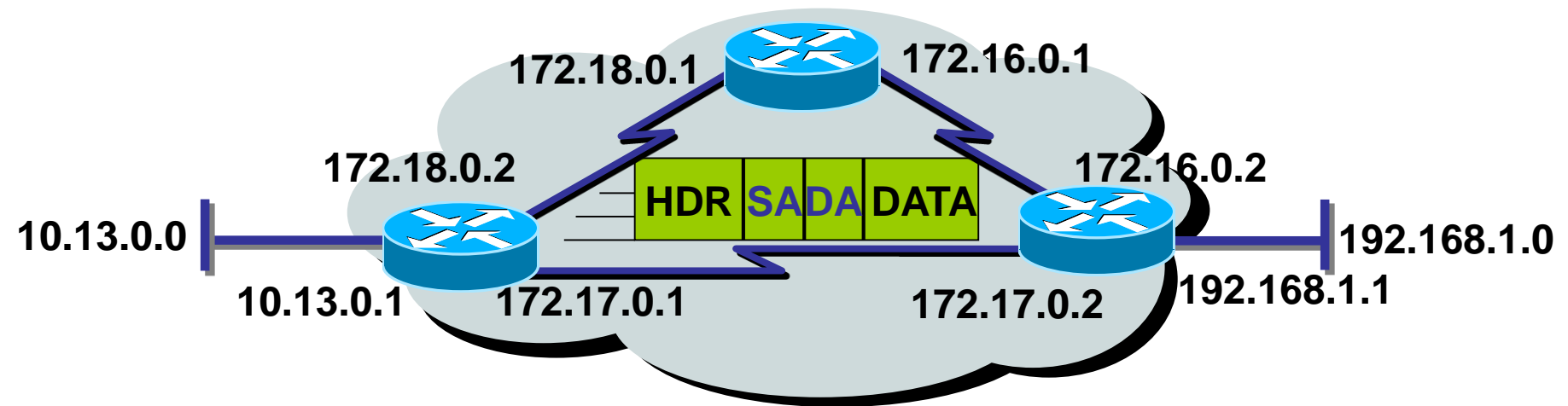
Remote Procedure Calls (RPCs) are functions that enable applications to communicate with other machines (typically servers). RPCs provide for programming functions, return codes and variables (user definable) to support distributed computing.

Trivial File Transfer Protocol (TFTP) is a simple, unsophisticated file transfer protocol that lacks error checking (uses UDP). TFTP is typically used to download images (software/microcode) to flash memory in bridges, routers or PCs.

Port Numbers

F T P	**T E L N E T**	**S M T P**	**D N S**	**T F T P**	**S N M P**	**R I P**

Application Layer

Transport Layer

21	23	25	53	69	161	520

TCP

UDP

← Port Numbers

Introduction to TCP/IP Addresses

172.18.0.1   **172.16.0.1**

172.18.0.2 | HDR | SA | DA | DATA | **172.16.0.2**

10.13.0.0   **192.168.1.0**

10.13.0.1   **172.17.0.1**   **172.17.0.2**   **192.168.1.1**
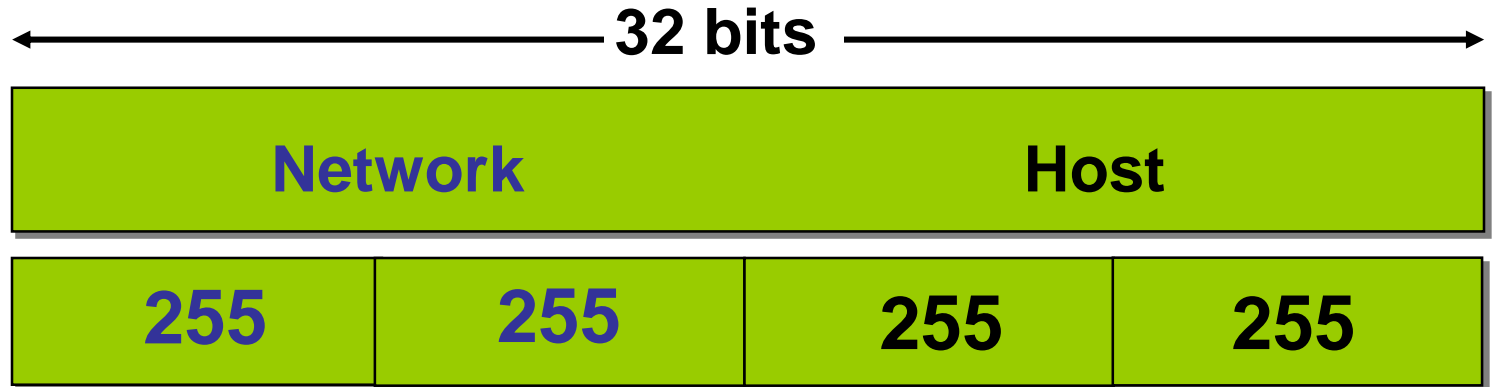
**Unique addressing allows communication
between end stations**

Path choice is based on location

Location is represented by an address

IP Addressing (Dotted Decimal)

32 bits

Dotted Decimal

Network	Host

Maximum
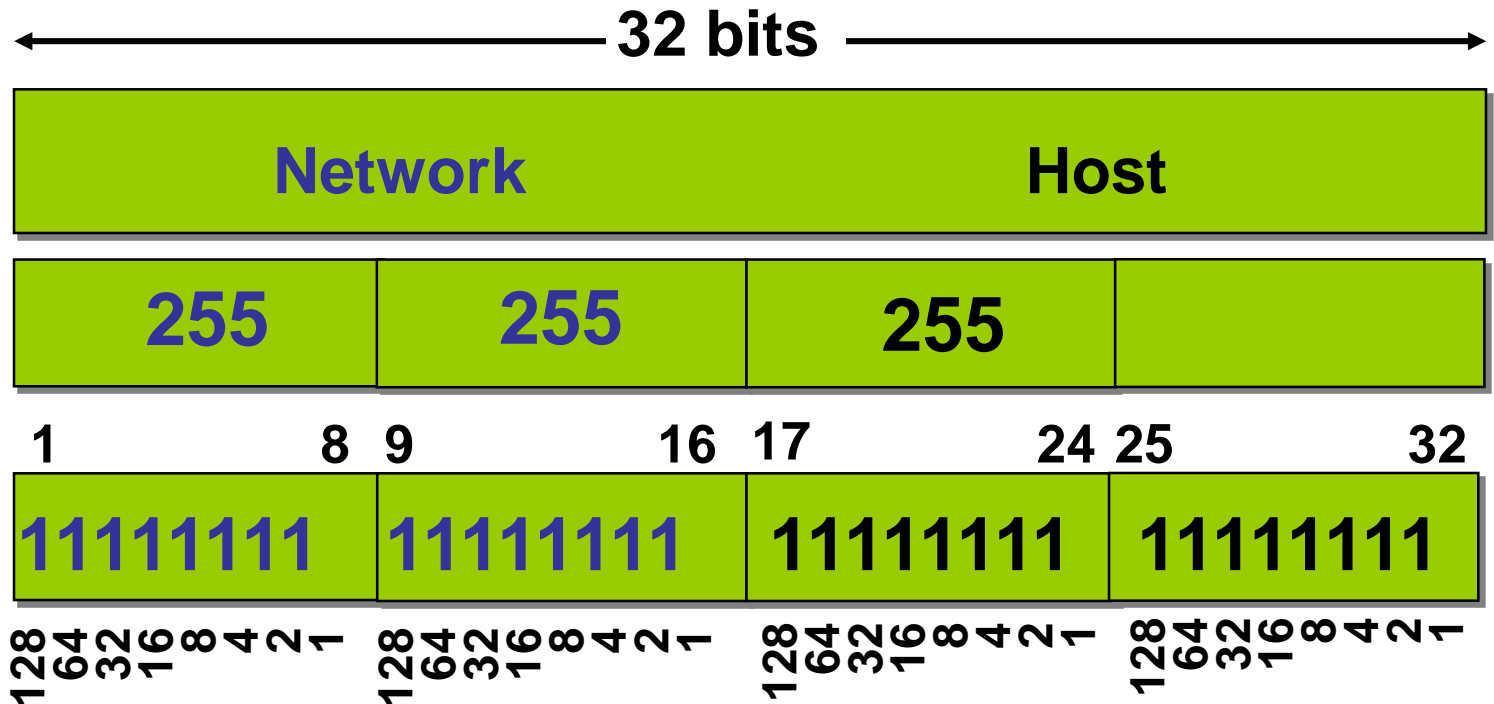
255	255	255	255

IP Addressing

32 bits

Dotted Decimal	Network		Host

Maximum	255	255	255

	1 — 8	9 — 16	17 — 24	25 — 32
Binary	11111111	11111111	11111111	11111111

128 64 32 16 8 4 2 1   128 64 32 16 8 4 2 1   128 64 32 16 8 4 2 1   128 64 32 16 8 4 2 1

IP Address Classes

8 bits	8 bits	8 bits	8 bits

- Class A: | **Network** | **Host** | **Host** | **Host** |

- Class B: | **Network** | **Network** | **Host** | **Host** |

- Class C: | **Network** | **Network** | **Network** | **Host** |

- Class D: Multicast

- Class E: Research

IP Address Classes

| Bits: | 1 | 8 | 9 | 16 | 17 | 24 | 25 | 32 |

Class A:

| 0NNNNNNN | Host | Host | Host |

Range (1-126)

| Bits: | 1 | 8 | 9 | 16 | 17 | 24 | 25 | 32 |

Class B:

| 10NNNNNN | Network | Host | Host |

Range (128-191)

| Bits: | 1 | 8 | 9 | 16 | 17 | 24 | 25 | 32 |

Class C:

| 110NNNNN | Network | Network | Host |

Range (192-223)

| Bits: | 1 | 8 | 9 | 16 | 17 | 24 | 25 | 32 |

Class D:

| 1110MMMM | Multicast Group | Multicast Group | Multicast Group |
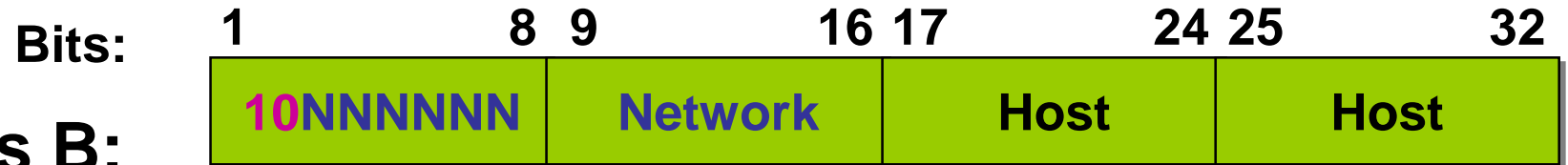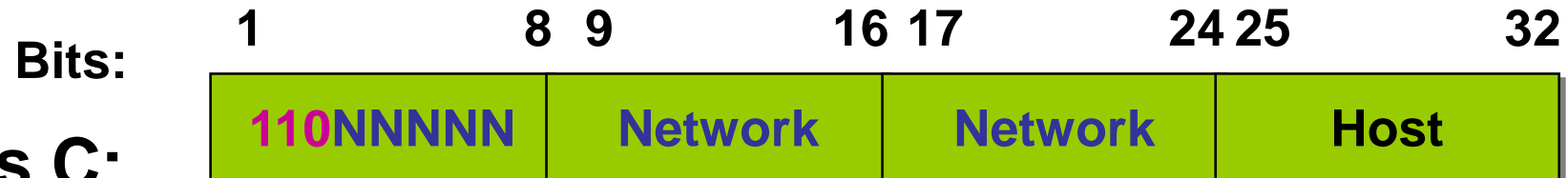
Range (224-239)

Addressing w/out Subnetting

172.16.0.1 172.16.0.2 172.16.0.3   172.16.254.253 172.16.254.254

…...
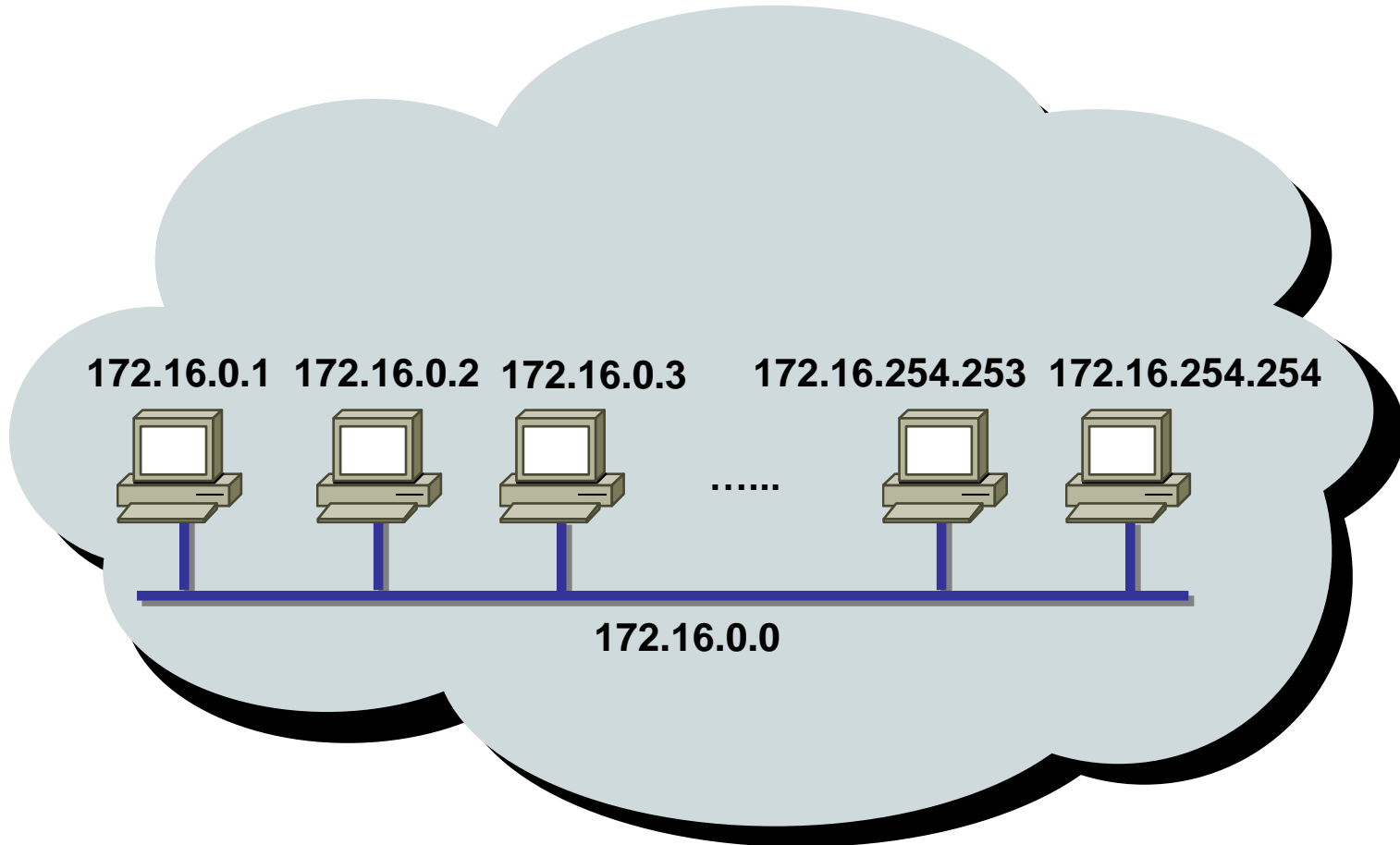
172.16.0.0

Network 172.16.0.0

Addressing with Subnets

172.16.3.0

172.16.4.0

172.16.1.0

172.16.2.0
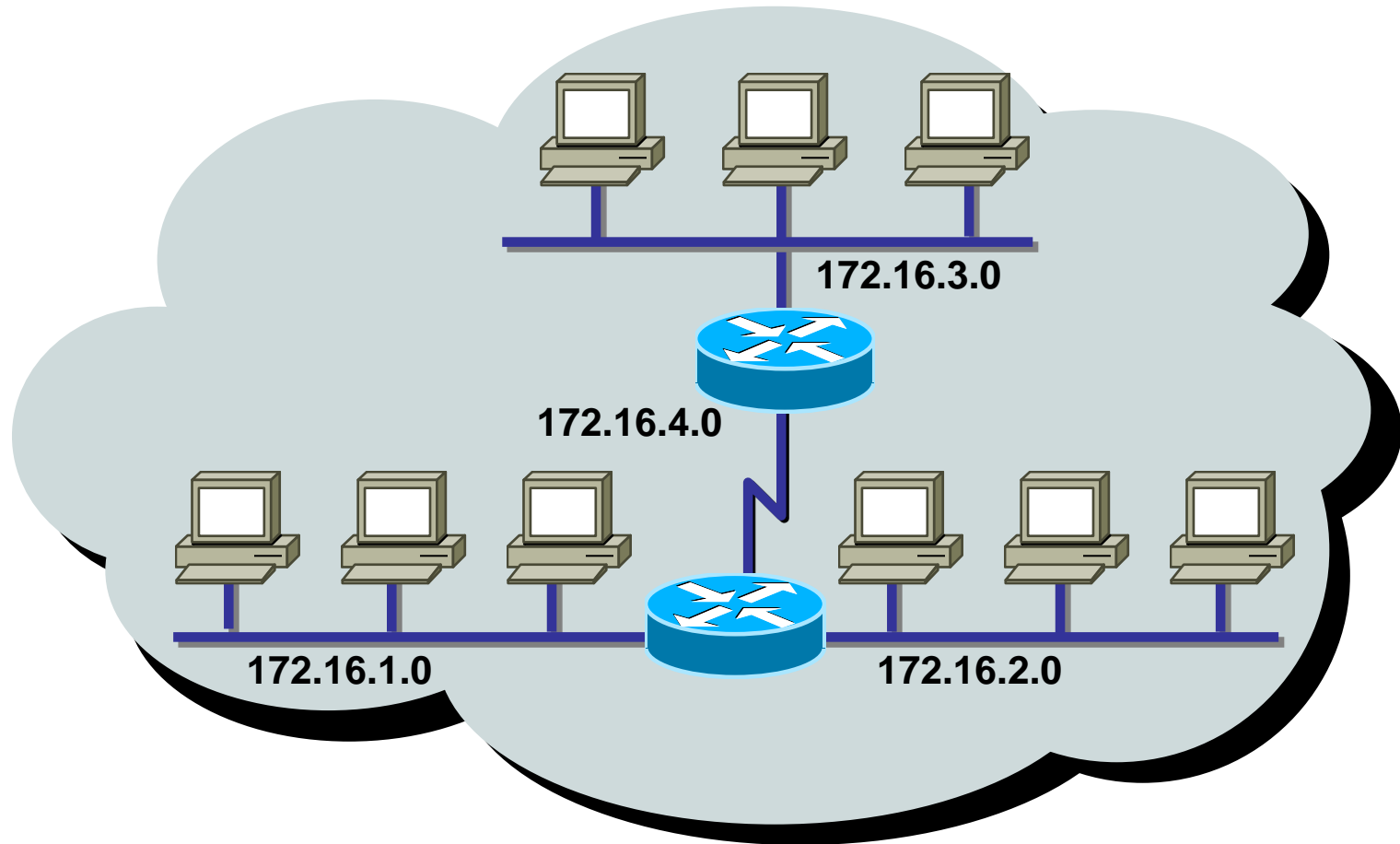
Network 172.16.0.0

TCP/IP Addressing

Subnet Mask − *what portion of the address is network add, and what portion of the address is host.*
Broadcast Add – *to everyone on my network/subnetwork*

IP address matrix (N – Network H – Host Bits)

A NNN	HHH	HHH	HHH
B NNN	NNN	HHH	HHH
C NNN	NNN	NNN	HHH

Internet (IP) Addressing

Class A Address: AAA.XXX.XXX.XXX

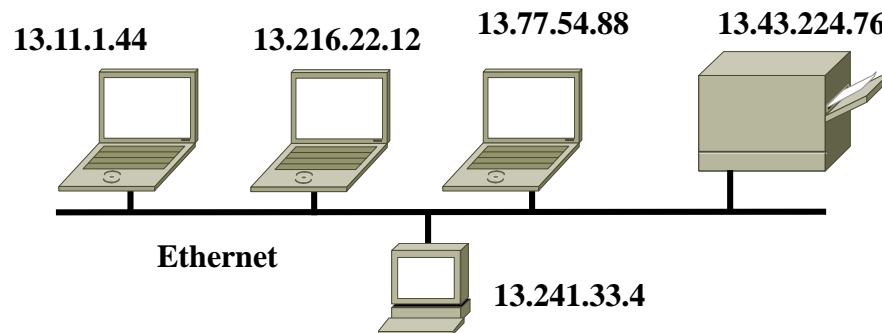**AAA = Network Address**   **XXX.XXX.XXX = Host Address**

Network Number   **Host Number**

7 bits		24 bits		
0	**1 - 127**	**0 - 254**	**0 - 254**	**0 - 254**
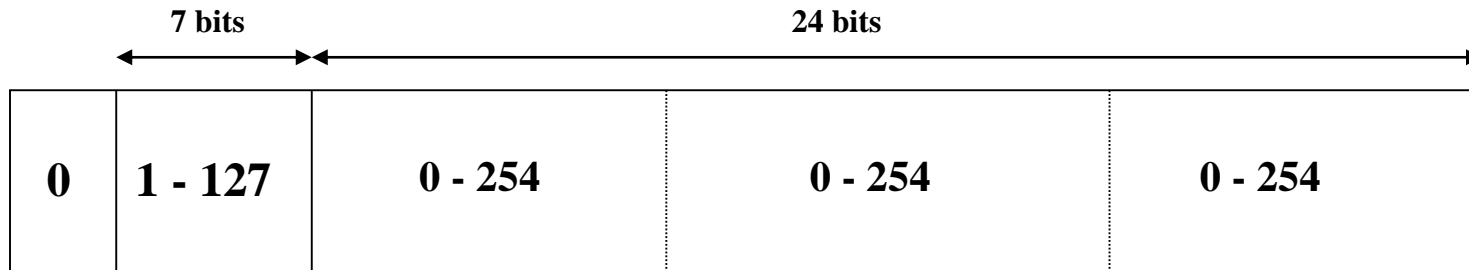
↑
Reserved

Class A Address: 0 – 127.xxx.xxx.xxx

13.11.1.44   13.216.22.12   13.77.54.88   13.43.224.76

Ethernet

13.241.33.4

Class A Addresses:

57.24.36.2 (Net 57.0.0.0)

12.21.63.228 (Net 12.0.0.0)

Internet (IP) Addressing

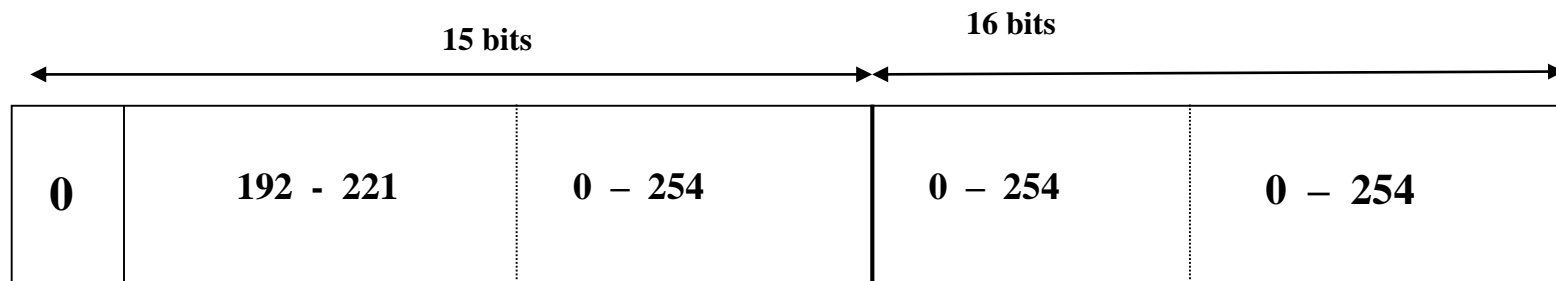## Class B Address: BBB.BBB.XXX.XXX

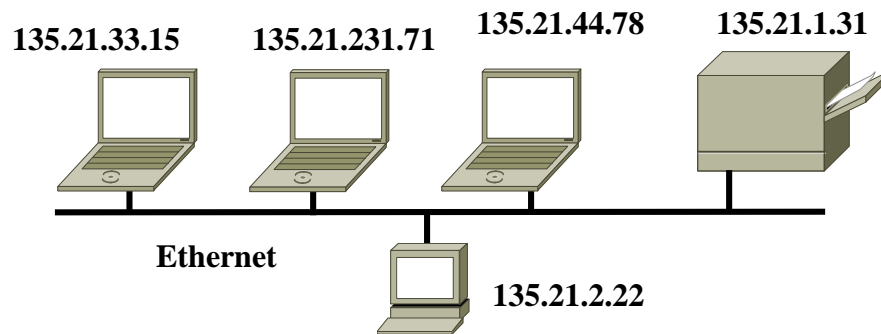**BBB.BBB = Network Address**   **XXX.XXX = Host Address**

Network Number   Host Number

15 bits   16 bits

0	192 - 221	0 – 254	0 – 254	0 – 254

↑
Reserved

Class B Address: 128 – 191.1-254.xxx.xxx

135.21.33.15   135.21.231.71   135.21.44.78   135.21.1.31

Ethernet

135.21.2.22

Class B Addresses:

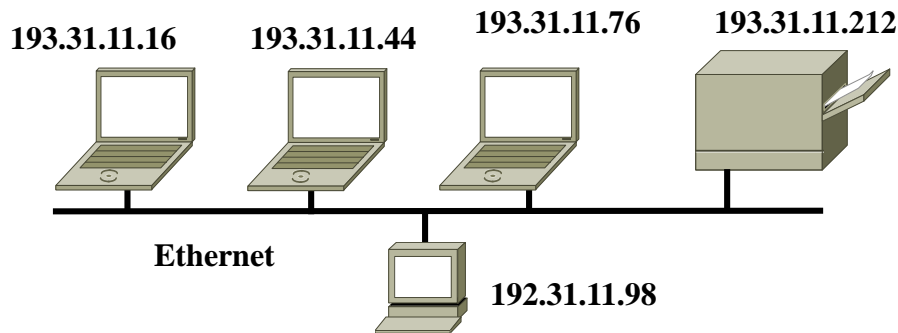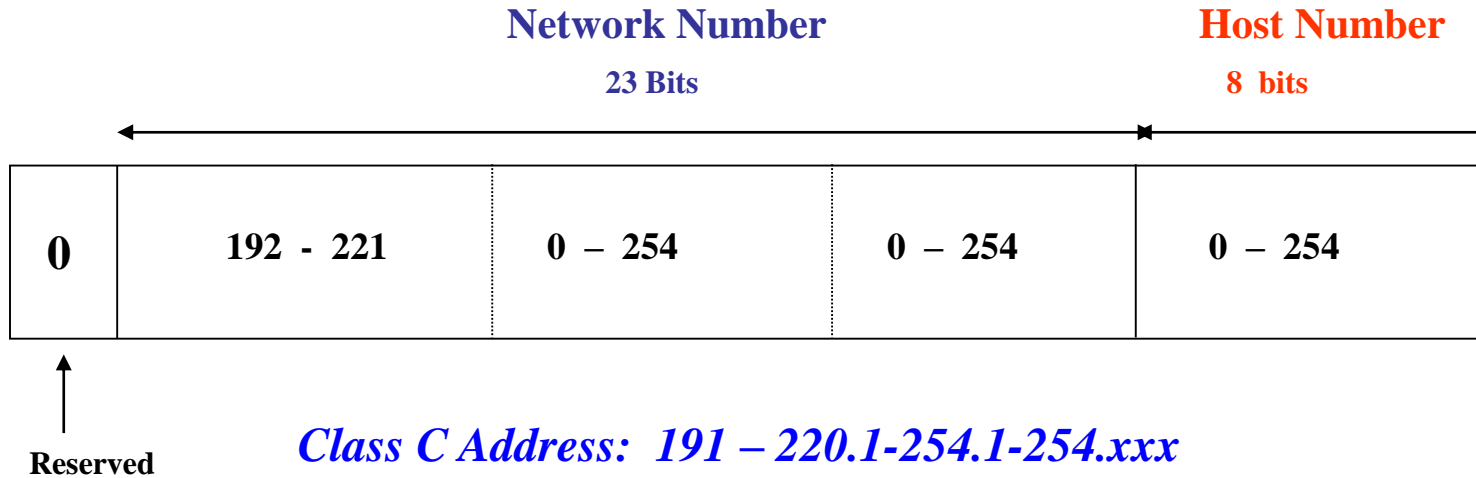137.137.76.41 (Net 137.137.0.0)

144.116.91.112 (Net 144.116.0.0)

Internet (IP) Addressing

Class C Address: CCC.CCC.CCC.**XXX**

CCC.CCC.CCC = Network Address   **XXX = Host Address**

	Network Number 23 Bits			Host Number 8 bits
0	192 - 221	0 – 254	0 – 254	0 – 254

↑
Reserved

Class C Address: 191 – 220.1-254.1-254.xxx

193.31.11.16   193.31.11.44   193.31.11.76   193.31.11.212

Ethernet

192.31.11.98

Class C Addresses:

193.241.16.**21** (Net 193.241.16.**0**)

194.16.191.**11** (Net 194.16.191.**0**)