

# Network Communications Technology

## Chapter 19

### Internet Architecture and TCP/IP

# Connecting a Network to the Internet

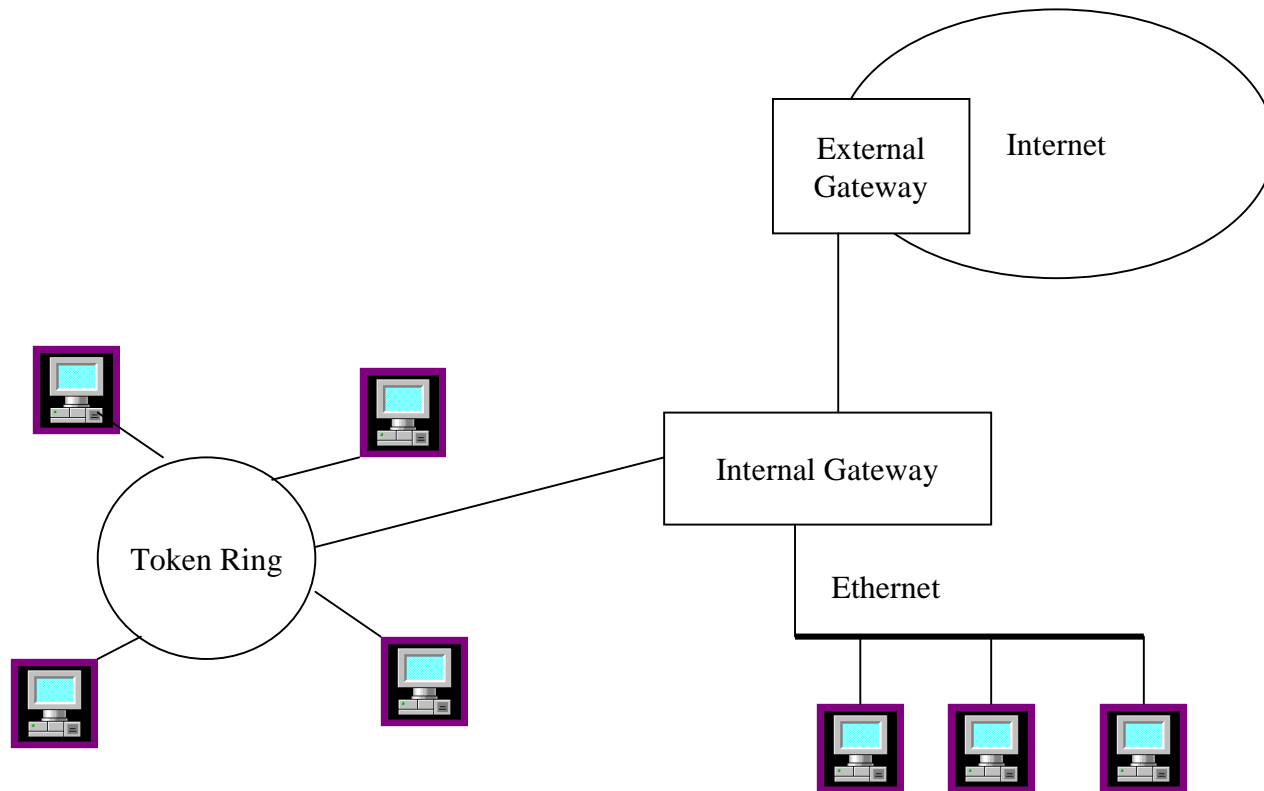


Figure 19.1

# NSFNET Backbone (1993)

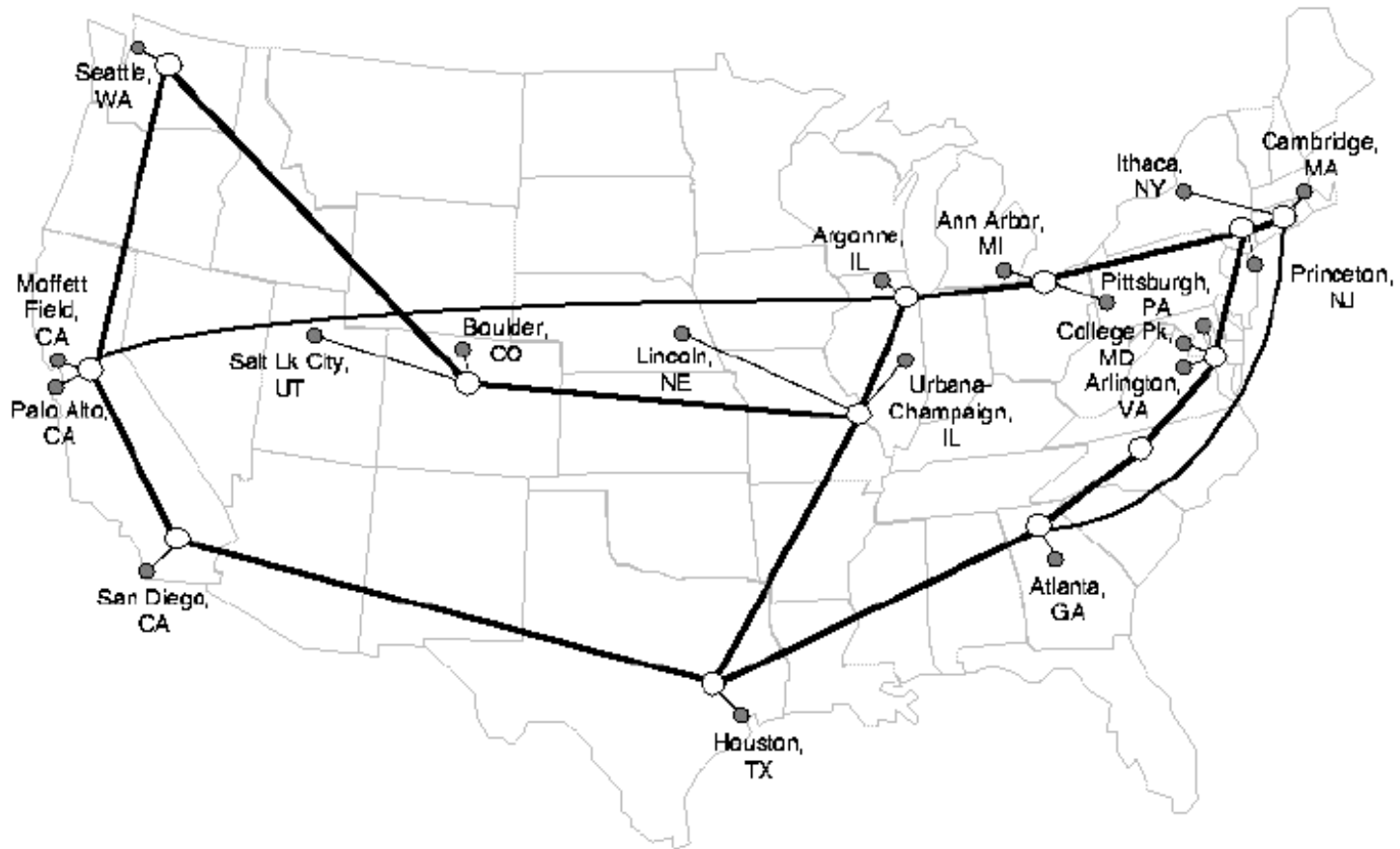


Figure 19.2

# GTE Internet Backbone (2000)

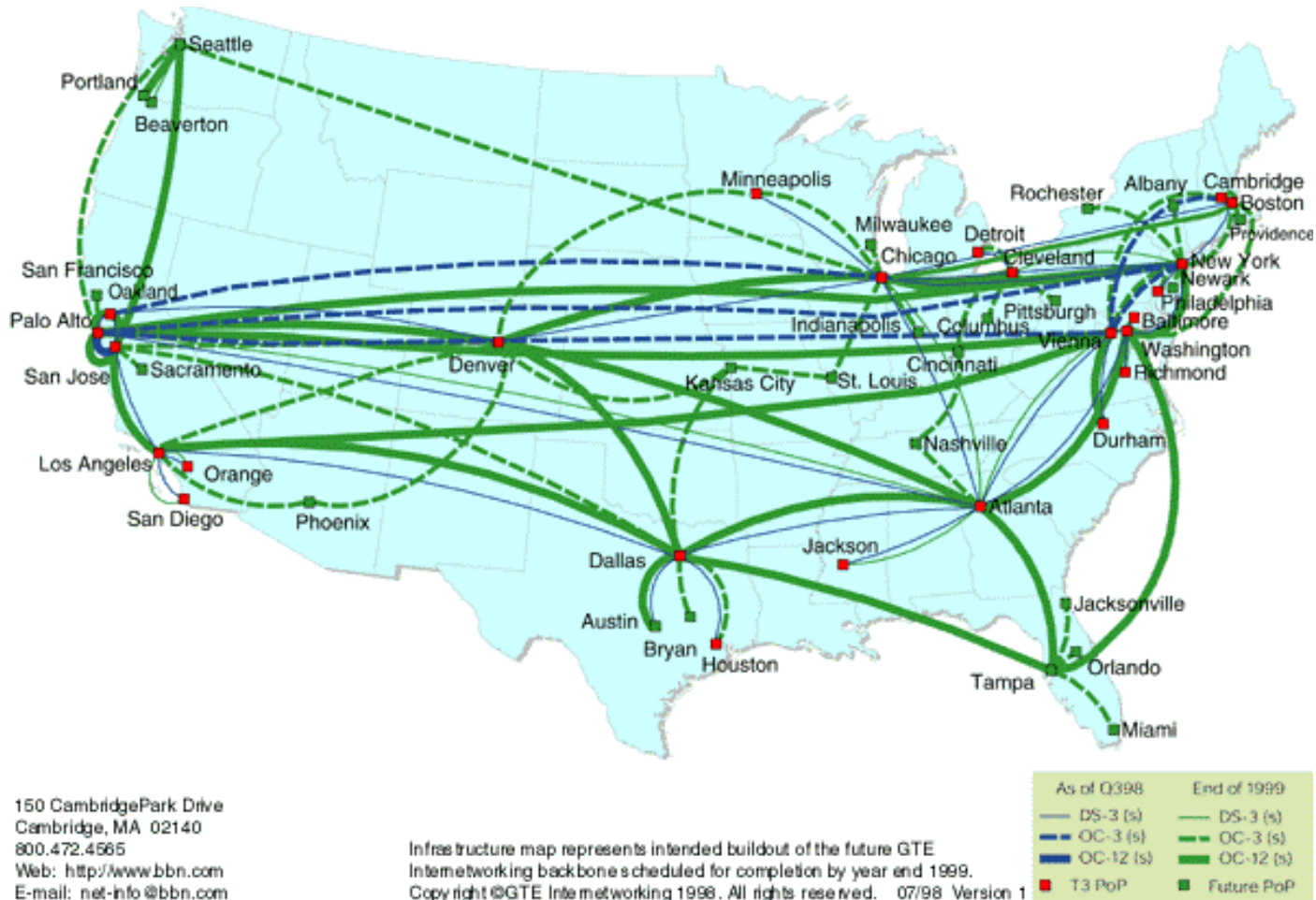


Figure 19.3:

# TCP/IP Reference Model

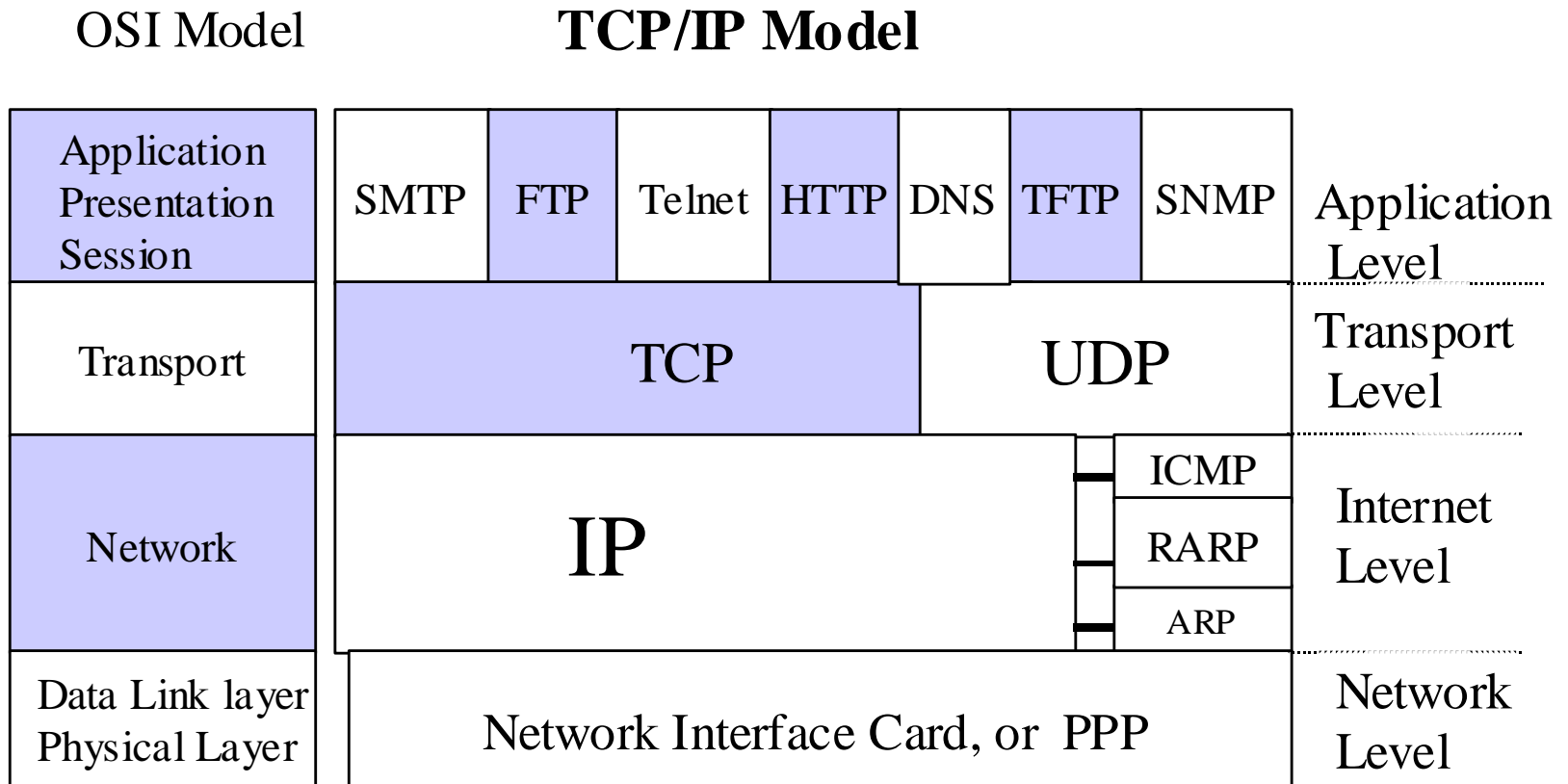


Figure 19.4

# TCP/IP Protocols

Internet Protocol (IP)	Packet Delivery between Networks
Internet Control Message Protocol (ICMP)	Transmission and Message Control between Hosts and Gateways
Address Resolution Protocol (ARP)	Request Physical Address from Source
Reverse ARP	ARP Response
User Datagram Protocol (UDP)	Best Effort Service (Connectionless, no Acknowledgement)
Transmission Control Protocol (TCP)	Reliable Service (Connection)
Simple Network Management Protocol (SNMP)	Diagnostics

Table 19.1

# TCP/IP Application Level

- Simple Mail Transfer Protocol (SMTP, Port 25)
  - Send email
  - POP3 (port 110) for access to received email
- Telnet – Remote login (port 23)
- File Transfer Protocol (FTP, port 20,21, more)
- HTTP – Web Pages (Client/Server, port 80)
- Domain Name System (DNS)

# DNS Top-Level Domain Names

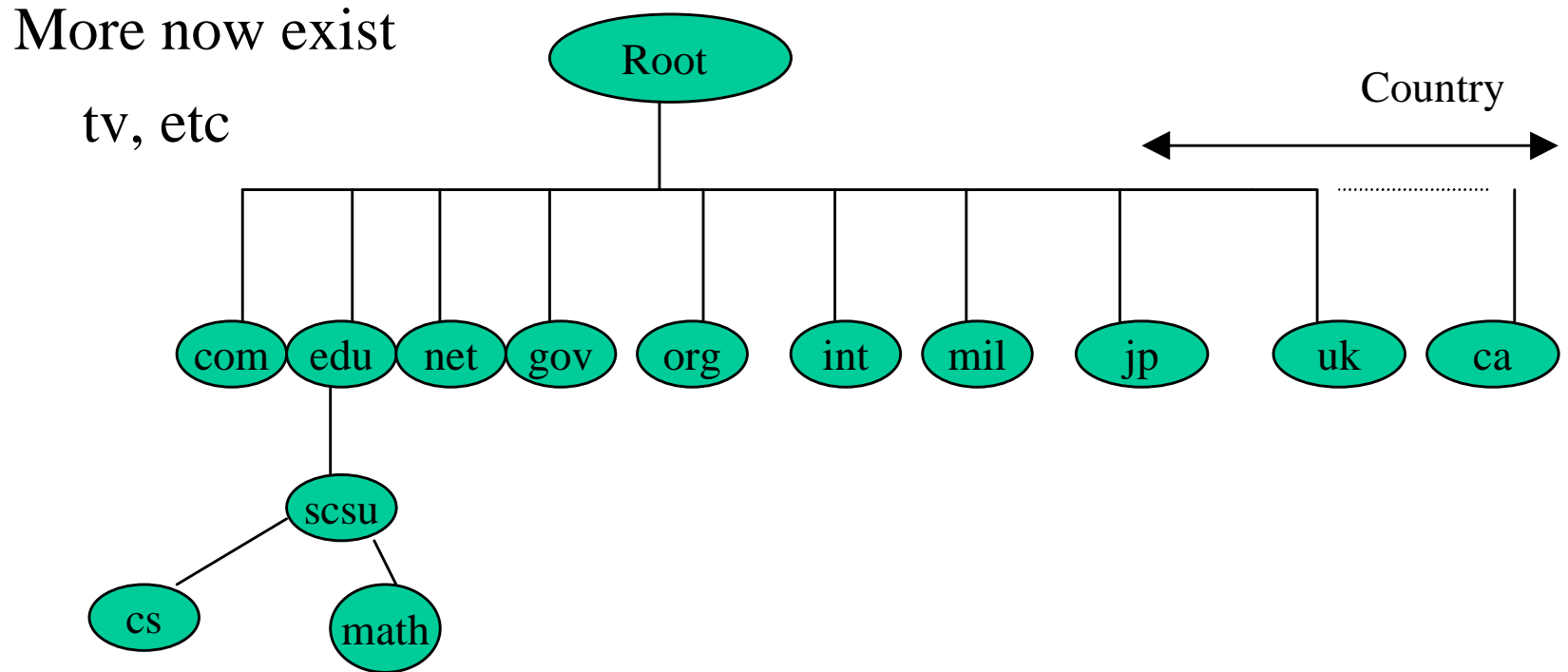


Figure 19.5



# UDP Operation

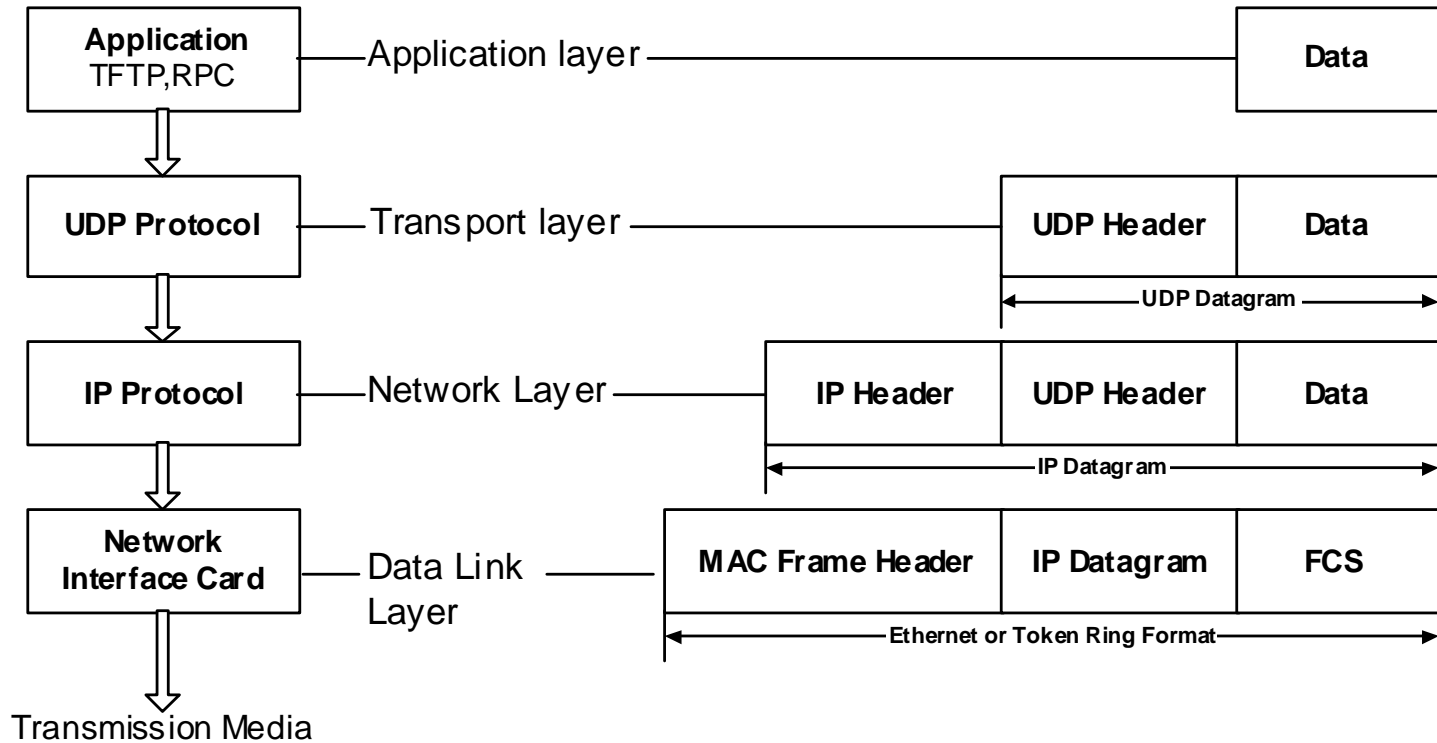


Figure 19.6

# UDP Packet Format

<b>Source Port</b> 16 bits Define application TFTP is port 69	<b>Destination Port</b> 16 bits Specifies Destination port on server
<b>UDP Length</b> 16 bits Define number of bytes in UDP header and data	<b>Check Sum</b> 16 bits Check sum use for error detection of UDP header and data
DATA	

Figure 19.7

# TCP Operation

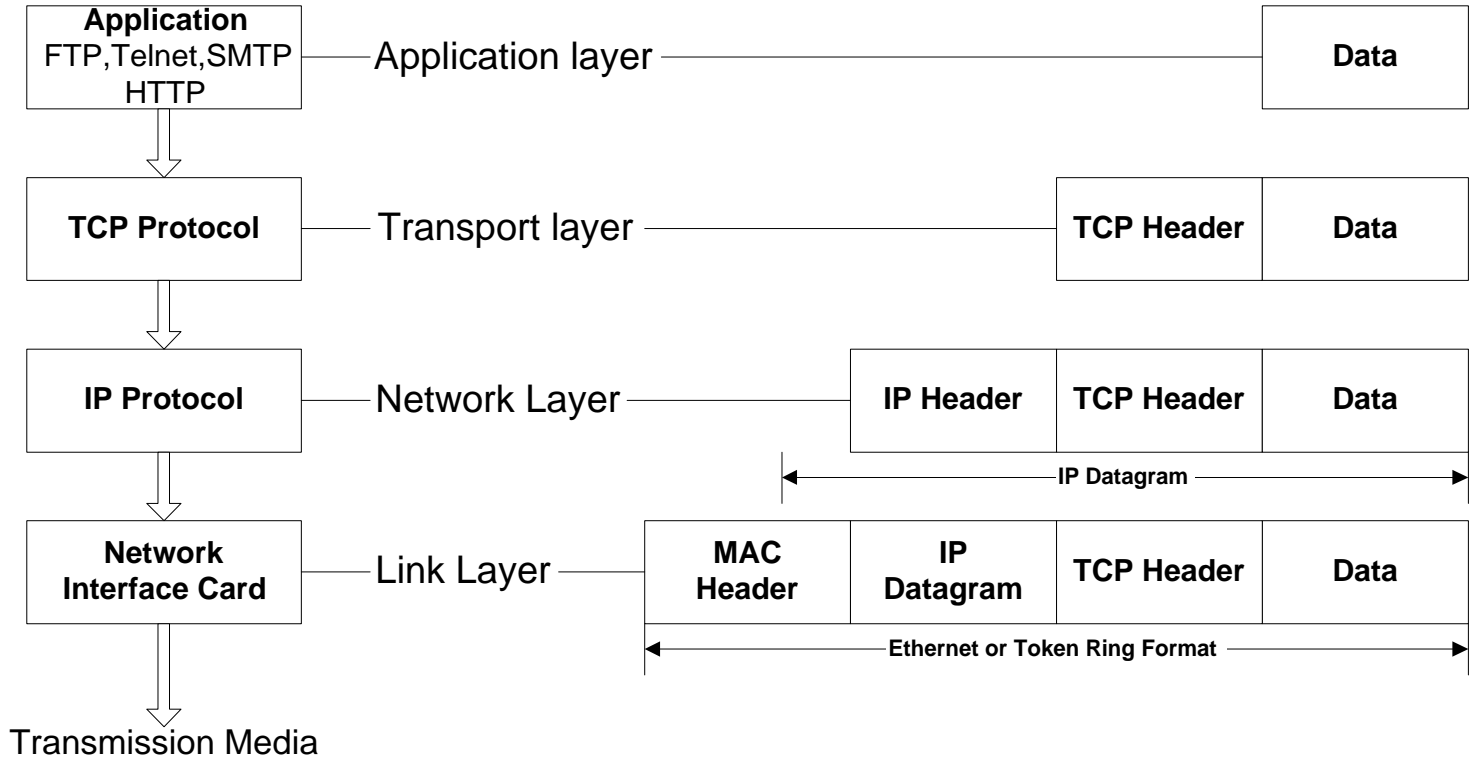


Figure 19.8

# TCP Packet Format

<b>Source Port</b> 16 bits Identifies source application program such as Telnet=23,FTP=21 and SMTP=25		<b>Destination Port</b> 16 bits Identifies which application program on the receiving side receive data	
<b>Sequence Number</b> ( 32 bits) A number assigned to the packed by the source			
<b>Acknowledgment Number</b> (32 bits) Acknowledge the next sequence number of the packet received from the source			
<b>Header Length</b> 4bits Identifies number of 32 bits word in TCP header	<b>Reserved</b> 6 bits	<b>Flag Bit</b> 6 bits	<b>Window Size</b> 16 bits, size of the buffer source
<b>TCP Checksum</b> 16 bits Used for error detection in TCP header and data field		<b>Urgent Pointer</b> 16 bits This field is valid if URG bit in flag is set	
Data if any			

Figure 19.9

# IP Datagram Packet Protocol

<b>IP VERSION</b> 4 bits (current version is 4)	<b>Header Length</b> 4 bits define number of 32 bits word in the header	<b>Type of the Service(TOS)</b> 8 bits specifies how the datagram should be handled	<b>Total Length</b> specifies the length of IP datagram including the header in bytes.
<b>Identification</b> 16 bits used by destination to identify different datagram from one file	<b>Flags</b> 3 bits currently used the first 2 bits DF and MF bits , DF=1 do not fragment, MF=1 More fragment is coming	<b>Fragment Offset</b> 13 bits contains the offset of the fragmented from the beginning of the original datagram	
<b>Time to Live TTL</b> 8 bits specifies number of routers the datagram can pass	<b>Protocol</b> 8 bits specifies the protocol which data belongs to such as TCP,UDP,ICMP	<b>Header Checksum</b> 16 bits the 16 bit one's complement sum of the header	
<b>Source IP Address</b> 32 bits IP address of sending machine			
<b>Destination IP address</b> 32 bits IP address of receiving information			
<b>Options if Any</b>	<b>Padding</b>		
<b>Data</b>			

Figure 19.10

# ARP Packet Format

<b>Hardware Type</b> 16 bits	
<b>Protocol Type</b> 16 bits	
<b>HLEN Hardware address Length</b> 8 bits	<b>PLEN IP address Length</b> 8 bits
<b>Operation Code</b> 16 bits ARP Request =1    ARP Response =2 RARP Request=3    RARP response =4	
<b>Sender Hardware Address</b> 48 bits	
<b>Sender IP Address</b> 32 bits	
<b>Target Hardware Address</b> 48 bits	
<b>Target IP Address</b> 32 bits	

Figure 19.11

# ARP / RARP

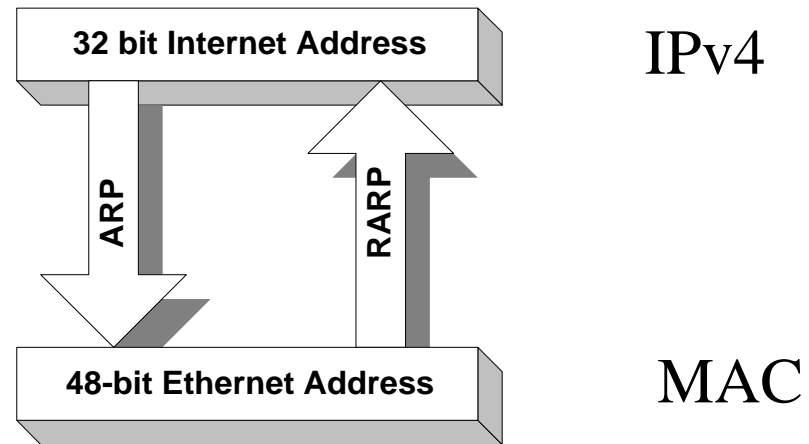


Figure 19.12:

# A Network

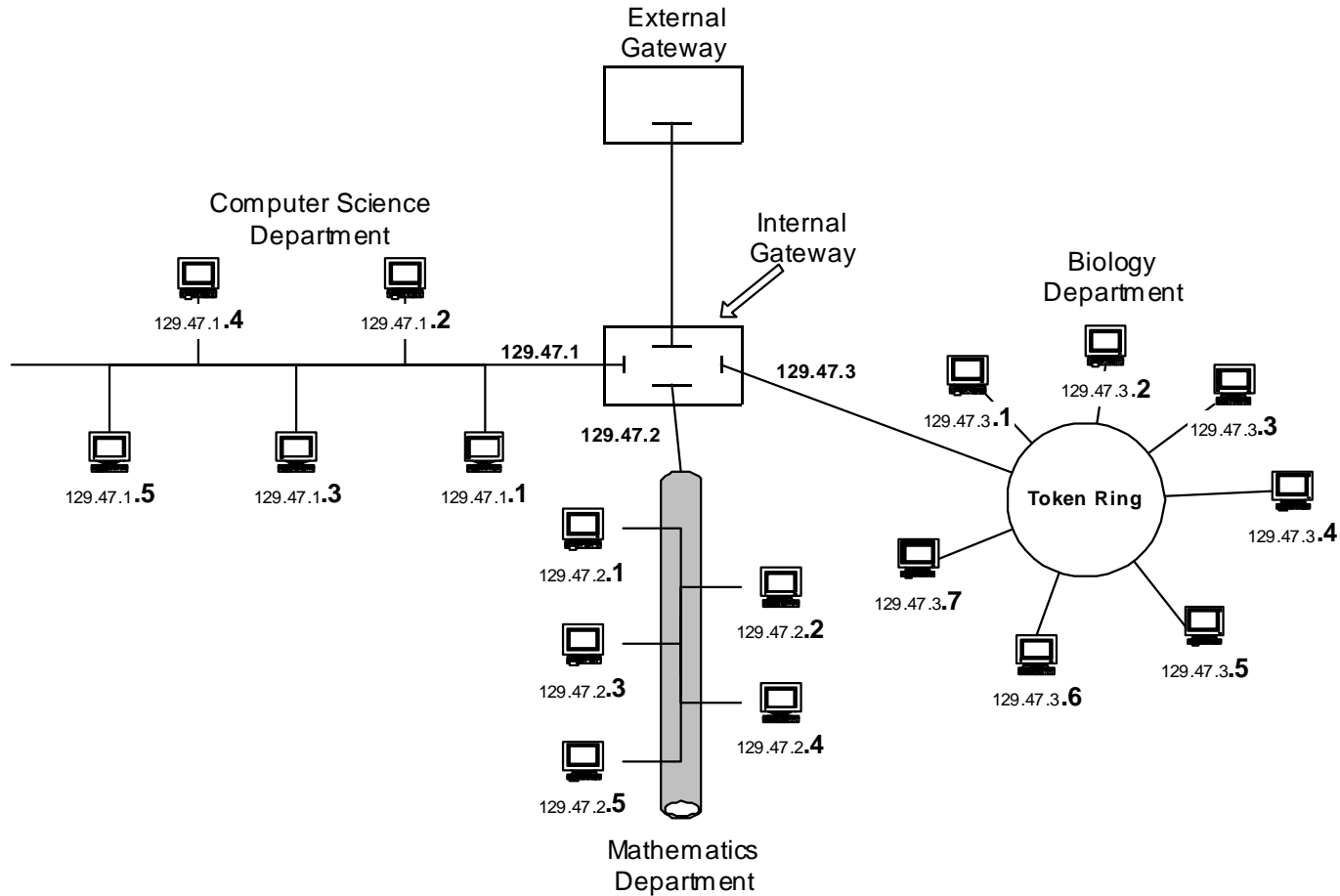


Figure: 19.13



# IPv4 Addresses

- Class A – 1.0.0.0 to 126.255.255.255
  - 126 large organizations (all gone)
- Class B – 128.0.0.0 to 191.255.255.255
  - $2^{14}$  networks each with  $2^{16}$  hosts
- Class C – 192.0.0.0 to 223.255.255.255
  - $2^{21}$  small networks , 255 hosts

# Address Mask

- Separates a network address from the Host address

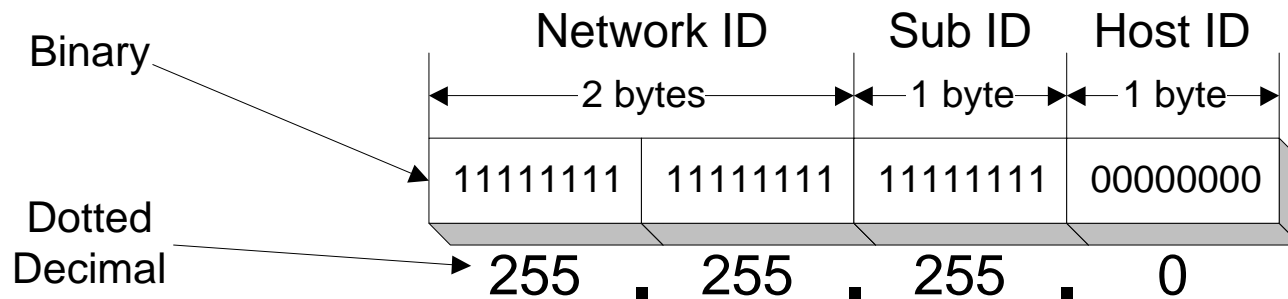


Figure: 19.14

# Point-to-Point Protocol Packet Format

Flag 7E	Address FF	Control 03 for PPP	Protocol type 0021 means information is IP datagram	Information	FCS	Flag 7E
1 byte	1 byte	1 byte	2 bytes	0-1500 Bytes	2 bytes	1 byte

Figure 19.15

# Demultiplexing Information

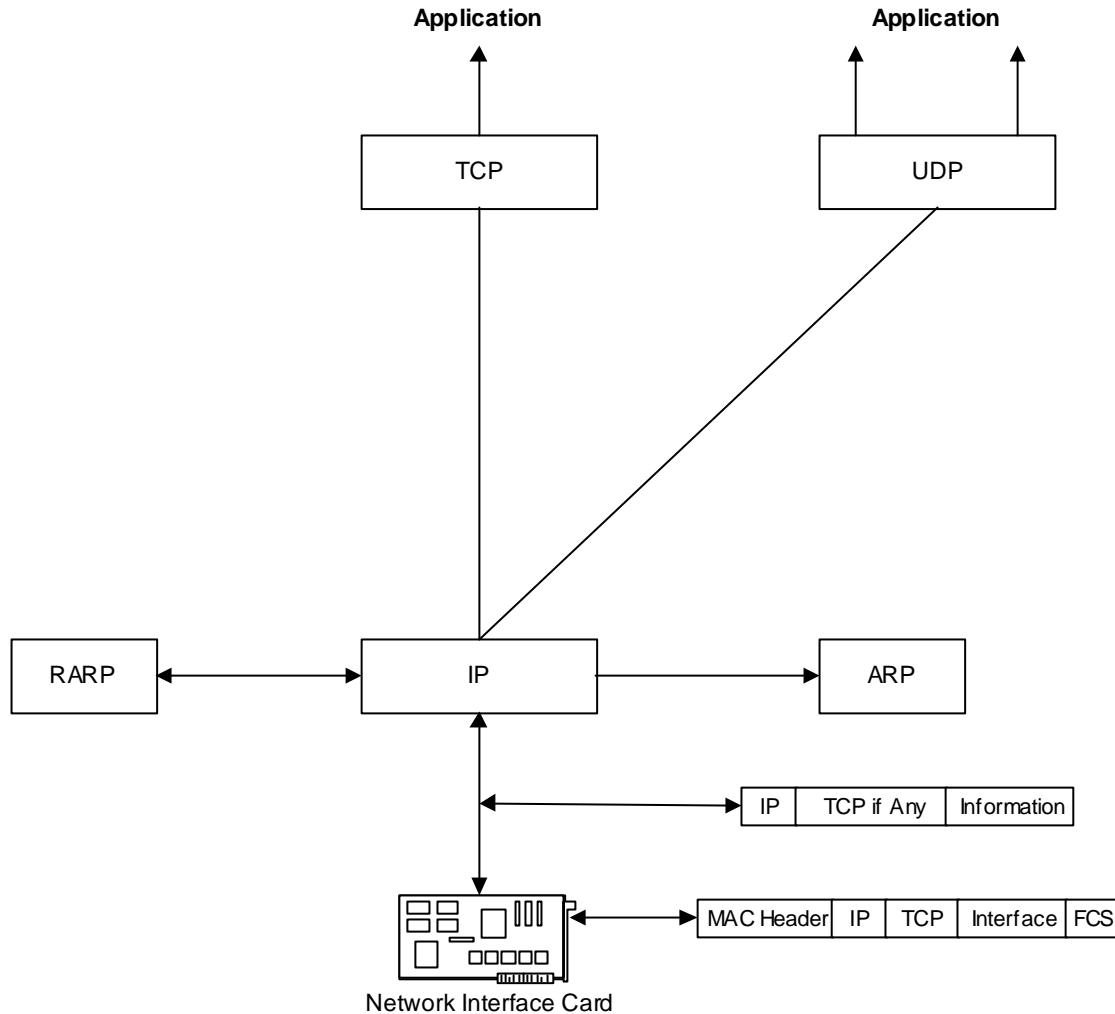


Figure 19.16:

# Setting up a TCP Connection

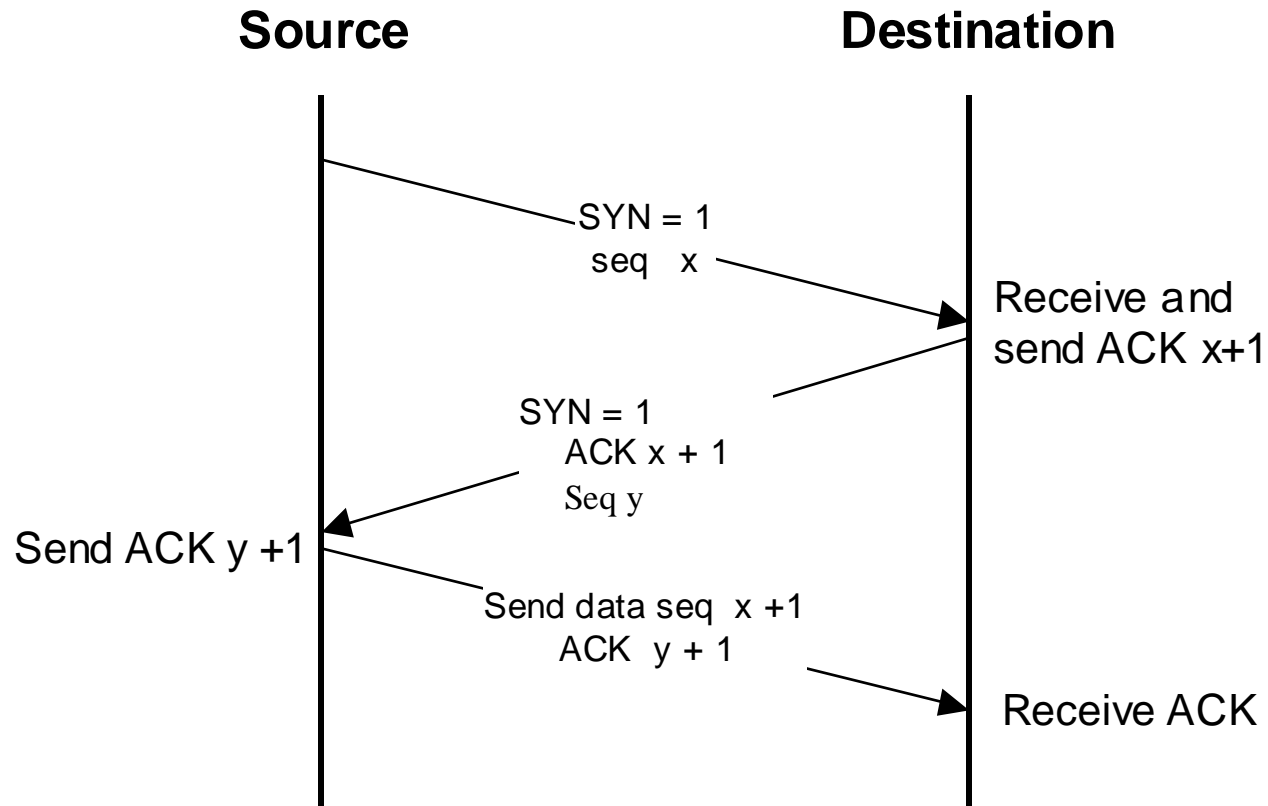


Figure 19.17:

# Disconnecting a TCP Connection

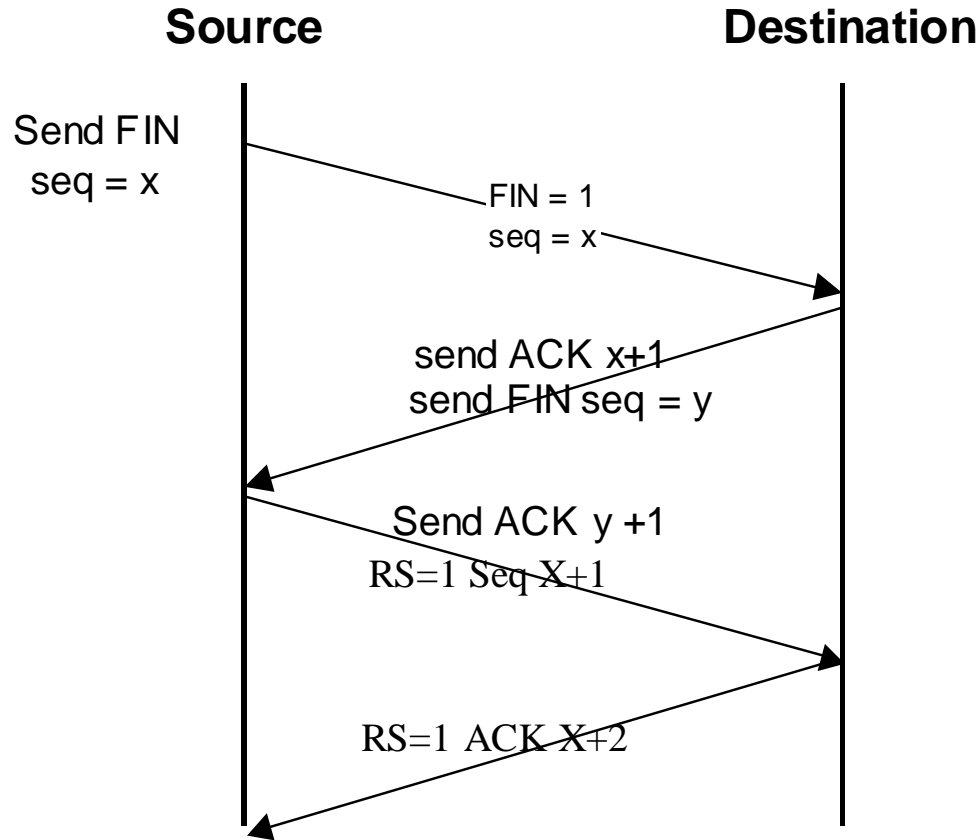


Figure 19.18:

# IPv6 Format

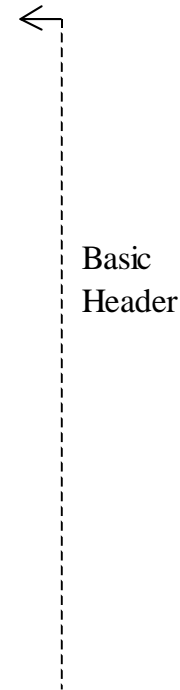
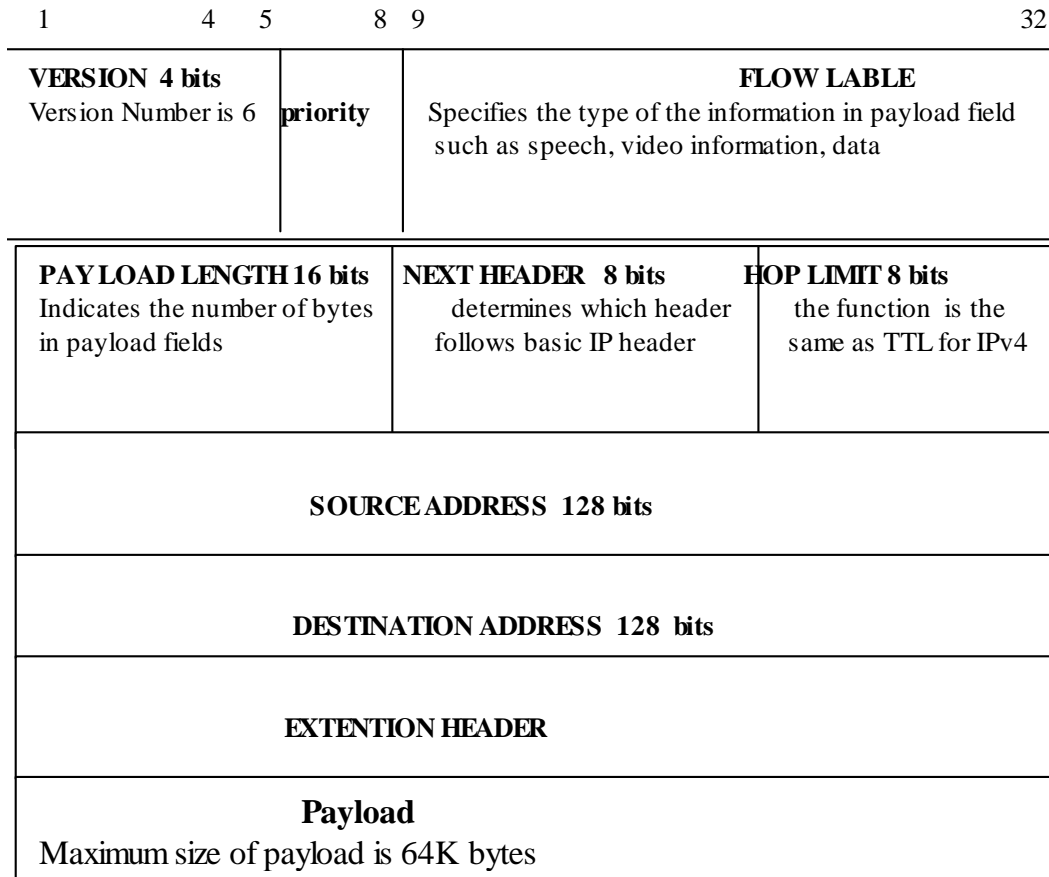


Figure 19.19:

# IP Datagram Extension Headers

Version	Priority	Flow label	
Payload length		Next Header 0	Hop limit
Source Address			
Destination Address			
Next header 43	Header length		
Hop by Hop options			
Next Header 06	Header Length		
Routing Information			
TCP Header and data			

Figure 19.20:



# IPv6 Unicast Address

3 bits	5 bits	16 bits	16 bits	8bits	32 bits	48 bits
Format prefix	Registry ID	Provider ID	Subscriber type	Subscriber ID	Sub-network ID	Interface ID

MAC

Figure 19.21:

# IPv4 to IPv6 Migration

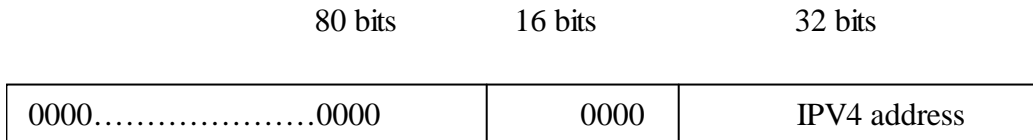


Figure 19.22a:  
IPv4 Imbedded in IPv6

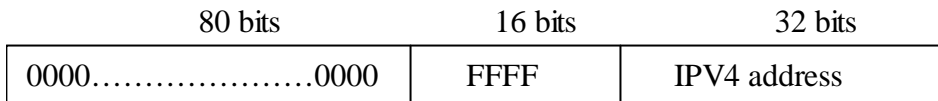


Figure 19.22b:  
For Station w/o  
IPv6 Support

# vBNS Backbone (2000)

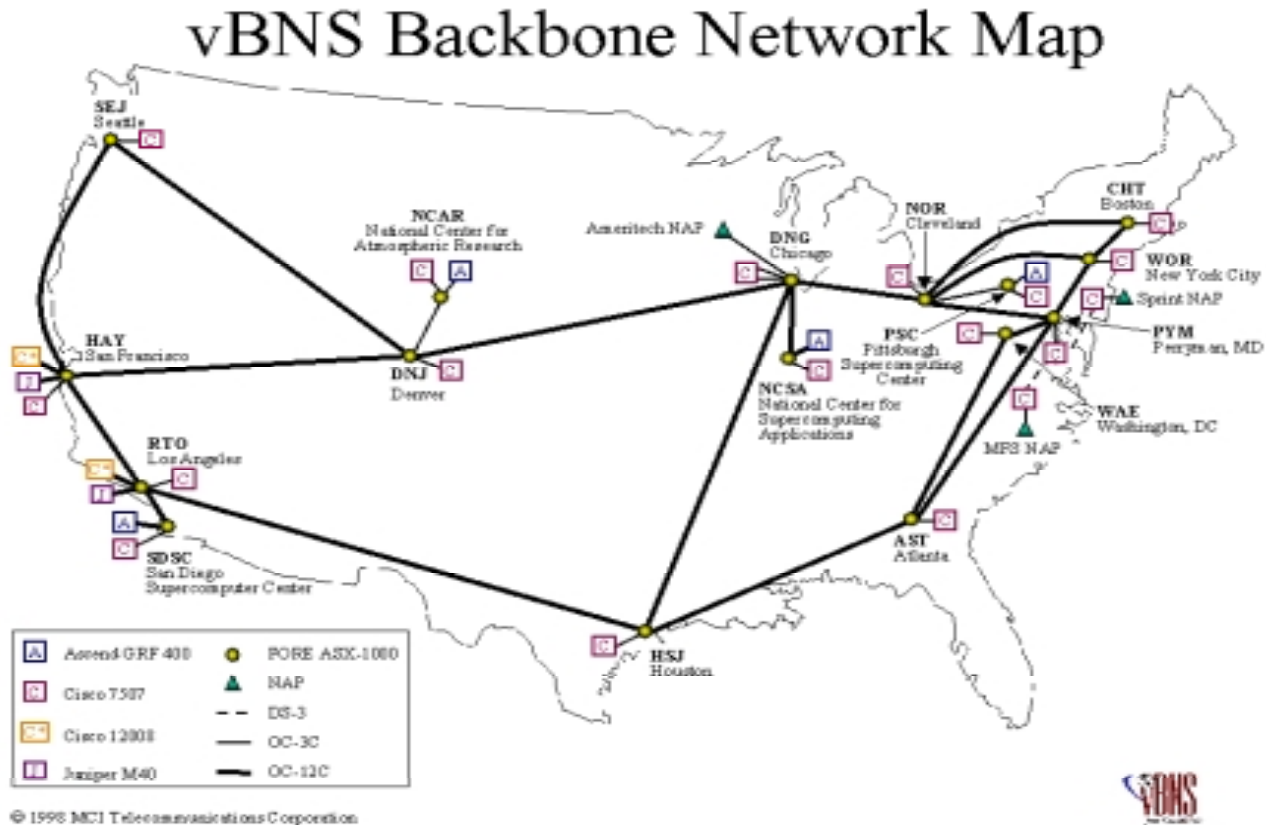


Figure 19.23: