Network Communications Technology

Chapter 19
Internet Architecture and TCP/IP

Connecting a Network to the Internet

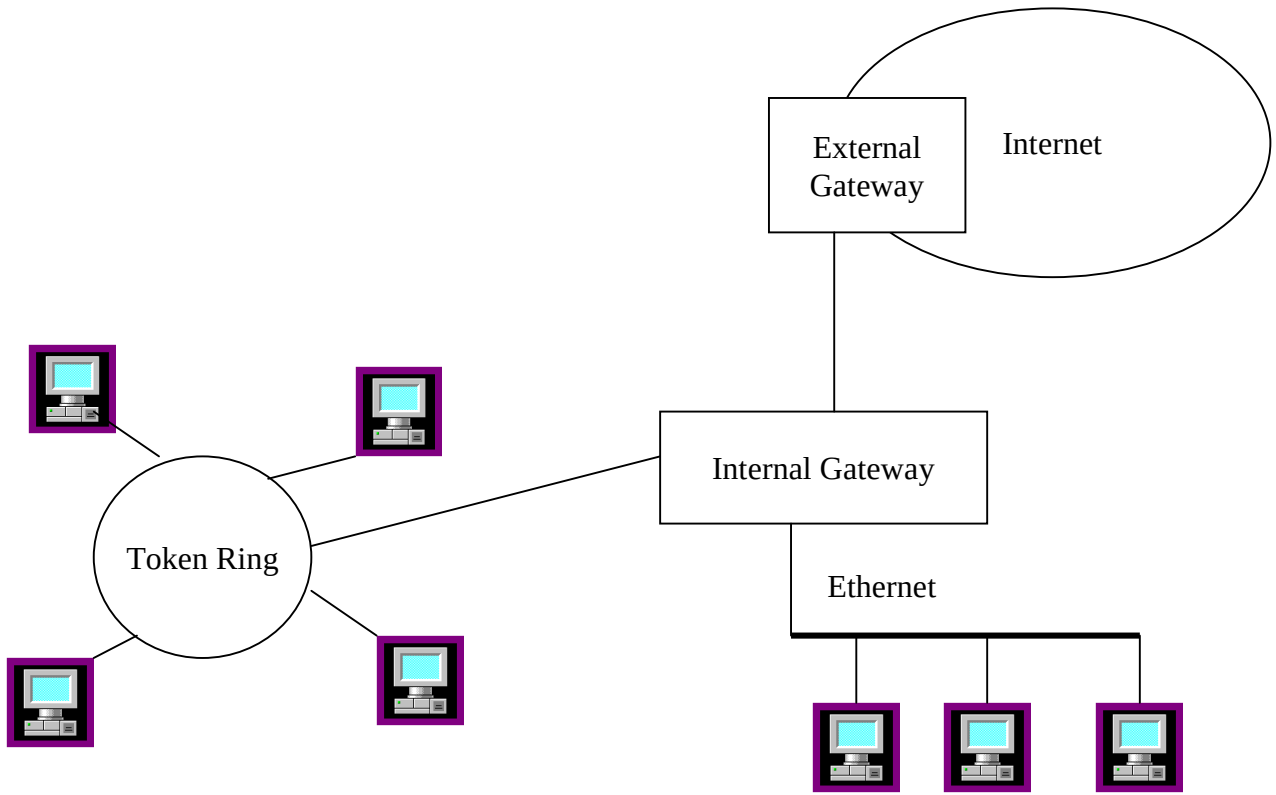


Figure 19.1

NSFNET Backbone (1993)

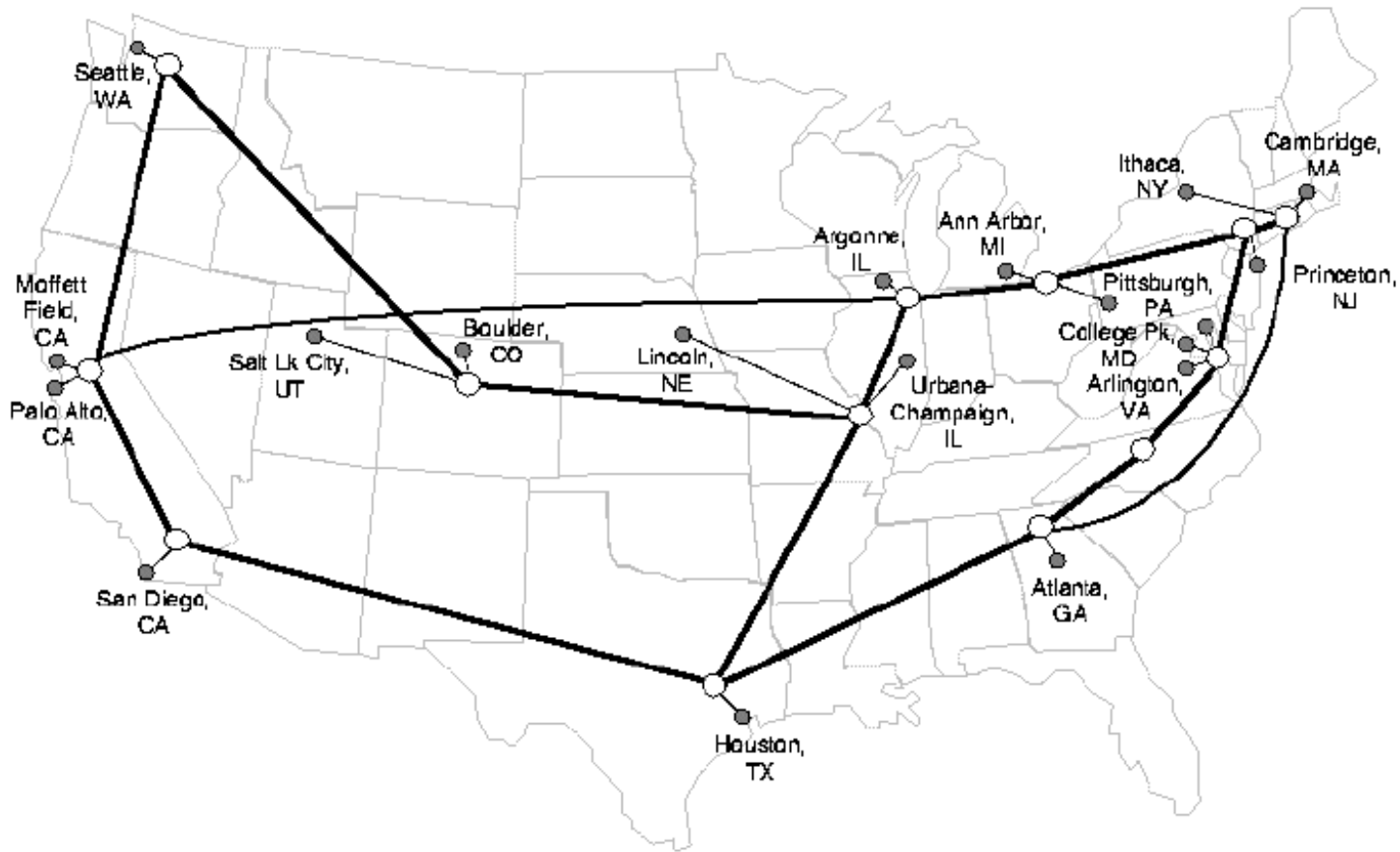


Figure 19.2

GTE Internet Backbone (2000)

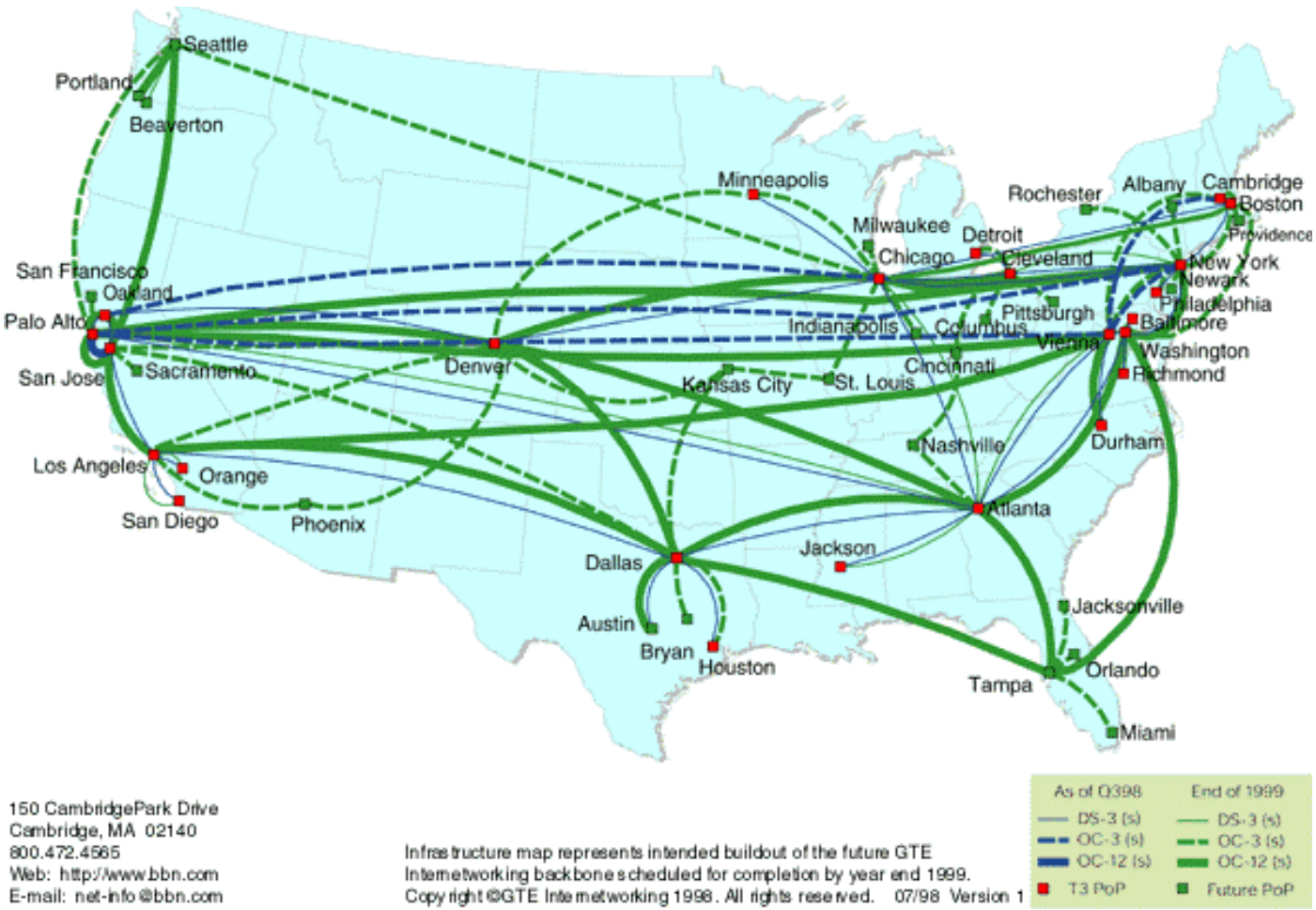


Figure 19.3:

TCP/IP Reference Model

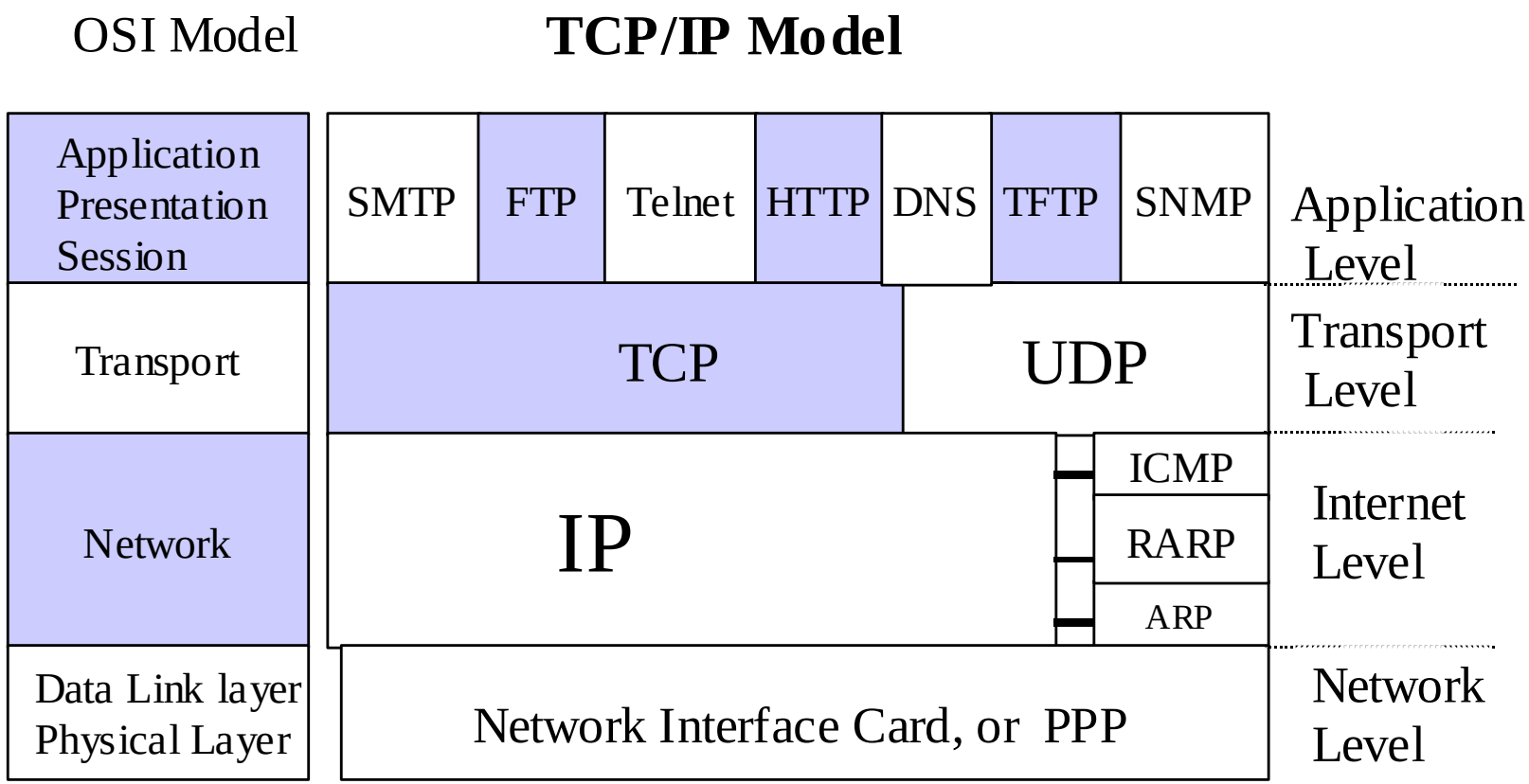


Figure 19.4

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 (SMPT, 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

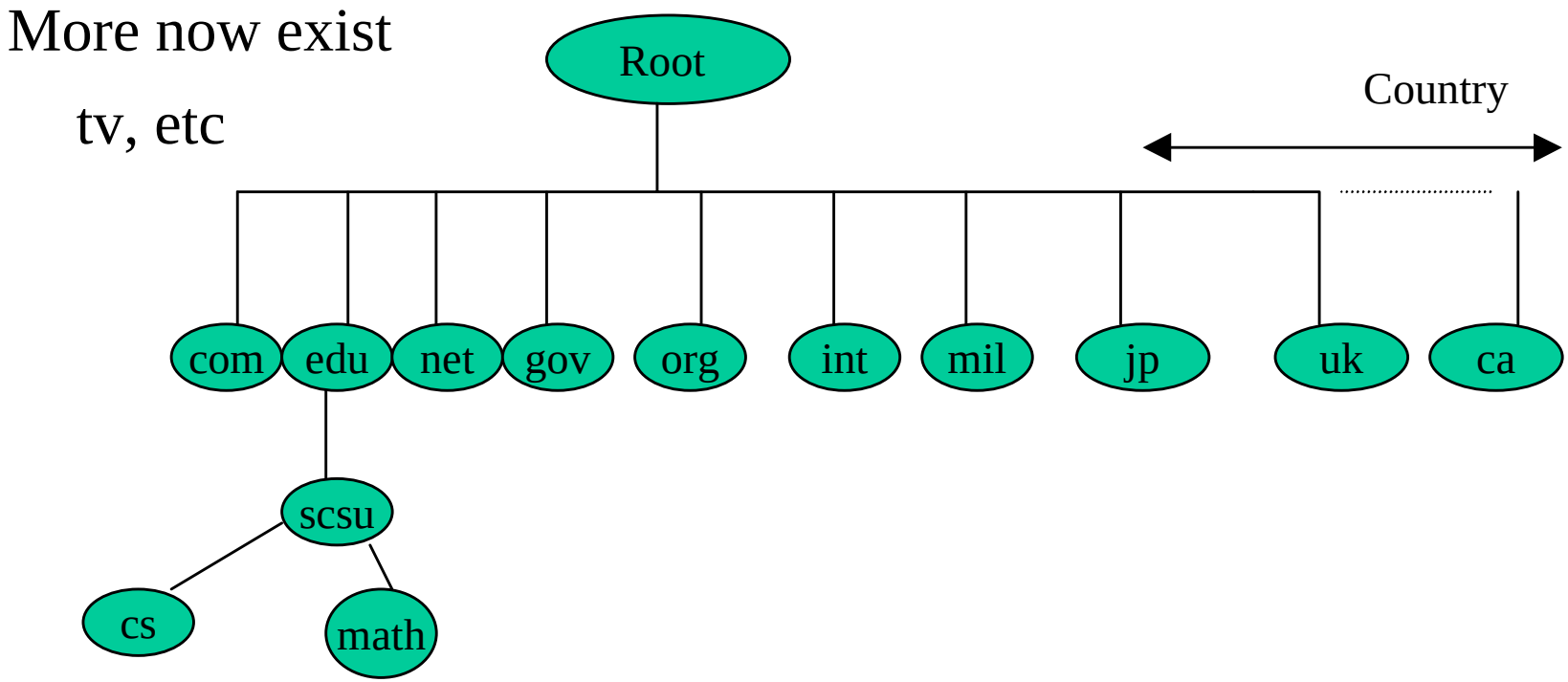


Figure 19.5

UDP Operation

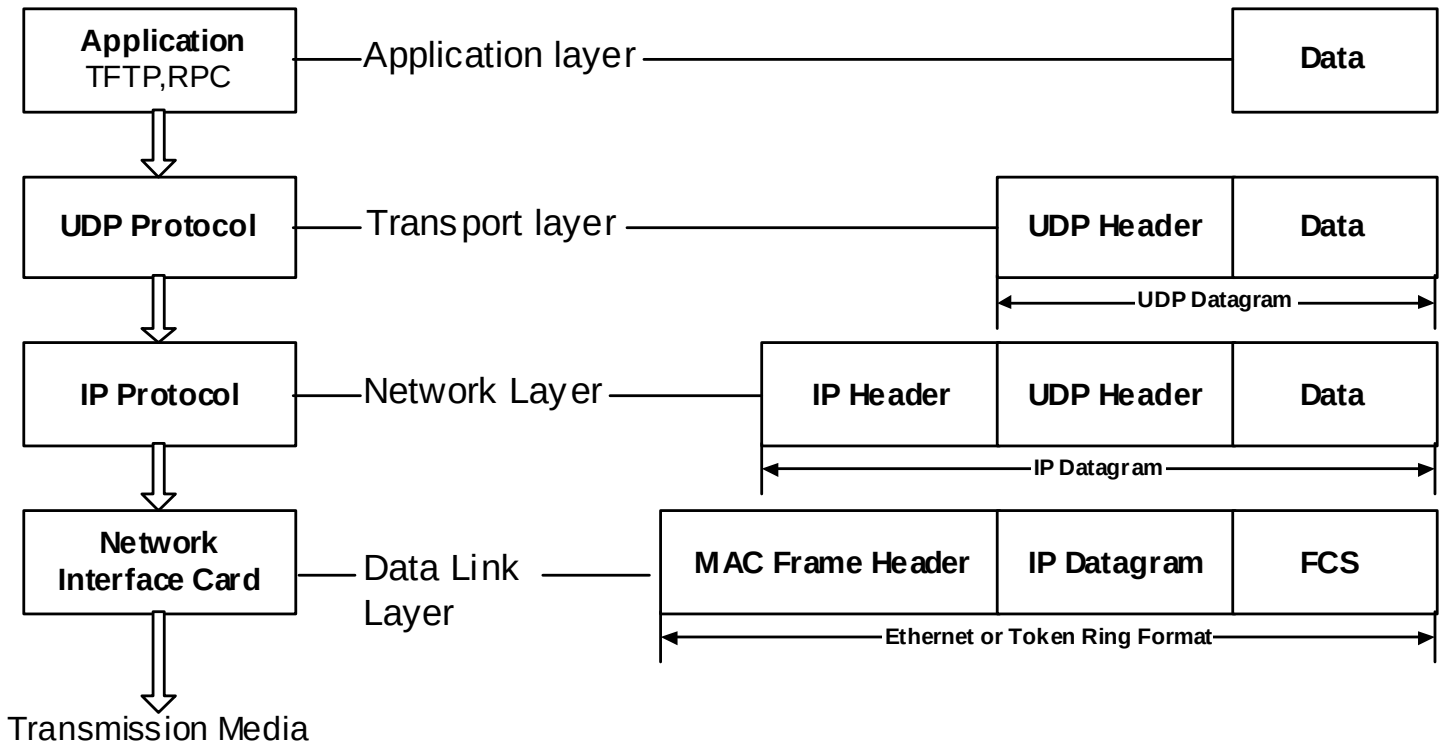


Figure 19.6

UDP Packet Format

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

Figure 19.7

TCP Operation

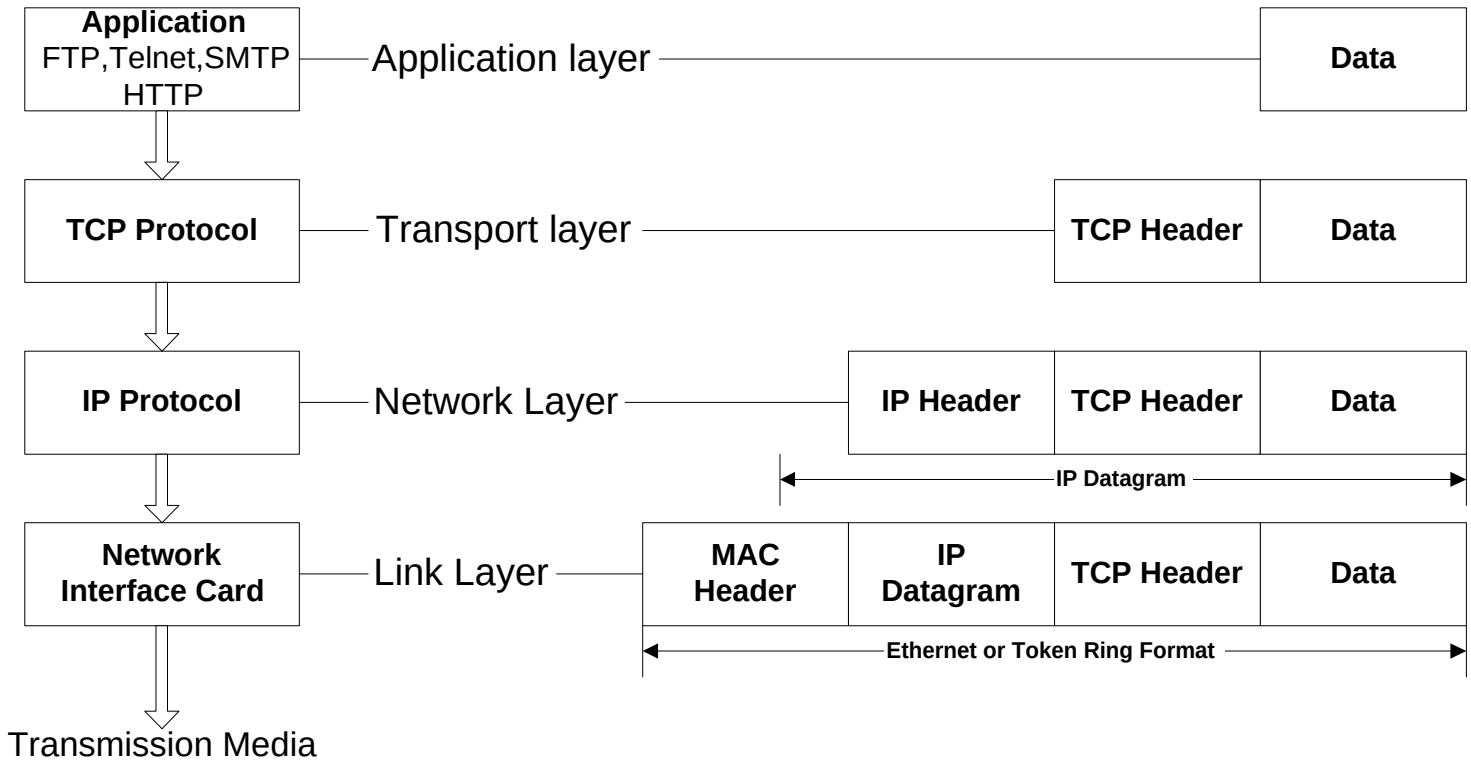


Figure 19.8

TCP Packet Format

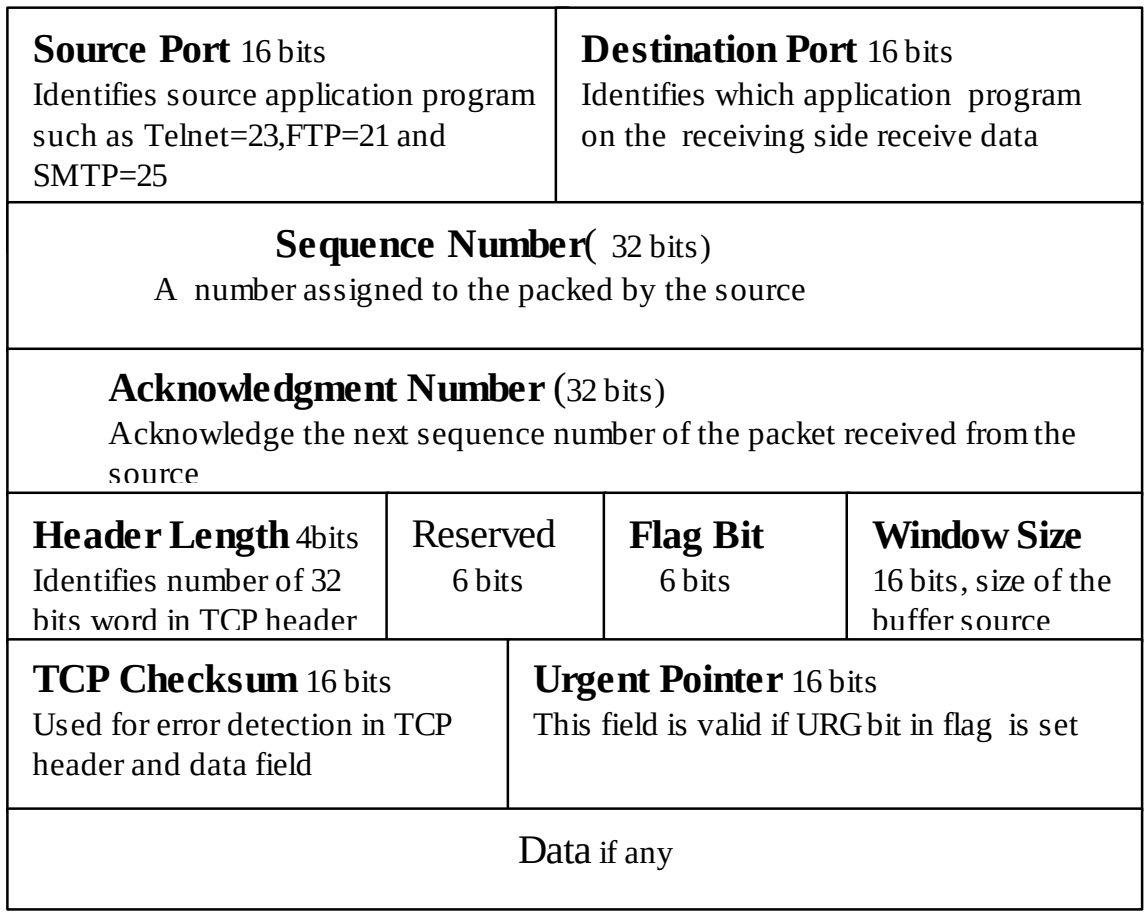


Figure 19.9

IP Datagram Packet Protocol

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

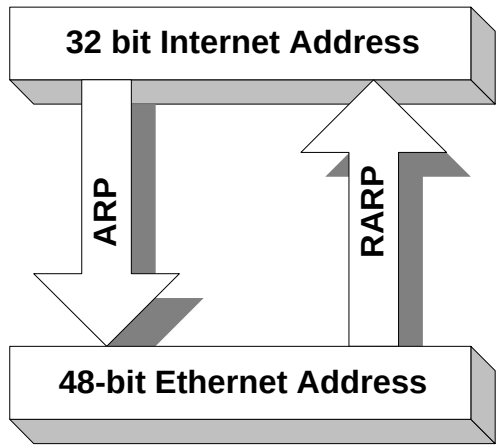
Figure 19.10

ARP Packet Format

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

Figure 19.11

ARP / RARP



IPv4

MAC

Figure 19.12:

A Network

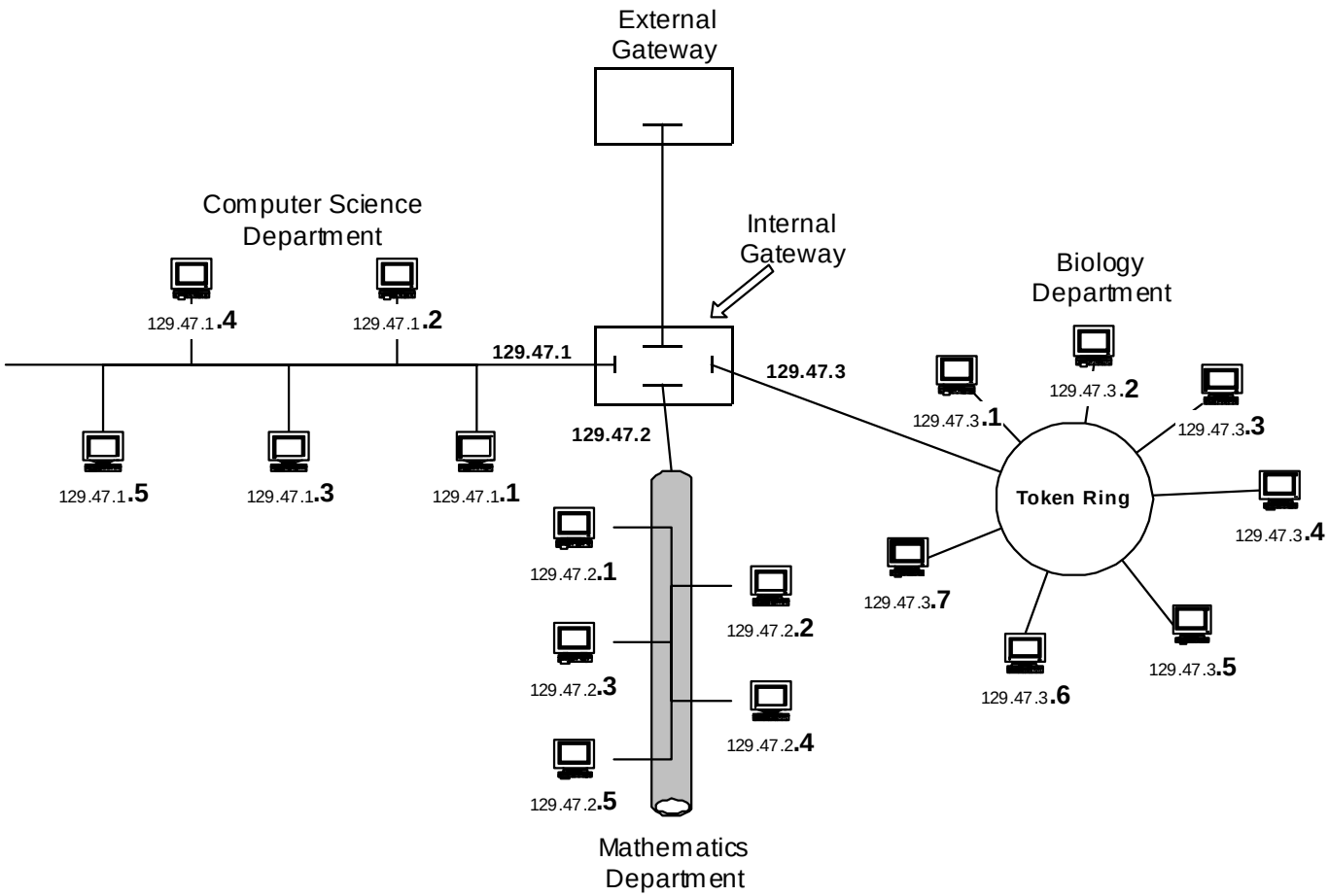


Figure: 19.13

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

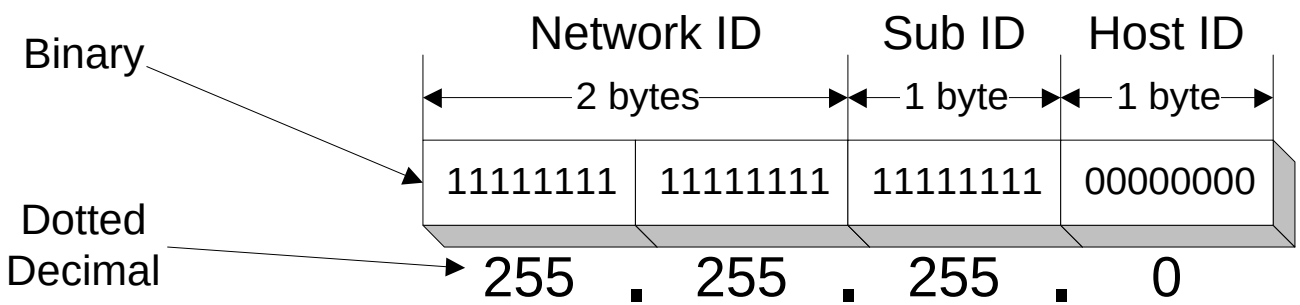


Figure: 19.14

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

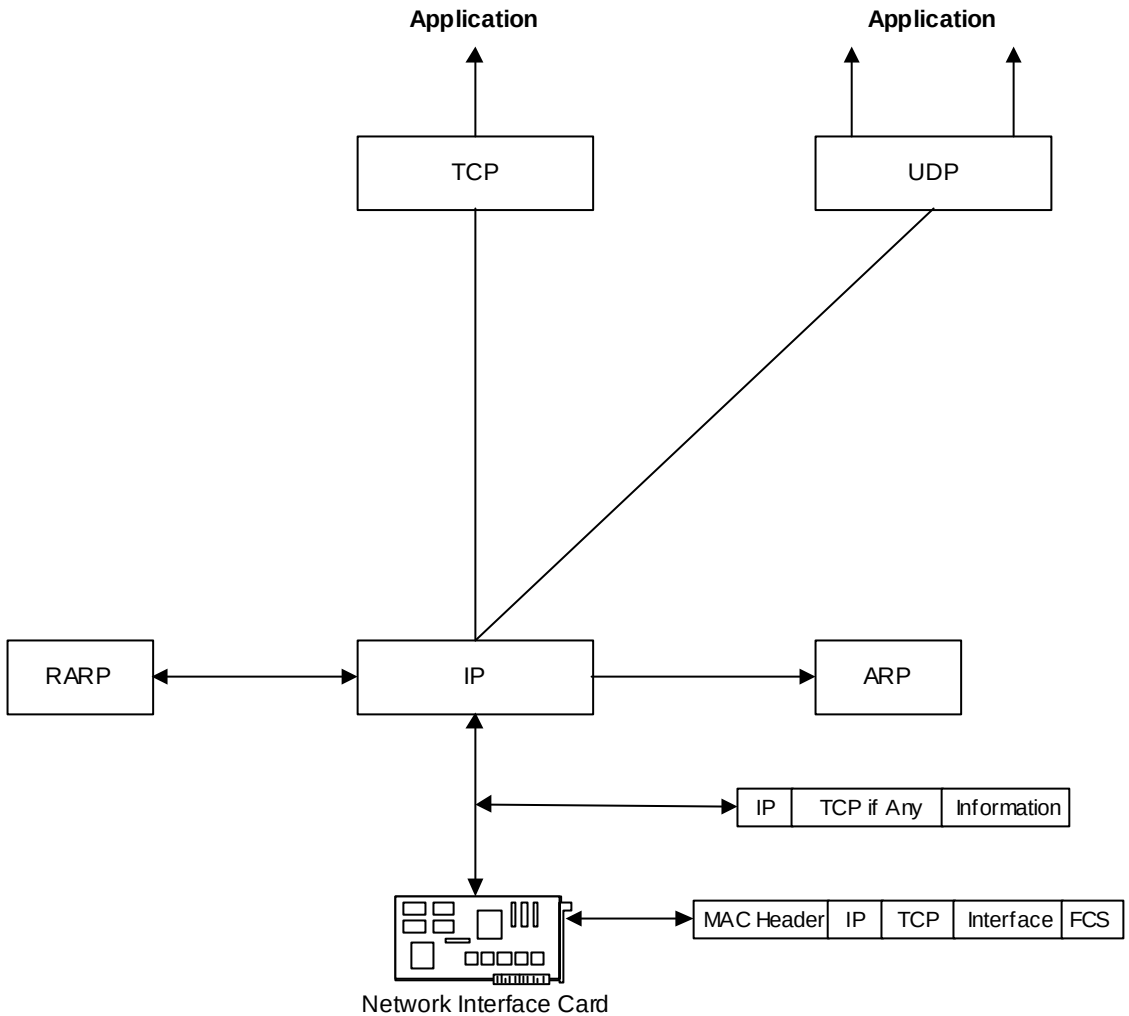


Figure 19.16:

Setting up a TCP Connection

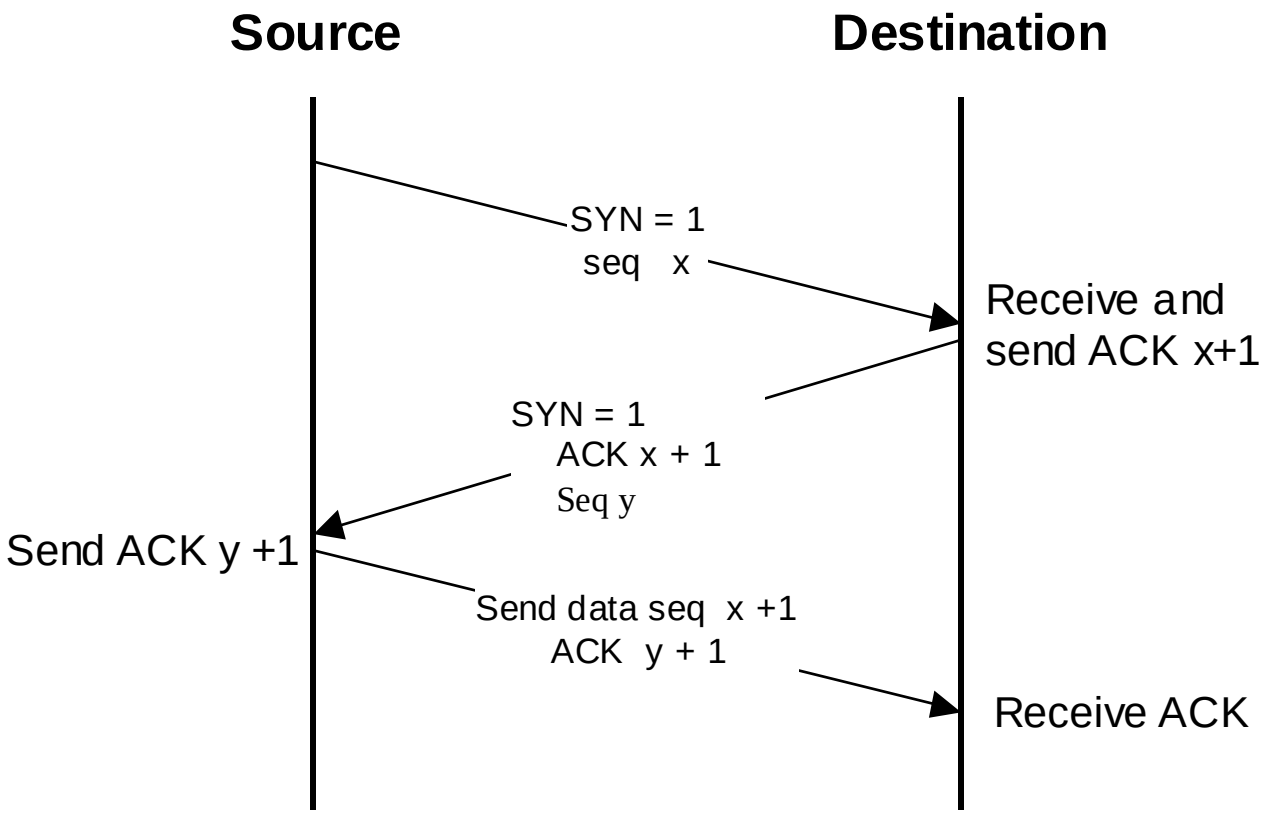


Figure 19.17:

Disconnecting a TCP Connection

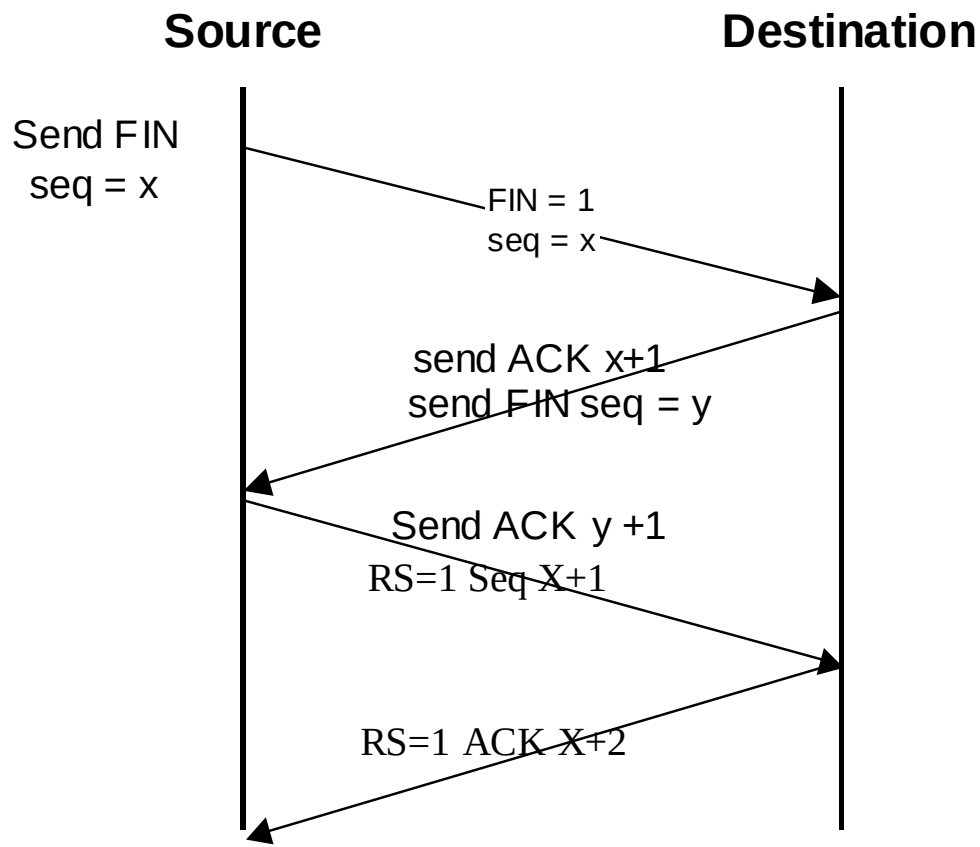


Figure 19.18:

IPv6 Format

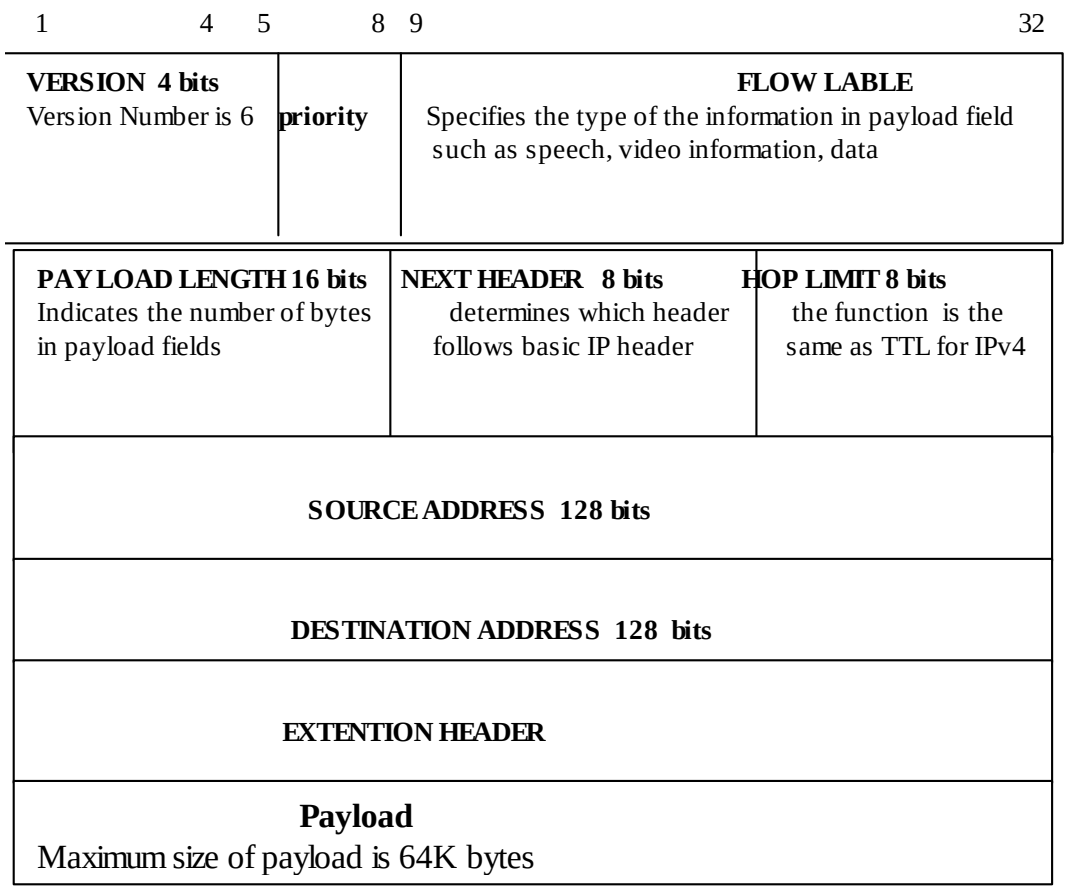


Figure 19.19:

IP Datagram Extension Headers

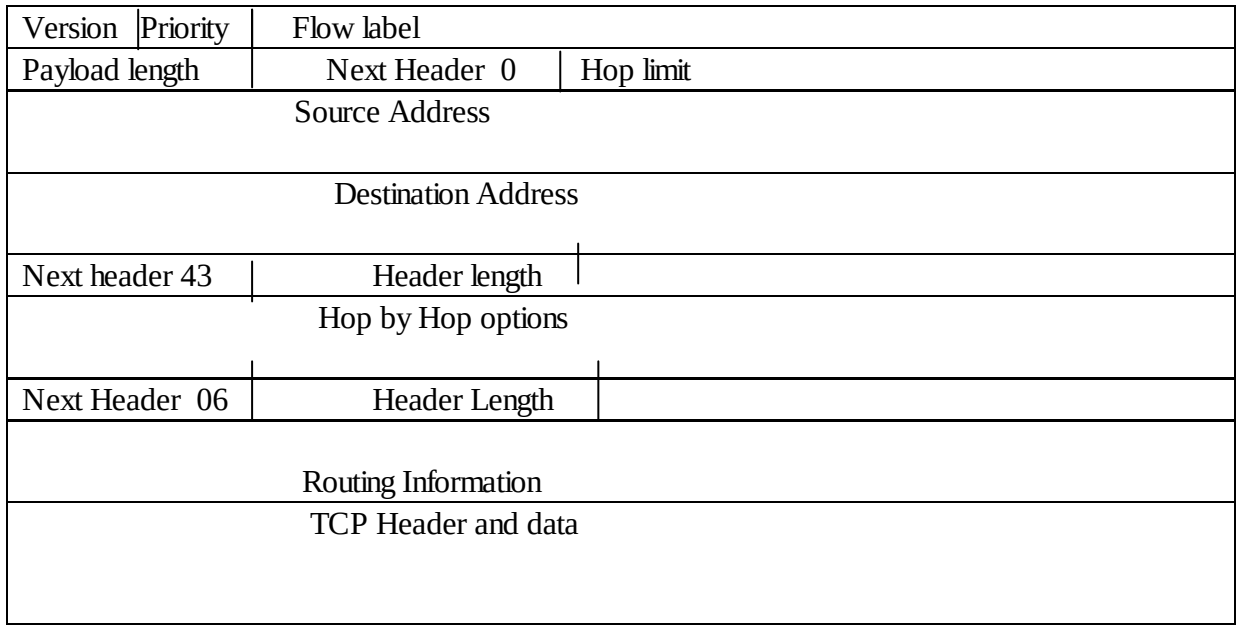


Figure 19.20:

IPv6 Unicast Address

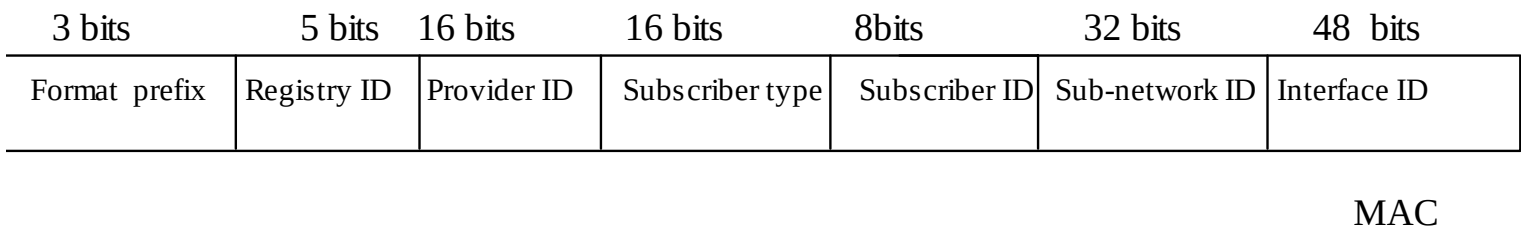


Figure 19.21:

IPv4 to IPv6 Migration

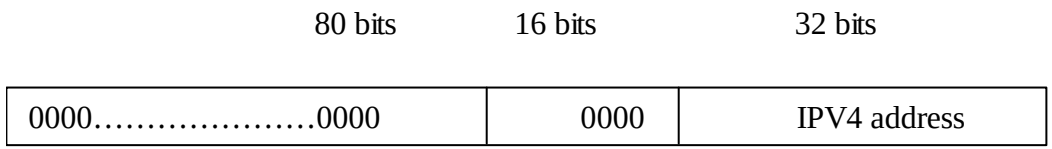


Figure 19.22a:
IPv4 Imbedded in IPv6

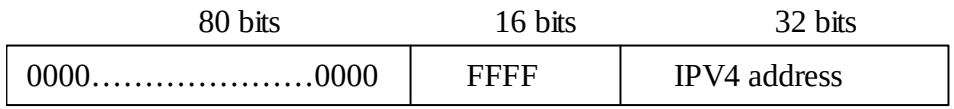


Figure 19.22b:
For Station w/o
IPv6 Support

vBNS Backbone (2000)

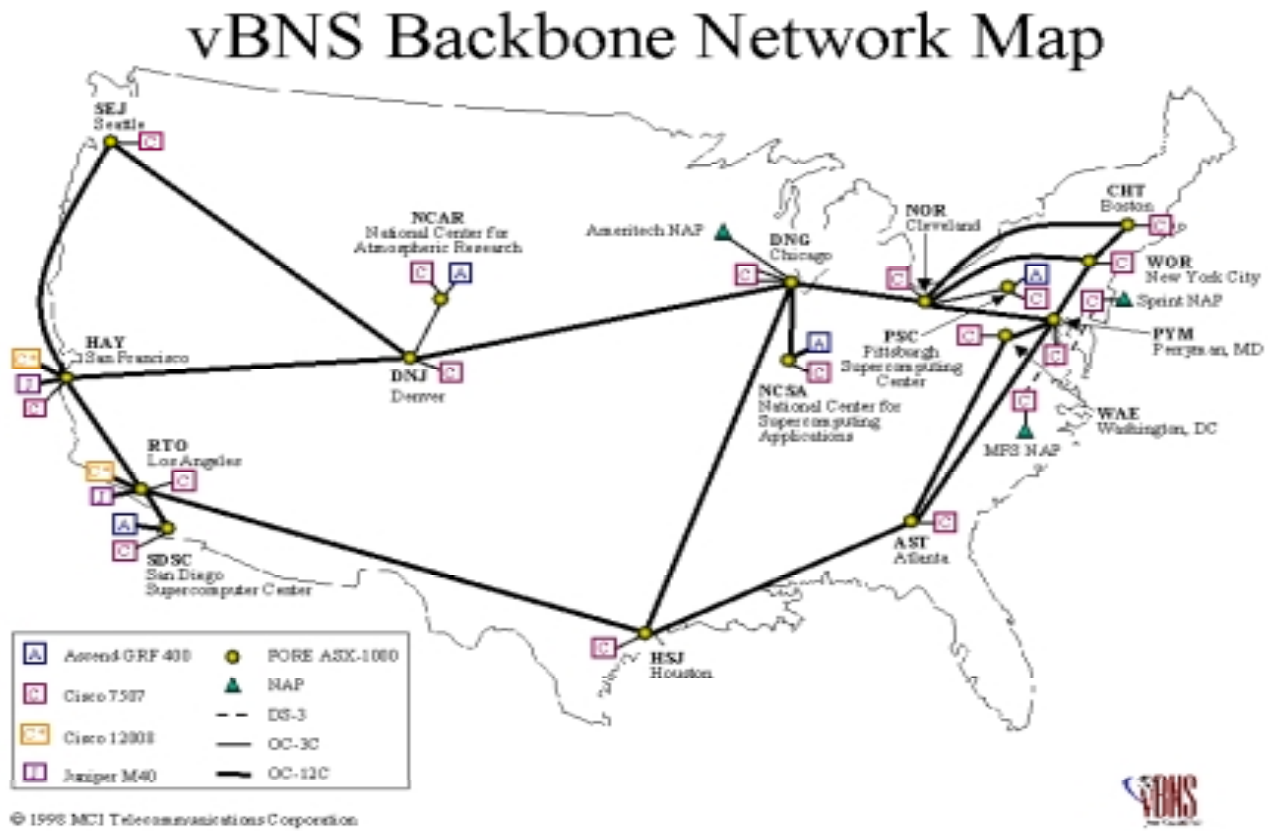


Figure 19.23: