

Networking

Distributed Capabilities

- Communications architectures
 - Software that supports a group of networked computers
- Network operating system
 - Each computer has its own private operating system
- Distributed operating system
 - Common operating system shared by a network of computers

The Need for a Protocol Architecture

- Computer communications
 - Exchange of information between computers for the purpose of cooperative action
- Computer network
 - When two or more computers are interconnected via a communication network

Two Concepts

- Protocol
 - Used for communication between entities in different systems
- Protocol architecture
 - Broken into subtasks, each of which is implemented separately

File Transfer

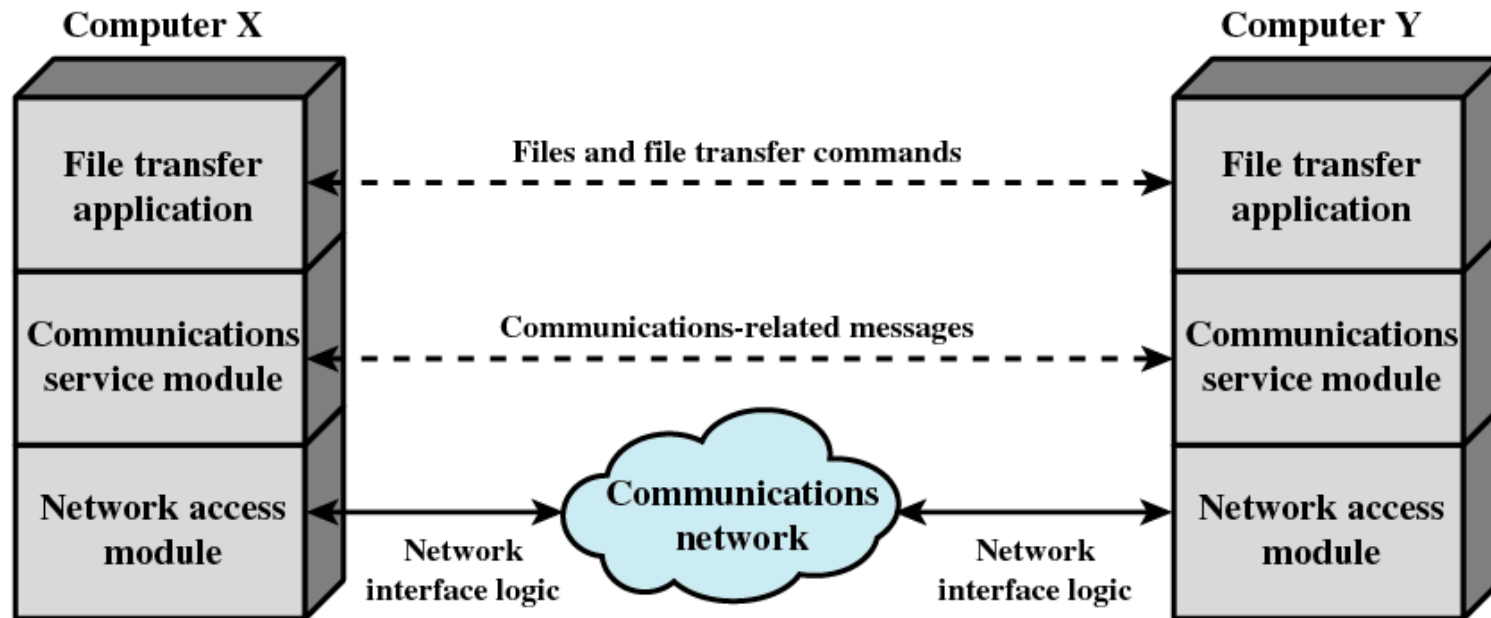


Figure 13.1 A Simplified Architecture for File Transfer

The TCP/IP Protocol Architecture

- Protocol suite
- Five relatively independent layers
 - Physical
 - Network access
 - Internet
 - Host-to-host, or transport
 - Application

Physical Layer

- Specifying
 - the characteristics of the transmission medium
 - Nature of the signals
 - Data rate

Network Access Layer

- Concerned with the exchange of data between an end system and the network
- Different standards
 - Circuit switching
 - Packet switching (frame relay)
 - LANs (Ethernet)

Internet Layer

- Procedures for data to traverse different networks
- Implemented in the end systems and routers

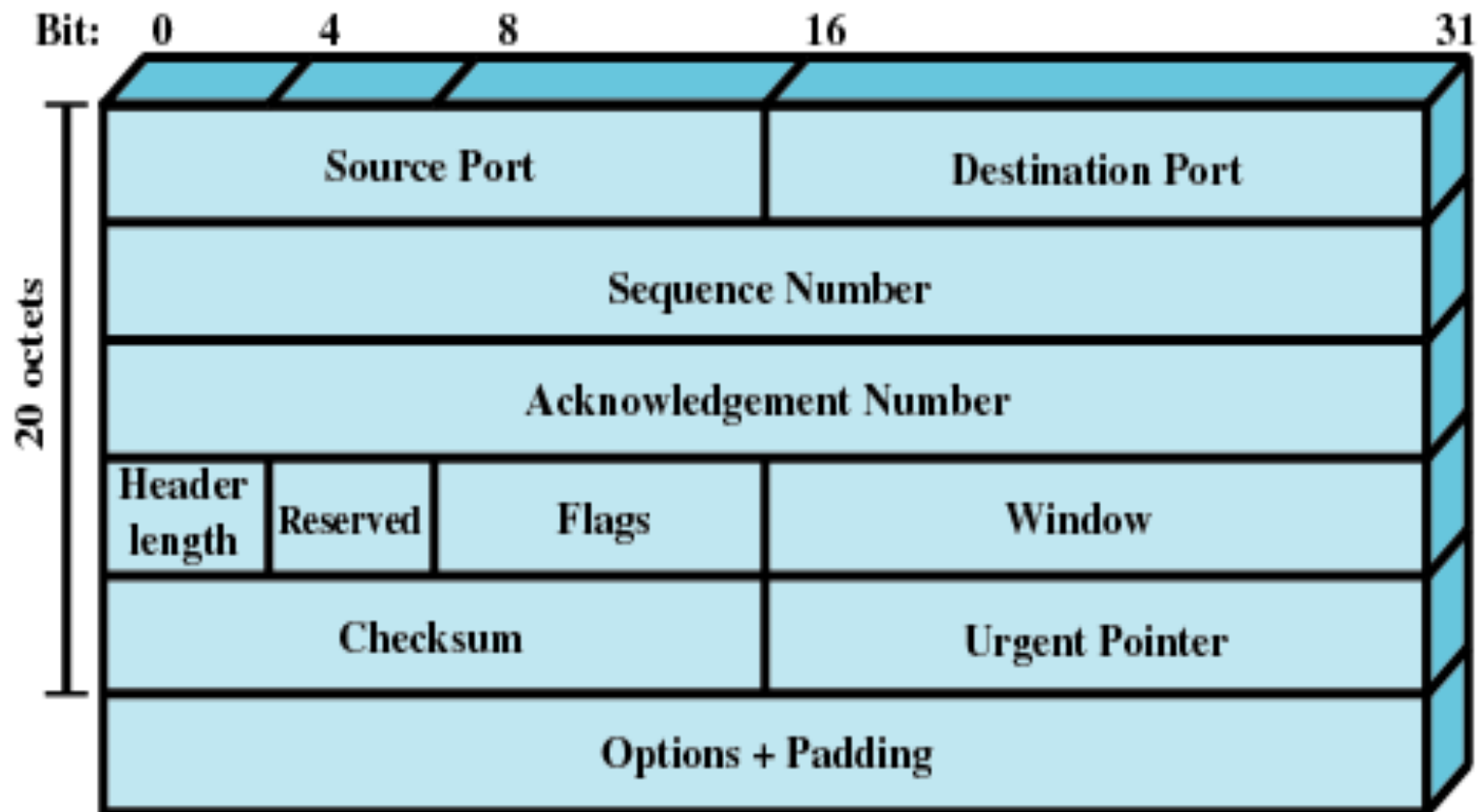
Transport Layer

- Ensures all data arrives at the destination and in the order sent
- TCP

Application Layer

- Supports various user application
- Example: file transfer

TCP Header



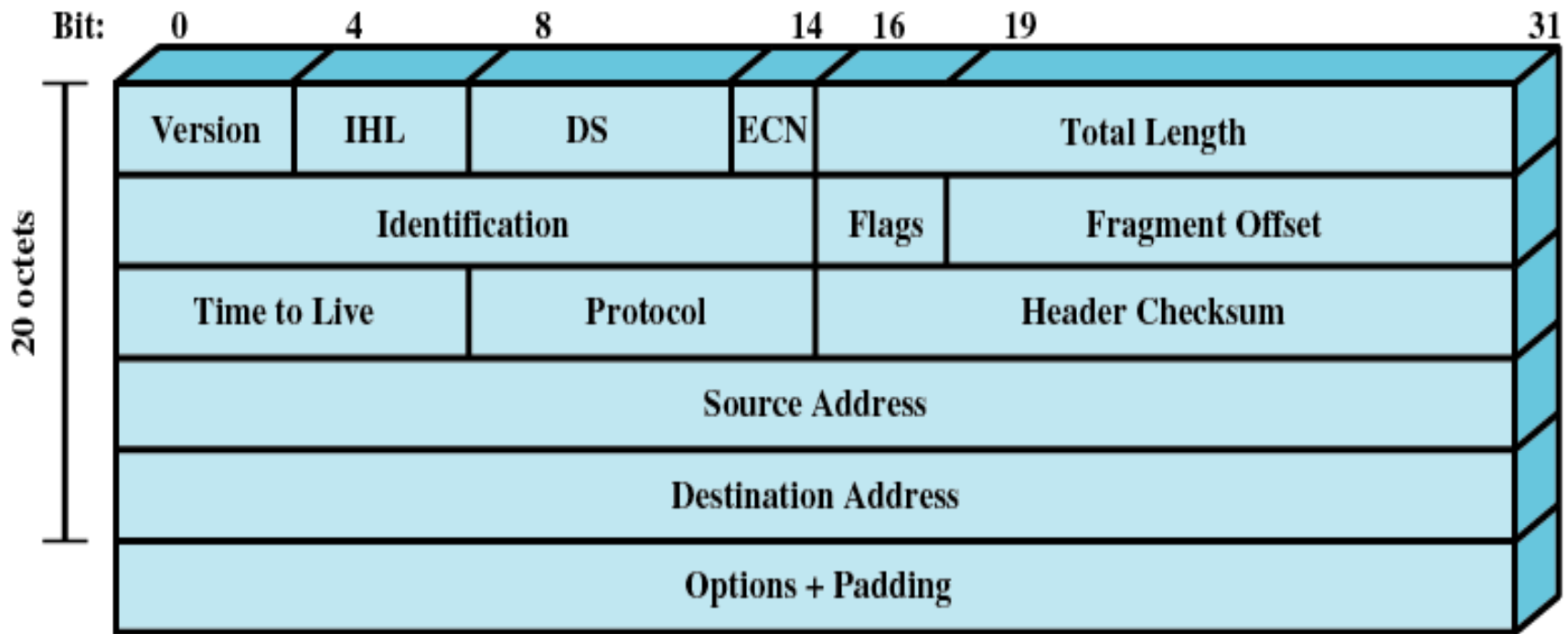
(a) TCP Header

UDP



(b) UDP Header

IP

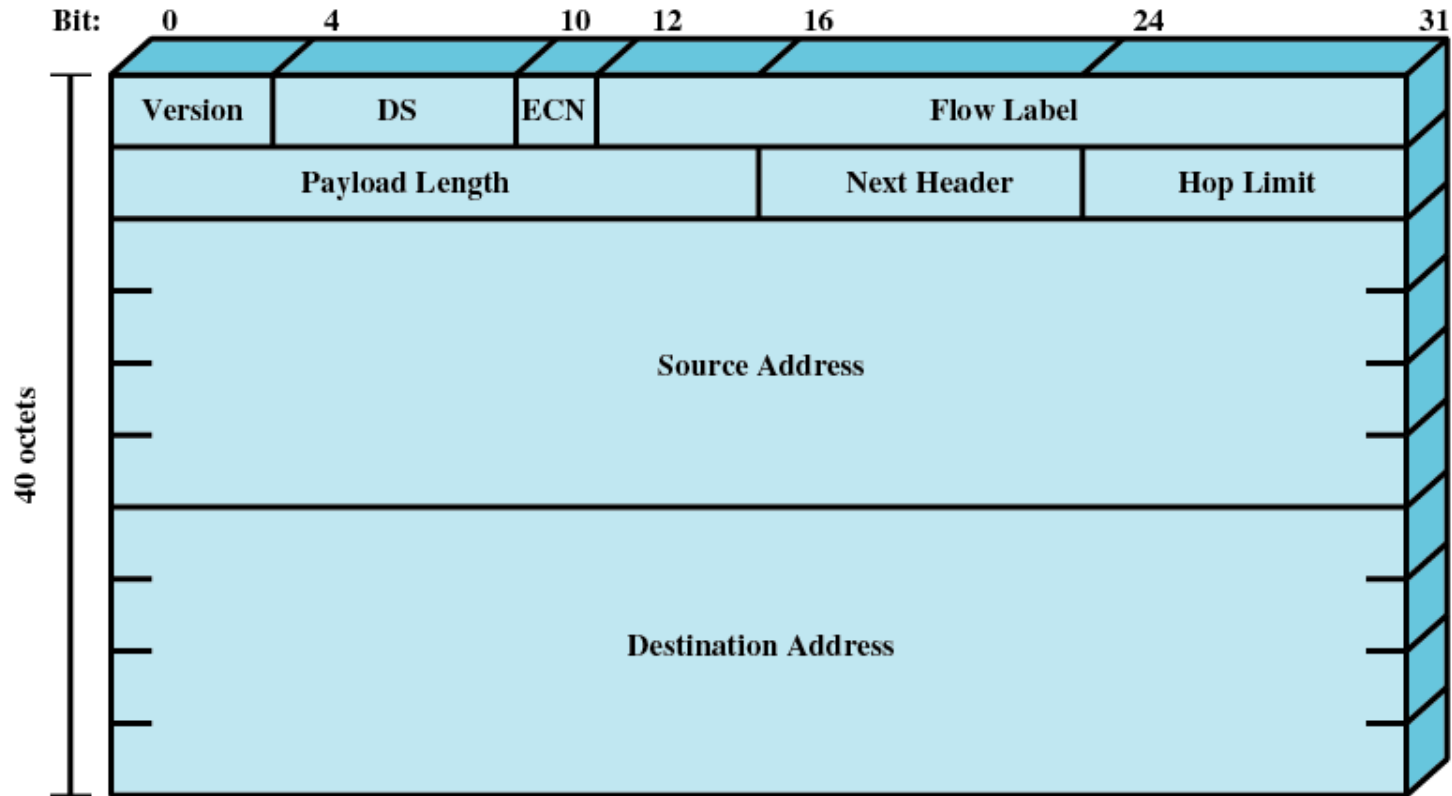


(a) IPv4 Header

IPv6

- Provides enhancements over existing IP
- Designed to accommodate higher speeds of a mix of data streams, graphic and video
- Provides more addresses
- Includes 128-bits for addresses
 - IP uses 32-bit address

IPv6



(b) IPv6 Header

DS = Differentiated services field
ECN = Explicit congestion notification field

Note: The 8-bit DS/ECN fields were formerly known as the Type of Service field in the IPv4 header and the Traffic Class field in the IPv6 header.

TCP/IP Concepts

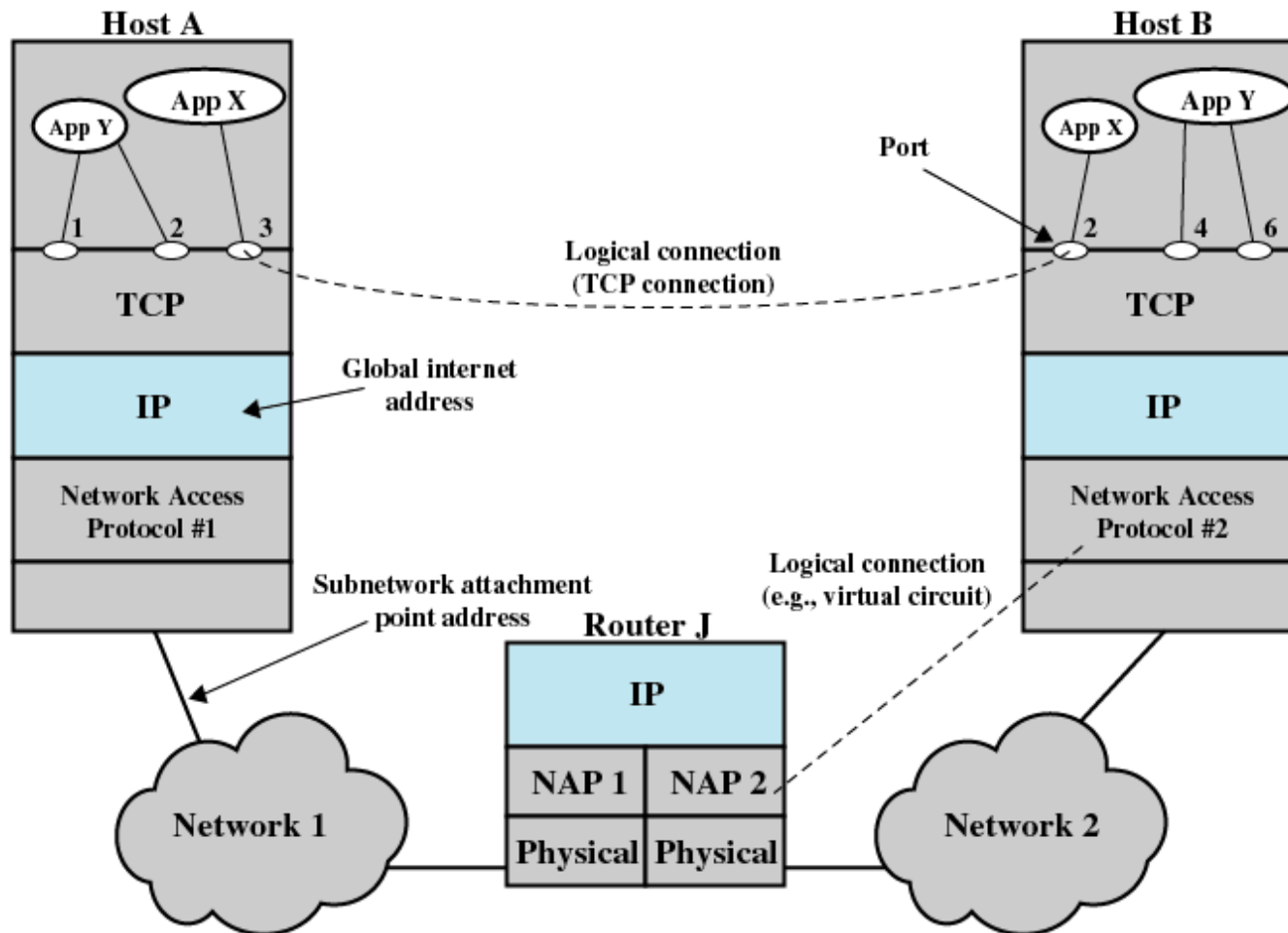


Figure 13.4 TCP/IP Concepts

Protocols and Headers

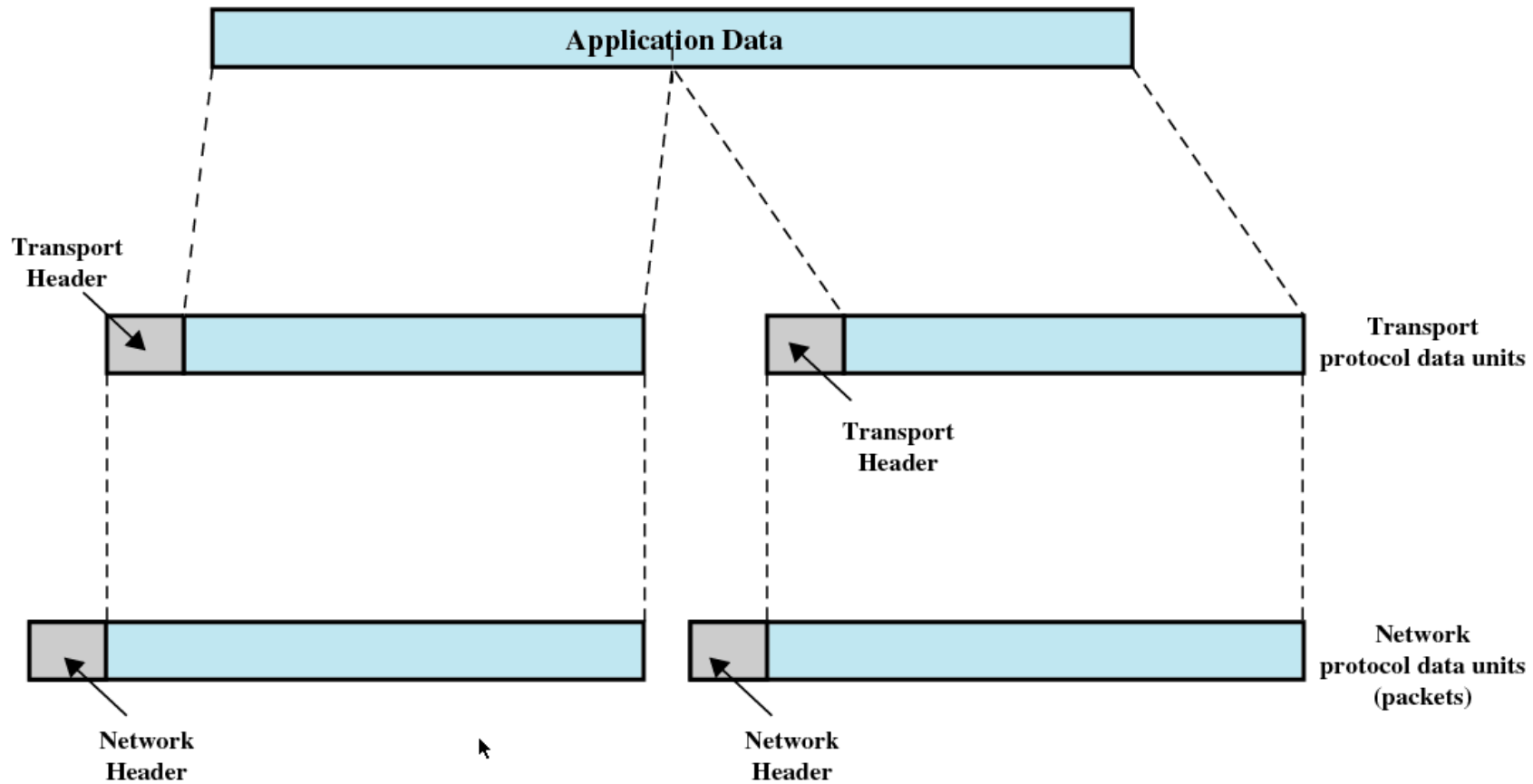


Figure 13.5 Protocols and Headers

Items in the Header

- Destination network address
- Facilities requests
 - Example: priority

TCP/IP Applications

- Simple Mail Transfer Protocol (SMTP)
- File Transfer Protocol
- TELNET
 - Note: telnet is never a good idea, use ssh!

Sockets

- Enable communication between a client and server
- Concatenation of a port value and an IP address form a socket

Two Types of Sockets

- Stream sockets
 - Use TCP
 - Reliable data transfer
- Datagram sockets
 - Use UDP
 - Delivery is not guaranteed

Socket Setup

- **socket ()** command
- Three parameters
 - Protocol family is always PF_INET for TCP/IP
 - Type specifies whether stream or datagram
 - Protocol specifies either TCP or UDP

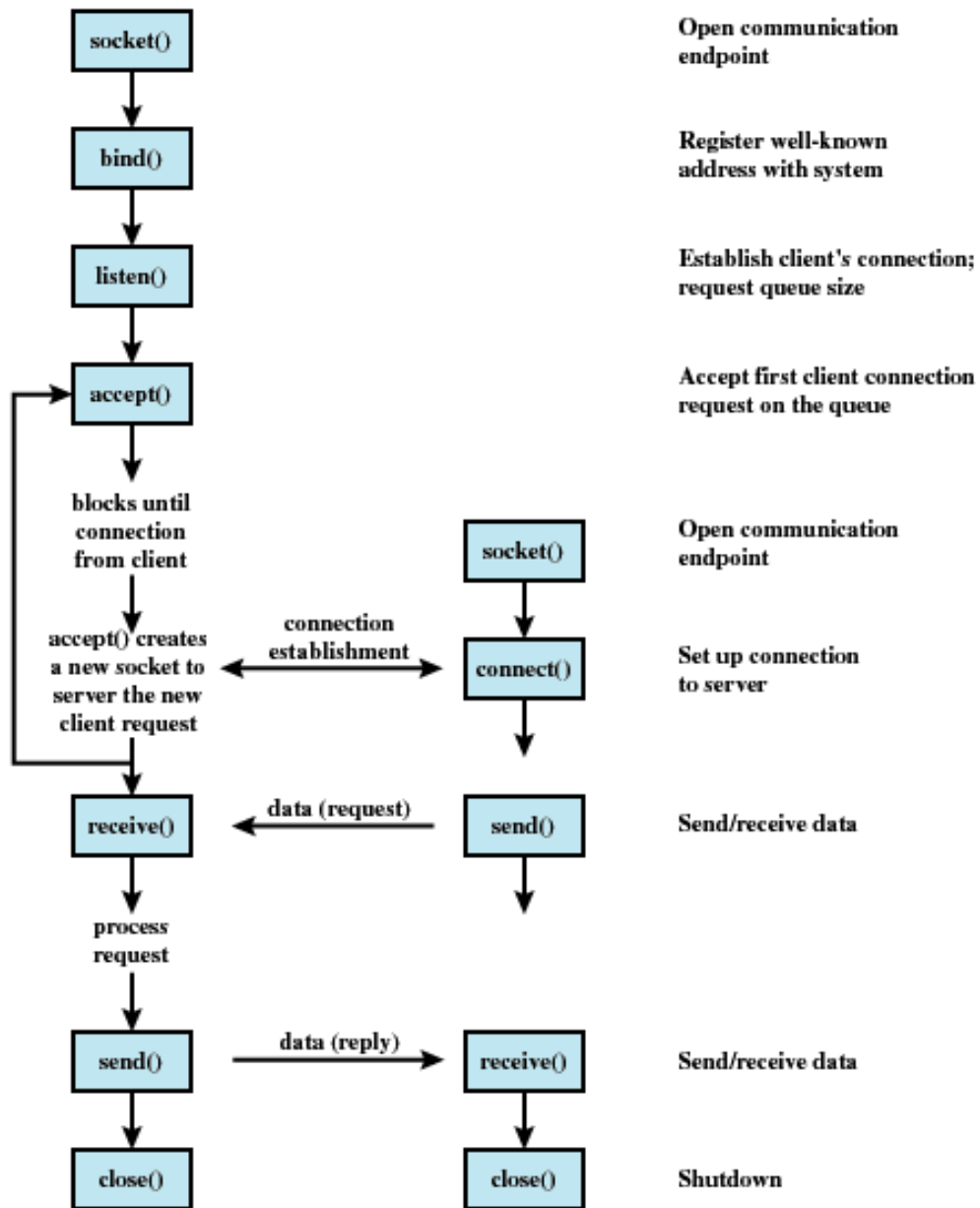


Figure 13.6 Socket System Calls for Connection-Oriented Protocol

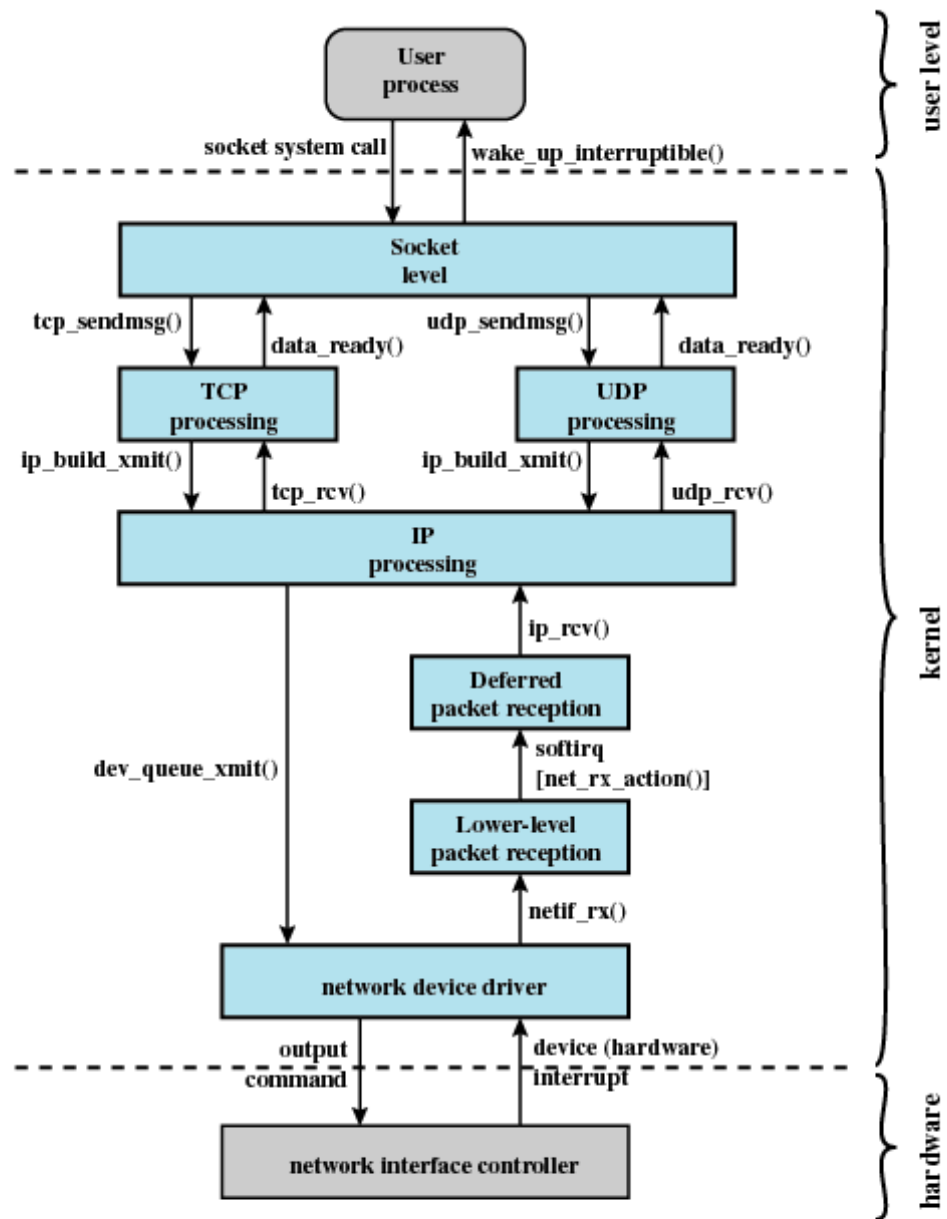


Figure 13.7 Linux Kernel Components for TCP/IP Processing