BLM6196 COMPUTER NETWORKS AND COMMUNICATION PROTOCOLS

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(2nd Week)

2. Protocol Architecture, TCP/IP, and Internet-Based Applications

2.Outline

- The Need for a Protocol Architecture
- A Simple Protocol Architecture
- TCP/IP Protocol Architecture
- Standardization within a Protocol Architecture
- Traditional Internet-Based Applications
- Multimedia

The Need for a Protocol Architecture

1.) The source must either activate the direct communications path or inform the network of the identity of the desired destination system

2.) The source system must ascertain that the destination system is prepared to receive data

To transfer data several tasks must be performed:

3.) The file transfer application on the source system must ascertain that the file management program on the destination system is prepared to accept and store the file for this particular user

4.) A format translation function may need to be performed by one or the other system if the file formats used on the two systems are different

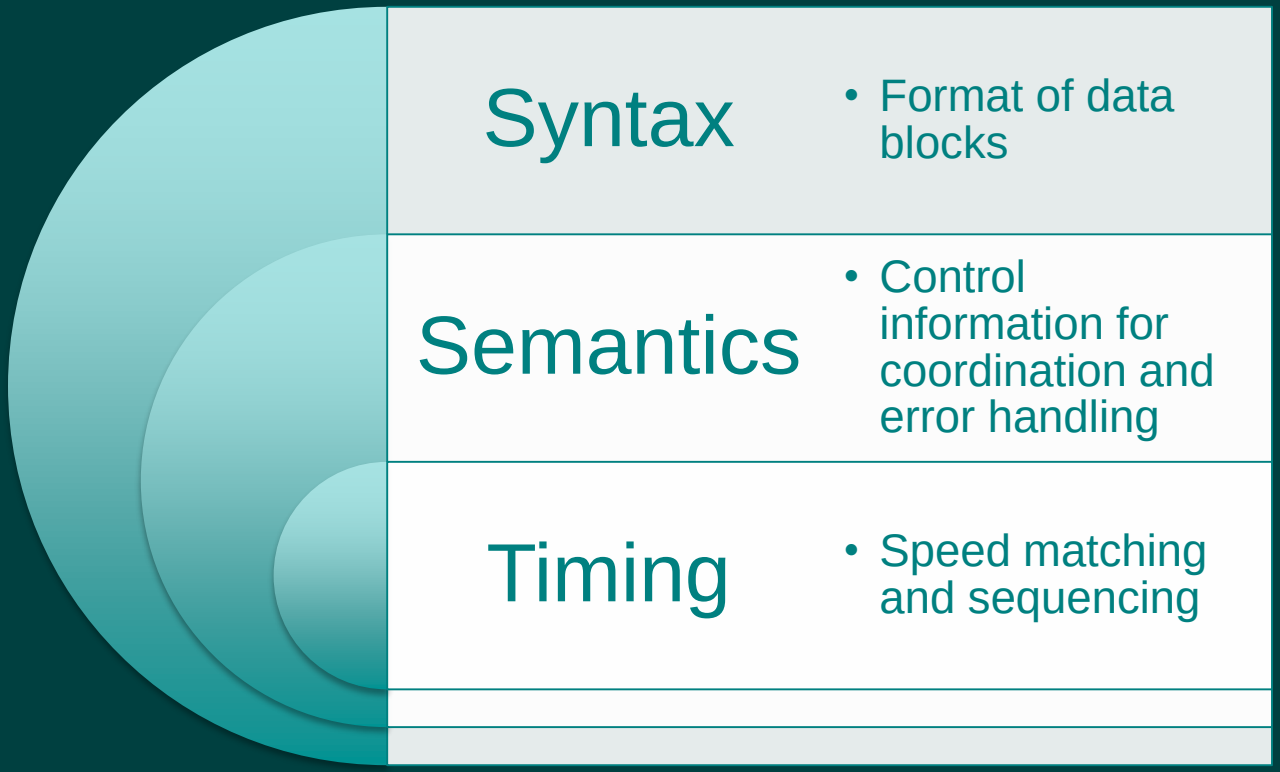
Functions of Protocol Architecture

- Breaks logic into subtask modules which are implemented separately
- Modules are arranged in a vertical stack
  - Each layer in the stack performs a subset of functions
  - Relies on next lower layer for primitive functions
  - Provides services to the next higher layer
  - Changes in one layer should not require changes in other layers

Key Features of a Protocol

A protocol is a set of rules or conventions that allow peer layers to communicate

The key features of a protocol are:



A Simple Protocol Architecture

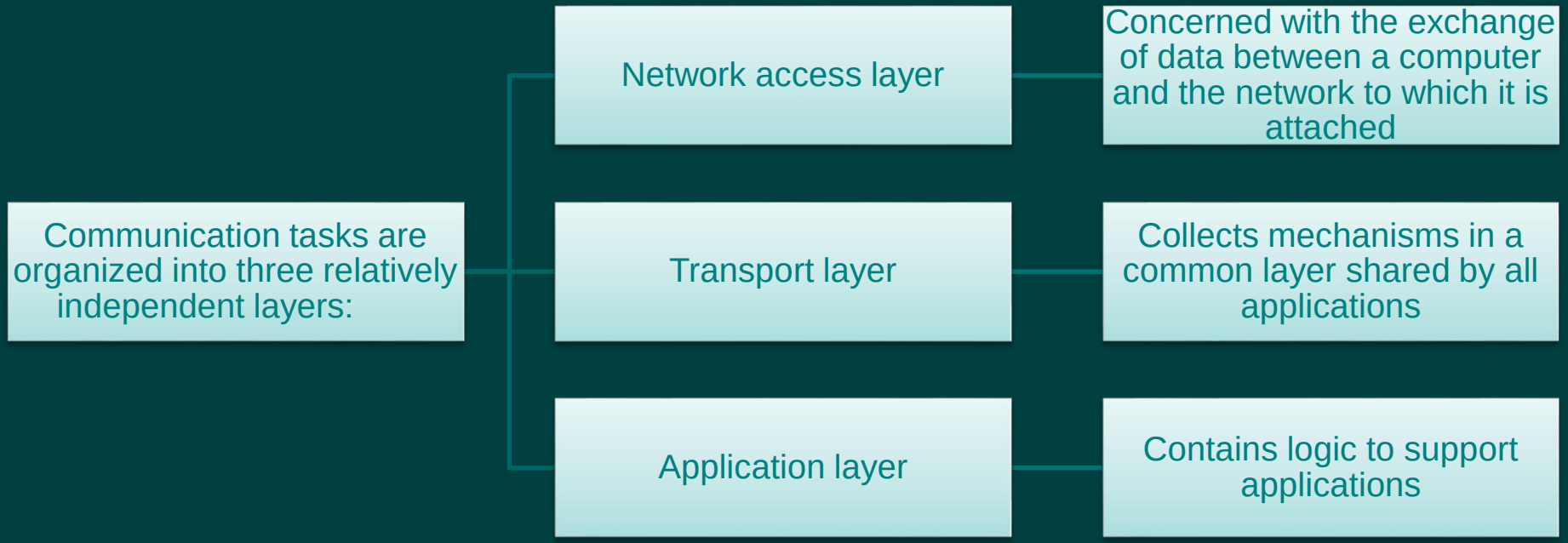
Agents involved:

- Applications
- Computers
- Networks

Examples of applications include file transfer and electronic mail

These execute on computers that support multiple simultaneous applications

Communication Layers



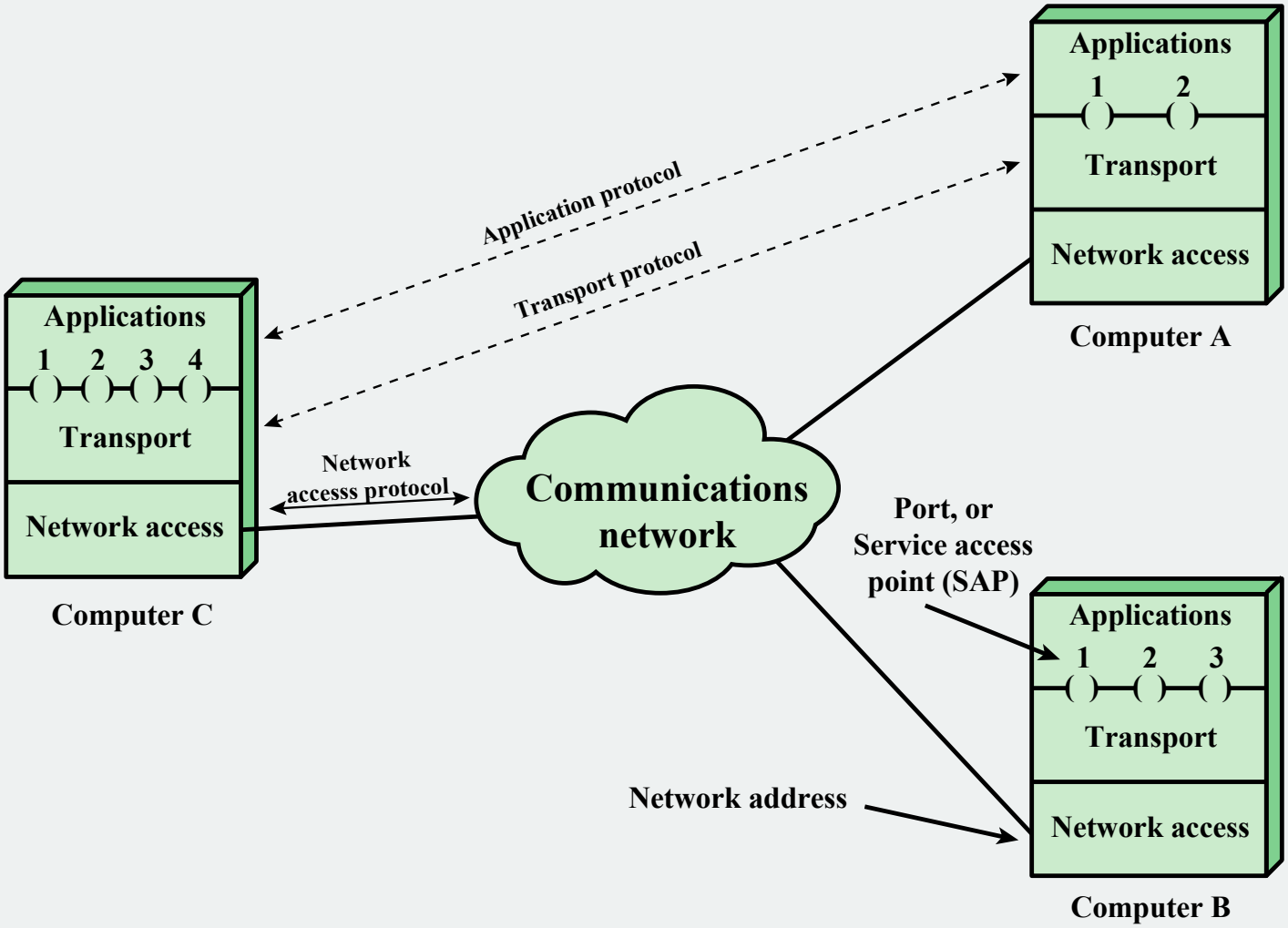


Figure 2.1 Protocol Architectures and Networks

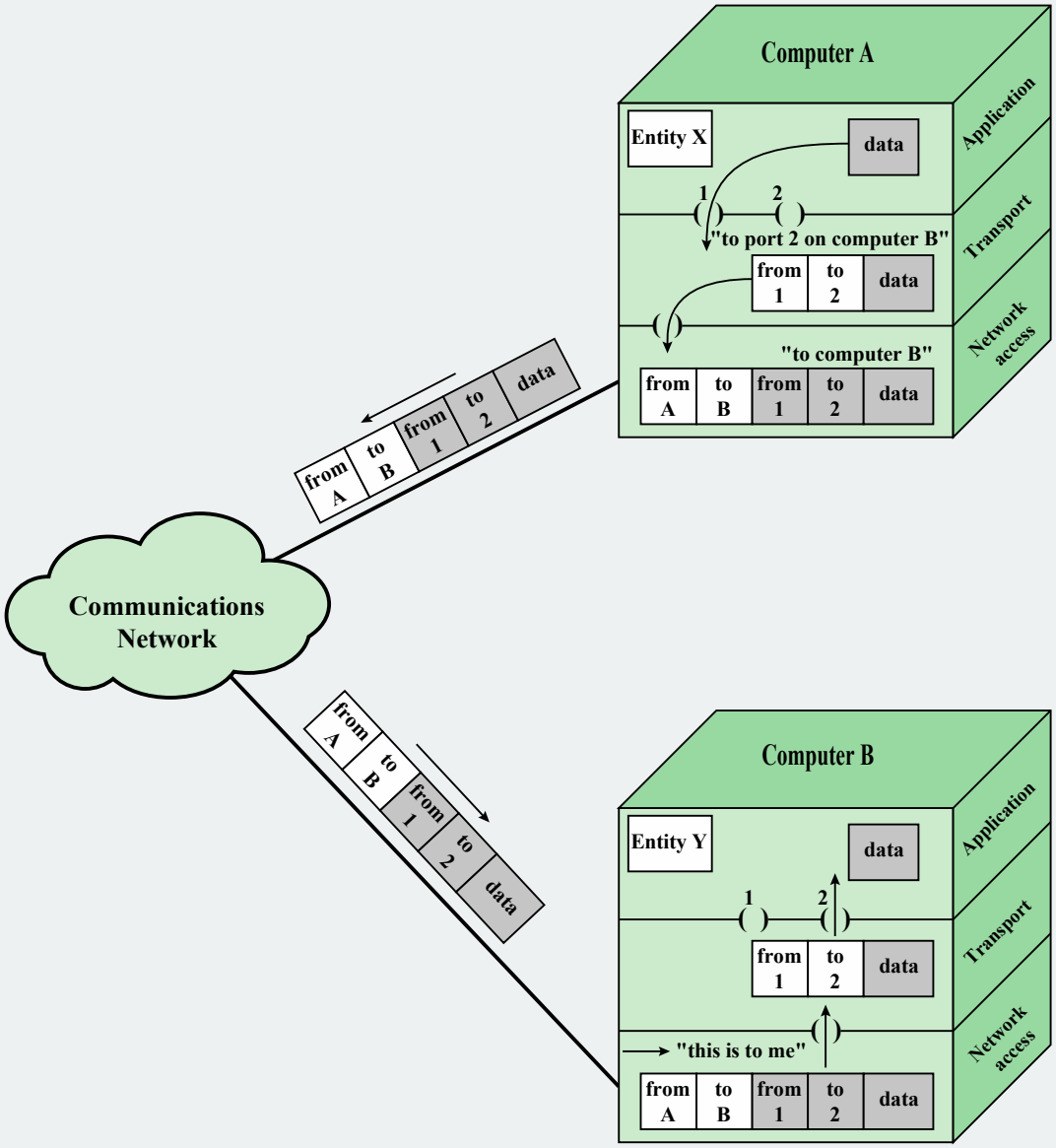
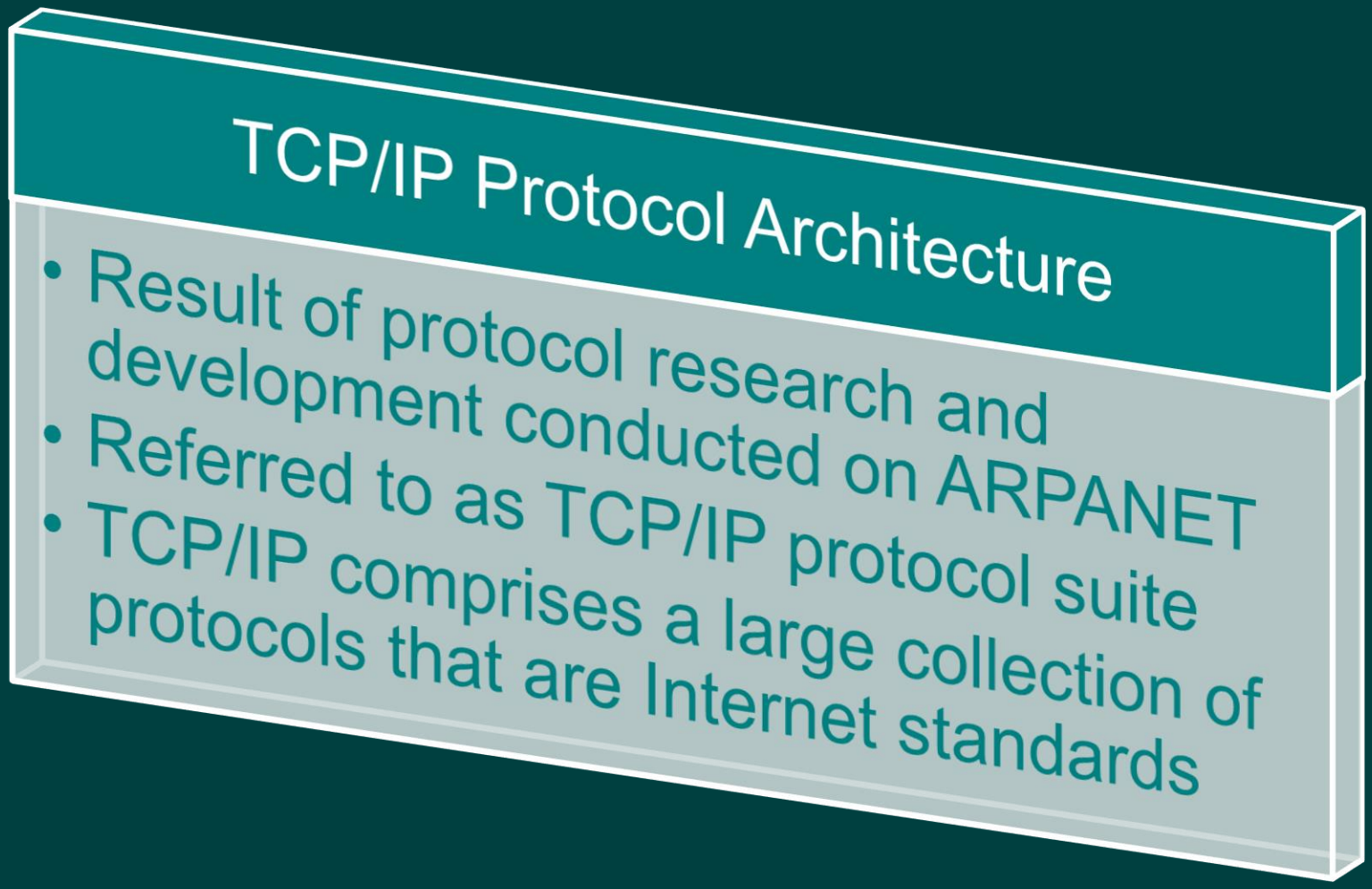


Figure 2.2 Protocols in a Simplified Architecture

TCP/IP Protocol Architecture



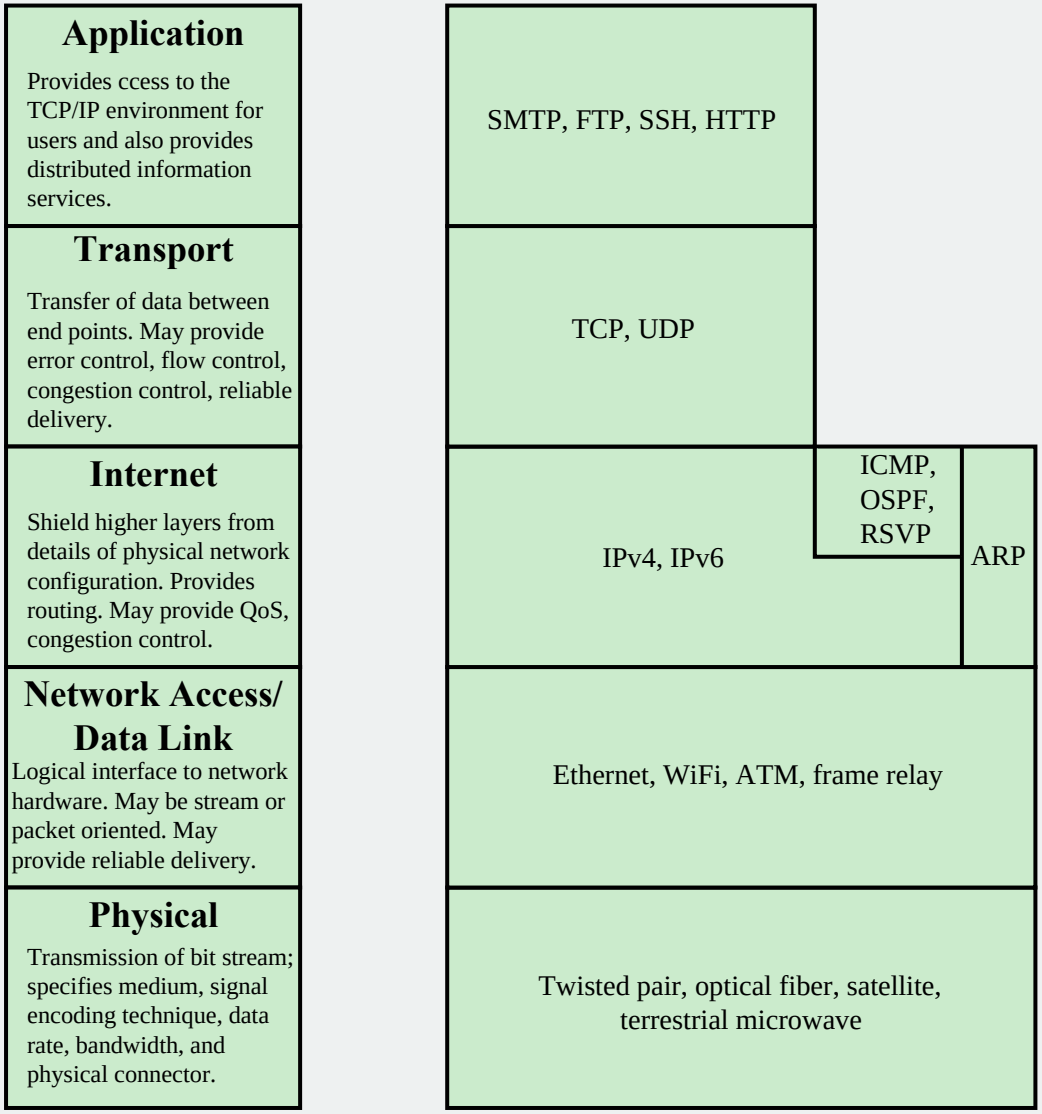


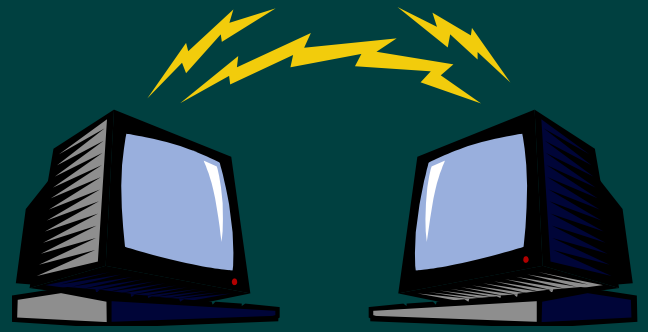
Figure 2.3 The TCP/IP Layers and Example Protocols

Physical Layer

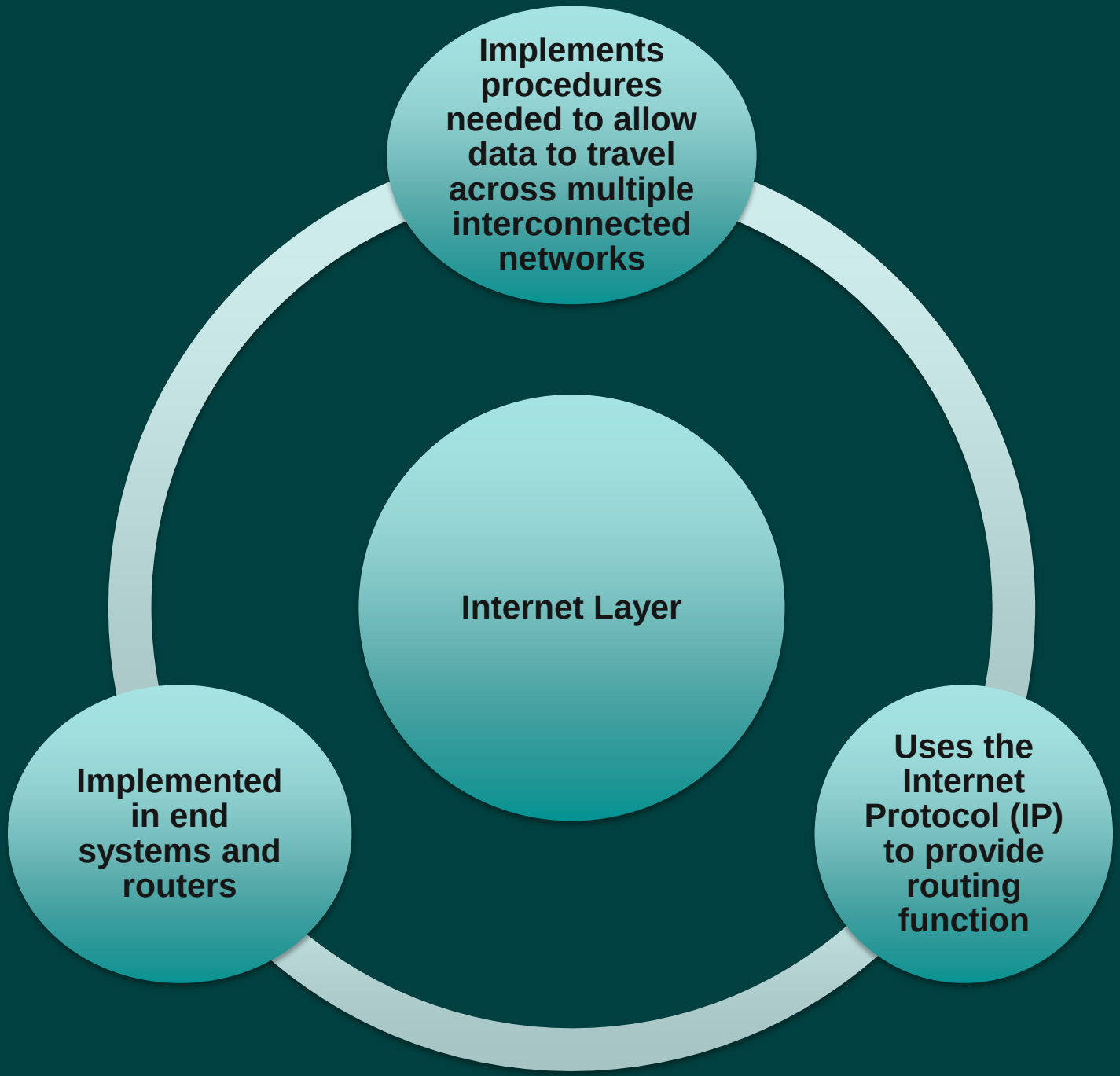
- Covers the physical interface between computer and network
- Concerned with issues like:
  - Characteristics of transmission medium
  - Nature of the signals
  - Data rates

Network Access/Data Link Layer

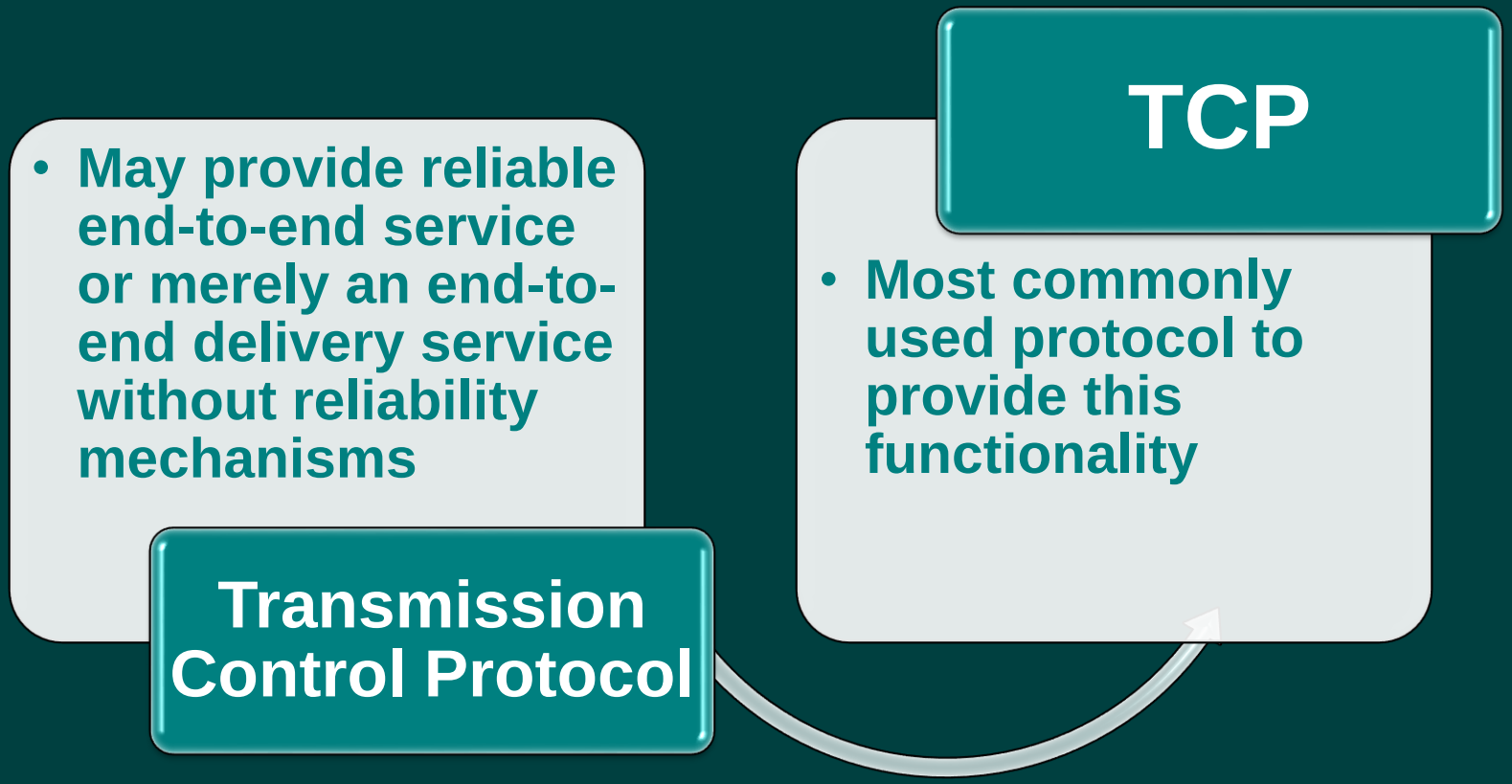
- Covers the exchange of data between an end system and the network that it is attached to
- Concerned with:
  - Access to and routing data across a network for two end systems attached to the same network



Internet Layer



Host-to-Host (Transport) Layer



Application Layer

- Contains the logic needed to support the various user applications
- A separate module is needed for each different type of application that is peculiar to that application

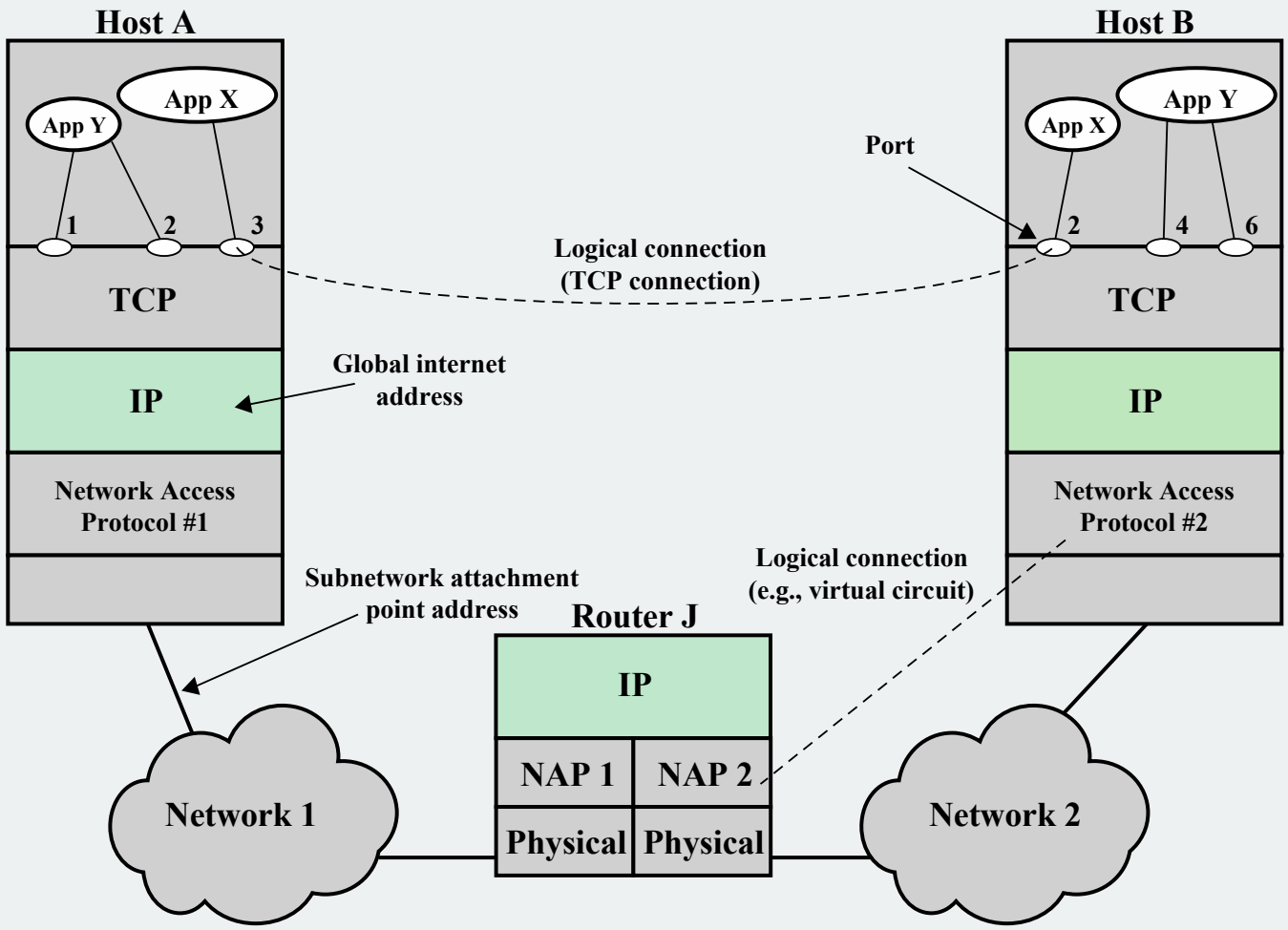
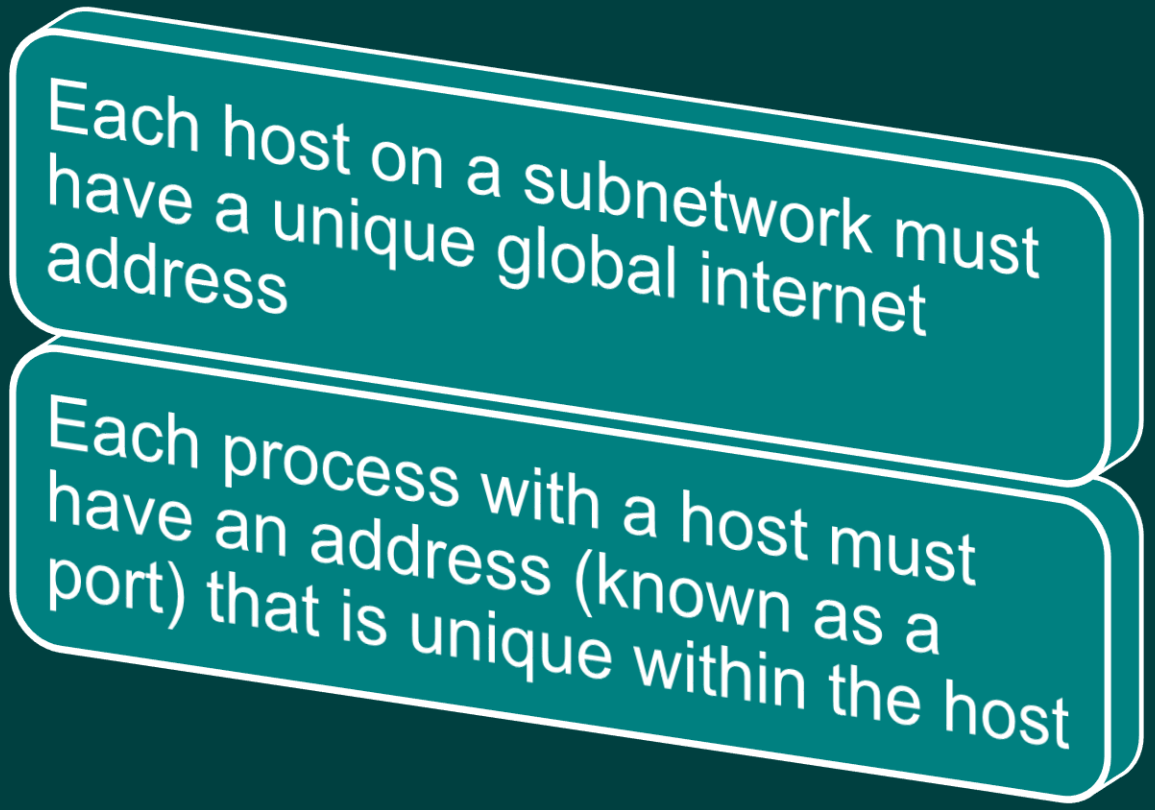


Figure 2.4 TCP/IP Concepts

TCP/IP Address Requirements

Two levels of addressing are needed:



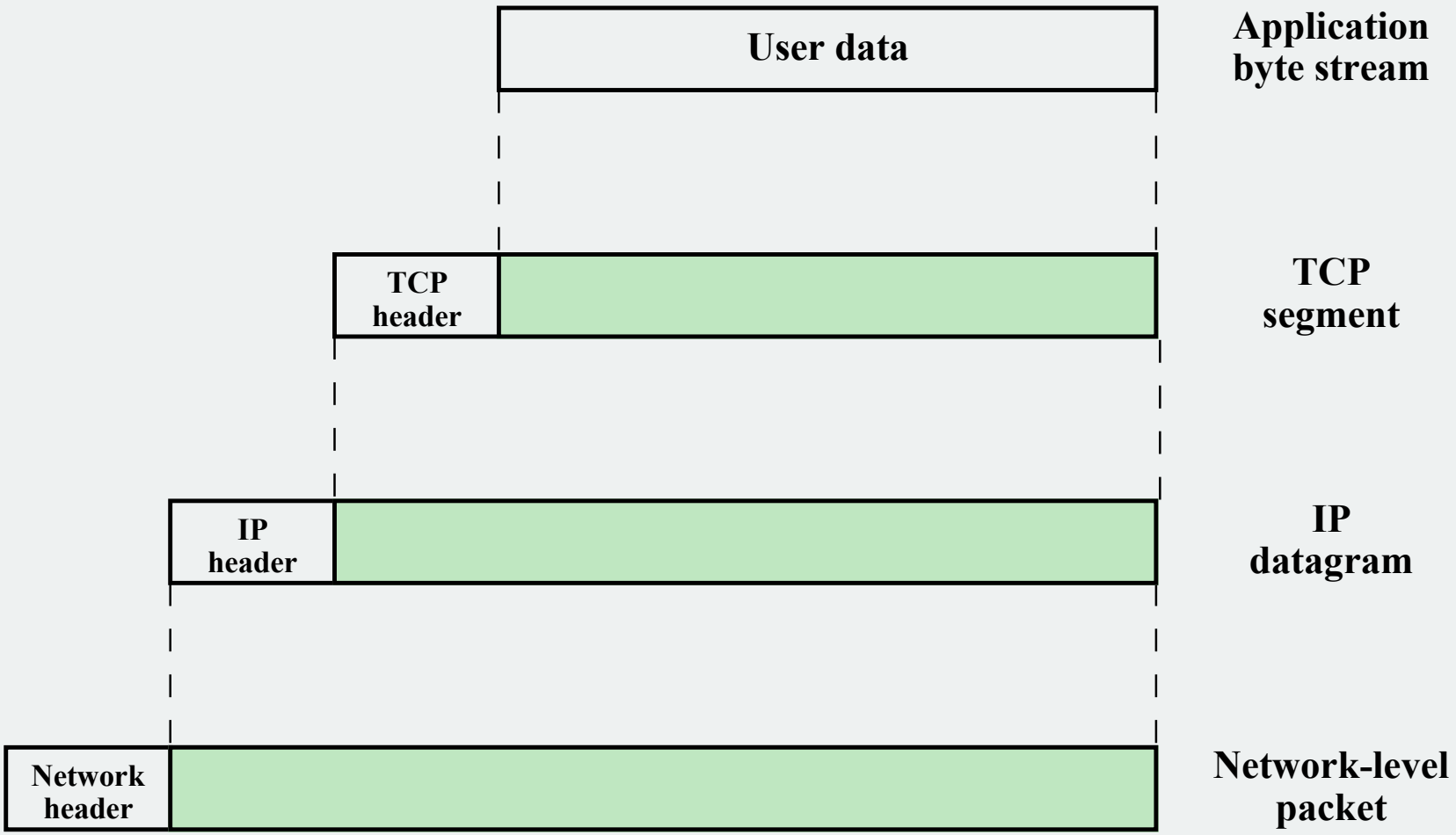
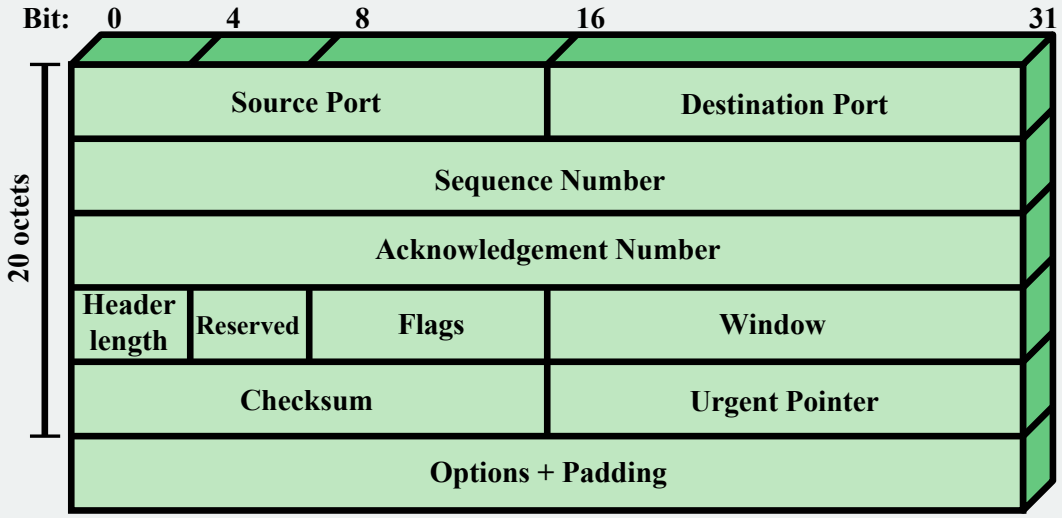


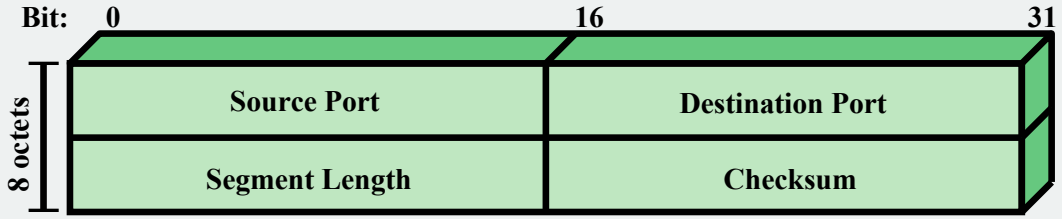
Figure 2.5 Protocol Data Units (PDUs) in the TCP/IP Architecture

Transmission Control Protocol (TCP)

- TCP is the transport layer protocol for most applications
- TCP provides a reliable connection for transfer of data between applications
- A TCP segment is the basic protocol unit
- TCP tracks segments between entities for duration of each connection



(a) TCP Header

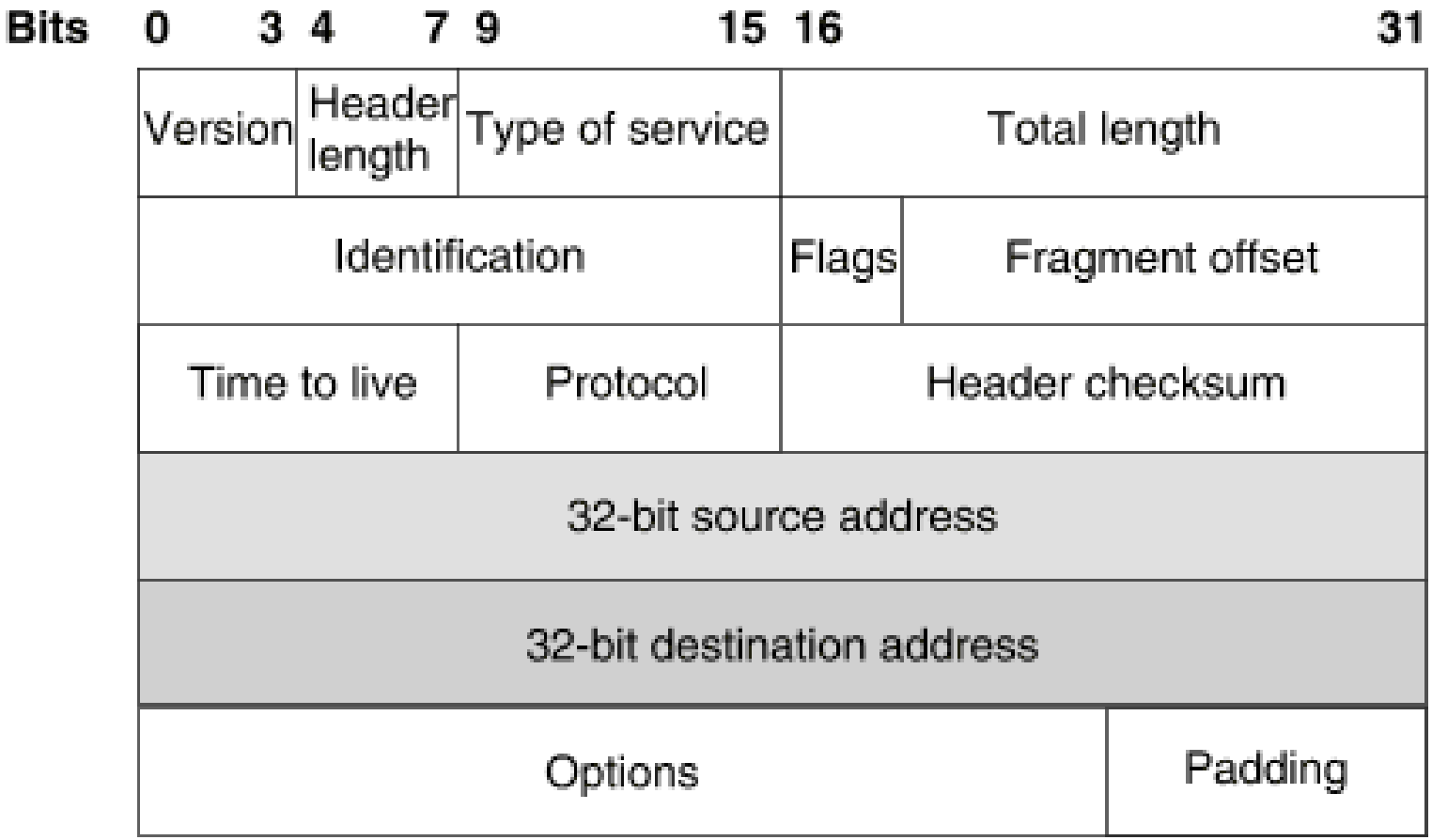


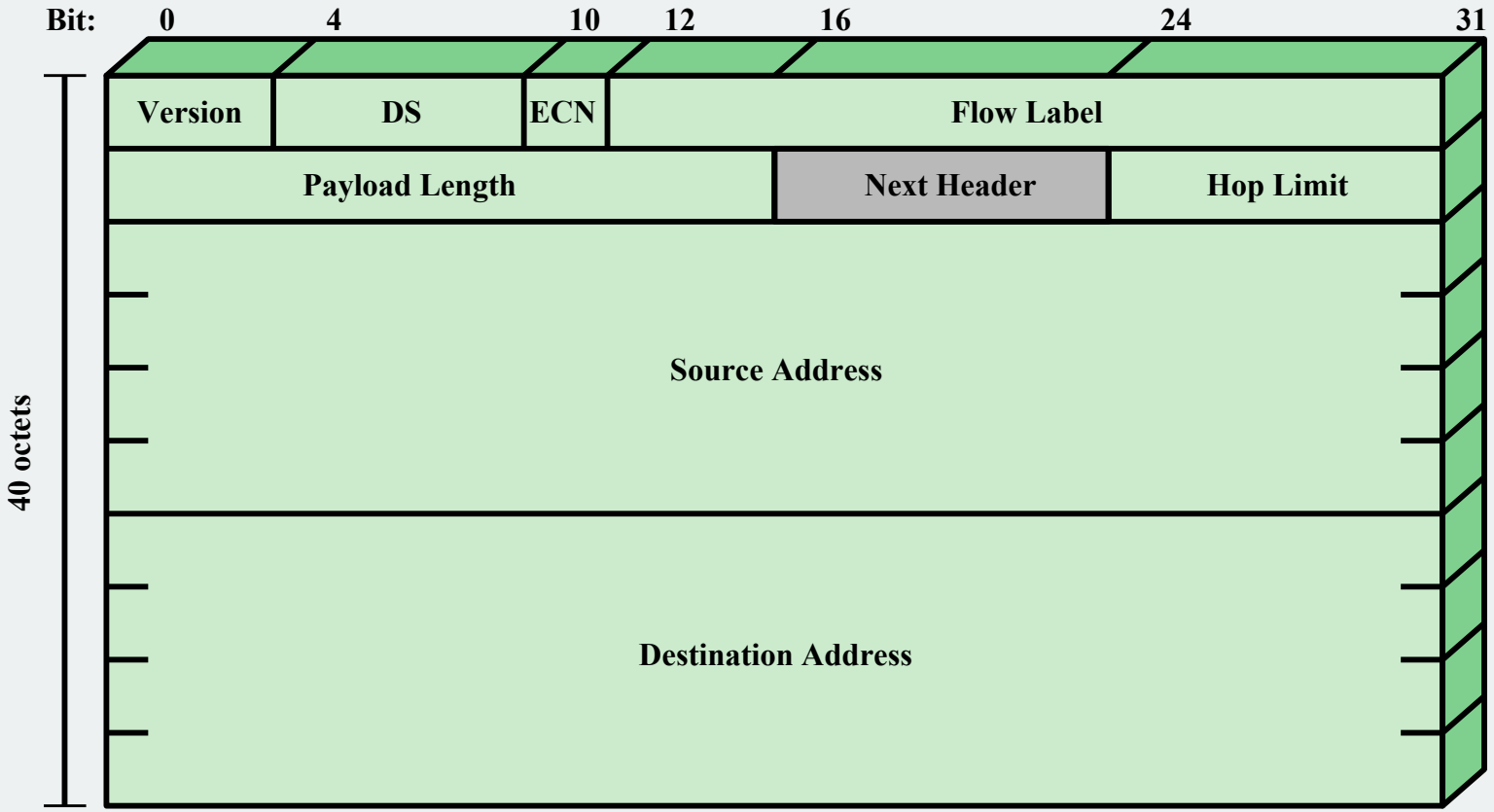
(b) UDP Header

Figure 2.6 TCP and UDP Headers

User Datagram Protocol (UDP)

- Alternative to TCP
- Does not guarantee delivery, preservation of sequence, or protection against duplication
- Enables a procedure to send messages to other procedures with a minimum of protocol mechanism
- Adds port addressing capability to IP
- Used with Simple Network Management Protocol (SNMP)
- Includes a checksum to verify that no error occurs in the data


Bits
0
3
4
7
9
15
16
31
Version
Header length
Type of service
Total length
Identification
Flags
Fragment offset
Time to live
Protocol
Header checksum
32-bit source address
32-bit destination address
Options
Padding

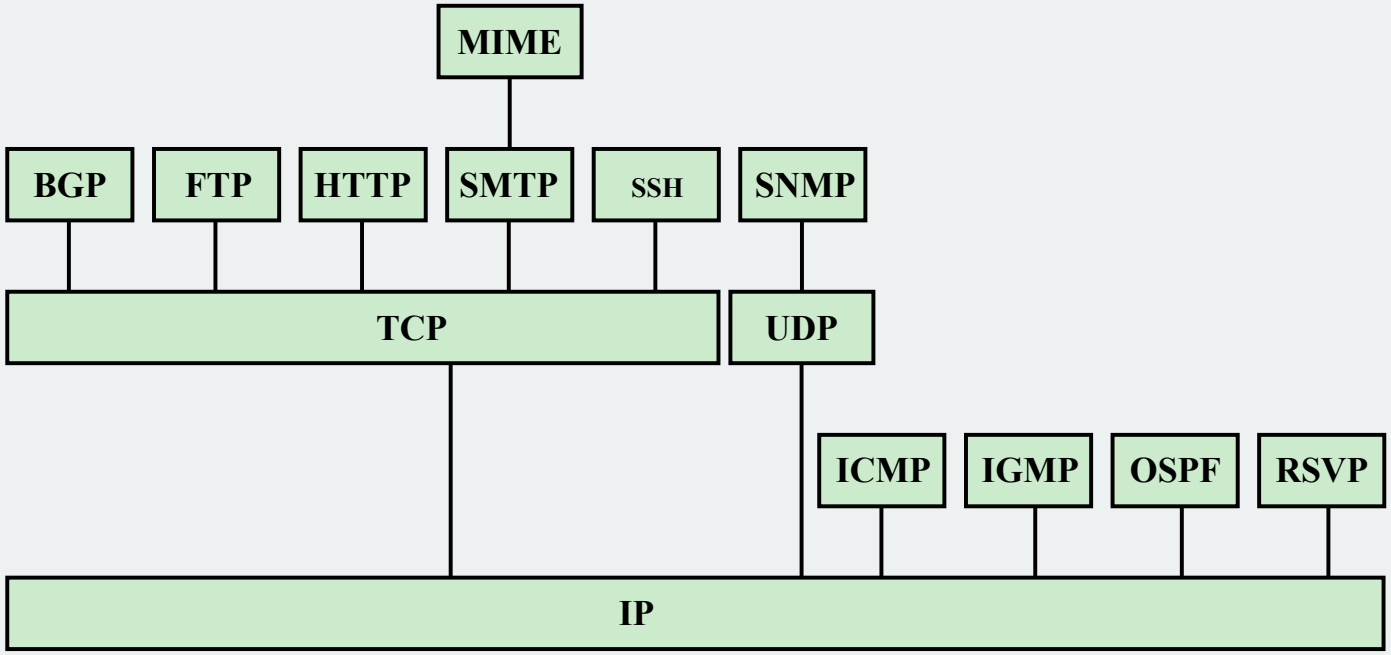


(b) IPv6 Header

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.

Figure 2.7 IP Headers



BGP = Border Gateway Protocol
FTP = File Transfer Protocol
HTTP = Hypertext Transfer Protocol
ICMP = Internet Control Message Protocol
IGMP = Internet Group Management Protocol
IP = Internet Protocol
MIME = Multipurpose Internet Mail Extension
OSPF = Open Shortest Path First
RSVP = Resource ReSerVation Protocol
SMTP = Simple Mail Transfer Protocol
SNMP = Simple Network Management Protocol
SSH = Secure Shell
TCP = Transmission Control Protocol
UDP = User Datagram Protocol

Figure 2.8 Some Protocols in the TCP/IP Protocol Suite

Service Primitives and Parameters

- Services between adjacent layers
- Expressed as:
  - **Primitive**s
    - Specify the function to be performed
  - **Parameters**
    - Used to pass data and control information

Service Primitive Types

REQUEST	A primitive issued by a service user to invoke some service and to pass the parameters needed to specify fully the requested service
INDICATION	A primitive issued by a service provider either to 1. indicate that a procedure has been invoked by the peer service user on the connection and to provide the associated parameters, or 2. notify the service user of a provider-initiated action
RESPONSE	A primitive issued by a service user to acknowledge or complete some procedure previously invoked by an indication to that user
CONFIRM	A primitive issued by a service provider to acknowledge or complete some procedure previously invoked by a request by the service user

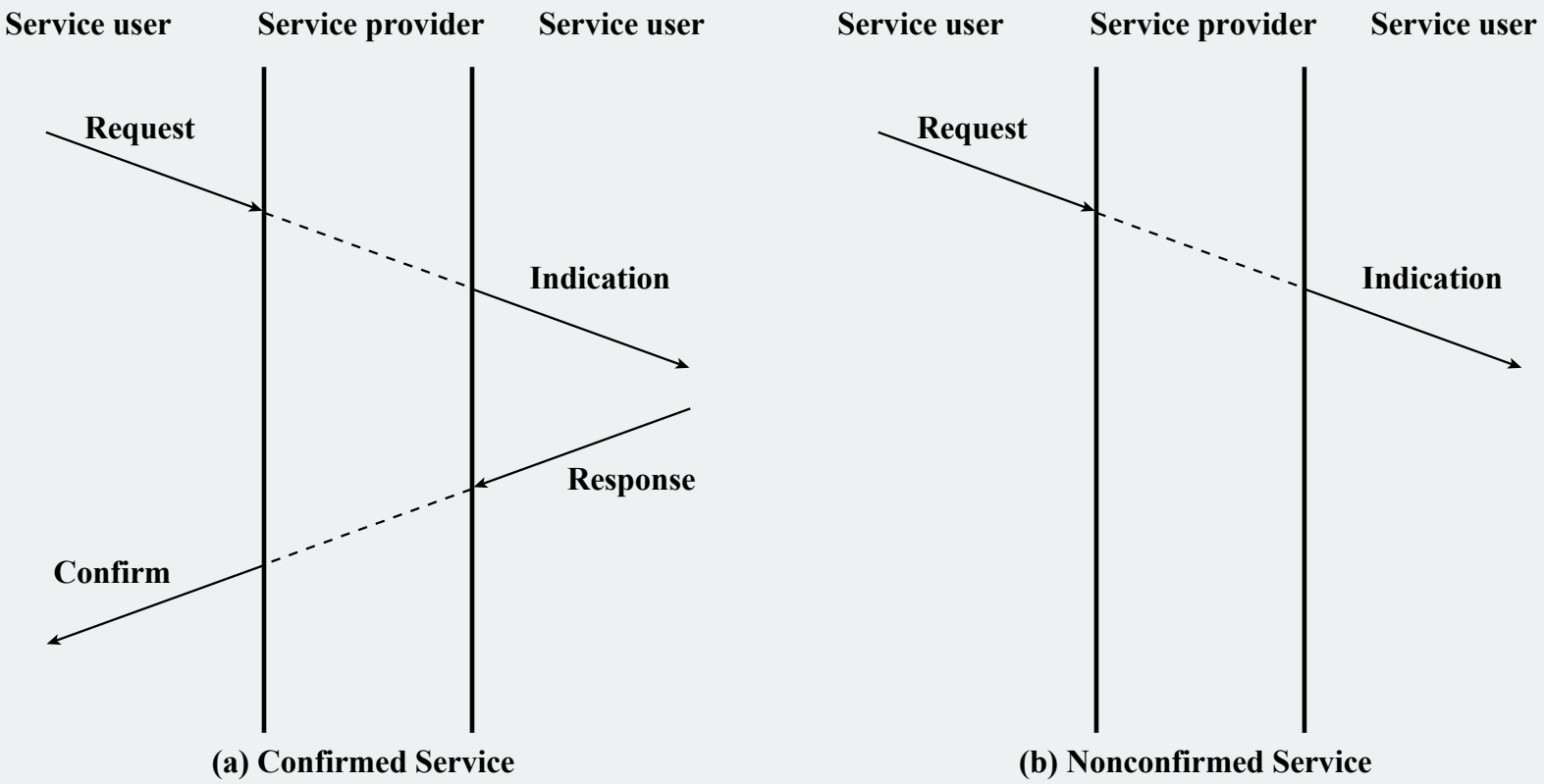


Figure 2.10 Time Sequence Diagrams for Service Primitives

Traditional Internet-Based Applications

- Three common applications that have been standardized to operate on top of TCP are:

Simple Mail Transfer Protocol (SMTP)

- Provides a mechanism for transferring messages among separate hosts

File Transfer Protocol (FTP)

- Used to send files from one system to another under user command
- Both text and binary files are accommodated

Secure Shell (SSH)

- Provides a secure remote logon capability

Multimedia Terminology

Media

Refers to the form of information and includes text, still images, audio, and video.

Multimedia

Human-computer interaction involving text, graphics, voice and video. Multimedia also refers to storage devices that are used to store multimedia content.

Streaming media

Refers to multimedia files, such as video clips and audio, that begin playing immediately or within seconds after it is received by a computer from the Internet or Web. Thus, the media content is consumed as it is delivered from the server rather than waiting until an entire file is downloaded.

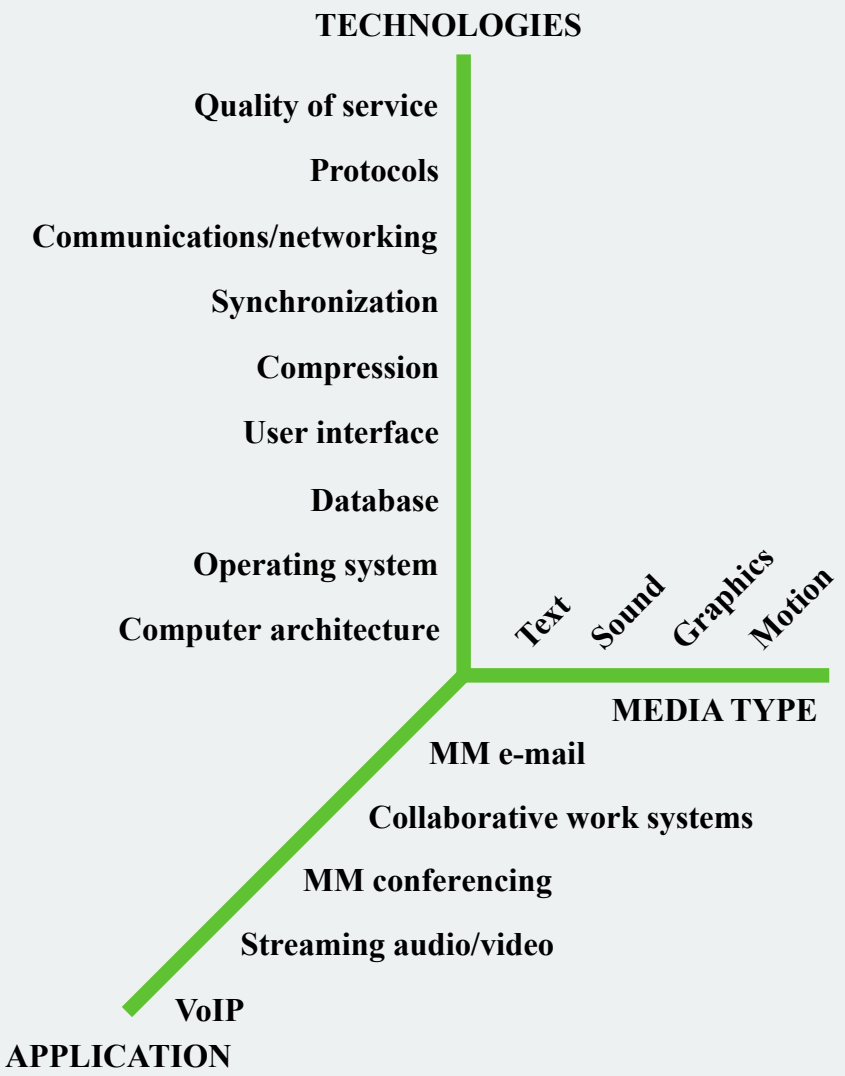
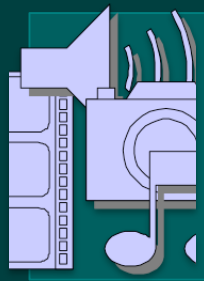


Figure 2.11 A Multimedia Taxonomy

Media Types



audio generally encompasses sounds that are produced by the human speech mechanism

image supports the communication of individual pictures, charts, or drawings

video service carries sequences of pictures in time

text is information that can be entered via a keyboard and is directly readable and printable

Multimedia Applications

Information systems

- Information kiosks, electronic books that include audio and video, and multimedia expert systems

Communication systems

- Support collaborative work, such as videoconferencing

Entertainment systems

- Computer and network games and other forms of audiovisual entertainment

Business systems

- Business-oriented multimedia presentations, video brochures, and online shopping

Educational systems

- Electronic books with a multimedia component, simulation and modeling applets, and other teaching support systems

Multimedia Technologies

- Some technologies that are relevant to the support of multimedia applications are: