



Computer Networks

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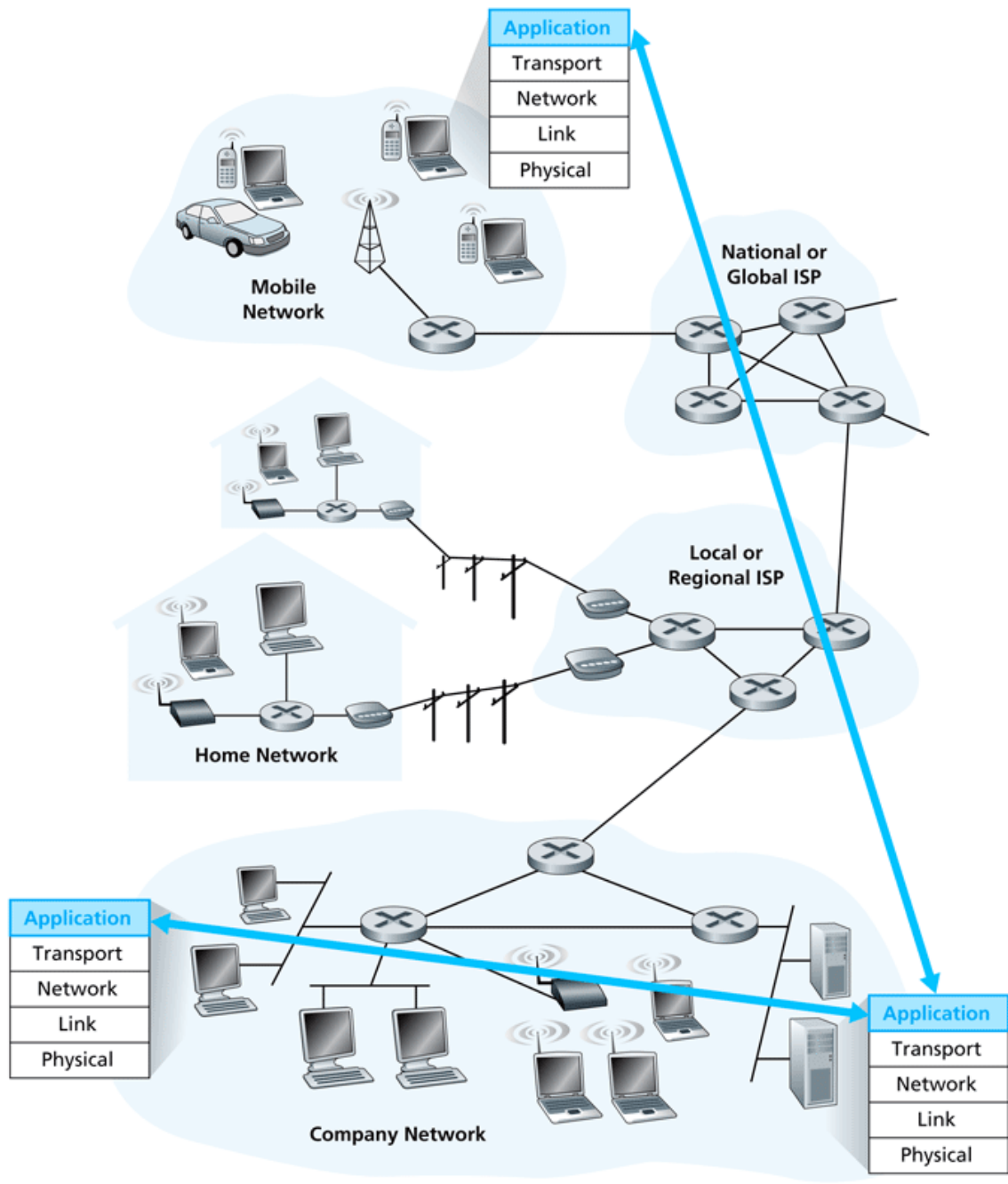
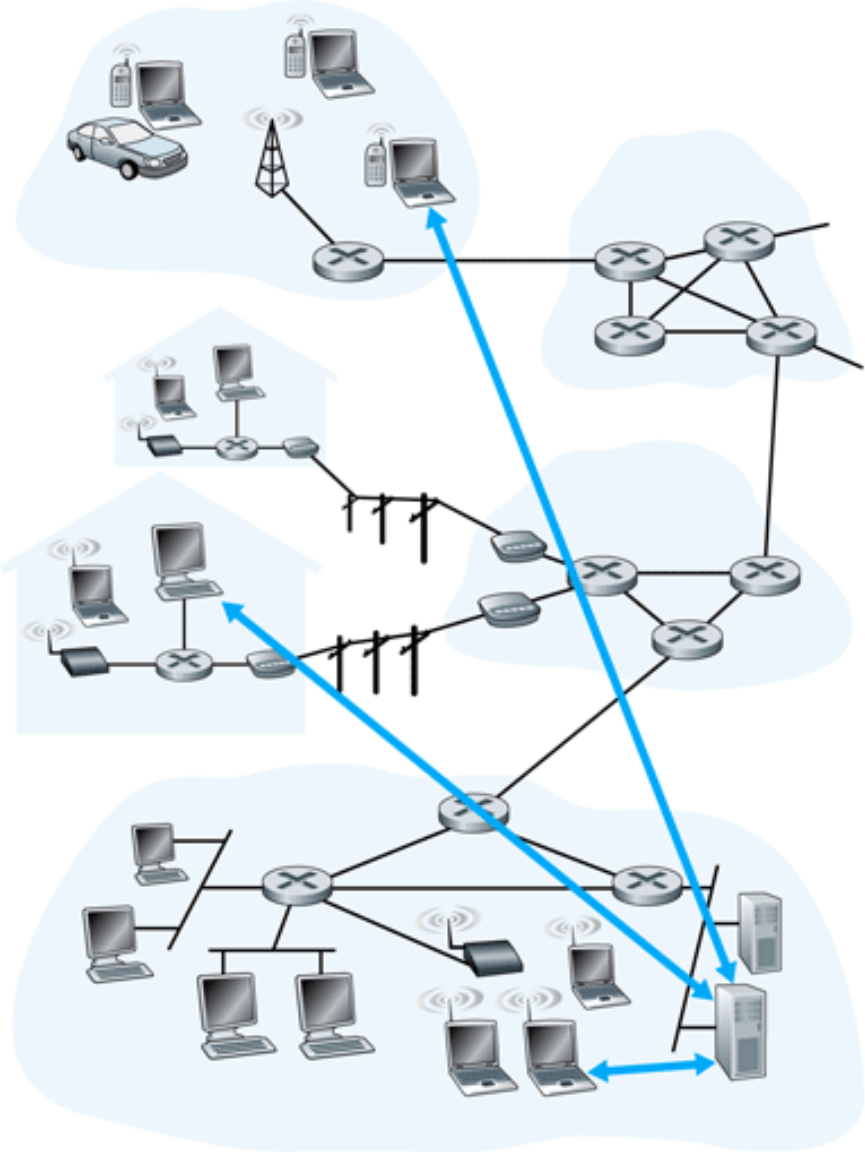
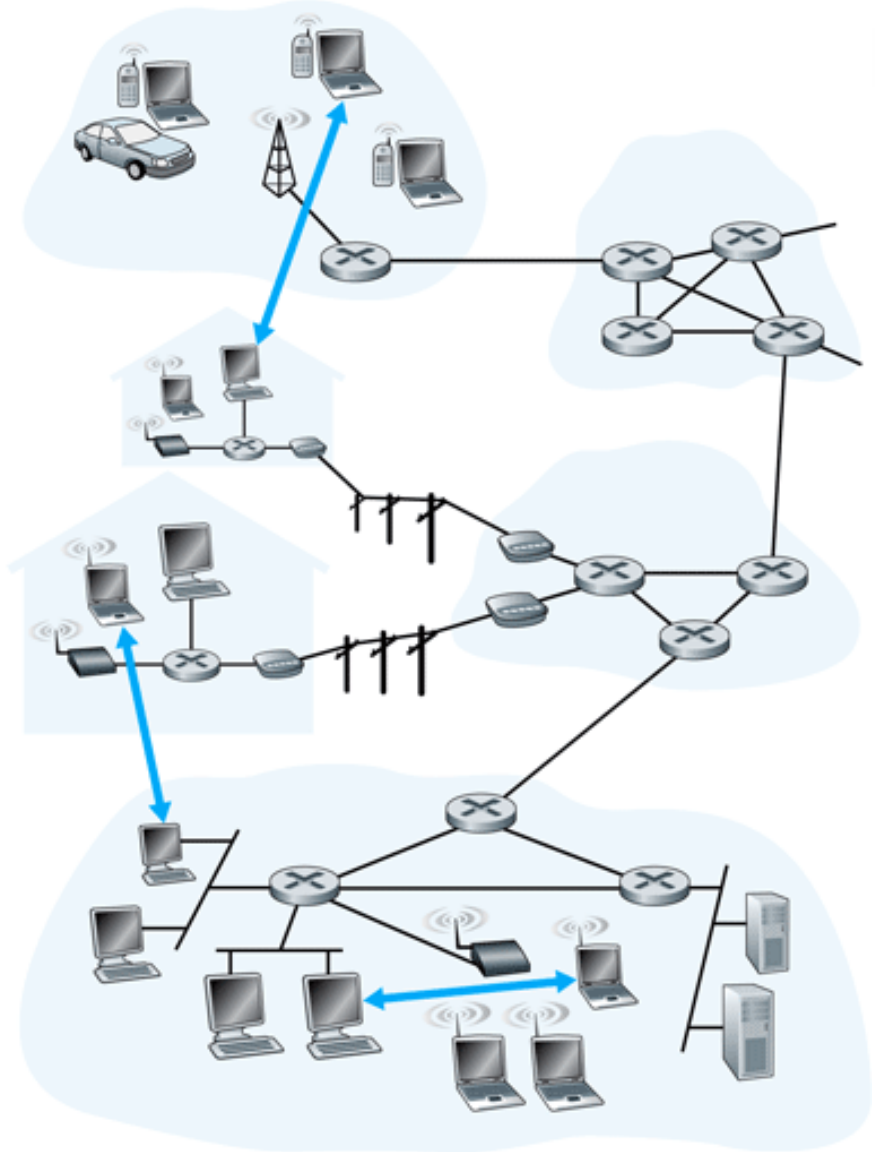


Figure 2.1 ♦ Communication for a network application takes place between end systems at the application layer.



a. Client-server architecture



b. Peer-to-peer architecture

Figure 2.2 ♦ (a) Client-server architecture; (b) P2P architecture.

- In a P2P file sharing application, do you agree with the statement, “There is no notion of client and server sides of a communication session”?
 1. Yes – true
 2. No - false



Process Communication

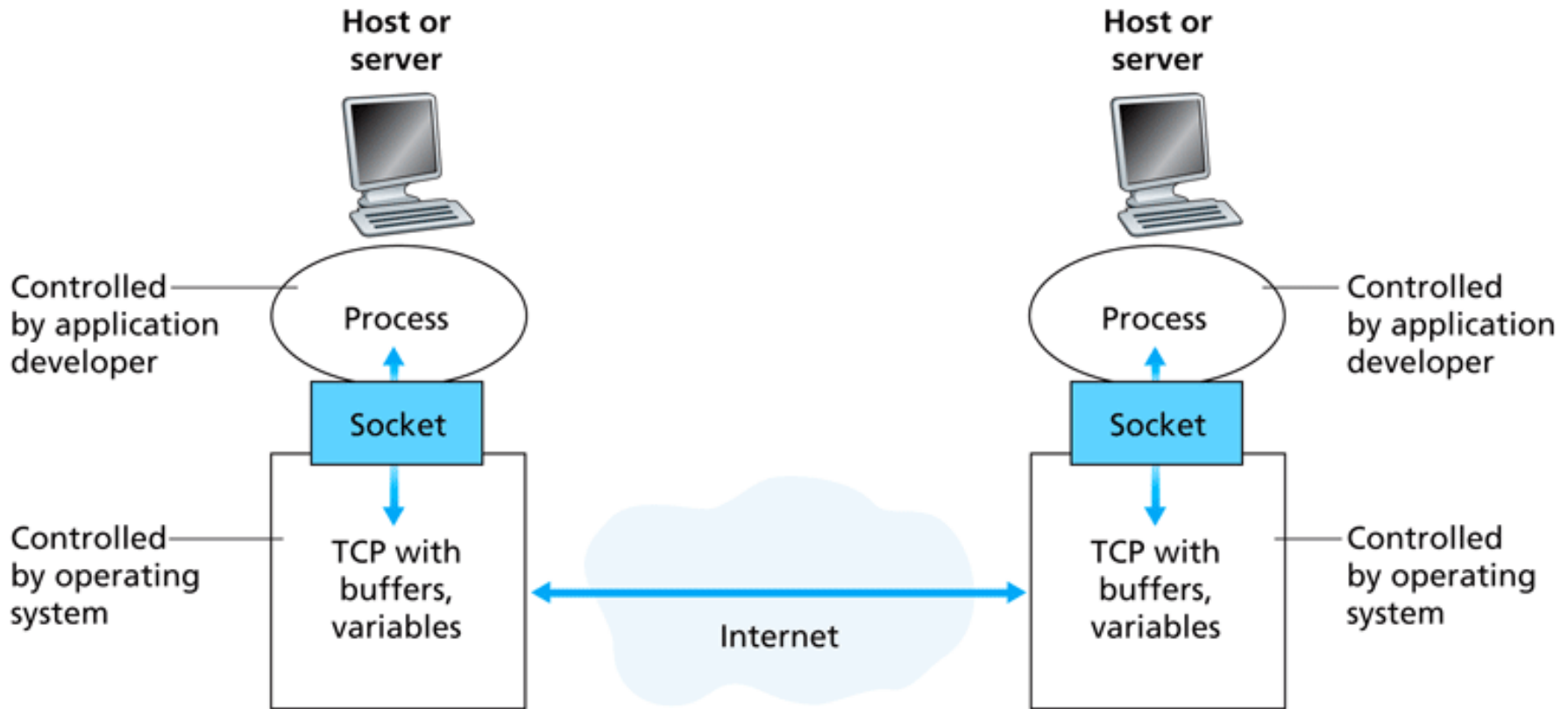


Figure 2.3 ♦ Application processes, sockets, and underlying transport protocol



Application-Layer Protocol

- The types of messages exchanged
- The syntax of the various message types
- The semantics of the fields
- Rules for determining when and how a process sends messages and responds to messages



Network Application Services

- Reliable data transfer
- Throughput
 - Bandwidth-sensitive Applications
 - Elastic Applications
- Timing
- Security

Transport Layer Protocols

■ TCP

- Connection-oriented
- Reliable

■ UDP


- Connectionless
- Unreliable
- Less overhead

- Why do HTTP, FTP, and E-mail protocols (SMTP, POP3, IMAP) run on top of TCP rather than on UDP?
 1. Easier to use for applications
 2. Data must be received in correct order
 3. Data must be received in correct order and without gaps
 4. Data must be received within given time constraints



| Application | Data Loss | Bandwidth | Time-Sensitive |
|---|---------------|---|-------------------|
| File transfer | No loss | Elastic | No |
| E-mail | No loss | Elastic | No |
| Web documents | No loss | Elastic (few kbps) | No |
| Internet telephony/ Video conferencing | Loss-tolerant | Audio: few kbps–1 Mbps Video: 10 kbps–5 Mbps | Yes: 100s of msec |
| Stored audio/video | Loss-tolerant | Same as above | Yes: few seconds |
| Interactive games | Loss-tolerant | Few kbps–10 kbps | Yes: 100s of msec |
| Instant messaging | No loss | Elastic | Yes and no |

Figure 2.4 ♦ Requirements of selected network applications



| Application | Application-Layer Protocol | Underlying Transport Protocol |
|------------------------|--|-------------------------------|
| Electronic mail | SMTP [RFC 2821] | TCP |
| Remote terminal access | Telnet [RFC 854] | TCP |
| Web | HTTP [RFC 2616] | TCP |
| File transfer | FTP [RFC 959] | TCP |
| Streaming multimedia | HTTP (e.g., YouTube), RTP | TCP or UDP |
| Internet telephony | SIP, RTP, or proprietary (e.g., Skype) | Typically UDP |

Figure 2.5 ♦ Popular Internet applications, their application-layer protocols, and their underlying transport protocols

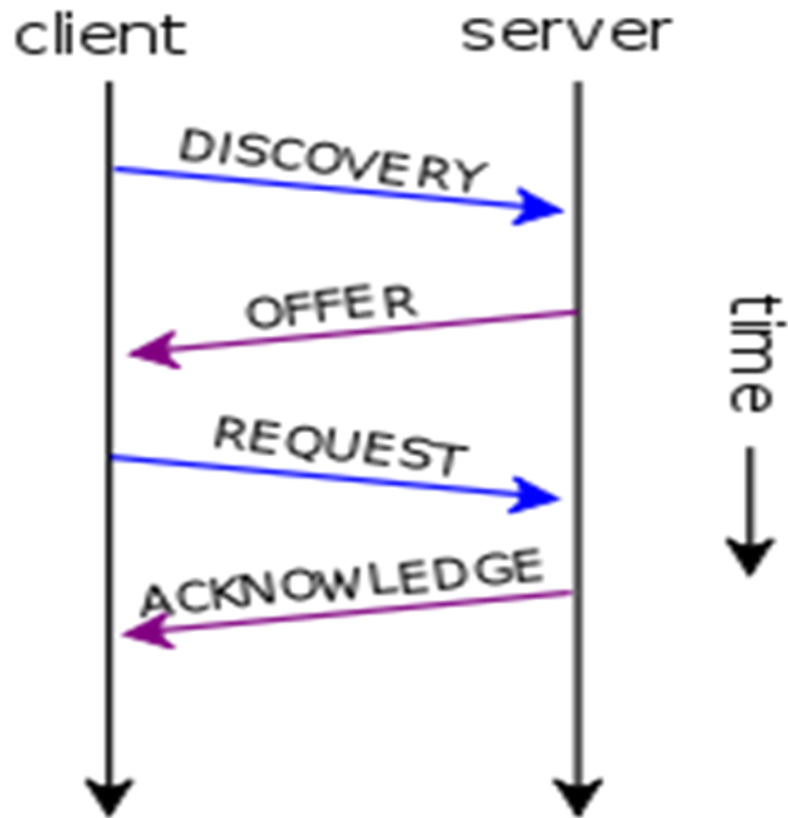
- What information is used by a process running on one host to identify a process running on another host?
 1. Destination IP address
 2. Destination port number
 3. Source IP address and destination IP address
 4. Destination IP address and port number
 5. Source IP address and source port number



DHCP

- Dynamic Host Configuration Protocol
- Components
 - DHCP Server
 - Address pools
 - DHCP Client

DHCP Message Types



DHCP Lease

- Lease obtained
- Lease time
- Expiration