Jaringan Komputer

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- Introduction
- Layer Fisik
- Layer Data link
- MAC
- IP Packet
- IP Addressing
- IP Routing
  - Statis
  - Dinamis
    - RIP
    - OSPF
- Layer Transport
  - TCP
  - UDP
- Layer Aplikasi
  - DNS
  - DHCP
  - HTTP
  - FTP

Buku

- Jaringan Komputer
  - AS Tanenbaum
- Data & Computer Communication
  - Williams Stallings

Penilaian

- Tugas/Kuis 30 %
- UTS 35 %
- UAS 35 %

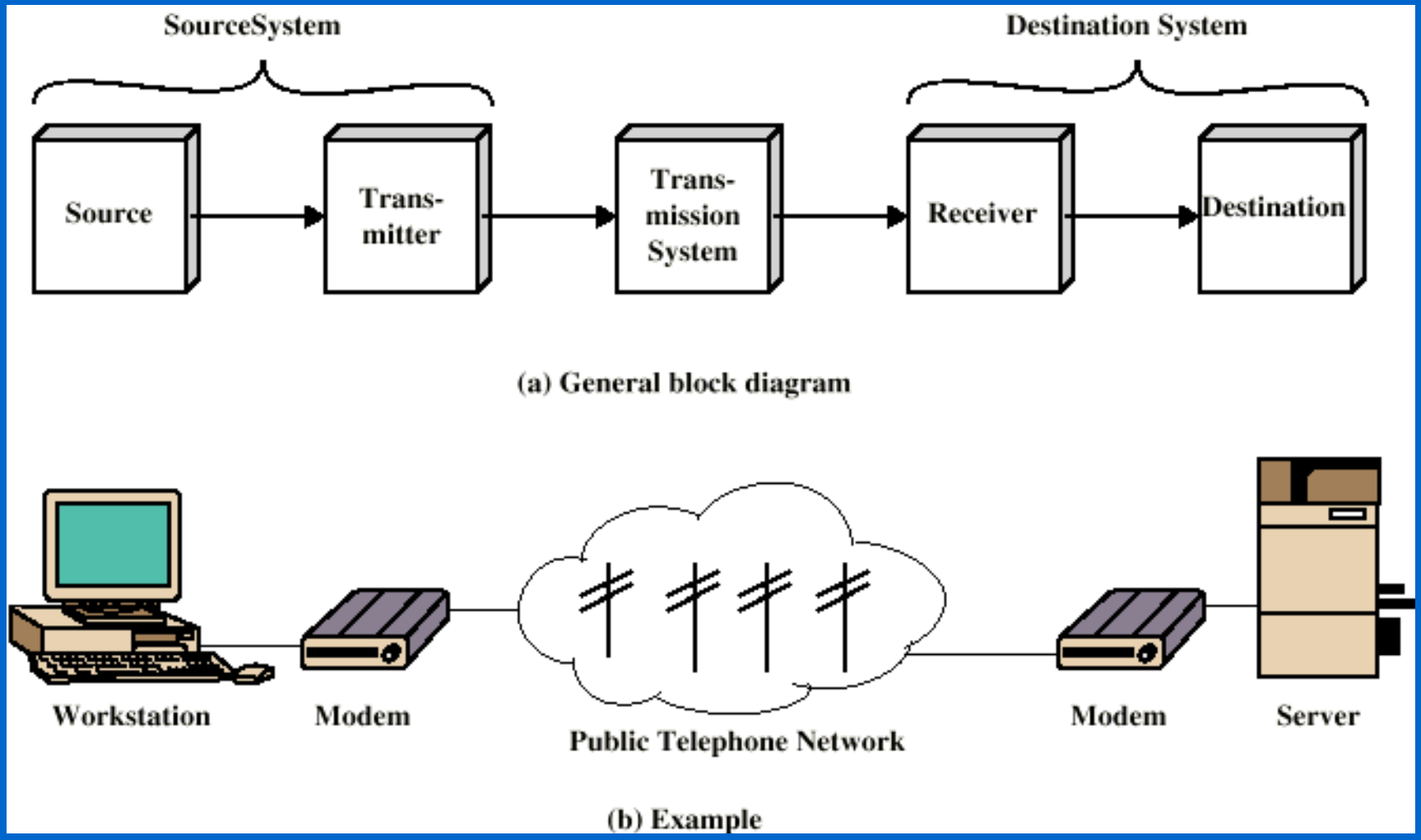
- Presensi CBIS min 75% tapi tidak masuk penilaian

Introduction

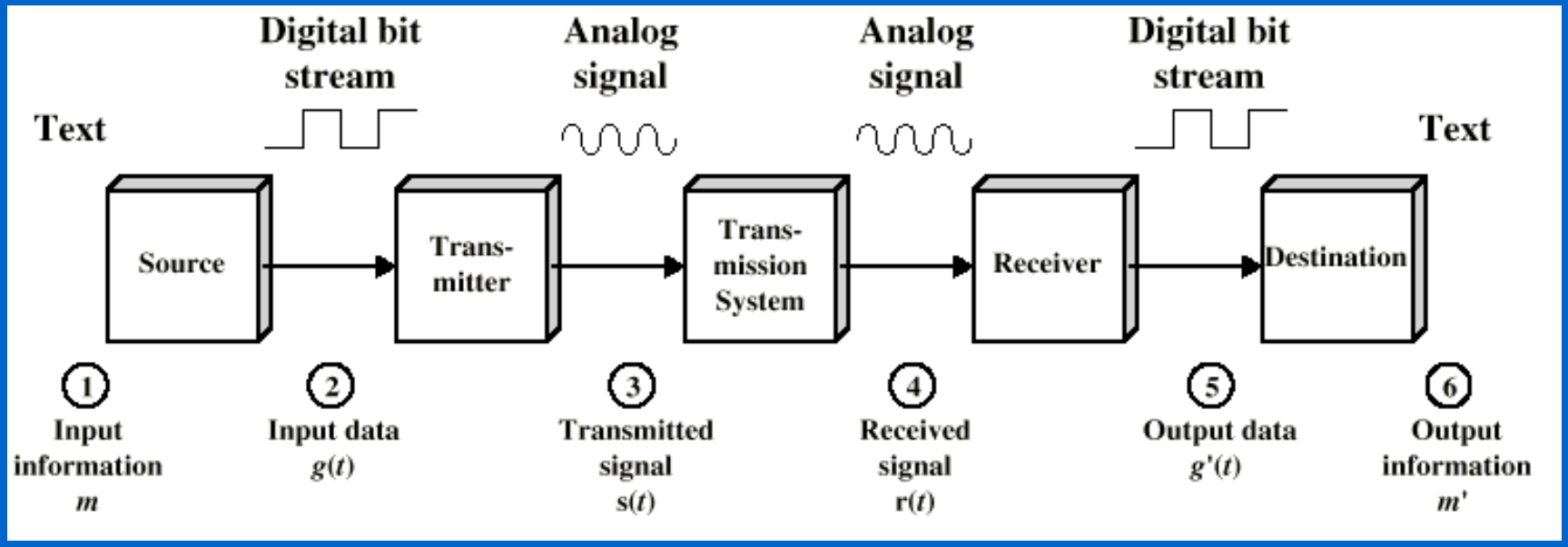
A Communications Model

- Source
  - generates data to be transmitted
- Transmitter
  - Converts data into transmittable signals
- Transmission System
  - Carries data
- Receiver
  - Converts received signal into data
- Destination
  - Takes incoming data

Simplified Communications Model - Diagram



Simplified Data Communications Model



Networking

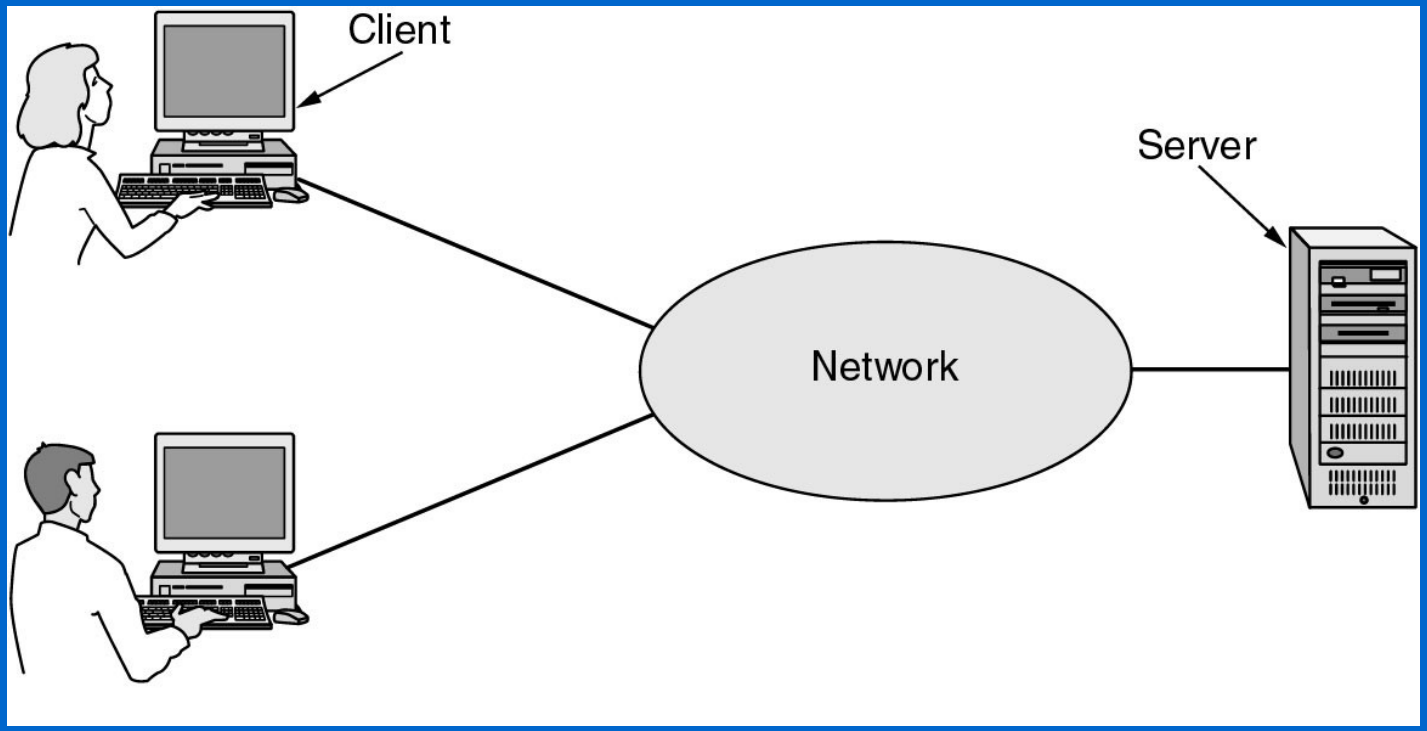
- Point to point communication not usually practical
  - Devices are too far apart
  - Large set of devices would need impractical number of connections
- Solution is a communications network

Uses of Computer Networks

- Business Applications
- Home Applications
- Mobile Users
- Social Issues

Business Applications of Networks

- A network with two clients and one server.

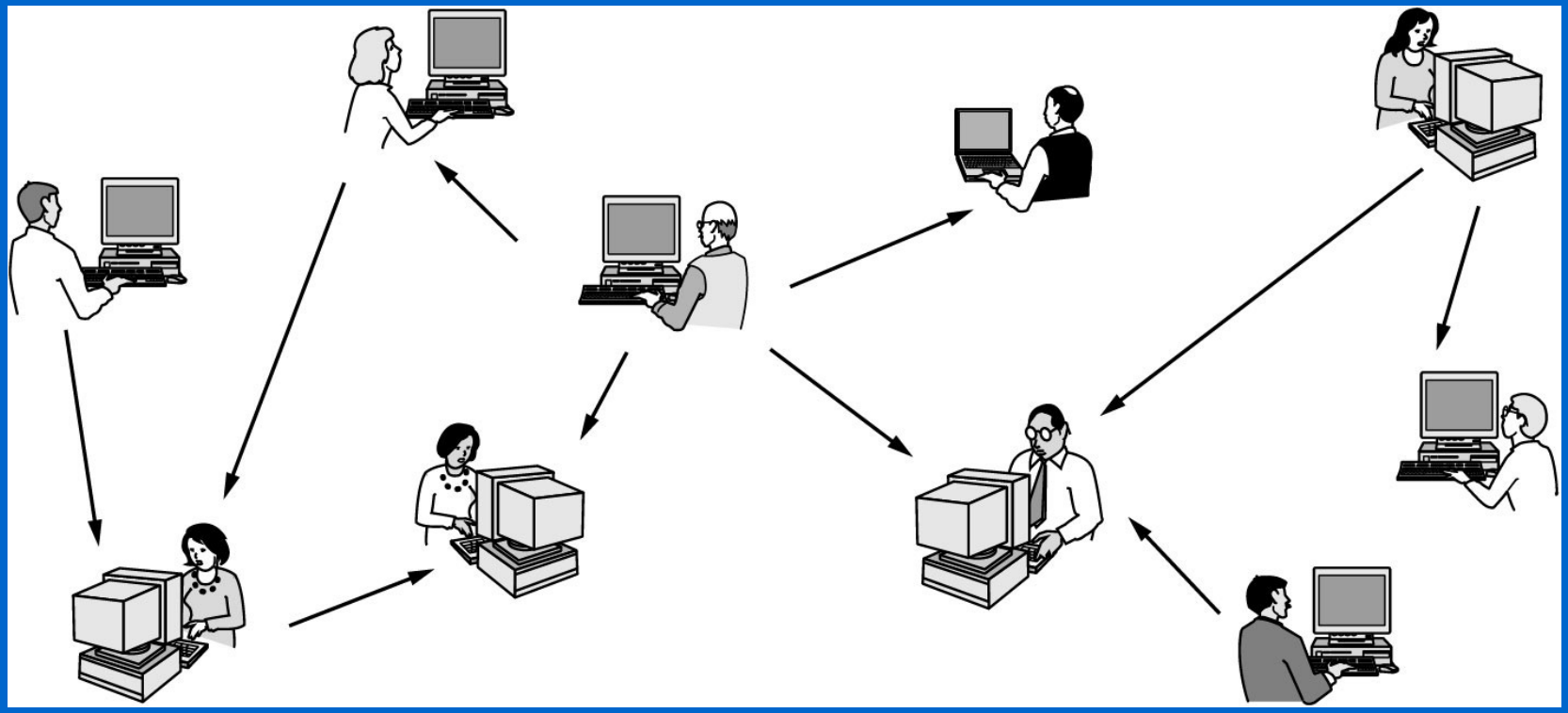


Home Network Applications

- Access to remote information
- Person-to-person communication
- Interactive entertainment
- Electronic commerce

Home Network Applications

- In peer-to-peer system there are no fixed clients and servers.

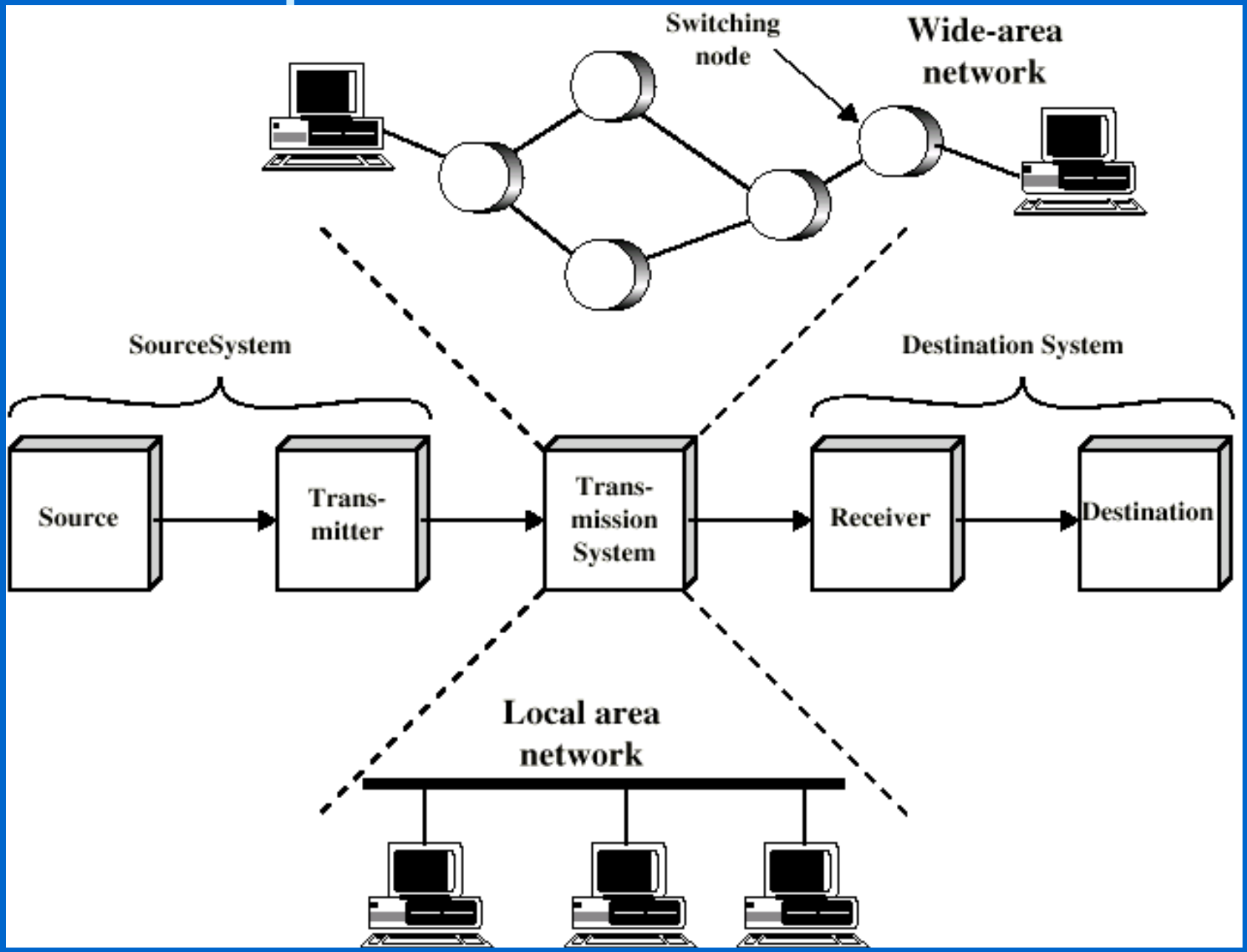


Home Network Applications

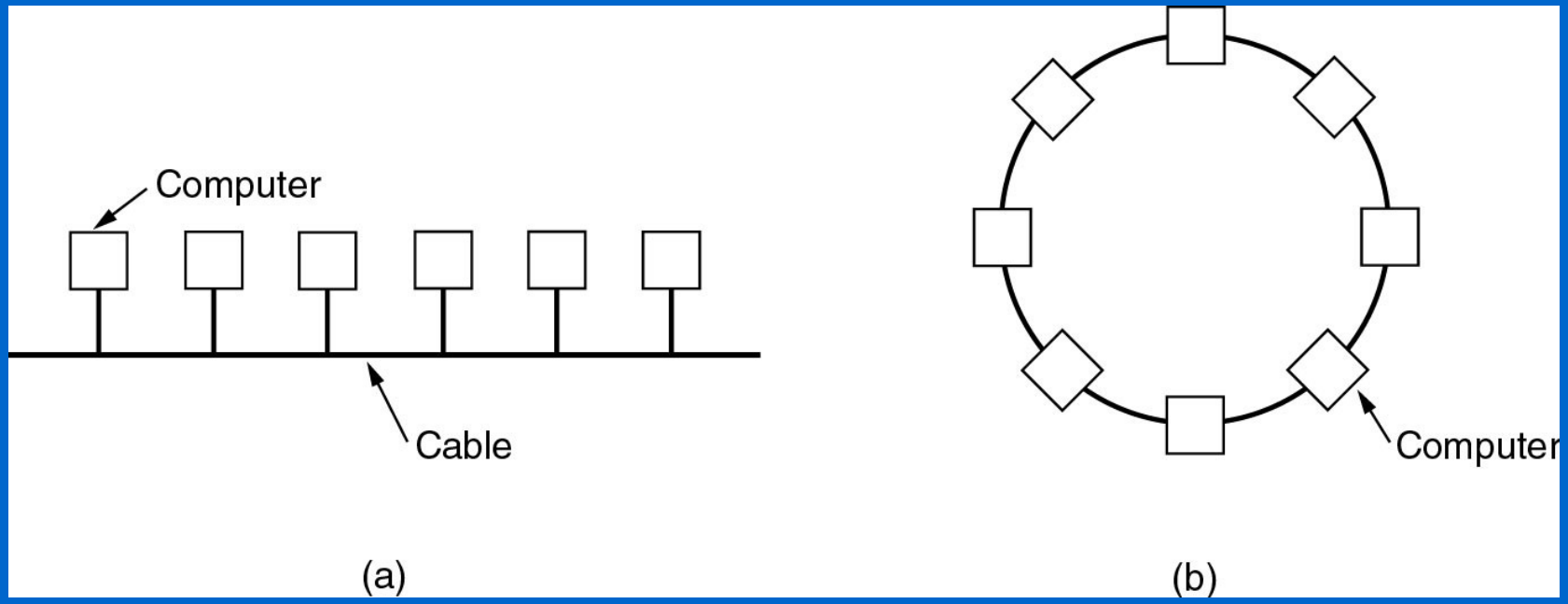
- Some forms of e-commerce.

Tag	Full name	Example
B2C	Business-to-consumer	Ordering books on-line
B2B	Business-to-business	Car manufacturer ordering tires from supplier
G2C	Government-to-consumer	Government distributing tax forms electronically
C2C	Consumer-to-consumer	Auctioning second-hand products on-line
P2P	Peer-to-peer	File sharing

Simplified Network Model



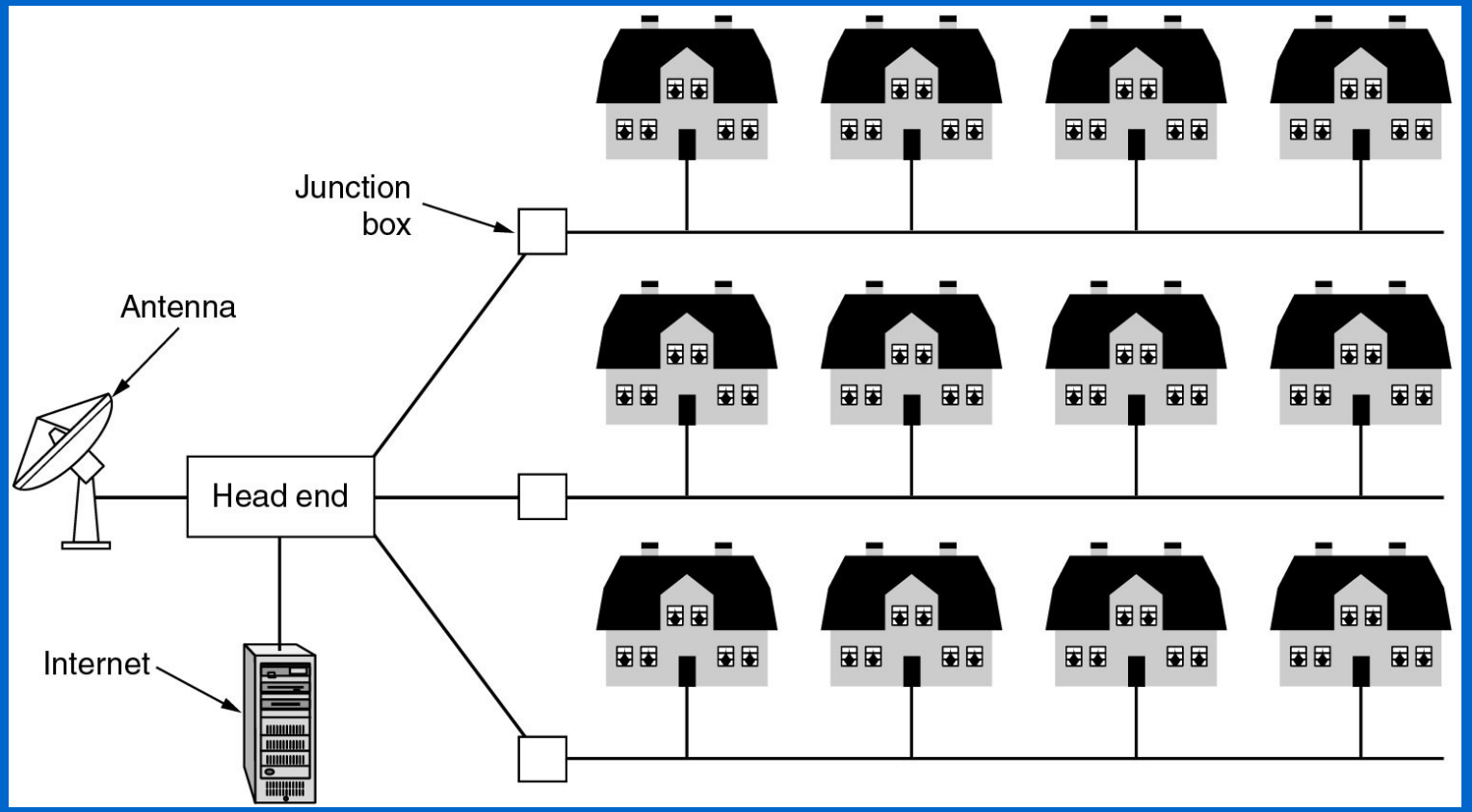
Local Area Networks



- Two broadcast networks
- (a) Bus
- (b) Ring

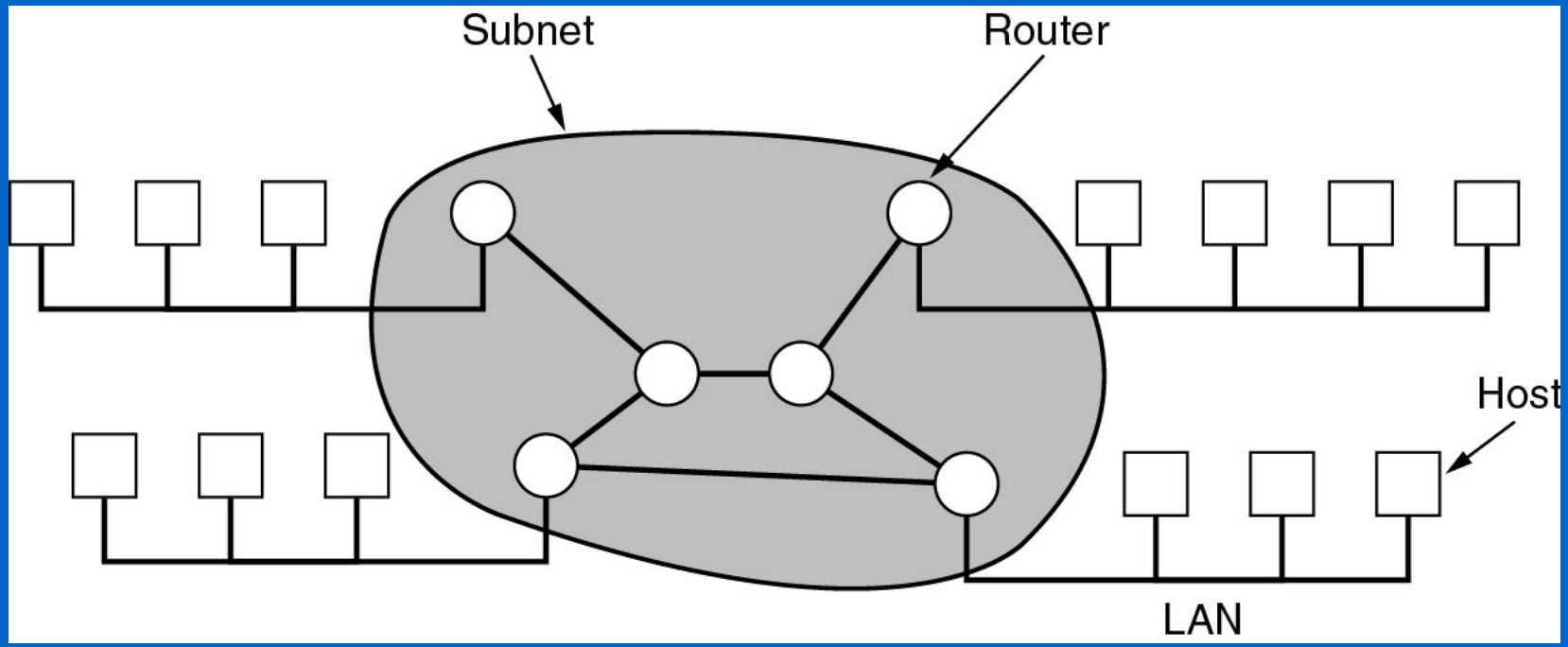
Metropolitan Area Networks

- A metropolitan area network based on cable TV.



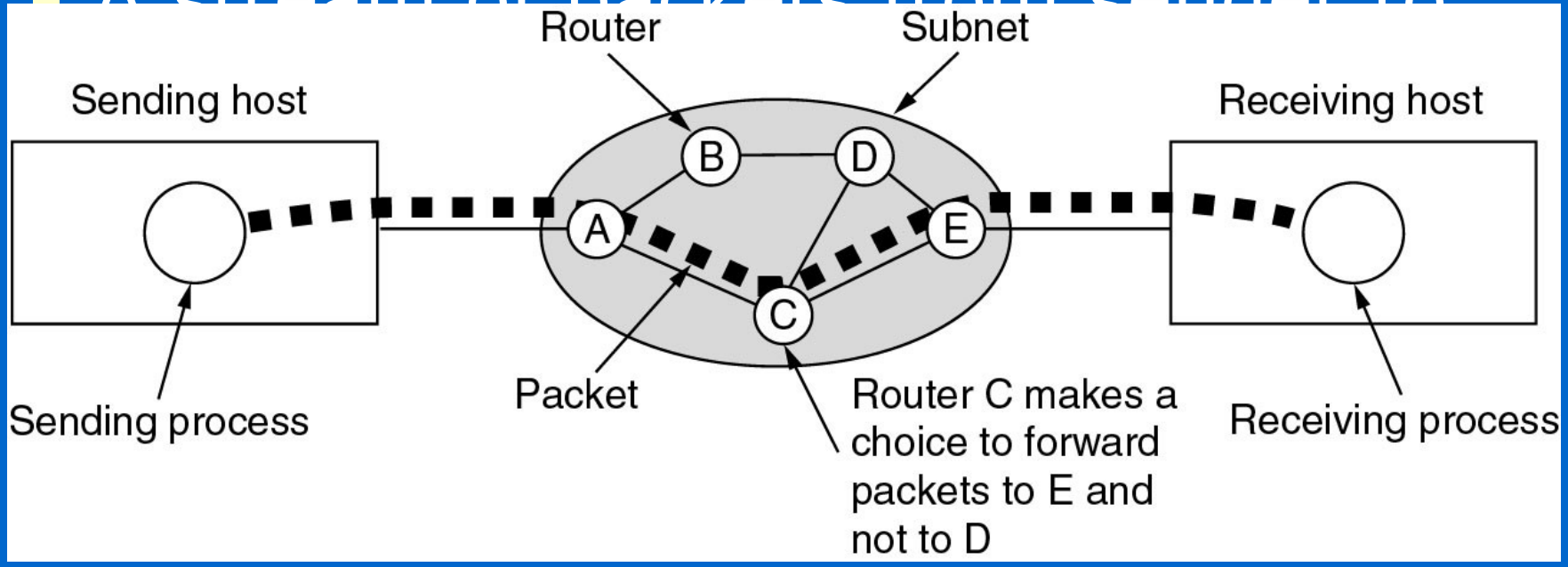
Wide Area Networks

- Relation between hosts on LANs and the subnet.



Wide Area Networks (2)

- A stream of packets from sender to

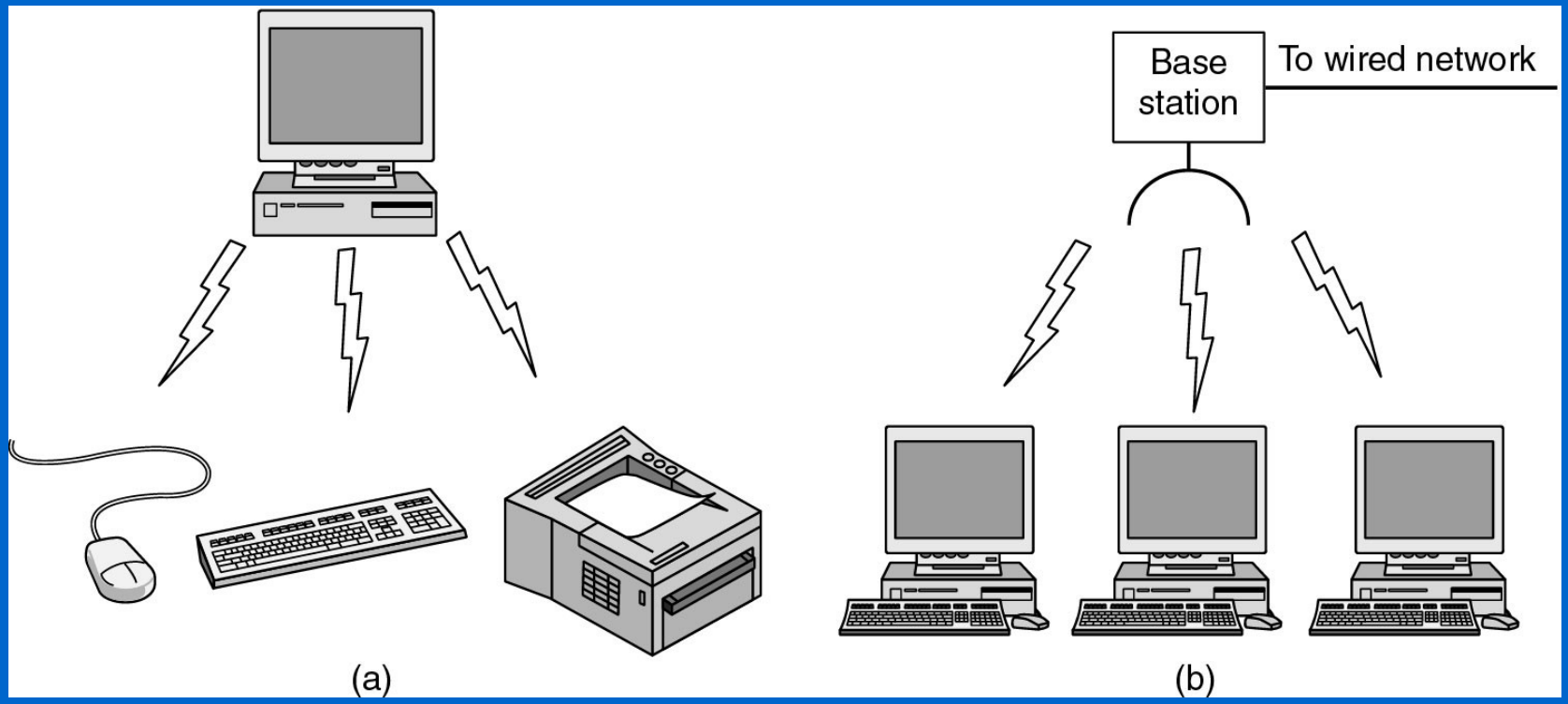


Wide Area Networks

- Large geographical area
- Crossing public rights of way
- Rely in part on common carrier circuits
- Alternative technologies
  - Circuit switching
  - Packet switching
  - Frame relay
  - Asynchronous Transfer Mode (ATM)

Wireless Networks

- (a) Bluetooth configuration
- (b) Wireless LAN



Protocols

- Used for communications between entities in a system
- Must speak the same language
- Entities
  - User applications
  - e-mail facilities
  - terminals
- Systems
  - Computer
  - Terminal
  - Remote sensor

What's a protocol?

human protocols:

- "what's the time?"
- "I have a question"
- introductions

… specific msgs sent

… specific actions taken when msgs received, or other events

network protocols:

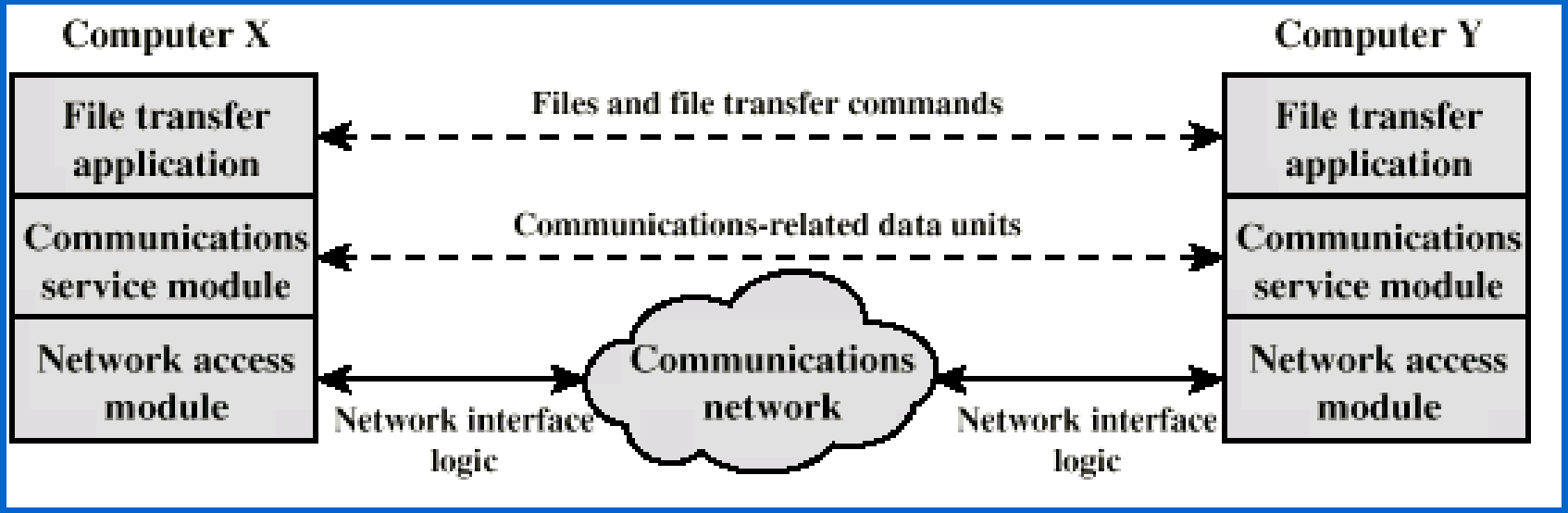
- machines rather than humans
- all communication activity in Internet governed by protocols

protocols define format, order of msgs sent and received among network entities, and actions taken on msg transmission, receipt

Protocol Architecture

- Task of communication broken up into modules
- For example file transfer could use three modules
  - File transfer application
  - Communication service module
  - Network access module

Simplified File Transfer Architecture



A Three Layer Model

- Network Access Layer
- Transport Layer
- Application Layer

Network Access Layer

- Exchange of data between the computer and the network
- Sending computer provides address of destination
- May invoke levels of service
- Dependent on type of network used (LAN, packet switched etc.)

Transport Layer

- Reliable data exchange
- Independent of network being used
- Independent of application

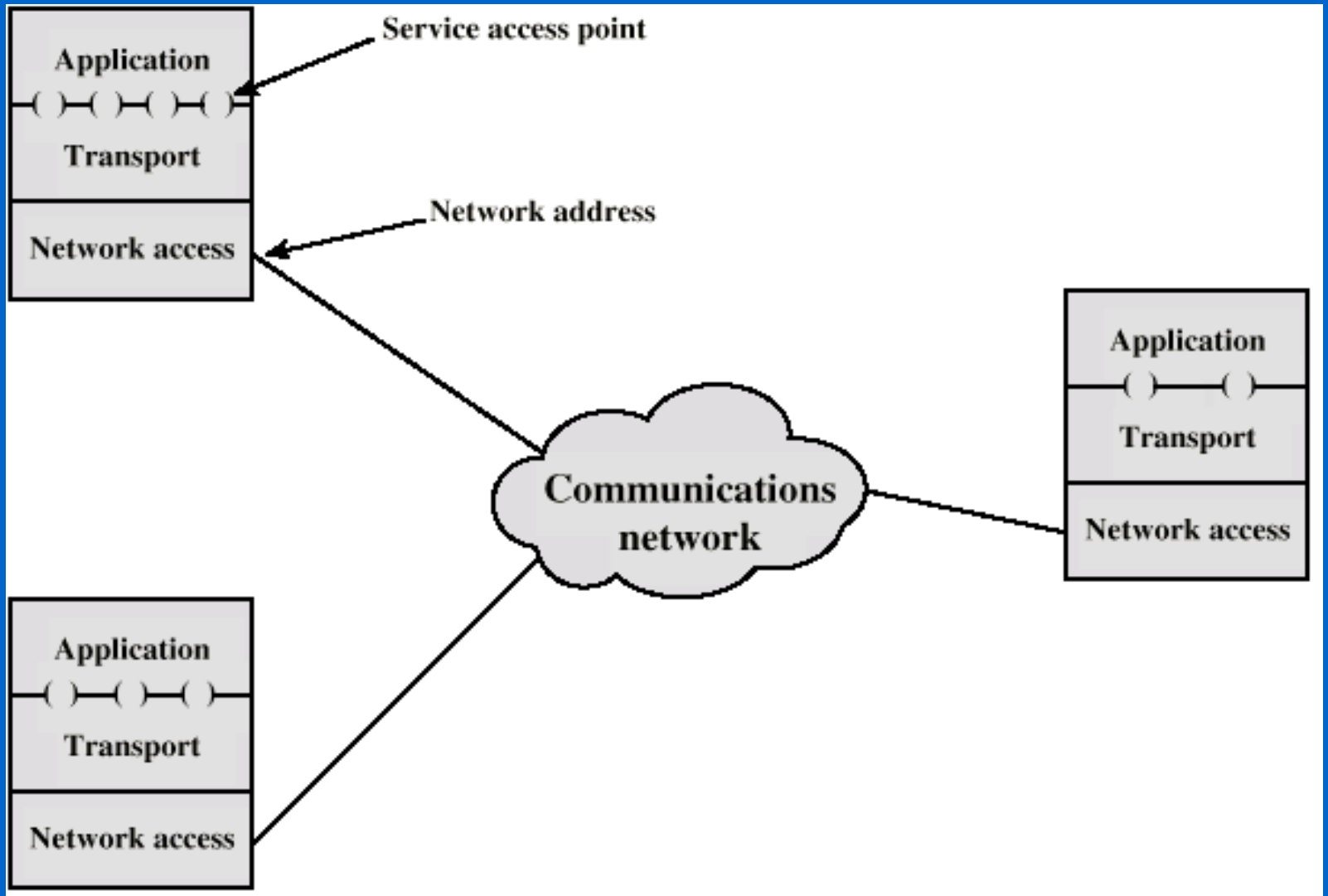
Application Layer

- Support for different user applications
- e.g. e-mail, file transfer

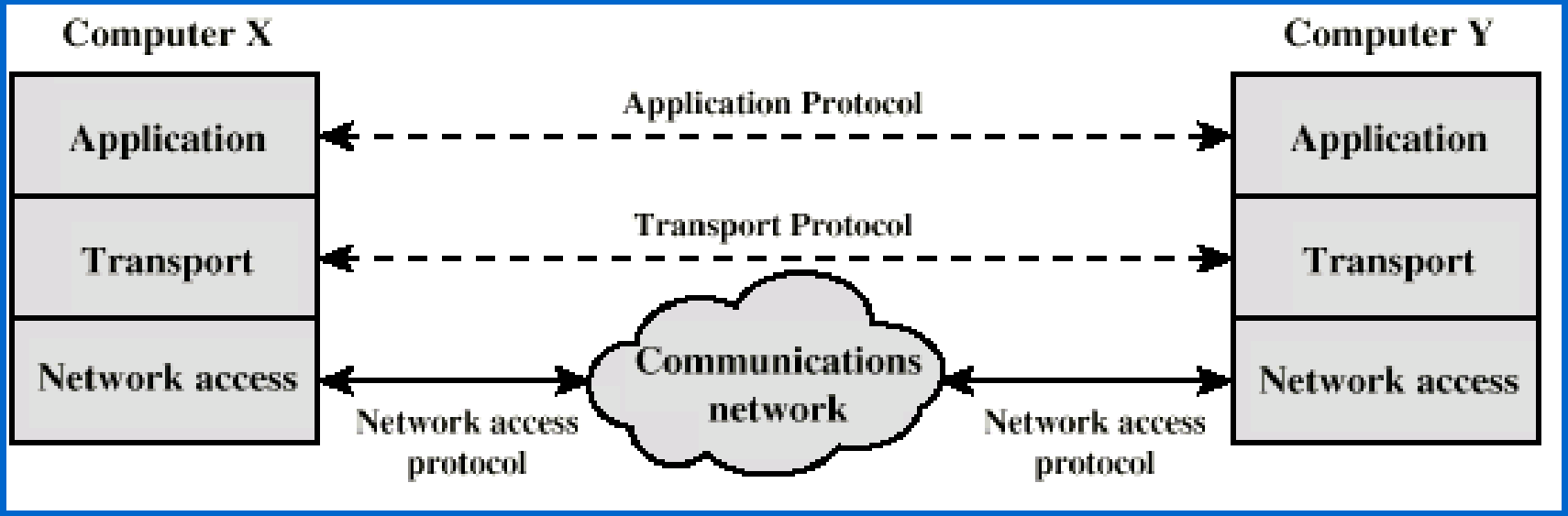
Addressing Requirements

- Two levels of addressing required
- Each computer needs unique network address
- Each application on a (multi-tasking) computer needs a unique address within the computer
  - The service access point or SAP

Protocol Architectures and Networks



Protocols in Simplified Architecture

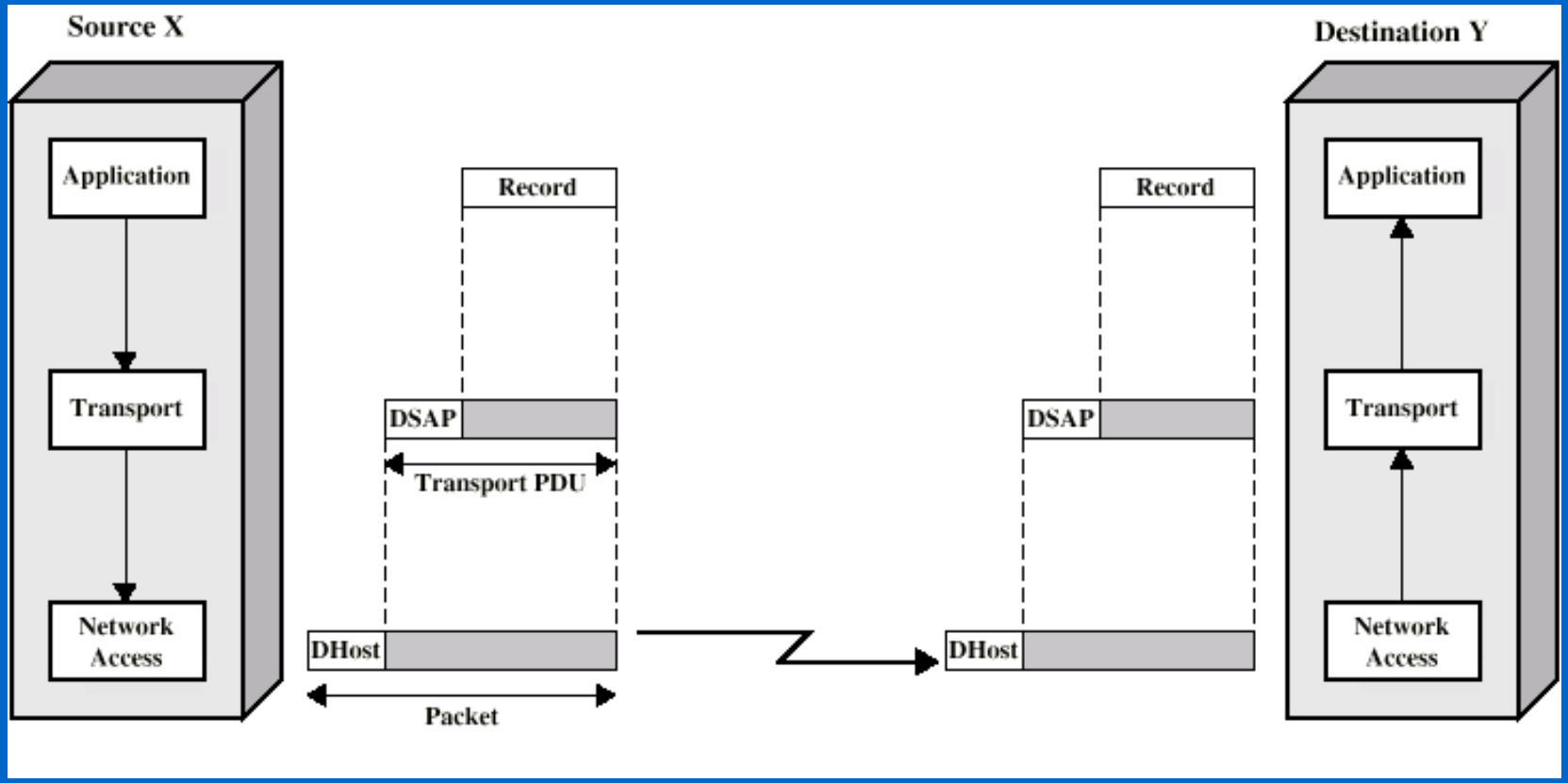


Protocol Data Units (PDU)

- At each layer, protocols are used to communicate
- Control information is added to user data at each layer
- Transport layer may fragment user data

- Each fragment has a transport header added
  - Destination SAP
  - Sequence number
  - Error detection code
- This gives a transport protocol data unit

Operation of a Protocol Architecture



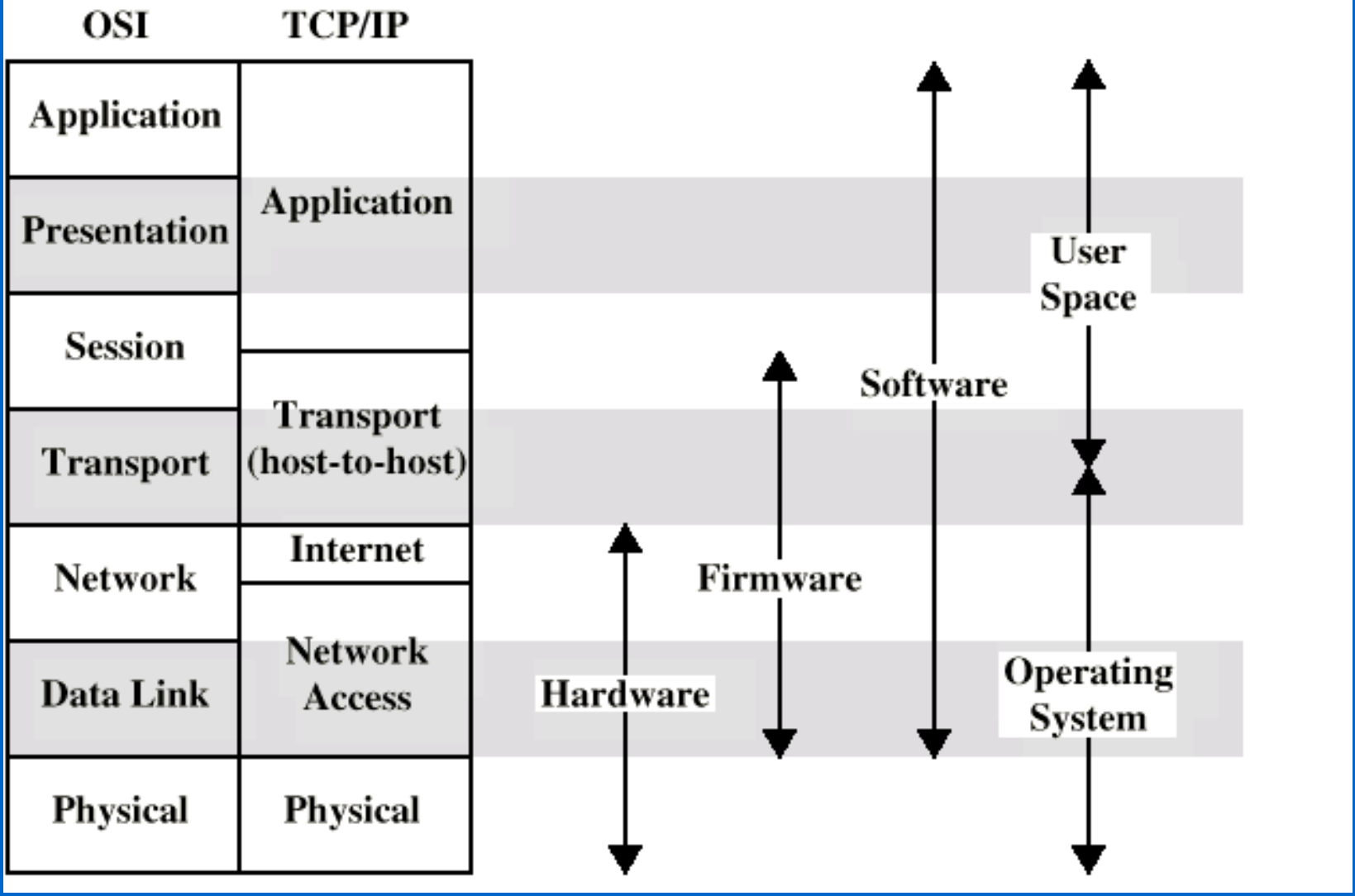
OSI Model

- Open Systems Interconnection
- Developed by the International Organization for Standardization (ISO)
- Seven layers
- A theoretical system delivered too late!
- TCP/IP is the de facto standard

OSI Layers

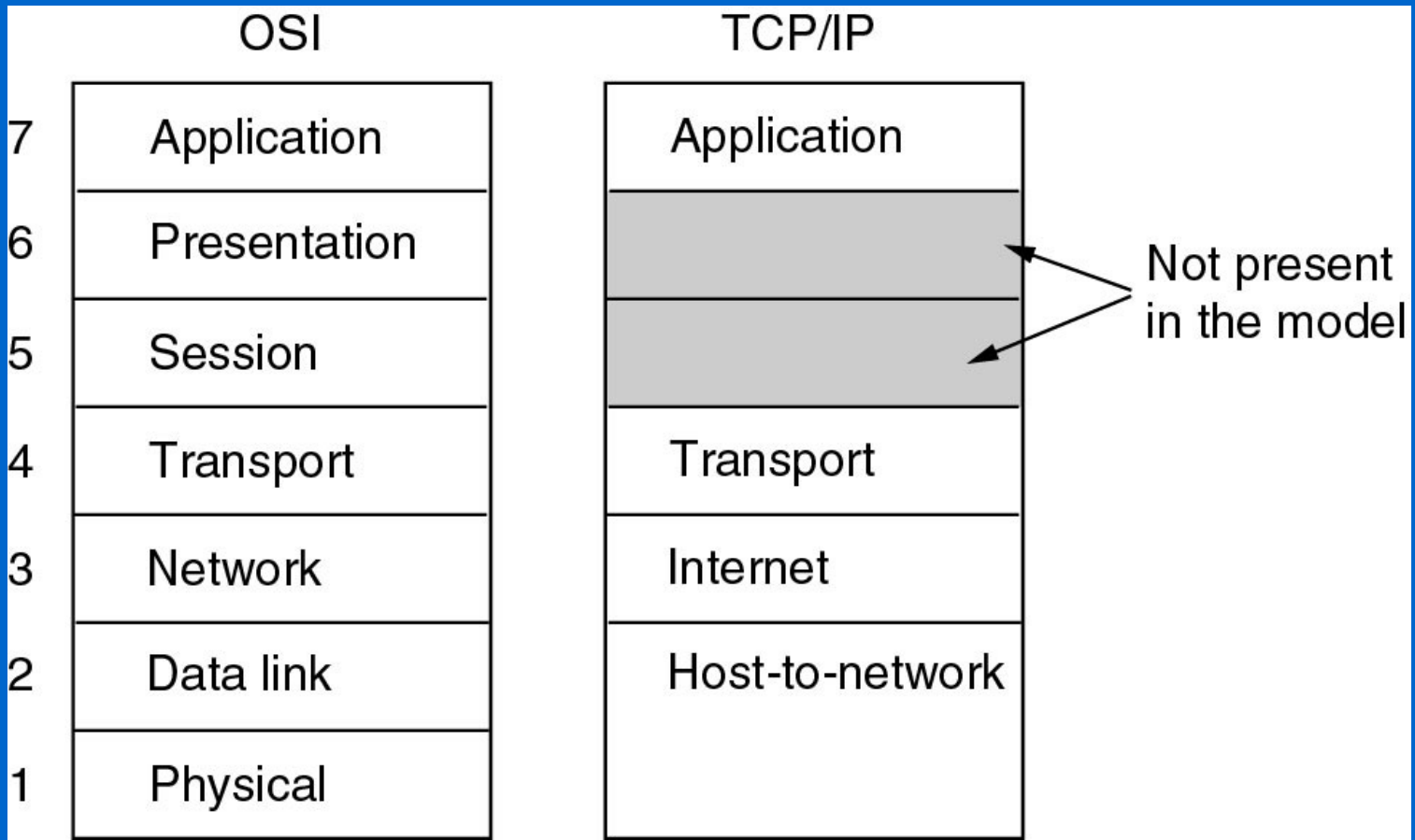
- Application
- Presentation
- Session
- Transport
- Network
- Data Link
- Physical

OSI v TCP/IP


OSI
TCP/IP
Application
Presentation
Session
Transport
Network
Data Link
Physical
Application
Transport (host-to-host)
Internet
Network Access
Physical
Hardware
Firmware
Software
User Space
Operating System

Reference Models (2)

- The TCP/IP reference model.

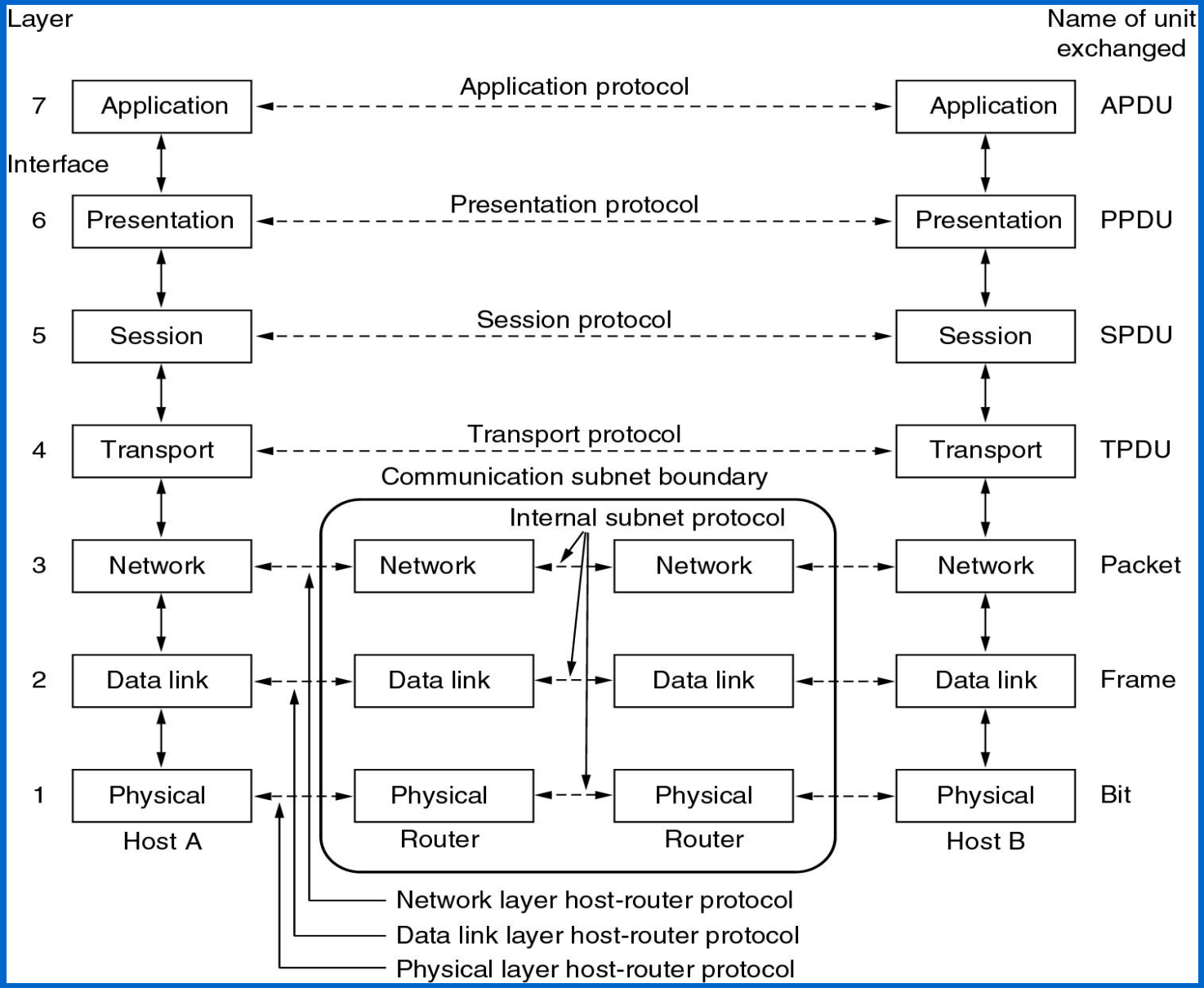


Standards Organizations

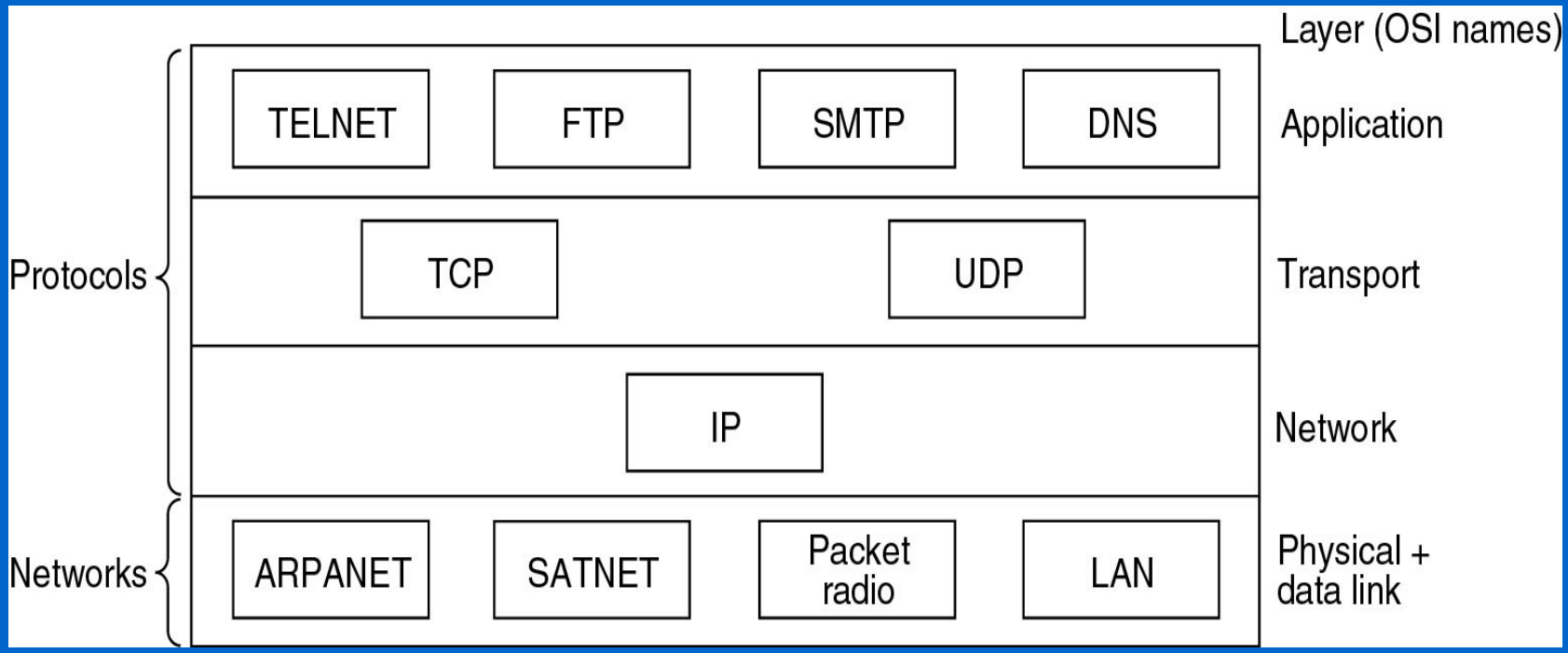
- Internet Society
- ISO
- ITU-T (formally CCITT)
- ATM forum

Reference Models

The OSI reference model.



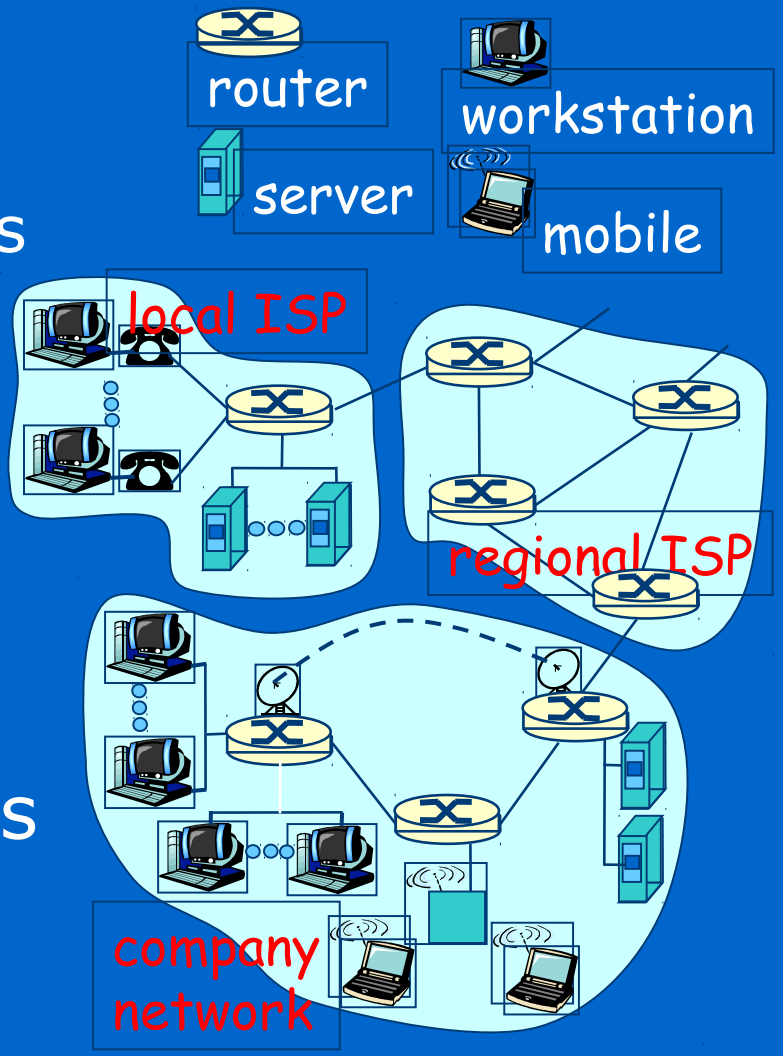
Reference Models (3)



What's the Internet: "nuts and bolts" view

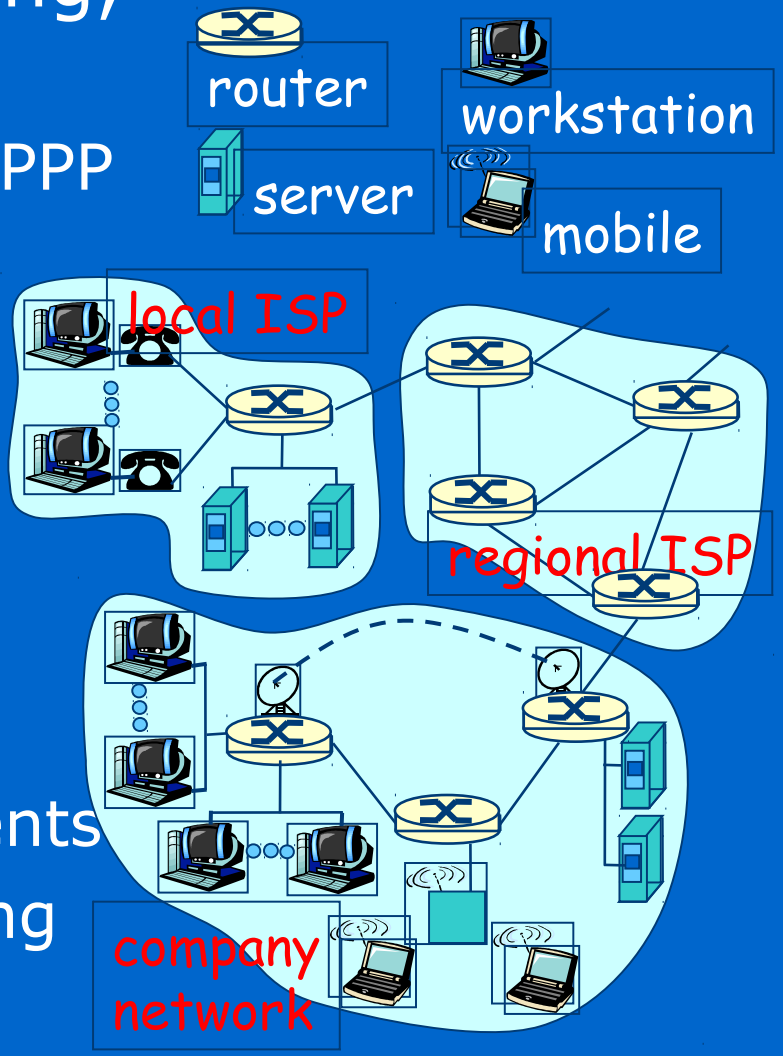
- millions of connected computing devices: *hosts, end-systems*
  - pc's workstations, servers
  - PDA's phones, toasters

  running *network apps*
- *communication links*
  - fiber, copper, radio, satellite
- *routers:* forward packets (chunks) of data thru network



What's the Internet: "nuts and bolts" view

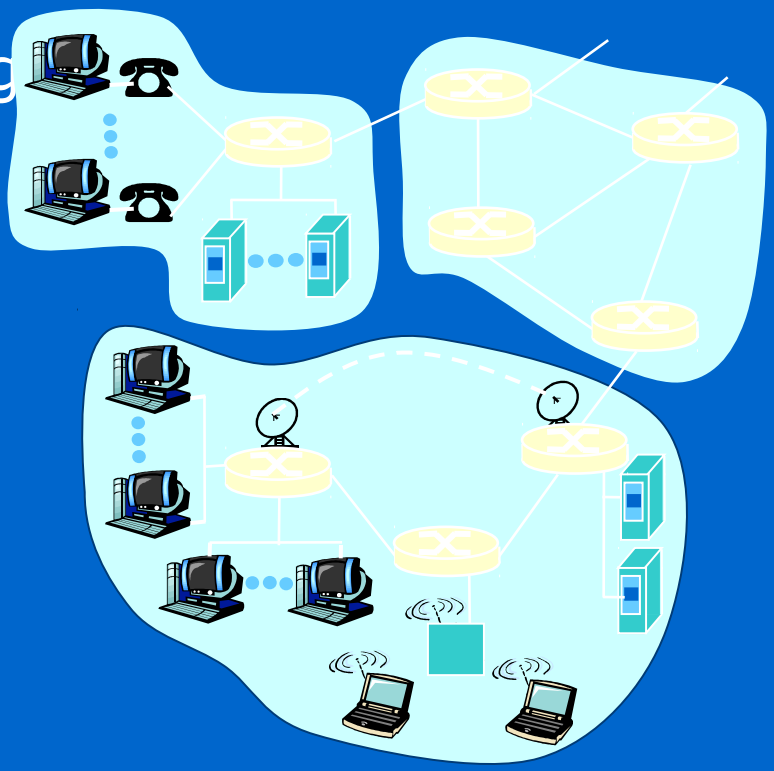
- *protocols*: control sending, receiving of msgs
  - e.g., TCP, IP, HTTP, FTP, PPP
- *Internet:* "network of networks"
  - loosely hierarchical
  - public Internet versus private intranet
- Internet standards
  - RFC: Request for comments
  - IETF: Internet Engineering Task Force



What's the Internet: a service view

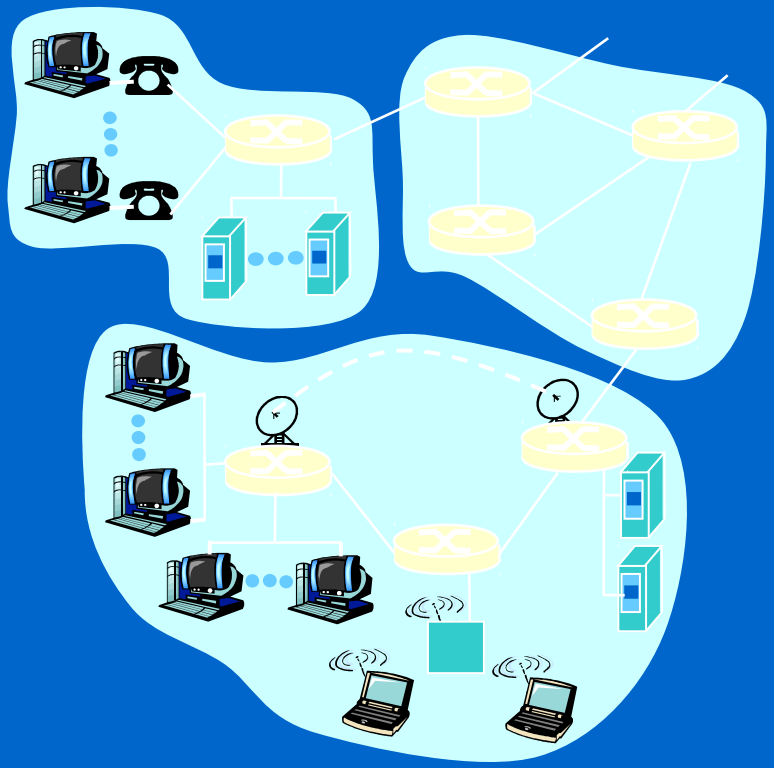
- communication *infrastructure* enables distributed applications:
  - WWW, email, games, e-commerce, database., voting
  - more?
- communication services provided:
  - connectionless
  - connection-oriented
- cyberspace [Gibson]:

  "a consensual hallucination experienced daily by billions of operators, in every nation, ..."



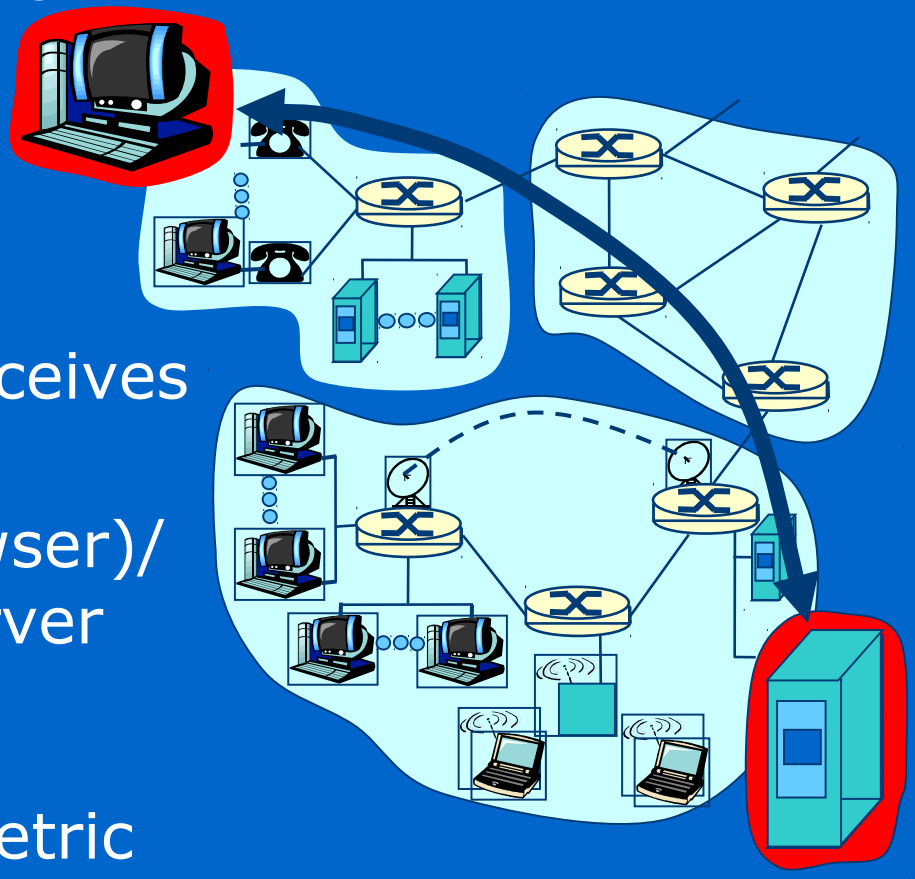
A closer look at network structure:

- network edge: applications and hosts
- network core:
  - routers
  - network of networks
- access networks, physical media: communication links



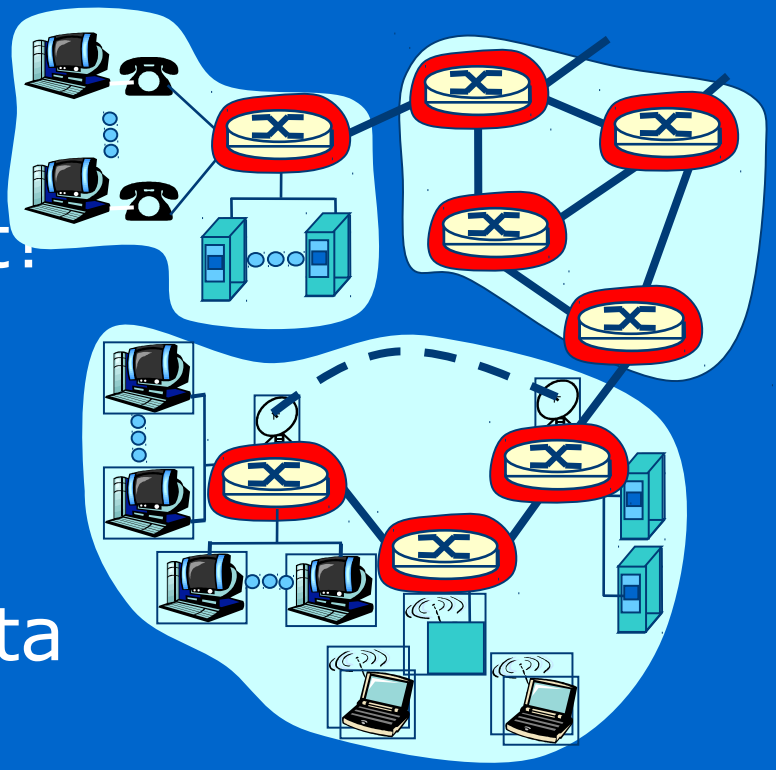
The network edge:

- end systems (hosts):
  - run application programs
  - e.g., WWW, email
  - at "edge of network"
- client/server model
  - client host requests, receives service from server
  - e.g., WWW client (browser)/ server; email client/server
- peer-peer model:
  - host interaction symmetric
  - e.g.: teleconferencing



The Network Core

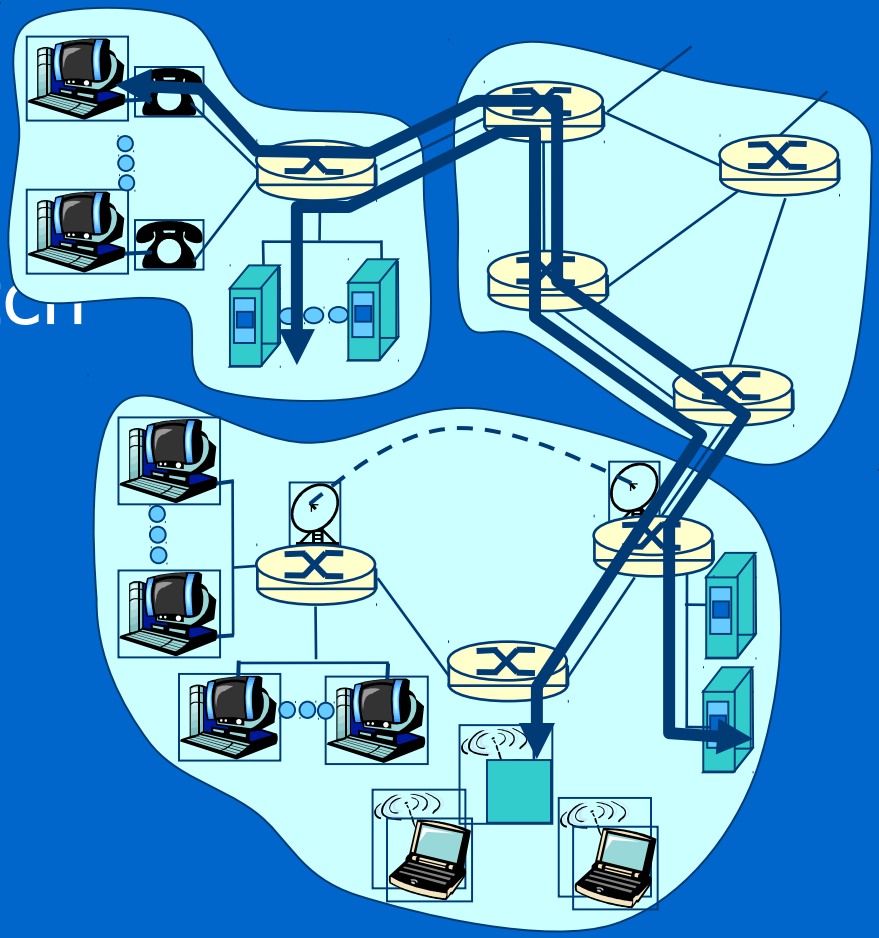
- mesh of interconnected routers
- *the* fundamental question: how is data transferred through net?
  - circuit switching: dedicated circuit per call: telephone net
  - packet-switching: data sent thru net in discrete "chunks"



Network Core: Circuit Switching

End-end resources reserved for "call"

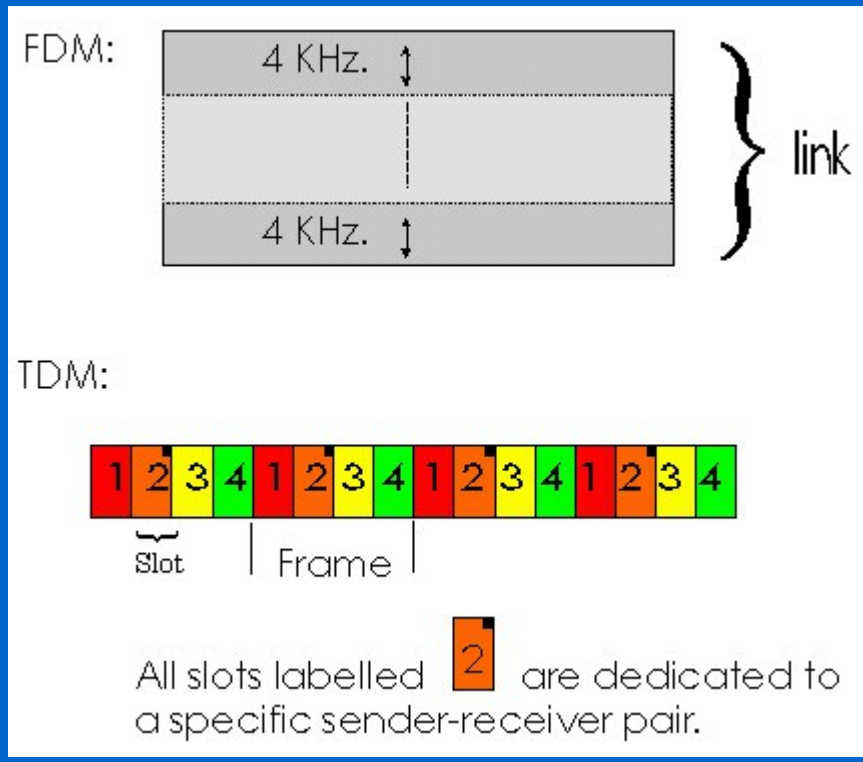
- link bandwidth, switch capacity
- dedicated resources: no sharing
- circuit-like (guaranteed) performance
- call setup required



Network Core: Circuit Switching

network resources (e.g., bandwidth) divided into "pieces"

- pieces allocated to calls
- resource piece *idle* if not used by owning call *(no sharing)*
- dividing link bandwidth into "pieces"
  - frequency division
  - time division



suppose 8000 frames/s with 8bits slots

how much BW per connection?

Network Core: Packet Switching

each end-end data stream divided into *packets*

- user A, B packets *share* network resources
- each packet uses full link bandwidth
- resources used *as needed*

Bandwidth division into pieces

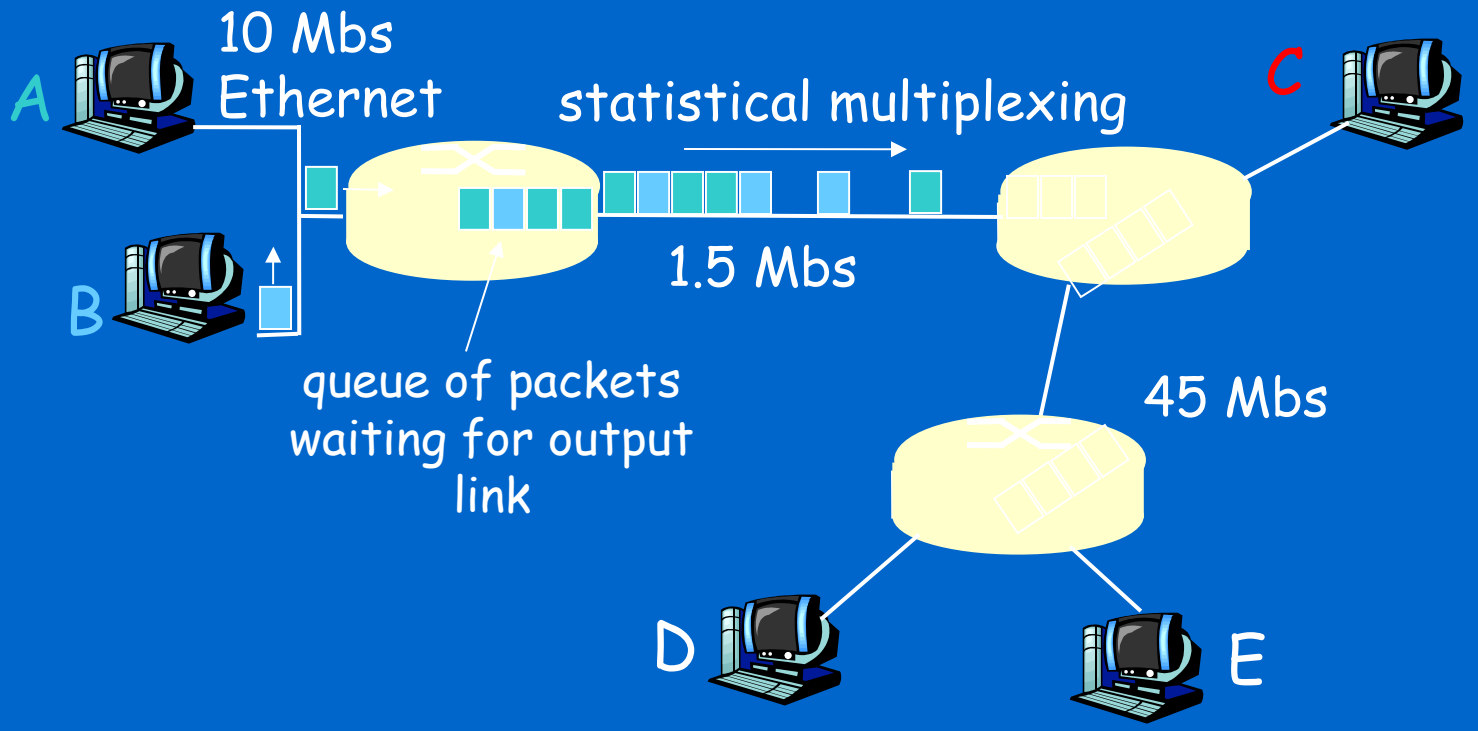
Dedicated allocation

Resource reservation

resource contention:

- aggregate resource demand can exceed amount available
- congestion: packets queue, wait for link use
- store and forward: packets move one hop at a time
  - transmit over

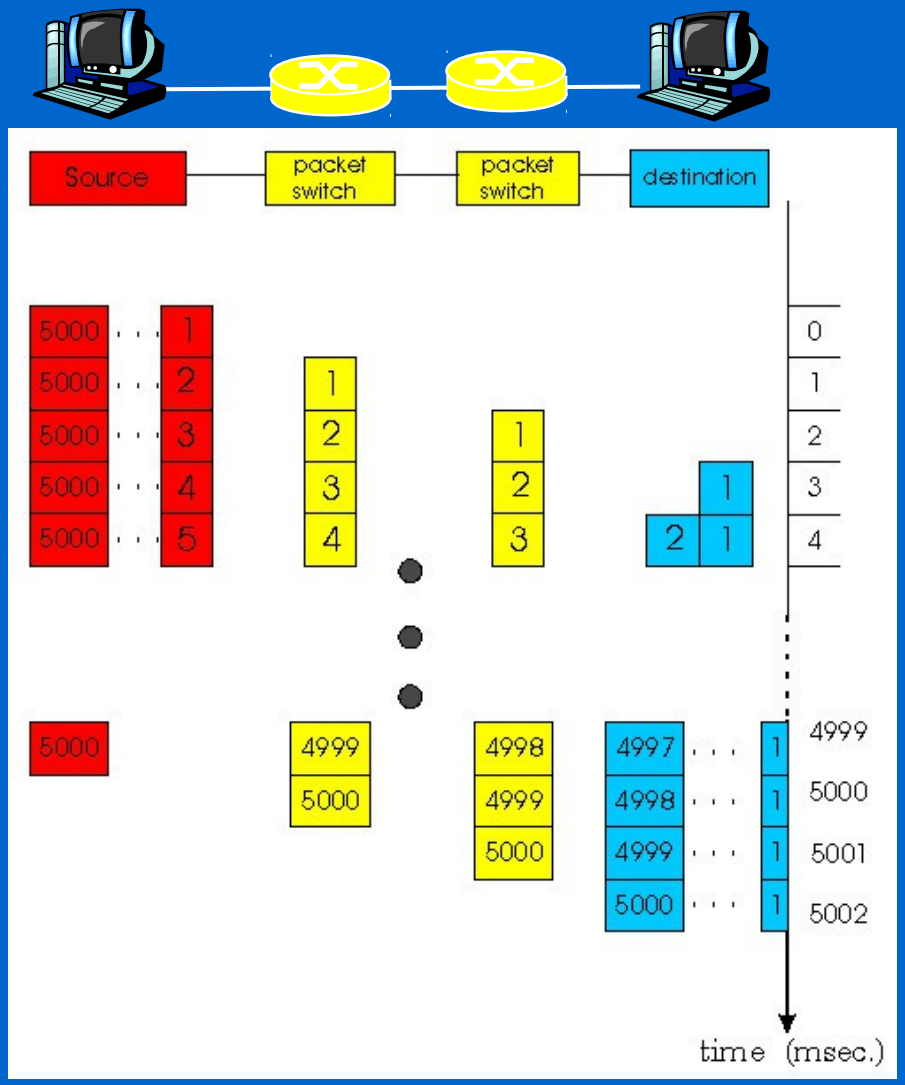
Network Core: Packet Switching



Packet-switching versus circuit switching: human restaurant analogy

- other human analogies?

Network Core: Packet Switching



Packet-switching:

store and forward behavior

Circuit Switching

- Dedicated communications path established for the duration of the conversation
- e.g. telephone network

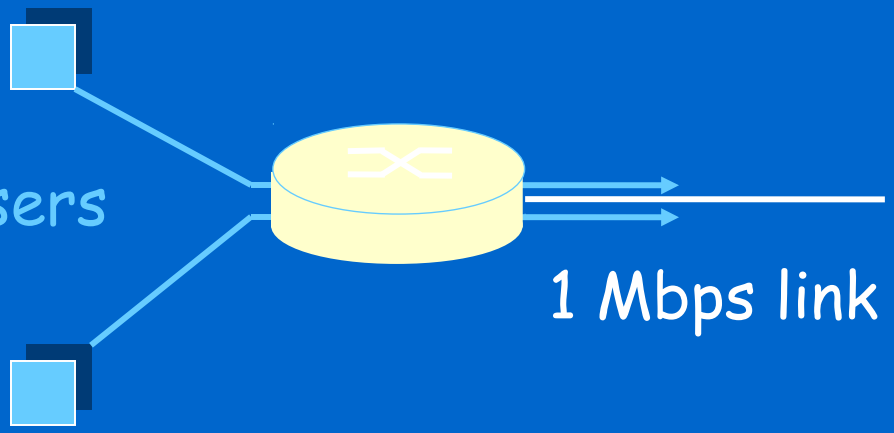
Packet Switching

- Data sent out of sequence
- Small chunks (packets) of data at a time
- Packets passed from node to node between source and destination
- Used for terminal to computer and computer to computer communications

Packet switching versus circuit switching

Packet switching allows more users to use network!

- 1 Mbit link
- each user:
  - 100Kbps when "active"
  - active 10% of time



- circuit-switching:
  - 10 users
- packet switching:
  - with 35 users, probability > 10 active less that .004

Frame Relay

- Packet switching systems have large overheads to compensate for errors
- Modern systems are more reliable
- Errors can be caught in end system
- Most overhead for error control is stripped out

Asynchronous Transfer Mode

- ATM
- Evolution of frame relay
- Little overhead for error control
- Fixed packet (called cell) length
- Anything from 10Mbps to Gbps
- Constant data rate using packet switching technique

Protocol Architecture

- Task of communication broken up into modules
- For example file transfer could use three modules
  - File transfer application
  - Communication service module
  - Network access module