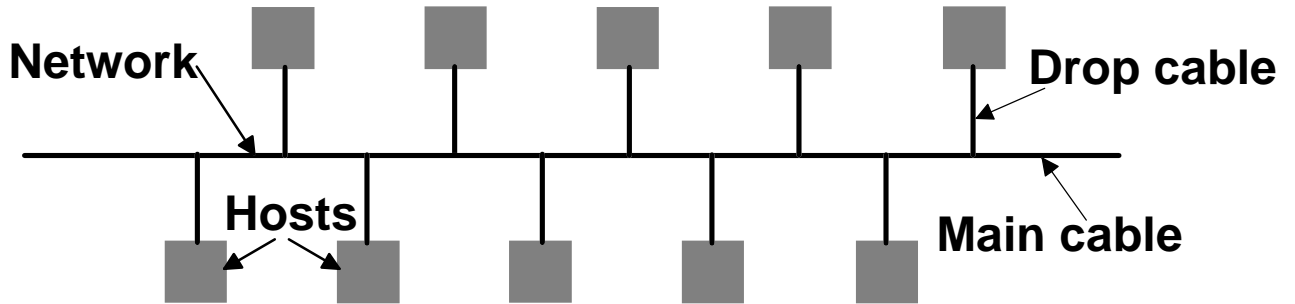
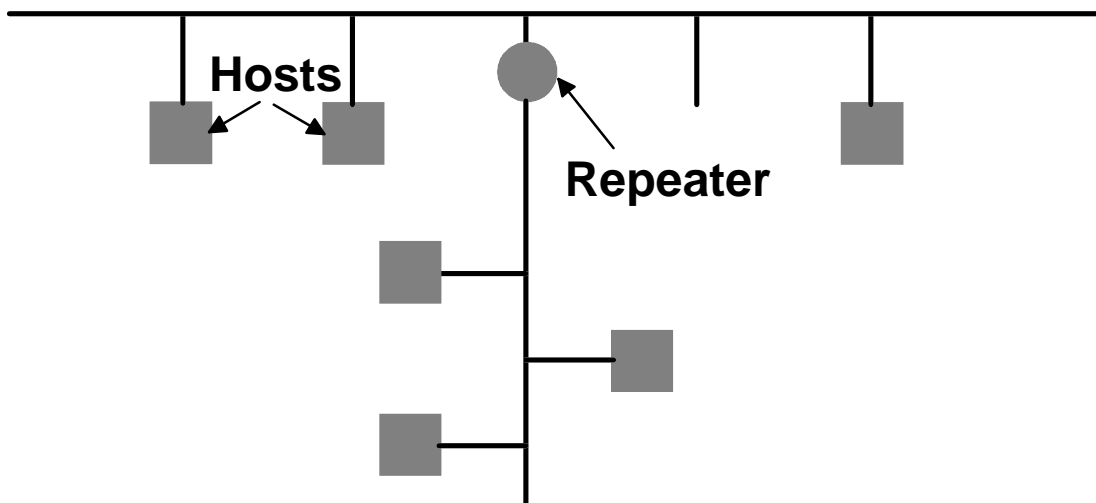


# Local Area Networks (LAN)

## Bus topologies (e.g. Ethernet)



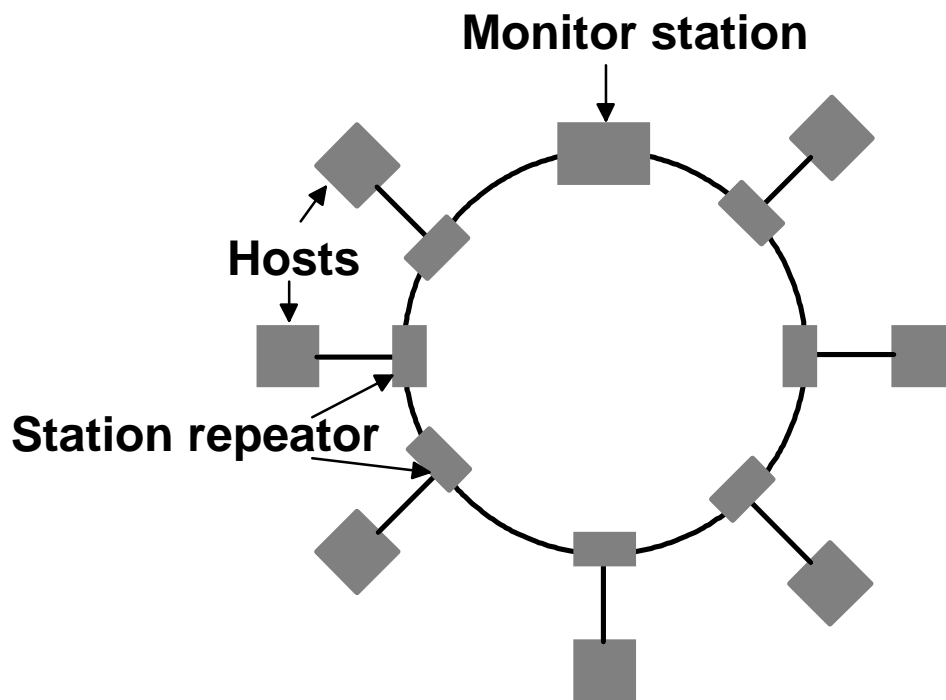
(a) Simple bus topology



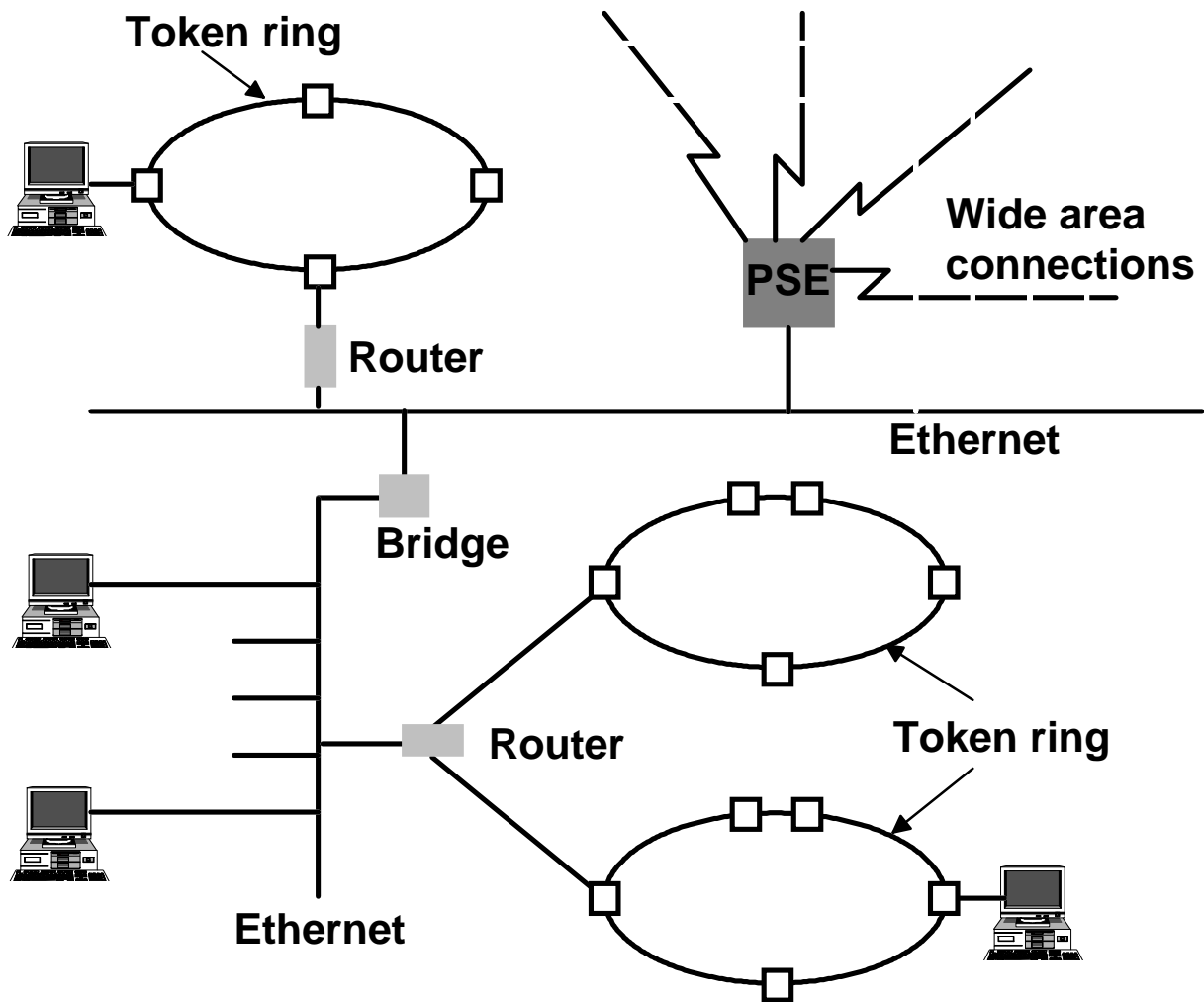
(b) Branching bus topology

## Ring topology

(e.g. Token ring)



## A typical campus internetwork



**Bridge: same network type.**

**Router:**

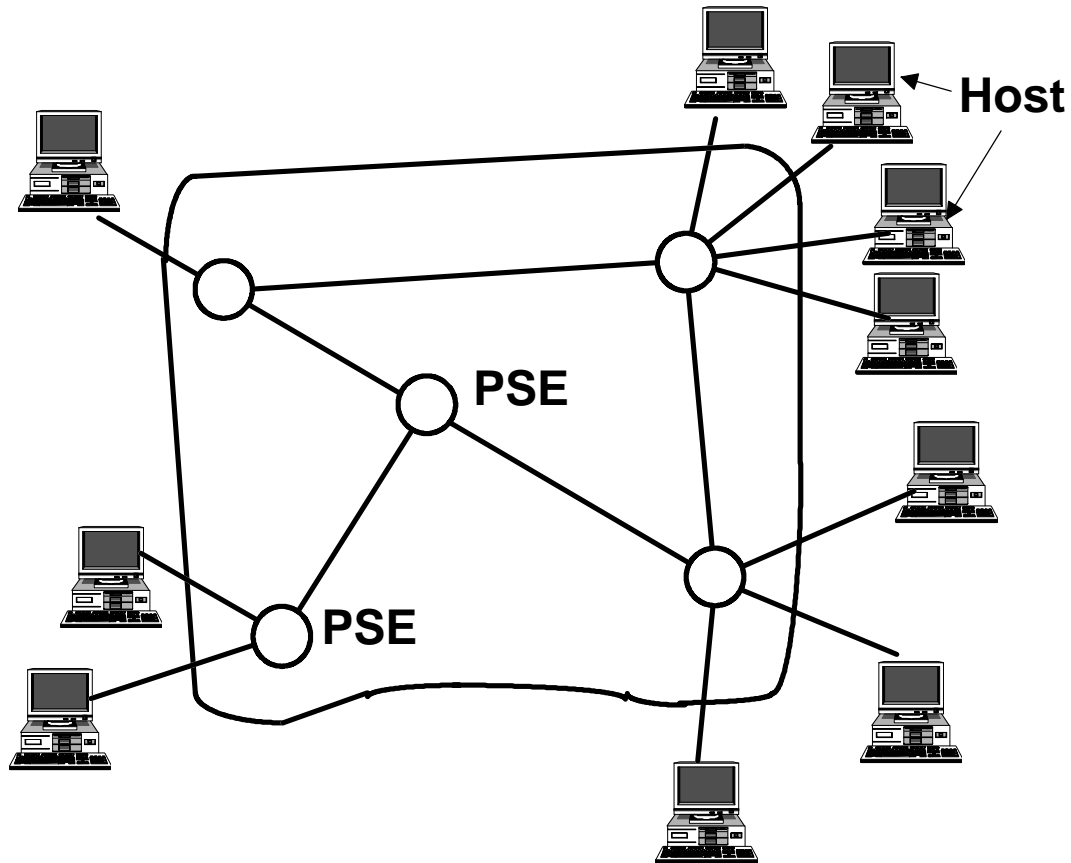
- Different network type.
- Special-purposes computer.
- Two or more networks.

**PSE: packet-switch exchange.**

**Gateways**

- General-purpose computers.
- Connecting two networks.
- Host.

# Wide Area Networks (WAN)



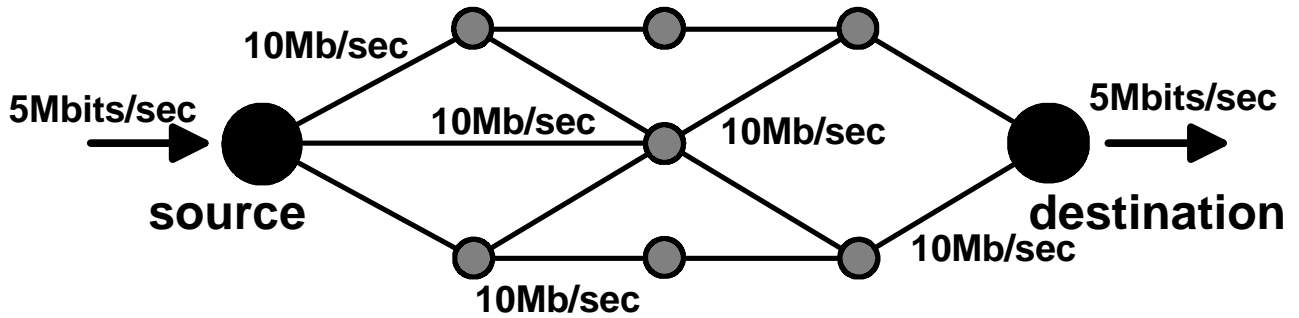
**The links may be:**

- Leased telephone lines
- Optical fibers
- Coaxial cable
- Satellite links
- Microwave links

**Purpose: Share links and resources.**

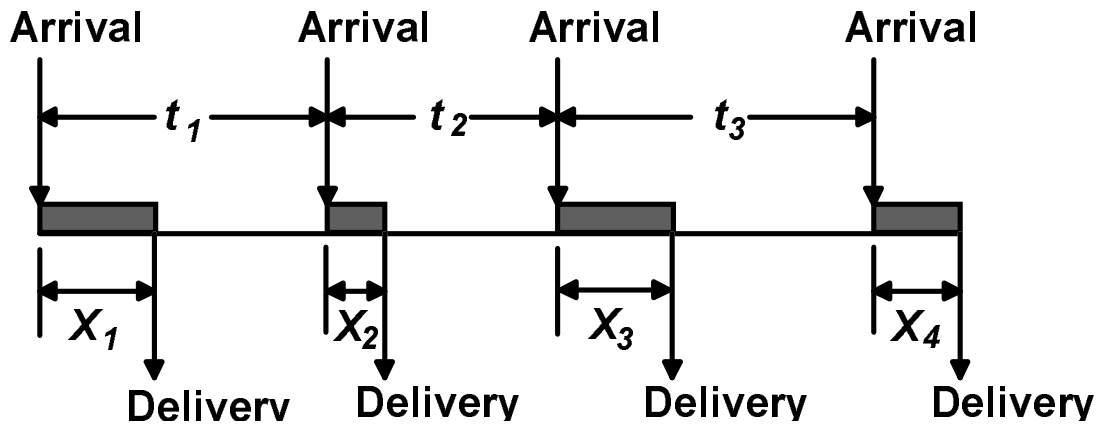
# Switching Techniques

## Circuit switching:



Each communication link is “broken” into smaller pieces and each piece is assigned exclusively to a session.

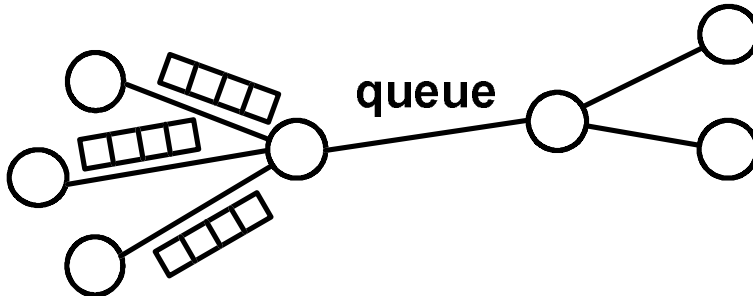
- Blocking may occur
- inefficiency due to idleness of communication links ( particularly with bursty sources)



- Delay for time to set-up the connection.

# Store-and-forward switching

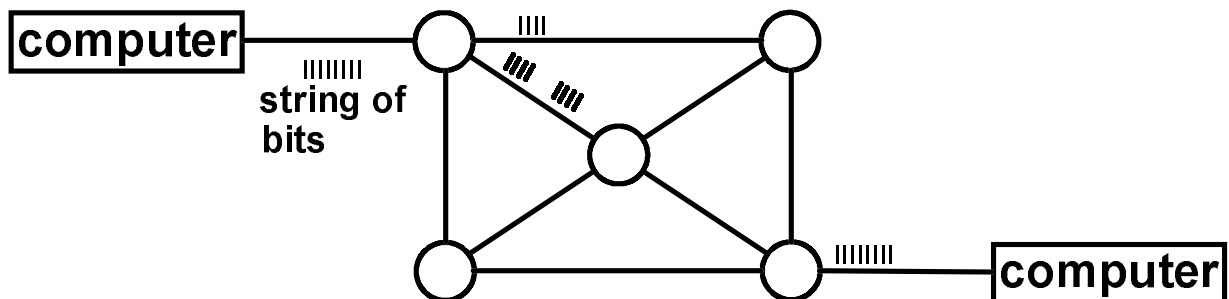
## Message switching



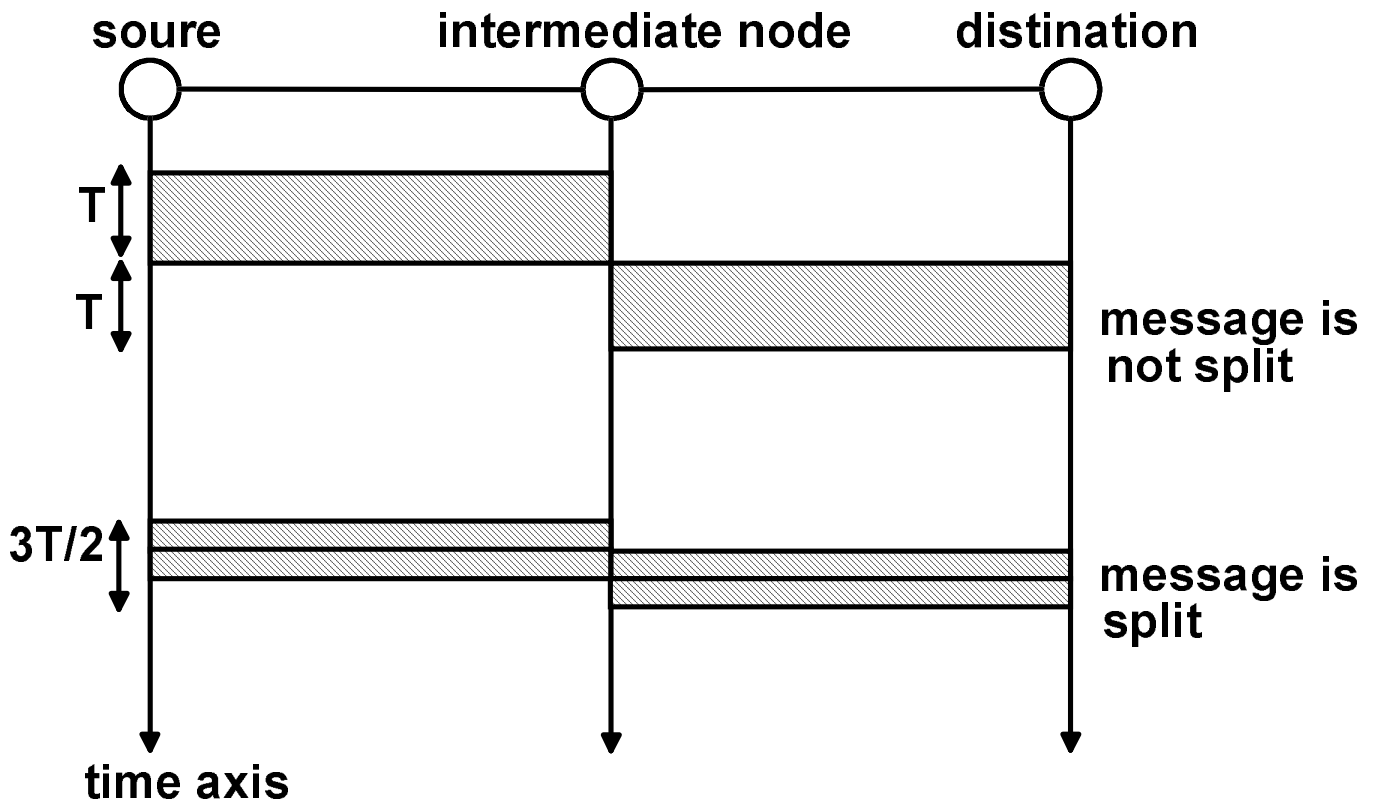
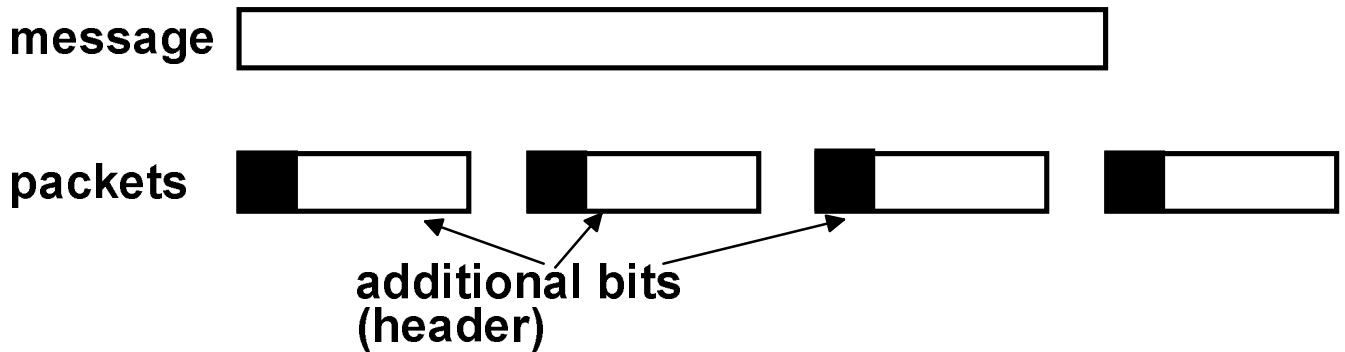
- Sessions share the communication resources (links and buffers) dynamically.
- Variable delay in crossing a link
- Messages may be lost due to buffer overflow

## Packet switching

A message is split into packets.



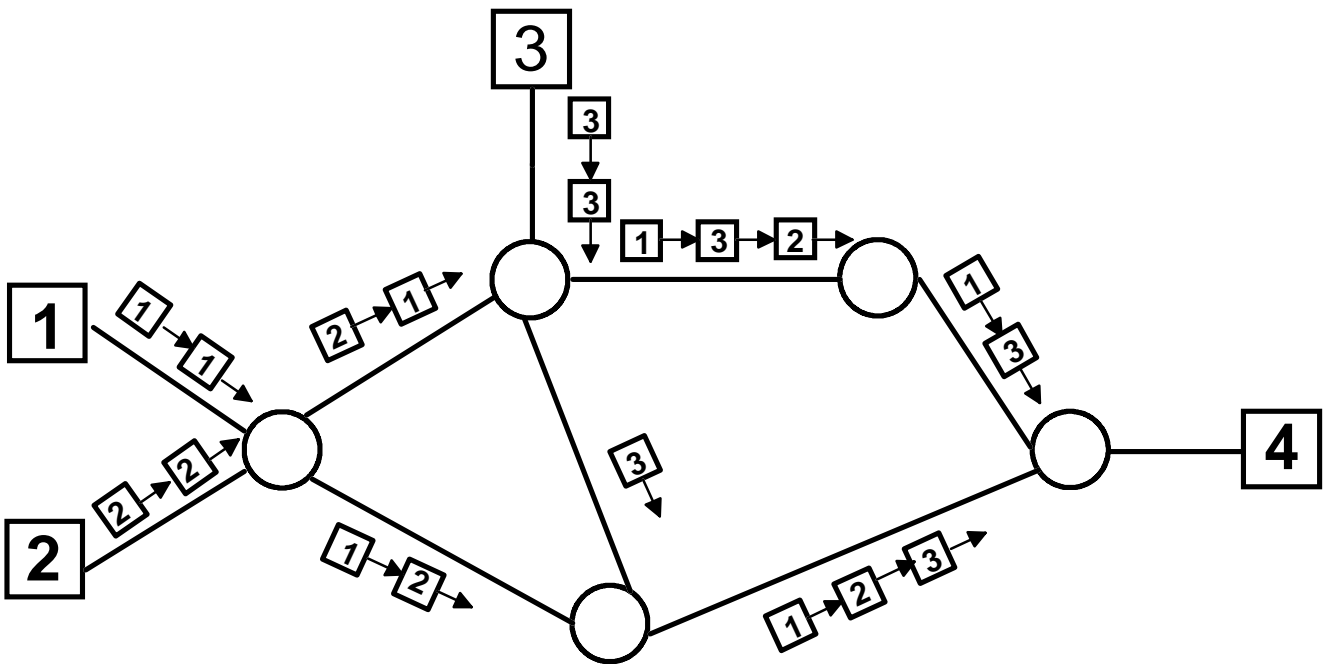
# Reasons for breaking-up messages into packets



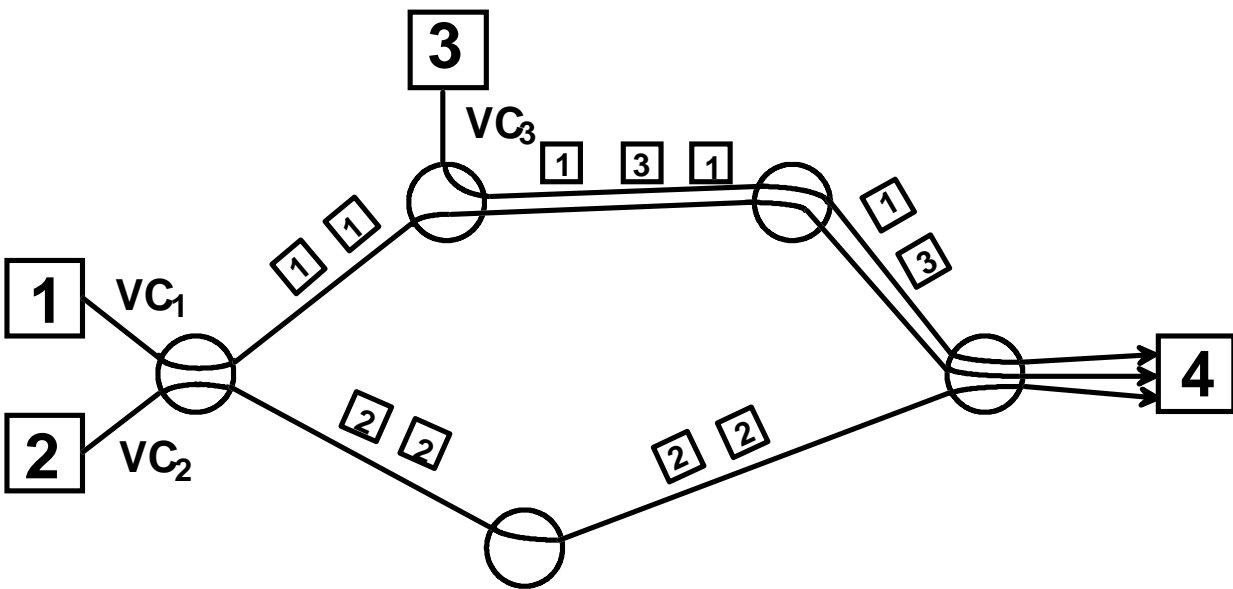
Advantages: smaller delay, easier buffering, flexibility in routing.

Disadvantages: overhead, reassemble problems.

## Two types of packet switching



(a) Routing in a datagram network.



(b) Routing in a virtual-circuit network.





**HERE IS A TENDENCY TOWARDS INTEGRATING  
DIFFERENT TYPES OF TRAFFIC ON THE SAME  
NETWORK.**

**Interactive traffic** : messages are short.  
message arrival rate is small.  
fast response needed.  
high reliability required.

**File transfer** : messages are long.  
traffic is bursty.  
high reliability required.  
large delays can be tolerated.

**Packetized voice** : packets are short.  
traffic is smooth.  
small delay required.  
reliability not important.

**Graphics & video**: messages are long.  
delay may or may not be important.  
variability of the delay must be  
small (for video).  
traffic may be smooth or bursty.

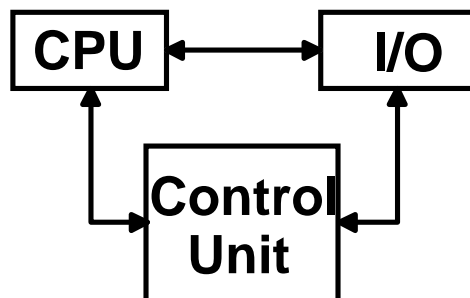
## Layered Network Architecture

ISO (international standards organization ) proposed the OSI standard (open systems interconnection )

Network is organized as a modular, hierarchical and distributed system.

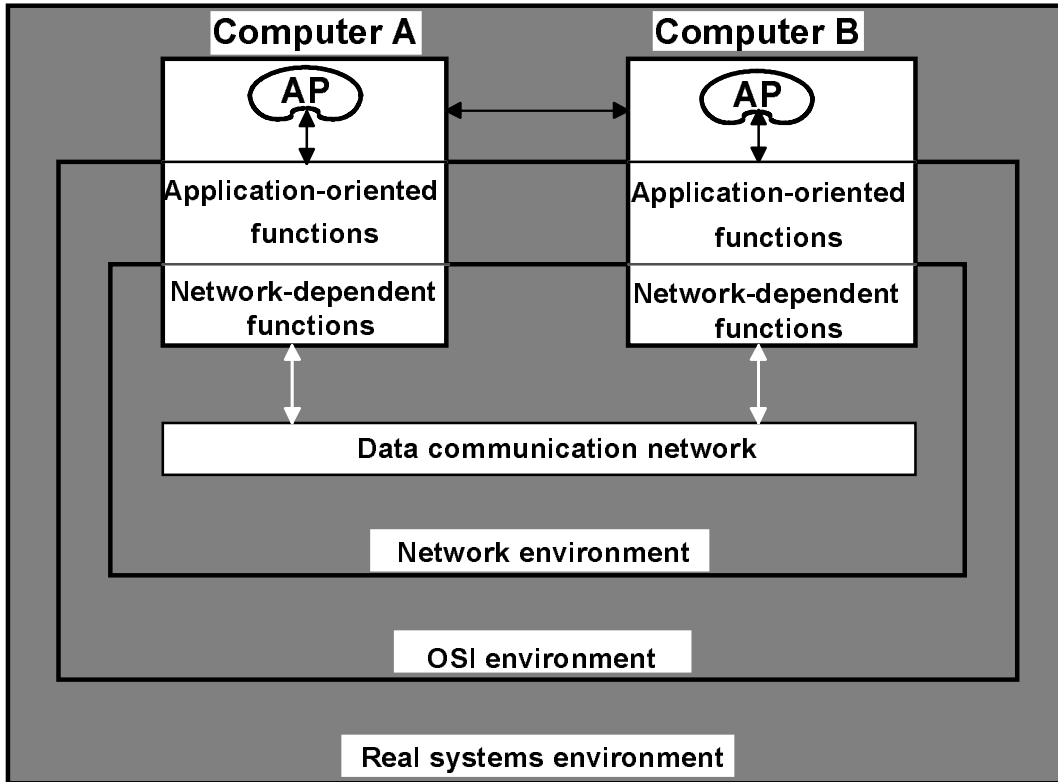
**Modular:** should consist of simpler components with agreed upon interfaces

e.g:

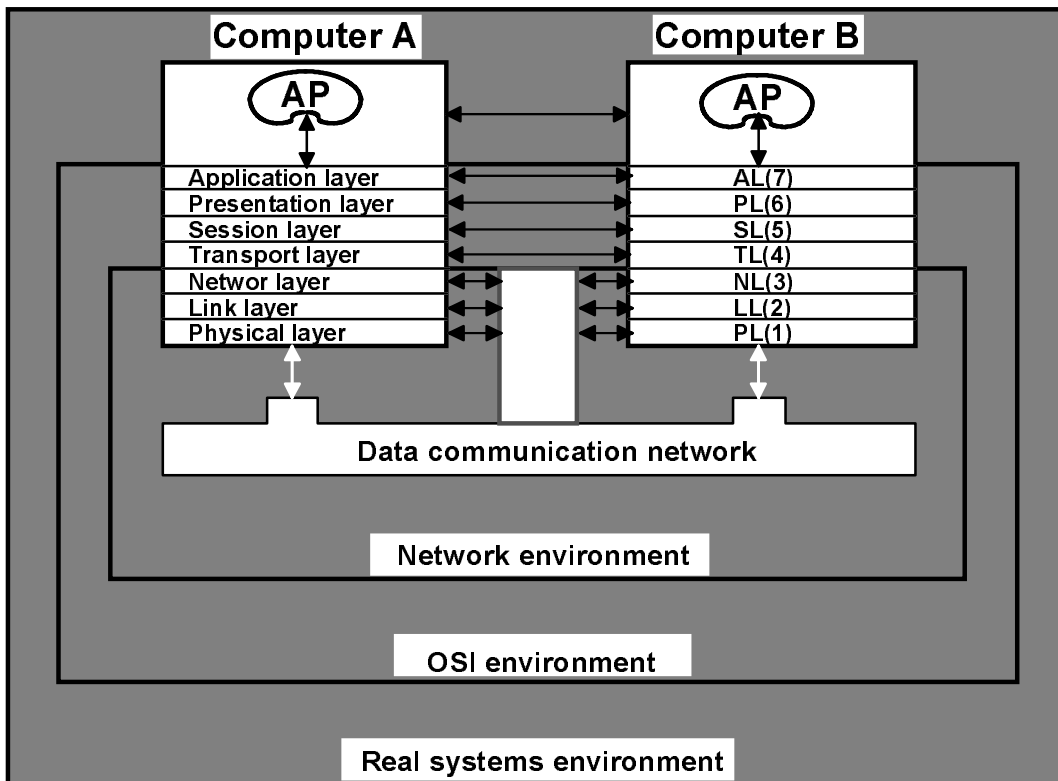


**Advantages:** interchangeability, standardization

## Operational environments

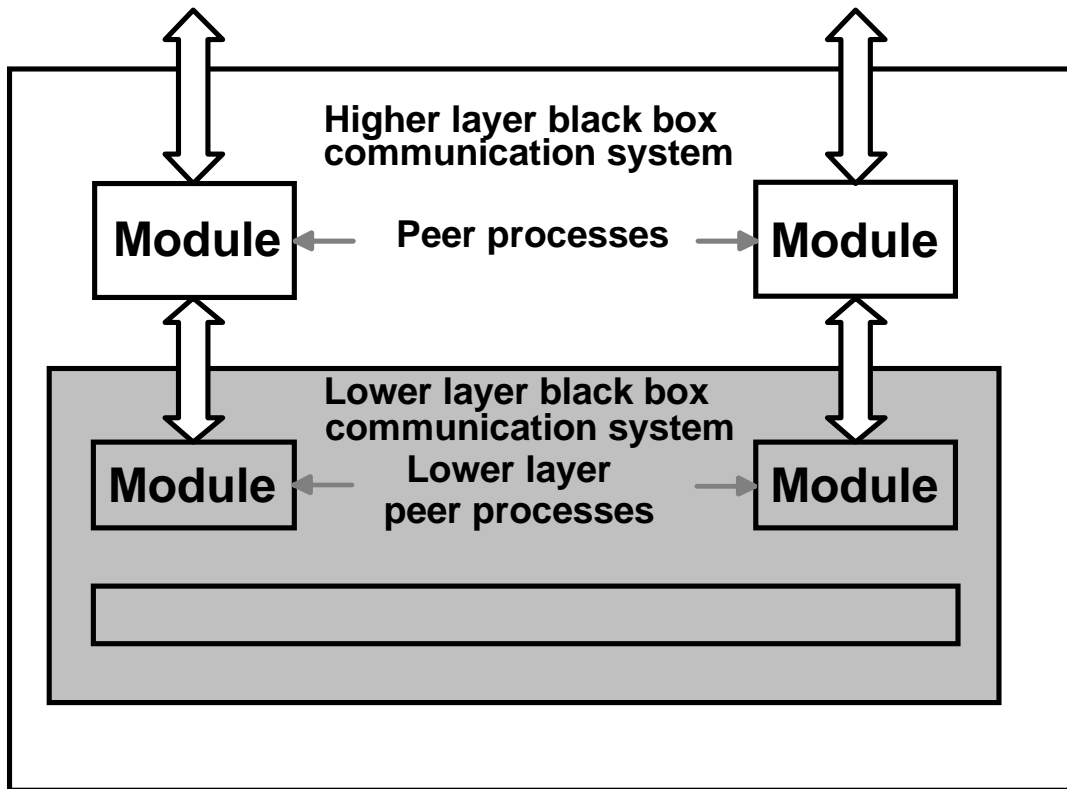


## Overall structure of the ISO reference model



AP = Application Process

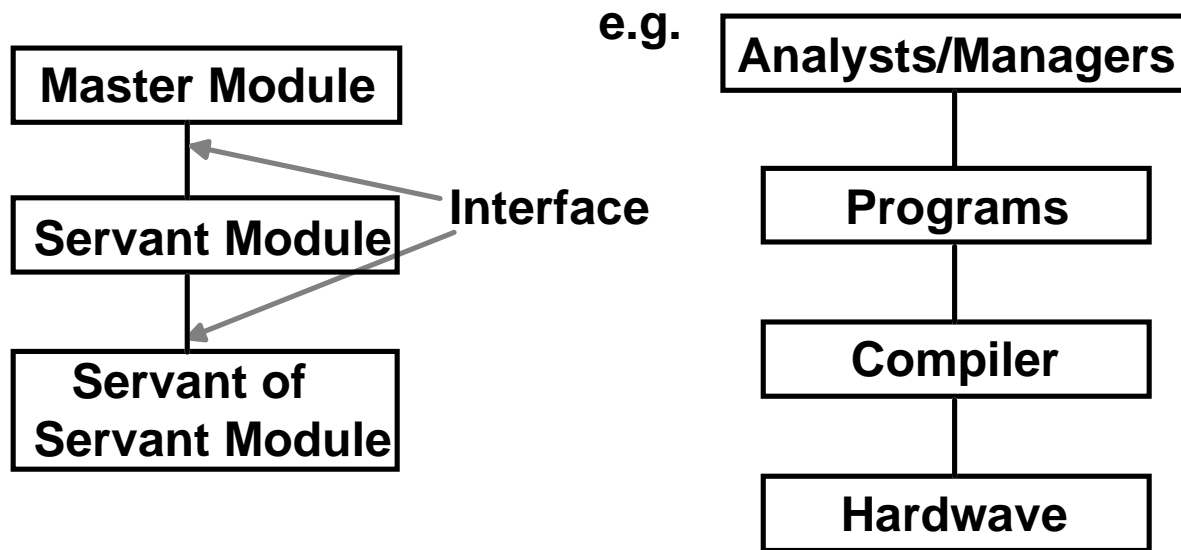
## Block box



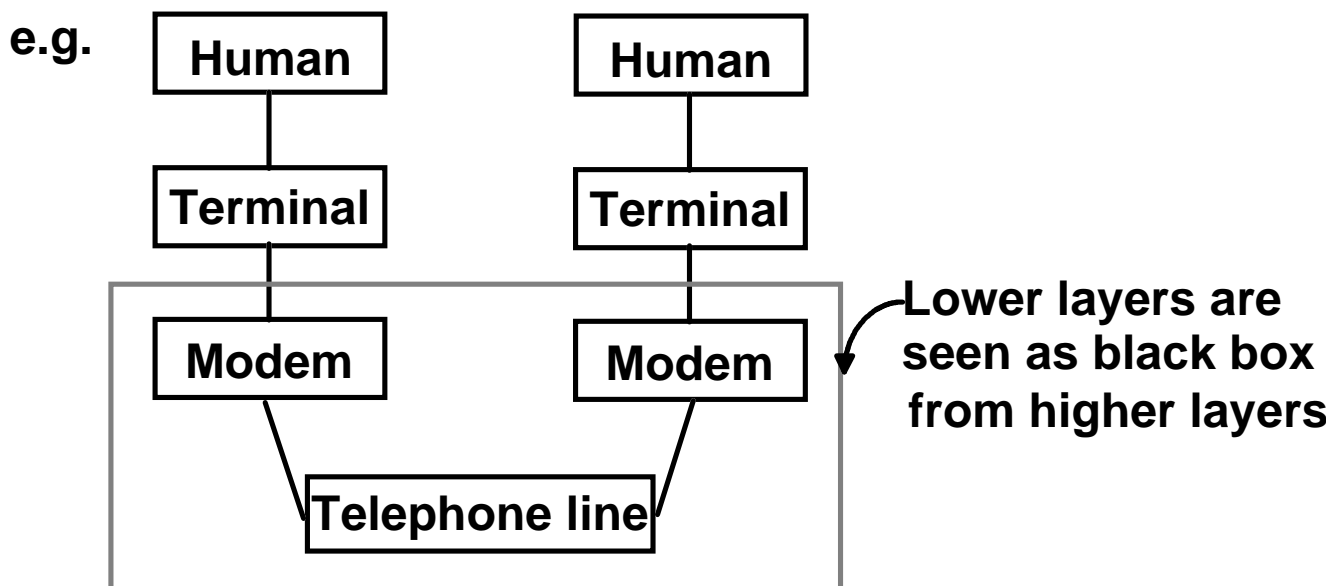
**Peer processes communicate through a lower-layer black box communication system.**

## Hierarchical:

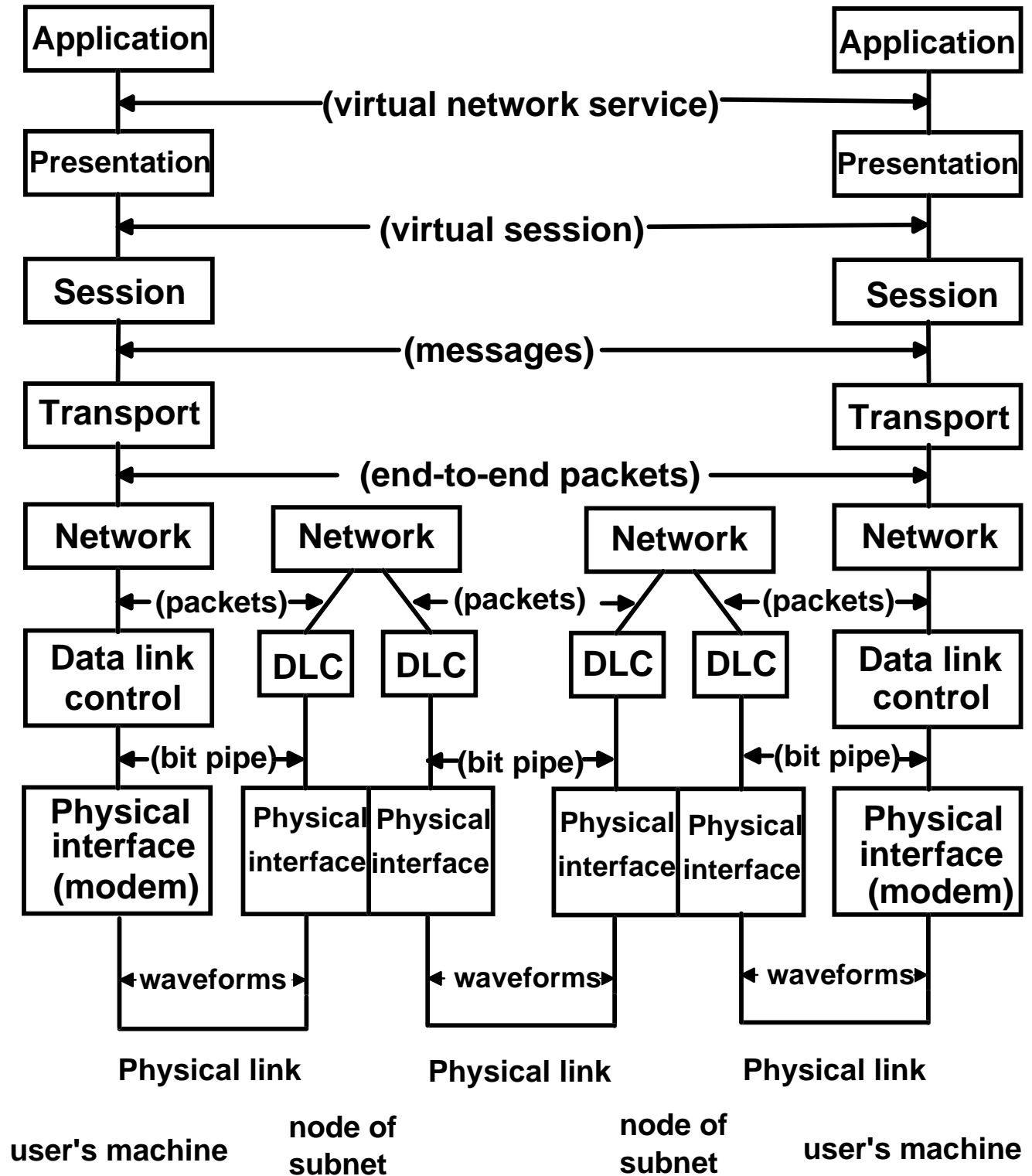
- **Service** (that the layer provides above)
- **Functions** (implementation of service)
- **Interfaces** (common language for provision of service)



## Distributed: The various layers are in fact distributed

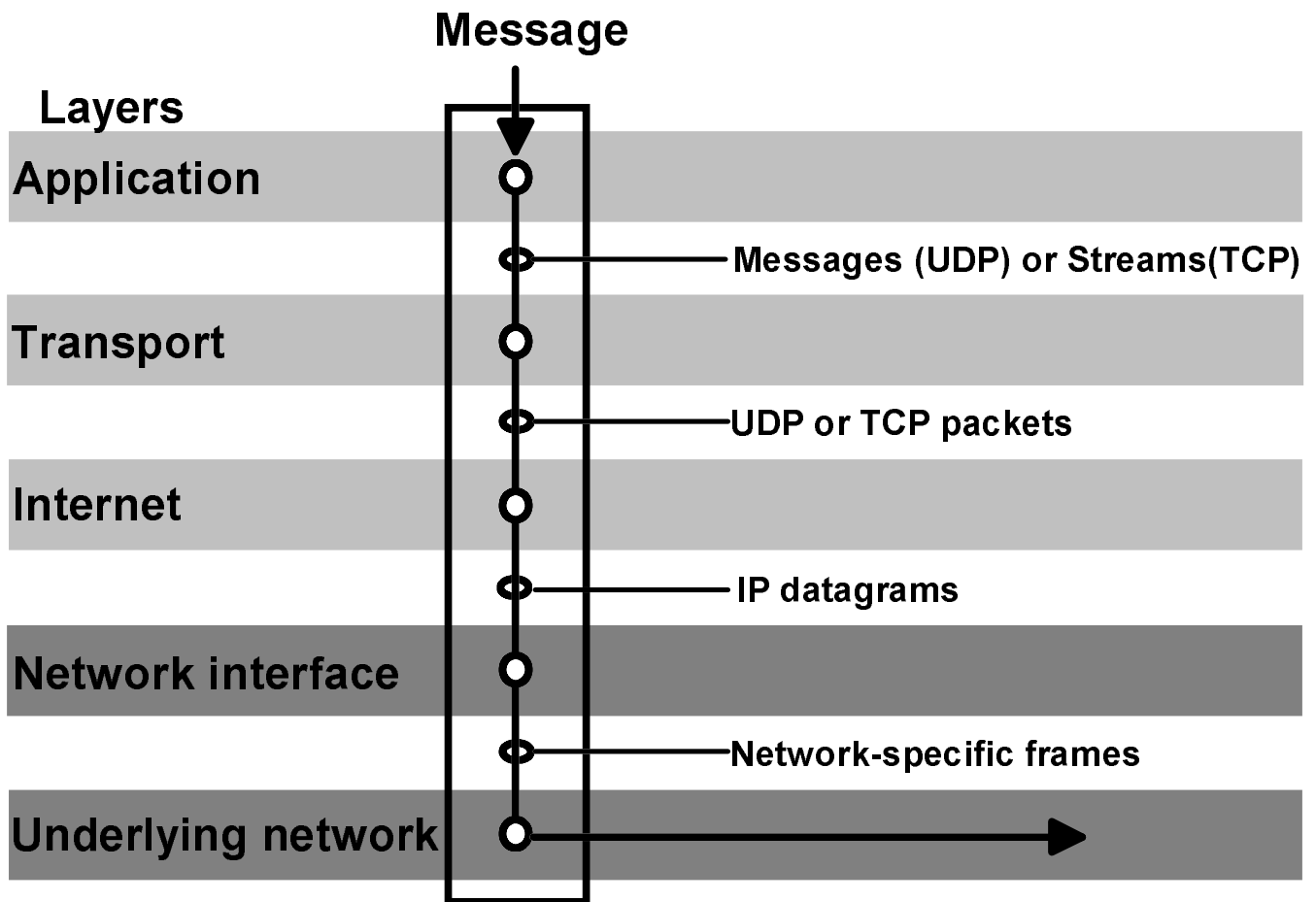


# OSI Standard



Layer	Internet protocols
Application	Ftp, telnet, etc.
Session	—
Transport	TCP,UDP
Internetwork	IP

### TCP/IP layers



UDP = User Datagram protocol .  
 TCP = Transport Control Protocol.  
 IP = Internet Protocol.