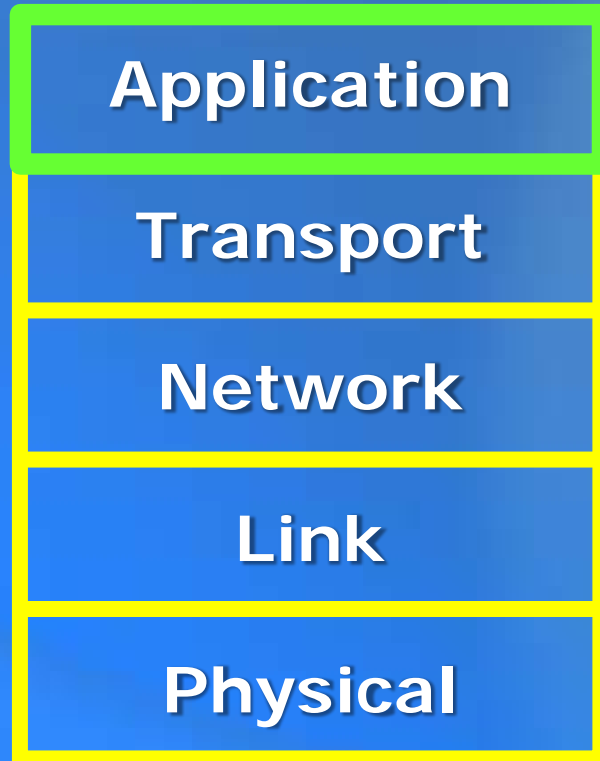


# Application Layer

# Internet protocol stack



## Application Layer

- The applications we run
  - e-mail
  - web browsing
  - instant messaging
  - P2P file sharing
  - multi-user network games
  - video streaming
  - video conferencing
  - Voice over IP
- Runs in hosts

# The Internet "Hourglass"

Many Applications

Web

FTP

Mail

News

Video

Audio

Video Calling

TCP

UDP

IP

Ethernet

802.11

Power lines

ATM

Optical

Satellite

Many Link Technologies

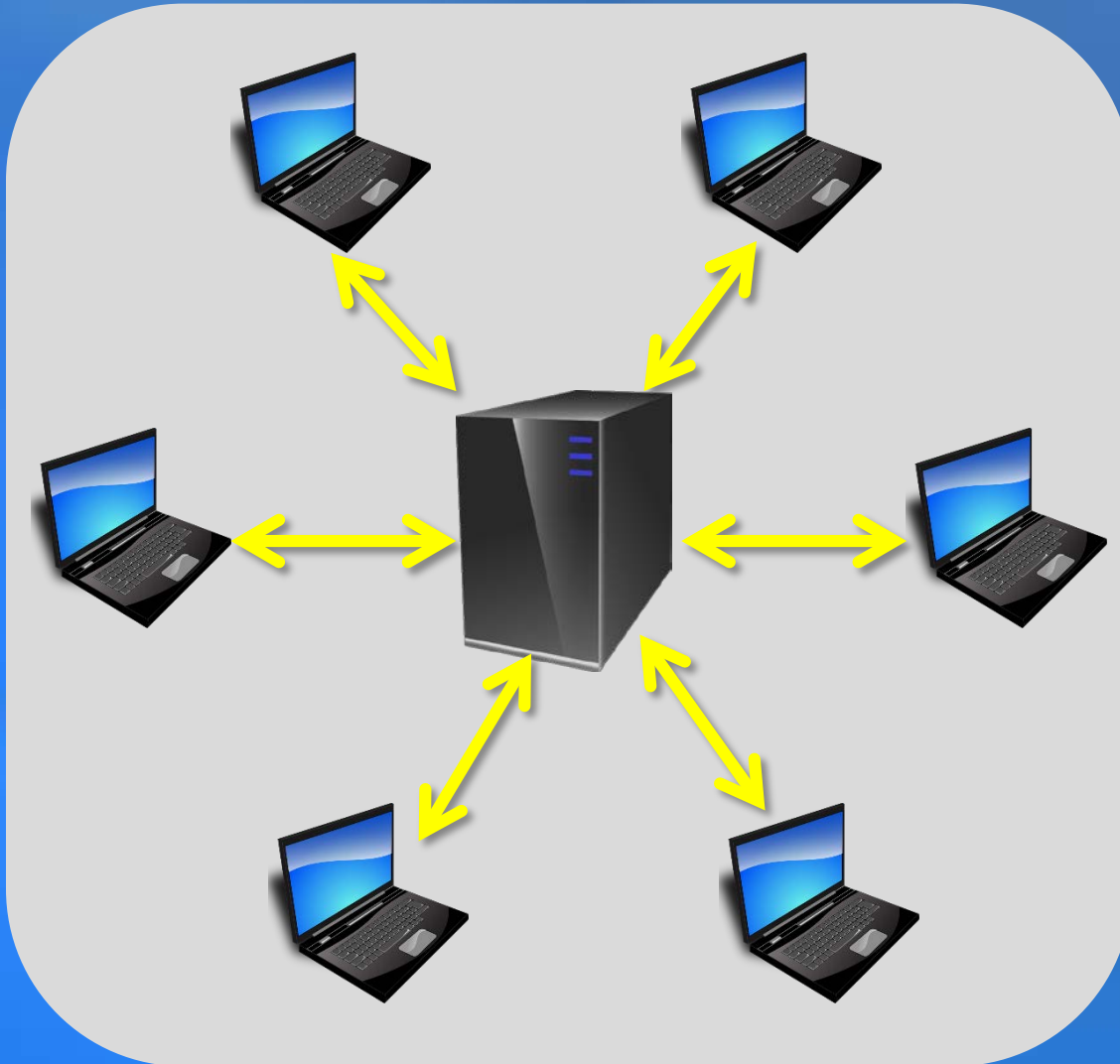
# Application architectures

Client-server

Peer-to-peer (P2P)

Hybrid of client-server and P2P

# Client-server architecture



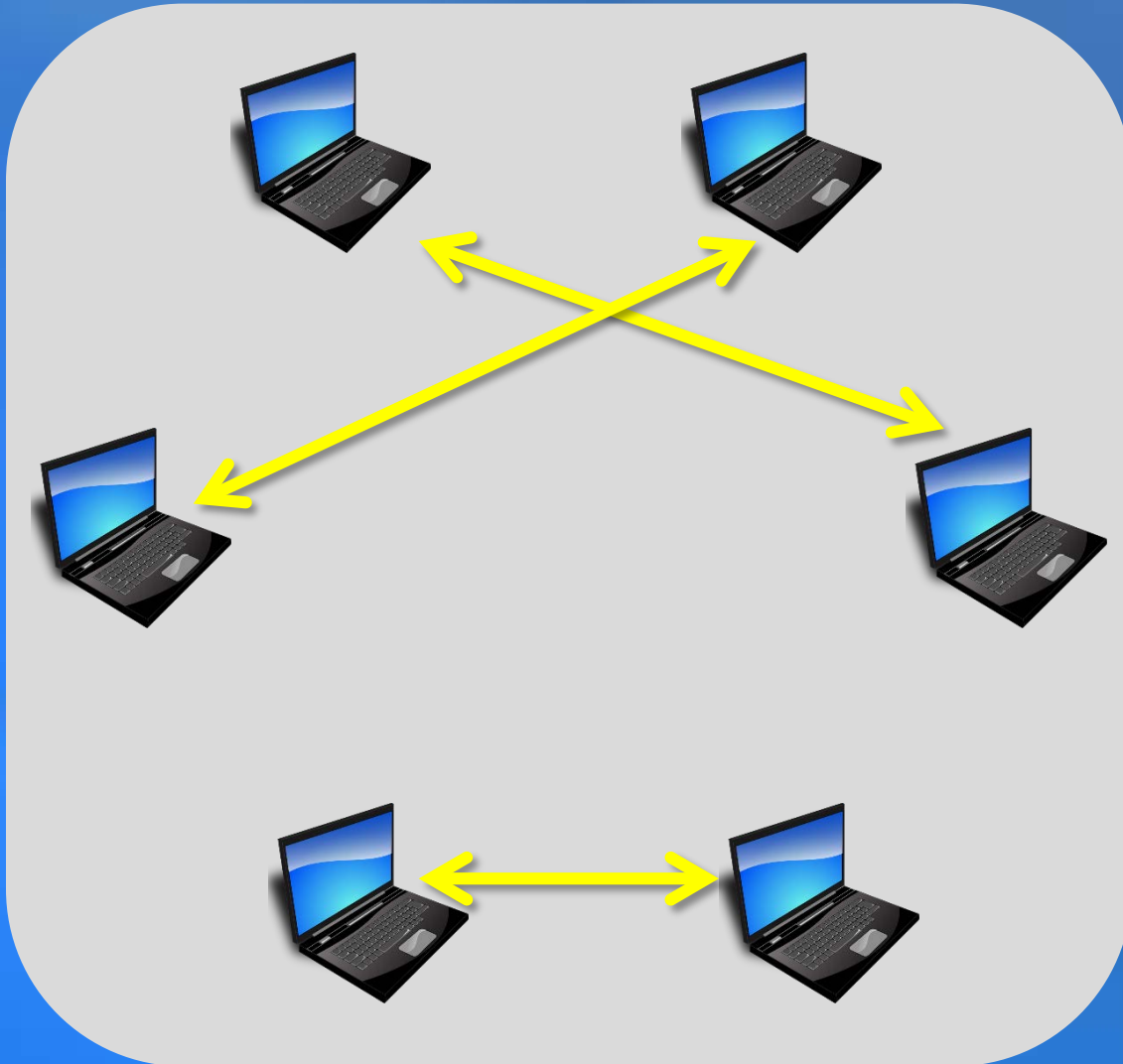
server:

- always-on host
- permanent IP address

clients:

- communicate with server, not each other
- may be intermittently connected or on
- may have dynamic IP addresses
- do not communicate directly with each other

# Peer-to-peer architecture



- no always-on server
- arbitrary end systems directly communicate
- peers are intermittently connected
- peers may change IP addresses
- Highly scalable but difficult to manage

# Hybrid Architectures

## Skype

- centralized server to find address of remote party
- client to client connection is direct (not through server)

## Instant messaging

- centralized server provides client presence and location
  - clients register their IP addresses with central server when online
  - clients query central server to find IP addresses of contacts
- chatting between two clients is peer to peer