Application Layer

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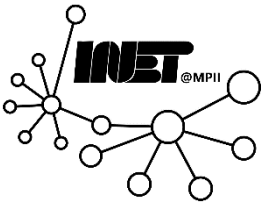
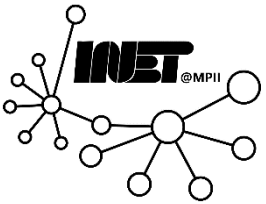
(Based on slide deck of Computer Networking, 7th ed., Jim Kurose and Keith Ross.)



Outline

- Principles of network applications
  - *Examples, design, architecture, and implementation*



Application Layer

Goals

- Conceptual, implementation aspects
- Implementation paradigms
  - *Client-server* and *Peer-to-peer*
  - *Sockets*
- Transport-layer service models

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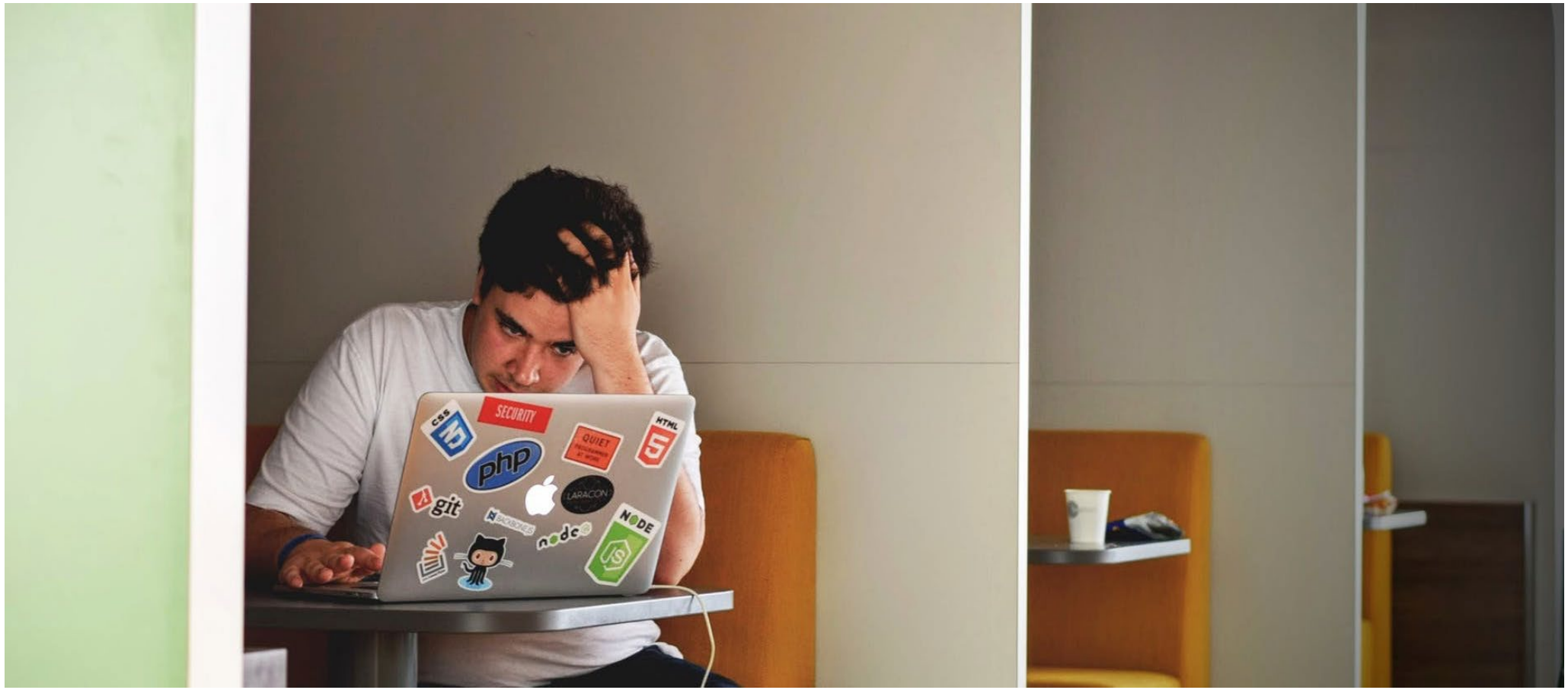
What!?



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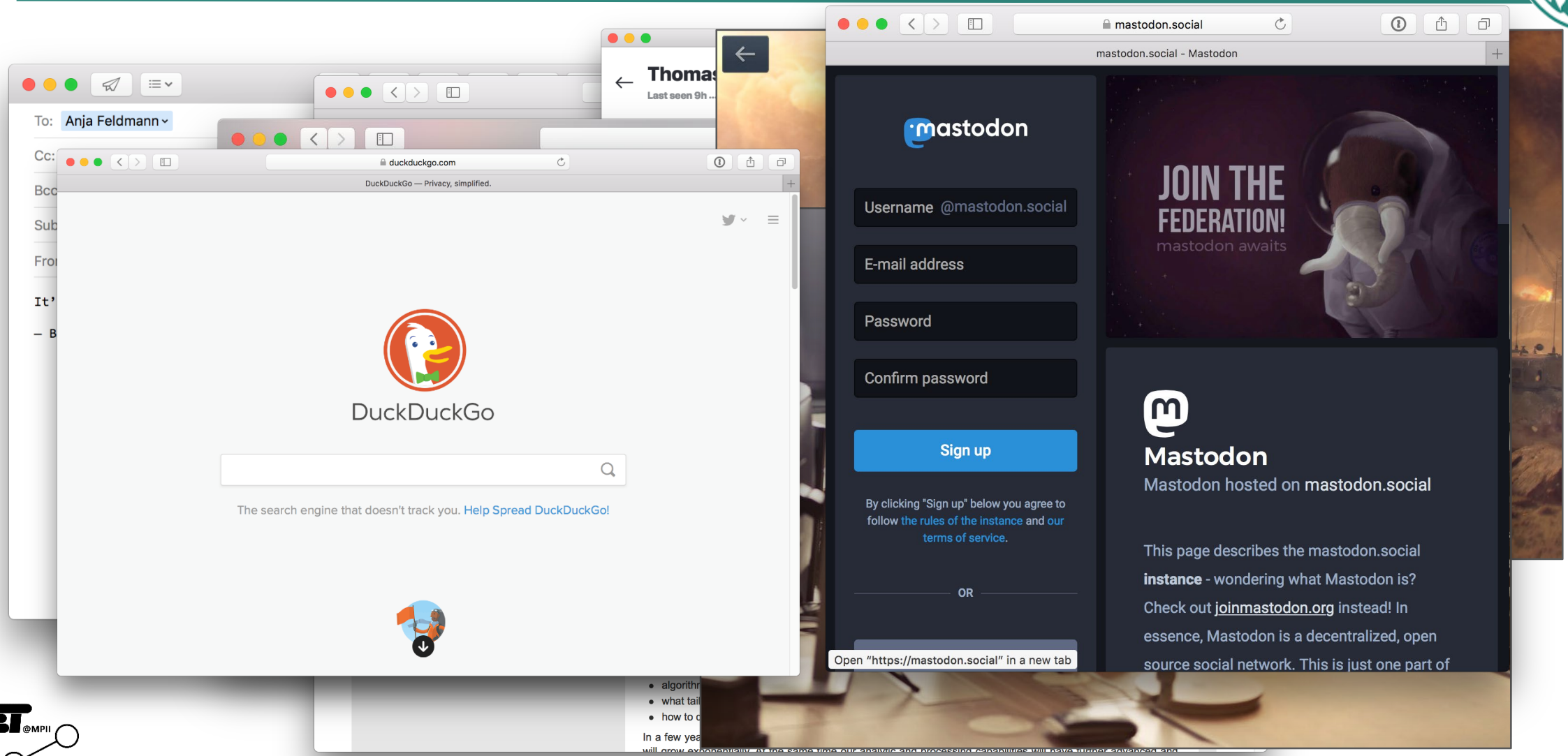
Network Applications: Examples



Network Applications: Examples

E-mail, Web, Text messaging, Remote login, P2P file sharing, Multi-user network games, Streaming stored video (e.g., YouTube, Hulu, and Netflix) , Voice over IP (e.g., Skype), Real-time video conferencing, Social networking, search, …

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- Conceptual, implementation aspects
- **Implementation paradigms**
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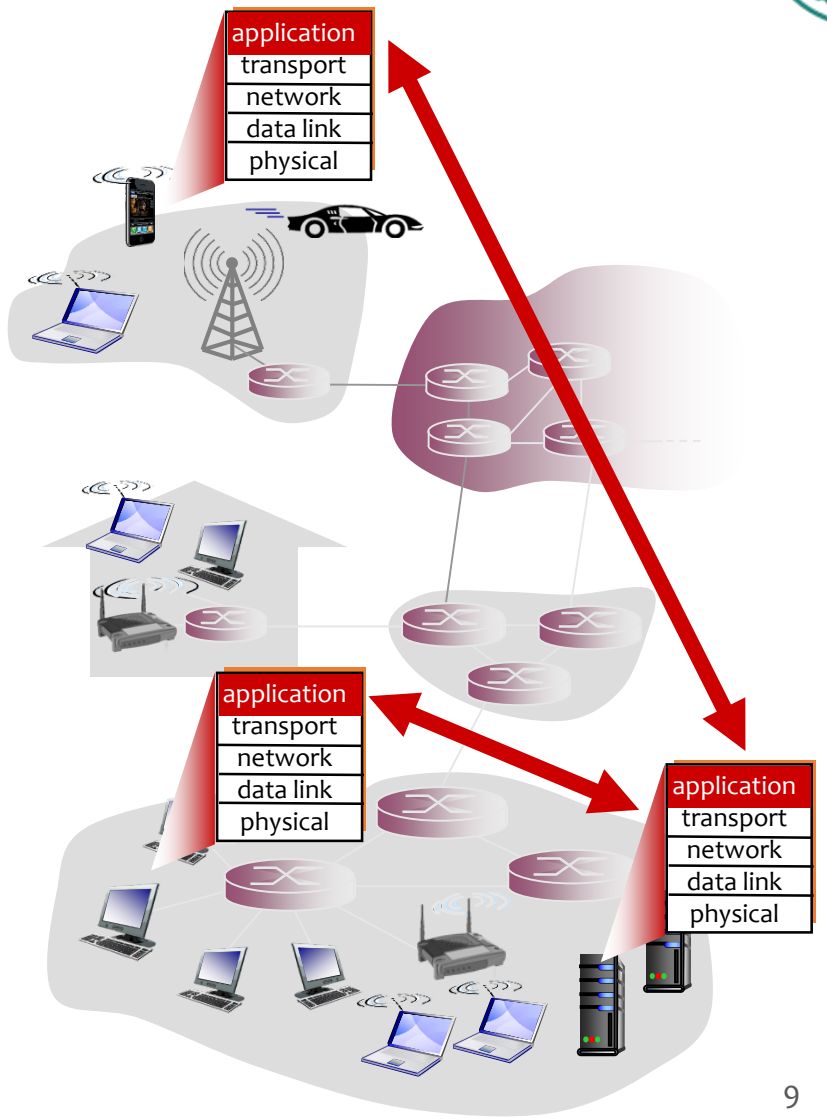
Creating a network application

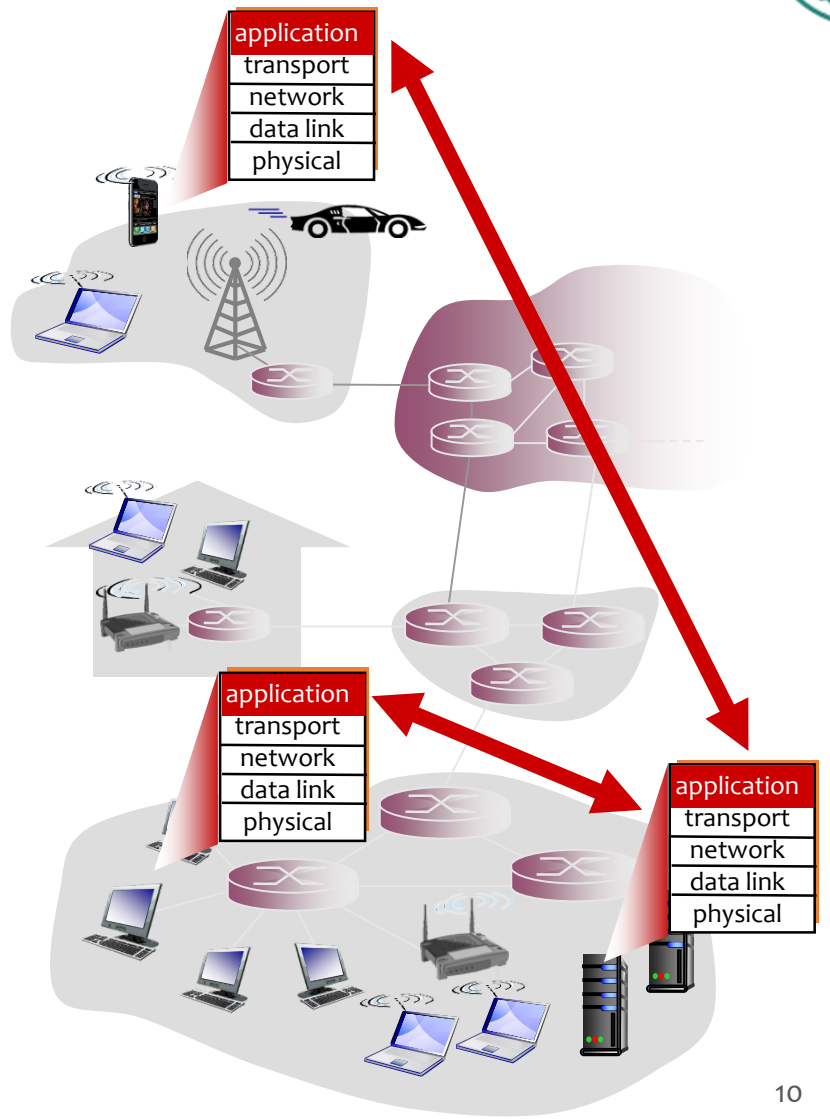
- Write *programs that*
  - Run on (***different***) end systems
  - Communicate over network

Example: Web server software communicates with browser software



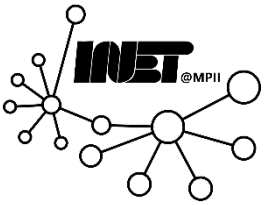
Creating a network application

- ***No need*** to write software for network-core devices
  - Why?
    - *Core devices do not run user applications*
  - Advantage?
    - *Rapid development and deployment*



Application Architectures

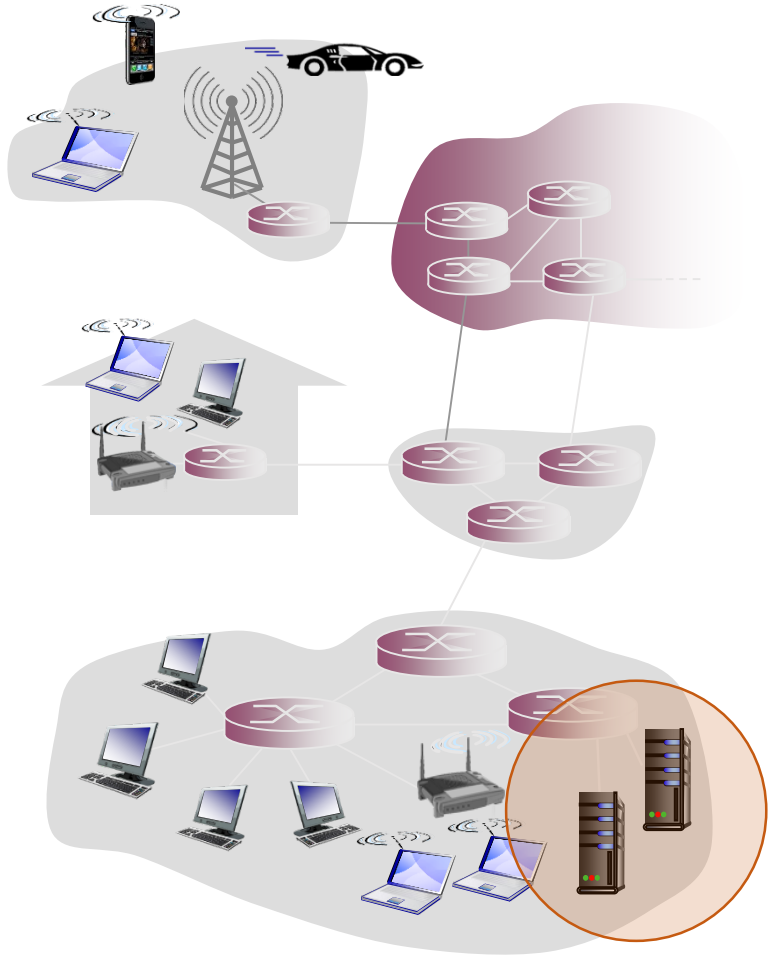
- Based on how data is exchanged …
  - ***Client-Server***
  - ***Peer-to-Peer***



Client-Server Architecture

Server:

- *Always-on* host
- *Permanent* IP address
- Data centers for scaling

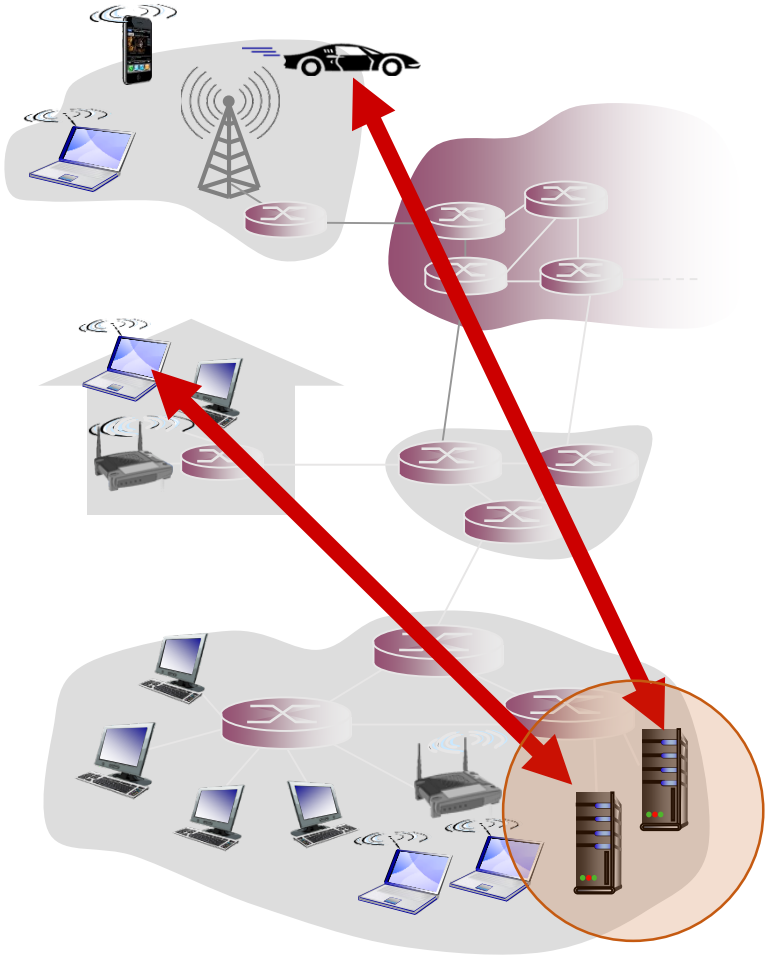


Client-Server Architecture

Client(s):

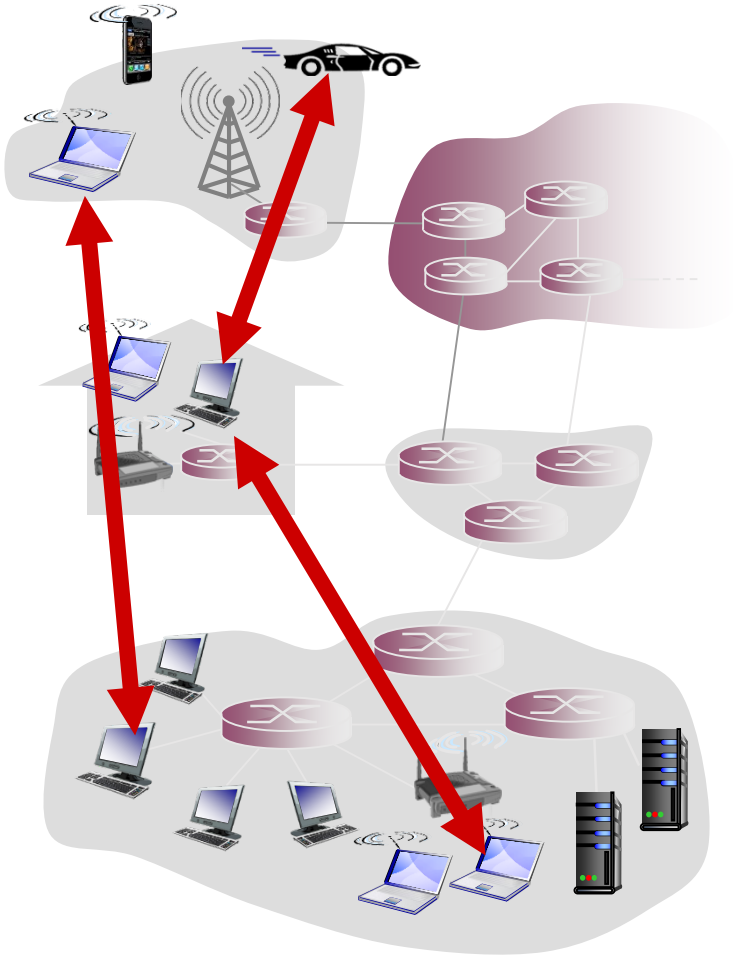
- Communicate with ***server***
- May be intermittently connected
- May have *dynamic* IP addresses

Do ***not*** communicate *directly* with each other



Peer-to-Peer Architecture

- ***No*** always-on server
- *Arbitrary* end systems directly communicate
- ***Peers***
  - Request service from other peers
  - Provide service (in return) to other peers
- ***Self Scalability*** – new peers …
  - Bring new service capacity ***and***
  - New service demands
- Peers are intermittently connected and change IP addresses
- Complex management



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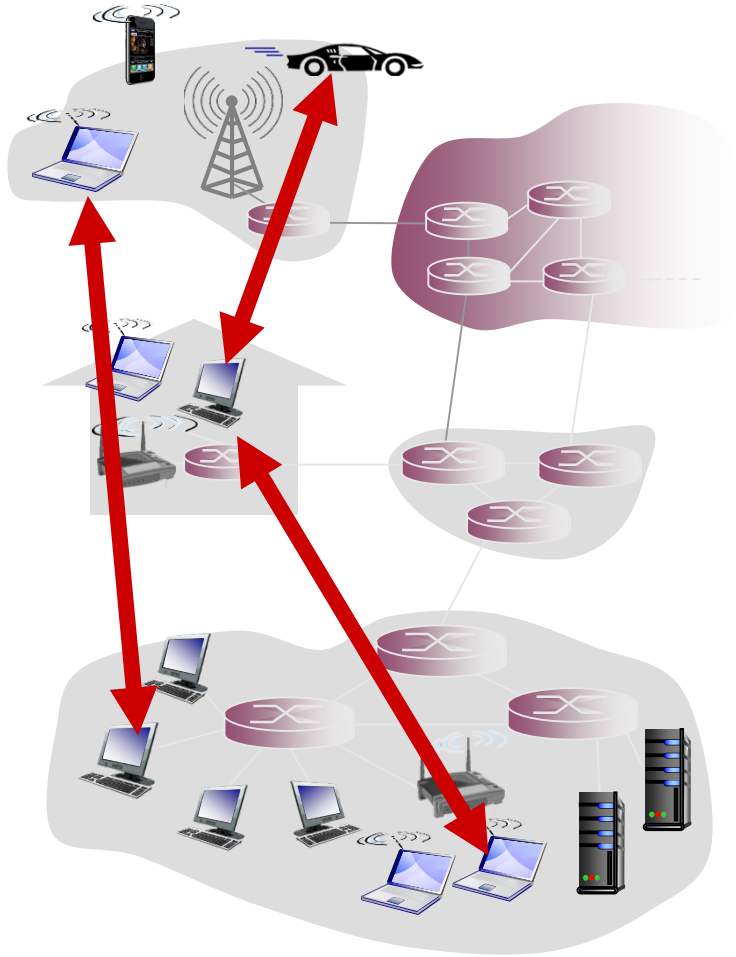

Communicating Processes

- ***Process***: *program* running within a host

Communication between two processes?

- Within ***same*** host
  - Using ***inter-process communication*** (defined by OS)
- In ***different*** hosts
  - By exchanging messages

Processes in Client-Server Arch.

- ***Client*** process:
  - Process that ***initiates*** communication

- ***Server*** process:
  - Process that ***waits*** to be contacted

OK, how about in *peer-to-peer* architecture?

Have both client and server processes!

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- Conceptual, implementation aspects
- Implementation paradigms
  - *Client-server* and *Peer-to-peer*
- Interface: Sockets
- Transport-layer service models