Chapter 1: Introduction

Our goal:

- get "feel" and terminology
- more depth, detail *later* in course
- approach:
  - use Internet as example

Overview:

- what's the Internet
- what's a protocol?
- network edge
- access net, physical media
- network core
- Internet/ISP structure
- performance: loss, delay
- protocol layers, service models
- network modeling

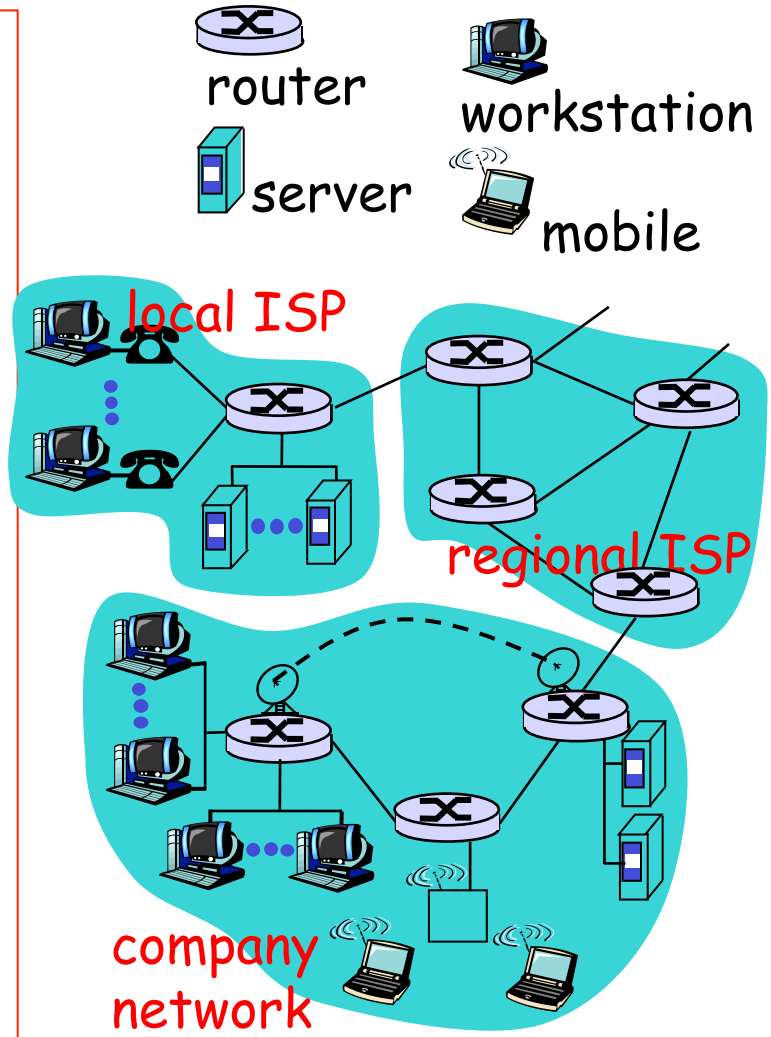
Chapter 1: Introduction

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

- millions of connected computing devices:
  - *hosts = end systems*
- running *network apps*
- *communication links*
  - fiber, copper, radio, satellite
  - Different transmission rates

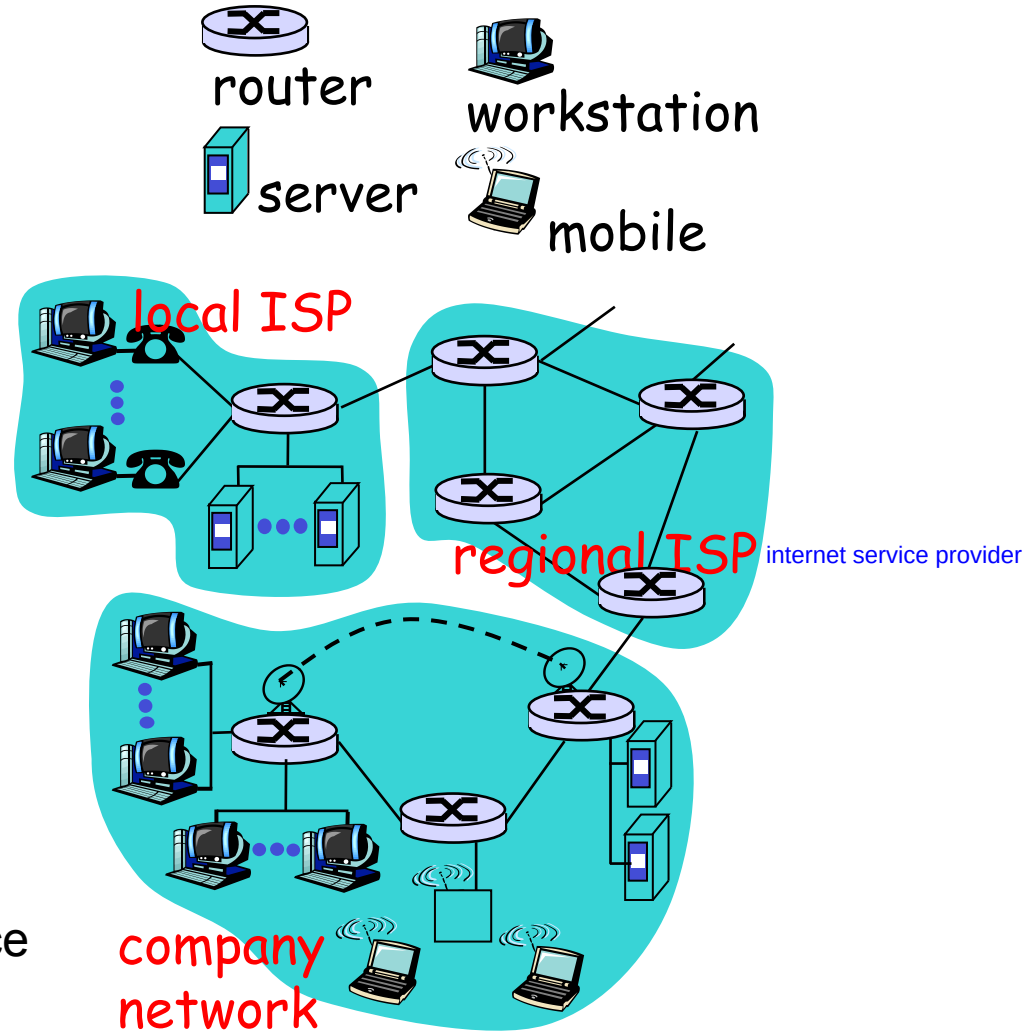
bandwidth : bps

- *routers:* forward packets (chunks of data)



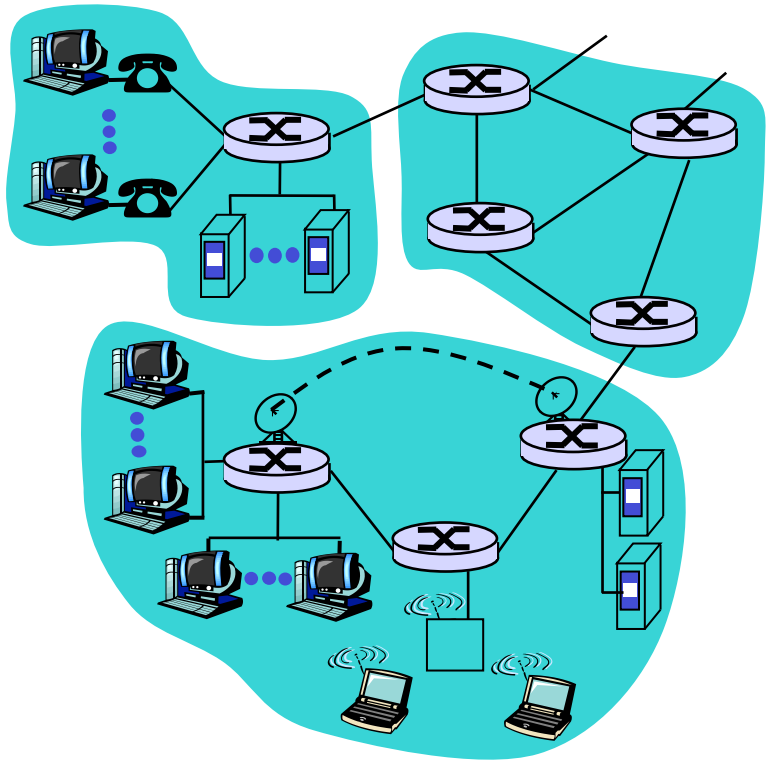
What's the Internet: "nuts and bolts" view

- *protocols* coordinate communication
  - Who gets to transmit?
  - What path to take?
  - What message format?
  - e.g., TCP, IP, HTTP, FTP, PPP
- *Internet:* "network of networks"
  - loosely hierarchical
  - public Internet Vs 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:
  - Web, email, games, e-commerce, file sharing



- communication services provided to apps:
  - Connectionless unreliable
  - connection-oriented reliable

Can you give an analogy of this in real life services

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

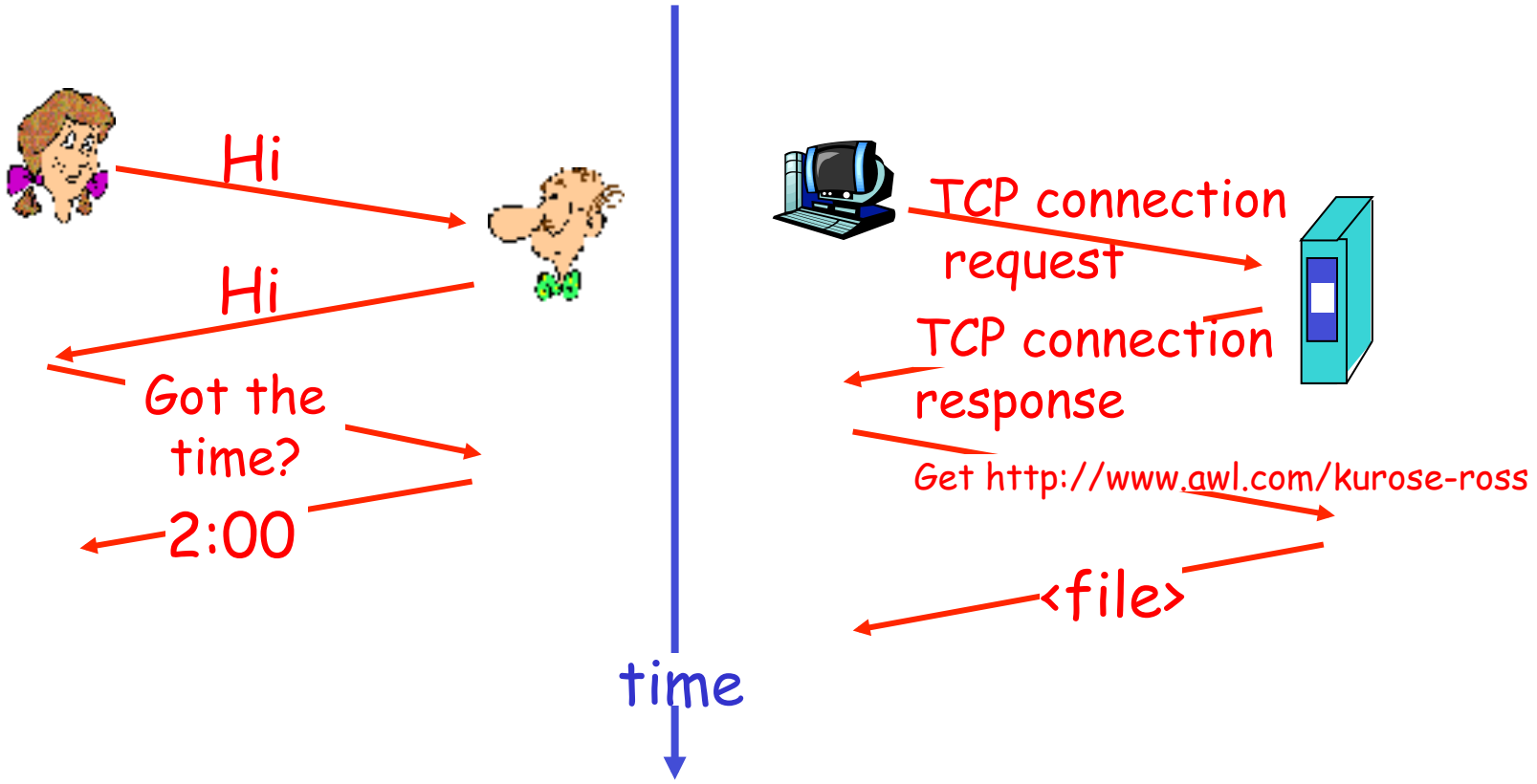
network protocols:

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

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

What's a protocol?

a human protocol and a computer network protocol:



- All communication in Internet coordinated by protocols

Chapter 1: roadmap

1.1 What *is* the Internet?

1.2 Network edge

1.3 Network access and physical media

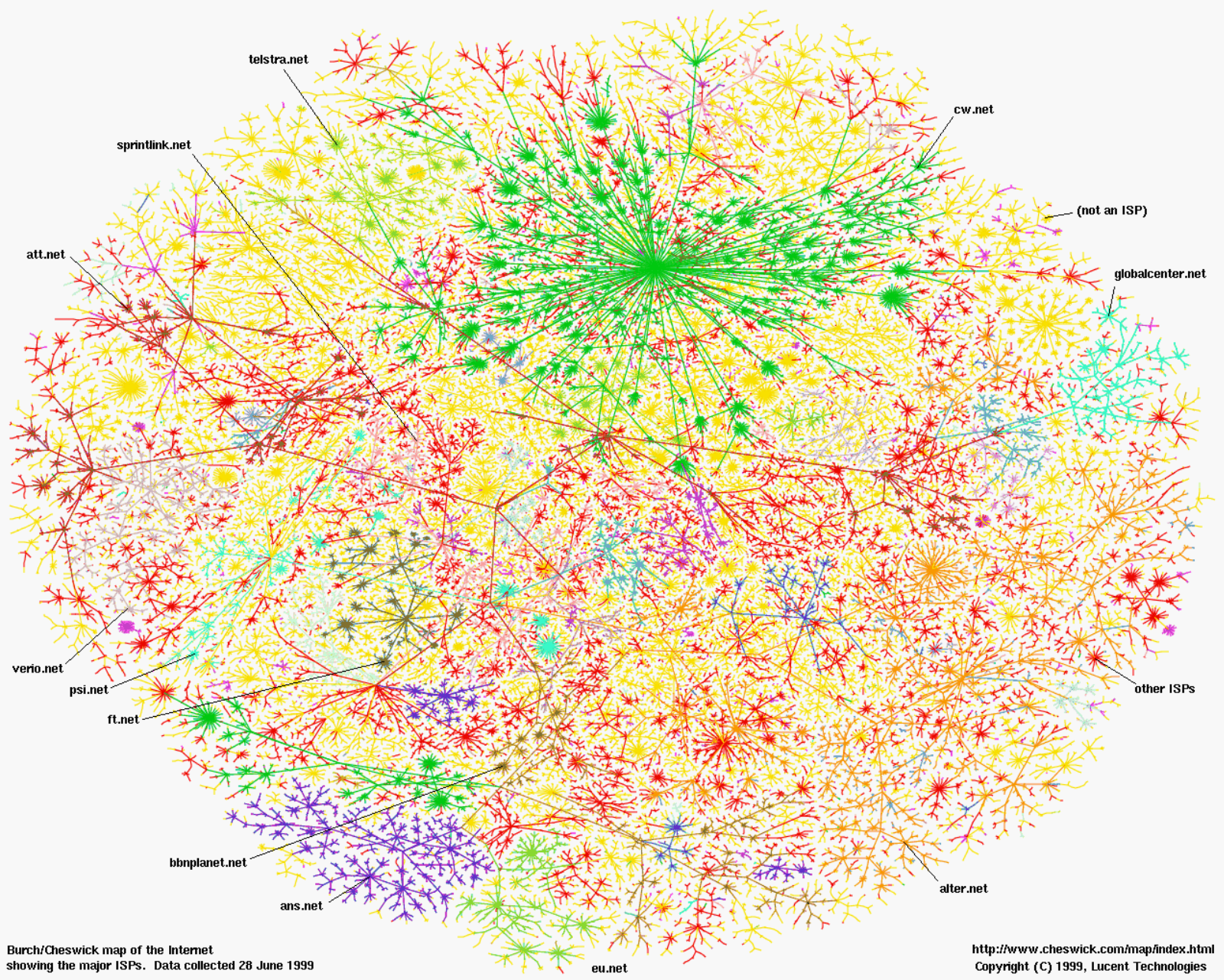
1.4 Network core

1.5 Internet structure and ISPs

1.6 Delay & loss in packet-switched networks

1.7 Protocol layers, service models

1.8 History


telstra.net
sprintlink.net
cw.net
(not an ISP)
att.net
globalcenter.net
verio.net
psi.net
ft.net
other ISPs
bbnplanet.net
alter.net
ans.net
eu.net
Burch/Cheswick map of the Internet
showing the major ISPs. Data collected 28 June 1999
http://www.cheswick.com/map/index.html
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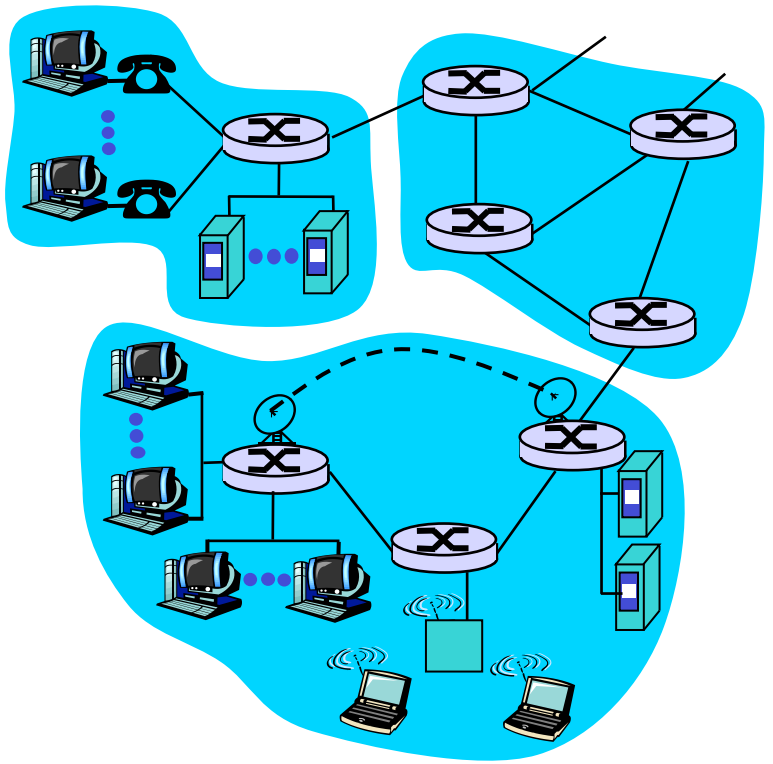
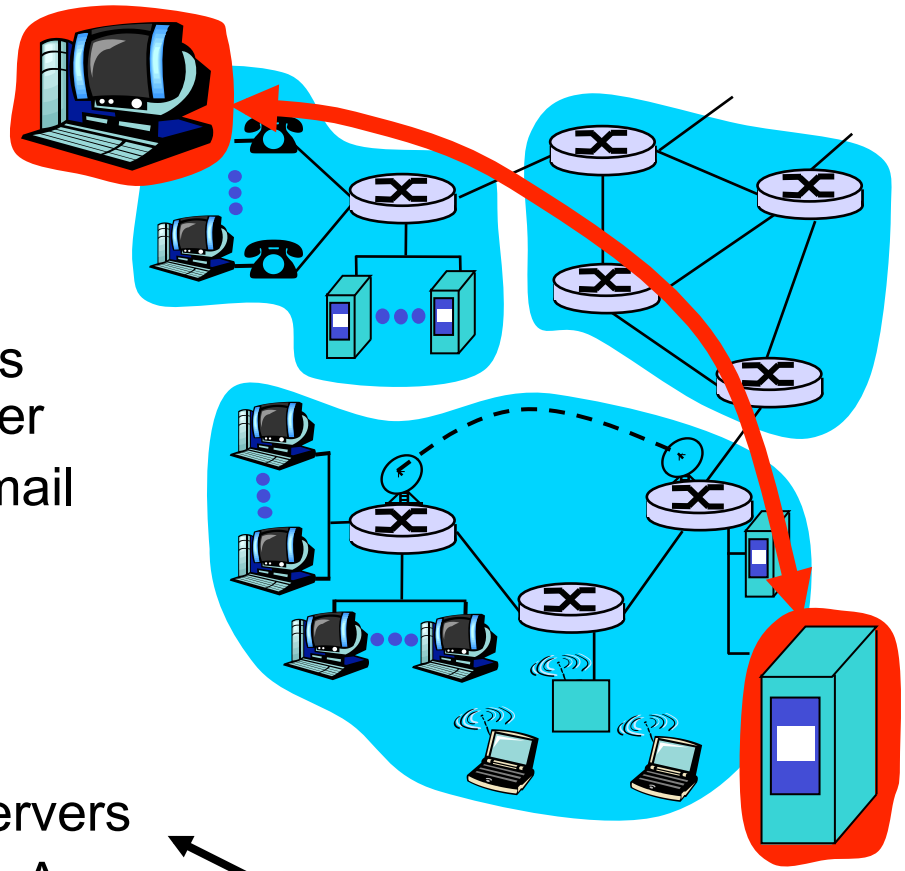
A closer look at network structure:

- 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. Web, email
- client/server model
  - client host requests, receives service from always-on server
  - e.g. Web browser/server; email client/server
- peer-peer model:
  - minimal use of dedicated servers
  - e.g. Skype, BitTorrent, KaZaA



Any idea how?

Network edge: connection-oriented service

Goal: data transfer between end systems

- ***Connection****:* prepare for data transfer ahead of time
  - Request / Respond
  - *set up "state"* in two communicating hosts
- TCP - Transmission Control Protocol
  - Internet's connection-oriented service

TCP service [RFC 793]

- *reliable, in-order* byte-stream data transfer
  - loss: acknowledgements and retransmissions
- *flow control:*
  - sender won't overwhelm receiver
- *congestion control:*
  - senders "slow down sending rate" when network congested

Network edge: connectionless service

Goal: data transfer between end systems

- same as before!

- UDP - User Datagram Protocol [RFC 768]:
  - connectionless
  - unreliable data transfer
  - no flow control
  - no congestion control

App's using TCP:

- HTTP (Web), FTP (file transfer), Telnet (remote login), SMTP (email)

App's using UDP:

- streaming media, teleconferencing, DNS, Internet telephony

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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"