

EECS 563 - Introduction to Communication Networks

Dr. Morteza Hashemi
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- **Instructor:** Dr. Morteza Hashemi (mhashemi@ku.edu), 2046 Eaton Hall
<https://hashemi.ku.edu/>
- **Office Hours:** Tuesday 12-2 pm or by appointment. The best way to reach me is via e-mail.
- **GTA and Grader:** William Hecht (will.hecht@ku.edu) and Srijanya Chetikaneni (s364c621@ku.edu).

- **Grading**

- 2 Midterm Exams: 40%
- Final Exam: 25%
- Homework: 25%
- In-Class Unannounced Quizzes: 10%
- Extra Points on Research Paper: up to 3%
- This class will use $+/-$ grading in Fall 2023. The grading scheme is as follows:
 - 90.0 - 92.9: A- | 93.0 - 100: A
 - 80.0 - 82.9: B- | 83.0 - 86.9: B | 87.0 - 89.9: B+
 - 70.0 - 72.9: C- | 73.0 - 76.9: C | 77.0 - 79.9: C+
 - 60.0 - 62.9: D- | 63.0 - 66.9: D | 67.0 - 69.9: D+
 - 0 - 59.9: F

- **Policy**

- **Assigned Homework are due at the beginning of the class on the date indicated.**
- Late homework/lab submission policy: one day late: max 75% of grade; two days late: max 50% of grade; three days late; max 25% of grade; later submissions receive a zero.

- **Rules of Conduct:** You may collaborate in study groups on the solution of homeworks. You must, however, write up solutions on your own. If you do collaborate you should acknowledge your collaborators in the write-up for each problem (I view this as essential!). Also If you used other material in obtaining a solution (e.g., other books and papers), you should reference your source.

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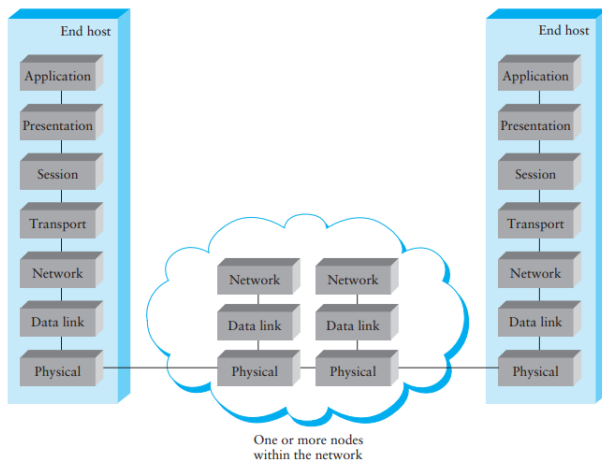
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- **Class Attendance Policy:** Students are expected to attend classes regularly (in-person or online). A student who incurs an excessive number of absences may be withdrawn from a class at the discretion of the professor.

- **Textbook:** James E. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, Eight Edition. (The sixth or seventh editions are fine.)
- **Prerequisites:** EECS 168 and MATH 526 or EECS 461
- **Course Description:** Computer networks, communication protocols, Internet TCP/IP and applications, wireless communications (and network security)

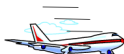
Course Goals

- Be competent with the basics of data communications and network architecture
- Be competent with network layer control and protocols
- Be competent with link layer control and protocols
- Be competent with using the TCP/IP protocol suite
- Be familiar with using high speed LANs
- Be familiar with various Internet technologies
- Be exposed to designing advanced communication protocols

GSI layers



Example: organization of air travel



ticket (purchase)

baggage (check)

gates (load)

runway takeoff

airplane routing

ticket (complain)

baggage (claim)

gates (unload)

runway landing

airplane routing

airplane routing

airline travel: a series of steps, involving many services

Course in One Shot...

Group	Layer Number	Layer Name	Description
Top Layers	7	Application	Provide user interface to send and receive the data
	6	Presentation	Encrypt, format and compress the data for transmission
	5	Session	Initiate and terminate session with remote system
Bottom Layers	4	Transport	Break data stream in smaller segments and provide reliable and unreliable data delivery
	3	Network	Provide logical addressing
	2	Data Link	Prepare data for transmission
	1	Physical	Move data between devices

Postal Service Example

- Bob (the Application) puts a letter in an envelope
- Bob writes Larry's address on the outside, and puts it in his mailbox.
- The mailman (the Transport) picks it up and takes it to the Post Office (the Network).
- Here, they look at the address (the Data Link layer), and decide how to send it (the Physical transportation means).
- At the destination, the process proceeds in the reverse order. They unload it from the train, look at the address, decide which of many mailmen to give it to, and take it to Larry's, who opens the letter, and reads the message.

Part 1: Introduction

- What is the Internet, What is a protocol?
- The Network Edge, Core, and Access Networks
- Physical Media
- Delay, Loss and throughput in Packet-Switched Networks
- Protocol Layers and Their Service Models
- The structure of the Internet
- A Brief History of Computer Networking and the Internet

Part 2: The Application Layer

- Principles of Application-Layer Protocols
- The World Wide Web: HTTP
- File Transfer: FTP
- Electronic Mail in the Internet
- The Internet's Directory Service: DNS
- Peer-peer systems
- Socket Programming

Part 3: The Transport Layer

- Transport-Layer Services and Principles
- Multiplexing and Demultiplexing Applications
- Connectionless Transport: UDP
- Principles of Reliable Data Transfer
- Connection-oriented transport (TCP): Reliable transfer, Flow control, Connection management
- Principles of Congestion Control
- TCP Congestion Control

Part 4: The Network Layer

- Network Layer services
- Internet Protocol (IP) and Addressing (IPv4, IPv6)
- Routing Algorithms: Link-State and Distance-Vector
- Internet Routing Protocols (Intra-domain, Inter-domain)
- Multicast and Anycast Routing

Part 5: The Link Layer and Local Area Networks

- Link Layer services
- Error detection, correction
- Multiple access protocols and LANs
- Link layer addressing, ARP
- Specific link layer technologies
 - Ethernet
 - Hubs, bridges, switches
 - IEEE 802.11 LANs
 - Data center networking

Part 6: Advanced Topics (3 weeks)

- Wireless communications
 - Wireless links, characteristics
 - IEEE 802.11 wireless LAN (Wi-Fi)
 - Network coding
 - Advanced variations of transport protocols (wireless, data center TCP, etc.)
- Network security
 - What is Network Security?
 - Attacks and Countermeasures
 - Principles of Cryptography
 - Authentication: Who are You?
 - Integrity
 - Key Distribution and Certification
 - Firewalls
 - Case Studies

Chapter 1: Introduction

Computer Networking: A Top-Down Approach

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Chapter 1: introduction

Chapter goal:

- Get “feel,” “big picture,” introduction to terminology
 - more depth, detail *later* in course
- Approach:
 - use Internet as example

Overview/roadmap:

- What *is* the Internet?
- What *is* a protocol?
- **Network edge:** hosts, access network, physical media
- **Network core:** packet/circuit switching, internet structure
- **Performance:** loss, delay, throughput
- Protocol layers, service models
- History

The Internet: a “nuts and bolts” view



Billions of connected computing *devices*:

- *hosts* = end systems
- running *network apps* at Internet’s “edge”



Packet switches: forward packets (chunks of data)

- *routers, switches*

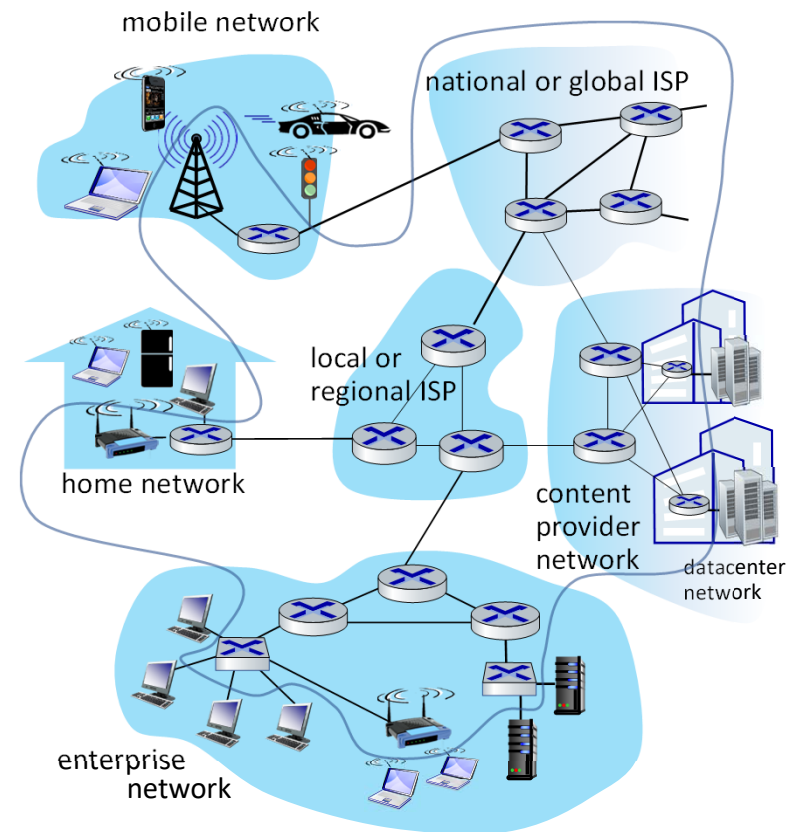


Communication links

- fiber, copper, radio, satellite
- transmission rate: *bandwidth*

Networks

- collection of devices, routers, links: managed by an organization



“Fun” Internet-connected devices



Amazon Echo



Internet refrigerator



IP picture frame



Pacemaker & Monitor



Tweet-a-watt:
monitor energy use



Security Camera



Slingbox: remote
control cable TV



Web-enabled toaster +
weather forecaster



AR devices

Internet phones



sensorized,
bed
mattress

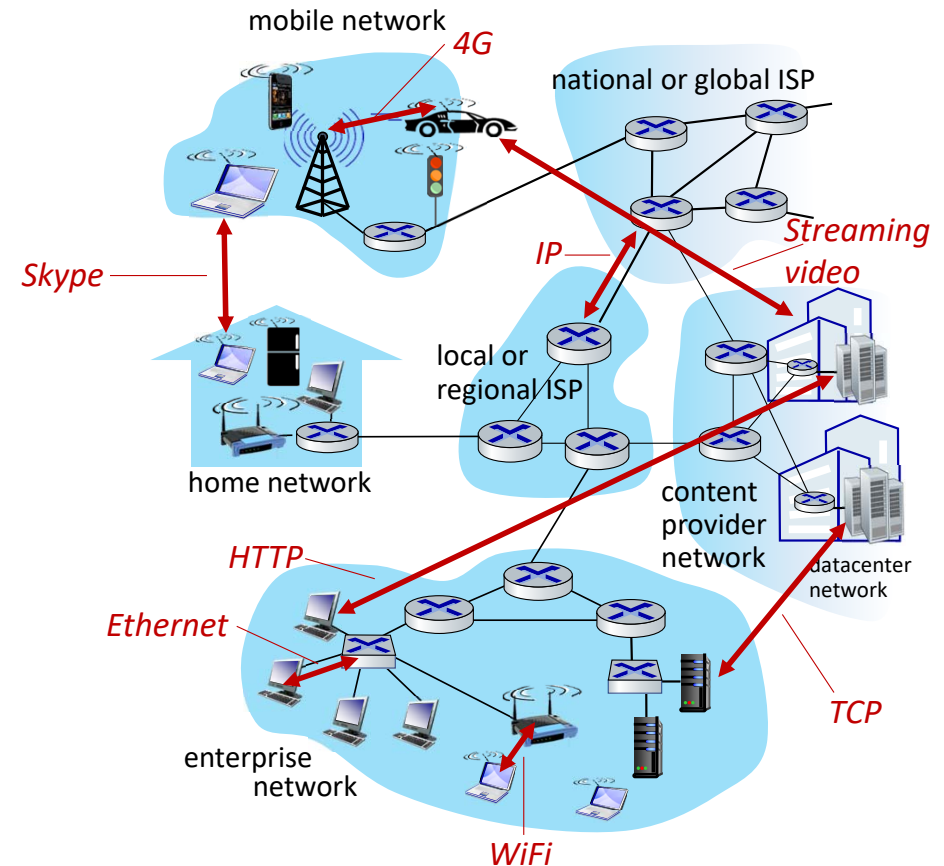


Fitbit

Others?

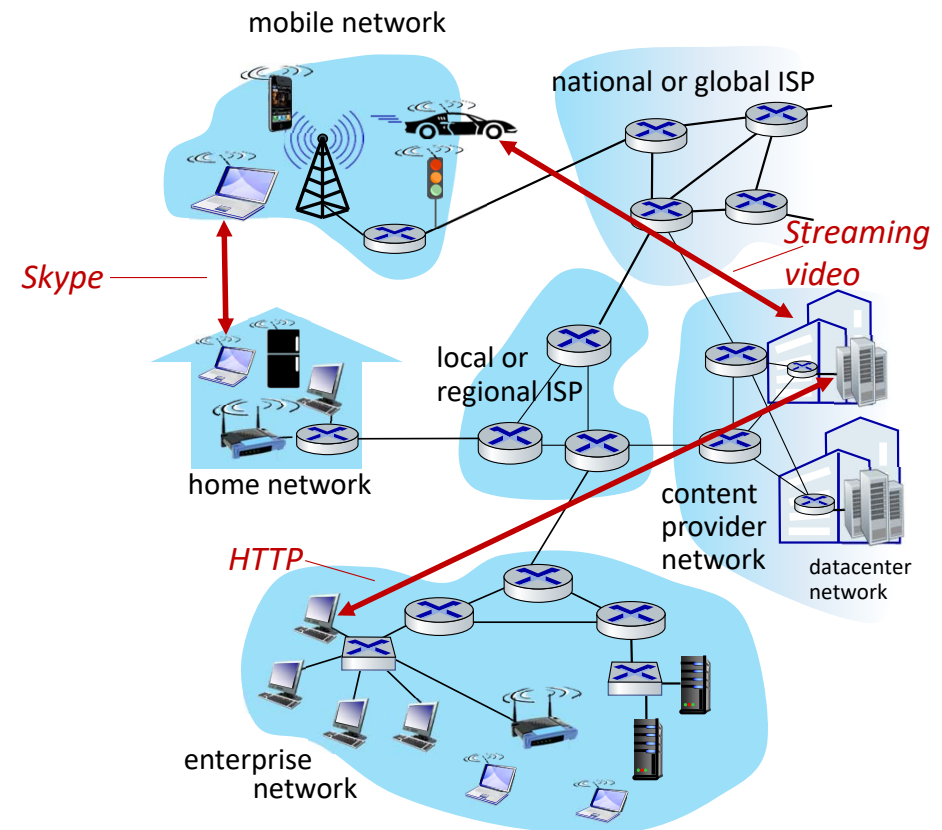
The Internet: a “nuts and bolts” view

- *Internet: “network of networks”*
 - Interconnected ISPs
- *protocols are everywhere*
 - control sending, receiving of messages
 - e.g., HTTP (Web), streaming video, Skype, TCP, IP, WiFi, 4G, Ethernet
- *Internet standards*
 - RFC: Request for Comments
 - IETF: Internet Engineering Task Force



The Internet: a “service” view

- *Infrastructure* that provides services to applications:
 - Web, streaming video, multimedia teleconferencing, email, games, e-commerce, social media, inter-connected appliances, ...
- provides *programming interface* to distributed applications:
 - “hooks” allowing sending/receiving apps to “connect” to, use Internet transport service
 - provides service options, analogous to postal service



What's a protocol?

Human protocols:

- “what’s the time?”
- “I have a question”
- introductions

... specific messages sent

... specific actions taken
when message received,
or other events

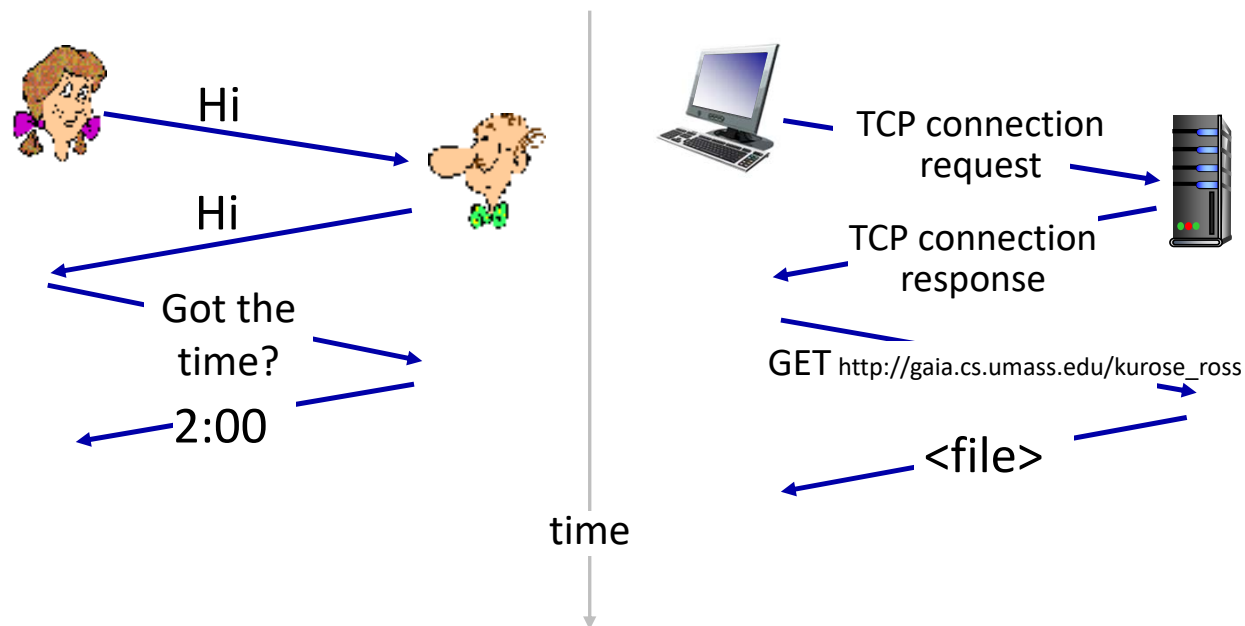
Network protocols:

- computers (devices) rather than humans
- all communication activity in Internet governed by protocols

*Protocols define the **format, order** of
messages 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:



Q: other human protocols?

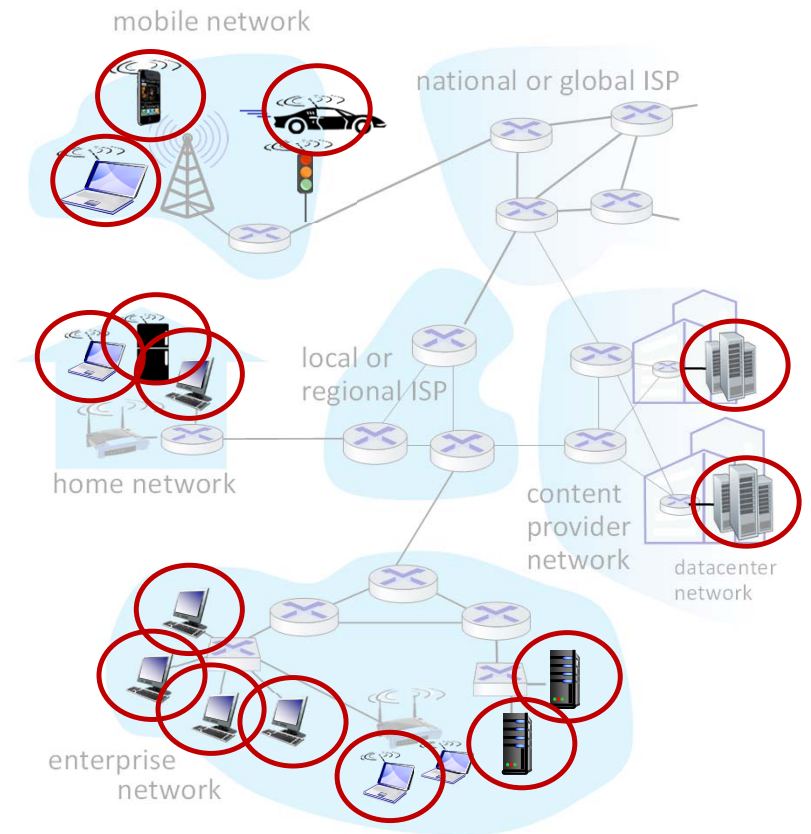
Chapter 1: roadmap

- What *is* the Internet?
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A closer look at Internet structure

Network edge:

- hosts: clients and servers
- servers often in data centers



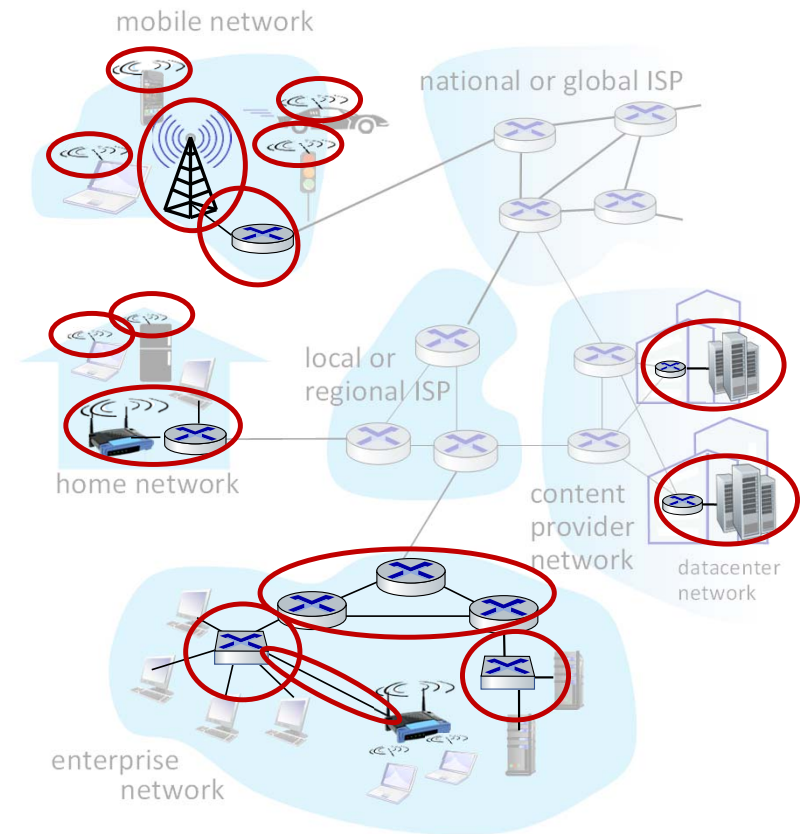
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Access networks, physical media:

- wired, wireless communication links



A closer look at Internet structure

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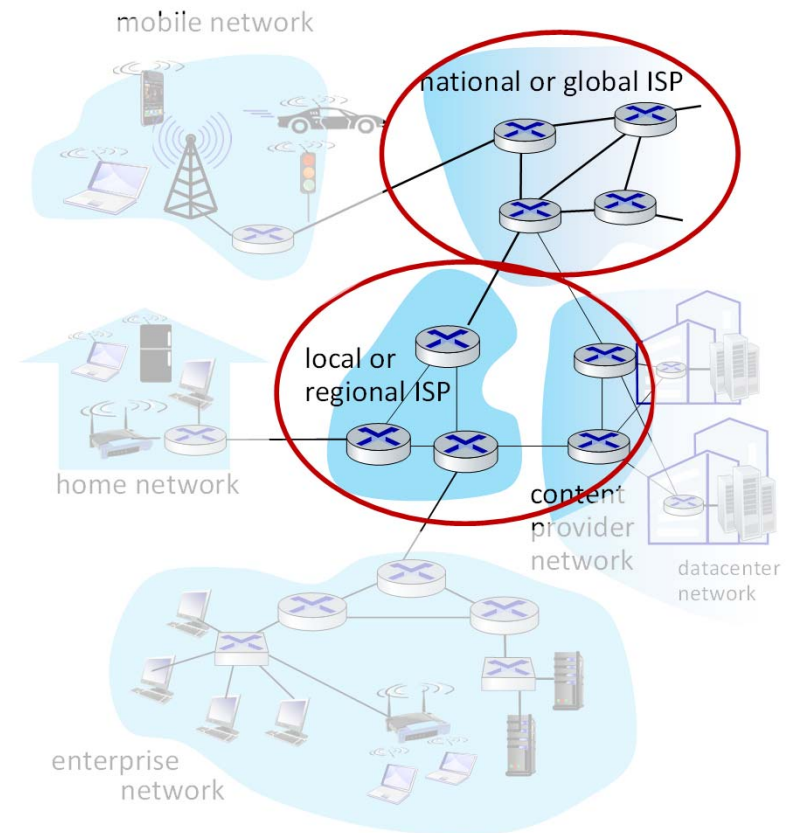
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Access networks, physical media:

- wired, wireless communication links

Network core:

- interconnected routers
- network of networks



Access networks and physical media

Q: How to connect end systems to edge router?

- residential access nets
- institutional access networks (school, company)
- mobile access networks (WiFi, 4G/5G)

What to look for:

- transmission rate (bits per second) of access network?
- shared or dedicated access among users?

