CSC/ECE 573
Internet Protocols
Fall 2023

Dr. Muhammad Shahzad
Department of Computer Science

- Slides adapted from J.F Kurose and K.W. Ross

What is this course about?

- Learn and understand protocols in Internet
- Communication in Internet
- Study wide area connectivity - interconnection of autonomous networks
- Networking devices and applications
- Some hands on work with network protocols

What this course is not about?

- Network troubleshooting
- Configuring networking devices

Course information

- Textbooks
  - *Computer Networking: A Top Down Approach*, James Kurose & Keith Ross, Pearson, 8th ed.
    - Some of the recent topics that we will cover may not be available in books.

Course information

- Moodle
  - Lecture slides
  - Programming assignments
  - Submissions
  - Deadlines
  - Forums
    - Turn on your notifications for new announcements and posts on all forum topics!

Office Hours

- Instructor
  - Every Tuesday from 1:15pm to 2:45pm on zoom
    - See Moodle for details
- TA
  - Xiaojian Wang
  - Hours TBD

Grading

- Two Programming Assignments: 20% each
- Three Exams: 20% each
  - To prepare, do end of chapter exercises
  - Conducted through Moodle
  - Exam dates (no classes on exam dates):
    - October 5, 2023
    - November 9, 2023
    - December 7, 2023

No Class

- October 3, 2023

Groups

- Programming Assignments will be done in groups of 4 students
- Propose your groups
  - Email the TA with group member names by September 5th
  - *Only* one student in the group should email the TA and keep the other group members in CC
  - You can use Moodle forums to find partners
- If you are having trouble finding a group, tell the TA by September 5th
  - If the TA does not receive your request and you are not part of any submitted groups, this implies you do not wish to do the programming assignments, and will not receive a grade for them
- The groups you make are only *suggestions*
  - The Instructor and the TA will discuss and make the final groups

Introduction: roadmap

1.1 what *is* the Internet?

1.2 network edge

- end systems, access networks, links

1.3 network core

- packet switching, circuit switching, network structure

1.4 delay, loss, throughput in networks

1.5 protocol layers, service models

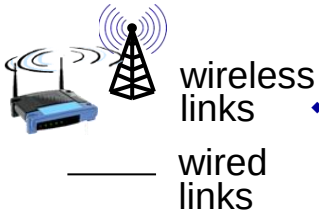
What is Internet?

What is it made of?

What services does it provide?

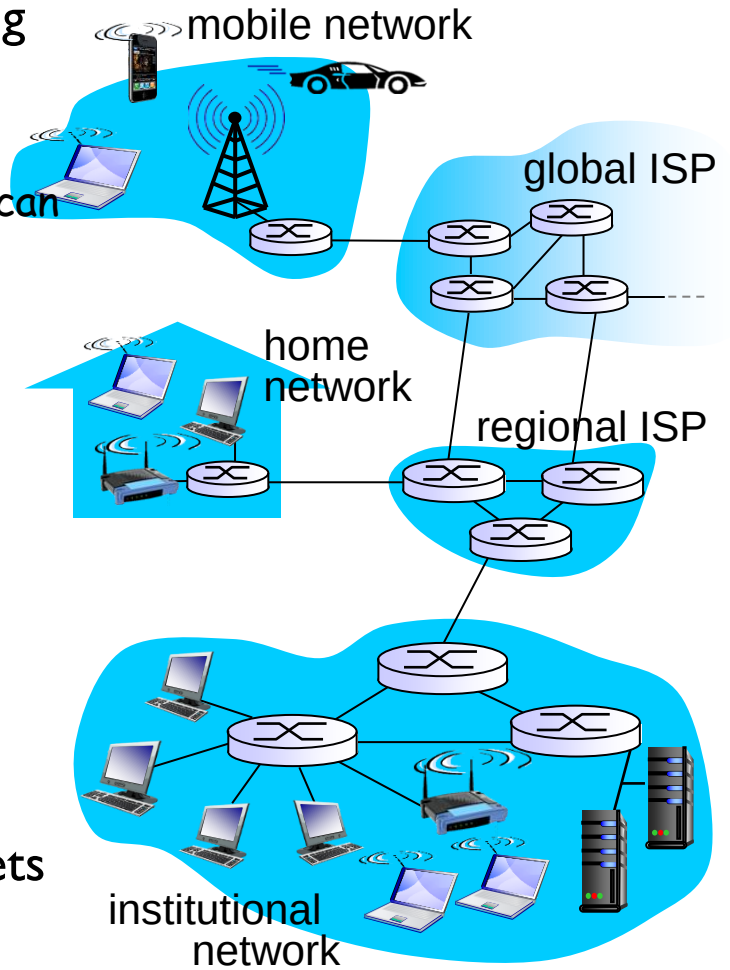
What is the Internet: "nuts and bolts" view

- millions of connected computing devices:
  - *hosts* = *end systems*
    - What other end systems can you think of?
  - running *network apps*
    - What are Internet apps?



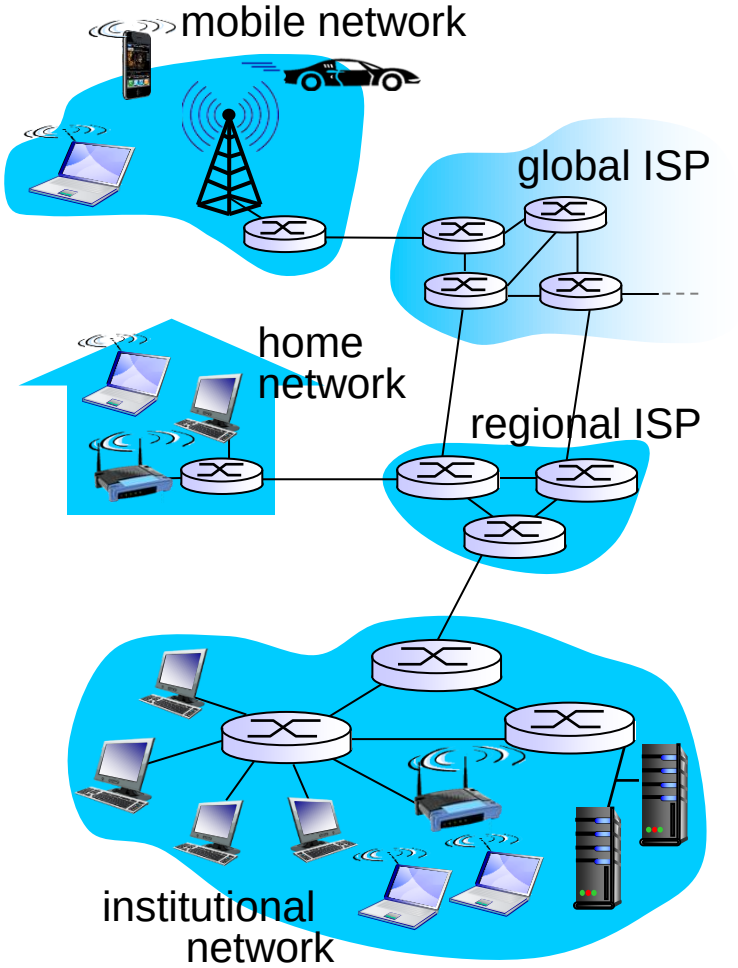
- *communication links*
  - fiber, copper, radio, satellite
  - transmission rate: *bandwidth*

- *Packet switches:* forward packets (chunks of data)
  - *routers* and *switches*



What is the Internet: "nuts and bolts" view

- *Internet:* "network of networks"
  - Interconnected ISPs
- *protocols* control sending, receiving of msgs
  - e.g., TCP, IP, HTTP, Skype, 802.11
- *Internet standards*
  - RFC: Request for comments
  - IETF: Internet Engineering Task Force



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

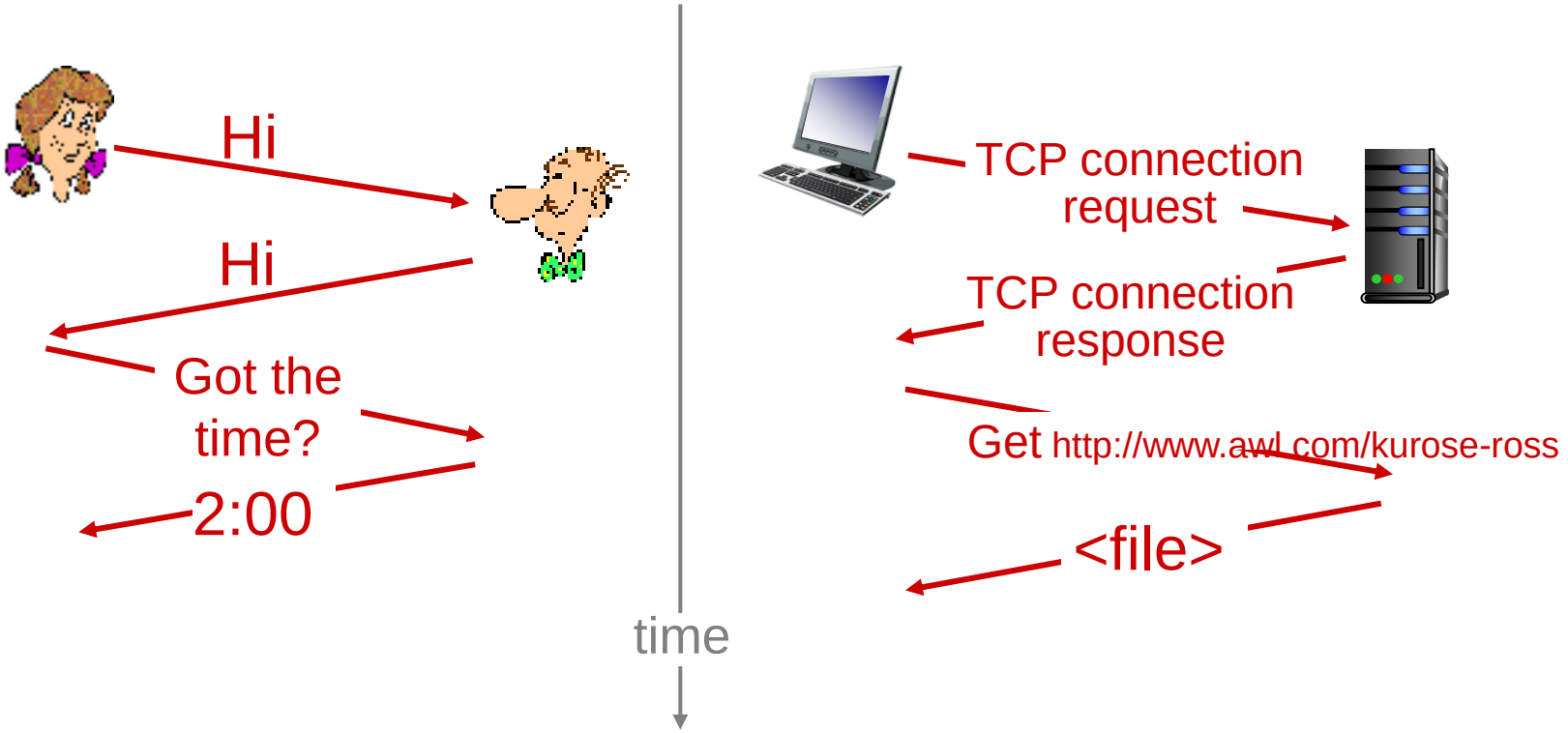
network protocols:

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

protocols define format and 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:



What's the Internet: a service view

- *Smartphone provides services through APIs to develop Apps*
  - Name a real world setup that provides some enabling services?
    - What do you have to do to use this service?
- *Internet is the infrastructure that provides services to applications:*
  - Web, VoIP, email, games, e-commerce, social nets, …
- *provides programming interface to apps*
  - hooks that allow sending and receiving app programs to "connect" to Internet
  - provides service options, analogous to postal service
  - reliable data delivery from source to destination
  - "best effort" (unreliable) data delivery

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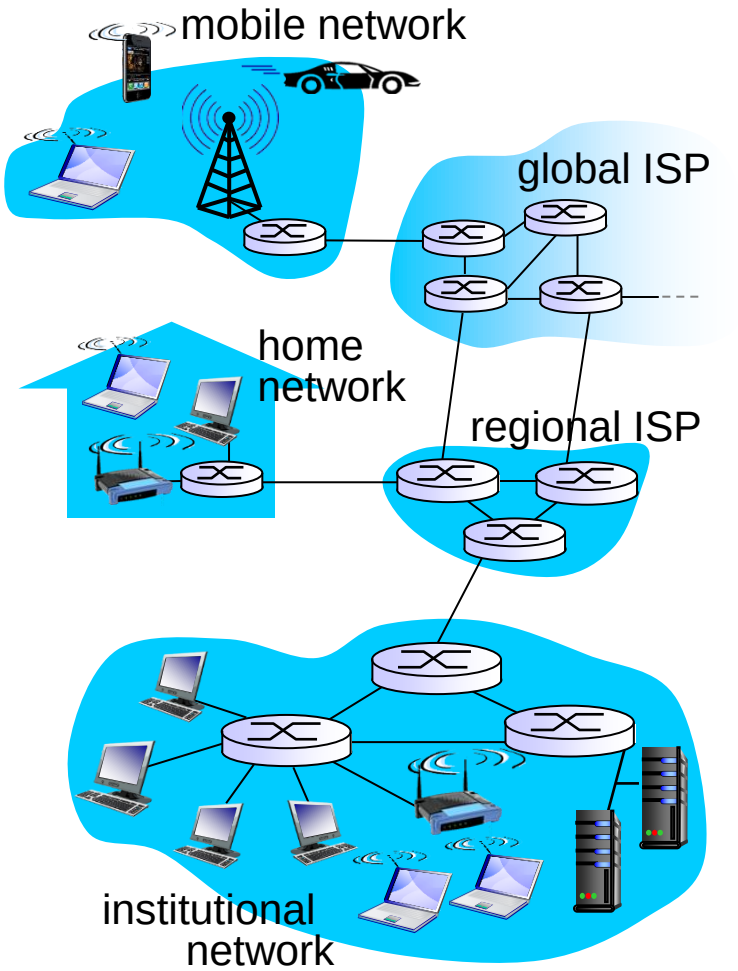
A closer look at network structure:

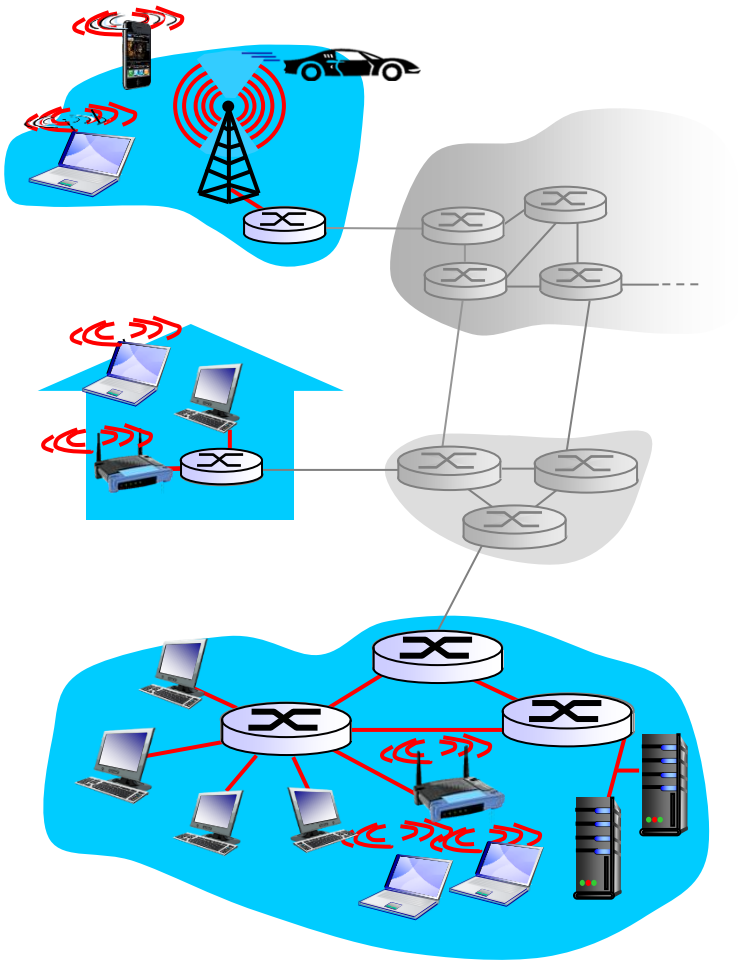
- *network edge:*
  - hosts: clients and servers
  - servers often in data centers
- *access networks, physical media:* wired, wireless communication links
- *network core:*
  - interconnected routers
  - network of networks



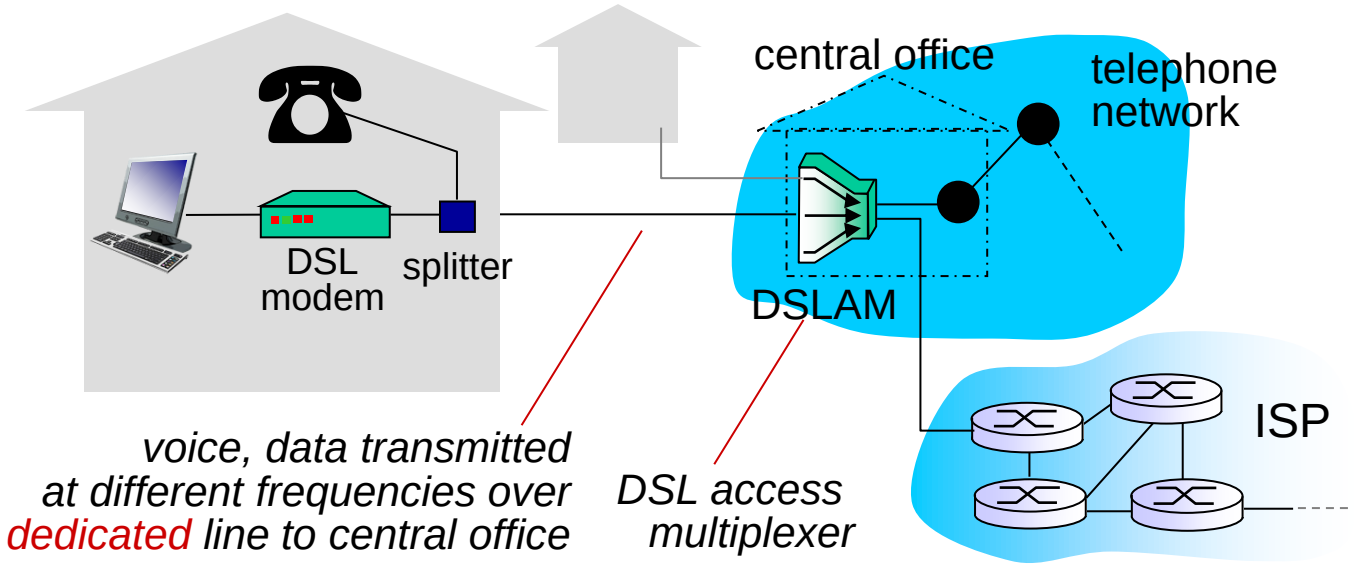
Access networks and physical media

How to connect end systems to edge router?

- residential access nets
- institutional access networks (school, company)
- mobile access networks

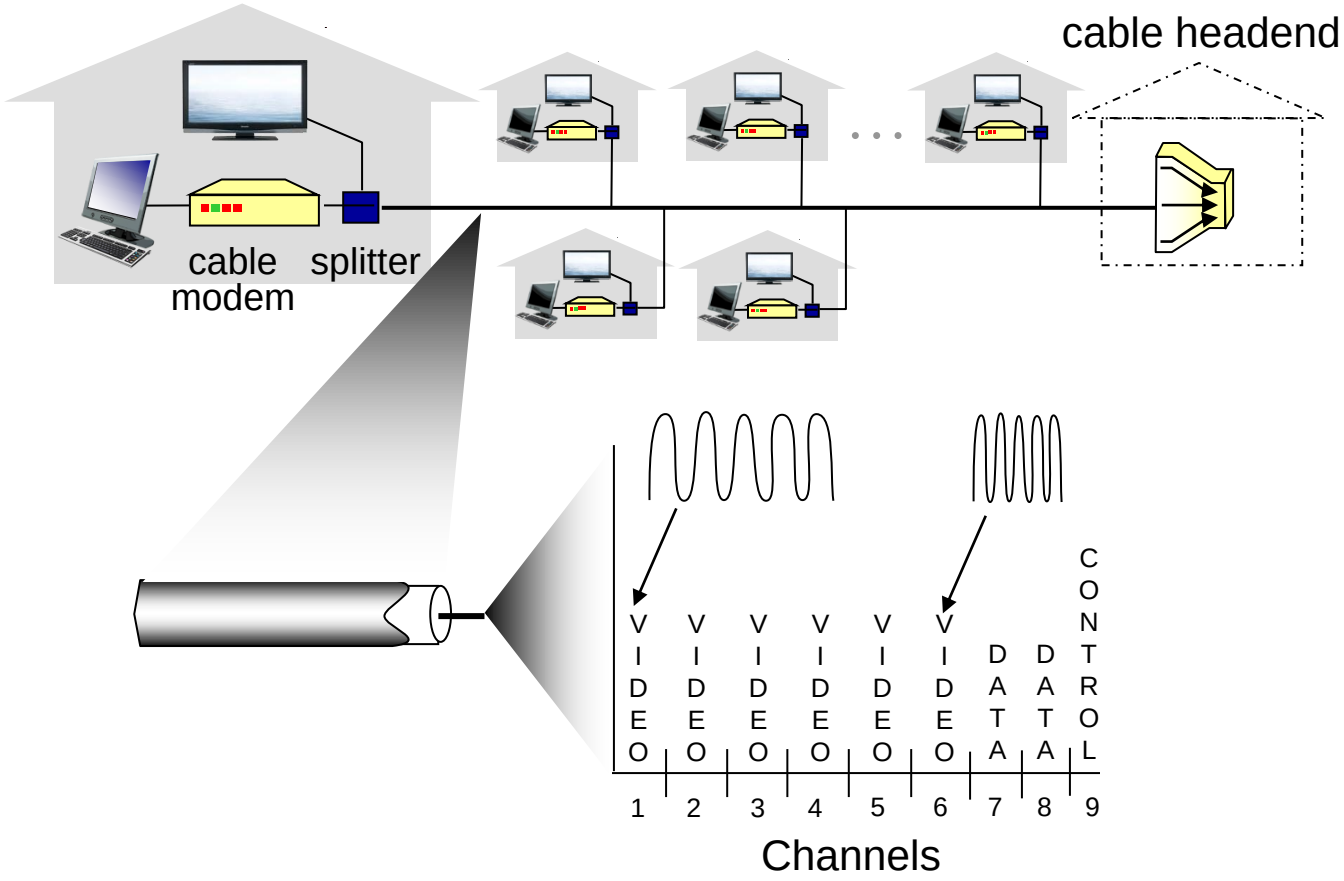


Access net: digital subscriber line (DSL)



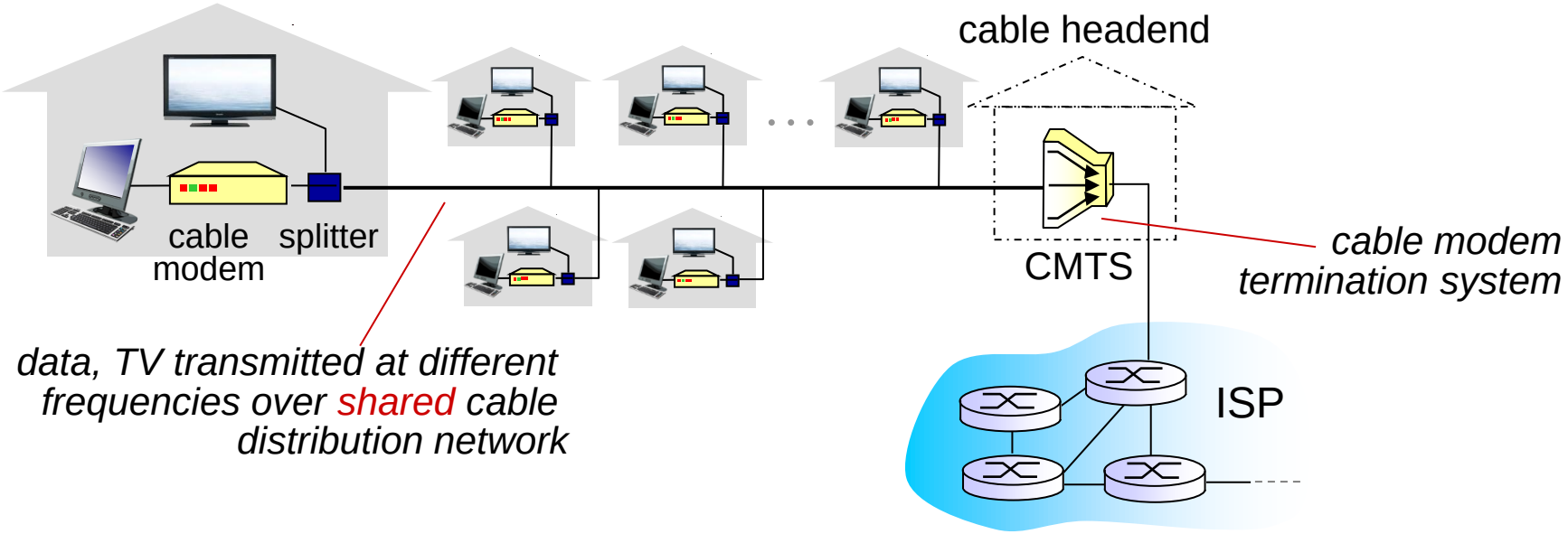
- use *existing* telephone line to central office DSLAM
  - data over DSL phone line goes to Internet
  - voice over DSL phone line goes to telephone net
- < 2.5 Mbps upstream transmission rate (typically < 1 Mbps)
- < 24 Mbps downstream transmission rate (typically < 10 Mbps)

Access net: cable network



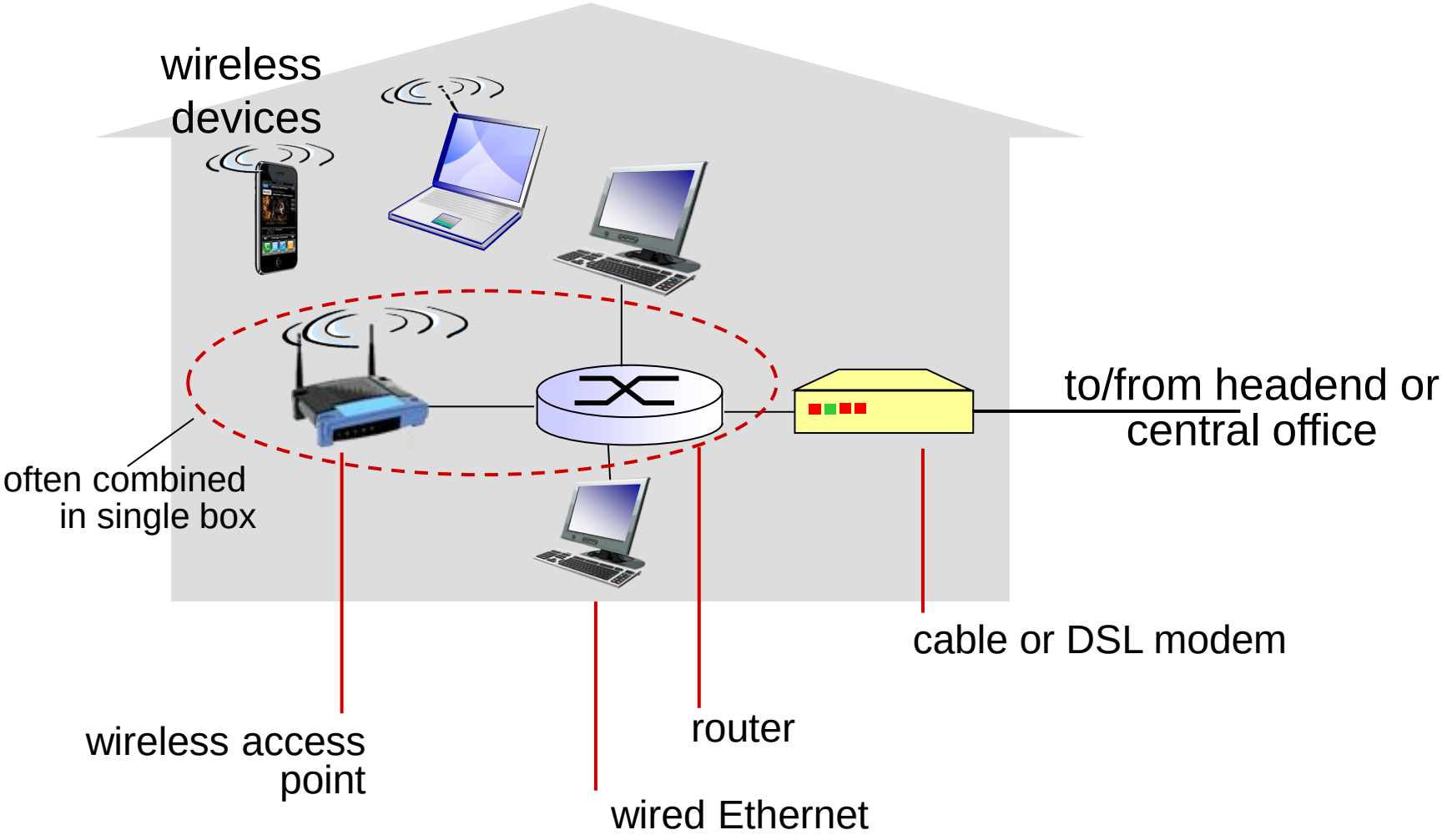
frequency division multiplexing: different channels transmitted in different frequency bands

Access net: cable network

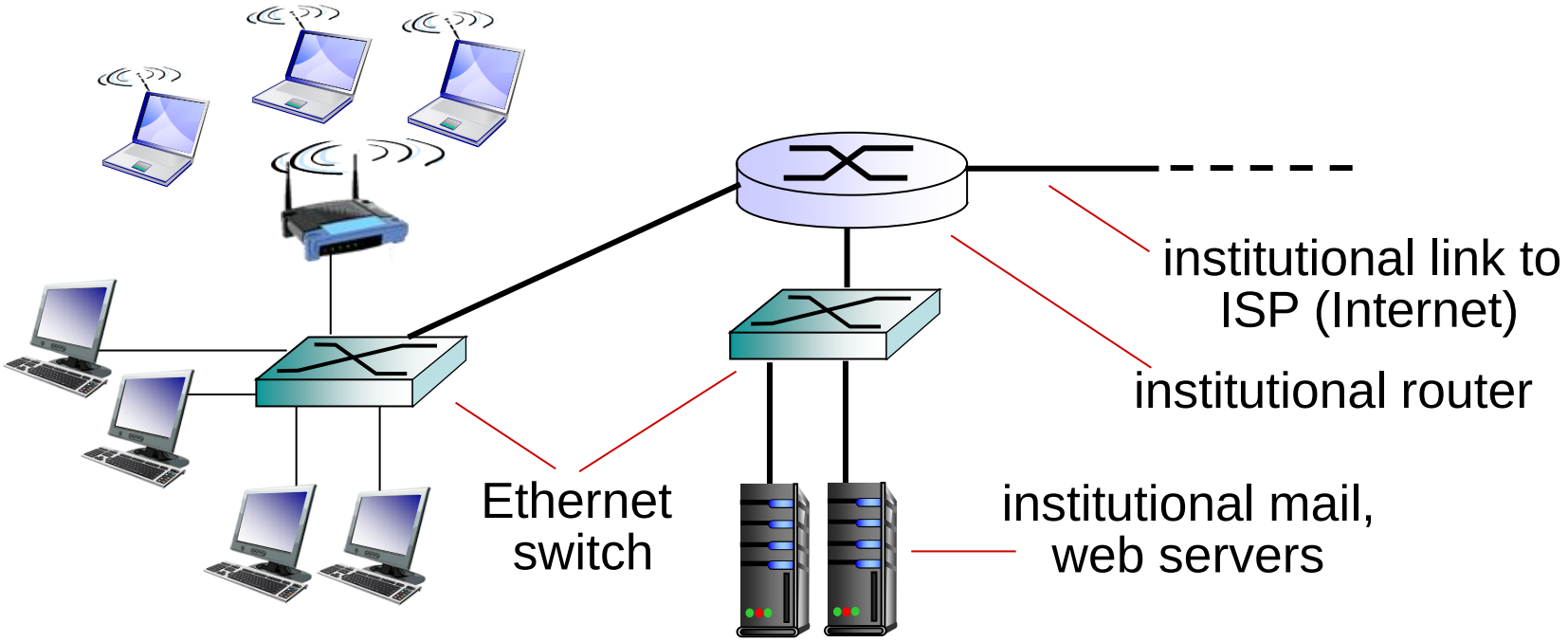


- HFC: hybrid fiber coax
  - asymmetric: up to 30Mbps downstream transmission rate, 2 Mbps upstream transmission rate
- network of cable, fiber attaches homes to ISP router
  - homes *share access network* to cable headend
  - unlike DSL, which has dedicated access to central office

Access net: home network



Enterprise access networks (Ethernet)



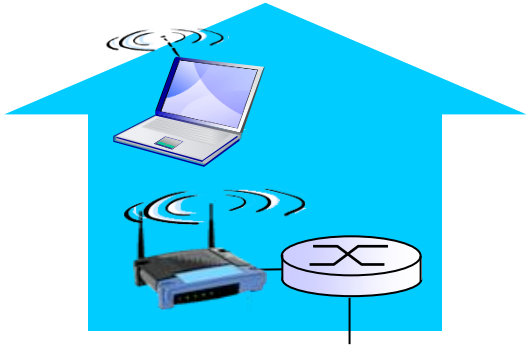
- typically used in companies, universities, etc
- 10 Mbps, 100Mbps, 1Gbps, 10Gbps transmission rates
- today, end systems typically connect into Ethernet switch

Wireless access networks

- shared *wireless* access network connects end system to router
  - via base station aka "access point"

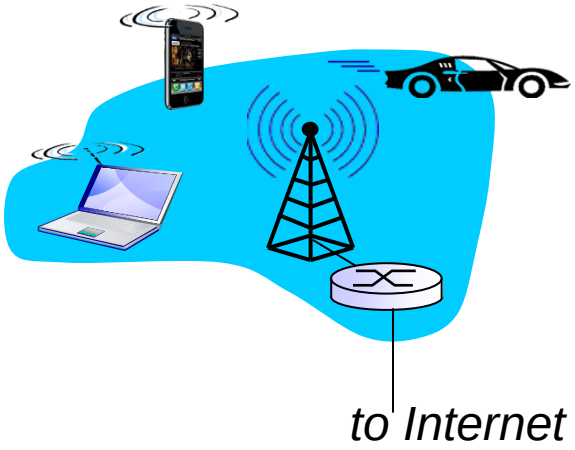
wireless LANs:

- within building (100 ft)
- 802.11b/g (WiFi): 11, 54 Mbps transmission rate



wide-area wireless access

- provided by telco (cellular) operator, several miles
- between 1 and 10 Mbps
- 3G, 4G: LTE



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