Network View

17CS52 - CN: L03

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https://www.youtube.com/watch?v=lqSKidHy1qk
https://www.youtube.com/watch?v=Bxsv_LEXEkE

What's a protocol?

- Protocol at a high level
  - Sender sends a specific msgs
  - When msgs received by receiver,
    - Takes some action, and
    - Sends response (if expected)
  - Different action taken on other events
  - Repeat the above steps till task is accomplished.

Internet: Access Network

- millions of connected computing devices:
  - *hosts* = *end systems*
  - running *network apps*

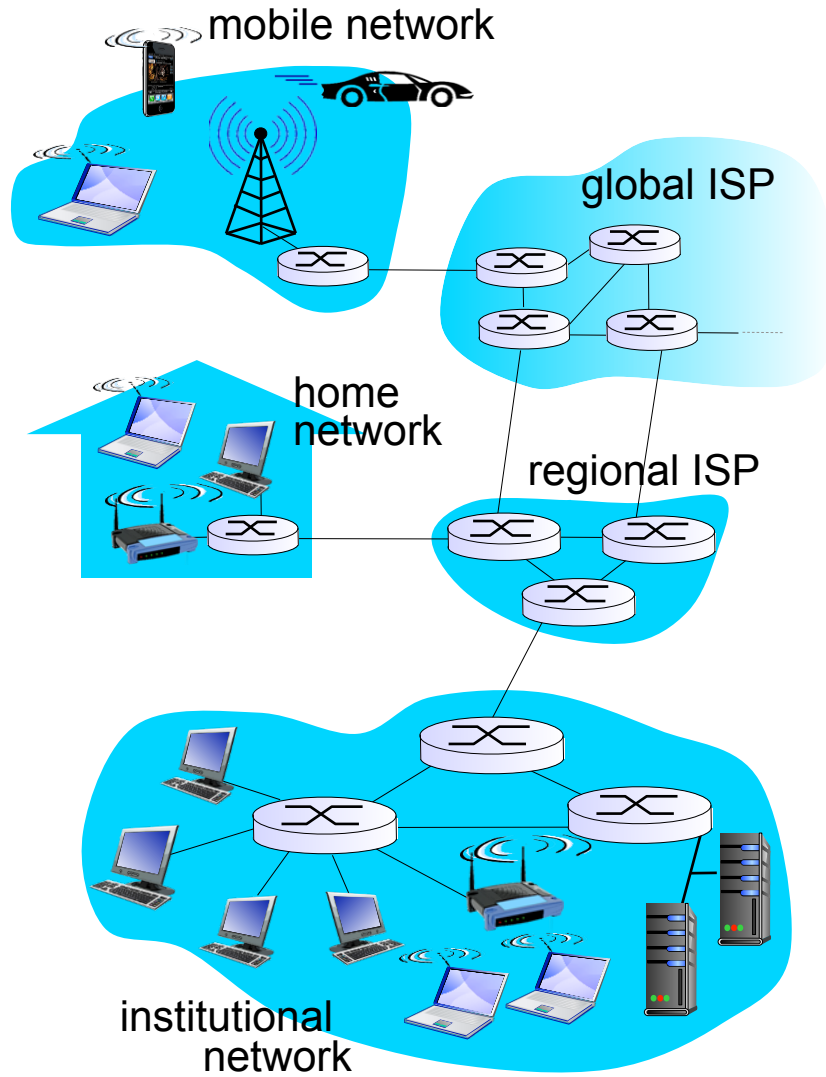
wireless links

wired links

- *communication links*
- Fiber, copper
- Radio, satellite
- Wireless
- Transmission rate: *bandwidth*

router

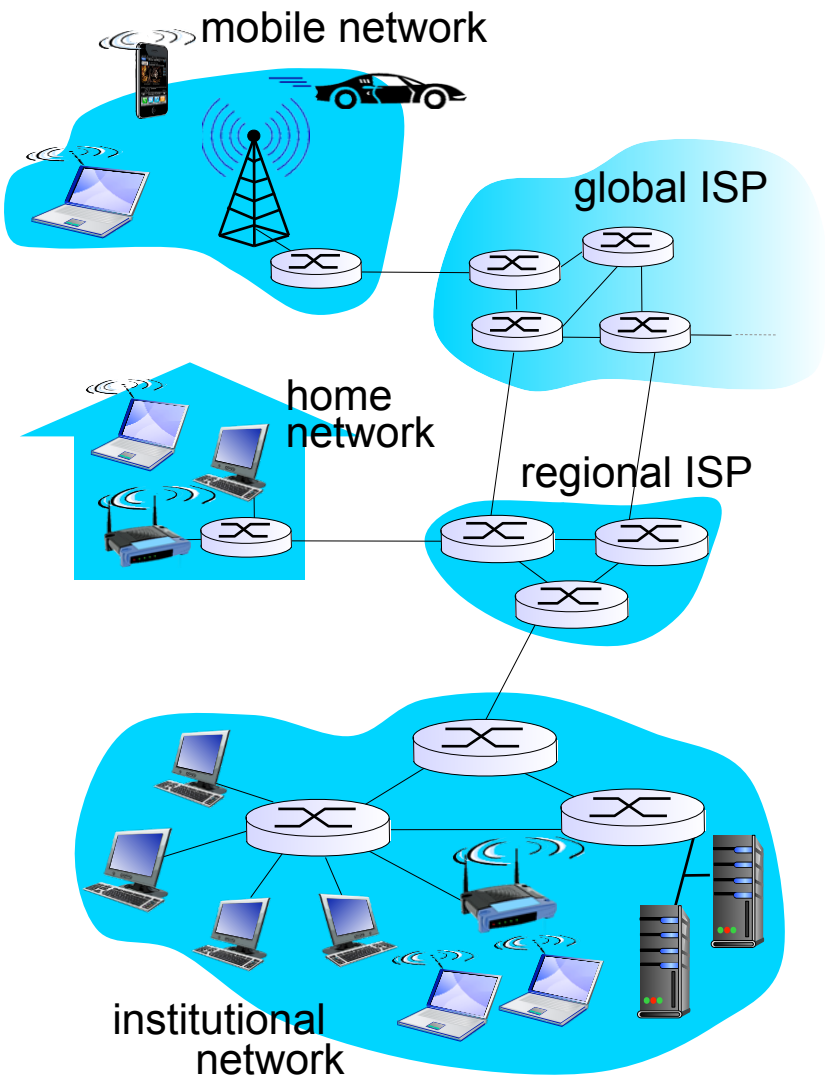
- *Packet switches:* forward packets (chunks of data)
- *routers* and *switches*



src: Computer Network: A top down approach; Kurose, Ross

What's the Internet: a service view

- *Infrastructure that provides services to applications:*
  - Web, email, e-commerce
  - Games, social nets, Music/Video streaming, messaging apps
  - Traffic, location based info…
  - Apps run on end systems
    - Not on packet switches
- New distributed appln
  - Developed in some prog lang
  - Runs on multiple hosts
  - Need to exchange data
    - Provide API



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Services view

- *Provides programming interface to apps*
  - hooks that allow sending and receiving app programs to "connect" to Internet
  - provides service options, analogous to postal service
- API
  - Set of rules that sender must follow
- Example: Postal service API
  - Put address with Pincode
  - Drop the letter in letterbox
  - Other services than letter delivery
    - Receipt confirmation, express delivery, money xfer

src: Computer Network: A top down approach; Kurose, Ross

Protocol view

- Network Protocols
  - Machines rather than humans
  - All communication activity governed by protocols
  - Example: accessing a web server (HTTP protocol)

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

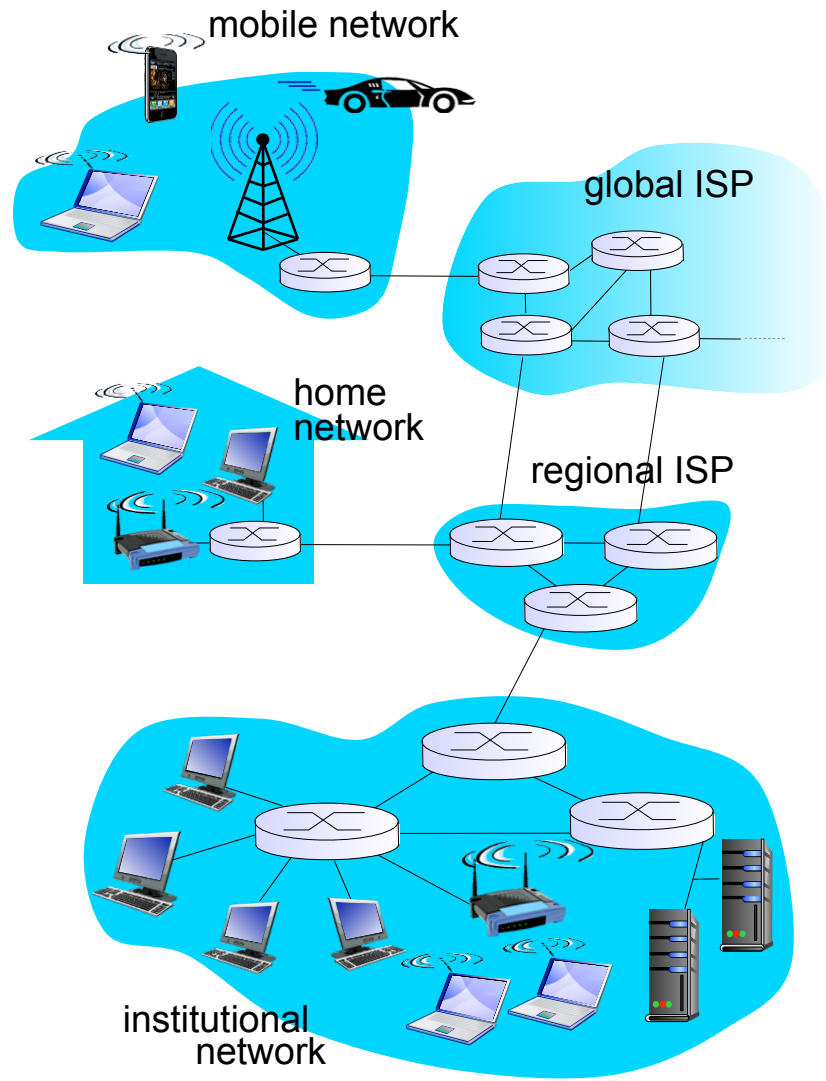
src: Computer Network: A top down approach; Kurose, Ross

Case Study

- A: Consider your college where you study and describe it from following 2 views:
  - Protocols View
  - Services View
- B: Consider the hostel where you stay and describe it from the view of
  - Protocols
  - Services

A closer look at network structure:

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



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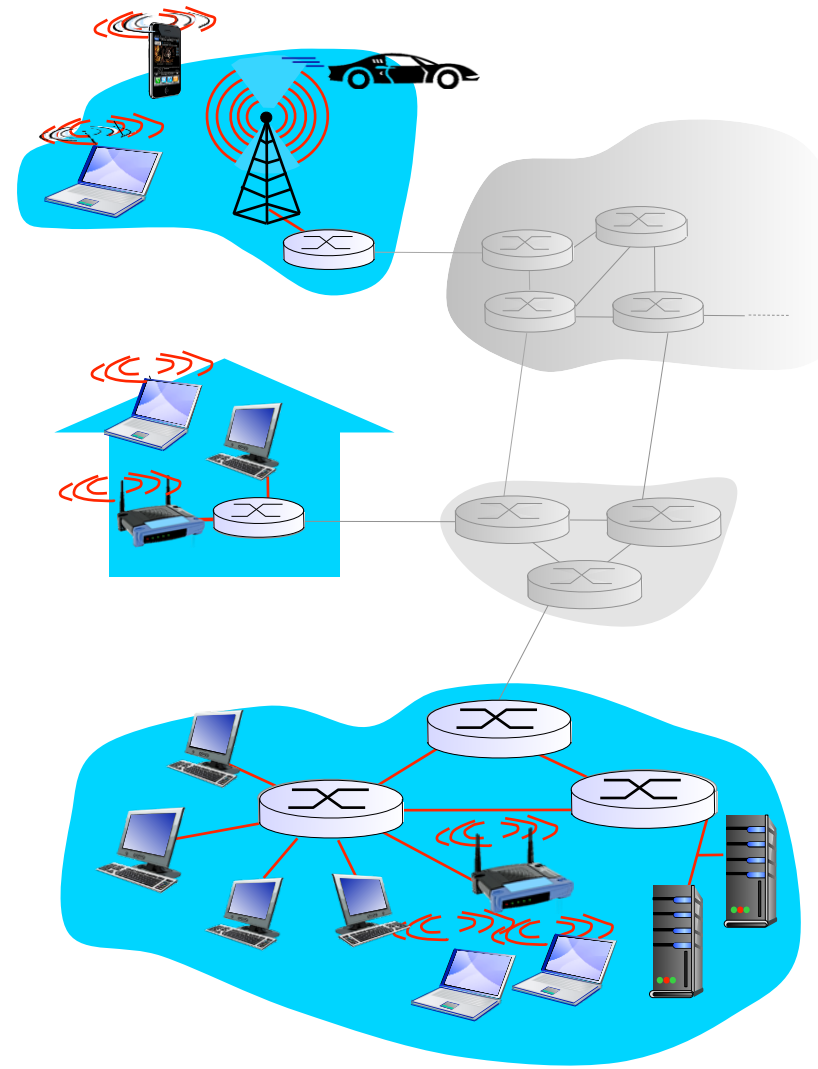
Network Edge devices

- Traditional end systems
  - PCs, desktops, laptops, servers etc.
- New age devices
  - Google glass
  - Game consoles (XBox, Kinect)
  - Internet TV
  - Digital picture frame
  - Network sensors - bridges, buildings, forests
    - Seismic activities, Wildlife habitats
  - Personal biometric devices
    - Body area networks
  - Wearable devices (smart watches, health bands…)
    - Called "Internet of Things"

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
- *Keep in mind:*
  - Bandwidth (bits per second) of access network?
  - Shared or dedicated?



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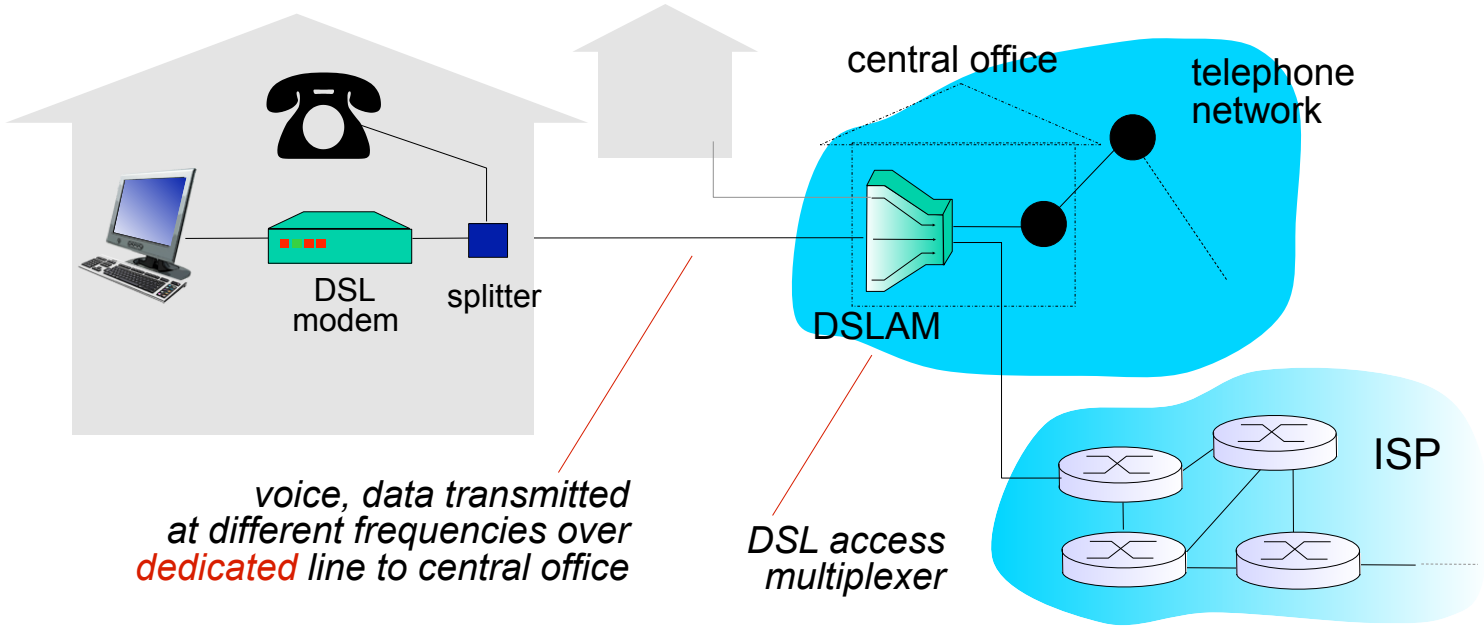
High Speed Home Access

- Access technologies
  - Dial-up (practically extinct)
  - DSL
  - Cable (not seen in India)
  - Satellite (only for remote places)
  - FTTH (BharatNet, rural connectivity)
  - 3G/4G /(5G - in the pipeline)
- Broadband access
  - Legal rights in Spain, Finland
  - BW definition varies from country to country
    - India defines it at 256Kbps??

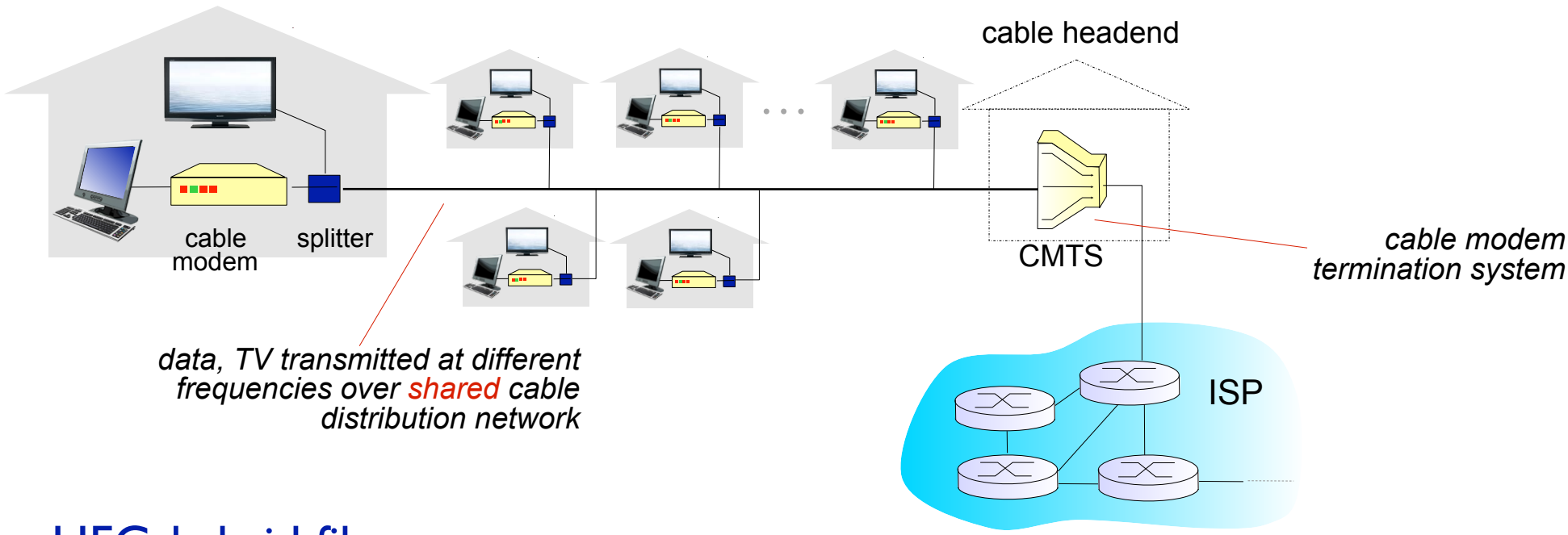
Access net: digital subscriber line (DSL)



- Use *existing* telephone line to central office DSLAM
- Data over DSL phone line goes to Internet
- Voice (0-4KHz) over DSL phone line goes to telephone net
  - < 15 Mbps upstream transmission rate (4-50KHz)
  - < 55 Mbps downstream transmission rate (50KHz-1MHz)

src: Computer Network: A top down approach; Kurose, Ross

Access net: cable network



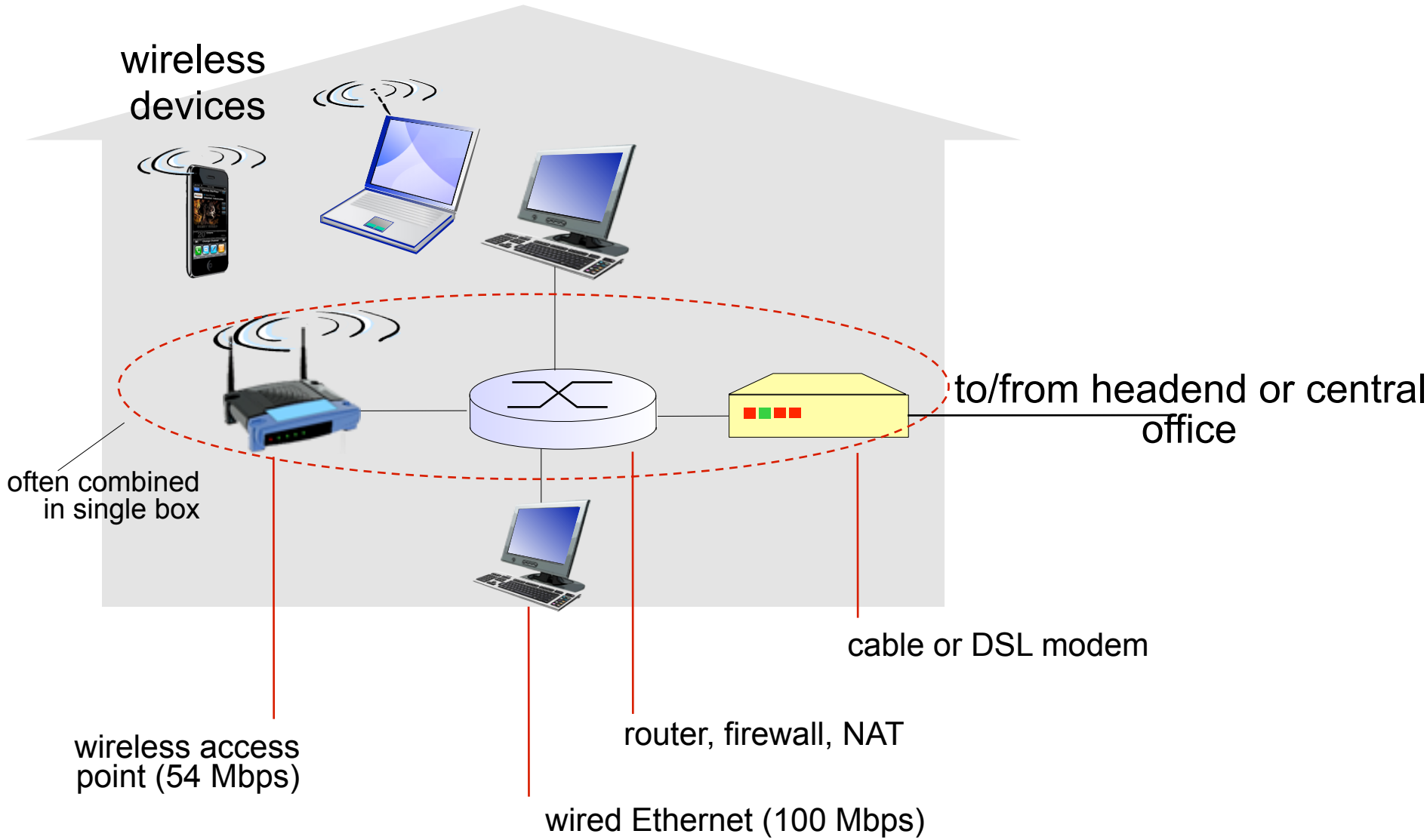
- HFC: hybrid fiber coax
  - asymmetric access
  - DOCSIS 2.0
    - upstream : 42.8Mbps, Downstream: 30.7Mbps
- network of cable, fiber attaches homes to ISP router
- homes *share access network* to cable headend
- unlike DSL, which has dedicated access to central office

src: Computer Network: A top down approach; Kurose, Ross

FTTH

- Fibre To The Home
  - India also has fibre laid up in cities/villages
  - Can provide Gbps connectivity
- Types of connectivity
  - Active Optical Networks (AON)
    - Like switched ethernet
  - Passive Optical Network
    - Like ethernet hub

Access net: home network



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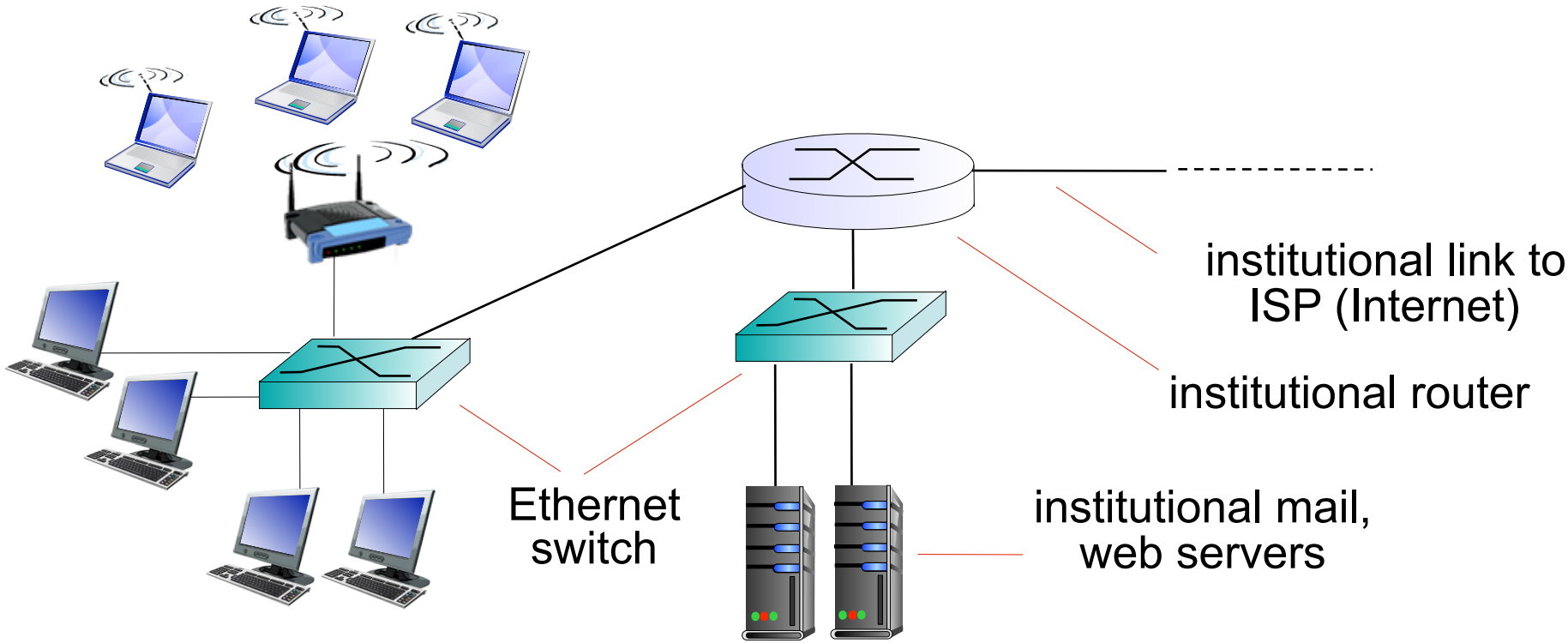
Enterprise access networks (Ethernet)



- Typically used in companies, universities, etc
  - 10 Mbps, 100Mbps, 1Gbps, 10Gbps transmit rates
  - End systems typically connect into Ethernet switch

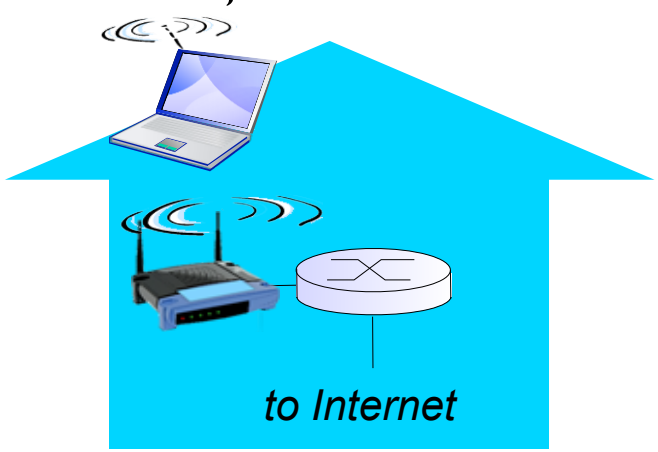
src: Computer Network: A top down approach; Kurose, Ross

Wireless access networks

- Shared *wireless* access n/w, connects end system to router
  - via base station aka "access point"

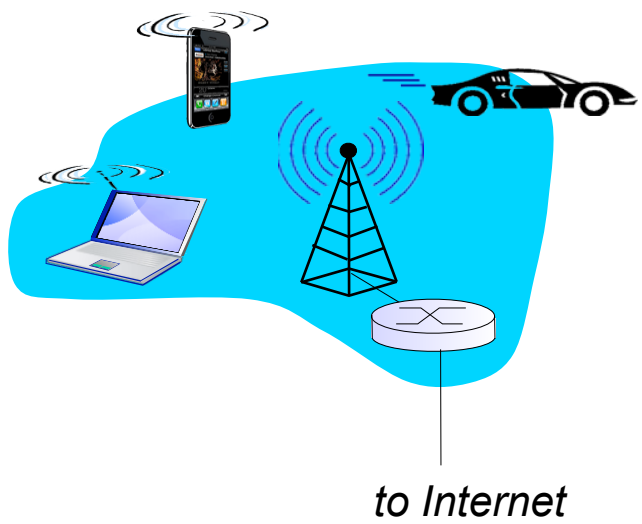
wireless LANs:

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



wide-area wireless access

- provided by telco (cellular) operator, 10's km
- between 1 and 10 Mbps
- 3G, 4G: LTE



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Physical Media

- Life of a bit
  - Transmitted many many times from src to dsn
  - Transmitted as EM waves or optical pulse
    - across a physical medium
- Physical medium are of many shapes, sizes
  - Twisted pair copper wire
  - Coax cable
  - (Multi mode) Fibre optic cable
  - Terrestrial radio
  - Satellite radio

Physical Media…

- Categories
  - Guided media
  - Unguided media
- Media cost
  - Perceived to be high
  - Comparatively lower than other n/w costs
    - e.g. Labour
  - Ethernet, Coax is laid during bldg construction

Physical Media…

- Twisted pair copper wire
  - Typically, a number of pairs are bundled
  - DSL and LAN
- UTP (Unshielded Twisted Pair)
  - LAN cable
  - 4 pairs: either 2 or 4 are used
  - Speed ranges from 10Mbps to 10Gbps
- Fibre Optic Cable
  - Conducts pulses of light (1 pulse - 1bit)
  - Immune to EM interference
  - Tapping is tough, stealing is useless
  - High cost of optical devices
    - Transmitters, receivers, switches

Summary

- What is internet
- Services View
- Protocols View
- Network edge
  - End systems
- Access links
- Home and Office Networking
- Physical Media
- Case studies