Organisatorisches (1)

- **Abteilung „Echtzeitsysteme und Kommunikation“**
  - http://ivs.cs.uni-magdeburg.de/EuK
  - nett@ivs.cs.uni-magdeburg.de
  - Sekretariat Frau Duckstein, 29/405, Tel. 67-18345
- **Web-Adresse**

  http://ivs.cs.uni-magdeburg.de/EuK/lehre/lehrveranstaltungen/ss09/KuN.shtml
  - Folien der Vorlesung (in englisch)
  - praktische Übungsaufgaben
  - Mitteilungen (z.B. Bekanntgabe der Übungsgruppeneinteilung)
  - Literaturhinweise
- **Übungen** (anmelden unter obiger Web-Adresse)
  - Übungsleiter: Herr Lindhorst (E-mail: lindhors@ivs.cs.uni-magdeburg.de)
  - Wöchentlich ab 15. KW (7. April)

Organisatorisches (2)

- **Inhalte der Übungen:**

  Praktische Umsetzung der in der Vorlesung vorgestellten Konzepte und Protokolle

  Programmieren von TCP-Sockets. Während des Semesters wird in der Übung ein Webserver programmiert, der weiterhin einen Chat-Service anbietet. Dazu werden in regelmäßigen Abständen Teilaufgaben zu bearbeiten sein. Die Programmierung erfolgt unter Linux in C. Grundlegende C-Kenntnisse werden vorausgesetzt, bzw. die Bereitschaft, sich solche anzueignen.

  Die Übungen finden in unserem Labor statt (Raum 425).
  - Anmeldung für Übungsgruppe
  - Anmeldung für Rechner-Account

- **Abschluss der Lehrveranstaltung:**

  –schriftliche Prüfung (Scheinerwerb: Note <= 4.0)

  –Zulassungsvoraussetzungen:
  - Regelmäßiger Besuch der Vorlesung
  - erfolgreiche Umsetzung der praktischen Aufgaben, sowie Vorstellung und Erklärung der Implementierung

Introduction (1)

Computer network:

An *interconnected* collection of *autonomous* computers

Interconnected computers:

Computers are said to be interconnected if they are able to exchange information

Examples for the physical connection medium:

copper wire, fiber optics (wired)

radio communication (micro waves), infrared (wireless)

Autonomous computers:

No computer can forcibly start, stop, or control computations (actions) on another one.

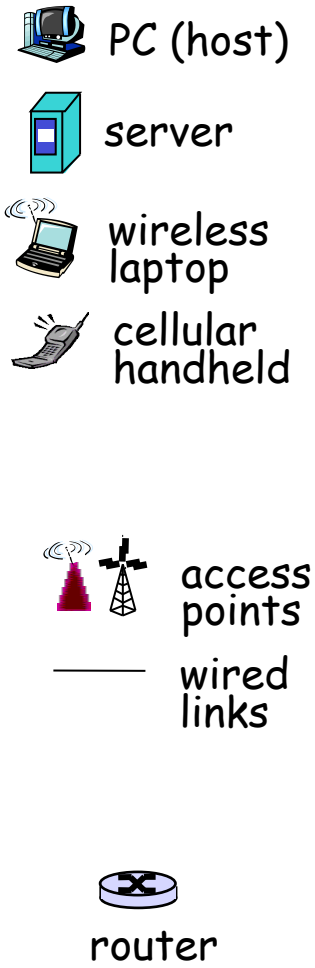
Distributed system:

The existence of multiple autonomous computers is transparent (not visible) to the user,i.e. no explicit path addressing (e.g. URL), no explicit moving of objects (files) etc.

Principle vehicle for discussing computer networks and their protocols:

The Internet

What's the Internet: "component's" view (1)

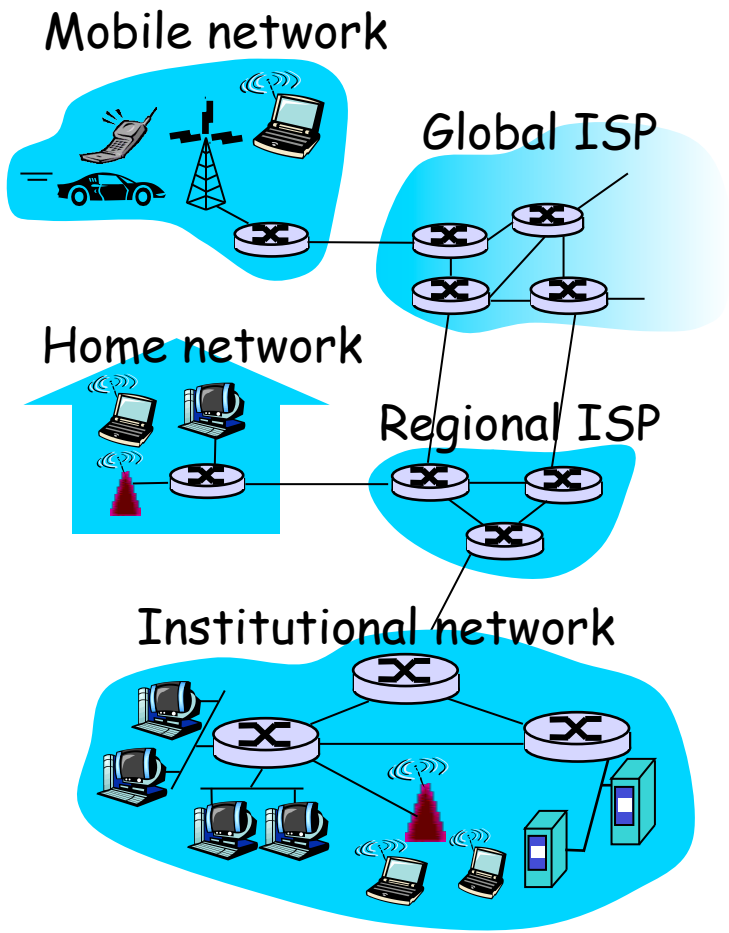


- millions of connected computing devices:

  hosts = end systems running *network applications*

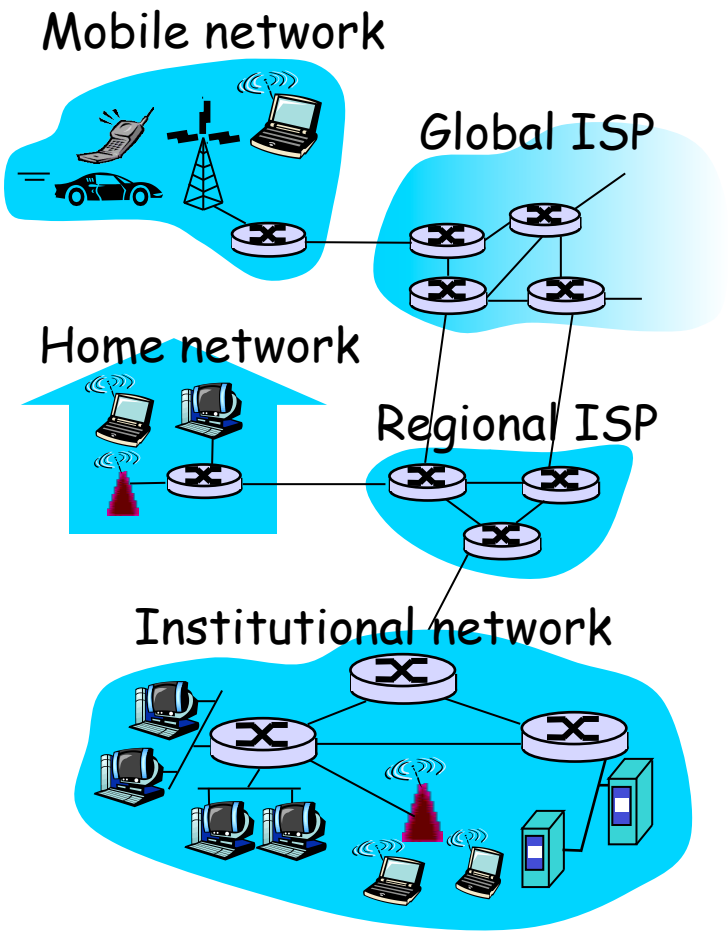
- *communication links*
  - fiber, copper, radio, satellite
  - transmission rate *bandwidth*

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



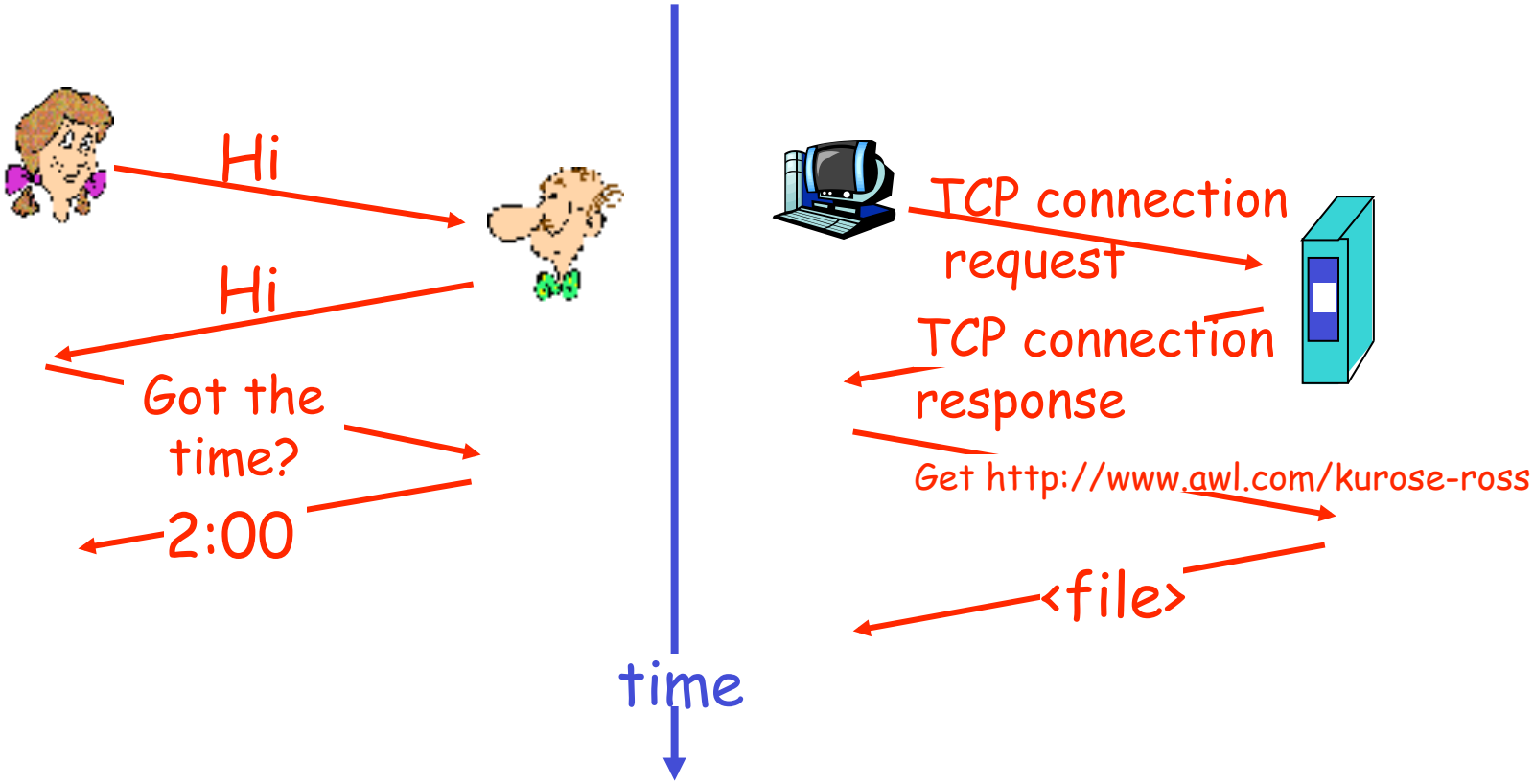
What's the Internet: "component's" view (2)

- *protocols* control sending, receiving of msgs
  - e.g., TCP, IP, HTTP, Ethernet
- *Internet:* "network of networks"
  - loosely hierarchical
  - public Internet versus private intranet
- Internet standards
  - RFC: Request for comments
  - IETF: Internet Engineering Task Force



What's a protocol?

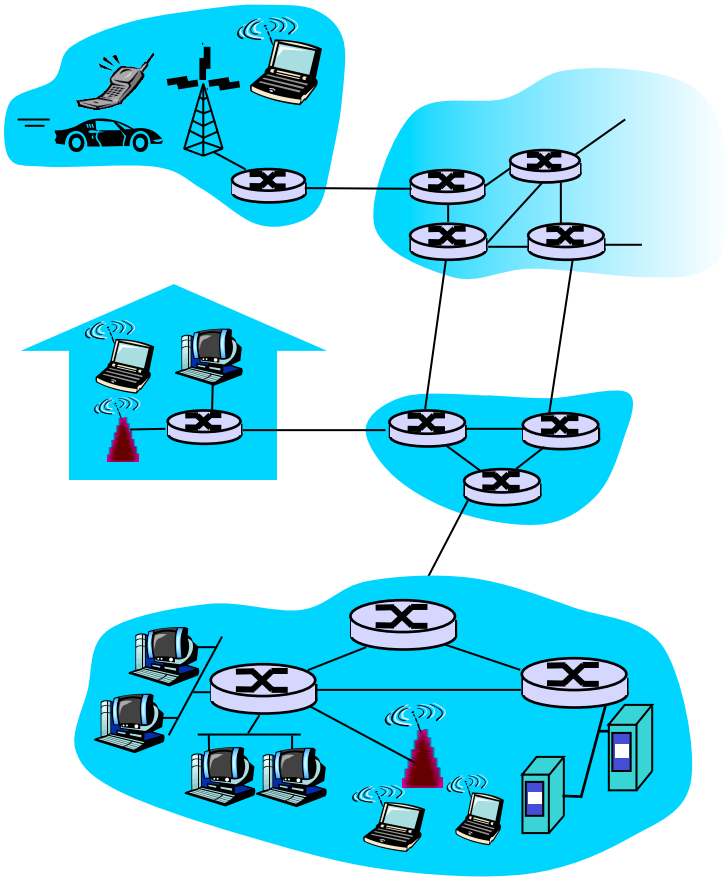
a human protocol and a computer network protocol:



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

What's the Internet: a service view

- communication *infrastructure* enables distributed applications:
  - Web, VoIP, email, games, e-commerce, file sharing, Skype
- communication services provided to apps:
  - reliable data delivery from source to destination
  - "best effort" (unreliable) data delivery



A closer look at network structure

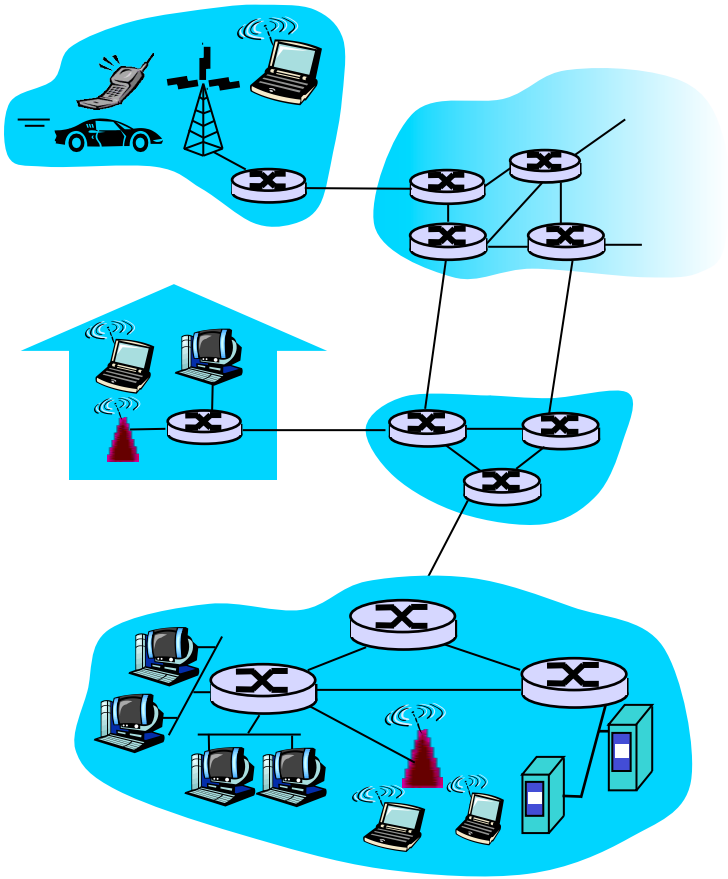
- network edge:

  applications running on hosts

- access networks:

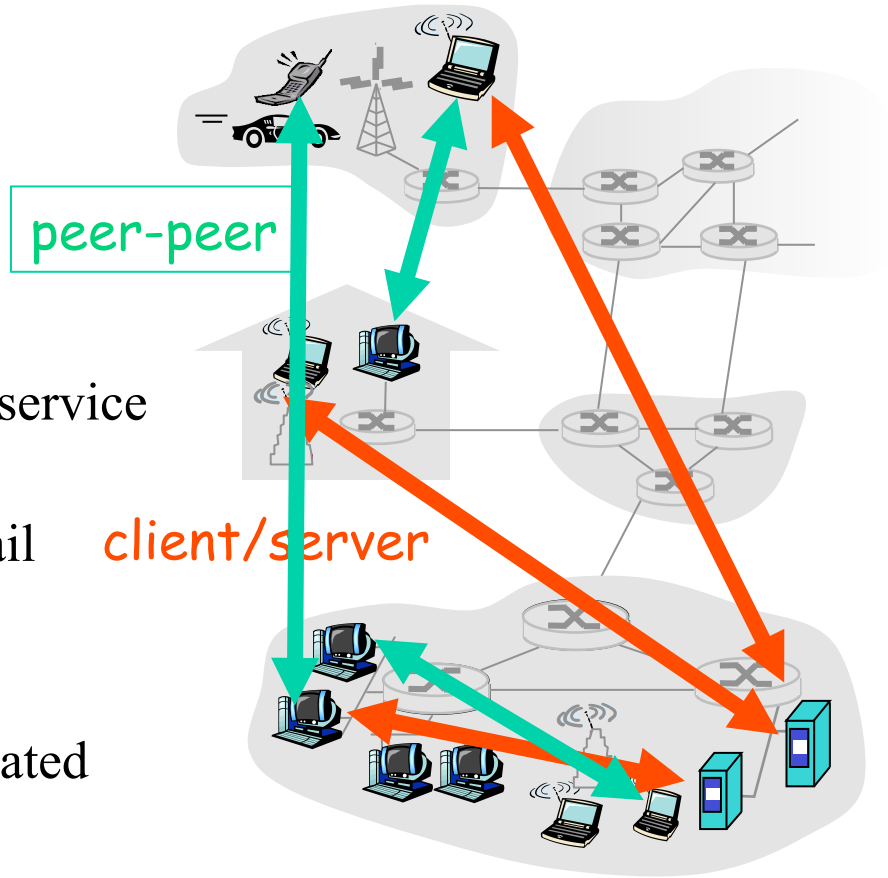
  wired or wireless communication links that connect hosts to their edge router

- network core:
  - interconnected routers
  - network of networks



The network edge

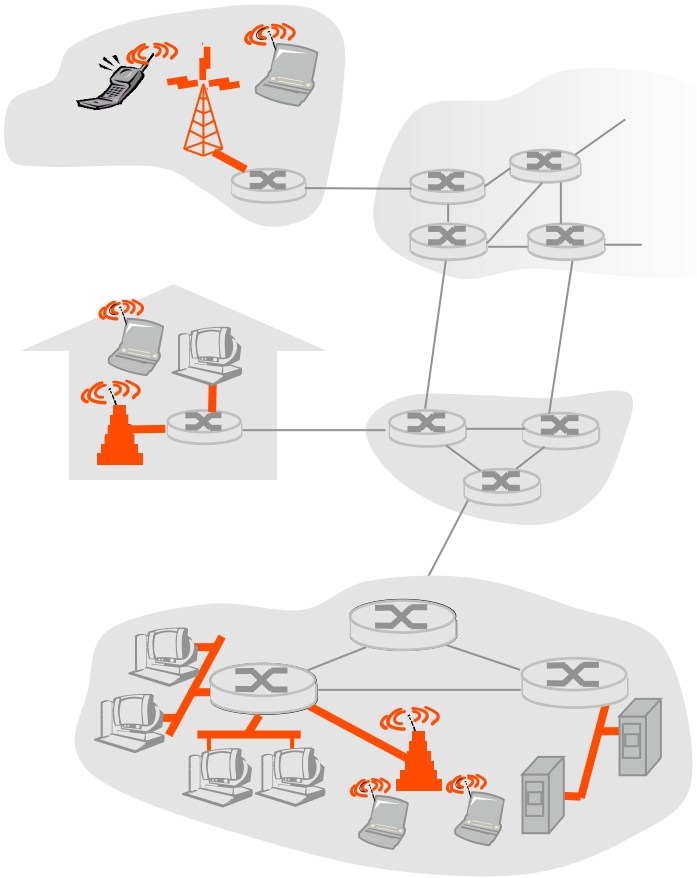
- end systems (hosts):
  - run application programs
  - e.g. Web, email
  - at "edge of network"
- client/server model
  - client host requests, receives service from always-on server
  - e.g. Web browser/server; email client/server
- peer-to-peer model:
  - minimal (or no) use of dedicated servers
  - e.g. VOIP, Skype



Access networks

How to connect end systems to edge router:

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

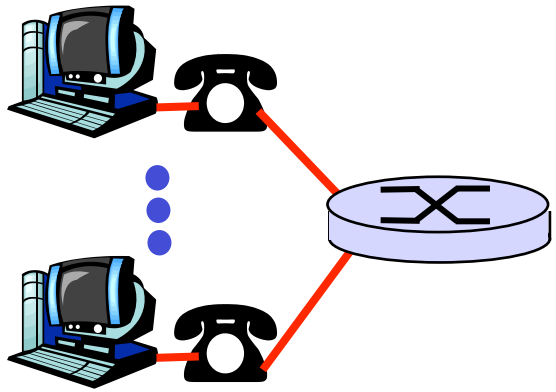


Important parameters:

- bandwidth (bits per second) of access network?
- shared or dedicated?

Residential access: point-to-point access

- Dialup via modem
  - up to 56Kbps direct access to router (often less)
  - Can't surf and phone at same time: can't be "always on"

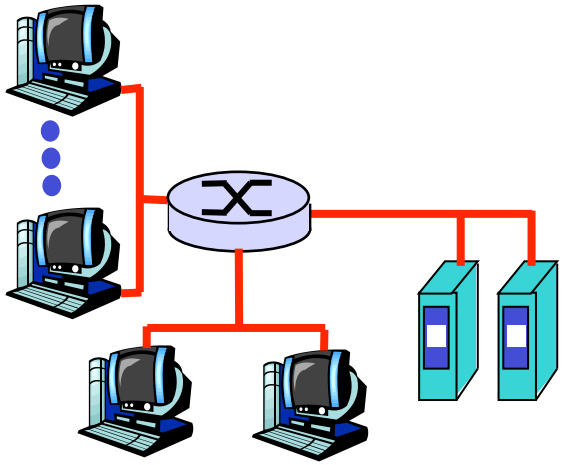


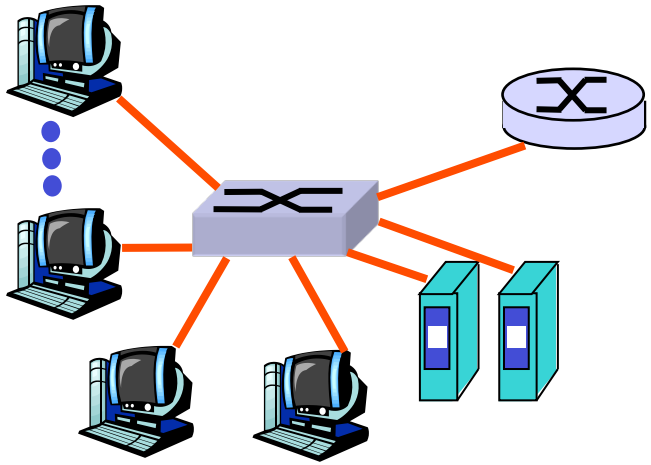
- DSL: digital subscriber line
  - deployment: telephone company or Internet provider
  - DSL divides communication link into 3 separate frequency bands (FDM):
    - up to 1 Mbps upstream (4 kHz bis 50 kHz)
    - up to 8 Mbps downstream (50 kHz bis 1 MHz)
    - normal telephone line (0 to 4 kHz)

Company access: local area networks

- company/univ local area network (LAN) connects end system to edge router

- Ethernet:
  - 10 Mbs, 100Mbps, 1Gbps, 10Gbps Ethernet
  - modern configuration: end systems connect into *Ethernet switch*

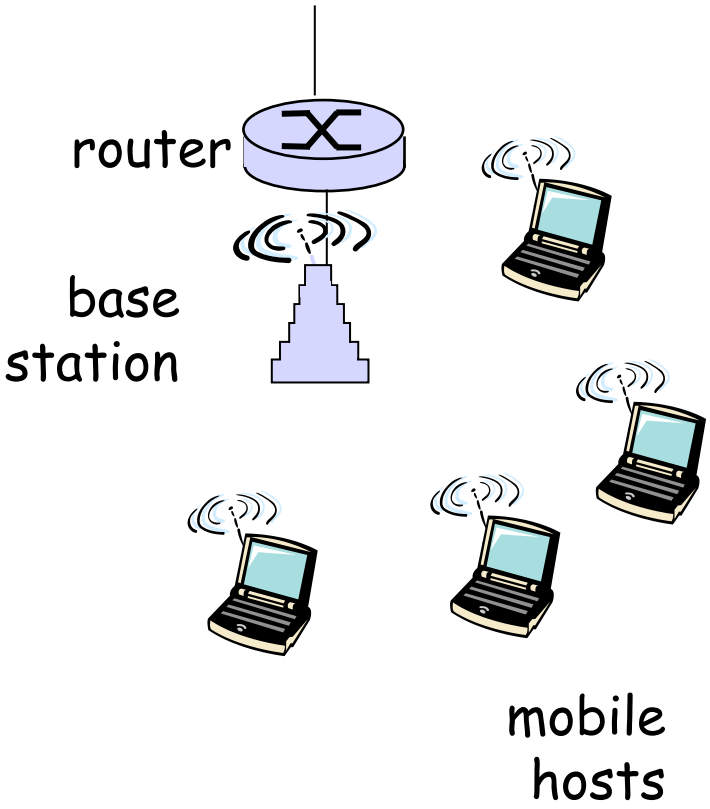




Wireless access networks

- shared *wireless* access network connects end system to router
  - via base station (access point)

- wireless LANs:
  - 802.11b/g : 11 or 54 Mbps



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"