Computer Networks

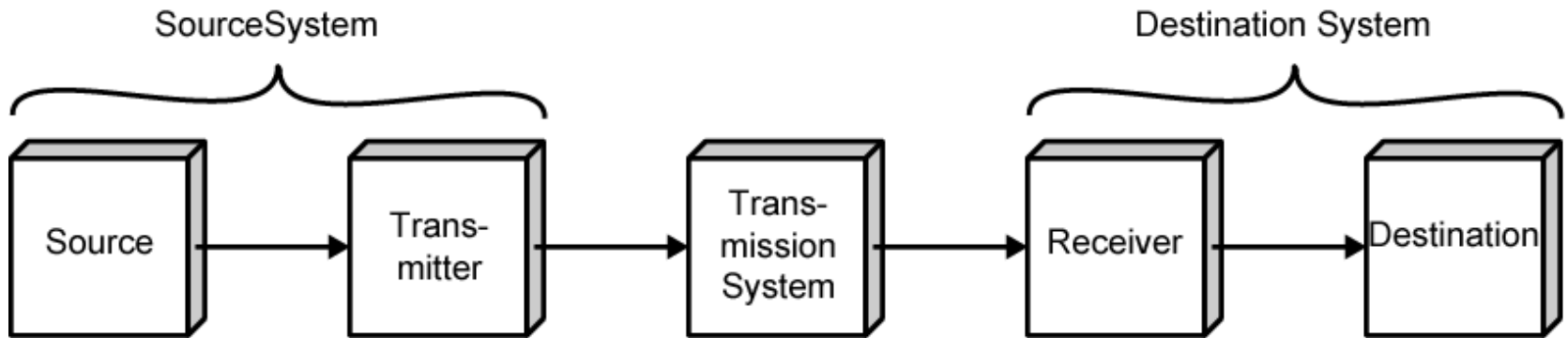# Introduction and Background

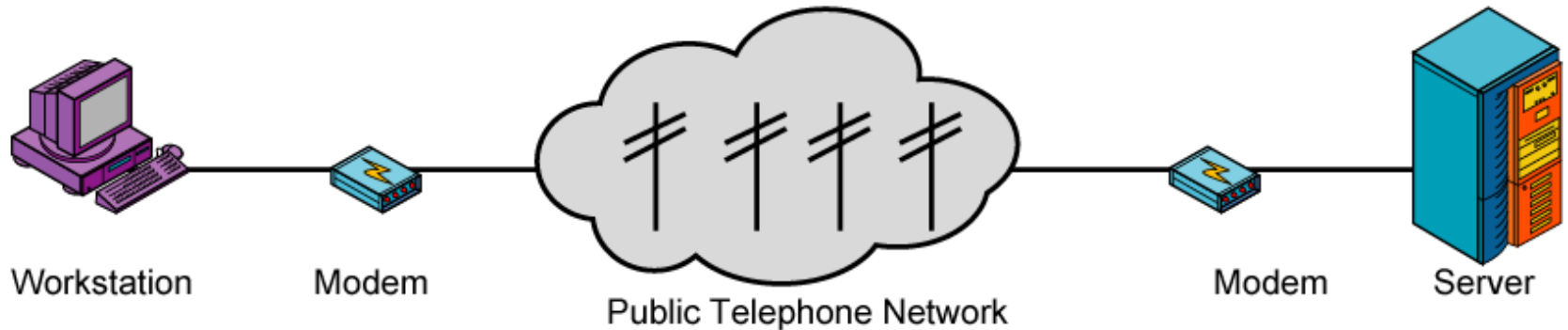Amitangshu Pal

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Data → Communications → Networking

- **Data:** Information being shared, e.g. text, numbers, images, audio, video

- **Communications:** Exchange of data between two or more devices via some transmission medium
    - Transmits signals in a reliable and efficient and efficient manner
    - Focuses on individual links
    - Key objectives: **Delivery**, **Accuracy** and **Timeliness**

- **Networking:** Communications across a set of links
    - Wide Area Networks (WAN)
    - Local Area Networks (LAN)
    - Metropolitan Area Networks (MAN)
    - The Internet

Simplified Communications Model

SourceSystem

Destination System

Source → Trans-mitter → Trans-mission System → Receiver → Destination

(a) General block diagram

Workstation — Modem — Public Telephone Network — Modem — Server

(b) Example

Simplified Communications Model

- ❑ Source: Device that generates data to be transmitted.
- ❑ Transmitter: Converts data from source into transmittable signals.
- ❑ Transmission system: Carries data from source to the destination.
- ❑ Receiver: Converts received signal into data.
- ❑ Destination: Takes and uses incoming data.
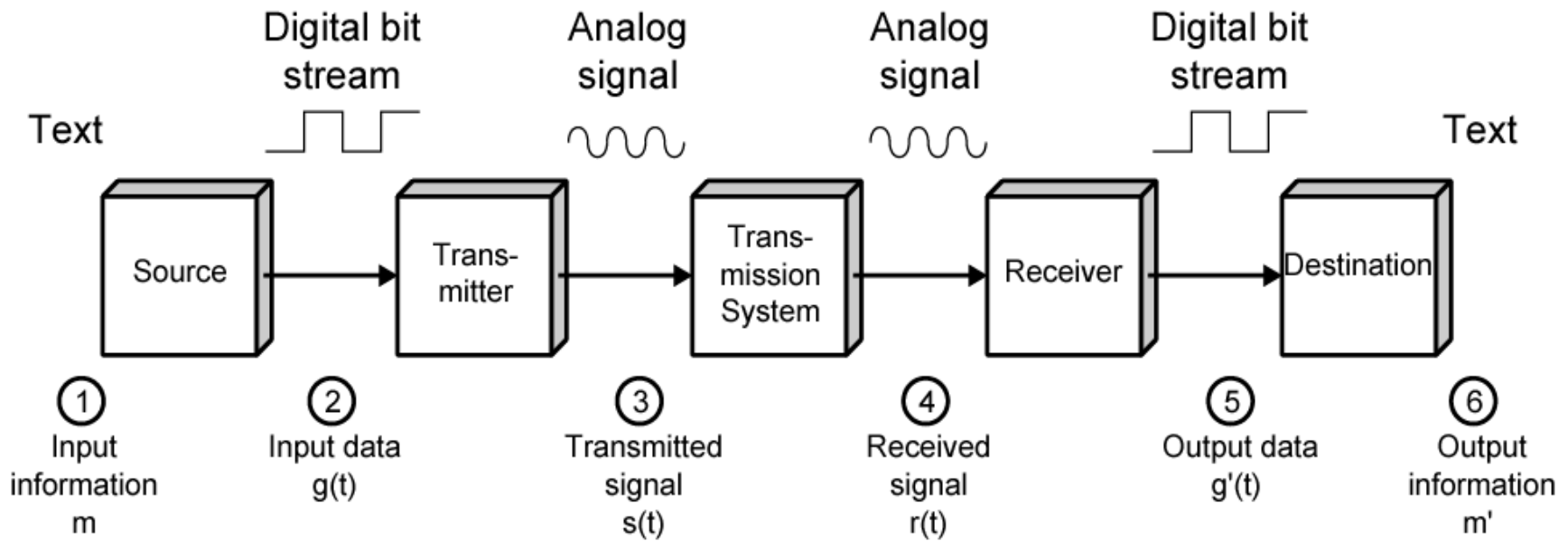
Communication Tasks

Transmission system utilization	Addressing
Interfacing	Routing
Signal generation	Recovery
Synchronization	Message formatting
Exchange management	Security
Error detection and correction	Network management
Flow control	

Transmission Line

❑ Transmission line is the key part of communications system

❑ Link between the transmitter and the receiver
  ❑ Wired transmission: Fiber Optic Transmission
  ❑ Wireless Transmission

❑ Needs to provide required capacity, with acceptable reliability at minimum cost

❑ Example: Want to transfer 50 GB of data from A to B
  ❑ Bluetooth: 1Mbps data transfer → 400000 seconds

  ❑ WiFi: 54Mbps data transfer → 7407 seconds

  ❑ LAN Cable: 1Gbps data transfer → 400 seconds

Transmission of Information

- Communication Techniques:
    - How to encode information into a signal?
    - How to detect and correct errors?

- Transmission Efficiency:
    - How to efficiently utilize/share the communication system?

Local Area Networks

❑ Small coverage area, e.g. building, campus

❑ Owned and operated by organization owing end-devices

❑ Higher data rate compared to WANs

❑ Example technologies: Ethernet, Wireless LAN

Wide Area Networks

- Span a large geographical area

- Carries data of multiple organizations

- Technologies used:
    - Circuit Switching
    - Packet Switching
    - Frame Relay
    - Asynchronous Transfer Mode (ATM)

- Metropolitan Area Network (MAN):
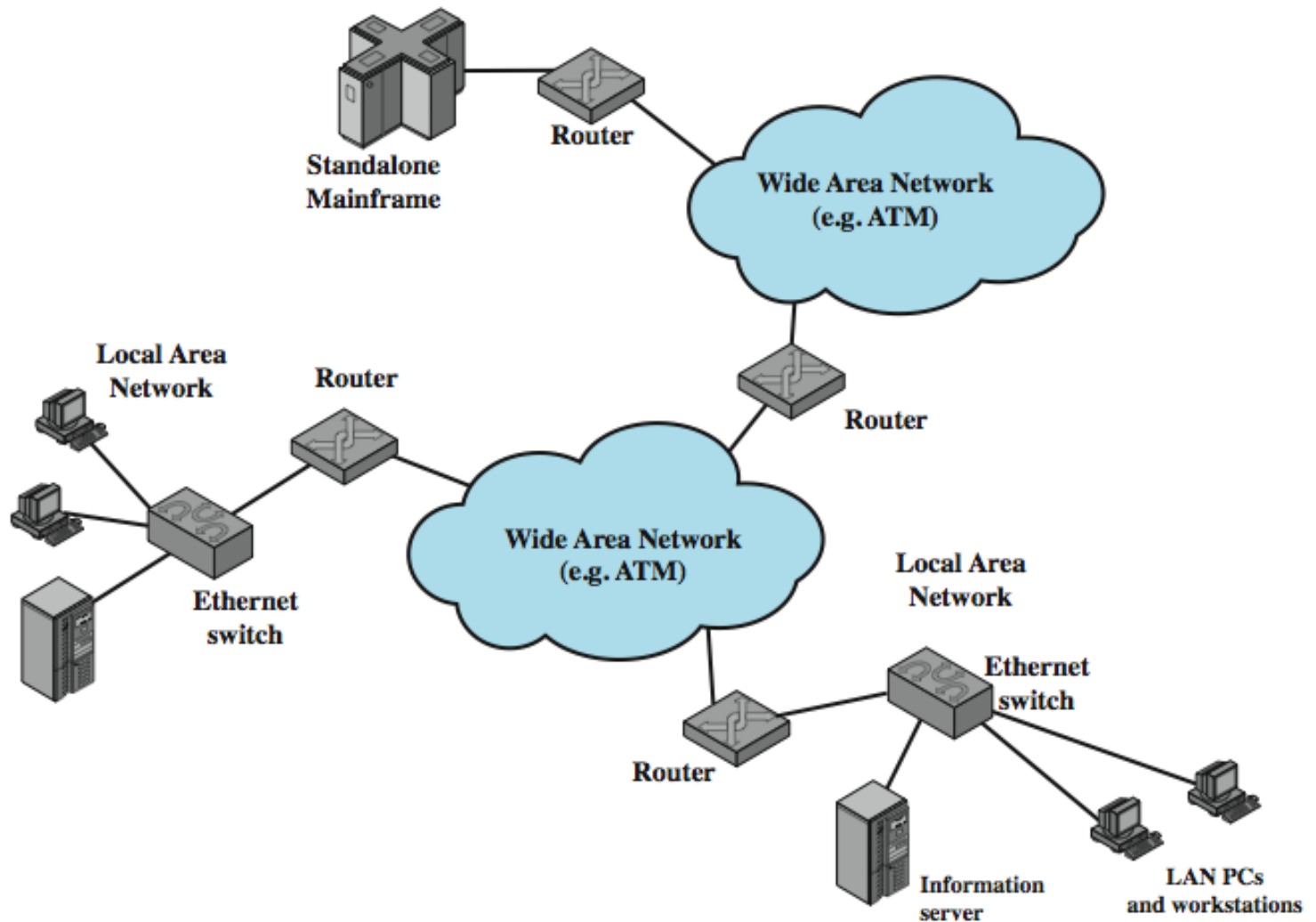   - Middle ground between LAN and MAN

The Internet

❑ **Origins**

   ❑ Evolved from US Department of Defense research network, APRANET in 1969

   ❑ Standardization of the Internet suite of protocols: TCP/IP

❑ **What is The Internet?**

   ❑ Interconnection of networks
   ❑ Although network technologies differ, any computer can communicate with any other computer

The Internet

The Internet: a "nuts and bolts" view

Billions of connected computing *devices*:

- *hosts* = *end systems*
- running *network apps* at Internet's "edge"

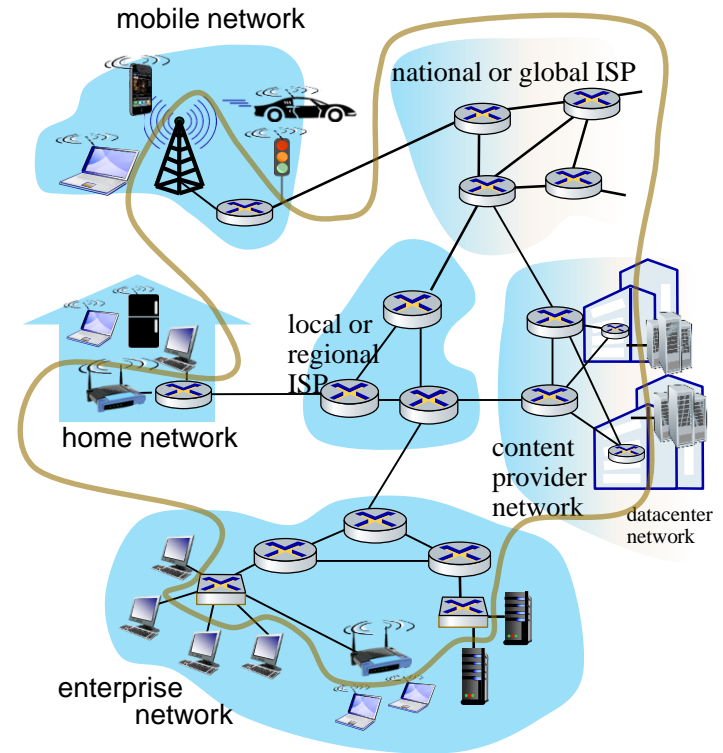*Switches/routers*: forward packets (chunks of data)

Communication links

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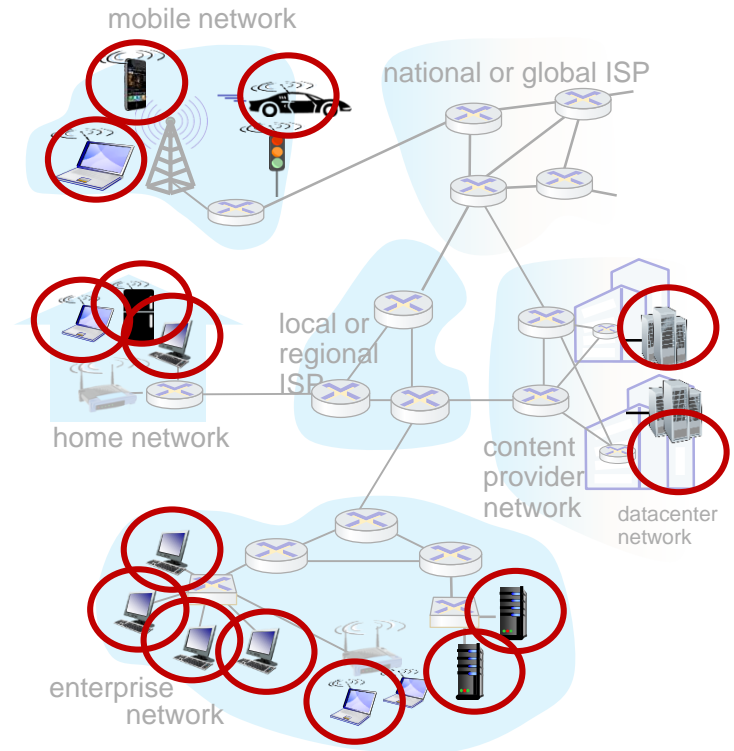- transmission rate: *bandwidth*

Networks

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

mobile network

national or global ISP

local or regional ISP

home network

content provider network

datacenter network

enterprise network

Network Edge and Network Core

Network edge:

- End systems/hosts: data producers and consumers
- Clients and servers
- Servers often in data centers
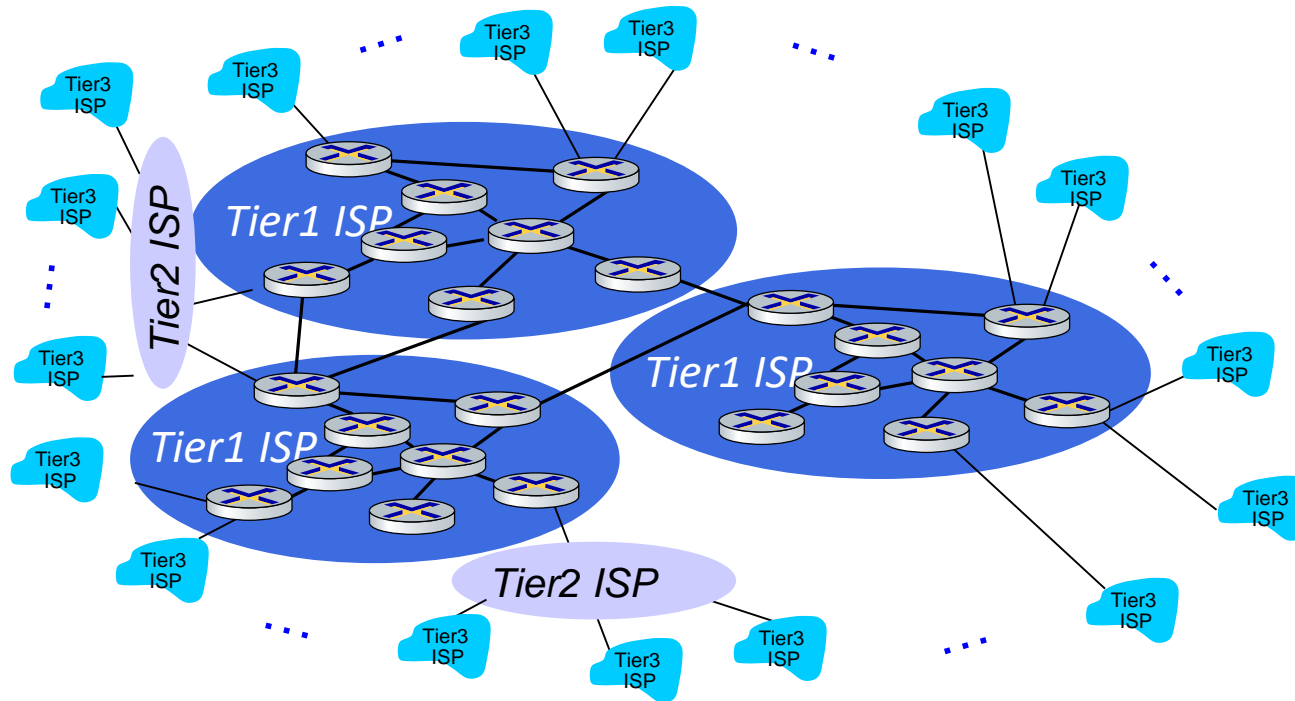- Access networks, physical media: wired, wireless communication links

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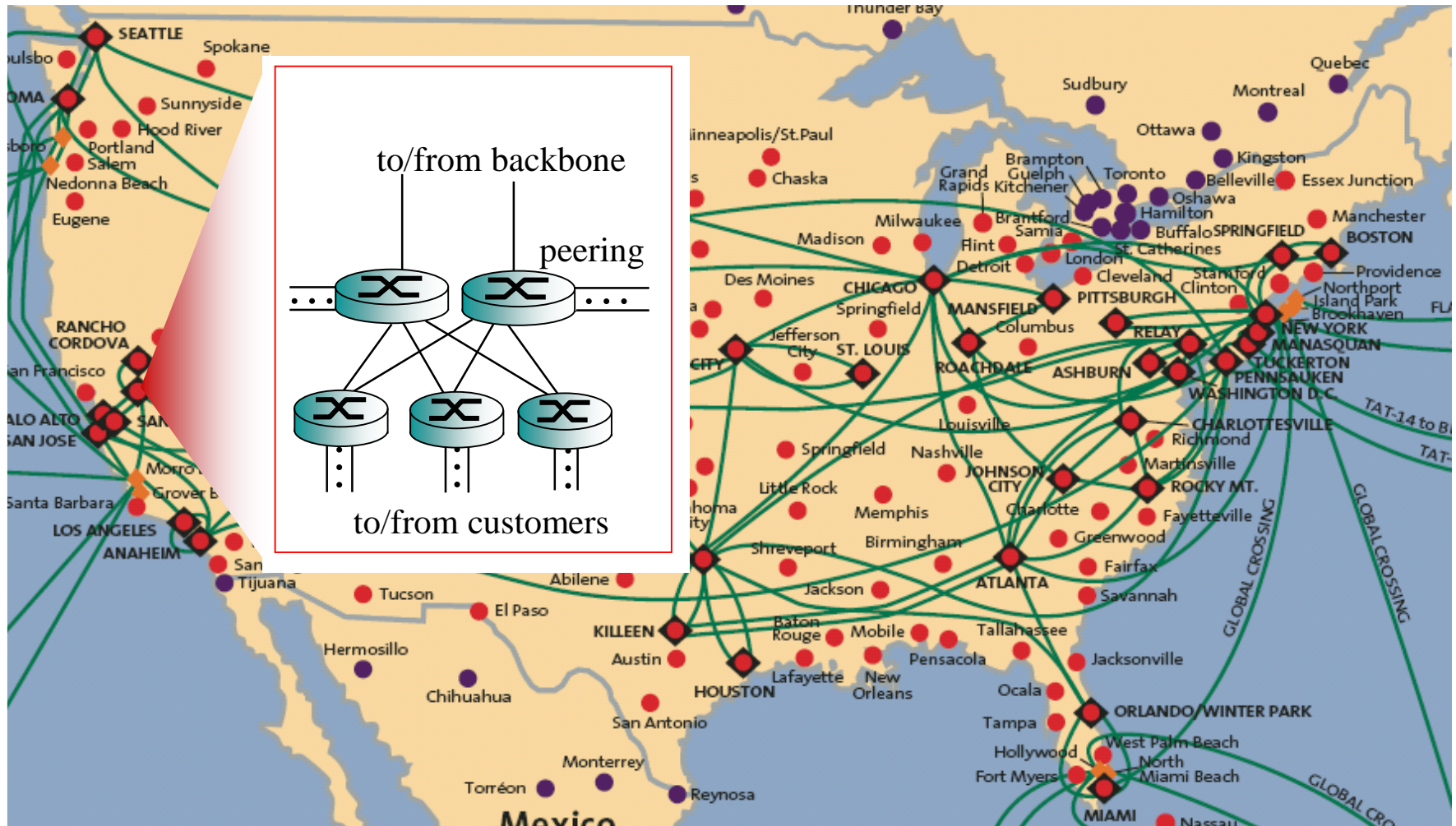
Network core:

- Interconnected routers
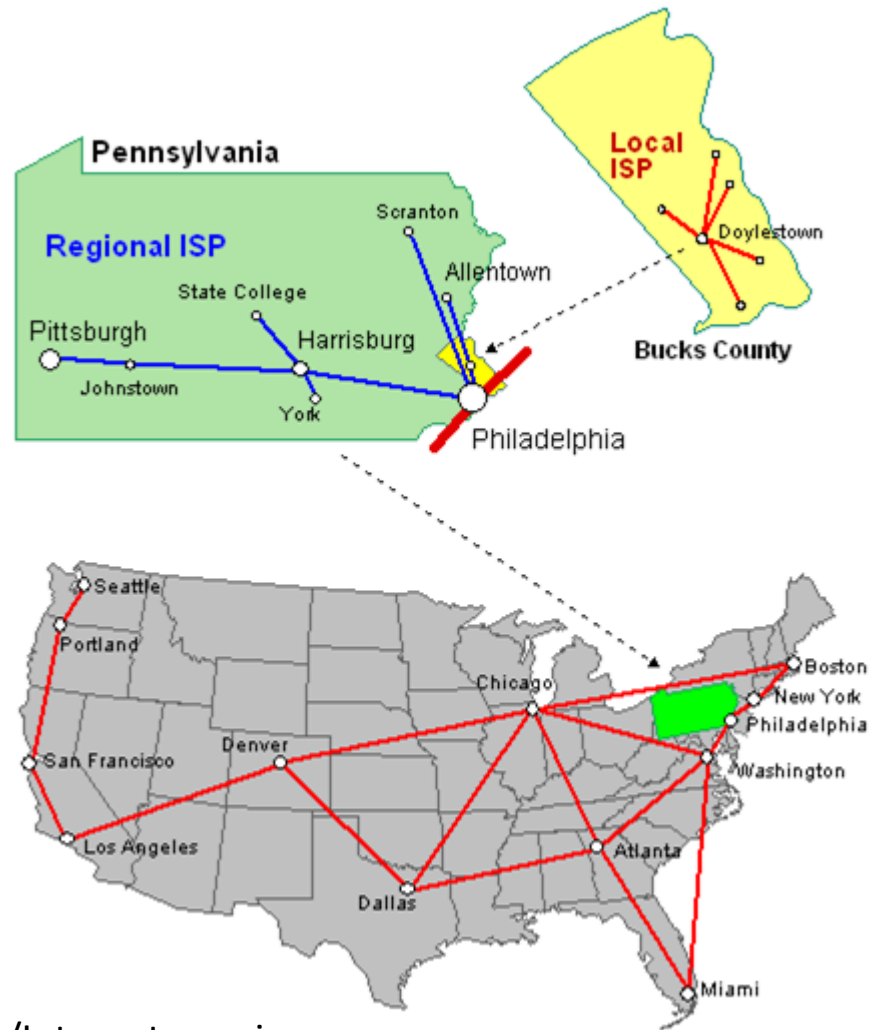- Forms the backbone of the Internet
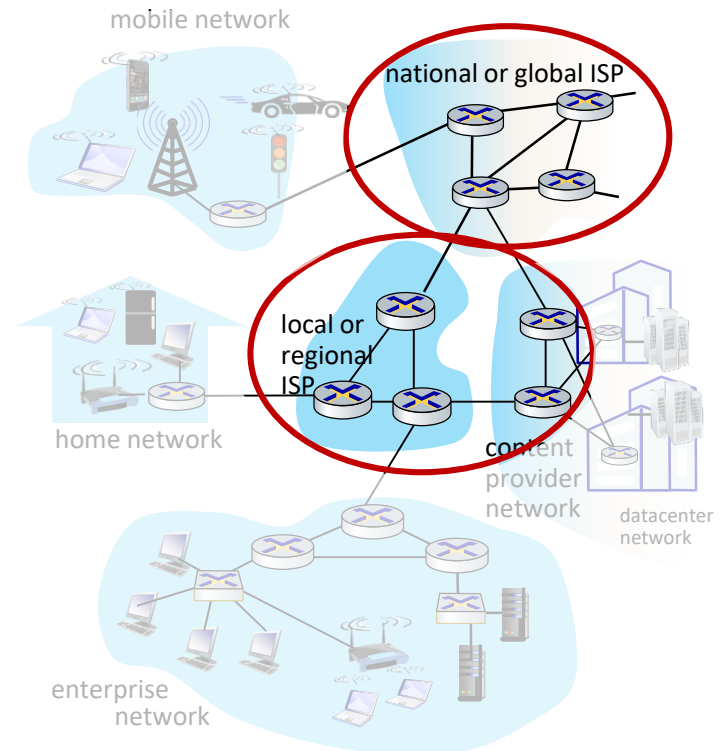
Internet structure: a "network of networks"

Tier-1 ISP: e.g., Sprint

to/from backbone

peering

to/from customers

Internet structure: a "network of networks"