Computer Networks

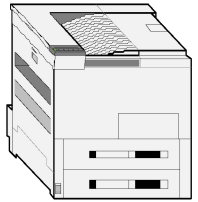
CSE 311

Introduction to Data Communications, Networks, Internet, Protocols

Introduction to Data Communication

Motivation

- Efficient way to share resources
  - Cost – less expensive
  - Accessibility – easier



- Efficient way to exchange information
  - Time – faster
  - Size – bigger
  - Correctness – more accurate

Data Communication: Characteristics

Delivery

Accuracy

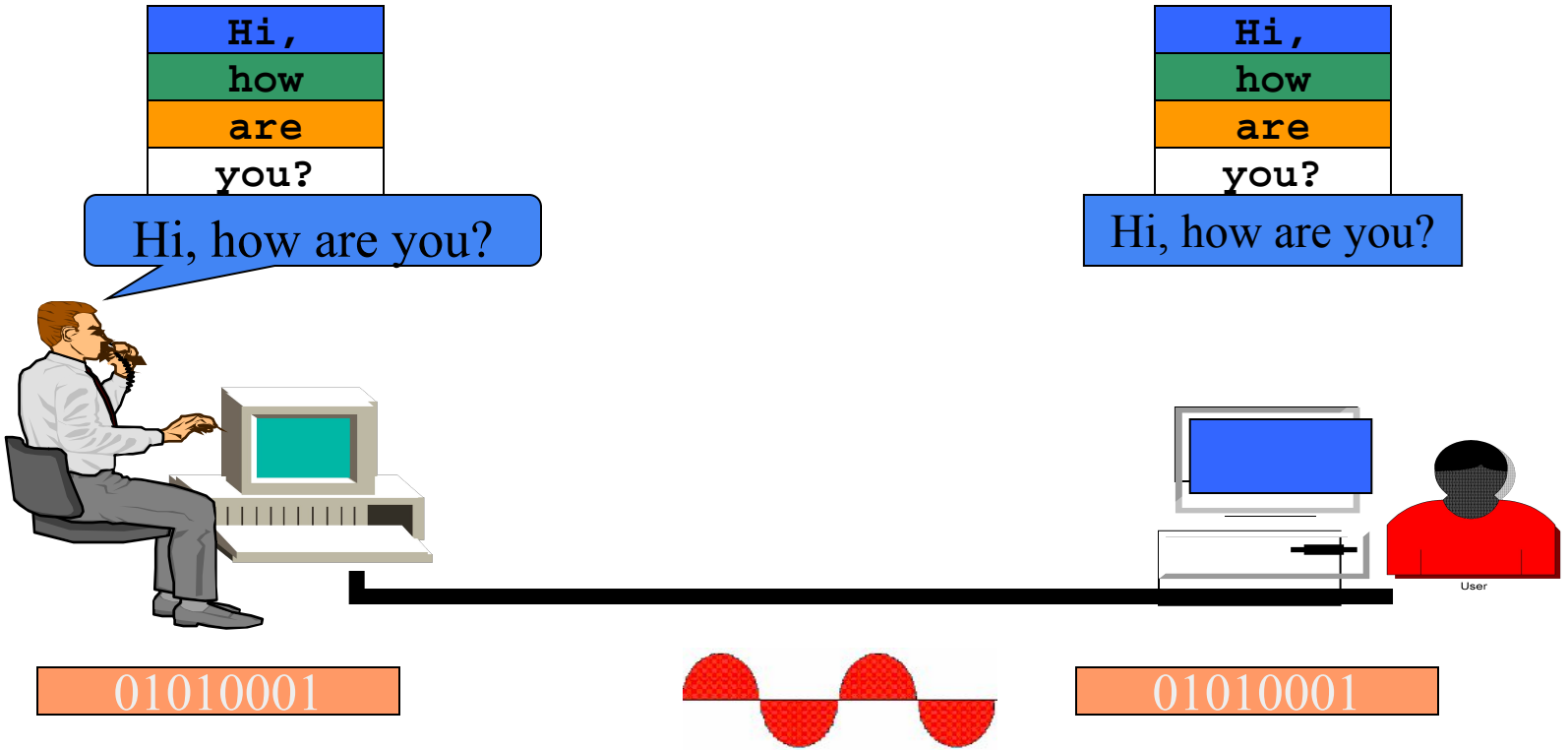
Transfer of data from one device to another via some form of transmission medium.

Timeliness

Jitter

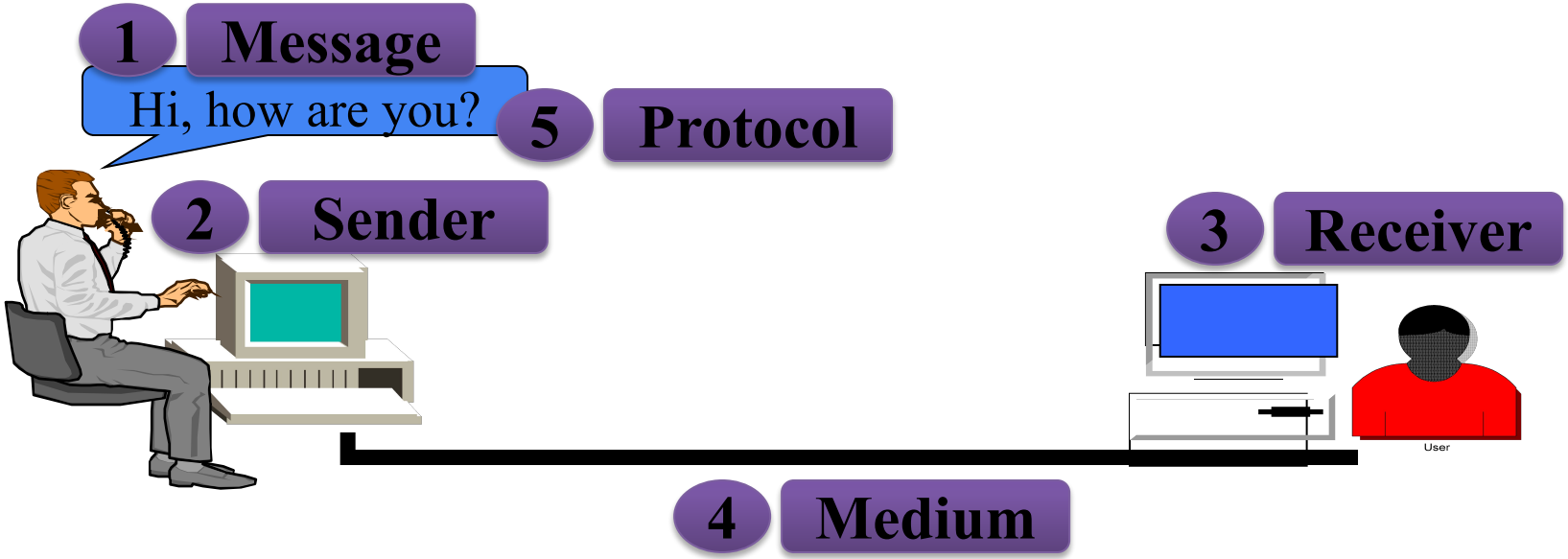
Computer

Data Communication



Computer

Components in Communication

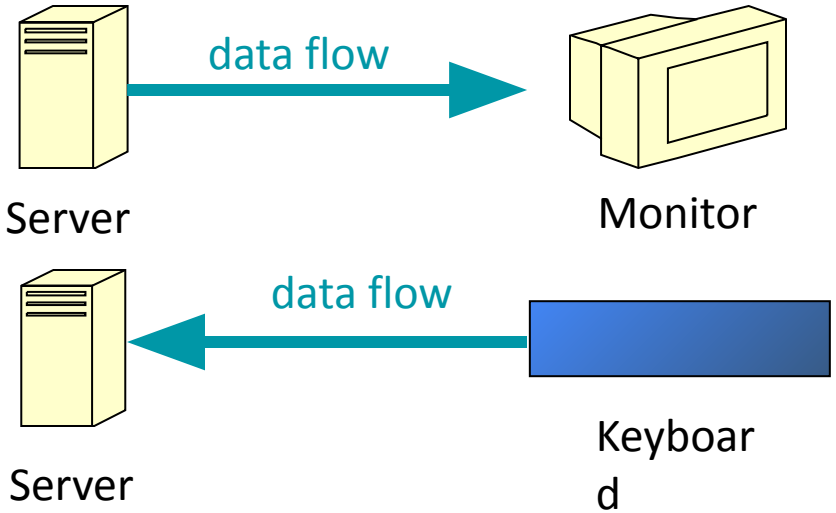


Data Representation

- Numbers
  - 8/16/32 bit integers
  - floating point
- Text
  - ASCII, Unicode
- Images
  - Bit patterns, Graphics formats JPG/GIF/etc
- Audio → Samples of continuous signal
- Video → Sequence of bitmap images

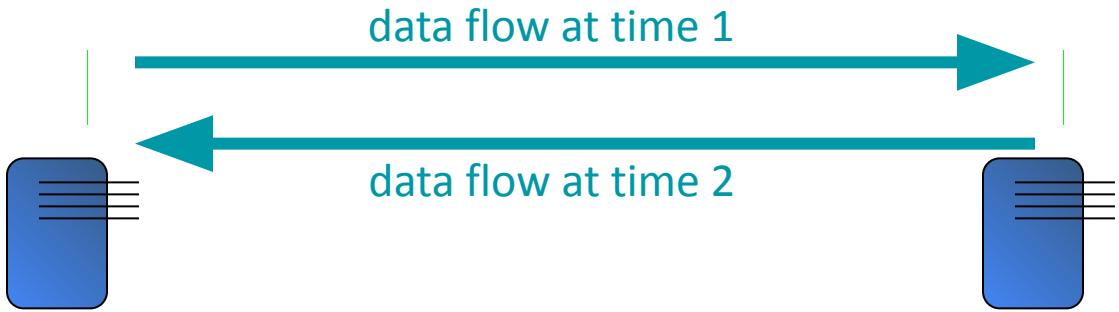
Direction of Data Flow

- **Simplex**: One direction only

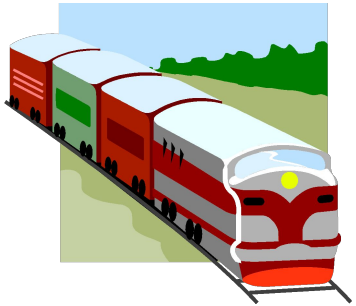


Direction of Data Flow

- **Half Duplex:** Both directions, one at a time



  - E.g., walkie-talkies



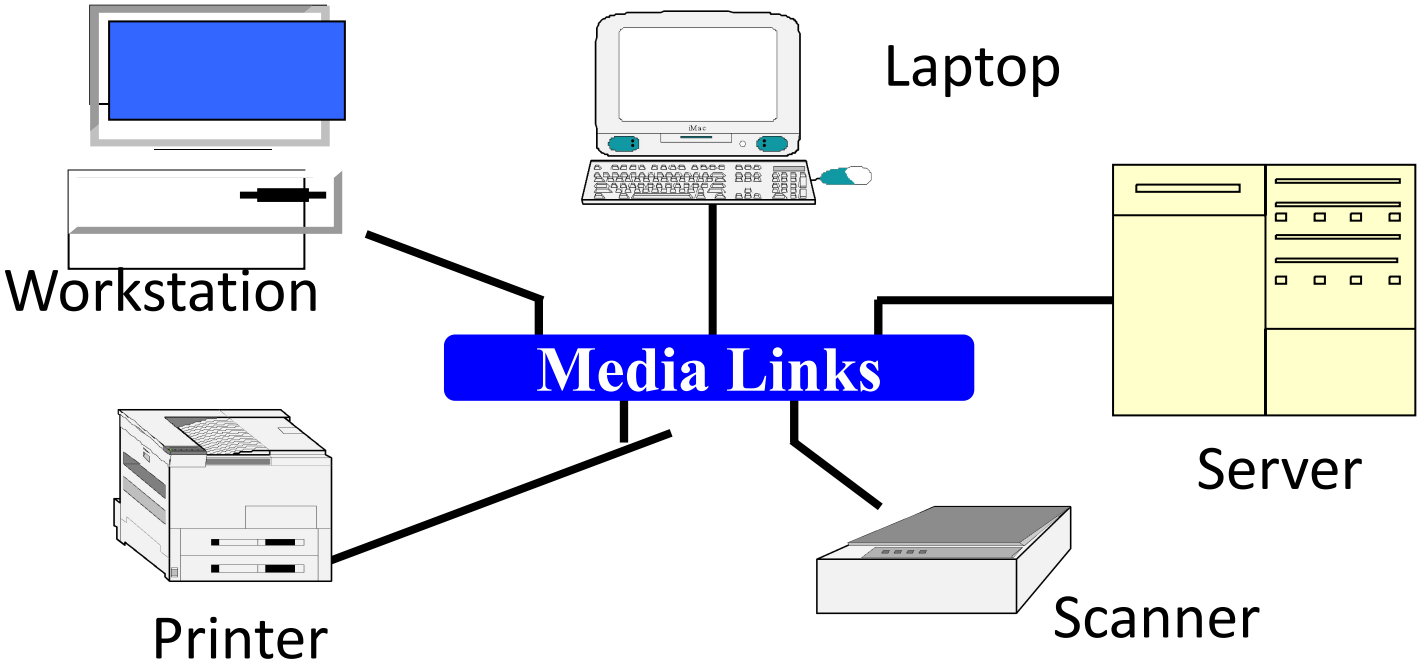
Direction of Data Flow

- **Full Duplex**: Both directions simultaneously

  - E.g. telephone
- The capacity of the channel is divided between the two directions.

Networks

Network: *a set of devices connected by communication links*



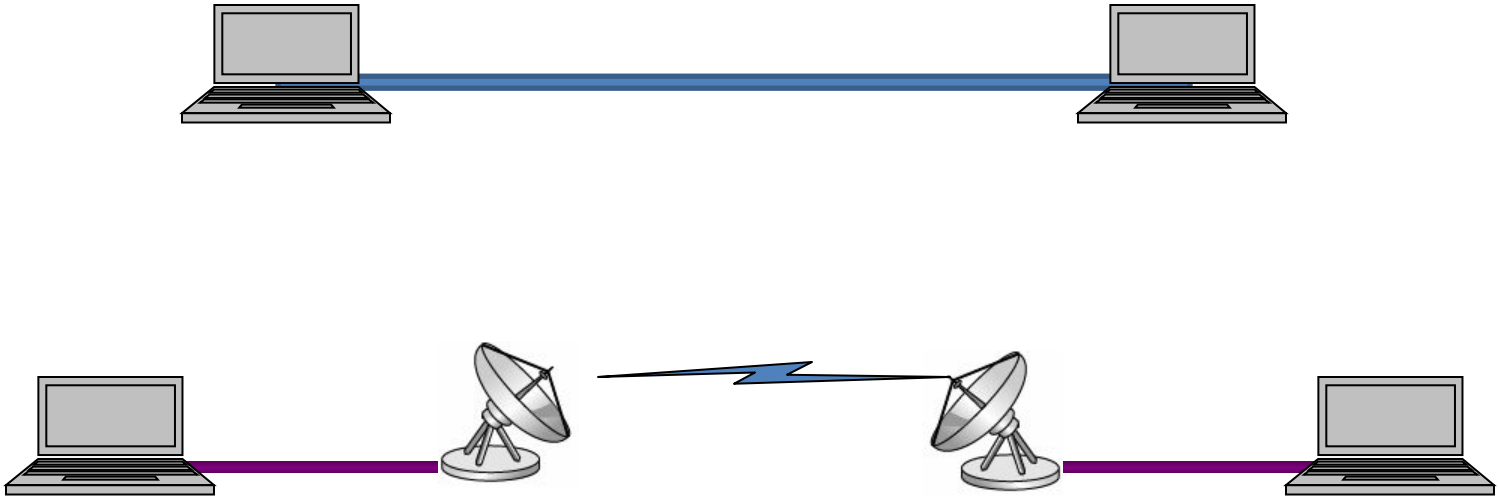
Network Criteria

- Performance
  - Throughput
  - Delay
- Reliability
  - Frequency of failure
  - Time to recover from a failure
  - Network’s robustness
- Security
  - Unauthorized access

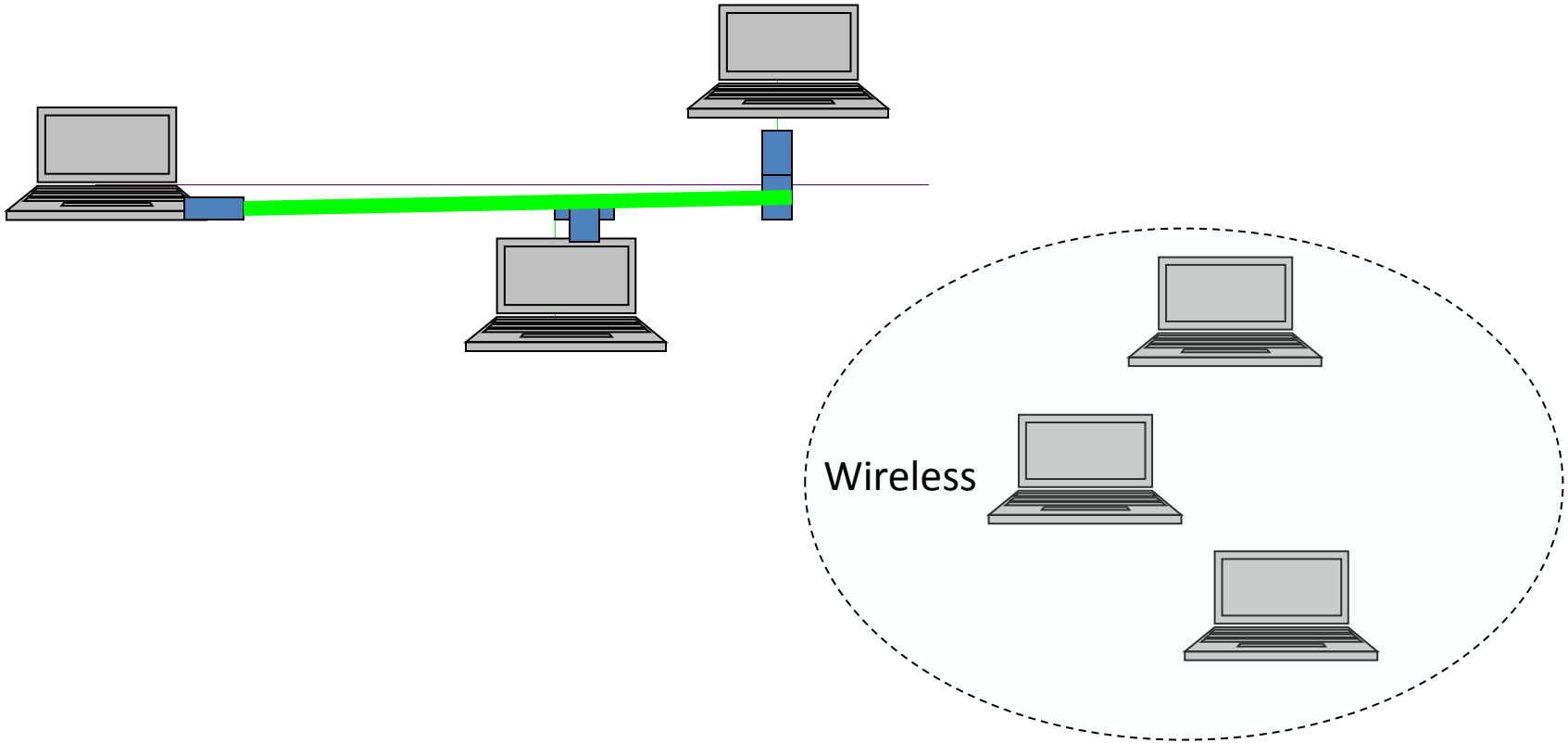
Types of Connections

- Point-to-point
  - A dedicated link between two devices
- Multipoint (multidrop)
  - Devices share a single link

Point-To-Point Connection



Multipoint Connection



Topology

- Topology: physical arrangement of devices
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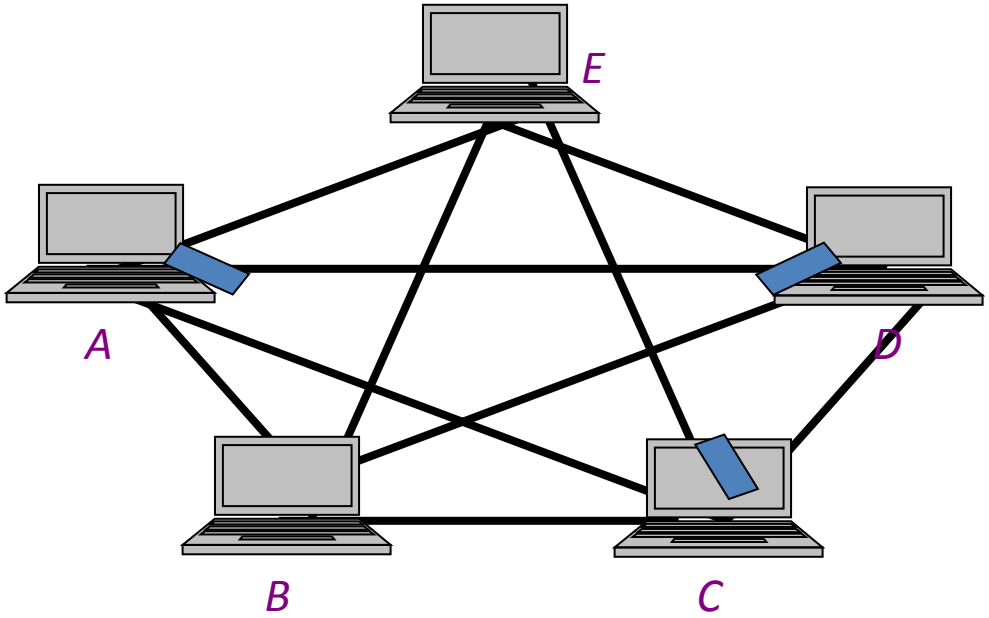
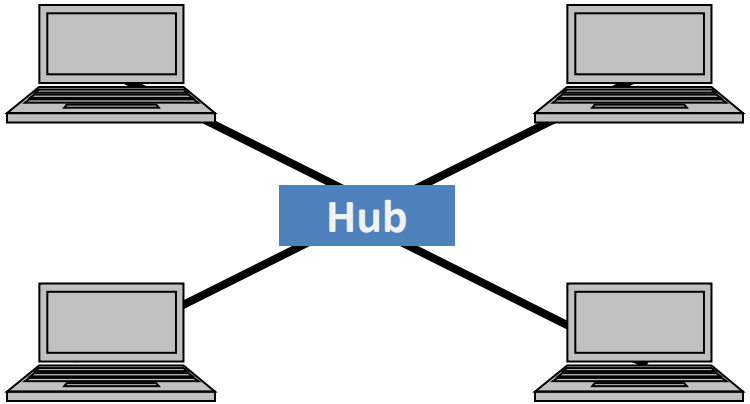
a. Mesh
b. Star
c. Bus
d. Ring
e. Hybrid

Fully Connected Mesh Topology



- **Pros:**
  - Dedicated links; n(n-1)/2 links
  - Robustness
  - Privacy
  - Easy to identify fault
- **Cons:**
  - A lot of cabling
  - I/O ports
  - Difficult to move

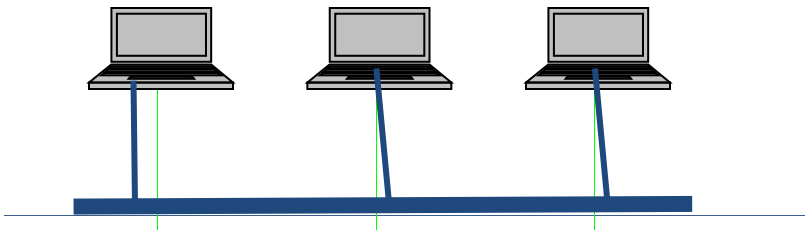
Star Topology



- **Pros:**
  - One I/O port per device
  - Little cabling
  - Easy to install
  - Robustness
  - Easy to identify fault

- **Cons:**
  - Single point of failure
  - More cabling still required

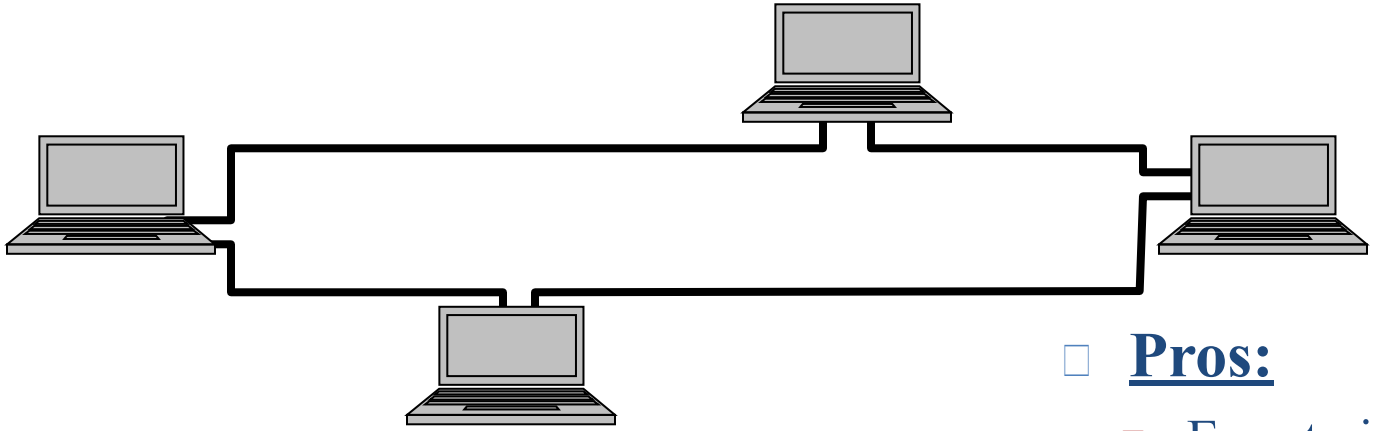
Bus Topology



- **Pros:**
  - Little cabling
  - Easy to install

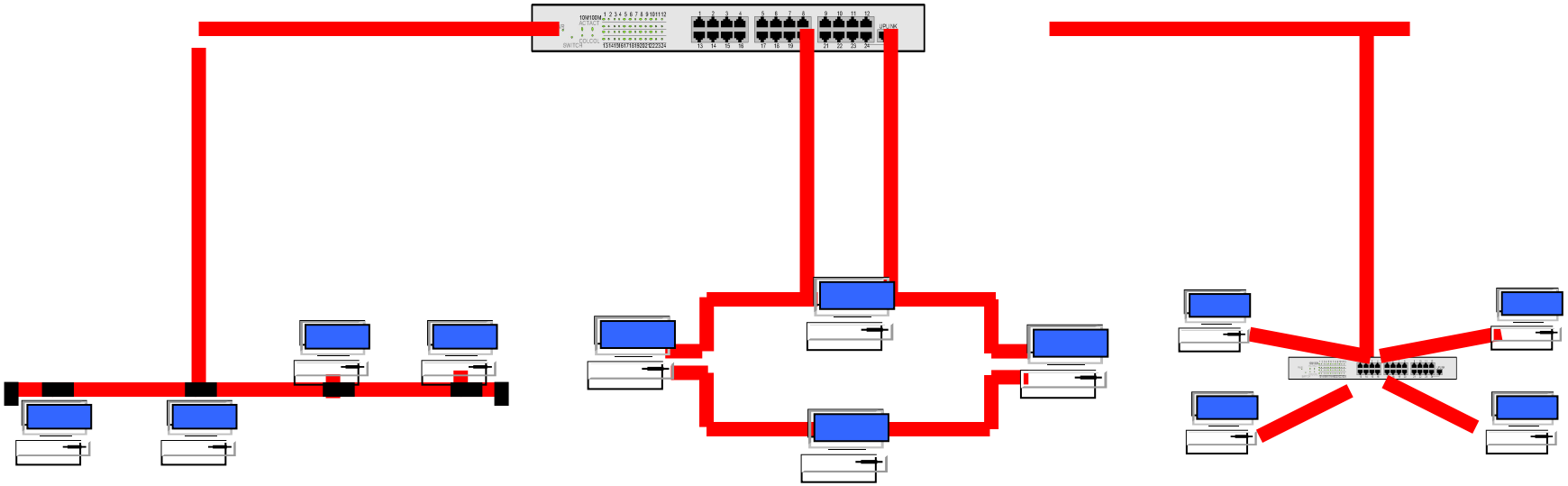
- **Cons:**
  - Difficult to modify
  - Difficult to isolate fault
  - Break in the bus cable stops all transmission

Ring Topology



- **Pros:**
  - Easy to install
  - Easy to identify fault
- **Cons:**
  - Delay in large ring
  - Break in the ring stops all transmission

Hybrid Topologies

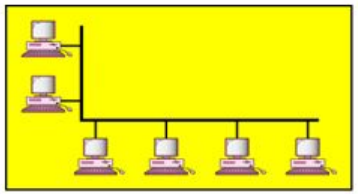


Network Categories

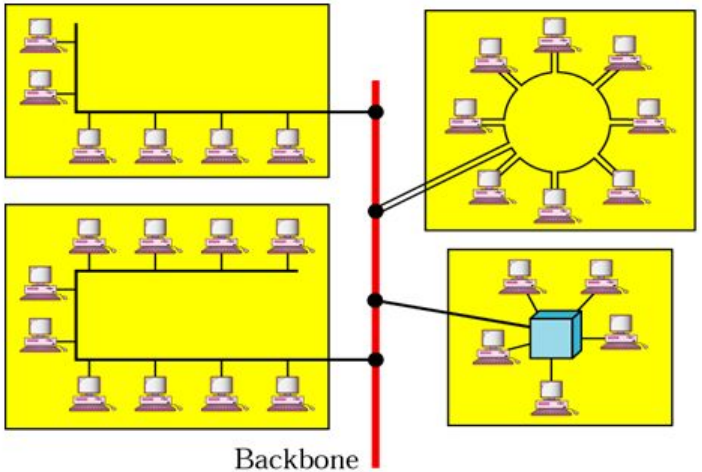
- Local Area Network (LAN)
- Wide Area Network (WAN)
- Metropolitan Area Network (MAN)

Local Area Networks

- Network in a single office, building, or campus



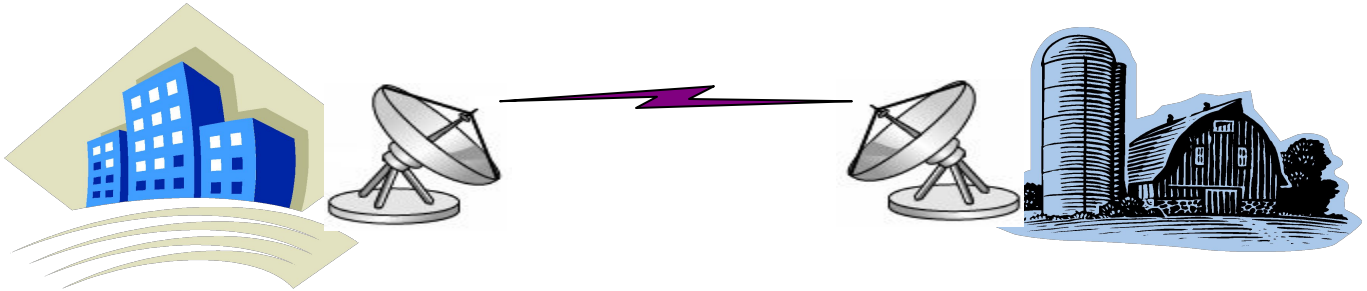
a. Single-building LAN



b. Multiple-building LAN

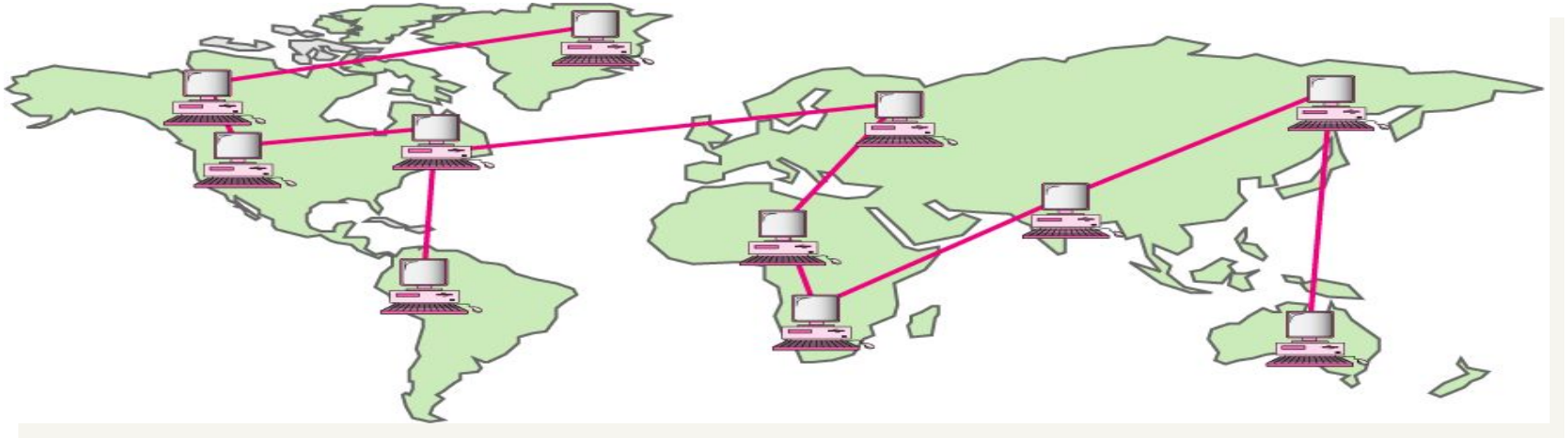
Metropolitan Area Networks

- Network extended over an entire city



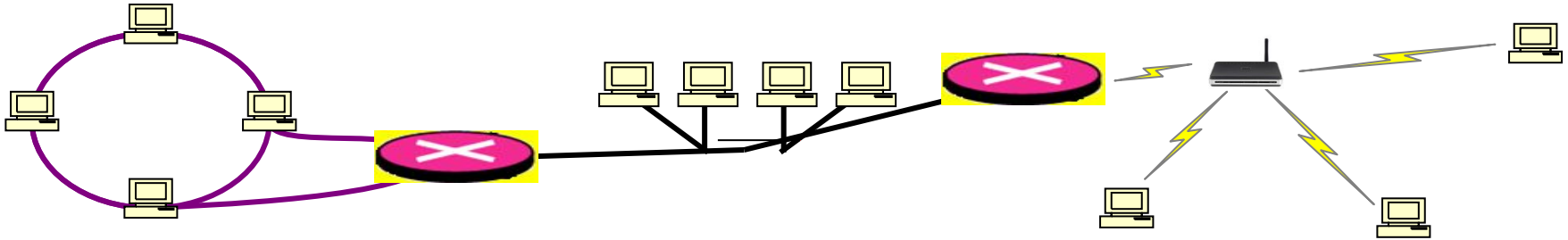
Wide Area Networks

- Network providing long-distance communication over a country, a continent, or the whole world



Internetworking

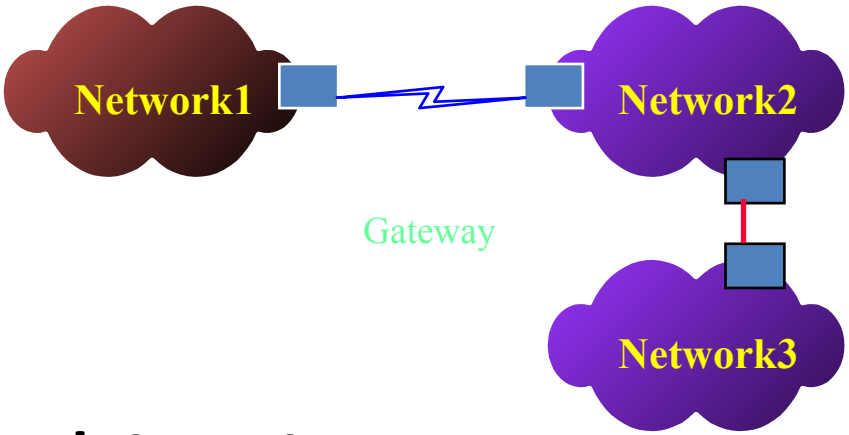
- How to allow devices from different standards to communicate?
- **Gateways/routers** – devices capable of communicating in several standards



- These become "network of networks"

Internetworks

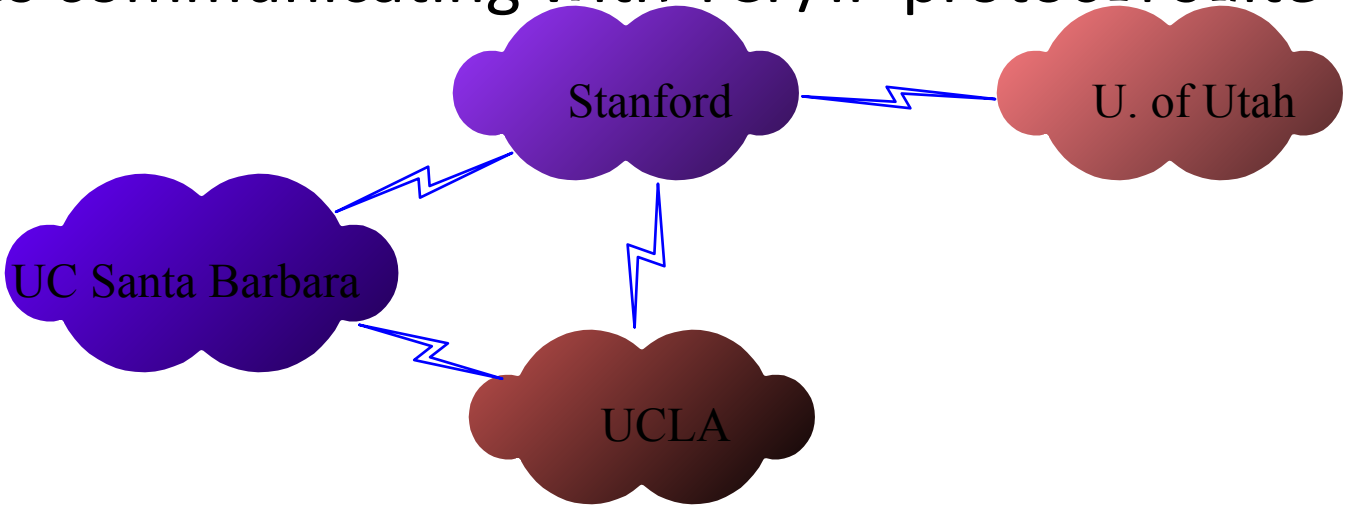
- Two or more networks connected become an *internetwork*, or *internet*



- Example: **The Internet**

The Internet

- The largest internetwork (network of networks) in the world
- Devices communicating with TCP/IP protocol suite



“Cool” Internet appliances

IP picture frame

Web-enabled toaster + weather forecaster

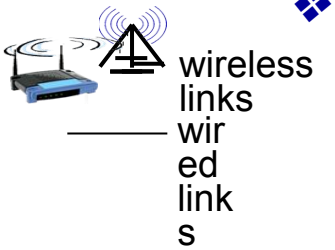
Tweet-a-watt: monitor energy use

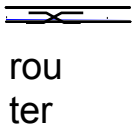
Internet refrigerator

Slingbox: watch, control cable TV remotely

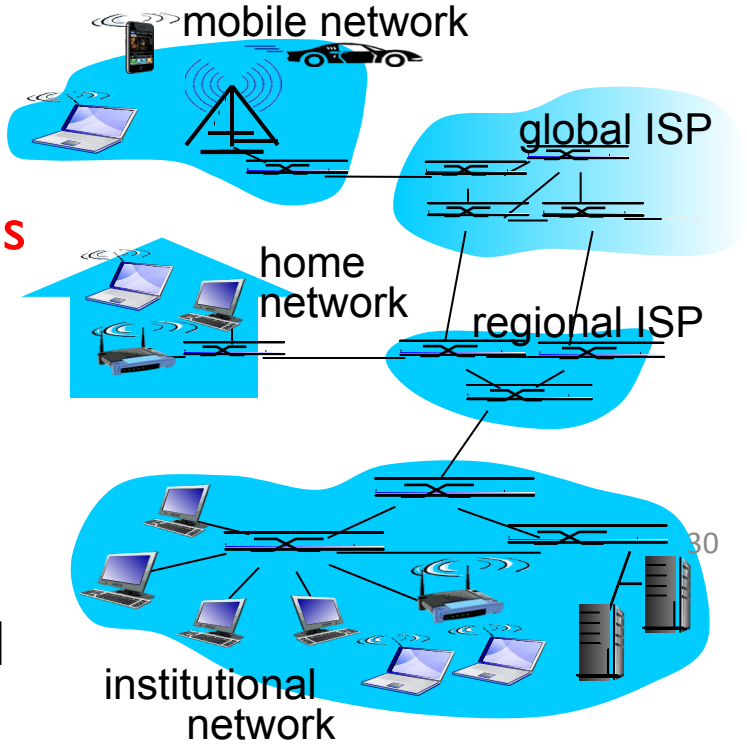
Internet phones

What is the Internet: "nuts and bolts" view



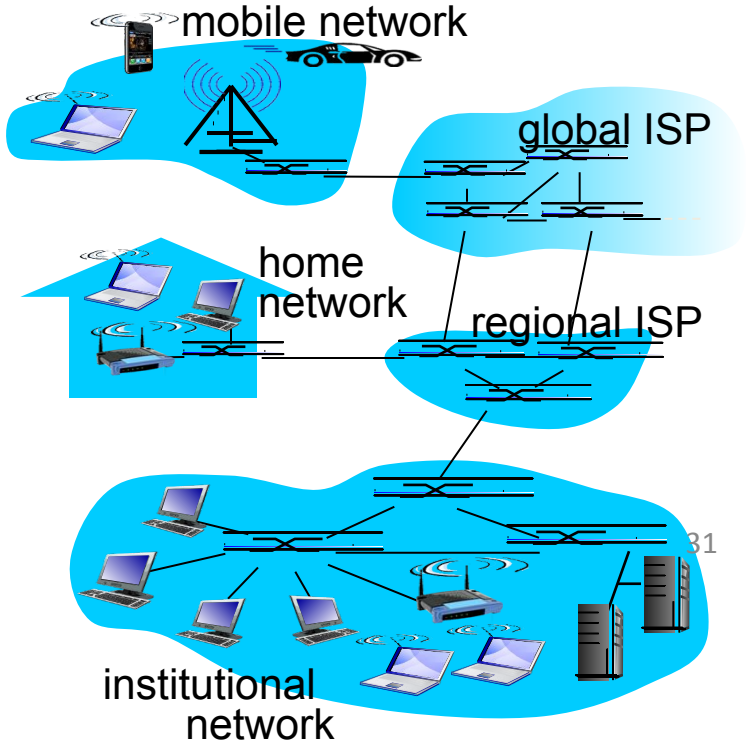


- *millions of connected computing devices:*
  - hosts = end systems
  - Running network apps
- *communication links*
  - fiber, copper, radio, satellite
  - transmission rate: *bandwidth*
- *Packet switches:* forward packets (chunks of data)
  - *routers* and *switches*



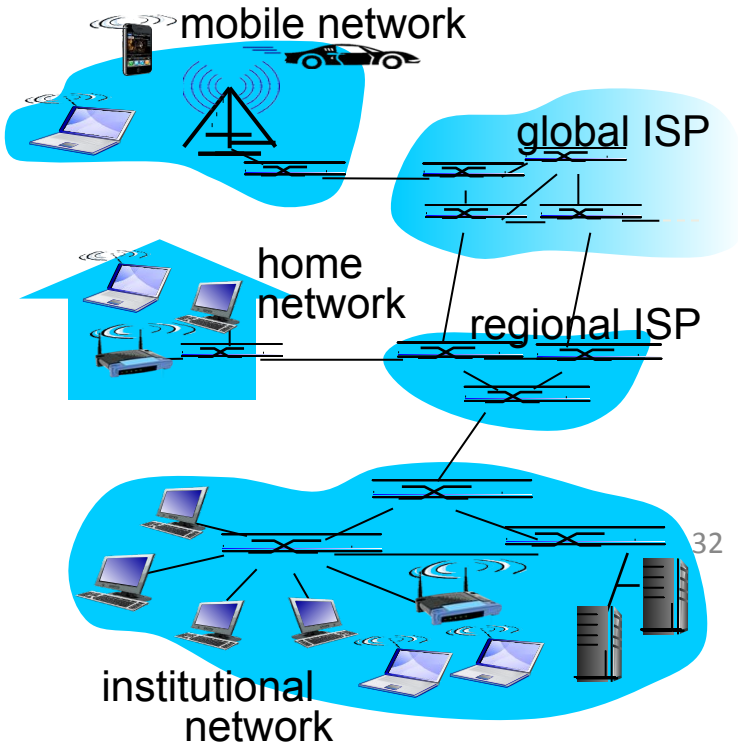
What is the Internet: "nuts and bolts" view

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



What is the Internet: a service view

- *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



What is a Protocol?

human protocols:

- "whats 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, order of msgs sent and received among network entities, and actions taken on msg transmission, receipt

What is a protocol?

a human protocol and a computer network protocol: