CS 420/520
Data Communication Systems

- Course Overview
  - **Instructor:**
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    - http://www.cs.uidaho.edu/~krings/CS420
  - **Text**:
    - *Data and Computer Communications,* William Stallings, Prentice Hall.
  - **Grading**:
    - CS420: Assignments, Three Exams
    - CS520: Assignments, Three Exams, Term Project

Syllabus and Scope of Course

- We will cover most of the chapters with selected topics from other sources
- This course will introduce you to the concepts, terminology, and approaches used in data communication systems.
- I expect you to walk away from this class being familiar with a wide variety of concepts and protocols (and detailed knowledge of some of them). In the future you should be able to use this knowledge to:
  - make intelligent decisions about network use, design and management,
  - be able to pick up and learn details of a particular system as you need it
  - be able to quickly find protocol descriptions and problem solutions/discussions
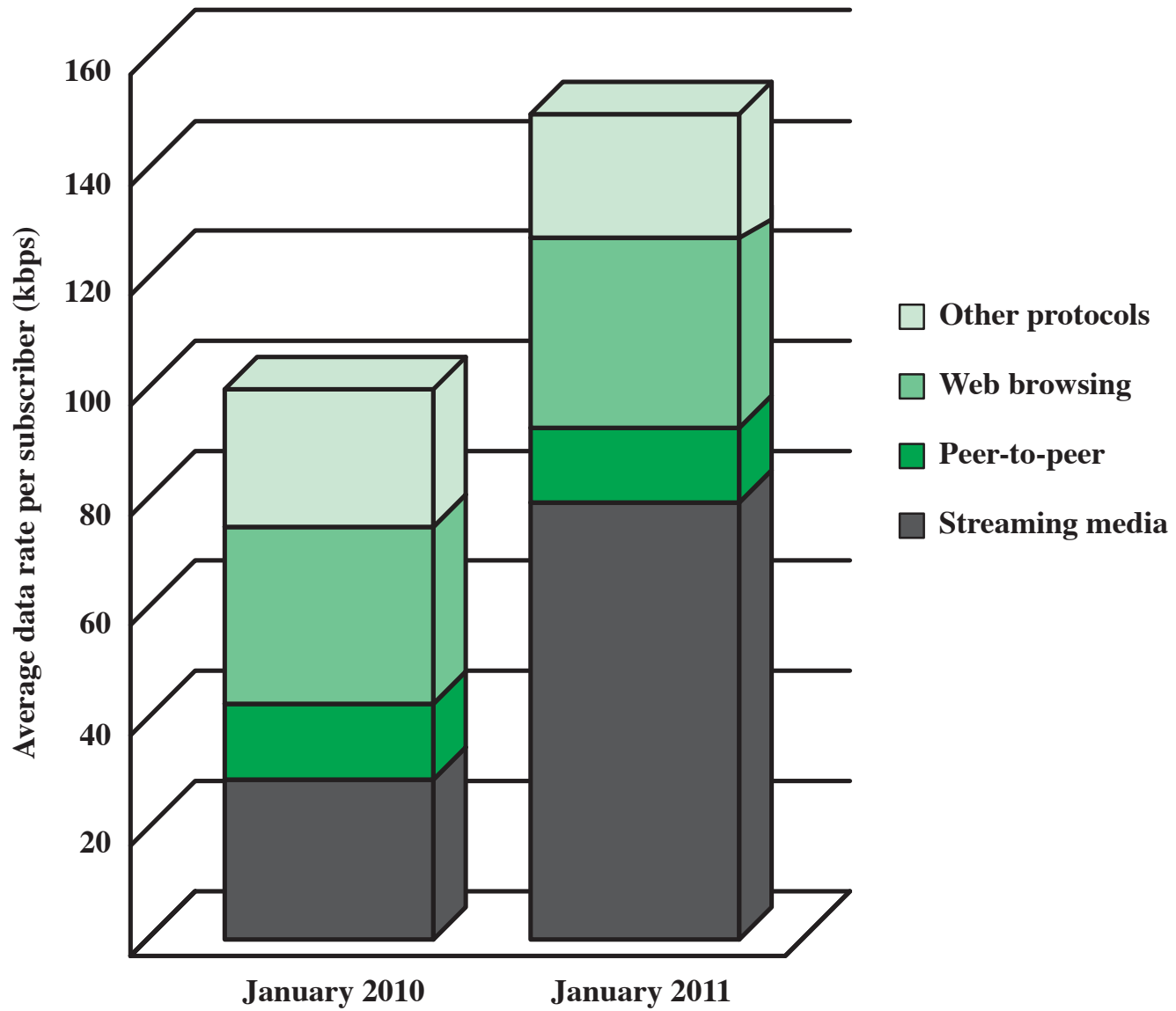 - be able to discuss data communication systems with supervisors and co-workers on the job

Figure 1.1   Average Downstream Traffic per Internet Subscriber

Technological Advancement
Driving Forces

Development of new services

Advances in technology

Traffic growth at a high and steady rate

Notable Trends

Trend toward faster and cheaper, in both computing and communication

- More powerful computers supporting more demanding applications
- The increasing use of optical fiber and high-speed wireless has brought transmission prices down and greatly increased capacity

Today's networks are more "intelligent"

- Differing levels of quality of service (QoS)
- Variety of customizable services in the areas of network management and security

The Internet, the Web, and associated applications have emerged as dominant features for both business and personal network landscapes

- "Everything over IP"
- Intranets and extranets are being used to isolate proprietary information

Mobility

- iPhone, Droid, and iPad have become drivers of the evolution of business networks and their use
- Enterprise applications are now routinely delivered on mobile devices
- Cloud computing is being embraced

A Communications Model

- Source
  - —generates data to be transmitted
- Transmitter
  - —Converts data into transmittable signals
- Transmission System
  - —Carries data
- Receiver
  - —Converts received signal into data
- Destination
  - —Takes incoming data

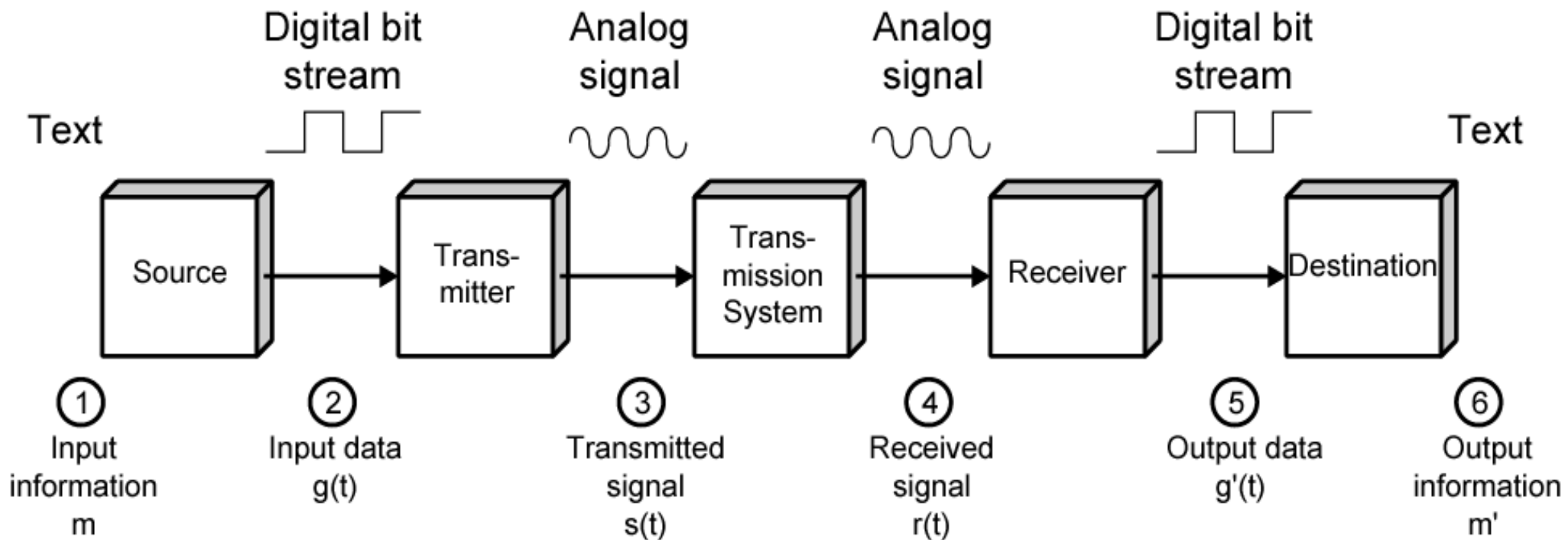# Simplified Communications Model - Diagram
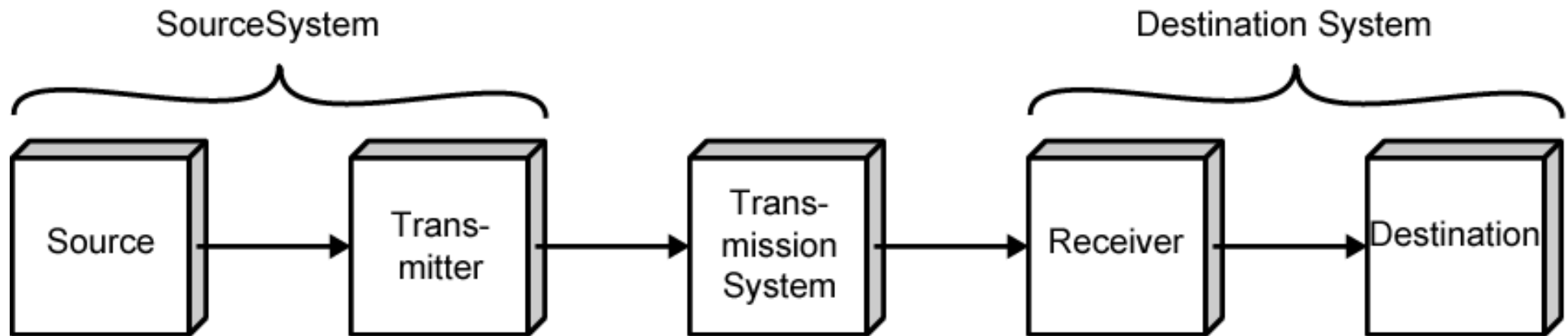
(a) General block diagram

(b) Example

Communications Tasks

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

Simplified Data Communications Model

Text   Digital bit stream   Analog signal   Analog signal   Digital bit stream   Text

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

① Input information m

② Input data g(t)

③ Transmitted signal s(t)

④ Received signal r(t)

⑤ Output data g'(t)

⑥ Output information m'

Transmission Lines

The basic building block of any communications facility is the transmission line

The business manager is concerned with a facility providing the required capacity, with acceptable reliability, at minimum cost

Capacity

Reliability
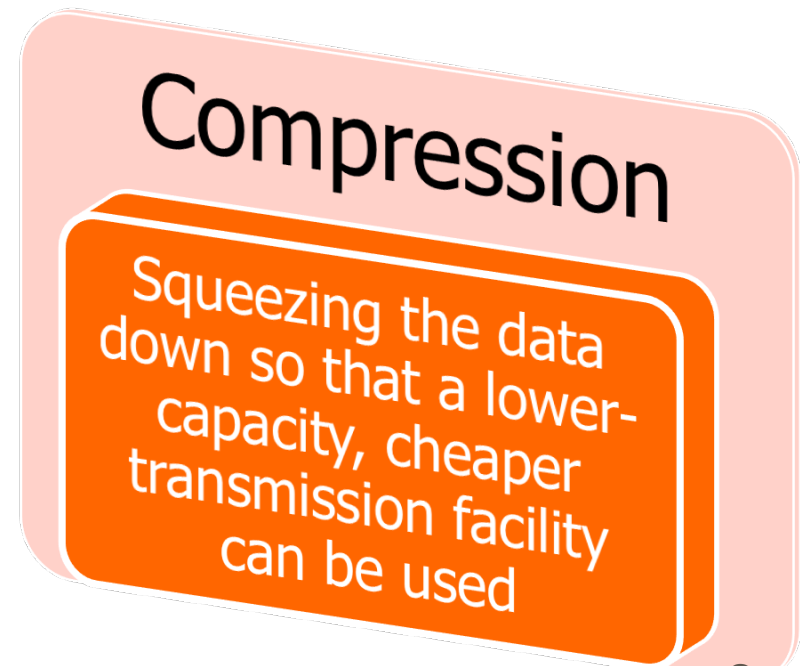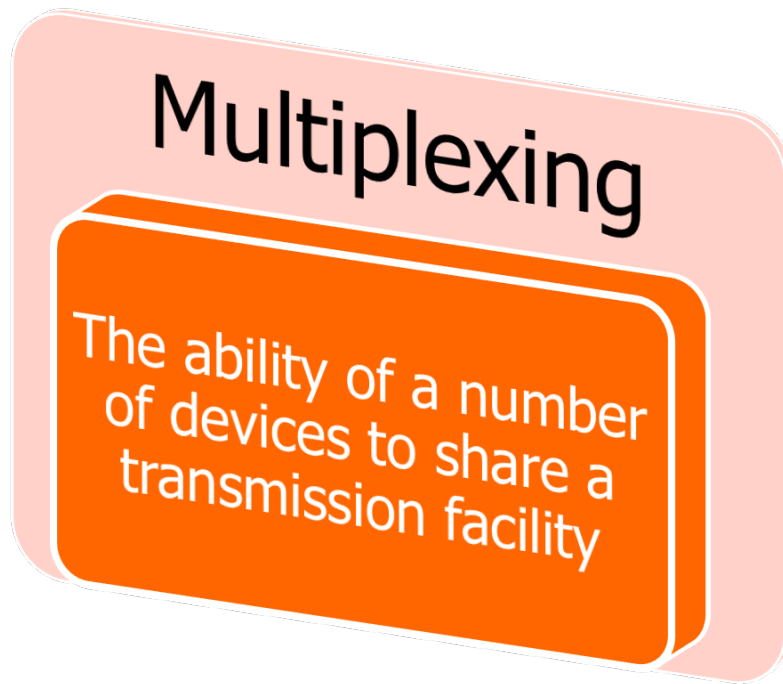
Cost

Transmission Line

Transmission Mediums

Two mediums currently driving

the evolution of data communications transmission are:

Fiber optic transmissions

and

Wireless transmissions

Transmission Services

- Remain the most costly component of a communications budget

- Two major approaches to greater efficiency:

Multiplexing

The ability of a number of devices to share a transmission facility

Compression

Squeezing the data down so that a lower-capacity, cheaper transmission facility can be used

Networking

Advances in technology have led to greatly increased capacity and the concept of integration, allowing equipment and networks to work simultaneously

Voice | Data
Image | Video
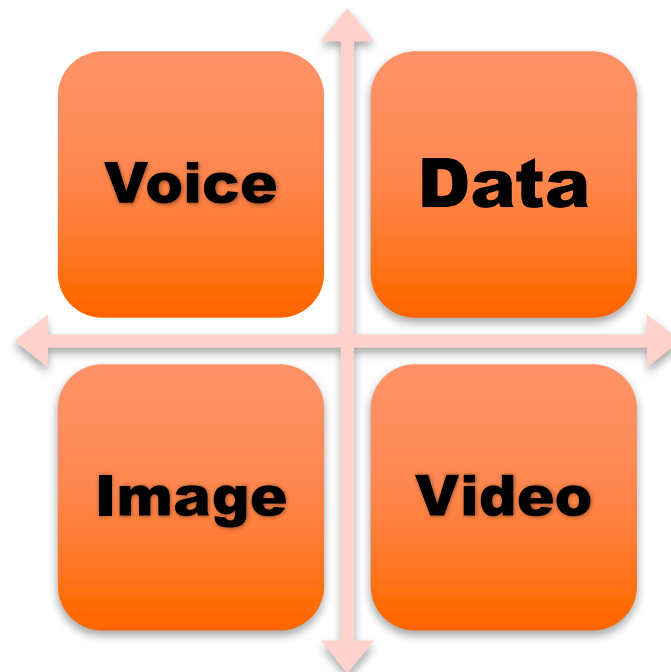
Networking

- Point to point communication not usually practical
  - Devices are too far apart
  - Large set of devices would need impractical number of connections
- Solution is a communications network, e.g.,
  - Wide Area Network (WAN)
  - Local Area Network (LAN)

Wide Area Networks

- Large geographical area
- Crossing public rights of way
- Rely in part on common carrier circuits
- Alternative technologies
  - Circuit switching
  - Packet switching
  - Frame relay
  - Asynchronous Transfer Mode (ATM)

Circuit Switching

- Dedicated communications path established for the duration of the conversation

- e.g., telephone network

Packet Switching

- Small "chunks" (packets) of data at a time
- Data sent may be out of sequence
- Packets passed from node to node between source and destination
- Used for terminal to computer and computer to computer communications

Frame Relay

- Packet switching systems have large overhead to compensate for errors

- Modern systems are more reliable

- Errors can be caught in end system

- Most overhead for error control is stripped out

Asynchronous Transfer Mode

- ATM
- Evolution of frame relay
- Little overhead for error control
- Fixed packet (called cell) length
- Anything from Mbps to Gbps
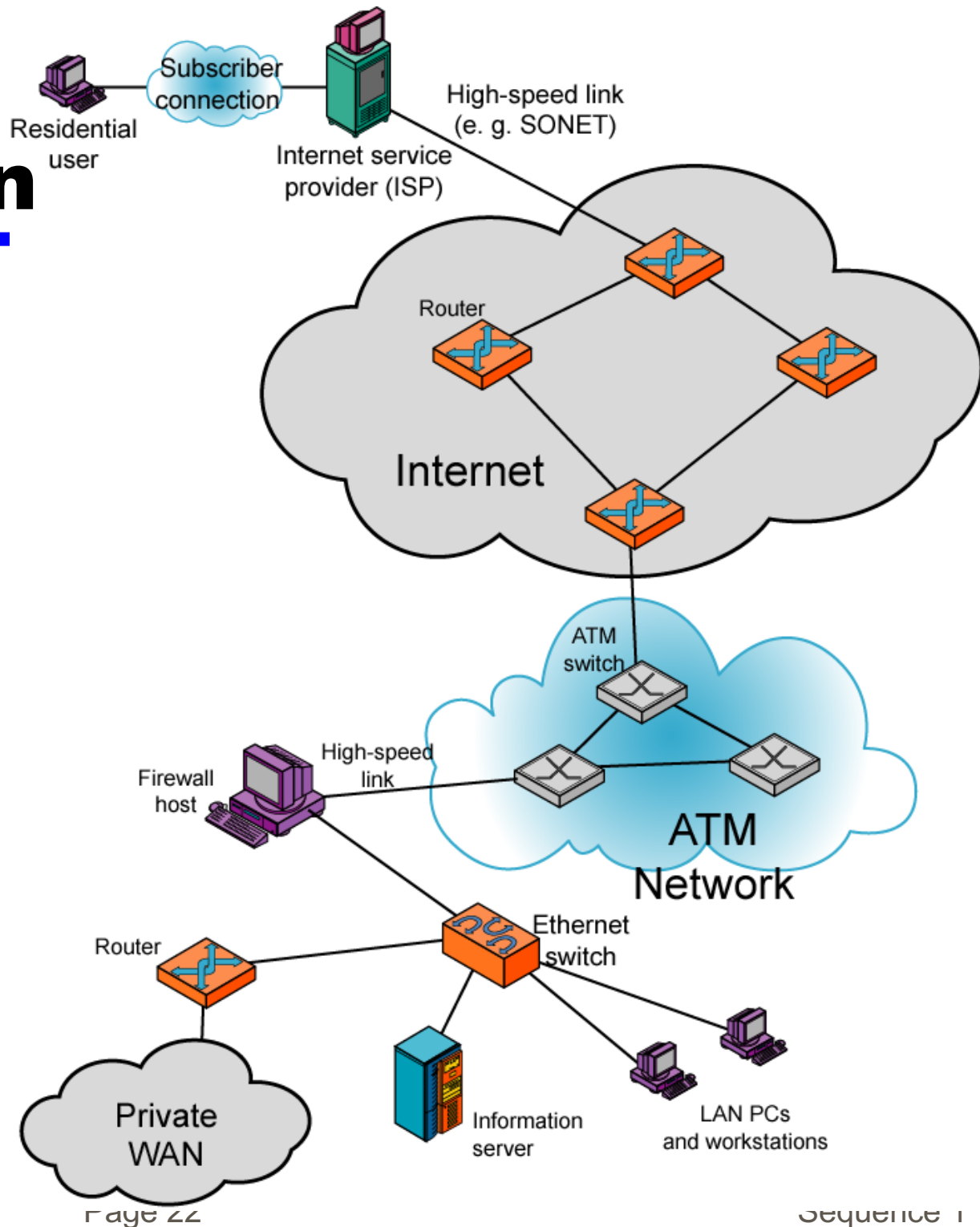- Constant data rate using packet switching technique

Local Area Networks

- Smaller scope
  - Building or small campus

- Usually owned by same organization as attached devices

- Data rates much higher

- Usually broadcast systems

- Now some switched systems and ATM are being introduced

Metropolitan Area Networks

- MAN
- Middle ground between LAN and WAN
- Private or public network
- High speed
- Large area

Networking Configuration

ATM WAN

Enterprise network (main campus)

Enterprise network (branch)

IP backbone

Public cellular network

Residential Wi-Fi network

Ethernet LAN

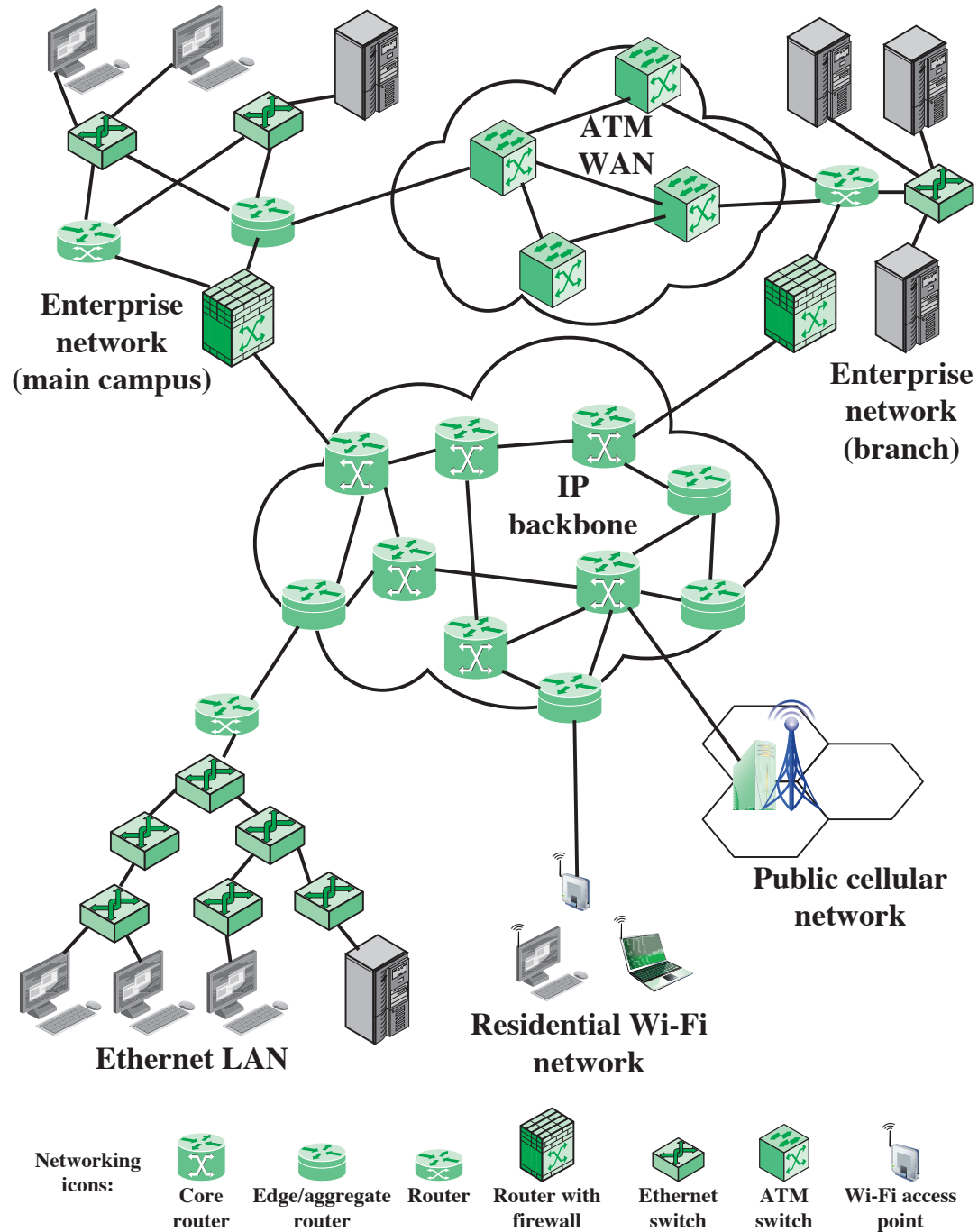| Networking icons: | Core router | Edge/aggregate router | Router | Router with firewall | Ethernet switch | ATM switch | Wi-Fi access point |

Figure 1.7 A Networking Configuration