LECTURE 01 : INTRODUCTION TO MODERN COMMUNICATIONS SYSTEMS

Prof. Dr. Qaysar Salih Mahdy

Communication Systems ME 229/A

Fall Semester : **Retake Course**

2023-2024

Week 1

Date : 10/10/2023

Outline

- Introduction to Modern Communications Systems
- Sampling and Pulse Modulation
- Pulse Code Modulation
- Digital Communications Line Codes and Pulse Shaping
- Digital Carrier Modulation
- M-ary Digital Carrier Modulation
- Error Detection and Correction
- Radar systems and CDMA techniques
- Radar systems and CDMA techniques II
- Line Coding for Digital Communication

Objectives

◦ The main objectives of this course:

◦ • To Introduce the basic types and principles of communication systems.

◦ •To understand the theory and applications of communication systems.

◦ •To give students Introduction to Modern Communications Systems

• Sampling and Pulse Modulation

• Pulse Code Modulation

• Line Coding for Digital Communication

• Digital Communications Line Codes and Pulse Shaping

• Digital Carrier Modulation

• M-ary Digital Carrier Modulation

• Error Detection and Correction

• Radar systems and CDMA techniques

• Radar systems and CDMA techniques II

◦ .

Lecture 1: Course Introduction

Today's Topics

- Course Information and Policies
- Course Syllabus
- Digital Communication Systems Today
- Examples of Communication Systems
- Design Challenges

Course Information

Instructor: Prof. Dr. Qaysar Salih Mahdi
Professor in Communication Engineering & Radar Engineering
Office hours: Tuesday 3-5 .
Grading:
Attendance
Participation
HW %,
Quizzes
Midterm Exam %,
 Final Exam 40%

Course Outline

- Modern communications systems

- Focus on transport layer.

- How do you encode information on a carrier?

- Finding your way around the RF spectrum

- Analog Systems

- Digital systems

- Sampling and Quantization

- Pulse code modulation (PCM)

- Digital modulation (PAM, ASK, FSK, PSK, QPSK, and QAM)

- Line Coding and ISI I SNR and performance

Early Communication Systems

Telegraph

1830, Joseph Henry

1832, Pavel Schilling

1837, Samuel B. Morese, Morse code

1844, What Hath God Wrought

Telephone

1876, Alexander G. Bell ("Watson come here; I need you.") 1888, Strowger stepper switch

1915, US transcontinental service (requires amplifiers)

Wireless telegraphy

1895, Jagadish Chandra Bose builds radio transmitter

1896, Marconi patents radio telegraphy

1901, Marconi, first transatlantic transmission

Radio

1906, Reginald Fessendend, first broadcast

Communication Systems Today

Public Switched Telephone Network (PSTN) for voice,
fax, modem

Radio and TV broadcasting

Citizens' band radio; ham short-wave radio

Computer networks (LANs, WANs, and the Internet)

Satellite systems (pagers, voice/data, movie broadcasts)

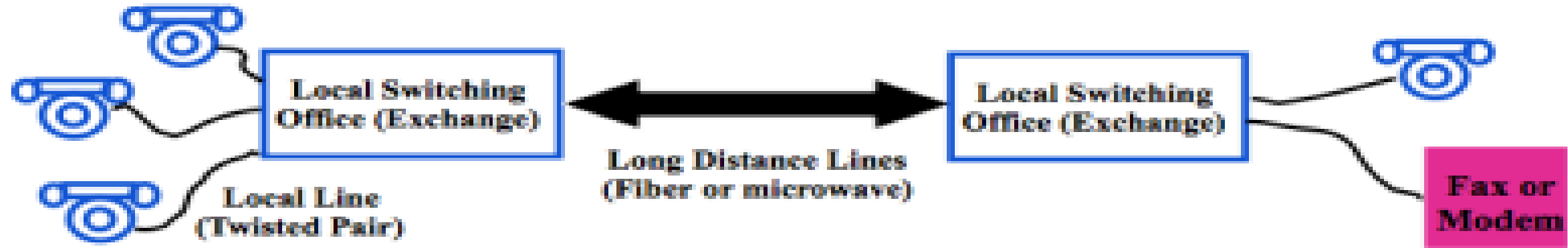Cable television (CATV) for video and data

Cellular phones

Bluetooth

GPS

Many others..

PSTN Design

- ▶ Local exchange
    - ▶ Handles local calls
    - ▶ Routes long distance calls over multiplexed high-speed connections
- ▶ Circuit switched network tailored for voice
- ▶ Faxes and modems modulate data for voice channel
- ▶ DSL uses advanced modulation to get 1.5-6.0 Mbps

Cellular System Basics
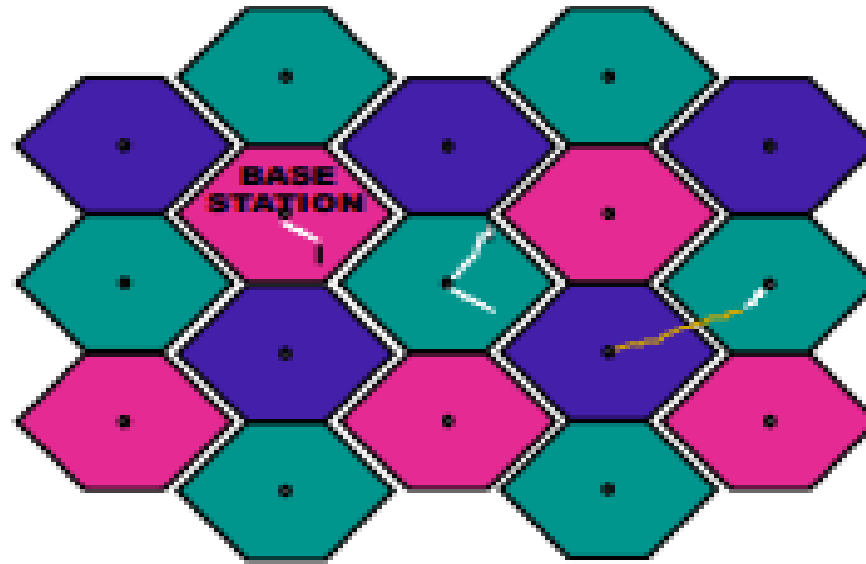
► Geographic region divided into hexagonal cells[1]

► Frequencies/timeslots/codes are reused at spatially-separated locations. (Analog systems use FD, digital systems use TD or CD.)

► Co-channel interference between same color cells

► Handoff and control coordinated through cell basestations

Cellular Phone Backbone Network

Mobile telephones depend on the PSTN — except for mobiles within the same MTSO (mobile telephone switching office)
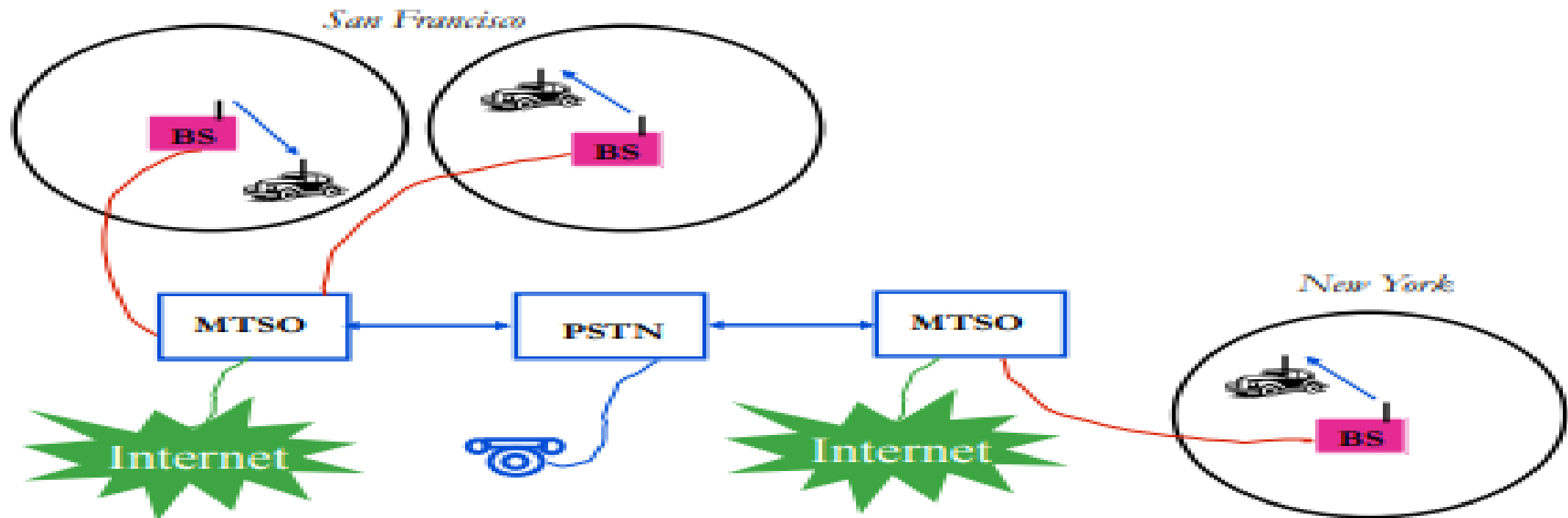
Local Area Networks (LAN)
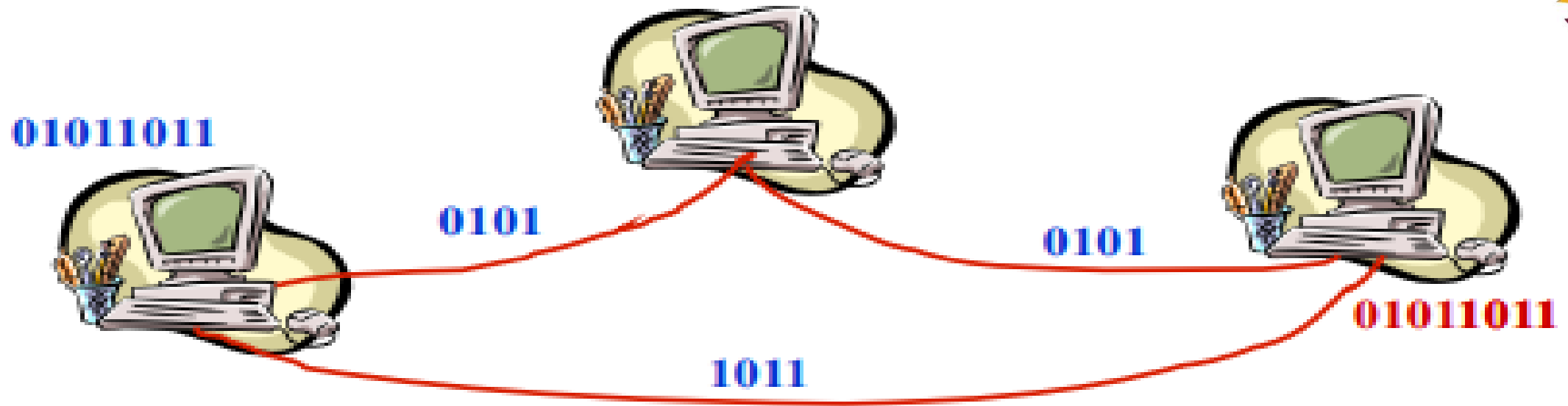
- "Local" means every computer can hear every other computer
- Packet switching instead of circuit switching (no dedicated channels)
- Data is broken down into packets
- Originally proprietary protocols; e.g., Ethernet was a collaboration between Intel, DEC, and Xerox. (DEC?)

Wireless Local Area Networks (WLAN)
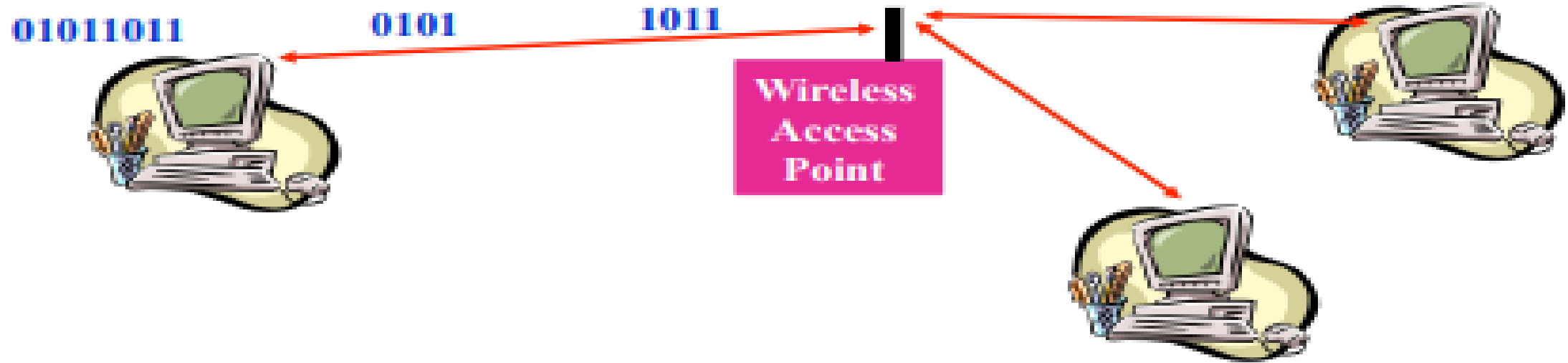
- ► WLANs connect "local" computers (100m range) to an access point
- ► As with LANs, data is broken down into packets
- ► Channel access is shared (random access)
- ► Access protocols for WLANs are much more complex than for LANs
- ► Backbone Internet provides best-effort service (no QOS guarantee)

Wide Area Networks; the Internet
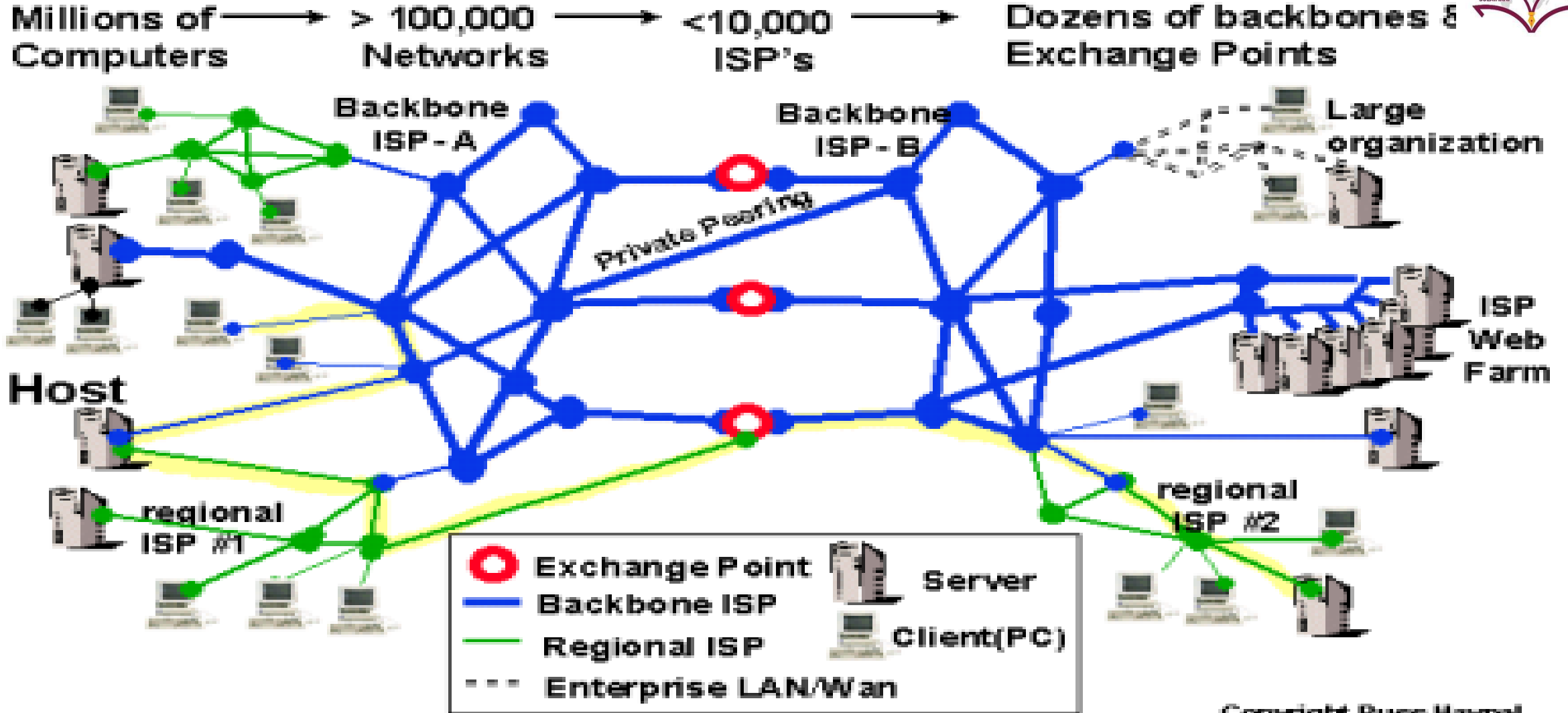
Satellite Systems

- ► Satellites cover very large areas
- ► Different orbit heights: GEOs (39000 Km) versus LEOs (2000 Km)
- ► Optimized for one-way transmission, such as radio (XM, DAB) and television (SatTV) broadcasting
- ► Latency (round trip delay) can be a problem

Bluetooth

- ► Ericsson, 1994, named for King Harald Blåtand Gormsen
- ► Intended as replacement for cables, such as RS-232
  Now used for input devices, cell phones, laptops, PDAs, etc.
- ► Short range connection (10–100 m)
- ► Bluetooth 1.2 has 1 data (721 Kbps) and 3 voice (56 Kbps) channels, and rudimentary networking capabilities

References

Textbook

1. B. P. Lathi, Zhi Ding - Modern Digital and Analog Communication Systems-Oxford University Press (2009)

2. Proakis, John, and Masoud Salehi. *Communication Systems Engineering*. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 2001. ISBN: 9780130617934.

Supplementary Texts and References

3. Bruce Carlson Late of Rensselaer Polytechnic Institute Paul B. Crilly University of Tennesse , COMMUNICATION SYSTEMS: AN INTRODUCTION TO SIGNALS AND NOISE IN ELECTRICAL COMMUNICATION, FIFTH EDITION.

4 . Haykin, Simon. *Communication Systems*. 5th ed. New York, NY: Wiley, 2009. ISBN: 9780470169964