

# CS5530

## Mobile/Wireless Systems

### Introduction

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# Intro of Intro

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- Yanyan Zhuang
  - PhD in network systems
  - [yzhuang@uccs.edu](mailto:yzhuang@uccs.edu)
- Office hours
  - M/W: an hour after class
  - F: 11am – 12pm
- Blackboard: announcement, schedules



# Outline

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- Why study mobile/wireless systems?
- What will you learn?
- Lectures, Assignments, Projects, Exams
- Course policy
- Overview



# Why study mobile/wireless systems?

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- Where does Internet come from?
  - Computer center → Computer networks → Internet
- Wireless
  - Mobility, flexibility



# What will you learn?

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- How do wireless networks work?
  - WiFi, cellular, Bluetooth, etc.
  - No heavy math!
- How to program on end-user devices?
  - iOS
  - Android



# Lectures, Assignments, Project, Exams

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- Lectures
  - Monday and Wednesday 4:45PM – 6:00 PM
  - ENGR 138
- Assignments (individual)
  - iOS/Android programming assignments
- Research project (individual or in groups)
  - Choose a topic that interests you, talk to me before you start
- Midterm and Final (online, open-book, limited time)
  - Midterm TBD, mid/late March (take home)
  - Final: 5:20 – 7:20 pm, May 10 (in class)  
<http://www.uccs.edu/Documents/cic/spring%202017/Final%20Exam%20Schedule.pdf>



# Course Policy

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- Grading scale

Percentage	Grade
90 - 100	A
87 - 89	A-
84- 86	B+
80 - 83	B
75 - 79	C+
70 - 74	C
65 - 69	D+
60 - 64	D
Below 60	F



# Course Policy (cont.)

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- Grading percentage
  - Assignments: 40%
  - Research project: 20%
  - Midterm: 20%
  - Final exam: 20%





# Where to get help?

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- Q&A in class
- Office hours
  - M/W one hour after class 6-7pm
  - F: 11:00am -- 12:00pm
  - By appointment
  - ENGR 184



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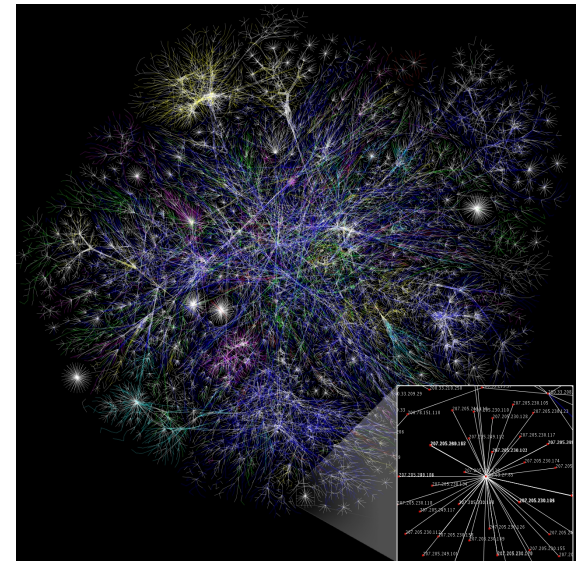
# Overview



# What is a Wireless Network

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- First, what is a network?
  - Computer networks
    - ▶ A large number of separate but interconnected computers
    - ▶ The connection: via a copper wire, fiber optics, microwaves, infrared, satellites, and so on
  - Internet
    - ▶ The most well-known network of networks



# Where did Internet come from?

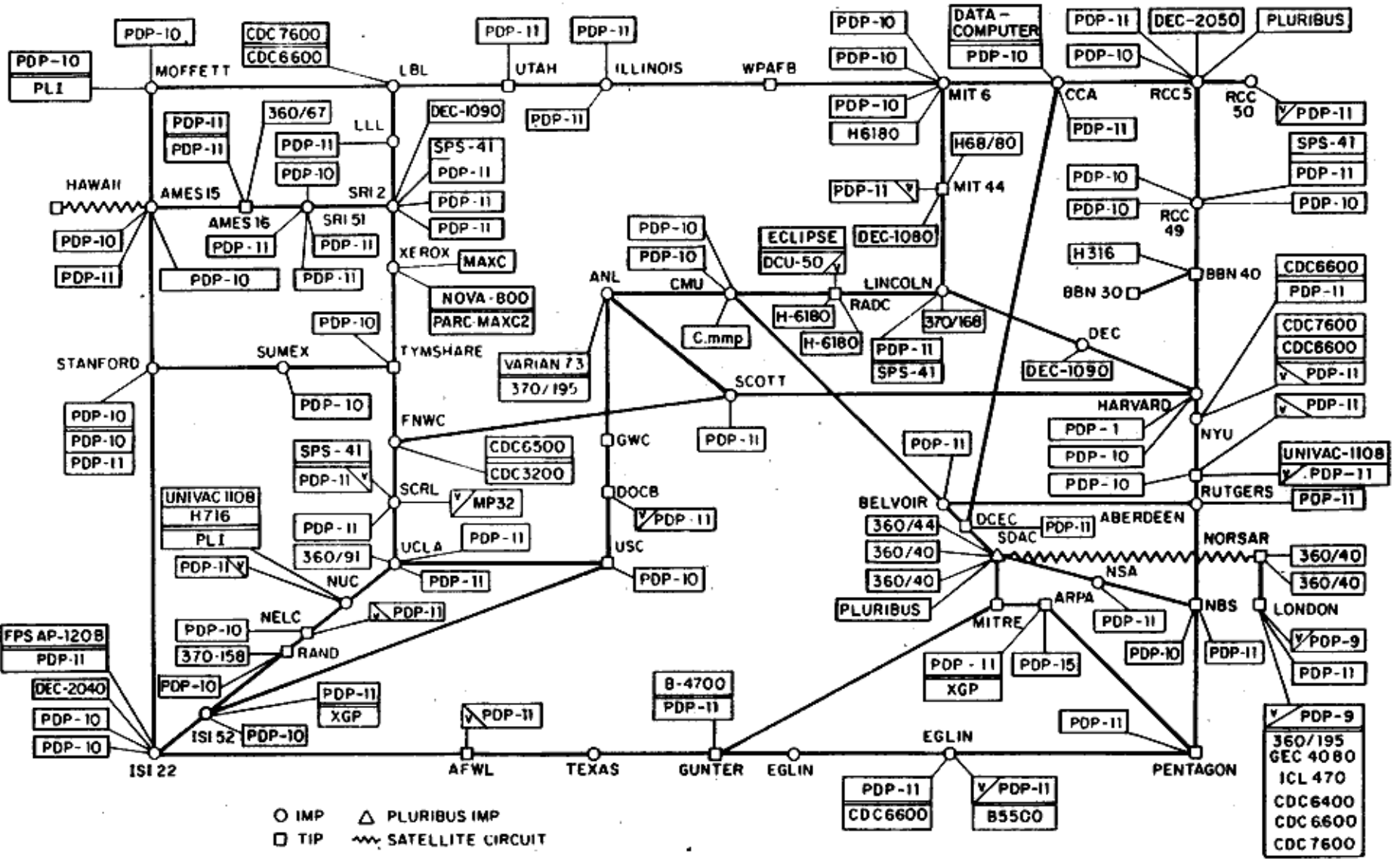
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- ARPANET (1966-1967): Advanced Research Projects Agency Network
  - Funded by Advanced Research Projects Agency (ARPA) of United States Department of Defense
- Goal: network academic computers (UCLA, SRI, UCSB, Utah -- first nodes in 1969)
- 1971: ~20 ARPANET nodes



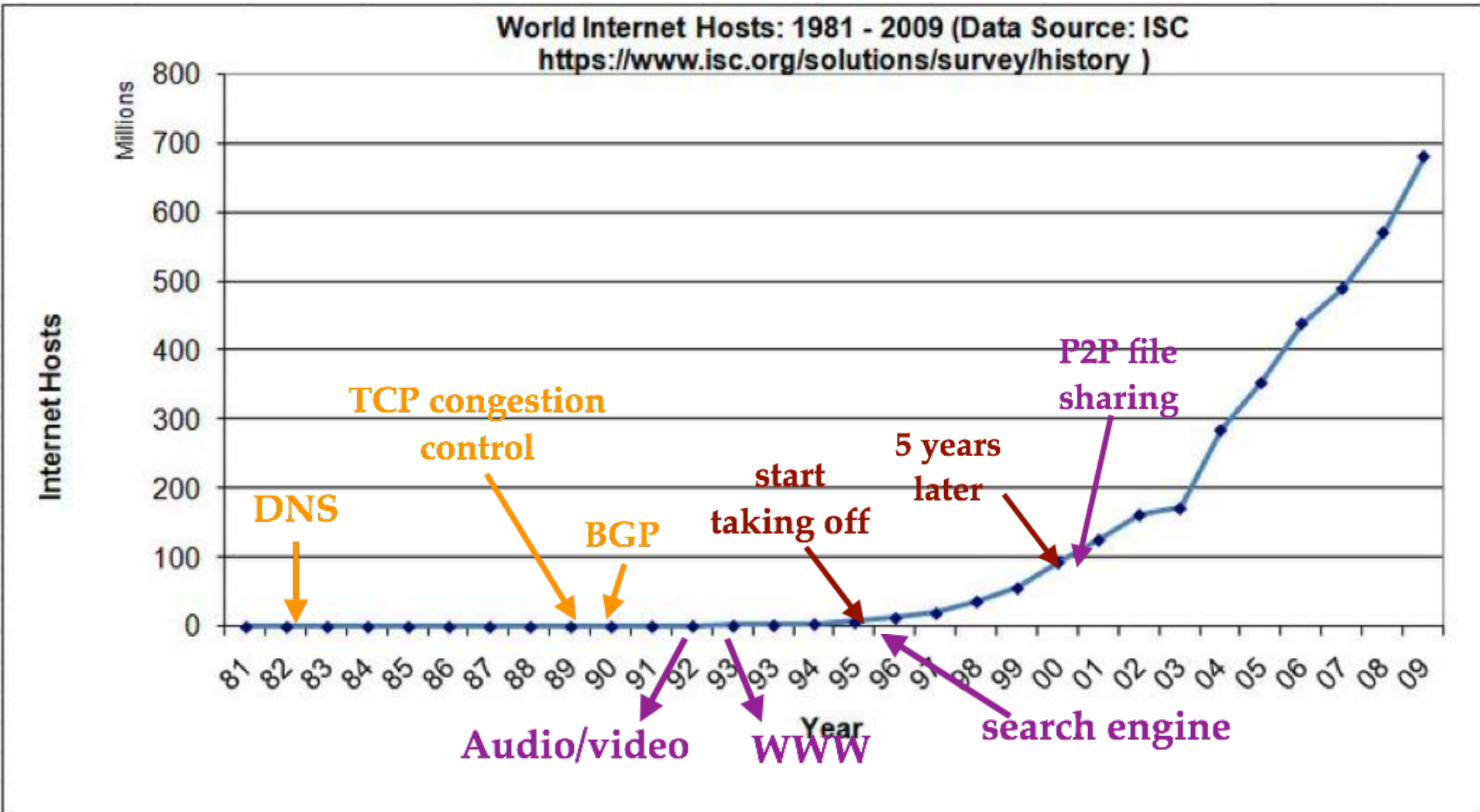


# ARPANET LOGICAL MAP, MARCH 1977



**1970s to 1980s: ARPANET transitioned to TCP/IP**

# Growth of Internet Hosts



# What is a Wireless Network (cont.)

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- Use of networks

- Business, home use

- Mobile users

- ▶ People **on the go** want to do all things they do at home and in office

- ▶ Mobile connectivity

- Cellular, WiFi (IEEE 802.11)

- ▶ Different mobile systems

- Smartphones/tablets/smart watch

- GPS

- RFID (Radio-Frequency IDentification)





# What is a Wireless Network (cont.)

- Some other wireless networks

- Sensor networks

- ▶ Made up of nodes that gather and wirelessly relay information they sense about the state of the physical world

- ▶ The nodes may be cars or phones, or may be separate devices

- Car's OBD sensors



- Separate devices

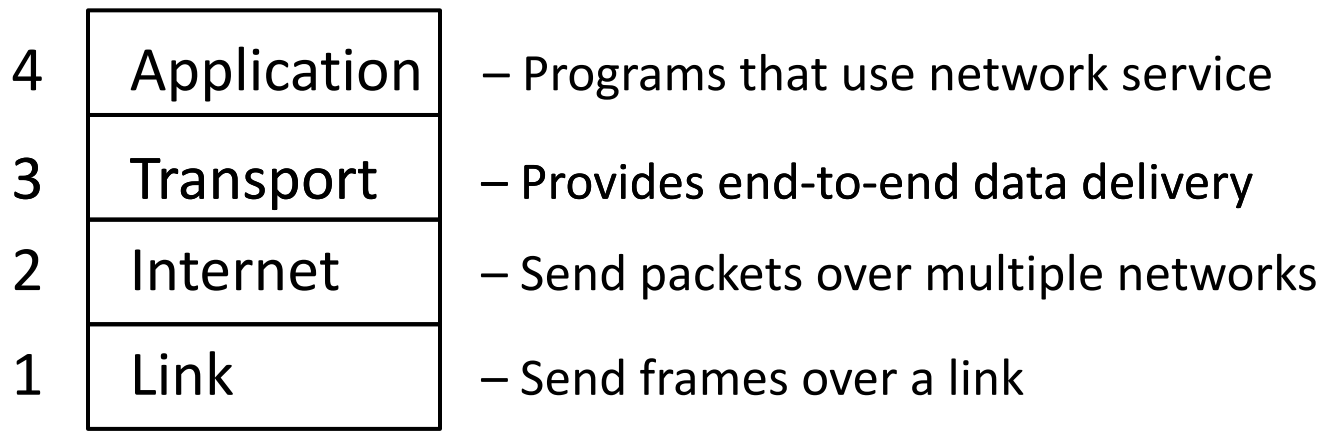
- accelerometers, barometers, ocean bottom seismometers, pressure recorders and hydrophone



# Network Reference Model

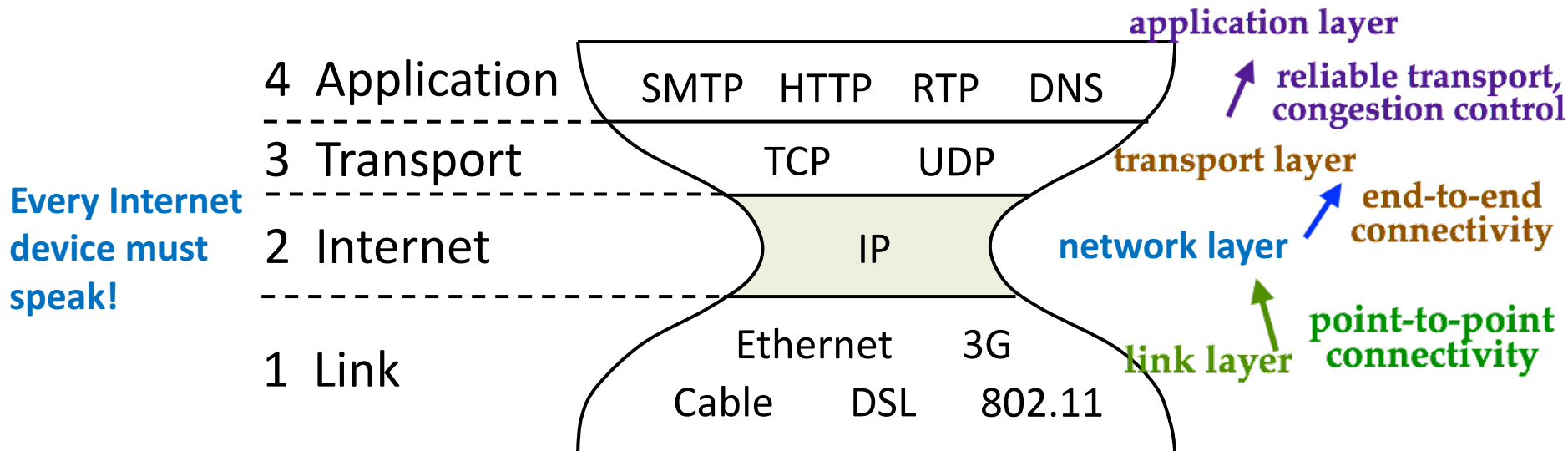
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- A four layer model based on experience



# Network Reference Model (cont.)

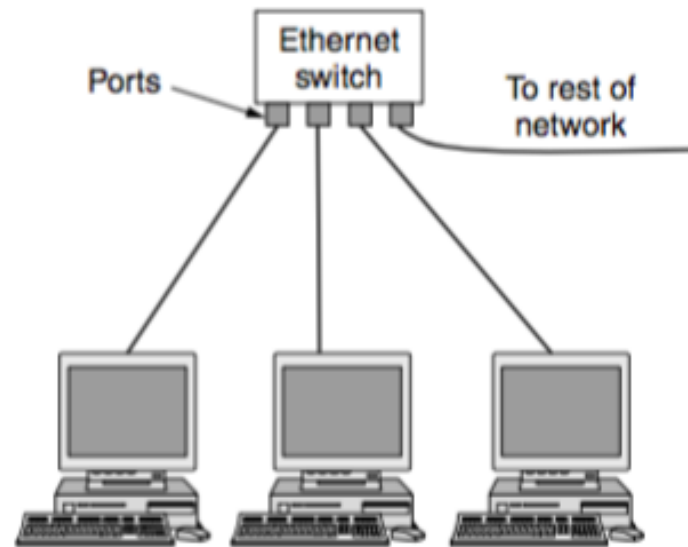
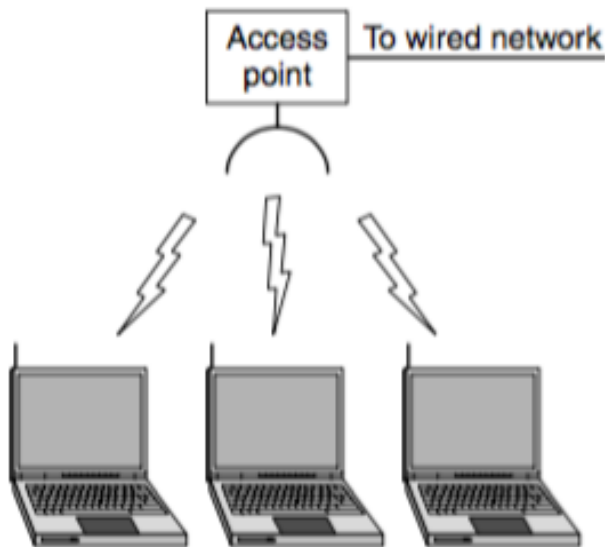
- A four layer model based on experience



# LAN and WLAN

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Wireless router  
/ Base station



The standard for wireless LANs is called **IEEE 802.11**, popularly known as **WiFi**



# Wireless vs. Wired

- Link layer

4 Application

SMTP HTTP RTP DNS

3 Transport

TCP UDP

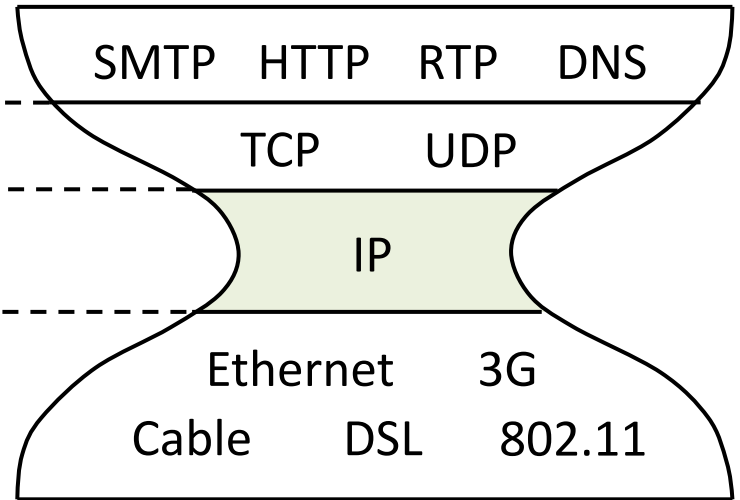
2 Internet

IP

1 Link

Ethernet 3G

Cable DSL 802.11



- Medium: open air

- No wiring required

- Less secure than wired networks

- It's a lot more difficult for unauthorized eavesdroppers and other snoops to monitor data in a wired network

# Wireless vs. Wired

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- Advantage
  - Allows mobility
  - Much cheaper and easier to deploy, change, and upgrade
- Disadvantage
  - Exposed (unshielded) medium
    - ▶ Susceptible to physical phenomena (interference)
    - ▶ More errors
  - Slower data rates for longer distances
  - Security: anyone in range hears transmission



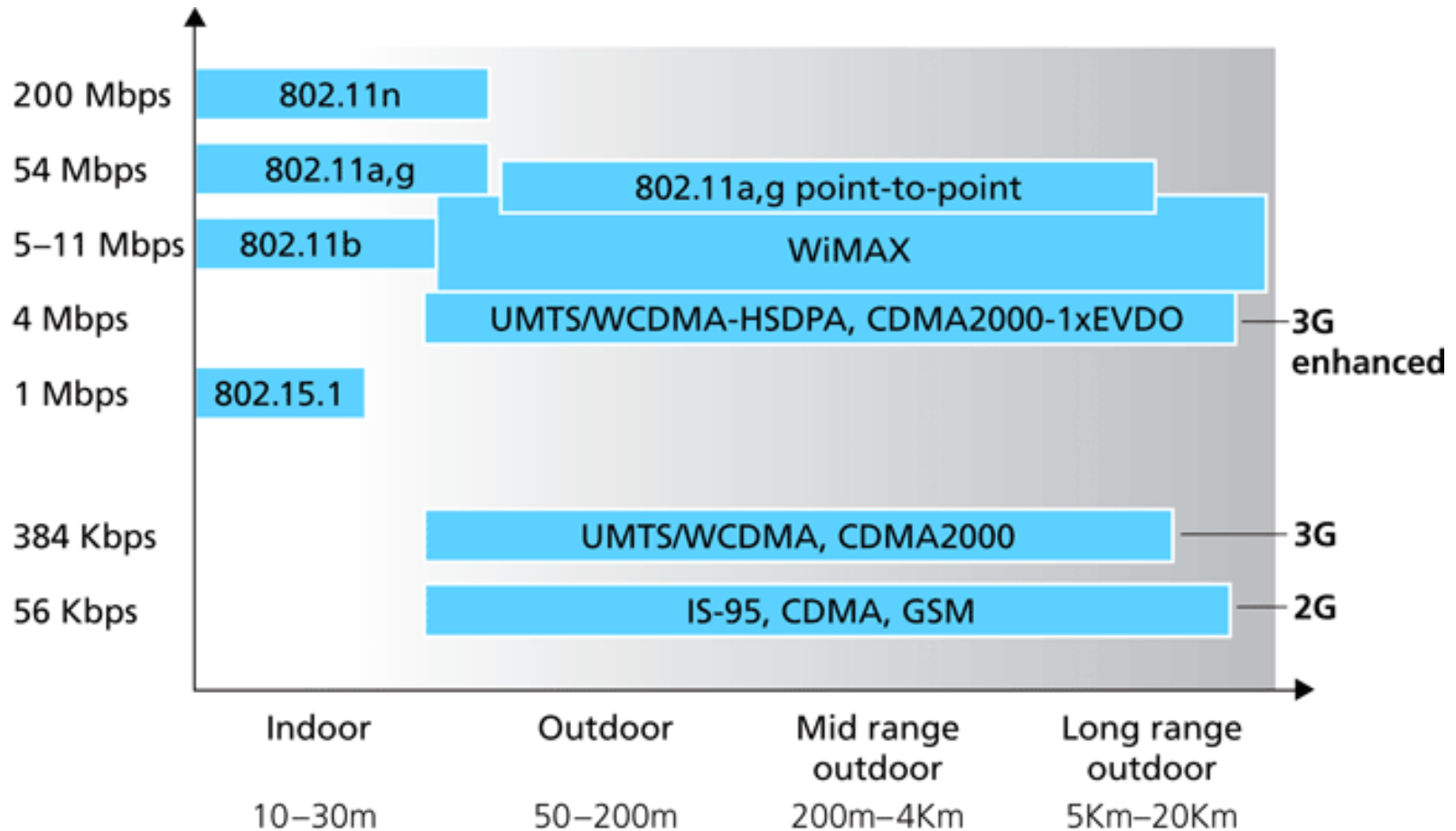
# Wireless Standards

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- Cellular
  - 2G: GSM, CDMA
  - 3G: CDMA2000, WCDMA, TD-SCDMA
  - 4G/5G/LTE
- IEEE 802.11
  - a: 5.0Ghz band, 54Mbps (*25 Mbps operating rate*)
  - b: 2.4Ghz band, 11Mbps (*4.5 Mbps operating rate*)
  - g: 2.4Ghz, 54Mbps (*19 Mbps operating rate*)
  - Other versions (802.11n, p, etc.)
- IEEE 802.15: low powered wireless
  - 802.15.1: 2.4Ghz, 2.1 Mbps (Bluetooth)
  - 802.15.4: 2.4Ghz, 250 Kbps (Sensor Networks)



# Wireless Link Characteristics



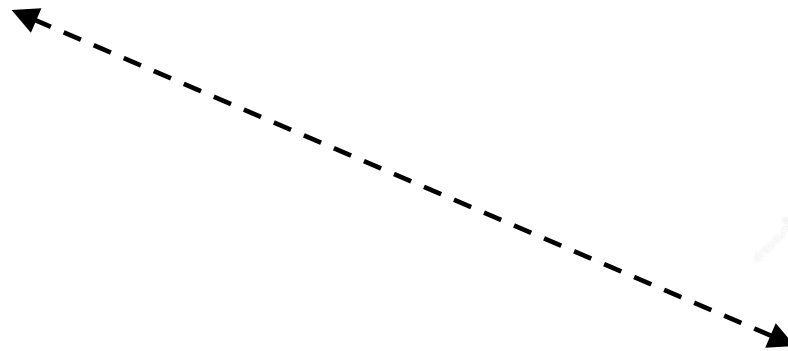


# Wireless Transmission Range

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The range that the receiver is just able to receive/decode the signal

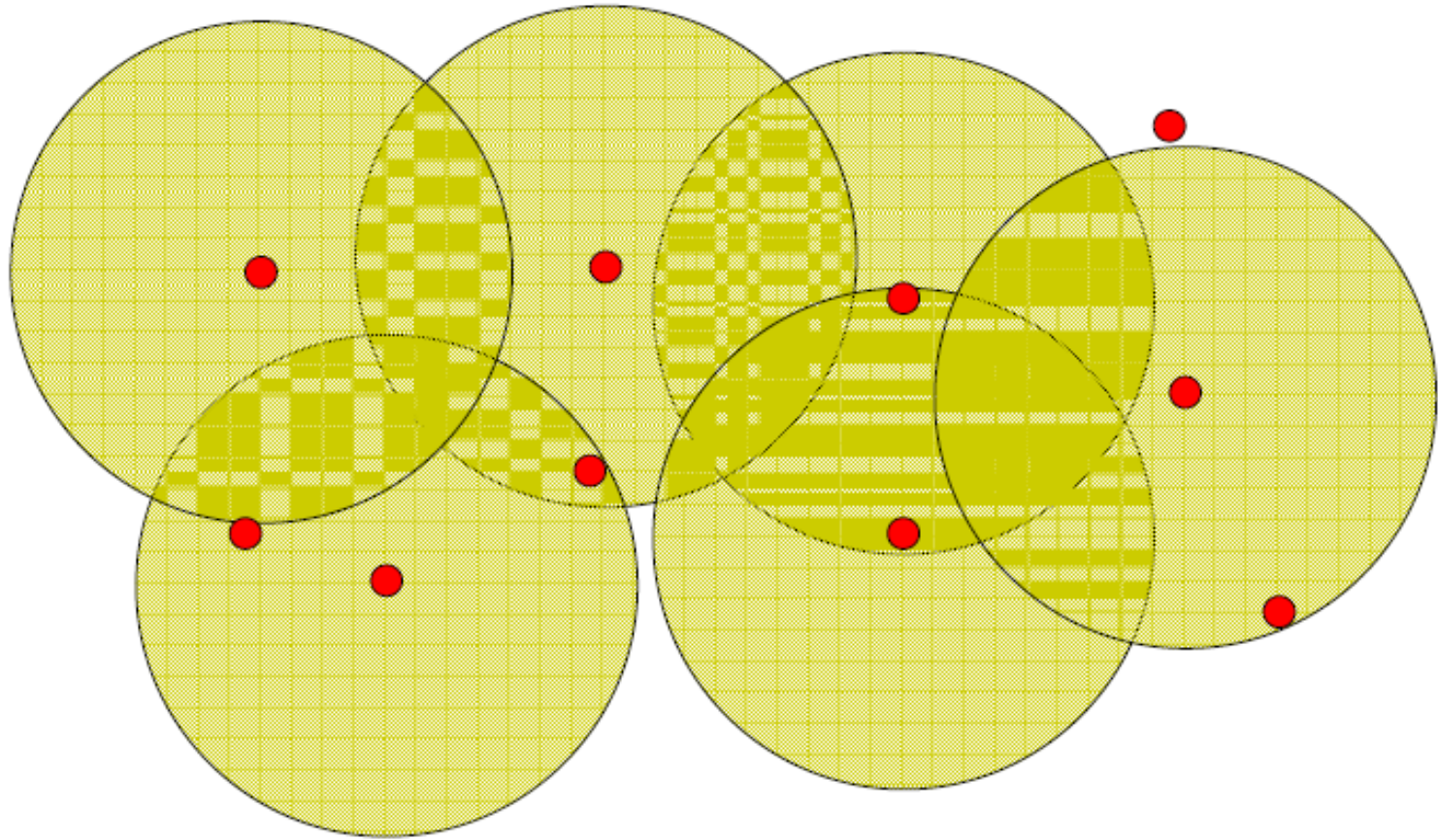


1. Transmission power
2. Signal-to-noise ratio



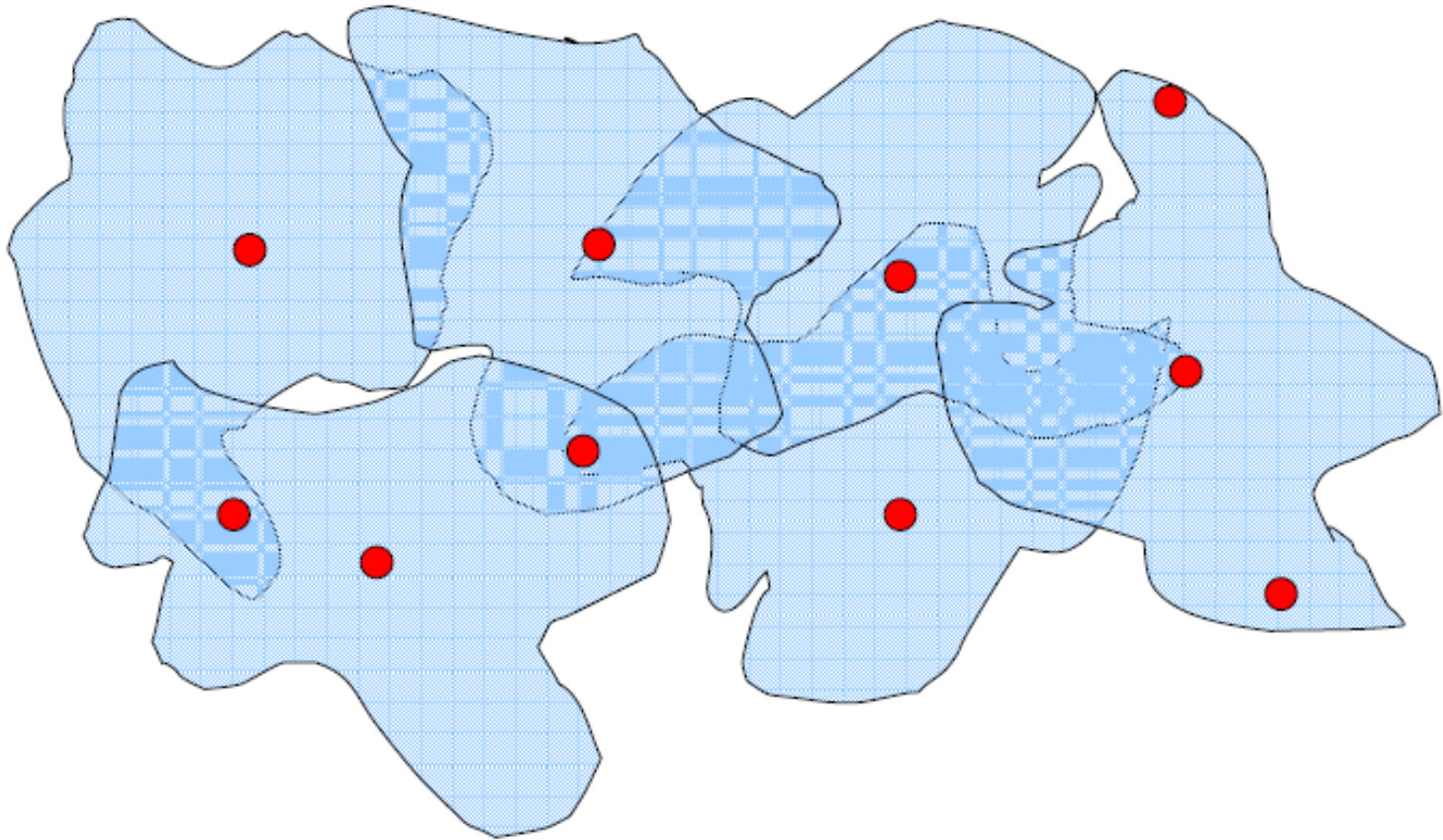
# A Wireless Link?

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# A Wireless Link!

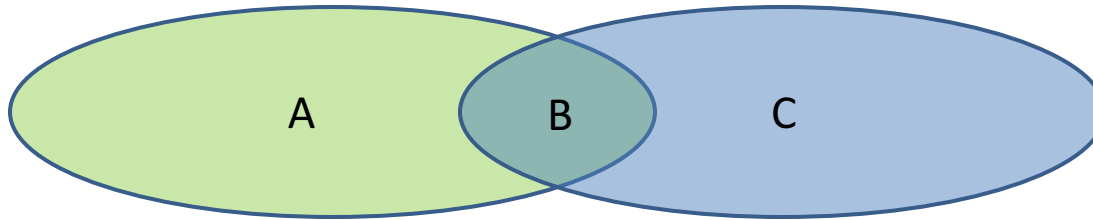
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# Some other issues

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- Hidden terminals

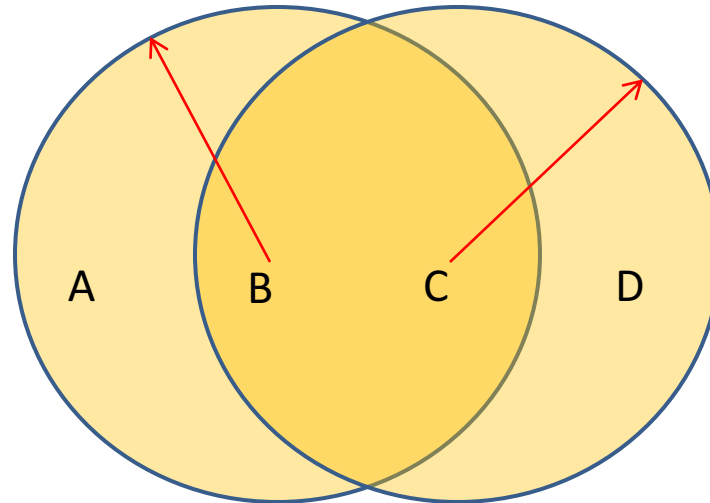


- A and C can both send to B but **can't hear each other**
  - A is a hidden terminal for C and vice versa

# Some other issues (cont.)

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- Exposed terminals



- **Exposed node**: B sends a packet to A; C hears this and decides not to send a packet to D (despite that this will not cause interference)

# Summary

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- What is a network
- Different kinds of wireless networks
- Wireless standards
- Issues with wireless networks

