Introduction to Wireless and Mobile Networking

Lecture 1: Introduction

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Course information

- Reference/Textbook:
  - A Guide to the Wireless Engineering Body of Knowledge (WEBOK), 2012
    - http://ieeexplore.ieee.org/xpl/bkabstractplus.jsp?bkn=6354027
- Grading
  - Homework (16%)
  - Midterm exam I(35%)
  - Midterm exam II (35%)
  - Final project (14%)
- In-class discussion
  - There is no stupid question!
  - Questions and discussions are encouraged
- Course website
  - https://ceiba.ntu.edu.tw/1022wmn

Schedule

- Course:
  - 9:10~12:00 every Monday
  - Ten-minute breaks * 2
- Semester Plan
  - Midterm exam
    - A4 cheat sheet (A4 大抄一張)
  - Simulation homework
    - Use C++ or Matlab
    - If you want to use other programming language, please talk to TA and me first.

What is this course about?

- Introduction to wireless and mobile networking
  - Introduction
    - Fundamental concepts and technology in mobile wireless systems
  - Wireless
    - What's special about wireless?
  - Mobile
    - What's special about mobile?
  - Networking
    - Cover topics in several OSI layers

Why should you take this course?

- Basic knowledge in wireless and mobile networking
- You will be able to do wireless and mobile networking research after taking this course

What will you learn?

- Basic knowledge in wireless and mobile networking
- Ability to understand a new wireless and mobile networking technology
- Ability to evaluate a wireless networking protocol with simulation
- Learn to work as a team
  - Team project
- Oral communications skills
  - [optional] Project proposal
  - Project presentation
- Written communications skills
  - Project report
  - [optional] Writing report with Latex
- Ability to start doing research
- Ability to analyze data sets
  - Data parsing and analysis (e.g. awk or Perl script)

Why wireless communications/mobile networking is important?

- Get a whole picture of wireless communications and mobile networking
- Wireless and mobile networks are important
  - Whether you are interested in IC design, communications, or networking, you should have basic understating about wireless and mobile networks.
- Many opportunities in this area
  - Technology advancement / research issues
  - Business ($$$) opportunities

Q & A

- Which course should I take before taking this course?
  - No prerequisite course
  - 電腦網路導論(Intro to Computer Networking) or 通信原理(Communication systems) will be helpful
  - But, you will be fine without them

    → This is an introduction course
    - There is one non-EECS background freshman took this course last year and he did well

Let's Get Started ☺

What is special about "wireless"?

- Wireless channel
  - Electromagnetic
  - Channel variation
  - Signal power attenuation
  - Sharing wireless medium

- What will happen if we apply the same wired-line networking protocol in wireless environments?

What is special about "mobile"?

- User mobility → where are you now?!
  - Mobility management
  - Handoff
- Tradeoffs
  - Precision of user location
    - Time to find your exact location
  - Signaling overhead
    - Cost of updating your location
  - Power consumption
    - Updating your location consumes battery power

Sometimes wireless != mobile

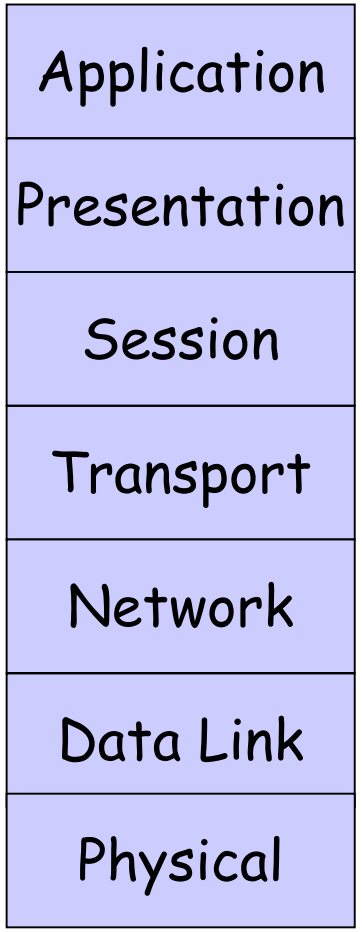
- Usually, if a network is wireless, it is mobile.
- But…
  - wireless not mobile
    - Sit in a coffee shop using WiFi access
  - mobile not wireless
    - Unplug your Ethernet cable of your laptop and move to library
- When you see a special system design, you should think why the system is designed in such a way?
  - wireless channel
  - mobility

Keep these 2 questions in mind

- While learning this course, ask yourself
  - What is special about "wireless"?
  - What is special about "mobile"?
- Hope you still remember the basic ideas about wireless and mobility
- When you find something challenging, there are opportunities!

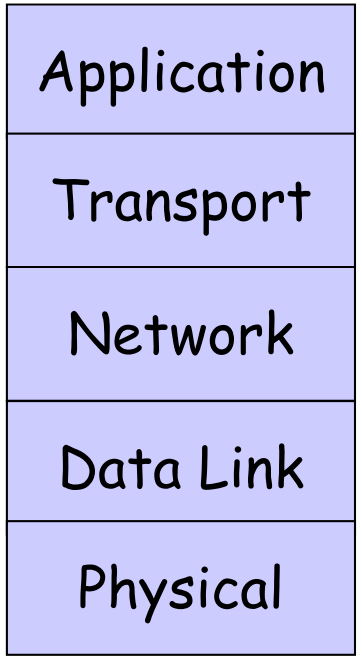
Overview of network architecture

- OSI Layer Reference Model
  - Open System Ineterconnection (OSI)
  - 7 Layers
- Why reference model?
  - Discuss communication protocols
  - Build product



Internet Protocol Stack

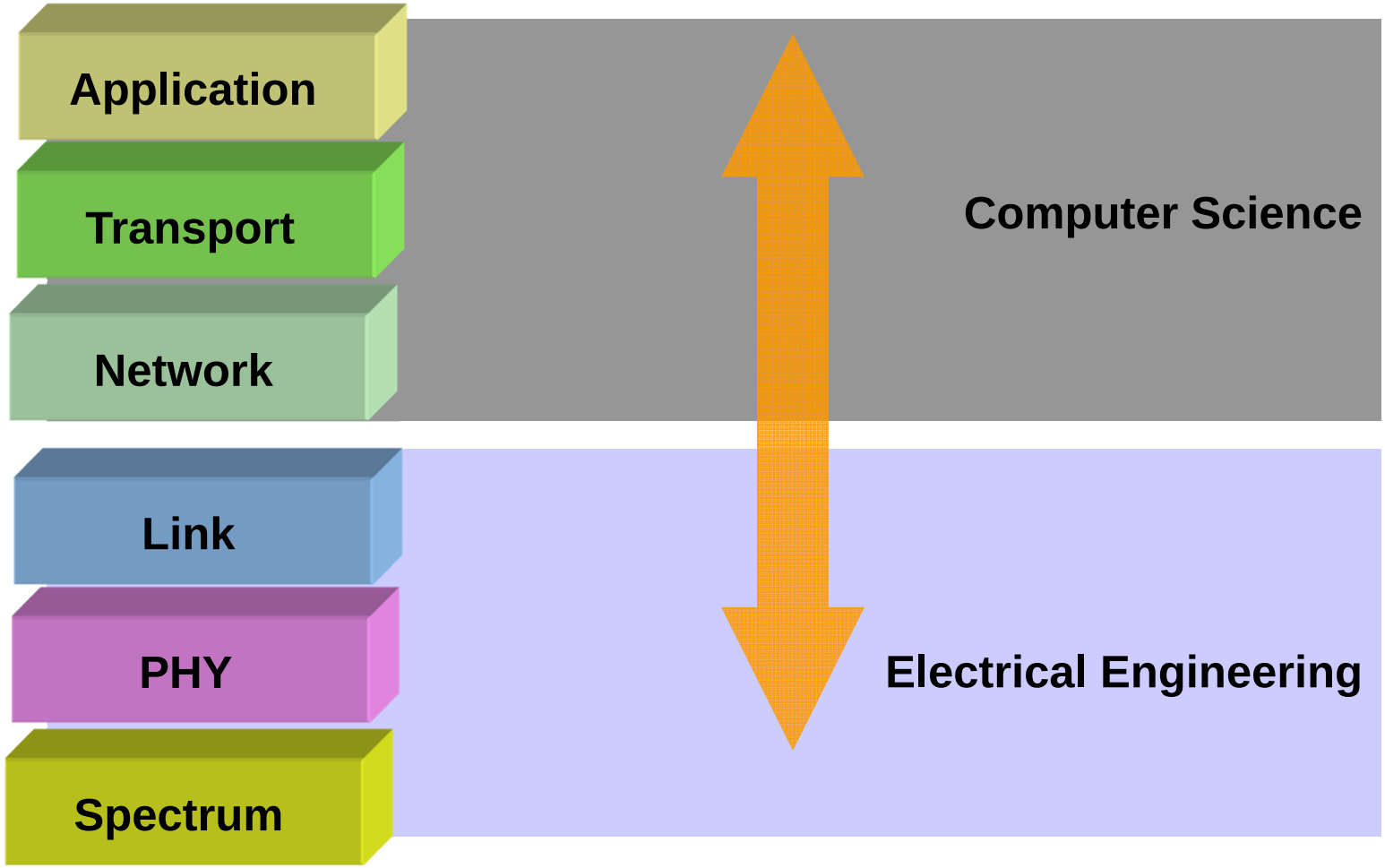
- Application layer
  - http, ftp, telnet
- Transport layer
  - TCP
  - UDP, RTP
- Network layer
  - IP
- Data link layer
  - 802.3 (Ethernet), 802.11
- Physical layer
  - Wireless, DSL



Why Layering?

- Modular design
  - Scalable network protocol design with separate modules
- Simplicity
  - Avoid complicated interactions between multiple layers
- Portability
  - Reuse the network protocol component in other scenarios
- Is layering always good? How about cross-layer approach?

Cross-Layer Approach



Convergent world

- Communications + Networking
- Data Communications + Telecommunications
- Hardware + Software
- EE + CS

My Teaching Plan

- A layered approach
  - Bottom-Up: from PHY, to upper layers
  - Go through issues in each layers, and some practical solutions to them
- Try to help you building a strong system concept
  - Problem solving paradigms
  - Wisdom from (your and others') experiences
  - Insight to future problems

Course Outline

- PHY Layer
- MAC Layer
- WLAN
- Network Layer
- Transport Layer
- Telecommunication Network
- Selected topics

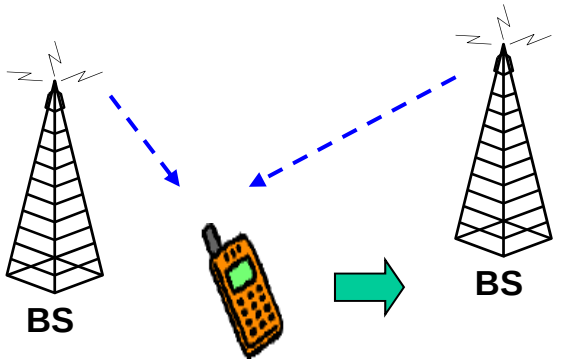
Physical Layer

- Wireless medium characteristics
  - Radio propagation model
- Communication perspective on wireless transmission
  - Modulation
  - Coding
  - How do I select modulation/coding scheme for my wireless system?

Link Layer (1)

- Sharing wireless resource
  - When should I transmit?
- Differences
  - I can overhear you!
  - I can interfere with your transmission!
  - I am not sure who is around me
    - This might be a 2D (3D) distributed problem

Link Layer (2)



- Handoff
  - User moves!
  - Definition: a mobile user moves from one base station to another base station
- Things to be done during handoff
  - Search who is available to serve me
  - Whom should I associate with?
  - Connect to the new base station
    - Registration
    - Security (authentication, authorization)
  - Update location database

Network layer

- Mobility
  - User can move!
  - Where are you?
- Mobility management and location management
  - Manage user location update
  - Cost to maintain precise user location
    - Registration signaling cost
  - Cost to find out exact user location
    - Paging cost

Transport Layer

- TCP
  - We use TCP everywhere
- Problem with TCP
  - TCP is designed to do congestion control
  - Packet loss is an indication for congestion
    - Packets are frequently lost in wireless and mobile networks
    - There might not be any congestion, but TCP agents think the network is congested
  - Acting weird!

Questions ?

There is no stupid question :D