CS120: Computer Networks

Lecture 1. Course Introduction 1

Zhice Yang

General Information

- Week 1-9
  - Zhice Yang (杨智策)
    - yangzhc@shanghaitech.edu.cn
    - Office hours:
      - Tuesday 10:30 a.m. – 11:30 a.m.
      - Office 1A-404E

- Week 9-16
  - Haoxian Chen (陈浩贤)
    - hxchen@shanghaitech.edu.cn
    - Office hours:
      - Thursday 10:30 a.m. – 11:30 a.m.
      - Office 1C-503A

General Information (cont.)

- TAs:
  - Fengxu Yang (杨丰旭)
    - yangfx@shanghaitech.edu.cn
  - Yihong Hang (杭奕泓)
    - hangyh2023@shanghaitech.edu.cn
  - Chenfei Gao (高宸飞)
    - gaochf2022@shanghaitech.edu.cn
- Wechat
  - Q&A
  - Urgent Notifications
- Blackboard (互动教学平台)
  - Notifications
  - Course Materials
  - Homework Submission
- Github
  - https://github.com/sist-cs120/project-wiki
  - Project-related Discussion

Wechat QR Code

General Information (cont.)

- Textbook
  - Computer Networks: A System Approach 5th
    - by Larry Peterson, Bruce Davie
  - Computer Networks: A System Approach 6th
    - by Larry Peterson, Bruce Davie
    - https://item.jd.com/13015993.html
    - Open access version: https://book.systemsapproach.org/
- Reference Textbook
  - Computer Networking: A Top-Down Approach 8th
    - by James Kurose, Keith Ross
    - https://item.jd.com/13464817.html

Grading

- **No Cheating !**
  - Once confirmed. Fail the course

- 20% Homework
  - Four Homework Assignments (5% each)

- 35% Final Exam
  - No Midterm

- 45% Course Project
  - Group: <= 2 students
    - email TA (hangyh2023@shanghaitech.edu.cn) your group members no later than Oct. 6
  - 40% for four subprojects (about 10% each)
    - Submit your project (code) to Blackboard
    - Ask TAs to check and grade your project before submitting your code
  - 5% if you finish all the four subprojects
    - "finish" means: obtain a minimum score of 60% of the compulsory parts of every subproject
  - Reference code of project 1 and 2 is provided after the due
  - Programming language: No restrictions (Java is suggested)
  - Estimated coding overhead (3000 lines)
  - You can use any open-source code (should be explicitly acknowledged with reference links)
  - Project checking is scheduled on weekends
  - Can only use the provided sound cards

- Up to 25% Bonus Score
  - For finishing Course Project optional parts

- Up to 5% Attendance

- Delayed Submissions
  - -10 % * N, N is the delayed time in unit of day (N<=10)
  - -5% for the first 0 – 12 Hours
  - -10 % for the first 12 – 24 Hours

START PROJECT EARLY

5

Week	Time		Time	
1	Sep. 25	Course Introduction 1	Sep. 27	Course Introduction 2
2	~~Oct. 2~~		~~Oct. 4~~	
3	Oct. 9	Physical Layer	Oct. 11	Discussion: Audio Interface
4	Oct. 16	Framing & Error Detection	Oct. 18	Reliable Transmission
5	Oct. 23	Multiple Access 1	Oct. 25	Multiple Access 2
6	Oct. 30	Switching	Nov. 1	IP address
7	Nov. 6	RIP and OSPF	Nov. 8	BGP
8	Nov. 13	NAT and Router Design	Nov. 15	Discussion: Network Simulator
9	Nov. 20	SDN	Nov. 22	Mobile Routing
10	Nov. 27	TCP 1	Nov. 29	TCP 2
11	Dec. 4	Congestion Control 1	Dec. 6	Congestion Control 2
12	Dec. 11	Other Topics in TCP	Dec. 13	Data Compression
13	Dec. 18	DNS	Dec. 20	HTTP & SMTP
14	Dec. 25	FTP & P2P	Dec. 27	Network Security 1
15	Jan. 1	Network Security 2	Jan. 3	Summary
16	Jan. 8		Jan. 10	
18	Jan. 22		Jan. 24	

Week	Time		Time	
1	Sep. 25	Course Introduction 1	Sep. 27	Course Introduction 2
2	~~Oct. 2~~		~~Oct. 4~~	
3	Oct. 9	Physical Layer	Oct. 11	Discussion: Audio Interface
4	Oct. 16	Framing & Error Detection	Oct. 18	...ission
5	Oct. 23	Multiple Access 1	Oct. 25	Multiple Access 2
6	Oct. 30	Switching	Nov. 1	IP address
7	Nov. 6	RIP and OSPF	Nov. 8	BGP
8	Nov. 13	NAT and Router Design	Nov. 15	...work Simulator
9	Nov. 20	SDN	Nov. 22	...bile Routing
10	Nov. 27	TCP 1	Nov. 29	TCP 2
11	Dec. 4	Congestion Control 1	Dec. 6	...ntrol 2
12	Dec. 11	Other Topics in TCP	Dec. 13	Data Presentation & Compression
13	Dec. 18	DNS	Dec. 20	HTTP & SMTP
14	Dec. 25	FTP & P2P	Dec. 27	Network Security 1
15	Jan. 1	Network Security 2	Jan. 3	Summary
16	Jan. 8		Jan. 10	
18	Jan. 22		Jan. 24	

proj0 release

proj1 release

proj0 due

proj1 due

proj2 release

proj2 due

proj3 release

proj3 due

proj4 release

proj4 due

Withdraw Policy

- According to University's Policies

What is a Computer Network

Internet

Information Sharing

Email

Device to Device Connections

USB Type-C

Wireless Connections

The Goal of This Course is

- NOT
  - Writing network apps
  - Configuring network devices

The Goal of This Course is

to Build a Computer Network

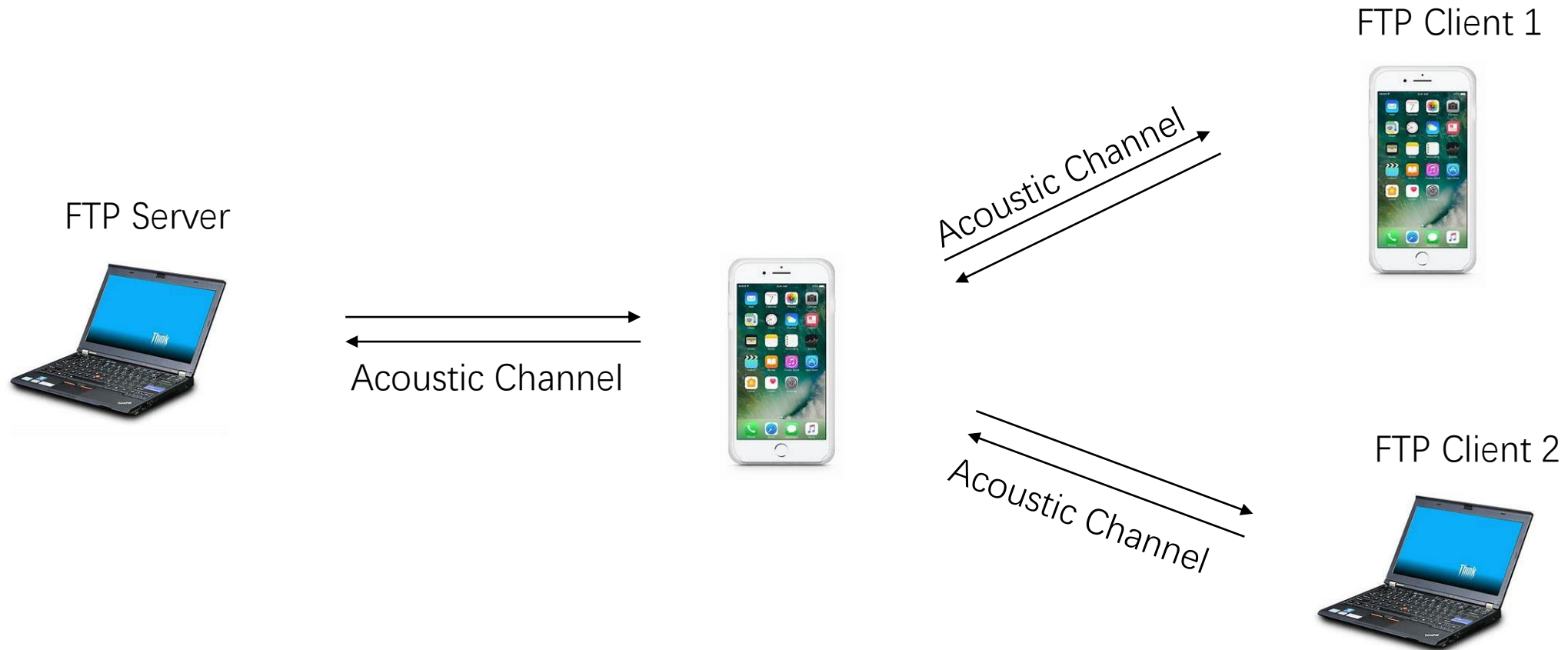to understand how real computer networks work

Top-Down

Bottom-Up

Build a HTTP Service from Ground up ?

- A Real Network Like Internet is too Complicated
  - Implement an http server (Apache, Nginx⋯)
  - Implement an http browser (Chrome, IE⋯)
  - Implement a TCP/IP stack (net/core, socket⋯)
  - Implement a link layer driver (ath9k, e1000⋯)
  - Implement a modem chip (ar9285, Intel i210⋯)

Too Much…

About our Project

- Acoustic Network (Athernet)

FTP Client 1

FTP Server

Acoustic Channel

Acoustic Channel

Acoustic Channel

Acoustic Channel

FTP Client 2

Subproject 1

- Acoustic Connection
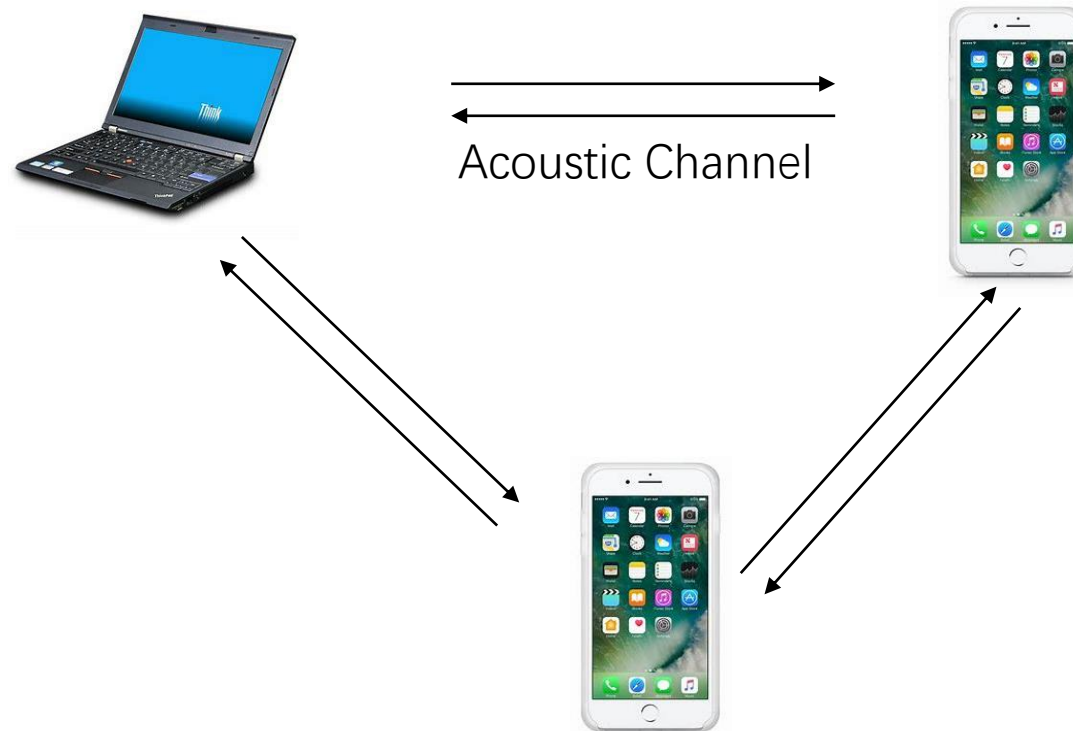 - Node to node connection through speakers and microphones

Acoustic Channel

Subproject 2

- Multiple Access
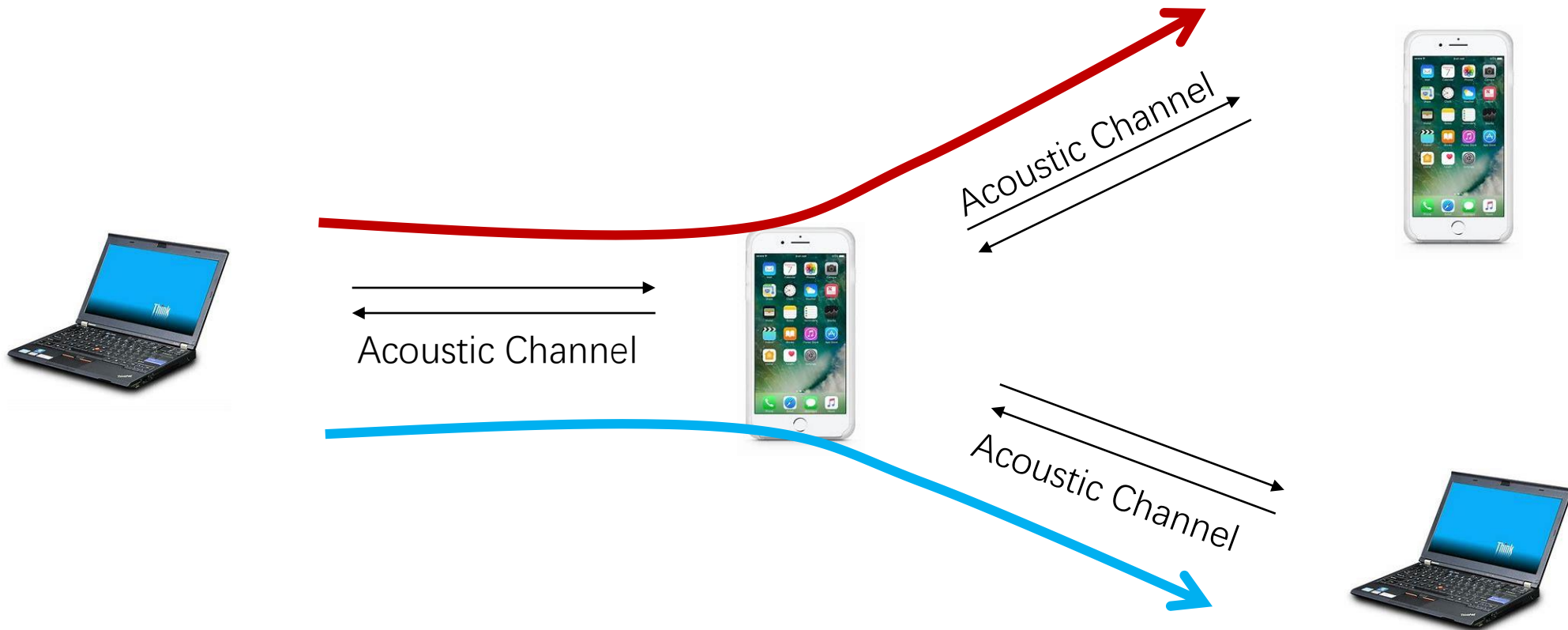   - Efficiently handle the access of multiple nodes
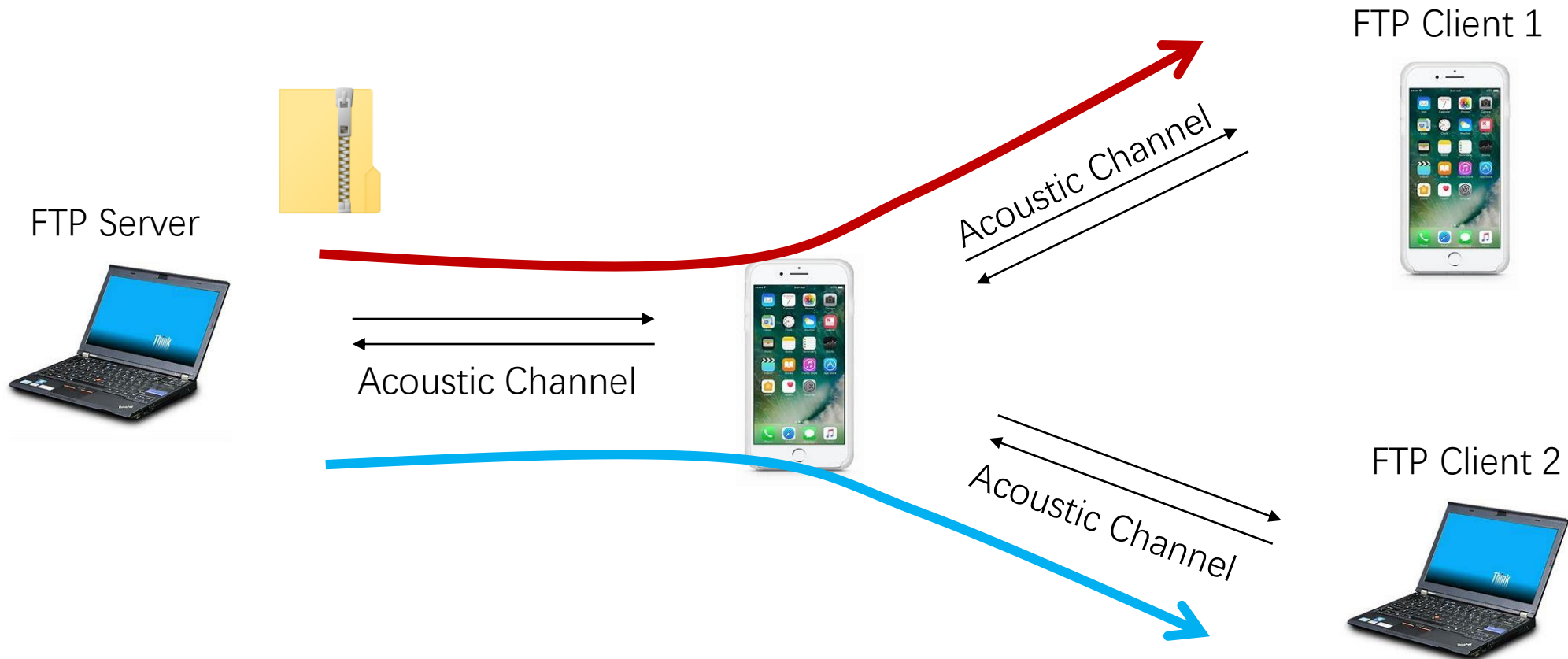
Acoustic Channel

Subproject 3

- NAT
  - Implement a network gateway

Acoustic Channel

Acoustic Channel

Acoustic Channel

Acoustic Channel

Subproject 4

- Reliable Delivery and Network Application
    - e.g.: FTP

FTP Client 1

Acoustic Channel

FTP Server

Acoustic Channel
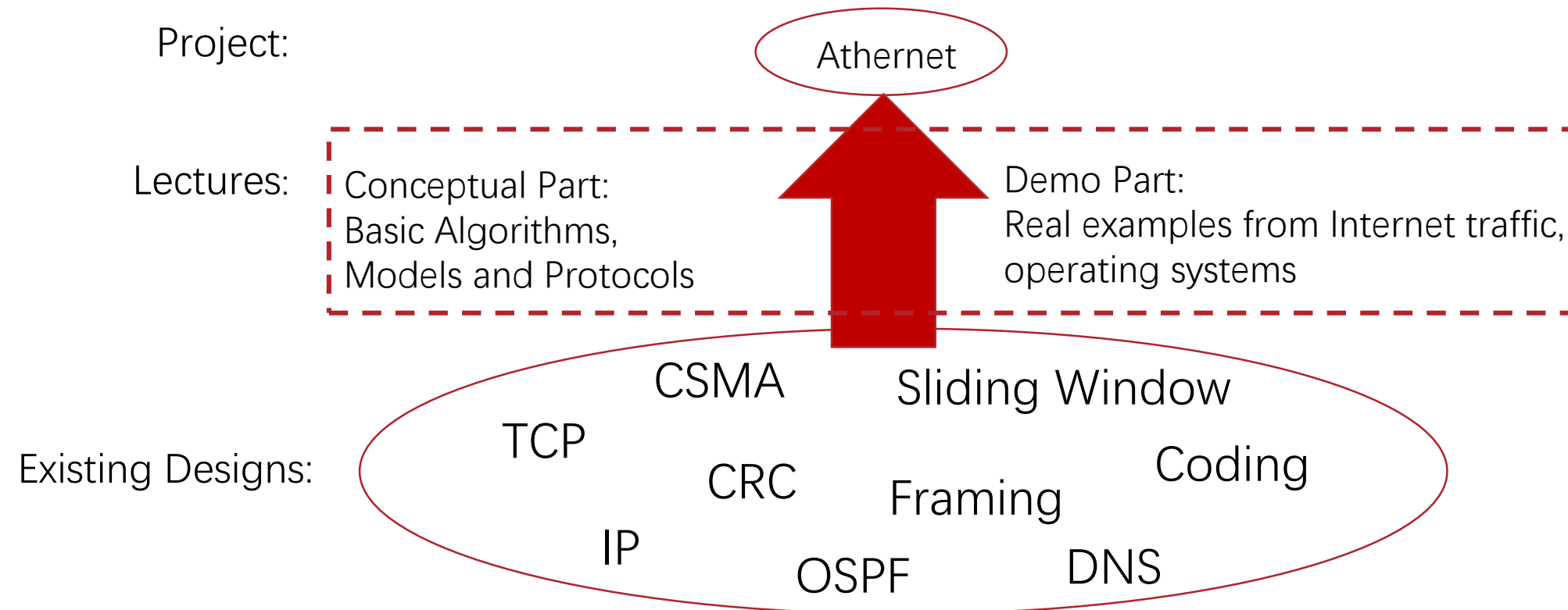
Acoustic Channel

FTP Client 2

About the Project

- Building the Acoustic Network
  - Basic Communication
  - Reliability
  - Resource Sharing
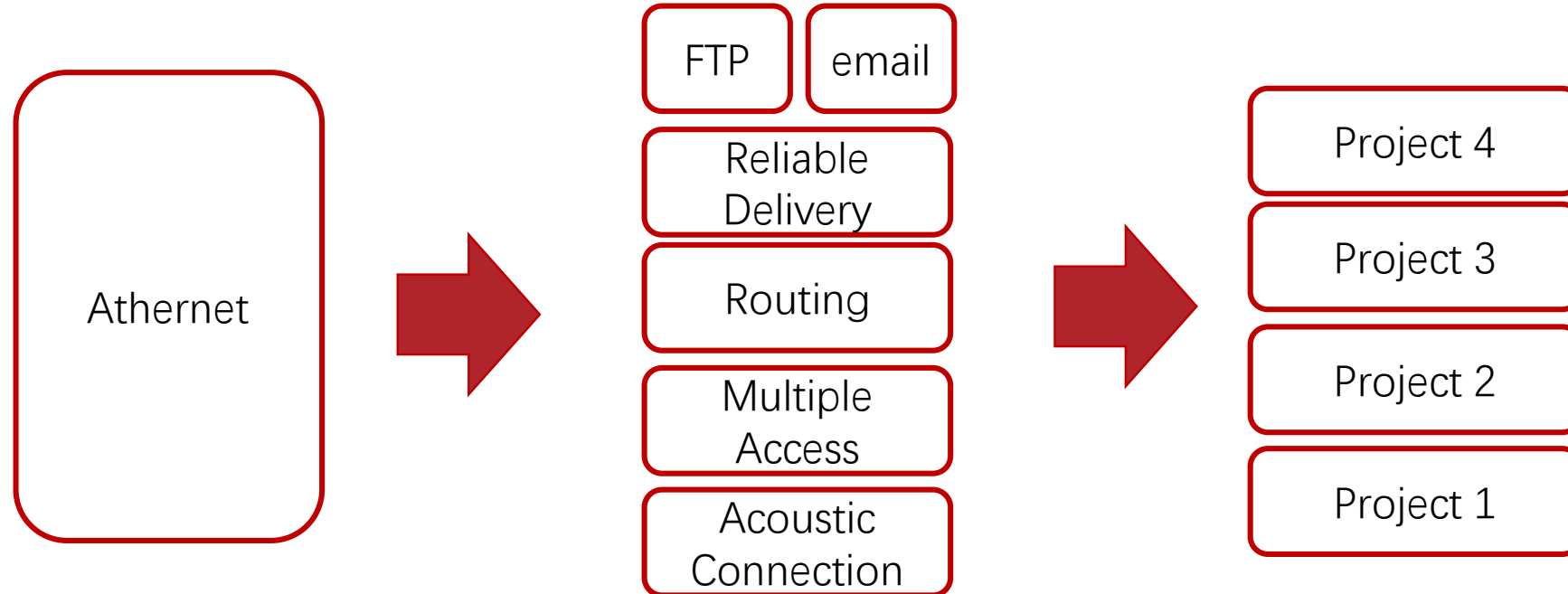 - Scalability
  - etc.

Still Very Challenging …

Shoulders of Giants

- We introduce and borrow existing designs from state-of-the-art network technologies (especially the Internet)

Project:

Athernet

Lectures:

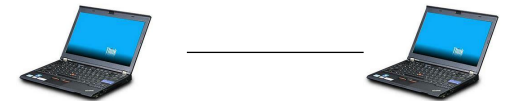Conceptual Part:
Basic Algorithms,
Models and Protocols

Demo Part:
Real examples from Internet traffic,
operating systems

Existing Designs:

CSMA   Sliding Window

TCP

CRC   Coding

Framing

IP

OSPF   DNS

The Concept of Network Layering

- Benefit
  - Modular Design

Athernet	→	FTP	email

Reliable Delivery

Routing
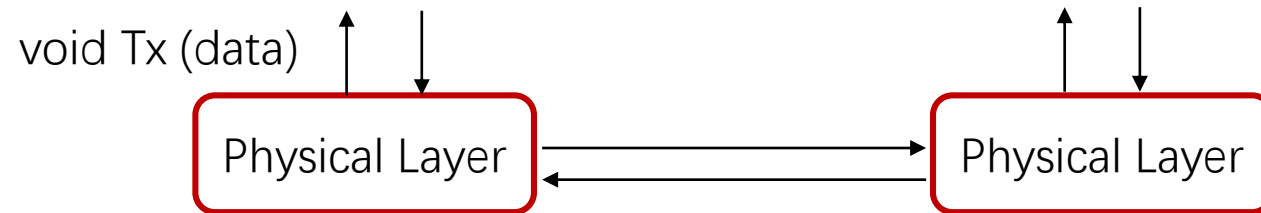
Multiple Access

Acoustic Connection
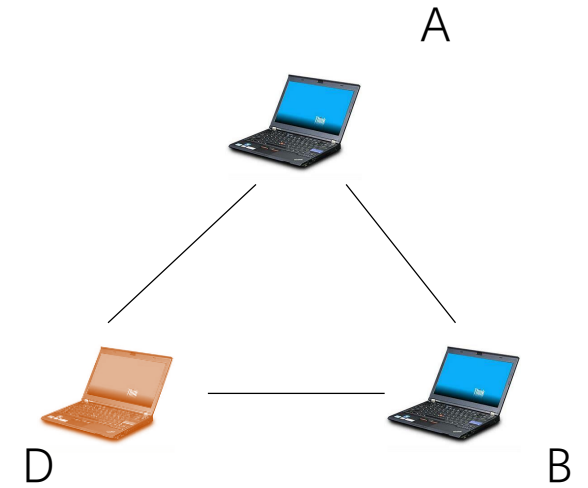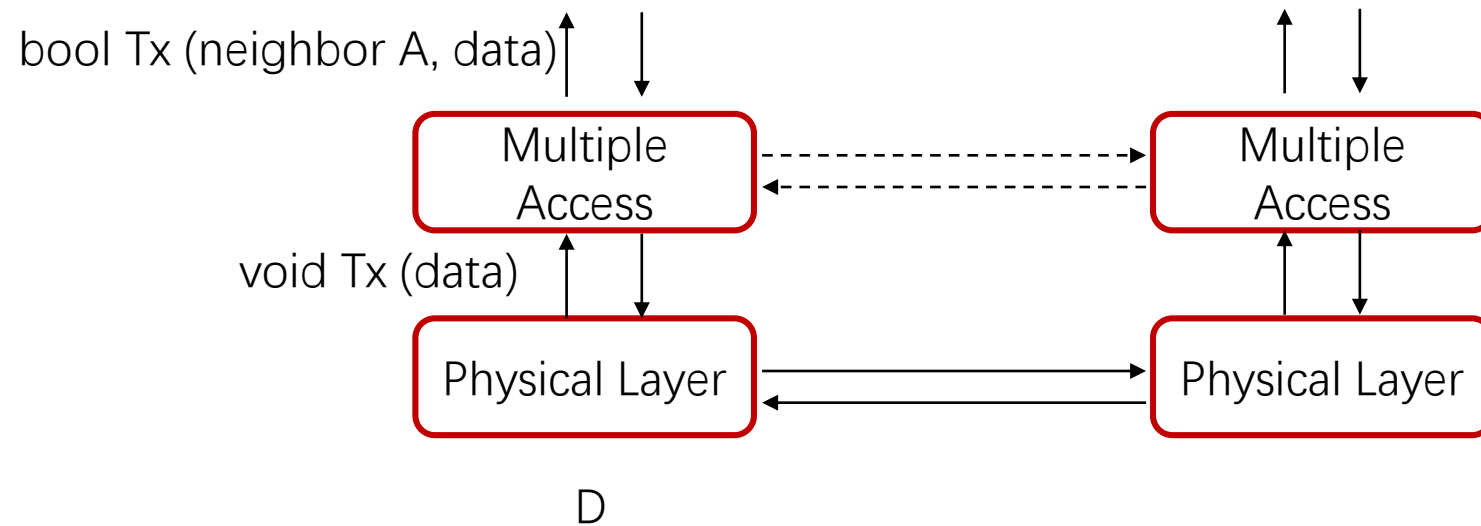
Project 4

Project 3

Project 2

Project 1

How Laying Works ?

- Protocols
  - One or more protocols implement the functionality of a certain layer
  - A protocol defines a communication service
    - Service Interface (for upper layer)
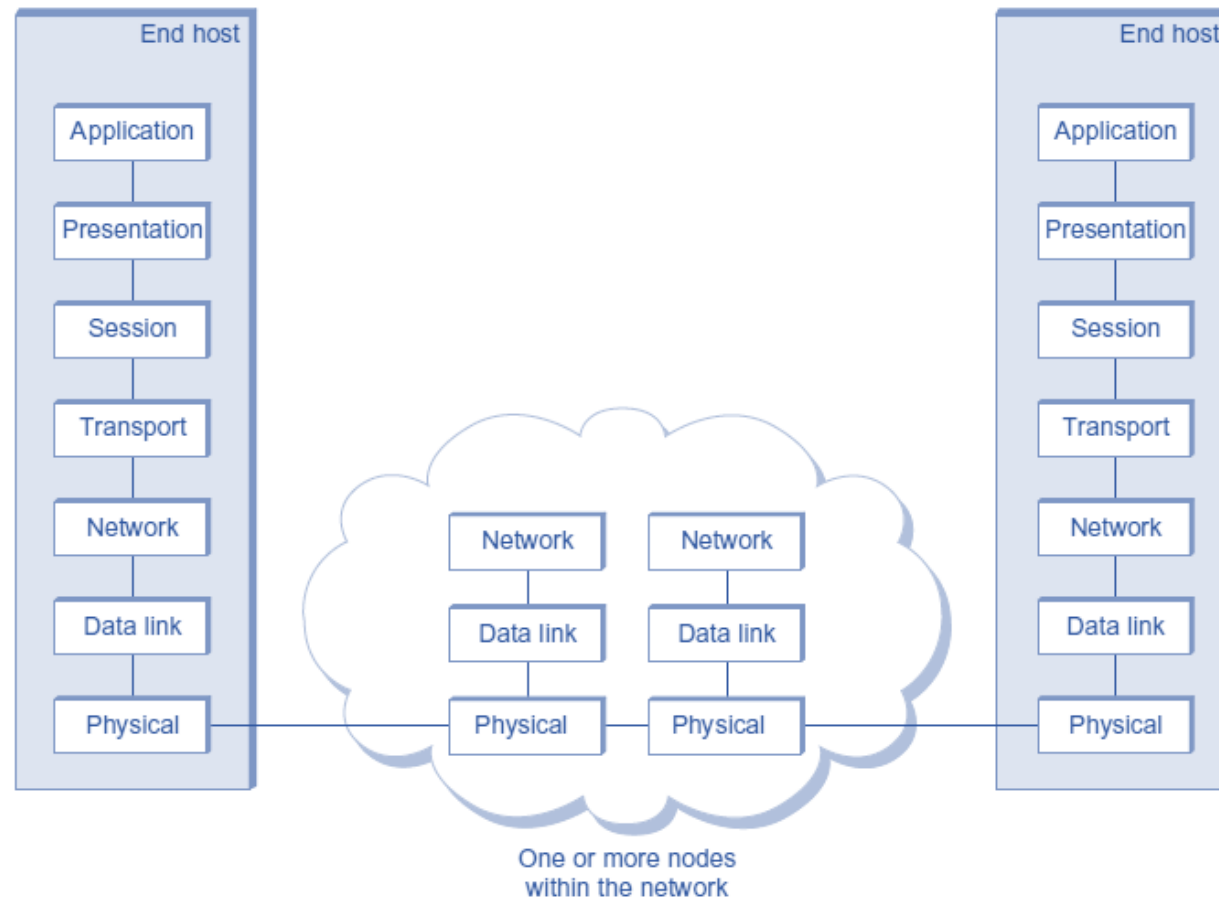   - Peer to peer Interface (for the same layer)

How Laying Works ?

void Tx (data)

Physical Layer

Physical Layer

How Laying Works ?

bool Tx (neighbor A, data)

```
┌──────────────┐                    ┌──────────────┐
│   Multiple   │ - - - - - - - ->   │   Multiple   │
│    Access    │ <- - - - - - - -   │    Access    │
└──────────────┘                    └──────────────┘
```

void Tx (data)

```
┌──────────────┐                    ┌──────────────┐
│Physical Layer│ ───────────────>   │Physical Layer│
│              │ <───────────────   │              │
└──────────────┘                    └──────────────┘
```
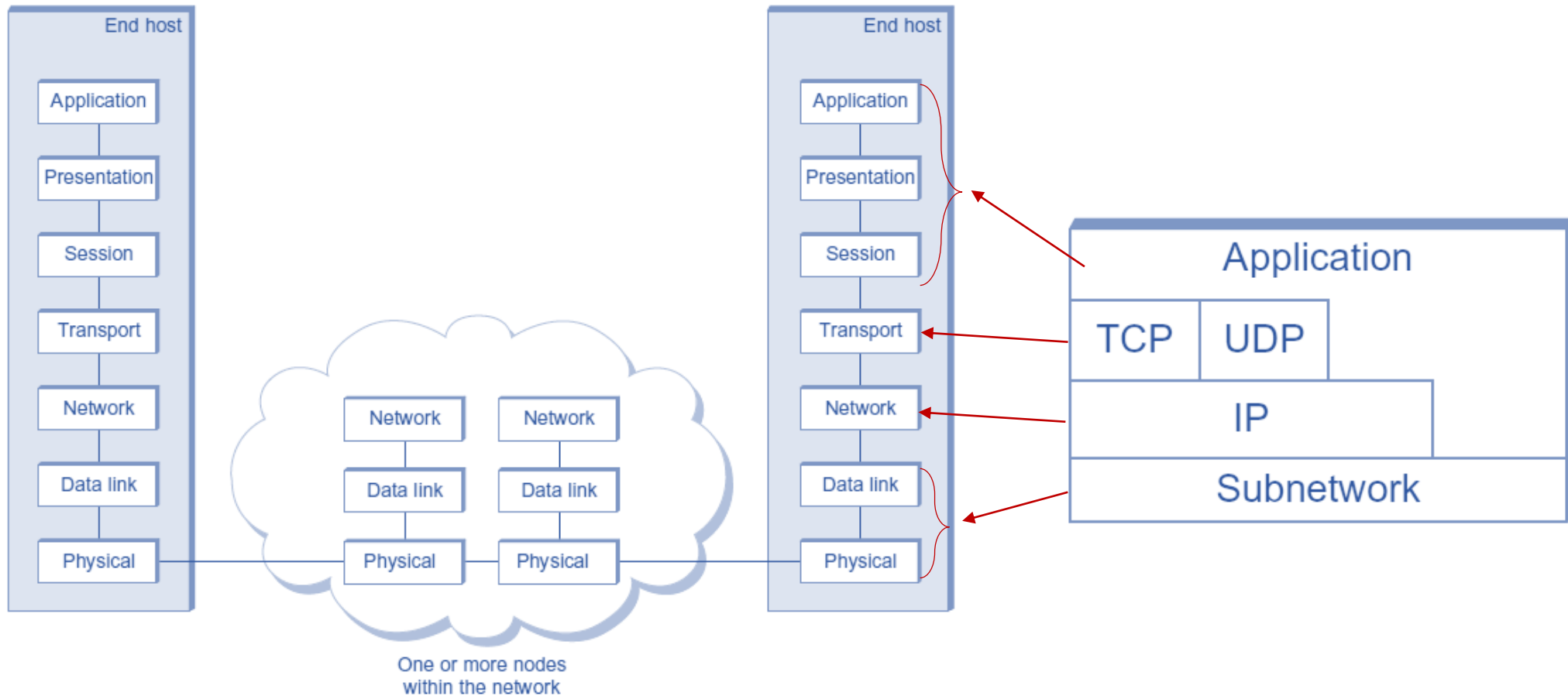
D

A

D   B

24

Canonical Layer Model

- OSI 7 Layer Model

Layering of the Real Internet

Layering of the Real Internet