CMPE 150/L : Introduction to Computer Networks

Chen Qian

Computer Engineering
UCSC Baskin Engineering

Lecture 1

Slides source: Kurose and Ross, Simon Lam, Katia Obraczka

Notetaker Position

❑ *   It is a paid position.

❑ *   Anyone interested needs to contact the DRC right away. (drcnotes@ucsc.edu)

❑ *   The DRC typically hires only one Notetaker for each class.

Welcome to CE 150/L!

Class information:

- ❑ When: T Th 01:30PM-03:05PM.
- ❑ Where: Engineering 2 180 (Simularium).
- ❑ Class Web page:
  https://cmpe150-winter17-01.courses.soe.ucsc.edu/home

Course Focus

From the catalog:

"Addresses issues arising in organizing communications among autonomous computers. Network models and conceptual layers; internetworking; switching techniques (packet switching, circuit switching); medium access control (MAC) protocols and local area networks; error-control strategies and link-level protocols; routing algorithms; congestion control mechanisms; transport protocols; application of concepts to practical wireless and wireline networks and standard protocol architectures."

About the Instructor

❑ Chen Qian.
   ❖ Office: E2 231.
   ❖ E-mail: cqian12 "at" ucsc.edu
   ❖ Office hours: Thu, 10am-11am
   ❖ Research lab: E2 211

Pre-Requisites

- CE 16.
- CE 12 and CE 12L, or CS 12B and CS 12M.
- Basic programming skills ideal (project).

Logistics

❑ CE 150/**L**: there is a lab companion to the class.

❑ Students must register for lecture AND one lab session.

❑ Lab session is not the only time you will need to use the lab!

❖ Key code for lab access can be picked up from BE 399C.

> Do it right now!

Lab

❑ Located in BE 301A.

Lab

❑ Weekly exercises (pre-labs and labs).

 ❖ Labs must be done individually unless noted otherwise.

Teaching Assistants

❑ Yalda Edalat
yalda@soe.ucsc.edu

❑ Cole Grim
cgrim@ucsc.edu

Books

❑ Lecture:
  ❖ *Computer Networking: A Top Down Approach,* by Kurose and Ross

  5th, 6th and 7th ed are all good

> You are required to read the book BEFORE every class. However the exam questions are ALL related to the material in the slides.

> Highly recommend to buy it! It is good based on my experience.

Grading

❑ 65% lecture
  ❖ Midterm 30%
  ❖ Final 35%

❑ 35% lab
  ❖ Lab exercises 25%
  ❖ Project 10%

Sample questions are not graded. It is important to work on it and ask/discuss if you don't understand. Exam questions will be very similar

Only a single grade will be issued for both CE 150 and CE 150L.

Class Web Page

❑ https://cmpe150-winter17-01.courses.soe.ucsc.edu/home

❑ Students must check the Web page frequently!
- ❖ Lecture notes.
- ❖ Labs.
- ❖ Forum.
- ❖ News.
- ❖ Project information.
- ❖ Announcements.

Student Responsibilities: Academic Integrity

❑ All submitted work must be individual.

❖ OK to have discussions on ideas but turn in **your own** work.

- Lab and pre-lab reports are done individually!

- Project is individual!

❖ Ask instructor and TAs if there are any questions.

❖ For more info, go to:

www.ucsc.edu/academics/academic_integrity/

Student Responsibilities: Academic Integrity

❑ Academic integrity violations will not be tolerated.

Student Responsibilities

❑ Attendance.
  ❖ Lectures.
  ❖ Lab sessions.
❑ Keep up with material covered in lecture
  ❖ Readings (chapters in the book).
  ❖ Sample questions.
❑ Keep up with lab assignments and project.

Resources

❑ Instructor.

❑ TAs.

❑ Class Web page.

❖ Lecture notes will be posted before class.

❑ Lab- and review sessions.

❑ Forum.

❖ We will piazza.

❖ Students need to create a piazza account.

❖ On-line resources.

Student Feedback

❏ Feedback is always welcome!
❏ Chance to do it at the end of the quarter.
❏ But you can also do it during the quarter…

Lectures

❑ The more interactivity, the better!
  ❖ Ask questions!
  ❖ Or answer my questions.
❑ Lecture notes:
  ❖ Will be posted on-line before class.
  ❖ But…
❑ Lectures and lab.

More Lab Logistics

❑ Register for ONE lab session.

❑ Welcome to attend more sessions.

❑ Students are expected to be in the lab
  ❖ **during their session and MORE!**

Lab Sessions

❑ Monday: 11am - 1pm (BE 301A).

❑ Tuesday: 4 – 6pm (BE 301A).

❑ Wednesday: 3 - 5pm (BE 301A).

❑ Thursday: 10 – noon (BE 301A).

❑ Friday: 12-2pm (BE 301A)

❑ Lab starts next week!

Usually 1 hour per week in the lab is not enough for you to do well for your assignments. So I SUGGEST you work on the assignments in your free time and use the lab session to interact with the TAs.

More Lab Logistics

❑ Pay attention to the lab schedule!

❖ Pre-labs.

❖ Labs.

❑ Submission due dates and guidelines will be strictly enforced!

❖ Late submissions will be penalized.

❑ Lab usage guidelines must be followed!

More Lab Logistics

❑ Lab exercises are posted on the Web page ahead of time.

❑ Students start getting familiar with the lab exercise and use lab sessions to ask questions.

Project

❑ Basic network programming project.
❑ Project deliverables:
  ❖ Project demo.
  ❖ Source code.
  ❖ README file.

Assignment Submission

❑ We use Canvas this semester rather than eCommons
  ❖ Linked to the main class Web page under "Assignments".
❑ TAs will go over it in lab this week.

Assignment late submission policy

❑ 20% deduction for each day late.

Administrative Info

❑ Communication:
   ❖ E-mail preferred.
   ❖ Send e-mail to instructor AND TAs.

Course Outline
"Top-down Approach"

What's "Top-Down"?

Internet Protocol Stack

application
transport
network
link
physical
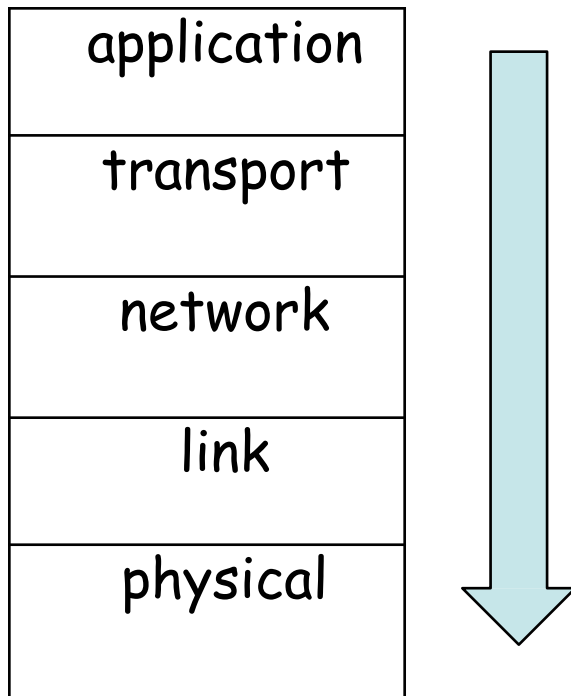
❑ "Top-down" means that we will start at the "Application" layer and make our way to the "bottom" of the "stack".

Course Outline (tentative)
"Top-down Approach"

- ❑ Introduction
- ❑ Application layer
  - ❖ Fundamentals
  - ❖ Application layer protocols.
- ❑ Transport layer
  - ❖ Fundamentals
  - ❖ Internet transport protocols:
    - • UDP and TCP

- ❑ Network layer
  - ❖ Fundamentals
  - ❖ Internetworking
  - ❖ IP v4 and v6
  - ❖ Routing
- ❑ Data link layer
  - ❖ MAC
  - ❖ Ethernet, 802.11
- ❑ Wireless networking

Course Objectives

❑ Upon successful completion of the course, you will have a good understanding of the layered network architecture, the fundamental design issues in each layer, and the solution approaches towards addressing these issues. You will also get well prepared for investigating advanced topics in the networking field.

Why networking is important for you?

❑ 1. Basics of other advanced areas:
  ❖ Cyber security
  ❖ Distributed systems
  ❖ Cyber physical systems
  ❖ Mobile computing
  ❖ Cloud computing
  ❖ Etc.

❑ 2. Tons of job opportunities
  ❖ Cisco, HP, Google, Facebook, Amazon, Microsoft, Nokia, Huawei, LBNL, etc.

My background

❑ PhD in Computer Science (2013), University of Texas at Austin

❑ Advisor: Simon Lam – researcher of the chapter for "*The Link Layer*" pp 511

Simon S. Lam

Simon S. Lam is Professor and Regents Chair in Computer Sciences at the University of Texas at Austin. From 1971 to 1974, he was with the ARPA Network Measurement Center at UCLA, where he worked on satellite and radio packet switching. He led a research group that invented secure sockets and prototyped, in 1993, the first secure sockets layer named Secure Network Programming, which won the 2004 ACM Software System Award. His research interests are in design and analysis of network protocols and security servic-es. He received his BSEE from Washington State University and his MS and PhD from UCLA. He was elected to the National Academy of Engineering in 2007.

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BTW....

- ❑ Simon Lam's PhD advisor was Leonard Kleinrock, Professor at UCLA
- ❑ researcher of the chapter for "*Chapter 1*"

Leonard Kleinrock

Leonard Kleinrock is a professor of computer science at the University of California, Los Angeles. In 1969, his computer at UCLA became the first node of the Internet. His creation of packet-switching principles in 1961 became the technology behind the Internet. He received his B.E.E. from the City College of New York (CCNY) and his masters and PhD in electrical engineering from MIT.

What made you decide to specialize in networking/Internet technology?

As a PhD student at MIT in 1959, I looked around and found that most of my classmates were doing research in the area of information theory and coding theory. At MIT, there was the great researcher, Claude Shannon, who had launched these fields and had solved most of the important problems already. The research problems that were left were hard and of less-

My Research

❑ Network algorithms, protocols, and systems

❖ Routing, switching, management, etc.

❑ Current focus: Internet of Things, Software Defined Networking, and Network Security

> 20 billion connected devices after 2016
New networking designs are required

Pervasive
Sensing

data collection
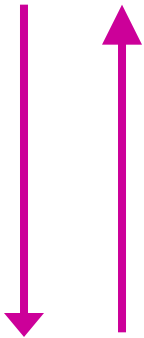
data transmission,
storage, processing

Internet
Cloud
Data centers

RFID trustworthy
sensing and tracking

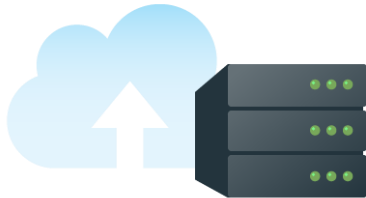Fast identification
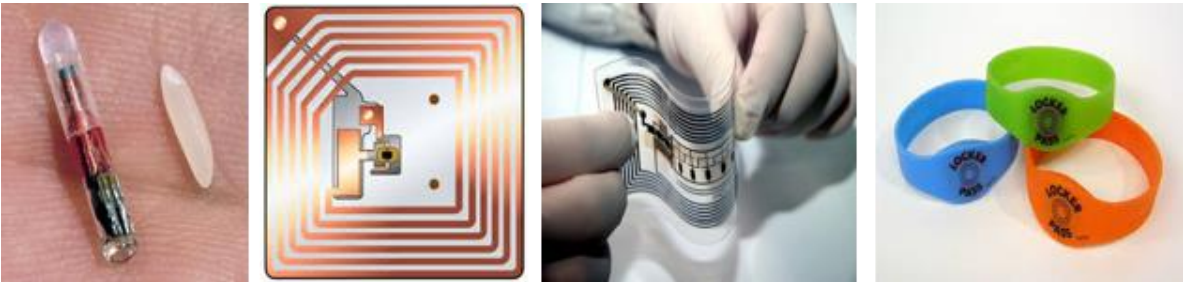
Mobile Security

Routing among devices

SECURITY **RELIABILITY** **SCALABILITY**

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Radio Frequency Identification (RFID)

Tags: battery-free

Vital system of IoT:
cost- and energy-efficient

TAGS

READER

Backscatter communication/sensing

Applications of RFID

Logistics

Supply chain

Warehousing

Retailing

Payment

Identification is important for access control
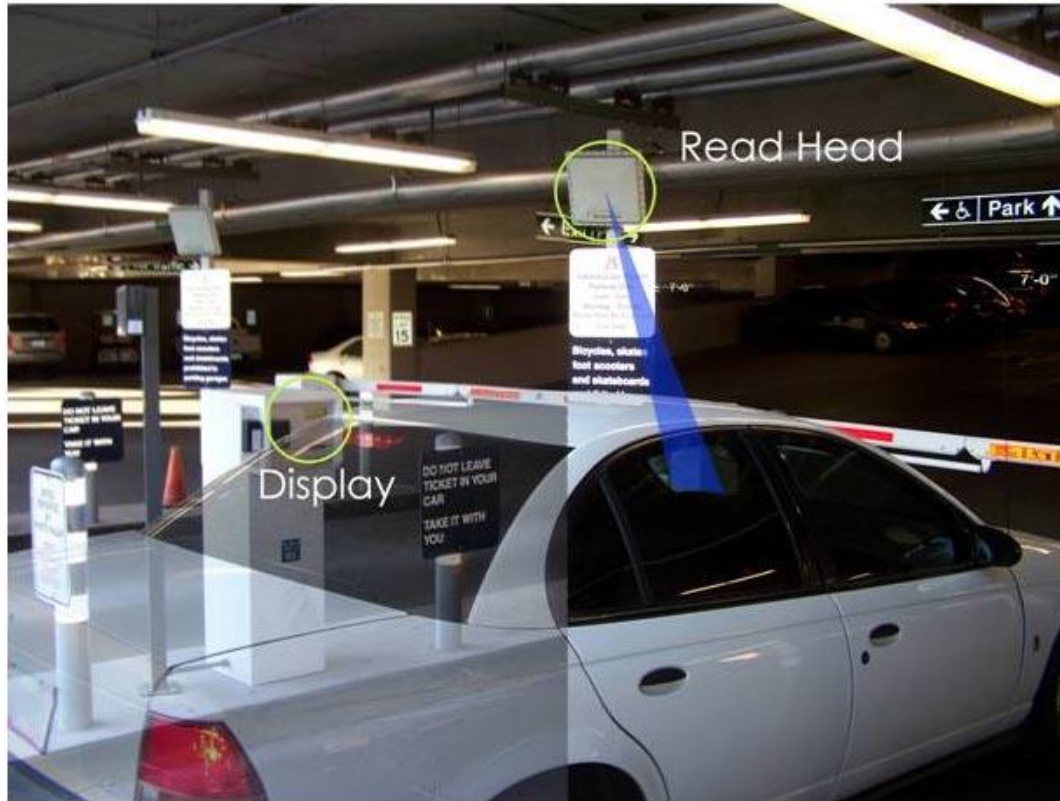
How to sense an intruder

◆ NEVER expect they would carry devices!
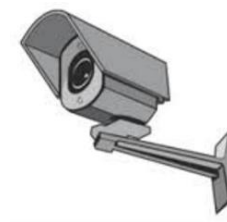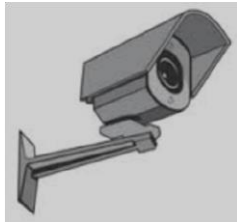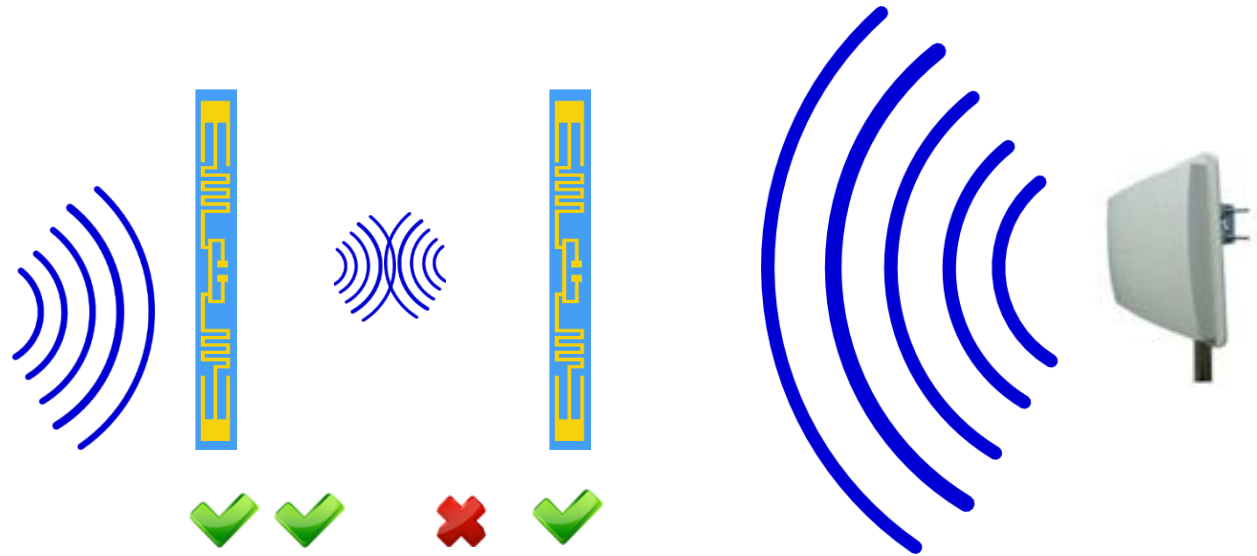
Extra cost and may lack of coverage

Device-free sensing
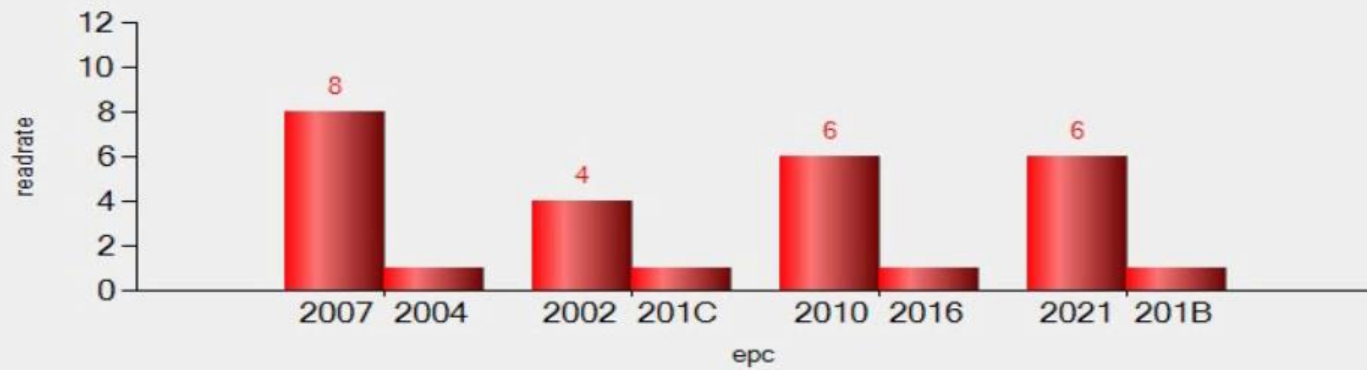
- Massive tags already deployed in warehouses, stores, etc.

Can we track device-free objects based on passive tags around?
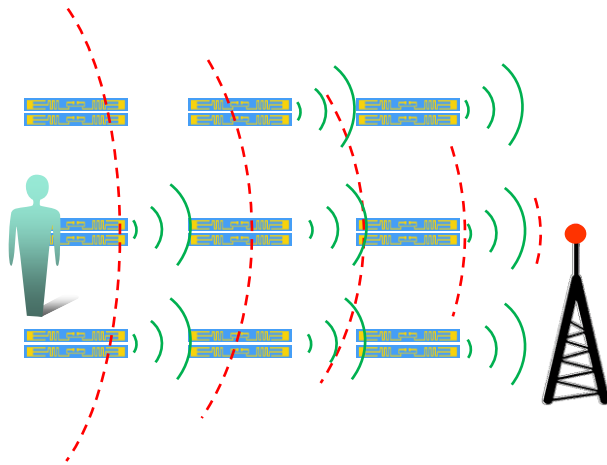
No solution until our work!

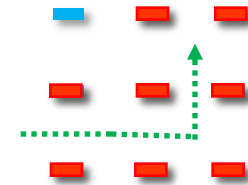# Critical state

Twins: Unexpected discovery makes big impact
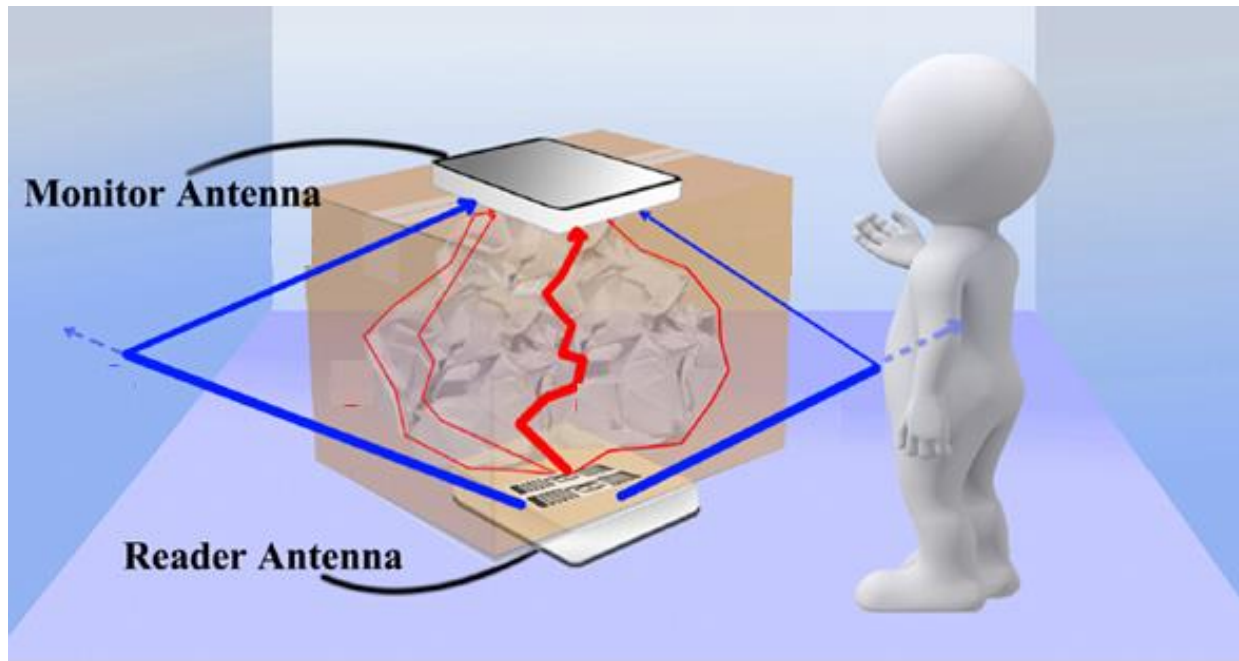
Physical environment — Server — Tracking results

Prototype and experiments

- COTS devices
- Surveillance in a warehouse 30m x 20m
- 72 Twins pairs
- Distance

Error: Less than 1 m
Smaller than those using battery sensors

Twins: Device-free Object Tracking using Passive Tags, in *IEEE INFOCOM'*14, extended version in *IEEE/ACM Transactions on Networking*.

Smart Packaging: verify internal status

RFID signal analysis may identify different materials

Smart control environment

?

Edge cloud

VADS: Visual Attention Detection with a Smartphone, in *IEEE INFOCOM*, 2016.
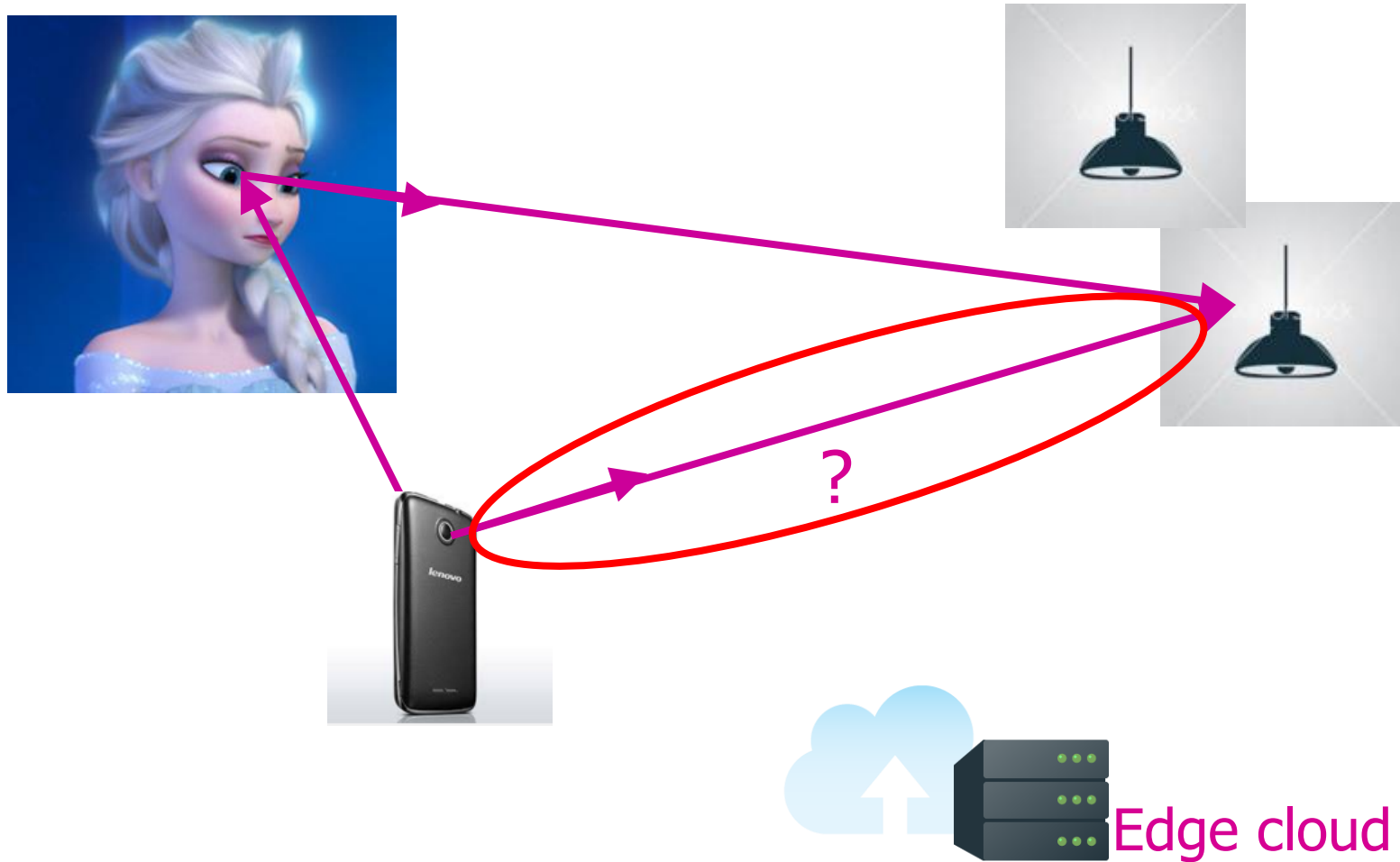
Secure mobile communication

Eve

Alice

Bob

Key agreement

◆ Most fundamental secure problem for communication

- 2002: Rivest, Shamir, and Adleman (1977)
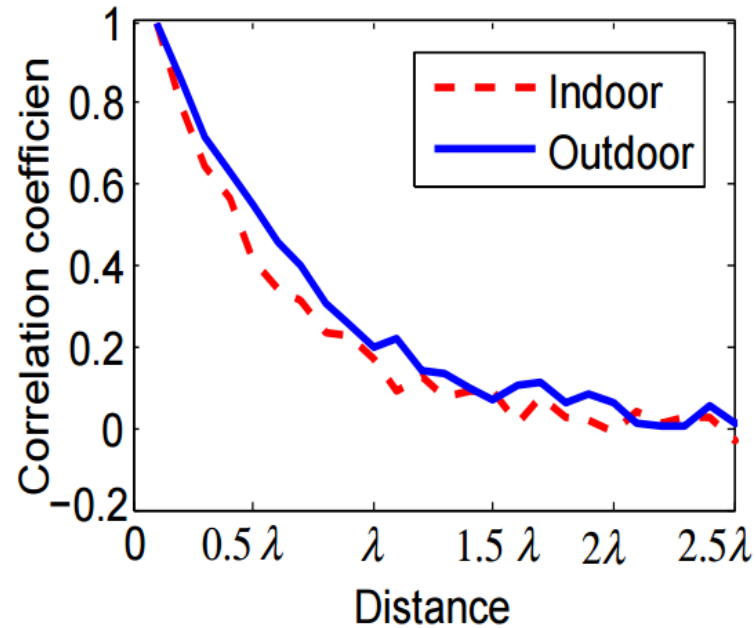- 2015: Diffie and Hellman (1976)

Alice   Bob

Key agreement

With in 6cm

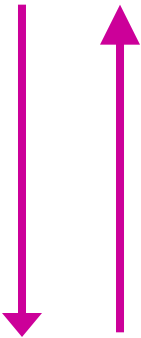Common physical layer features: CSI

The Dancing Signals

- Using CSI and common secret to generate a key
- 2 secs for a 512-bit key
- Prior work:
  - Can only use TV signals
  - 2 mins for a 512-bit key

Instant and Robust Authentication and Key Agreement among Mobile Devices, in *ACM CCS'16*

Pervasive Sensing

data collection

data transmission, storage, processing

Internet Cloud Data centers

SECURITY   RELIABILITY   SCALABILITY

Software defined nets
Virtual network functions

Small and fast FIB

Cloud privacy

Research opening

- Students are welcome to join my lab for research or senior project.

- They could be paid (depending on whether my REU proposal is approved by National Science Foundation)

About research in my lab

◆ I do not expect any student to do actual project in my lab this quarter

- It's a good idea to work on this course first if you are interested in computer networking
- Read the textbook chapters and the references that attract you

◆ AFTER this quarter if you are still interested and feel good in computer networking, let me know.

Notetaker Position

◆ *   It is a paid position.

◆ *   Anyone interested needs to contact the DRC right away. (drcnotes@ucsc.edu)

◆ *   The DRC typically hires only one Notetaker for each class.

Next class

◆ Please read Chapter 1.1-1.3 of your textbook BEFORE Class