

# CS 179i: Project in Computer Science (Networks)

Jiasi Chen

Lectures: Monday 3:10-4pm in Spieth 1307

TA: Shikhar Garg

Lab: Wednesday 6:10-9pm in Winston Chung 132

[http://www.cs.ucr.edu/~jiasi/teaching/cs179i\\_winter16/](http://www.cs.ucr.edu/~jiasi/teaching/cs179i_winter16/)

# Outline

- Why networks?
- Course Organization
- Project

# Why Networks?

Supports the applications that we use today...

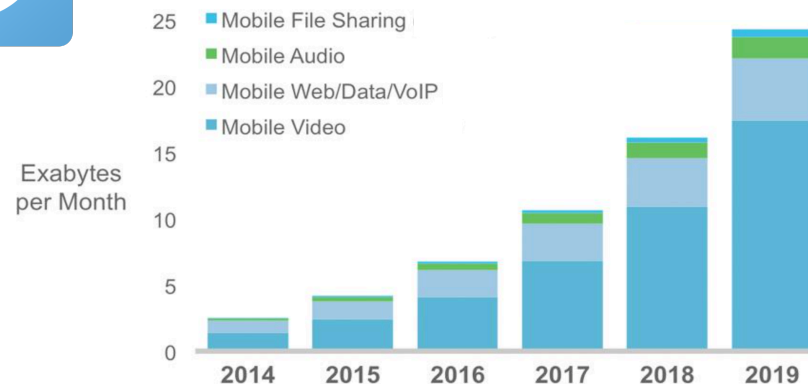
## Social media



## Number of Internet users

- 97% of Americans between 18-29
- 40% of the world population → scope for more users

## Video streaming



<http://www.pewinternet.org/data-trend/internet-use/latest-stats/>  
[https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_number\\_of\\_internet\\_users](https://en.wikipedia.org/wiki/List_of_countries_by_number_of_internet_users)

# Why Networks?

But also a source of conflict.

## Cyber security

### A Look Back at the Target Breach

Posted: 04/06/2015 10:30 am EDT | Updated: 06/06/2015 5:59 am EDT



## Network neutrality

TECHNOLOGY

### T-Mobile Video Plan Could Test F.C.C.'s New Net Neutrality Rules

By CECILIA KANG NOV. 11, 2015

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A new plan from [T-Mobile USA](#) to allow unlimited streaming of some video services may become the first test of the federal government's rules to prevent favoritism on the Internet.

On Tuesday, T-Mobile, the nation's third-largest wireless carrier, said customers could stream as many videos as they want — regardless of their data plan limits — from more than two dozen video providers, including Hulu and Netflix.



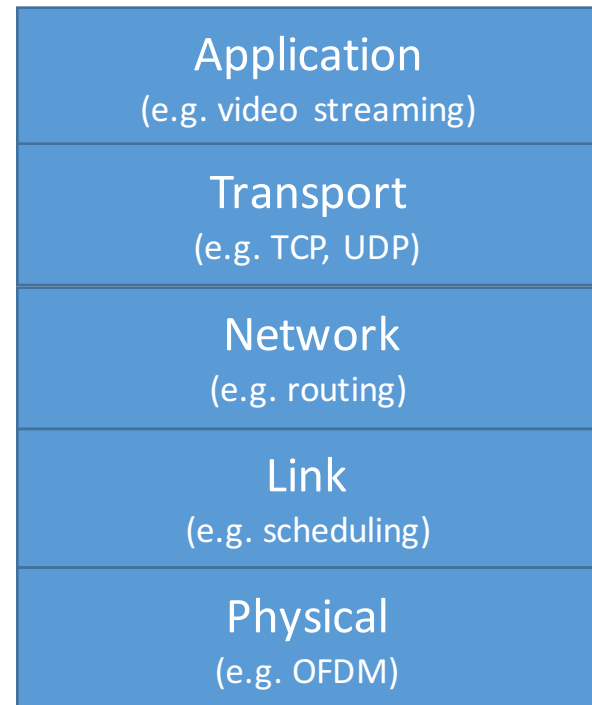
[http://www.huffingtonpost.com/eric-dezenhall/a-look-back-at-the-target\\_b\\_7000816.html](http://www.huffingtonpost.com/eric-dezenhall/a-look-back-at-the-target_b_7000816.html)

<http://www.nytimes.com/2015/11/12/technology/t-mobile-video-plan-could-test-fccs-new-net-neutrality-rules.html>

# Major Areas in Networking

- **Wireless**
  - How to provide a one-to-one communication pipe in an inherently broadcast environment?
- **Layering**
  - How to modularize the design to enable easy innovation?
- **Protocols**
  - How to interact within each layer, and talk to other layers?
- **Resource allocation**
  - How to share limited resources between competing users?

## OSI 5-layer model of the Internet



How to design the network to best support these applications?

How to design applications that make the best use of the network?

# Course Organization

# What You Will Learn in this Course

- Knowledge: Common networking tools/protocols, depending on your choice of project
  - Android programming
  - MPEG-DASH video streaming
  - Kernel and socket programming
- Skills
  - How to work in teams
  - How to lead your own project
  - How to learn on your own



# Logistics

- Lecture: Jiasi Chen
  - Slides available on course website
  - Office hours: Thursday 3-5pm, or by appointment
- Lab: Shikhar Garg
  - Office hours: TBA
- Required to attend lectures and labs
  - No lab session this week (1/6)
- Submit assignments on iLearn
- Check class website for latest updates
  - [http://www.cs.ucr.edu/~jiasi/teaching/cs179i\\_winter16/](http://www.cs.ucr.edu/~jiasi/teaching/cs179i_winter16/)

# Grading

- Project: 75% total
  - Proposal: 10%
  - Progress update: 10%
  - Final report: 20%
  - Final presentation: 15%
  - Technical merit and originality: 20%
- 4 essays: 15%
  - ABET requirement
  - One free late day during the quarter
- Participation: 10%
  - Attending lecture and lab
  - Giving feedback during other teams' final presentations

# Calendar

Date	Lecture	Assignment Due
Jan. 4	Introduction	
Jan. 11	Project details I	Group formation
Jan. 18	(holiday)	Project proposal
Jan. 25	Project details II	
Feb. 1	Ethics	New trends essay
Feb. 8	Progress update	Brief oral presentation from each team
Feb. 15	(holiday)	
Feb. 22	Guest lecture	Ethics essay
Feb. 27	Final presentations	
March 7	Final presentations	Presentation essay
March 14	(exams week)	Teamwork essay, final report due

If the class agrees, we may combine Feb. 27 + March 7 final presentations onto a single day, e.g., one day during the weekend of March 5/6.

# Project

# Project Outline

- Form groups of 3
- I will provide some project ideas, or design your own
  1. Google Cardboard
  2. Adaptive video streaming
  3. Download booster
- Goal: open-ended projects and the relevant resources to succeed
- Suggestion: choose your project with your future career/job interviews in mind

# 1. Google Cardboard

- Virtual reality (VR) using commodity hardware
  - \$20 cardboard viewer to use your smartphone as a VR display
- Demo
  - <https://www.youtube.com/watch?v=29uXoePowzQ>
- Existing apps are rudimentary
  - E.g., White House Christmas tour, find the ball
  - Single user, single view



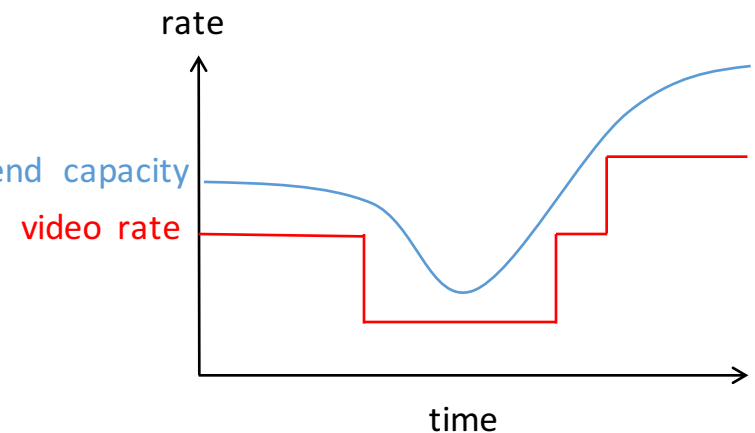
# 1. Google Cardboard

- Street View
  - Single view → multiple views
  - User interface for navigation
  - Tour of a location of your choice
  - Request views from server with low latency
- Periscope
  - Single user → multiple users
  - Simple version: Copy the currently viewed screen to another user, with audio voiceover (e.g., campus tour)
  - More challenging: live streaming with camera passthrough
- Your imagination?
- Requires Android phone (emulation doesn't work ☹ )
- Resources
  - Cardboard Android API: <https://developers.google.com/cardboard/android/>

## 2. Adaptive Video Streaming Using MPEG-DASH

- MPEG-DASH

- Application-layer protocol for adapting video quality to network conditions
- Client-driven: client estimates network conditions and requests appropriate video quality
- Standard doesn't specify adaptation algorithm, just the communication protocol between client and server



- Who uses it?





## 2. Adaptive Video Streaming Using MPEG-DASH

- Current approaches
  - Numerous approaches proposed in research literature and in practice
  - Need a apples-to-apples comparison under common set of test conditions
- Resources
  - MPEG-DASH video player: <https://github.com/Dash-Industry-Forum/dash.js/wiki>

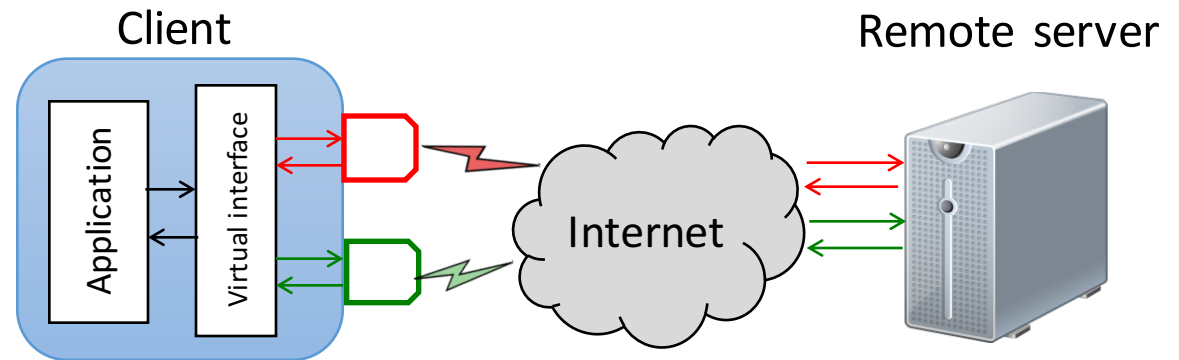
# 3. Download Booster Using Multiple Interfaces



- Want to speed up downloads of large files by using multiple interfaces simultaneously (e.g., WiFi, 4G, Ethernet)
- Samsung introduced Download Booster, but it got blocked by major carriers
- Multipath-TCP is another major standardization effort to enable multiple networks

# 3. Download Booster Using Multiple Interfaces

- Transport layer: multipath-TCP
  - Extension to TCP to split a single flow into multiple subflows
  - Each subflow can use a different interface
  - Problems: requires server and client kernel modifications, difficult for widespread deployment



- Application layer: HTTP client proxy
  - Implement in the application layer using common HTTP protocol
  - Use HTTP GET requests to request different pieces of the content over different interfaces
- Transport vs application layer
  - Which version is better? What are the pros and cons?
  - What improvements can be made to either protocol?
- Resources
  - MPTCP kernel: <http://www.multipath-tcp.org/>

# Do-It-Yourself

- Have a cool idea for a project? Pursue it!
- Potentially more points for technical merit and originality (20%)
- Please schedule a meeting with me and the TA as soon as possible to discuss this
- Resources
  - Datasets of wireless traces: <http://www.crowdad.org/>
  - Previous senior design projects at Stanford: <http://web.stanford.edu/class/cs210/2013SoftwareFaireProgramDraft.pdf>

# Conclusions

- Next lecture: Tips about suggested projects
- To do by next class (1/11)
  - Form groups and send one email per group to myself and TA, CC-ing all group members
- Questions?