

CS 179i: Project in Computer Science (Networks)

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Lectures: Monday 1:10-2pm in Sproul 2343

TA: Ryan Holt

Lab: TBD

http://www.cs.ucr.edu/~rholt002/cs179i_winter17/

Outline

- Why networks?
- Course Organization
- Project

Why Networks?

Supports the applications that we use today...

Social media

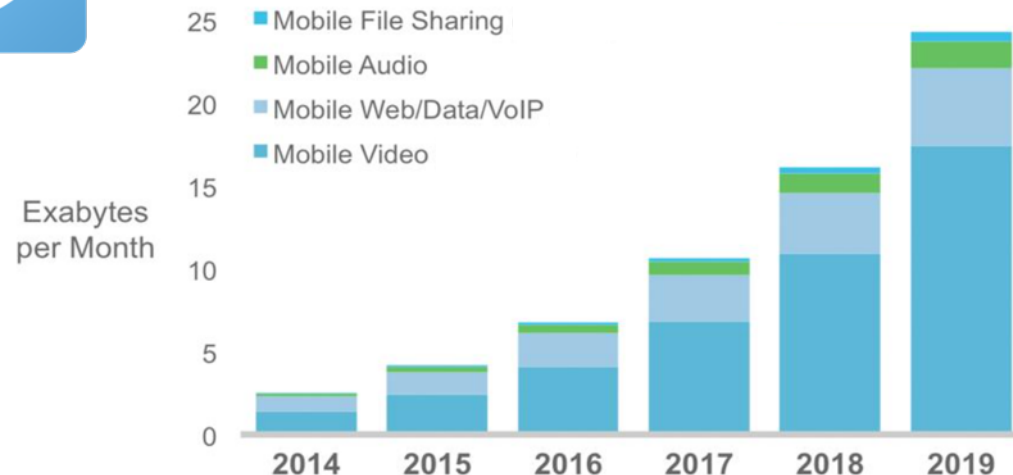


Number of Internet users

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

<http://www.pewinternet.org/data-trend/internet-use/latest-stats/>
https://en.wikipedia.org/wiki/List_of_countries_by_number_of_internet_users

Video streaming



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.



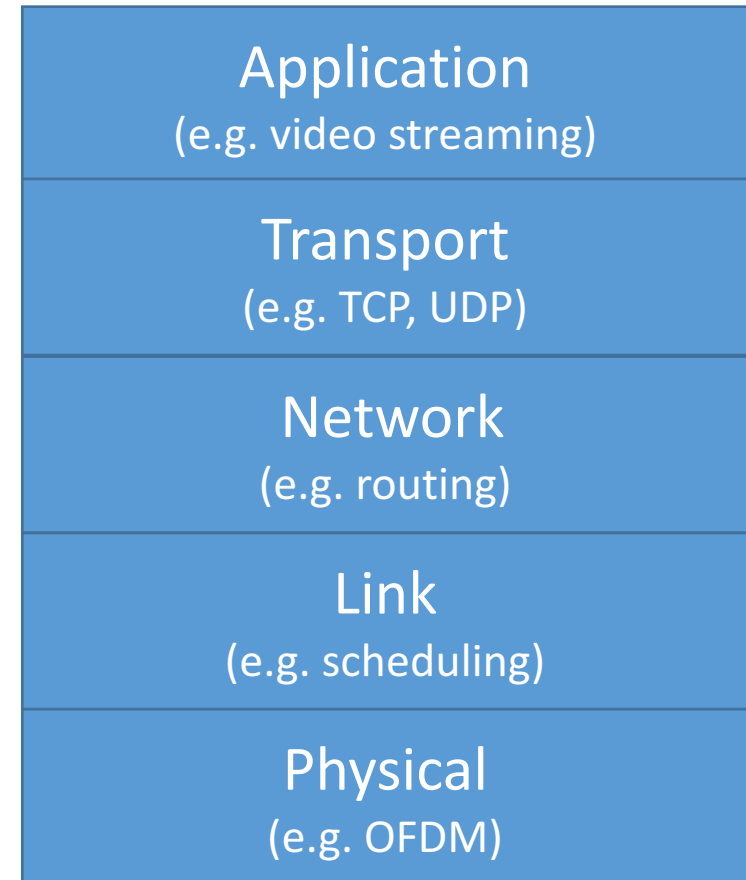
http://www.huffingtonpost.com/eric-dezenhall/a-look-back-at-the-target_b_7000816.html

<http://www.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?

Project Ideas

Project Outline

- Form groups of 2+
- I will provide some project ideas, or come up with your own
 1. Virtual reality
 2. Adaptive video streaming
 3. Download booster
 4. Smart home
 5. Kids learning
- Goal: open-ended projects and the relevant resources to succeed
- Suggestion: choose your project with your future career/job interviews in mind

1. Virtual Reality

- Different types of hardware
 - Low-end: Google Cardboard
 - High-end: Oculus Rift, HTC Vive
- Demo
 - <https://www.youtube.com/watch?v=29uXoePowzQ>
- Existing apps are rudimentary
 - E.g., White House Christmas tour, Fantastic Beasts promo
 - Single user, single view



1. Virtual Reality

- Indoor Street View

- Single view → multiple views
- Tour a virtual location
- Challenge: storing the content on the server (long latency) vs client (high storage¹)



- Social VR

- Single user → multiple users
- Interact with others' avatars
- Challenge: synchronizing the users over the network



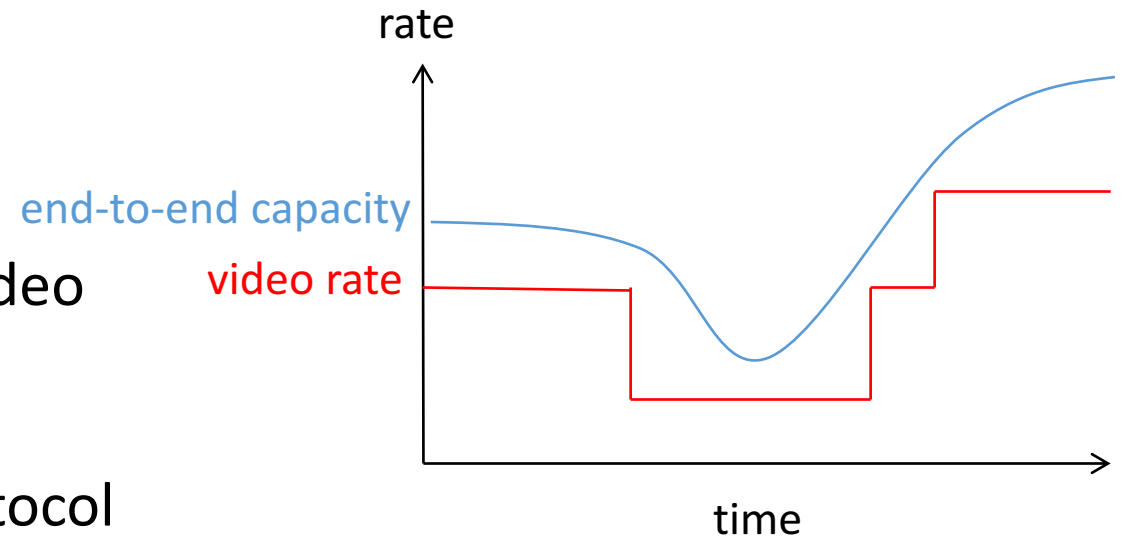
Resources:

Cardboard Android API: <https://developers.google.com/cardboard/android/>
Unity programming

2. Adaptive Video Streaming

- 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

- Current approaches
 - Numerous approaches proposed in research literature and in practice
 - Current buffer level
 - Predicted bandwidth
 - Need an 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

The Most Accelerated Network Experience



Download Booster

Powered speed with LTE & Wi-Fi together

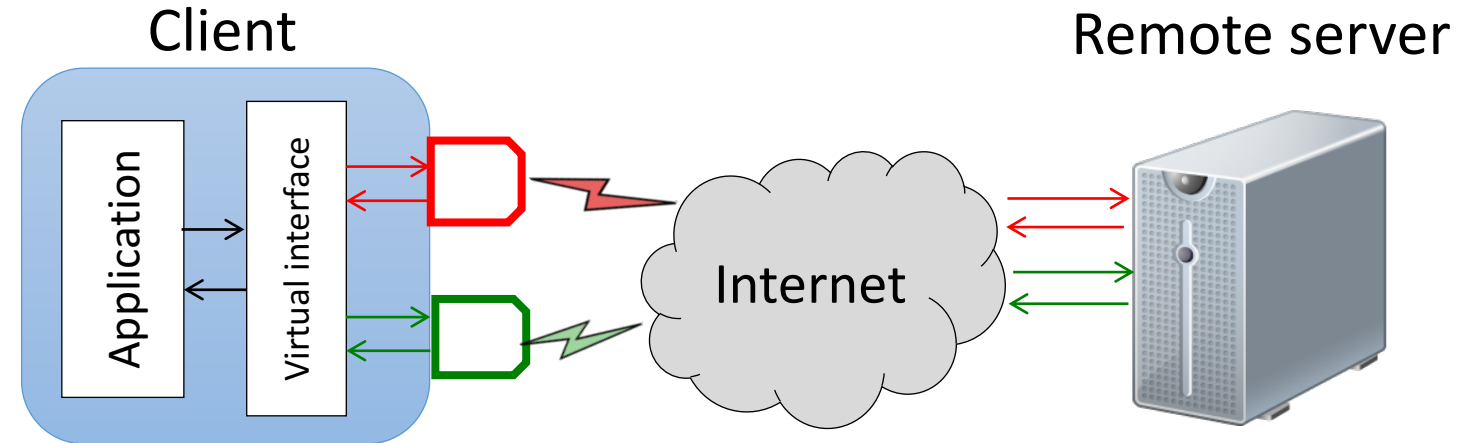
The Download Booster technology lets you use the LTE and Wi-Fi simultaneously to give you an unrivaled network experience! When you need to download files in a hurry, turn on the LTE and Wi-Fi together and experience approximately 80~90% of the added network speed of LTE and Wi-Fi.

The image shows a Samsung smartphone screen with the 'Download booster' toggle turned on. The speed is displayed as 160Mbps. Below this, two progress bars show the contribution of each network: Wi-Fi at 100Mbps and LTE at 80Mbps. The phone's status bar at the top shows the time as 12:45 on Monday, 24 February.

- 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/>

4. Smart Home

- Measurement study
 - How much do these devices use the network?
 - What protocols do they use?
- Control household appliances
 - Complex logic to integrate different devices



5. Helping Kids Learn

- Creating games for to help young kids learn
- Understanding how well children learn from realistic vs fantastical environments
 - For example, cartoon animals vs human figures
- Can the learning experience be improved through:
 - Virtual reality?
 - Virtual assistants like Alexa?
- Collaboration with a psychology professor
 - User study in the psychology department
 - Potential for real impact!



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>

Wait... How does this relate to my networking class?

- What about your favorite networking topics?
 - ALOHA
 - TCP retransmission
 - 802.11 backoff
 - ...

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 2-4pm, or by appointment
- Lab: Ryan Holt
- Submit assignments on iLearn
- Check class website for latest updates
 - http://www.cs.ucr.edu/~rholt002/cs179i_winter17/

Grading

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

Calendar

Week	Lecture	Assignment Due
1	Introduction	
2	(holiday)	Group formation
3	Project details I	Project proposal
4	Project details II	
5	Ethics	New trends essay
6	Progress update	Brief (10 minute) presentation
7	(holiday)	
8	Guest lecture	Ethics essay
9	Final presentations	
10	Final presentations	Presentation essay
Finals week	(exams week)	Teamwork essay, final report due

Conclusions

- Next lecture (in 2 weeks): Project details
- To do by next Monday
 - Form groups and send one email per group to myself and TA
 - Sign up for lab time availability
- Questions?