CSC6730 – Advanced Networking - Introduction

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Topics covered in this Lecture

- Course outline
- Critical Reviews
- Presentation
- List of papers
- Grading

Course Objectives

Learn to do Research

Thinking with a research mindset and communicate effectively.

In broad strokes we will cover the following topics:

- The design rationale of the Internet and how it has evolved.
- Look at the state-of-the-art research landscape in networking
- Identify and present design choices
  - Why things were designed the way they are?
  - What are the **trade-offs**? Where do things break?
- Identify shortcomings of the current design and future directions
  - This can be your future thesis/dissertation!!

Research Areas

- Fundamental and Next-generation protocols
  - Design decisions of the Internet
  - Domain name systems
  - Border Gateway Protocol
  - Software Defined Networking
  - Named Data Networking
- Networked Applications
  - Content Delivery Networks (CDNs)
  - Next Generation Protocols for CDNs
  - Next Generation Protocols for Internet of Things (IoT)
  - Networking for the Cloud
  - Networking for the Edge
- Network Security
  - DDoS
  - Next Generation Networks for network security
  - Next Generation Networks for Vehicular Networks

Grading Policy

- Critical reviews - 40%
- Presentation - 30%
- Class participation - 20%

This class is awesome :)

No midterm or Final!

90 or above = "A"
Below 90 = Based on relative score distribution

Critical Reviews

- 2 Pages, 11 point, Single Spaced. See the overleaf template on the website.
- You don't need to defend the paper
- 0.5 page - Summary of the paper
  - Don't copy and paste from the abstract
  - Summarize your own understanding - not the authors' words

Critical Reviews

- 1.5 pages critical review
  - You don't need to defend the paper
  - Criticize it - see where things don't work
  - Construct scenarios where things will break
  - What are the possible inefficiencies in their approach?
  - In your opinion, how can we address those inefficiencies?
  - What are the future research questions left unanswered?
  - How would you extend the work?

Critical Reviews

- You will turn in 8 critical reviews.
- Approximately one every two weeks.
- You can choose which ones you want to write.
- ▸ Review Template

Presentations

- You will present a topic, not a paper
- You will form a research question
- You will use 4 papers to support or refute your research question
- 2 papers are supplied, you will find two more papers
- You will meet with me regularly to work on your papers and presentation

Presentations

- Construct a hypothesis from the papers
- In which scenarios do these solutions work?
- Where do they break?
- Your presentation needs to tell a story

Presentations

Example Hypothesis

I think DNS based server redirection mechanisms do not work well for current Content Delivery Networks.

Break the hypothesis into smaller components:

- How does DNS redirection mechanisms is currently applied to a CDN? - Mostly anycast
- Hmm, what does it mean to not "not work"? Large latency? No lookup? Define the problem space.
- When do they work well? Define the solution space! - When we need 40ms latency for 80% of the traffic.
- Where does it break? Find out the problems with Anycast. (If your IP-Name mapping is broken, DNS cache injection, topology changes, routing changes, bad mapping, availability and so on)

Presentations

Example Hypothesis

DNS based server redirection mechanisms do not work well for current Content Delivery Networks.

Okay - so you establish DNS redirection does not work. How would you fix it?

- Why does it not work? Find the reasons.
- How do you create a new mechanism to address those problems?
- Does that solve everything? What new problems does this introduce?

Presentations

Think of this as mini thesis/dissertation defense -

- We will post your critical review on the website.
- Make sure you practice your presentation!!!
- Make sure you meet with me to discuss your presentation.

Non-Presenters

Valid question

Your solution does not seem to take care of TTL expiration problem. How would you address that shortcoming?

Invalid question

Anycast works for Akamai - why do I need to listen to your presentation?

- Each student is expected to ask a question.
- Let the presenter know your perspective - why are you asking this question.
- Think why you are asking this question - maybe you want to learn more, maybe you disagree with the hypothesis.

Survey

- At the end of each class - we will have a survey:
  - Three things that you understood
  - Three things that were not clear
- We will discuss those in the next class

How to Read Papers?

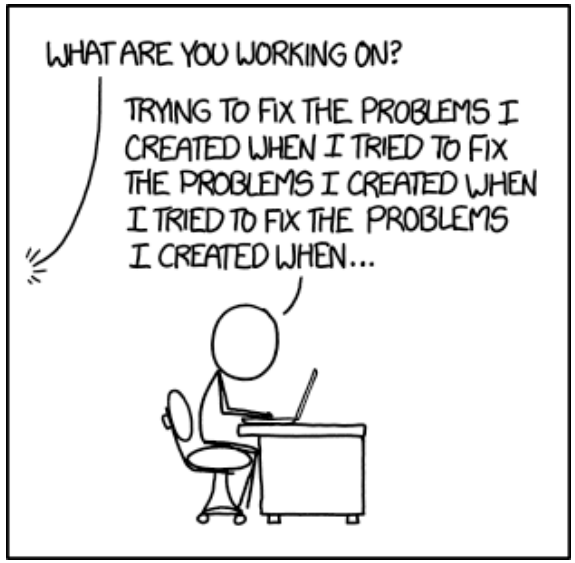

Figure: Caption

- Read a few papers about reading papers
  - How to read a paper
  - Efficient Reading of Papers in Science and Technology

I forgot networking fundamentals - Help!

With the right proportion of inspiration and panic - you can do this!

- ▸ CSC4200
- ▸ Kurose, Ross
- ▸ Peterson, Davie

The Internet

- Why the Internet was designed the way it was designed?
- How this design has evolved over time?
- Is the current design is sufficient today?

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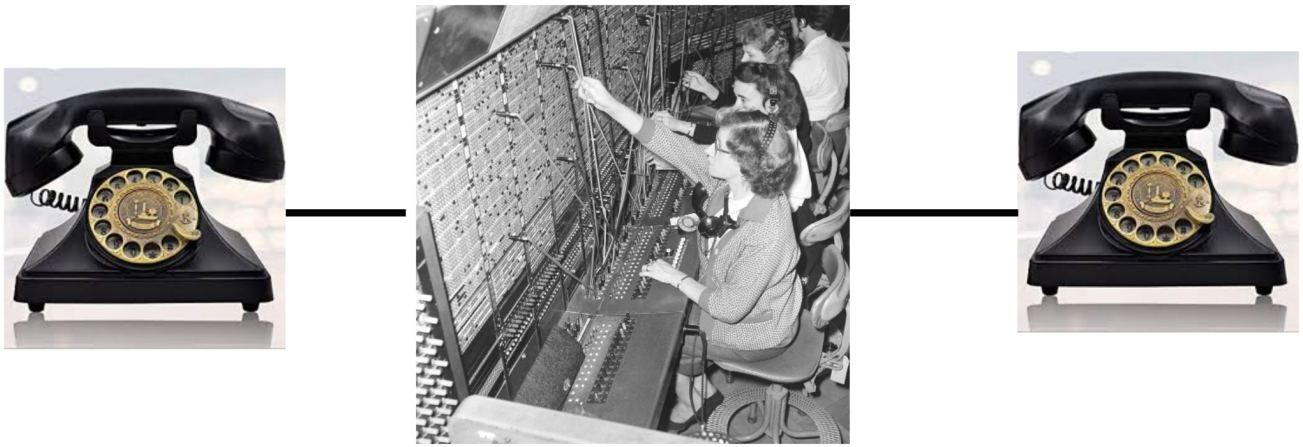
First Network - Telephones



- Communication between 2 points: a caller (source) and a listener(destination)
- Communication identifier: telephone number
- Established circuit between source and destination
- Highly reliable, but slow
- Take-away point: "Dumb" terminals, "smart" networks

Telephony

- Constant bit rate - 64 Kbps
- Reliable
- Error recovery?
- Tight delay constraints (100-200ms)
- How do we send pictures?

Early days of the Internet

- US military project through Defense Advanced Research Project Agency (DARPA –at that time ARPA)
- Outcome - ARPANET
- Enable robust communication even if links are broken
- Opened to the universities in the 1980s

Early Days of the Internet

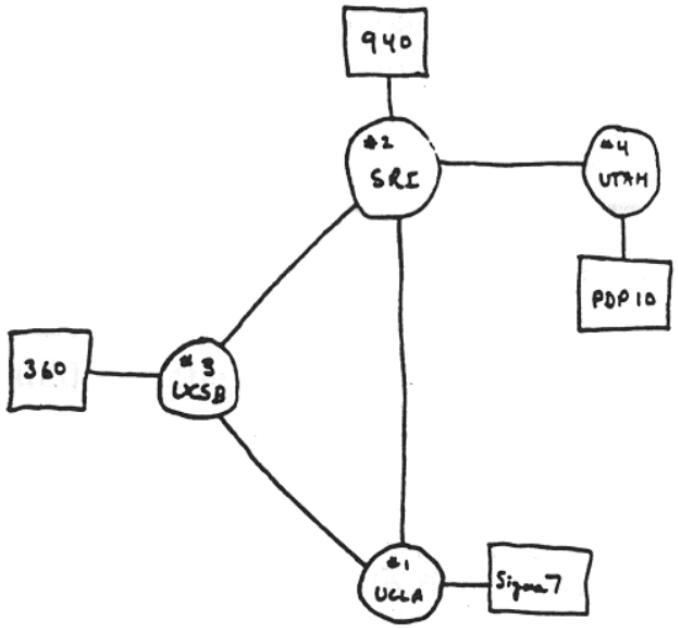
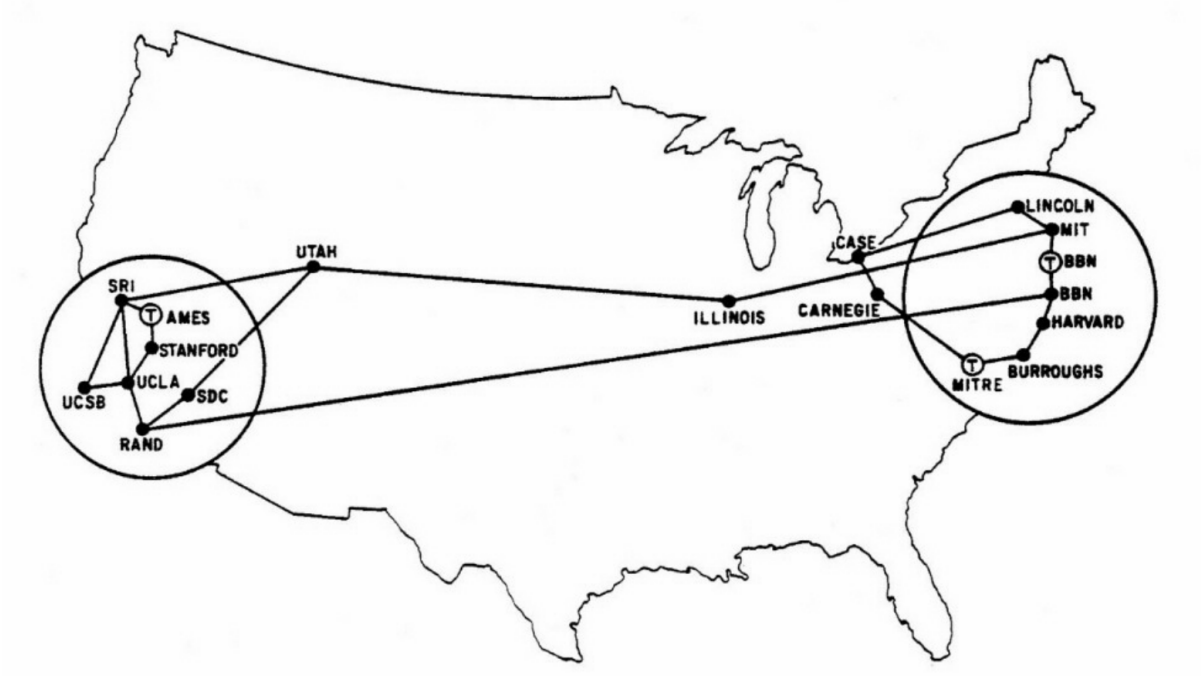


FIGURE 6.2 Drawing of 4 Node Network
(Courtesy of Alex McKenzie)

Early Days of the Internet



- 1970, ARPANET hosts start using NCP; first two cross-country lines (BBN-UCLA and MIT-Utah)

Early Days of the Internet

- 1961 – Packet switching
- 1971 - 15 nodes (23 hosts): UCLA, SRI, UCSB, Univ of Utah, BBN, MIT, RAND, SDC, Harvard, Lincoln Lab, Stanford, UIU(C), CWRU, CMU, NASA/Ames on ARPANET
- 1974 – Telnet , TCP design
- 1984 – DNS
- 1986 - NSFNET created (backbone speed of 56Kbps)
- 1993 - InterNIC (directory, information services)
- 1995 – Commercial Internet
- Then things explode...

Design Goals

In order of importance:

- Inter-connect existing networks (ARPANET, packet radio, satellite, etc.)
- Survivability (ensure communication when router and link failures happen)
- Support different types of services/applications
- Must accommodate a variety of networks
- Permit distributed management of resources
- Be cost effective
- Permit host attachment with low levels of effort
- Resources used must be accountable

Some thoughts

Different ordering of the previous goals may have resulted in a different architectural design
Fundamentally different design compared to telephony! Needed to serve MANY different applications
Traffic can be bursty, many different protocols.
Best-effort delivery no quality of service
2 fundamental design principles - Layering and End-to-end principle