CSE 486/586 Distributed Systems The Internet in 2 Hours: The First Hour

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Recap

- Please make an effort to come to every class.
- Please do the work yourself and get permissions for other sources. Also, acknowledge them.
- Please check if you have the background by doing PA1 all by yourself.
- · This course is about:
 - Introducing common problems that arise when building a distributed system
 - Discussing algorithms, architectures, and abstractions that solve those problems
 - Practicing how to adapt those algorithms and concepts

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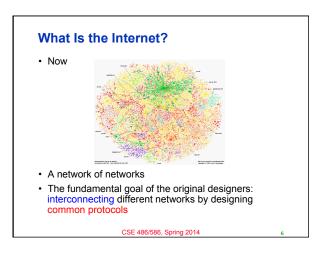
Today and Next

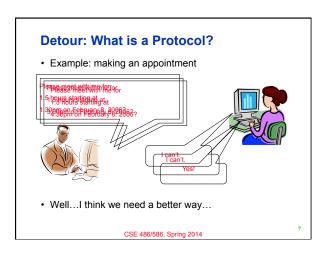
- · A brief overview of the Internet
- Two things
 - The design philosophy of the Internet ("The Design Philosophy of the DARPA Internet Protocols" by David Clark): today
 - Transport & application layers: next lecture
- Obviously can't replace a networking course; this should be just a recap for you.
- · Why teach these?
 - Because I want to ;-)
 - If there's no network, there's no distributed system.
 - Not just that: the design of the Internet is a great example of designing a solid distributed system.

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What is the internet? • 1969 QUELLES STATES TO STATES

• 1977 • 1977 • CSE 486/586, Spring 2014





Detour: What Is a Protocol?

- Bob: When are you free to meet for 1.5 hours during the next two weeks?
- Alice: 10:30am on Feb 8 and 1:15pm on Feb 9.
- Bob: Book me for 1.5 hours at 10:30am on Feb 8.
- · Alice: Yes.

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Detour: What is a Protocol?

- An agreement between entities in communication
 - Two things: 1) syntax, 2) semantics
- Syntax
 - What language?
 - What's the time format? Granularity?
 - Etc.
- Semantics
 - If broken into pieces, how do you reassemble?
 - If a msg gets lost, what do you do?
 - If you get a msg, what do you do?
 - Etc.

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Returning back: What Is the Internet?



- A network of networks
- The fundamental goal of the original designers: interconnecting different networks by designing common protocols

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- · Once again, no recitations.
 - I think office hours are much more effective.
- PA 1 is out. Please try it yourself.
- Please use Piazza; all announcements will go there.
 - Anonymous/private posting: generally questions are beneficial to the whole class; please consider posting it publicly first.
- · Please come to my office during the office hours!
 - Give feedback about the class, ask questions, etc.
- · Extra credit for good code styles.
 - Everyone will get a chance.
 - We will randomly pick one out of PA2 PA4 and examine the style.
 - Use the Android code style guideline posted on Piazza.

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Building the Internet

- · Why care?
- Now: you might be just doing what's given to you.
 - Later: you will likely define what you want to do and do it.
- Internet as a case study of a distributed system
 - Put a designer's hat on for a moment.
- · Questions to think about:
 - Why? i.e., why do we want to connect computers?
 - What is the ideal outcome? i.e., what do we want?
 - How do we do that?

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Why and What

- Why
 - "The whole can be greater than the sum of its parts"
- What
 - Internet communication must continue despite loss of networks or gateways.
 - The Internet must support multiple types of communications service.
 - The Internet architecture must accommodate a variety of
 - The Internet architecture must permit distributed management of its resources.
 - The Internet architecture must be cost effective.
 - The Internet architecture must permit host attachment with a low level of effort.
 - The resources used in the Internet architecture must be accountable.

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How to Interconnect?

- There were many types of networks based on various physical media.
 - Coax, radio, satellite, etc.
- The original designers wanted to interconnect those somehow.
- A potential solution
 - Designing a "multi-media" network (e.g., via physical signal translator for various physical media)
- · Solution chosen?
 - Hint: "All problems in computer science can be solved by another level of indirection." --- David Wheeler
 - Connecting by layering with packet switching
 - (We will not cover packet switching vs. circuit switching)

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Layering: A Modular Approach

- · Sub-divide the problem
 - Each layer relies on services from layer below
 - Each layer exports services to layer above
- · Interface between layers defines interaction
 - Hides implementation details
 - Layers can change without disturbing other layers
- "The" computer science approach
 - ISA, OS, networking...

Application

Application-to-application channels

Host-to-host connectivity

Link hardware

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Challenges in Layering

- What to put on top of physical networks?
- · Assumption (for the sake of the discussion):
 - Packet switching (a conversation is divided into smaller units called packets).
- Basic things for enabling a conversation between remote hosts:
 - Addressing (where do I send a msg?)
 - Routing (how do I reach that address?)
- Most importantly, survivability
 - Protection of a conversation as long as there's a physical path between entities communicating and they are alive.
- What are some of the threats that disrupt a conversation?
 - Packet loss, out-of-order delivery, duplicate packets, etc.

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We Must Ask Ourselves...

- · In a conversation, there are two components involved
 - Hosts
 - Network
- So, one more question: where do we want to put the functionalities? More specifically, what would be a good network/host division of labor?
- · Addressing and routing?
 - Yeah, probably in the network
- · What about conversation protection mechanisms?
 - The network or hosts?

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Summary

- · The Internet
 - A network of networks
 - A case study as a distributed system
- Protoco
- An agreement between multiple parties
- Syntax & semantics
- Design a system
 - Why, what, and how
- The Internet
 - Connecting by layering

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