Technical and Social Foundations of the Internet

Technical and Social Foundations

- What is the Internet?
  - According to Wikipedia
  - According to Jon Stewart and Ted Stevens

  - A collection of autonomous systems (ASs)
    - Network of networks
    - How do these networks communicate?
    - Country level, company level, ...
    - Until 2007, 16-bit AS numbers, now 32 bits

Communication on the Internet

- AS level, communication between AS's
  - Send email from Duke to Malaysia
  - visualroute.visualware.com
  - What names and numbers are involved?

  - Duke has ASN 13371
    - what is an ASN for YouTube?
    - AS communicates with neighbors using BGP
    - Computers on the internet communicate with IP
    - Mail works because of SMTP

Can the Internet break?

- Internet Glitch Can Strand You
  - Similar incidents in the past
  - What about this phrasing?
  - The upstream carrier accepted the routing message, and passed it along to other carriers across the world, which started sending all requests for YouTube videos to Pakistan Telecom, Soon, even Internet users in the U.S. were deprived of videos of singing cats and skateboarding dogs for a few hours.
  - Did Pakistan hijack YouTube intentionally?

Internet Protocol RFC 791, 1981

  - The internet protocol is specifically limited in scope to provide the functions necessary to deliver a package of bits (an internet datagram) from a source to a destination over an interconnected system of networks. There are no mechanisms to augment end-to-end data reliability, flow control, sequencing, or other services commonly found in host-to-host protocols. The internet protocol can capitalize on the services of its supporting networks to provide various types and qualities of service.

  - A distinction is made between names, addresses, and routes [4]. A name indicates what we seek. An address indicates where it is. A route indicates how to get there. The internet protocol deals primarily with addresses.
Internet Addresses and Routing

Jon Postel
- Size matters
- DNS
- Names
- Numbers
- ICANN
- U.S.A. v World

Jon Postel, Wrong Turn in Cyberspace

What is IPv6?
- What is the 6 in IPv6? Is Vint Cerf in on it?
- When will the Internet stop growing?
- What did Chicken Little say?
- Who made up IPv4 and IPv6?
- Difference between 32 bits and 128 bits?
  - $2^{32} = 4,294,967,296$
  - $2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456$

Google and Scale
- # Queries/day?
- How does Google make money?
- What about privacy?
- What about gmail?

Who are Sergey and Larry?

What is google.org?

Niklas Zennstrom and Janus Friis
- Kazaa, Skype, Rdio
- Transforming Society
- Buy, Sell, Buy, Sue
  - eBay and Skype
- Google phone
  - August 26, 2010!

Estimates and Sources
- How many packages does Fedex ship a day through Memphis, TN?
  - Verifiable?
- How many packets are sent each day over the Internet?
  - Verifiable?
- How many cell phone calls made each day?
  - Verifiable?

Questions

Bits and Atoms
  - Are there differences?
- I want to watch Hot Tub Time Machine
  - Right now vs. tomorrow, in my living room
  - Netflix, Amazon, Pizate Bay/issbunt, Rapidshare
  - Shipping bits or atoms? Differences?
- Negroponte's Being Digital
  - http://bit.ly/12xV0f
  - "Worse, a book can go out of print. Digital books never go out of print. They are always there."
Bits and Atoms again
- Amazon, Kindle, 1984
  - July, 2009

Comparing Bits and Atoms
- Number of atoms in the observable universe
  - Where do you find an answer to this?
  - What about atoms on Earth? Different?
- Number of IPv6 addresses
  - Where do you find this out?
  - How does compare to IPv4?
  - What is the v in IPvv?

Aside: Akamai for neophytes
- http://www.youtube.com/watch?v=d2E3NfcomVI
- How do cnn.com and facebook.com cope?
  - What was traffic like at 10:00 pm EST?
  - Web/Internet cope with flash crowds?
- 15,000 servers; 69 countries; 1,000 networks
  - Richmedia, software, e-commerce, ...
  - 70%? Of CDN market
- Customized DNS, overlay network, patented
  - Location, Server, ...

Akamai and other CDNs
- Referenced in local/cache YouTube article
  - Redirect URL to distributed hosting service
  - Leverages capabilities in HTTP (what's the P?)
- Facebook has and uses CDNs
  - Largest photo-site on the web
  - Custom and commercial CDNs
- Patent: Limelight law suit
  - How do lawsuits work?

IP: Intellectual Property
- Copyright, Patent, Trade Secret: IP
  - IP term is pervasive, so we will use it
  - Differences from "real" property?
  - What does IP mean to Cisco employee?
- In US, and most other countries, IP similar
  - Copyright: fixed/expressed, not an idea
  - Patent: idea/invention, non-obvious, useful
  - Trade-secret: not-disclosed, secret

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Patents and the Internet
- Internet built on open standards and source
  - What are open standards? Why?
  - cf: patented, licensed, proprietary standards?
- Is IP an oxymoron with Internet's start?
  - Why was there a change (e.g., patents)?
  - Court system and economics/business
  - Why does the world change?

Key Patent Aspects
- US: First to File
  - Provisional Patent (protect invention)
  - $1500 provisional to $15K full (legal fees)
  - Lasts 20 years from date of filing
  - Requires paying "maintenance fees"
- Non-obvious to one skilled-in-the-art
  - Must examine prior art, who must?
- Must be useful, must exist!
  - No speculative patents

Why patent something?
- Effectively grants monopoly: invention/idea
  - Not expression as copyright, but novel concept
  - Different protection than trade secret
    - If it stays secret, good forever, but once out, gone!
- Defensive patent
  - Keep invention accessible/available
  - Lessen concerns about infringement
  - More common with software, esp. Open Source

Software Patent: Brief History
- State Street Bank & Trust, 1998
  - Software running mutual funds
  - State Street asks to invalidate patent
- Patent upheld: useful, concrete and tangible result should be considered patentable.
- Beginning of huge number of software patents being filed
  - Prior to this no algorithms patented
Amazon One-Click

- What does patent cover? How to find this?
  - USPTO online, Google Patents
  - Essentially store credit card
  - Sues B&N 23 days/issue
- Some claims invalidated
  - What’s a claim?

Patents: good, bad, ugly, other?

- USPTO examiners not always "expert"
  - Are they skilled-in-the-art?
  - Getting better, but...
- Defensive patenting: Red Hat, IBM, Sun
  - Procure patents, no enforcement, why?
- Patent trolls as business model
  - Buy patents, not "in business" per se
  - http://patentwatch.com/
  - http://pubpat.org/

Patent issues

- Repeal: prior art ignored
  - Robert Silvers: photo mosaic
- License to infringers, MP3
  - Law/Lawyers can intervene
- Sue infringers
  - Google query: patent suit. Settled or in court

Copyright Infringement?

- Questions

Copyright Basics

- What can be copyrighted?
  - US Code Title 17, Section 102
    - https://www.eff.org/cases/electric-slide-litigation
- Software and computer programs, facts and data, parodies and copies, ...
  - What about Fair Use? What about infringement?
From IP to IP via copyright

- Intellectual Property
  - What does this mean? Can we own it?
  - When Jefferson and his fellow creatures of the Enlightenment designed the system that became American copyright law, their primary objective was assuring the widespread distribution of thought, not profit. Profit was the fuel that would carry ideas into the libraries and minds of their new republic. Libraries would purchase books, thus rewarding the authors for their work in assembling ideas; these ideas, otherwise "incapable of confinement," would then become freely available to the public.

- Economy of Ideas
  - Libraries in the absence of books. How does society now pay for the distribution of ideas if not by charging for the ideas themselves?

Software, Copyright (towards Patents)

- Software the code v. software the program
  - Competitor’s viewpoint, user’s viewpoint
  - Tangible medium when written
    - What about when running on a machine?
  - What a program does, rather than the code
    - Whelan v. Jaslow 1985/6
      - Supreme Court goes 4/4, look and feel not copyrighted
  - More cases that change interpretation of laws

Facts not subject to copyright

- http://mlb.mlb.com/mediacenter/
  - Since facts do not owe their origin to an act of authorship, they are not original, and thus are not copyrightable.
  - Feist v. Rural (Wikipedia and others)

Sunglasses or recipes copyrighted?

- http://amzn.to/aTtcTy
- $189.99 at Amazon
- $9.99 at …

Molten Chocolate Cakes Recipe by Jean-Georges Vongerichten

Copyrights and Licensing

- Most software is licensed rather than sold
  - Why isn’t it sold? First-sale doctrine
  - Are EULAs valid? According to whom?
  - Can I back up my software? DVD/CD?

- Tale of three logos
  - Linux
  - Windows
  - SQLite

Toward Open Source

- http://tinyurl.com/yqfcq (Groklaw)
- Copyright law, guarantees protections
  - Exclusive right to copy
  - Exclusive right to create derivative works
  - Exclusive right to distribute work
  - Exclusive right to perform/display work
- Fair use exceptions, First Amendment tension, facts and ideas vs their expression

Fair use, face-to-face education

- Educational Exceptions
  - What about YouTube videos?
  - What about Social Network Torrent?
  - Clip from Ferris Bueller?

- Four prongs copy/use copyrighted work:
  - (1) For commercial or non-profit use
  - (2) Nature of copyrighted work, e.g., original?
  - (3) How much of work used
  - (4) Effect on market or value

Digital Millennium Copyright Act, DMCA

- Copyright law of United States
  - Passed in 1998, general industry support
  - What’s different about digital copyright?

- DMCA I: Rules against circumvention
  - Can’t try to bypass DRM, CSS, …
  - What about Bittorrent, Rapidshare, Elliott’s server, Youtube

- DMCA II: Safe Harbor provisions
  - Protect online service providers (blogs?)

DMCA: Chilling Effects (according to?)

- Anti-circumvention (1201) aspects of DMCA
  - Prevents legitimate back-up/archive
  - Fair use "under siege"
  - Inhibits free speech

- Impedes innovation, science, invention, …
  - Despite research exceptions
  - What happens on violation or threat of?
  - Review and comments every three years
  - Why Library of Congress?
DMCA: Safe Harbor

- DMCA saved the web (2.0)
- Safe harbor provision (S12) is indispensable
  - No knowledge of offense!
  - Take down notices
  - Counter notice
  - Eligible for safe-harbor?
- If I post a video to YouTube that infringes...
  - Who gets in trouble?

DMCA and chilling effects

- Dmitry Sklyarov, Elcomsoft, 2001
  - Arrested? Conference?
- Ed Felten, SDMI, 2001
  - RIAA urges reconsideration
  - Princeton Profs anti-circumvention
  - Alex Halderman, Sony rootkit
  - Ben Edelman and CIPA (children’s internet protection act)
    - Research, tools, distribution, "just sue"

Jon Lech Johansen (DVD Jon)

- DeCSS
  - How does DVD encryption work?
  - What is GPL issue with original code?
- Apple, iTunes, Fairplay, DRM
  - Digital Rights Management
  - iPhone
  - Hacker Jon

Questions

- Vicarious infringement
  - Ability to control users, financial benefit
  - Liability without knowledge, Napster?
- Contributory infringement
  - You know it, you did it (abet piracy)
  - Host forum for others to post
- What about DMCA safe harbor provisions?

Background on Bits

- Bit is a "binary" "digit"
  - What’s binary? What’s a digit?
  - It’s all zeros and ones in computers on Internet?
  - What about MP4, MP3, .aac, .jpg, .pdf, ...

Scale and Bits: Binary Digits

- Number of IPv4, 32-bit addresses?
  - How many 33-bit addresses?
- If you use a 32-bit encryption key, and computers can test one billion keys/second
  - # seconds to break with brute force?
  - If we add 1 bit, how many seconds?
  - # seconds for 128-bit encryption key?
- Skype uses 256-bit encryption key?

Can we double every two years?

- Explaining Moore’s Law:
  - http://www.youtube.com/watch?v=bLSMn0cNWAw
  - http://www.youtube.com/watch?v=D3dKbq5AXz8

Moore’s Law meets Hurley’s Law

- See Wikipedia entry for complete Info
  - http://en.wikipedia.org/wiki/Moore’s_law
  - http://tinyurl.com/582kkjg 13 hrs/min in 2008
- Over the next decade, people will be at the center of their video and media experience. More and more consumers will become creators. We will continue to help give people unlimited options and access to information, and the world will be a smaller place."
Compsci 182s, Spring 2011 Overview

**Internet Censorship**

- What is censorship? Does venue matter?
  - Cigarette commercials on TV, profanity, military and national-security documents, Google Earth images, Super Bowl commercials,

- What about Internet censorship?
  - Nationwide: where and why
  - School-wide: where and why
  - Family-wide: where and why

**Censorship in Australia (Denmark, …)**

- Blacklists for ISPs at the country level
  - Domain name censorship

- Wikileaks hosts site, threatened with fines
- Started with good intentions (perhaps), but ...
  - How does a domain name get on the list? Off?

**Internet/Web Censorship**

- Blacklists, client, ISP, country, other?
  - How are these implemented?
  - Possible to bypass with 79.141.34.22
  - Counteract with whitelist?

- Can we block, filter, or examine IP address?
  - Where is the IP address?
    - ISP-wide, bottlenecks, technologically feasible?
  - What about *deep packet inspection*?

**Questions**

- Skype, TOM-Skype, China
  - http://skype.com
  - http://skype.tom.com
  - http://www.nartv.org/2008/10/01/breaching-trust-tom-skype/

- Our investigation reveals troubling security and privacy breaches affecting TOM-Skype — the Chinese version of the popular voice and text chat software Skype. It also raises troubling questions regarding how these practices are related to the Government of China’s censorship and surveillance policies.

**Internet (and other) Censorship**

- What is censorship? Does venue matter?
  - Cigarette commercials on TV, profanity, military and national-security documents, Google Earth images, Super Bowl commercials,

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  - Nationwide: where and why
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**“Censorship” Internet laws in the US**

- Communications Decency Act: ACLU v Reno
  - "offensive" material off-limits to minors
  - 1997 SCOTUS, unanimously unconstitutional.
  - Section 230 survives: blogger/ISP immunity

- Children’s Internet Protection Act: CIPA
  - Schools, libraries must install and use filtering software (e-rate: Duke? Durham?…)
  - Affirmed by SCOTUS in 2003, filters must be *disableable*, though not by minors

**Firewalls and Proxies**

- Golden Shield
  - Great Firewall of China
  - Atlantic on firewall.cn

- Personal/Corporate Firewall
  - IP packet layer, Application layer
  - Stop or allow, based on ...
  - Port numbers used for granularity

- Proxy server
  - For firewall, for content, for censorship?
Software filters, what do they do?

  - Does where a message comes from affect the status of whether it’s ok?

- China: Green Dam/Youth Escort
  - Uproar 7/09-8/09!: all laptops in China must have filtering software installed!

- preliminary Green Dam analysis

http://opennet.net

Straightforward state regulation of speech without technological components can, of course, result in censorship; our work here is designed to focus on regulation that, when implemented through code, seems more of a force of nature than an exercise of political or physical power.

Thus it is entirely possible that a state that does not require or inspire technical filtering can possess a set of regulations or social norms or market factors that render its information environment less free than a state with fairly extensive technical filtering.

Laws in Other Countries

Yahoo!, France, Nazi Memorabilia

- Ligue contre le racisme et l’antisémitisme et Union des étudiants juifs de France c. Yahoo! Inc. et Société Yahoo! France (LICRA v. Yahoo!)
  - http://www.lapres.net/yahweb.html

- French student groups sue Yahoo!
  - Sue in US, take down material
  - Violation of French law, but what about US First Amendment rights?
  - Court case complicated by "ripeness"

Turkey, YouTube, Ataturk

- YouTube hosts videos deemed "insulting", so Turkey orders their removal
  - Remove in Turkey
  - Remove worldwide
  - Ban YouTube in Turkey
  - Why? How?

Adnan Oktar

- Adnan Oktar is a prominent Turkish intellectual.
  - Completely devoted to moral values and dedicated to communicating the sacred values he cherishes to other people,

- A Muslim creationist has succeeded in having Richard Dawkins’ website banned in Turkey, after complaining that its atheist content was blasphemous.
  - Boston Globe, October 2009

What’s wrong with this picture?

Google buys …

- Postini: web, email security, malware filters
  - 2007/$625M, malware filtering by Google
  - Oct 2009, Postini Fails

- DoubleClick: online advertising, rich media
  - 2008/$3.1B advertising juggernaut?

- On2: video codecs, Theora, others
  - 2009/$106M, video is everywhere?

- Recaptcha: web security? OCR?
Does Google Have Too Much Power?

- **Google's Gatekeepers**
  - The Decider
  - Google as Monopoly
    - Harbinger?

- **www.globalnetworkinitiative.org**
  - EFF, Berkman Center, CDT, Human Rights Watch
  - Google, Microsoft, Yahoo
  - kld.com, domini.com, bostoncommonasset.com, ...
  - Who are these stakeholders? What are their goals?
  - A multi-stakeholder group of companies, civil society organizations (including human rights and press freedom groups), investors and academics spent two years negotiating and creating a collaborative approach to protect and advance freedom of expression and privacy in the ICT sector, and have formed an Initiative to take this work forward.

Legal v Technical: Courts of Law

- **Perfect 10 v everyone**
  - Mostly copyright: fair-use, infringement

- **Blizzard v BNETD and MDY**
  - Copyright, licensing, section 117
  - Who is liable for libel online?

- **Blumenthal v Drudge and AOL**
  - Who files Amicus Briefs?

Perfect 10 v Google (and others)

- Thumbnails "transformative"
  - Anatomy of Google results

- History of Perfect 10
  - Who is sued and why?

- Who files Amicus Briefs?

Blizzard v BNETD and MDY

- Blizzard: $100 Million/month on WOW
  - MMO, how is it played? Licensed? Purchased
  - Network and updates (currently Bittorrent!)

- BNETD, open source, network alternative
  - MDY, "Glider," auto-player
  - Warden as either spyware or protection
  - Tremendous implications if Blizzard wins

Blumenthal v Drudge and AOL

- Drudge alleges spousal abuse
  - Retracts "immediately"

- Blumenthal sues both
  - Why is AOL dismissed?

- What recourse here?
  - Good Samaritan clause
    - Section 230 of CDA