Tussles† in Cyberspace

† 'tus-sle: an intense argument, controversy, or struggle

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Outline

- A recap of Lessig's "Code is Law"
- The Internet Architecture and its Evolution
- Tussles within the Internet
- Tussles atop the Internet
- Closing remarks
- Discussion

Lessig's Contention: Code is Law

"The software and hardware that make [up] cyberspace constitute a set of constraints [on] access to cyberspace… Code or software or architecture or protocols … constrain some behavior by making other behavior possible, or impossible."

"Code can achieve perfection of control that will render it, in cyberspace, the most powerful regulator of all."

"The invisible hand [of government and commerce] is building an architecture that is quite the opposite of what it was at cyberspace's birth … an architecture that perfects control."

Code is Law: Implications

- Commerce is moving cyberspace towards *"a fairly unified regulation through code"…*
- Shaped by code, cyberspace will become a world in which:
  - *"[Code can do] the work that the law used to do … far more effectively than the law did."*
  - *"Effective regulatory power [shifts] from law to code, from sovereigns to software."*
  - *"[Code] displaces law by codifying the rules, making them more efficient than they were just as rules."*

Code is Law: Perfect Control

"[W]hat happens when code protects the interests now protected by copyright law? Should we expect code to mirror the limits that the law imposes? Fair use? Limited term? Would private code build these "bugs" into its protections?"

"The point should be obvious: when intellectual property is protected by code, nothing requires that the same balance be struck. Nothing requires the owner to grant the right of fair use. She might, just as a bookstore allows individuals to browse for free, but she might not. Whether she grants this right depends on whether it profits her. Fair use becomes subject to private gain."

Code is Law: Implications

- If we do nothing, cyberspace will become a place of perfect control, devoid of the liberty and free expression that we hold sacred.

"The underpaid heroes who built the Net have ideological reasons to resist government's mandate. They are not likely to yield to its threats. And unlike some commercial interests, they do not have millions riding on a single architecture winning out in the end."

"But as code writing becomes the product of a smaller number of large companies, the government's ability to regulate it increases."

Code is Law: Maybe not…

"Just as there was a push toward convergence on a simple set of network protocols, there will be a push toward convergence on a uniform set of rules to govern network transactions. This set of rules will include

- *not the law of trademark that many nations have, but a unified system of trademark, enforced by a single committee;*
- *not a diverse set of policies governing privacy, but a single set of rules implicit in the architecture of Internet protocols;*
- *not a range of contract law policies, implemented in different ways according to the values of different states, but a single, implicit set of rules decided through click-wrap agreements and enforced where the agreement says."*

- What Lessig doesn't get (or perhaps what I don't get about Lessig's conclusion) is *why should code regulations converge?*

Standards ≠ Uniformity

- Standards are needed for interoperability and ***not*** for control.
- The Internet architecture (code) promotes a diversity of standards ***not*** a single one.
- Internet protocols continue to be invented, extending functionality and diversity.
- Need to understand how (Cyberspace) code evolved and continues to evolve.

Necessity is the mother of invention

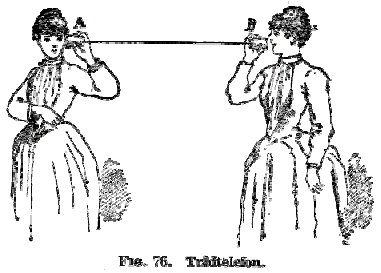
Engineers solve problems

- Find the most efficient solutions – no more/less.
- Must make assumptions.

Society adopts new technologies

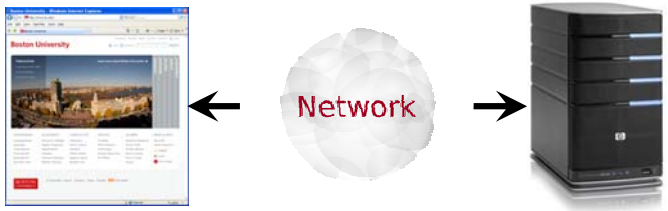
- Find new uses/abuses, resulting in new problems.

Some context…



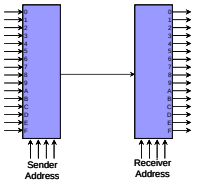
The 19th century 'tin can', or 'lover's' telephone
Source: Wikipedia

Today…



Circuit-switched networks

- Set up a “circuit” between the sender and the receiver.
- This is how telephone communication started.
- Problem: Only one connection per switchboard (router) even though router can go much faster.



Packet-switched networks

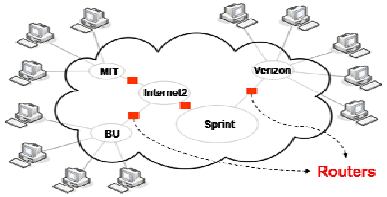
- Data divided in packets that are stored and forwarded from one switchboard (router) to the next.

- To send more data, divide into multiple packets and send one after the other.

- US Mail Analogy.

"Store-and-Forward" networks

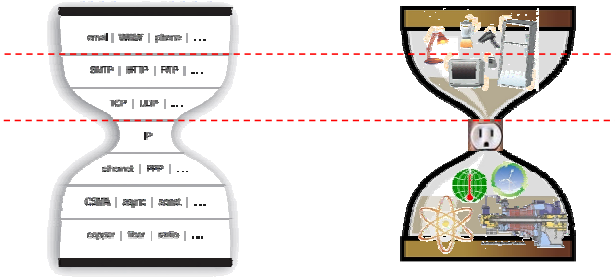
- Every computer (on the Internet) has a unique address – called the IP address
- A router handles any packet whose destination is not local, storing it, and then forwarding it to the "next" network (hop) towards its destination.



Internet = Network of Networks

The Internet Protocol(s)

- Why is the Internet really different?



- The end-to-end principle and implications

Tussle: It's all bits

- Store-and-forward communication
  - In 1996, the 1934 telecom act was modified to distinguish "telecom" from "info"† services.
  - Common carriers are held to higher safety standards and must be neutral, and in return are afforded special protections.
  - Now, IP voice and video services are unregulated "information services" that compete directly with regulated voice and video services by "common carriers".

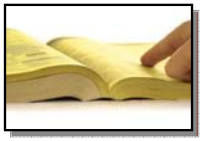
† *generating, acquiring, storing, transforming, processing, retrieving, utilizing or making available information via telecommunications*

Tussle: Net Neutrality

- What is it?
- Neutrality with respect to what?
- Is it a panacea?
- In the news
  - AT&T wants a piece of Google's ads pie
  - Apple does not allow Google Phone App
  - Google contemplates broadband offerings

Tussle: What's in the name?

- DNS
  - A technology invented in 1983 to go from friendly names (csa2.bu.edu) to IP addresses (128.197.12.4)



  - By the late 1990s, it changed the vocabulary of society – "Walmart" ➔ "www.walmart.com"
  - At the root of big trademark problems – e.g., whitehouse.org, nissan.com.

Truth in Domain Names Act…

- Anti-cybersquatting Consumer Protection Act is a US federal law enacted in 1999.
  - It makes people who register domain names with the sole intent of selling the rights to these domain names for a profit liable to civil action.
- URL hijacking is a form of "cybersquatting" that capitalizes on typographical errors made by Internet users to lead them to an alternative website owned by a cybersquatter.
- Organizations often register misspelled domain names (e.g., gogle.com, googel.com)!

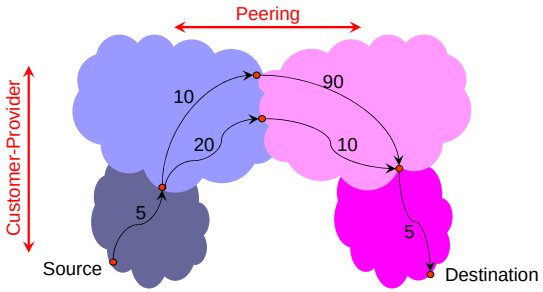
Tussle: What's in the email?

- SMTP
  - A technology invented in 1971 to enable a researcher to send a text message to geek@lab15.mit.edu.
  - By late 1990s an email address has become one's cyber identity.
  - Today, it limits customer mobility (and hence ISP competition) – not possible to solve as with "local wireless number portability".
  - Oh yes, and then there is SPAM.

Tussle: Routing

- BGP
  - A technology invented in early 1990s to enable multiple co-operating ISPs to collectively find best routes for Internet traffic.
  - By mid 2000s it has turned into a mechanism for competing ISPs to encode and enforce business relationships.
  - Today, it is the “weakest link” of the Internet – a time bomb.

Hot Potato Routing across ISPs



- Internet paths are not the best possible!

Tussle: Congestion Control

- TCP
  - Invented in 1971, it allows two communicating users to decide at what speed they should communicate to be “friendly” to other users.
  - By mid 2000s, the Internet has become the playground of selfish, competing users who “abused” TCP.
  - Today, ISPs are struggling to reign in selfish users – being accused of jeopardizing “net neutrality”.

The Perils of Ossification

Myopic design choices

- Cyberspace architects are not good at anticipating how inventions might be used, or in predicting future problems or “killer apps”.

Revisiting design choices is hard

- Wide adoption requires standardizing early design choices, making it much harder to change.
- Particularly problematic when a technology does not get replaced.

Two Viewpoints

- It's not broken – extend it by adding (overlaying) the functionality you want on top of existing protocols.
- Start over with a "clean slate" that recognizes current and future "tussles", offering mechanisms not solutions.

Tussles: Beyond net architecture

- Application programmers make "coding" decisions that are seldom known to users:
  - Word processors may not really delete "deleted" text.
  - Web browser sends the referrer URL to the server.
  - Web browser sends capabilities of your computer to the web server.
  - Plug-ins to web browsers bypass browser settings.
- *It's not a bug, it's a feature!*

How tractable are you?

The Panopticon is a prison architecture designed by English philosopher and social theorist Jeremy Bentham in 1785. The concept of the design is to allow an observer to observe (*-opticon*) all (*pan-*) prisoners without the prisoners being able to tell whether they are being watched, conveying what one architect has called the *"sentiment of an invisible omniscience."* – Wikipedia

How tractable are you?

Browser Characteristic	bits of identifying information	one in x browsers have this value	value
User Agent	8.93	488.73	Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0; .NET CLR 1.1.4322; .NET CLR 2.0.50727; .NET CLR 3.0.4506.2152; .NET CLR 3.5.30729)
HTTP_ACCEPT Headers	3.69	12.94	text/html, */* gzip, deflate en-us
Browser Plugin Details	16.61	100353	Java 1.6.0_17; QuickTime 7.6.5.0; Flash 10.0.42.34; Windows Media Player 11.0.5721.5268; Silverlight 3.0.50106.0; Adobe Acrobat version 5.?
Time Zone	2.64	6.23	300
Screen Size and Color Depth	15.5	46316.77	1364x768x16
System Fonts	19.2	301059	Marlett, Arial, Arial CE, Arial CYR, Arial Greek, Arial TUR, Arial Baltic, Courier New, Courier New CE, Courier New CYR, Courier New Greek, Courier New TUR, Courier New Baltic, Lucida Console, Lucida Sans Unicode, Times New Roman, Times New Roman CE, Times New Roman CYR, Times New Roman Greek, Times New Roman TUR, Times New Roman Baltic, Wingdings, Symbol, Verdana, Comic Sans MS, Impact, Georgia, Franklin Gothic Medium, Palatino Linotype, Tahoma, Trebuchet MS, Webdings, Estrangelo Edessa, Gautami, Latha, Mangal, MV Boli, Raavi, Shruti, Tunga, Sylfaen, Microsoft Sans Serif, ZWAdobeF, Kartika, Vrinda, Arial Unicode MS, Batang, Book Antiqua, Bookman Old Style, Century, MS Mincho, Monotype Corsiva, SimSun, Agency FB, Arial Rounded MT Bold, Blackadder ITC, Bodoni MT, Bodoni MT Black, Bodoni MT Condensed, Bradley Hand ITC, Calisto MT, Castellar, Century Gothic, Century Schoolbook, Copperplate Gothic Bold, Copperplate Gothic Light, Curlz MT, Edwardian Script ITC, Elephant, Engravers MT, Eras Bold ITC, Eras Demi ITC, Eras Light ITC, Eras Medium ITC, Felix Titling, Forte, Franklin Gothic Book, Franklin Gothic Demi, Franklin Gothic Demi Cond, Franklin Gothic Heavy, Franklin Gothic Medium Cond, French Script MT, Garamond, Gigi, Gill Sans MT Ext Condensed Bold, Gill Sans MT, Gill Sans MT Condensed, Gill Sans Ultra Bold, Gill Sans Ultra Bold Condensed, Gloucester MT Extra Condensed, Goudy Old Style, Goudy Stout, Haettenschweiler, Imprint MT Shadow, Lucida Sans, Lucida Sans Typewriter, MS Outlook, Malandra GD, OCR A Extended, Palace Script MT, Papyrus, Perpetua, Perpetua Titling MT, Pristina, Rage Italic, Rockwell, Rockwell Condensed, Rockwell Extra Bold, Script MT Bold, Tw Cen MT, Tw Cen MT Condensed, Wingdings 2, Wingdings 3, MS Reference Sans Serif, MS Reference Specialty, Tw Cen MT Condensed Extra Bold, Arial Narrow, Bookshelf Symbol 7, Cambria, Cambria Math, Calibri, Candara, Consolas, Constantia, Corbel, MT Extra, Mathematica1, Mathematica1Mono, Mathematica2, Mathematica2Mono, Mathematica3, Mathematica3Mono, Mathematica4, Mathematica4Mono, Mathematica5, Mathematica5Mono, Mathematica6, Mathematica6Mono, Mathematica7, Mathematica7Mono, Segoe UI (via Flash)
Are Cookies Enabled?	0.27	1.2	Yes
Limited supercookie test	4.13	17.5	DOM localStorage: Yes, DOM sessionStorage: Yes, IE userData: Yes

Tussles: Beyond net architecture

- Tussles resulting from user interactions, e.g., in a social networking setting:
  - Notions of intellectual property are not well defined in multi-party exchanges (e.g., blog).
  - Privacy is compromised due to associations and structure of interactions (e.g., even if I want my age to be private, the age of my classmates will reveal it.
- What do Facebook quizzes know about you (and about your friends through you)? A lot!

Tussles: Beyond net architecture

- Unpredictable tussles between different applications and services:
  - Breaking the e2e principle: supporting WAP on cell phones breaks Facebook's authentication!


AP Exclusive: Network flaw causes scary Web error

Associated Press

By JORDAN ROBERTSON, AP Technology Writer – Fri Jan 15, 5:12 pm ET

facebook at&t

SAN FRANCISCO – A Georgia mother and her two daughters logged onto Facebook from mobile phones last weekend and wound up in a startling place: strangers' accounts with full access to troves of private information.

The glitch — the result of a routing problem at the family's wireless carrier, AT&T — revealed a little known security flaw with far reaching implications for everyone on the Internet, not just Facebook users.

RELATED QUOTES

Tussles: Beyond net architecture

- Unpredictable tussles between different applications and services:
  - Bugs!

Tussles: Beyond net architecture

- Tussles resulting from how "code" is used, e.g., depending on the nature of the bits!
  - Pointing to (indexing) copyrighted music will get you an RIAA lawsuit
  - Caching (de-duplicating) copyrighted music will get you an RIAA lawsuit

Music cannot live in the cloud!

Closing remarks

- Understand the new reality of the Internet
  - The days when all players had a common goal are gone; players have conflicting interests that the Internet should leverage / accommodate.
- Internet architects must not offer solutions to Cyberspace tussles, but the means for such tussles to run their course.
  - e.g., support “Cap and Trade” (of bandwidth) and “Collocation Games” (in the cloud).

Closing remarks

- Design principle: One size does not fit all – allow for multiple “visions” of the Internet to co-exist – e.g., GENI.
- Design for variation in outcome not for a particular outcome.
  - Modularize along tussle boundaries (e.g., naming vs routing, reliability vs anonymity).
  - Design for choice (e.g., circuit switching vs store-and-forward).

Closing remarks

- Computer Scientists have an obligation to educate society about what is possible:
  - I don’t have to know the ID of a person to check if he/she is entitled to access a building.
- Computer Scientists have an obligation to act as watchdogs and to promote best practices:
  - Open Source Software

Closing remarks

- Society must be ready to "pay" for the code (law) it wants – we get what we pay for:
  - If we want net neutrality, then we should be ready to pay (be taxed) more for it.
  - If we want code (law) to be transparent, then we should insist on / support open source software.

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