Why the Internet Matters to You
BTW - There is no "Internet"

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Agenda

- Telecom Regulations for Context
- Internet History
- Key Internet Technology Features
- Internet Control
- Technology Standards
- Network Neutrality
- What Made the Internet the Internet?
- What is the Internet? (If there is one?)

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Telecom Regulation/Governance (for context)

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Telecom Regulation International

- It started with the telegraph
- In 1865 20 European government representatives gathered in Paris

  Agreed to an *International Telegraph Convention*

  - Governed interconnection between national telegraph companies
  - Almost all process – 1 technical paragraph
  - Defined fees, policies and procedures

  Created *International Telegraph Union* (ITU) to maintain agreement

  - Evolved into *International Telecommunications Union* (ITU)
    - Creates & maintains standards & regulations for telephone

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Block Based on Content

- Article 20

  The High contracting Parties reserve the ability to stop any private communication that would appear to endanger the security of the State, or would be violating the laws of the country, the public order or moral standards/values, and shall immediately notify the administration of the country of origin.
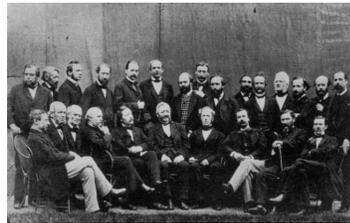
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Common carriage

- *"Any man undertaking for hire to carry the goods of all persons indifferently … is … a common carrier."* (Gisbourn v. Hurst – London Court - 1710)

- Must serve all customers equally

  Including not refusing customers

- Started with freight carriers

  E.g., trucking companies, railroads, bus lines, airlines, public utilities, et
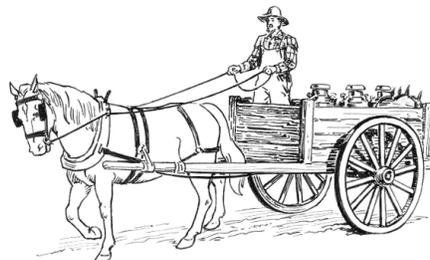
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Common carriage for US telecom

- AT&T agreed to become a regulated monopoly 1913
  - Agreed to be a common carrier for telephone service
- Communications Act of 1934 FCC regulatory authority over telecom
- Communications Act of 1996 - Title II concerns common carriage
  - Covers telephone companies
  - Very detailed rules
   - E.g. over 700 individual regulations
      - Accounting, record keeping, interconnections, numbering, universal service, infrastructure sharing, tariffs, new line, discontinuing service, rate of return, access charges ….

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The Internet History

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The Pre-Internet

- 1957: Sputnik
- 1958: Advanced Research Project Agency - DoD
- 1962: Paul Baran: packet networks/redundant links and forwarding devices (routers)
    Publicize technology (to prevent a first strike)
- 1966: ARPA allocates $1M to build ARPANET
    To enable remote access to ARPA-funded computers
- 1969: 1st 4 hosts
- 1970: 9 hosts (including Harvard)
- 1980: 200 hosts (international)
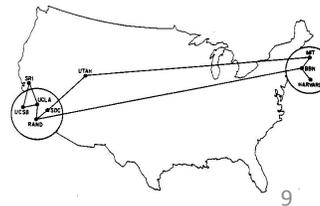
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The Beginning of the Internet

- 1972: Louis Pouzin designed the CYCLADES network
    Pure datagram (packet), no delivery assumptions
    Reliability the responsibility of the end nodes – "e2e"
- 1974: Vint Cerf & Bob Kahn: 1st version of TCP/IP
    Benefited from Pouzin's concepts
- 1983: ARPANET switches to TCP/IP
    Actual start of the Internet (network of networks)

Pouzin   Cerf   Kahn   10

Internet Architecture

- Interconnected independent (non-state) networks
- Pair-wise interconnection decisions
  - No central planning or interconnection regulations
- No central control & little coordination are required
  - Protocol parameters
    - Fields in protocols that need to be in sync – value unimportant
  - Bulk IP address assignments
    - Actual assignments & assignment policy done regionally
  - Maintain DNS root zone file
    - Set of pointers to servers for TLDs (e.g. .com, .company, .fr)   Postel
- Above functions done by the IANA
  - Internet Assigned Numbers Authority

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The Technology

- Packets (vs circuits)
- Run over existing networks (vs purpose-built network)
- No QoS guarantees (vs per-call dedicated capacity)
- No assumptions of underlying network quality (vs 5-9s service reliability in telephone network)
  - Packets can be reordered, duplicated or dropped
  - End systems responsible for reliability & security, if wanted
- End-to-end model (e2e)
  - network is "stupid"- application agnostic
  - Vs. "Intelligent Network" – applications are in the network
    - Exception: touch tone, which can be e2e

Isenberg   12

Could not possibly be of any use

- No guarantees
- No quality of service
- No security
- No carrier requirement (where the carrier provides both connections and applications)
  Thus, **no business model**
- IBM, AT&T etc., said that the Internet would not work
- So they, and the regulators, ignored it

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Control?

- There is no control of Internet
  Applications,
  Service providers,
  Content, or
  Devices
- The Internet (as we know it) could not have happened if there had been such control

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Control, contd.

🔔 ≠ Innovation

(FCC seal) ≠ Innovation
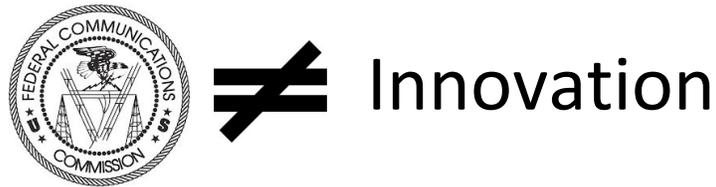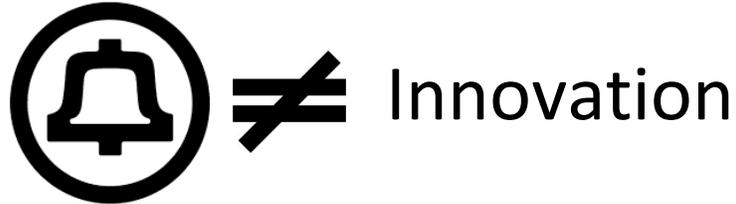
Control ≠ Innovation

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Internet: The Anti-Network

- Everything that the telephone network was not

  Flexible

  Enabling

 Platform for innovation

  Distributed innovation

  Generative

  Distributed authority

  (mostly) internationally seamless

  (mostly) unregulated/ungoverned

    Exceptions in some countries – e.g. China, England, …
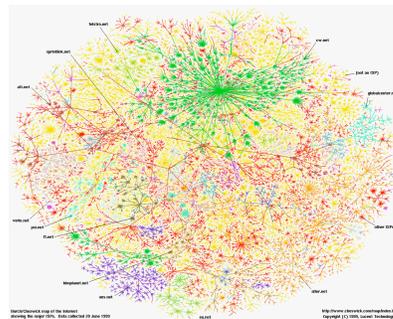
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Giving Away the Internet?

- IANA function was run by ICANN, a private multistakeholder organization under a contract with the U.S. government since 1998
    - **Just the three technical coordination functions** – nothing more (i.e., no governance)
- U.S. Government announced in Mach 2014 that it was ready to let the contract expire and let ICANN go it alone if the Internet community would support the idea – let contract lapse in Oct 2016
- Some in Congress saw this as '*giving away the Internet*' with a potential to '*destroy our First Amendment rights on the Internet*'
- NTIA asked in June 2018 if this should be reversed

Cruz

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What this Points Out

- There is no one and no organization that runs the Internet
- There is no "Internet governance" as a thing
- The Internet is the result of millions of cooperating people and organizations
    - E.g. the IANA edits the root zone, which points to the .edu nameserver, EDUCAUSE runs the .edu nameservers which point to to the Harvard nameservers, which provide information about computers at Harvard and to subdoman nameservers, e.g., dfci.harvard.edu which provide information on computers at Dana-Farber Cancer Institute
- All that binds these entities together are technical standards

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Internet Technical Standards

- All important Internet technical standards come from the IETF or W3C
  - Internet Engineering Task Force
  - World Wide Web Consortium
- Open voluntary standards organizations that produce open voluntary standards
- Participants driven to 'do what's right'
- ITU, on the other hand, does what its member states think is right
  - Many in the ITU still think the Internet does not work, or at least, can not continue to look like it works, & want to fix it
  - Creates technical standards that are ignored (e.g. NGN)

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Technical Standards, contd.

- IETF & W3C technical standards tend to be disruption enablers
  - e.g., Voice over IP (VoIP)
    - Enabled hundreds of "over the top" telephone companies
      - Slowed a bit by FCC ruling that some rules apply (not many)
    - Wiped out international telephone settlements
      - Huge impact on poor countries
  - e.g., support for streaming audio & video
    - Enabled (illegal) music & movie sharing
    - Huge impact on music industry
  - e.g., World Wide Web & blogs
    - Enabled anyone to be a publisher
    - Huge impact on publishing industry (ask newspapers)
    - Facilitated "fake news"

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Limitation on Innovation

- The power of the Internet is only realized if the users are free to use the Internet as they want to

  Create & use new applications

  Create new content & share that content

  Use whatever devices they want to on the network

1921

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FCC Four Principles

- FCC has been trying to require ISPs follow 4 principles through multiple rulemakings over many years

  1. consumers are entitled to access the lawful Internet content of their choice

  2. consumers are entitled to run applications and use services of their choice, subject to the needs of law enforcement

  3. consumers are entitled to connect their choice of legal devices that do not harm the network

  4. consumers are entitled to competition among network providers, application and service providers, and content providers

     Sept 2005

- Blocked by the courts each time

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2/14/19

ISPs Under Title II

- In February 2015 the FCC reclassified ISPs as being subject to Title II
- But said that they would forbear (not enforce) most of the Title II rules that govern telephone services – just enforcing those that would ensure a neutral network
- The carriers sued but this time the FCC won
- Many in congress did not like it – they claimed that regulations would destroy the Internet
  But they were only looking at the carriers not the $trillions of business & innovation over the 'Net

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ISPs Not Under Title II

- In December 2017 the FCC (under new leadership) repealed reclassification of ISPs as being subject to Title II - the "*Restoring Internet Freedom Order*"
- After receiving and ignoring over 21 million comments on proposal
  Many comments from bots, but millions from people
    Bots wanted to repeal Title II order, humans wanted to keep it
    Both ignored by FCC majority
- Very widespread public opposition to repeal
- Congress tried & failed to reject new FCC regulation
- Many states have passed their own NN laws
  They will be sued, FCC included preemption in new regulation

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Today

- There is no "Internet governance" at the International level

  Though many countries would like to see lots

- There is no "Internet governance" at the U.S. level

  Other than the FCC rules that ISPs have to be transparent

- The Internet exists by cooperation not control

- A bit of utopia? -- can it last?

  The lack of Internet governance has lasted since the 1980's and it is what created the Internet of today

- But that could all change tomorrow (literally)

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Internet Technology
What is the Internet?

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What Made the Internet the Internet

- The underlying technology did not require that the company that provided connectivity (an ISP) also provide services

- And it did not make it easy for a ISP to force the customer to use the ISP's services
  - Possible but not easy (at the start, easier now)

- The architecture did not include choke points
  - 1000s of pair-wise interconnections – no "backbone"

- ISPs during the expansion were ISPs (providers of Internet connectivity) not carriers (providers of content or services)

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Code is Law

- The technology limits what rules can be applied

- e.g. no single filter point, no single backbone

- U.S. government tried: Communications Decency Act
  - Users were required to ensure their messages could not be seen by someone under 18 if the material could be "harmful"
  - Not technically possible
  - Ruled unconstitutional (not because it was impossible)
  - But because another approach would be more effective and would not limit 1st amendment rights to speak on the Internet

1995

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Upsides & Downsides

- Innovation at the speed of light
- Failures almost as fast but do not have wide spread impact
- Changed just about all communications technology
- Changed just about all business models
- Vector for threatening society
    - Soapbox for demagogues & conspiracy theorists
- Enabling non-proximal communities
    - Bind dispersed communities
    - Create communities that survive on internal feed-back

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Result

- The users were in charge
    - Not the suppliers
- e.g., the web spread like wildfire because no permission was needed
    - Very different result than if all innovation was controlled by the carrier or regulators
- Self organizing communications group
    - Inuits & ship models to ISIS & the Arab Spring
    - Student protests in Bangladesh for a week
- Uncontrolled & unpredictable impact, uncontrolled & unpredictable content

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Keep in mind

- There is no "Internet"

  In the context of this workshop

- The Internet itself is like the telephone network, communications support or the highway system, transport support

  At least for now – the removal of network neutrality may change that in time

- What people refer to when saying "the Internet" is the applications (social media, web sites, VoIP) that run over the communications mechanism

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Thanks for listening &

have a productive workshop

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