The Internet: Its Past, Present, and Possible Futures

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ISOC-NE

10/20/10

The ARPANET

V1 - 1969
Network Control Program (NCP)
host to host

V2 - 1983
Transmission Control Protocol/
Internet Protocol (TCP/IP)
network to network

end - 1990

U.S. DoD funded - for federally supported research
56Kbps

The NSFNet

V1 - 1986
  56 Kbps between SC centers

V2 - 1988
  1.5 Mbps between **regional networks**

V3 - 1991
  45 Mbps between regional networks

end (as backbone) - 1995
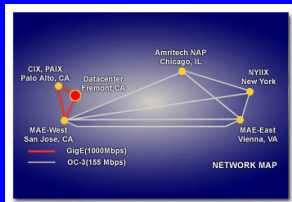
U.S. National Science Foundation funded

TCP/IP mandate

AUP drove commercial ISPs

The Commercial Internet

started in late 1980s

US funding out of the picture by 1995

multiple Internet service providers (ISPs)

ISPs **interconnect** to provide the "Internet"
  at peak - ~ 6,500 ISPs

most big independent ISPs now gone
  at least for residential service

telephone & cable **carriers** have
  taken over

Back to the Start - What was there?

The Phone Network
from The Phone Company - AT&T

circuit-based

statically **predictable** calling patterns

predictable growth rates

assumed absolute requirement for QoS

assumption of being carrier-provided

a regulated **monopoly**

the **largest** corporation in the world

most of the $ from **communication**

not from other services

Internet Protocol Basics

Dest Addr	Src Addr	payload

FIGURE 2.1 A four-layer model for the Open Data Network

Realizing the Information Future

self contained packets

use existing networks
not have to build new infrastructure
not tied to one network technology

thus, required **Common Bearer Service**
(IP) & treat networks as generic

IP **very** simple
just transport packet to destination
no delivery guarantees

ends are responsible for security &
reliability

End-to-End Argument

e2e

initially a 1981 paper
  Saltzer, Reed, & Clark
end systems know what they can do
  e.g., performance
end systems know what they are doing
  e.g., what application
end systems know they want
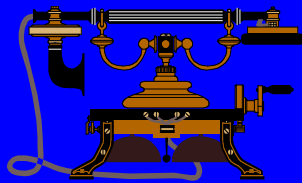 e.g., reliability, security, etc.

network cannot reliably know
  without being told by end system
  some try using deep packet inspection

Back to the Start Again, Services

self named "**Intelligent Network**"
services 'in the network'
  mostly voice related services
  e.g., time of day dialing, *69,
  (lots of) usage accounting
thus, new services required **permission**
  & economic decision by carrier
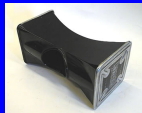central resource control
Touch Tone was an aberration
  allowed **end-to-end signaling**
  enabled non-carrier services
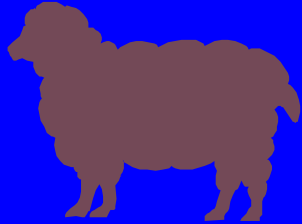physical access controlled
  until Hush-a-Phone & Carterphone

Internet Services

end-to-end
packets & best effort *"stupid network"*
services at the edges
   services ride **over** network
agnostic core
multiple services
no required link between carrier
   and services
permission not required
must play by the same technical rules
   but no enforcement
     The Tragedy of the Commons
unrestrained innovation

Back to the Start Again, Regulations

telecommunications regulated under Title II
of the Communications Act of 1934.
   telephone: **common carrier**
     must not discriminate between customers
     enabled ISPs to run over telephone
       network
mandate technology standards
pre approval required for many things
   services, functions, quality, tariffs, etc.
   e.g., must be able to wiretap (CALEA)
less regulation for cable TV companies
   but some, e.g., 'must carry'
almost no Internet-specific regulations

What Did Teleco think of the Internet?

by definition

The Irrelevant Internet

common wisdom:
no guarantees, security, QoS, etc.
Internet useless for real work
cannot build a corporate data network
with TCP/IP - IBM about 1992
no 'formal' standards process
no governments involved
IETF does not exist
cannot create 'standards'

Netheads vs. Bellheads WIRED 1996

Internet **ignored** by regulators (in the US),
formal SDOs, big business, carriers, etc.
until late 1990s

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The Web Changed Everything

Internet Mind Share
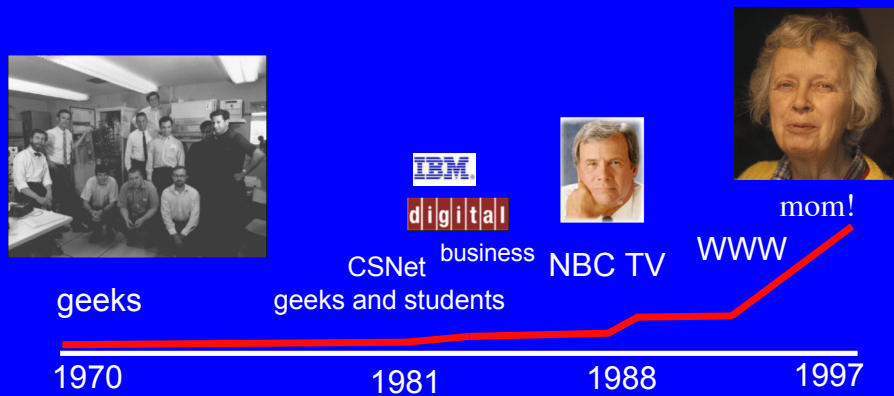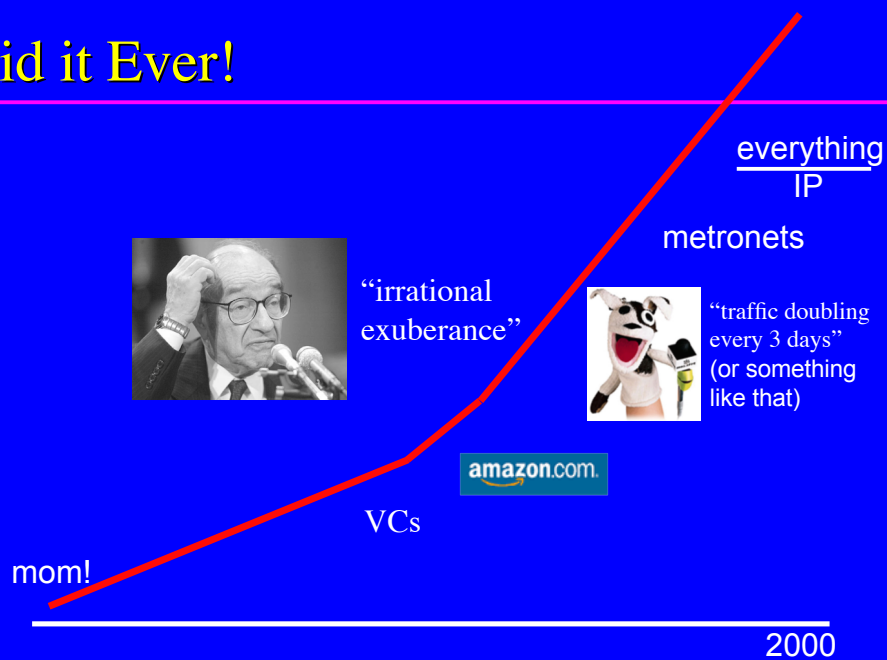
mom!

IBM
digital
business   NBC TV   WWW

CSNet
geeks and students

geeks

1970   1981   1988   1997

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Did it Ever!

everything
IP

metronets

"irrational
exuberance"

"traffic doubling
every 3 days"
(or something
like that)

amazon.com.

VCs

mom!

2000

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Lets Ignore This

reality
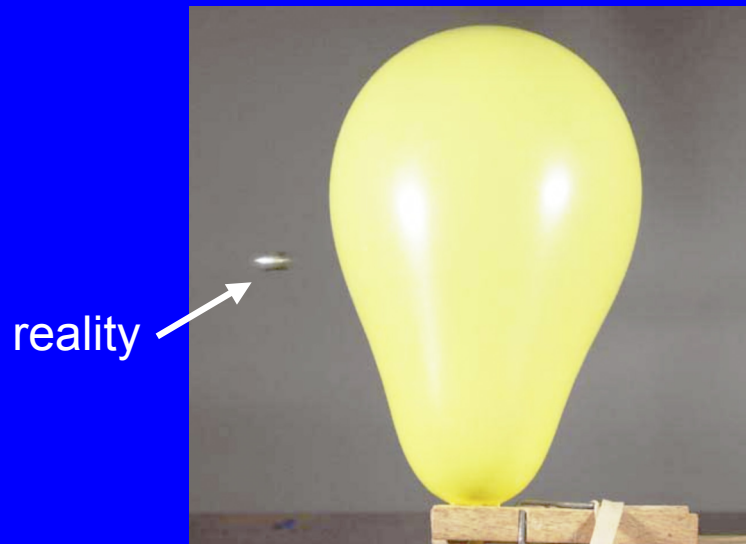
Today's Internet
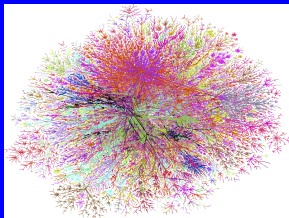
the Internet matters
   1.8 B people
   700 M hosts
   200 M web sites
   $180 B e-commerce (in U.S.)
replacing all of old telecommunications
      infrastructure
ISPs not making much money
few, but very **big**, carriers as ISPs
      old teleco or cable TV
         little serious competition
regulatory mixed bag
   wiretapping requirements
      not much else

More Today's Internet

confuses citizens
has **no security**
    for user, little security for infrastructure
        redirect YouTube
           & 37K prefixes to China April 8
has **no privacy**
    Google knows all
        3rd party advertisers know more
bypasses taxed telephone carriers
bankrupts businesses
    newspapers, music publishers
frustrates governments
    e.g., .iq TLD

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Internet Economics

lots of money made **using** the Internet
    Google , amazoncom , **iTunes**, porn
much less money made **providing**
    the wired Internet
    Verizon FiOS , Comcast , at&t
carriers claim a need for increased revenue
    to keep investors happy
    to pay for new infrastructure
      at a time of flattening customer growth
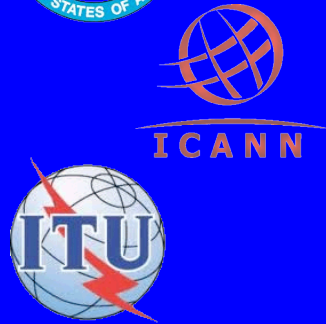carriers claim need to **manage** networks
wireless carriers doing better
carriers looking to content for revenue
    but must be 'in the loop' to benefit

MODE

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Internet Governance

no one in charge
> internationally or domestically in
> > many countries

U.S. has some control through ICANN
> ICANN does technical coordination
> > protocol values, DNS & addresses

power vacuum?
> some governments think so

want the ITU to fill the perceived vacuum
> government-based decision process

e.g., International settlements

What Did the Internet Give Us?
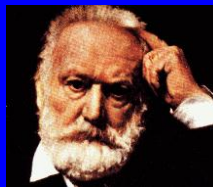
Internet is *generative*
> enable innovation by others
> no permission required

unrestrained communication
> bypass controls

unrestrained innovation
> disrupt old business models
> enable new ones

> > > e.g., newspapers

AR&D

chaos, for lack of a better word, is good?

the Internet is a "**parent revolution**"

Network Neutrality

invisible network - common carriage
   just transport the bits to the destination
support any application
   as well as it can with best effort service
connect to any service provider
transport any content
no handing differences based on source,
   destination, application or content

paying more for a bigger pipe is OK
   as long as anyone can do so
marking packets for "better" service is OK
   even if that costs extra
   as long as anyone can do so

Network Neutrality: Carrier View

*"How do you think they're going to get customers? Through a broadband pipe. Cable companies have them. We have them. Now what they would like to do is use my pipes for **free**, but I ain't going to let them do that because we have spent this capital and we have to have a **return** on it."*

SBC (now AT&T) CEO Edward Withacre 11/7/05

El Dorado of the Net

myth

"content revenue could dwarf the revenue generated by voice and the Internet"
columnist Thomas Nolle

net neutrality *"is about streaming movies"*
Jim Cicconi AT&T

reality (2008 numbers)
US telecommunications revenue $225B
world wide Hollywood revenue $10B
US porn industry (estimate) $8B

"content is not king" Andrew Odlyzko

Communications

the real money is in communications
me **talking** to you

almost all of the $225B in 2008 telecommunications $ was voice or IM
both **very low** bandwidth applications

carriers do not accept that
they see the Internet as a way to access content not as a communications mechanism

Rorschach test
is You Tube one or two way?

Governments

the Internet operates with *"the total absence of rules"* it is a *"moral imperative"* to fix

French President N. Sarkozy

make sure that the Internet does not erode the *"culture, values & traditions"* of the people

Malaysia at the ITU

worried about social disruption
worried about IPR
worried about users

what is the law court for the Internet?

Governments, US Efforts
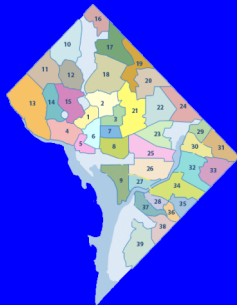
censor content
   Combating Online Infringements and Counterfeits Act (**COICA**)
      government maintain list of websites to block
maintain copyright business models
   DMCA
   ACTA - less bad than it once was, but ...
FBI request to require all Internet applications to be wiretap ready
FCC proposal to regulate Internet as a Title II common carrier
      but to "forebear" on most rules

Politicians

*"America should be about preserving the vibrant and competitive free market that exists for the Internet and other interactive computer services, **unfettered** by federal or state regulation"* - Rep Joe Barton (R-TX)

*"we need to **reengineer** the Internet to make attribution, geolocation, intelligence analysis and impact assessment -- who did it, from where, why and what was the result -- more manageable."* ex-NSA director Mike McConnell

A Few of the Many Possible Futures

Future #1: The End-to-End Internet

dynamic innovation
creating **wealth**

challenging the social order
challenging ISP business models

Future #2: Unregulated Carriers

enriching carriers
carrier driven "innovation"
    inhibit unapproved content &
      applications
   (benign) **dictatorship**?
partnering with traditional businesses
merging with content owners
coddling the social order
chasing dreams of participating in value
    chain
few new entrants
    at any level

the old AT&T **without** a balancing force

Future #2: Unregulated Carriers, contd.

INTERNET PACKAGES

BROADBAND INTERNET SERVICES INC.:
"Your connection to the world"

Internet packages
Depending on where you live,
you can choose from up to 2,000 web sites!
More surfing choices than ever before!

Basic $69.99 per month
- Access to 200 shopping sites
- Over 100 entertainment, sports and movie sites
- Top 6 news sites
- Top 30 blogs
- Gaming, file sharing, VPN traffic not permitted

Premium $99.99 per month
- Access to 400 shopping sites.
- Over 200 entertainment, sports and movie sites
- Top 20 news sites
- Top 60 blogs
- 15 hours of gaming per month
- 10 Gigabytes of file sharing and VPN traffic

Super-premium $149.99 per month
- Access to 1,000 shopping sites
- 400 entertainment, sports and movie sites
- Top 60 news sites
- Top 1,000 blogs
- Unlimited gaming, file sharing, VPN usage
- FreeSurf® – access to most non-partner sites*

* access speed and availability not guaranteed

TERMS: Broadband Internet Services Inc. reserves the right to alter available partner sites at any time. All included sites have been certified by FamilyLife® as free of obscene or controversial material, and come with ChannelBlocker® for additional protection. ChannelBlocker® filtering can be turned off for an additional monthly fee of $16.99. Transmission of encrypted materials not permitted. Complete terms online.
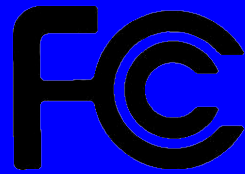
ACLU vision of a bad future

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Future #3: Regulated Carriers

depends on the forbearance - worst case
carrier driven "innovation"
partnering with traditional businesses
coddling the social order
few new entrants
regulations to '**protect the consumer**'
many new taxes

i.e., the old AT&T with the **force of law**

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Future #4: International Regulation

steering technology
protecting traditional businesses
  who are players in the traditional SDOs
protecting the social order
  driven by the most conservative countries

interconnection regulations
settlement/cost sharing
defining services

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Future #5: Reengineered Network(s)

to meet attribution requirements
to meet wiretapping requirements
to meet filtering requirements
to meet IPR tracking requirements
to meet QoS requirements
to meet billing requirements
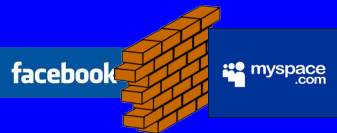to optimize for particular applications

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Future #6: Multiple Internets

per-government govnets
per country networks
  protected by filters
per carrier networks
per company networks

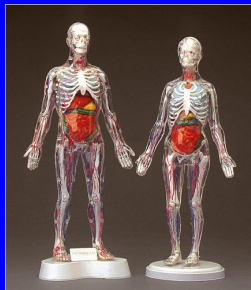cross network communications limited
  and billed for

Future #7: Transparent Users

governments **watch everything**
  in real time or after the fact
companies watch everything
  in real time

the bad guys can easily **hide** bad stuff
  from governments
  only the good guys are **exposed**
harder to hide activities from companies

Internet in 2020

there will be an "**Internet**" in 2020
  at least as a brand name
likely to be a mix rather than pure anything
what it will actually be is up to **us**

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for some movies of some other predictions
        http://www.isoc.org/tools/blogs/scenarios/

Thank You