

“It” will be called “The Internet”  
but ...

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NANOG On the Road  
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- So Scott, what is on your mind these days?

“That doesn’t make any sense at all!”

Political science student said to me when told how the  
DNS roots are run.

**“That doesn’t make any sense at all!”**

Political science student said to me when told how the DNS roots are run.

**‘That doesn’t make any sense at all!’**

Government of Iraq when told that the .iq ccTLD was tied up in a Texas Bankruptcy court .

**‘That doesn’t make any sense at all!’**

Traditional telecommunications SDOs when they realized that governments have no formal role in IETF technical standards.

**‘That doesn’t make any sense at all!’**

Law enforcement (and spy) agencies when told that end-to-end-encryption should be the default on the Internet.

**‘That doesn’t make any sense at all!’**

Telephone carrier when told it should treat its customers fairly.

**‘That doesn’t make any sense at all!’**

Telstra when it was told it had to cover the cost of connecting to the Internet.

. . .

Come to think of it, the Internet as we know it, does not make sense to lots of people

It never did.  
(And that protected it.)

How did we get here?

(For reference, I have been doom-whining about this since the mid 1990s.)

# A biased history, starting BP (Before Packets)

# Telecommunications in the 1950s



Nation-state-based telephone companies

One service: voice (+ some “wires”)

One quality: ‘toll-quality voice’

Very highly regulated – much revenue for countries

Interconnection via ITU rules

# ITU rules, 1<sup>st</sup> set – ITC (1865)

International Telegraph Conference decisions made by country representatives

Set pattern for future telephone rules

- tariffs & settlements

- technical standards

- complaint process

- protect state & morality

  - be able to stop messages that *“may appear dangerous to the safety of the State or which would be contrary to the laws of the country, public order or morality”*



# Communications Governance V1

Governance by governments

Enforced by country regulators

More than just technology

Also protect state, money & morality

Westphalian ideal?



Circuits: the golden measure of perfection

- Pre-defined quality

- Enforced by busy signals

- If the call gets through, it WILL be the right quality

Minutes: the golden measure of quantity

- Exclusive use of resources for duration of call

- Caller pays (other than special cases)

- Settlements paid to the carriers that terminate calls

In the 1980s, the largest company in the world was a telephone carrier

- And a regulated monopoly





Packets peering over the horizon

Global data networks dream (1962):

J.C.R Licklider: *Galactic Network*

First mention of the concept (1962)

Paul Baran: *On Distributed  
Communications Networks*

“short message blocks”

Expanded on in 11 volume 1964 RAND series

Term “Packet” from Donald Davies (1966)



## Packets:

Dest Addr	Src Addr	payload
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Split data stream into short message blocks

Blocks include destination addresses

Blocks treated independently when forwarded through network

Destination node responsible for reassembling blocks into data stream

## Network:

Forwards packets based on destination addresses

Provides no sequence or reliability functions or guarantees

Does not 'see' what is being carried in packets

## Packet networks:

- Many services

  - Limited by imagination

- Many levels of quality

  - Quality generally not controllable

- Regulations do not define services or tariffs

  - Anyone can offer a service

- Interconnection by bilateral agreements

  - No interconnection “rules”

So

No quality

No reliability

No control by carrier

Capricious interconnection



*The rise of the stupid network*

Also

Applications/services in end nodes not in the network

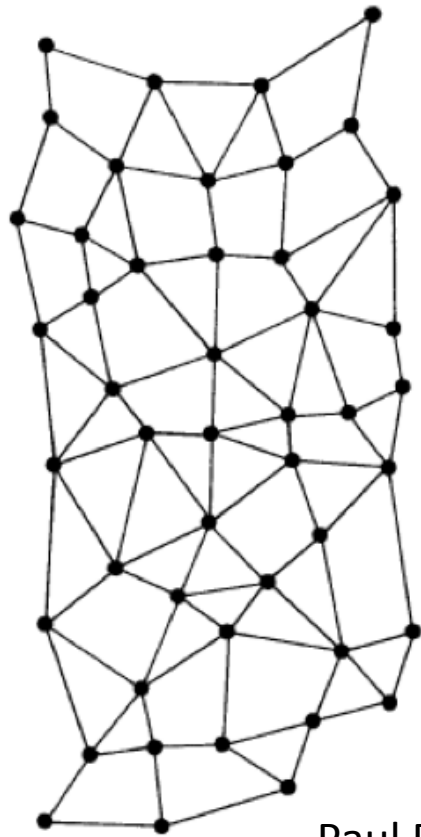
*Who's going to make money on that?*

John McQuillan



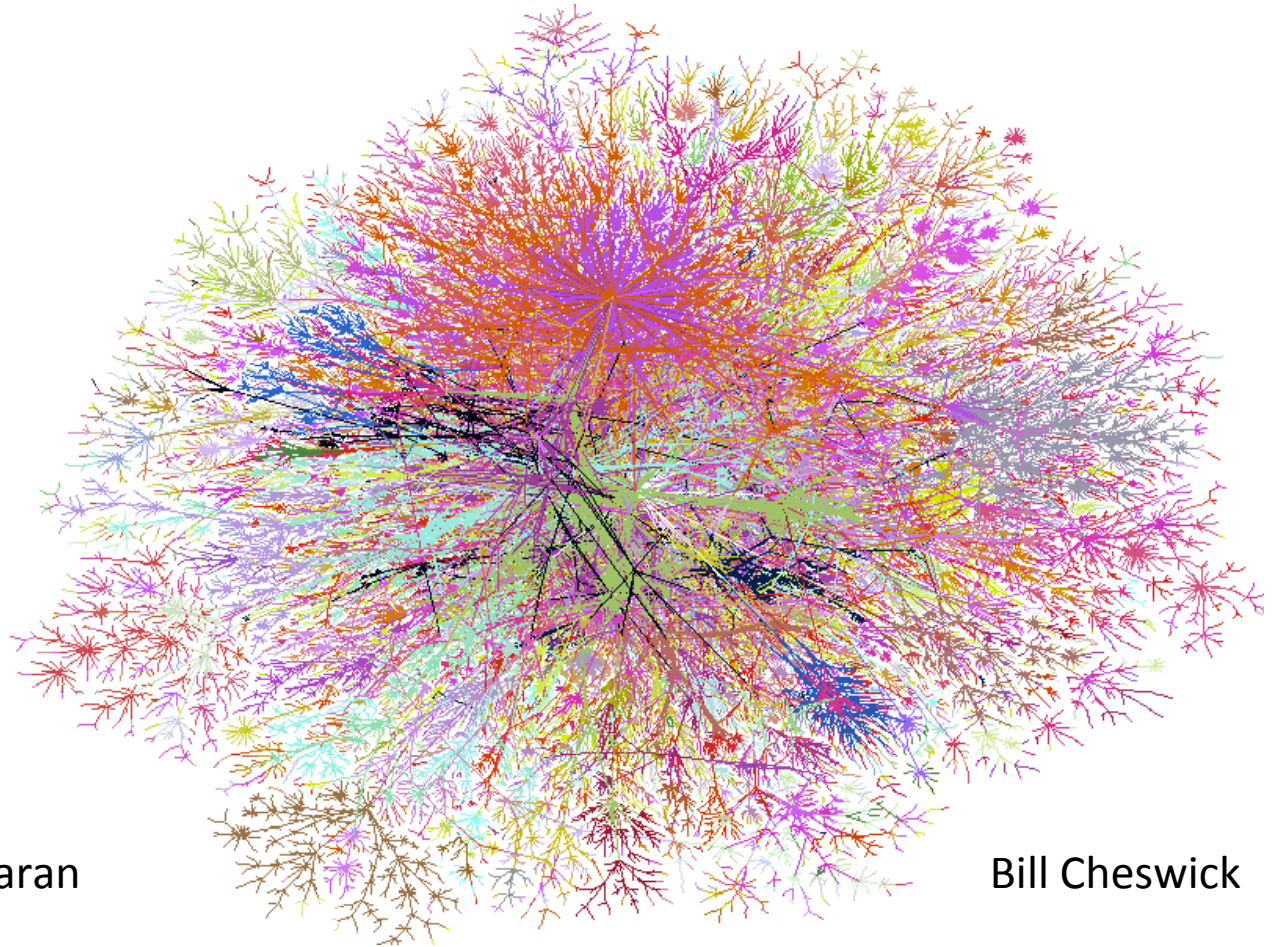


# Capricious network architecture



Paul Baran

DISTRIBUTED  
(C)



Bill Cheswick



# Proofs of concept



MAP 4 September 1903



NCSA



# A rider not a builder

The ARPANET, and the follow on Internet, rode on the telephone network

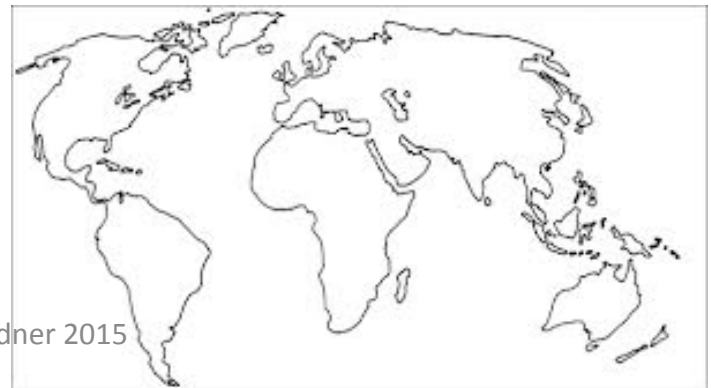
But were not services offered by the telephone companies

Internet service providers (ISPs) bought “wires” from telephone companies

ISP routers interconnected these wires

ISPs not limited to a single telephone carrier or to a single country

From inside the net you could not see political boundaries



# But, what did they prove (by 1990s)?

That wide-area packet networks “work”

If you can define what “work means”

That worms and viruses also “work”

That hacking “works”

That ISPs could (reliably) go bankrupt



Not sure if the Internet was “of this world”

Technical relevance or politically

# Inconceivable relevance

Existing telecommunications world did not believe

E.g., IBM no-bid ARPANET router

no future in packet-based networks

Conventional wisdom: best effort useless

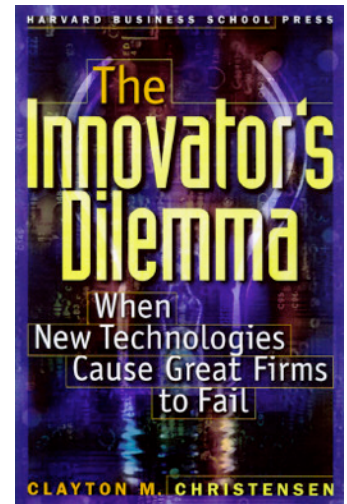
Guaranteed QoS required

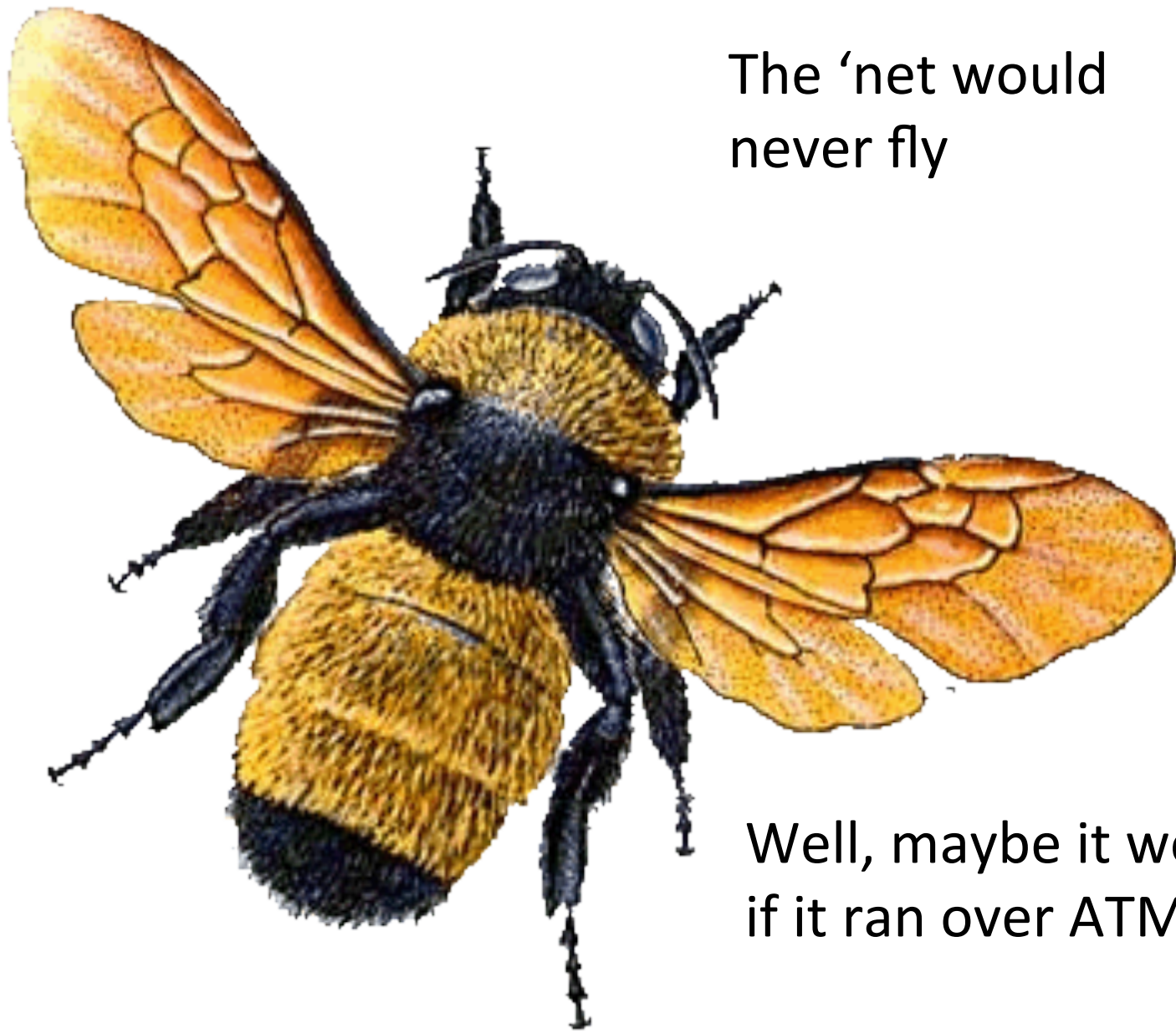
Most connections low speed (dial-up)

No threat seen to telephone companies

Thus, totally ignored by regulators

including the FCC & the ITU





The 'net would  
never fly

Well, maybe it would  
if it ran over ATM

# 1990s

1991: WWW

Permissionless innovation

Growing connectivity

Hosts: 1991: 376 K, 1999: 56 M

Countries: 1990: 31, 1997: 171

Users: 2000: 260 M

“Always on” growing

Still mostly ignored by regulators as “useless”

The US did try to regulate Internet speech

The Computer Decency Act of 1996

# The importance of occasional chaos

*“What achieved success was the very chaos that the Internet is. The strength of the Internet is that chaos. It's the ability to have the forum to innovate” S.*

Bradner, witness, CDA trial, 3/'96

*“Just as the strength of the Internet is chaos, so the strength of our liberty depends upon the chaos and cacophony of the unfettered speech the First Amendment protects.” Judge Dalzel, decision, 6/'97*

# The Internet in the 1990s

Doubling annually

Exploding in mindshare

But still no meaningful regulation

FCC explicitly declined to regulate

From inside the net you could still not see national borders

i.e., it was **cyberspace**, and looked like it was not of this world



# “Shine perishing republic”

The brief reign of the republic of cyberspace

*A Declaration of the Independence of Cyberspace* –  
John Perry Barlow – 1996

*“Your legal concepts of property,  
expression, identity, movement,  
and context do not apply to us.  
They are all based on matter,  
and there is no matter here..”*



*‘the Internet will get rid of countries’* – participant,  
*International Forum on the White Paper (IFWP)* –  
1998

# Cautionary Vignette

NET '97 - Kuala Lumpur

ISOC Developing Country Workshop



# Managing cyberspace in the 1990s

Internet technology did not require centralized management

Bilateral agreements between ISPs defined connectivity & architecture

Services rode on top of Internet

Like the Internet rode on top of telephone networks

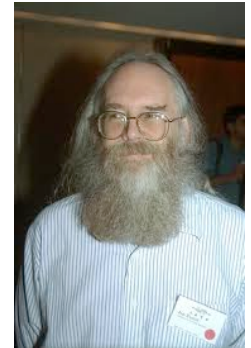
Two exceptions: IP addresses & domain names

# IP Addresses

Blocks of addresses assigned to independent regional Internet registries (RIRs) by IANA

Internet assigned numbers authority

i.e. Jon Postel



RIRs independently developed assignment policies

Community-based policy development process

IETF accepted self described global policies

No government involvement



# Domain Names

IANA, under US government contract, delegated operation of top level domains (TLDs)

E.g., .com, .net, .us, .jp

Commercial TLD delegations directed by US

Country code delegations done by IANA alone

Generally first come, first got

IANA also managed “root zone”

List of TLD delegations in a US government-run root zone server (“the A root”)

12 other Root name servers retrieve zone from the A root

## The 'net in '98

More than 180 million users

More than 35 million hosts

More than 2.4 million web sites

A year into the dot com bubble



# The beginning of the end

Jan 1998 – Jon Postel “redirected the root”

Asked the root server operators to retrieve zone from his server (instead of the government run one) - and 10 did



VS.



“The Internet”

VS.

“The Government”

# Aftermath

Ira Magaziner threatened to send in the Marines  
Jon relented after a short while (*'it was an experiment'*) & ICANN was formed soon after  
With strong “guidance” from the US Government





By now everybody has woken up – the ‘Net is:  
Replacing all telecommunications infrastructure  
Trashing traditional businesses



Helping to topple governments



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# A real, but not new, threat to order

*“The invention of the [...] is the greatest event in history. It is the mother of revolution.”*

*“In its [...] form, thought is more imperishable than ever; it is volatile, irresistible, indestructible. It is mingled with the air. ... Now it converts itself into a flock of birds, scatters itself to the four winds, and occupies all points of air and space at once.”*

*“A [...] is so soon made, costs so little, and can go so far! How can it surprise us that all human thought flows in this channel?”*

Who said this about what?

# Victor Hugo: Hunchback

*“The invention of the **printing press** is the greatest event in history. **It is the mother of revolution.**”*

*“In its **printed** form, thought is more imperishable than ever; it is volatile, irresistible, indestructible. It is mingled with the air. ... Now it converts itself into a flock of birds, scatters itself to the four winds, and occupies all points of air and space at once.”*

*“A **book** is so soon made, costs so little, and can go so far! How can it surprise us that all human thought flows in this channel?”*

# Privacy? Ha!

Google  
IS WATCHING  
YOU

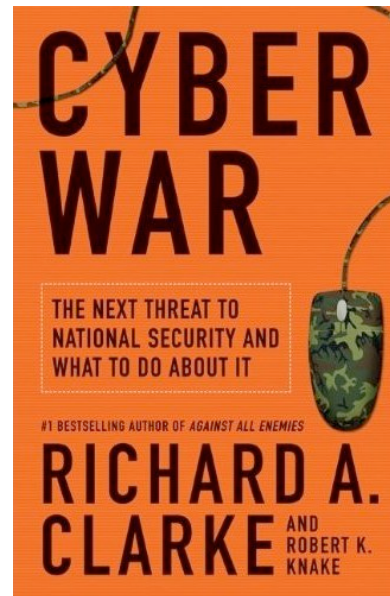
soxfirst.com



eff



And then there is



Just ask



SECURITY

SONY



Stuxnet



Estonia

The Internet is now far too important to leave it to the people that know how it actually works

Because what is there now '*does not make any sense*' (at least to governments, carriers, politicians)

But now what?

# The elephant in the background

It is a Post Snowden World

US no longer has moral authority to “run the Internet”

Embolden ITU

Justify countries that filter or disconnect



The Guardian



# Current picture - international

U.S. offered to relinquish control of ICANN

Conditionally: alternative must be multistakeholder model, maintain stability of DNS, meet needs of IANA customers & maintain open Internet

This should be of little interest

Just the technical coordination of 3 functions

But seen as “running the Internet”

Proposals being considered by NTIA/IANA  
Stewardship Transition Coordination Group

Meanwhile – Congress is trying to say “no”



# Current picture – international, contd.

Many countries want ITU-T to take over standards & regulations of the Internet

A dance that has been going on for many years

Latest round (ITU Plenipotentiary Conference – Oct/Nov 2014) – kept status quo



# Current picture – U.S.

FCC has been trying to enforce (sort of) network neutrality

Overtaken in court – lack of statutory authority

Changed ISP classification to be covered by “title II”

Title II is heavy handed telecom regulation

FCC will “forebear” most regulations

Congress trying to limit FCC controls

An ISP association has sued.

Verizon & AT&T have threatened to sue



# Going dark

The FBI says they want regulations to require back doors in all Internet applications – so they can see in “dark places”

e.g., to counter Apple’s iOS and iMessage locks

Now using All Writs Act (1798) to force compliance

So they can wiretap or get at contents

Never mind that they can not show any example where this would have made a difference

“a child will die” US Deputy Attorney General James Cole

Note: the real bad guys already have their own tools and are incented to hide

The Internet is:

A destroyer of businesses

A confuser of citizens

A toppler of governments

An enabler of terrorists, pornographers & child molesters

A forum for hate

Unpredictable & uncontrollable

A bypasser of taxes

. . .

The Internet also is:

The most important communications facilitator the world has ever known (other than the spoken & written word)

The parent revolution (in business, politics, science, society, ...)

And it does not make any sense at all

So Scott, what will the Internet look like in 2020?

I have no idea

It could look like the telegraph network of the 1890s

It could look like a copyright industry-run TiVo

It could look like Big Brother from 1984

It could look like the Internet we have today

Which is a combination of all of the above



But, it will be called

# The Internet

