

A Short History of the Internet

NANOG

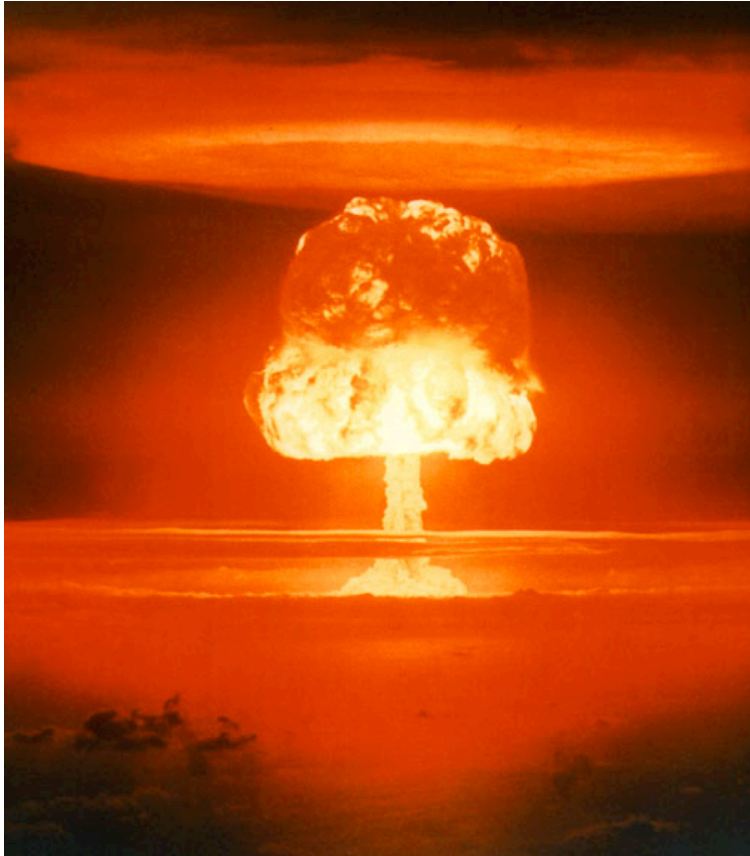
February 9, 2003

Scott Bradner

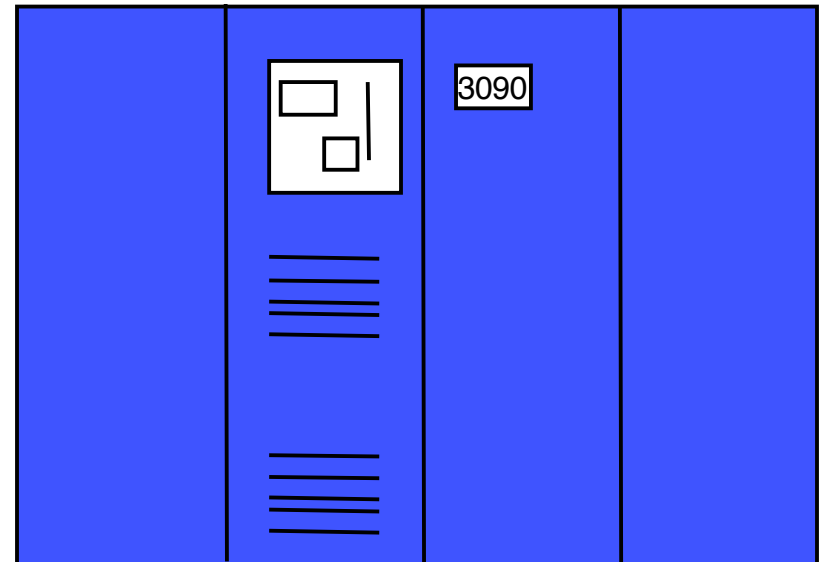
Harvard University

sob@harvard.edu

Why?



or



What was there?

The Phone Net from **The** Phone Company (TPC) (trivia alert)

circuit-based

assumed simple & predictable interconnections
between ends

assumed requirement for QoS

assumption of being carrier-provided
voice-oriented

What Was Wrong With That?

nothing, if you just wanted to talk

nothing, if you just wanted to talk to Joe

nothing, if you just wanted one service

trick question - what does a **fast busy** signal mean?

nothing, if you thought that AT&T innovated

note: this was pre breakup & pre Carterphone

nothing, if you wanted your data service provided
to the wall by a carrier

So, Lets Make (Not Build) our own

multiple unrelated efforts (early to mid 1960's)

packet switching theory: (Kleinrock) 1961

day dreaming: (Licklider's Galactic Network) 1962

make use of remote expensive computers: (Roberts) 1964

survivable infrastructure for voice and data: (Baron) 1964

ARPANET (late 1960's)

Roberts ARPANET paper 1967

RFP for Interface Message Processor won by BBN 1968

four ARPANET hosts by 1969

public demo and email in 1972

Make What?



- 0/ multiplexed utilization of **existing** networks
- 1/ **survivability** in the face of failure
- 2/ support **multiple types** of communications service
- 3/ accommodate a **variety** of network types
- 4/ permit **distributed management** of resources
- 5/ **cost effective**
- 6/ **low effort** to attach a host
- 7/ **account** for use of resources

!security

!QoS

!efficiency

e2e!

Non Goal

*“the lesson of the Internet is that **efficiency is not the primary consideration**. Ability to grow and adapt to changing requirements is the primary consideration. This makes simplicity and uniformity very precious indeed.”*

Bob Braden

IETF mailing list 2-Feb-2001

“Huh?” (says the phone world)

What did *they* think the Internet was?



by definition



net his-15

Architecture Feature

service can be provided by 3rd parties - not just by carriers

a quote from an IETF mailing list

Hi Roy,

I still don't understand why it is a "users" choice where the "services" are executed - I would have thought that this would be networks choice

Feature of Architecture Feature

ISP does not profit from services running
over network

telcos do not grok concept

AT&T building “content aware” next-gen network

“We do not know how to route money”

Dave Clark

Another Feature of Architecture Feature

- no “tapping” point

 - traffic does not flow in a tree

- security (authentication, encryption) is e2e

 - where “e” could be server somewhere

- not even in an ISP

 - traffic between customers on same POP stays
in POP

- no knowledge of geographical location

- governments do not grok concept

The Importance of Phones (or emergency traffic, or ...)

I'm more important!

I'm more important!

I'm more important!

I'm more important!

I'm more important!

ME!

I'm

I'm more important!

Are Differentiated Services an Answer?

pay more to get a better service?

a way for ISP to get application-based revenue

but the Internet is not consistently crappy enough

“It fails to fail often enough so it looks like it works.”

Mike O'Dell

assumption:

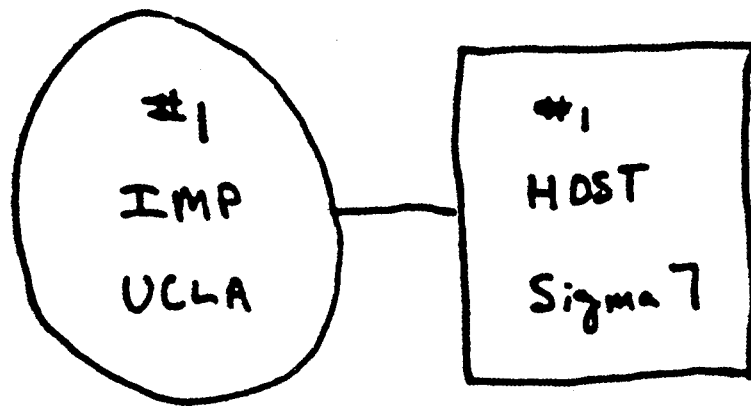
you will pay more every time to make the service better
some of the time

e.g., IAD- vs. Ethernet-attached phones (**IQ test**)

IT managers: yes, real world: ???

e.g. VoIP in enterprises

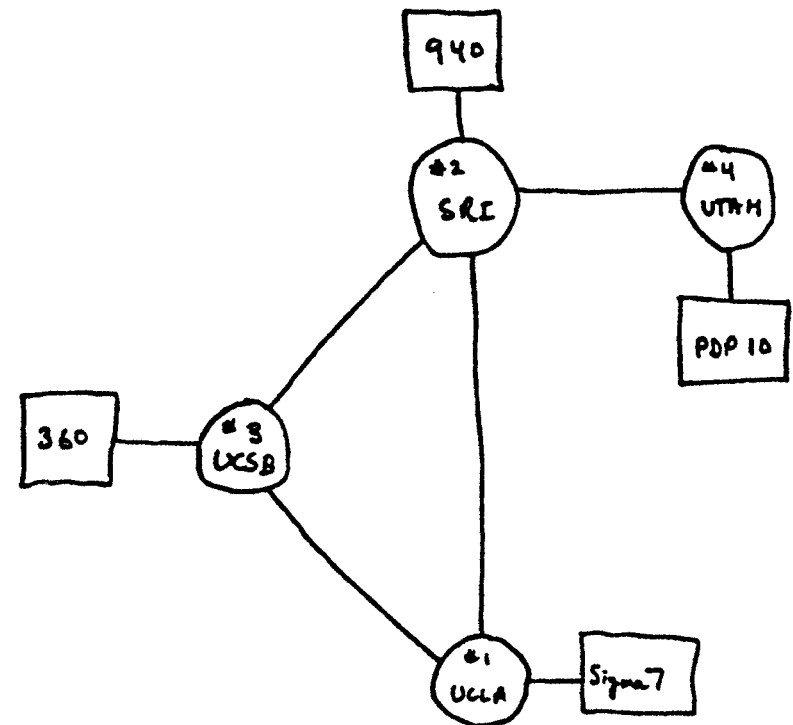
obligatory topology maps



THE ARPA NETWORK

SEPT 1969

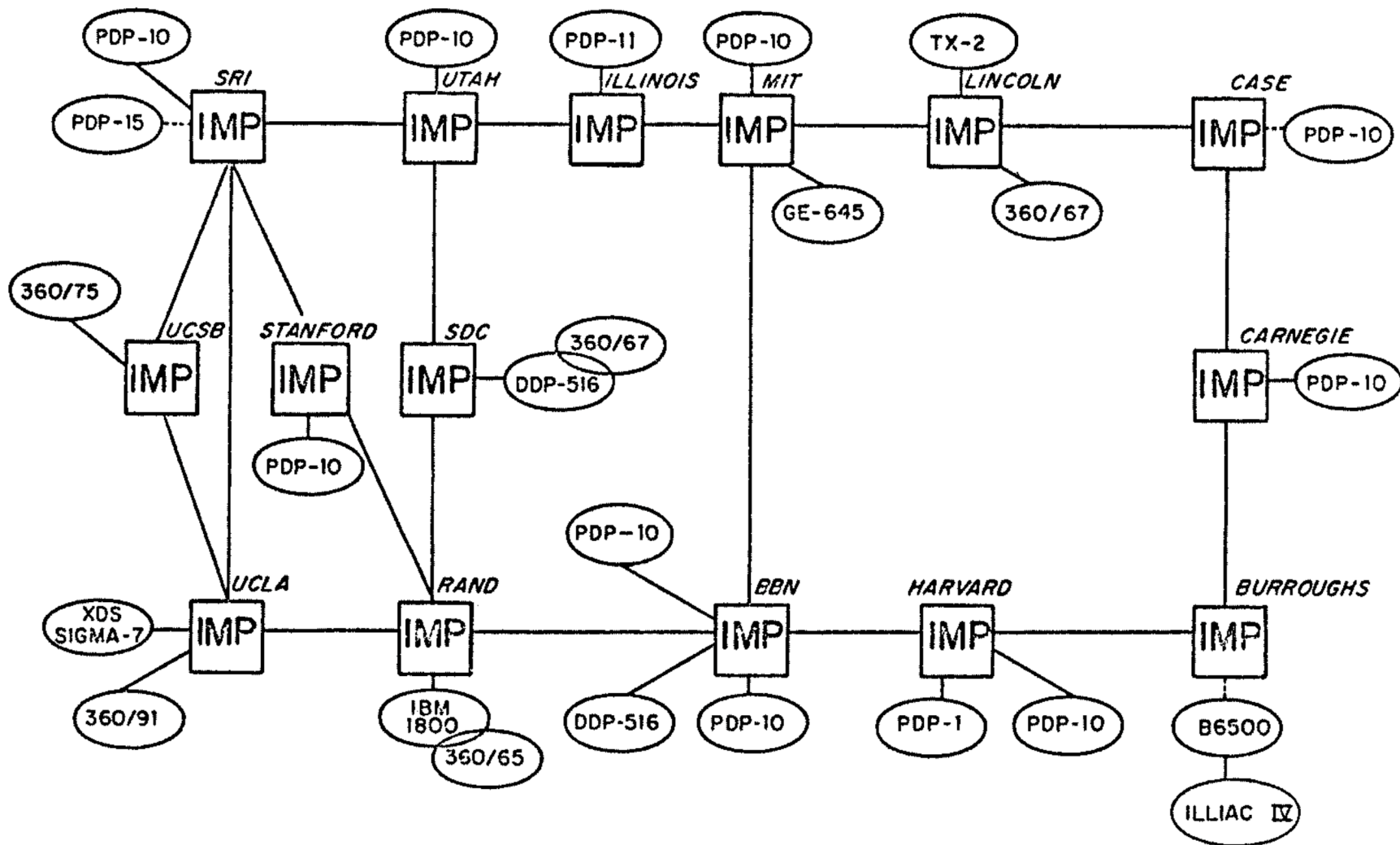
1 NODE



THE ARPA NETWORK

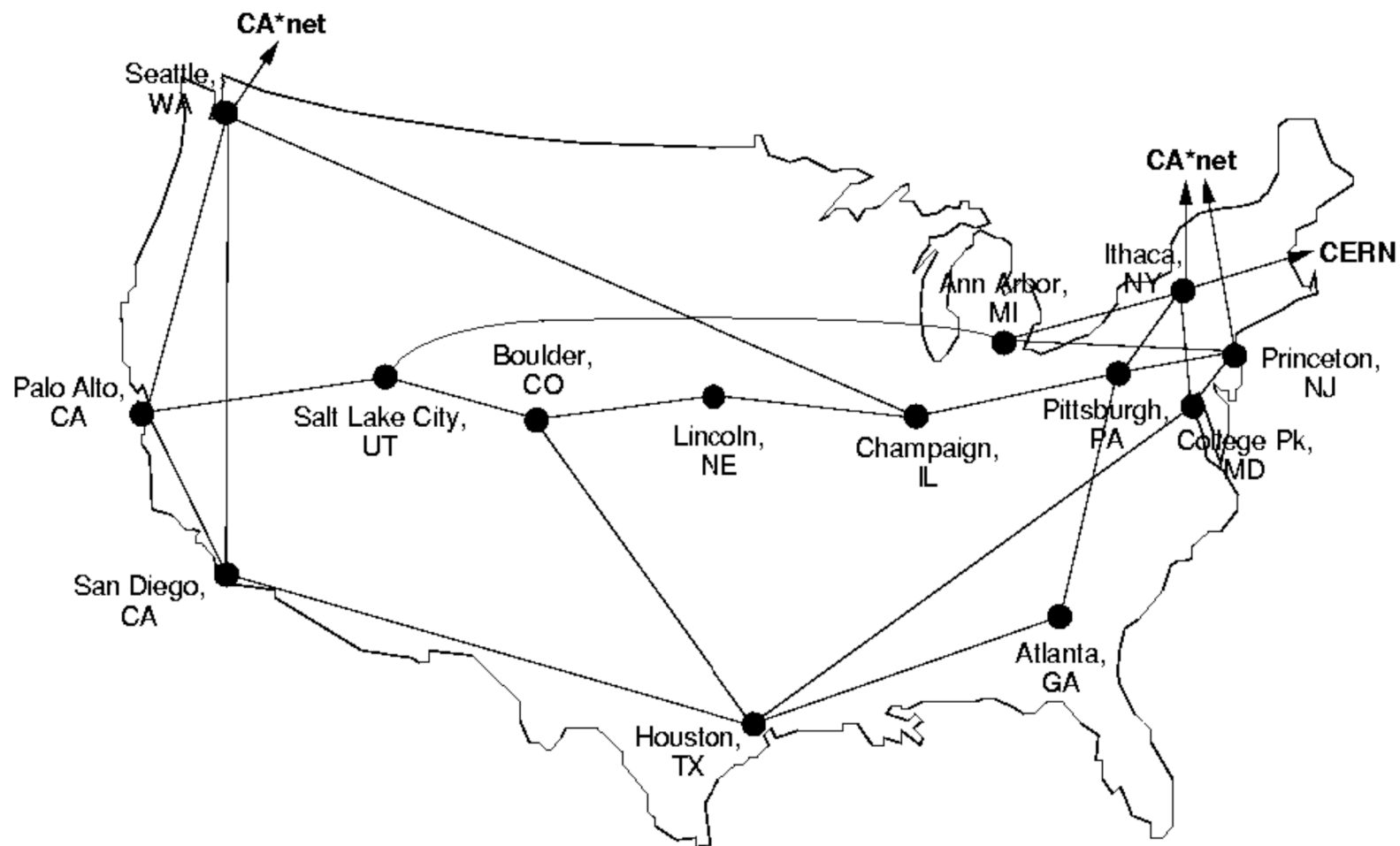
DEC 1969

4 NODES



ARPANET 1971

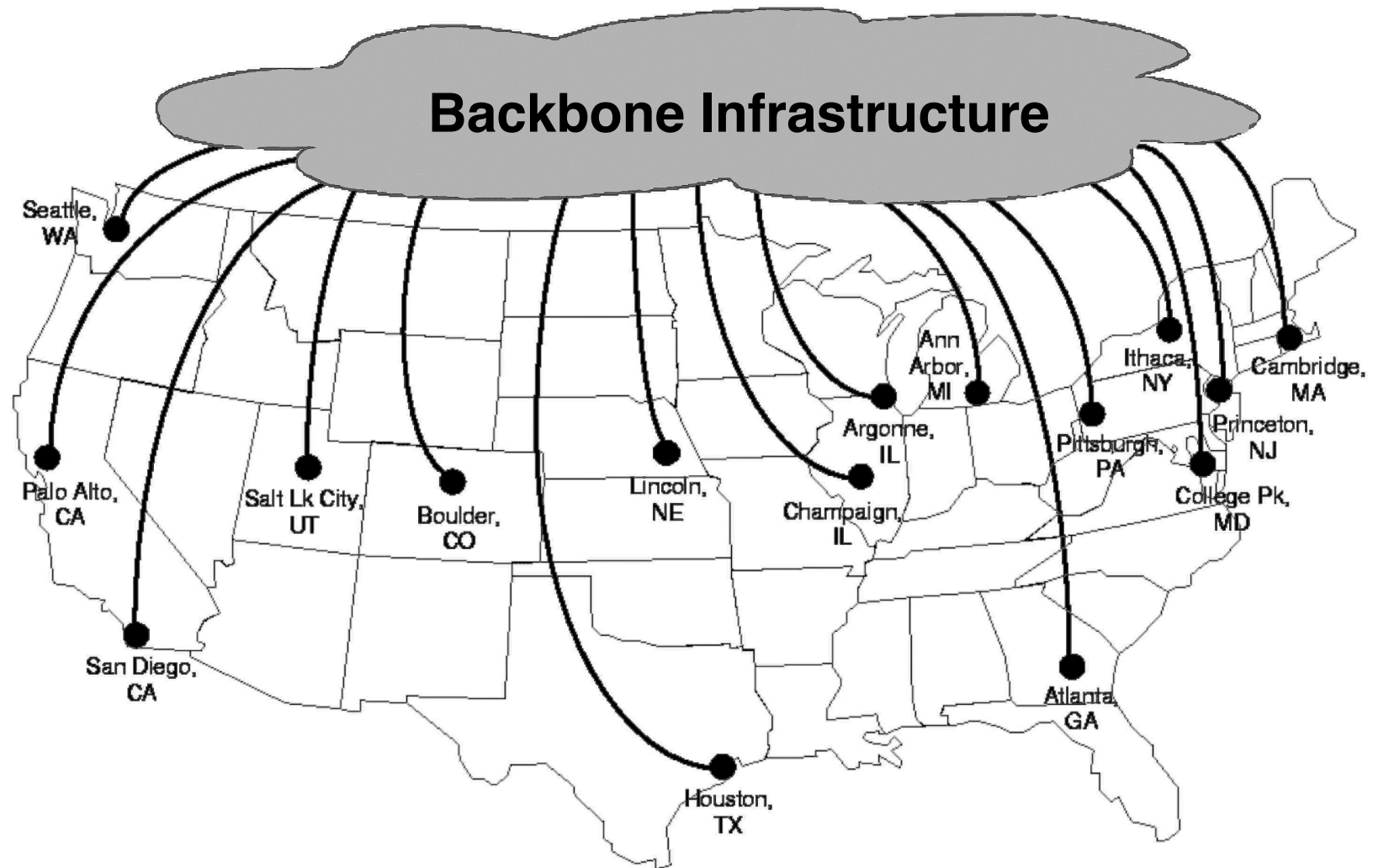




© Merit Network, Inc.

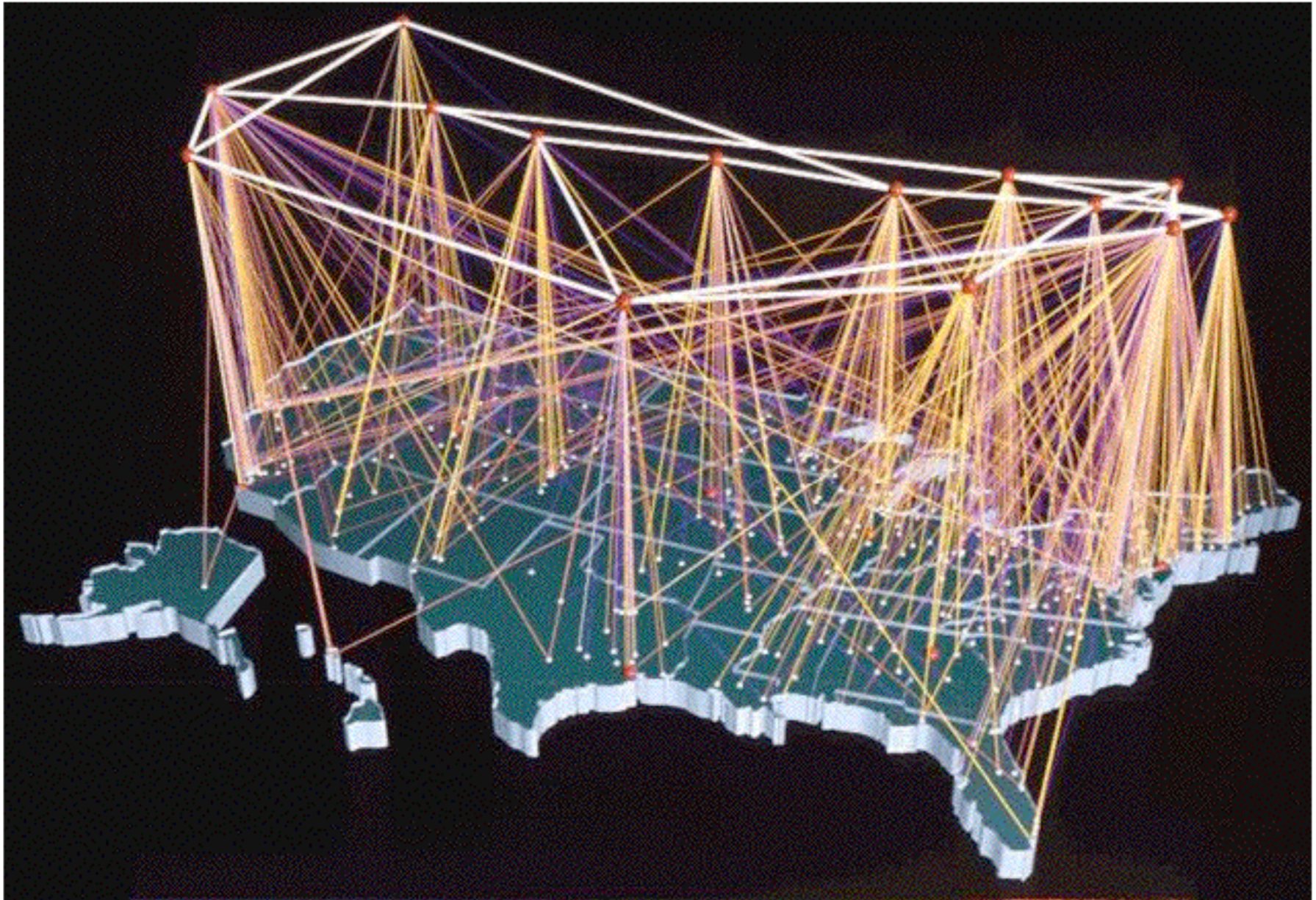
NSFNET T1 1991

minus regional nets

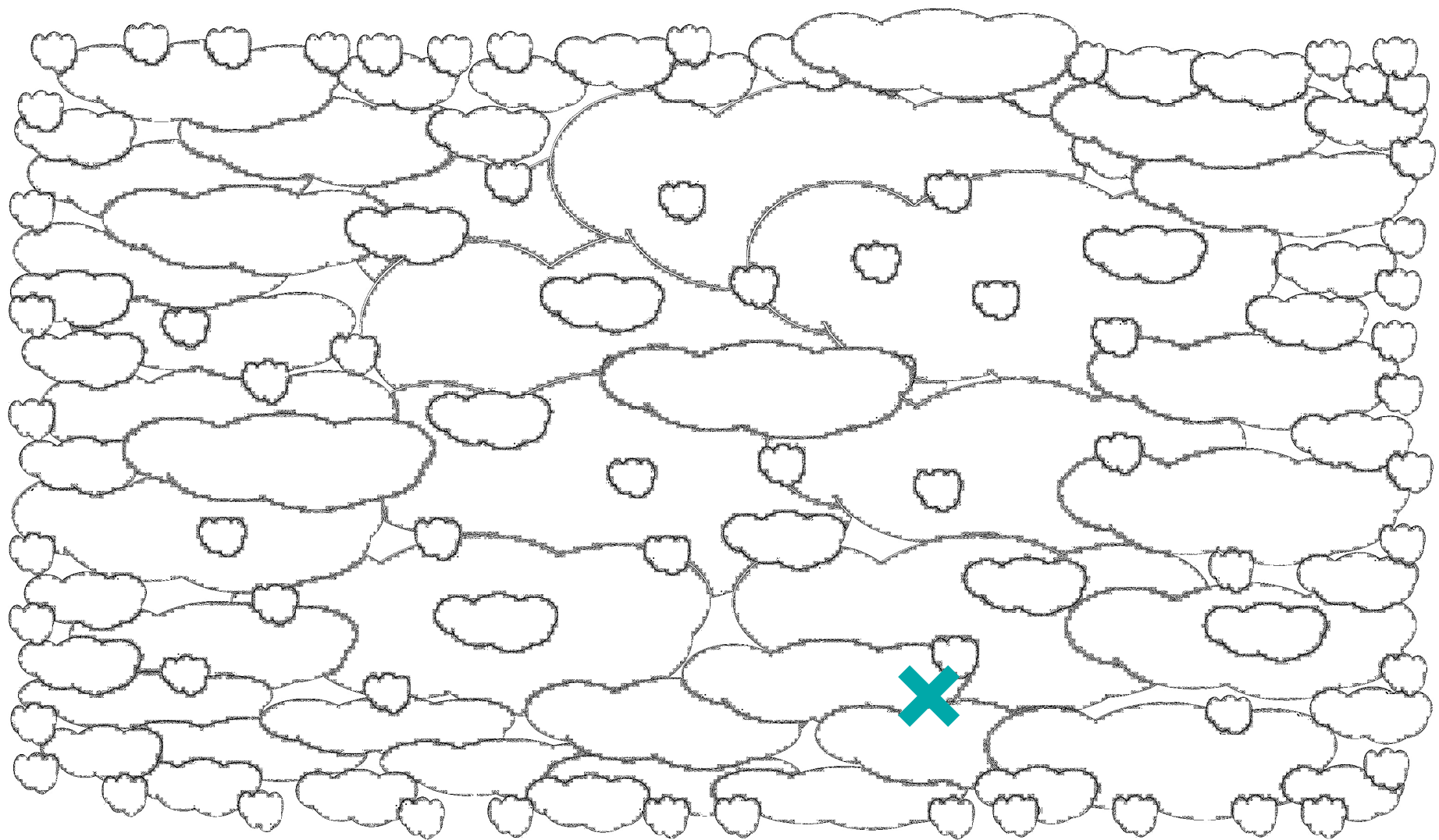


Merit/NSFNET Information Services


Alternate view 1991

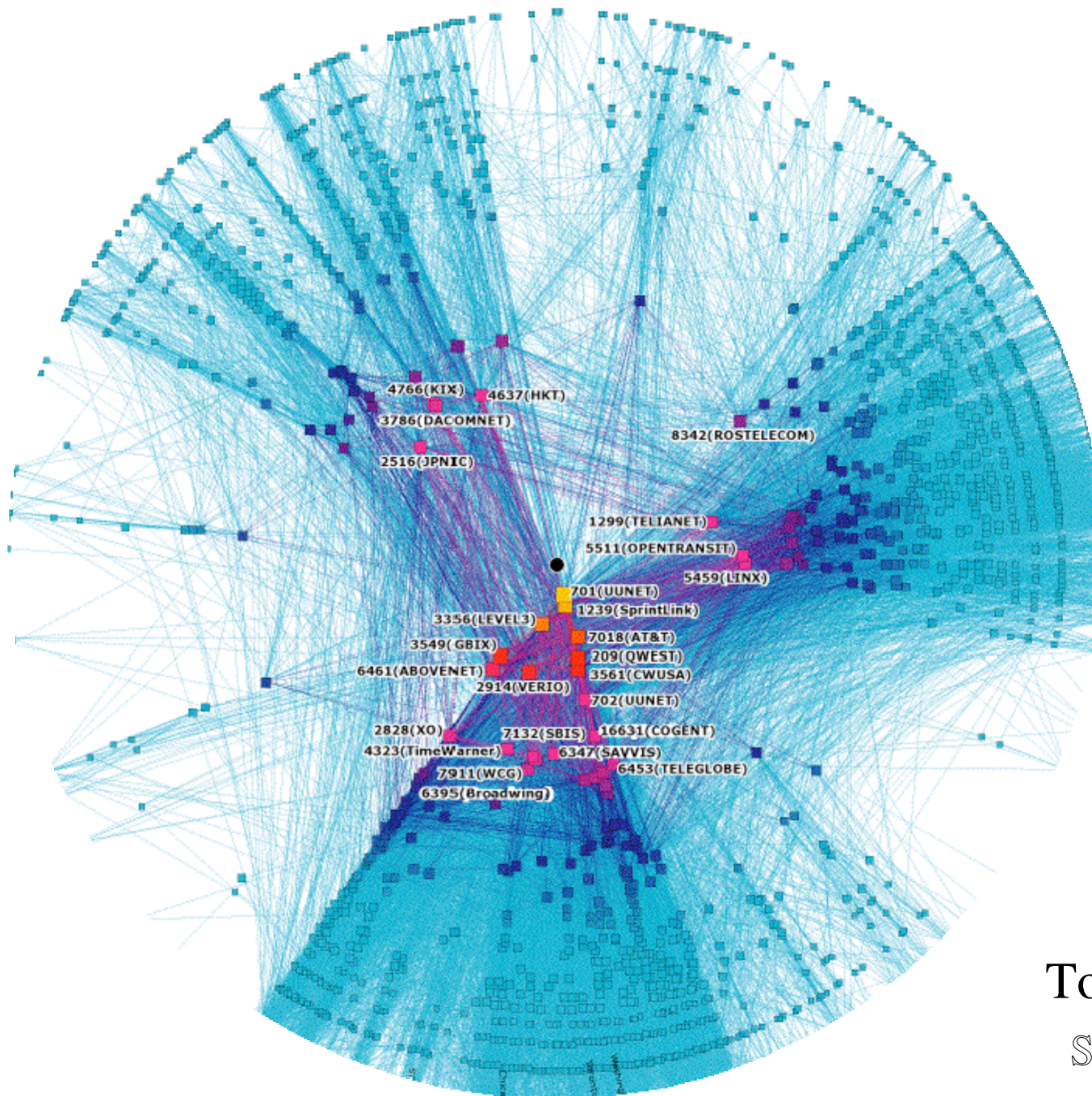


NSFNET PR graphic



Today v1

 you are here



Today v2
SKITTER

Psychological Time Line

Part 1



geeks

geeks and students

IBM

digital

business



NBC TV



mom!

WWW

1970

1988

1997

Psychological Time Line

Part 2

everything
IP

metronets

“irrational
exuberance”

“traffic doubling
every 3 days”



VCs

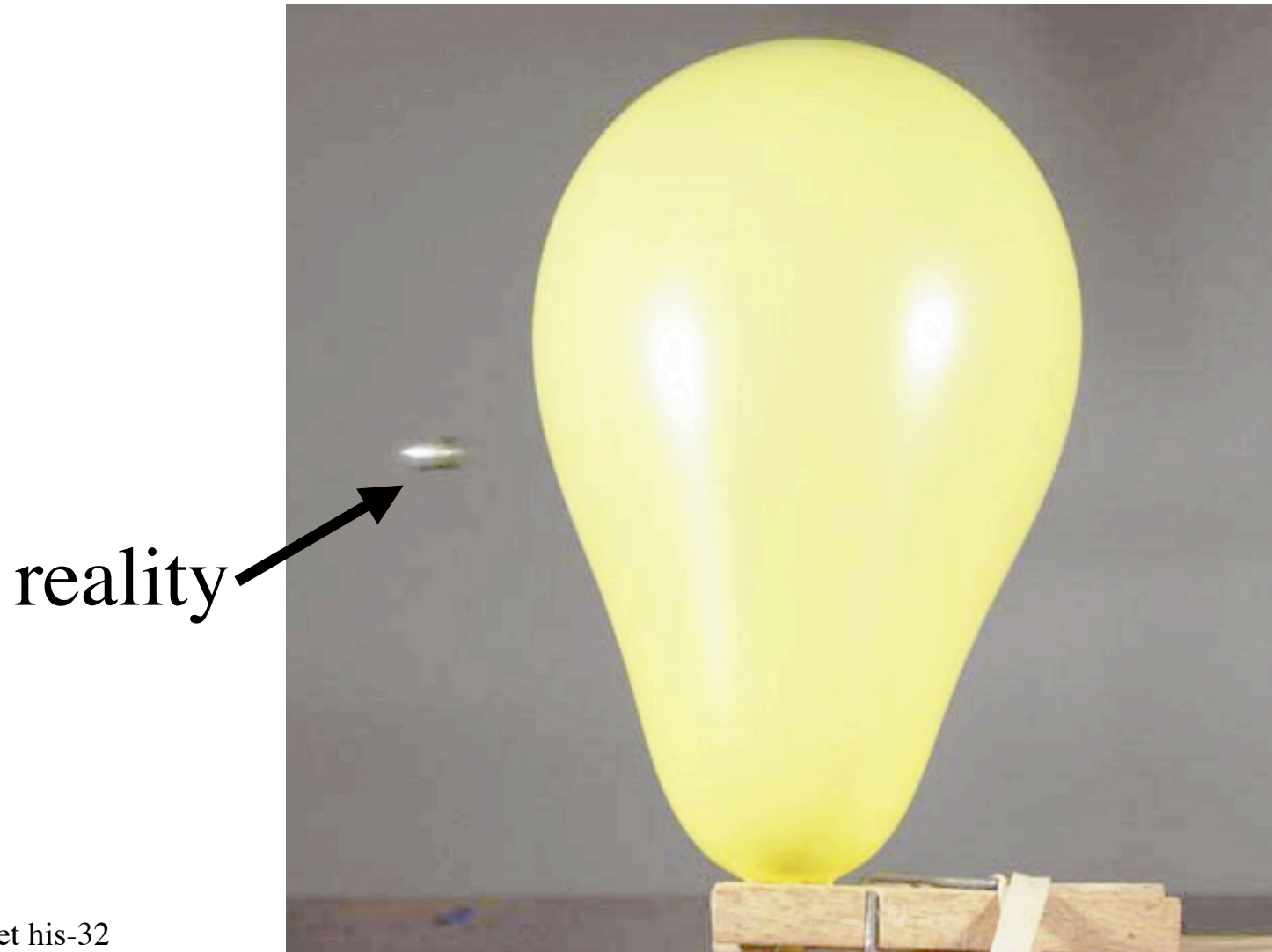
mom!

1998

2000

Psychological Time Line

Part 2 - in retrospect



Psychological Time Line

Part 3



diversions

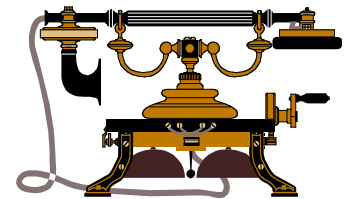
“he has an out of balance ego to clue ratio”

Dave Clark



there is no need to fund the
'NSFnet', we can provide
data connectivity with ISDN
late '80s

Charles L. Brown
AT&T Chairman & CEO



OSI is the answer, what
was the question?



various governments
and corporations

GOSIP



Internet collapse
imminent - .gif at 11



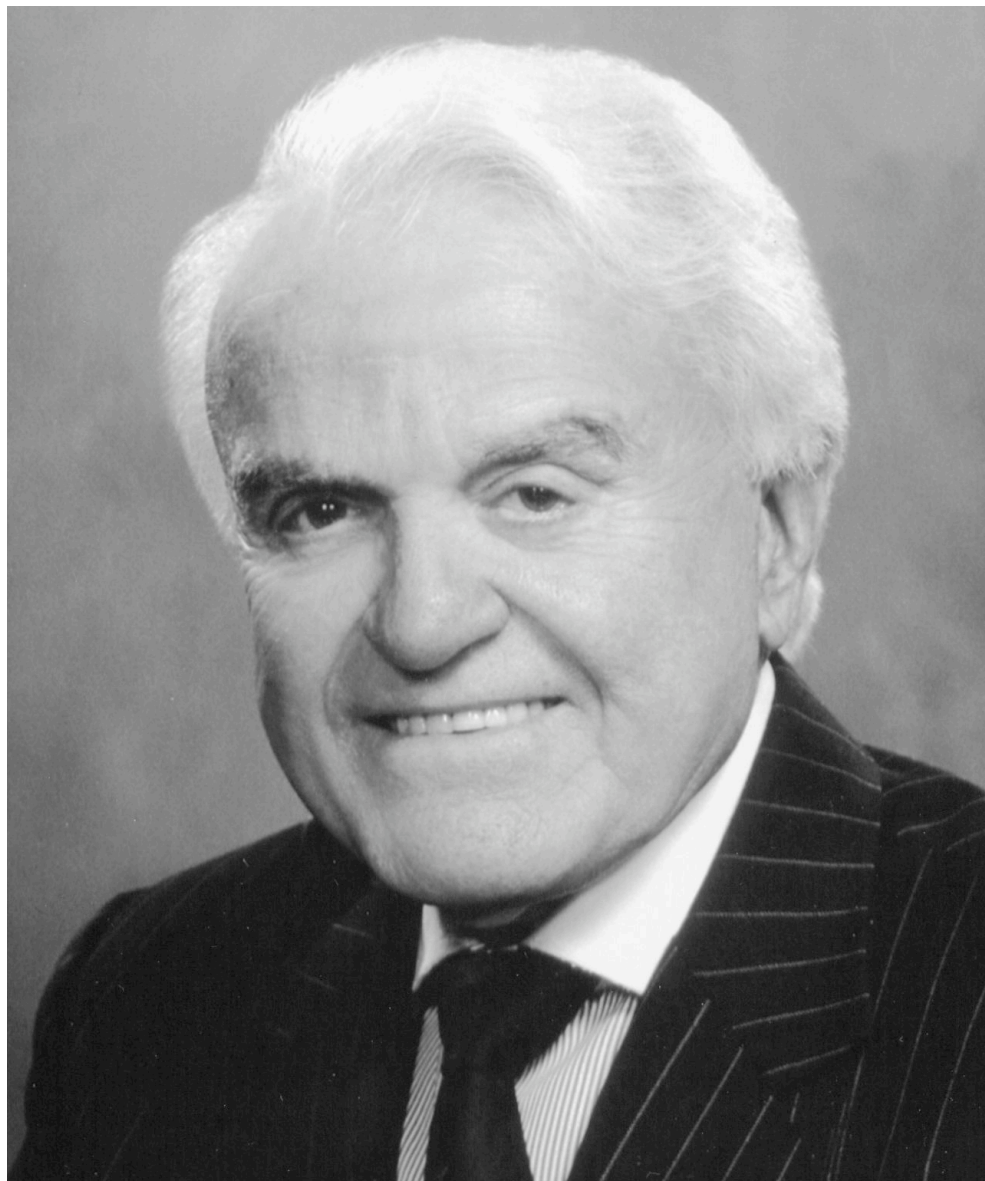
Bob Metcalfe
ex-pundit

ATM is the answer, do
we need a question?



John McQuillan
one of the idle rich

\$\$\$\$\$\$
\$\$\$\$\$\$



what makes you
think you own the
movie you bought?



Jack Valenti
president & CEO MPAA



and I say that 200
years *is* a limited period

Michael Eisner
chairman, Walt Disney





the answer is
National Security
but the question is
secret



John Ashcroft
US Attorney General

Innovation?

PBS American Experience show on “1900”

*“The turn of the century, particularly in America, represented a period that will someday be compared to the Renaissance. Within a period of very short time, 15-20 years, most of the breakthroughs in technology occurred that now influence our lives so heavily. Everything since then has been engineering. You capture motion. Motion picture comes about this time. Now everything since is engineering. It's technology. Sure, the picture's better, but the idea of seeing people move on a screen is new. The telephone. “Hello? I'm talking to Chicago.” A miracle. But we take it for granted. You break through and record sound. It's gotten better, but everything since is **simply engineering.**”*

Imitation

good for learning
but one needs to move
beyond



New Inet (since 1900) Applications

web

mail (increasingly a.k.a spam), FAX, **IM**

remote login

data transfer, storage

commerce

audio & video

search

content

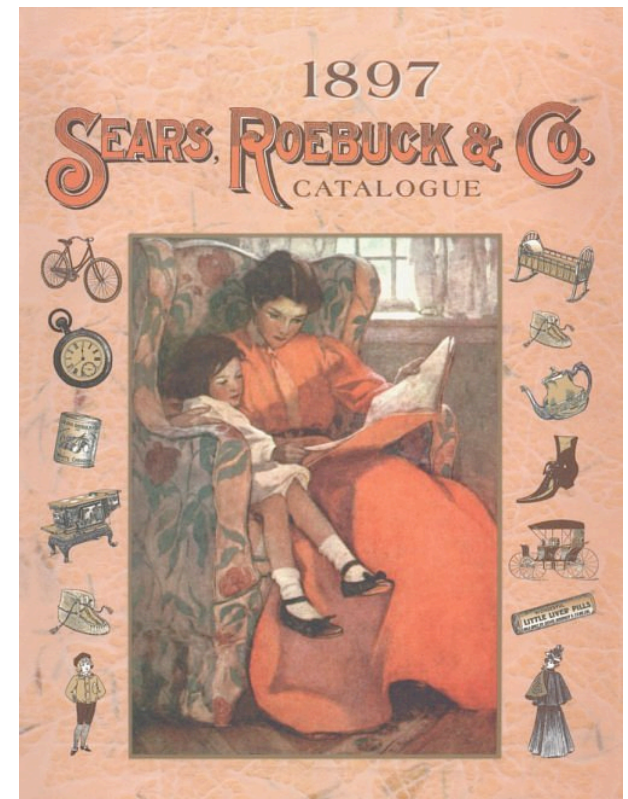
How Important is the E?

how much in **e**-commerce is new?

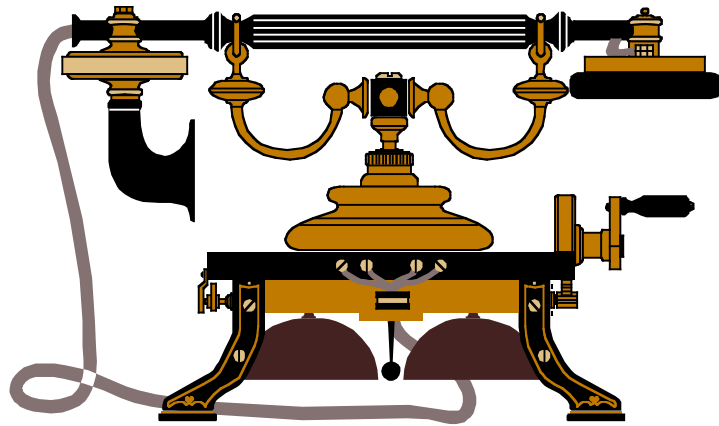
i.e., not just Sears, Roebuck & Co. with near-instant gratification & better indexes

is moving a postal-based system to the Internet innovative?

important, yes - but innovative?



IP Telephony or Internet Telephony?



IP

or

IP

voice

“make sure it stays good”

“it is good enough”

ITU & others want to “define” voice over IP

but no way to know what it *will* be

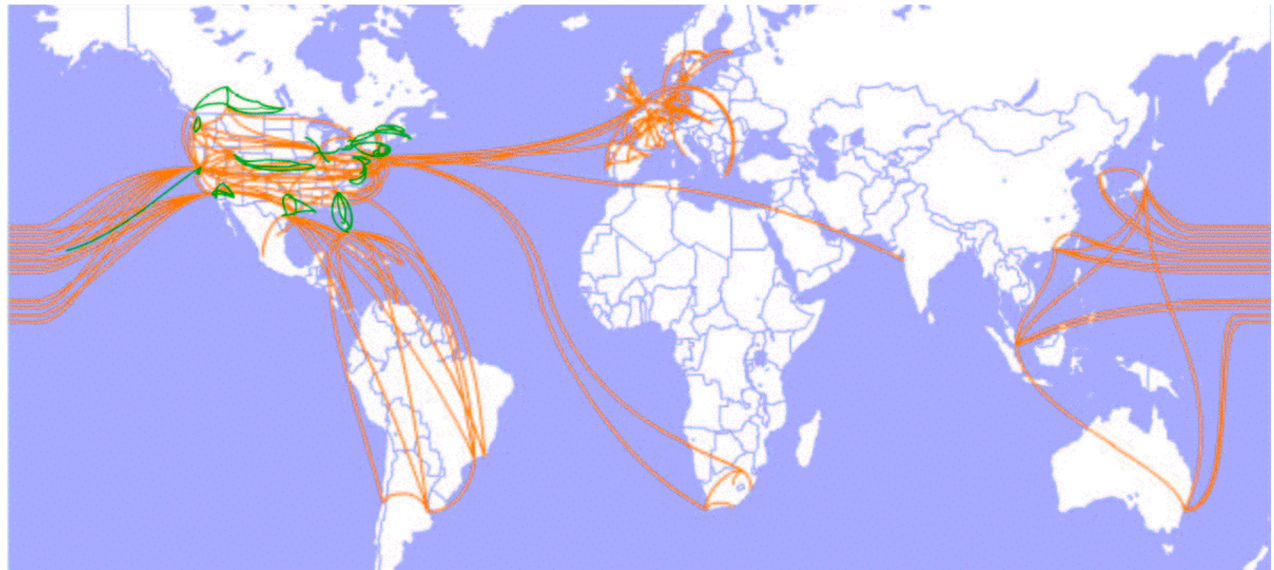
“New” Networks

Sprint conversion to ‘packet’ technology

(the quotes were in the Nortel 2001 press release)

Verizon, SBC and BellSouth FTTH

but what technology?



What Would Be Innovative?

how about Internet Telephony
with

smart voice terminals

downloadable applications

open to the Internet

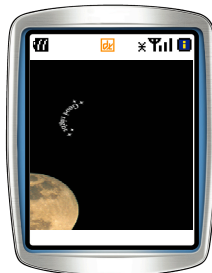
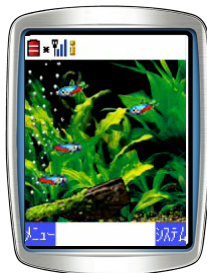
standard open protocols

actually this is **not** innovation

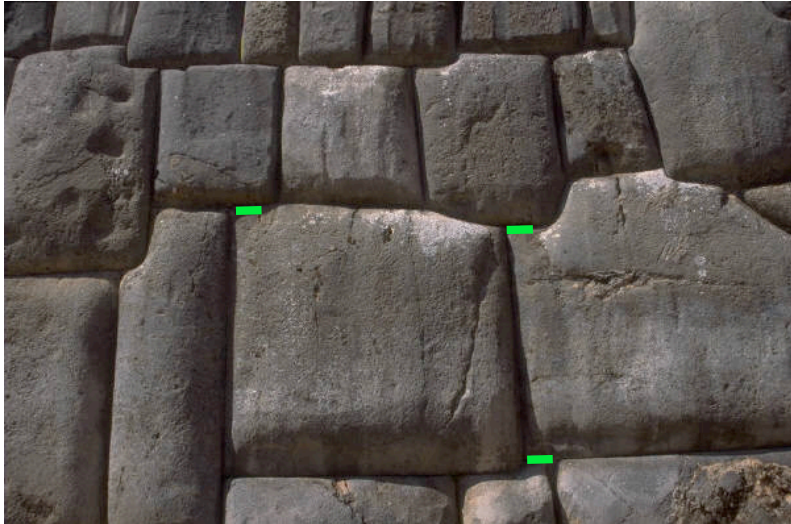
but would (does) **enable** innovation



M O D E



What is the Internet now?



spam

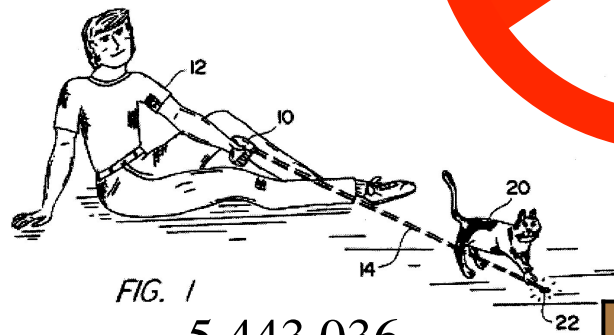
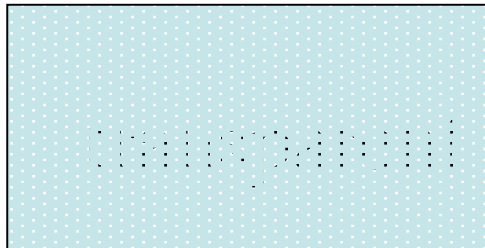
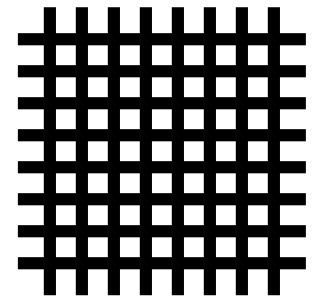
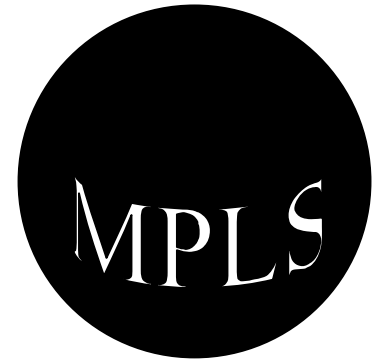
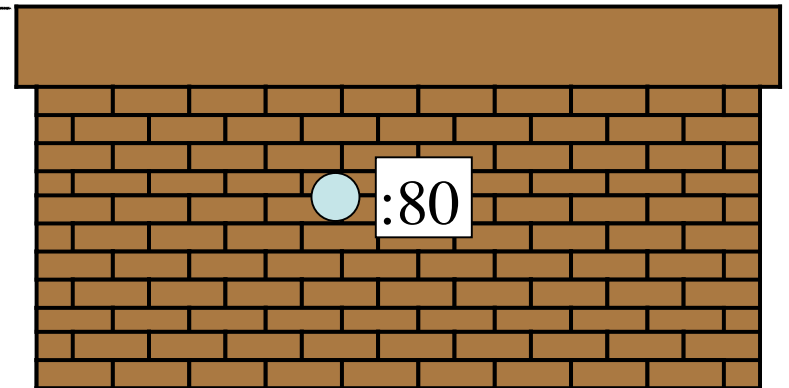


FIG. 1
5,443,036

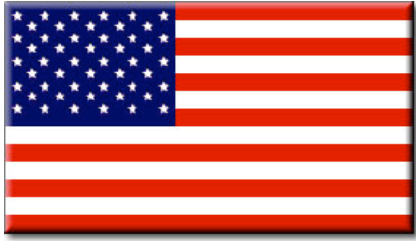
RIAA



WIFI



Alternate Future Histories?

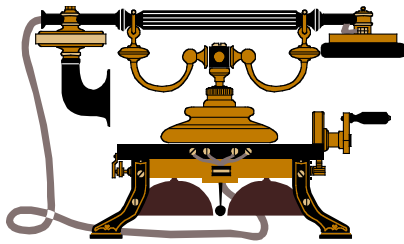


we built it so we own it!



Internal Revenue Service

DEPARTMENT OF THE TREASURY



IP

far too important for the geeks



world summit
on the information society
Geneva 2003 - Tunis 2005



“make sure it stays good”





content



Qwest. 
Spirit of Service™



VOD

 **BELLSOUTH**

games
games

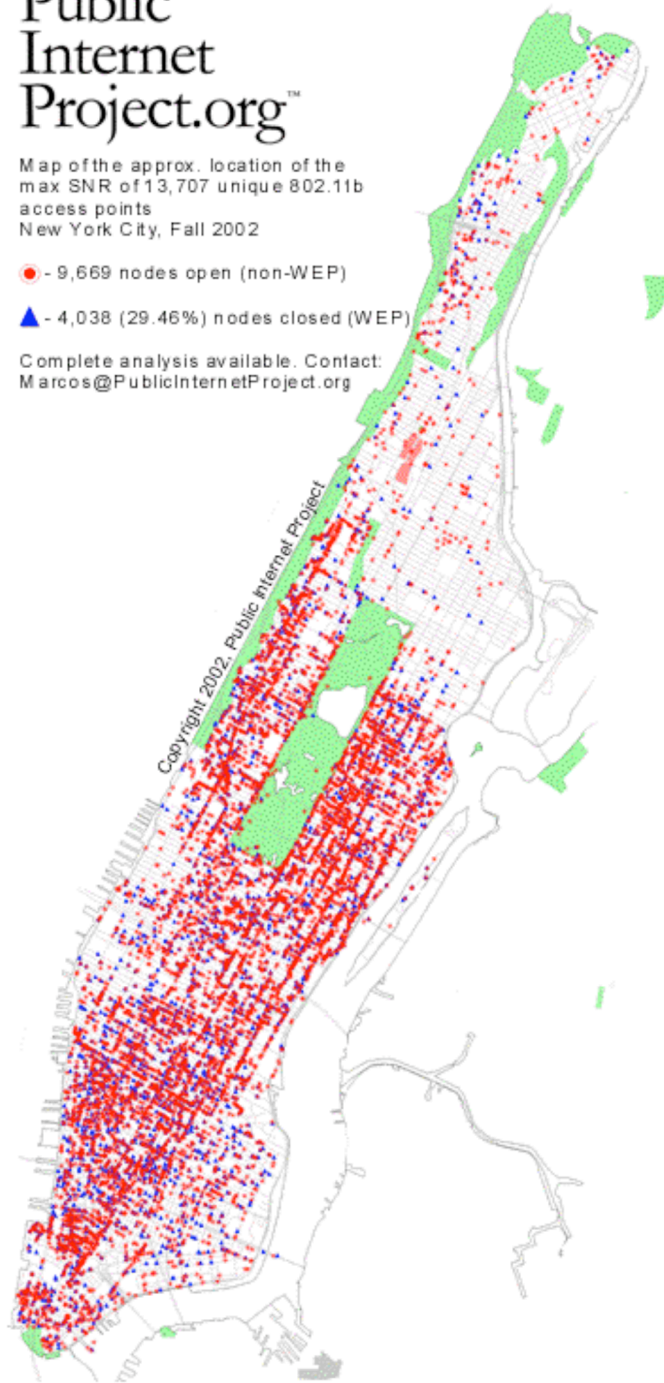
Public Internet Project.org™

Map of the approx. location of the
max SNR of 13,707 unique 802.11b
access points
New York City, Fall 2002

● - 9,669 nodes open (non-WEP)

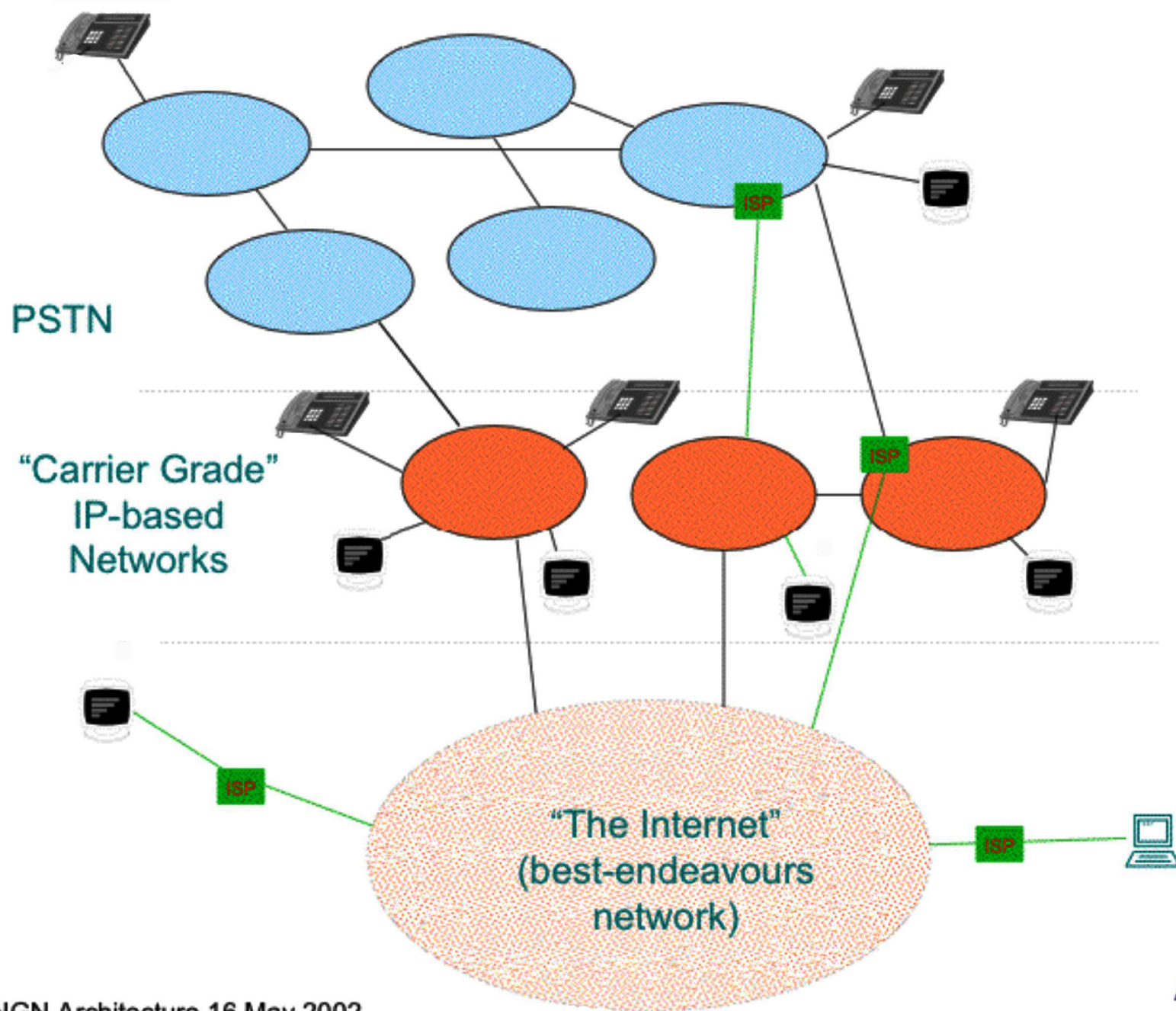
▲ - 4,038 (29.46%) nodes closed (WEP)

Complete analysis available. Contact:
Marcos@PublicInternetProject.org



+ community
nets?

back to the future?



NGN Architecture 16 May 2002



Then again the ISPs might survive
to keep providing the Internet
rather than a Disney-controlled



as a driver, the Internet has quite a
future if there is any traditional
Internet in it

next time? (or is it now?)

support **existing** networks

datagram-based

creating the **router** function

split TCP **and** IP

DARPA fund Berkeley to add TCP/IP to **UNIX**

CSNET and **CSNET/ARPANET** deal

NSF **require TCP/IP** on NSFnet

ISO **turn down** TCP/IP

NSF Acceptable Use Policy (**AUP**)

minimal regulation

**decisions that made
a difference**

Some Current Decisions

path openness

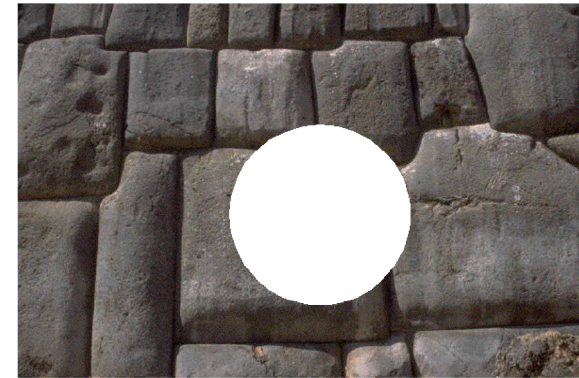
standards?

security

privacy

ISP business model

regulations



or



Key Open Questions

Who says who makes the rules?

Who says who pays for what?

watch out for WSIS
answering these questions





it is **NOW**
(and it is us)

I'm pessimistically optimistic

