Cybercrime, Cyberterrorism, and Cyberwar

Hostilities

Juan Tapiador

uc3m

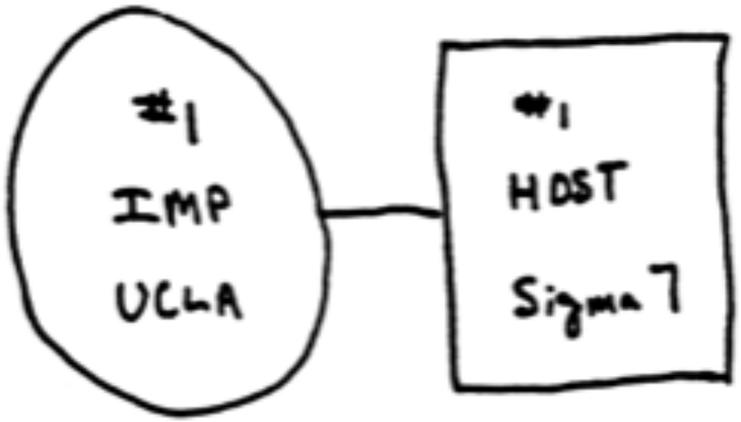
In the beginning was the ~~command line~~ Internet

A drama in two parts

*"It seems reasonable to envision, for a time 10 or 15 years hence, a **'thinking center' that will incorporate the functions of present-day libraries** together with anticipated advances in information storage and retrieval [...] The picture readily enlarges itself into a **network of such centers**, connected to one another by **wide-band communication lines** and to individual users by **leased-wire services**. In such a system, the speed of the computers would be balanced, and the cost of the gigantic memories and the sophisticated programs would be divided by the number of users."*

J.C.R. Licklider, “Man-Computer Symbiosis”, 1960

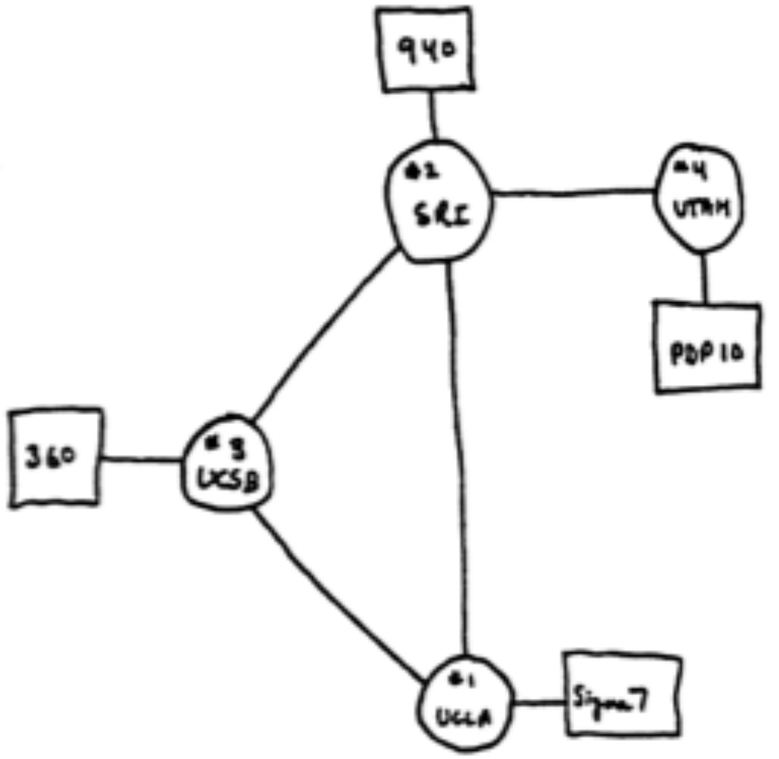
1969



THE ARPA NETWORK

SEPT 1969

1 NODE

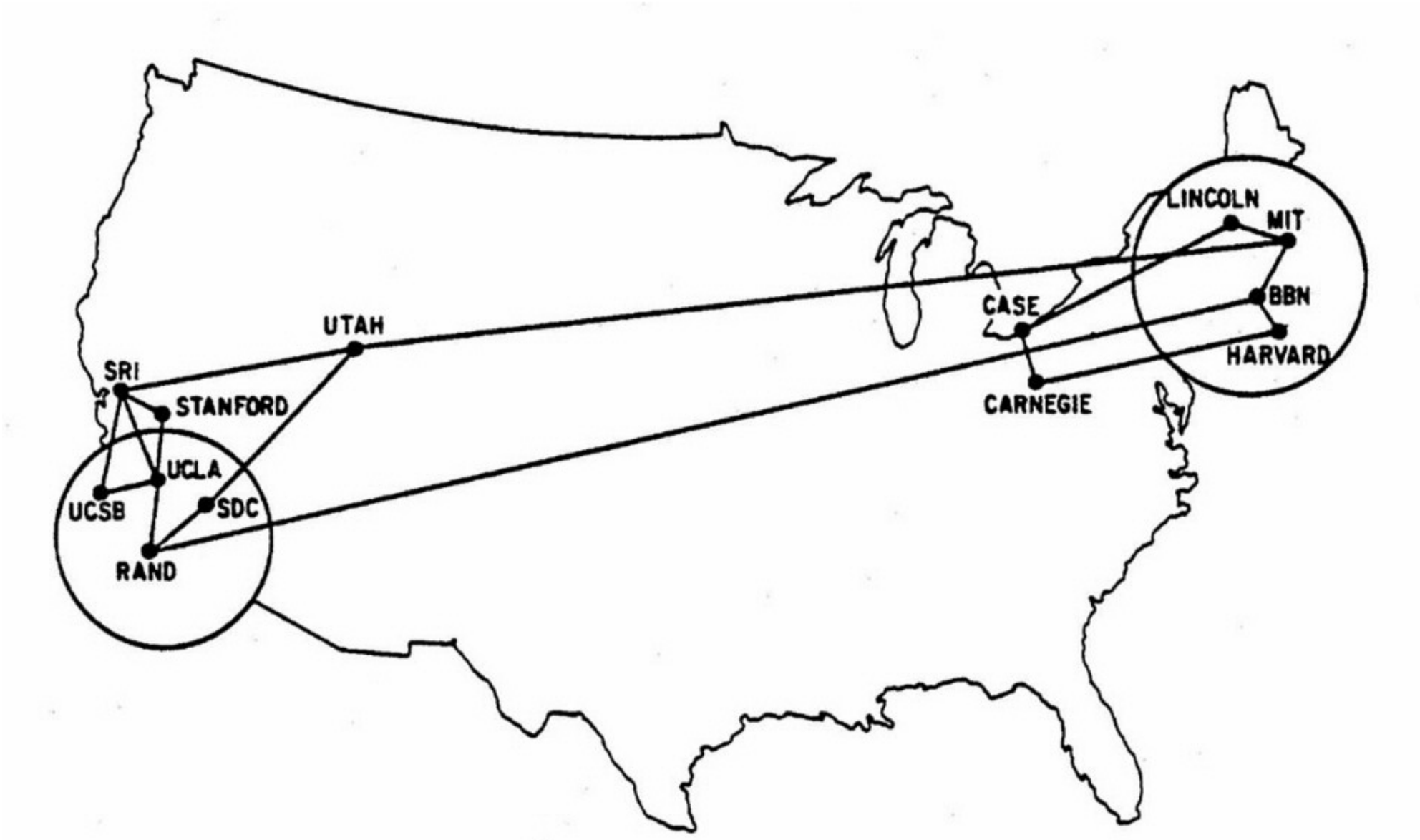


THE ARPA NETWORK

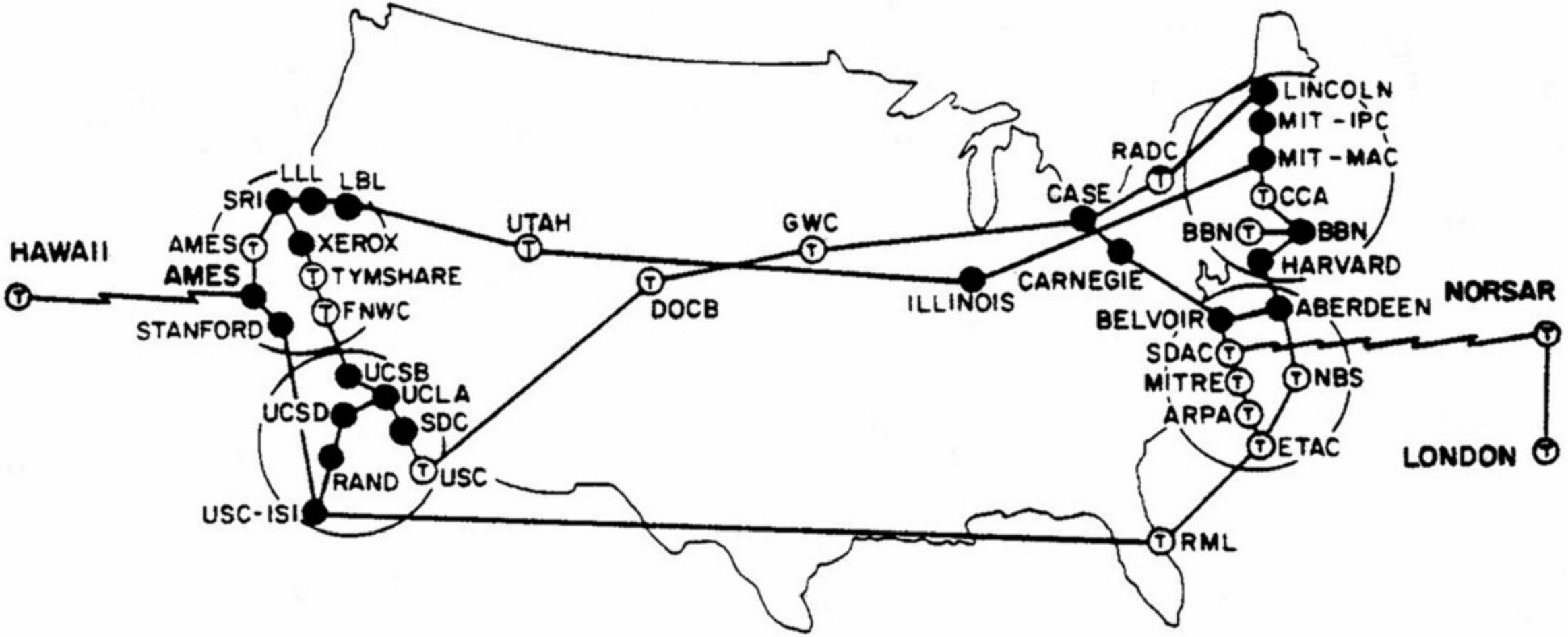
DEC 1969

4 NODES

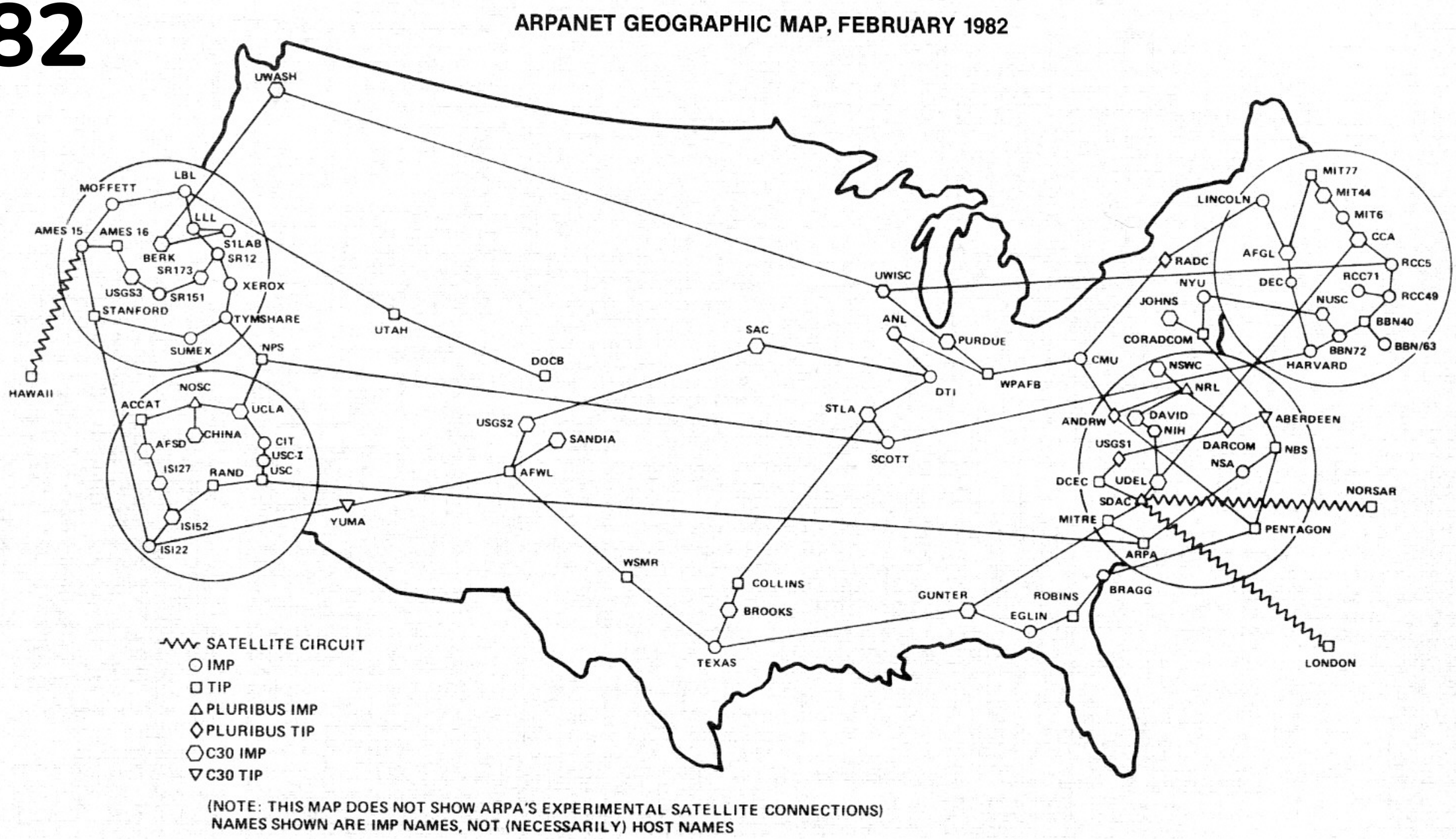
1970


LINCOLN
MIT
BBN
HARVARD
CASE
CARNEGIE
UTAH
SRI
STANFORD
UCLA
UCSB
SDC
RAND

1973


LINCOLN
MIT - IPC
MIT - MAC
CCA
BBN
BBN
HARVARD
RADC
CASE
CARNEGIE
ABERDEEN
BELVOIR
SDAC
MITRE
ARPA
NBS
ETAC
NORSAR
LONDON
RML
LLL
LBL
SRI
AMES
XEROX
TYMSHARE
FNWC
HAWAII
AMES
STANFORD
UCSB
UCLA
UCSD
SDC
RAND
USC
USC-ISI
UTAH
GWC
DOCB
ILLINOIS

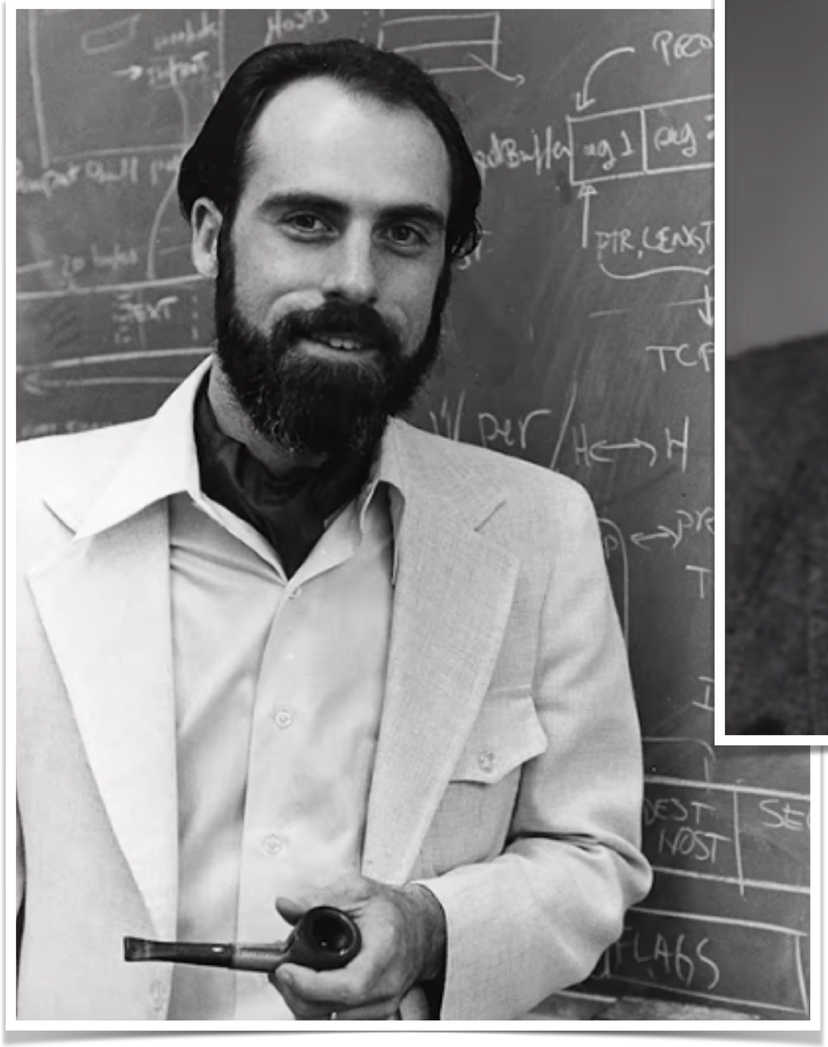
1982


ARPANET GEOGRAPHIC MAP, FEBRUARY 1982
UWASH
LBL
MOFFETT
LLL
AMES 15
AMES 16
S1LAB
BERK
SR12
SR173
XEROX
USGS3
SR151
STANFORD
TYMSHARE
SUMEX
NPS
UTAH
HAWAII
NOSC
ACCAT
UCLA
AFSD
CHINA
CIT
USC-I
ISI27
RAND
USC
ISI52
ISI22
YUMA
DOCB
SAC
USGS2
SANDIA
AFWL
WSMR
COLLINS
BROOKS
TEXAS
UWISC
ANL
PURDUE
DTI
WPAFB
STLA
SCOTT
CMU
MIT77
MIT44
LINCOLN
MIT6
CCA
AFGL
RADC
RCC5
DEC
RCC71
NYU
JOHNS
NUSC
RCC49
BBN40
CORADCOM
BBN72
BBN/63
HARVARD
NSWC
NRL
ANDRW
DAVID
NIH
ABERDEEN
USGS1
DARCOM
NBS
NSA
DCEC
UDEL
NORSAR
SDAC
MITRE
PENTAGON
ARPA
BRAGG
GUNTER
ROBINS
EGLIN
LONDON
SATELLITE CIRCUIT
IMP
TIP
PLURIBUS IMP
PLURIBUS TIP
C30 IMP
C30 TIP
(NOTE: THIS MAP DOES NOT SHOW ARPA'S EXPERIMENTAL SATELLITE CONNECTIONS)
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

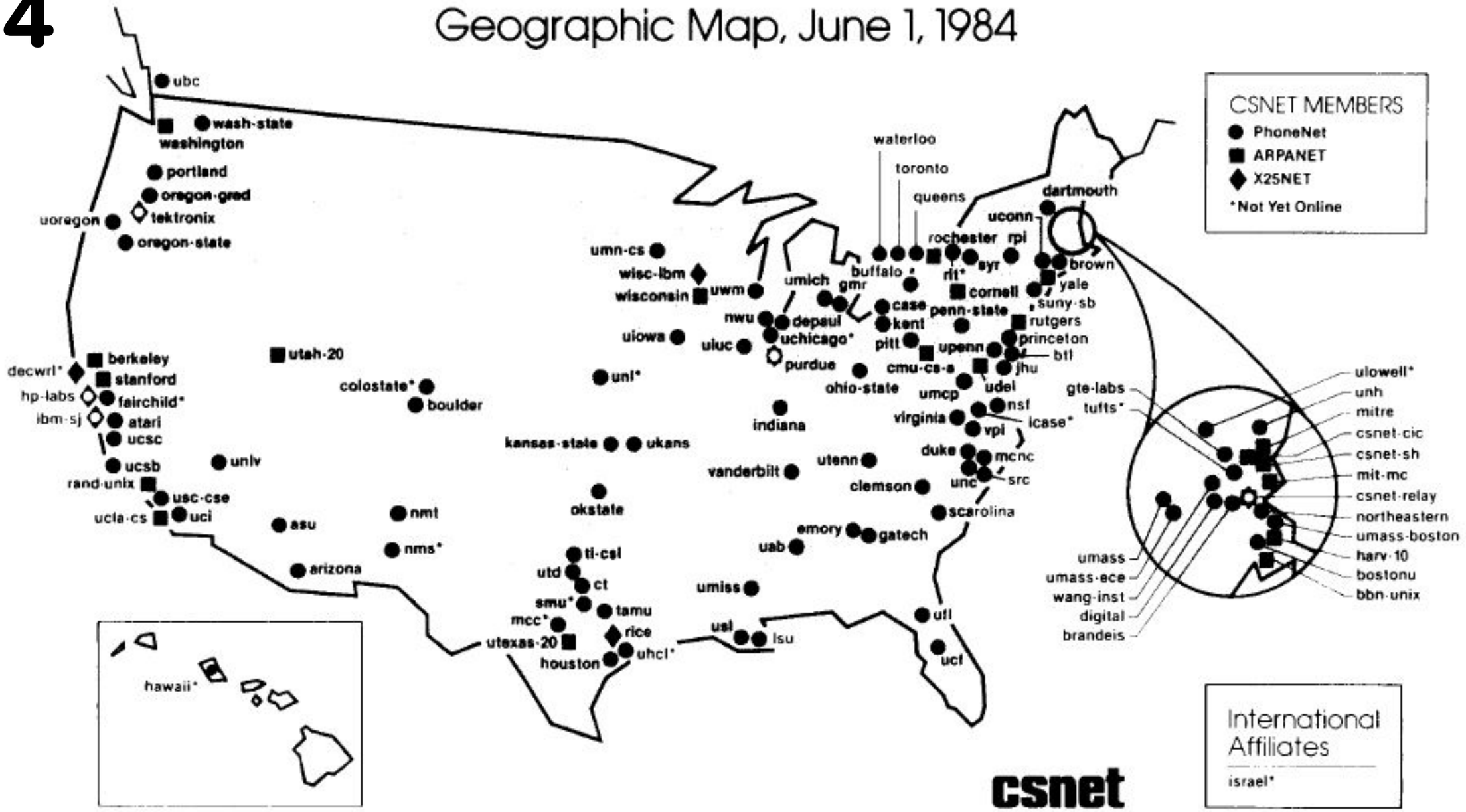
1983

January 1, 1983

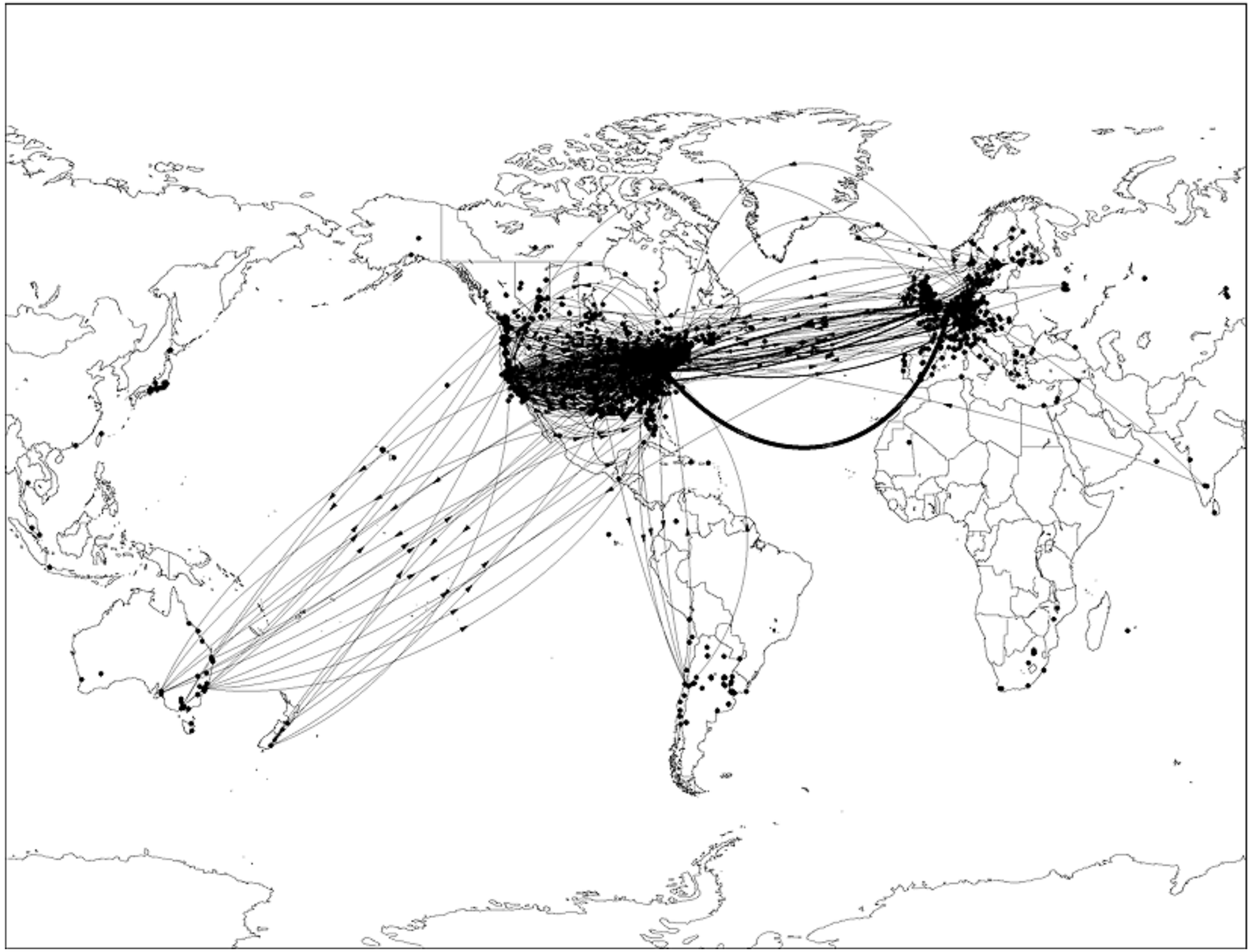
The ARPANET switched to using TCP/IP, marking the birth of the modern Internet



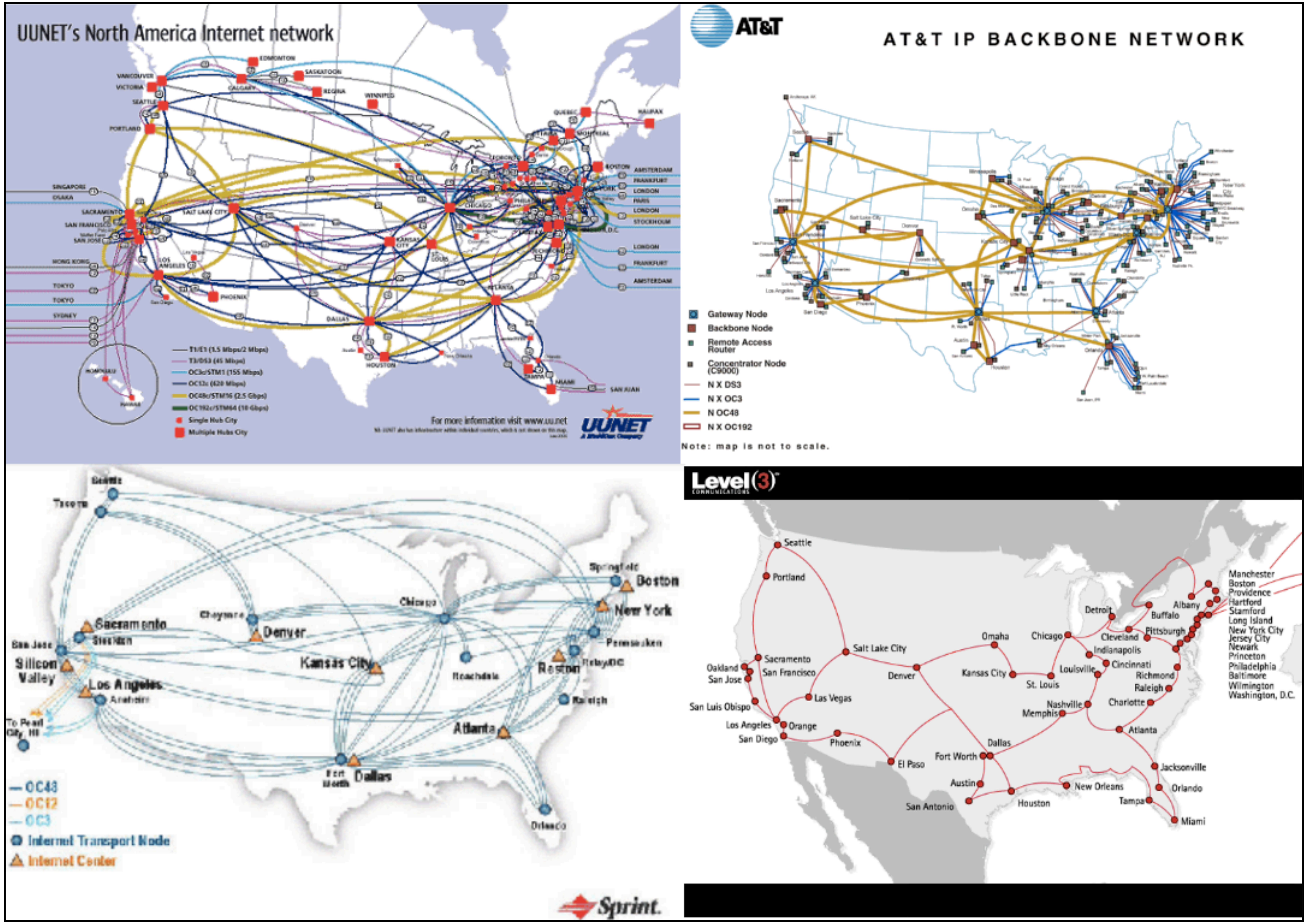
1984


Geographic Map, June 1, 1984
CSNET MEMBERS
PhoneNet
ARPANET
X25NET
*Not Yet Online
ubc
wash-state
washington
portland
oregon-grad
tektronix
uoregon
oregon-state
berkeley
stanford
fairchild*
hp-labs
ibm-sj
atari
ucsc
decwrl*
ucsb
rand-unix
usc-cse
ucla-cs
uci
utah-20
colostate*
boulder
unlv
asu
arizona
nmt
nms*
kansas-state
ukans
okstate
ti-csl
utd
ct
smu*
tamu
mcc*
rice
utexas-20
houston
uhcl*
umn-cs
wisc-ibm
wisconsin
uwm
uiowa
uiuc
unl*
nwu
depaul
uchicago*
purdue
indiana
umich
gmr
waterloo
toronto
queens
buffalo
rit*
rochester
rpi
syr
dartmouth
uconn
brown
yale
cornell
suny-sb
case
kent
penn-state
rutgers
pitt
upenn
princeton
btl
cmu-cs-a
jhu
ohio-state
umcp
udel
nsf
virginia
vpi
icase*
duke
mcnc
unc
src
scarolina
clemson
utenn
vanderbilt
emory
gatech
uab
umiss
usl
lsu
ufl
ucf
gte-labs
tufts*
ulowell*
unh
mitre
csnet-cic
csnet-sh
mit-mc
csnet-relay
northeastern
umass-boston
harv-10
bostonu
bbn-unix
umass
umass-ece
wang-inst
digital
brandeis
hawaii*
csnet
International Affiliates
israel*

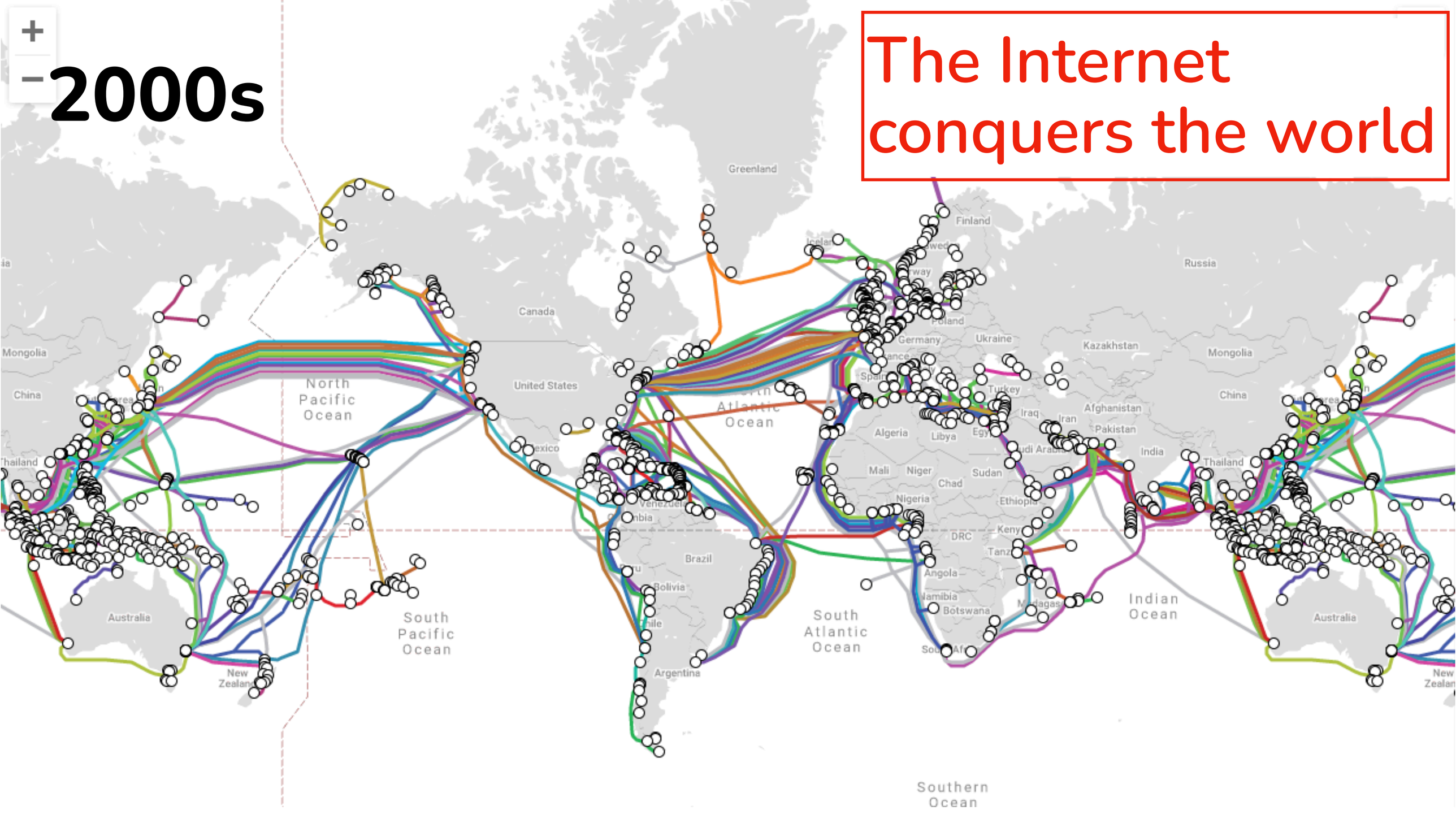
1993


Complete aggregate news flow, worldwide
Line width proportional to directional effective flow volume
DECWRL netmap-2.1 by Brian Reid at Thu May 13 13:49:34 1993
Gall Stereographic Projection, Map center: [15°N, 88°W]

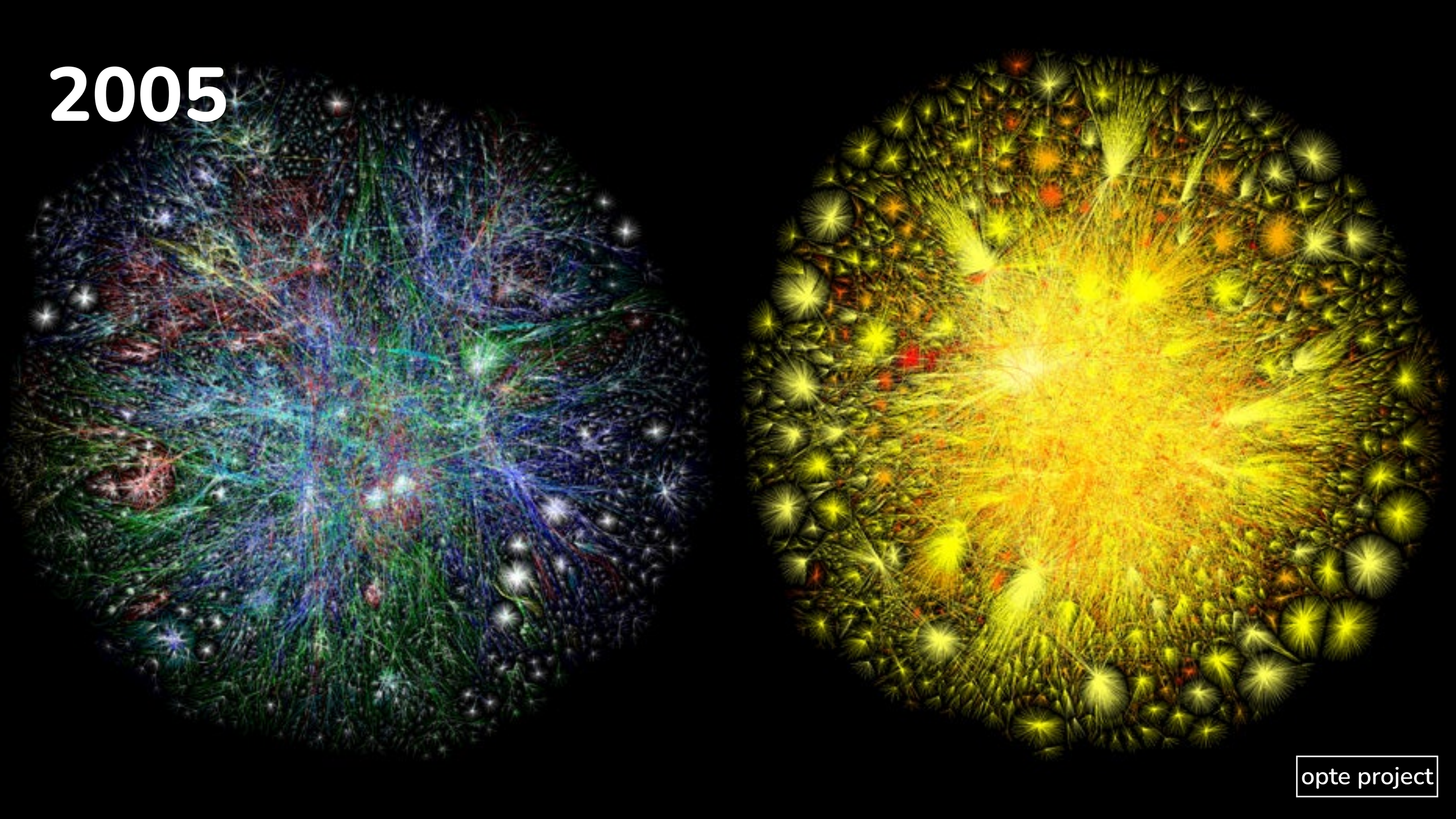
1994



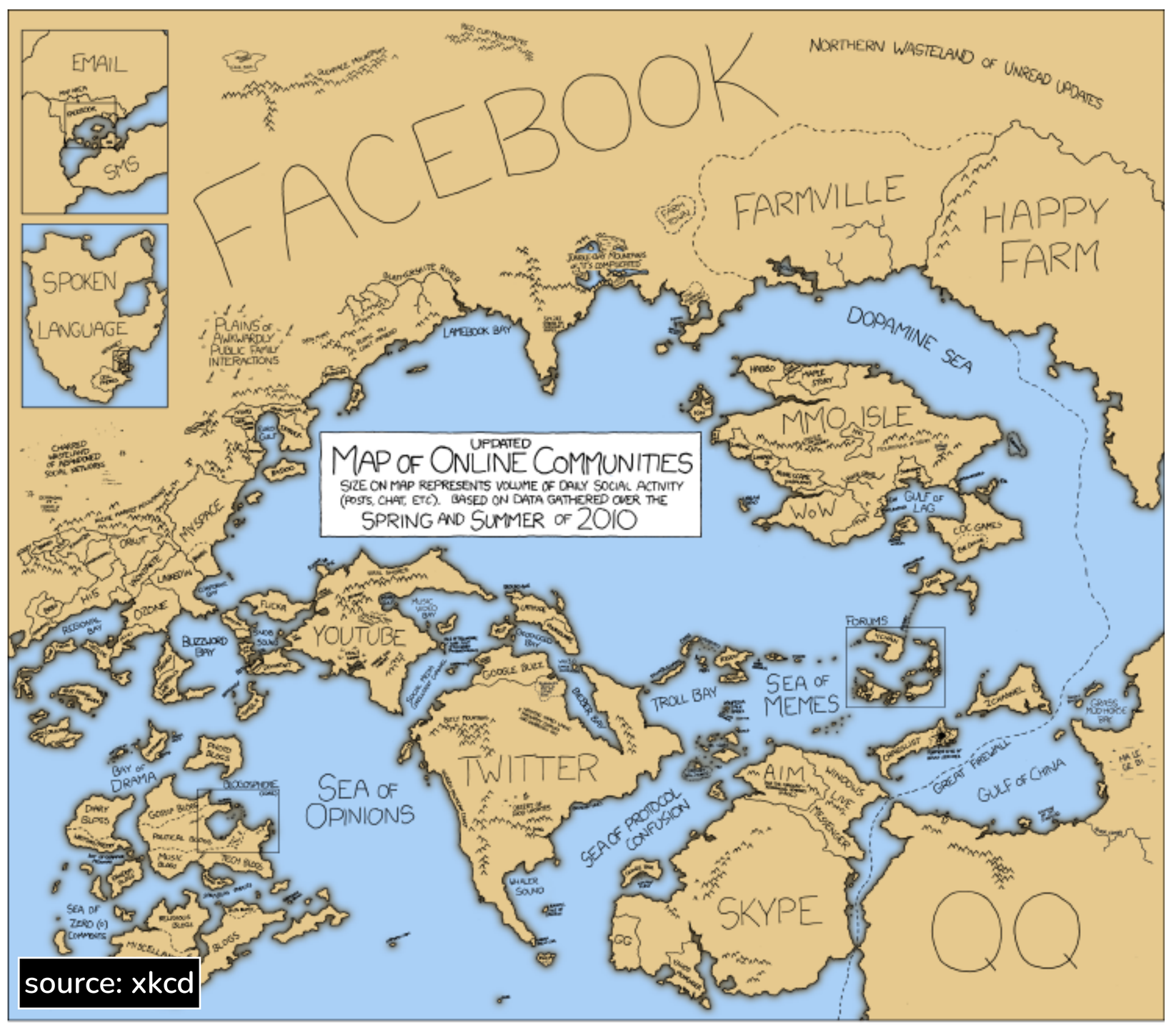
UUNET's North America Internet network
For more information visit www.uu.net
UUNET
AT&T
AT&T IP BACKBONE NETWORK
Gateway Node
Backbone Node
Remote Access Router
Concentrator Node (C9000)
N X DS3
N X OC3
N X OC48
N X OC192
Note: map is not to scale.
Level(3)
Seattle
Portland
Salt Lake City
Omaha
Chicago
Detroit
Buffalo
Albany
Cleveland
Pittsburgh
Indianapolis
Cincinnati
Louisville
St. Louis
Kansas City
Denver
Oakland
San Jose
Sacramento
San Francisco
Las Vegas
San Luis Obispo
Los Angeles
Orange
San Diego
Phoenix
El Paso
Fort Worth
Dallas
Austin
San Antonio
Houston
New Orleans
Nashville
Memphis
Atlanta
Charlotte
Raleigh
Richmond
Jacksonville
Orlando
Tampa
Miami
Manchester
Boston
Providence
Hartford
Stamford
Long Island
New York City
Jersey City
Newark
Princeton
Philadelphia
Baltimore
Wilmington
Washington, D.C.
Boston
New York
Denver
Kansas City
Sacramento
Silicon Valley
Los Angeles
Atlanta
Dallas
Chicago
OC48
OC12
OC3
Internet Transport Node
Internet Center
Sprint


2000s
The Internet conquers the world
Greenland
Canada
United States
Mongolia
China
North Pacific Ocean
South Pacific Ocean
Australia
New Zealand
Brazil
Bolivia
Argentina
South Atlantic Ocean
Finland
Russia
Germany
Ukraine
Kazakhstan
Turkey
Iraq
Iran
Afghanistan
Pakistan
India
Algeria
Libya
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
DRC
Angola
Namibia
Botswana
Indian Ocean
Thailand
Southern Ocean

2005

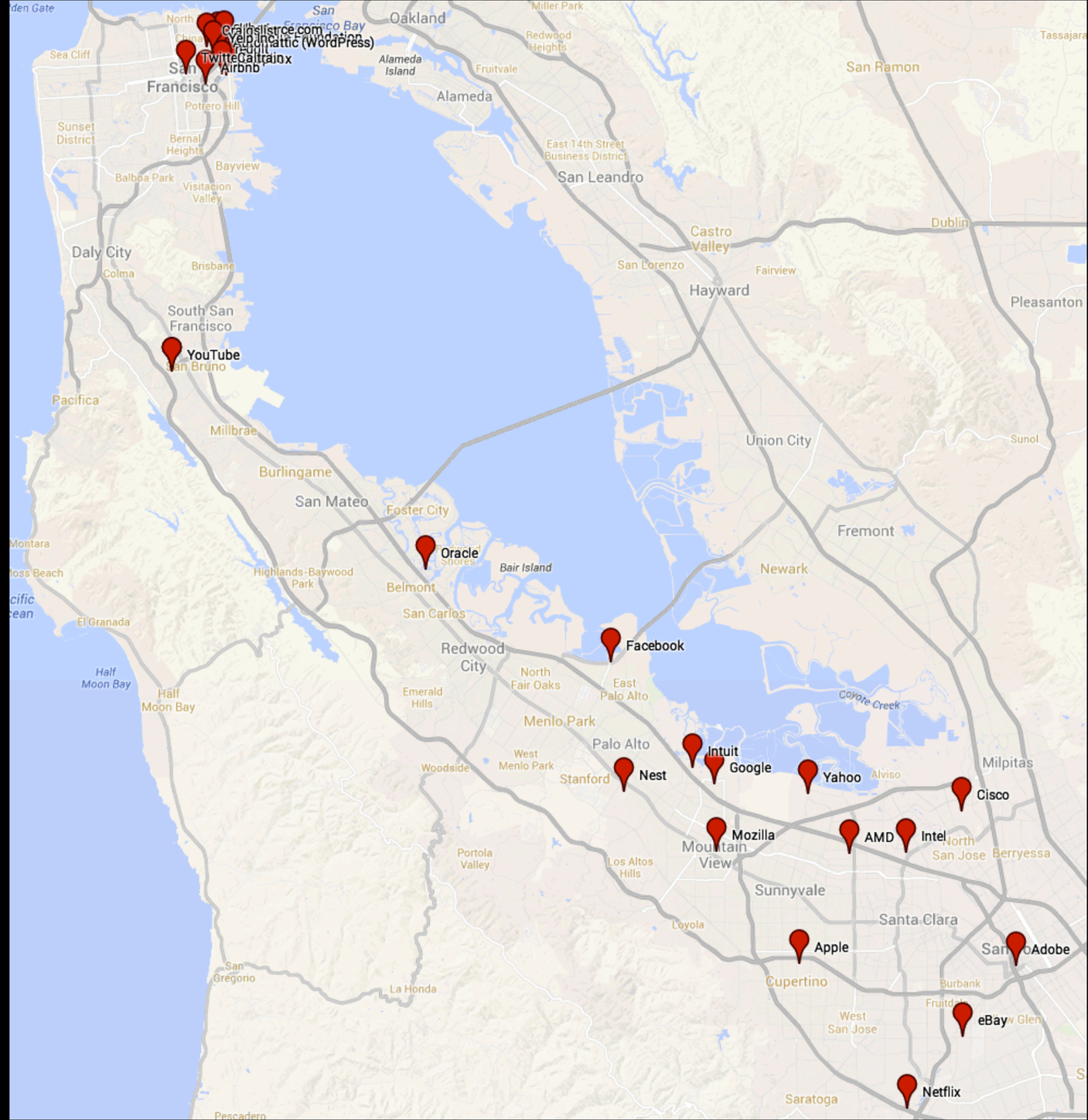


opte project


EMAIL
SMS
SPOKEN LANGUAGE
FACEBOOK
NORTHERN WASTELAND OF UNREAD UPDATES
FARMVILLE
HAPPY FARM
PLAINS OF AWKWARDLY PUBLIC FAMILY INTERACTIONS
LAMEBOOK BAY
DOPAMINE SEA
MMO ISLE
WoW
GULF OF LAG
CDC GAMES
UPDATED
MAP OF ONLINE COMMUNITIES
SIZE ON MAP REPRESENTS VOLUME OF DAILY SOCIAL ACTIVITY (POSTS, CHAT, ETC). BASED ON DATA GATHERED OVER THE SPRING AND SUMMER OF 2010
MYSPACE
YOUTUBE
BLIZZARD BAY
FORUMS
TROLL BAY
SEA OF MEMES
TWITTER
SEA OF OPINIONS
BAY OF DRAMA
AIM
GREAT FIREWALL
GULF OF CHINA
SEA OF PROTOCOL CONFUSION
SKYPE
QQ
SEA OF ZERO (0) COMMENTS
source: xkcd
BLOGOSPHERE
(CORE REGION)
GOSSIP BLOGS
LIBERAL BLOGS
BAY OF FLAME
TECH BLOGS
FORUMS
4CHAN
/b/
JUX
D2JSP

How big is the Internet?

The capital of the Internet



The Internet is one of humanity's greatest achievements

It is the basis for all human communication at any distance

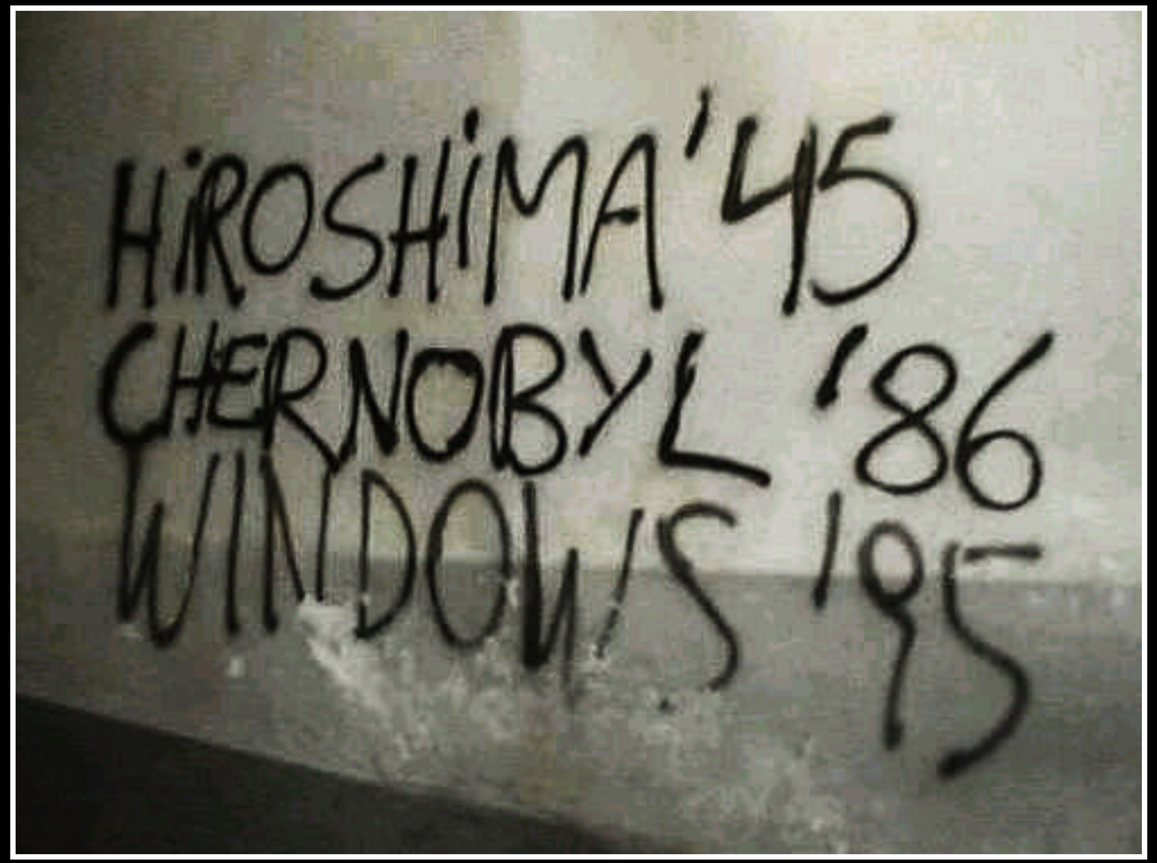
It is the ultimate repository of human's knowledge

It is the foundation of all world-scale software services

It is increasingly the basis for sensing and actuation in our world

and we are just getting started!

The Story
Part II



It is the basis for all human communication at any distance

It is the ultimate repository of human's knowledge

It is the foundation of all world-scale software services

It is increasingly the basis for sensing and actuation in our world

What can possibly go wrong?

Threats

Multiple classifications depending on

result (type of incident)
severity (impact of the incident)
structure (type of opponent)
motive (reasons for attack)

threat vs threat actor

Types of security incidents

Class	Type	Description
Abusive content	Spam	"Or 'Unsolicited Bulk Email', this means that the recipient has not granted verifiable permission for the message to be sent and that the message is sent as part of a larger collection of messages, all having a functionally comparable content
	Harmful Speech	Discretization or discrimination of somebody, e.g. cyber stalking, racism or threats against one or more individuals
	(Child) Sexual Exploitation/Sexual/ Violent Content	Child Sexual Exploitation (CSE), sexual content, glorification of violence, etc.

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Malicious code	Infected system	System infected with malware, e.g. PC, smartphone or server infected with a rootkit. Most often this refers to a connection to a sinkholed C2 server
	C2 server	Command-and-control server contacted by malware on infected systems
	Malware distribution	URI used for malware distribution, e.g. a download URL included in fake invoice malware spam or exploit-kits (on websites)
	Malware configuration	URI hosting a malware configuration file, e.g. web-injects for a banking trojan

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Information gathering	Scanning	Attacks that send requests to a system to discover weaknesses. This also includes testing processes to gather information on hosts, services and accounts. Examples: fingerd, DNS querying, ICMP, SMTP (EXPN, RCPT, ...), port scanning
	Sniffing	Observing and recording of network traffic (wiretapping)
	Social engineering	Gathering information from a human being in a non-technical way (e.g. lies, tricks, bribes, or threats)

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Intrusion attempts	Exploitation of known vulnerabilities	An attempt to compromise a system or to disrupt any service by exploiting vulnerabilities with a standardised identifier such as CVE name (e.g. buffer overflow, backdoor, cross site scripting, etc.)
	Login attempts	Multiple login attempts (Guessing / cracking of passwords, brute force). This IOC refers to a resource, which has been observed to perform brute-force attacks over a given application protocol
	New attack signature	An attack using an unknown exploit

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Intrusions	Privileged account compromise	Compromise of a system where the attacker gained administrative privileges
	Unprivileged account compromise	Compromise of a system using an unprivileged (user/ service) account
	Application compromise	Compromise of an application by exploiting (un-)known software vulnerabilities, e.g. SQL injection
	System compromise	Compromise of a system, e.g. unauthorised logins or commands. This includes compromising attempts on honeypot systems
	Burglary	Physical intrusion, e.g. into corporate building or data-centre

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Availability	Denial of service (DoS)	Denial of Service attack, e.g. sending specially crafted requests to a web application which causes the application to crash or slow down
	Distributed denial of service (DDoS)	Distributed Denial of Service attack, e.g. SYN-Flood or UDP-based reflection/amplification attacks
	Misconfiguration	Software misconfiguration resulting in service availability issues, e.g. DNS server with outdated DNSSEC Root Zone KSK
	Sabotage	Physical sabotage, e.g cutting wires or malicious arson
	Outage	Outage caused e.g. by air condition failure or natural disaster

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Information content security	Unauthorised access to information	Unauthorised access to information, e.g. by abusing stolen login credentials for a system or application, intercepting traffic or gaining access to physical documents
	Unauthorised modification of information	Unauthorised modification of information, e.g. by an attacker abusing stolen login credentials for a system or application or a ransomware encrypting data. Also includes defacements
	Data loss	Loss of data, e.g. caused by harddisk failure or physical theft
	Leak of confidential information	Leaked confidential information like credentials or personal data

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Fraud	Unauthorised use of resources	Using resources for unauthorised purposes including profit-making ventures, e.g. the use of e-mail to participate in illegal profit chain letters or pyramid schemes
	Copyright	Offering or Installing copies of unlicensed commercial software or other copyright protected materials (Warez)
	Masquerade	Type of attack in which one entity illegitimately impersonates the identity of another in order to benefit from it
	Phishing	Masquerading as another entity in order to persuade the user to reveal private credentials. This IOC most often refers to a URL, which is used to phish user credentials

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Vulnerable	Weak crypto	Publicly accessible services offering weak crypto, e.g. web servers susceptible to POODLE/FREAK attacks
	DoS amplifier	Publicly accessible services that can be abused for conducting DDoS reflection/amplification attacks, e.g. DNS open-resolvers or NTP servers with monlist enabled
	Potentially unwanted accessible services	Potentially unwanted publicly accessible services, e.g. Telnet, RDP or VNC
	Information disclosure	Publicly accessible services potentially disclosing sensitive information, e.g. SNMP or Redis
	Vulnerable system	A system which is vulnerable to certain attacks, i.e., misconfigured client proxy settings (e.g., WPAD), outdated operating system, XSS vulnerabilities, etc

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Types of security incidents

Class	Type	Description
Others	Uncategorized	All incidents which don't fit in one of the given categories should be put into this class or the incident is not categorized
	Undetermined	The categorization of the incident is unknown/ undetermined

ENISA's Reference Security Incident Taxonomy Working Group – RSIT WG

Threats according to potential for harm

	Class	Type(s)	
Critical	Others	APT	
Very high	Malicious code	Malware distribution	Malware configuration
	Intrusion	Theft	
	Availability	Sabotage	Interruptions
High	Abusive content	Child pornography	Inadequate sexual or violent content
	Harmful code	Infected system	C&C server
	Intrusion	App compromise	Privileged account compromise
	Intrusion attempt	Unknown attack	
	Availability	DoS	DDoS
	Data compromise	Unauthorized access	Data leak Unauthorized data modif.
	Fraud	Phishing	

Threats according to potential for harm

	Class	Type(s)	
Medium	Abusive content	Harmful speech	
	Info gathering	Social engineering	
	Intrusion attempt	Exploitation of known vulns	Login attempts
	Intrusion	Unprivileged account compromise	
	Availability	Misconfiguration	
	Fraud	Unauthorized use of resources	Copyright
	Masquerade		
	Vulnerable	Weak crypto	DDoS amplifier
		Information disclosure	Vulnerable system
Low	Abusive content	Spam	
	Info gathering	Scanning	Sniffing
	Others	Others	

Threats according to impact

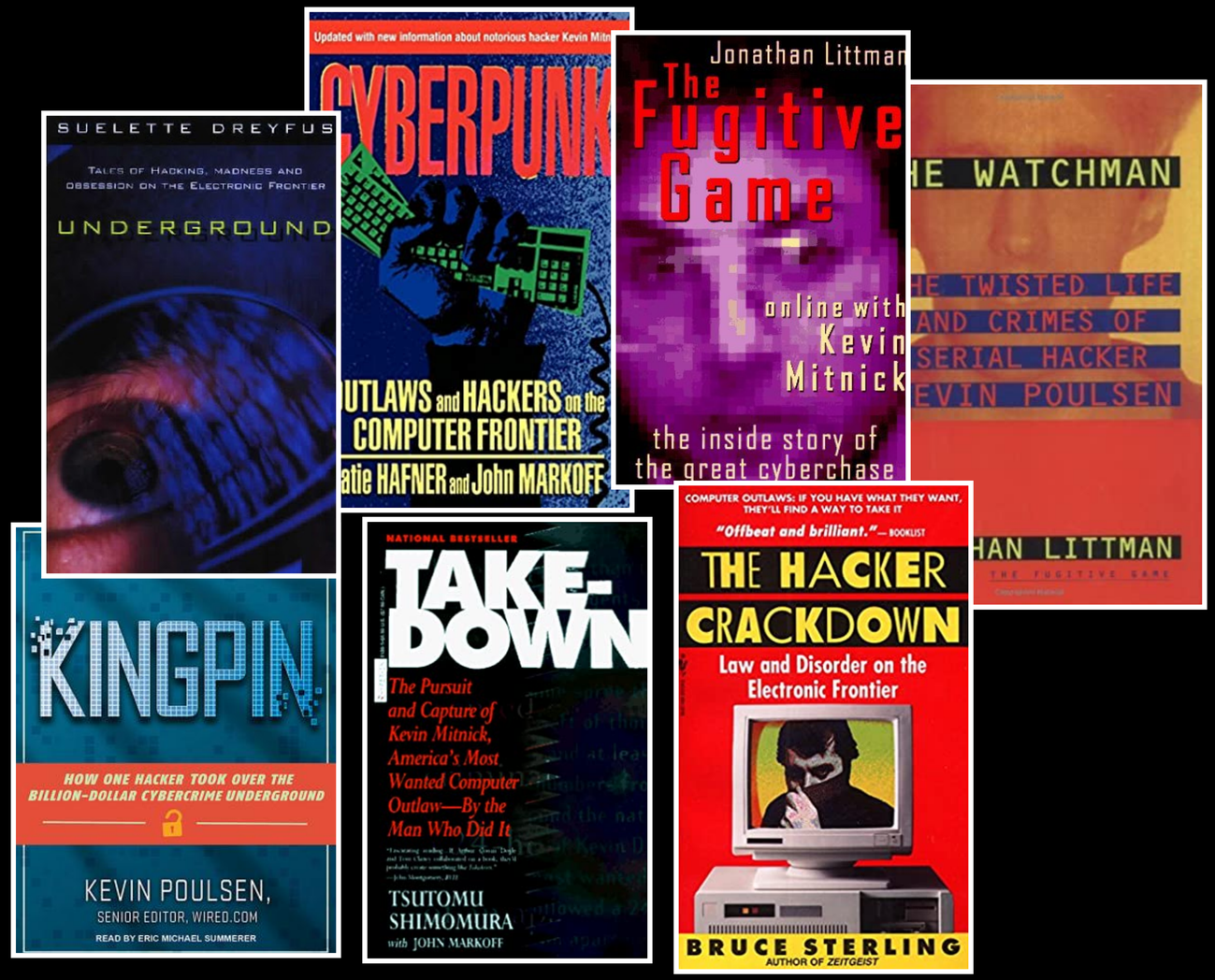
	National security Citizens' lives	Critical infras. Essential service	% affected systems	Recovery time & cost	Economic impact	Reputational impact
Critical	potentially	yes	90%+ systems 50%+ users	100+ person-day	0,1% GDP	very high continuous intl. news coverage
Very high	…	…	…	…	…	…
High	…	…	…	…	…	…
Medium	…	…	…	…	…	…
Low	no	no	1 isolated system	<1 person-day	[0.001%, 0.0001%] GDP	isolated, no news
No impact	no	no	negligible	negligible	negligible	negligible

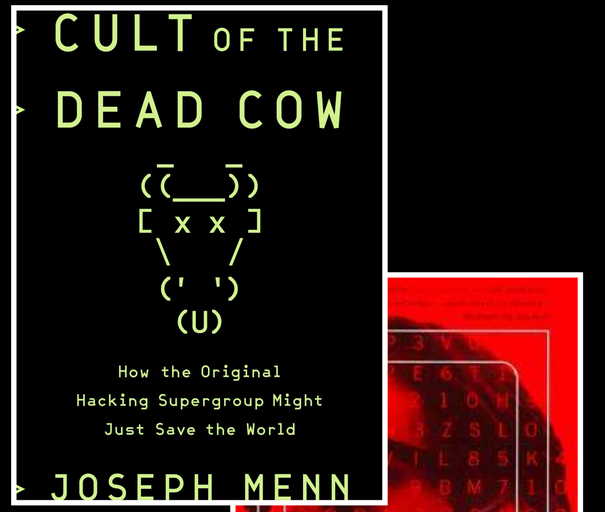
Threats according to structure

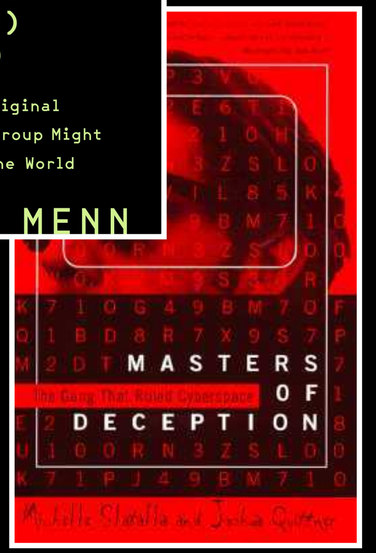
	Unstructured	Structured	Highly structured
Who	individuals small groups	groups	units
Organization	little to none	well organized and planned	well organized and planned
Funding	no	good	extensive & sustained over time
Intelligence	OSINT easily detectable	OSINT private / insiders	all
TTPs	documented	documented 0days	documented 0days
Target	opportunistic	specific	strategic
Motivation	bragging, personal, economic, ...	gain of IP/secrets, military/political dominance	state reasons

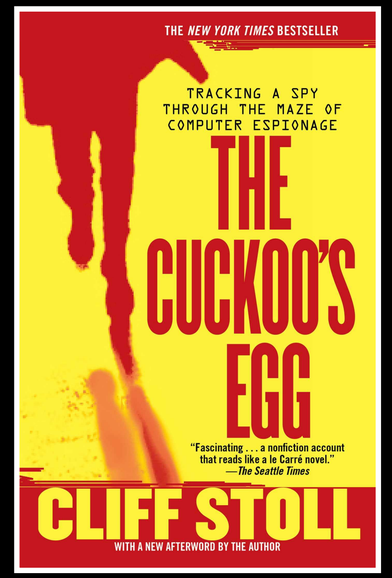
How did we get here?

The early(-ish) days









And then things changed forever

Early-to-mid 2000s

From	To
no payload	spammers, infostealers, …
noisy	quiet & evasive
large scale, same threat	micro distribution
10s per week	10,000s per day
fame	**profit**

The underground economy of cybercrime

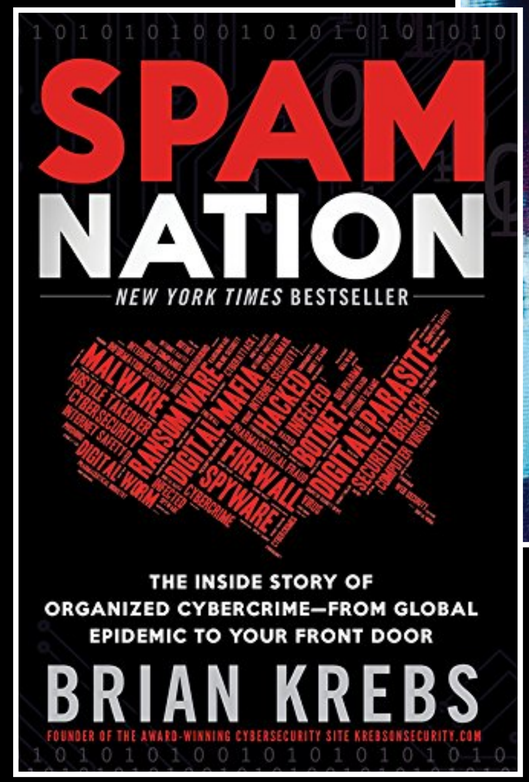
Underground markets where actors

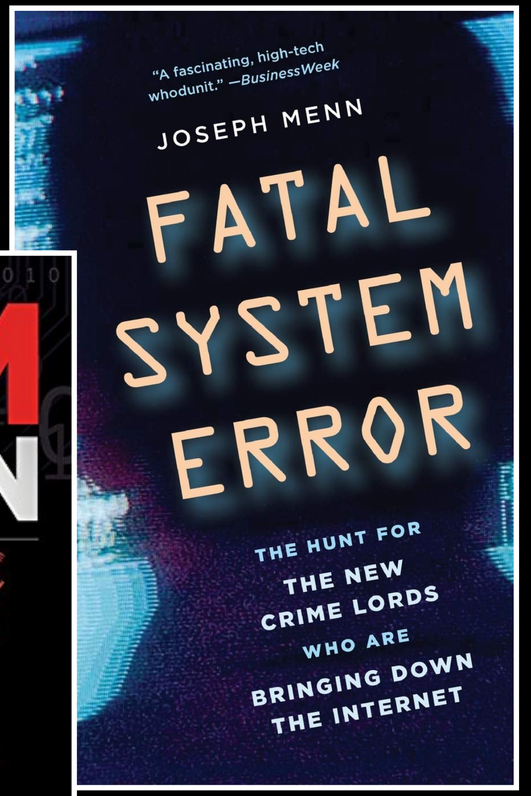
specialize

scale up

globalize

(as manufacturing did in the late 18th century)





theguardian

NSA FILES: *DECODED*

What the revelations mean for you.

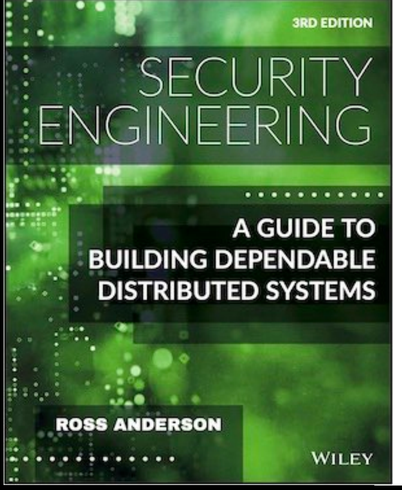
The 2010s

Platforms

Stabilization of the cybercrime ecosystem

Online abuse & hostility

Opponents



Chapter 2

Who is the Opponent?

The Spooks

The Crooks

The Geeks

The Swamp

Why is security hard?

At the start of this century, security technology was an archipelago of mutually suspicious islands – the cryptologists, the operating system protection people, the burglar alarm industry, right through to the chemists who did banknote inks. We all thought the world ended at our shore. By 2010, security engineering was an established and growing discipline; the islands were being joined up by bridges as practitioners realised we had to look beyond our comfort zones. The banknote ink chemist who didn't want to understand digital watermarks, and the cryptologist who could only talk about confidentiality, were steadily marginalised.

Now, in 2020, everyone needs to have a systems perspective in order to design components that can be integrated usefully into real products and services. And as these are used by real people, and often at global scale, our field is embracing the humanities and social sciences too.

Ross Anderson, "Security Engineering", 3rd Edition, Ch.29

Many persistent security failures
are incentive failures

Many persistent security failures
are usability failures

Many persistent security failures are complexity failures

Technical and—especially—social complexity

New technologies have unanticipated consequences

addictive

invasive

alienating

spying

apocalyptic

Many persistent security failures are politics failures

What would our technology look like if it aspired to keep everyone safe?
Who loses and who gains when “computer says no”?

Tech monopolies and the nature of power

Facebook becoming the de facto arbiter of political speech

Google and Apple dictating policy on coronavirus contact tracing

Amazon, Microsoft and Google dictating policy on facial recognition