Internet and Standards in the 21st Century

Vint Cerf

Internet Evangelist at Work

Internet - Global Statistics

22.5 Million Hosts

(Bellcore June 1997)

50 Million Users

(NUA Jul 1997)

542 Million Hosts

(www.isc.org, Jan 2008)

1,320 Million Users

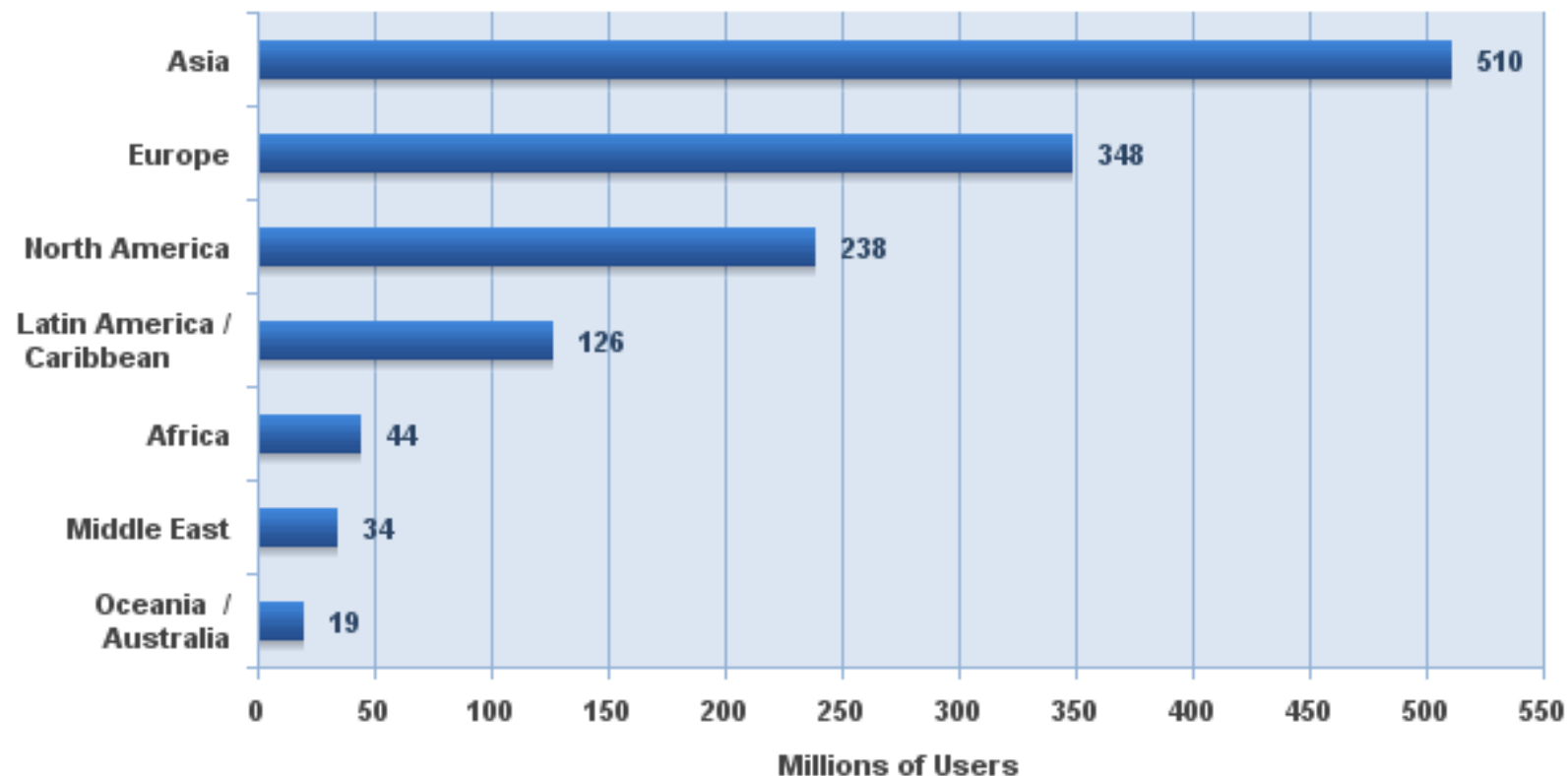(InternetWorldStats.com, December 2007)

(approx. 4.1 Billion Telephone Terminations including 3.0 B mobiles and >1 Billion PCs [Comp. Industries Assoc.])

WORLD INTERNET USAGE AND POPULATION STATISTICS

World Regions	Population (2007 Est.)	Population % of World	Internet Usage, Latest Data	% Population (Penetration)	Usage % of World	Usage Growth 2000-2007
Africa	941,249,130	14.2 %	44,361,940	4.7 %	3.4 %	882.7 %
Asia	3,733,783,474	56.5 %	510,478,743	13.7 %	38.7 %	346.6 %
Europe	801,821,187	12.1 %	348,125,847	43.4 %	26.4 %	231.2 %
Middle East	192,755,045	2.9 %	33,510,500	17.4 %	2.5 %	920.2 %
North America	334,659,631	5.1 %	238,015,529	71.1 %	18.0 %	120.2 %
Latin America/Caribbean	569,133,474	8.6 %	126,203,714	22.2 %	9.6 %	598.5 %
Oceania / Australia	33,569,718	0.5 %	19,175,836	57.1 %	1.5 %	151.6 %
WORLD TOTAL	6,606,971,659	100.0 %	1,319,872,109	20.0 %	100.0 %	265.6 %

Internetworldstats.com (Dec 2007)

Internet Users in the World
December 2007

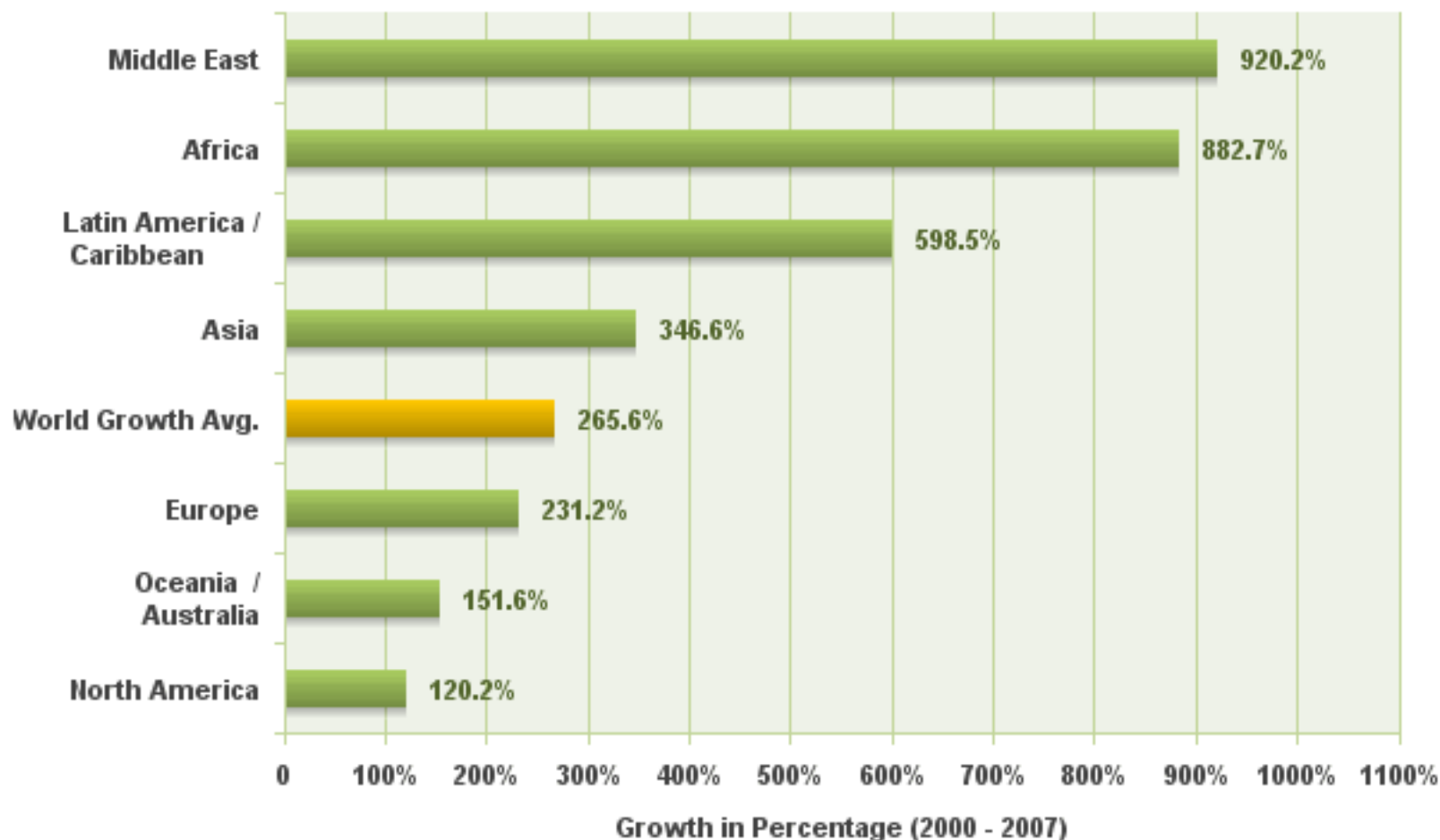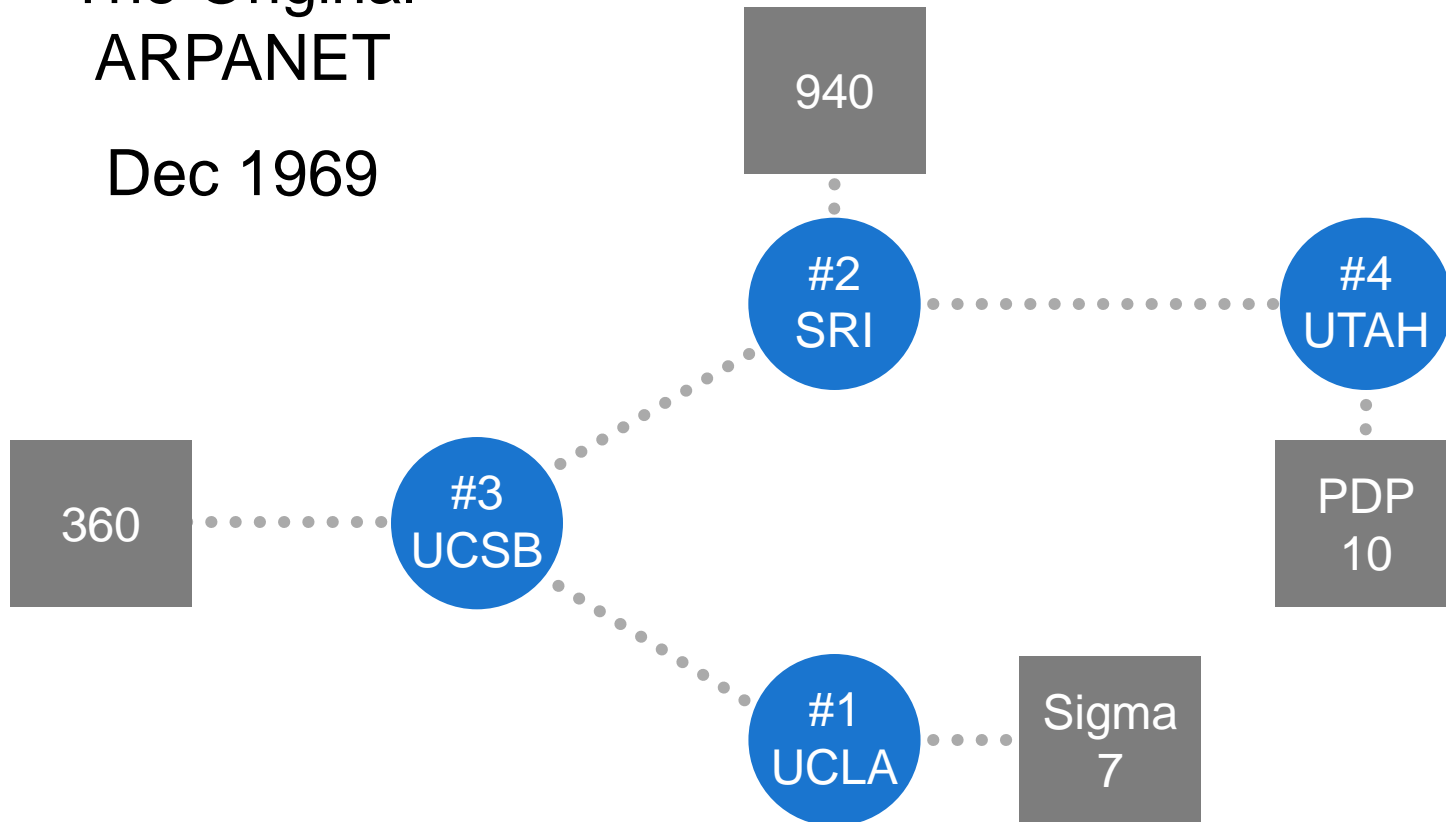| Region	Millions of Users
Asia	510
Europe	348
North America	238
Latin America / Caribbean	126
Africa	44
Middle East	34
Oceania / Australia	19

Note: Total World Internet Users estimate is 1,319,872,109 for year-end 2007
Copyright © 2008, Miniwatts Marketing Group - www.internetworldstats.com

World Internet Penetration Rates
December 2007

Region	Penetration Rate
North America	71.1%
Oceania / Australia	57.1%
Europe	43.4%
Latin America / Caribbean	22.2%
World, Average	20.0%
Middle East	17.4%
Asia	13.7%
Africa	4.7%

Penetration Rate
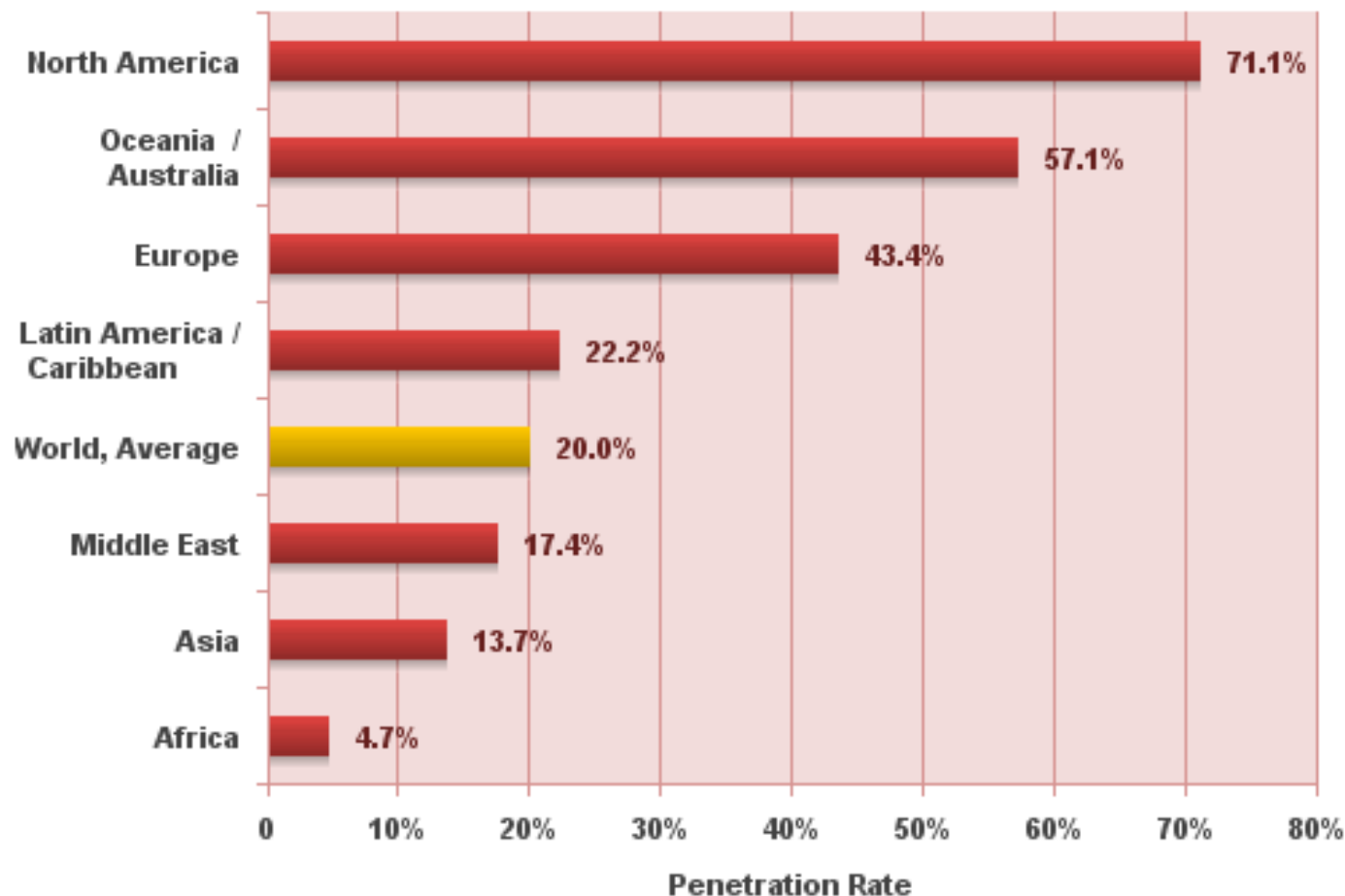
Internet Users in the World
Growth Between 2000 and 2007

Region	Growth
Middle East	920.2%
Africa	882.7%
Latin America / Caribbean	598.5%
Asia	346.6%
World Growth Avg.	265.6%
Europe	231.2%
Oceania / Australia	151.6%
North America	120.2%

Growth in Percentage (2000 - 2007)

Note: Total World Internet Users estimate is 1,319,872,109 for year-end 2007.
Copyright © 2008, Miniwatts Marketing Group - www.internetworldstats.com
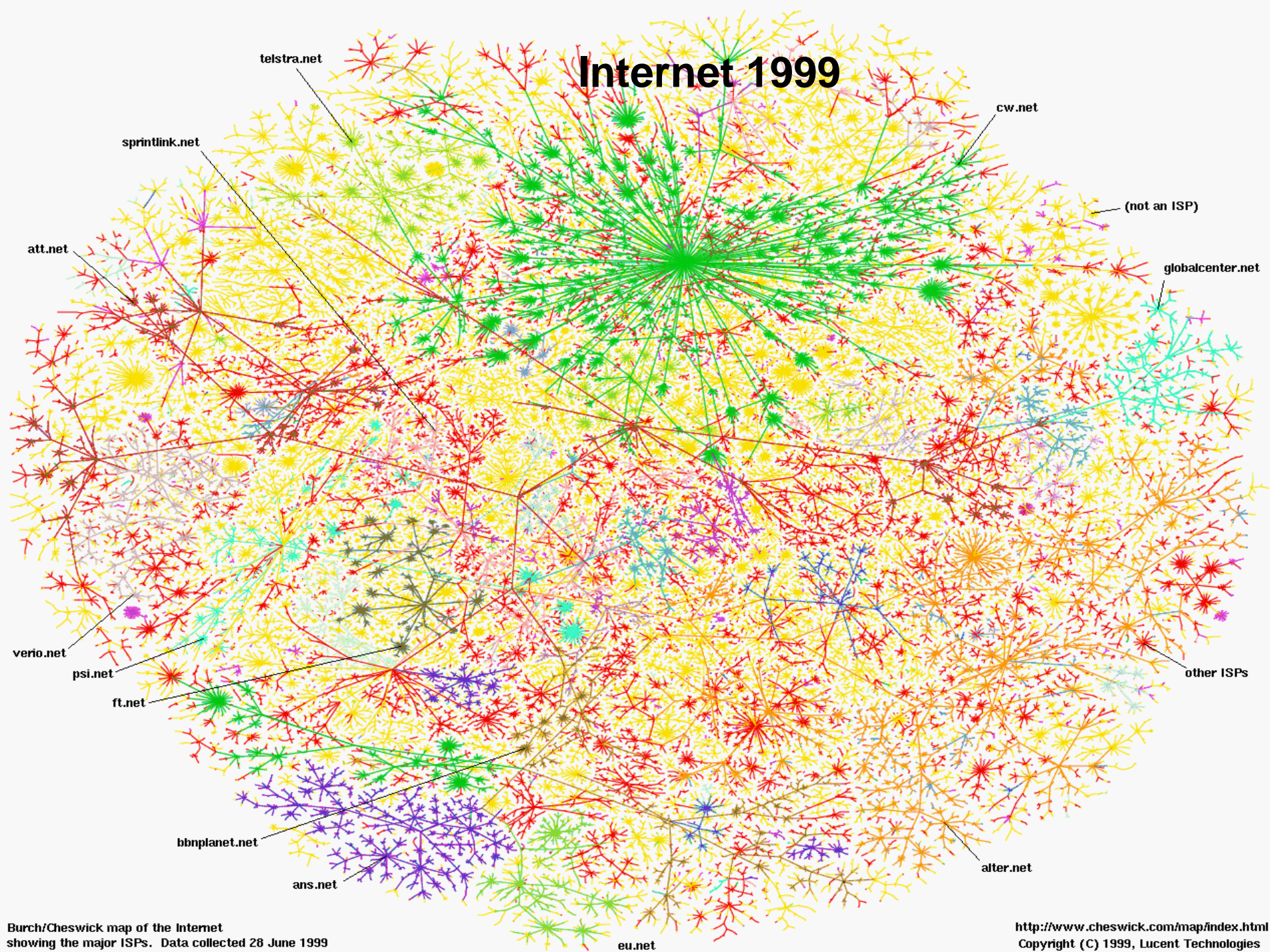
Google

The Original
ARPANET

Dec 1969

940

#2
SRI

#4
UTAH

360

#3
UCSB

PDP
10

#1
UCLA

Sigma
7

Google
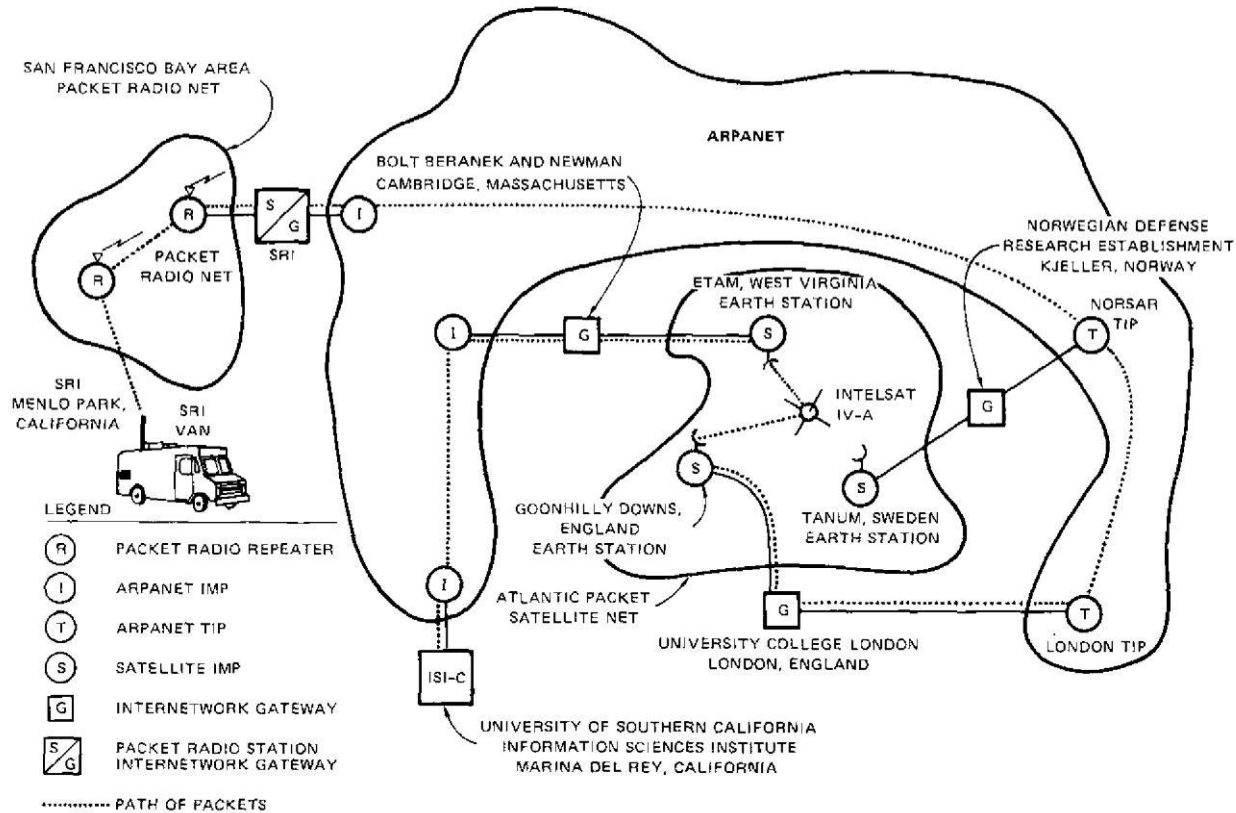
November 22, 1977

Internet 1999

telstra.net

cw.net

sprintlink.net

(not an ISP)

att.net

globalcenter.net

verio.net

psi.net

ft.net

other ISPs

bbnplanet.net

ans.net

alter.net

Burch/Cheswick map of the Internet
showing the major ISPs. Data collected 28 June 1999

eu.net

http://www.cheswick.com/map/index.html
Copyright (C) 1999, Lucent Technologies

Technology Shapers
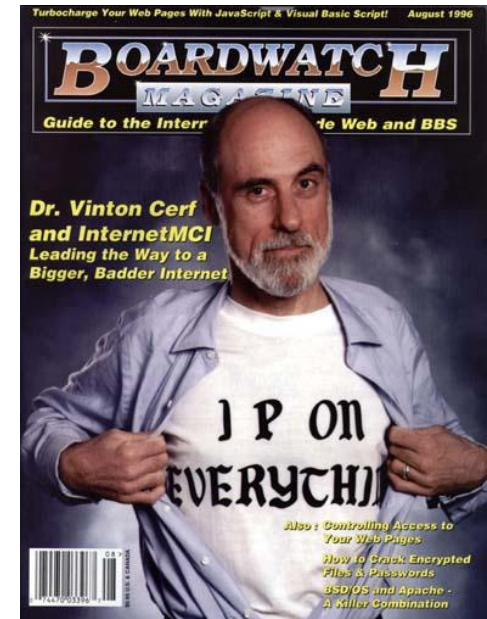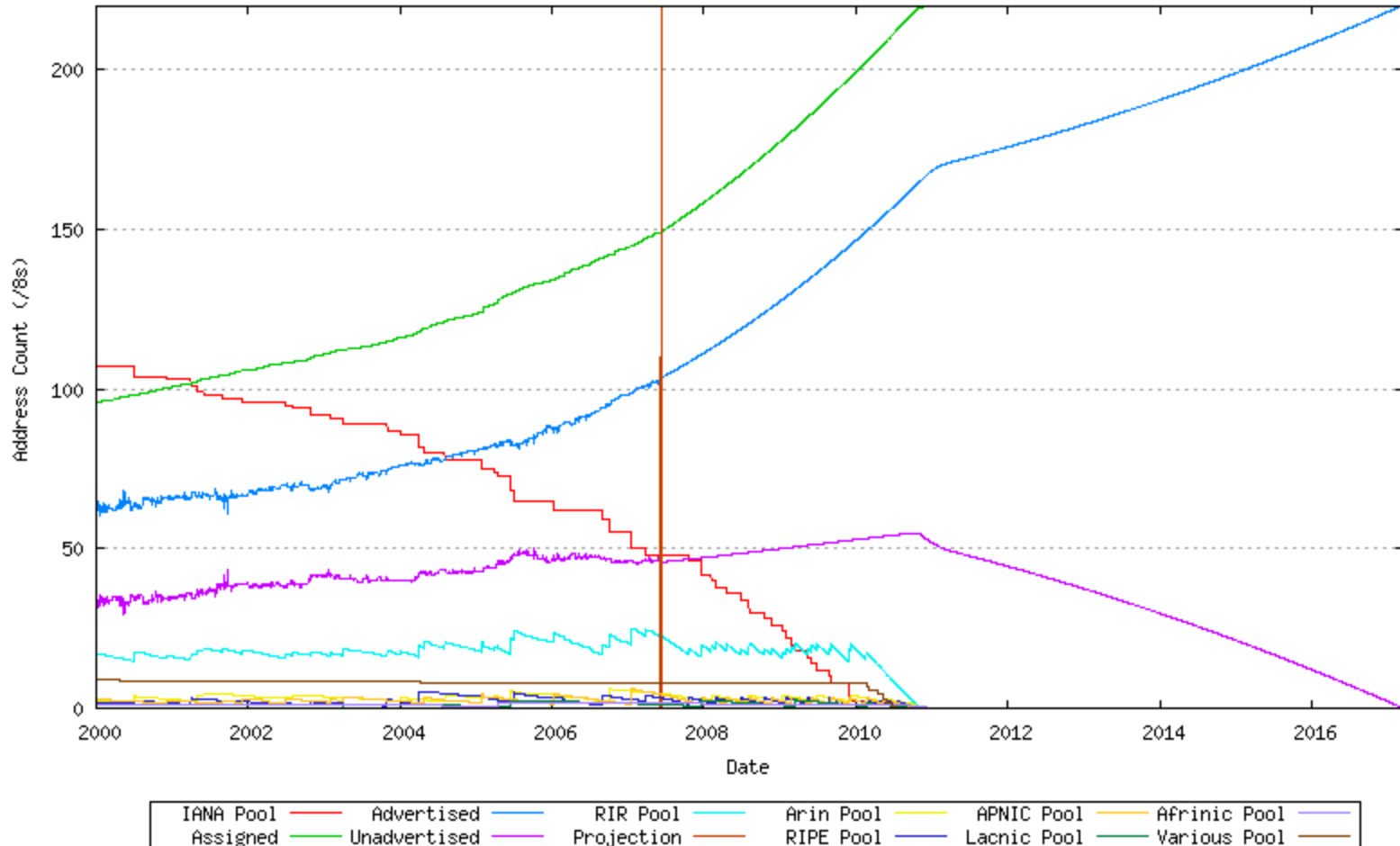
- Internet uses any communication service (IP on everything!)

- IP carries anything digital

- End/End Principle (neutrality and user freedom)

- Radio supplies mobility

- Fiber/Cable/DSL supplies speed

- Broadband (choice, symmetry)

- IPv6 supplies address space
  - (IPv4 runout in 2011)

IPv4 runout diagram (Geoff Huston)

http://www.potaroo.net/tools/ipv4/index.html

Security at all levels

Internet "Erlang" formulas

QOS debates (smart routers?)

Internationalized Domain Names (ccTLDs & GTLDs)

Distributed Algorithms

Presence (multi-level)

Mobility, persistence (processes, connections, references)

Multihoming

Multipath routing

Broadcast utilization

Mesh and Sensor networks

Virtualization (net, storage, processing)

Internet Research Problems - 2

Authentication, Identity, Authorization

Multi-core Processor Algorithms

Delay and Disruption Tolerance

Integration of Applications (e.g. drag/drop gadgets in calendar)

Intellectual Property Protection (tracking rights, enforcement)

Role of Layering

Governance

- Law Enforcement

- Policy Development

- Homologation

- Facilitation of electronic commerce

- Privacy and confidentiality

Internet Research Problems - 3

Mobile operation

Dynamic joining (new IP address?, Authentication?)

Dynamic Routing (Dynamic Topology)

Persistent connection (ID at TCP/UDP/RTP layer?)

Interplanetary Long-Haul Architecture   (RFC 4838)

Licklider Transport Protocol (LTP)

Bundle Protocol (RFC 5050)

Delayed Binding of Identifiers

Email-like behavior

Socio-Economic Effects of Internet

- Information Consumers are becoming Producers
    - Blogging, YouTube/Google Video, Personal Web Pages

- Innovation at the edge (e.g. wikipedia)

- Social Networking (Linked in, My Space, Facebook, Orkut…)

- Gameplaying (Second Life, World of Warcraft…)

- New Business Models
    - eBay, Amazon, Dell, Google, Yahoo!,MSN, AOL, iTunes, VOIP…

- Internet can transport and display print, video, audio media

- Internet permits group interaction (not only mass one-way medium)

Critical Role of Standards

- Standards confer interoperability (pick one way to do a particular thing, not two!)

- Standards spur competition (user choice of suppliers)

- Standards spur innovation (standards create common platforms on top of which new inventions can operate. TCP/IP led to HTTP (WWW) and to Java-based applications, cloud computing, etc.)

- Standards enable global communication, information exchange and preservation of information for future generations.

- Standards foster global economic growth

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

YouTube
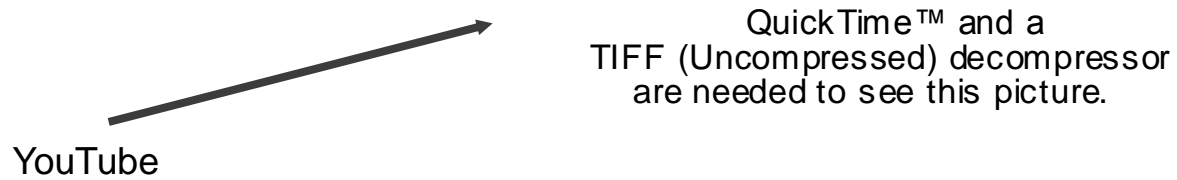
- Streaming and Downloading
  - iPOD and vPOD behaviors?
- Mixing of all media as IP packets
- Ancillary information access
  - Downloaded texts, programs, videos, audio, captions
  - Advertising material
- Screen Control (icons, widgets)
- Multiple streams to multiple displays (beauty of packet switching)
- Online interaction while viewing
  - Group commentary
  - Advertising and product information

Mobility and Mobiles

- 3 Billion Mobiles and counting

- Text/Web Access

- Payment systems

- Innovative interfaces (challenges!)

- Navigation systems
    - GPS, Galileo, Google Earth/Maps,…

- Geo-location based services

- Access to Web searching

Internet-enabled Devices

Programmable – Java, Python, etc.

Examples:

- WebTV, Personal Digital Assistants, Mobiles,Video games, Picture Frames, Washing Machines, Surf Board!

- Refrigerator (and the bathroom scales)

- Automobiles (Japan, Germany)

- Internet-enabled wine corks (also note new quantum theory of wine: Schrödinger's wine bottle)

- Internet-enabled socks (clothing)

- Universal Remote Controls

Coming Internet Standards Milestones

- Introduction of Internationalized Top Level Domains

    – See idn.icann.org for current testing

- Introduction of new generic TLDs in 2008

- Introduction of IPv6 (root zone, elsewhere)

- Introduction of DNSSEC (.se, .bg, .br, .pr, …)

Challenges of the Digital Age

- Intellectual property treatment
  - Digital material is easy to copy and distribute

- Semantic Web

- Complex objects that can only be rendered via computer
  - 3D interactive objects
  - Complex spreadsheets
  - Interactive environments

- BIT ROT!
  - Preserving interpretive programs (Windows 3000 and PPT 1997)
  - And the operating systems that run them
  - And the hardware that run the operating systems
  - For thousands of years!!