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# Internet Speculations

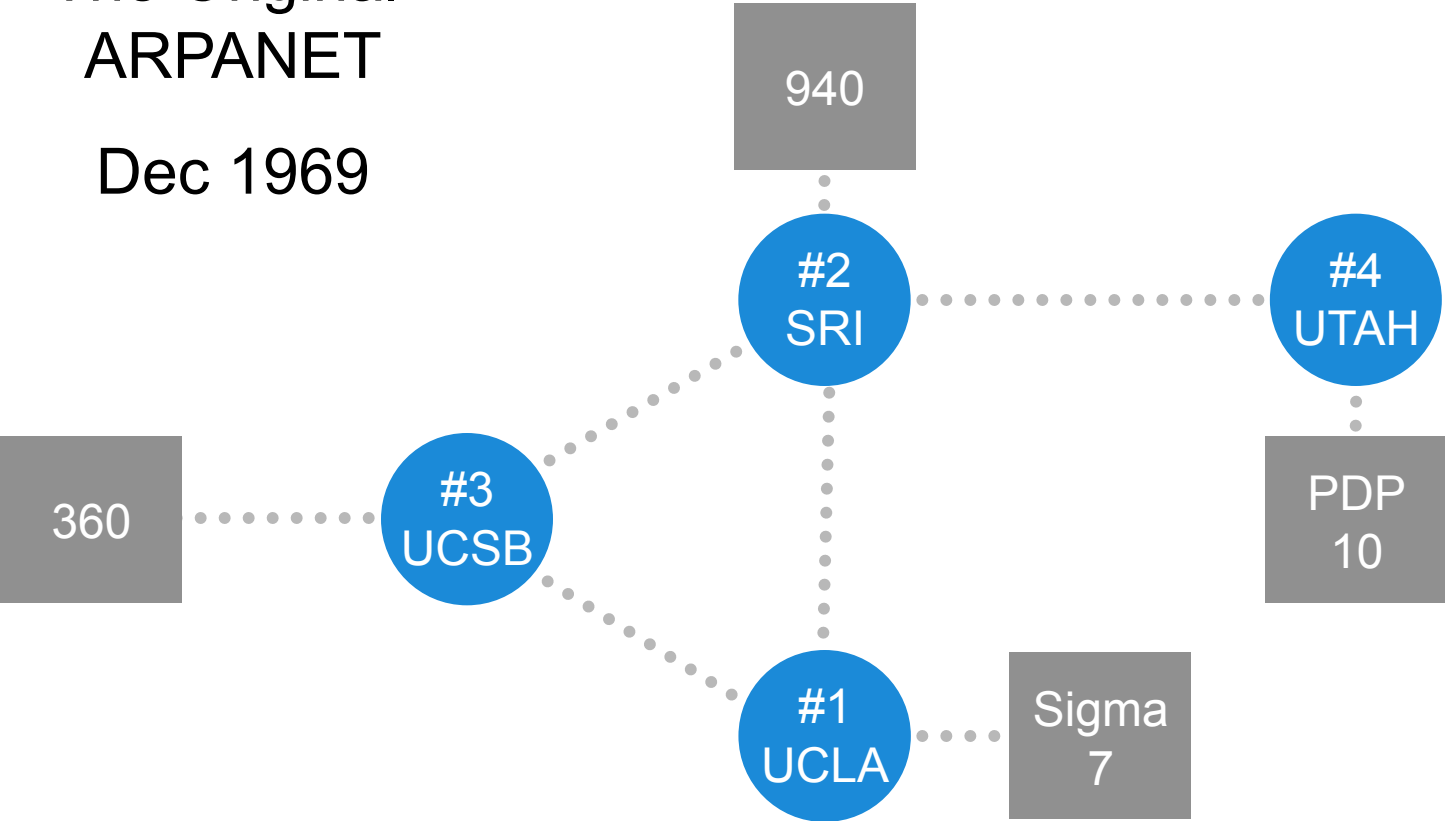
Vint Cerf

February 2011

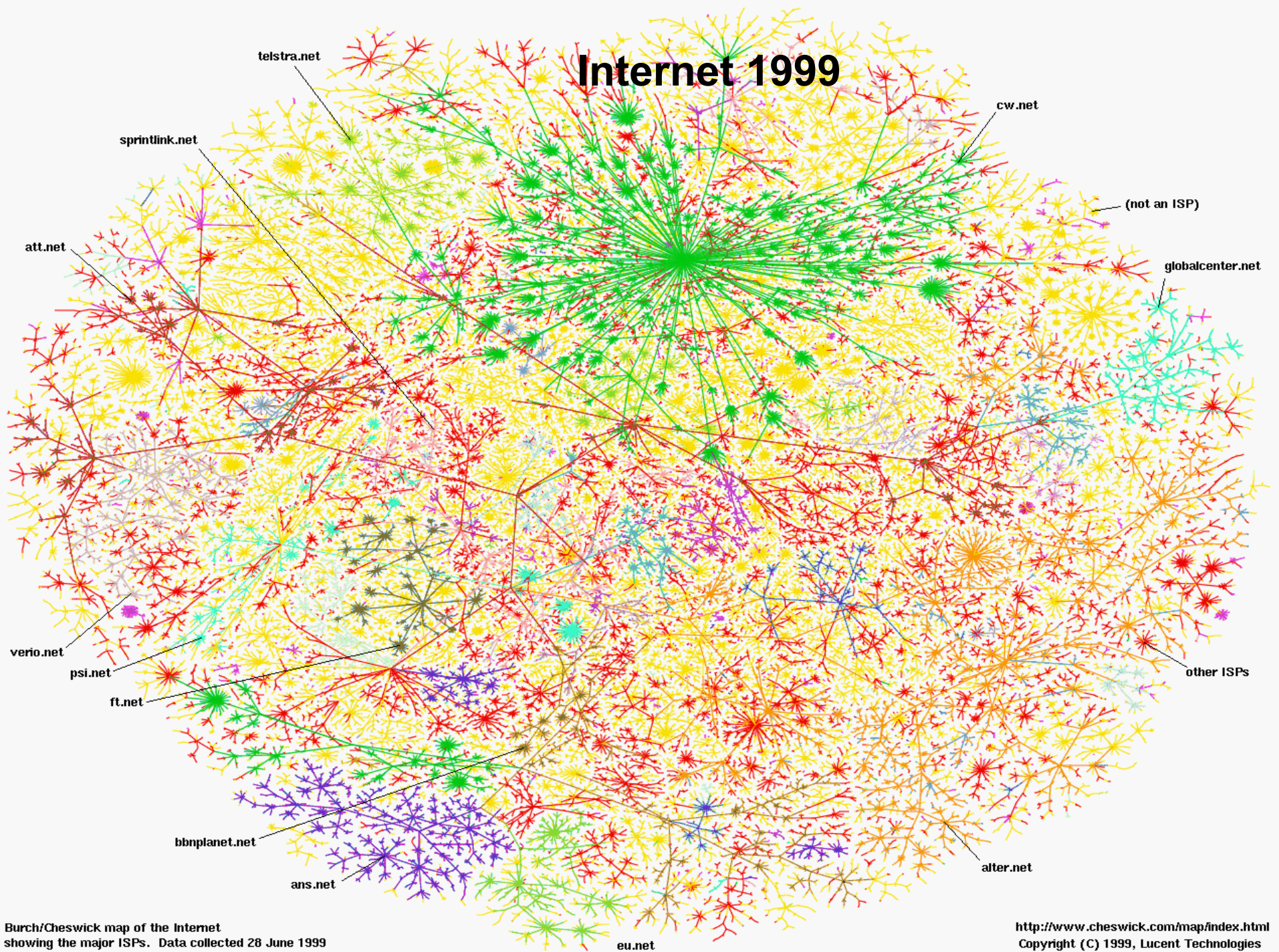


# The Original ARPANET

Dec 1969



# Internet 1999



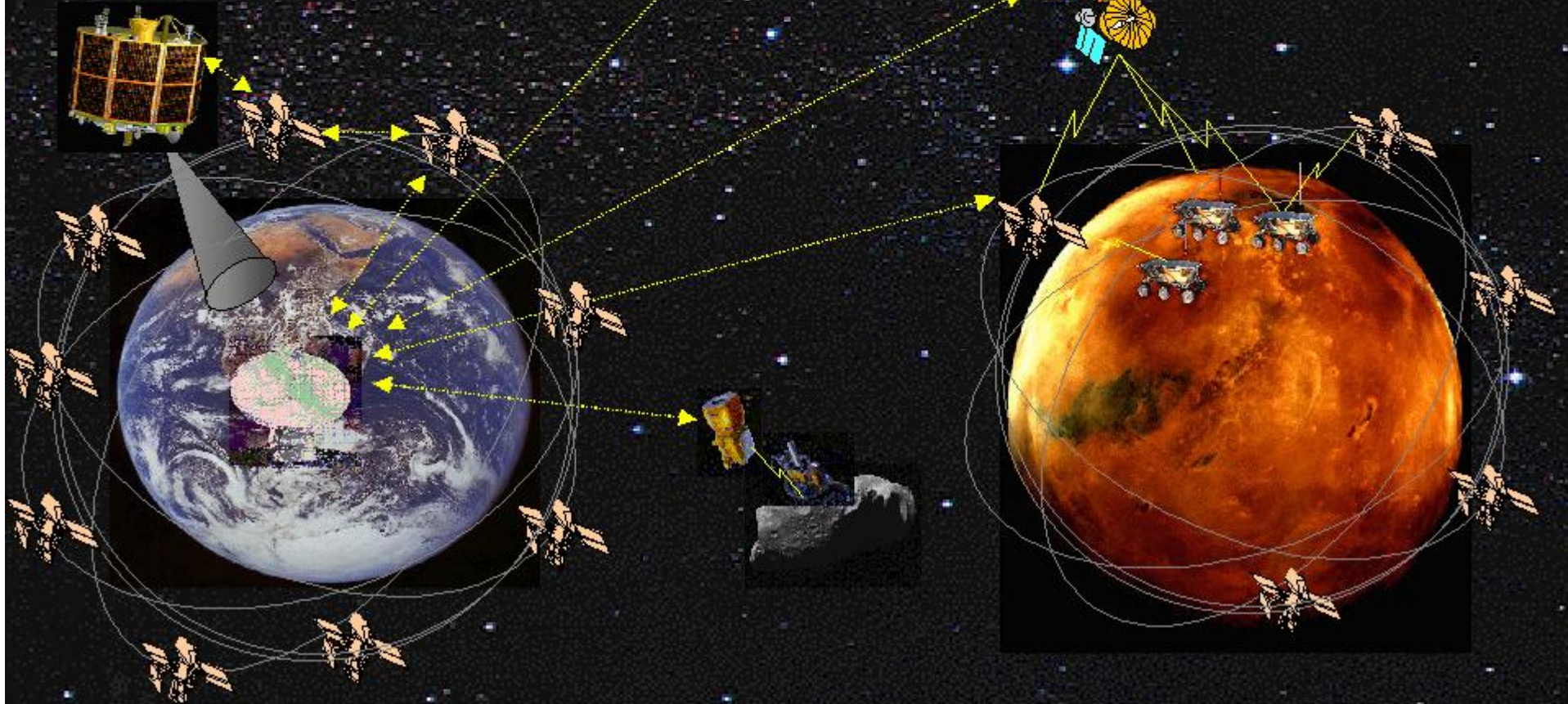
Burch/Cheswick map of the Internet  
showing the major ISPs. Data collected 28 June 1999

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

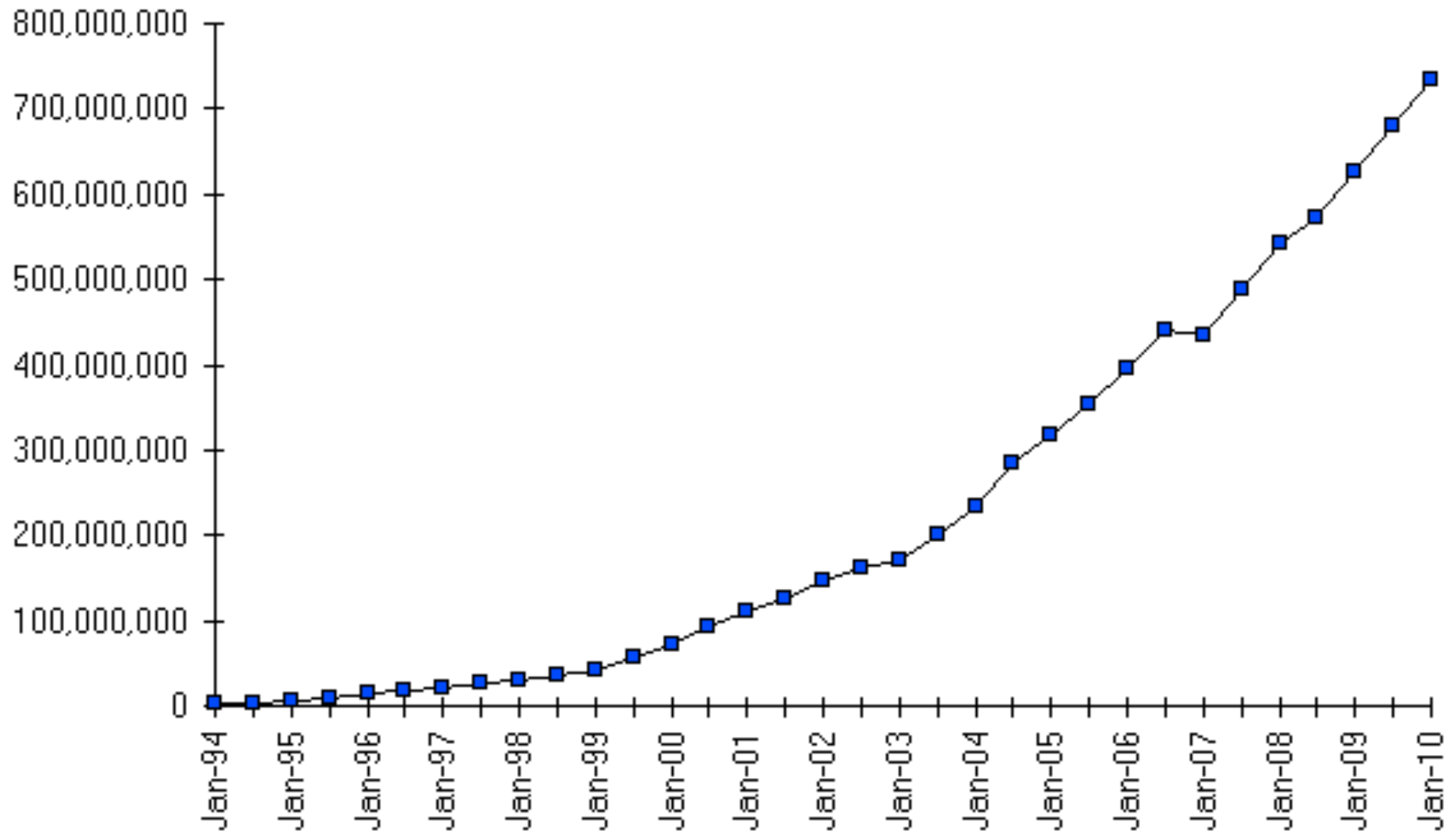


# Interplanetary Internet

- *End-to-end information flow across the solar system*
- *Layered architecture for evolvability and interoperability*
- *IP-like protocol suite tailored to operate over long round trip light times*
- *Integrated communications and navigation services*



## Internet Domain Survey Host Count



Source: Internet Systems Consortium ([www.isc.org](http://www.isc.org))

**777,994,517**

*(ftp.isc.org/www/survey/reports/current/  
Oct 2010)*

**1,966 Million Users**

*(InternetWorldStats.com, Jun 30, 2010)*

*(approx. 5.0 B mobiles and >1 Billion PCs)*

## Regional Internet Statistics 6/30/2010



Region	Internet Population	% penetration
Asia	825.1 Mil.	21.5 %
Europe	475.18 Mil.	58.0 %
North Am.	266.2 Mil.	77.4 %
LATAM/C	204.7 Mil.	34.5 %
Mid-East	63.2 Mil.	29.8 %
Oceania/Aus	21.3 Mil.	61.3 %
Africa	110.9 Mil.	10.9 %
TOTAL	1,966.0 Mil.	28.7 %

# IPv4 Address Space Exhaustion



- February 4, 2011: IANA allocates last IPv4 blocks to RIRs
- Likely runout in 2012 in Regional Internet Registry Level
- Need ISP and Application Service Provider cooperation
- 6/8/11 target for major (inter)national IPv6 demonstration
- Issues: parallel operation of IPv4 and IPv6; catering to IPv6-only modes (and IPv4 only?)

# Internationalized Top Level Domains













## Internationalized country codes

IDN ccTLD	DNSSEC	Country	ASCII form	Transliteration	Other ccTLD
.中国	No	 China	.xn--fiqs8s	<i>zhōngguó</i>	.cn
.中國	No	 China	.xn--fiqz9s	<i>zhōngguó</i>	.cn
.مصر	No	 Egypt	.xn--wgbh1c	<i>masr</i> <sup>[3]</sup>	.eg
.香港	No	 Hong Kong	.xn--j6w193g	<i>hoeng1 gong2</i>	.hk
.рф	No	 Russia	.xn--p1ai	RF (Russian Federation)	.ru
.السعودية	No	 Saudi Arabia	.xn--mgberp4a5d4ar	<i>as-sa'ūdiyyah</i>	.sa
.台湾	No	 Taiwan	.xn--kprw13d	<i>táiwān</i>	.tw
.台灣	No	 Taiwan	.xn--kpry57d	<i>táiwān</i>	.tw
.امارات	No	 United Arab Emirates	.xn--mgbam7a8h	<i>emarat</i>	.ae

# Proposed Internationalized Domain Names



IDN ccTLD	Country	ASCII form	Transliteration	Script	Current ccTLD
.бг	 Bulgaria	.xn--90ae	<i>bg</i>	Cyrillic	.bg
.الاردن	 Jordan	.xn--mgbayh7gpa	<i>al-ordon</i>	Arabic	.jo
فلسطين	 Palestine	.xn--ygb12ammx	<i>filastin</i>	Arabic	.ps
قطر	 Qatar	.xn--wgb16a	<i>qatar</i>	Arabic	.qa
سوريا	 Syria	.xn--mgbtf8fl	<i>sūryā</i>	Arabic	.sy
تونس	 Tunisia	.xn--pgbs0dh	<i>tunis</i>	Arabic	.tn
.ලංකා	 Sri Lanka	.xn--fzc2c9e2c	<i>lanka</i>	Sinhala	.lk
.இலங்கை	 Sri Lanka	.xn--xkc2a13hye2a	<i>ilangai</i>	Tamil	.lk
.ไทย	 Thailand	.xn--o3cw4h	<i>thai</i>	Thai	.th
.укр	 Ukraine	.xn--j1amh	<i>ukr</i>	Cyrillic	.ua

# Example Security Responses



- Open Source Software (Linux, Chrome, Android, ...)
- Domain Name System Security Extensions (DNSSEC)
- Routing System Security: Resource Public Key Infrastructure
- Virtual Private Networks (Transport Level Security - various)
- Certificate authentication: Certificate Authorities (using PKI)
- Two-Factor Authentication (e.g. crypto-generated passwords)
- WWW Index (“crawl”) and malware site detection
  - cf: StopBadWare
- Virus, worm and trojan horse detection products
- Intrusion Detection Systems, Source Address Validation

# Internet-enabled Devices





## Woodhurst sensor net

2008-09-21 4:16:38 pm EDT

[Help on this Page](#)  
[How to Build this Page](#)

Home

Setup

Server  
Routers  
Nodes  
Software Update

System and Network

Connectivity  
Energy  
Traffic  
Reliability

Sensing and Control

Sensor/Actuator Devices  
Sensor Data Analysis  
Actuator Control  
Data Export

Support

User Guide  
Network Admin Guide  
Developer Guide

I wish this page would...

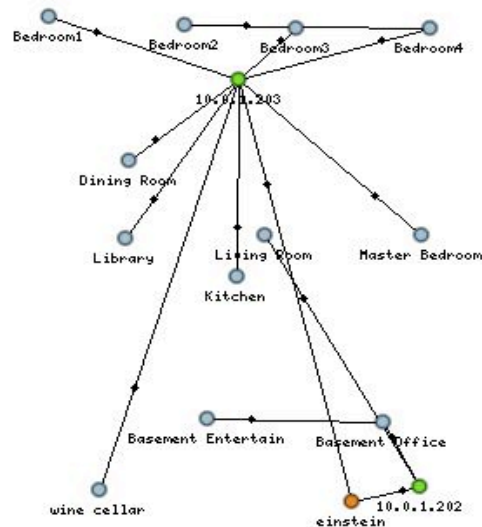

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## Home

● Server
 ● Router
 ● Node
 ● Missing Router or Node

Deployment started on 2008-07-11 12:35:48 pm EDT, running for 72d 3h 40m 51s.

### Deployment Map



### Network Devices

15 Devices

● einstein

● 10.0.1.202

4:15:01 pm

● 10.0.1.203

4:15:00 pm

1st Floor

● Dining Room

4:15:05 pm

71 °F 55.3 % 10 lux 1 lux

● Kitchen

4:12:03 pm

72.9 °F 51 % 21 lux 1 lux

● Library

4:12:35 pm

73.3 °F 50.1 % 10 lux 0 lux

● Living Room

4:14:57 pm

70.4 °F 51.5 % 7 lux 0 lux

● Master Bedroom

4:15:13 pm

70.1 °F 56 % 14 lux 2 lux

2nd Floor

● Bedroom1

4:12:14 pm

74 °F 48 % 14 lux 1 lux

● Bedroom2

4:15:10 pm

74.4 °F 49 % 80 lux 17 lux

● Bedroom3

4:15:12 pm

73.5 °F 47.9 % 14 lux 1 lux

● Bedroom4

4:15:06 pm

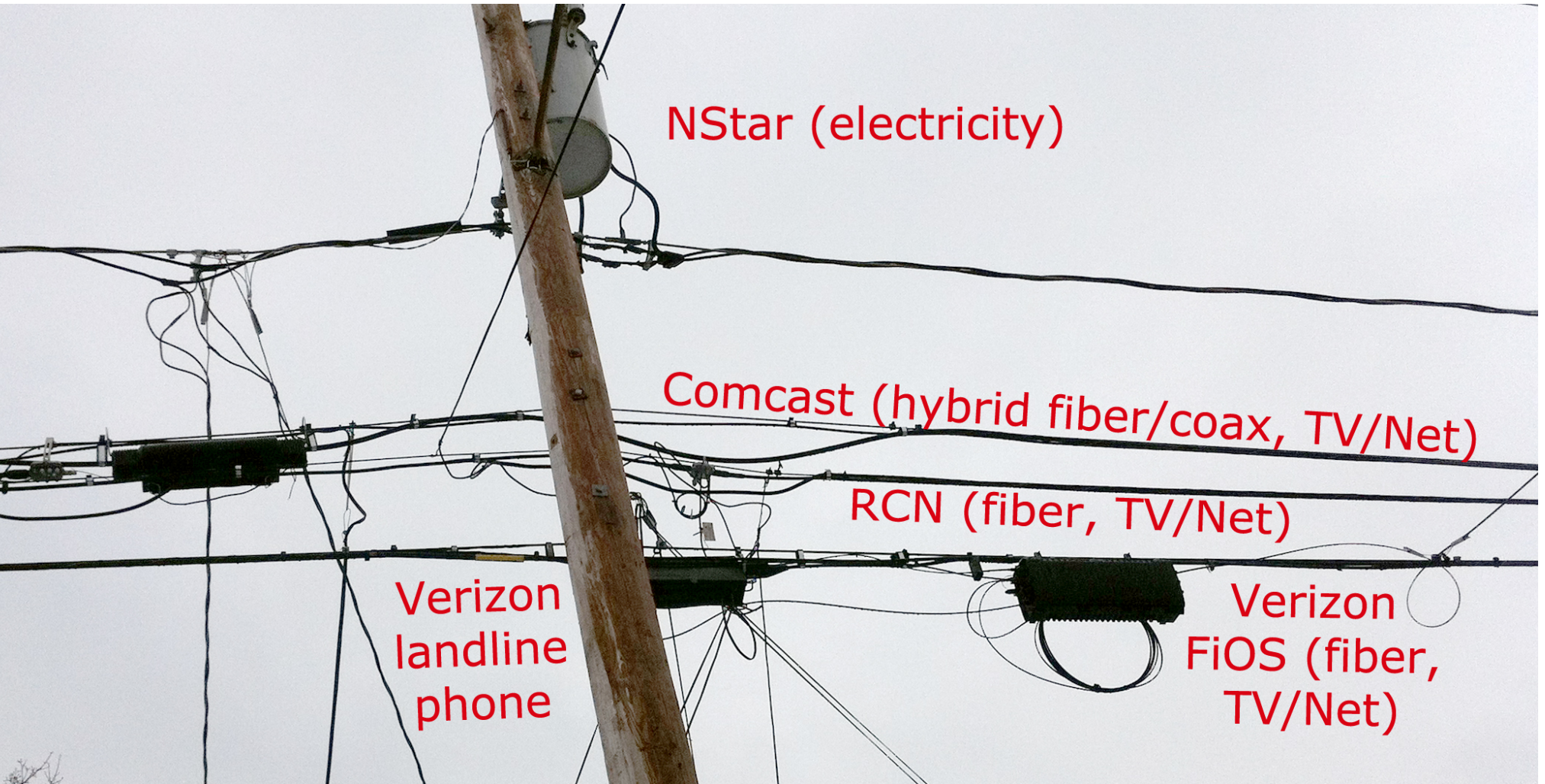
70.7 °F 56.7 % 3 lux 0 lux

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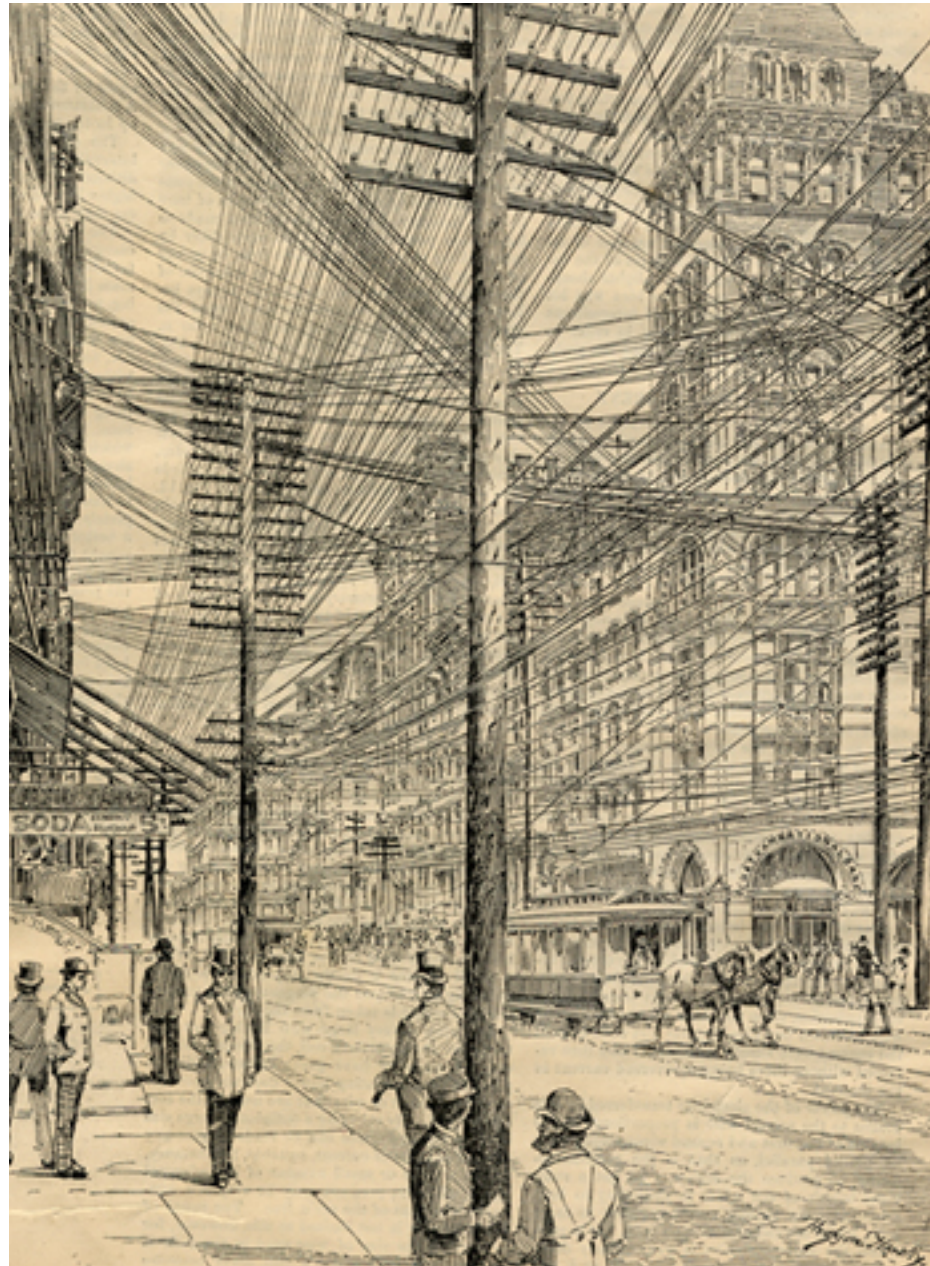
# Internet Transport Infrastructure



Circa 2011



Circa July 1889 (NYC)



- Local Exchange Carriers (e.g. VZ, ATT, MANY Independents)
- Cable Carriers (e.g. Comcast, Cox, Time-Warner, MANY MORE)
- Wireless Internet Service Providers (MANY!)
- Satellite (e.g. DirecTV, Iridium, O3B, ...)
- Economics: Capex, Opex, Interconnect
- Business Models (pure carriage? Value add?)

- Original model: build a piece of Internet and connect it with willing partners
- Evolved model: Add Internet to existing infrastructure (dial up, DSL, Fiber, Coax) and augment revenue with (telephone, TV,...)
- Speculative model: Build layer 2 transport structure, recover costs, open access to any ISP?
- Speculative model: consumer-owned infrastructure (fiber? Wireless?)
- Speculative model: municipal networks (some exist)

# Policy Considerations



- Broadband and wireless infrastructure
- Non-discriminatory access (“net neutrality”)
- Common Carriage style safe harbors regarding content
- Permissionless innovation
- Cloud computing
- Domestic and International Privacy, Security, Law Enforcement
- Multi-lateral legal frameworks
- Forums for policy development, debate, implementation
- New TLDs (non-Latin, generic)