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# Internet Today

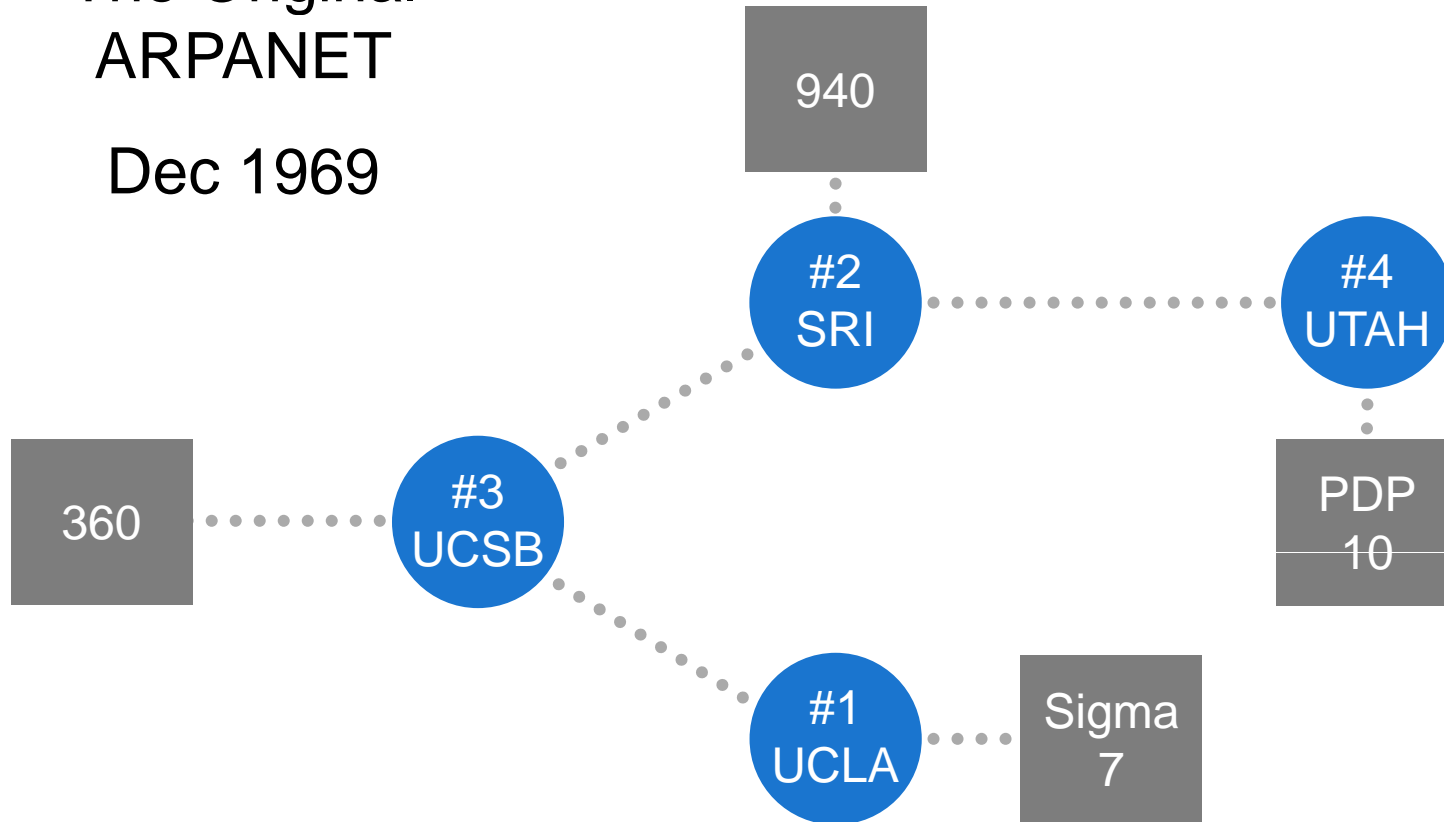
Vint Cerf

February 2009



# The Original ARPANET

Dec 1969



# The ARPANET IMP



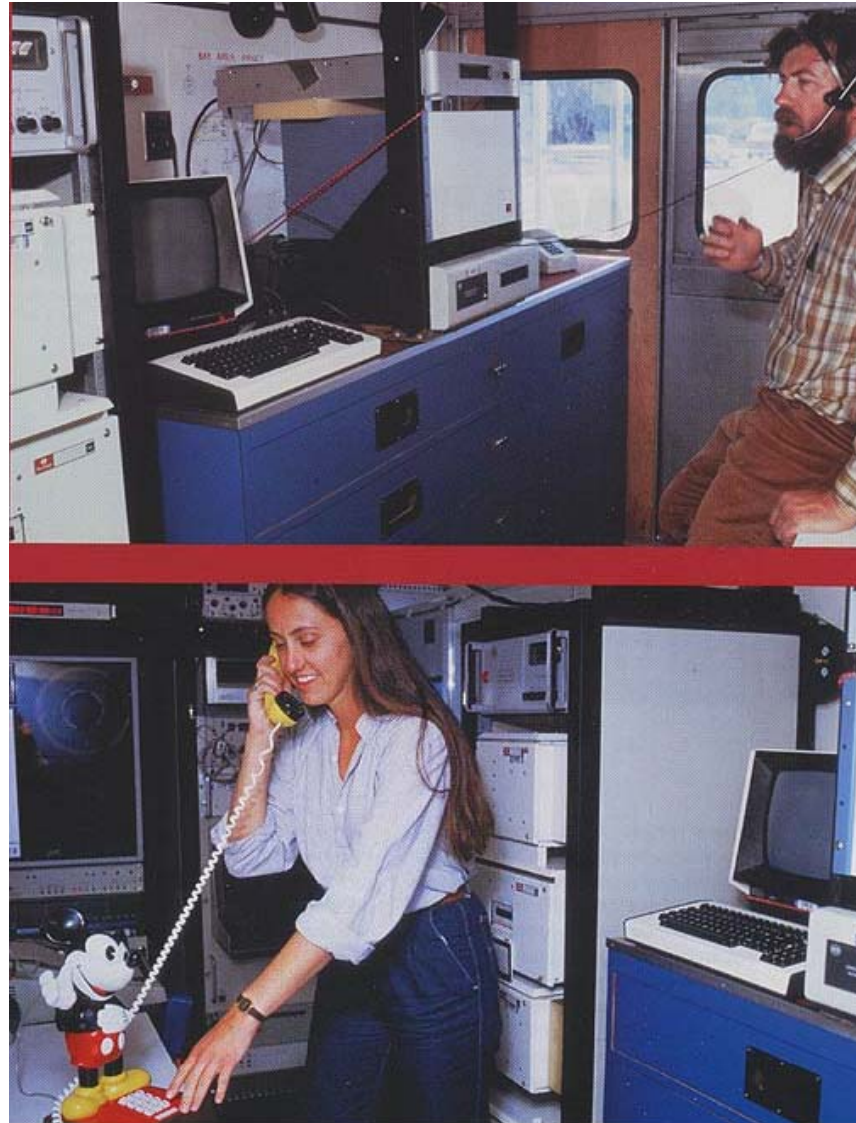
# Packet Radio Van



# Inside the PR Van



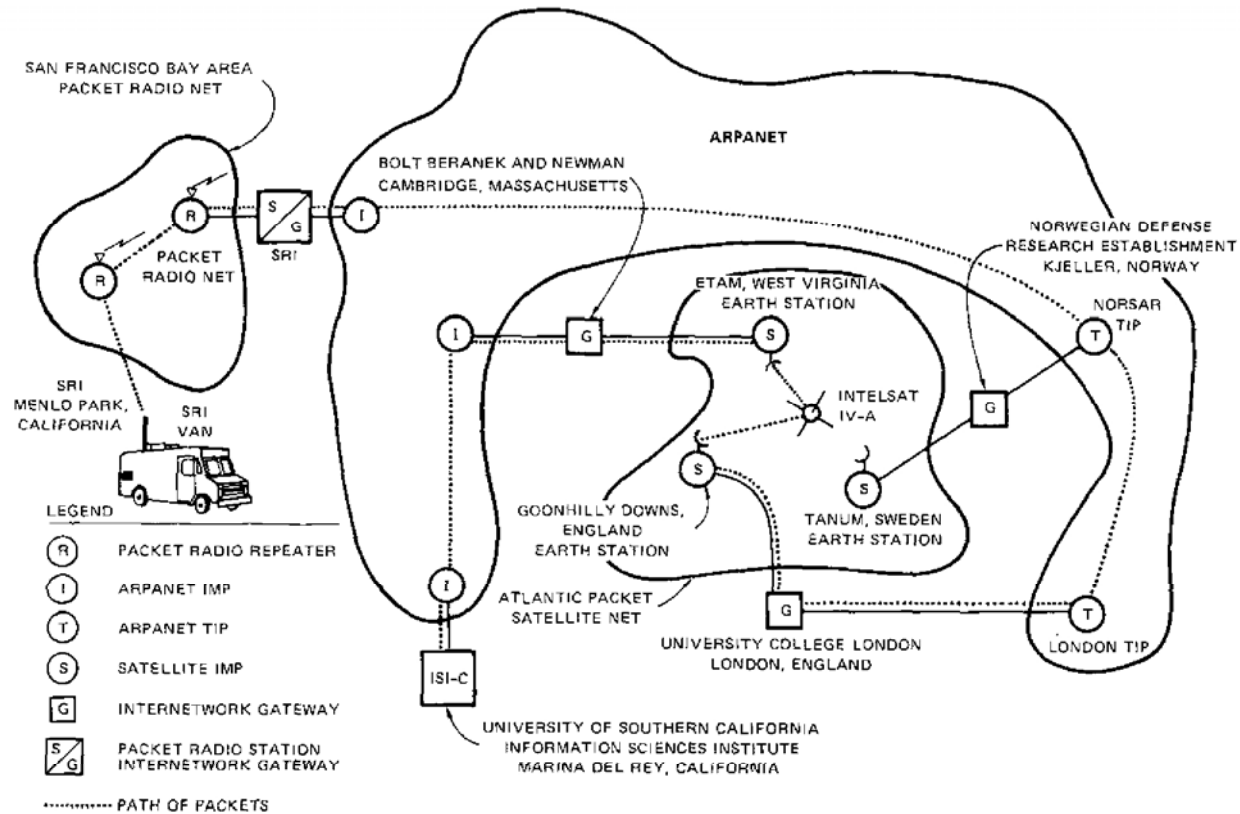
# Inside the PR Van (2)



# Intelsat IVA - Packet Satellite Network



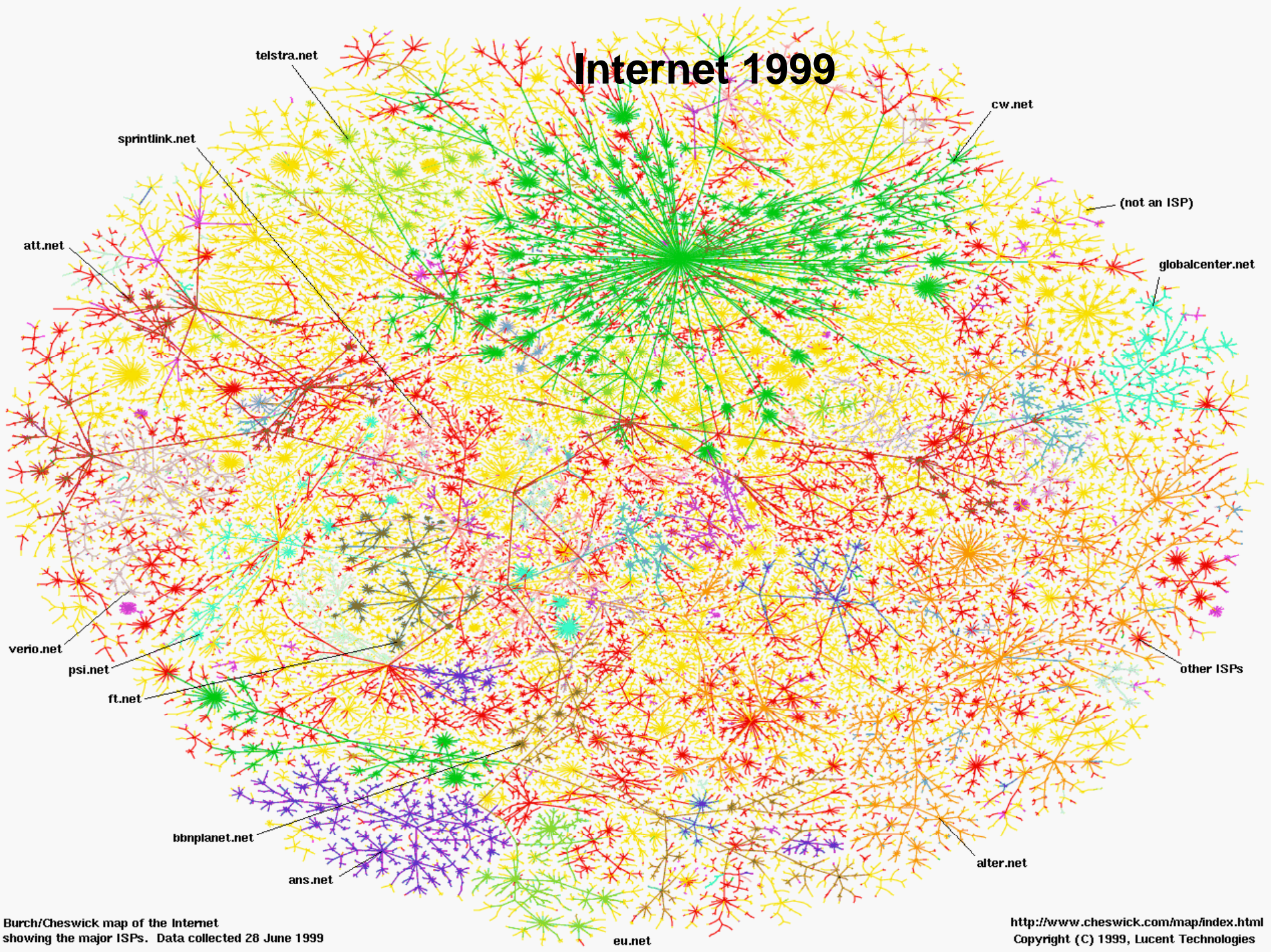
# First Three-Network Test of Internet



**November 22, 1977**



# 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

**625,226,456**

(<ftp.isc.org/www/survey/reports/current/>  
Jan 2009)

**1,464 Million Users**

(InternetWorldStats.com, June 30, 2008)

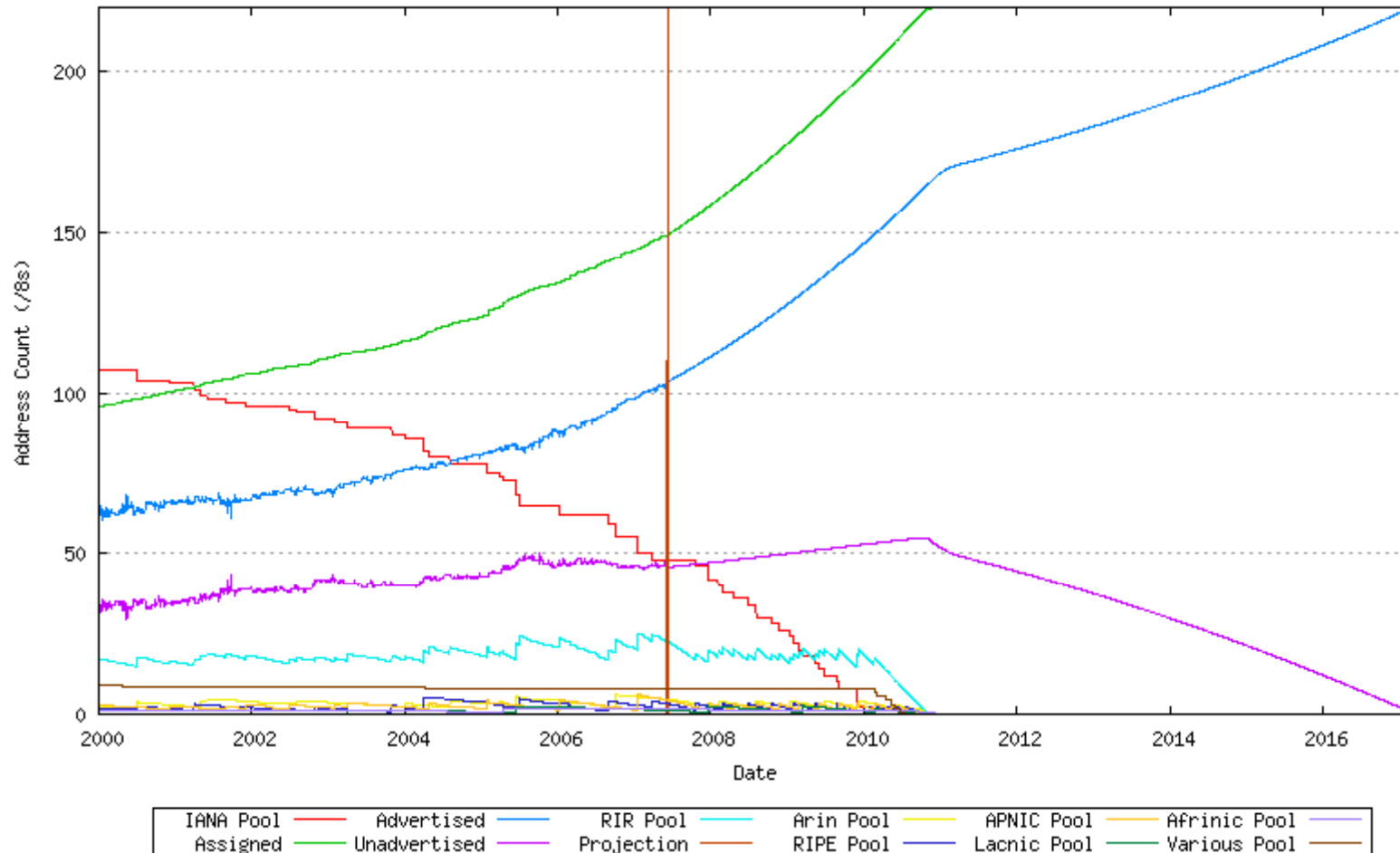
(approx. 3.5 B mobiles and 1 Billion PCs)

## Regional Internet Statistics 6/30/08



Region	Internet Population	% penetration
Asia	578.5 Mil.	15.3 %
Europe	384.6 Mil.	48.1 %
North Am.	248.2 Mil.	73.6 %
LATAM/C	139.0 Mil.	24.1 %
Mid-East	41.9 Mil.	21.3 %
Oceania	20.2 Mil.	59.5 %
Africa	51.0 Mil.	5.3 %
TOTAL	1,463.6 Mil.	21.9 %

# IPv4 runout diagram (Geoff Huston)



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

- 128 bits of address space

340 X 10<sup>36</sup> unique addresses

- IPSEC not optional
- Flow ID
- [ipv6.google.com](http://ipv6.google.com) (animated Google logo)

- 3.5 Billion Mobiles and counting (15% Internet enabled)
- Text/Web Access
- Payment systems
- Innovative interfaces - Note I/O discovery
- Navigation systems
  - GPS, Galileo?, Mobile Tower triangulation, Bldg Announcements?
- Geo-location based services

# 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
- Internet-enabled wine corks (also note new quantum theory of wine: Schrödinger's wine bottle)
- Internet-enabled socks (clothing)
- Universal Remote Controls
- Sensor Networks





# 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...

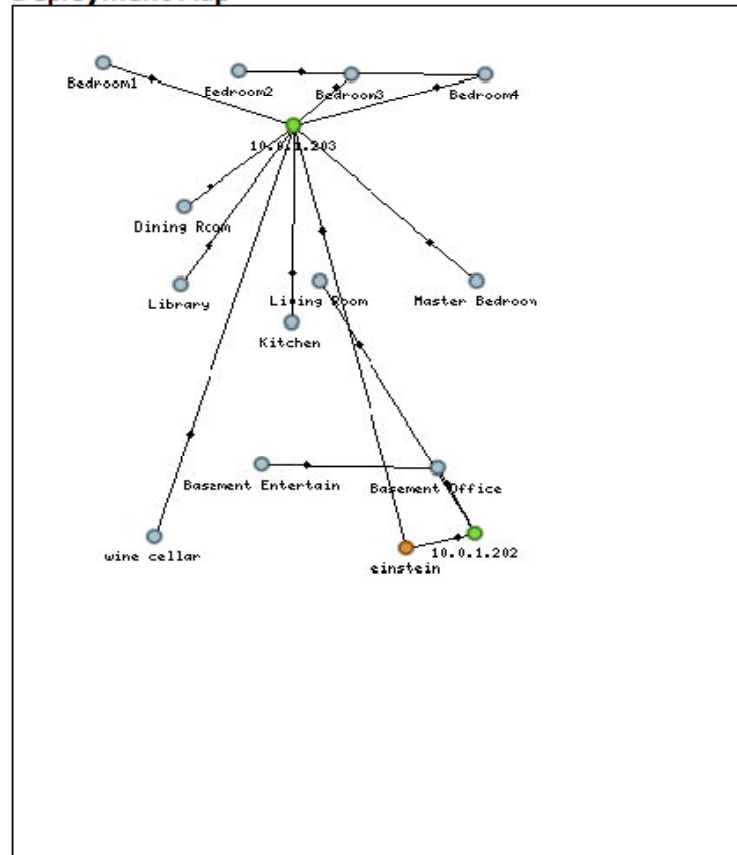
© 2006-2008 Arch Rock Corporation.  
All Rights Reserved.

## 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

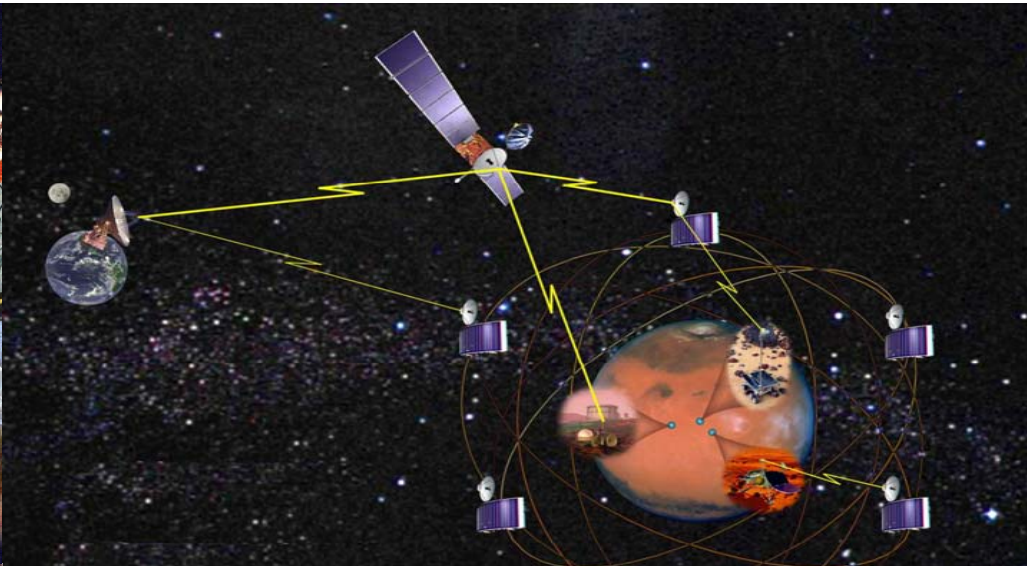
2nd Floor

- 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

- IPv6 - 128 bit addresses ( $3.4 \times 10^{38}$ )
- DNSSEC (.se, .pr, .bg, .br, others?)
  - Root zone a big issue
  - Challenge for \*.google.com
- Internationalized Domain Names
  - Non-Latin Unicode characters
  - ASCII Punycode encoding “xn--...”
  - Potential hazards (e.g. paypal, .py (paraguay or russia?))
- New ccTLDs and gTLDs
  - ISO 3166-1 (ASCII 2 char) -> iCCTLDs?

- Multiple Data Centers (replication, responsiveness)
- Dynamic capacity sharing
- Data sharing (“latest copy is always in the cloud”)
- Video and audio conferencing with data sharing
- Inter-Cloud interactions (new research area!)
  - How to refer to other clouds?
  - How to refer to data in other clouds?
  - How to make data references persistent (unlike URLs)?
  - How to protect Clouds from various forms of attack (inside, outside)?
  - How to establish an access control regime (inside, between clouds)?
  - What semantics can we rely on with inter-cloud data exchange?
  - What notion of “object” would be useful for inter-cloud exchange?

- 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!!



# InterPlaNetary Internet

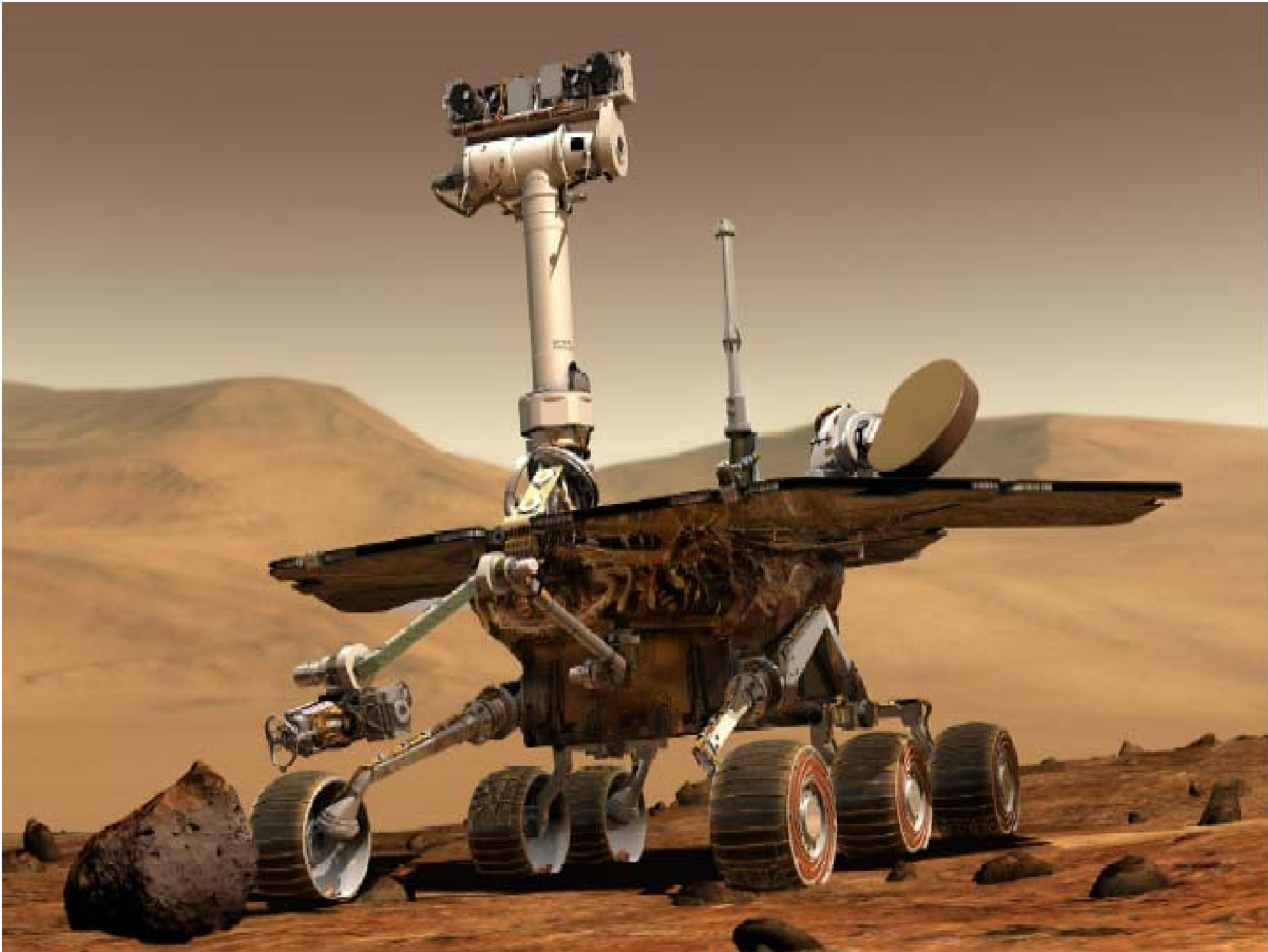


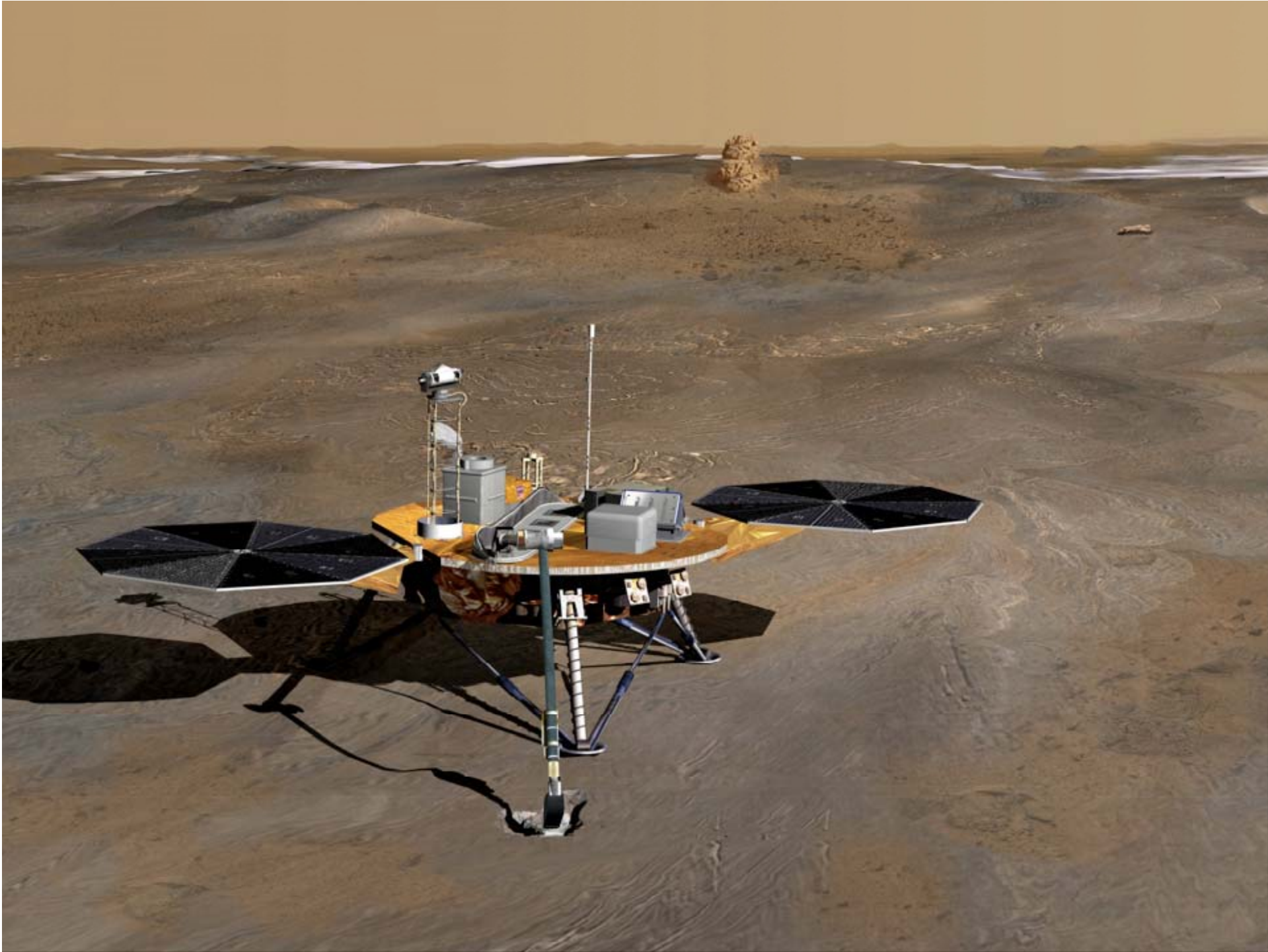














# Interplanetary Internet: “InterPlaNet” (IPN)

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- Planetary internets
- Interplanetary Gateways
- Interplanetary Long-Haul Architecture (RFC 4838)
  - Licklider Transport Protocol (LTP)
  - Bundle Protocol (RFC 5050)
    - Delayed Binding of Identifiers
    - Email-like behavior
- TDRSS and NASA in-space routing
- Delay and Disruption Tolerant Protocols
  - Tactical Mobile applications (DARPA)
  - Civilian Mobile applications (SameNet!)
  - Deep Impact Testing October 2008
  - Space Station Testing 2009



# 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*

