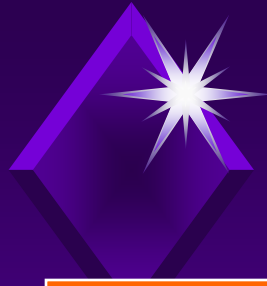


# Tracking the Internet into the 21<sup>st</sup> Century

Vint Cerf

Google

January 17, 2006



# Internet - Global Statistics

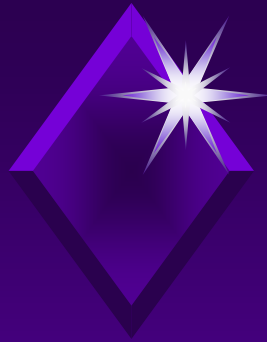
22.5 Million Hosts  
(Bellcore June 1997)

50 Million Users  
(NUA Jul 1997)

360 Million Hosts  
(ISC July 2005)

972.8 Million Users  
(InternetWorldStats.com  
Nov 21, 2005)

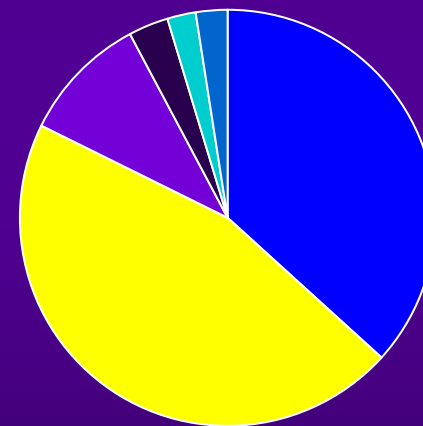
(approx. 3.1 Billion Telephone Terminations including 2 B mobiles and  
822 Million PCs [Comp. Industries Assoc.] )



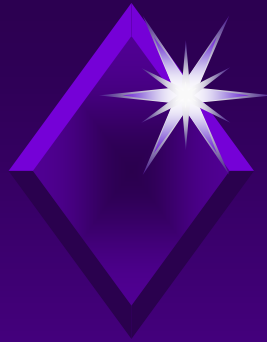
# Internet Penetration Nov 2005

- ◆ Asia - 332.6 M
- ◆ No. Amer. - 224.1M
- ◆ Europe - 285.4 M
- ◆ Latin Am - 72.7 M
- ◆ Africa - 23.9 M
- ◆ Mid-east - 16.2 M
- ◆ Oceania/AU-17.69 M

- 
- ◆ Total - 972.8 M
  - ◆ 15.1% total penetration

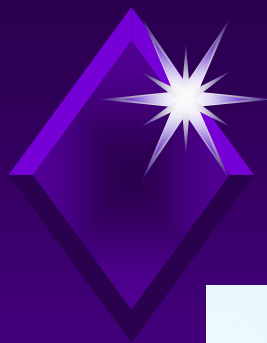


*(Source [www.internetstats.com](http://www.internetstats.com))*



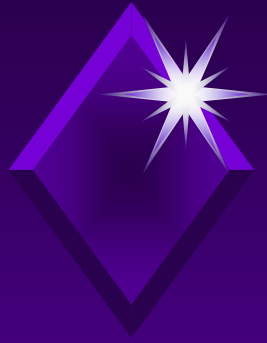
# % Internet Use (July 2005)

- ◆ Malta (78.3%)
- ◆ New Zealand (77.6%)
- ◆ Iceland (76.5%)
- ◆ Sweden (75.2%)
- ◆ Hong Kong (70.7%)
- ◆ Denmark (69.5%)
- ◆ United States (68.7%)
- ◆ Singapore (68.3%)
- ◆ Norway (68.2%)
- ◆ Australia (68.2%)
- ◆ Faroe Islands (67.8%)
- ◆ Greenland (66.6%)
- ◆ Netherlands (66.2%)
- ◆ Switzerland (64.9%)
- ◆ South Korea (65.2%)
- ◆ Canada (63.8%)
- ◆ United Kingdom (63.1%)
- ◆ Finland (62.6%)
- ◆ Bermuda (61.1%)
- ◆ Japan (60.9%)
- ◆ Chinese Taipei (60.5%)
- ◆ Luxemburg (59.4%)
- ◆ Portugal (58.2%)
- ◆ Liechtenstein (57.3%)
- ◆ Germany (57%)
- ◆ Austria (57%)
- ◆ Barbados (56.4%)
- ◆ Ireland (51.2%)



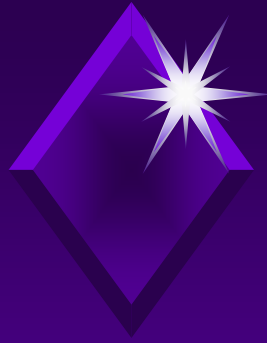
# Internet expansion





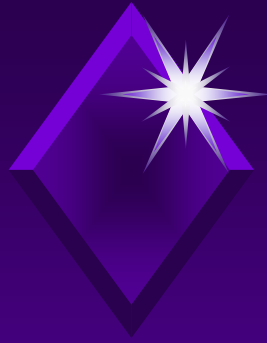
# The Power of IP

- ◆ Layering of Protocols
- ◆ End-to-End Principle
- ◆ IP decouples application from transmission/transport
  - ◆ IP does not care what transport is used (satellite, fiber, twisted pair, radio, ATM...)
  - ◆ IP does not care what application it is carrying (video, audio, web, email...)
- ◆ Embedding of all modalities under program control via IP
- ◆ Profound impact on regulatory models



# Convergence is real

- ◆ Disrupted business models
- ◆ IP on Everything and now Everything on IP
- ◆ Instant Messaging -> Presence
  - ◆ 21<sup>st</sup> Century “dial tone” – SIP, ENUM
  - ◆ Programs, processes, people
  - ◆ VOIP (no big deal but wrecks traditional telephony model)
    - ◆ Text, voice, video, collaborative tools
- ◆ Standardized Application Programming I/Fs

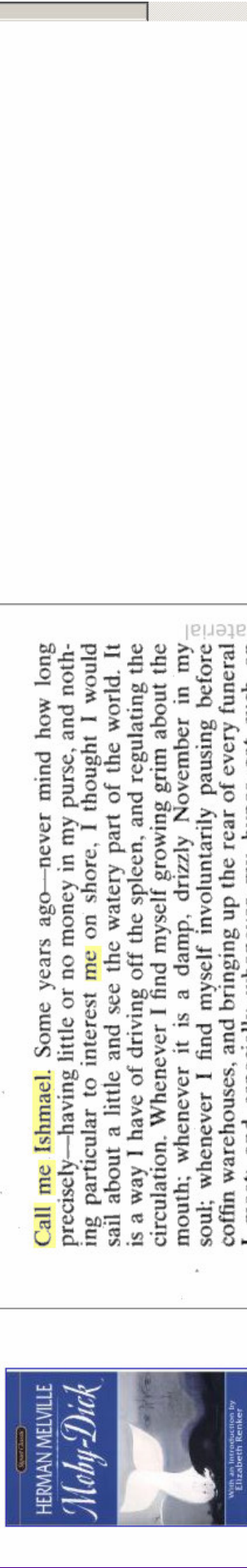


# Digital Media

- ◆ Digital Media Production Systems
  - ◆ Real-time media production (full service)
  - ◆ Storage and distribution (streaming, FTP)
  - ◆ The Long Tail
- ◆ Interactive Game Platform(s)
- ◆ Information Archives
  - ◆ Oceans of information (World Digital Library)
  - ◆ Free, pay per view, subscription, sponsored



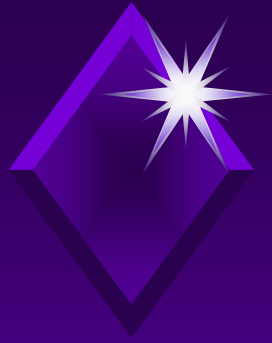
[Back to Search results](#)  
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**CHAPTER I**  
*Loomings*

**Call me Ishmael.** Some years ago—never mind how long precisely—having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen, and regulating the circulation. Whenever I find myself growing grim about the mouth; whenever it is a damp, drizzly November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet; and especially whenever my hypos get such an upper hand of me, that it requires a strong moral principle to prevent me from deliberately stepping into the street, and methodically knocking people's hats off—then, I account it high time to get to sea as soon as I can. This is my substitute for pistol and ball. With a philosophical flourish Cato throws himself upon his sword; I quietly take to the ship. There is nothing surprising in this. If they but knew it, almost all men in their degree, some time or other, cherish very nearly the same feelings towards the ocean with me.

There now is your insular city of the Manhattoes, belted round by wharves as Indian isles by coral reefs—commerce surrounds it with her surf. Right and left, the streets take you back to the bottom.



# Mobility and Mobiles

- ◆ 2 Billion Mobiles and counting
- ◆ Short Message Systems
- ◆ Payment systems
- ◆ Navigation systems
  - ◆ GPS, Galileo, Google Earth/Maps,...
- ◆ Geo-location based services

**Google Local**  Search

[Web](#) [Images](#) [Groups](#) [News](#) [Froogle](#) [Local](#) [Desktop](#) [Moma](#) [more >](#)  
[Search the map](#)  
[Find businesses](#)  
[Get Directions](#)

e.g., "hotels near lax" or "10 market st, san francisco"

**Local** [New!](#) Download Google Local to your mobile phone.

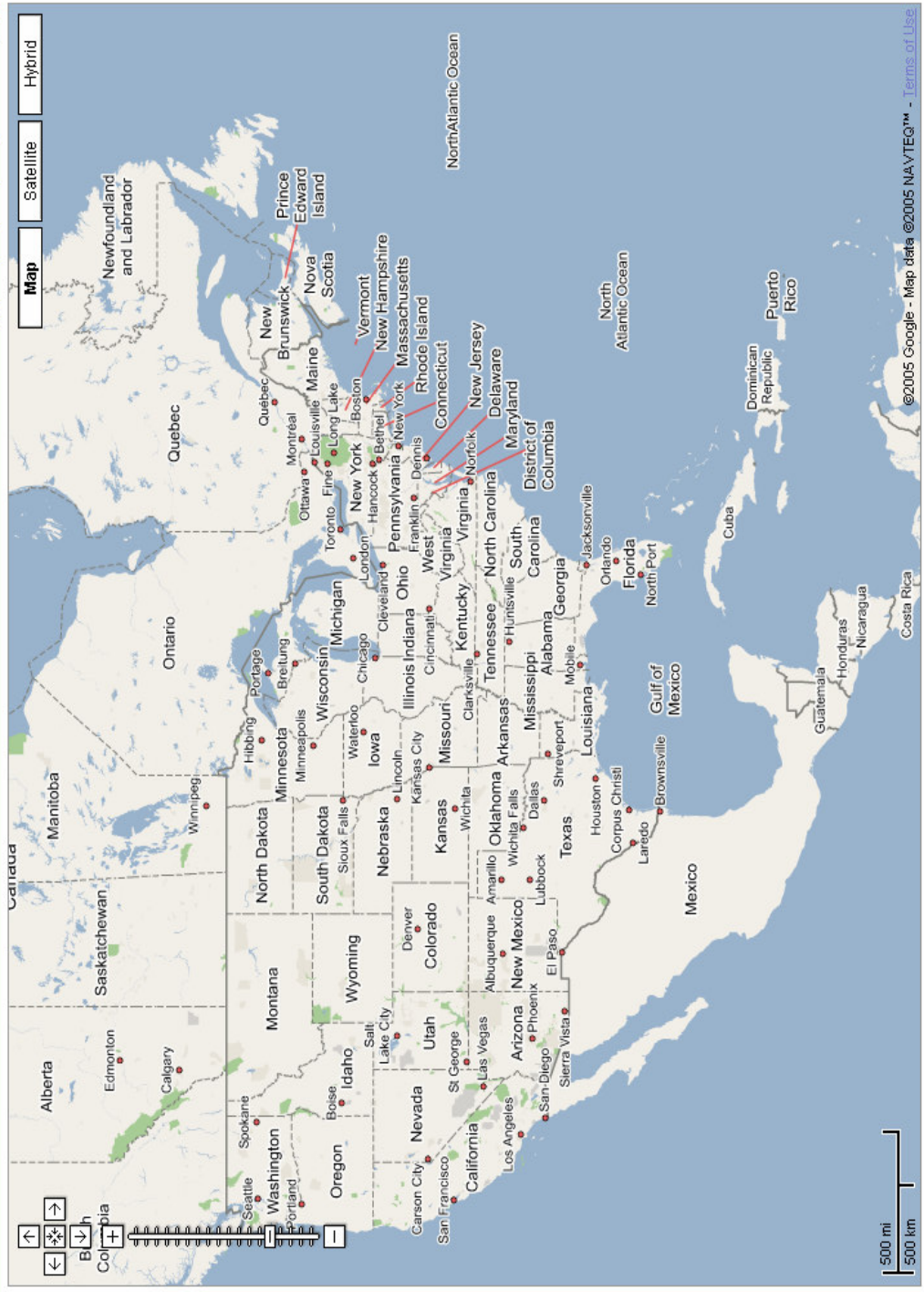
**Example searches:**

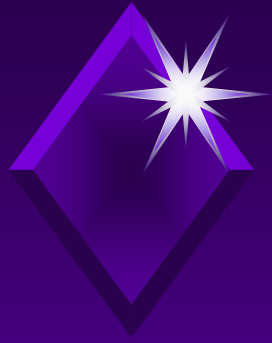
**Go to a location**  
[kansas city](#)  
[10\\_market\\_st.,san francisco](#)

**Find a business**  
[hotels\\_near lax](#)  
[pizza](#)

**Get directions**  
[jfk to 360 5th ave, new york](#)  
[seattle to 98109](#)

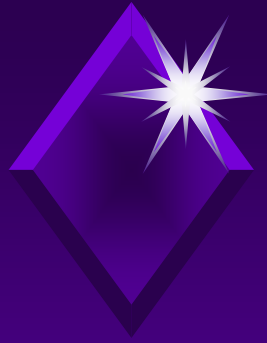
Drag the map with your mouse, or double-click to center. [Take a tour >](#)





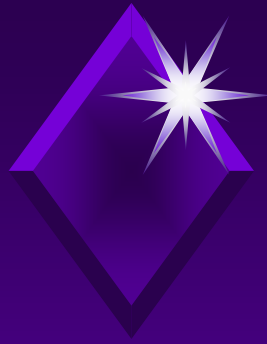
# New Business Models

- ◆ Online Advertising – targeted, relevant
- ◆ Total 2005 “advertising” revenues in the US = \$420B (all media, promotions...)
- ◆ Third party applications over standard APIs (Google Earth/Maps example)



# Broadband Services

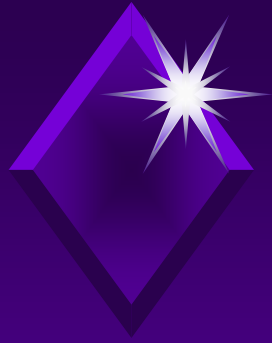
- ◆ Cable, DSL – asymmetric
- ◆ Broadband over Power Lines
- ◆ Radio based (WiMax, Gigabeam, etc.)
- ◆ WiFi for local access
- ◆ Fiber to the Home (100-1000 Mb/s)



# Technology & Policy

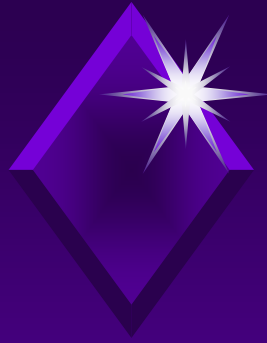
- ◆ Internationalized Domain Names
- ◆ New Top Level Domains
- ◆ Network Interconnection Regimes (peering, transit)
- ◆ Wireless services (licensed/unlicensed)
- ◆ Municipal Networking
- ◆ WHOIS (privacy, IP protection)
- ◆ Intellectual Property Protection
- ◆ IPv6
- ◆ Internet QOS issues (differential services)
- ◆ Consumer Choice for Broadband/Neutrality





# Internet Governance

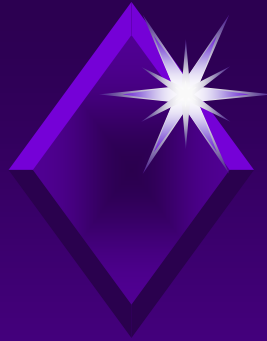
- ◆ World Summit on the Information Society
  - ◆ Working Group on Internet Governance
  - ◆ Multi-stakeholder model (e.g. ICANN)
  - ◆ Internet Governance Forum



## Internet Governance (2)

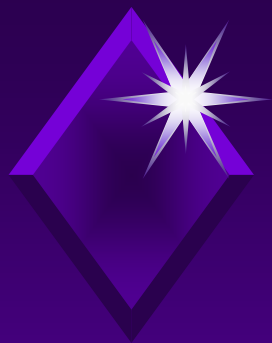
- ◆ Broad definition of scope of IG
  - ◆ Fraud, abuse, intellectual property, harassment, privacy, spam, spim, spit...
- ◆ Limited role of ICANN
  - ◆ Domain Name System oversight and root zone management
  - ◆ Internet Address allocations to RIRs
  - ◆ Recordation of TCP/IP protocol suite parameters
  - ◆ Coordination among many other supporting organizations (RIRs/NRO, Root Servers, Domain Name registrars and registries, IETF/IAB, Governmental Advisory Committee...)





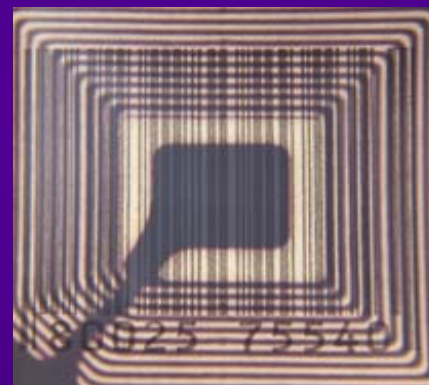
# Internet-enabled Appliances





# RFID

- ◆ Toll-Road passive transponder
- ◆ Consumer product identifier (like UPC)
- ◆ Drug/Food shelf-life and identification
- ◆ Patient identification

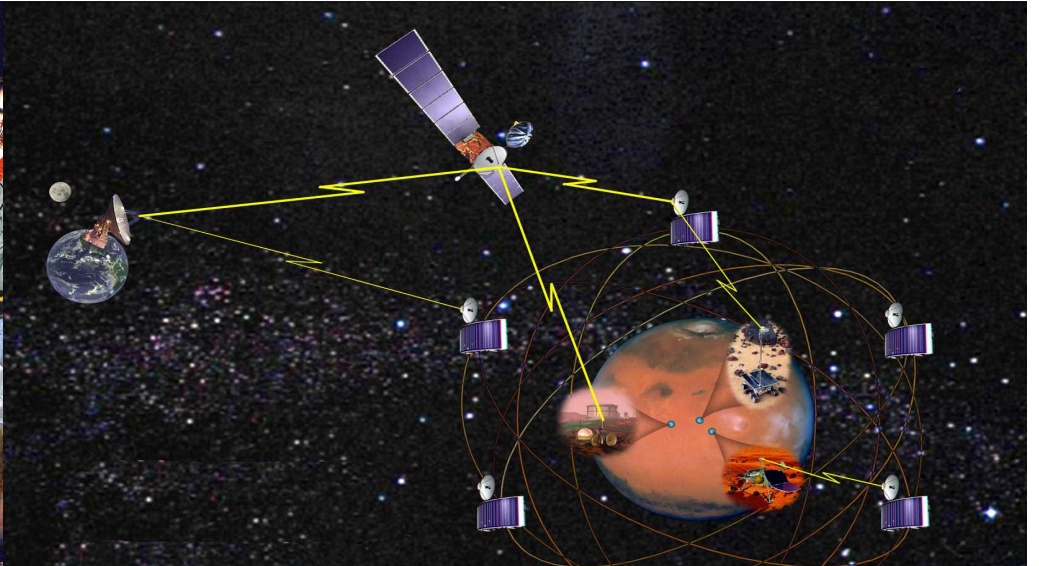
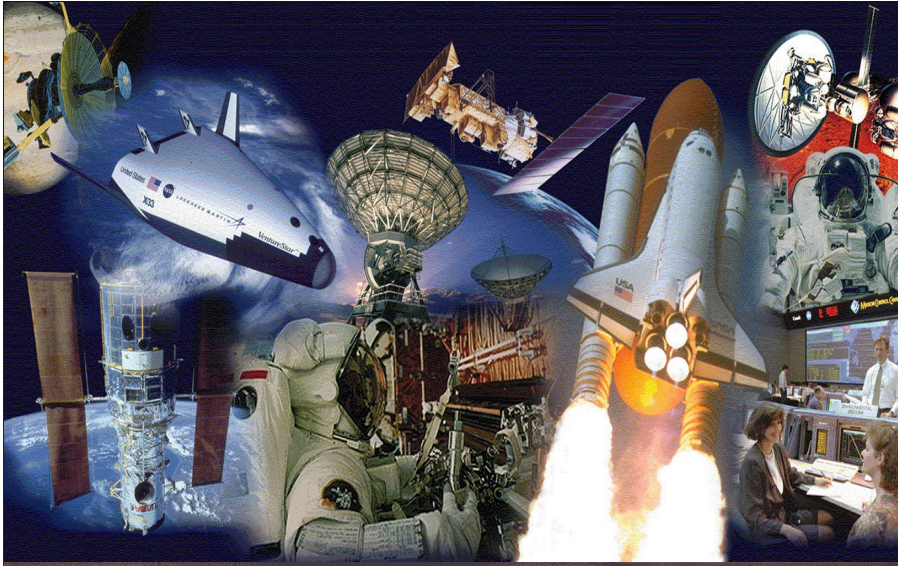




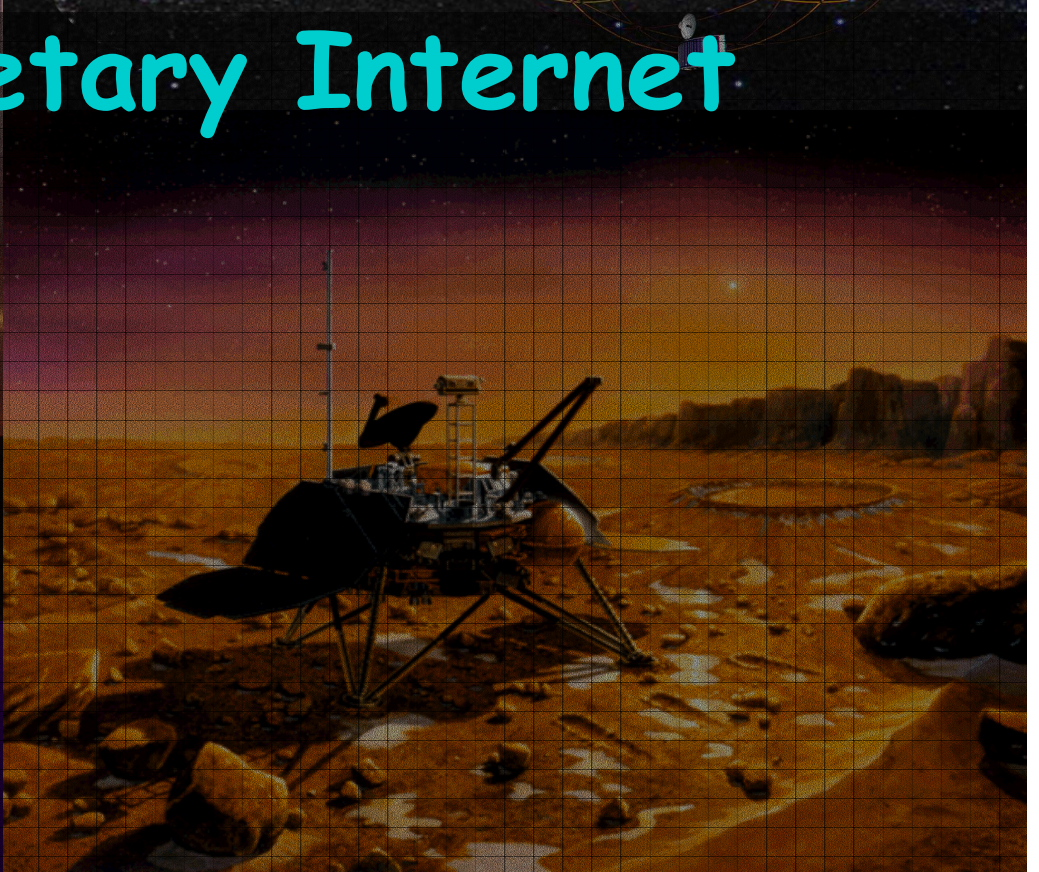
# Internet-enabled Devices

- ◆ Programmable – Java, Python, etc.
- ◆ Examples:  
WebTV, Palm-Pilot, 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
- ◆ Universal Remote Control





# InterPlaNetary Internet

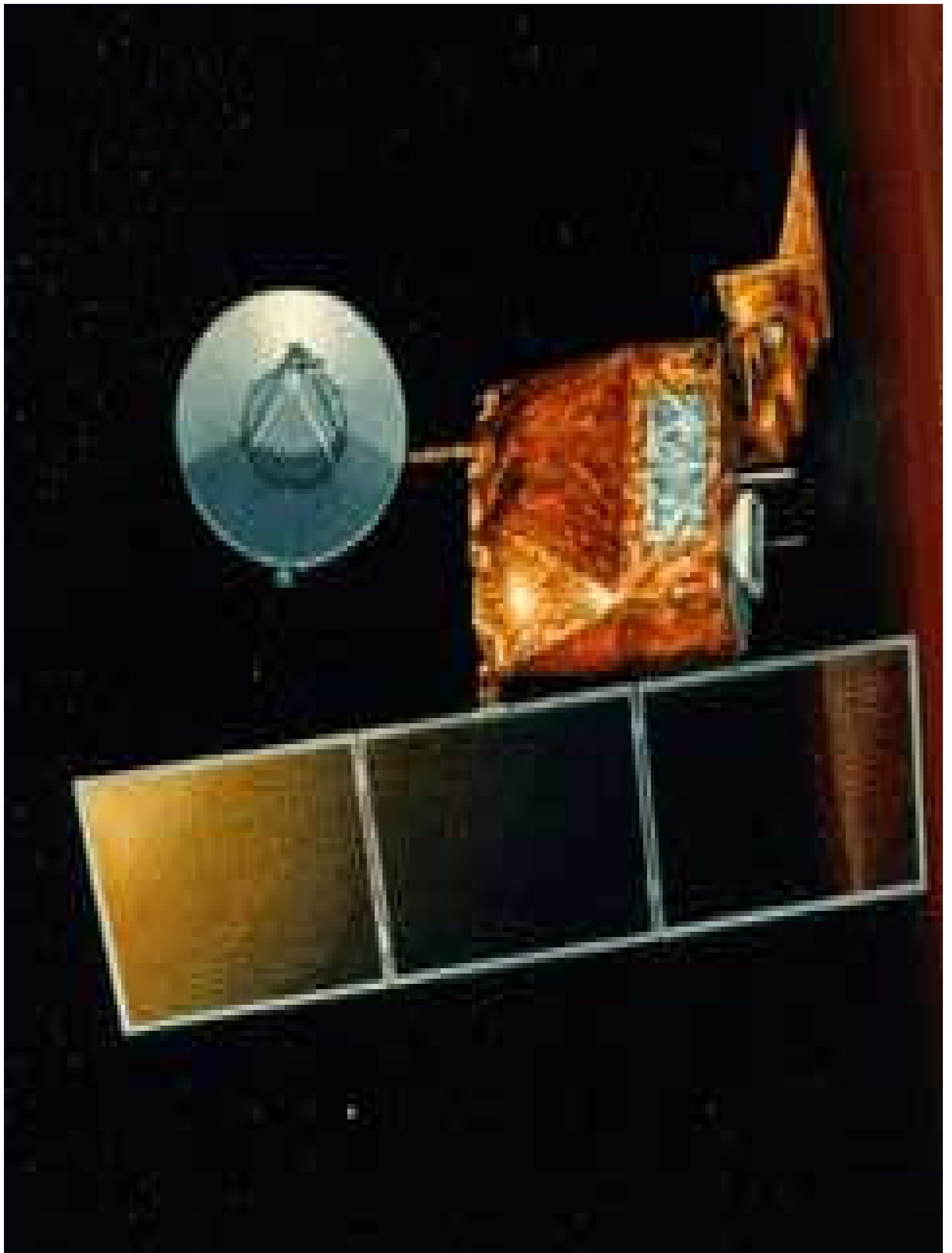




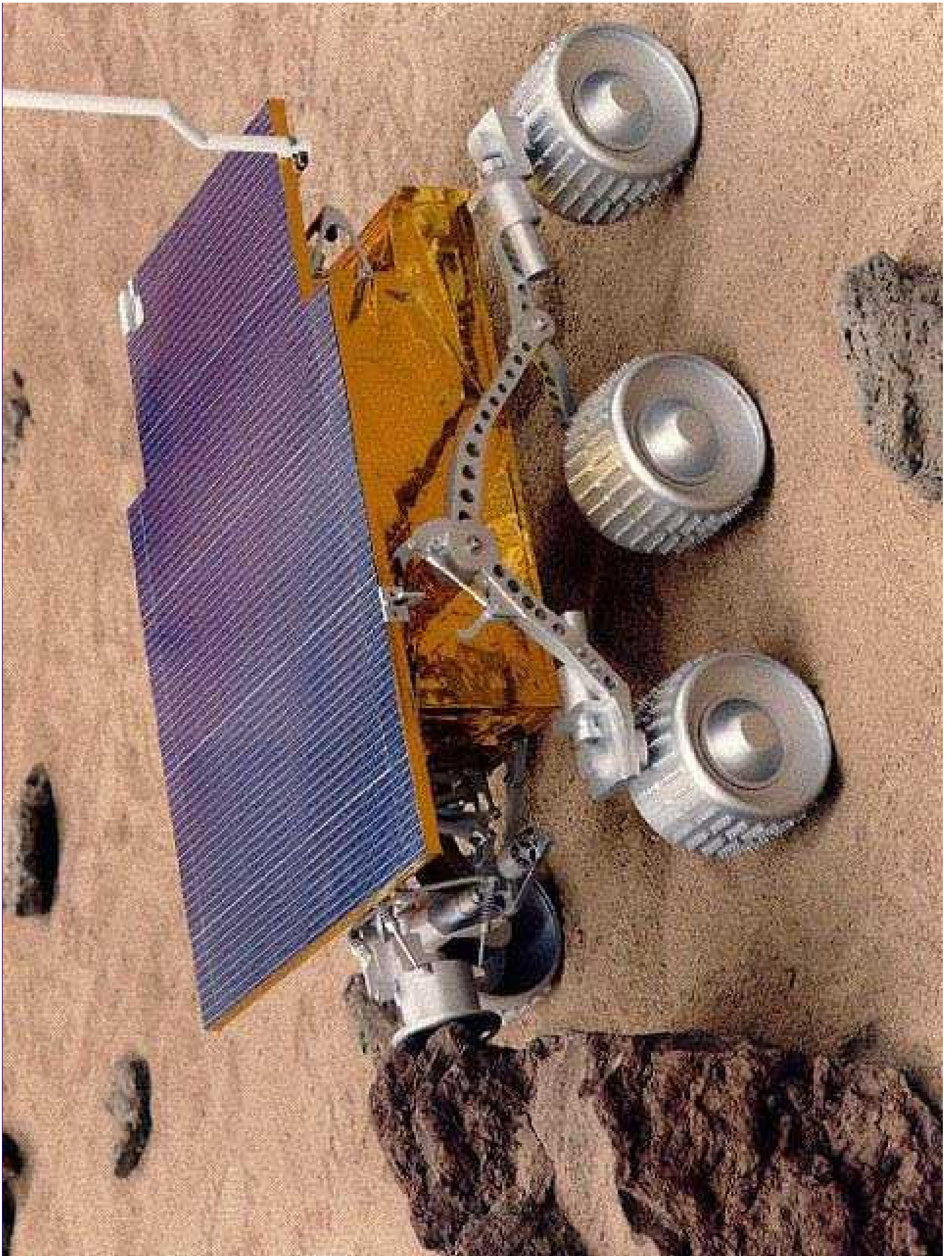


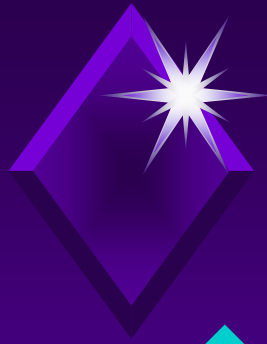












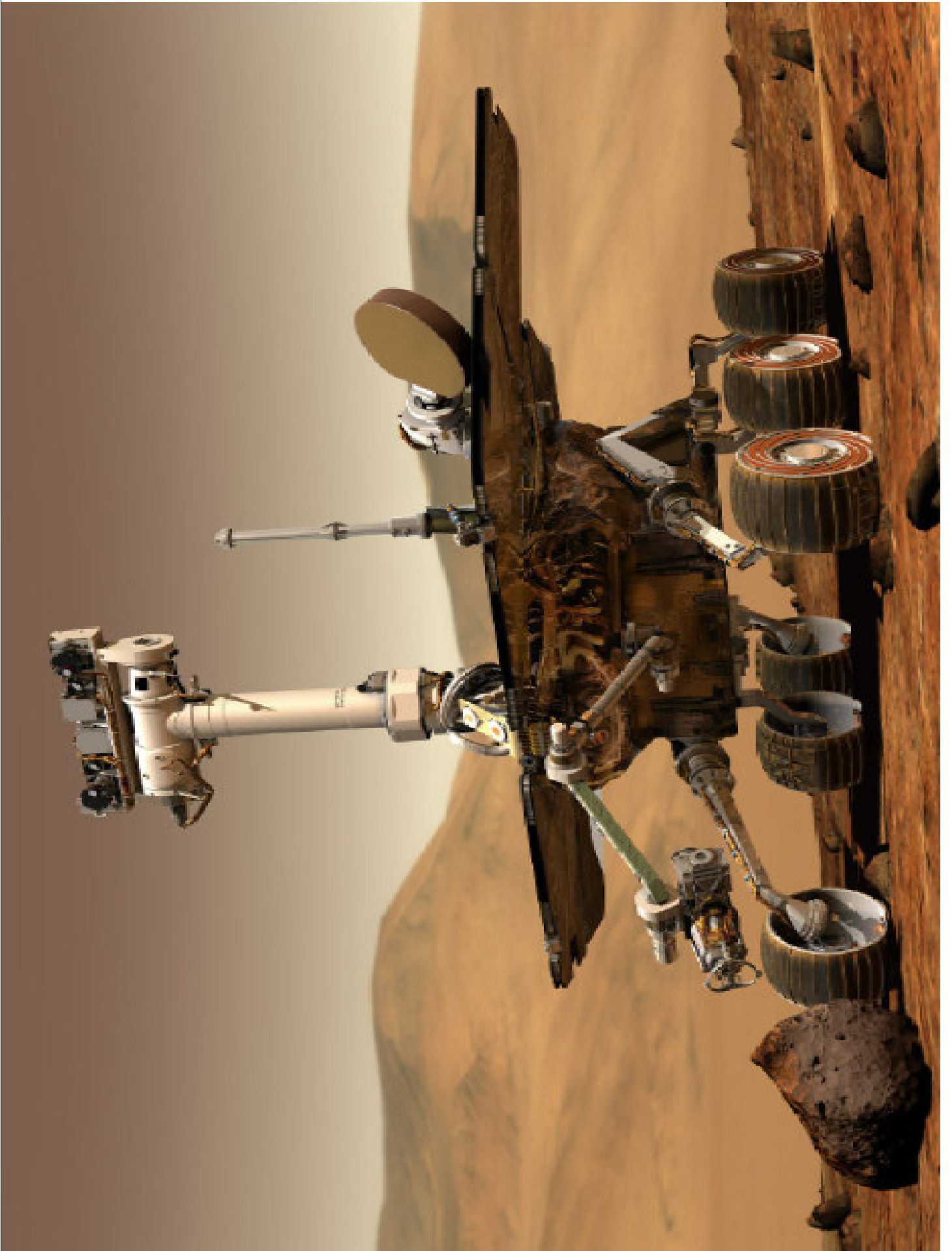
# 2003-2004 Missions to Mars

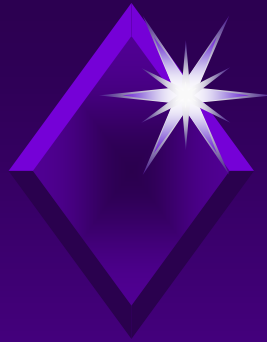
## ◆ Spirit

- ◆ launched 6/10/2003
- ◆ arrived Jan 4, 2004
- ◆ Gusev Crater in Gusev Plain

## ◆ Opportunity

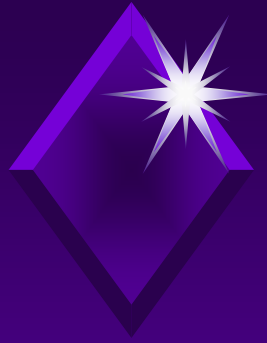
- ◆ Launched 7/7/2003
- ◆ arrived Jan 25, 2004
- ◆ Meridiani Planum





# Interplanetary Internet: “InterPlaNet” (IPN)

- ◆ Planetary internets
- ◆ Interplanetary Gateways
- ◆ Interplanetary Long-Haul Protocol
- ◆ Delayed Binding of Identifiers
- ◆ Email-like behavior
- ◆ Delay and Disruption Tolerant Protocols
  - ◆ Tactical Mobile applications (DARPA)
  - ◆ Civilian Mobile applications (SameNet!)
- ◆ TDRSS and NASA in-space routing



# Mars Reconnaissance Orbiter

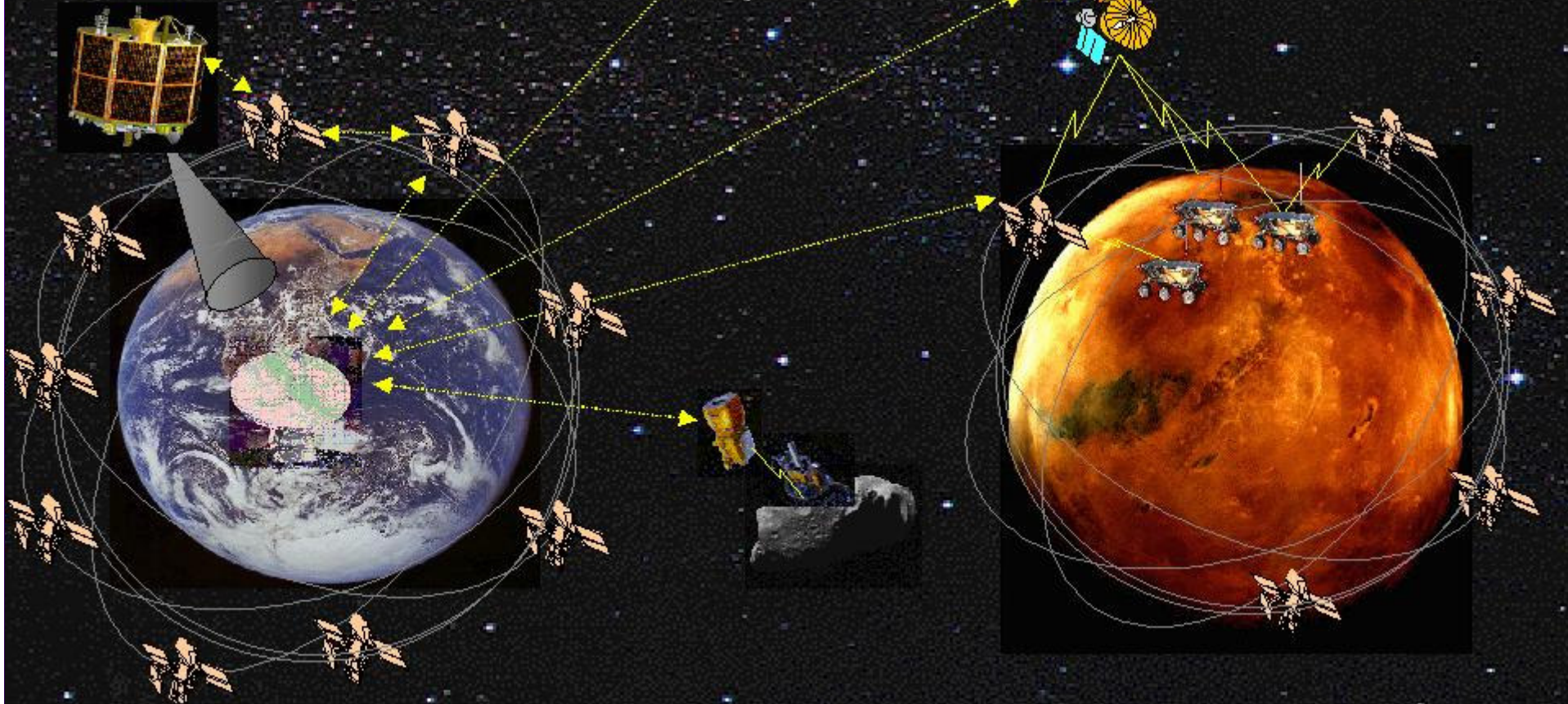
- ◆ Launched August 2005
- ◆ Survey for new landing sites
- ◆ Potential relay node for networking
- ◆ Joining other orbiters in use today

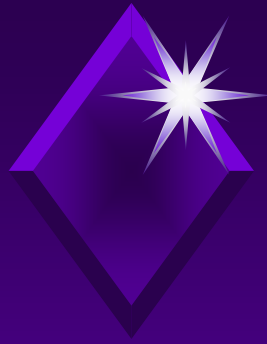




# Interplanetary Internet

- *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*





Other Internet information can  
be found at:

[www.isoc.org/internet](http://www.isoc.org/internet)

[livinginternet.com](http://livinginternet.com)

[www.ipv6forum.com](http://www.ipv6forum.com)

[www.nav6tf.org](http://www.nav6tf.org)

[www.dtnrg.org](http://www.dtnrg.org)

