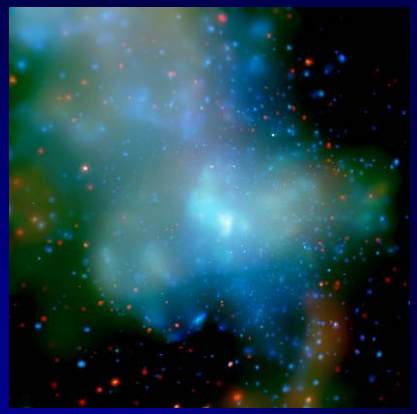
Capturing Whispers from Space: The Deep Space Network



Ota Lutz and Chris Jacobs

Jet Propulsion Laboratory
California Institute of Technology

POLL

What is considered “deep” space for communications?

A. Low Earth Orbit

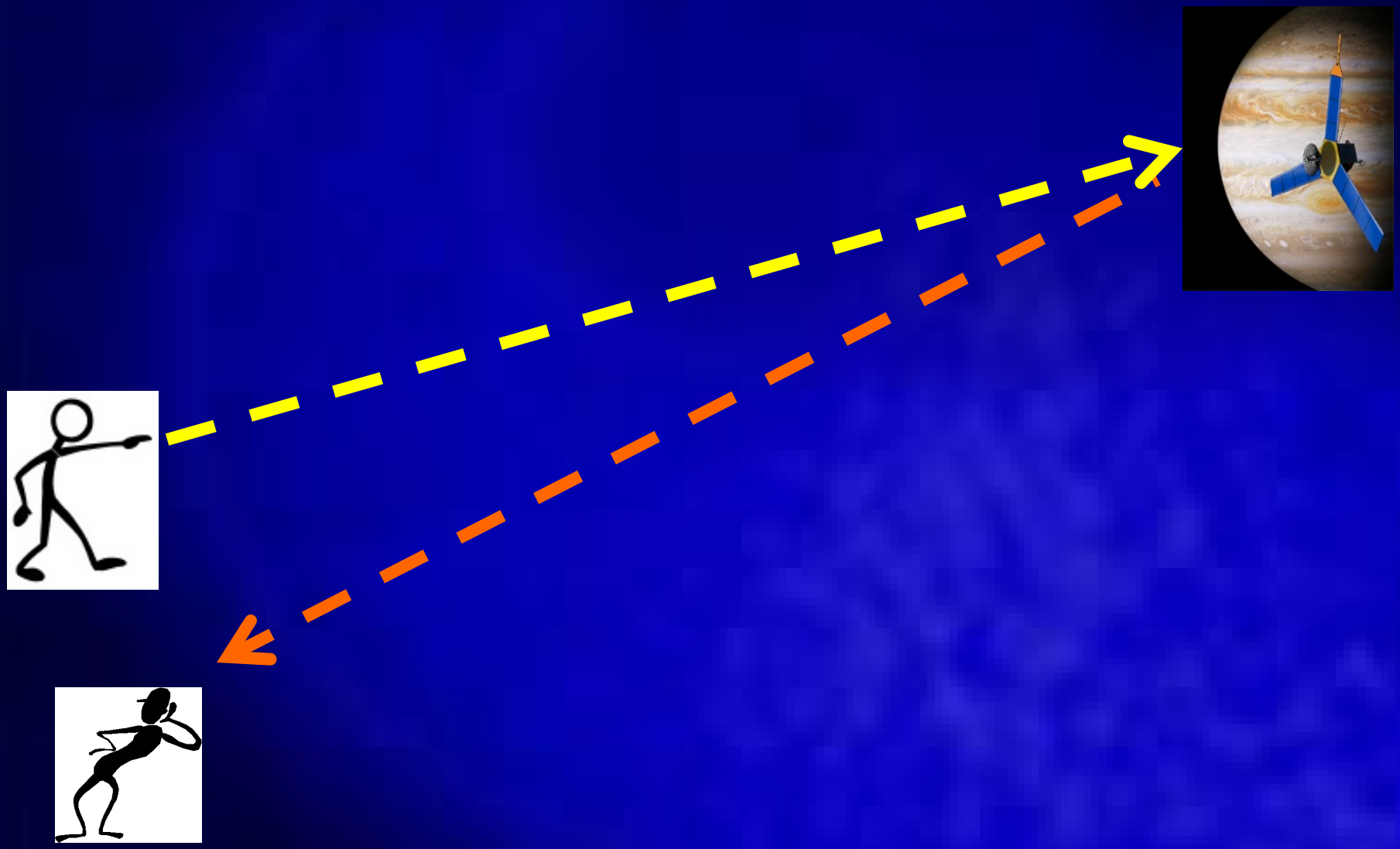
B. Moon

C. Mars

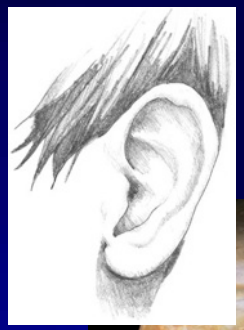
D. Jupiter

E. Edge of Solar System

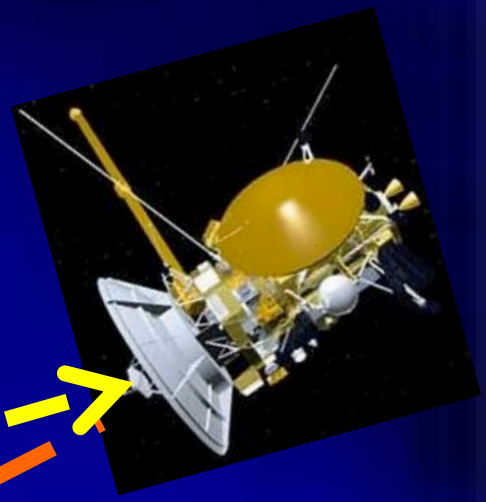
Problem/challenge

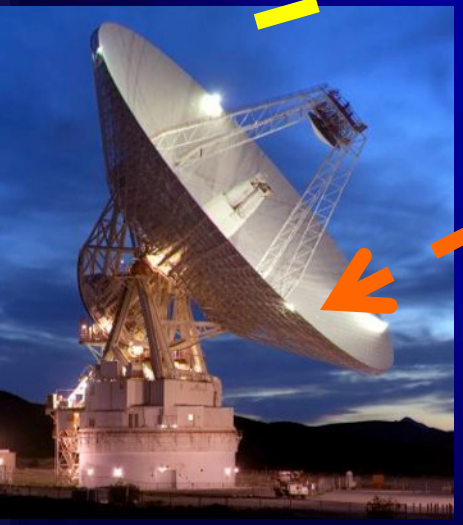


Solution

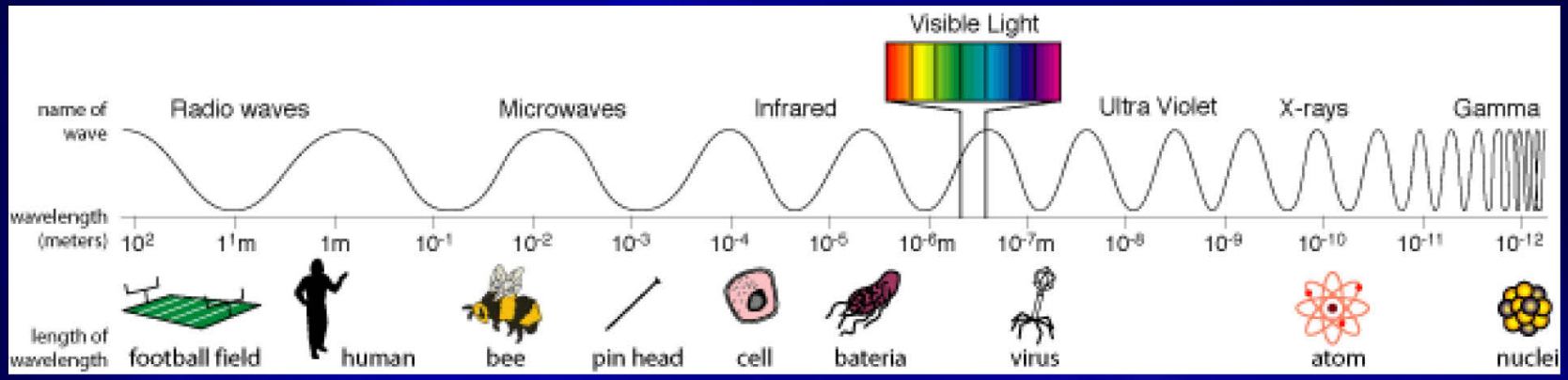


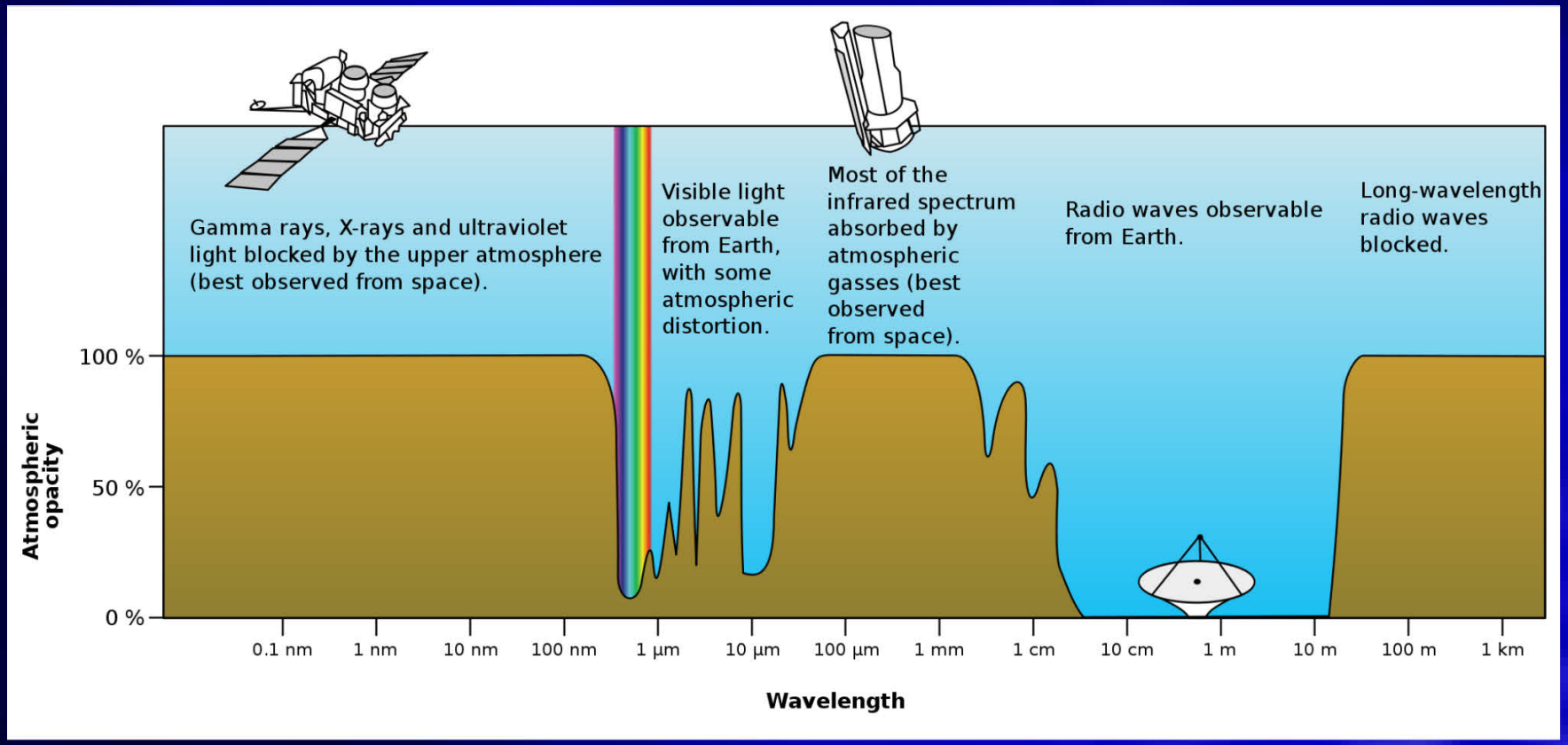
Solution



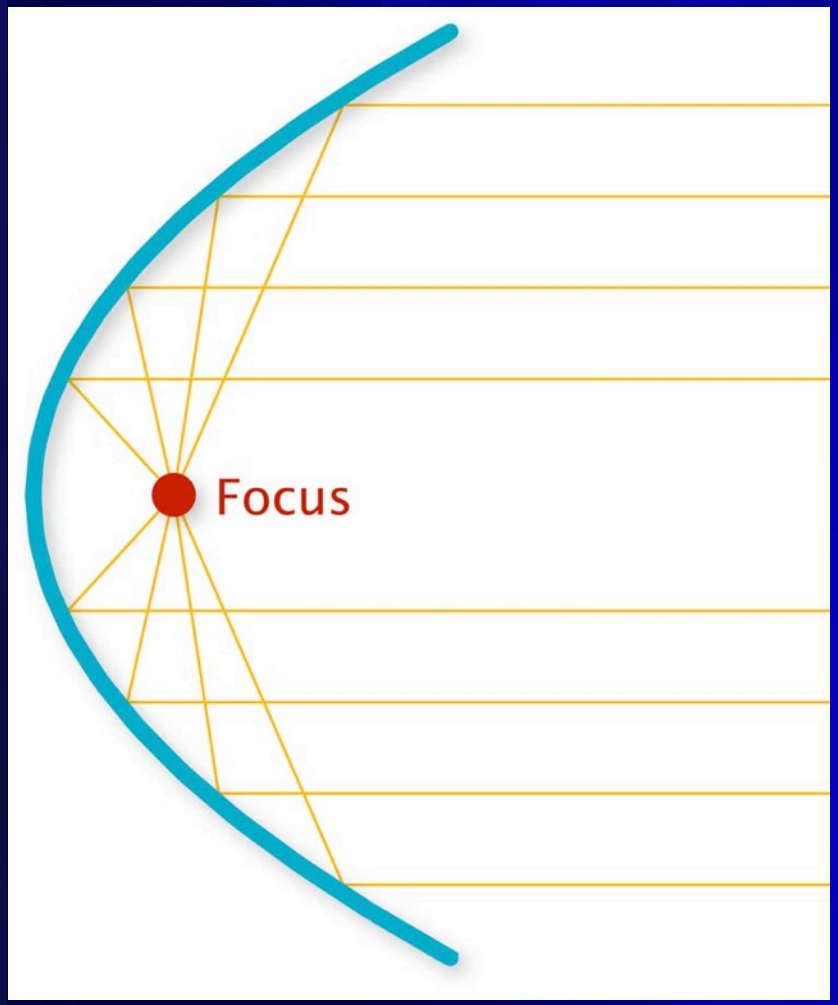


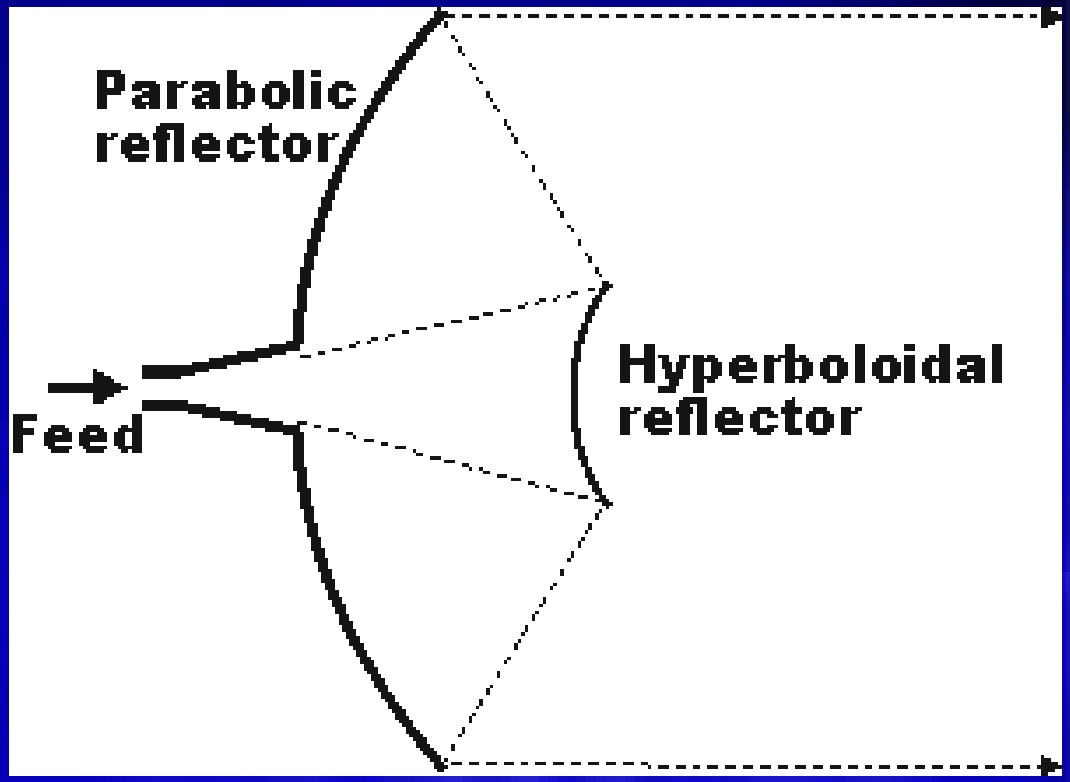
How do we communicate?





Antenna dishes are paraboloids





Credit: http://www.radio-electronics.com/info/antennas/parabolic/parabolic_reflector_cassegrain.gif

Credit: http://langlopress.net/homeeducation/resources/science/content/support/illustrations/Parabolic%20Reflector/Parabolic%20Reflector.jpg

POLL

How many antennas do you need on Earth in order to communicate with any spacecraft in the solar system at any given time?

A. 2

B. 3

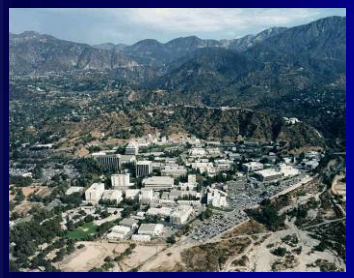
C. 4

D. 5

E. 6

Deep Space Network

Madrid



Jet Propulsion Laboratory

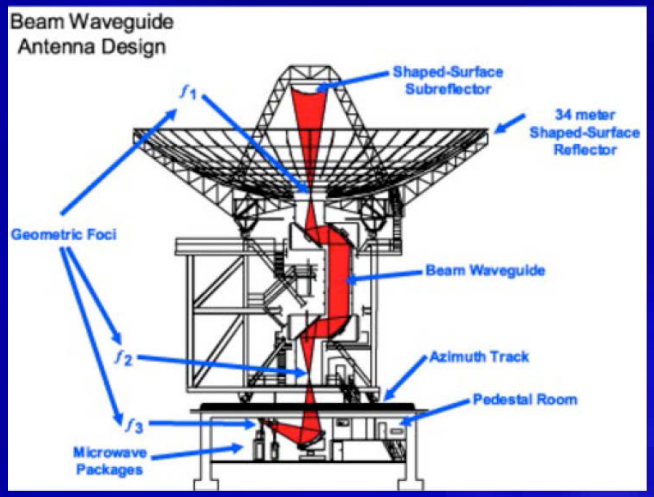
Goldstone

ONE TEAM—ONE MISSION
DSN TEAM
PARTNERS IN DEEP SPACE EXPLORATION

Canberra

The DSN has 3 different types of antennas:

70-meter antenna

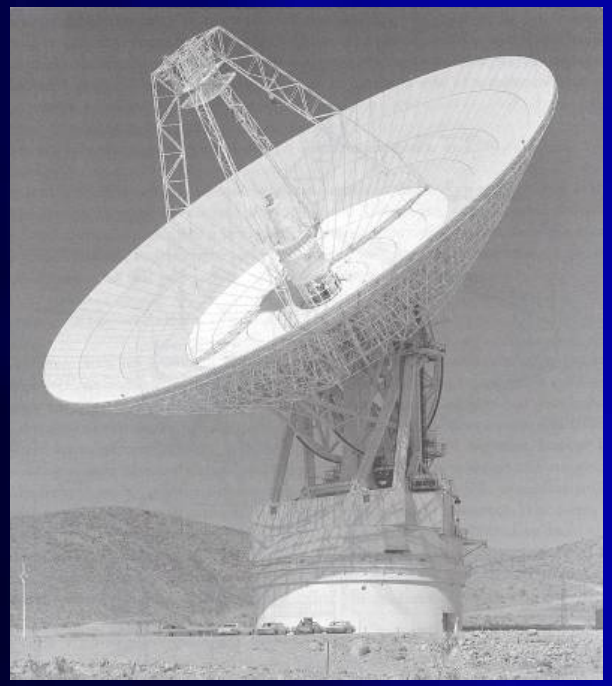


34-meter beam waveguide antenna

34-meter High Efficiency antenna

Mars DSS-14

Built in 1960s as 64-meter antenna;
Upgraded in 1980s to be a 70-meter antenna



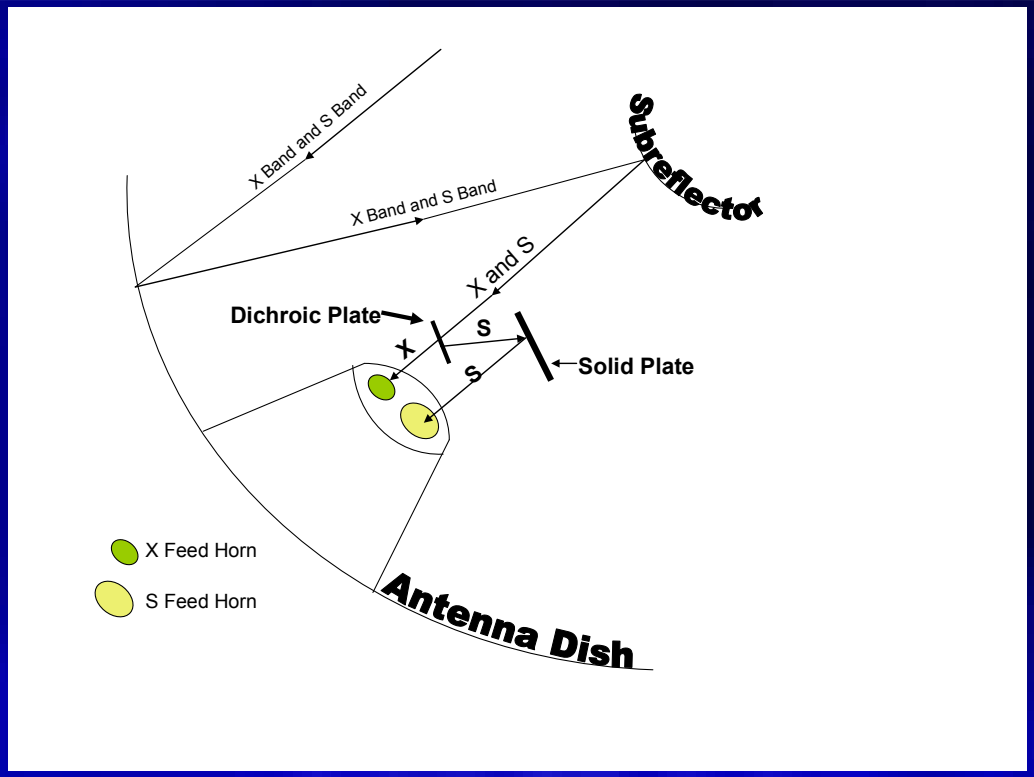
DSS-14, 70-Meter Antenna in the Rose Bowl

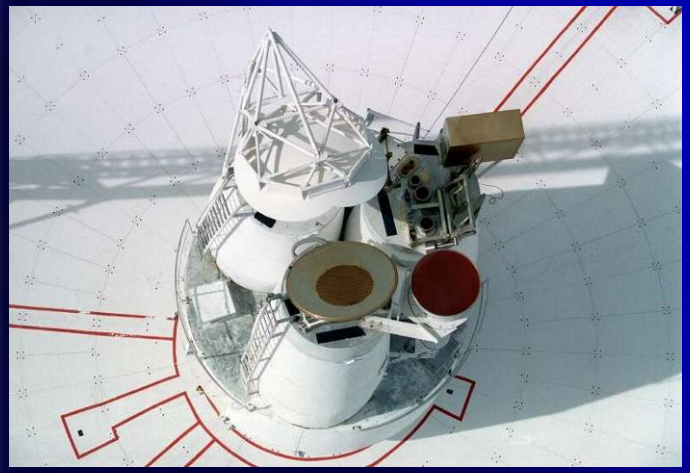
Apollo Valley

Antennas may be wired together to form a larger virtual antenna.

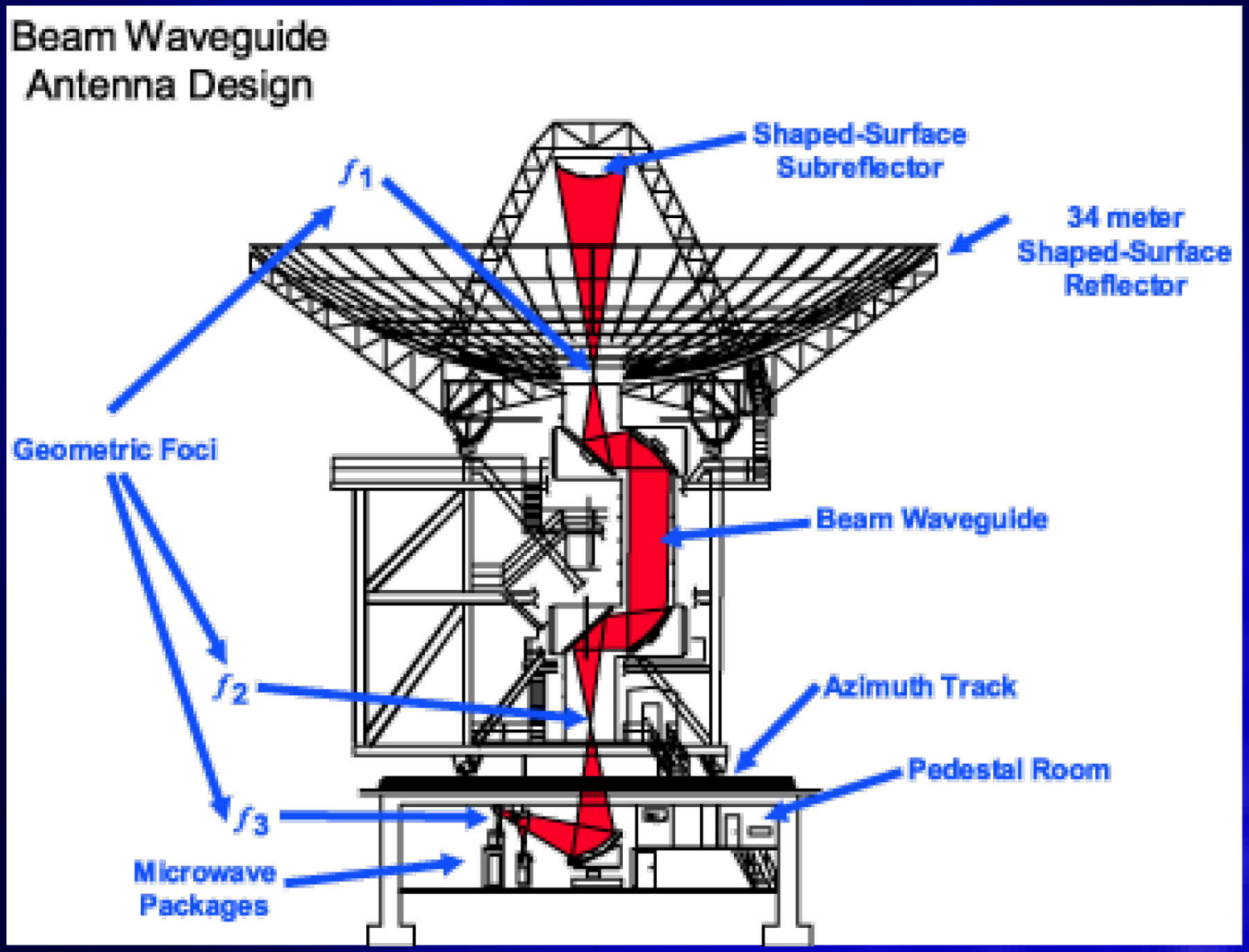
We call this “arraying.”

Subreflector & Dichroic Plate

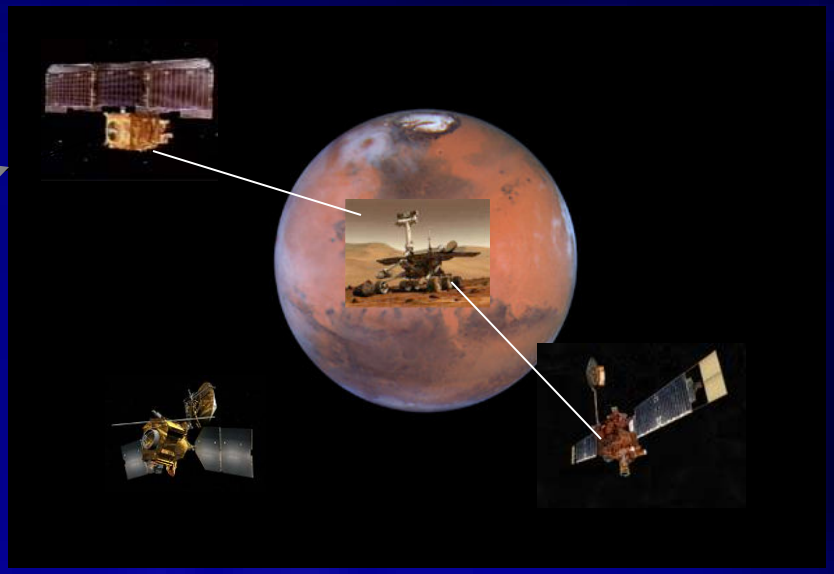




Beam Wave Guide Antenna Signal Pathway



Pathways of Communication



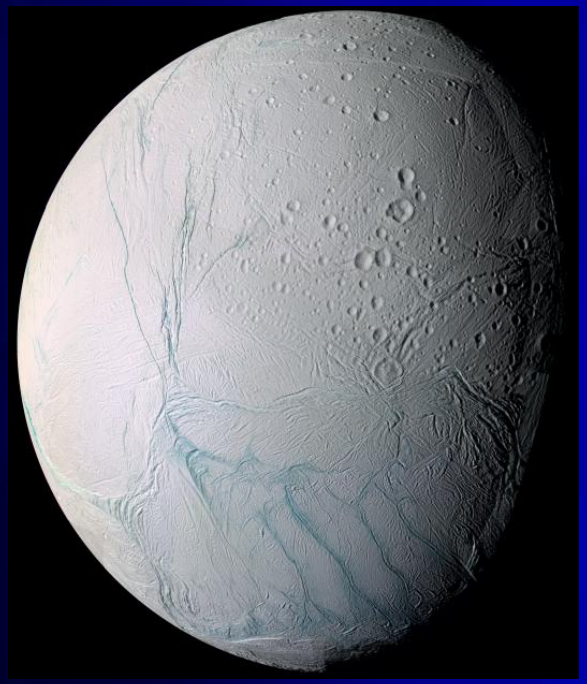
70 meter antenna
at Goldstone, CA

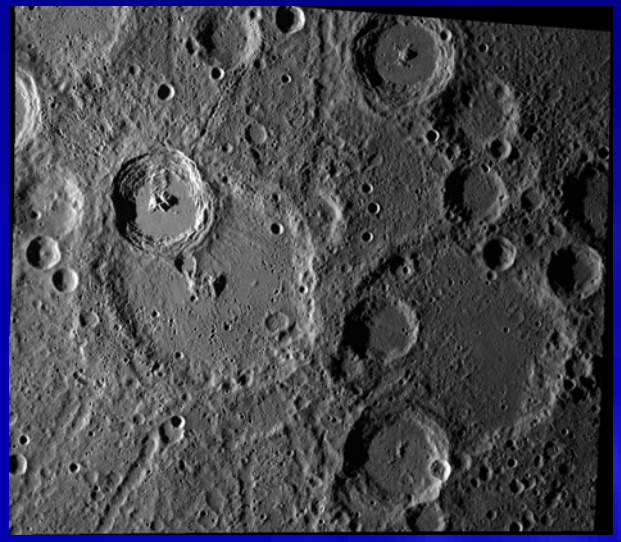
Deep Space Network to Mars and Back

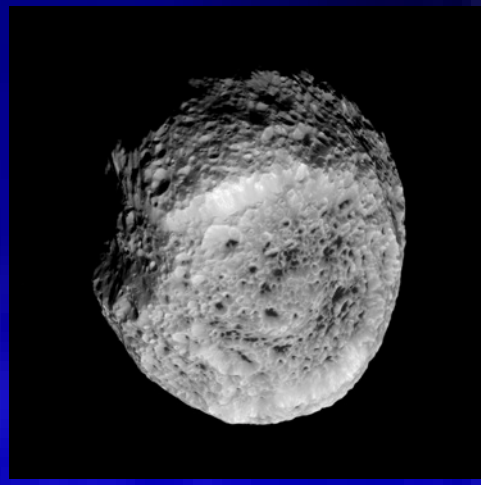
DSN Control Room Goldstone

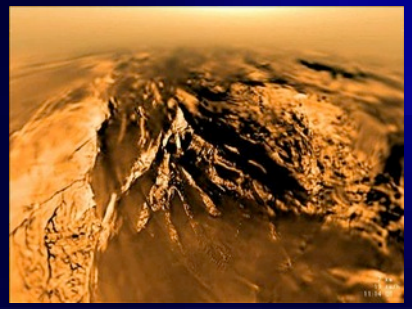
JPL Control Room

Mars Rover Project Control Room

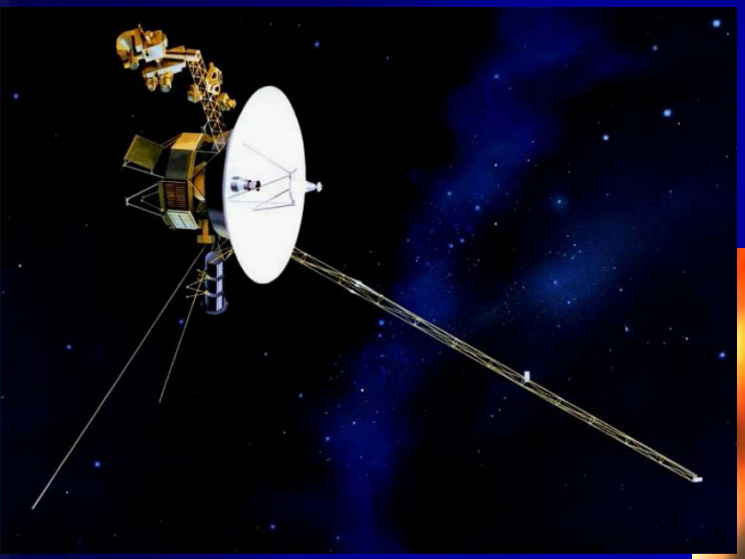


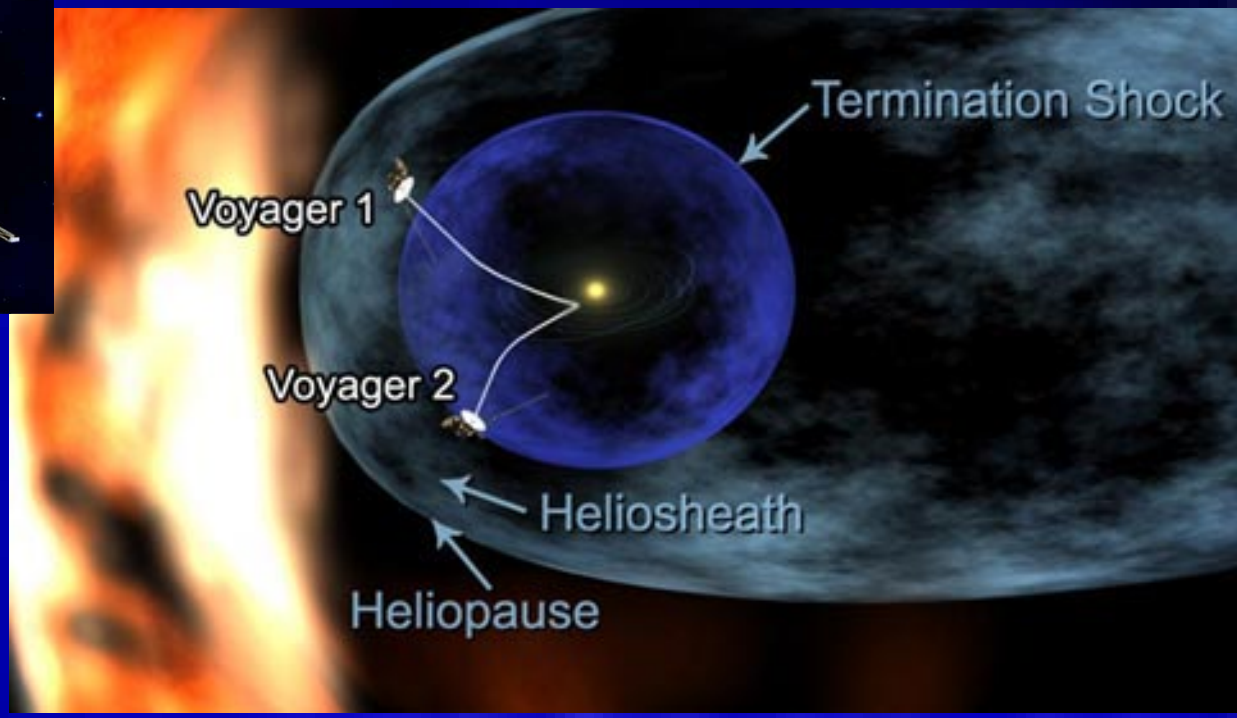






VOYAGERS 1 & 2





Spacecraft speed:
38,000 mph or approx.
1 million miles per day

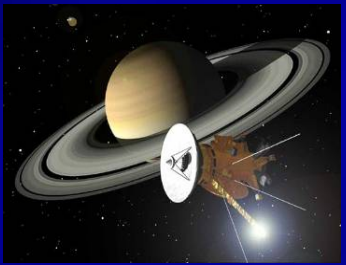
Voyager 1 is nearly
120 AU from Earth

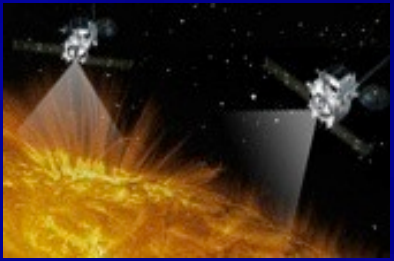
RTLT: 33 hrs 13 min
(as of 12/01/11)

Transmitting with less power than a cell phone

SPACECRAFT CURRENTLY TRACKED BY THE DSN

Voyager 1


Cassini


Stereo A & B

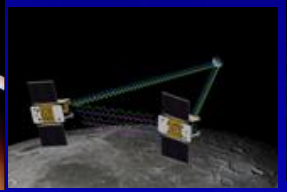
MRO

Mars Odyssey

Messenger

Cluster 1, 2, 3 & 4

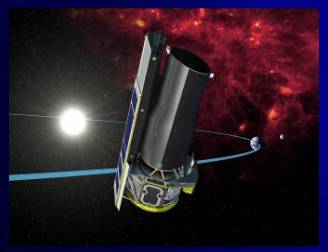
SOHO


GRAIL

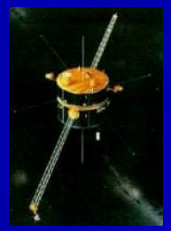
Dawn

New Horizons

Mars Exploration Rovers


Spitzer

MSL


Wind

Rosetta

Kepler

Mars Express

Chandra

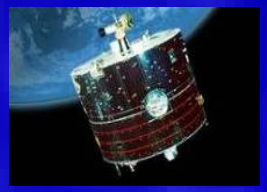
GOES

LRO

JUNO

ACE

Themis C


Geotail

D

S

N

Learn more:

http://deepspace.jpl.nasa.gov/

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