8TH BRIEFING FOR INDUSTRY

Enabling Space Science and Exploration

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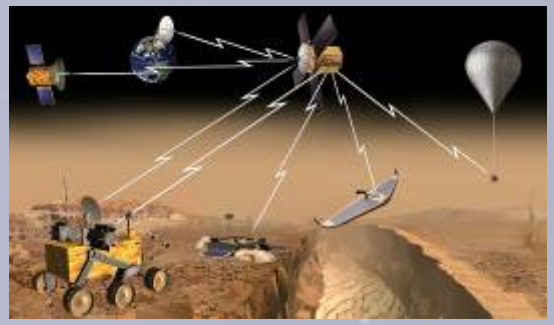


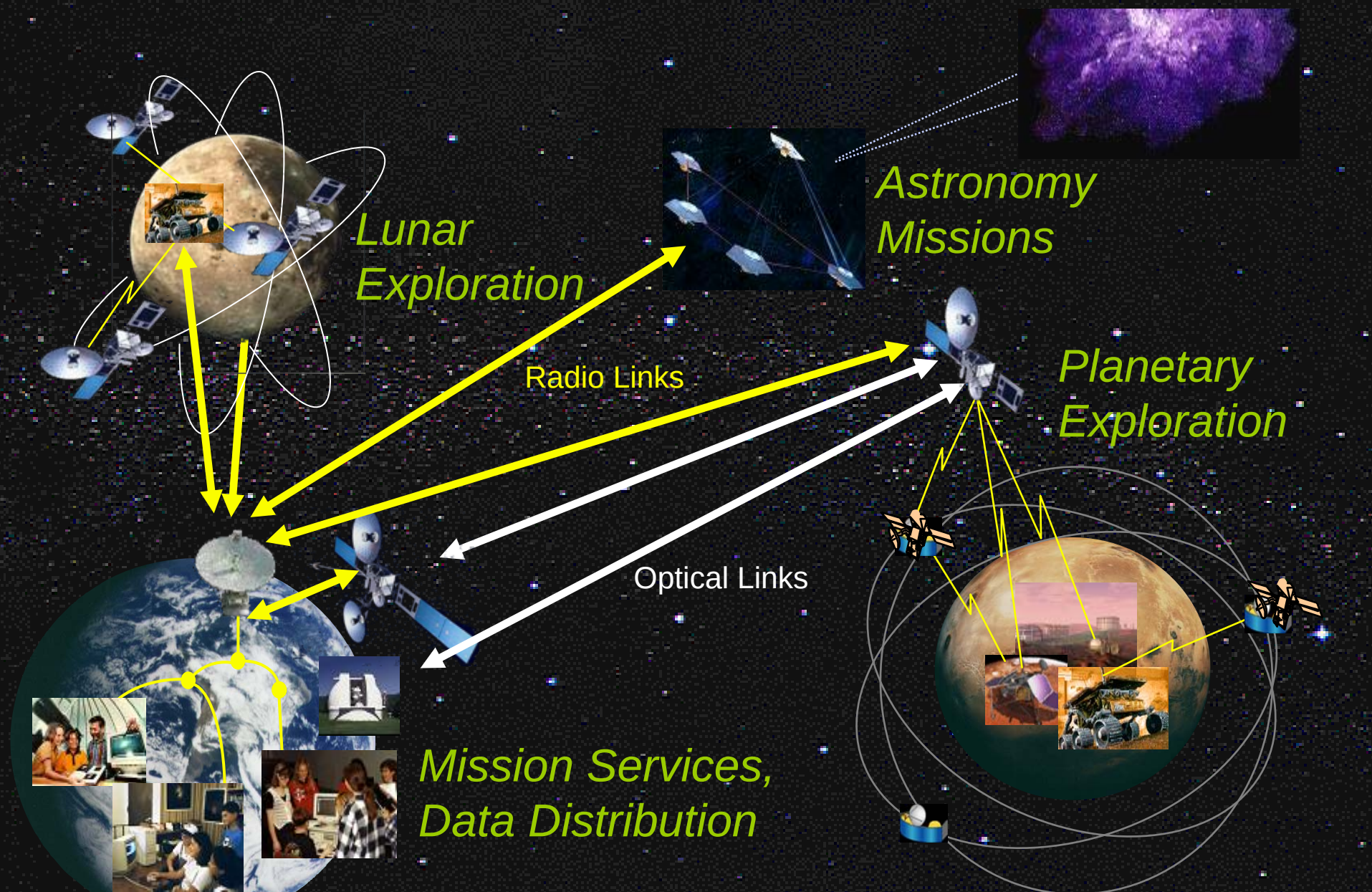
The Interplanetary Network

Mission Statement

Enable telescience and telepresence throughout the Solar System and beyond….

“Bringing the sensors to the scientists, and the planets to the public.”

The Interplanetary Network

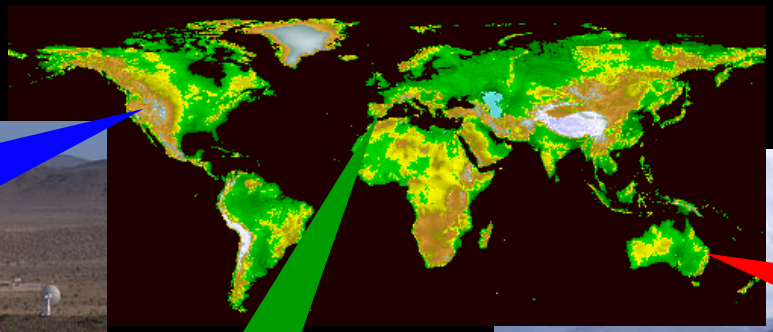


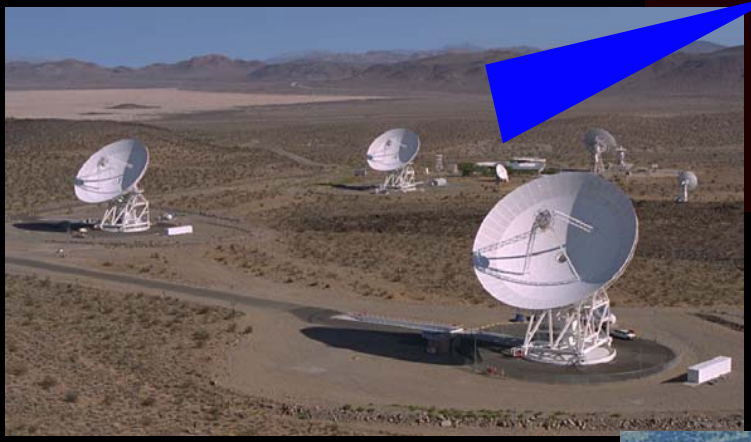
Major Elements

- Today's Deep Space Network
- Next Generation Deep Space Network
  - Array-based
  - Optical
- Needed technologies
- Mission IT and networking
- Multi-mission operations

The Deep Space Network

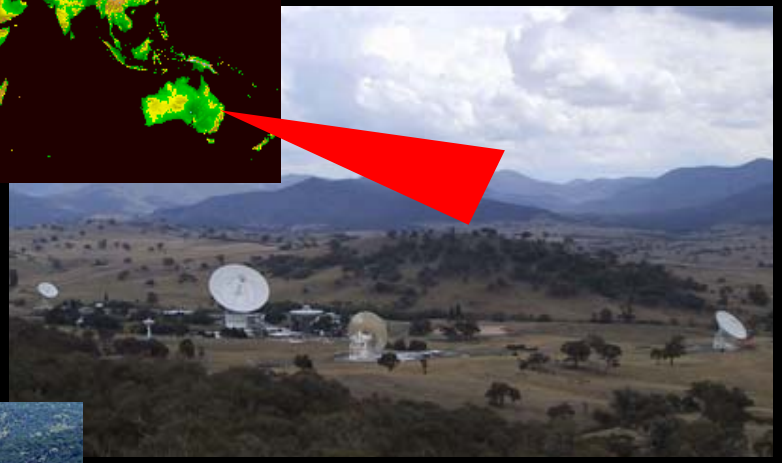
Comprises three major tracking sites around the globe to provide continuous communication and navigation support for the world's deep space missions.





Goldstone
Operated by ITT for NASA/JPL

Madrid
Operated by INSA for INTA



Canberra
Operated by Raytheon for CSIRO

Aging DSN

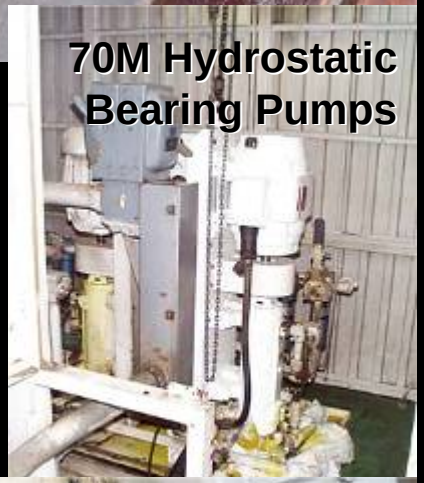
70M Backup
Structure

G-26 HVAC

HEF Azimuth Track
Miter Joint

70M
Elevation
Suspension
Strut

70M Hydrostatic
Bearing

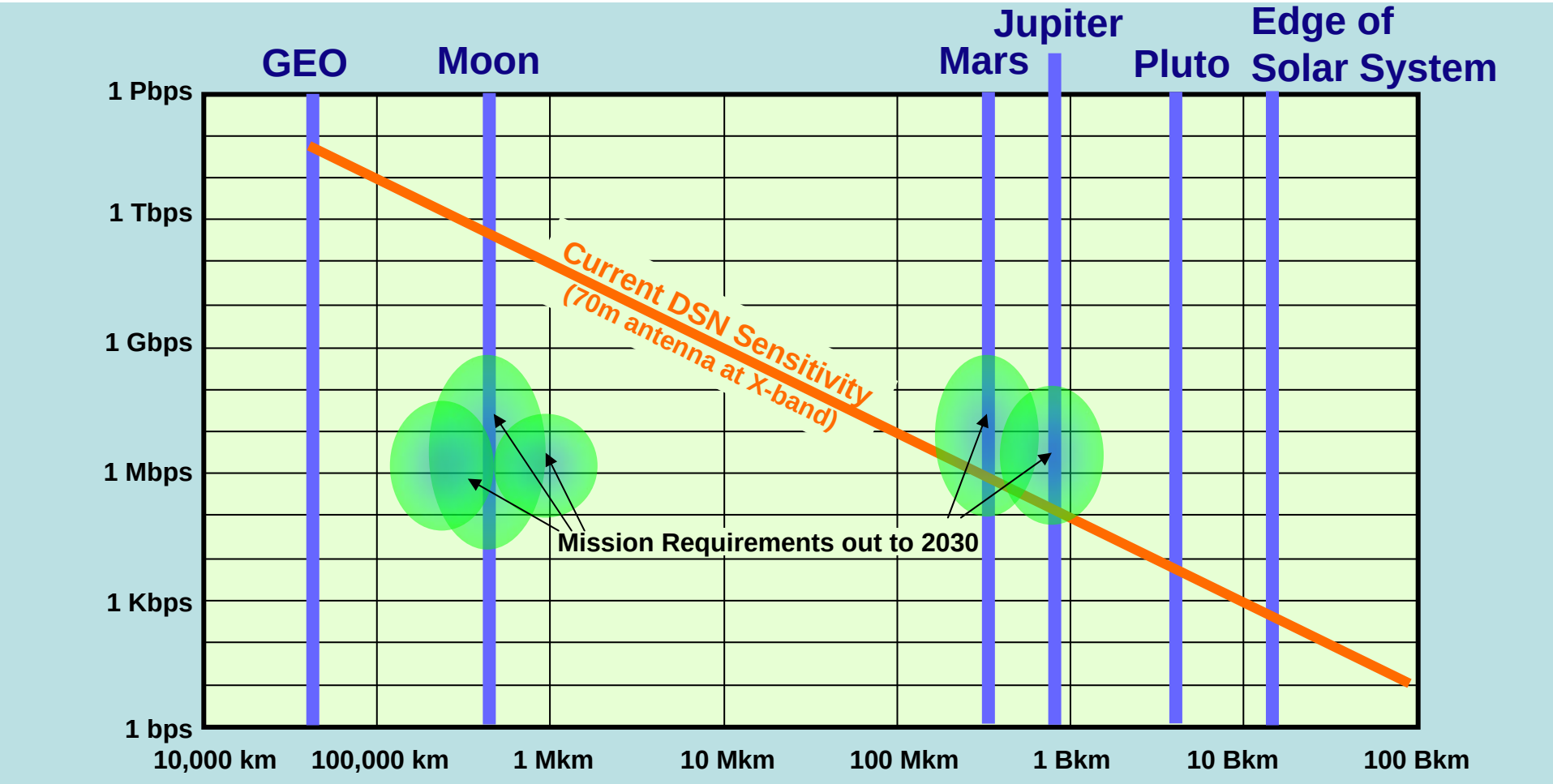

70M Hydrostatic
Bearing Pumps

Diesel Generator
- MDSCC

Erosion of Roads

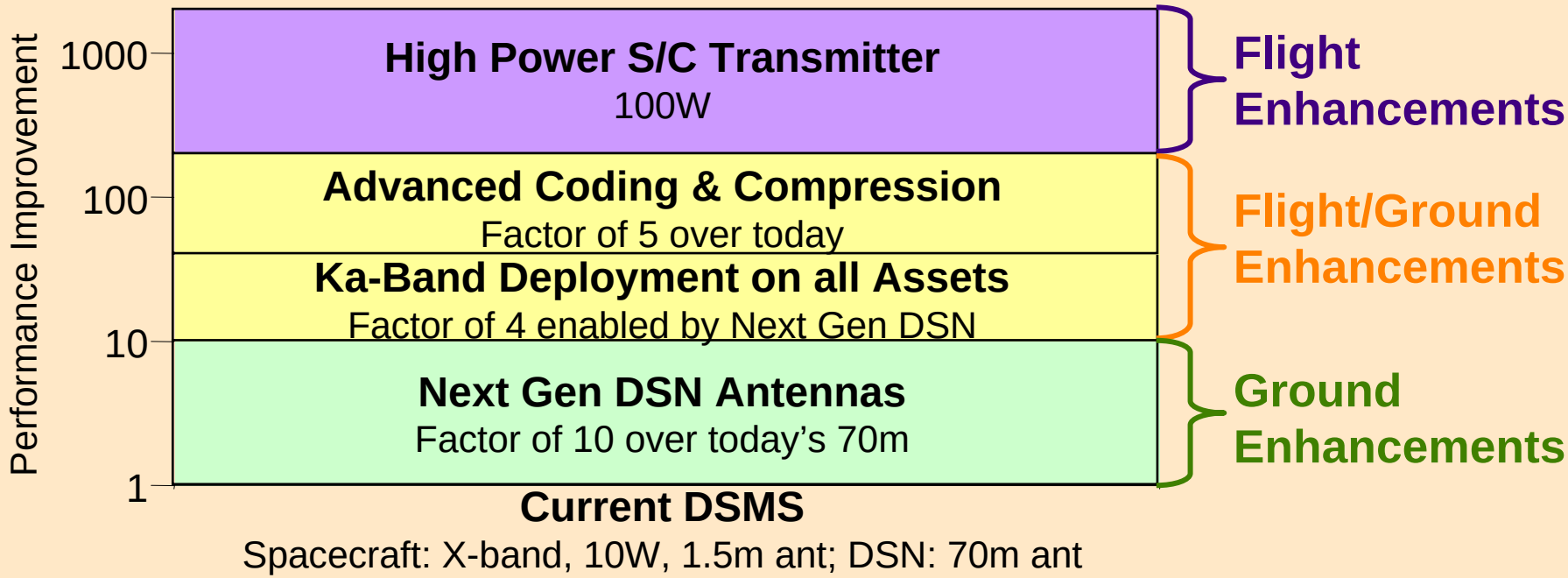
HEF El
Gearbox Bearing

DSN Performance Gap



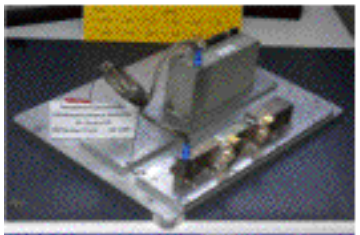
- 1,000-fold increase is needed to support planetary missions
- Adequate sensitivity already exists for all lunar and Earth libration point missions

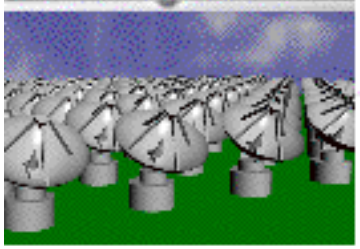
End-to-End RF Communication Performance Requirements

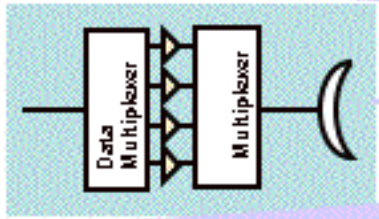


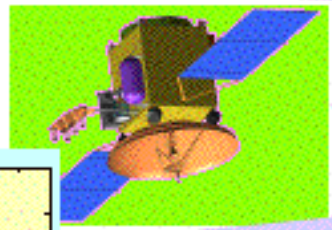
- Factor of 1,000 performance increase for most deep space missions
- Some missions will require more – up to 1,000,000
  - Higher power (~1 kW) transmitters
  - Larger (~10m) high gain antenna
  - Optical communications

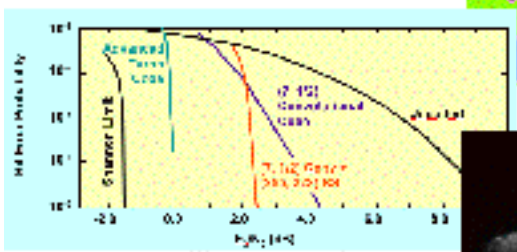
Key Technology Areas

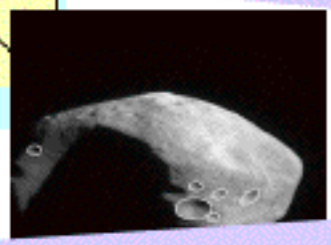






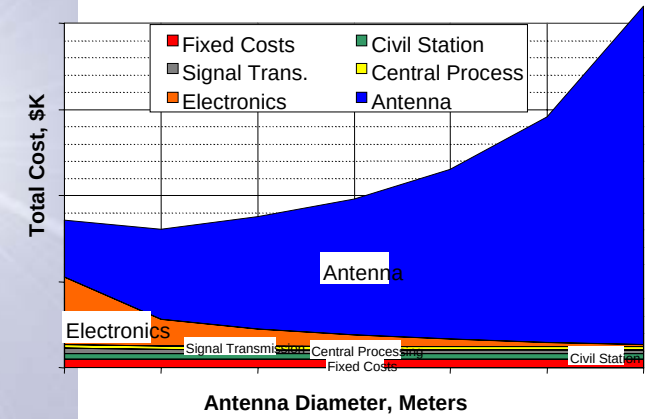






- **Ka-band communications**
  - 4x performance gain and increased bandwidth
- **High power spacecraft comm**
  - Take advantage of Project Prometheus
- **Large arrays of small antennas**
  - Earth infrastructure of the future
- **Optical communications**
  - New infrastructure for high bandwidth
- **Error-correcting codes**
  - Protect data sent through deep space
- **Data compression**
  - Use links efficiently
- **Ultra-stable clocks (including spaceborne)**
  - Perform precision navigation
- **Communications standards**
  - Guarantee quality and interagency cross-support

Synthesizing Large Antenna Apertures



- A new paradigm for microwave, large-aperture synthesis
- Requirements:
  - Low cost, high performance antennas
  - Low cost, low noise amplifiers
  - Low cost, reliable, cryogenics
  - Mass production efficiencies
- Potential for significantly lower cost than large microwave antennas

Next Gen DSN: *Why Arraying?*

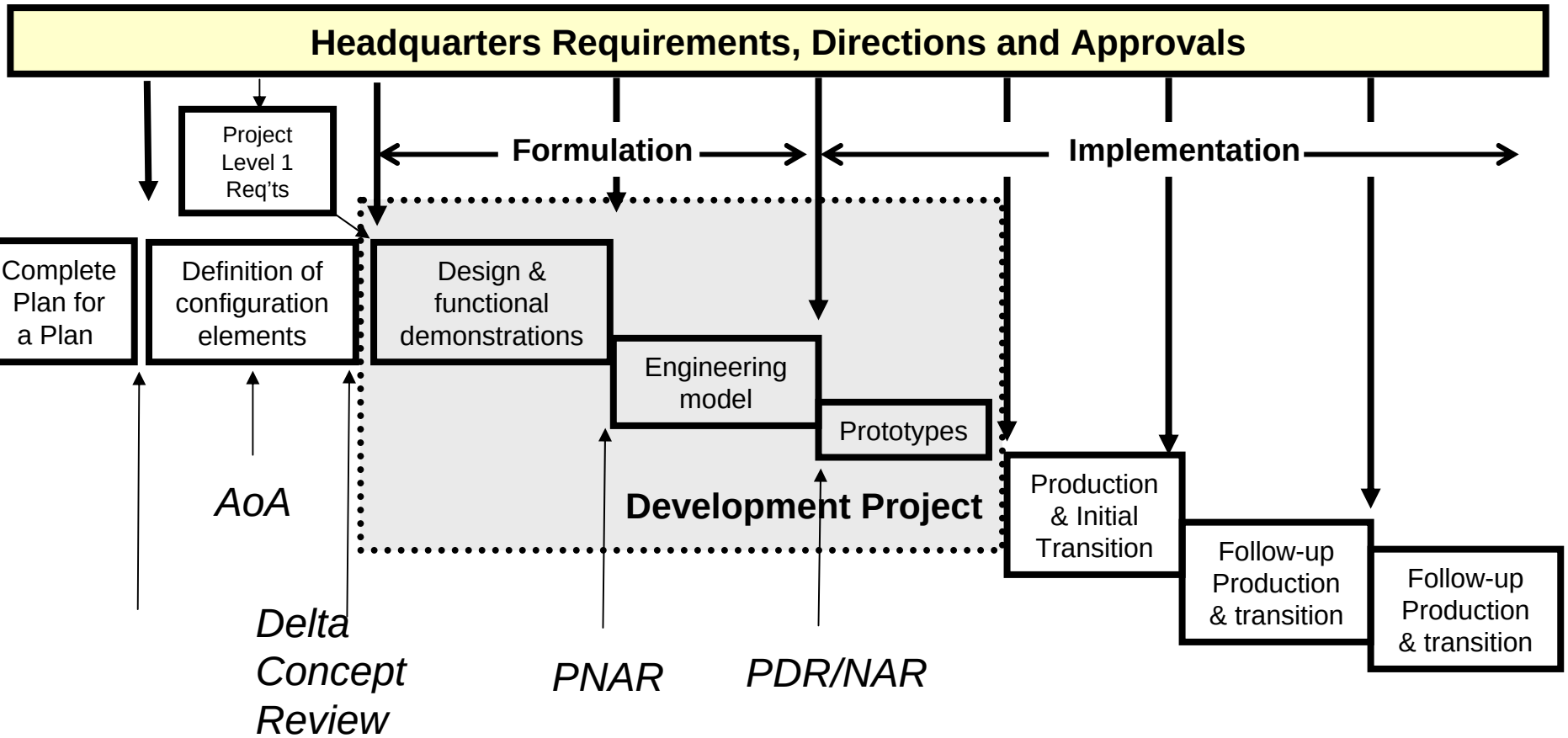
- Less expensive than large monolithic antennas
- Supports current and future missions
  - Consistent with NASA mission set implications for increased capabilities
- Modular and expandable to enable gradual deployment, commensurate with needs and funding availability
  - Can replace existing assets as they become uneconomical, or can create all new capabilities

Why Arraying? (continued)

- Higher reliability
  - Graceful degradation with component failures
- Lower real-time operations costs built in from the start

Phased Deployment Strategy

- Phased deployment
  - Scope, schedule and JPL/HQ commitments can be adjusted to reflect the evolving requirements and available budgets
- Transition from current DSN to future DSN



Optical Communications

- Optical comm is a key element of the DSN vision
  - High bandwidth for trunk lines from exploration targets
  - High performance for extreme outer planet missions
- With the demise of MLCD, a new infusion path is required for optical technology
- Missions of opportunity need to be identified

DSMS Program's Optical Comm Telescope Laboratory

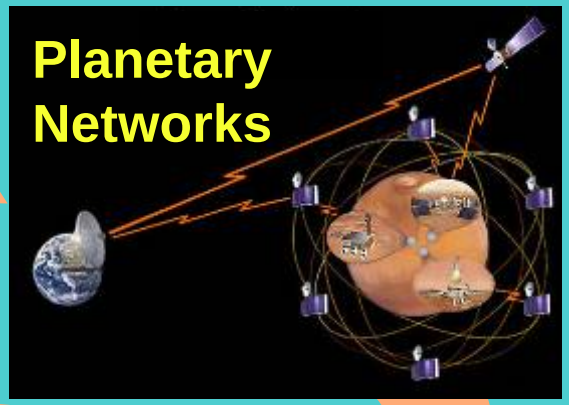
Prototype optical comm payload

Today's DSN

Global coverage of Deep Space

Current state of the art

Planetary Networks



High performance exploration

Increased accessibility

Improved nav and position locations

DSN Array

Modular and expandable

Low cost manufacturing and operations

x40 performance

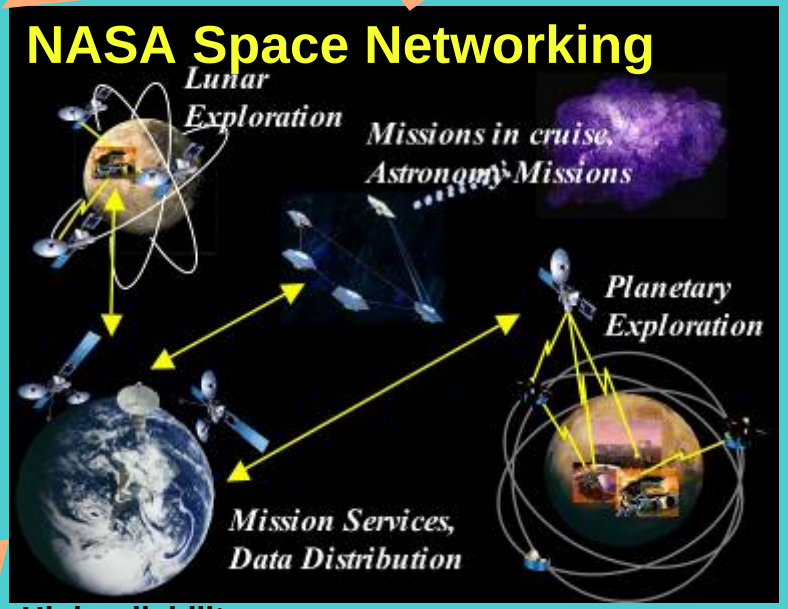
Optical Communications

High bandwidth communications

Low mass spacecraft components

Beginning of technology growth curve

NASA Space Networking



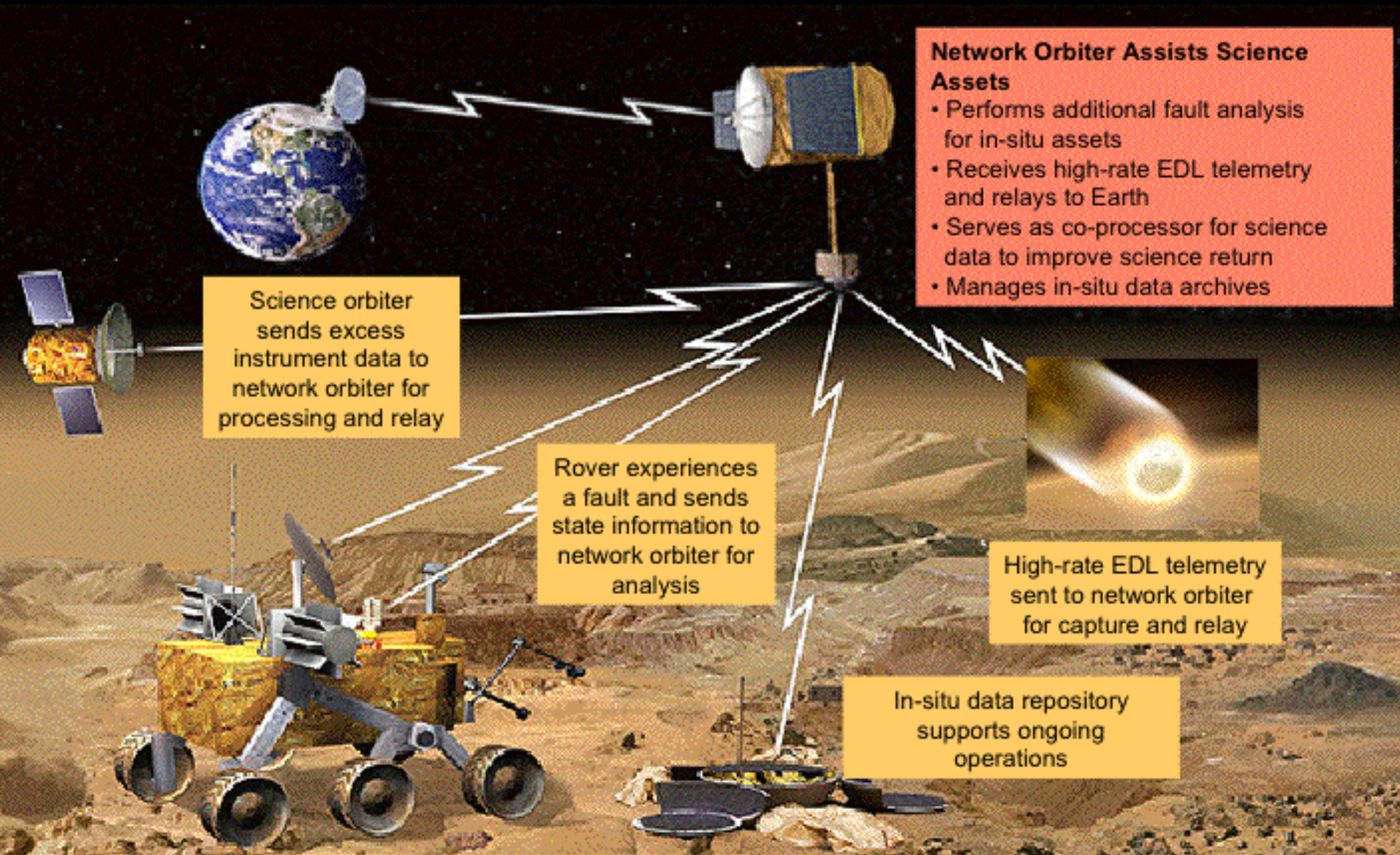
High reliability

High Performance: ≥ x1000 by 2015

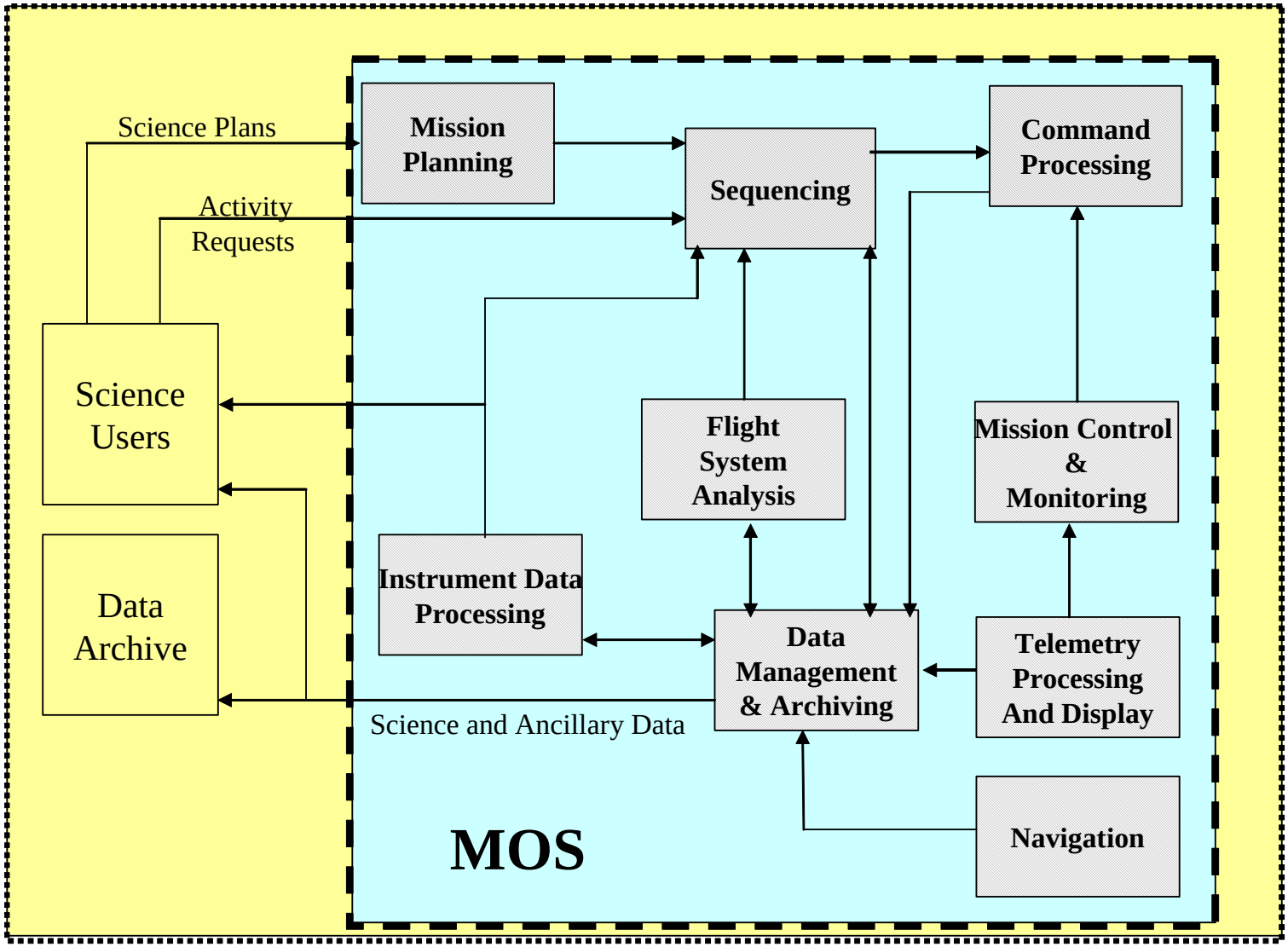
Cost effective

Planetary networks, seamless connectivity

Network Orbiter-Assisted Operations



Advanced Multi-Mission Operations System (AMMOS)



Questions?

Please talk with 9x personnel at the breakout session.