Planetary Science Update

Presentation at OPAG

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Director, Planetary Science Division

Outline

- Administrative Items
- FY09 Presidents Budget
- Planetary Announcements
- Cassini Extended Mission
- Establishment of SBAG
- DSN and Arecibo

JLG Reflections

- 19 months ago the PSD had these problems:
  - Research & Analysis was cut by 15%
    - Below life support! - Professors telling students don't go into PS
  - Astrobiology cut 50%
    - Putting in question if it would survive - NASA abandoning field?
  - New Frontiers mission Juno was being considered for cancellat Phase-A and over $1B)
    - Leading to the possible killing of NF program entirely
  - All NEO activities were moving to ESMD
    - A very small program but a political football
  - VSE did not include science to/from/on the Moon
    - LSSO was SMD's only activity and it was a token at best
  - No Discovery selection (deja vu)
  - No Outer Planets Flagship
    - Community to be forced to survive within a dwindling R&A program
  - PSD was grossly understaffed with low morale
- Today these are no longer PSD top problems but we do have different challenges

PSD Administration

- Dr. Mike Kelly Joined us; Duties include:
  - Program Scientist for NExT and EPOXI
  - Program Officer for PG&G
  - Hq contact on SBAG
- Dr. Sarah Noble - new NASA Post-Doc
- Jim Adams (PSD Deputy) on temporary assignment to front c (Dep AA for Flight Programs)

SMD Administration

- Alan Stern has resigned effective early Apı
- Dr. Ed Weiler (GSFC Center Director) will l interim SMD AA

MAJOR FY09 BUDGET CHANGES

~$600M transfer from Space Science (Astro, Helio, Planeta Earth Science over 5 years for their new Decadal missions

Six new FY09 missions starts: more than in the past four bu combined; at least one per SMD science area:

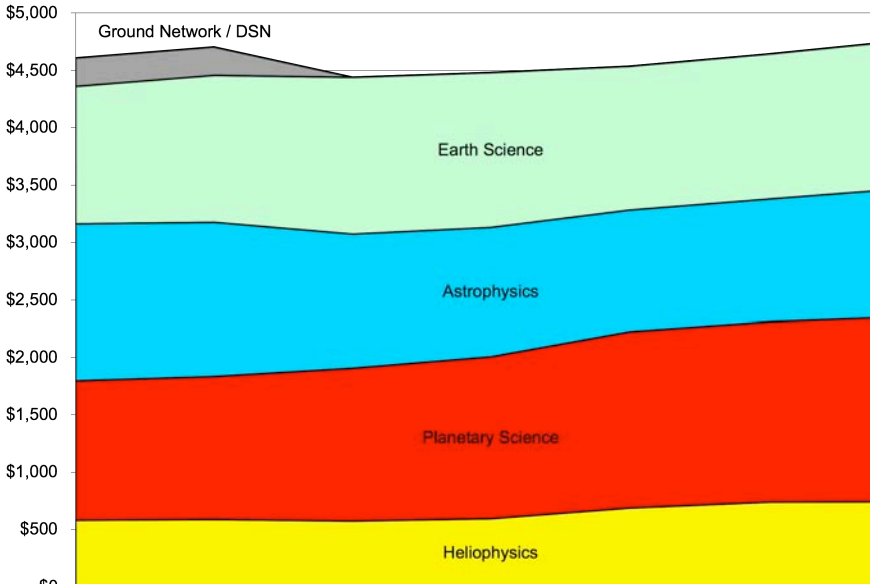
- Earth Science: IceSat II & DESTYNI (2012, 2015 launch
- Astrophysics: JDEM (launch in 2014)
- Heliophysics: Solar Probe Plus (launch in 2015)
- Planetary: Outer Planets Flagship (launch in 2016/2017) lunar science orbiter (launch in 2010/2011)

Substantial increases in astrophysics, heliophysics, and pla science R&A/MO&DA

Increased budgets for suborbital rockets and balloons

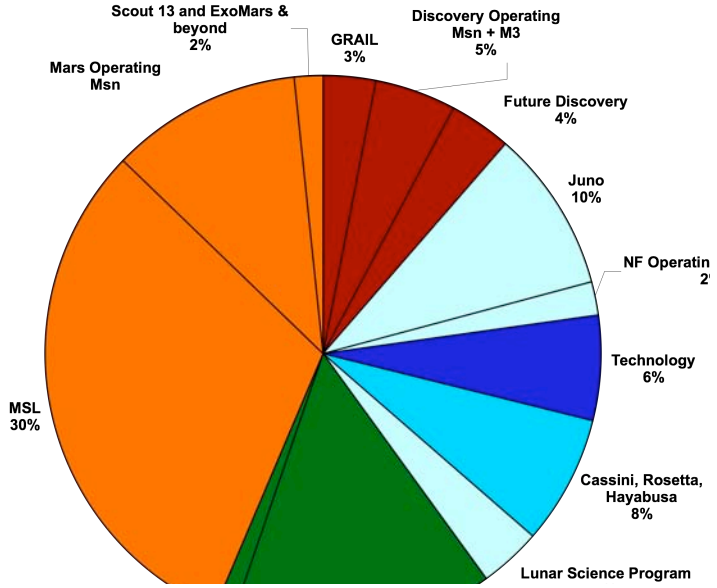
Funding for new starts and R&A increases came from internal transfers, efficiencies, out-year mission ops savi

BUDGET BY SCIENCE THEME

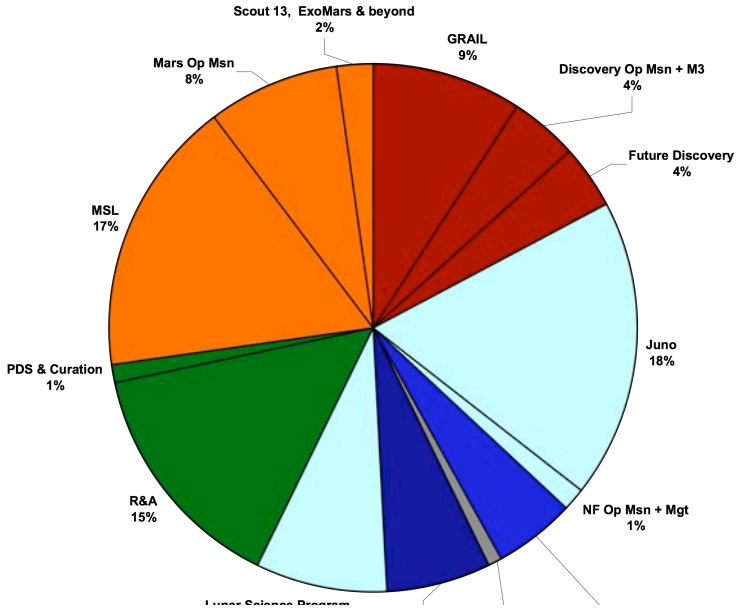


Planetary Division

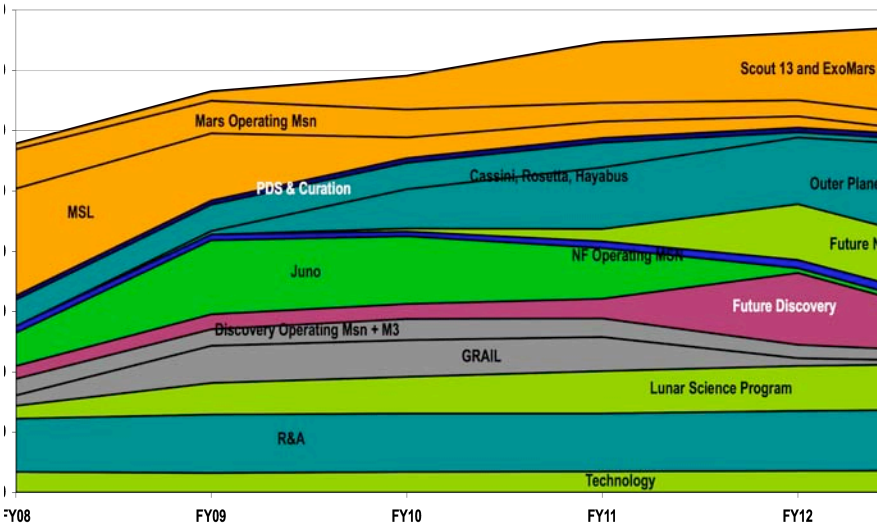
FY 2008 "Enacted" Budget, $1158M



Planetary Division
FY09 President's Budget, $1330M



Planetary Division
FY 2009 Budget ($M)*



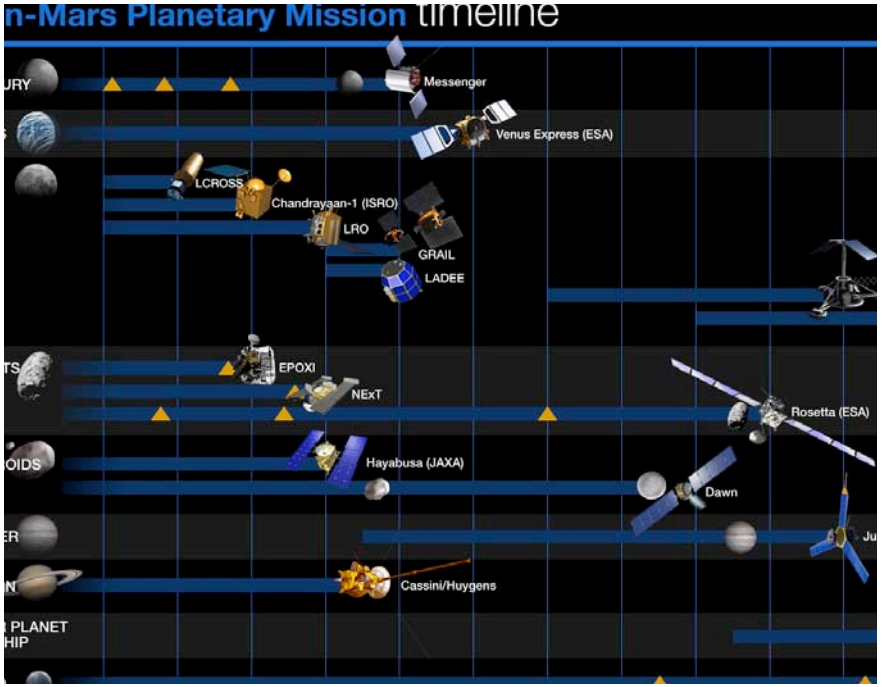
What Changed, What's the Same

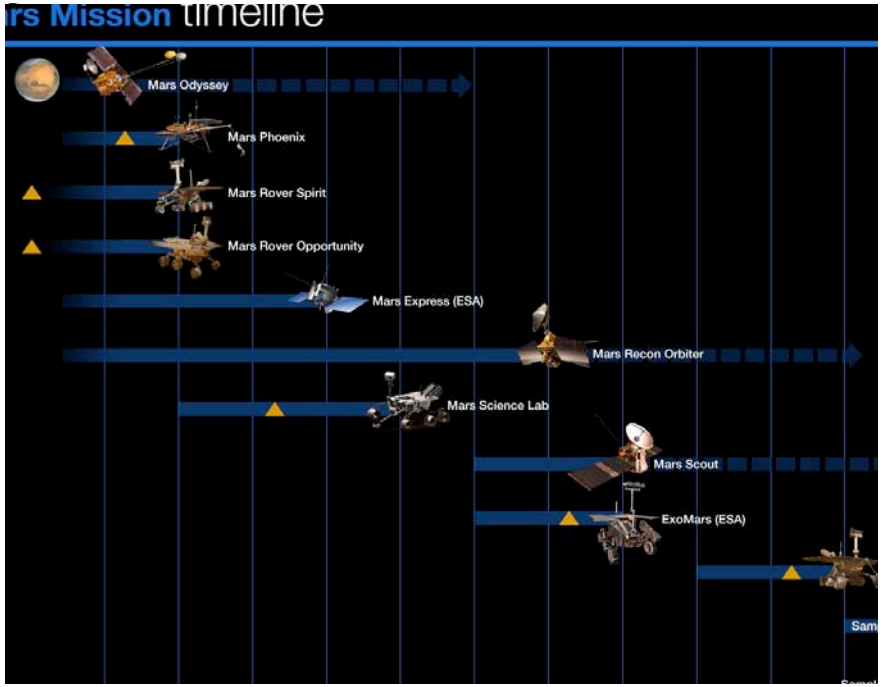
What Changed:

- Initiates an Outer Planets Flagship (OPF) to establish a balance between inner and oute system exploration.
- Lunar Science Research augmented to include a series of small lunar spacecraft.
- Augments and enhances R&A to return more results from Planetary missions.
- Discovery Program: Includes the recently selected MoOs (EPOXI and Stardust-NExT), a Aspera-3 2nd extension (ESA/Mars Express), and selected GRAIL.
- Preserves critical ISP work FY08 thru FY10, but deletes outyear activities in favor of mo R&A and RPS enhancements.
- Completes the Advanced Stirling RPS development and prepares for flight demonstratio
- Mars Scout 2011 delayed to 2013 due to conflict of interest discovered during proposal evaluation.
- Redirects the Mars Program to focus on Mars Sample Return (MSR)
- Expands US participation on the ESA/ExoMars mission by funding the potential selectio BOTH candidate U.S. instruments and EDL support.

What's the Same:

- Discovery Program: MESSENGER, Dawn, Mars Express/Aspera-3, Chandraayn/MMM
- New Frontiers Program: Juno and New Horizons
- Mars Program: Odyssey, MER, MRO, Phoenix, MSL
- Research Program: Lunar Science, PDS, ESA/Rosetta, JAXA/Hayabusa



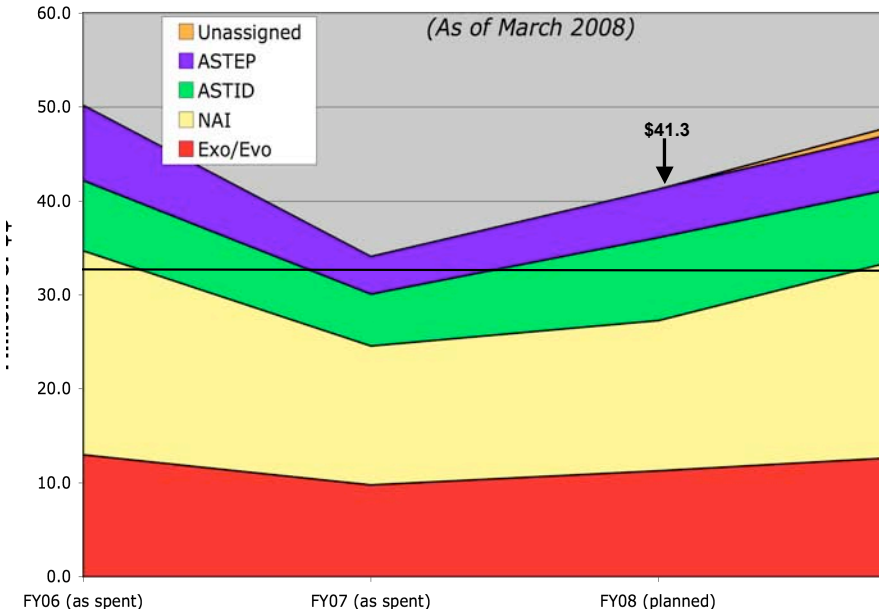


R&A Program

Planetary R&A Overview

ROSES	Spent FY07	Planned FY08	Presidents FY09
Mars R&A	**$14,158**	**$23,333**	**$24,938**
Mars Fundamental Research			
Mars DAP			
Discovery Research	**$11,881**	**$16,898**	**$18,816**
Sample Return Lab Inst &DAP			
Discovery DAP & Stardust DAP			
MESSENGER Participating Scientists Prog			
Planetary R&A	**$79,256**	**$101,367**	**$101,223**
PG&G			
Cosmochemistry			
Planetary Astronomy			
Planetary Atmospheres			
Planetary Instruments			
Origins of Solar Systems			
Planetary Protection			
Outer Planets Research			
New Horizons & Jupiter DAP			
Cassini Data Analysis Program (OPF)			
Astrobiology	**$32,414**	**$40,283**	**$49,258**
ASTEP			
ASTID			
NASA Astrobiology Institute			
Astrobiology: Exo and Evo			
Lunar Research	**$3,800**	**$18,700**	**$25,000**
Lunar Sortie Science Opportunity			
LRO- Participating Scientist Program			

Astrobiology Budget Past & Future Plans



Planetary Announcements

• Disco & Scout Missions Capability Enhancement

• New Frontiers #3 Destinations

• Stand-Alone Mission Opportunity Notification (SALMON)

DSMCE Program Overview

- Program solicited mission concept proposals for small planetary missions that require the ASRG power source
  - Two Stirling Engines with ~140 Watts each (as GFE)
- Intended to foster science exploration in planetary science by missions enabled by ASRG
- Mission design assistance for these 6 month miss concept studies will be offered by NASA
- Selected 9 proposals
  - 40 proposals submitted with average budget of $271K
  - NRA directed proposers to budget $200,000-$300,000

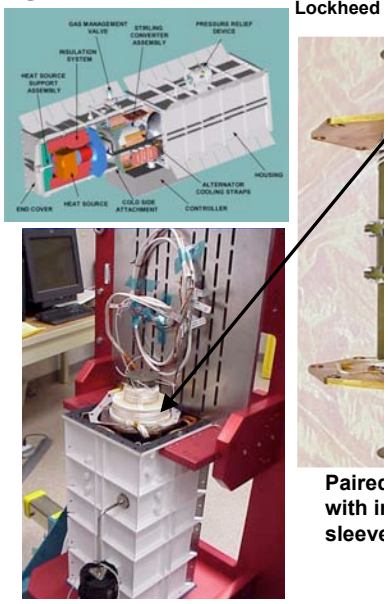
Advanced Stirling Radioisotope Generator Engineering Unit

Operation in space and on surface of atmosphere-bearing planets and moons

Characteristics:

- ≥14 year lifetime
- Nominal power : 140 We
- Mass ~ 20 kg
- System efficiency: ~ 30 %
- 2 GPHS ("Pu^{238} Bricks") modules
- Uses 0.8 kg Pu^{238}

Final wiring and connections for ASRG engineering unit underway



DSMCE Selections

nes, Kevin	JPL	Venus	Aerial Vehicle	Polar VALOR: The Feasibility of A Nuclea Duration Balloon Mission to Explore the Pc
hic, Richard	Los Alamos National Laboratory	Moon	Lander	Locating and Characterizing Lunar Polar V of a Discovery-Class Mission
iff, Bradley	Washington University	Moon	Rover	Journey to the land of Eternal Darkness an Lunar Polar Volatile Explorer
kin, Andrew	Applied Physics Lab	Asteroid	Lander	Ilion: An ASRG-Enabled Trojan Asteroid M
ght, Michael	JPL	Mars	Lander	A tour through Martian history: An ASRG-p borehole.
fan, Ellen	Proxemy Research	Outer Planets	Lander	Titan Mare Explorer (TiME)
Ewen, Alfred	University of Arizona	Outer Planets	Orbiter	Mission Concept: Io Volcano Observer (IV
ıdford, Scott	NASA/AMES	Comet	Sample Return	Concept Study for a Comet Coma Rendez Return Mission
ıshine, Jessica	Univeristy of Maryland	Comet	Lander	Comet Hopper

Just Released NRC NOSSE Report

- "*Opening New Frontiers in Space: Choices for the New Frontiers AO*" - NASA should:
  - R1: Emphasize science objectives
  - R2: Expand the list of candidate missions
  - R3: Limit to the list below unless compelling science
- Complete NF target list in alphabetic order:
  - *Asteroid Rover/Sample Return**
  - Comet Surface Sample Return
  - *Ganymede Observer**
  - *Io Observer**
  - Jupiter Polar Orbiter with Probes - Juno
  - Kuiper Belt/Pluto -> New Horizons
  - Lunar South Pole Aitken Basin Sample Return
  - *Network Science**
  - *Trojan/Centaur Reconnaissance**
  - Venus In-Situ Explorer

Current NASA/PSD Response

- NASA accepts the NRC's recommendations
- Consistent with the NRC report: NF3 will be open any Solar System target except the Sun and Earth
- All missions proposed must fit NF3 mission cost, timescale, and launch vehicle constraints
- Proposed missions must also be consistent with the unavailability of radioisotope power sources
- Although missions to any target can be proposed, priority will be given to the NRC report list
- NF3 Schedule:
  - Draft ~July 2008
  - AO ~October 2008
- Expect NF3 AO to be greatly simplified
- PI experience requirements

Current SALMON AO Schedule

SALMON Solicitation Development	Sept 2007 – Feb
Release Draft for comment	March 2008 (Fri
Revise SALMON based on comments	April 2008
SALMON Release	
– Program Element Cycle I	May 2008
Proposals Due	August 2008
Selections Announced	NLT February 20
SALMON Amendments (notional)	
– Program Element Cycle II (special)	May 2008
– Program Element Cycle III (regular)	May 2009

- Final approval for the release of this AO is with Dr. W

Types of Missions of Opportunity

- Traditional MoOs
  - Investigations involving participation in non-NASA space miss (ie: science instrument, technology demonstrations, hardware components …)
- U.S. Participating Investigator
  - Co-Investigator (non-hardware) for a science or technology experiment to be built and flown by an agency other than NAS
- New Science Missions using Existing Spacecraft
  - Investigations that propose a new scientific use of existing NA spacecraft (ie: NExT, EPOXI …)
- Small Complete Missions
  - Science investigations that can be realized within the specifie cap (includes all phases from access to space through data publication)
- Focused Opportunities

Cassini Senior Review

Prime mission July 2004 – July 2008
- Cassini spacecraft virtually 100% operational

Proposed extended mission goes to July 2010

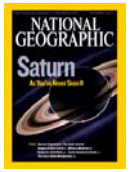
Extended mission science goals include:
- Titan (26 encounters)
- Enceladus (7 encounters + Rhea, Dione)
- Observe Saturn System thru Aug. '09 equinox

Estimate ~46% of hydrazine will remains at end of the extended mission
- Important for end of life to retain adequate fuel

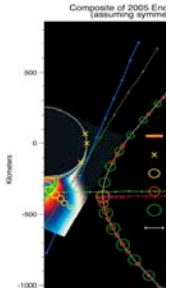
Science Panel recommendations and findings March 9, 2007

Operations review completed

Will be briefing Dr. Weiler as soon as



The extende includes 2 ~ thru Encela Prime obse curve



Small Bodies Assessment Group

- Official recognized AG for NASA
- SBAG has formed a steering committee
- Faith Vilas, Chair
- NASA Headquarters POC is Mike Kelley
- The terms of reference have been drafted
- First meeting is planned to be held immedia prior to or following the *Asteroids, Comets, Meteors 2008* conference in July.

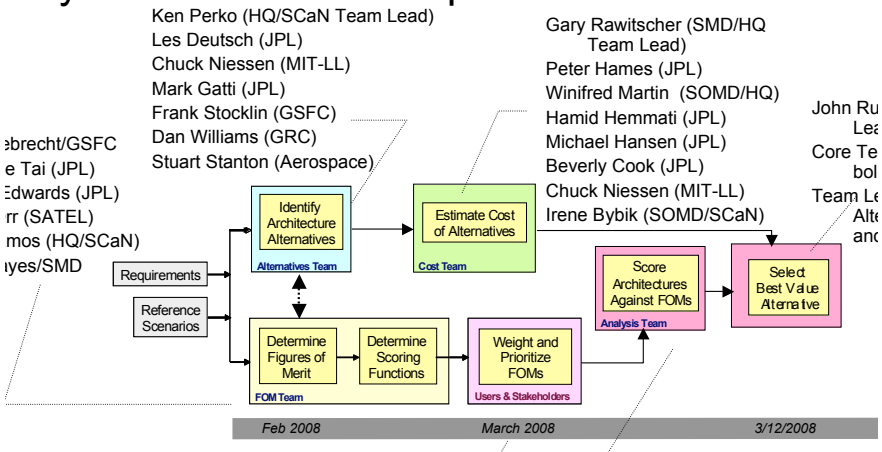
Deep Space Network

Fate of the 70m Dishes

Study Background

- DSN 70m Antennas are going through a life extension progra the 2015 time frame (as budgeted)
- SOMD initiated a 70m study to determine what actions should taken to address any continuing need for the 70m antennas o equivalent aperture in the post 2015 time frame. Three teams up:
  - Alternatives (options) Team
  - Figures of Merit Team
  - Costing Team
- The study team received an updated set of requirements gene by SMD specific to the 70m antenna capability beyond 2015.
- Note: Ka band on a 34m is equivalent to X band on a 70m
  - 70m used a lot for critical events

tudy Team Process Sequence & Team Makeu



Bogan (SMD/HQ) - Prog Scientist, Cassini, New Horizons
DePaula (SMD/HQ) - Planetary Science Division
Holmes (SMD/HQ) Dir, Heliophysics Great Observatory
Johnson (SMD/HQ) - PSD/Disc Scientist - PE
Meyer (SMD/HQ) - PSD/Mars Exp Prog Lead Scientist
Saunders (SMD/HQ) - PSD/Disciplinary Scientist
dbetter (OCE/SMD) - Chief Engineer
rotsos (SOMD/SCaN) - Dir, Network Services

Doug Abraham (JPL) - Loadin Considerations
Sami Asmar (JPL) - Radio Sc
Don Boroson (LL) - Optical
Jonathan Bruzzi (APL) - User
Chad Edwards (JPL) - Team
Hamid Hemmati (JPL) - Optic
Dave Morris (JPL) - Loading

Alternatives Team

Developed list of alternatives for replacing the 70m DSN capability Initi description matrix developed.

Core team reduced alternatives to be analyzed to 7 by elimination of Alternatives that were determined to be technically difficult to achieve

Alternatives list passed to Analysis Team

- Option 0: Retire 70m antennas in 2015, replace one for one with 34m
- Option 1: Just keep one 70m, replace others one for one with 34m
- Option 2: Maintain status quo by extending 70m life through 2025
- *Option 3: Offload applicable missions to other networks within NASA*
- *Option 4: Offload peak services externally (other agencies/nations) to lev rqmts*
- Option 5: Direct replacement with new monolithic 70m antennas
- Option 6: Gradual Replacement with 4x34m Arrays over the 2015-2025 p
- Option 7: Replace with 4x34m Arrays at all sites available in 2015
- Option 8: Build New Service Class – Optical
- Option 9: Build new service class - RF mm-wave

Major Figures of Merit (FOM) and Criteria Established

FOM Team Objective: develop discriminating criteria to enable quantitative/qualitative comparisons among alternative options to enab subsequent technical ranking and scoring of alternatives

- Study deliberately separated risk based Life Cycle Cost as a FOM

FOM Categories and Sub-criteria:

- User Need/Requirements Satisfaction
  - Nominal Science & TT&C Link Performance and Critical Event Emergency TT&C Performance
  - Radio Science (Frequency bands and Polarization)
  - Radar Science (Frequency bands, EIRP x G/T, and Polarization)
  - Capacity (Uplinks/Downlinks at 34/70M apertures at X and Ka Frequencies)
- System Consideration
  - Adaptability (Changes in mission schedules, Profiles, data rates and number of
  - Scalability (Capacity or Data Rate extension/reduction)
  - Evolvability (Addition of new capabilities and/or technology)
  - Robustness (Reliability and Availability, Maintainability,Operational Risk, & Oper
- User Burden (Telecom Flight Subsystem, Spacecraft Pointing, and Missio Operations)

Weighting of FOMs

- ***Users from SMD, ESMD, other stakeholders participated in methodical 'pair-wise comparison' process to prioritize and weight importance of each figure of merit***
- ***Prioritization and Weighting of FOMs accomplished using Decision Lens***

User Need/Requirements Satisfaction (.49)

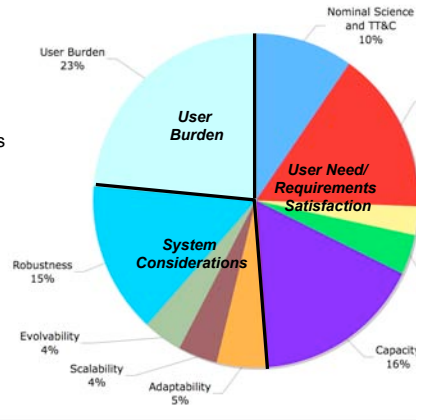
- Nominal Science & TT&C Link Performance and Critical Event Emergency TT&C Link Performance
- Radio Science (Frequency bands and Polarization)
- Radar Science (Frequency bands, EIRP x G/T, and Polarization)
- Capacity (Uplinks/Downlinks at 34/70M apertures at X and Ka Frequencies)

System Consideration (.28)

- Adaptability (Changes in mission schedules, Profiles, data rates and number of users)
- Scalability (Capacity or Data Rate extension/reduction)
- Evolvability (Addition of new capabilities and/or technology)
- Robustness (Reliability and Availability, Maintainability,Operational Risk, & Operability)

User Burden (.23)

- User Burden: Telecom Flight Subsystem
- User Burden: Spacecraft Pointing



70m Study Way Forward

The 70m Study Team recommends Option #2 as a best value Agency

- Invest in maintenance & upgrades to extend the life of the 70's to
- Should be no additional cost to SMD for this approach

SOMD should initiate a proactive monitoring program for the 7 antennas to assure long term reliability of the 70m antennas th 2025.

SOMD develop plans for the advancement of optical comm technology and identify near term deep space flight demonstra opportunity to mitigate risk.

Arecibo

- Congress has directed both NASA and NSF to fun Arecibo operations in FY08
  - NSF has confirmed they will fully fund Arecibo in FY08
- Congress has also directed NASA to task the Natic Academy to "address issues in the detection of potentially hazardous NEOs and approaches to mitigating identified hazards"
  - "In order to assist Congress in determining the optimal ap regarding the Arecibo Observatory, NASA shall contract v National Research Council to study the issue and make recommendations"
  - Study shall include an assessment of the costs of various alternatives, including options that may blend the use of d facilities (whether ground or space-based)
  - Optimal approach to developing a deflection capability