

WORKING GROUP 5: "WHEN"

PURPOSE

Working Group 5 is to consider ideas about specific architectures (the "WHEN" group) for the Mars Exploration program that integrate mission concepts (specifically those that validate critical phases and elements of future potential science and human missions) into a time-phased sequence with specific definition of mission approaches, experiments, and expected results.

OVERVIEW OF "WHEN" ABSTRACTS

- Outreach (1 paper)
- Remote Sensing (2 papers)
- Networking (1 paper)
- Roving (2 papers)
- Returning Samples (3 papers)
- Human Mission Considerations (2 papers)
- Communications (4 papers)
- Architecture Considerations (7 papers)

HIGHLIGHTS OF "WHEN" PRESENTATIONS (1)

- Outreach
 - To reach the public, involve planetaria in addition to K-12 schools
 - Share challenges with the public as you build the program
 - Actively engage the public in mission operations
- Remote Sensing
 - Understanding the volatile history requires a sustained multi-mission effort
 - Ground-truth measurements can significantly improve our ability to calibrate and understand remote sensing data
- Networking
 - The concepts aren't new, but their science value remains high
- Roving
 - Next generation Rovers can increase science payload capacity and range by an order of magnitude, even using only solar power
 - Field experience shows rover operations to be more difficult than anticipated

HIGHLIGHTS OF "WHEN" PRESENTATIONS (2)

- Returning Samples
 - Sample return in '07 will retain the cost-effective benefits of strong international participation
 - New data sets and technologies (e.g., SEP) can add flexibility and robustness to the sample return mission design
 - CAPTEM recommendations should guide sampling requirements and ensure science integrity
- Human Mission Considerations
 - Astronaut field training is also a prerequisite
 - Mars science contamination from human presence needs to be addressed
- Communications
 - A Mars communication infrastructure is critical to any effective exploration architecture (comm bottleneck already exists)
 - Standards and new technologies must be part of the infrastructure

HIGHLIGHTS OF "WHEN" PRESENTATIONS (3)

- Architecture Considerations
 - Plans are worthless (i.e., our previous plan was inflexible to events and new information), planning is everything (i.e., our new plan should stress adaptability, embrace new technologies, and adjust to evolved science understanding)
 - Lessons-learned in lunar exploration point to the importance of in situ measurements and early "sample return" to calibrate global data sets and establish measurement context; it is the only way to know absolute ages
 - Early sample return by-passes in situ exploration, consumes all resources, is risky, and invites "mission accomplished" termination
 - Mission development cycles don't fit launch opportunity intervals; a two-pronged exploration approach, possibly including "Discovery" missions should be considered

Architecture Strategy Questions

- **International Participation:** What roles (science, engineering, operations, etc.) and how should it be engaged?
- **Technology:** Use SOA or Invest New Program \$'s to enable?
- **Surface Power:** Solar or Nuclear? If nuclear, how soon?
- **Sample Return:** ASAP or later (better knowledge and technology)?
- **Surface Science:** What are the critical challenges (knowledge, technology, demonstrations) for the conduct of early, effective surface science (in situ investigations and sampling)?
- **Airborne Science:** What is the role of medium resolution/medium coverage Mars airborne (balloons, hoppers, airplanes) and descent imaging science?
- **Orbit Science:** After Mars '01 and Mars Express what are the important investigations and at what pace should they be conducted?

"WHEN" GROUP OPEN DISCUSSION (1)

- International Participation
 - Engage partners at the start
 - ITAR compliance requires diligence, but can be worked
 - Margins may need to increase to smooth interfaces
- Technology
 - New technologies are needed (power, subsystems, comm)
 - Invest program \$'s on unique needs; rely on other NASA investments for cross-cutting technologies
 - Don't build entire program around new technologies (parallel tracks)
- Surface Power
 - Nuclear power source clearly enhances surface science capabilities; it enables long duration surface missions
 - Issues include conversion development, fuel supply, hazards
 - Engage the public in the development process (don't hide it!)

"WHEN" GROUP OPEN DISCUSSION (2)

- Orbital Science
 - Hi-res images needed across entire landing ellipses
 - To understand climate will require more orbital investigations
 - Analysis tools will handle the rapidly growing global data sets
 - DoD experience may prove useful when inverting orbital data
- Airborne Science
 - Offers better resolution and a totally new perspective
 - A major benefit is increased mobility
 - Adaptability and supporting infrastructure are essential
- Surface Science Challenges
 - Objectives should be broad (vs focus on "search for life")
 - 3-D (mobility and subsurface) access will require new technologies
 - Adaptive measurement techniques are needed

"WHEN" GROUP OPEN DISCUSSION (3)

- Sample Return
 - Experience says "early" sample return is an important step in the exploration process (provides ground truth and context)
 - But, others worry that "early" sample return is risky and will consume all program funding for many years (all our eggs in one basket)
 - Proper sample return will first require substantial global reconnaissance
 - Atmospheric samples will yield valuable science

Summary

- Maintain exploration momentum with two-pronged approach
 - One for technology dependent missions, e.g. Sample Return
 - One with proven capabilities (perhaps with Discovery-type projects)
- Avoid detailed multi-opportunity plans so that program is robust to unforeseen events and responsive to new discoveries