NASA’s Exploration Plans and The Lunar Architecture

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The U.S. Space Exploration Policy: Foundation for Exploration

- Complete the International Space Station
- Safely fly the Space Shuttle until 2010
- Develop & fly the Crew Exploration Vehicle no later than 2014
- Return to the Moon no later than 2020
- Extend human presence across the solar system & beyond
- Implement a sustained & affordable human & robotic program
- Promote international & commercial participation in Exploration
Architecture Development Driven By A Strategy
Where We Have Been and Next Steps

Global Exploration Strategy Development – Themes and Objectives

Architecture Assessment (LAT1) Dec 06 – Outpost first at one of the Poles, elements critical to US

Detailed Design Concepts (LAT2) Aug 07 – Operations concepts, technology needs, element requirements

Lunar Capabilities Concept Review June 08 – Refinement of concepts in support of the transportation system

Lunar surface concept additional analysis cycles

Lunar Surface Concept Review, June 2010

Lunar transportation and surface systems SRRs

Lunar surface system element SRRs

Time
Why Explore the Moon?

- **Human Civilization**
- **Scientific Knowledge**
- **Exploration Preparation**
- **Global Partnerships**
- **Economic Expansion**
- **Public Engagement**
Defining and International Lunar Exploration Architecture

• Working with International Partners
  – Nov 2007: Establishment of the International Space Exploration Coordination Group (ISECG)
  – NASA and other ISECG members participating in series of workshops to jointly examine architectures and approaches for human exploration beyond low-Earth orbit
  – Develop several lunar exploration scenarios based on potential exploration objectives across the international community
  – Assess respective priorities, identify potential time dependencies between systems, and assess impact on development of standards
Constellation Program Fleet of Vehicles

- **Ares I**: Crew Launch Vehicle
- **Ares V**: Cargo Launch Vehicle
- **Orion**: Crew Exploration Vehicle
- **Altair**: Lunar Lander

*Earth Departure Stage*
Lunar Architecture Framework — A Notional Point of Departure

- Human lunar missions will be used to build an outpost at a polar site.
- The ability to fly human sorties and cargo missions with the human lander will be preserved.
- Initial power architecture will be solar with the potential augmentation of nuclear power at a later time.

- Robotic missions will be used to:
  - Characterize critical environmental parameters and lunar resources.
  - Test technical capabilities as needed (Build-up approach).
- The ability to fly robotic missions from the outpost or from Earth will be a possible augmentation.
Possible South Pole Outpost

- The lunar South Pole is a likely candidate for outpost site
- Elevated quantities of hydrogen, possibly water ice (e.g., Shackelton Crater)
- Several areas with greater than 80% sunlight and less extreme temperatures
- Incremental deployment of systems – one mission at a time
  - Power system
  - Communications/navigation
  - Habitat
  - Rovers
  - Etc.
Notional Elements of an Outpost

- Lander and Ascent vehicle
- Carrier Mobility
- Basic Hab
- Initial EVA System
- Augmented Power System
- Logistics Module
- Solar Power
- Site survey, resource mapping
- Communications
- ISRU
- Habitation
- Science Lab
- Logistics carriers
- Regolith moving
Importance of Mobility in the Lunar Architecture
Summary

• Challenges lie ahead but NASA continues to deliver as promised
  - Major work, research and studies is underway
  - Contracts are in place and milestones to be met
  - Our plan is executable

• NASA has planned and paced the multi-decade program to live within its means, while carefully identifying and mitigating the threats to mission success

• International, Commercial, Science, and Other Government Agency Partnerships are Vital to Exploration Success