Implementing the Vision
2nd Space Exploration Conference

Exploration Strategy and Architecture

EMBARGOED until Monday, December 4, 12:00 EST

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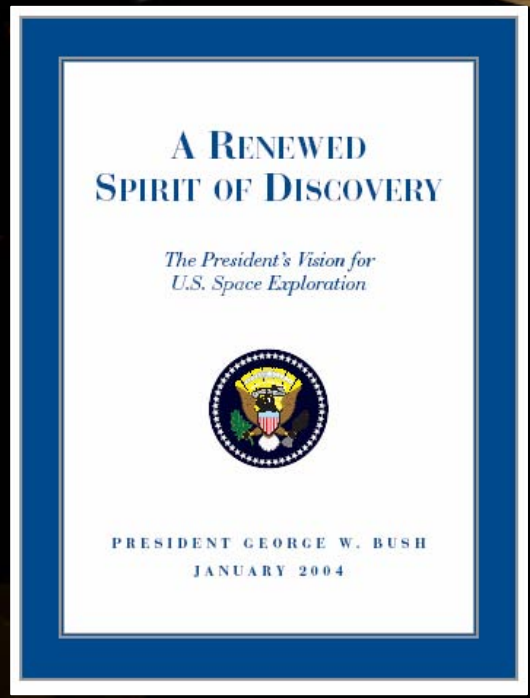
DRAFT

A Bold Vision for Space Exploration, Authorized by Congress

- Complete the International Space Station
- Safely fly the Space Shuttle until 2010
- Develop and fly the Crew Exploration Vehicle no later than 2014 (goal of 2012)
- Return to the Moon no later than 2020
- Extend human presence across the solar system and beyond
- Implement a sustained and affordable human and robotic program
- Develop supporting innovative technologies, knowledge, and infrastructures
- Promote international and commercial participation in exploration



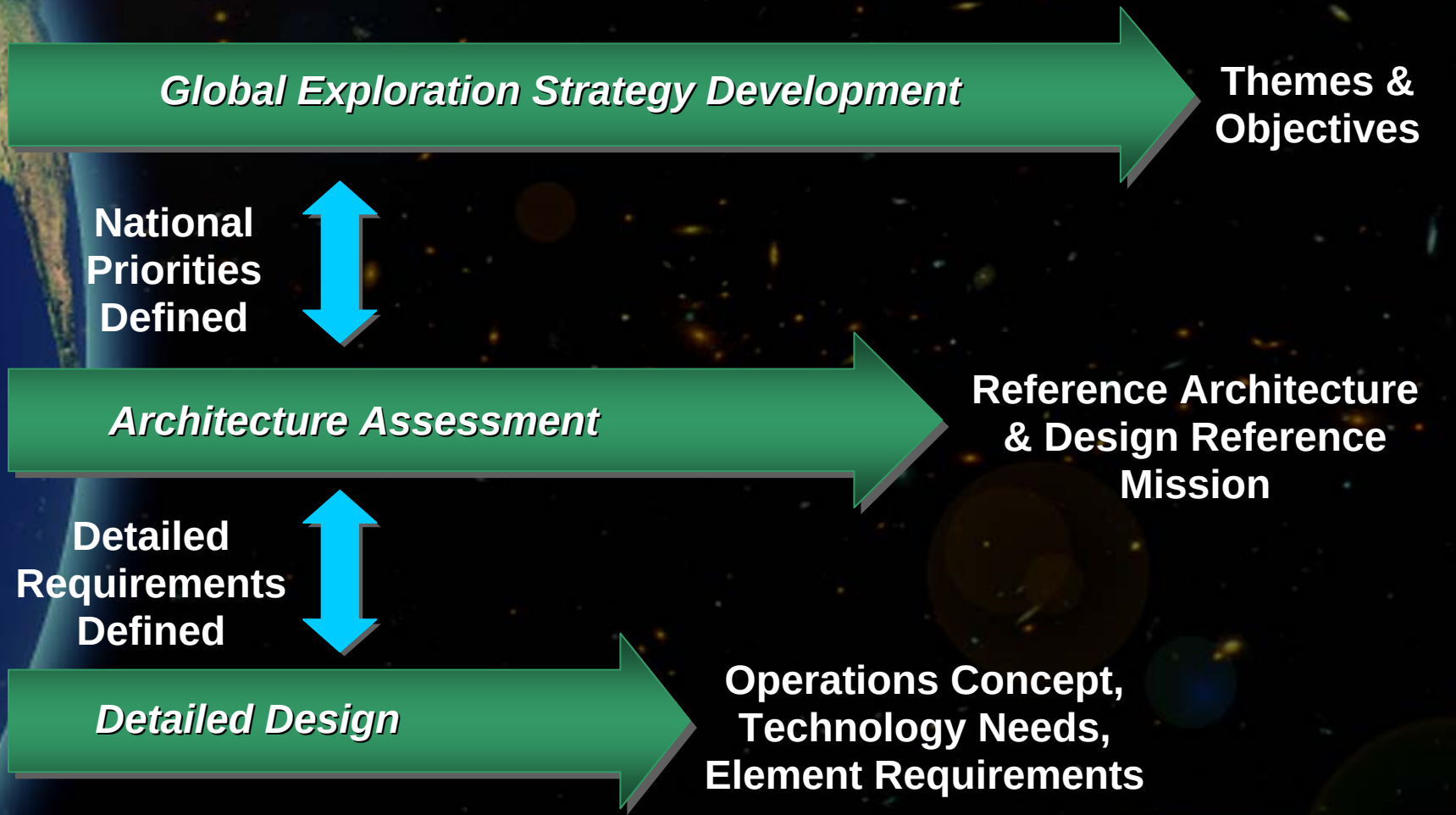
NASA Authorization Act of 2005

The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.

US Role in Exploration – Derived from the Vision

- **Leadership in US Exploration Strategy and Architecture Development-**
  - A collaborative effort
  - Identifying common interests with others
- **Provide the US Transportation and certain exploration infrastructure.**
- **Extend operational experience in a hostile planetary environment**
- **Early US Robotic and Human mission definition**
- **Prepare for Human exploration of Mars**
- **Early experiments and demos to characterize the planetary environment and test feasibility of planned operations (ISRU for example)**
- **Provide Educational Benefits**
- **Provide and facilitate opportunities for :**
  - Science
  - Economic development
  - International participation

Our Approach: An Architecture Driven By A Strategy



NASA Exploration Lunar Activities addressing Themes

Human Civilization

Global Partnerships

Scientific Knowledge

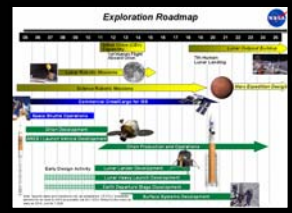
Economic Expansion

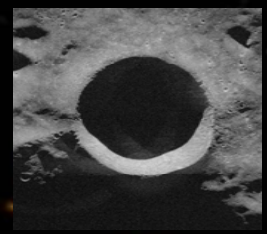
Exploration Preparation

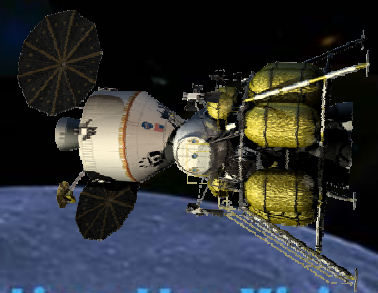
Public Engagement

What are the Big Lunar Architecture Questions?

- **What are the US priorities and phasing for what we will achieve at the moon?**
- **How do priorities drive important decisions?**
  - Outpost vs. Sorties
  - Landing site(s)
  - Architecture flexibility to address lower US priorities or far-term interests
- **What infrastructure is required to support priorities?**
  Considerations:
  - Schedule/ flight rate
  - Cost/ available budget
- **What will we plan on developing ourselves?**
  - Critical path hardware to achieve primary objectives
  - Allowing for parallel developments from commercial and/or international communities
- **What level of limiting resources will allow for optimum realizable capability?**
  - Enabled by basic NASA transportation architecture
  - Down-mass and up-mass at the Moon
  - Power

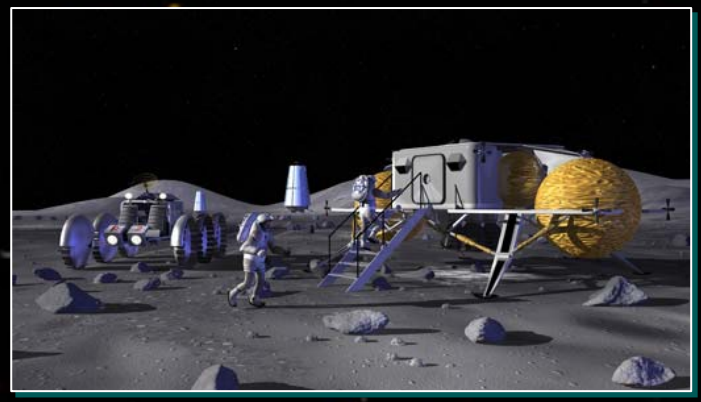






Lunar Architecture Framework — Point of Departure

- 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
- The ability to fly robotic missions from the outpost or from Earth will be a possible augmentation

NASA Implementation Philosophy

- The US will build the transportation infrastructure and initial communication & navigation and initial EVA
- Open Architecture: NASA will welcome external development of lunar surface infrastructure

- The US will perform early demonstrations to encourage subsequent development
- External parallel development of NASA developed capabilities will be welcomed

Open Architecture: Infrastructure Open for Potential External Cooperation

- **Lander and ascent vehicle**
- **EVA system**
  - CEV and Initial Surface capability
  - Long duration surface suit
- **Power**
  - Basic power
  - Augmented
- **Habitation**
- **Mobility**
  - Basic rover
  - Pressurized rover
  - Other; mules, regolith moving, module unloading
- **Navigation and Communication**
  - Basic mission support
  - Augmented
  - High bandwidth
- **ISRU**
  - Characterization
  - Demos
  - Production

- **Robotic Missions**
  - LRO- Remote sensing and map development
  - Basic environmental data
  - Flight system validation (Descent and landing)
  - Lander
  - Small sats
  - Rovers
  - Instrumentation
  - Materials identification and characterization for ISRU
  - ISRU demonstration
  - ISRU Production
  - Parallel missions
- **Logistics Resupply**
- **Specific Capabilities**
  - Drills, scoops, sample handling, arms
  - Logistics rover
  - Instrumentation
  - Components
  - Sample return

**** US/NASA Developed hardware**

Forward Work (January – July 07)

Using current architecture as a point of departure

- Develop global view and mature architecture
- Coordinate lunar exploration plans among international and commercial partners and continue to look for other collaboration opportunities
- Refine campaign and architecture concepts and also element hardware concepts
- Update and baseline ESMD Requirements
- Develop Mars Reference Mission
- Continue to engage academia, the private sector, and other stakeholders in defining a sustainable program of exploration

Post 2025 Opportunities

By 2025 NASA will have developed the capabilities required to enable various future paths. Agency decision: Which future path(s) to take?

Agency Decision on Future Path(s)

2025 Capabilities

- Mature transportation system
- Closed loop habitat
- Long duration human missions beyond LEO
- Surface EVA and mobility
- Autonomous operations
- Advanced robotic missions
- Minimize reliance on Earth via In-Situ fabrication and resource utilization
- Enhanced by Commercial and International Partners

Humans to Mars

NASA Follow-on Strategy

Mars

Expand Lunar Outpost Site Exploration

Expand Lunar Outpost via Commercial and/or International Partners

Human Exploration of Other Lunar Sites via Sorties