

Lunar Robotic Missions International-Commercial Involvement

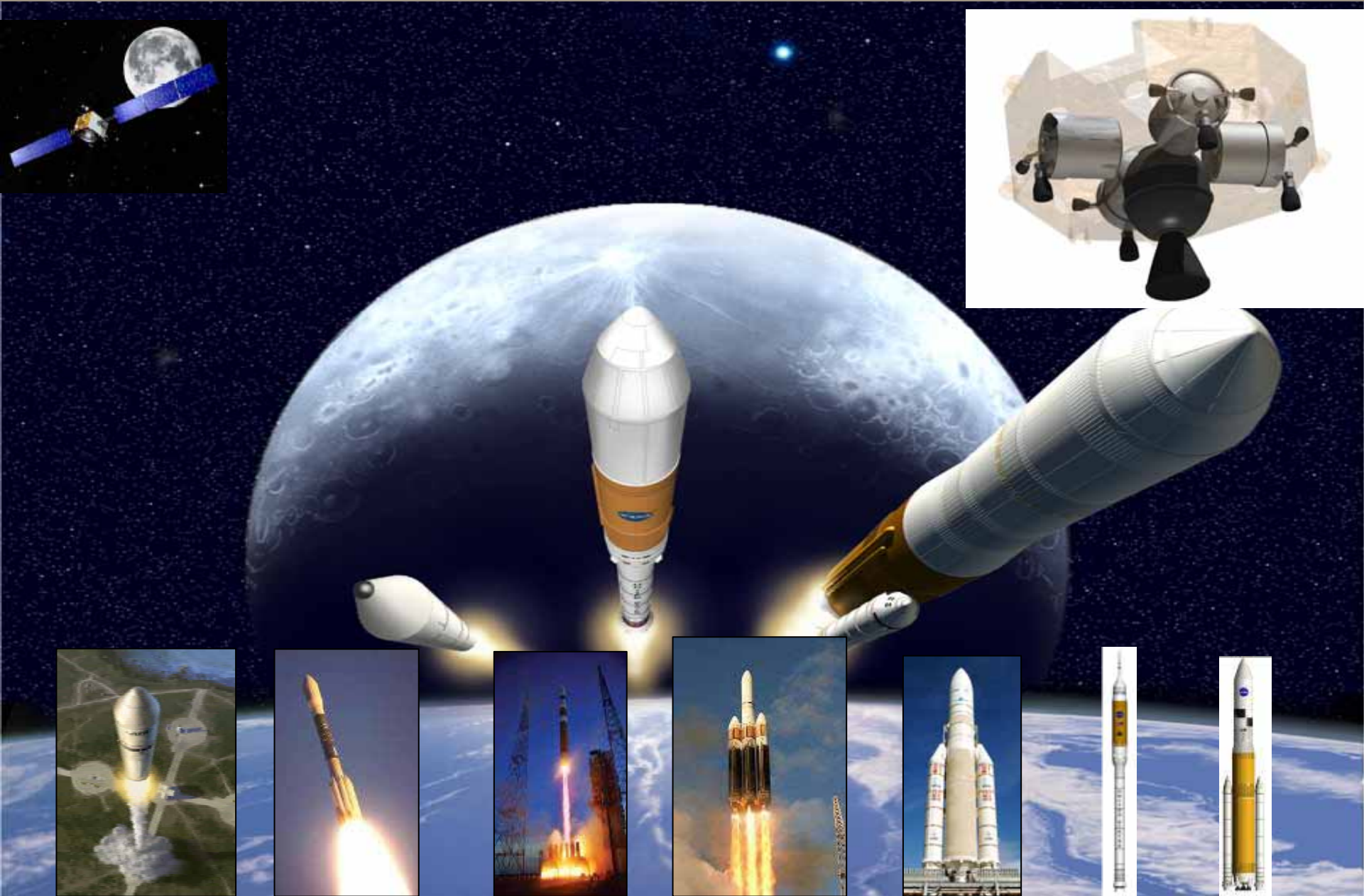
October 2, 2007



International-Commercial Involvement Lunar Robotic Missions



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Observations:

- Significant and thorough LAT efforts will insure the first steps back on the lunar surface will be productive and worth while
 - All 4 NASA directorates working together for a common goal is commendable
 - Initially focusing on Constellation and Outpost needs while demonstrating Mars technology is the logical first steps
- Additional science and commerce related missions could enhance the success of the exploration efforts in a shorter time period

Concern:

- Insufficient budget to fund a timely robust lunar robotic assessment of the lunar surface
 - No single space agency can afford to conduct and sustain an optimum lunar exploration effort
 - Statistically sound assessments require large number of missions in diverse locations
 - Precursor missions sufficient to further dive down risk of manned missions and provide early science data can be expensive

Opportunities:

- Additional International/commercial precursor missions can enhance current exploration efforts
 - Crew mission risk can be reduced further
 - Early enhanced science returns possible
 - Can enable early commercial ISRU related manufacturing
 - Can facilitate early off ramps for space agencies with commercial efforts continuing to enhance sustainability

Solution:

- While focusing on the manned transportation aspects of the mission NASA leaves open the options of other sources (commercial, international, etc.) providing other elements of lunar exploration
- International and commercial participation
 - Various funding streams can enable sufficient robotic efforts in a timely manner
 - Global space agency participation combined with commercial investments can significant drive down cost to any one stake holder
 - Schedule and financial risk minimized
- Background:
 - Budget allocations appear to be sufficient for Space Shuttle, Space Station, and Constellation transportation needs
 - NASA's LAT effort addresses opportunity for global participation in robotic missions and has identified possible areas of collaboration
 - NASA Research Council report "Scientific Context for Exploration of the Moon" strongly encourages international participation
 - NASA and 13 International Space Agencies are currently developing a "Global Sustainable Space Exploration Strategy"

NASA LAT I Phase 1

Global Exploration Strategy - 6 Themes



Human Civilization



Scientific Knowledge



Exploration Preparation



Global Partnerships



Economic Expansion



Public Engagement

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**

NASA LAT I Phase 2 (LAT 2)


Architecture Guidelines

- **In addition to supporting the basic goals and objectives of the Vision, the Architecture must have the following:**
 - **Programmatic Flexibility** – The Architecture must be able to adapt to changes in national priorities and budgets over several election cycles
 - **Participant Flexibility** – The Architecture must be able to adapt to changes in external participation (Commercial or IP) and changes to their priorities
 - **Exploration Flexibility** – The Architecture must be able to adapt to changes in exploration priorities and changes in exploration methods

Architecture Desired Attributes

- **Enable lunar sustained presence early**
- **Develop infrastructure while actively engaged in science and exploration**
- **Ensure architecture is flexible to redirection**
- **Ensure architecture supports Objectives**
- **Support the establishment of Mars analog**
- **Allow the earliest partnership opportunities for commerce and International Partners**
- **Continuous and measurable progress**
- **Continuous and focused public engagement**

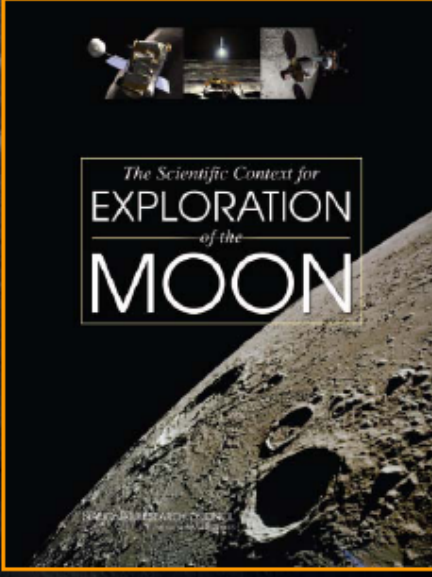
National Research Council Report

National Research Council Report: “Scientific Context for Exploration of the Moon” 

- Asked by NASA SMD to provide guidance on the **scientific challenges and opportunities enabled by a sustained program of robotic and human exploration** of the Moon during the period 2008-2023 and beyond

Key Science Findings:

- **Enabling activities** are critical in the near term
- Strong ties with **international programs** are essential
- Exploration of the **South Pole-Aitken Basin** remains a priority
- **Diversity of lunar samples** is required for major advances
- The Moon may provide a **unique location for observation and study of Earth, near-Earth space, and the universe**



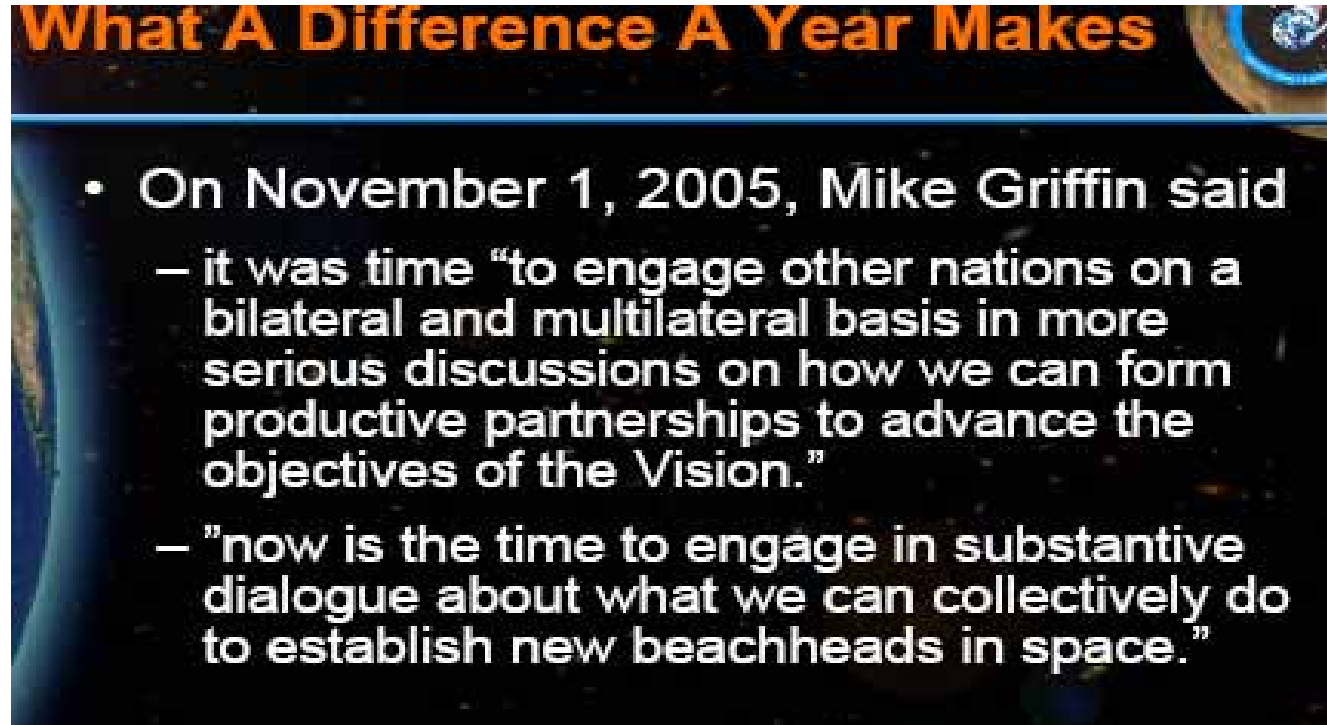
Suggested Approach for Creation of a Global Space Enterprise:

- Lunar exploration in it's early stages should work toward the goal of setting up a sustainable outpost where space agency off ramps are used and commerce takes over
- Formation of an international "Steering/Oversight Committee" composed of participating Space Agencies used to establish common Global Architecture
- Each Space Agency forms it's own "Space Enterprise Counsel" composed of the Space Agency, Industry, and commerce
- "Steering/Oversight Committee" insures minimal duplication of efforts and responsible for developing and executing a "Strategic Roadmap"
- Strategic Roadmap to insure each stake holder benefits from exploration efforts as well as shares the cost
- Maximum use of commercially provided launch, landing, media, and outpost infrastructure services enables early off ramps
- Review "International Space Station and other global efforts lessons learned" as a way to improve this proposed new Global Enterprise approach

Suggested Approaches to Enabling Long Term Commerce Participation:

- Provide early on ramps for commerce thru maximum use of commercially provided launch, landing, media, and outpost infrastructure services
 - Vibrant and profitable Lunar economy can reduce or eliminate the need for government funding (ie early off ramps for space agencies)
 - Economic growth while increasing investments could also reduce risk
 - Real commerce, with non-government customers, is the key to economic growth and sustainable progress
- Early incentives/encouragement can result in less upfront expense to Space Agencies
 - Involvement of commercial and Industry enterprises in the architectural development phase can encourage investor support
 - Improvement in regulatory laws (ie. ITAR, intellectual property protection, etc.) can encourage more shared funding participation

Drivers and Benefits of International-Commerce Participation:



Congressional space policy agreement mandates International and commercial participation

All Space Agencies benefit from Global Enterprise

Robust Exploration Goals Met

Additional cost and risk reductions possible

Sustainable and more affordable robotic program

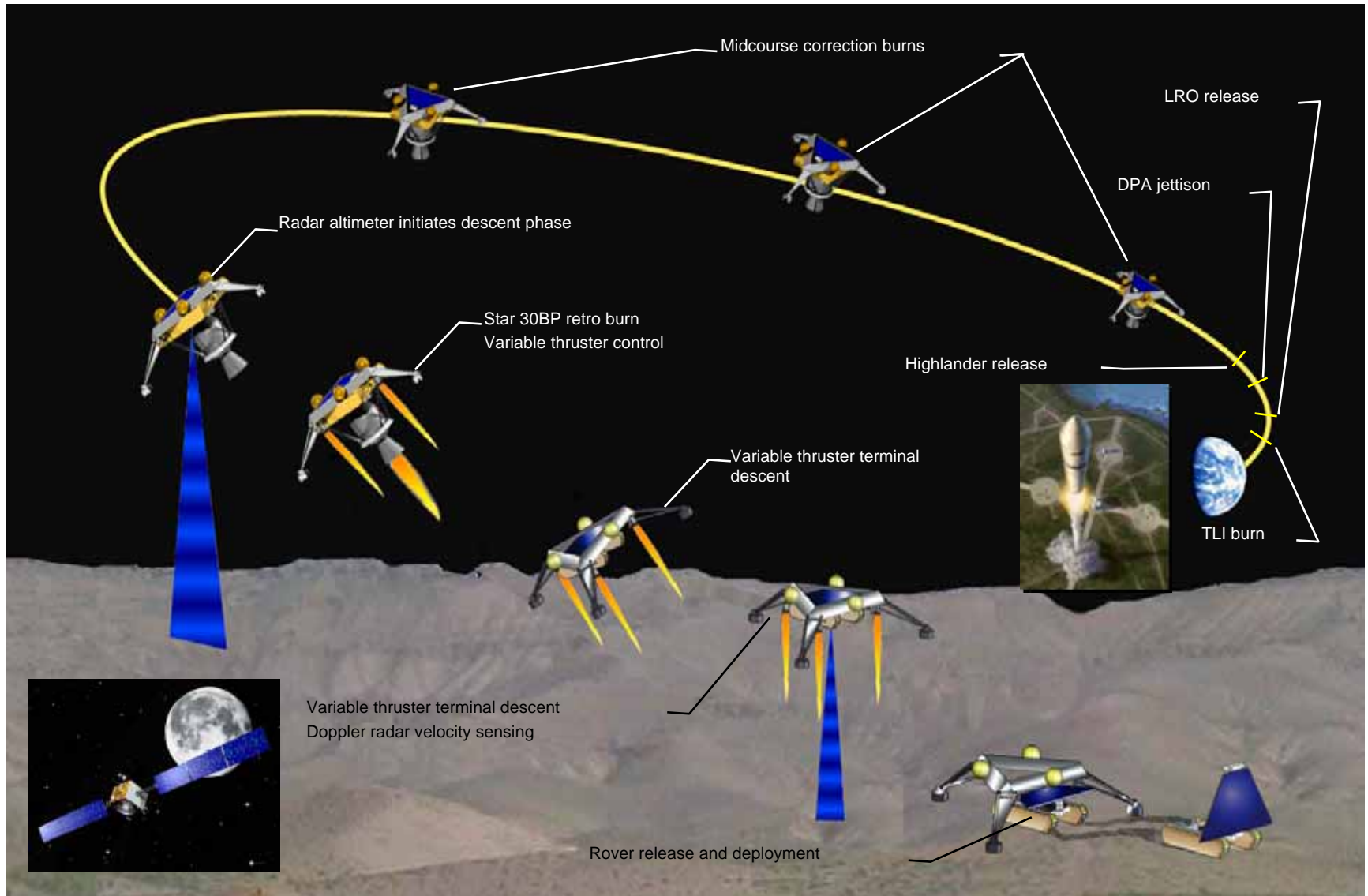
Science leads the way and commerce takes over

Additional Information

Sample Notional Small Robotic Mission (GRC Highlander and ESA Lunar SAT Shown)

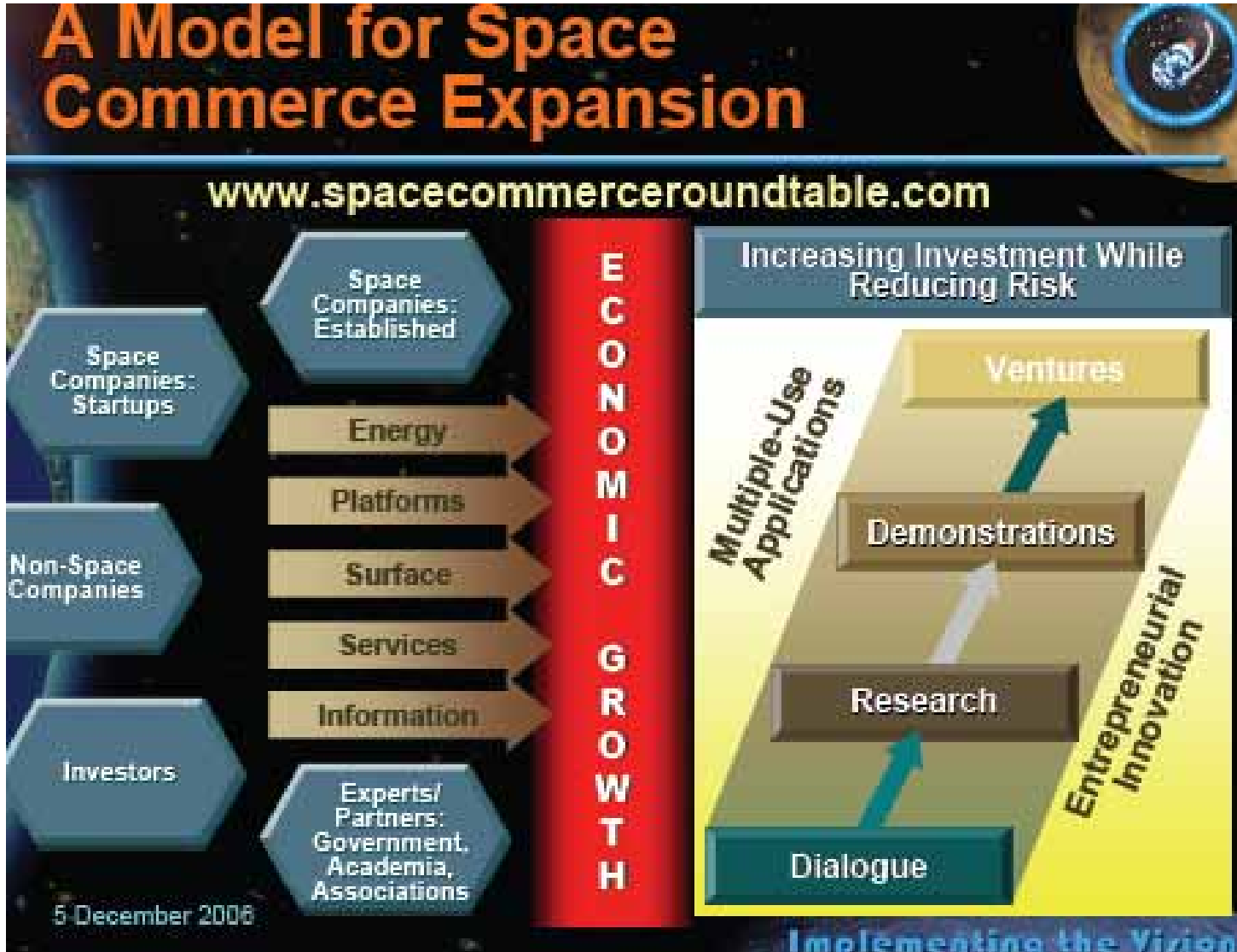


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To create a vibrant, profitable lunar economy that makes maximum efficient use of lunar resources and drives human settlement of the Moon

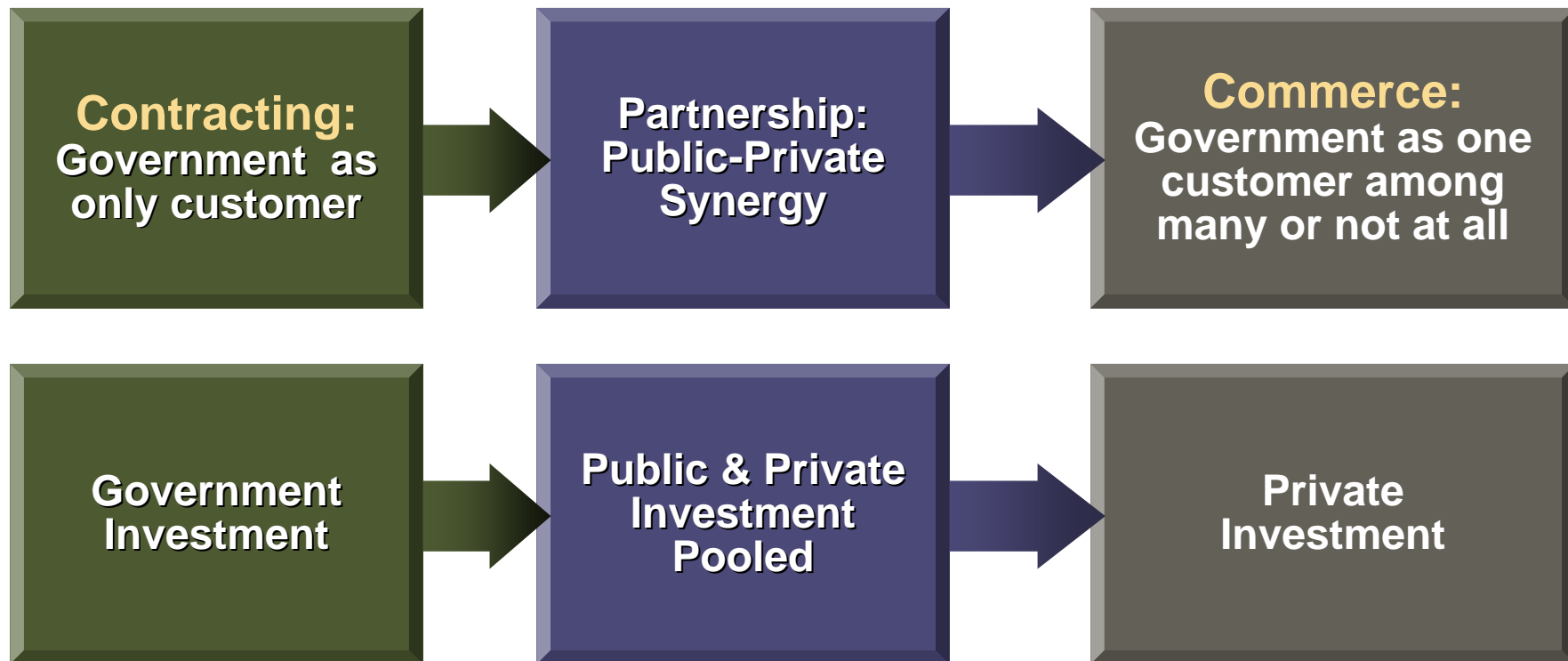




OUR GOAL:

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Multiple



Real commerce, with non-government customers,
is the key to economic **growth**

Solar Power



Larry Taylor, Univ. of Tennessee

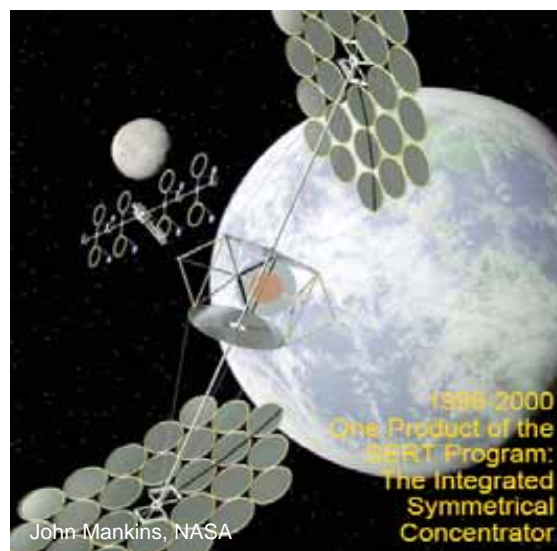
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NASA



David Criswell, Univ. of Houston

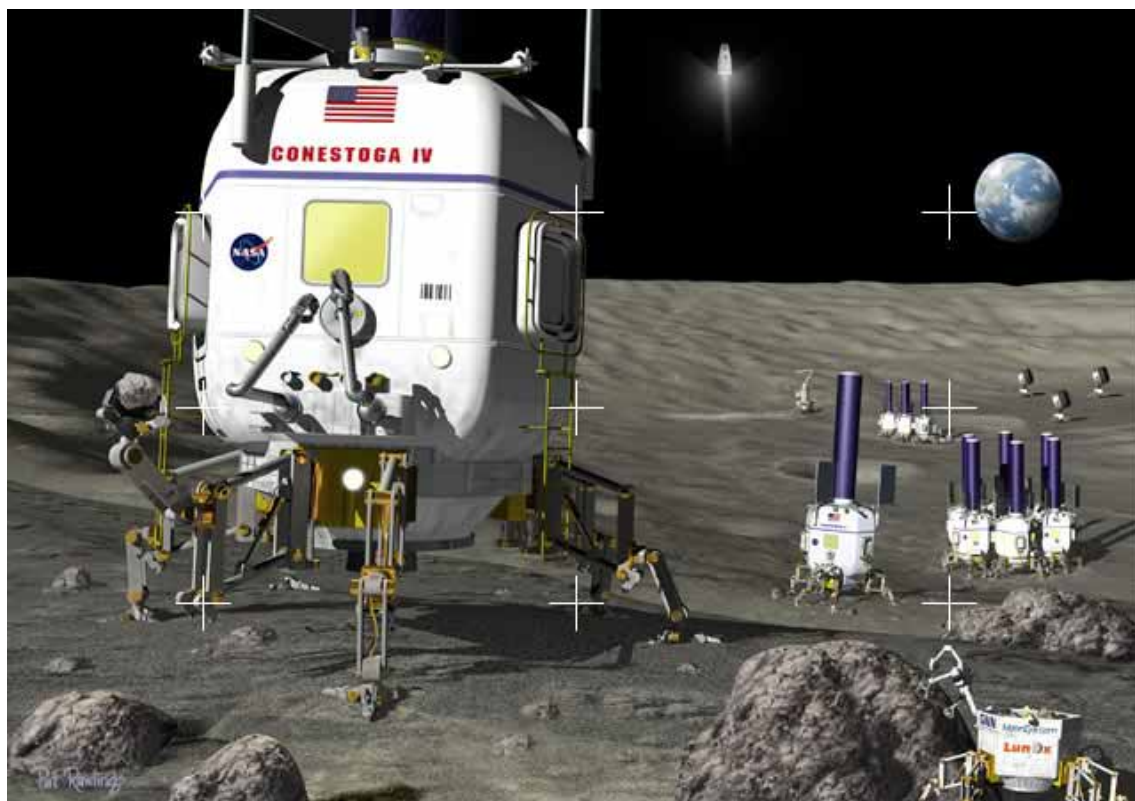
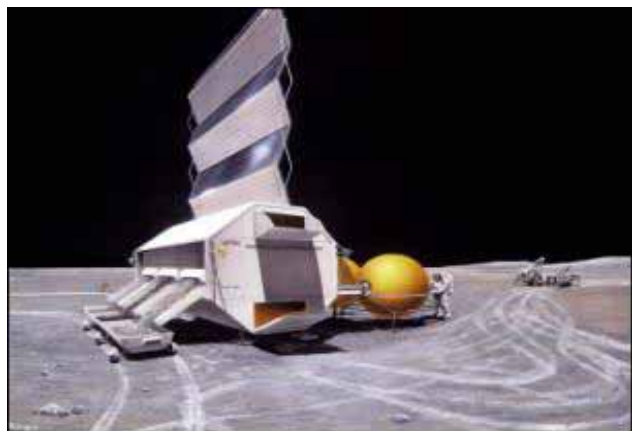


John Mankins, NASA

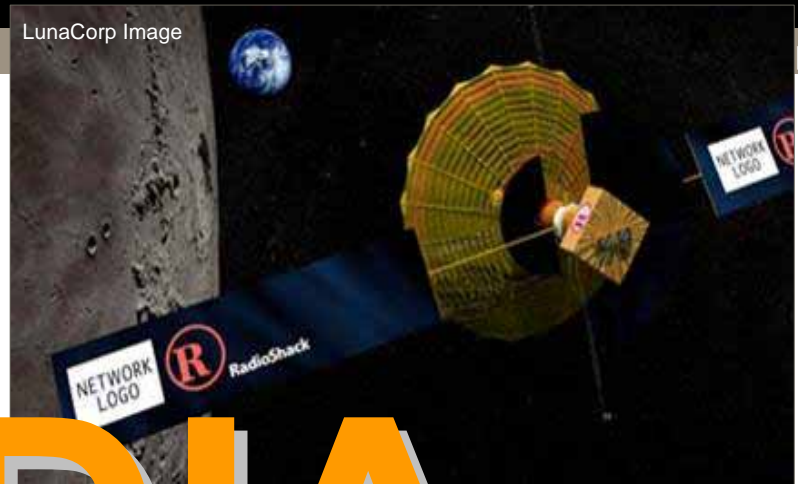
1998-2000
One Product of the
SERT Program:
The Integrated
Symmetrical
Concentrator

... we can do it with robots

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Source: John Mankins, NASA



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MEDIA

**Selling
the
Story**



Entertainment,
Education,
Advertising,
Branding,
Sponsorship