

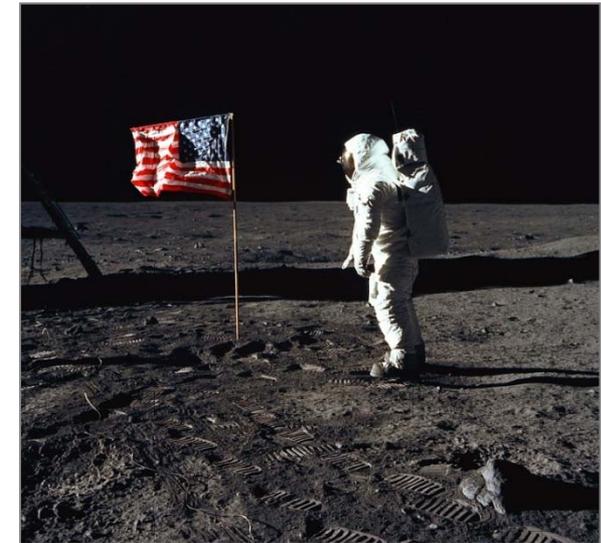
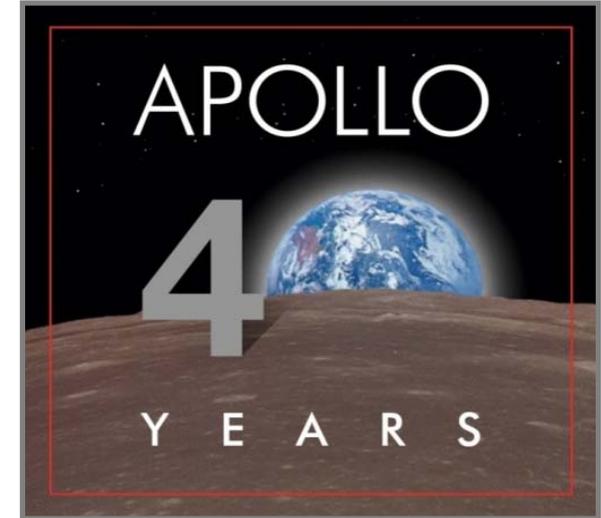


International Partnerships: Highlights on Progress and Future Opportunities

Douglas A. Craig
Exploration Systems Mission Directorate
NASA Headquarters
Washington, DC

JUSTSAP 2009
November 9, 2009

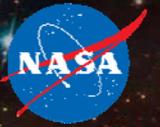
Honoring the Past As We Boldly Go Towards the Future



STS 129



ISS Progress



Why Do We Explore?



- **Inspiration**

- Inspire students to explore, learn, contribute to our nation's economic competitiveness, and build a better future

- **Innovation**

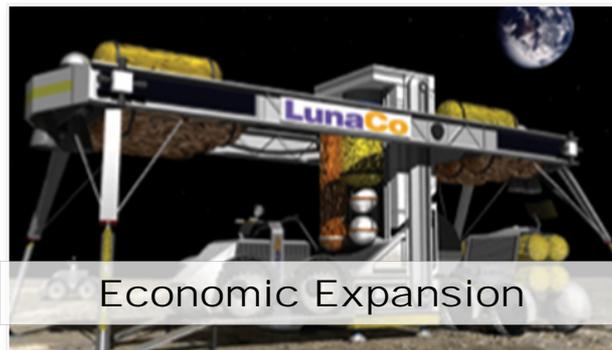
- Provide opportunities to develop new technologies, new jobs, and new markets

- **Discovery**

- Discover new information about ourselves, our world, and how to manage and protect it



Global Plan: Exploration Themes



GEOSYNCHRONOUS ORBIT

Aproximately 36,000 km/ 22,000 mi

MID-EARTH ORBIT

Aproximately 2,000 - 36,000 km/
1,240-22,000 mi

LOW EARTH ORBIT

Aproximately 2,000 km/ 1,240 mi

International Space Station

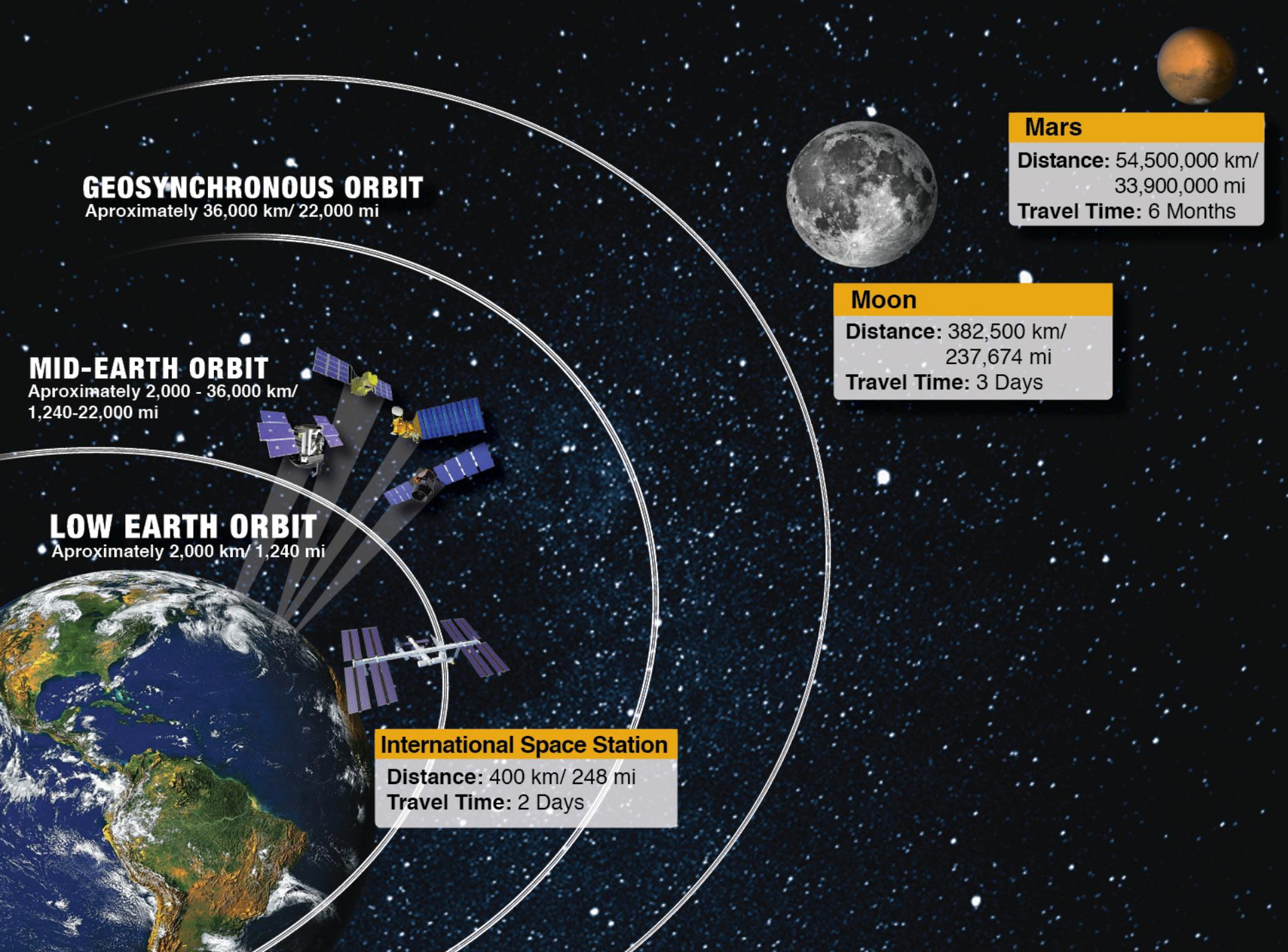
Distance: 400 km/ 248 mi
Travel Time: 2 Days

Mars

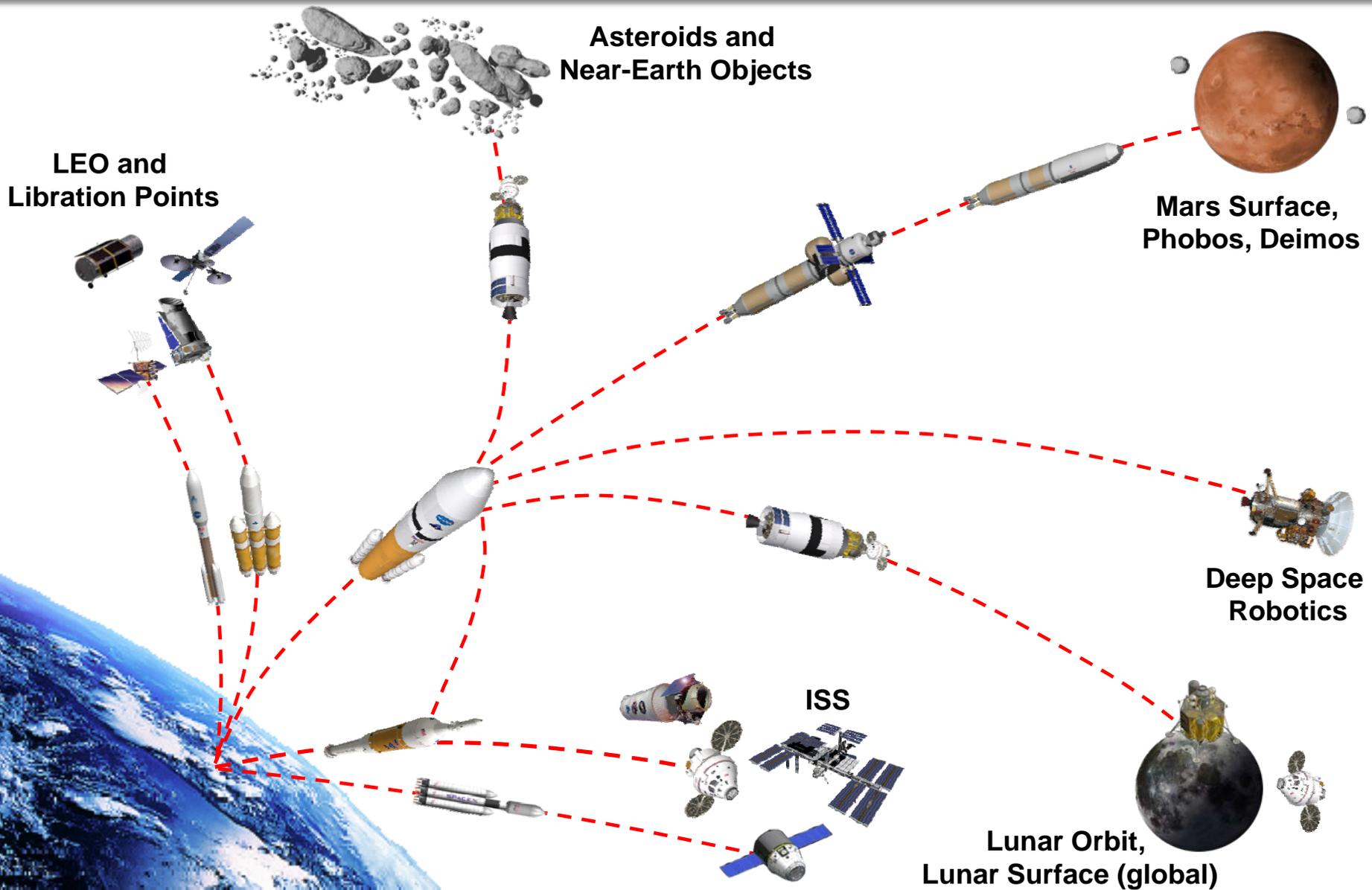
Distance: 54,500,000 km/
33,900,000 mi
Travel Time: 6 Months

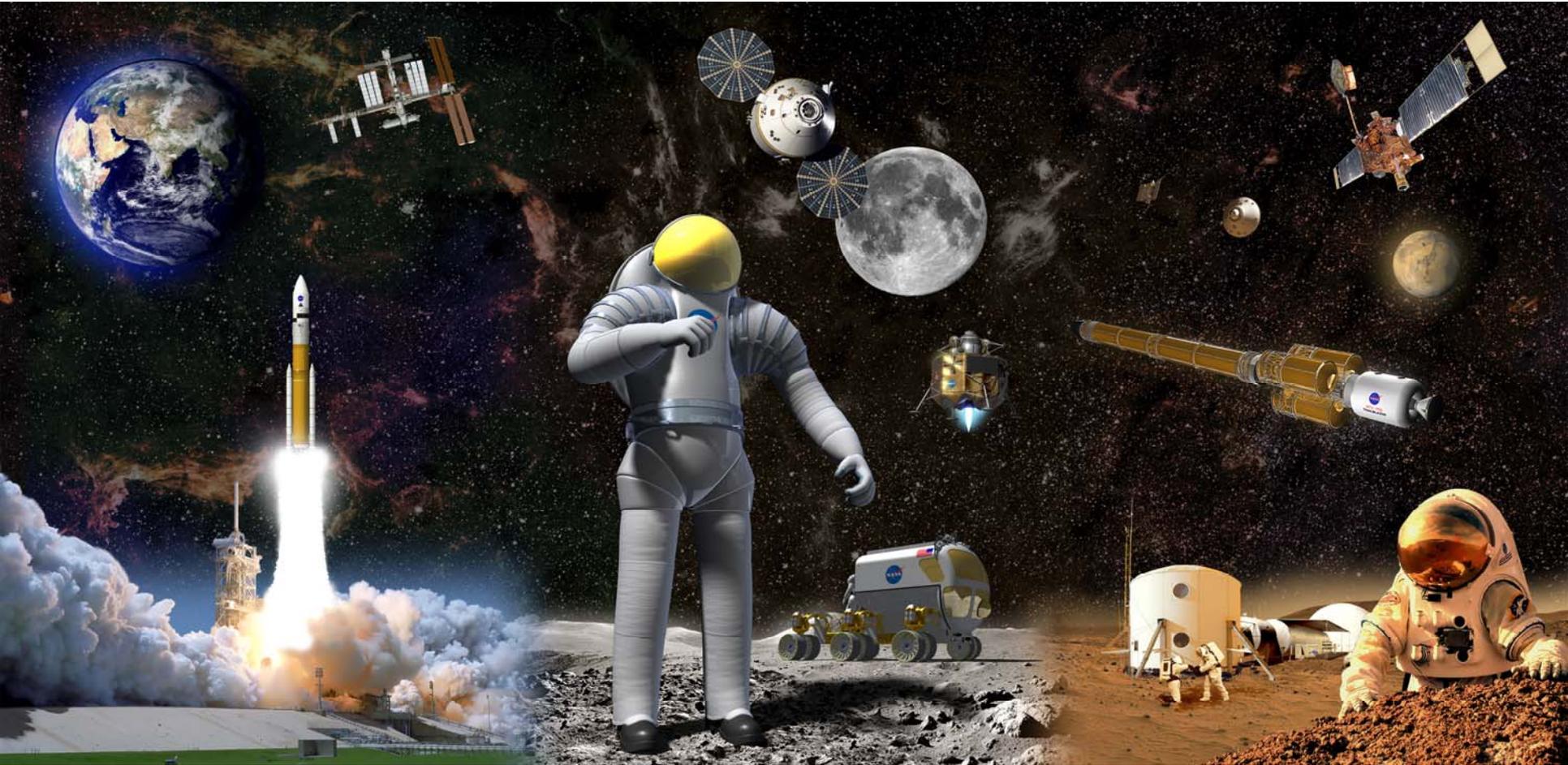
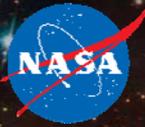
Moon

Distance: 382,500 km/
237,674 mi
Travel Time: 3 Days



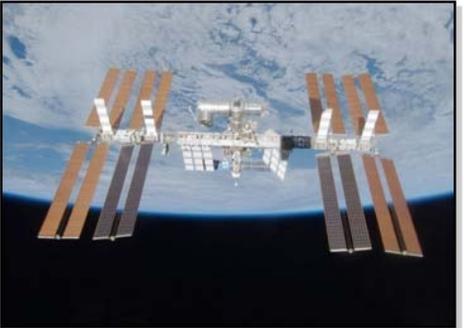
U.S. Human Spaceflight Future Exploration Capabilities





Forging New Roles: Evolution and Revolution

International & Partnership Engagement

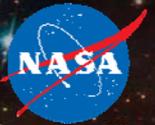


Formulation of the Global Exploration Strategy

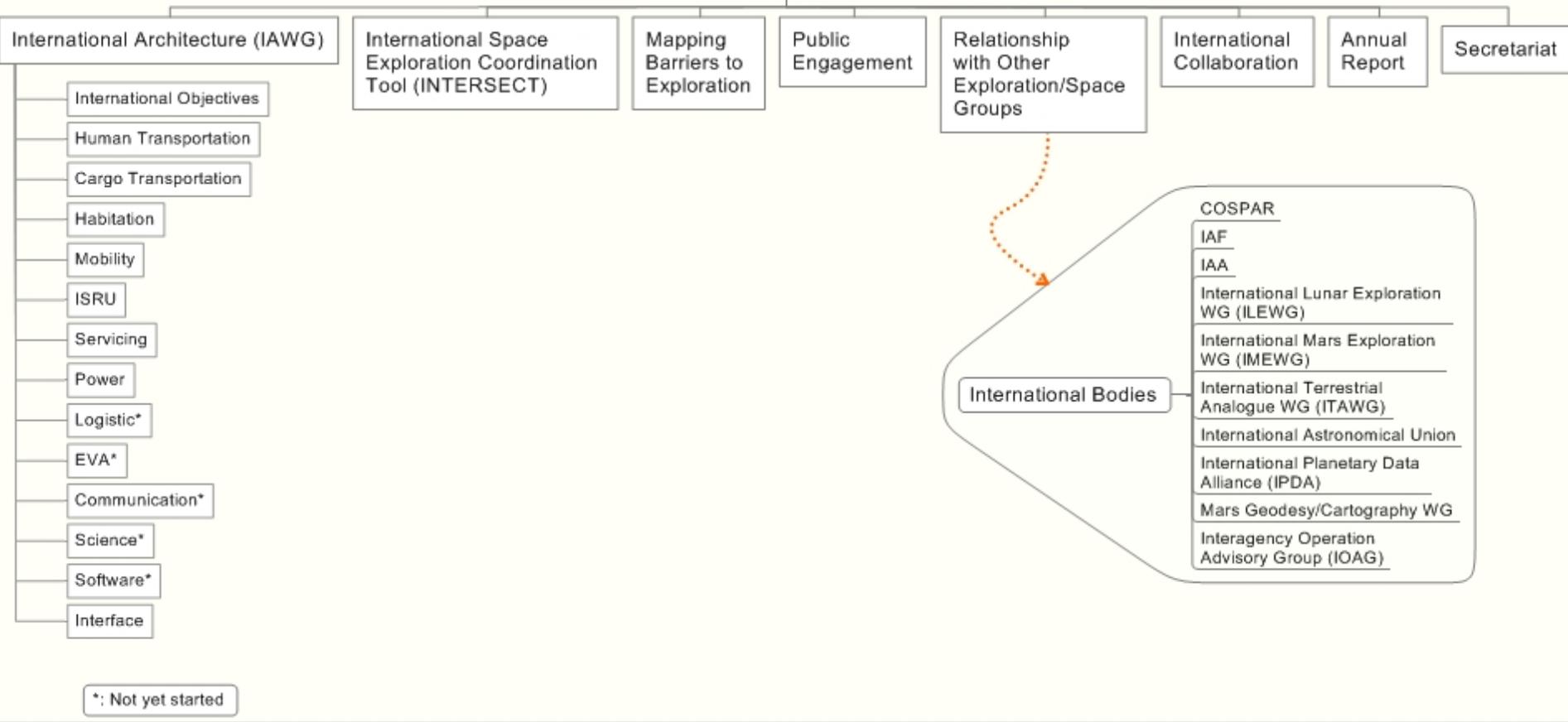


- **Following announcement of the US Space Exploration Policy in 2005, NASA began to engage nations on a bilateral and multilateral basis to explain progress in implementing the Policy and to discuss potential partnerships**
 - Literally hundreds of meetings/discussions with current and potential partners to explain the policy and assess interest
 - Variety of Workshops and Conferences, both in the U.S. and around the world, have allowed NASA to inform on the broad aspects of the policy with industry and international participation
- **In April 2006, NASA initiated multilateral discussions aimed at seeking global input on a set of compelling reasons and objectives for human and robotic exploration of the moon**
- **This activity evolved into a globally coordinated strategy for exploration – the Global Exploration Strategy (GES)**
 - Australia, Canada, China, the European Space Agency, France, Germany, Great Britain, India, Italy, Japan, Russia, the Republic of Korea and Ukraine
- **In May 2007, NASA and the 13 GES space agencies released the results of 12 months of intensive discussion: “The Global Exploration Strategy – The Framework for Coordination”**

ISECG and Sub-Groups



International Space Exploration Coordination Group (ISECG)





- **IAWG Scope of Activities**
 - Develop several lunar exploration scenarios based on potential human lunar exploration goals and objectives across the international community
 - Goals and objectives should be compelling and traceable to GES themes
 - Create an international working level architecture for human lunar exploration
- **IAWG identified three human lunar exploration scenarios that the ISECG adopted in March 2009**
 - Sortie Missions, Extended Stay Sortie Missions, Polar Outpost
- **Working towards a “Global Point of Departure” architecture by summer 2010 that addresses set of themes, goals, objectives and scenarios**
 - Will also identify important elements for lunar exploration
 - Building on architecture work done by NASA, ESA, JAXA and CSA





- **Sortie Missions**

- Short-duration mission, ~7 days for crew of 4, crew will live on the lander
- Lunar daylight, Does not assume pre-deployed assets, may go to any location
- Conduct science, validate elements and capabilities

- **Extended Stay Missions**

- Medium duration missions (~14 to 40 days)
- May include some lunar night activity; no crew stay over multiple lunar nights
- Habitation is provided by something other than the lander vehicle
- Pre-deployed assets may be in place when crew arrives
- May go to any location, may or may not, be re-visited, no permanent infrastructure
- Early science opportunities, technical demonstrations and validation

- **Outpost Development**

- Long-duration human lander (> 7 days, up to permanent presence)
- Multiple visits to a fixed position; deployed and mission-assembled assets
- Habitation is provided by something other than the lander vehicle
- Local permanent infrastructure expands with each mission
- Support human operations during lunar day & night missions
- Establish framework for future infrastructure expansion, enable longer duration crew; demonstrating capabilities to live on planetary surface; conduct science

Global Point of Departure Architecture



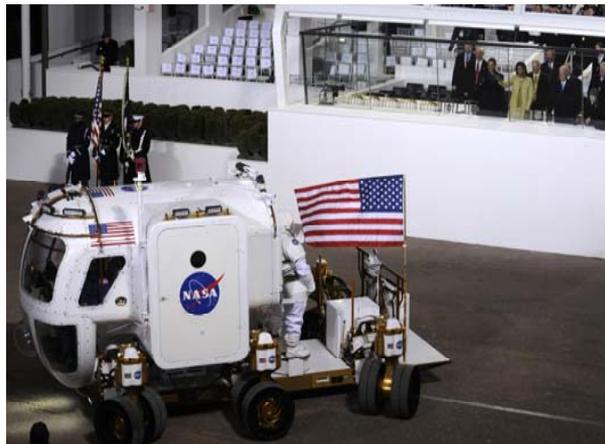
- **The Global Point of Departure (gPOD) architecture is intended as a reference human lunar exploration campaign, not an international baseline**
 - Is flexible and evolutionary; allows lunar programs around the world to evolve
 - Addresses national goals and objectives of participating agencies
 - Builds on international robotic lunar exploration activities conducted prior to human lunar return
- **Participants are considering key drivers such as**
 - ISS lessons learned regarding importance of redundancy for critical functions
 - Political and technical sustainability of the exploration campaign
 - Opportunities to maximize international participation in lunar exploration consistent with emerging national priorities
- **The gPOD is emerging as an opportunity to concretely advance international cooperation in space exploration**
 - Will inform bilateral agreements regarding hardware, elements
 - Will inform discussion on exploration management framework
 - Will inform priorities for interface standardization to enhance robustness of overall exploration architecture over time
 - Will inform early terrestrial analog activity priorities

International Engagement – Moving Forward



- **NASA will communicate the new Administration's policy on exploration to our partners once guidance is established**
 - Will continue to utilize the ISECG for coordinating space exploration initiatives
- **NASA will continue to emphasize the importance of international cooperation in space exploration by highlighting the following**
 - Promoting shared values of transparency, reciprocity and mutual benefit
 - Continuing strong alliances established with traditional partners
 - Enabling new alliances by providing forums for relationship building
- **NASA will continue to form agreements with partners that help NASA meet U.S. objectives in space exploration**
 - Collaboration with Japan on SELENE, ESA on common architectures, DLR and CSA on ISRU technologies and mobility systems, India on Chandrayaan-1 is laying a foundation for cooperative ventures, and KARI on future possibilities
 - Bilateral opportunities potentially exist with BNSC on MoonLITE, DLR on LEO, JAXA on SELENE-2, and ISRO on Chandrayaan-2
 - Based on Feedback from International Partners, Visible Administration encouragement will help NASA engage potential partners and may encourage them to pursue complementary space exploration initiatives

- **NASA is leading global space exploration efforts**
- **NASA has emplaced multilateral and bilateral mechanisms and relationships to form the international partnerships for space exploration**
- **The GES Framework document represents a shared vision for space exploration that embraces international cooperation for technical, scientific, economic, public outreach and education reasons**
- **Many nations are currently defining/refining policy, strategies, long term plans**
 - NASA leadership is helping shaping future activities
 - Mission flexibility, systems evolution, and interoperability are key to future success



Bold New Frontiers Await...



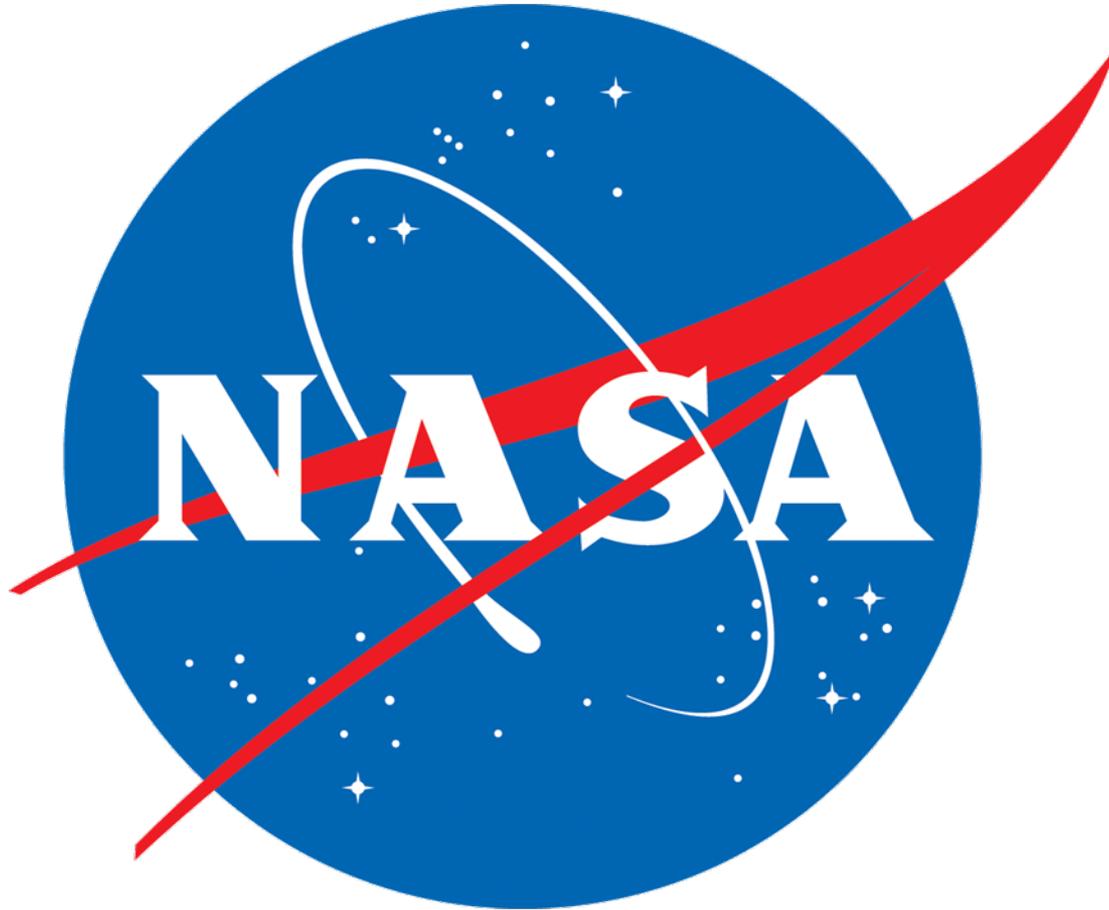
**New Opportunities for
Innovation, Interoperability, Cooperation**

We must go forward together...



Cooperation: Key to the Future!

Questions?



www.nasa.gov/exploration



Backup



Human Missions to the Moon

US/NASA Developed initial capabilities

- Launch Vehicle Architecture
- Lunar Lander: ascent vehicle and descent vehicle
- Initial EVA system for CEV and an Initial Surface Suit
- Basic Navigation and Communication

Open for Cooperation

Systems & Capabilities Envisioned for an Outpost including Outpost enabled sorties

- Long duration surface suit
- Advanced, long-duration Habitation
- Basic and Augmented Power Systems
- Basic, unpressurized rover
- Pressurized rover
- Logistics rover
- Augmented, high bandwidth satellite communication/navigation
- Logistics Resupply
- ISRU Production

Time

Partner and Participant Flexibility Strategy

- Parallel capabilities while seeking “open architecture” contributions
- Continue success of the Global Exploration Strategy through multilateral engagement in International Space Exploration Coordination Group (ISECG)
- Continue success of International and Commercial engagement
- Build on long-standing bilateral relationships while seeking new relationships when opportunities and conditions permit