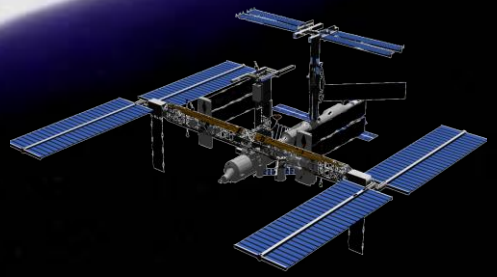
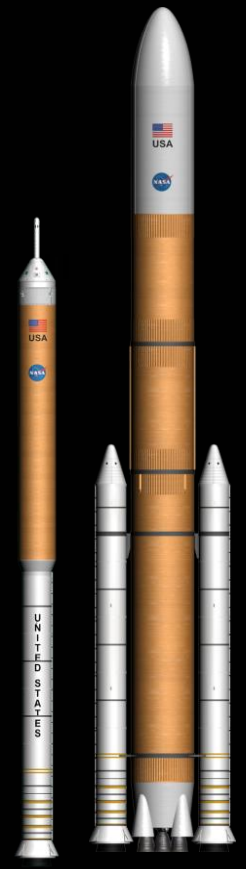




NASA's International Space Cooperation

Presentation to University of North Dakota
Space Studies Colloquium

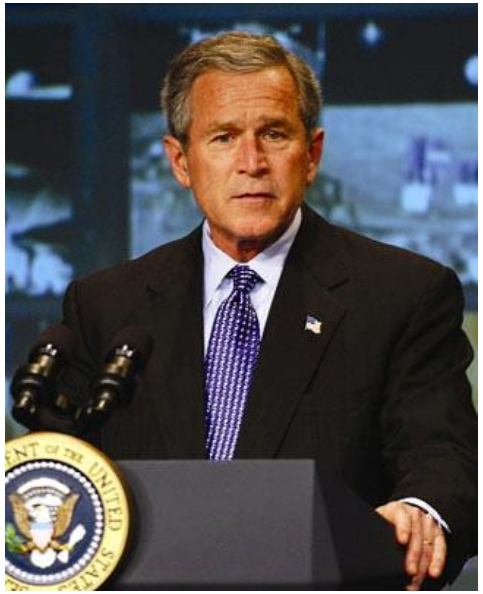
P. Diane Rausch
Director, Advisory Committee Management Division
Office of External Relations
NASA Headquarters
Washington, DC
April 30, 2007

Agenda

- Vision for U.S. Space Exploration
- NASA's International Cooperation
- Lessons Learned: Key Negotiating Skills
- Conclusion
- Q & A

The Goals of the Vision for U.S. Space Exploration

- Complete the International Space Station, meet international commitments
- Safely fly the Space Shuttle until 2010, when it will be retired
- Develop and fly the Crew Exploration Vehicle no later than 2014
- 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



"We'll invite other nations to share the challenges and opportunities of this new era of discovery. The vision I outline today is a journey, not a race, and I call on other nations to join us on this journey, in a spirit of cooperation and friendship."

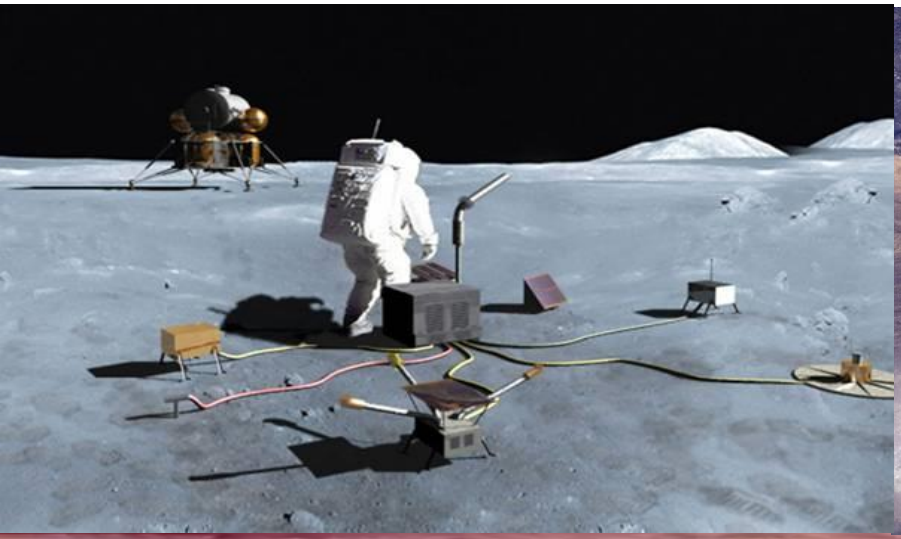
President George W. Bush

January 14, 2004

A Bold Vision Authorized by Congress

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.



NASA's Exploration Roadmap

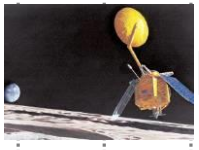
05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Initial CEV Capability

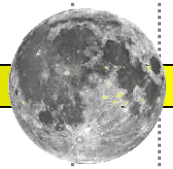
1st Human CEV Flight

Lunar Outpost Buildup

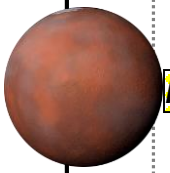
7th Human Lunar Landing



Lunar Robotic Missions

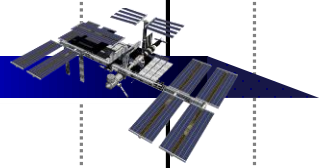


Science Robotic Missions



Mars Expedition Design

Commercial Crew/Cargo for ISS

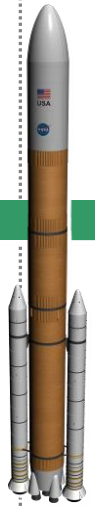


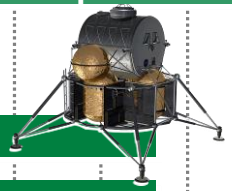
Space Shuttle Ops

CEV Development

Crew Launch Development

CEV Production and Operations





Early Design Activity

Lunar Lander Development

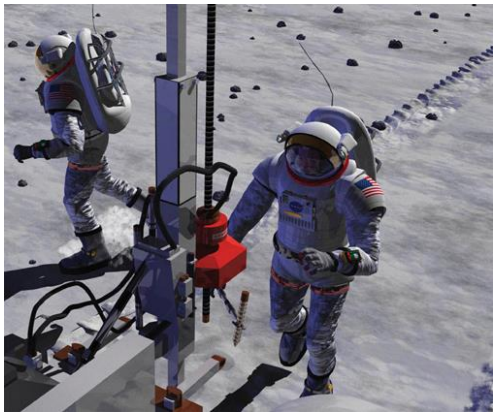
Lunar Heavy Launch Development

Earth Departure Stage Development

Surface Systems Development

Why the Moon?

- Human civilization
- Scientific knowledge
- Exploration preparation for future missions to Mars and beyond
- Global partnerships
- Economic expansion
- Public engagement



Exploration Architecture Elements Underway

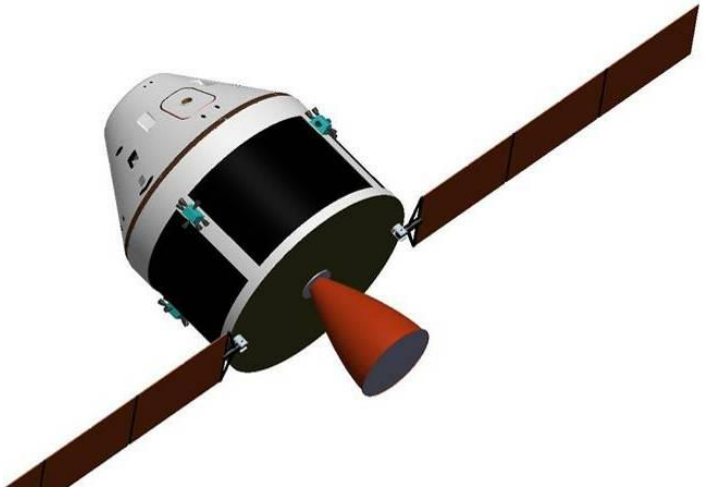
- Crew Exploration Vehicle (Orion)
- Crew Launch Vehicle, Heavy Lift Launch Vehicle (Ares I, Ares V)
- Lunar Precursor Robotic Program (LPRP)
- Human Research & Technology Development
- Lunar Surface Activities/Definition
- Commercial

Crew Exploration Vehicle (Orion)

- **Command Module**
  - Mold Line: Apollo-Derived Capsule
  - Crew: 6 for ISS & Mars, 4 for Moon
  - Size: 16.4 ft (5 Meter) Diameter
  - Docking Mechanism: APAS or LIDS

- **Service Module**
  - Propulsion: Industry Propose Best Solution
  - Some Capability for Delivering Unpressurized Cargo

- **Ongoing Analysis**
  - Impact of Reducing Volume
  - Trading Functionality between Command and Service Module
  - Eventual Migration to Non-Toxic Propellants

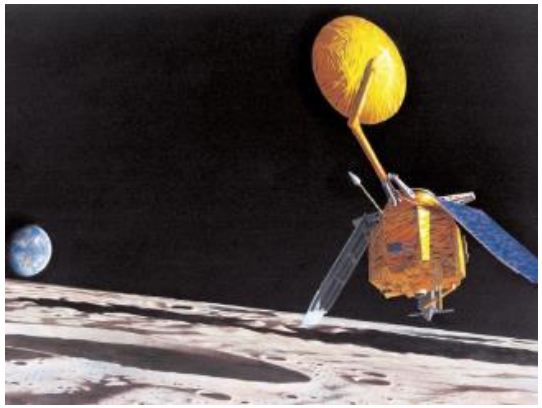


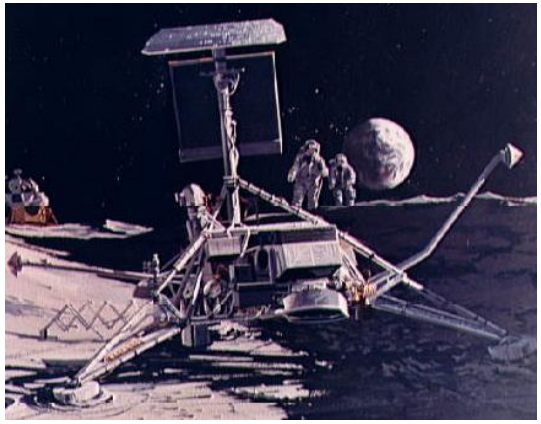
Crew Launch Vehicle (Ares I)
Heavy Lift Launch Vehicle (Ares V)

- **Crew Launch Vehicle – Ares I**
  - Single 5 segment RSRB/M 1st stage
  - Upper stage powered by a single engine derived from the Saturn J-2
- **Cargo Heavy Lift Launch Vehicle - Ares V**
  - Twin 5 segment RSRB/M 1st stage (from CLV)
  - Core stage derived from the External Tank
  - Powered by 5 low cost SSMEs
  - CLV-derived avionics
- **Earth Departure Stage**
  - Upper stage derived from the External Tank
  - Powered by a single J-2 derived engine - 2 burn capability
  - CLV-derived main propulsion systems and avionics

Lunar Precursor Robotic Program (LPRP)

- Provide early information for human missions to the Moon
- Evolvable to later human systems
- Most unknowns are associated with the North and South Poles – a likely destination for a lunar outpost
- Make exploration more capable and sustainable
- Key requirements involve establishment of
  - Terrain and surface properties
  - Knowledge of polar regions
  - Support infrastructure
- Lunar Reconnaissance Orbiter (LRO)
- Provides major scientific and exploration benefit by 2009
- Selected instruments complement other foreign efforts
- LRO launch planned for late 2008; one-year mission





NASA and the Vision for U.S. Space Exploration

"None of this is to say that the United States should necessarily plan to "go it alone" in space exploration. Great nations must be prepared to do so when necessary, but it is equally true that great nations need great allies and partners. There is room for these relationships in the President's Vision for Space Exploration . . . . But in the future, the United States should avoid dependence upon other nations for critical spacefaring systems."

- Statement of NASA Administrator Michael Griffin
April 12, 2005

The Science Mission Directorate

Astrophysics

Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets

Earth Science

Study Earth from space to advance scientific understanding and meet societal needs

Heliophysics

Understand the Sun and its effects on Earth and the solar system

Planetary Science

Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space

Reshaping NASA Aeronautics Research

OLD		NEW
Vehicle Systems	→	Fundamental Aeronautics
Aviation Safety and Security	→	Aviation Safety
Airspace Systems	→	Airspace Systems

The Space Shuttle

International Space Station

The International Space Station Partners

Canadian Space Agency

European Space Agency

Belgium	Italy	Sweden
Denmark	The Netherlands	Switzerland
France	Norway	United Kingdom
Germany	Spain	

Japan Aerospace Exploration Agency

National Aeronautics and Space Administration

Russian Federal Space Agency

International Launch Vehicles Planned for ISS

Shuttle

Proton

Soyuz

Ariane

H-IIB

Why International Cooperation?

- **The National Aeronautics and Space Act of 1958**
  - Directs NASA to conduct its activities so as to: "*contribute materially to . . . cooperation by the United States with other nations*."
- **Benefits to NASA programs**
  - Pooling of financial resources
  - Access to foreign capabilities or geography
  - Adds unique capability and/or expertise
  - Increases mission flight opportunities
  - Enhances the scientific return
- **Promotion of U.S. foreign policy interests**

International Cooperation to Date

- **Since 1958, NASA has had a broad program of international cooperation involving over 4000 agreements with over 100 nations/international organizations**

- **In last 10 years, NASA has concluded over 900 agreements with organizations in 68 countries:**
  - 10 foreign partners account for 75% of these agreements:

    ESA, France, Germany, Italy, UK, Russia, Canada, Japan, Brazil, Australia

- **NASA has space cooperation in every region of the world**

- **Every NASA Mission Directorate has a long history of successful international space cooperation**

Global Reach: Current International Cooperation at NASA

Canada

Europe
Armenia, Austria, Denmark, Estonia, ESA, EU, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Moldova, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, Ukraine, UK

Russia

Japan

UN

East Asia
China, Mongolia, Republic of Korea, Taiwan

Central and South America
Argentina, Belize, Bermuda, Bolivia, Brazil, Chile, Costa Rica, Mexico, Panama, Peru, Suriname

Africa and the Middle East
Algeria, Israel, Kenya, Morocco, Mozambique, South Africa, Uganda UAE, Zambia

South and South East Asia
India, Pakistan, Philippines, Thailand, Vietnam

Australia, Kiribati New Zealand

Total 57 countries and 3 international organizations

Global Reach:
Current International Cooperation at NASA

Canada (10)

Europe (143)
ESA (18)
France (27)
Germany (20)
Italy (8)
UK (15)
19 Other Countries
And Organizations (55)

Russia (7)

Japan (24)

UN (1)

East Asia (10)
China (1)
Mongolia (1)
Republic of Korea (6)
Taiwan (2)

Central and South America (27)
Argentina (3)
Bolivia (4)
Brazil (6)
Chile (4)
Costa Rica (4)
6 Other Countries (6)

Africa and the Middle East (19)
Israel (3)
South Africa (4)
7 Other Countries (12)

South and South East Asia (9)
India (3)
Thailand (3)
3 Other Countries (3)

Australia, Kiribati New Zealand (8)

(#) = Active agreements with international partner
Grand total = 258, with 110 Earth science-related

International Cooperation by NASA Mission Directorate

- **Exploration Systems**
  - Established in Jan. 2004 to implement Vision for U.S. Space Exploration
  - Well over 100 NASA bilateral meetings since Jan. 2004
  - International Exploration Workshop – Nov. 2004
  - Global Exploration Strategy (why/what, lunar outpost)– Dec. 2006
- **Space Operations**
  - International Space Station (ISS): largest, most complex international scientific/engineering program in history – 5 Int'l Partners, 15 nations
  - 58 foreign astronauts from 14 countries have flown on 83 Shuttle flights
- **Science**
  - 42 operating Science missions, 23 with international participation
  - 34 planned Science missions, 19 with international participation
  - International Exploration Science Workshop – held Mar. 2005
- **Aeronautics Research**
  - Cooperation in fundamental aeronautical research and wind tunnels

NASA International Cooperation Policy

- Project has scientific and technical merit, and meets NASA's programmatic objectives.
- Each Partner funds its respective contributions, but contributions need not be equivalent; no exchange of funds.
- Partners are generally government agencies due to the level of investment and legal requirements.
- Project structured to establish clearly defined and distinct managerial and technical interfaces to minimize complexity.
- Project structured to protect against unwarranted technology transfer and take into account industrial competitiveness.
- Project demonstrates a specific benefit to NASA (e.g., data, service, contribution to flight mission or operational infrastructure).
- Cooperation documented in a written, specific agreement.

How is Cooperation Identified?

- **Cooperation can develop through a variety of avenues:**
  - Top-down direction (from Administration or NASA Administrator)
  - Bottom-up proposals (competitive peer-review process)
    - Announcement of Opportunity (AO)
    - NASA Research Announcements (NRA)
  - Established consultative mechanisms – bilateral or multilateral, long-term or short-term
  - Strategic missions, determined by NASA Mission Directorates
  - Scientist-to-scientist cooperation, determined by PI's
  - Inquiries from a potential foreign partner

Types of International Cooperation

- **Joint mission development programs**
- **Flight of scientific instruments and subsatellites on foreign spacecraft (and vice-versa)**
- **Highly coordinated set of independent space missions**
- **Joint sounding rocket campaigns**
- **Cooperative ground-based tracking support**
- **Scientist-to-scientist data exchanges with joint analysis, interpretation and publication of results**

International Agreements

- **NASA uses many approaches in developing and negotiating international agreements, depending on the project:**
  - Government-to-Government Framework Agreement (S&T, Space)
  - Inter-Governmental Agreement (IGA)
  - Agency-to-Agency Memorandum of Understanding (MOU)
  - Implementing Arrangement (IA)
  - Letter of Agreement (LOA)
  - Statement of Intent (SOI)
- **Numerous management models:**
  - Highly integrated
  - Coordinated through consultative groups
  - Joint management
  - Shared leadership vs. lead role for one partner
  - Consensus
- **Majority of NASA's international agreements are bilateral**

Challenges to Cooperation

- **Management complexity**
  - Decision-making is more complex
  - Communications difficulties; time zones
  - Differing specifications, standards and assumptions
- **Technical and programmatic risk**
  - The "critical path" issue
  - "Piecepart cooperation" with numerous countries to stay within NASA mission cost-caps
  - Interfaces are difficult to manage at a distance; harder to monitor progress and get early warning of problems
  - Programmatic redirection in midst of an agreed joint program
- **Political risk**
  - Budgetary and bureaucratic uncertainties
  - Potential linkage to political activities or economic problems

Lessons Learned: Key Negotiating Skills

- **Preparation! Take time to understand one's own agency's "big-picture" before any negotiations take place:**
  - Vision, mission, budget outlook, international policy
  - Programmatic goals/objectives, issues and concerns
  - Consultations with State Department, other USG agencies
  - What do we want?

- **Preparation! Take time to understand the foreign partner agency's "big-picture" before any negotiations take place**
  - Advance research
  - Informal discussions with foreign counterparts
  - Consultations with State Department, other USG agencies
  - What do they want?

- **Relationship-building**

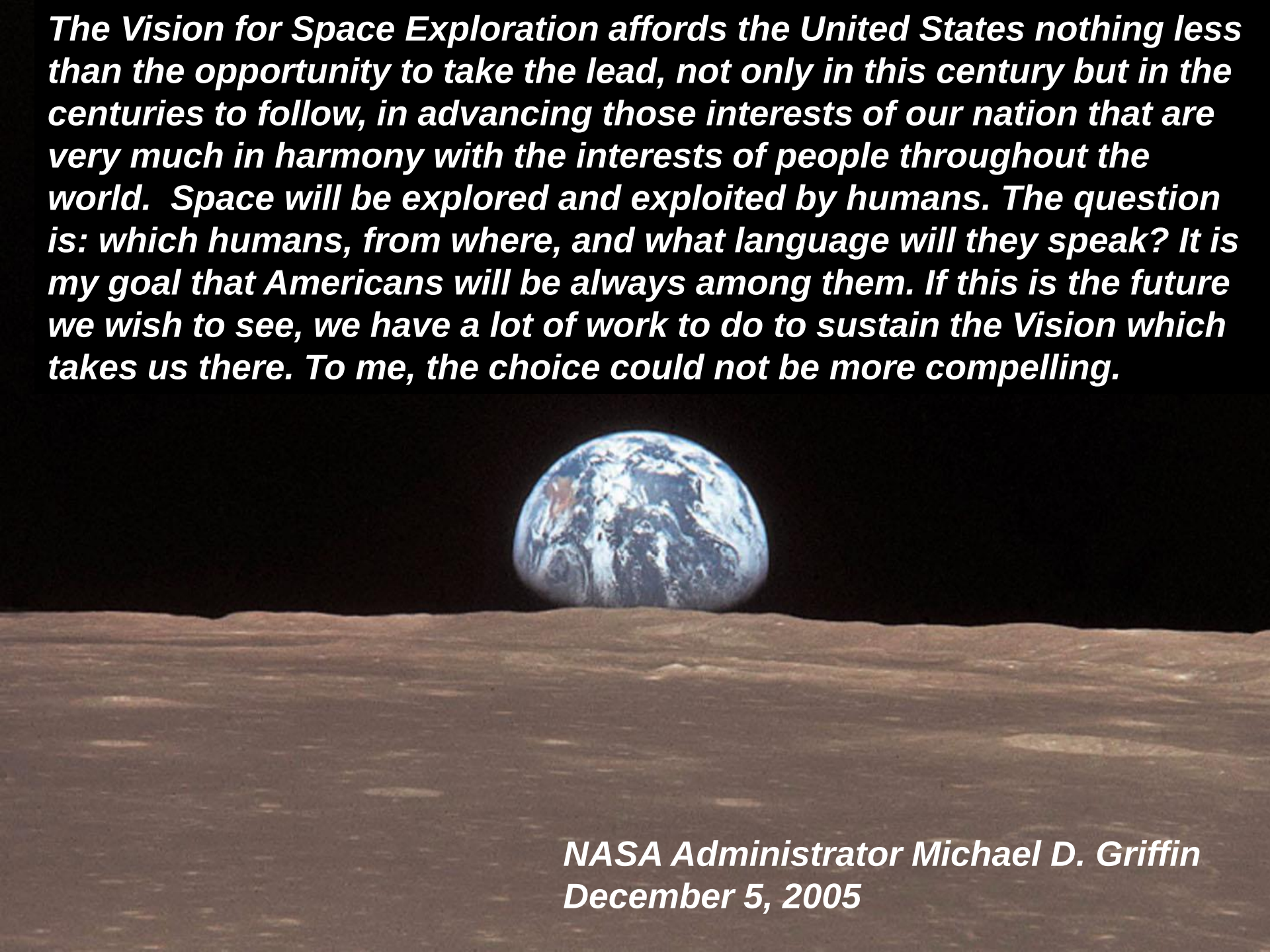
Lessons Learned: Key Negotiating Skills

- **Respect for international partners: their point of view, their interests, their internal pressures**
- **Listening and asking many questions to truly understand**
- **Credibility, commitment and consistency**
- **Strong communications skills – oral and written**
- **Flexibility and creativity**
- **Seeking "win-win" outcomes – not "win-lose"**
- **Patience!**

Conclusion

- **Since 1958, NASA has pursued a broad, successful program of international space cooperation**
  - Over 4000 agreements with over 100 nations/international organizations
  - Operates within U.S. scientific, economic and foreign policy framework
  - Benefits are numerous and well demonstrated over 5 decades
  - Challenges must be managed to ensure mission success
  - NASA enjoys excellent, enduring relationships with its international space partners based on mutual interest, mutual benefit and mutual respect
- **Looking to future, NASA is pursuing international cooperation supporting the Vision for U.S. Space Exploration**
  - New direction for U.S. space program set in 2004
  - Hundreds of meetings to date with foreign space partners
  - Intense interest around world in this exciting program of human exploration to Moon, Mars and beyond
- **NASA's traditional international cooperation in its longstanding programs will continue: ISS, Space/Earth Science, Aeronautics**

The Vision for Space Exploration affords the United States nothing less than the opportunity to take the lead, not only in this century but in the centuries to follow, in advancing those interests of our nation that are very much in harmony with the interests of people throughout the world. Space will be explored and exploited by humans. The question is: which humans, from where, and what language will they speak? It is my goal that Americans will be always among them. If this is the future we wish to see, we have a lot of work to do to sustain the Vision which takes us there. To me, the choice could not be more compelling.



NASA Administrator Michael D. Griffin
December 5, 2005

Questions?