



Office of Exploration Systems

Program Overview



June 9, 2004

*Associate Administrator,
Office of Exploration Systems
Rear Admiral Craig E. Steidle (Ret.)*



A New Future for U.S. Civil Space Programs

"This cause of exploration and discovery is not an option we choose; it is a desire written in the human heart."

President George W. Bush
February 4, 2003

"We leave as we came, and God willing as we shall return, with peace and hope for all mankind."

Eugene Cernan (Commander of last Apollo mission)
December 17, 1972

"... America will make those words come true."

President George W. Bush
January 14, 2004

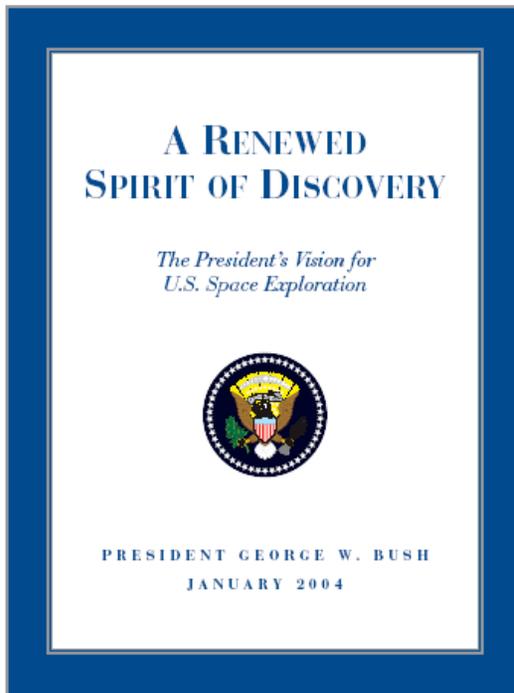


- On January 14, 2004, President Bush articulated a new Vision for Space Exploration in the 21st Century
- This Vision encompasses a broad range of human and robotic missions, including the Moon, Mars and destinations beyond
- It establishes clear goals and objectives, but sets equally clear budgetary 'boundaries' by stating firm priorities and tough choices
- It also establishes as policy the goals of pursuing commercial and international collaboration in realizing the new vision



Nation's Vision for Space Exploration

THE FUNDAMENTAL GOAL OF THIS VISION IS TO ADVANCE U.S. SCIENTIFIC, SECURITY, AND ECONOMIC INTEREST THROUGH A ROBUST SPACE EXPLORATION PROGRAM



Implement a sustained and affordable human and robotic program to explore the solar system and beyond

Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;

Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration; and

Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.



The Nation's Vision

1. Return the Shuttle to safe flight as soon as practical, based on CAIB recommendations
2. Use Shuttle to complete ISS assembly
3. Retire the Shuttle after assembly complete (2010 target)
4. ***Focus ISS research to support exploration goals; understanding space environment and countermeasures***
5. Meet foreign commitments
6. ***Undertake lunar exploration to support sustained human and robotic exploration of Mars and beyond***
7. ***Series of robotic missions to Moon by 2008 to prepare for human exploration***
8. ***Expedition to lunar surface as early as 2015 but no later than 2020***
9. ***Use lunar activities to further science, and test approaches (including lunar resources) for exploration to Mars & beyond***
10. ***Conduct robotic exploration of Mars to prepare for future expedition***
11. ***Conduct robotic exploration across solar system to search for life, understand history of universe, search for resources***
12. ***Conduct advanced telescope searches for habitable environments around other stars***
13. ***Demonstrate power, propulsion, life support capabilities for long duration, more distant human and robotic missions***
14. ***Conduct human expeditions to Mars after acquiring adequate knowledge and capability demonstrations***
15. ***Develop a new Crew Exploration Vehicle; flight test before end of decade; human exploration capability by 2014***
16. ***Separate cargo from crew as soon as practical to support ISS; acquire crew transport to ISS after Shuttle retirement***
17. Pursue international participation
18. Pursue commercial opportunity for transportation and other services



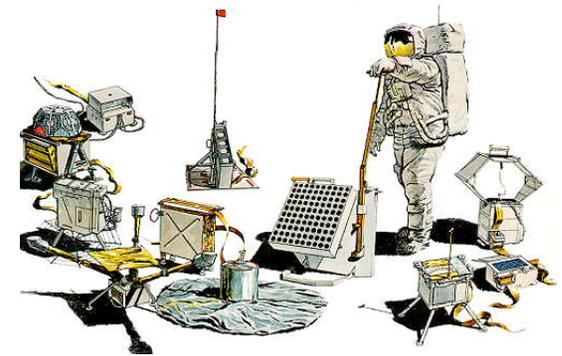
Key Elements of the Nation's Vision

- **Objectives**

- Implement a sustained and affordable human and robotic program
- Extend human presence across the solar system and beyond
- Develop supporting innovative technologies, knowledge, and infrastructures
- Promote international and commercial participation in exploration

- **Major Milestones**

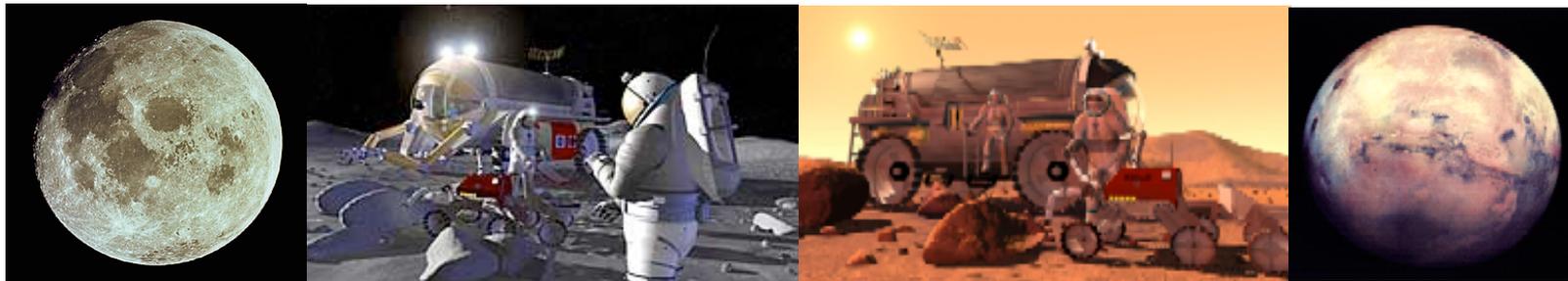
- 2008: Initial flight test of CEV
- 2008: Launch first lunar robotic orbiter
- 2009-2010: Robotic mission to lunar surface
- 2011 First Unmanned CEV flight
- 2014: First crewed CEV flight
- 2012-2015: Jupiter Icy Moon Orbiter (JIMO)/Prometheus
- 2015-2020: First human mission to the Moon





Preparing for Mars Exploration

- **Moon as a test bed to reduce risk for future human Mars missions**
 - **Technology advancement** reduces mission costs and supports expanded human exploration
 - **Systems testing** and technology test beds to develop reliability in harsh environments.
 - **Expand mission and science surface operations** experience and techniques
 - **Human and machine collaboration:** Machines serve as an extension of human explorers, together achieving more than either can do alone
 - **Breaking the bonds of dependence on Earth:** (e.g./Life Science/Closed loop life support tests)
 - **Power generation and propulsion** development and testing
 - **Common investments** in hardware systems for Moon, Mars and other space objectives





Background

- 1993 Secretary of Defense “Bottom-Up” Review
 - Shut-down Navy Advanced Fighter (AF/X) program
 - Shut-down Air Force Multi-Role Fighter (MRF) program
 - Established Advanced Short Take Off/ Vertical Landing program
 - Established Joint Advanced Strike Technology Office
- } Unaffordable

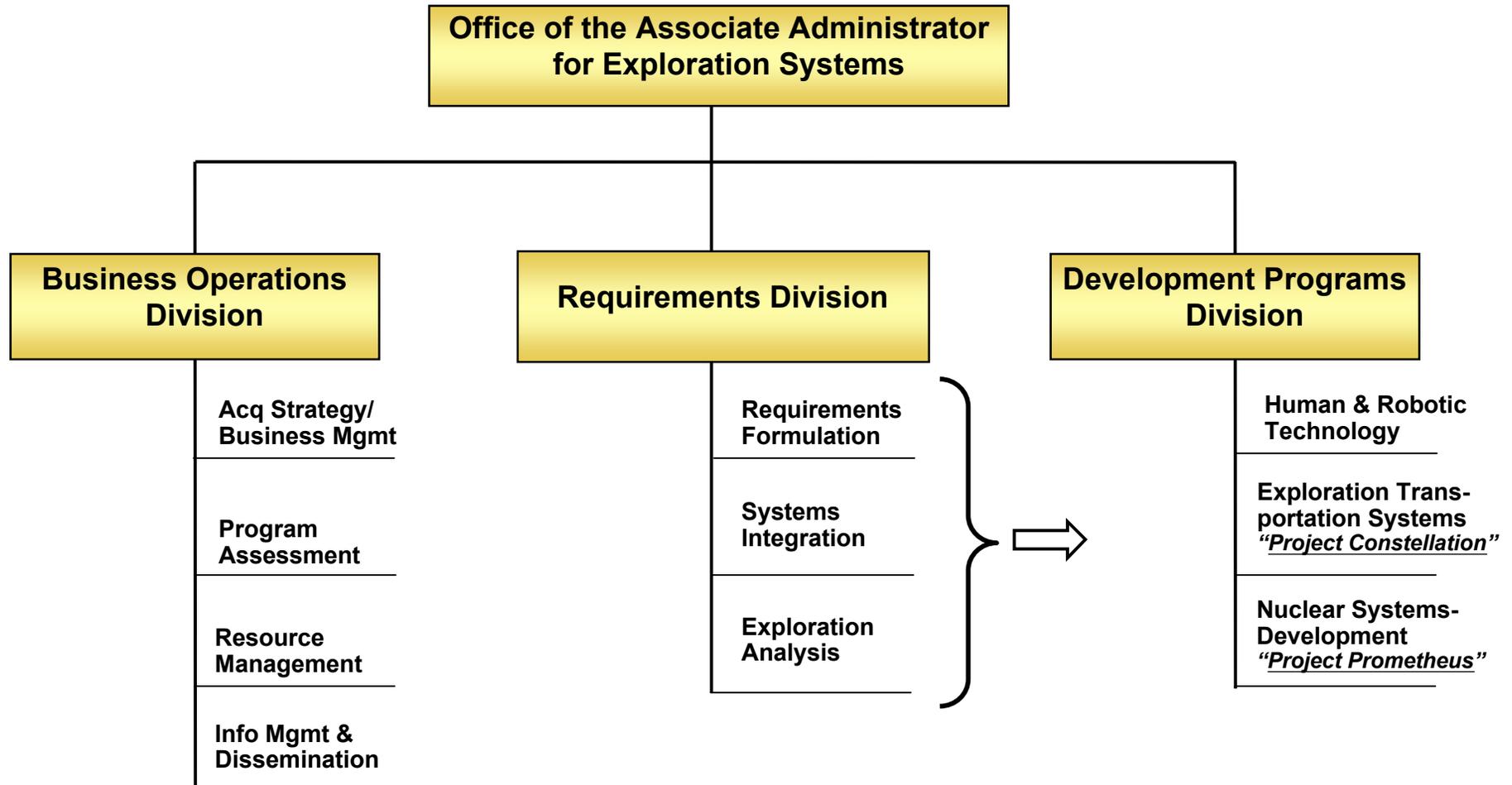


Exploration Systems: Building on Past Findings and Lessons Learned

- **Packard Commission Findings**
 - Get operators and technologists together to enable the leveraging of cost-performance trades
 - Apply technology to lower cost of system, not just to increase its performance
 - Mature technology prior to entering engineering and systems development
 - Partnerships with Industry to identify innovative solutions
- **Report of the DSB/AFSAB (Young Report)**
 - Requirements definition and control are dominant drivers of cost, schedule, and risk in space systems development programs



Office of Exploration Systems Organization





Building on Lessons-Learned

- **Task**

- Develop a consolidated database of Lessons-Learned from human and robotic mission experience. Sample review areas:
 - Space Station / Shuttle
 - CAIB / Challenger report
 - Previous NASA reviews
 - Etc.

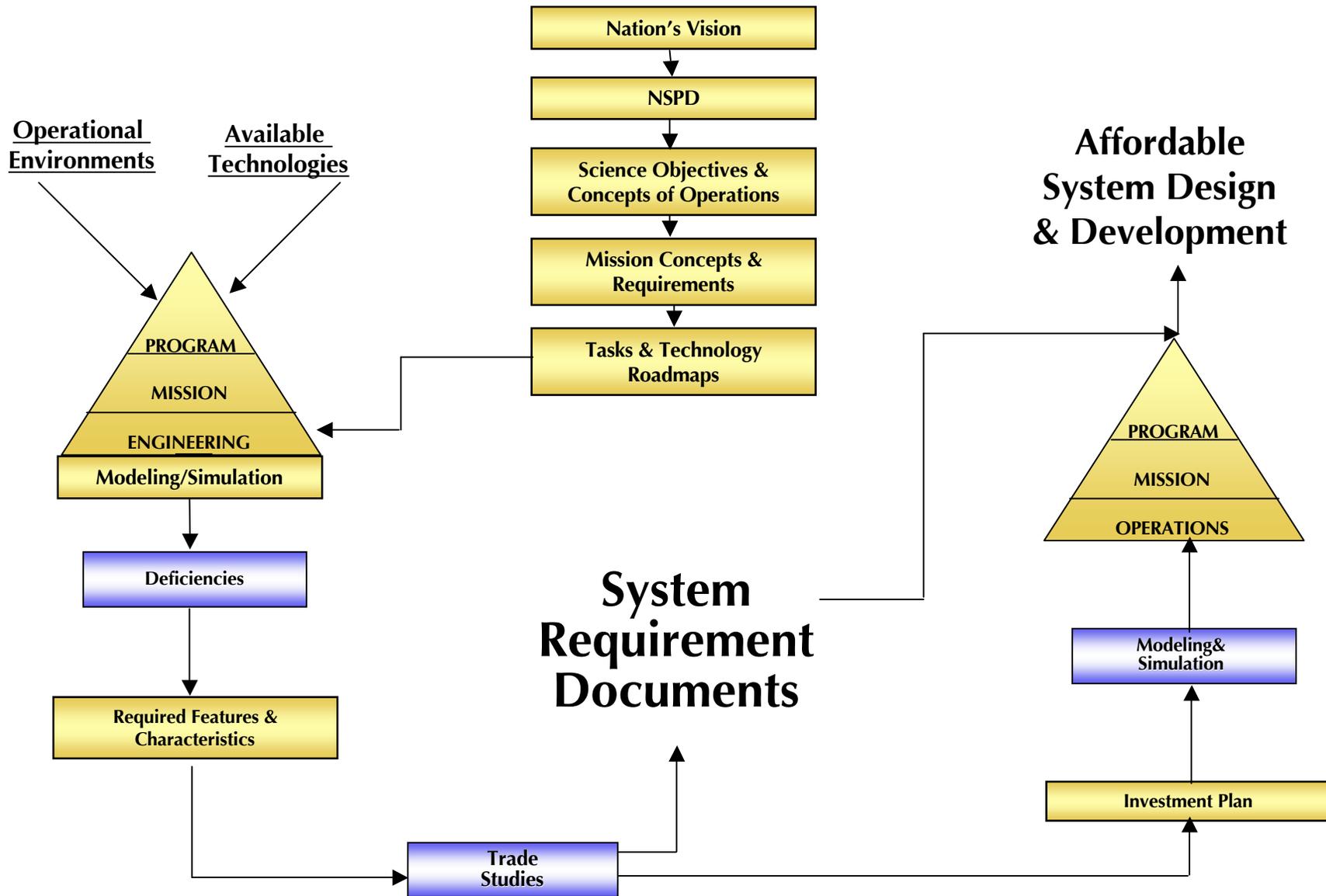
- **Actions**

- Initiated task with Systems Management office at Langley Research Center. Topic areas defined to include:
 - Cultural Issues
 - Programmatic considerations
 - Technical/Engineering considerations
 - Communications
 - Ground Operations
 - Risk Assessment

- **Initial results due at the end of June**



Strategy-to-Task-to-Technology Process





Constellation Architectural Components

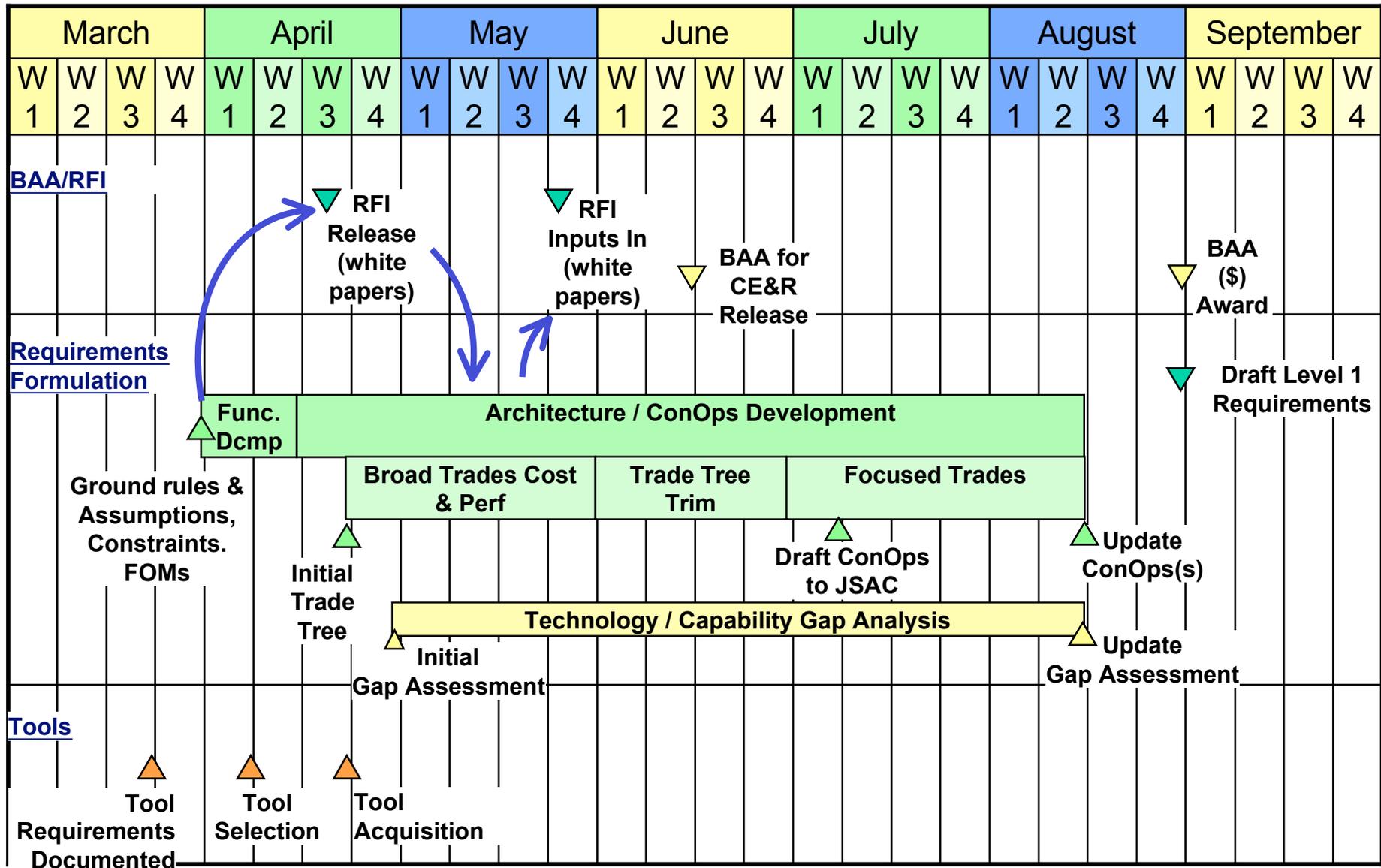
<ul style="list-style-type: none">✓ Robotic Precursors✓ Lift Capability✓ Crew Transfer Capability (CEV)Life SupportScalable PropulsionToolsExploration Science Instrumentation	<ul style="list-style-type: none">Surface MobilityLander ExtensionsHabitationLarge Structure TransportAssemblyLarge Scale Power Generation✓ Communications Infrastructure
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✓ = Specific programs underway. Other components being addressed through on-going analysis/trades



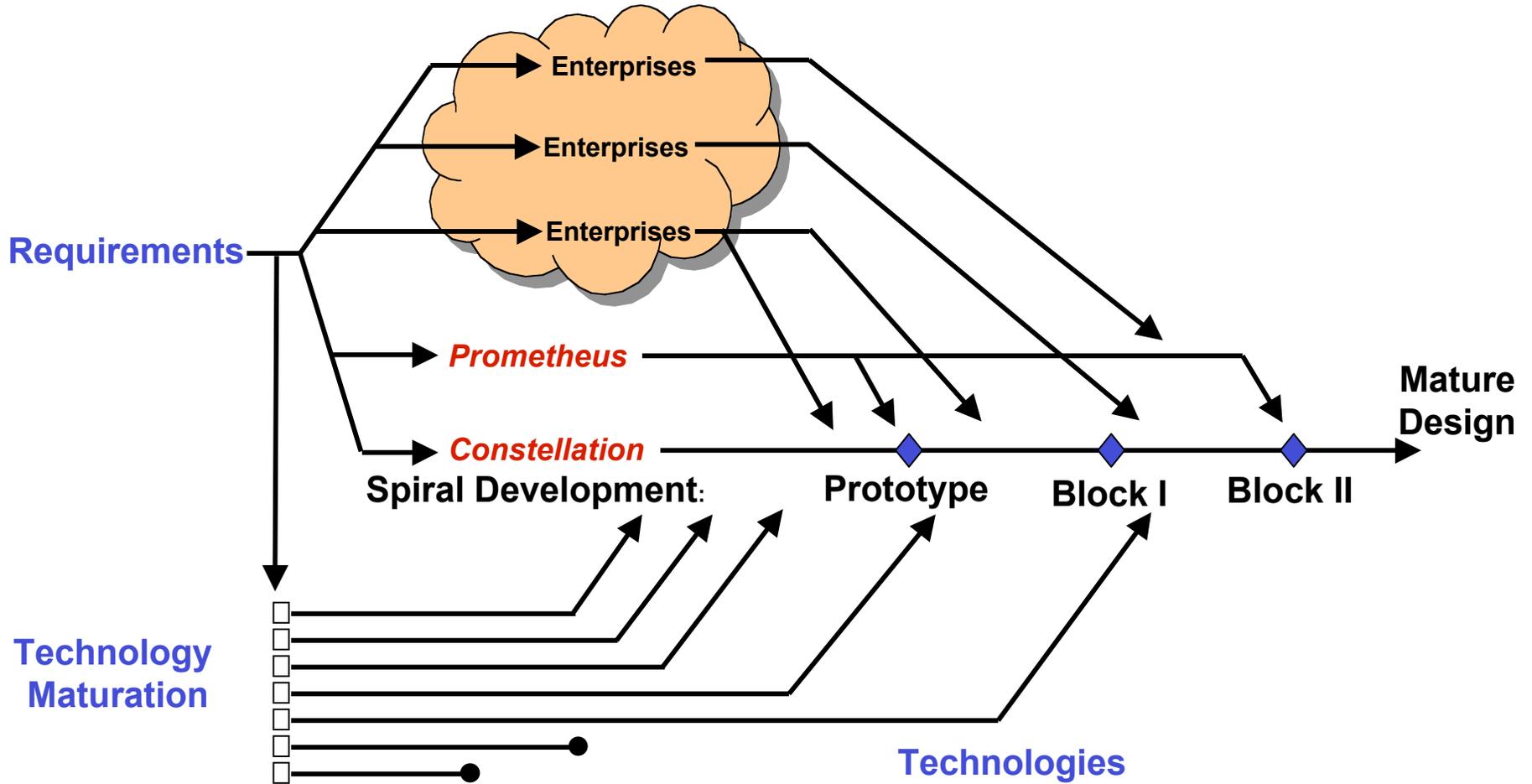
Requirements Roadmap

FY 2004 Schedule





Requirements and Technology Investment Flow





Beginning New Collaborations

- **In Depth Discussions between The Office of Space Science and the Office of Exploration Systems**
 - Developing collaborative processes and integrating with all Enterprises
 - Understanding responsibilities for mission requirements/ mission implementations
 - Lunar Robotic Missions
 - Mars Robotic Missions
 - Prometheus program
 - **Early Progress- 2008 Lunar mission definition**
 - Code T delivered draft requirements to Code S
 - Code S sponsored workshop to define measurement requirements
 - Participation by key lunar scientists
 - Participation by human space flight representatives
 - Code S/T preliminary review/concurrence of proposed instrument requirements to be followed by near term formal review
- **Developing strong working relationships with all Enterprises to ensure proper coordination and integration of all Vision activities**



OExS Acquisition Strategy

Constellation as a System-of-Systems



Transit and Launch Systems

Crew Transport

Launch

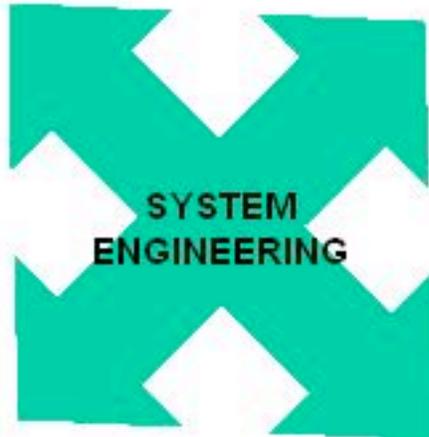
Crew Support

Surface and Orbital Systems

Landing Systems

Comm/Nav

Surface Mobility



Biomedical Countermeasures and Limits

Resource Identification and Characterization

Supporting Research

Long-Duration Habitation

Pre-Positioned Propellants

Surface Power and Resource Utilization

Technology Options

Mars Candidates

Telescope Candidates

Outer Moons Candidates

Commonality/Evolvability For Future Missions



Development

Major Elements

Project Constellation

- Development of a Crew Exploration Vehicle

• **Project Prometheus**

- The Nuclear Systems Program...

• **Advanced Space Technology**

- Advance and mature a range of novel concepts and high-leverage technologies and transition them to application in the Exploration Systems Enterprise and other NASA Enterprises...

• **Technology Maturation**

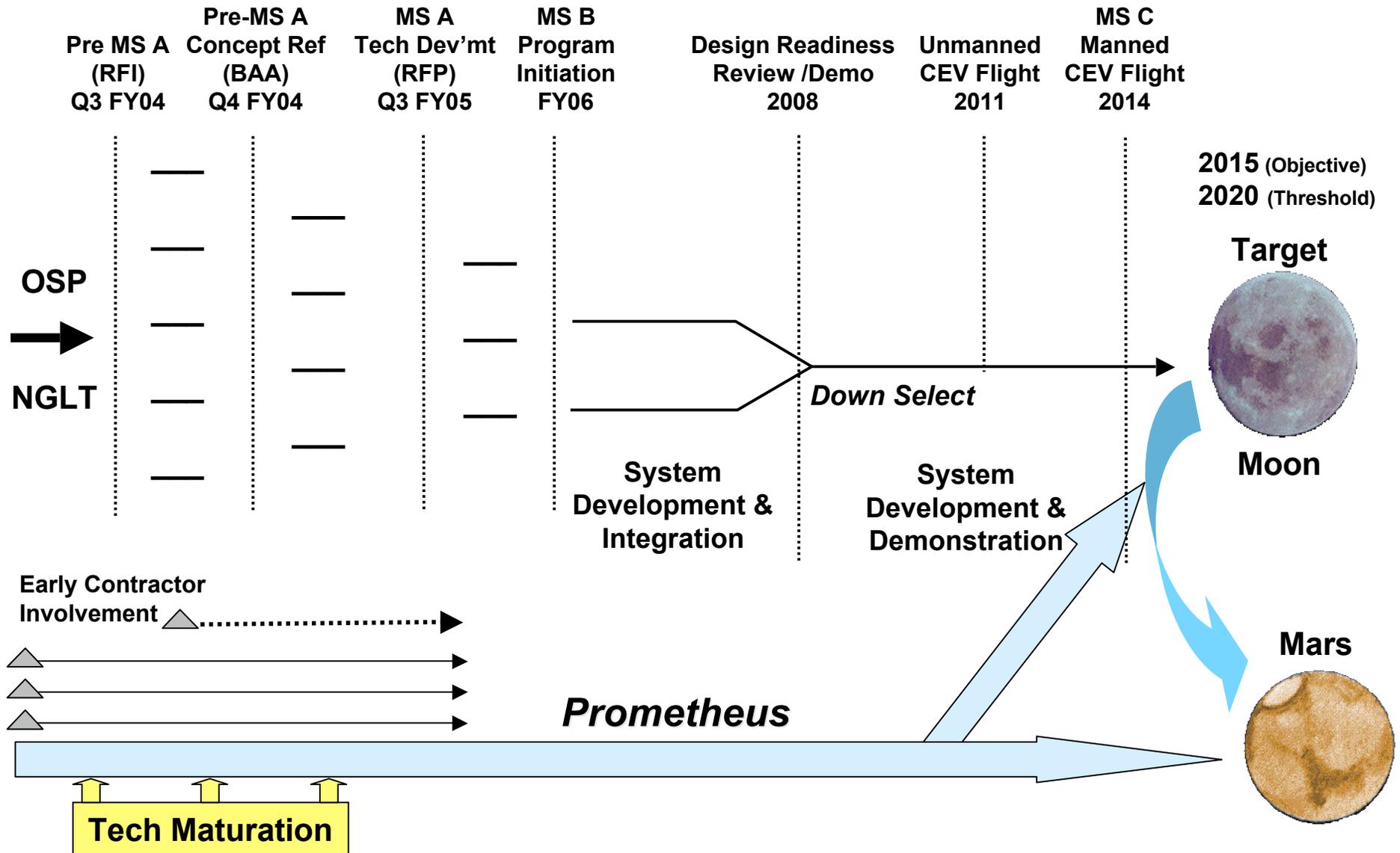
- Develop and validate novel concepts and high-leverage technologies to enable safe, affordable, effective and sustainable human and robotic exploration...

• **Innovative Technology Transfer Partnerships**

- Enable the creative use of intellectual assets both inside and outside NASA to meet Agency needs and to benefit the Nation...



Constellation Program Acquisition Strategy Overview (Baseline)





Constellation Acquisition Processes and Personnel

- Building Acquisition Approach Using Both DoD 5000 and NASA 7120.5B → C
 - Incorporated Spiral Development
 - Established Program Review Process – Event Driven
 - Completed WBS
 - Drafting Single Acquisition Management Plan (SAMP) to Include:
 - Key Performance Parameters (KPP)
 - Acquisition Program Baseline (APB)
 - Integrated Baseline Reviews (IBR)
 - Independent Cost Estimates
 - Risk Management Plan in Development; Reviewing Automation Tools
- Personnel
 - Key Personnel & major PM's Selected and Onboard for Constellation and CEV
 - Two CEV senior managers scheduled for DoD acquisition Training at DSMC



Project Prometheus

To reflect Nation's Vision for Space Exploration, Project Prometheus has been augmented as follows:

– **Advanced Space Nuclear Propulsion Technology**

- Issued technology development solicitation for High Power Electric Propulsion; Supports technologies leading to potential application in human missions
- Initiated studies to assess use of fission technologies in potential support of human Moon and Mars exploration missions

– **Jupiter Icy Moons Orbiter (JIMO)**

- Augmented scope of three Phase A contracts for JIMO to add studies for potential derived applications of JIMO technologies:
 - Lunar surface power
 - Mars surface power
 - Mars cargo transporter (5000 kg class)
 - Follow-on outer planetary exploration
- Added scope to planned JIMO Phase B work for the same four derived applications as above

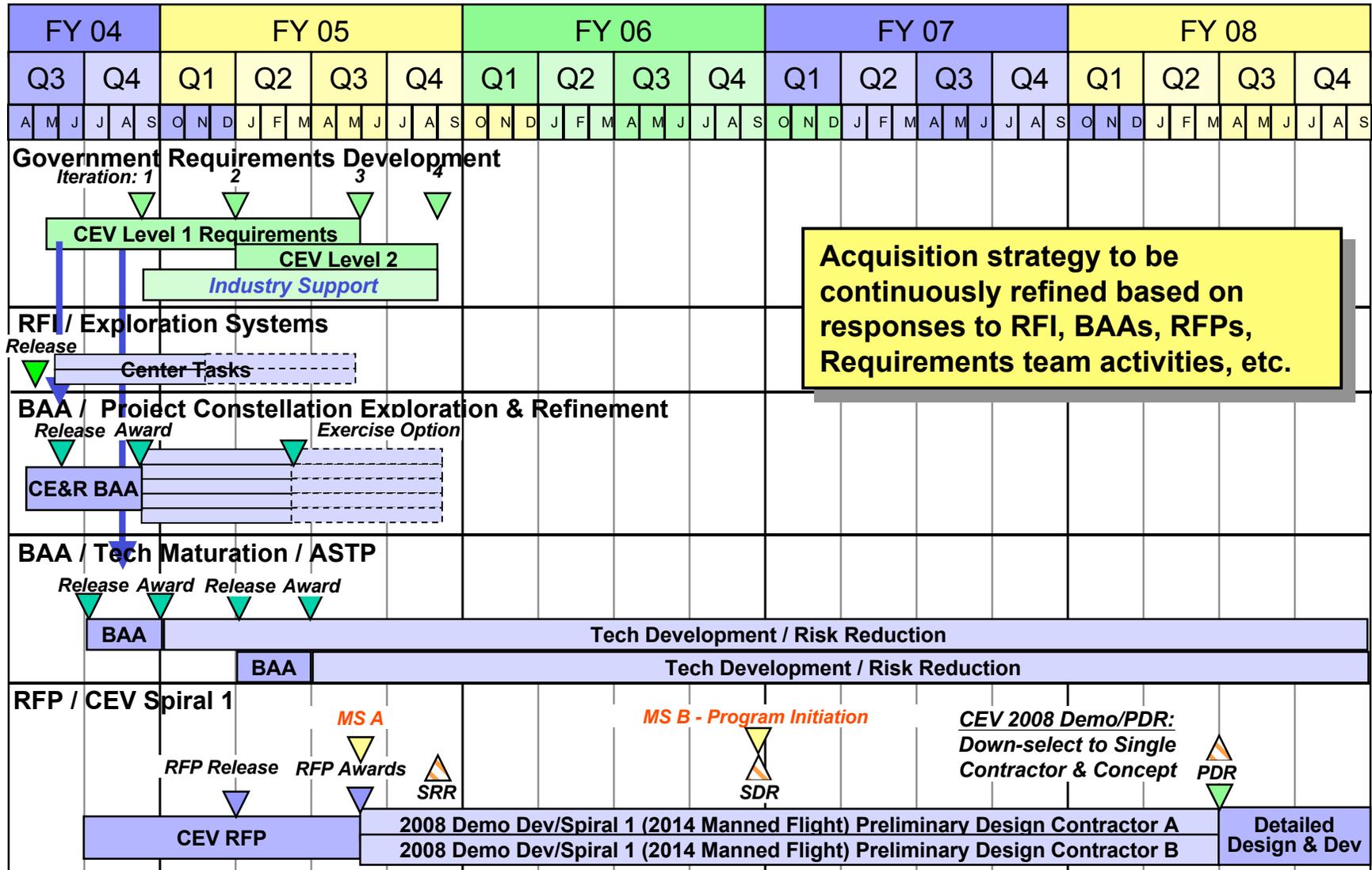


Human & Robotic Technology Status

- Various Technology Programs Consolidated Under H&RT
 - Advanced Space Technology Program (formerly Mission and Science Measurement Technologies (MSM))
 - Innovative Technology Transfer Program (including SBIR/STTR)
 - Technology Maturation Program
 - Plus...Project Prometheus, Centennial Challenges (discussed elsewhere)
- Technologies Inventoried and Mapped into Exploration Systems Requirements
 - Initial Capability Gaps Identified: i.e. Integrated Vehicle Health Management, Inflight refueling, Inspace assembly...
- Investment Strategy Established to Fund Technologies that:
 - Fills Gaps and Improves Affordability by focusing on “System of System” Improvements such as Reusability, Reliability, System Effectiveness...
 - Emphasizes technologies of broad potential value
- First Broad Agency Announcement (BAA) for Advanced Technology Research & Development in Exploration to be Awarded in Oct 2004
- Follow-on Award in Apr 2005 Will Address Specific Technology Gaps in Project Constellation Spiral I Which Includes CEV



Near-Term Acquisition Strategy





Centennial Challenges

- **Description:**

- A program of contests in which NASA will establish cash awards to stimulate innovation and competition in technical areas of interest to Civil Space and Aeronautics.
- Specifically, Centennial Challenges is a low risk program designed to:
 - Encourage innovation in ways that standard federal procurement cannot
 - Enrich NASA research by reaching new communities
 - Help address technology pitfalls
 - Promote returns that outweigh the investment
 - Educate, inspire and motivate the public

- **Innovation Sought:**

- Revolutionary advances in fundamental technologies
- Breakthrough robotic capabilities
- Very low cost space missions

- **Participants:**

- U.S. citizens who are not federal employees (including FFRDCs) unless otherwise specified in challenge rules
- Industry, academia, non-profits, students, individuals

- **Activities:**

- Announcements released for:
 - Prize formulation workshop involving external community (15 -16 June)
 - Informational website announced and active (www.centennialchallenges.nasa.gov)



International Cooperation Strategy

- **JSF lessons-learned:**

- March 18th meeting between AA, Office of Exploration Systems and Mr. Jon Schreiber, Director of the JSF International Directorate, to review strategies/ lessons-learned
- JSF Program aspects with potential application to NASA:
 - Used early “buy-in” by foreign governments to encourage full participation throughout the program’s development and production stages
 - Allowed foreign partners to influence development & production process to varying degrees based on level of their investment, but control of final key decisions remained with U.S. program authorities
 - Instituted Integrated Program Team (IPT) participation by foreign partners which never lead
 - Established on/off ramps for participation
 - Suggested meeting with Missile Defense Agency to review their strategies/ lessons-learned based on their application of JSF model to a unique program.
 - Meeting with MDA conducted 21 April. Results to be folded into developing International Cooperation strategy



International Cooperation Strategy

Work to be Done

- **Key objectives developed:**

- Promote common objectives and cooperative/complementary efforts for space exploration
- Utilize international capabilities to help close capability gaps and develop breakthrough technologies

- **Issues to be worked**

- Potential partners and levels of involvement
- How does NASA protect its program's critical path
- Return-on-Investment for participating partners
- Length of time to gain approval for a cooperation plan through all interested parties

- **Actions in-work**

- Establishing International Cooperation IPT with Code I (External Relations) serving as co-lead to develop and implement a strategy for international participation
- Conducting study of program management implications of International Space Station (ISS) cooperation strategy.
- Evaluating current ISS group for potential partners/cooperation
- Developing a comprehensive set of lessons learned and recommended principles for international participation
- Continuing to work with the JSF/MDA Program Offices to facilitate the transfer of international cooperation best practices, lessons learned and mgmt principles



Exploration Systems

The President's budget request for FY05 includes:

- \$428 million for Project Constellation (\$6.6 billion over five years) to develop a new crew exploration vehicle.
- \$438 million for Project Prometheus to develop advanced nuclear technologies for power and propulsion.
- \$115 million in new funding for Technology Maturation to identify and develop the technologies and building blocks necessary in pursuit of the exploration vision, growing to \$500 million by FY 2009.
- \$20 million in new funding for Centennial Challenge, an innovative new approach to achieving new technological capabilities.



\$ In Millions	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Exploration Systems	1,563	1,782	2,579	2,941	2,809	3,313
Human and Robotic Technology	655	1,094	1,318	1,317	1,386	1,450
Transportation Systems	909	689	1,261	1,624	1,423	1,863

Note: FY04 does not include earmarks



Office of Explorations Systems FY04 Products

Office of Exploration Systems

- Cross Agency Focus
- Focused, prioritized requirements based on a common operational concept
- Spiral, modular transformation
 - Development in stages (spirals) with evolving modular components
 - Technology maturation for inclusion in future spirals
- Mgmt rigor focused on scheduled priorities, cost performance, and personnel development

Requirements Division

- Crew Exploration Vehicle (CEV) Level 1 requirements and concepts of operations
- Lunar Orbiter and Lunar Lander Mission Level 1 requirements with supporting documentation
- Prometheus Level 1 capability development requirements
- Tech maturation plan

Development Division

- Work Breakdown Structure (WBS) based on requirements for Exploration Systems
- Re-aligned Advanced Space Technology, Technology Maturation, and Space Transportation technology projects plus OSP and NGLT lessons-learned
- Investment Plan based on WBS gap analysis / Industry concept studies
- Award Prometheus/JIMO follow-on contract for tech maturation



Office of Explorations Systems FY04 Products (cont'd)

Development Division (Cont'd)

- Single Acquisition Management Plan Framework to include:
 - Key Performance Parameters (KPPs), and Operational Thresholds and Objectives
 - Spiral Development Objectives and Milestones
 - Acquisition Strategy/Acquisition Program Baseline (APB)
 - Performance-Based measures for cost, schedule & performance
 - Integrated Baseline Reviews, EVMS tracking, Risk Analysis and Mitigation, Entrance/Exit Criteria...

Business Operations Division

- Acquisition strategy & business formulation
- Resource management
 - Establish disciplined funds obligation & cost execution process
 - Match workforce competencies with mission needs
- Program assessment
 - Create integrated program & financial management module (EVMS)
- Conduct several NASA / Industry Days
- Complete charter and first draft of Exploration Systems Master Plan
- Formulate / Implement / Enforce Broad Agency Announcement (BAA) Strategy



One Step at a Time

It is affordable and sustainable

- Paced by experience, technology readiness and flexibility
- Establishing Stepping Stones
- Developing Building Blocks –technology to enable each successive step
- Employing New Approaches – spiral development – build and test
- Fiscal Acquisition Management – Disciplined

It is focused and achievable

- Responds to the nation's call for a long term space vision
- We have an integrated agency approach
- We have the talent, experience and leadership – recent successes and demonstrated management reforms
- We have the passion and commitment to succeed



Office of Exploration Systems

*We're not where we want to be,
We're not where we're going to be,
BUT we're certainly not where we
were yesterday.*

M.L. King Jr., Jan '68





Back-up



Trade Studies

Responsible Org.		Task Identifier	Status			Task Information														
Code	Division		Stoplight	Proposed	Due Date	Title	Area of Focus					Centers								
							Reqs	Arch.	System	Tech	SE&I	ARC	DFRC	GRC	GSFC	JPL	JSC	KSC	LaRC	MSFC
T	RQ	RFT 0001.04JSC	Released	02-Apr-04	27-May-04	Lunar Design Reference Mission 2		X								L				
T	RQ	RFT 0002.04LaRC	Released	07-Apr-04	03-Jun-04	Lunar Architecture Broad Trades	X	X	X	X	S		S			S		L	S	
T	RQ	RFT 0004.04JSC	Released	28-Apr-04	11-Jun-04	Lunar Surface Element Study - Crew Systems				X						L				
T	RQ	RFT 0006.04GRC	In Negotiation	23-Apr-04		Lunar Surface Element Study - Power				X			L			S				
T	RQ	RFT 0005.04JSC	In Negotiation	20-Apr-04	08-Jun-04	Exploration DRA Capability Assessment		X		X	S		S	S		L	S	S	S	
T	RQ		In Draft			Lunar Testing										L				
T	RQ					Robotics Requirements														
T	RQ	RFT 0007.04MSFC	In Negotiation	26-Apr-04		Human-Rated Launch Vehicle Requirements	X									S	S		L	
T	RQ					Launch Vehicle Special Studies										X	X		X	
T	RQ	RFT 0014.04JSC	In Draft			OAG								S	S	L	S		S	
T	RQ	RSI 0003.04MSFC	In Negotiation	30-Apr-04		Code T Modeling and Simulation Support Plan, Benchmarking, & Capability Catalogue				X	S	S	S	S	S	S	S	S	L	S
T	RQ	RFT 0015.04LaRC	In Draft			Risk-Based Analysis Capability										S	S	L		
T	RQ	RSI 0009.04LaRC	In Negotiation	30-Apr-04		M&S Prototyping				X						S		L		
T	RQ					Systems Engineering and Project Management Capability				X										
T	RQ					M&S HW, SW and personnel Purchases				X										
T	RQ	RFT 0012.04	In Draft			Conops development							S	S	S	S				
T	RQ	RFT 0013.04KSC	In Draft			Ops and processing facilities											L			
T	RQ	RFT 0008.04MSFC	In Negotiation	13-Apr-04		Agency Requirements	X			X						S	S		L	
T	RQ					Draft Requirements														
T	RQ					LDRM 2 Focused Trades							X		X	X	X	X	X	
T	RQ					LDRM X Trades							X		X	X	X	X	X	
T	RQ					Special CEV Studies (ISS)										L				
T	RQ					Special CEV Studies										L				
T	RQ					Level 2 Trades*							X		X	X	X	X	X	
T	RQ	RFT 0010.04JPL	In Draft			JIMO Architecture A										L				
T	RQ	RFT 0011.04GRC	In Draft			JIMO Architecture B										L				
						Industry Concept Integration					S	S	S	S	S	S	S	S	S	S
A	Trans.		In Negotiation			Sensitivity Analysis of Space Transportation Impacts on Architectures		X	X										L	
A	Trans.	Trans Task 2	In Negotiation			Modularity Impacts to Space Transportation System		X	X							S	S	L	S	
A	Trans.		In Negotiation			Integrated Space Transportation Plan Analysis			X	X			S			S	S	L	S	
A	Trans.		In Negotiation			NASA Space Transportation Traffic Model and Risk Analysis for Space Exploration										S	S	L	S	
A	Trans.		Released			Earth-to-Orbit (ETO) Trade Study for Future Moon-Mars Exploration		X	X				S			S	S	S	L	
A	Arch.		In Draft			Lunar Strategy		X								S	S			
A	Arch.		In Draft			Integrated Human-Robotic Approach		X		X										
A	Arch.		In Draft			Human Health and Performance	X													
A	Arch.		In Draft			Nuclear Investment Strategy		X	X	X										
T	Const.	CT0001.1	In Negotiation	22-Mar-04	26-Apr-04	Proposal for Configuration Management (CM) Approach				X									L	
T	Const.	CT0001.2	Released	24-Mar-04	10-May-04	OES Enterprise Work Breakdown Structure (WBS) Development				X	S	S	S	S	S	S	S	S	L	S
T	Const.	CT0001.3	In Negotiation	01-Apr-04	01-Jun-04	Division Level Risk Management Approach				X									L	
T	Const.	CT0001.4	In Negotiation	01-Apr-04	31-May-04	Common Term Glossary Development				X									L	
T	Const.	CT0002R3	Complete	08-Feb-04	04-Mar-04	NGLT Program Content Relevance Assessment				X	S	S	S	S	S	S	S	S	L	S
T	Const.	CT0003R2	Complete	09-Feb-04	24-Feb-04	Previous Space Transportation Studies	X	X	X		S		S			S	S	S	L	
M	Const.	CT0004	Released	09-Feb-04	17-May-04	EELV Derived Heavy Lift Launch Vehicles	X	X	X								L			
T	Const.	CT0005	Released	09-Feb-04	17-May-04	Heavy Lift Launch Vehicles	X	X	X								S		L	
T	Const.	CT0006	Complete	04-Feb-04	11-Feb-04	Provide Program Control and Management Documentation				X									L	
T	Const.	CT0007	Complete	09-Feb-04	18-Feb-04	Provide Report on Facilities Requirements for Space Transportation Development	X			X	S	S	S	S	S	S	S	S	L	S



BAA/RFP Summary Slide

Acq Strategy Spt	Gvt	Non Gvt	Req's Dev ¹	CEV RFP	Tech Dev ²	Release Date
Task Orders for Baseline Req considerations	✓		✓	✓		Issued
Request for Information (RFI's)	✓	✓	✓	✓	✓	Issued Apr
HR&T DRC for Tech Mat & Advanced Science Tech	✓				✓	May 04
BAA for Concept Exploration & Refinement		✓	✓	✓		Jun 04
RFI Extended Studies	✓		✓	✓		TBD
Task Orders for Validation of BAA results	✓		✓	✓		TBD
HR&T BAA for Advanced Science Tech		✓			✓	Jul 04
HR&T BAA for Tech Mat		✓			✓	Jan 05
CEV Request for Proposal	✓	✓	✓	✓		Jan 05

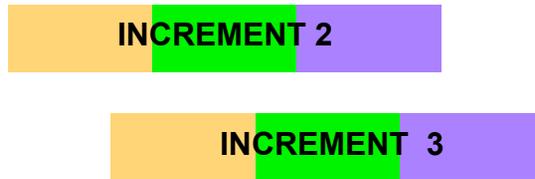
BAA: Broad Agency Announcement
 RFP: Request for Proposal

Note 1: For Spiral 1 only

Note 2: For subsequent Spirals



Evolutionary Acquisition



OR *Single Step to Full Capability ?*

Evolutionary Acquisition

- **Spiral Development:** The end-state requirements are not known at program initiation. Those requirements are refined through system development and demonstration, risk management and continuous user feedback
- **Incremental Development:** The end-state requirement is known, and that requirement is met over time by developing several increments, each dependent on available mature technology and resources

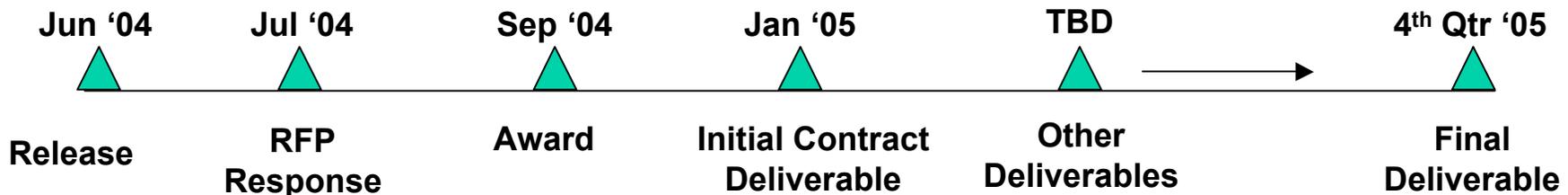
Key Considerations

- **Urgency of Requirement**
- **Maturity of Key Technologies**
- **Interoperability, Supportability, and Affordability of Alternative Acquisition Approaches**
- **Cost/Benefit of Evolutionary vs. Single Step Approach**



Concept Exploration & Refinement (BAA)

- **Solicitation: Broad Area Announcement (BAA):**
 - In support of Projects Constellation and Prometheus requirements development and acquisition strategy
 - Expected response from industry
 - Multiple Awards/Varying Response Times
- **Deliverables:**
 - Architectural Trade Studies and Risk Reduction Analyses
 - Concepts for Lunar Missions and Architecture
 - Concepts for CEV
 - Methods for incorporating TECHMAT into CEV and Lunar Architecture
 - Recommendations for Streamlining Acquisition
- **Purpose:**
 - Advanced Development of Potential Risk Reduction Concepts
 - Support Systems Integration and CEV contract process
 - Continued pursuit of innovative concepts determined to be feasible/affordable based on Jan RFI results and recommendations



Note: Additional BAA Procurement Cycles will further define the System-of-Systems operations concepts and perform integrated systems trade studies.



Early Concept Definition (RFI)

- **Solicitation: Request for Information (RFI):**
 - In support of Projects Constellation and Prometheus requirements development and acquisition strategy
 - Expected response from industry, academia, NASA centers, related commercial enterprises, etc.
- **Deliverables:**
 - Unfunded “White Papers” addressing key areas for further study and risk reduction
- **Purpose:**
 - Identification of areas for future trade studies & risk reduction activities
 - Identification of technical risk areas and cost drivers
 - Assessment of design drivers and other critical architecture considerations
 - Innovative concepts or considerations in key areas such as:
 - Sustainability
 - Affordability
 - Reliability & Safety
 - Launch Infrastructure
 - Crew size
 - Payloads
 - In-space repair
 - Maintenance & assembly
 - Lunar/Mars Commonality
 - Power/propulsion Issues
 - Acquisition Strategy/PM Tools
 - ETC.





Spiral 1 CEV Development (RFP)

- **Solicitation: Request for Proposal (RFP):**
 - In support of Project Constellation's development and acquisition strategy for unmanned CEV flight by 2011 and manned CEV flight by 2014
 - Expected response from major industry primes with multiple teaming arrangements possible
 - For competitive effects and further risk reduction, objective is to carry 2 contractors through preliminary design then down-select to single prime who best demonstrates:
 - Greatest performance / Lowest cost & schedule risk
 - Open design facilitating new technology insertion / Design compatibility for future spirals
 - Affordability, Supportability, Safety of Flight, Etc.
- **Deliverables:**
 - Major risk reduction activities and technology **demonstrations to include 2008 1st flight CEV demonstration**
 - Work Breakdown Structure (WBS), Integrated Master/Mgmt Plan (IMP), Integrated Master Schedule (IMS)
 - Plans: Risk Management, Resource allocation, Safety, T&E, Support, Producibility...
 - Integrated Baseline Review (IBR), Utilization of Earned Value Management; Quarterly program reviews to track/manage performance, cost, schedule, and risk



Spiral 1 CEV Development (RFP) Cont.

- Deliverables (Con't):
 - Major test activities to demonstrate system performance / safety of flight
 - 2011 Unmanned flight demonstration
 - 2014 Manned CEV flight demonstration
- Purpose
 - Provide human space flight capability to support preparation for a human Lunar mission no later than 2020
 - Develop initial requirements / risk reduction activities supporting future Mars exploration





Development Programs Status

- **Constellation**
 - Initial strategy for CEV acquisition program complete
 - Spiral I of acquisition defined, focused on 2014 capability for manned spaceflight
 - Request for information released to industry, government, academia
 - Solicitation for CEV concepts to be released to industry in June 2004
- **Prometheus**
 - Jupiter icy moons orbiter (JIMO) acquisition strategy realigned with exploration systems
 - Nuclear power and propulsion level I requirements for exploration systems to be completed in May 2004
 - RFP for follow-on JIMO development to be awarded in Nov 2004
 - Secretary of Energy tasked the Department of Energy Office of Naval Reactors (NR) to support Project Prometheus
- **Orbital Express**
 - Continuing development with DARPA
- **X-37**
 - Completing approach & landing test vehicle (ALTV) and tech for orbital vehicle (OV)
 - Efforts will continue in FY05
- **Demonstration of Automated Rendezvous Technology (DART)**
 - Completed reviews for environmental test series readiness and design certification
 - Planning for Oct 2004 launch