

ENTERPRISE: Aerospace Technology



The 12-foot long X-43A hypersonic demonstrator is a scramjet-powered test. Powered by a supersonic combustion ram-jet engine and at a speed of Mach-5, this technology could enable travel to any point on Earth in two-hours, if the ultra high-speed flight proves successful in September 2003 as planned.

THEMES (Aeronautics)



Aeronautics Technology

THEMES (Crosscutting Technologies)



Space Launch Initiative



Mission and Science Measurement Technology



Innovative Technology Transfer Partnerships

Note: The four Themes of the Aerospace Technology Enterprise are split across the two appropriations. The Crosscutting Technologies can be found here in the Space Flight Capabilities appropriation.

AEROSPACE TECHNOLOGY

(CROSSCUTTING TECHNOLOGIES)

PURPOSE

NASA's Integrated Space Transportation Plan (ISTP) has been formulated by the Agency to ensure safe, affordable, capable, and reliable space transportation systems are provided to support NASA's missions. The Space Launch Initiative (SLI) began as a key component of the ISTP, with a goal to provide the necessary technology development, risk reduction, and systems analysis to enable a NASA decision whether to proceed into full-scale development of a Reusable Launch Vehicle (RLV). The ISTP has been updated based on recent systems analyses, resulting in reprogramming some of the planned SLI funding to help achieve the Agency's International Space Station (ISS), Space Shuttle and science objectives. The SLI is focused on the highest agency space transportation priorities: investing in an Orbital Space Plan (OSP) for assured access to the ISS and maintaining technology investments in space transportation launch technologies through the Next Generation Launch Technology (NGLT) Program in support of a future implementation decision.

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The Mission and Science Measurement Technology (MSM) Theme enables revolutionary capabilities through new technology. MSM objectives are to develop science-driven architectures and technology, to create knowledge from scientific data, and to develop capabilities for assessing and managing mission risk. The advanced system concepts, fundamental technologies, and engineering tools developed by MSM are unique to NASA requirements, and are applicable across many classes of missions in multiple Enterprises. These products may require many years to progress from initial concept definition to mission infusion. Three programs have been formulated to accomplish MSM objectives. The Computing, Information, and Communications Technologies (CICT) Program develops breakthrough information and communication systems to increase our understanding of scientific data and phenomena. The Engineering for Complex Systems (ECS) Program develops the capabilities to assess and manage risk in the synthesis of complex systems. The Enabling Concepts and Technologies (ECT) Program defines new system concepts and develops new technologies to enable new science measurements.

Innovative Technology Transfer Partnerships Theme consists of the Technology Transfer Activity and the Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) programs. NASA's strategy is to make technology transfer a normal part of doing business whenever it is developing new technologies and leverage existing mechanisms for technology transfer. In addition the budget provides for a new approach, known as the Enterprise Engine, to partner with venture capital firms and U.S. industry for the development of technologies that can directly contribute to the agency's core research activities, while benefiting private industry. The Technology Transfer Activity contributes to support the Enterprise mission requirements, as well as contributes to improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.

FY 2002 ACCOMPLISHMENTS

Risk reduction and technology development activities conducted by the Second Generation Reusable Launch Vehicle (RLV) program culminated in the analysis and evaluation of competing second-generation reusable launch vehicle architectures and technologies against NASA safety and cost goals. The architecture definition studies focused the available trade space from over 100 candidate architectures to the 15 most promising candidates, identified the key technology drivers for a 2nd Generation RLV, and prioritized the technology development needs. Propulsion system requirements definition and conceptual design studies were performed in support of these architectures. These studies focused the selection of the thrust class and fuel for the booster stage, second stage, and on-orbit auxiliary rocket engines and led to the decision to prioritize further rocket engine work on reusable kerosene engines to support a booster stage of an RLV. Airframe design evaluations included assessments of hot aeroshell/integral tank structures and a demonstration of a self-reacting friction stir welding process for metallic cryogenic tanks. Additional technology development activities were conducted in integrated vehicle health management, flight mechanics, operations, and power systems.

The results of these efforts were evaluated against the Program cost and safety goals. This research indicated that although significant improvements in RLV safety, reliability and cost are possible, large uncertainties surrounding acquisition and operations costs remain, and development of a second generation RLV lacks economic justification for the foreseeable future. As a result, NASA determined that pursuit of a multipurpose Orbital Space Plane that could provide both crew transport and crew return capability would be the best use of agency resources, providing a vehicle of more robust capability and a wider range of potential applications. Investments in space transportation launch technologies will be continued in the Next Generation Launch Technology Program with decision points outlined in the future on whether to implement a new launch vehicle.

A suite of autonomy and collaborative workspace technologies for planetary rovers has been developed and demonstrated in both simulations and field tests. Many of these technologies will be utilized in the upcoming Mars Exploration Rover (MER) mission, and several of the technologies represent key enablers for future planetary exploration missions such as the 2009 Mars Science Laboratory (MSL).

Integrated autonomy software components, including a ground-based task and resources planner, an on-board rover executive for contingency planning, imaging for target acquisition and assessment, and a visual interface for scientists and engineers have demonstrated short traverse instrument placement in a single command cycle. The baseline capabilities of previous rovers required up to three command cycles to perform this type of task. This advance in rover autonomy can significantly reduce the time and resources required, and increase the science return of planetary exploration missions.

An autonomy-architecture has also been demonstrated for the purposes of long-range traverses, which are generally beyond the current capabilities of planetary rovers. This architecture includes a decision layer, which is responsible for robust, dynamic

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replanning, path-planning, and overall execution, and a functional layer for low-level autonomy capabilities such as locomotion, manipulation, and vision-based navigation. The application of this technology would enable rapid response and replanning based on unexpected events or opportunistic (unplanned) science, which are often inherent in long-range traverse scenarios. Elements of these high-level autonomy capabilities will be tested and evaluated in the upcoming MER mission, with full infusion anticipated for the MSL mission.

Another advanced information technology to be demonstrated on the MER mission is a collaborative workspace to streamline mission operations. The workspace, called MERBoard, allows dispersed scientists, engineers, and mission operators to interactively develop mission plans and monitor mission status. The workspace functions as an electronic bulletin board where the science team can make requests for data and targets to be acquired by the rover. The MERBoard provides a common framework for naming targets and communicating science intentions so that the mission team can work together more efficiently.

Collaborative engineering environments can substantially reduce the time needed to conduct tests and plan mission operations. Instead of the transparencies that were often used during the planning phase of the Pathfinder mission, scientists and engineers can now display images on a 50-inch plasma monitor with touch-screen capabilities. Individuals can mark up images on the screen, which can be viewed in real time on other MERBoards connected to a network.

THEME DISTRIBUTIONS

Budget Authority (\$ in millions)	FY 2002	FY 2003 President's Budget, As Amended	FY 2004 President's Budget
Space Launch Initiative	535.1	879.4	1,064.6
Mission and Science Measurement Technology	276.1	274.9	438.4
Innovative Technology Transfer Partnerships	163.8	146.9	169.3
<u>Institutional</u>	<u>543.1</u>	<u>528.2</u>	<u>—</u>
Total	1,518.1	1,829.4	1,672.3

Note: For all formats, the FY 2002 column reflects the FY 2002 Congressional Operating Plan dated 9/30/02. The FY 2003 column reflects the FY 2003 Presidents Budget Submit (PBS) as Amended. FY2004 is in full cost.

Indicates budget numbers in Full Cost.

Space Launch Initiative

This theme ensures safe, affordable, and reliable access to space. New space transportation capabilities are needed to ensure that America continues its leadership in space. The theme gives special emphasis to NASA's unique needs, including crew escape and survival systems. It helps create a more secure world by collaborating with the DOD on critical access to space and hypersonics technologies that support future civil and military aerospace missions. Highlights for FY 2004 include:

Overall budget

FY 2004 request is \$1,065 million, a \$85 million or 7.4 percent decrease from FY 2003 President's Request (full cost):

- \$550 million for Orbital Space Plane program to develop a crew return capability from Space Station by 2010 and crew transfer capability atop an expendable launch vehicle by 2012. Funding supports technology demonstrators such as X-37 and advanced design studies.
- \$515 million for Next Generation Launch Technology program to meet NASA's future space launch needs. Funding includes advanced kerosene engine development and hypersonic propulsion research and testing.

Mission and Science Measurement Technologies

This theme is responsible for developing crosscutting technology for a variety of aviation and space applications, such as communications, power and propulsion systems, micro-devices and instruments, information technology, nanotechnology, and biotechnology. These technology advances will have the potential to open a new era in aviation and allow space missions to expand our knowledge of Earth and the Universe. Our technologies are unique to NASA because we focus on space mission

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applications. Highlights for FY 2004 include:

Overall budget

FY 2004 request is \$438 million, a \$4 million or 0.9 percent increase over FY 2003 President's Request (full cost):

- \$233 million for Computing, Information, and Communications Technologies program including intelligent and autonomous systems for science exploration missions.
- \$44 million for Engineering for Complex Systems program including development of engineering tools to improve safety and mission success.
- \$161 million for Enabling Concepts and Technologies program including development of revolutionary technologies in support of NASA's other enterprises.

Innovative Technology Transfer Partnerships

Under this theme, we will work to develop partnerships with industry and academia to develop new technology that supports Enterprise programs; commercialize and transfer NASA technology to U.S. industry; and enhance NASA technology and commercial objectives through the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs. Highlights for FY 2004 include:

Overall budget

FY 2004 request is \$169 million, a \$14 million or 7.6 percent decrease from FY 2003 President's Request (full cost):

- \$5 million for Enterprise Engine being introduced to create partnerships with innovators to sponsor dual use technologies to further NASA's mission and meet our future technology needs.
- \$29 million for discontinuing the existing commercial technology promotion efforts and, instead, recompeting and refocusing our technology transfer programs to maximize benefits to the taxpayer.
- \$135 million for SBIR/STTR programs.