

Overview

NASA's Space Operations Mission Directorate (SOMD) is responsible for providing space exploration services to both NASA customers and to other partners in the United States and throughout the world. SOMD manages the safe flyout of the Space Shuttle Program (SSP), oversees the operation of the system and payloads on the International Space Station (ISS), provides safe and reliable access to space through the Launch Services Program (LSP) and world-class rocket testing capabilities through the Rocket Propulsion Test (RPT) Program, maintains secure and dependable communications to ground stations and between platforms across the solar system through the Space Communication and Navigation (SCaN) Program; and provides the necessary training and supports the health and safety of our Nation's astronauts through the Human Space Flight Operations (HSFO) Program.

The International Space Station is a unique multinational orbital outpost for learning how to live and work in space as well as carrying out the scientific and engineering research needed for prolonged stays in space, including on the Moon, Mars and other bodies. To enhance benefits, NASA has secured partnerships with other United States Government agencies and private firms to utilize a portion of the ISS as a National Laboratory. For over a decade, the Space Shuttle and International Space Station programs have worked closely together to safely complete this critical element of our Nation's space infrastructure. Completing assembly of the International Space Station will be the crowning achievement of the Space Shuttle's forty year history. Once this historic task is complete after four more flights, estimated by the end of fiscal year 2010, the Space Shuttle will be retired so that NASA can focus on new challenges of a 21st century space agency. The FY 2011 budget for Space Shuttle Program continues to support the planning, optimized utilization, and responsive disposition of processes, personnel, resources, and real and personal property. We will embark on extended and enhanced International Space Station utilization, focusing on basic scientific research and technology demonstration that will prepare us for future exploration and benefit life on Earth. We will invest in the Space Station facility itself by initiating new activities to increase functionality. The activities are intended to support ISS upgrade efforts while proving new space technologies.

In addition to these high-profile programs, SOMD also is responsible for ensuring that the critical infrastructure to access and use space is available to meet the needs of NASA's internal and external customers. The Space and Flight Support Theme (SFS) is comprised of multiple programs that provide Agency-level enabling capabilities that play a critical role in the success of NASA missions and goals. The Space Communication and Navigation Program operates NASA's extensive network of terrestrial and orbiting communications nodes, as well as all of the associated hardware and software needed to pull down the terabytes of data generated by NASA's fleet of crewed vehicles and robotic spacecraft. The Launch Services Program facilitates access to space by providing leadership, expertise and cost-effective Expendable Launch Vehicle services for NASA's missions. The Rocket Propulsion Test Program maintains NASA's wide variety of test facilities for use by NASA, other agencies and commercial partners. The Human Space Flight Operations Program ensures that NASA's astronauts are fully prepared for current and future missions. Funding also is being provided to establish a 21st Century Space Launch Complex Program at the Kennedy Space Center (KSC). This effort is intended to benefit not only NASA's current and future operations at the KSC including commercial activities, but also to enhance the capabilities of the Florida launch range for the benefit of future NASA launches.

Mission Directorate: Space Operations

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	5,764.7	6,180.6	4,887.8	4,290.2	4,253.3	4,362.6	4,130.5
Space Shuttle	2,979.5	3,139.4	989.1	86.1	0.0	0.0	0.0
International Space Station	2,060.2	2,317.0	2,779.8	2,983.6	3,129.4	3,221.9	3,182.8
Space and Flight Support (SFS)	725.0	724.2	1,119.0	1,220.6	1,123.9	1,140.7	947.7
FY 2010 President's Budget Request	5,764.7	6,175.6	3,663.8	3,485.3	3,318.6	3,154.8	--
Space Shuttle	2,981.7	3,157.1	382.8	87.8	0.0	0.0	--
International Space Station	2,060.2	2,267.0	2,548.2	2,651.6	2,568.9	2,405.9	--
Space and Flight Support (SFS)	722.8	751.5	732.7	745.9	749.7	748.9	--
Total Change from FY 2010 President's Budget Request	0.0	5.0	1,224.0	804.9	934.7	1,207.8	--

Note: In all budget tables, the FY 2011 President's Budget Request depicts the July 2009 Operating Plan including American Recovery and Reinvestment Act for the FY 2009 Actual column and the Consolidated Appropriations Act, 2010 (P.L. 111-117) without the Administrative transfers for the FY 2010 enacted column.

Plans for FY 2011

Space Operations

Space Shuttle

New Initiatives:

None.

Major Changes:

The FY 2011 budget includes an increase in FY 2011 to allow for flying the Space Shuttle through December 31, 2010, if necessary, to safely execute the remaining manifest.

Major Highlights for FY 2011

NASA has manifested the last six Space Shuttle missions for FY 2010 including the STS-129 mission that was flown in November 2009. As of February 2010, NASA has four remaining missions to launch. NASA's focus has been and will continue to be on the safe execution of these flights. Once these flights are flown, the Space Shuttle will be retired.

International Space Station

New Initiatives:

We will invest in the Space Station facility itself by initiating new activities to increase functionality. The activities are intended to support ISS upgrade efforts while proving new space technologies. Potential objectives include reducing demands on crew time, lowering ground-based costs, mitigating capabilities lost when the Shuttle retires, improving ISS capabilities, improving ISS safety, and supporting activities benefiting future human spaceflight programs.

The ISS will also be used as a platform for developing and testing technologies and capabilities that are funded and operated within both the Exploration Technology and Space Technology programs. The Exploration Systems Mission Directorate (ESMD) has budgeted \$6 billion over the next five years to develop U.S. commercial crew transportation which will ultimately be utilized by ISS

Major Changes:

The FY 2011 budget provides \$2.5 billion in additional funding over five years to extend ISS, likely through 2020 or beyond, to enable full utilization of ISS, and to initiate activities to increase ISS functionality and maximize operations. The budget also includes a \$250 million increase over five years for science and engineering research, intended to augment current basic research on ISS and supports some transportation of these experiments.

Major Highlights for FY 2011

Following assembly completion in FY 2010, the ISS will serve as a fully functional and permanently crewed research laboratory and technology test bed providing a critical stepping stone for exploration and future international cooperation. The Commercial Resupply Services (CRS) contracts awarded to Space Exploration Technologies (SpaceX) and Orbital Sciences Corporation (OSC) will provide commercial resupply flights beginning in FY 2011. Cargo transportation to ISS will also be supplemented by the Japanese HII Transfer Vehicle (HTV), European Automated Transfer Vehicle (ATV) and Russian Progress flights. Crew transportation and rescue will be provided by the Russian Soyuz vehicle until domestic commercial services are available.

Space and Flight Support (SFS)

New Initiatives:

Funding is being provided to establish a 21st Century Space Launch Complex Program at the Kennedy Space Center and the Florida launch range to transform KSC and Cape Canaveral area into modern facilities poised to play a key role in 21st century space exploration. This new initiative focuses on upgrades to the Florida launch range, expanding capabilities to support commercial crew and cargo providers, consolidating and disposing of unused or underutilized facilities, and performing environmental work to improve the surrounding area. With this large, multi-year investment, this effort will benefit NASA's current and future operations at KSC and Cape Canaveral by targeting increased efficiency and safer operations.

Major Changes:

In FY 2011, changes are proposed to the SCaN Program and the HSFO Program within the SFS Theme. The Optical Communication System (OCS) was deleted from SCaN beginning in FY 2011, but is being considered for funding in the new Space Technology portfolio. The initial demonstration of OCS, the Lunar Atmosphere and Dust Environment Explorer (LADEE) will occur and is fully funded through FY 2010. Core crew health and medical services, which had been funded within ISS and CxP in FY 2010 are consolidated into a single budget line under Crew Health and Safety (CHS) and transferred to HSFO. The activities that will be included under HSFO in the future will be those deemed to be discrete multi-program functions that support the Agency's human space flight operations required regardless of vehicle supported.

Major Highlights for FY 2011

In FY 2011, the SCaN Program will begin procurement of a 34m antenna as part of the effort to improve the robustness of the Deep Space Network and replace the aging 70m antenna capability. SCaN will conduct a System Requirements Review (SRR) of the Space Network Ground Segment Sustainment (SGSS) Project in the third quarter of FY 2011 and will also complete the Critical Design Review (CDR) for the Tracking and Data Relay Satellite (TDRS) K&L. The Communication Navigation and Networking Reconfigurable Testbed (CoNNeCT) will be installed on ISS during FY 2011.

The LSP program has six planned NASA launches in FY 2011 including Glory, Aquarius, Juno, Nuclear Spectroscopic Telescope Array (NuSTAR), NPOESS Preparatory Project (NPP) and the Gravity Recovery and Interior Laboratory (GRAIL) mission. In addition to processing, mission analysis, spacecraft integration and launch services, LSP will continue to provide support for the development and certification of emerging launch services.

The RPT Program will continue to provide test facility management, and provide maintenance, sustaining engineering, operations, and facility modernization projects necessary to keep the test-related facilities in the appropriate state of operational readiness.

The HSFO Program includes CHS and Space Flight Crew Operations (SFCO). SFCO will provide trained crew for the manifested Shuttle requirements as well as four ISS long-duration crew rotation missions and crew expertise for development of future vehicles. CHS will identify necessary medical capabilities and identify and leverage the development of clinical care capabilities. NASA will also enlist the National Research Council (NRC) to conduct an independent study of the activities funded within NASA's Human Space Flight Operations program office to focus on the requirements post-Shuttle retirement, including the role and size of the astronaut corps, crew related facility requirements, and the most cost effective means to support NASA's new human spaceflight program.

Theme Overview

Thirty-eight years ago, NASA was charged with developing the world's first reusable space transportation system, a vehicle capable of astonishing power and versatility that would revolutionize humanity's ability to operate regularly in near-Earth space. With these last flights on the Space Shuttle manifest, the assembly and outfitting of the ISS, an extraordinary period in the history of space exploration will come to a close. As NASA retires the Space Shuttle, the Agency is transitioning key workforce, technology, facilities, and operational experience to a new generation of human spaceflight exploration activities. For more information, please visit www.nasa.gov/shuttle.

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	<u>2,979.5</u>	<u>3,139.4</u>	<u>989.1</u>	<u>86.1</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Space Shuttle Program	2,979.5	3,139.4	989.1	86.1	0.0	0.0	0.0
FY 2010 President's Budget Request	<u>2,981.7</u>	<u>3,157.1</u>	<u>382.8</u>	<u>87.8</u>	<u>0.0</u>	<u>0.0</u>	<u>--</u>
Space Shuttle Program	2,981.7	3,157.1	382.8	87.8	0.0	0.0	--
Total Change from FY 2010 Request	-2.2	-17.7	606.2	-1.7	0.0	0.0	--

Plans for FY 2011

Space Shuttle Program

NASA has manifested the last six Space Shuttle missions for FY 2010, including the STS-129 mission that was flown in November 2009 and the STS-130 mission in February 2010. The final six flights of the Space Shuttle are dedicated to completing assembly of the International Space Station (ISS), delivering and installing the Alpha Magnetic Spectrometer (AMS) to the ISS, and repositioning equipment so that the ISS can achieve its full research potential. NASA will continue its priority to safely complete the remaining Space Shuttle manifest.

The FY 2011 budget includes funds to support an additional three months of operations, if necessary, to safely complete the existing manifest by the end of the calendar year 2010. NASA's focus has been and will continue to be on the safe execution of these flights. While NASA remains confident that these last missions can be safely and successfully completed in FY 2010, the FY 2011 budget for the Space Shuttle Program will retain the capability to accommodate a slip of one or two of these flights into FY 2011, if that should prove necessary to finish the manifest. Once these flights are flown, the Space Shuttle will be retired. If retirement occurs earlier than December 2010, NASA will work with the Administration and Congress to determine the highest priority use of FY 2011 funds. FY 2011 is also the first year of major T&R activities. T&R plans will be in place for all SSP hardware elements as well as primary supporting Centers and all organizations with a substantial role in ensuring a safe and efficient phase-out of SSP capabilities.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

NASA's mission is to pioneer the future in space exploration, scientific discovery, and aeronautics research. With the completion of ISS assembly and the retirement of the Space Shuttle, the program's next step is to only transfer the Space Shuttle program's assets that will support the next generation of human space exploration activities while safeguarding the long-term viability of key technical capabilities. Capabilities that are no longer needed or are obsolete will be retired.

Relevance to education and public benefits:

For twenty-nine years, the Space Shuttle has carried more people (over 320) and more cargo (almost four million pounds) on more (and more different types of) missions than any other launch system in history. For the past twelve years, the full capabilities of the Space Shuttle have been applied to the mission for which the system was originally conceived and uniquely designed: assembly of a large, advanced research station in low-Earth orbit, one which can serve as a critical international research technology test bed to learn how humans can live in space and to prepare for further missions out to the Moon, to Mars, and beyond. The Space Shuttle's final series of missions are essential to the completion of the ISS, a facility with potential for addressing national priorities including education, international cooperation, and economic competitiveness.

Performance Achievement Highlights:

The Space Shuttle safely and successfully completed or exceeded every mission objective, including 4 crew rotations, for all five flights in FY 2009. This was accomplished on budget while overcoming several significant technical problems. Flight STS-126, launched in November 2008, delivered a Multi-Purpose Logistics Module loaded with hardware and supplies to support expansion of the ISS crew size from three to six. STS-126 also repaired the ISS's port Solar Alpha Rotary Joint (SARJ). The 10-foot-wide, wagon-wheel-shaped SARJ allows the electricity-generating solar arrays to track the sun and generate power for the Station. STS-119 launched in March 2009 and focused on the installation of the S-6 starboard truss, the last truss and solar array assembly for the ISS. STS-125 launched in May 2009 to perform the final servicing mission to the Hubble Space Telescope. In this mission, the crew successfully repaired two of Hubble's primary scientific instruments, replaced two other instruments with more advanced capabilities (including the new Wide Field Camera 3 and Cosmic Origins Spectrometer), attached a soft capture mechanism to facilitate eventual de-orbiting of the telescope, and refurbished the telescope's batteries, gyroscopes, guidance sensors, and thermal blankets. STS-127 launched in July 2009 to deliver and install the final pieces of the Japan Aerospace Exploration Agency's (JAXA) Kibo laboratory to provide a way to expose science experiments to the extreme environment of space. Although the Japanese provided this capability and will use it, the facility is available for use by NASA. A payload flown for NASA provided by the Naval Research laboratory is now collecting data from the exposed facility. STS-128 launched in August 2009 to deliver hardware and logistics in support of future ISS assembly and research support.

NASA continues to prepare for the retirement of the Space Shuttle once the Shuttle's role in assembling the ISS is complete. In FY 2009, the Space Shuttle program issued a request for information for final placement of the Space Shuttle Orbiters and Space Shuttle Main Engines after retirement. The program completed the final Space Shuttle Main Engine test at the Stennis Space Center, completed production of the final Main Engine, and continued production work on the last External Tank. The SSP released two Workforce Transition Strategy reports in FY 2009, and continues actively managing workforce reductions consistent with the reduction of Space Shuttle production capabilities.

Mission Directorate: Space Operations
Theme: Space Shuttle

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	NASA Advisory Council	10/2009	Provides independent guidance for the NASA Administrator. No recommendations were provided to SSP at this time.	02/2010
Other	ASAP	10/2009	Provides independent assessments of safety to the NASA Administrator. In their 2008 Annual Report, the Aerospace Safety Advisory Panel (ASAP) stated that they "strongly endorse the NASA position on not extending Shuttle operations beyond successful execution of the December 2008 manifest, completing the ISS". NASA will fly the Space Shuttle to complete the International Space Station and then retire the Shuttle.	TBD

Mission Directorate: Space Operations
Theme: Space Shuttle
Program: Space Shuttle Program

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	2,979.5	3,139.4	989.1	86.1	0.0	0.0	0.0
Program Integration	458.5	678.1	284.8	25.1	0.0	0.0	0.0
Flight and Ground Operations	1,037.4	1,035.1	373.2	28.6	0.0	0.0	0.0
Flight Hardware	1,483.6	1,426.2	331.1	32.3	0.0	0.0	0.0
FY 2010 President's Budget Request	2,981.7	3,157.1	382.8	87.8	0.0	0.0	--
Program Integration	489.6	678.1	152.0	22.7	0.0	0.0	--
Flight and Ground Operations	1,031.2	1,035.1	109.5	49.1	0.0	0.0	--
Flight Hardware	1,460.9	1,443.9	121.3	16.0	0.0	0.0	--
Changes from FY 2010 Request	-2.2	-17.7	606.2	-1.7	0.0	0.0	--

Note: NASA will work with the Administration and Congress to determine the highest priority use of the FY 2011 funds if they are not required to fly the Shuttle in the first quarter of FY 2011.

Mission Directorate:	Space Operations
Theme:	Space Shuttle
Program:	Space Shuttle Program

Project Descriptions and Explanation of Changes

Program Integration

The Program Integration budget for mission execution in FY 2011 is focused on maintaining workforce needed to extend operations into the first quarter of the fiscal year, if necessary, to safely complete the existing manifest. The Program Integration budget includes the following: funds for flight software; system engineering, flight operations, and management integration; safety and mission assurance; business management; propulsion system integration; safety and sustainability; payload integration into the Space Shuttle; and systems integration of the Flight Hardware elements through all phases of flight. It provides for the engineering analysis needed to ensure that payloads are safe and meet Space Shuttle interface requirements. Finally, Program Integration includes the necessary mechanical, aerodynamic and avionics engineering tasks to ensure that the launch vehicle can be safely launched, fly a safe ascent trajectory, achieve planned performance and descend to a safe landing through the last Shuttle flight.

The Program Integration budget for transition and retirement (T&R) in FY 2011 is focused on retirement of the Space Shuttle Program (SSP) and the efficient transition of assets to other uses, as applicable to future exploration programs, once they are no longer needed for safe SSP mission execution. It includes the funds needed to ensure the overall safety and efficiency of SSP T&R activities. Similar to mission execution, Program Integration T&R provides for software support, systems engineering, business management, and overall support to the T&R process. Program Integration T&R funding also covers severance and retention costs associated with managing the drawdown of the Space Shuttle workforce.

Mission Directorate:	Space Operations
Theme:	Space Shuttle
Program:	Space Shuttle Program

Flight and Ground Operations

The Flight Operations budget for mission execution in FY 2011 is focused on maintaining workforce needed to extend operations into the first quarter of the fiscal year, if necessary to safely complete the existing manifest. The Flight Operations budget will provide the resources needed to ensure the successful accomplishment of pre-flight planning, mission training, operations control activities, and life sciences operations support for each mission. Flight operations funding also provides for the operation and maintenance of critical mission support facilities including the Mission Control Center, Integrated Training Facility, Integrated Planning System, and the Software Production Facility. The Ground Operations budget provides resources for final integration and checkout of all hardware elements for launch. It also includes coordination with other government agencies and foreign entities for Shuttle landing capabilities. The major launch site operational facilities at the Kennedy Space Center include three Orbiter Processing Facilities, two launch pads, the Vehicle Assembly Building, the Launch Control Center and three Mobile Launcher Platforms (MLP). Ground Operations support capabilities include launch countdown and landing for Space Shuttle missions. Ground support for Shuttle landing includes both the Kennedy Space Center and Edwards Air Force Base runways and multiple contingency landing sites in the United States and other countries. Ground Operations also includes the maintenance and operations of ground infrastructure to support launch and landing through the last Shuttle flight.

The Flight and Ground Operations budget for T&R includes resources needed to identify, process, safe, and transfer flight and ground assets once they are no longer needed for safe SSP mission execution. The T&R budget includes funds needed for assets such as the Mission Control Center, the launch pads, the Vehicle Assembly Building, and the Launch Control Center to prepare these assets for modification, and use for future needs, or transferred to other users or disposed if appropriate.. For assets such as the Mobile Launch Platforms, the Orbiter Processing Facilities, and landing site hardware that NASA no longer needs after Space Shuttle retires, Flight and Ground Operations T&R funding is used to ensure that the property is safed of hazardous materials and ready for either transfer to other Federal government users or disposition.

Flight Hardware

The Flight Hardware budget for mission execution in FY 2011 is focused on maintaining workforce needed to extend operations into the first quarter of the fiscal year, if necessary, to safely complete the manifest. By the end of FY 2010, production of all flight elements required to support the manifest will be completed and only sustaining engineering and mission execution support may be required in the first quarter FY 2011.

The Flight Hardware budget for T&R includes resources needed to identify, process, safe, and transfer flight hardware assets once they are no longer needed for safe SSP mission execution. For Orbiter, these costs include safing the vehicles of hazardous materials. For the main engines, these costs also include safing and transportation preparation activities for components from both the current fleet of flight engines as well as older engines that are no longer used for flight but would be available for use or display. The flight hardware T&R budget also covers the costs of dispositioning Orbiter, Space Shuttle Main Engine, External Tank, and Reusable Solid Rocket Motor production tooling that NASA no longer needs once the Space Shuttle fleet is retired.

Mission Directorate: Space Operations
Theme: Space Shuttle
Program: Space Shuttle Program

Program Commitments

Commitment/Output FY 2011	Program/Project	Changes from FY 2010 PB Request
Safely complete manifest by the end of FY2010, but fly into FY2011 if necessary to complete manifest.	The Space Shuttle Program	Added an additional 3 months of operations funding so the program can be safely and affordably completed by the end of CY 2010 if necessary.

Implementation Schedule

Project	Schedule by Fiscal Year															Phase Dates																
	Prior	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23		Beg	End													
Program Integration (Planned end date is September 2010, but funding is requested to fly through December 2010 if necessary.)																					Tech Form Dev Ops Res	Dec-04	Dec-10									
Flight and Ground Operations (Planned end date is September 2010, but funding is requested to fly through December 2010 if necessary.)																					Tech Form Dev Ops Res	Dec-04	Dec-10									
Flight Hardware (Planned end date is September 2010, but funding is requested to fly through December 2010 if necessary.)																					Tech Form Dev Ops Res	Dec-04	Dec-10									
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	Represents a period of no activity for the Project																															

Mission Directorate: Space Operations
Theme: Space Shuttle
Program: Space Shuttle Program

Program Management

The Space Shuttle Program Manager reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Program Integration	Johnson Space Center	Johnson Space Center	N/A
Flight and Ground Operations	Kennedy Space Center	Kennedy Space Center and Johnson Space Center	N/A
Flight Hardware	Johnson Space Center	Johnson Space Center and Marshall Space Flight Center	N/A

Acquisition Strategy

The Space Program Operations Contract (SPOC) prime contractor is United Space Alliance. Other prime contractors providing flight hardware are ATK Thiokol (Reusable Solid Rocket Motor), Lockheed Martin (External Tank), and Pratt & Whitney Rocketdyne (Space Shuttle Main Engines).

Theme Overview

The ISS orbits the Earth 16 times a day at an altitude that ranges from 230 to 286 miles and at a speed of 17,500 miles per hour. The ISS is a research and development (R&D) test bed. It is an experiment in the design, development, and assembly of an orbital space facility. It serves as a habitat for its crew, a command post for orbital operations, and a port for the rendezvous and berthing of smaller orbiting vehicles. It functions as an orbital microgravity and life sciences laboratory, a test bed for new technologies in areas like life support and robotics, a platform for astronomical and Earth observations, and a market and destination for the burgeoning commercial crew and cargo transportation industry. ISS has been continuously crewed since November 2000. Through CY 2009, there have been 93 United States and International Partner flights to the ISS, including flights for assembly, crew rotation, and logistical support. At assembly complete, the ISS will be composed of approximately 1,000,000 pounds of hardware brought to orbit in approximately 40 separate launches over the course of more than a decade. The ISS is the largest human-made object ever to orbit Earth.

The ISS Program represents an unprecedented level of international cooperation. The ISS international partnership is composed of NASA, the Russian Federal Space Agency (Roscosmos), the Canadian Space Agency (CSA), the European Space Agency (ESA), and the Japanese Aerospace Exploration Agency (JAXA). International participation in the program has significantly enhanced the capabilities of the ISS.

ISS will be extended beyond 2016, likely through 2020 or beyond, to fully utilize the orbiting facility as a basic research facility, a testbed for exploration technology development and demonstrations, and a market/destination for commercial crew and cargo transportation services. The FY 2011 budget provides \$2.5 billion in additional funding to support these robust efforts, and to initiate activities to increase ISS functionality.

NASA has secured partnerships with other United States Government agencies and private firms to utilize a portion of the ISS as a National Laboratory, as designated by the NASA Authorization Act of 2005. NASA's plan for the ISS National Laboratory, the National Lab Report, was submitted to Congress in May 2007. Approximately 50 percent of planned U.S. utilization resources and accommodations on ISS could be available for non-NASA use. Firm interest in ISS use has been demonstrated in the areas of education, human, plant and animal biotechnologies, aerospace technologies, and defense sciences research. NASA has signed Memoranda of Understanding (MOUs) for use of the ISS with the National Institutes of Health and the Department of Agriculture, and has pre-existing agreements with the Department of Energy, the Department of Defense and the National Science Foundation. In addition, NASA re-issued an announcement of "Opportunity for Use of the ISS by Non-Government Entities for Research and Development and Industrial Processing Purposes" in August 2009. To date, NASA has entered into Space Act Agreements (SAA) with 4 private firms and a university. Additional MOUs and SAAs are in various stages of discussion. In addition, current basic research on ISS has been augmented by providing funding within ISS for basic science and engineering research.

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	<u>2,060.2</u>	<u>2,317.0</u>	<u>2,779.8</u>	<u>2,983.6</u>	<u>3,129.4</u>	<u>3,221.9</u>	<u>3,182.8</u>
International Space Station Program	2,060.2	2,317.0	2,779.8	2,983.6	3,129.4	3,221.9	3,182.8
FY 2010 President's Budget Request	<u>2,060.2</u>	<u>2,267.0</u>	<u>2,548.2</u>	<u>2,651.6</u>	<u>2,568.9</u>	<u>2,405.9</u>	--
International Space Station Program	2,060.2	2,267.0	2,548.2	2,651.6	2,568.9	2,405.9	--
Total Change from FY 2010 Request	0.0	50.0	231.5	332.0	560.5	816.0	--

Plans for FY 2011

International Space Station Program

Post assembly complete, having fulfilled its international partner agreements to launch and outfit their modules, NASA will focus on increasing research, continuing safe operations, and utilizing space station to its full capacity as a testbed for exploration technology demonstrations and development. These efforts are intended to revitalize, enhance, and augment the ISS program and are discussed below.

Section 206 of the National Aeronautics and Space Administration Authorization Act of 2008 states "The Administrator shall take all necessary steps to ensure that the International Space Station remains a viable and productive facility capable of potential United States utilization through at least 2020 and shall take no steps that would preclude its continued operation and utilization by the United States after 2015." The FY 2011 budget request provides funding for work required to extend and maximize utilization of ISS, likely through at least 2020.

NASA will invest in the Space Station facility itself by initiating new activities to revitalize ISS and increase functionality. The activities are intended to support ISS upgrade efforts while proving new space technologies, reducing costs, and increasing functionality. Potential objectives include reducing demands on crew time, lowering ground-based costs, mitigating capabilities lost when the Shuttle retires, improving ISS capabilities, improving ISS safety, and supporting activities benefiting future human spaceflight programs.

The Commercial Resupply Service (CRS) contracts awarded to Space Exploration Technologies (SpaceX) and Orbital Sciences Corporation (OSC) will provide commercial resupply flights beginning in FY 2011. The Exploration Systems Mission Directorate has budgeted \$312 million for additional incentives for NASA's current domestic commercial cargo service providers. Cargo transportation to ISS will also be supplemented by the Japanese HII Transfer Vehicle (HTV), European Automated Transfer Vehicle (ATV) and Russian Progress flights. Crew transportation and rescue will be provided by the Russian Soyuz vehicle until domestic transportation providers are available. The Exploration budget includes \$6 billion over five years to support this effort.

As we embark on the full utilization phase, the ISS will be utilized to conduct multidisciplinary research and technology development and operate as an outpost for human exploration. In FY 2011, NASA will begin operations on new external unpressurized payloads including the Alpha Magnetic Spectrometer (AMS) particle physics detector, a communications navigation and networking demonstration, and an advanced materials technology testbed.

Additionally, internal pressurized payloads will include ongoing studies to support NASA's human research program for exploration. NASA will continue National Laboratory collaborations with the National Institutes of Health (NIH), Department of Defense (DoD), Department of Energy (DOE), National Science Foundation (NSF); private industry collaborations with Astrogenetix, Inc. and Ad Astra Rocket Company; collaborations with academic institutions University of Colorado-Bioserve; and interagency collaborations on Science, Technology, Engineering, and Mathematics (STEM) education.

The ISS will be used as a major asset for demonstrating technologies and capabilities that are funded and operated within both the Space Technology Office and the Exploration Systems Mission Directorate. The goal is to enhance the Nation's ability to operate future human spaceflight activities and make space exploration more affordable and effective. In addition to the ISS research funding in other programs, beginning in FY 2011, ISS Operations will have funding to assist in National Laboratory research and fund engineering research consistent with Agency overall research objectives.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

NASA's mission is to pioneer the future in space exploration, scientific discovery, and aeronautics research. The ISS objective is to support scientific research and the development of new technologies and capabilities for human space exploration and other activities requiring the unique attributes of humans in space. Consistent with NASA's objectives, ISS research is focused on science and technology development that will prepare human explorers and spacecraft to travel beyond low-Earth orbit (LEO). Research aboard the ISS is critical to understand the effects of space environments on the human body and develop mitigation techniques, minimize the logistical burden of supporting humans far from Earth, address remote medical emergencies, and demonstrate enabling technologies for human exploration. NASA and the International Partners are applying the information learned to plan for future human and robotic missions. Techniques demonstrated in robotics, assembly, and maintainability on the ISS will guide development of next-generation space vehicles that will fly farther, faster, and for longer duration.

Research conducted on ISS in its role as a National Laboratory by other U.S. government agencies, private firms and universities will yield important new data applicable to their respective missions in human health, energy and the environment. The ISS also promotes the commercial space transportation industry by providing a market for crew and cargo transportation. The ISS partnership also provides a successful example of peaceful and constructive international cooperation that provides tangible benefits here on earth.

The FY 2011 budget revitalizes and strengthens the ISS program by ensuring increased functionality that will allow ISS to meet its full potential, and by augmenting the program to pursue additional basic and applied research.

Relevance to education and public benefits:

The benefits of ISS research cross all areas of American life, including public health, energy, environment, education, and promoting international cooperation. Specific examples include: new uses of ultrasound technology; embedded Web technology to allow remote monitoring and control of devices through a computer and Web browser; and, work to help researchers understand and mitigate muscle, balance, and bone problems.

Research performed on the ISS will contribute to a broader understanding of injury and disease in support of Earth-based medical applications. For example, a new vaccine for salmonella-induced infectious disease has been identified through ISS research and an investigational new drug (IND) classification will be applied for under Food and Drug Administration (FDA) approval. Ongoing investigations are being focused on a vaccine for methicillin-resistant staphylococcus aureas (MRSA), which has been responsible for over 19,000 deaths per year in the U.S. according to the Centers for Disease Control.

The ISS, an exploration research and technology test bed, will be used to develop and demonstrate, among other things, closed loop life support systems and remote medical care capabilities. Both technologies can be used to benefit people here on Earth. For example, water recycling technology is being used to provide potable water to places devastated by natural disasters. NASA will also demonstrate technologies on the ISS necessary for future space systems such as thermal control, environmental control, and power generation. As an earth observing platform, the onboard crew utilizes the ISS as a low-cost platform to monitor and record natural and human-driven changes and events on earth.

Performance Achievement Highlights:

November 2, 2008 represented completion of the eighth year of continuous human presence in space on the ISS. The ISS celebrated the 10th anniversary of the first element on orbit, Zarya, on November 20, 2008. In November 2008, ULF2 was launched delivering a galley, Crew Quarters, Waste and Hygiene Compartment, and Water Recovery System (WRS) among other equipment necessary to increase ISS crew size to six. The Water Recovery System recycles urine and condensate into drinking and coolant water, and helps reduce water upmass requirements after Shuttle retirement. As part of the Regenerative Environmental Control and Life Support System, WRS takes an important step toward the self sustaining crew support systems needed for long duration spaceflight beyond low Earth orbit. First drink of reprocessed water occurred on May 20, 2009. In March 2009, Flight15A added the S6 Truss and solar array completing assembly of the ISS power system. ISS six crew operations began with the docking of Soyuz 19S on May 29, 2009.

In July 2009, Flight 2J/A delivered the final JAXA segment, the Kibo Exposed Facility (EF) completing assembly of International Partner laboratories. Flight 17A, in August 2009, delivered about 15,500 pounds of pressurized cargo including three racks of research equipment, and additional crew habitation and environmental control equipment. This flight also delivered the Combined Operational Load Bearing External Resistance Treadmill (COLBERT).

JAXA launched the first H-II Transfer Vehicle (HTV) in September 2009 which was successfully captured and berthed to the ISS. HTV will contribute to the effort of resupplying the ISS when the Space Shuttle retires.

The ISS program continued processing activities, ground testing, and integration of flight hardware for future missions, while operating and monitoring the health of the vehicle systems and conducting operations. One hundred and six research experiments were conducted on ISS in FY 2009. During this period ISS crews were supported by re-supply and crew rotation using the Space Shuttle, the HTV and four Russian Progress and four Russian Soyuz vehicles. Ground training is ongoing for future flight crews, and ISS is continuing to conduct ISS-based Extravehicular Activities (EVAs) for ISS maintenance, science, and assembly. More detailed information may be found at http://www.nasa.gov/mission_pages/station/main/index.html.

Mission Directorate: Space Operations
Theme: International Space Station

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	ISS Advisory Committee	10/2009	Assess ISS operational readiness to support new crew, assess Russian flight team preparedness to accommodate the Expedition 15 mission, and assess health and flight readiness of Expedition 15 crew.	Ongoing
Other	NASA Advisory Council (NAC)	10/2009	Provides independent guidance for the NASA Administrator. The NAC was briefed by the JSC Safety and Mission Assurance Office on NASA Lessons Learned program. The Space Operations committee made two recommendations on NASA utilization of known Lessons Learned, including expanding the teaching aspect.	02/2010
Other	ASAP	10/2009	Provides independent assessments of safety to the NASA Administrator. No recommendations nor inquiries issued relating to the ISS.	02/2010
Other	Program Implementation Review	08/2008	Provides an independent review of ongoing ISS and SSP operations. The report cited concerns on budget resources which have been addressed in this budget and in cargo transportation availability post Shuttle.	2010

Mission Directorate: Space Operations
Theme: International Space Station
Program: International Space Station Program

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	2,060.2	2,317.0	2,779.8	2,983.6	3,129.4	3,221.9	3,182.8
ISS Operations	1,594.9	1,689.0	1,923.0	1,797.8	1,903.9	1,934.2	1,971.2
ISS Cargo Crew Services	465.2	628.0	856.8	1,185.7	1,225.5	1,287.6	1,211.6
FY 2010 President's Budget Request	2,060.2	2,267.0	2,548.2	2,651.6	2,568.9	2,405.9	--
ISS Operations	1,755.4	1,639.0	1,717.3	1,513.9	1,437.8	1,449.0	--
ISS Cargo Crew Services	304.8	628.0	830.9	1,137.7	1,131.1	956.9	--
Changes from FY 2010 Request	0.0	50.0	231.5	332.0	560.5	816.0	--

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Project Descriptions and Explanation of Changes

Operations

The ISS Program brings together international flight crews; globally distributed launch, operations, training, engineering, and development facilities; communications networks; and the international scientific research community. Operating ISS is often more complicated than other space flight endeavors because of its many international partner components. Each ISS partner has the primary responsibility to manage and run the hardware it provides, but the various elements provided by the partners are not independent and they must be operated by NASA as an integrated system. The FY 2011 budget provides funds for work required to extend ISS Operations and support full utilization, likely through at least CY 2020 including: recertification of ISS structures; purchase of additional spares and consumables; extension of baseline operational services; enabling services for National Laboratory partnerships; and initiation of activities to increase functionality intended to support ISS upgrade efforts while proving new space technologies, reducing costs, and increasing available research capacity. ISS Operations encompasses several key functions necessary to plan, control and execute the ISS Program. The ISS Systems Engineering, Analysis and Integration function entails optimization of the system architecture, integrated system performance and verification analyses, tracking of vehicle configuration, interface requirements, and mission design. The Spacecraft function is responsible for maintaining the ISS on orbit in a fully crewed and mission-ready mode. The Safety & Mission Assurance function implements safety, reliability, maintainability, and quality assurance requirements to ensure that all significant risks are reviewed, tracked, and mitigated so that ISS is safe, reliable, and fully operational.

Having completed assembly, all of U.S. and International Partner elements and established six-person crew capability, the ISS Program focus will turn to utilization beginning in FY 2011. Current basic research on ISS has been augmented by providing funding within ISS for science and engineering research, including some funding to cover additional transportation costs for non-NASA users. Plans will be finalized to establish an independent organization with responsibility to further develop national uses of the ISS through partnerships with other U.S. government agencies, private firms and non-profit institutions. Research opportunities will then be expanded to conduct research in life sciences, material sciences, biotechnologies, condensed matter physics and thermal sciences (fluid mechanics, thermodynamics, heat transfer and combustion). The ISS Program will also continue pursuit of its primary research objective to serve as a test bed for the development and demonstration of technology for future space exploration missions. The Multi-User Systems Support (MUSS) function is responsible for projecting available utilization resources and accommodations, tactical planning and execution of the day-today ISS integrated research plan. This function manages all payload physical, analytical and operations integration activities.

During FY 2011, ISS Operations will establish an independent organization to further develop and facilitate national uses of the ISS, as well as to assist users and integrate the overall U.S. utilization strategy. The goals of this organization will be to act as a single entry point to allow users to interface efficiently with the Space Station; assist researchers in developing experiments, in meeting safety and integration rules, and in acting as an ombudsman on researchers' behalf; perform outreach to draw in researchers and to disseminate the results of ISS research activities; and further develop online ISS information materials to provide easy access to details about laboratory facilities, available research hardware, resource constraints, etc.

Mission Directorate:	Space Operations
Theme:	International Space Station
Program:	International Space Station Program

Acquisition Strategy

NASA extended the Boeing U.S. On-Orbit Segment (USOS) contract until September 30, 2010; a follow-on extension is currently in process. NASA has also exercised the final options under the Cargo Mission Contract (CMC) and the Mission Integration Contract (MIC) for ongoing services through September 2010 and is in the process of re-competing these services. The Program Integration Contract (PIC) was awarded earlier this year for services beginning in October, 2009 and continuing for up to five years.

NASA awarded commercial cargo transportation services to Space Exploration Technologies Corporation (Space X) and Orbital Sciences Corporation through the CRS contracts on December 23, 2008. Initial activities have begun for cargo services beginning as early as CY 2011, with services available until early 2016. NASA has also extended its contract with Roscosmos to purchase crew launches through CY 2012 and crew rescue and return through mid 2013 and plans to continue to purchase Russian crew transportation services until a domestic capability is available. The Exploration Systems Mission Directorate (ESMD) has budgeted \$312 million for additional incentives for NASA's current domestic commercial cargo service providers, and \$6 billion over five years to develop commercial crew transportation.

Theme Overview

As explorers, pioneers and innovators, NASA boldly expands frontiers to inspire and serve America and to benefit the quality of life on Earth. Space and Flight Support (SFS) provides multiple Agency-level capabilities that enable exploration and science.

The Space Communications and Navigation (SCaN) Program is a vital element of the underlying support structure needed to conduct exploration and science. SCaN manages multiple space communication networks including the Deep Space Network, the Space Network, the Near Earth Network and also provides the support functions to regulate, maintain, and grow NASA's space communication and navigation capabilities in support of all NASA's space missions. Whether NASA missions are providing data about our home planet, focusing science instruments on cosmic phenomena or exploring far regions in space, reliable communication with Earth-based control centers is critical to mission success. As new spacecraft with different objectives and advanced technology are launched, the communication needs change. In response, NASA modifies and evolves its space communications capabilities to ensure Agency mission needs are fulfilled.

NASA has assigned responsibility for understanding the full range of civil space launch needs to the Launch Services Program (LSP). LSP works closely with other government agencies and the launch industry, seeking to ensure that safe, reliable, on-time and cost-effective launch opportunities are available on a wide range of launch systems.

The 21st Century Space Launch Complex Program at the Kennedy Space Center (KSC) is being established in the SFS Theme to transform KSC and Cape Canaveral Air Force Station into modern facilities poised to play a key role in 21st century space exploration. Focused on benefiting NASA's current and future operations at KSC, these operations will include NASA test flights, commercial cargo flights in support of ISS, and expendable launch vehicles in support of the Science mission directorate payloads, and robotic precursor missions. These upgrades will additionally help to improve KSC launch operations for future and current non NASA users of the range. It will also include consolidating and disposing of unused or underutilized facilities, and performing environmental work to improve the surrounding area.

The Rocket Propulsion Test (RPT) Program reviews, approves and provides direction on rocket propulsion test assignments, capital asset improvements, test facility modernization and refurbishments, integration for multi-site test activities, identification and protection of core capabilities and the advancement and development of test technologies.

The Human Space Flight Operations (HSFO) Program provides multi-program capabilities that support all current SOMD programs and future exploration activities. HSFO is comprised of the Space Flight Crew Operations (SFCO) and Crew Health and Safety (CHS). SFCO provides trained crew members for all NASA human space flight endeavors and is responsible for all JSC aircraft operations including aircrew training. The care of the Astronaut Corps is the responsibility of space medical operations at the Johnson Space Center. A portion of these responsibilities are managed within CHS which is realigned to HSFO beginning in FY 2011. CHS enables healthy and productive crew during all phases of space flight missions; implementation of a comprehensive health care program for astronauts; and the prevention and mitigation of negative long-term health consequences of spaceflight. NASA will also enlist the National Research Council (NRC) to conduct an independent study of the activities funded within NASA's Human Space Flight Operations program office to focus on the requirements, post-Shuttle retirement, including the role and size of the astronaut corps, crew related facility requirements, and the most cost effective means to support NASA's new human spaceflight program.

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	<u>725.0</u>	<u>724.2</u>	<u>1,119.0</u>	<u>1,220.6</u>	<u>1,123.9</u>	<u>1,140.7</u>	<u>947.7</u>
21st Century Space Launch Complex	0.0	0.0	428.6	500.0	400.0	400.0	200.0
Space Communications and Navigation	582.9	485.3	452.9	478.0	479.5	488.4	489.6
Human Space Flight Operations	0.0	102.3	114.4	115.8	117.7	118.1	121.0
Launch Services	91.7	83.8	78.9	82.6	82.5	86.0	87.9
Rocket Propulsion Test	41.8	44.3	44.3	44.2	44.2	48.2	49.2
Crew Health & Safety	8.6	8.6	0.0	0.0	0.0	0.0	0.0
FY 2010 President's Budget Request	<u>722.8</u>	<u>751.5</u>	<u>732.7</u>	<u>745.9</u>	<u>749.7</u>	<u>748.9</u>	--
Space Communications and Navigation	582.9	496.6	506.9	520.3	524.0	524.0	--
Human Space Flight Operations	0.0	114.7	88.5	88.6	88.7	89.0	--
Launch Services	89.6	85.9	84.1	83.9	83.9	82.8	--
Rocket Propulsion Test	41.8	45.8	44.6	44.5	44.5	44.5	--
Crew Health & Safety	8.6	8.6	8.5	8.5	8.5	8.5	--
Total Change from FY 2010 Request	2.2	-27.3	386.2	474.6	374.2	391.8	--

Plans for FY 2011

21st Century Space Launch Complex

Efforts for the 21st Century Space Launch Complex Program are intended to benefit NASA's current and future operations at the KSC, but also to enhance the capabilities for non NASA users of the range. This new initiative focuses on upgrades to the Florida launch range, expanding capabilities to support commercial launch providers, and transforming KSC into a modern facility that is well positioned to support the next century of space exploration. Areas under consideration include modernization activities to support safer and more efficient launch operations; enhancing payload processing capabilities; relocating the KSC perimeter to facilitate certain private sector activities and operations; environmental remediation; and supporting the modernization of the launch range capabilities.

Space Communications and Navigation

In FY 2011, the SCaN Program will continue to successfully provide space communications and navigation capabilities to all missions and continue to define future communications requirements. SCaN will also continue to advance cross support opportunities with foreign space agencies through the definition and adoption of common standards and protocols, as well as proceed with the implementation of infrastructure upgrades and continue the development of enabling capabilities and technologies. Milestones to be completed in FY 2011 include completion of the SRR for the Space Network Ground Segment Sustainment Project, completion of the CDR for the Tracking and Data Relay Satellite (TDRS) K&L, completion of the CDR for the Optical Communication System payload Lunar Laser Communication Demonstration (LLCD), installation of the Communication Navigation and Networking Reconfigurable Testbed (CoNNeCT) on ISS and begin procurement of a 34m antenna to increase the robustness of the Deep Space Network.

Human Space Flight Operations

HSFO is comprised of SFCO and CHS. For FY 2011, SFCO will provide crew expertise for future vehicle development and will support the manifested Shuttle Program requirements as well as four ISS long-duration crew rotation missions by providing and maintaining an adequate number of astronauts with appropriate skills and experience. This will be accomplished by maintaining safe and effective aircraft operation, supporting human space flight program activities such as boards, and technical evaluations that require operational input and expertise, and representing NASA to the public directly and through media. Also under HSFO, CHS will work to identify necessary medical capabilities including the identification and development of cost efficient clinical care capabilities. NASA will enlist the National Research Council (NRC) to conduct an independent study of the activities funded within NASA's Human Space Flight Operations program. The study will focus on the role and size of the human spaceflight office in the post Space Shuttle retirement and Space Station assembly environment; the crew-related facility, aircraft and training requirements to support the astronaut corps' for the requirements of NASA's new human spaceflight program, and the more cost-effective means of meeting these requirements. Initiation of the study will commence as soon as possible.

Launch Services

The LSP program has six planned NASA launches including: 1) Glory, which will be launched on a Taurus XL; 2) Aquarius on a Delta II; 3) Juno on an Atlas V; 4) Nuclear Spectroscopic Telescope Array (NuSTAR) on a Pegasus XL; 5) NPOESS Preparatory Project (NPP) on a Delta II and 6) the Gravity Recovery and Interior Laboratory (GRAIL) mission, the last mission to be launched on a Delta II. In addition to processing, mission analysis, spacecraft integration and launch services of the above missions, LSP will continue to provide support for the development and certification of emerging launch services.

Rocket Propulsion Test

RPT will continue to provide test facility management, and provide maintenance, sustaining engineering, operations, and facility modernization projects necessary to keep the test-related facilities in the appropriate state of operational readiness. RPT continues to use the established testing requirements from all of the RPT customers to identify excess and "at-risk" test facilities and will support decisions relative to test asset consolidation initiatives.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The SFS theme provides the enabling capabilities required to advance space exploration and expand scientific knowledge of Earth and the universe. Without these capabilities NASA could not perform any of its missions.

The SCaN Program provides able and dependable space communications and navigation capabilities vital to successfully conduct human and robotic space missions.

The LSP enables access to space for NASA and other select government missions. The LSP provides safe, reliable, cost-effective, and on-time commercial launch services for NASA and NASA-sponsored payloads using expendable launch vehicles.

The RPT capabilities continue to support safe operation of the Space Shuttle through retirement, and provide test facilities for use by other DOD and commercial programs.

SFCO provides trained crew members for all NASA human space flight endeavors, brings expertise to resolve operational or development issues and plays a major role in the public advocacy of human space flight. CHS provides enhancements to the health care provision environment both in space and on the ground for the Astronaut Corps. CHS contributes to the medical and health certification of astronauts before flight and the provision of care throughout their careers.

Relevance to education and public benefits:

The benefits of SFS to education and the public includes the return of scientific and educational data from space to Earth; the safe launching of expendable launch vehicles necessary for research; the assurance that rocket systems have been adequately tested; and the testing and implementation of various human health and illness prevention measures. A space program properly supported by this Theme will produce research data that can be used to generate new scientific knowledge through the study of heliophysics, astrophysics, solar system exploration, Earth science, biological and physical research, and more.

SFCO provides support to the NASA Education Outreach program by assigning astronauts for requested appearances and supplying the accompanying presentation materials. Astronauts support numerous public appearances with a variety of groups to disseminate information to the general public regarding current and future space missions. These appearances had a major impact on the spread of information about the space program and the development of critical relationships that help NASA programs.

Performance Achievement Highlights:

SCaN has successfully provided space communications services to over 80 NASA and non-NASA missions meeting or exceeding the SCaN proficiency metric despite aging network infrastructure and hardware obsolescence. SCaN successfully completed the PDR, the Non-Advocate Review (NAR) and the Sub-System PDR for TDRS K & L. In September 2009, SCaN initiated a request for proposal (RFP) for the Space Network Ground Segment Sustainment (SGSS) contract and plans to award the contract by June 2010. The SGSS will replace aging and obsolete infrastructure and move the network into an integrated architecture thus reducing operational costs. Studies have also been completed for the Deep Space Network 70-meter antenna replacement effort and plans for the 34-meter phased array antenna system are being initiated. SCaN successfully completed the CoNNeCT PDR in September 2009, This test bed will become NASA's orbiting Space Communications and Navigation National Laboratory on ISS and will be used to validate new flexible technology enabling greater spacecraft productivity.

In calendar year 2009, there were seven successful NASA/LSP launches including; NOAA-N, Kepler, STSS ATRR, LRO/LCROSS, STSS DEMO and WISE and one unsuccessful launch of the OCO satellite. NASA/LSP also served in an advisory role for the GOES-O mission. Also in FY 2009, the ISS Program Commercial Resupply Services (CRS) contract was issued. Contract terms and deliverables are included for the LSP evaluation of the launch vehicles to be used to resupply the space station. The LSP has begun initial technical exchanges with SpaceX under the CRS contract. Furthermore, two Space Act Agreements (SAAs) have been established by LSP, one is for Taurus II, and the second with ATK for their SLV A and B small launch vehicles. Technical exchanges between LSP and ATK have been initiated in FY 2009 as a result of this SAA.

The Rocket Propulsion Test Program (RPT) continued to maintain the Agency's ability to safely test rocket propulsion systems by evaluating requirements and focusing resources to complete those requirements. To assure the accuracy of requirements, RPT has maintained close coordination with NASA and the Department of Defense (DOD) programs.

SFCO provided trained crew members to successfully complete five Space Shuttle missions. SFCO also provided trained crew members to successfully complete three long-duration crew rotation missions on the ISS and provided space flight readiness training in support of future Space Shuttle and ISS long-duration flights on the space flight manifest. Lastly, SFCO completed over 460 appearances to the public on behalf of the Agency in support of public outreach. CHS further enhanced the Longitudinal Study of Astronaut Health (LSAH) and implemented a system to enable flight surgeons easy access to analysis of medical requirements. CHS has also continued to identify and leverage the development of clinical care capabilities such as ultrasound units and is developing new technologies such as the Lightweight Trauma Module for hazardous and/or extreme environments ranging from the battlefield to space exploration use.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: 21st Century Space Launch Complex

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	0.0	0.0	428.6	500.0	400.0	400.0	200.0
21st Century Space Launch Complex	0.0	0.0	428.6	500.0	400.0	400.0	200.0
Changes from FY 2010 Request	0.0	0.0	428.6	500.0	400.0	400.0	--

Program Overview

This funding establishes a 21st Century Space Launch Complex Program at Kennedy Space Center (KSC) and the Florida launch range. This effort will benefit both NASA's current and future operations at the KSC, as well as help to improve KSC launch operations for future and current non NASA users of the range. Working with other users of the Florida launch range, the goal is to transform KSC into a modern facility poised to play a key role in 21st century space exploration. This new initiative focuses on upgrades to the Florida launch range, expanding capabilities to support commercial launch providers, such as commercial cargo flights and future commercial crew flights in support of ISS, and expendable launch vehicles in support of the Science mission directorate payloads and robotic precursor missions. Additional areas under consideration include modernization activities to support safer and more efficient launch operations; enhancing payload processing capabilities through capacity increases, improvement, and modernization, in addition to potentially relocating the KSC perimeter where appropriate and feasible, to enable certain existing private sector facilities to lie outside the security perimeter, thus making it far more convenient to use those facilities; environmental remediation to reduce the impact on the surrounding areas; and supporting the modernization of the launch range capabilities.

Plans For FY 2011

Efforts for the 21st Century Space Launch Complex Program are intended to benefit NASA's current and future operations at the KSC, but also to enhance the capabilities for non NASA users of the range. Working closely with other users of the range, this new initiative focuses on upgrades to the Florida launch range, expanding capabilities to support commercial launch providers, and transforming KSC into a modern facility. Areas under consideration include modernization activities to support safer and more efficient launch operations; enhancing payload processing capabilities; relocating the KSC perimeter to facilitate certain private sector activities and operations; environmental remediation; and supporting the modernization of the launch range capabilities. Implementation will be targeted to achieve increased operational efficiency and reduced launch costs not only for NASA, but also for other users of these facilities. The program will encompass overall launch and processing operations. We will be working closely with the KSC, the USAF, FAA, and the space user community to develop a plan that includes specific requirements, as well as a list of ongoing or future projects to which NASA may contribute and build upon.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	582.9	485.3	452.9	478.0	479.5	488.4	489.6
Space Communications Networks	342.2	372.8	371.2	404.7	412.3	429.2	436.1
Space Communications Support	86.7	86.6	62.6	50.7	53.8	59.2	53.5
TDRS Replenishment	154.0	26.0	19.0	22.6	13.4	0.0	0.0
FY 2010 President's Budget Request	582.9	496.6	506.9	520.3	524.0	524.0	--
Space Communications Networks	363.5	427.2	423.0	440.8	431.1	444.3	--
Space Communications Support	65.4	43.4	64.9	56.9	79.5	79.7	--
TDRS Replenishment	154.0	26.0	19.0	22.6	13.4	0.0	--
Changes from FY 2010 Request	0.0	-11.3	-54.0	-42.3	-44.5	-35.6	--

Note: The FY 2011 President's Budget request numbers in the FY 2010 column reflects the Initial Operating Plan budget numbers to be submitted to Congress.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications and Navigation

Program Overview

Today's spacecraft are increasingly more powerful, complex, and capable of acquiring increasing amounts of mission data. They can also employ artificial intelligence enabling autonomous decisions. However complex and sophisticated these machines have become, two key functions have not changed: the need to communicate with Earth and to navigate in space. A failure of space communications and navigation on the spacecraft or on Earth could result in a complete loss of a mission. Hence, space communications and navigation is a fundamental capability of missions that depends on a high quality of hardware and software present on the spacecraft and the ground.

NASA's space communications and navigation capabilities rely on ground-based and space-based assets that enable near Earth and deep space missions, as well as those of the other U.S. agencies and of our international partners. These national assets are managed as dedicated projects within the Space Communications and Navigation (SCaN) program. The SCaN program manages these assets for the Agency and provides a cost efficient approach to effectively meeting all missions' needs throughout all stages of their life.

SCaN is also responsible for all Spectrum Management and Data Standards policy, oversight and management for the Agency. It represents NASA before all domestic and international regulatory or technical bodies dealing with Spectrum and/or Data Standards, thus providing NASA with an integrated approach to promoting and safeguarding its SCaN equities and interests. Additionally, SCaN leads all NASA activities associated with present and future navigation technology and capabilities such as supporting spacecraft tracking and position determination.

These seemingly disparate functions, sustainment of existing assets, technology development, spectrum management, and international standards, are integrated through a robust System Engineering and Integration (SE&I) activity to assure uninterrupted SCaN capabilities and to avoid loss of or any impact to science or exploration missions. In addition, SE&I also conducts long-range planning based on projected mission needs and identifies technical performance targets for new technologies such as Disruption Tolerant Networking (DTN), Optical Communications, and Software Defined Radio.

By planning, developing, operating, and maintaining space and ground networks of tracking and data systems, SCaN services the Nation's space missions, both crewed and robotic, from low Earth orbit to the fringes of the solar system.

For more information, please see <https://www.spacecomm.nasa.gov/spacecomm/>.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications and Navigation

Plans For FY 2011

The SCaN Program will award the contract for the Space Network Ground Segment Sustainment (SGSS) by June 2010 and will conduct the System Requirement Review for this project. The implementation of the SGSS will be in full swing in FY 2011 with an expected completion by FY 2015. The SGSS will introduce a concept of operations and new technology that will enable integration of all NASA assets into a unified and integrated network with robust capabilities critical to meeting evolving NASA mission needs in science and exploration, through the next decade and beyond. SCaN will continue to work towards the demonstration of Disruption Tolerant Networking (DTN) on ISS and Extrasolar Planet Observatory and Deep Impact Extended Investigation (EPOXI). SCaN will complete the Critical Design Review (CDR) for both the Tracking and Data Relay Satellite (TDRS) K & L and for the Optical Communications Systems payload Lunar Laser Communications Demonstration (LLCD) manifested on the Lunar Atmosphere and Dust Environment Explorer (LADEE) and their implementation will be well underway in FY 2011. SCaN will also have begun the procurement of 34m antennas to replace the aging Deep Space Network (DSN) 70m antennas in a scalable array configuration designed to provide maximum flexibility and robustness as well as substantial increase of capabilities and support to DSN users. The Communication Navigation and Networking Reconfigurable Testbed (CoNNeCT) will be installed on ISS during FY 2011.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications and Navigation

Project Descriptions and Explanation of Changes

Space Communications Networks

Deep Space Network (DSN): The DSN consists of three facilities spaced approximately 120 degrees apart on the globe to enable continuous communications to spacecraft as the Earth rotates. The facilities are located in Spain, Australia, and California. DSN stations are NASA-owned assets managed by the DSN Project Office at the Jet Propulsion Laboratory. To maintain facility assets, ScaN utilizes Construction of Facilities (CoF) funding to provide minor revitalization of the three DSN facilities. A list of the total COF projects are included in the Construction and ECR section of this document.

Near Earth Network (NEN): The NEN consists of globally distributed tracking stations that are strategically located to maximize the communications service coverage provided to flight missions. The stations are located in Norway and Alaska, with additional antennas located at Wallops Island, VA and Merritt Island, FL. The NEN Project Office at GSFC manages the network, which includes both commercially owned assets and NASA facilities. The NEN provides communications services to a variety of missions in certain orbital and suborbital locations, including Low Earth Orbit (LEO), Geosynchronous Earth Orbit (GEO), lunar, and highly elliptical orbits. ScaN is presently looking into implementing higher data rate capability in the Ka-Band to meet the evolving needs of future NASA missions such as DesDNI and reduce the mission load on the X-Band that is limited in capacity.

Space Network (SN): The SN is a combination of the Tracking and Data Relay Satellite System (TDRSS) and a set of supporting Space-to-Ground Link Terminals (SGLT) located at White Sands, NM and Guam. The ground terminals transmit signals to and from the TDRSS, which in turn relays those signals to and from flight missions. The SN predominantly supports LEO missions with global coverage, but it can also support launch vehicles and provide communications services to researchers in remote locations on Earth, such as the South Pole. The SN has demonstrated to be an effective National Asset meeting critical NASA and U.S. needs that cannot be supported by commercial providers or any other U.S. assets.

SN Ground Segment Sustainment (SGSS): SGSS is responsible for replacing outdated equipment and standardizing systems at all SN ground locations. The ground locations are White Sands, NM and the Guam Remote Ground Terminal (GRGT). After replacement, the SGLT equipment at each SN ground station will be capable of supporting any spacecraft in the TDRSS fleet. A key objective of SGSS is to establish the capabilities required to support future space exploration vehicles.

NASA Integrated Services Network (NISN): This network has commercial service backbones providing point-to-point terrestrial signal transport services and routing network services. The Office of Chief Information Officer has management responsibility for this project.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Space Communications and Navigation

Space Communications Support

Space Communications Support manages cross-cutting communication functions, which are responsible for defining and protecting the integrity of the overall SCaN architecture, including identifying, assessing, and establishing policy or response to external policies. These functions include Spectrum Management, Systems Planning, and advanced concept enabling technology such as Optical Communications and the Disruption Tolerant Networking (DTN).

Spectrum Management ensures the availability and allocation of radio frequency (RF) spectrum for all Agency programs to support the operation of navigation systems, space and ground based radio transmission, and mission active and passive remote sensing requirements.

Systems Planning develops the communications and navigation architecture to support Exploration and Science Programs through FY 2030. This includes Space Data Standards, which pursues the implementation of national and international space data standards with the aim of improved interoperability; Technology, which aims to predict the needs of future communications missions in a manner that will yield initiatives with performance enhancements with reduced costs; and Systems Engineering, which coordinates all SCaN systems engineering activities and manages the requirements that enable NASA to fulfill its space communications and navigation needs for future missions.

An important part of the SCaN Technology Program is Optical Communications technology development and demonstration. The first NASA demonstration of this technology will be during the LADEE mission, which is fully funded through FY 2010 and schedule to launch in June 2012. The optical communication capability would provide NASA with a high rate communication technique for deep space mission data with an objective of at least a 10-fold data rate increase over that achievable with RF technology. This revolutionary technology will provide higher data rates for less space, weight, and power burden compared to RF technology. Higher data rates will allow more science spacecraft to share the same Earth-based optical receivers, and enable greater science return over spacecraft life, thus gaining higher mission utilization. Funding for additional Optical Communications technology demonstrations is currently under consideration within the Space Technology portfolio.

Another SCaN Technology Program effort currently in the demonstration phase is DTN. Two DTN nodes have been installed on ISS and initial demonstration results indicate significant productivity gains through automation of data transfers in the ISS's disruptive communications environment. DTN has also been demonstrated in a deep space environment during FY 2009 aboard the EPOXI spacecraft and a more rigorous second demonstration is planned for FY 2010 that will show that data transport efficiency can be improved 100%. International standardization of the DTN protocols will be moved forward by the SCaN Standards Program along with other communication data standards that provide a sound base for interoperability of NASA missions with other International space agencies.

In addition, SCaN provides subject matter expertise to the NASA Deputy Administrator for the Deputy Secretary-level Positioning, Navigation, and Timing (PNT) Executive Committee that manages the U.S. Global Positioning System (GPS). GPS is a critical infrastructure component for NASA human spaceflight and science, and enables greater autonomous navigation of spacecraft while reducing the operational and cost burdens of traditional two-way ranging and tracking.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation

Tracking and Data Relay Satellite (TDRS) Replenishment

The TDRS Replenishment Project is responsible for the acquisition of two new Tracking and Data Relay Satellites, TDRS-K and TDRS-L, to replenish the aging fleet of communications spacecraft in the SN. The TDRS K and L Project Office at the Goddard Space Flight Center is managing the procurement, which includes on-orbit delivery, and acceptance of two spacecraft: TDRS-K to be launched in December 2012, followed by launch of TDRS-L in December 2013. Modifications of the SGLT equipment at the White Sands Complex (WSC) are included. In July 2009, the TDRS Replenishment Project completed Key Decision Point (KDP) - C, and the development documentation was approved. The SN is an effective National Asset meeting critical NASA and U.S. needs that cannot be supported by commercial providers or any other U.S. assets. The mission load on the SN has grown substantially potentially requiring additional TDRS spacecrafts. In light of the recent decommissioning of TDRS-1 and the emerging battery problem with the older generation spacecraft, SCA is presently using the TDRS reliability model to assess future requirements for the TDRS Constellation.

Program Commitments

Commitment/Output FY 2011	Program/Project	Changes from FY 2010 PB Request
Achieve less than 3% of lost operating time on NISN available services.	NASA Integrated Services Network, NISN	Same
Achieve at least 98% Network proficiency for delivery of Space Communications services.	Space Network, Deep Space Network, and Near Earth Network	Same

Implementation Schedule

Project	Schedule by Fiscal Year													Phase Dates					
	Prior	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23		Beg	End
Space Communications and Navigation Operations																			
TDRS Replenishment - TDRS K																			
TDRS Replenishment - TDRS L																			
<div style="display: flex; flex-direction: column; gap: 5px;"> <div> Tech & Adv Concepts (Tech)</div> <div> Formulation (Form)</div> <div> Development (Dev)</div> <div> Operations (Ops)</div> <div> Research (Res)</div> <div> Represents a period of no activity for the Project</div> </div>																			

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation

Program Management

The Deputy Associate Administrator for Space Communications and Navigation (SCaN) reports to the Associate Administrator for Space Operations at NASA Headquarters. SCaN projects are managed from NASA Headquarters.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Deep Space Network	Space Communications and Navigation Program Office - NASA Headquarters	Jet Propulsion Laboratory	N/A
Near Earth Network	Space Communications and Navigation Program Office - NASA Headquarters	Goddard Space Flight Center	N/A
SN Ground Segment Sustainment	Space Communications and Navigation Program Office - NASA Headquarters	Goddard Space Flight Center	Other Government Agencies
Network Integration and Engineering	Space Communications and Navigation Program Office - NASA Headquarters	Goddard Space Flight Center, Glenn Research Center, Jet Propulsion Laboratory	N/A
Space Network	Space Communications and Navigation Program Office - NASA Headquarters	Goddard Space Flight Center	Other Government Agencies
Space Communications Support	Space Communications Program Office - NASA Headquarters	Glenn Research Center, Goddard Space Flight Center, Jet Propulsion Laboratory, Johnson Space Center	N/A
Optical Communications	Space Communications and Navigation Program Office - NASA Headquarters	Goddard Space Flight Center, Jet Propulsion Laboratory	Other Government Agencies
NASA Integrated Services Network	Space Communications and Navigation Program Office - NASA Headquarters	Goddard Space Flight Center, Marshall Space Flight Center	N/A
TDRS Replenishment	Space Communications and Navigation Program Office - NASA Headquarters	Goddard Space Flight Center, Kennedy Space Center	Other Government Agencies

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation

Acquisition Strategy

NASA owns a large, established base of space communications assets located nationally, internationally, and in orbit near Earth and Mars. The SCaN Program conducts acquisition planning with the objective of preserving the governments past investments, and altering capability or capacity in response to mission needs and NASA SCaN architecture goals.

NASA conducts major SCaN acquisitions on a competitive basis. To meet mission support objectives and achieve best value for NASA, mission suitability and cost criteria are appropriately weighted and evaluated for competitively awarded acquisitions. When feasible, NASA pursues commercially available space communications services and products in preference to developing NASA-owned systems. NASA may also consider unique technical capabilities and maintenance of core competency in the NASA work force during the "make versus buy" decision process. To further achieve best value for NASA and the U.S. Government, the Agency may place task orders on Government Wide Acquisition Contracts (GWAC).

To support future Agency SCaN requirements, flight systems and associated ground terminals will be required at several locations in the Solar System. The type of contract depends upon the maturity of the technology and the associated mission risk. In general, lower risk radio frequency relay spacecraft near the Earth are acquired under "fixed price" terms with delivery on-orbit. Relay satellites at distant locations or acquisitions involving new technology, such as optical space communications, may be acquired under "cost plus award fee" terms.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	NASA Advisory Committee	09/2009	SCaN was reviewed by the NASA Advisory Committee with the report delivered by 09/30/2009. The report recommended that an independent study to review the aging infrastructure that will need to be upgraded or replaced to support the science and operational space missions be conducted. The improved infrastructure will support the human and robotic exploration of the moon, the solar system and the universe.	10/2011

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation
Project In Development: TDRS Replenishment

FY 2011 Budget Request

Budget Authority (\$ millions)	Prior	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	BTC	LCC TOTAL
FY 2011 President's Budget Request	<u>215.0</u>	<u>154.0</u>	<u>26.0</u>	<u>19.0</u>	<u>22.6</u>	<u>13.4</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>450.0</u>
Formulation	215.0	25.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.6
Development / Implementation	0.0	128.4	26.0	19.0	22.6	13.4	0.0	0.0	0.0	209.4
Operations / Close-out	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--
FY 2010 President's Budget Request	<u>150.0</u>	<u>154.0</u>	<u>26.0</u>	<u>19.0</u>	<u>22.6</u>	<u>13.4</u>	<u>0.0</u>	--	<u>0.0</u>	<u>385.0</u>
Formulation	150.0	25.6	0.0	0.0	0.0	0.0	0.0	--	0.0	175.6
Development / Implementation	0.0	128.4	26.0	19.0	22.6	13.4	0.0	--	0.0	209.4
Operations / Close-out	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	--
Changes from FY 2010 Request	<u>65.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	--	<u>0.0</u>	<u>65.0</u>
Formulation	65.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	65.0
Development / Implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	--
Operations / Close-out	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	--

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation
Project In Development: TDRS Replenishment

Project Purpose

The existing fleet of the Tracking and Data Relay Satellite System (TDRSS) supports tracking, data, voice, and video services to the International Space Station (ISS), Space and Earth science missions, as well as other government agency users. The total mission load is predicted to increase, which will require additional satellites to be added to the fleet. The existing fleet is aging and reliability analyses predicts a shortage of flight assets to support NASA missions and the user community by FY 2011. As a result, NASA began in FY 2007 the acquisition of two additional spacecraft, TDRS-K and TDRS-L, to be launched in December 2012 and December 2013 respectively. By adding these two spacecraft to the TDRSS fleet, continuity of service will be insured for NASA and other government agency user missions through approximately FY 2016. The TDRS Replenishment Project supports future Agency requirements and technology initiatives consistent with the approved baseline of the SCan architecture.

Project Parameters

The TDRS system consists of in-orbit telecommunications satellites stationed at a geosynchronous altitude with associated ground stations located at White Sands, NM and Guam. This system of satellites and ground stations is the Space Network (SN) which provides services for near earth user satellites and orbiting resources. The SN supports spacecraft that depend on it for reliable services to continue their missions. The TDRSS constellation includes the first-generation satellites (TDRS 1-6), the replacement satellite (TDRS 7), and the second-generation satellites (TDRS 8, 9, and 10).

Project Commitments

The TDRS-K and TDRS-L spacecraft will be fully compatible and capable of functioning as a part of the existing TDRS System operated by the White Sands Complex (WSC) and Guam ground terminals. Contract requirements are design, development, fabrication, integration, test, on-orbit delivery, and launch vehicle and services. Launch dates for TDRS-K and TDRS-L are in December 2012 and December 2013 respectively. The spacecraft are required to have an operational life of 11 years. The basic requirement will also include modification of the WSC Space-to-Ground Link Terminals (SGLT) to provide compatibility with the new spacecraft.

Project Element	Provider	Description	FY 2010 PB Request	FY 2011 PB Request
TDRS Replenishment	NASA	Aging hardware replacement	Same	Same

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation
Project In Development: TDRS Replenishment

Schedule Commitments

The Tracking and Data Relay Satellite (TDRS) Replenishment project was approved for entry into Phase C, Development in July 2009. The launch vehicle and payload are to be delivered to the Kennedy Space Center for processing to meet the TDRS-K and TDRS-L launch dates in December 2012 and December 2013 respectively.

Milestone Name	Confirmation Baseline	FY 2010 PB Request	FY 2011 PB Request
<i>Development</i>			
TDRS System Critical Design Review (CDR)	January 2010	N/A	Same
TDRS Systems Integration Review (SIR)	January 2011	N/A	Same
TDRS Flight Readiness Review (FRR)	November 2012	N/A	Same
TDRS K Launch Readiness Date (LRD)	December 2012	N/A	Same
TDRS L Launch Readiness Date (LRD)	December 2013	N/A	Same

Development Cost and Schedule Summary

The TDRS Replenishment LRD represents the completion of both TDRS K and L launches.

Project	Base Year	Base Year Development Cost Estimate (\$M)	Current Year	Current Year Development Cost Estimate (\$M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
TDRS Replenishment	2010	209.4	2010	209.4	0	LRD	12/2013	12/2013	0

Development Cost Details

There are no changes to between the base year and current year cost estimates.

Element	Base Year Development Cost Estimate (\$M)	Current Year Development Cost Estimate (\$M)	Delta
Total:	209.4	209.4	0.0
Aircraft/Spacecraft	56.7	56.7	0.0
Ground Systems	53.7	53.7	0.0
Other Direct Project Cost	99.0	99.0	0.0

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation
Project In Development: TDRS Replenishment

Project Management

The Deputy Associate Administrator for Space Communications and Navigation reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
TDRS Replenishment	Space Communications and Navigation (SCAN) Office	Headquarters SCA N Program Office	GSFC, KSC, and Non-NASA Agencies

Acquisition Strategy

The Acquisition Strategy for this procurement uses a Firm Fixed Price with Incentive Fee contract.

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
TDRS-K and TDRS-L Obsolescence Risk Management	Aging spacecraft requires replacement hardware by FY 2013. The mission load is predicted to exceed current capacity and will need additional spacecraft to provide enough capacity.	The project has awarded a Firm Fixed Price with Incentive Fee contract as of December 2007 to Boeing Satellite Systems, Inc. Spacecraft will launch in December 2012 and December 2013, respectively.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Human Space Flight Operations

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	0.0	102.3	114.4	115.8	117.7	118.1	121.0
Human Space Flight Operations	0.0	102.3	114.4	115.8	117.7	118.1	121.0
FY 2010 President's Budget Request	0.0	114.7	88.5	88.6	88.7	89.0	--
Space Flight Crew Operations	0.0	114.7	88.5	88.6	88.7	89.0	--
Changes from FY 2010 Request	0.0	-12.4	25.8	27.2	29.0	29.1	--

Program Overview

As the Space Shuttle program (SSP) completes the International Space Station (ISS) in 2010, there are a number of unique human spaceflight capabilities and facilities that have primarily supported the Space Shuttle and ISS assembly that NASA may wish to preserve. These capabilities are required for continued support of the ISS and future support of human space exploration activities. In FY 2011, Human Space Flight Operations (HSFO) includes Space Flight Crew Operations (SFCO) and the realignment of Crew Health and Safety (CHS). NASA will continue to assess and define projects requiring crew to provide program support, including technical input, via boards and panels; requirements, concept and design support; hardware development and testing support; mission support; and essential training.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Human Space Flight Operations

Plans For FY 2011

SFCO provides trained astronauts for all of NASA human space flight endeavors. For FY 2011, the SFCO will support four ISS long-duration crew rotation missions, which will include the support of the first commercial delivery of cargo to the ISS under the contract with Space Exploration Technologies. If necessary to complete the existing manifest, SFCO will also support Space Shuttle flight into FY2011.

NASA will enlist the National Research Council (NRC) to conduct an independent study of the activities funded within NASA's Human Space Flight Operations program. The study will focus on the role and size of the human spaceflight office in the post Space Shuttle retirement and Space Station assembly environment; the crew-related facility, aircraft and training requirements to support the astronaut corps' for the requirements of NASA's new human spaceflight program, and the more cost-effective means of meeting these requirements. Initiation of the study will commence as soon as possible, with the goal of being completed in time to inform the FY 2013 budget process. The SFCO will also provide support and training for astronauts preparing for future flights to the ISS as well as provide technical and safety panel support to development of future human space systems.

CHS will enable healthy and productive crew during all phases of space flight missions; implementation of a comprehensive health care program for astronauts; and the prevention and mitigation of negative long-term health consequences of spaceflight. CHS will continue to collect, maintain, and mine health data related to the long term affects of space flight in order to enable the mitigation of those affects. This data will be useful to ongoing operations and assist human space exploration activities in defining requirements for the assuring safe human space operations for future systems. CHS will also work to implement technologies for monitoring health status before, during, and after flight and assure that medical personnel and crew members are trained to best use those technologies.

Project Descriptions and Explanation of Changes

Human Space Flight Operations

In FY 2011, SFCO and CHS are funded under the HSFO Program. SFCO provides trained astronauts for all of NASA human space flight endeavors and brings astronaut expertise to help resolve operations or development issues within the human space flight programs. SFCO is responsible for all JSC aircraft operations including aircrew training. CHS will continue to help develop and refine a standardized battery of clinical and physiological tests for all crew members. The Crew Health Surveillance will focus on developing and refining medical standards that are critical to meet the needs that will facilitate human space exploration activities. Similarly, real-time mission evaluation will continue to help define and deliver medical operations hardware for current programs and meet the needs of known architectures.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Human Space Flight Operations

Program Commitments

Commitment/Output FY 2011	Program/Project	Changes from FY 2010 PB Request
SFCO will provide trained astronauts for all U.S. human space flight endeavors and bring experienced astronauts expertise to help resolve operations or development issues.	HSFO/SFCO	Transfer flight crew operations engineering support from ISS.
CHS will provide the full suite of medical capabilities necessary for the health and safety of the astronauts, and to assure they are mission ready from a health perspective.	HSFO/CHS	Realignment of Crew Health and Safety to HSFO.

Program Management

The SFCO and CHS managers report to the Associate Administrator for Space Operations at NASA Headquarters.

Acquisition Strategy

The contracts supporting SFCO are the Aircraft Maintenance and Modification Program (AMMP) provided by the Computer Services Corp. and the Aircraft Simulation Pro (ASP) contract with Lockheed Martin. The contract supporting CHS Bioastronautics is provided by Wyle Labs.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Human Space Flight Operations

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	NASA Advisory Council	10/2009	Provides independent guidance for the NASA Administrator. No recommendations were provided to SFCO at this time.	02/2010
Performance	ASAP	10/2009	Provides independent assessments of safety to the NASA Administrator. In their 2008 Annual Report, the Aerospace Safety Advisory Panel (ASAP) stated that they "strongly endorse the NASA position on not extending Shuttle operations beyond successful execution of the December 2008 manifest, completing the ISS". NASA will fly the Space Shuttle to complete the International Space Station and then retire the Shuttle.	TBD
Performance	Institute of Medicine	03/2007	At the request of NASA, the Institute of Medicine established a committee and issued this report. The committee was charged with examining the process by which NASA establishes space flight health standards for human performance. It assured the transparency of the current process, as well as considering its validity and integrity, particularly related to ensuring worker safety and integrating stakeholder input.	TBD
Performance	Institute of Medicine	04/2009	This report examines NASA's plans to assemble the available evidence on human health risks of spaceflight and to move forward in identifying and addressing gaps in research. The committee provided recommendations to strengthen the content, composition, and dissemination of the evidence books.	TBD

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Launch Services

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	91.7	83.8	78.9	82.6	82.5	86.0	87.9
Launch Services	91.7	83.8	78.9	82.6	82.5	86.0	87.9
FY 2010 President's Budget Request	89.6	85.9	84.1	83.9	83.9	82.8	--
Launch Services	89.6	85.9	84.1	83.9	83.9	82.8	--
Changes from FY 2010 Request	2.2	-2.1	-5.3	-1.3	-1.4	3.2	--

Program Overview

Assuring reliable and cost-effective access to space for missions is critical to achieving NASA's goals. NASA has assigned responsibility for understanding the full range of civil space launch needs to the Space Operations Mission Directorate's Launch Services Program (LSP). The LSP, which works closely with other government agencies and the launch industry, seeks to ensure that the most safe, reliable, on-time, cost-effective commercial launch opportunities are available on a wide range of launch systems. The program works with customers from universities, industry, government agencies, and international partners from the earliest phase of a mission. A key challenge for the program is matching the launch capabilities to the needs of the different customers. Through various scientific missions, these customers seek to: understand the origins, evolution, and destiny of the universe; the nature of life in the universe and what kinds of life may exist beyond Earth's orbit; the solar system, both scientifically and in preparation for human exploration; and the Sun and Earth and the consequences of the Earth-Sun relationship for life on Earth. Customers further seek to provide integrated space communications, navigation and data system services that enable mission success in addition to providing missile technologies for improved National Security. The program purchases fixed-price launch services from domestic suppliers and provides oversight to ensure that these valuable, one-of-a-kind missions safely leave Earth to explore this planet and the universe beyond. The funding provides the capability for NASA to maintain critical skills that provide technical management of launch services on the full fleet of existing and new launch systems. For more information, please see <http://www.nasa.gov/centers/kennedy/launchingrockets/index.html>.

The LSP budget also supports integration activities for the Alpha Magnetic Spectrometer particle physics and astrophysics experiment planned for the ISS that will look for dark matter, anti-matter, and strange matter. This experiment is sponsored by the Department of Energy and funded largely by International Partners.

Mission Directorate:	Space Operations
Theme:	Space and Flight Support (SFS)
Program:	Launch Services

Plans For FY 2011

The LSP program has six planned NASA launches including: 1) Glory, which will be launched on a Taurus XL; 2) Aquarius on a Delta II; 3) Juno on an Atlas V; 4) Nuclear Spectroscopic Telescope Array (NuSTAR) on a Pegasus XL; 5) NPOESS Preparatory Project (NPP) on a Delta II; and 6) the Gravity Recovery and Interior Laboratory (GRAIL) mission, the last mission to be launched on a Delta II. In addition to processing, mission analysis, spacecraft integration and launch services of the above missions, LSP will continue to provide support for the development and certification of emerging launch providers that will be critical to supporting NASA programs.

Project Descriptions and Explanation of Changes

Launch Services Program

The primary elements of the LSP are described below. The LSP provides the acquisition and program management of Expendable Launch Vehicle (ELV) missions using primarily domestic launch vehicles and associated standard services with mission unique options. These services are contracted through LSP at the Kennedy Space Center. The LSP provides all program-related services including program-level financial management and the integration and insight of the launch services tasks across multiple Centers as well as management of all program resource requirements. The LSP provides the Contracting Officer Technical Representative function for launch service contracts, and support services contracts, ensuring consistency and best practices. The LSP assures that NASA retains the technical, management, and acquisition skills necessary to meet Agency and customer needs.

The LSP provides mission integration, technical, and launch management functions. Manifesting and scheduling of payload launches are accomplished through the auspices of the Flight Planning Board. Through this process all space access requirements and priorities are assessed to develop flight planning manifests that best meet customer requirements. The LSP acquires launch services to meet the full range of requirements, ranging from finding space for small payloads as secondary payloads to the launch of dedicated payloads on a range of launch vehicles. The LSP also provides technical management of the launch service, including planning, execution, and support for flight project customer requirements. This element of the program provides for planning and implementation of mission-specific integration activities, coordination and approval of mission-unique launch vehicle hardware/software development, and provision of payload-processing accommodations. Additionally, LSP offers management of the launch campaign/countdown including coordination with other government agencies and the commercial sector.

The LSP provides engineering services and analysis for launch vehicle certification at levels of detail commensurate with the mission risk tolerance. The program maximizes the mission success of commercially developed expendable launch services by employing a technical oversight approach that includes a combination of specified approvals and targeted insight. This element also provides for the coordination of mission-specific and fleet-wide launch vehicle analyses, hardware changes, and production oversight, assessments, and out-of-family anomaly resolution.

The LSP Construction of Facility (COF) projects support repairs and modifications to existing buildings and launch pads on the East and West Coasts, which sustain the processing, operations, and launch of NASA spacecrafts. A list of the total COF projects are included in the Construction and ECR section of this document.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Launch Services

Program Commitments

Commitment/Output FY 2011	Program/Project	Changes from FY 2010 PB Request
The Launch Services Program is planning for 11 Missions by FY 2014 and is providing an advisory role for 6 additional missions.	SMD - 9 Missions, and SOMD - 2 Missions	Updated number of missions

Program Management

The Launch Services Program Manager reports to the Assistant Associate Administrator for Launch Services, Space Operations Mission Directorate at NASA Headquarters.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Launch Services Acquisition and Management	LSP, Kennedy Space Center	Kennedy Space Center	Air Force, National Reconnaissance Office
Engine Assembly and Test	LSP, Kennedy Space Center	Stennis Space Center	Air Force, National Reconnaissance Office
Mission Planning and Integration	LSP, Kennedy Space Center	Kennedy Space Center	Science Mission Directorate, Exploration Systems Mission Directorate, Space Operations Mission Directorate, Missile Defense Agency, NOAA
Vehicle Production Insight	LSP, Kennedy Space Center	Marshall Space Flight Center	Air Force, National Reconnaissance Office

Acquisition Strategy

Under the NASA Launch Services (NLS) contracts with United Launch Alliance, Orbital Sciences Corporation (OSC), and Space Exploration Technologies, Inc. (SpaceX), the program acquires services associated with launches of Delta, Atlas, Pegasus, Taurus, and Falcon launch vehicles. Services are provided on a Firm-Fixed-Price / Indefinite-Delivery-Indefinite-Quantity (IDIQ) basis, and missions can be ordered under these contracts through June 2010. Missions not presently under contract are competed among existing NLS contractors through use of a Launch Service Task Order mechanism. In addition to the NLS contracts, Glory is the only active mission remaining under the Small Expendable Launch Vehicle Services contract with OSC. Award of the NLS II follow-on contract is anticipated by the end of June 2010.

The NLS solicitation contains a provision that permits technology infusion or improvements. New offerors may seek an NLS contract during open seasons that occur each year in February and August. The NLS contracts enable ordering of standard and non-standard services, as well as special studies and mission-unique modifications.

Integrated launch services are provided by the Analex Corporation through a hybrid fixed-price/cost contract which contains options to continue performance through September 2011. Payload processing for East Coast missions is provided by Astrotech Space Operations. West Coast payload processing is provided after a competitive selection by either Astrotech or Spaceport Systems International.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Launch Services

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO Assessment	08/2009	This was a Non-Advocate Review (NAR) of LSP to present information to Agency decision-making councils. The IPAO Review Team found that LSP is a highly successful program compliant with Agency direction, policy and directives. The review, completed before the OCO launch failure, further illustrated that LSP's 100 percent launch success record, together with sound cost management, and demonstrates exceptional performance.	2012

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Rocket Propulsion Test

FY 2011 Budget Request

Budget Authority (\$ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	41.8	44.3	44.3	44.2	44.2	48.2	49.2
Rocket Propulsion Testing	41.8	44.3	44.3	44.2	44.2	48.2	49.2
FY 2010 President's Budget Request	41.8	45.8	44.6	44.5	44.5	44.5	--
Rocket Propulsion Testing	41.8	45.8	44.6	44.5	44.5	44.5	--
Changes from FY 2010 Request	0.0	-1.5	-0.4	-0.4	-0.3	3.6	--

Program Overview

As the principal implementing authority for NASA's rocket propulsion testing, the Rocket Propulsion Test (RPT) Program reviews, approves, and provides direction on rocket propulsion test assignments, capital asset improvements, test facility modernizations and refurbishments, integration for multi-site test activities, identification and protection of core capabilities, and the advancement and development of test technologies.

RPT employs a collaborative approach to ensure rocket propulsion test activities are conducted in a manner that reduces cost, enhances safety, provides credible schedules, achieves technical objectives, and leverages the lessons learned. RPT reduces propulsion test costs through the safe and efficient utilization of rocket propulsion test facilities in support of NASA programs, commercial partners, and the Department of Defense, while eliminating unwarranted duplication. RPT sustains and improves Agency-wide rocket propulsion test core capabilities (both infrastructure and critical skills) and ensures appropriate levels of capability and competency are maintained.

The program strategy is to fund and maintain a core competency of skilled test and engineering crews and test stand facilities; consolidate and streamline NASA's rocket test infrastructure; establish and maintain world-class test facilities; modernize test facility equipment; provide non-project specific equipment and supplies; and develop effective facility/infrastructure maintenance strategies and performance. RPT provides critical institutional and program capabilities to support NASA's missions.

Further information on the RPT Program can be found at <http://rockettest.nasa.gov/>.

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Rocket Propulsion Test

Plans For FY 2011

Test facility management, maintenance, sustaining engineering, operations, and facility modernization projects required to keep the test-related facilities in the appropriate state of operational readiness will continue to be funded. Established testing requirements for the Agency's exploration program will be used to identify excess and "at-risk" test facilities and will support decisions relative to test asset consolidation initiatives. RPT's inventory of 32 test locations, ranging from active to mothballed facilities, will continue to be maintained at various states of operational readiness as required. Propulsion test technology development will also be continued. By working with Exploration and the new Heavy Lift and propulsion technology development projects, RPT will continue to identify new technologies to improve the efficiency and reliability of the propulsion test infrastructure.

The RPT Program will also continue to assist in the rocket propulsion testing requirements definition for low Earth orbit and in-space propulsion systems and related technologies.

Project Descriptions and Explanation of Changes

RPT

RPT represents the single point interface for NASA's rocket propulsion test facilities located at: Stennis Space Center (SSC), Marshall Space Flight Center (MSFC), Johnson Space Center-White Sands Test Facility (JSC-WSTF), and Glenn Research Center-Plum Brook Station (GRC-PBS). These facilities have a replacement value of greater than \$2 billion. The RPT sustains and improves Agency-wide rocket propulsion test core competencies (both infrastructure and critical skills), ensures appropriate levels of capability and competency are maintained, and eliminates unwarranted duplication. The program strategy is to fund and maintain core competencies of skilled test and engineering crews and test stand facilities; consolidate and streamline NASA's rocket test infrastructure; establish and maintain world-class test facilities; modernize test facility equipment; provide non-project specific equipment and supplies; and develop effective facility/infrastructure maintenance strategies and performance. The RPT budget does not include resources to support the marginal costs of testing (e.g., direct labor, propellants, materials, program-unique facility modifications, etc.) since these activities are funded by programs as a direct cost when they utilize the RPT test stands. When NASA, DoD, and commercial partners use the RPT-supported test stands, they are responsible for program-specific facility modifications in addition to the active testing of the program-specific test article.

Program Commitments

Commitment/Output FY 2011	Program/Project	Changes from FY 2010 PB Request
Support continued commercial testing of RS-68 engine	Pratt Whitney Rocketdyne/Air Force	Same

Mission Directorate: Space Operations
Theme: Space and Flight Support (SFS)
Program: Rocket Propulsion Test

Program Management

The Rocket Propulsion Testing Program Manager reports to the Assistant Associate Administrator for Launch Services, Space Operations Mission Directorate at NASA Headquarters.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Technical Services and Support	Stennis Space Center	Jacobs-Sverdrup, Mississippi Space Services, Plum Brook Operations Support Group	Rocket Propulsion Test Management Board Members: Stennis Space Center, Marshall Space Flight Center, Johnson Space Center, White Sands Test Facility, Glenn Research Center's Plum Brook Station, Kennedy Space Center (associate member), and Glenn Research Center (associate member). National Rocket Propulsion Test Management Board Department of Defense Members: Air Force Research Lab, Arnold Engineering Development Center, Redstone Technical Test Center, and Naval Air Warfare Center.

Acquisition Strategy

The Test Operations Contract (TOC) will be completing its final option contract period in September 2010. A 3-month extension to December 2010 is in negotiation. A new contract will be openly competed at that time.

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