

**MISSION SUPPORT
FISCAL YEAR 1998 ESTIMATES
BUDGET SUMMARY**

**OFFICE OF SPACE FLIGHT
SPACE COMMUNICATIONS SERVICES**

SUMMARY OF RESOURCES REQUIREMENTS

SPACE COMMUNICATIONS SERVICES	FY 1996	FY 1997	FY 1998
Space Network	157,200	185,100	161,200
Telecommunications	98,200	92,600	84,500
Total	255,400	277,700	245,700

Distribution of Program Amount by Installation	FY 1996	FY 1997	FY 1998
Johnson Space Center	--	3,800	--
Marshall Space Flight Center	54,800	55,400	79,000
Ames Research Center	150	--	--
Lewis Research Center	3,200	17,900	50,500
Goddard Space Flight Center	189,393	191,600	109,000
Jet Propulsion Laboratory	4,955	6,000	4,300
Headquarters	2,902	3,000	2,900
Total	255,400	277,700	245,700

PROGRAM GOALS

The Space Communications goal is to enable the conduct of the NASA strategic enterprises by providing telecommunications systems and services. Reliable electronic communications are essential to the success of every NASA flight mission, from planetary spacecraft to the Space Shuttle to aeronautical flight tests.

The National Space Policy stipulates that NASA will "seek to privatize or commercialize its space communications operations no later than 2005". The Space Operations Management Office (SOMO), located at the Johnson Space Center, manages the telecommunication, data processing, mission operation, and mission planning services needed to ensure the goals of

NASA's exploration, science, and research and development programs are met in an integrated and cost-effective manner. In line with the National Space Policy, the SOMO is committed to seeking and encouraging commercialization of NASA operations services and to participate with NASA's strategic enterprises in collaborative interagency, international, and commercial initiatives. As NASA's agent for operational communications and associated information handling services, the SOMO seeks opportunities for using technology in pursuit of more cost-effective solutions, highly optimized designs of mission systems, and advancement of NASA's and the nation's best technological and commercial interests.

The Space Communications Services program is composed of Space Network and Telecommunications programs. These programs provide communications support to human space flight missions and low-Earth-orbital spacecraft and the Tracking and Data Relay Satellite (TDRS) system; to expendable launch vehicles and research aircraft; and for telecommunications interconnectivity among NASA flight support networks, project and the mission control centers, data processing centers, NASA Centers and facilities, contractor facilities, and investigator science facilities located throughout the nation and the world.

STRATEGY FOR ACHIEVING GOALS

The Space Communications program provides command, tracking and telemetry data services between the ground facilities and flight mission vehicles. The program also supports all the interconnecting telecommunications services to link tracking and data acquisition network facilities, mission control facilities, data capture and processing facilities, industry and university research and laboratory facilities, and the investigating scientists. The program provides integrated solutions to operational communications and information management needs common to all NASA strategic enterprises as well as NASA-wide telecommunications network services to support all of NASA's administrative communications needs.

The range of telecommunications systems and services are provided to conduct mission operations, enable tracking, telemetry, and command of spacecraft and sub-orbital aeronautical and balloon research flights. Additionally, services and systems are provided to facilitate data capture, data processing, and data delivery for scientific analysis. The program also provides the high speed computer networking, voice and video conferencing, fax, and other electronic mail services necessary to administer NASA programs.

These communications functions are provided through the use of space and ground-based antennas and network systems, mission control facilities, computational facilities, command management systems, data capture and telemetry processing systems, and a myriad of leased interconnecting communications systems ranging from phone lines and satellite links to optical fibers.

The program provides the necessary research and development to adapt emerging technologies

to NASA communications needs. New coding and modulation techniques, antenna and transponder development, and automation applications are explored and, based on merit, demonstrated for application to future communications needs. The program also provides scheduling, network management and engineering, pre-flight communications test and verification, as well as flight system maneuver planning and analysis for selected missions. NASA's flight programs are supported through the study and coordination of data standards and communication frequencies to be used in the future. These are all parts of the strategic approach to providing the vital communications systems and services common to all NASA programs and to achieve compatibility with future commercial satellite systems and services.

Many science and exploration goals require inter-agency or international cooperation in order to be achieved. NASA's Space Communications assets are provided through collaborative agreements to other U.S. Government agencies, commercial space enterprises, and international cooperative programs. Consistent with the National Space Policy, NASA will purchase commercially available goods and services to the fullest extent feasible, and will not conduct activities with commercial application that preclude or deter commercial space activities.

The modernization of the original White Sands Ground Terminal, Cacique, was completed last year, and returned to operational service. With its twin, Danzante (Second TDRS Ground Terminal), these ground terminals provide fail-safe operations of the Space Network and its TDRS spacecraft. Initial planning and design of a remote ground terminal capability at Guam, extending the White Sands Ground Terminal capability by providing for coverage of the Zone of Exclusion, was completed in FY 1996. Development of the system will occur during FY 1997 and FY 1998, with completion of the system in FY 1998. The Space Network provides communications for the Space Transportation System, the Hubble Space Telescope (HST) astronomical observatory and many other NASA missions, as well as for non-NASA users on a reimbursable basis. The development of the Replenishment Tracking and Data Relay Satellites is on-going. The Telecommunications program will consolidate all NASA wide-area network systems in FY 1997, providing integrated services for operational and administrative communication needs at reduced costs.

Efforts are ongoing to consolidate and streamline major support contract services in order to optimize space operations. In

FY 1996, a voluntary contractor partnership was established between the major incumbents, AlliedSignal Technical Services Corporation and Computer Sciences Corporation. Transition to a Consolidated Space Operations Contract (CSOC) is planned. The CSOC acquisition process will be implemented in two phases. In FY 1997, multiple short-term, fixed-price study contracts to develop an Integrated Operations Architecture (IOA) are planned. In FY 1998, a single Cost-Plus-Award-Fee, ten year contract is envisioned to implement the IOA. A full and open competition is planned to develop an integrated architecture and implementation

across all NASA programs to produce efficiencies and economies over the life of the contract.

SPACE NETWORK

BASIS OF FY 1998 FUNDING REQUIREMENT (Thousands of Dollars)	FY 1996	FY 1997	FY 1998
Space Network Services	6,800	5,100	3,700
TDRS Replenishment Spacecraft	147,200	162,100	107,000
TDRS Replenishment - Launch Services	3,200	17,900	50,500
Total	157,200	185,100	161,200

PROGRAM GOALS

The Space Network program goal is to provide reliable, cost-effective space-based tracking, command and data acquisition telecommunications services to the Human Space Flight program, other low-Earth-orbital science missions including observatory-class flights, and selected sub-orbital flight missions. The Space Network program provides for the implementation, maintenance, and operation of the communications systems and facilities necessary to ensure and sustain the high-quality performance of NASA flight operations systems. Replenishment Tracking and Data Relay Satellites and the launch systems required to deploy them are also included in this program.

The Space Network participates in collaborative interagency and international programs, and independently provides communications services to other national and commercial endeavors on a reimbursable basis.

STRATEGY FOR ACHIEVING GOALS

NASA's Space Network is comprised of a constellation of geosynchronous TDRS and associated dual ground terminals located in White Sands, New Mexico. The current TDRS constellation consists of two fully operational satellites in service (TDRS-4 & 5), two fully functional satellites stored on-orbit (TDRS-6 & 7), and two partially functional spacecraft (TDRS-1 & 3). TDRS-3 is positioned over the Indian Ocean, in conjunction with a remote terminal in Australia, to increase data return from the Compton Gamma Ray Observatory (CGRO) and support Shuttle MIR operations. TDRS-1, now in its thirteenth year, is still providing service to expendable vehicle launches and other peak loads in the eastern network node.

The Goddard Space Flight Center manages the Space Network program, including the TDRS Replenishment Spacecraft program, and the modification and/or system replacement of the ground facilities and equipment as necessary to sustain network operations for current and future missions. The Replenishment Spacecraft program will provide three TDRS spacecraft under a fixed-price, commercial practices contract. The prime contract was awarded to the Hughes Space and Communications Company in 1995, and development is now under way. The first spacecraft's launch readiness is scheduled for the third quarter of CY 1999. The program provides for spacecraft compatibility modifications to the New Mexico ground terminals. Lockheed Martin Corporation is the prime contractor for launch services for the TDRS Replenishment Spacecraft.

The AlliedSignal Technical Services Corporation and the Computer Sciences Corporation are the primary support service contractors responsible for maintenance and operations of the ground terminal facilities and orbital operations of the spacecraft as well as engineering and test support. The two contractors established a voluntary partnership in 1996 for these services under the Consolidated Network and Mission Operations (CNMOS) performance-based contract.

The Space Network provides communication services at data rates up to 300 megabits-per-second (MBPS) using its Ku-band single-access services, data rates of up to three MBPS using its S-band, single-access services, and a low-rate service of up to 50 kilobits-per-second (KBPS) through its multiple-access service. These services provide unparalleled, flexible high-data-rate communications capabilities for flight operations of low-Earth-orbital missions. Customer satellites are provided with command, tracking, and telemetry services via the TDRS spacecraft, which act as relays for commands from and science telemetry return to the ground terminals. The ground terminals are interconnected with flight control, data capture and processing facilities responsible for mission operations.

Communications services are provided to non-NASA customers on a reimbursable basis. A large share of the Space Network Services program that provides for the operations and maintenance of the ground terminal complex is funded with the receipts from reimbursable services. This reimbursable revenue is anticipated to continue and has been taken into account in formulating the NASA FY 1998 budget request.

Space Network services provide the primary communications for orbital operations of the Space Transportation System and its attached payloads. Services are also provided to automated Earth-orbital missions which have communications systems compatible with the TDRS, and can provide nearly continuous high-data-rate services. The Space Network will provide communications services for the International Space Station (ISS) beginning in FY 1998. Services will also be provided on an agreed-to basis to NASA's International partners. Agreements are in place with Japan, the European Space Agency, and Canada. Negotiations

are continuing with the Russian Space Agency as a participant for potential cooperative endeavors in telecommunications.

In addition to the day-to-day operations of the Space Network satellites and ground terminals, the program provides for the replenishment of the satellite assets.

MEASURES OF PERFORMANCE

	<u>FY 1996</u> <u>Plan</u>	<u>FY 1996</u> <u>Actual</u>	<u>FY 1997</u> <u>Plan</u>	<u>FY 1997</u> <u>Current</u>	<u>FY 1998</u> <u>Plan</u>
Number of hours of network service	26,200	26,200	26,400	27,000	35,000

The projected output of network services will remain relatively level until FY 1998. The initiation of ISS assembly, and the launch of Earth Observation System (EOS) AM-1 and Landsat-7 will necessitate an increased level of communications services.

TDRS Replenishment Spacecraft

Performance Metric	Plan	Actual/Revised	Description/Status
Contract Award	February 1995	February 1995	Early design activities began in April 1995. The contract was awarded on schedule, but initiation of activity was delayed due to a protest, which was resolved by GAO in July 1995
Preliminary Design Review	July 1996	July 1996	The review verified that the proposed contractor design will meet NASA performance requirements.
Critical Design Review (CDR)	January 1997	April 1997	Verification that the contractor is prepared to develop, including manufacture, assembly, integrate, and test, the TDRS spacecraft. CDR was re-phased due to the delay in the development of engineering models as a result of the lack of contractor resources and late requirements flow down. The schedule was re-planned with no impact to the completion of integration and test

Start TDRS-H Integration and Test	May 1997	August 1997	Start of spacecraft assembly, as well as electrical, environmental, and performance testing. The process begins with spacecraft and with spacecraft-level assembly and test. I&T was re-phased due to the delay in the development of engineering models as a result of the lack of contractor resources and late requirements flow down. The schedule was re-planned with no impact to the completion of integration and test.
Complete TDRS-H Integration and Test	January 1999	--	Completion of spacecraft performance and environmental tests allows final assembly and re-testing to begin prior to shipment for launch.
Launch TDRS-H	3rd Qtr FY 1999	--	Launch within four years of contract award will be performed, ensuring the continuity of TDRSS services to user space flight systems. Launch of TDRS-I and TDRS-J is scheduled for 2002 and 2003 following the launch of the first TDRS Replenishment Spacecraft.

ACCOMPLISHMENTS AND PLANS

In FY 1996, the TDRS Replacement Spacecraft (TDRS-7) was placed in on-orbit storage. Launch services for the TDRS-H Replenishment Spacecraft were negotiated with Lockheed Martin Corporation in May 1996. During July 1996, the preliminary design review for the development of the TDRS Replenishment Spacecraft was completed. Both the TDRS Replacement Spacecraft and the Second TDRSS Ground Terminal programs were completed within the total funding limitations established in response to the FY 1992 Appropriations Conference Report. Space Network extended service (on a reimbursable basis) to the expendable launch vehicle community concluding agreements with U.S.A.F. Titan and Lockheed Martin's commercial Atlas programs. In addition, the Space Network provided data relay services to eight Space Shuttle flights and their attached payloads.

In FY 1997, the Space Network is required to operate 24 hours per day, 7 days per week, providing data relay services to many flight missions. These missions include seven planned Space Shuttle flights and their attached payloads, observatory-class spacecraft in low-Earth orbit such as HST and the CGRO, as well as other compatible missions such as Ocean Topography Experiment, Extreme Ultraviolet Explorer (EUVE), Tropical Rainfall Measurement Mission (TRMM), Department of Defense customers, the X-ray Timing

Explorer (XTE), the Starlink research aircraft, and the Long Duration Balloon program.

Development activities will continue with the critical design review of the TDRS Replenishment Spacecraft scheduled for April 1997. TDRS-H integration and test will begin in late August 1997. Negotiations for the TDRS-I and TDRS-J launch services will be definitized in early 1997. The Guam Remote Ground Terminal (GRGT) development will continue with site development at a U.S. Navy location in Guam. The GRGT extends the capability of the White Sands Ground Terminals to provide full service coverage in the former Zone of Exclusion. Within the FY 1995 funds for the Space Network, funding availability of \$9.0 million was identified for this activity as a result of completion of the Tracking and Data Relay Satellite (TDRS)-7 and the Second TDRS Ground Terminal projects. The remaining \$12.4 million required for this activity are available within the Space Network program funds as a result of receiving reimbursable funds greater than originally anticipated, including revenues resulting from the agreement with Columbia Communications Corporation for lease of excess C-band capacity.

In FY 1998, the Space Network will continue to operate 24 hours per day, 7 days per week providing services to seven Space Shuttle flights and their attached payloads, as well as the International Space Station, Landsat-7, and the Earth Observation System AM-1 mission. Support to the missions listed above will also continue. The Guam Remote Ground Terminal will conclude integration and test activities and become operational late in the fiscal year. Full services will then be available on a continuous basis with no geographical gaps for low-orbit missions. The Replenishment Spacecraft will continue integration and test activities to prepare for the completion of TDRS-H development in early 1999.

TELECOMMUNICATIONS

<u>BASIS OF FY 1998 FUNDING REQUIREMENT</u> (Thousands of Dollars)	FY 1996	FY 1997	FY 1998
Telecommunications	98,200	92,600	84,500

PROGRAM GOALS

The Telecommunications goal is to provide high-quality, reliable, cost-effective telecommunications systems and services for mission control, science data handling, and program administration for NASA programs. The Telecommunications program provides for the implementation, maintenance, and operation of the telecommunications services, control centers, switching systems, and other equipment necessary to provide an integrated approach

to NASA communication requirements.

The Telecommunications program supports NASA's programs in collaborative interagency, international, and commercial enterprises. Many collaborative arrangements are performed on a reimbursable basis.

STRATEGY FOR ACHIEVING GOALS

NASA's Telecommunications program is a nationwide system of leased voice, video, and data services; leased wide-band terrestrial and satellite circuits; and control centers, switching centers, network equipment and other communications devices. International telecommunications links are also provided to NASA's Deep Space Network (DSN) sites in Australia and Spain; Spaceflight Tracking and Data Network (STDN) sites outside the Continental U.S.; and common telecommunications exchange points that provide interconnectivity to NASA international partners. Administrative, scientific, and mission control exchanges among NASA and its industrial and scientific partners are supported by NASA's telecommunications networks and systems. Support and participation by other U.S. agencies, universities, and research centers, and by other space-faring nations, are also facilitated, including the provision of secure circuits, systems, and facilities. Domestic telecommunications circuits are primarily leased by NASA under the FTS-2000 contract managed by the General Services Administration; international circuits are leased under separate contractual arrangements. NASA's telecommunications program maintains cooperative networking agreements for exchanging services with the European Space Agency (ESA), Canada, Japan, France, and Russia. The Computer Science Corporation and AlliedSignal Technical Services Corporation provide engineering and operations support for the telecommunications network.

NASA telecommunications services are provided by the NASA Integrated Services Network (NISN) Project Office, and managed by the Marshall Space Flight Center, in partnership with the Goddard Space Flight Center. NISN is a new organization which consolidates the NASA Communications and the Program Support Communications Network. NISN provides unique mission and mission support telecommunications services to all NASA Centers, supporting contractor locations, international partners, research institutes, and universities. NASA also provides telecommunications services to non-NASA customers on a reimbursable basis. This reimbursable revenue is anticipated to continue and has been taken into account in formulating the NASA FY 1998 budget request.

Command, telemetry, and voice systems communications are provided between spacecraft mission control facilities, tracking and data acquisition networks, launch sites, NASA data processing centers, and scientific investigators whose support is critical to mission control and command. NISN supports NASA aeronautical test sites, as well as preflight verification of NASA spacecraft systems and their interconnectivity with NASA communications systems.

The NISN interconnects NASA installations and national and international aerospace contractors, laboratories, scientific investigators, educational institutions, and other Government installations in support of administrative, science data exchange, and other research and analysis activities. Specific mission-support services provided by the NISN are voice and video teleconferencing, broadcast television, computer networking services, as well as data handling and transfer services including Internet connectivity.

NASA's Telecommunications program provides for the improvement, operation and maintenance of NASA network systems and facilities. Telecommunications network systems include digital voice; data and video switching equipment; audio and video conferencing and bridging systems; wide-band multiplexing equipment; and sophisticated network management, monitoring and fault isolation systems. Equipment and facilities of NASA Select Television are also provided by the Telecommunications program.

Initially, the telecommunications services required by NASA were not available commercially. However, with the advancements of telecommunications technology and standards, NASA telecommunications services are now more readily available from commercial sources. NASA will analyze current telecommunications requirements to determine the feasibility of providing these services through commercial sources. Based on the Asynchronous Transfer Mode (ATM) study and cost analyses conducted in

FY 1996, NASA has determined that ATM is a viable and cost effective method to support NASA's growing telecommunications needs, and that the technology is available commercially. Similar services provided by legacy systems and networks are also being studied for consolidation.

MEASURES OF PERFORMANCE

	<u>FY 1996 Plan</u>	<u>FY 1996 Actual</u>	<u>FY 1997 Plan</u>	<u>FY 1997 Current</u>	<u>FY 1998 Plan</u>
Number of end-user spacecraft contacts	96,000	89,400	105,600	105,000	115,000
Number of locations connected	430	430	470	400	450
Number of electronic conferences	27,600	30,800	31,400	31,500	34,500

The decrease in end-user spacecraft contacts in FY 1996 was caused by delays in the launch manifest and reduced support to Hubble Space Telescope. Constrained travel budgets resulted

in an increase in the number of electronic conferences. The planned, actual and current number of electronic conferences are currently stated as annual numbers. The budget estimates submitted in the FY 1997 Congressional Budget Estimate displayed the number of electronic conferences based on average monthly occurrences versus annual numbers.

ACCOMPLISHMENTS AND PLANS

In FY 1996, telecommunications services and systems were provided to support all NASA operational flight systems. Services were also provided for all administrative, programmatic, and technical information exchanges required for pre-flight systems and for NASA transmission of data to NASA-supported scientists and researchers. NISN services were added to support new missions and increased requirements of ongoing missions. The missions include International Solar Terrestrial Physics (ISTP)/Polar, international RADARSAT, Near Earth Asteroid Rendezvous (NEAR), Mars Global Surveyor (MGS), United States Microgravity Laboratory, and International Microgravity Laboratory. In addition, NISN services were extended to new university and contractor locations in support of the scientific missions. The network backbone capacity was also increased for the aeronautics supercomputer program and the International Space Station development. NASA has consolidated multiple telecommunications contracts into one. This allows for improved focus to better manage telecommunications services being provided to NASA.

In FY 1997, NASA will finalize planning and implementation activities for the commercialization of appropriate telecommunication services. These services will transition to commercially available technology required to support increased program requirements, particularly from the Earth Observation System and the International Space Station. NASA will be adding services in support of Mars Global Surveyor, Mars Pathfinder, ISS Phase II, National Oceanic and Atmospheric Administration (NOAA)-K, Advanced Composition Explorer (ACE), Advanced Earth Observing Satellite (ADEOS) and TRMM. From FY 1997 and into FY 1998, growth can be anticipated in the areas of Space Station on-orbit fabrication and Mission To Planet Earth endeavors.

FY 1998 support will continue for Mars Global Surveyor and Pathfinder. Other new service will support Advanced X-Ray Astrophysics Facility (AXAF), Cassini, EOS AM-1, Landsat-7, NOAA-L, and Transition Region and Coronal Explorer (TRACE).