NASA Facts

National Aeronautics and
Space Administration

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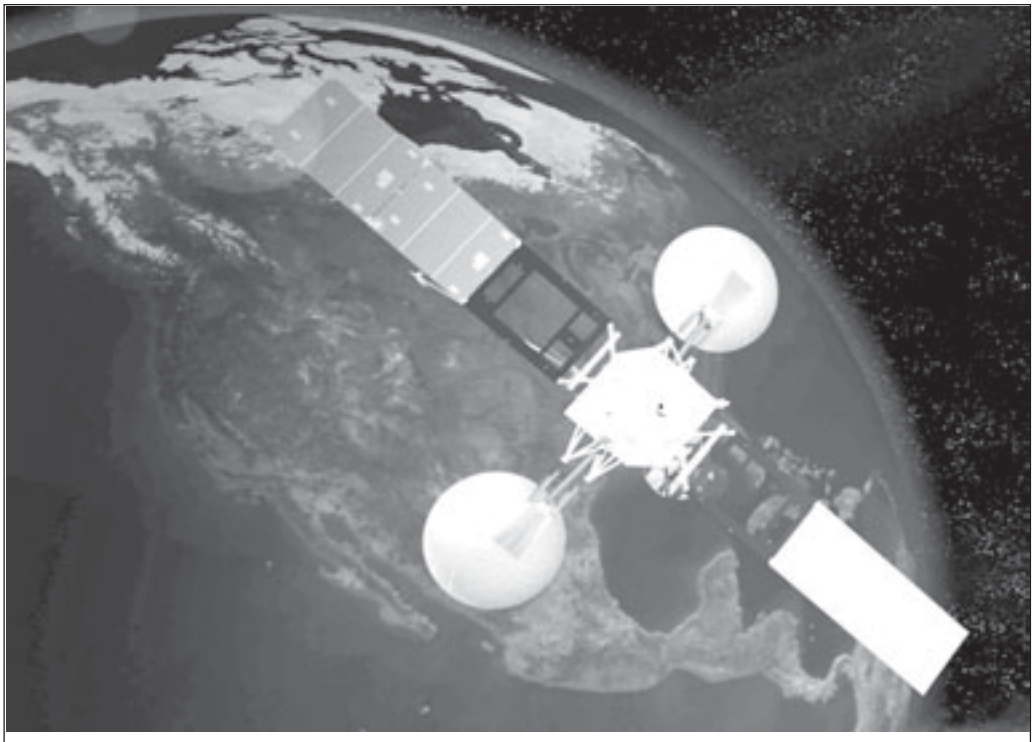
New Series of Tracking and Data Relay Satellites Replenishing The Original Fleet

NASA's next generation Tracking and Data Relay Satellites (TDRS) consist of three enhanced satellites that provide vital communication links with astronauts aboard the Space Shuttle and International Space Station, as well as enable the transfer of data from numerous Earth and space science missions.

The first in this trio, TDRS-H, launched from Cape Canaveral Air Force Station, Fla. in June 2000, the second, TDRS-I, launched in March 2002, and the third, TDRS-J, is scheduled to launch sometime during the fourth quarter of 2002. The new trio of satellites will complement the original TDRS constellation of six satellites, which has served the world-wide scientific community and other organizations since 1983.

Similar to many other communications satellites, TDRS-H,I and J are placed into a geosynchronous orbit 22,300 miles above the



Artist concept of TDRS-H spacecraft on orbit.

equator. Each satellite maintains a fixed position above the Earth, tracking fast moving satellites to provide nearly continuous communication links with controllers and researchers on the ground.

Satellite Capabilities

TDRS-H,I and J provides users with the following services -

S-Band Single Access:

- Provides continuous forward and return services to individual users in each orbit and at fixed locations;

- Supports two-way communication during user satellite data recorder playbacks, or full-time high-rate service to high-priority users such as the Space Shuttle and International Space Station;

- Tunable over a range of frequencies, including Multiple Access;

- Can provide high gain support to a Multiple Access user satellite with degraded communications, or temporaily provide an increased data rate;

- Provides near full-time coverage for scheduled users within NASA's Space Network.

S-Band Multiple Access:

- Supplies five simultaneous Multiple Access return channels (user satellite to ground) and one Multiple Access forward channel (ground to user);

- Features return services that use a common (2287.5 megaHertz) with code division multiple access to avoid common channel interference;

- Upgraded to 3 megabits per second (nearly equivalent to S-band Single Access capability) versus 100 kilobits per second return on the original TDRS fleet, and up to 300 kilobits per second forward.

Ku-Band Single Access:

- Operates at frequencies between 13.7 gigaHertz for forward service and 15.0 gigaHertz for return service. Provides higher bandwidth for user satellites with data rates up to 300 megabits per second return, which is 5,000 times faster than the standard 56K home computer modem, and 25 megabits per second forward;

- Supports high-data rate telemetry and high resolution digital television for Space Shuttle and, once equipped, International Space Station video communications. (Space Station video is currently downlinked through Ku-band single access, and will soon be upgraded to provide digital capability.)

- Efficiently transfers enormous volumes of data from tape or solid-state data recorders aboard NASA scientific spacecraft.

Ka-Band Single Access:

- Features a new higher-frequency servicethat provides the capability to increase data rates to 800* megabits per second for future missions with higher bandwidth communication needs, such as multi-spectral instruments for Earth science applications. (*Rates above 300 megabits per second require additional ground station modifications.)

- Establishes international compatibility with Japanese and European space relay programs, allowing for mutual support in emergency situations;

- Provides high bandwidth, less interference with terrestrial communications, and lower user

satellite equipment burden.

Satellite Navigation - In addition to telemetry, command and mission data communications services, the TDRS system will continue to provide user navigational data needed to locate the orbit and position of user satellites.

New Antenna Design

Two mechanically steered 15-foot diameter antenna reflectors provide high data rate communications and tracking services to user satellites.

An innovation called 'active' tuningenbles the shape of the single-access reflectors to be adjusted on orbit to correct residual contour distortion, which can be occur during stowage within the launch vehicle's fairing. The new feature provides an antenna surface accuracy 15 times greater than that used for the L-band MSAT mobile satellite program.

New Acquisition Approaches

The new trio of satellites was developed for NASA under a fixed price contract with Boeing Satellite Systems (Boeing Integrated Defense Systems) of El Segundo, Calif. An innovative approach substituted higher-level performance specifications in lieu of detailed technical design specifications, allowing the contractor to use commercial practices in developing TDRS-H, I, and J.

The contract also includes a payback provision, which protects NASA's interests should service failures occur during the first eight years of each spacecraft's 11-year design lifetime.

Tracking and Data Relay System

The current Tracking and Data Relay Satellite System, or TDRSS, consists of the following components:

- TDRS 1-7 satellites, built by TRW of Redondo Beach, Calif.);

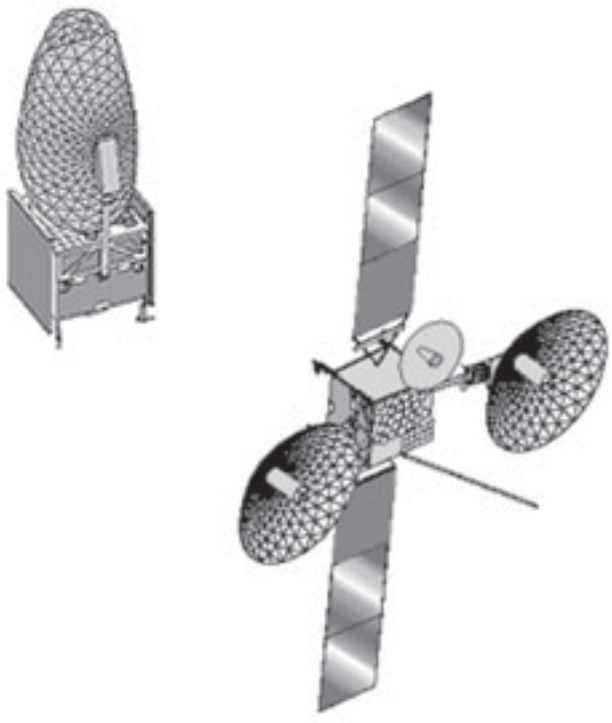
- TDRS-8, previously designated TDRS-H, and launched in June 2000;

- NASA's White Sands Complex in New Mexico;

- A ground terminal extension on the island of Guam, South Pacific; and

- Various customer scheduling and data handling facilities.

(Note: TDRS-I is currently undergoing pre-acceptance testing.)



Upper Left: TDRS-H,I,J shown in the stowed configuration for launch.
Lower Right: TDRS-H,I,J shown on-orbit and fully deployed.

(Images courtesy of Boeing Satellite Systems)

From their geosynchronous location 22,300 miles above the equator, TDRS-H, I and J provide nearly continuous contact with lower orbiting satellites.

The Space Network Project at NASA Goddard Space Flight Center, Greenbelt, Md. manages the daily operations of each on-orbit TDRS.

In addition to the Tracking and Data Relay System's outstanding success in improving space flight communications, other far reaching achievements include:

Flight Operations - Replacing an extensive and costly ground-based tracking system, which relied on foreign sites, numerous personnel, tracking vessels and aircraft, and provided users less than 15 percent contact per orbit.

Multiple Users - Pioneered simultaneous support to multiple space users by sharing space and ground assets, and employing advanced communications technologies and scheduling operations.

Innovative acquisition - Being a trailblazer of commercial/government dual use of spacecraft, of lease and purchase procurement, and of hosting a commercial communications package.

Launch Operations - A unique capability to track launches anywhere on Earth, and providing increased user support for new and advanced expendable launch vehicles while helping to lower cost.

Communications Research - Successful test platform for many research efforts, such as radio-frequency propagation, very long-base interferometry, digital radio broadcasting, telemedicine and aircraft satellite communications.

Remote Support - Remaining TDRS-1services provide a vital communication and video links, supporting ongoing research at the South Pole. In 2002, TDRS-1 supported the first telemedicine link for surgery at the South Pole, drastically improving medical services to researchers stationed in Antarctica.

NASA's Mission

With their advanced capacity for relaying vital data back and forth from space to users on the ground, the Tracking and Data Relay Satellite System is enabling NASA to meet its mission...

To understand and protect our home planet,
To explore the Universe and search for life,
To inspire the next generation of explorers
. . . as only NASA can

* By providing a communications backbone, which supports current and future scientific and engineering research on the Space Shuttle and International Space Station, enabling researchers access to real-time science results;

* By supporting an array of sophisticated Earth science satellites which, for the first time, are allowing scientists to understand the total Earth system and effects of natural and human-induced changes on the global environment.

* By relaying data back from observatories such as the Hubble Space Telescope and Chandra X-Ray Telescope, providing scientists with insight about the evolution and possible future of the universe.

Mission Website

For more information about this advanced trio of satellites, go to:

http://tdrs.gsfc.nasa.gov/Tdrsproject/