The Integrator

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Features

GN Supports Suborbital Missions

The Ground Network (GN) Project (GSFC Code 453) provides a variety of support services to suborbital missions, including radar tracking, data acquisition, meteorological services, voice and data communications, and more. In Fiscal Year 2002, the GN supported approximately 830 mission events, such as the Navy's BQM Unmanned Aerial Vehicle, pictured above.

To learn more about GN suborbital mission support, turn to page 16.

Code 450 Mission Services Program

In This Issue ...

A Message from the Associate Director / Program Manager for Mission Services

"Business as usual…" You may have heard that term expressed, and envisioned an unchanging, static scenario. But does this term apply to us in the MSP? The answer is, "Yes, and no." Yes, we are continually providing reliable, crucial support on a daily basis to numerous missions with diverse requirements. That aspect of our business is unchanging. To enable this seamless support, however, we must all rise together to meet the various challenges we encounter from time to time. This is where our business becomes anything but mundane. One of those challenges is to ensure contract coverage for these critical Network and Mission services beyond the end of the Consolidated Space Operations Contract. Many members of our team are working according to extremely tight schedules to ensure that this happens. I applaud your efforts to meet this challenge and have full confidence in your ability to meet our commitments and deliver quality services to our customers.

We have good news to report regarding the TDRS-I spacecraft. On September 30, 2002, TDRS-I (which had been experiencing difficulties with its propulsion system) was placed in its proper geosysnchronous orbit. Subsequently, engineers and operators successfully accomplished handover of control of TDRS-I from Boeing's Mission Control Center to NASA's White Sands Complex on October 15. The spacecraft is currently undergoing a two-month, on-orbit test program designed to demonstrate spacecraft health and performance prior to government acceptance. The complexity of this task and the challenges involved were enormous. I congratulate the civil servant and contractor team who worked together to achieve this significant milestone. As if this effort were not enough, TDRS-J is currently at KSC being fueled for its late November launch on an Atlas II rocket. The TDRS team has been very busy!

In addition, the Aqua spacecraft, launched last May, continues to provide the scientific community with detailed images of events all over the globe, including typhoons, wildfires, and floods. Our Space and Ground Networks and Flight Dynamics services enable the Aqua mission, providing Aqua's communication links and orbits for scientists and operators on Earth. This mission is one of the most challenging the MSP had to prepare to support this year. Thanks to all the mission readiness team members who pulled it off, and successfully supported this complex mission! This is only one example of the many missions we supported recently.

In closing, I would like to encourage all staff and MSP constituents to take advantage of the many educational opportunities and in-house training courses offered at GSFC. Only with a work force that is knowledgeable about current technology and practices, can we continue to evolve our service offerings to provide our customers with the responsive service they require.

Phil Liebrecht

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CODE 450

Mission Services Program

NASA Declines To Renew CSOC

NASA announced in late August that the agency had decided to not exercise the option extending the Consolidated Space Operations Contract for an additional five years. This means that CSOC, which began on January 1, 1999 will end when the basic contract period expires on December 31, 2003.

The decision not to exercise the option was made because of a basic incompatibility between the CSOC structure and NASA's dynamic mission requirements. In addition, the centralized contract management approach utilized with CSOC resulted in a non-optimal customer response. Technical performance was not an issue in the decision.

The process for acquiring the follow-on to CSOC is being managed by NASA Headquarters, with direct, heavy involvement by the individual NASA Centers. Details about that process and its schedule will be released in early 2003. Goddard and the other Centers affected by this decision have begun intensive efforts to determine the requirements for any follow-on contracts. It is expected that several separate contract awards will result from the solicitation, and that those contracts will be awarded and managed by the Centers.

The Mission Services Program, the Code 400 mission operations organizations, and other Goddard organizations involved in space operations have a lot of work ahead. To ensure a smooth continuation of contract coverage and uninterrupted support of our customers, we must concurrently support the new contract solicitation process and manage the continuing CSOC activities. A very capable team, representing Goddard's diverse space operations interests, has been formed and is actively working on the new contract requirements.

As for the ongoing management of CSOC, Phil Liebrecht distributed a message soon after the decision was announced in which he emphasized a mutual MSP and CSOC commitment to continued mission success. He solicited the assistance of all space operations personnel in maintaining a constructive working relationship as we go through the contract transition, so we can manage the risk to mission support, and can continue to provide quality space operations services for our NASA and other customer missions.

By Dennis VanderTuig/GSFC Code 450

MSP Continues Outreach Initiatives

During the summer when schools are not in session, outreach activity tends to slow down. However, Bob Stanley and Hugh O'Donnell still managed (for the 15th straight year!) to carry the GSFC banner with a summer student from the National Space Club. This year, they hosted Tracy Scindian, who worked at the GSFC Radio Frequency Simulation Operation Center (RF SOC) and built a robot for her project. Tracy graduated from high school last spring and started college classes at the University of Maryland this fall.

In July, the Mission Services Program also provided two speakers to non-GSFC organizations. Roger Flaherty spoke to the Institute of Electrical and Electronics Engineers (IEEE) Communications Group of Northern Virginia, and Joe Stevens participated in the Presidential Classroom program, speaking to high school students about TDRS: NASA's Switchboard in the Sky.

By Rosemary Bruner/GSFC Code 450

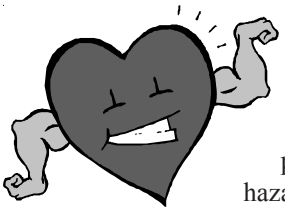
For additional information on these and other outreach opportunities, please contact the author via telephone (301-286-2648) or email (Rosemary.V.Bruner@gsfc.nasa.gov).

MSP Continues Monthly Safety Messages

Code 450 Safety Managers have been very creative when choosing the monthly safety topics that they present to their project teams. For example, a summertime emphasis on outdoor and weather safety was evident. We looked at beach, water, sun, heat, camping, and power equipment safety.

In autumn, safety presentations emphasized back-to-school safety, along with facts on traffic and driving safety, including information on helping teenage drivers to be safe, child safety in vehicles, and preventing fires at the gas pump. Holiday safety was spotlighted with safe cooking tips, a look at food-borne bacteria, and air pollution.

Finally, we encouraged each other to be healthy and safe by managing e-stress, knowing first aid, and looking at heart health and hearing safety. Acknowledging that terrorism is a threat, we looked at ways to deal with the unexpected. Then we looked into the status of GSFC's plans to protect its workforce, which include hazard training for all by the end of the calendar year.



By Rosemary Bruner/GSFC Code 450

For further information on safety-related issues, please contact the author via telephone (301-286-2648) or email (Rosemary.V.Bruner@gsfc.nasa.gov).

MOA for the Management of NASA's Space Communications Networks Signed

A Memorandum of Agreement (MOA) for the Management of NASA's Space Communications Networks was signed on September 12, 2002. This MOA formalized the Space Communications and Data Systems (SCDS) Program roles and responsibilities. The SCDS program was discussed in the November 2001 and March 2002 issues of *The Integrator*. The MOA is posted on the GSFC Centralized Configuration Management System (*http://gdms.gsfc.nasa.gov/gdms/pls/appmenu*) in the Document Library under Code 450, with a document number of 450-AGMT-0040.

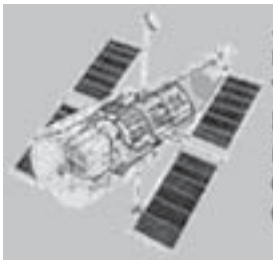
By Kevin McCarthy/GSFC Code 450

For further information on this topic, please contact the author via telephone (301-286-9516) or email (kevin.mccarthy@gsfc.nasa.gov).

Be sure to check out the ***Mission Services Milestone Chart*** *in the center of this issue.*

We have updated it to reflect current dates and activities.

Further updates to this chart will be provided in future issues of ***The Integrator.***



Customer Commitment Office

Did you know ... that each day the Hubble transmits enough data to fill 10,000 standard computer diskettes—the equivalent of five encyclopedias?

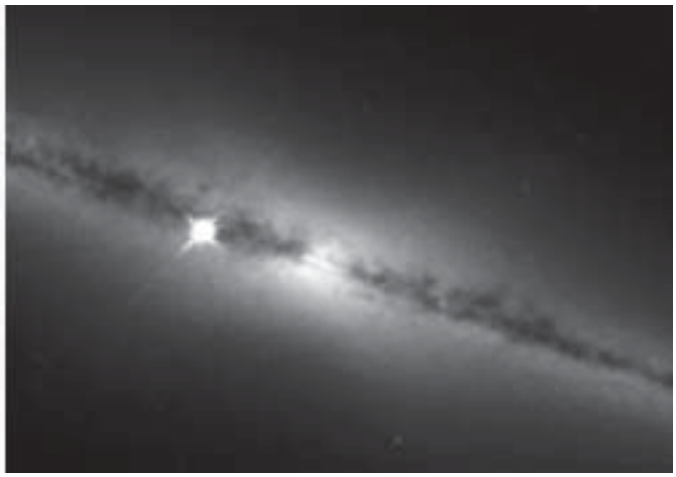
Hubble Space Telescope Team Plans Even More Upgrades

The instruments installed and refurbished on the Hubble Space Telescope (HST) during Servicing Mission 3B (SM3B) in March 2002 have already proven their immense value to scientists. (For details regarding SM3B, please see the article in the July 2002 *Integrator*.) In October, investigators announced that they had used the Hubble's new Advanced Camera for Surveys (ACS) to directly measure the size of Quaoar (pronounced kwa-whar), the largest object in the solar system ever seen since the discovery of Pluto 72 years ago. Quaoar lies in the Kuiper belt, an icy realm containing comet-like objects, approximately seven billion miles beyond Neptune's orbit. Previously, the size of an object in the Kuiper belt could only be inferred from assumed properties of reflectivity and temperature measurements. Hubble's ACS, installed on SM3B, is the only instrument with the resolution needed to make a direct size measurement of Kuiper belt objects.

SM3B astronauts also replaced the cooling system for HST's Near Infrared Camera and Multi-Object Spectrometer (NICMOS) with a new cryogenic system, allowing the NICMOS instrument to be turned on once again. During preliminary testing, the newly restored instrument was used to observe the galaxy NGC 4013 (see figure below). NICMOS's high resolution enabled scientists to view something they ordinarily are not able to observe in edge-on galaxies—a ring of stars encircling the galaxy's nucleus.

But these instruments are not the last of the improvements and advancements that will be implemented on the space-based telescope. The HST team is already preparing for Servicing Mission 4 (SM4), scheduled for March 2004. During SM4, astronauts will install two new instruments on HST—the Wide Field Camera 3 (WFC3) and the Cosmic Origins Spectrograph (COS).

Engineers at GSFC, Ball Aerospace, the Jet Propulsion Laboratory, and the Hubble Space Telescope Institute are currently developing WFC3. The instrument is designed to replace the Wide-Field Planetary Camera 2 (WFPC2), which was installed during the First Servicing Mission in December 1993. WFC3 will make use of the latest advances in optics, and will increase



After more than three years of inactivity, HST's NICMOS is providing scientists with amazing views of astronomical objects. This NICMOS photo shows the galaxy NGC 4013, an edge-on spiral galaxy, approximately 55 million light years from Earth.

Photo courtesy of NASA/ STScI/AURA

HST's discovery power for this type of observation by a factor of thirteen. The instrument is being developed in an innovative, cost effective manner, utilizing much of the hardware, software, and expertise from the previous Wide Field Camera instruments. The instrument is currently completing the component development phase, and is well into the integration and test phase.

The COS instrument will physically replace COSTAR (the Corrective Optics Space Telescope Axial Replacement), the "eyeglasses" for HST which corrected a spherical aberration in the primary mirror. COSTAR's functions are now provided by internal systems on the instruments subsequently installed on the HST, and thus COSTAR will be removed during SM4. COS will be the most sensitive ultraviolet instrument on HST, and will consist of two detectors—a far ultraviolet detector and a near ultraviolet detector. It will be used to observe high energy regions in the universe, including newly formed hot stars. Scientists will also use COS to determine the composition and character of the interstellar medium, or ISM—the gas and dust which is found between the stars. The ISM has an extremely low density, lower than that of the best vacuum created on Earth.

SM4 is the last servicing mission scheduled for HST, whose lifetime is expected to extend through 2010. Time will tell what exciting discoveries astronomers will make using these new, advanced instruments.

Information from David Campbell/GSFC Code 581

For more information about the Hubble Space Telescope and its servicing missions, visit the GSFC HST web site at http://hubble.gsfc.nasa.gov/.

COMING SOON!

Mission Services Customer Forum

November 21, 2002
Building 3 Auditorium
1:00 - 3:00 p.m.

Here is your chance to provide feedback to Mission Services Program representatives regarding our support to your mission.

All current customers and prospective customers are welcomed.

For more information, visit http://npas19.honeywell-tsi.com/mscf, or contact Al Levine (301-286-9436)

Space Network On-line Information Center

The SN On-line Information Center contains information modules beyond those for the Tracking and Data Relay Satellite System (TDRSS). You'll still find authoritative information about TDRSS at the site, but information and links to other Mission Services Program and Space Network activities are also included. So, as always, if you have questions about the Space Network, check out the Space Network On-line Information Center!

We are continually updating and improving the site. For example, we are currently updating the telecommunication systems information modules to ensure consistency with the recent release of the Space Network Users Guide Revision 8. The Users Guide is also available for download at *http://msp.gsfc.nasa.gov/tdrss/guide.html*. The latest information on the White Sands Complex (WSC) Transmission Control Protocol (TCP)/Internet Protocol (IP) Data Interface Service Capability—also known as WDISC—is also located on the site, along with information on Ka-Band capabilities and recent SN overview presentations. Updated TDRS constellation information is also available.

If you have a specific question, send an email message to us using our feedback form. We'll direct your question to the appropriate expert, and return an answer directly to you via email. As always, the calendar of upcoming events, launches, and other activities of interest is updated monthly. The entire site is reviewed and updated twice monthly to ensure information is current and accurate.

The SN On-line Information Center can be accessed at *http://msp.gsfc.nasa.gov/tdrss/.*

Detailed information is currently available on:

- The Tracking and Data Relay Satellites (including TDRS H, I, J)
- Demand Access
- The White Sands Complex, including WDISC
- Guam Remote Ground Terminal
- McMurdo TDRSS Relay Terminal System
- SN Telecommunication Services
- Customer Communication Systems and Products (including Transponders)
- Plus much more…

By Jeff Glass/FHA

Launch Approaching for ICESat!

The ICESat team is working toward a launch date of December 19, 2002. NASA's Ground Network sites (including commercial sites in Alaska and Norway) have been tested, and are ready to support ICESat launch and operations.

appreciable results: a 6% increase in overall transits with a 40% increase in beneficial transits and an 83% reduction in unwanted transits. The star catalog flight software update included extensive validation through modeling and simulation over a six week period to ensure a seamless transition of the catalogs, resulting in no impact to ongoing image acquisitions.

	Catalog		
	Old (last year)	New (this year)	Change
Total Transits Observed	444	471	6%
Beneficial (in catalog)	323	451	40%
Unbeneficial (Total)	120	20	(83%)
Not in catalog	88	3	
Unpredicted	29	17	
Mis-identified	3	0	

Landsat-7 Star Catalog Update Results

Landsat-7 Sustains Global Landmass Survey Mission

During calendar year 2002, Landsat-7 tackled significant challenges while successfully fulfilling its charter to survey the global landmass. The U.S. Geological Survey (USGS) mission, now in its 42nd month on-orbit, continues to collect 250 detailed earth images per day, creating a continuous record of land cover and land use for the Landsat Program's archive, which now spans 30 years. The following details some of the challenges encountered in the past year.

Star Catalog Update

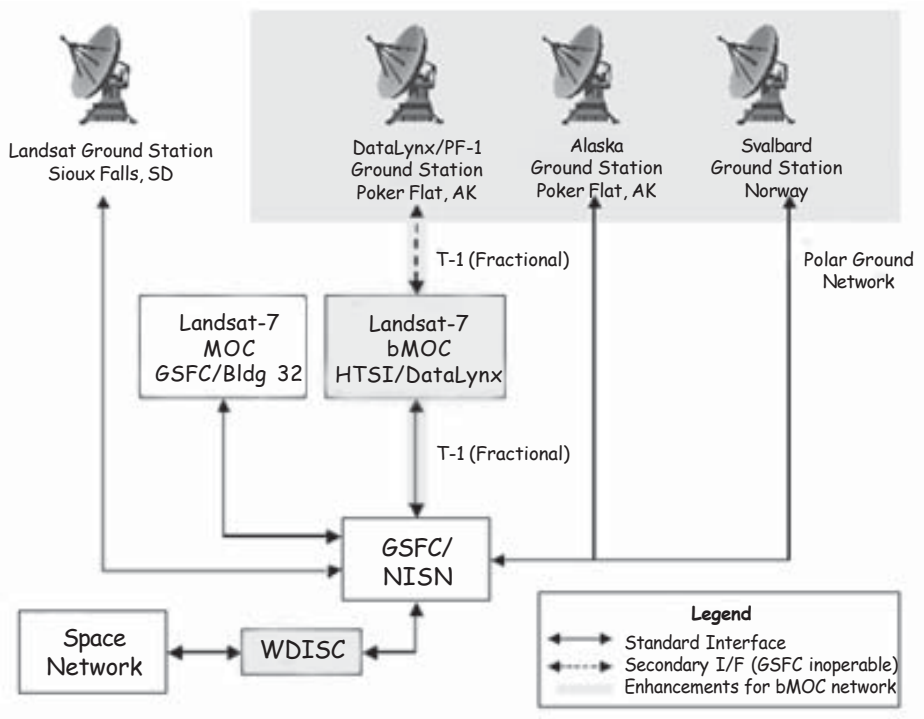
In April 2002, Landsat-7 Flight Operations successfully updated the on-board star catalog to improve the spacecraft's attitude control subsystem performance, concluding three years of detailed analysis and planning. After observing a gap in predicted star transits detected by the Celestial Star Assembly, and analyzing over 61,000 star transits using an in-house developed tool—the "Star Logger"—the Flight Operations Team (FOT) recommended to USGS management that a star catalog update was in order. The USGS/Flight Systems Manager obtained the help of NASA/GSFC Code 570, Guidance, Navigation, and Control (provider of the star catalog) to support the FOT in refining the star catalog. By swapping out 138 stars in the original catalog with more appropriate stars, the star catalog was fine-tuned to produce initial

Backup Mission Operations Center (bMOC)

On June 24, 2002, Landsat-7 Flight Operations achieved a backup Mission Operations Center (bMOC) capability just 45 days after formal direction from the USGS. The Landsat-7 bMOC, located at the HTSI/DataLynx Control Center in Columbia, MD, is the USGS Landsat Program's fallback control center for Landsat-7, should operations at Goddard Space Flight Center become impaired. USGS made this move to ensure the earth-imaging spacecraft would continue to fly if threatened by natural, accidental, or other disaster. In the event that normal flight operations at the Goddard Space Flight Center are disrupted, Landsat-7 flight operations could relocate to the bMOC in a matter of hours. The DataLynx control center provides the Landsat-7 mission several layers of redundancy. The bMOC offers not only an affordable secondary location (just 22 miles from GSFC) but a control center that is on a separate power and telecommunications grid than Goddard, thereby protecting against multiple failure scenarios. Additionally, the bMOC provides an alternate data path apart from Goddard's telecommunications infrastructure to ensure access to the DataLynx's PF-1 ground station in Alaska.

The bMOC can be used to host Landsat-7 flight operations for short-term outages, or when the primary MOC at GSFC/Bldg 32 is experiencing extended downtime. The Landsat-7 bMOC replicates all of the operational functionality of the primary MOC, with the

exception of flight software maintenance. Electronic security presented the greatest challenge in implementing the bMOC, requiring an almost complete reversal of client/server and FTP "put/get" relationships with Landsat-7's numerous interfaces. As a result of the bMOC implementation, Landsat-7 is migrating from its mission-unique Landsat-7 Internet Protocol Processing System (LIPPS) to the WSC Data Interface Service Capability (WDISC) to interface with the Space Network. The WDISC will also allow Landsat-7 to conduct automated "lights out" operations with the Space Network—an enhancement unavailable using the LIPPS interface. Full bMOC network functionality and operational readiness is scheduled for mid-November, and will include "lights-out" automated operations in the bMOC to reduce operations costs in an extended backup MOC operations scenario.



Landsat-7 Backup MOC Concept

Dual Burn Delta Inclination Maneuver and Cool Down Imaging

On October 8, Landsat-7 Flight Operations performed a complex two-burn delta-inclination (delta-i) maneuver to maintain the Landsat-7 mission specification for a 10:00 AM (+/- 15 min) ascending node crossing. The delta-i is a yearly event, needed to correct for orbital disturbances, and keep the spacecraft in a sun-synchronous orbit on the Worldwide-Reference System (WRS) 16-day repeating ground track. Coincident with the delta-i, calibration, imaging by the Landsat-7 Enhanced Thermatic Mapper Plus (ETM+) instrument took place.

Two consecutive burns were executed, each approximately 700 seconds in duration. Both burns were preceded by a 90.5 degree yaw slew (in order to orient the thrust jets nearly perpendicular to the orbit velocity vector) followed by a return slew. Two orbits separated the burns to confirm spacecraft health and safety prior to executing the second slew-burn-yaw combination.

As a consequence of the delta-i operations, the ETM+ cold focal plane heats above normal operating temperatures. During the cool down operations, calibration imaging took place during a 40-hour period prior to resuming normal imaging operations. The cool down imaging helps the Landsat Science Project Office better understand the performance of the ETM+ calibration lamps.

The orbit modifications resulting from the dual delta-i are nearly identical to the pre-burn predictions. Landsat-7 is positioned for another year of highly successful mission operations.

By Tegan Collier/Honeywell Technology Solutions Inc.

For additional information about Landsat-7, please visit http://landsat7.usgs.gov/index.php.

"Congratulations on a Successful Delta-i"

Expendable Launch Vehicle News

The first "heavy lifter" made a successful launch on August 21, 2002, when the Atlas V vehicle completed its maiden flight. The Atlas V was the first of the Evolved Expendable Launch Vehicles (EELV) to take flight. Launch occurred at 6:05 PM from the new Launch Complex 41 at Cape Canaveral, FL. The payload was the HOT BIRD 6 broadcast satellite owned by Eutelsat of Paris. Delta IV, which represents the other half of the EELV program, continues preparation for its inaugural flight. Problems with the ground launch control software are responsible for several delays of this first flight, originally planned for April of this year.

Additional significant launch activities are detailed below.

Titan 2 – June 24, 2002

Using a missile that for 18 years stood nuclear-tipped and ready for launch in Little Rock, Arkansas, Lockheed Martin launched the NOAA-M satellite into a polar-orbit. Launch occurred on June 24, 2002 at 11:23 AM PDT from Vandenberg Air Force Base, California. NOAA-M, which was renamed NOAA-17 after reaching orbit, is the third in a series of five Polar Operational Environmental Satellites. Normally the NOAA spacecraft are launched around 7:30 AM, but to take advantage of better lighting conditions, the satellite was launched at 10:00 AM. NOAA expects the later launch time to provide better imagery than previous NOAA birds.

The Titan 2 rocket used for this launch was a leftover missile from the cold war. After being retired by the Air Force, the vehicle was converted for conventional use. This was the 11th Titan 2 to be refurbished and launched since 1988.

H-2A - September 10, 2002

NASDA continued its H-2A program with its first operational mission carrying a pair of satellites to orbit. Launch occurred at 4:20 AM EDT, which was late in the afternoon at the Tanegashima Island launch site. This was the third successful launch in a row for the H-2A vehicle.

NASDA plans to launch ten or more H-2A flights between now and 2006, including the SN supported SELENE (SELenological and Engineering Explorer) mission to the moon in 2005.

Atlas 2AS – September 18, 2002

A Lockheed Martin Atlas 2AS rocket carried the Hispasat 1D satellite into orbit on September 18, 2002. Launch occurred at 6:04 PM EDT from Cape Canaveral, FL. Hispasat was placed in a geostationary orbit above the equator at 30 degrees West longitude and is expected to provide TV and data transmission services to Europe, North Africa, and the Middle East for the next 15 years.

Inaugural launch of Atlas 5 from
Launch Complex 41 at Cape Canaveral

H-2A Technical Interchange Meeting # 5

Members of the GSFC ELV support team are traveling to Tokyo in November to meet with the NASDA H-2A team for Technical Interchange Meeting #5. Jim Bangerter/GSFC Code 451 will lead the Goddard team, which will include Stanley Drezek/Honeywell-Customer Support Representative for CSOC, Tom Russell/Honeywell-Network Operations Manager, and David Wampler/ITT-Communications Link Analysis and Simulation Systems Representative. The meeting will be supplemented by a one-day trip to the Yoshinobu Launch Complex at the Tanegahima Space Center, which is 1000 km southwest of Tokyo.

Boeing Delta IV News

As we go to press with this issue of *The Integrator*, Delta IV is preparing to fire its new liquid hydrogen-fueled main engine for a few seconds. Poised on the rebuild pad 37B at Cape Canaveral, the Flight Readiness Firing (FRF) will serve to check out ground systems and new software in place for the inaugural Delta 4 launch planned for November 14/16, 2002. The RS068 main engine,

developed by Rocketdyne, is the first large all-American liquid-fueled rocket engine built since the shuttle main engine.

Delta IV like Atlas 5 was built as part of the Air Force's EELV program. The Boeing IV and the Lockheed Martin Atlas 5 will share heavy lift missions for DOD payloads and will supplement those with commercial missions.

By Joe St. John/Lockheed Martin

For further information on ELV support, please contact Jim Bangerter/GSFC via telephone (301-286-7306) or email (James.Bangerter@gsfc.nasa.gov)

Upcoming Significant ELV missions (dates subject to change)	
Nov 14/16	Delta IV/Eutelsat W5 from Cape Canaveral, FL
Nov 21	Atlas II/TDRS-J from Cape Canaveral, FL
Dec 12	SeaLaunch/SL-10 from mid-Pacific location
Dec 13	Pegasus/Source from the Eastern Range, offshore coastal FL
Dec 20	Delta II/ICESAT from Vandenberg AFB, CA
Jan 9	Delta II/SIRTF from Cape Canaveral, FL
Jan 13	Atlas IIIB/AsiaSat 4 from Cape Canaveral, FL

TRMM Team Resolves Power Problem

The Tropical Rainfall Measuring Mission (TRMM) mission had been operating in nominal fashion throughout the summer of 2002. All this changed, however, on September 4, when the -Y Solar Array wing stuck for two minutes and nineteen seconds at the -50 degree stop. This event occurred during a routine Attitude Control System (ACS) command sequence that drives both arrays to a feathered position for the duration of any orbit eclipse (night). The -Y array stuck in similar fashion on the subsequent eclipse for 13 seconds, but operated without further mishap while the concern was assessed. At no time did the +Y Array fault, which was expected since the +Y array is shadowed by the spacecraft while the -Y is not. High temperature on the –Y solar array drive motor has been a concern since launch.

A decision was reached, and at 247/202052z on September 4, both arrays were commanded to feathered position to prevent further sticking at a position that could compromise the mission. In addition, the Earth Sensor Assembly (not in use) and the Lightning Imaging Sensor (LIS) and Visible and Infrared Scanner (VIRS) instruments were commanded off beforehand as a means of reducing the load on the batteries, thereby protecting the Power system from further stress. In an attempt to recharge the batteries, the VT (voltage/temperature) mode had been set at VT5 and 24 Amps per battery. While helpful, the batteries were not charging back up to 100% State of Charge (SOC), while the End of Night (EON) charges were dropping into the low 70% range. Nevertheless the mission was able to operate safely in the interim with the two prime instruments (Precipitation Radar and the TRMM Microwave Imager) on throughout, and the LIS instrument collecting science data periodically. VIRS, unfortunately, remained off.

The TRMM team continued to monitor power subsystem performance and all but ceased scheduling Space Network events in orbit eclipse while they awaited table changes/patches which would enable the spacecraft to operate with the +Y Array tracking the Sun and the –Y array in feathered position. On Friday October 11, the TRMM team received and uplinked those table changes which returned the +Y Array to +/- 50 degree tracking. Solar array drive motor winding relays were opened on the -Y Array (to inhibit tracking) and the power system was configured back to 12 Amps per battery.

After an initial and expected dip, the battery SOC numbers began to increase even through a Delta-V maneuver on October 12. The SOC is reaching 100% on battery 2 and about 95% on battery 1 with EON percentages well into the 80% range. The charge/discharge ratio also improved to the point where the VIRS instrument was powered on during a Space Network event on October 15. After its usual 36-hour outgas period, VIRS commenced science data collection on October 17.

By Lou Kurzmiller/TRMM FOT

For additional information regarding TRMM, please visit the TRMM web site (http://trmm.gsfc.nasa.gov/index.html) or contact the author (lkurzmil@pop500.gsfc.nasa.gov) or Vickie Moran/TRMM Mission Director (vickie.e.moran.1@gsfc.nasa.gov).

NOTICE: Due to an editorial error, the July 2002 issue of *The Integrator* incorrectly stated that Reuven Ramaty was instrumental to the Aqua program. Mr. Ramaty actually worked on the High Energy Spectroscopic Imager (HESSI).

CODE 452

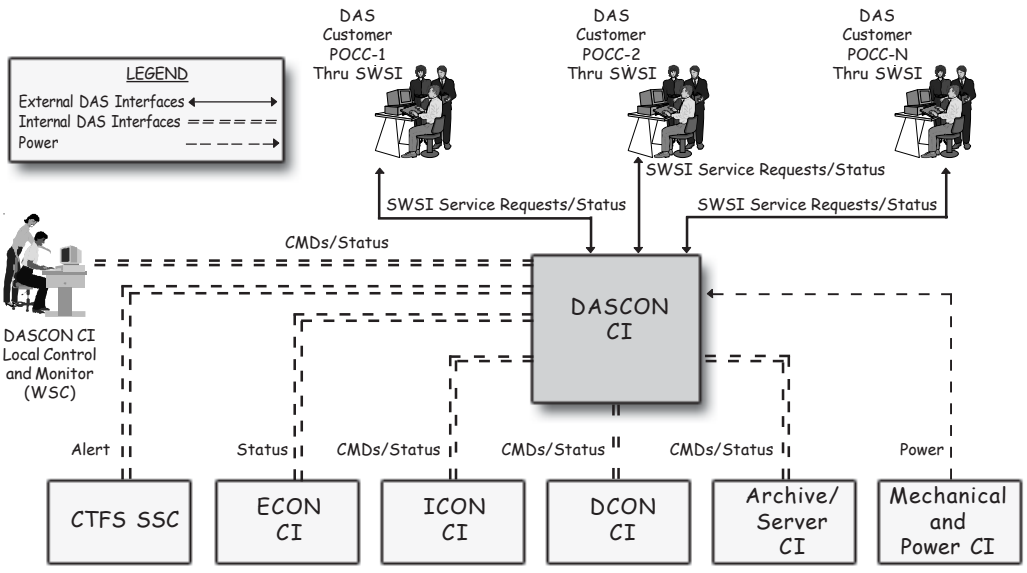
Space Network Project

Demand Access System Development Update

The June 2002 issue of *The Integrator* provided an update and overview of the Demand Access System (DAS) integration and testing program. In this issue we supply an update on the status of integration and testing and the plans for the start of DAS operations in Spring 2003.

DAS consists of a variety of Commercial Off-the-Shelf (COTS) hardware and software, along with a customized program to tie all the various pieces together. DAS will expand SN Multiple Access (MA) return service capabilities by adding new receiver systems, new data configuration capabilities and monitoring tools, TCP/IP telemetry capabilities, as well as Consultative Committee for Space Data Systems (CCSDS) data distribution capabilities via the NISN IONet. The Consolidated Space Operations Contract (CSOC) is providing systems engineering support at both GSFC and the White Sands Complex (WSC) for this effort.

DAS is still in the integration and test phase. The formal Test Readiness Review (TRR) will tentatively be conducted on November 20, 2002, at GSFC. Formal qualification testing begins in early December, and will continue for two and a half weeks. Regression testing/cleanup will follow shortly after, and then Factory Acceptance Testing (FAT) begins. FAT is scheduled to finish in early January. DAS will then be deployed to the WSC and to the Guam Remote Ground Terminal (GRGT) for installation and Site Acceptance Testing (SAT). DAS is scheduled to transition to CSOC operations in late April 2003.



DAS Controller Interfaces

The DAS interface to the Space Network Web Services Interface (SWSI), which will be used as the customer interface to DAS, continues to be tested in preparation for formal interface testing in December.

The DAS Web site at *http://msp.gsfc.nasa.gov/das/* provides the history and goals for the project, as well as DAS documentation such as the Test Readiness Review updates, the Operations and Maintenance Manual, DAS ground rules that describe how customers can execute services, and the latest DAS schedule. The web site also has useful links to other relevant sites, such as the SWSI web site.

Potential DAS customers include Aqua, Swift, AGILE, Aura, LDBP, C/NOFS, and GPM. The respective Mission Managers for these projects are working with the DAS project, preparing to become DAS customers. DAS is looking forward to supporting pre-mission testing with the Swift project in early March at the WSC. DAS team members have also assisted in reviewing GPM's draft DAS Users Guide for GPM International Partners. Additionally, a paper on the DAS system was submitted to the SpaceOps 2002 symposium held in early October 2002.

By Denise Gilliland/ITT

To learn more about DAS, please visit our web page at http://msp.gsfc.nasa.gov/das or contact the Tom Gitlin/GSFC Code 453 via telephone (301-286-9257) or email (tom.gitlin@gsfc.nasa.gov).

DAS Customer Matrix	
Project	**Launch Date**
AQUA	5/4/02
LDBP	12/02-01/03
ULDBP	12/02-01/03
Swift	9/30/03
C/NOFS	10/1/03
AURA	1/1/04
AGILE	NET 4/1/04
GLAST	3/1/06
GPM-1	11/07
GPM-2	8/08
ESA-GPM	NET 2008

New UPS Release 14 Is Adopted by Five Missions

The latest version of the User Planning System (UPS), Release 14, has been installed at the multi-mission UPS site at GSFC. Release 14 provides several new features, such as an integrated tabular/graphical display, electronic message identification in all displays, and enhanced Replace Request capabilities. Release 14 is available to any UPS customers who desire to take advantage of the new features.

GSFC's multi-mission UPS site has been supporting the RXTE, TRMM, UARS, and ERBS missions for several years. Recently, this UPS site has added the FUSE mission to its supported set of missions. Welcome, FUSE! The FUSE mission has switched from a human-intensive scheduling process of emailing SN schedule requests to the Data Services Management Center (DSMC), to automated schedule request generation using the UPS Recurrent Scheduling (RS) feature. The use of UPS RS has not only significantly reduced the time required to create and submit schedule requests, but has allowed FUSE to take full advantage of schedule request flexibility, further increasing efficiency.

In addition, the Mission Control Center (MCC) at Johnson Space Center (JSC), which supports both the Space Shuttle (STS) and the International Space Station (ISS), is planning to take advantage of new UPS features in the December/January timeframe.

Some of the UPS features that JSC MCC schedulers will use include:

- RS to automatically generate a weekly set of STS/ISS flexible schedule requests
- Submission of Replace Requests to facilitate faster real-time rescheduling
- The graphical representation of the intersection of STS/ISS orbital views with TDRS Unscheduled Time (TUT), to allow the MCC schedulers a continuous real-time "snapshot" of available TDRS time slots (critical when real-time STS/ISS rescheduling is necessary)
- Using the Potential Conflicts capability to produce an STS/ISS conflict-free set of schedule requests to submit to the Data Services Management Center (DSMC).

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JSC MCC schedulers predict that the use of these advanced UPS features will significantly reduce the time required to generate Space Network requests, produce conflict-free STS/ISS requests, and reschedule events in real-time.

By Howard Michelsen / CSC

Further information regarding the UPS Project can be found on the WWW at http://rtsel.gsfc.nasa.gov/isolde/ups/ or contact the author via email (hmichels@csc.com).

SWSI Team Receives SETS Technical Excellence Award

The Space Network (SN) Web Services Interface (SWSI) development team recently received a Computer Sciences Corporation (CSC) Space and Earth Technology Systems (SETS) award for Technical Excellence. SWSI is being developed by a joint NASA/CSC team, and will provide a low-cost, standards-based customer interface for performing SN scheduling and real-time service control and monitoring.

The SWSI Team

(left to right):
Front Row: Geri Klitsch (CSC), Alan Zinkgraf (CSC), Joe Stevens (NASA), Tom Sardella (NASA)

Back Row: Cathy Chang (CSC), Scott Robinson (CSC), Harshna Sampat (CSC), Sergey Nikhinson (CSC)

SWSI uses an innovative architecture that allows SN customers to access it from the NISN Open or Closed IONet, or from the Internet. Client software designed to run on a customer workstation is Java-based, allowing use of low-cost Windows or Unix computers. Digital Certificates and Secure Socket Layer (SSL) protocol are used to authenticate customers and encrypt data traversing the network, ensuring that customers can operate in a secure environment regardless of network connectivity. An interface to the Demand Access System (DAS), also under development, provides a unified customer interface for all SN services. eXtensible Markup Language (XML) is used to communicate with DAS, providing a standardized technology for communication, and simplifying the development of the interface between the two systems.

Congratulations to the SWSI team for a job well done!

By Tom Sardella/GSFC Code 583.

For further information, please contact Tom Sardella via email (Tom.Sardella@gsfc.nasa.gov) or telephone (301-286-7686), or visit http://swsi.gsfc.nasa.gov.

CODE 453

Ground Network Project

MILA/PDL Tracking Stations Provide New Perspective Via TV

Occupying 61 acres of land on Kennedy Space Center (KSC), the MILA Tracking Station is managed by NASA Goddard Space Flight Center, and operated and maintained by the Consolidated Space Operations Contractor. The name, "MILA," is an acronym derived from the words, Merritt Island Launch Annex to Cape Canaveral, the previous name of the area that eventually became named Kennedy Space Center.

MILA's antennas and equipment provide communications between a space vehicle and its control centers. In addition to ranging data, information transmitted between the space vehicle and MILA includes voice (if there are astronauts on board), commands from the control center, and telemetry and television from the space vehicle. The NASA Integrated Services Network (NISN) provides connectivity to control centers located outside of KSC.

Established in 1966 to support the Apollo moon landing program, MILA provides the communication path for Space Shuttle Orbiters while they are tested, launched, and landed at Kennedy Space Center, and provides backup support while they are in orbit. Sometimes, MILA also provides the communication path for Expendable Launch Vehicles tested and launched from Cape Canaveral Air Force Station, for scientific satellites orbiting the earth, for TDRS, and for payloads being prepared for launch.

Occupying 1.4 acres of land on U.S. Coast Guard property on the south bank of Ponce De Leon Inlet at New Smyrna Beach, the Ponce De Leon (PDL) Tracking Station was established in 1979 to provide communications with the Shuttle orbiter during launch assent when the Solid Rocket Booster (SRB) plume blocks radio signals to MILA (from launch plus one minute to launch plus two and a half minutes). PDL is located 35 miles north of MILA, does not look through the SRB plume, and receives a usable signal from the Shuttle a few seconds after launch.

In the last few months, personnel at MILA and PDL checked out new equipment installed at the stations and on the Shuttle (STS 112) for the External Tank Television (ET-TV) system. A TV camera, a transmitter, and antennas were installed on the Shuttle's External Tank to provide a view of Earth during the first 15 minutes of launch ascent. With the Orbiter and SRBs in the camera field of view, a spectacular perspective of launch is available, as Earth shrinks and the Boosters and Orbiter detach.

The ET-TV system was tested the day the Shuttle arrived at the launch pad. The signal from the external tank was transmitted to MILA, where the TV was extracted and sent to the KSC Public Affairs Office for broadcast via satellite to the other NASA Centers. Picture quality was very good, but not as good at KSC PAO as it was at MILA. Therefore, a video distribution amplifier was flown in and installed at MILA to compensate for frequency roll-off on the wide band fiber optic line between MILA and KSC PAO.

A video system was also installed at PDL. A rented TV truck transmits the TV picture received at PDL to KSC PAO via satellite. TV from PDL is necessary while the TV signal to MILA is corrupted by the SRB plume.

MILA/PDL will receive the TV picture for the first seven and a half minutes after launch, and will lose the signal as the Shuttle goes below the horizon.

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A video system has also been installed at Wallops, and a rented television truck will transmit the TV picture to KSC PAO via satellite, enabling the ET-TV picture to be seen after the Orbiter detaches, until the camera is turned off at Launch plus fifteen minutes.

By Tony Ippolito/GSFC Code 452

For further information, please contact the author via email (Tony.Ippolito-1@ksc.nasa.gov).

GN Supports Suborbital Missions

The Wallops Flight Facility Test Range has maintained a busy schedule over the course of fiscal year 2002. During that year, Wallops Test Range conducted approximately 920 mission events. The Ground Network (GN) provided support to approximately 830 of those mission events. This support included precision and surveillance radar tracking, telemetry data acquisition, photographic and video data acquisition, meteorological services, voice and data communications, and flight control and termination command services. These services were provided at the Wallops Flight Facility and remote locations worldwide including Kodiak, Alaska; Poker Flat Research Range, Alaska; Andenes, Norway; Key West, Florida; Antigua; and Andros Island.

The mission events for fiscal year 2002 included a number of orbital radar tracking requirements. The orbital targets included the Space Shuttle, International Space Station, Soyuz escape capsule, RADCAL satellite, Hubble Space Telescope, and the TIMED satellite. This orbital activity totaled approximately 450 mission events.

Mission events at suborbital altitudes and velocities included an Athena launch, sounding rocket launches and campaigns, aircraft missions, Unmanned Aerial Vehicle (UAV) missions, weather and environment related data measurement missions, DoD target and ballistic research missions, and support of the RHESSI satellite launch operation. The Kodiak Star mission was launched just hours before FY 2002 on September 30, 2001. A GN tracking site was set up at the Kodiak launch head and also downrange in Cordova, Alaska in support of this launch to orbit mission.

KodiakStar - Code Y Launch

The Ground Network supported 20 of 30 total fiscal year 2002 sounding rocket launches. Seven missions launched from Wallops Island, while the winter campaign in Alaska launched eleven. The final two Dr. Goldberg/GSFC sounding rockets were launched in Norway.

UAVs are in Wallops long range planning as a platform suitable for performing coastal zone research. The UAV mission count rose to over 25 events in fiscal year 2002; all of these events were supported by the Ground Network.

Ground Network suborbital services personnel are looking forward to a very busy year in fiscal year 2003. Many new programs are beginning to emerge on the reimbursable roster. Another 21 sounding rocket launches are anticipated for GN support in FY 03, as well.

By Steve Currier/WFF

For more information, please contact the author via phone (757-824-1646)

GN-supported Missions
(left) VANDAL, Navy Target Program / (right) NASA TERN Unmanned Aerial Vehicle

GN Prepares for Winter Sounding Rocket Campaigns

The Ground Network (GN) Project is gearing up for a busy winter supporting NASA's Sounding Rocket (SR) Program campaign launches from Svalbard, Norway; Poker Flat, Alaska; and Kiruna, Sweden. This means we have mobile range support systems and technical personnel traveling to extreme, remote sites—one approximately 600 miles above and two other sites within 100 miles of the Arctic Circle—to gather science data. GN resources are also scheduled to support various non-campaign reimbursable sounding rocket launches from the Wallops Flight Facility (WFF) Test Range this winter.

The GN is also currently involved in premission planning for launching fourteen one- and two-stage rockets from Punta Lobos, Peru during the winter of 2004. A site survey crew just returned from Peru with a plan to place the following GN mobile range support systems: one electrical generator trailer (with 2 generators), one mobile command center (MCS-1A), one C-band radar, a 3.3-meter and a 7-meter S-band telemetry (TM) antenna; and the Wallops Flight Facility (WFF) SuperVan.

All GN personnel sent to these remote sites to operate the various systems are seasoned and experienced Consolidated Space Operations Contract (CSOC) technicians.

December 2002: Launch from Ny-Ålesund, Svalbard, (Norway)

The GN is sending CSOC personnel and an S-band telemetry antenna system, commonly known as Antenna #9 or "the 20-footer" to Ny-Ålesund, Svalbard to support a December 2002 launch of a Black Brant X three-stage sounding rocket for a plasma physics project. Figure 1 shows the beauty and remoteness of Ny-Ålesund, Svalbard. Figure 2 shows Antenna #9 in a file photo at WFF prior to departure (the GN 9-meter TM system can be seen in the background).

Figure 1. Ny-Ålesund, Svalbard

Figure 2. Antenna #9 at WFF

Also supporting the launch is a crew sited at the Norwegian Space Centre's Andoya Rocket Range (*http://www.rocketrange.no/*); the range is shown in Figure 3. The new GN 7-meter S-band telemetry antenna system at Andoya is shown in Figure 4.

Figure 3. Andoya Rocket Range

Figure 4. 7-meter S-band TM System at Andoya Rocket Range

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January 2003: Launch from Kiruna, Sweden

The GN is sending CSOC personnel to provide meteorological support for this mission. The team will gather data regarding prelaunch upper air meteorological conditions using sondes for winds aloft to 60,000 feet. This January 2003 deployment is to support the launch of a pair of Terrier-Orion two stage sounding rockets for NASA's Mountain and Convective Waves Ascending Vertically (MaCWAVE) geospace sciences project.

January/February 2003: Launches from Poker Flats Research Range in Fairbanks, Alaska

The GN is sending CSOC personnel to operate existing GN equipment located at the Poker Flats Research Range (*http://www.pfrr.alaska.edu/*) in Alaska in support of the Winter 2003 NASA Sounding Rocket Campaign. NASA is scheduled to launch one Black Brant (BB) VB, one BB X, two BB IX, and three Terrier-Orion rockets over a two month period to gather geospace information. Range telemetry support will be provided by two S-band auto-track systems, incorporating an 8-foot dish and a 16-foot dish located on Middle Range. An 8-meter Transportable Orbital Tracking Systems (TOTS), one antenna system of the Alaska Ground Station (AGS), will also be used on Middle Range for telemetry support of the Campaign (see Figure 5).

Figure 5. TOTS #1 at AGS - Fairbanks, Alaska

Other range instrumentation to be used are: the C-band radar system (Radar # 10) for vehicle tracking, surveillance radar for local air traffic monitoring, and a meteorological balloon inflation building for upper air sondes. Last but certainly not least, the Mobile Range Control Center/Range Safety Command/Destruct and Real-Time Instantaneous Impact Prediction System (MRCCS) will be sent to Alaska from WFF to support the campaign. The MRCCS is needed because the NASA Sounding Rocket Program requires remote wind-weighing, payload recovery, sounding rocket and/or payload real-time command control, and real-time metrics display data.

NASA's Ground Network suborbital services personnel anticipate another very busy winter campaign supporting the NASA Sounding Rocket Program and other sounding rocket launches, as required. If the past is any indication of the future, GN resources will again successfully meet project objectives and goals, in keeping with NASA's long-term best interests.

By Michael Conger/CSOC/Wallops Flight Facility

GN Evolution Plan Update

The Ground Network (GN) Project is developing the GN Evolution Plan, which was described in the July 2002 issue of *The Integrator*. Currently, the Project is rolling out the Plan for discussion and review.

The objective of the GN Evolution Plan is to determine a development path that will enable the GN to meet future mission customer needs and Project objectives and goals, consistent with NASA's long-term best interest.

The Evolution Plan examines the ground network environment, future customer needs, and the GN's organizational and asset capabilities, and identifies key evolution challenges. The Plan identifies a vision and plan for the GN that responds to future trends and challenges and that meets future customer needs. The Evolution Plan includes a time-phased roadmap of GN elements that will provide future services.

Look for further updates in future issues of *The Integrator*.

Wallops Team Develops Mission-Unique System for ADEOS-II

A joint NASA and Consolidated Space Operations Contract (CSOC) team at Wallops is participating in final mission readiness testing for the ADEOS-II spacecraft, scheduled to launch in December. The NASA team worked for more than three years to develop, integrate, and validate a mission-unique data processing system for the Ground Network (GN). According to Karen Clark, CSOC Test Engineer, team accomplishments are "remarkable" and "due to cooperation between the diverse NASA team, multiple data product customers and multiple vendors."

Several members of the ADEOS-II team in front of the new data processing system.

From left to right: Mark Harris, Alan Schonbrunner, Jim Evans, Karen Clark, Warren McNeil

In addition to developing the new processing system, the Wallops team helped draft mission requirements, wrote and executed engineering acceptance tests, participated in operational readiness testing and data product analysis, validated data latency requirements, and represented the GN at weekly and monthly project status meetings. The team also attended reviews held in Japan and Alaska.

Ron Forsythe and Dave Davis, both members of Wallops Code 584, led the ground systems development effort with support from Computer Sciences Corporation, ViaSat, TSI Telsys, and CSOC. The new system is capable of performing level zero processing of ADEOS-II telemetry. It comprises TSI Data Strippers and a Data Stripper Controller to interface with the existing 11-meter station automation architecture. The system subsets data of interest for customers, according to Application ID (AP-ID). Data sets are then sent to the Standard Autonomous File Server (SAFS) for near-real-time distribution. (Wallops previously developed the SAFS for the QuikSCAT project.)

ADEOS-II is a cooperative project initiated by Japan's National Space Development Agency (NASDA) and shared with the French Centre National d'Etudes Spatiales (CNES), the U.S. National Oceanic and Atmospheric Administration (NOAA), and NASA's Earth Science Enterprise. The Japanese spacecraft will be placed into an 803-km circular orbit with an inclination of 98.62 degrees. The orbit will be sun-synchronous, with descending node at 10:30 a.m. (+/- 15 min) Local Solar Time. It will monitor frequent climate changes occurring in the world, expansion of the ozone holes, and global environmental changes, and will investigate the causes of these phenomena. It is scheduled to collect data for three years with the possibility of a two-year extension.

Supporting stations in the U.S. are the Alaska Synthetic Aperture Radar Facility (ASF) in Fairbanks, Alaska (University of Alaska), and the 11-meter Wallops Ground Station at the Wallops Flight Facility. The newly developed data processing capability has been integrated at both stations. The GN will be responsible for receiving and level zero processing X-Band data, and for electronic distribution of specifically scheduled subsets of ADEOS-II telemetry.

Activities are underway to transition system operations, maintenance, and sustaining engineering responsibilities for the system to CSOC.

By Pati Peskett/CSOC

For more information on this topic, please refer to the WFF/ADEOS-II web site (http://www.wff.nasa.gov/~adeos/).

TDRS Project

Handover of TDRS-I from the Boeing Mission Control Center to the White Sands Complex occurred on October 15, 2002.

TDRS-I Recovery Effort A Success!

TDRS-I was launched on March 8, 2002, from Cape Canaveral on an Atlas IIA launch vehicle. The launch and transfer orbit injection went off without a hitch, and the Centaur did an excellent job of placing the spacecraft in the desired geosynchronous transfer orbit. After separation from the Centaur, controllers in the Mission Control Center (MCC) at Boeing in El Segundo, CA took control of the spacecraft, and began the task of raising the satellite to its final geosynchronous orbit using the integral 110 lb. Liquid Apogee Motor (LAM). The first three burns of the planned ten-day transfer orbit were successfully completed on March 10, 11, and 12.

After the third burn, engineers reviewing the fuel tank pressures noticed an unexpected signature on Fuel Tank #2. Dynamics data substantiated the belief that a serious problem existed. A test was devised to evaluate the situation, and it confirmed that Fuel Tank #2 was not being properly pressurized. The problem was isolated to a faulty squib valve controlling Fuel Tank #2 pressurization. Since the bulk of the fuel contained in the two fuel tanks was required to raise the orbit (typically, about 16 percent of the fuel would have remained after final orbit was reached), the success of the mission hinged on being able to use the fuel in the second tank. The oxidizer for the bipropellant propulsion system is contained in two additional tanks, which were operating correctly.

Boeing quickly assembled a team of senior attitude control system and propulsion system engineers, and challenged them to come up with a solution that could salvage the mission. This crash effort was Boeing's highest priority, and for several weeks the conference rooms in the MCC and the propulsion department were packed with Boeing's most experienced engineers.

As with any design exercise, several potential solutions were devised and analyzed in detail, with the approach promising the highest probability of success selected for implementation. The chosen course consisted of a never-before-attempted scheme of performing LAM burns from Fuel Tank #1 until it was emptied, and then transferring Helium gas (pressurant) through the emptied tank and into the fuel outlet of the Propellant Management Device (PMD) in Fuel Tank #2. From there, the gas had to be coaxed into the bulk space of the tank in order to provide gas-free fuel at the outlet during LAM burns and Attitude Control System (ACS) firings.

Sounds simple. Far from it! From a fluid dynamics standpoint, the PMD was designed to effectively gather the fuel in the bulk space of the tank during both the spinning transfer orbit phase and also during the three-axis (on-station/Zero-G) phase, and to deliver it to the outlet to meet the demand of the firing thrusters. In fact, the PMDs were designed to prevent gas from passing through and reaching the thrusters. For the old-timers on the Project, this challenge was reminiscent of the one faced in recovery of TDRS-1, when it had been put in an off-nominal transfer orbit with failed thrusters. That recovered mission is now approaching 20 years of successful Space Network service.

To move from concept to the detailed design necessary to effect the recovery, the team conducted numerous sessions over many weeks to hammer out a precise series of burns to first deplete the fuel in Fuel Tank #1, and then to begin the tedious process of transferring the gas to Fuel Tank #2. As

described earlier, it was not as easy as simply throwing a switch to open a line and "filling 'er up." Once the team thought they had a workable propulsion system solution, other dynamics problems had to be tackled. For instance, engineers had to deal with the offset to the spacecraft center of mass that was created by having one tank completely empty and the second nearly full of fuel. Dynamics experts had to perform simulations to ensure the spacecraft could be controlled during the orbit raising burns. The answer was to fire the LAM in a pulsed mode instead of a normal continuous burn, while simultaneously firing a 5-pounds-force axial thruster to counteract the overturning torque caused by the shift in the center of gravity.

The actual transfer of the gas to the second tank involved a complex series of burns, repressurizations from the Fuel Tank #1, vents, and fuel line priming. One phase involved changing the spacecraft from the nominal 5 rpm spinning transfer orbit configuration, to a near 3-axis stabilized mode. All of these cycles and phases were necessary to nudge the gas from the PMD into the bulk space of Fuel Tank #2 in order to have gas pressure to push the fuel out to the thrusters. Later in the process, the spacecraft had to be changed back to a spinning phase. Each phase required its own analyses, simulations, design reviews, and mission operations team rehearsals prior to the actual execution of the special procedures developed.

The team's efforts were rewarded when the spacecraft was successfully placed in a geosysnchronous orbit with the final LAM burn on September 30, 2002. Additional gas and liquid transfers were necessary to get the propulsion system in the proper configuration for its fifteen-year service life. The spacecraft was then de-spun for deployment of the Single-Access antenna booms, the Space-Ground Link Antenna that points at the White Sands Complex, and the Forward Omni antenna. After these deployments were completed, the spacecraft was switched from inertial mode, to sun hold mode, and then to normal mode pointing at Earth. Handover from the MCC, which had been using Ground Network and Deep Space Network stations, to the White Sands Complex was accomplished on October 15. TDRS-I is currently undergoing an approximately two-month on-orbit test program to demonstrate spacecraft health and performance prior to government acceptance and integration into the operational Space Network as TDRS-9.

While Boeing engineers and operations personnel were responsible for the recovery (including the necessary analysis, design work, procedure generation, and operations during the recovery mission), the TDRS Project and other Goddard organizations played a significant part in the effort. The NASA team—consisting of TDRS Project members, Applied Engineering and Technology Directorate staff, Aerospace Corporation employees, and project support contractors from Swales—provided technical advice and independent review of the Boeing designs. They also were present in the MCC for all of the many recovery mission maneuvers over the course of the seven-month effort. Space Network personnel also were part of the operations team, and worked side-by-side with Boeing to schedule the Ground Network and Deep Space Network assets in the very dynamic environment that was required to support the mission. In addition, the Flight Dynamics Facility supported the recovery by providing backup orbit determination products.

The TDRS-I recovery required a phenomenal effort and great commitment from everyone involved, resulting in an incredible engineering success story.

By Jeff Gramling/GSFC Code 454

For additional information about the TDRS-I recovery effort, please contact the author via email (Jeffrey.J.Gramling.1@gsfc.nasa.gov).

TDRS-J Prepares for November 20 Launch

On October 17, 2002, an Air Force C-17 aircraft transported the TDRS-J spacecraft from the satellite manufacturing facility in El Segundo, California, to Kennedy Space Center's (KSC) Shuttle Landing Facility (SLF). The Boeing Satellite Systems shipping container with TDRS-J inside was off-loaded from the aircraft at the SLF, and a mobile crane hoisted it onto a flatbed trailer for transport to the Spacecraft Assembly and Encapsulation Facility 2 (SAEF-2). There, it was placed in the SAEF-2 airlock for cleaning and subsequent transfer into the high bay clean room. After removal of the container lid, the container strongback assembly

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Off-load of the shipping container for TDRS-J from inside a C-17 aircraft

Transporting TDRS-J to SAEF-2
Loading the shipping container onto the flatbed for transport (left) and
the convoy during transport with the vehicle assembly building in the background (right)

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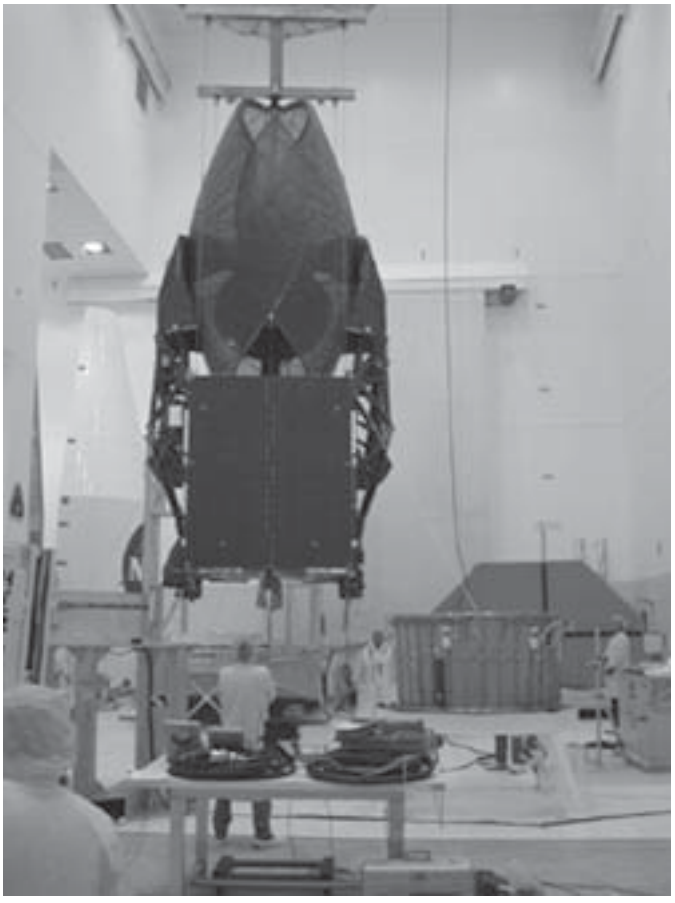
was rotated into the vertical position. Then workers at KSC mated electrical connectors to the spacecraft and initiated launch site electrical testing.

The following day, the spacecraft was lifted off the strongback and lowered onto the flight launch vehicle (LV) payload adapter (PLA) for LV interface checks. After this interface was verified, workers hoisted the spacecraft off the PLA and moved it to the BSS fueling stand to continue electrical and propulsion system testing until October 25. During the week of November 4, approximately 3,686 pounds of monomethyhydrazine and nitrogen tetroxide propellant are scheduled to be loaded into the spacecraft, and the helium tanks are to be filled and pressurized.

After flight mechanical closeouts are accomplished, TDRS-J is scheduled for LV integrated operations on November 4, 2002, and is to be mated to the PLA on the following day. The spacecraft/PLA stack is scheduled to undergo payload fairing encapsulation



TDRS-J is hoisted to the payload adapter.
The launch vehicle fairing can be seen in the
background at left.

and preparations for transport during the period of November 7-11. The encapsulated spacecraft will be transported to Space Launch Complex (SLC) 36A on November 12, and mated to the Atlas Centaur. The launch vehicle/spacecraft Combined Electrical Readiness Test will be performed the following day. Launch rehearsals, final testing and closeout activities, and prelaunch reviews will be accomplished during the remaining days before launch.

The KSC Center Director's Launch Vehicle Launch Readiness Review was successfully completed on October 15, 2002. The Atlas IIA Booster and Centaur upper stage have been erected on SLC 36A and the Lockheed Martin Ground Operations Readiness Review was completed on October 18. The GSFC Mission Readiness Review for the TDRS-J mission was held on October 30.

The TDRS-J launch is scheduled for 10:36 EST on November 20, 2002. TDRS-J is the third in the series of TDRS H, I, J communications satellites, and the latest addition to the fleet of eight on-orbit TDRS satellites. In addition to providing tracking services for expendable launch vehicles, the TDRS provide high data rate communication links for the Space Shuttle, the recently refurbished Hubble Space Telescope, the International Space Station, and numerous other Earth-orbiting spacecraft. This launch will mark the last flight of the Atlas IIA launch vehicle.

By Mike Goeser/TDRS-J Launch Manager and Marco Toral/ GSFC Code 454

TDRS Resident Office News

Since the July 2002 *Integrator* item on the NASA/TDRS BSS (Boeing Satellite Systems) Resident Office, tremendous progress on TDRS-I and TDRS-J has been made. For the Resident Office, it has been a very busy time, with activity occurring on both spacecraft simultaneously.

TDRS I was successfully placed into a proper geosynchronous orbit on September 30 by a dedicated BSS/NASA team (see article on page 20). On-orbit checkout of the spacecraft is now underway. The Resident Office played a key role in keeping the NASA part of the team informed in near real-time as the recovery effort progressed.

In parallel with the TDRS I recovery effort, TDRS J was carefully and meticulously prepared for launch. On October 16, in the early evening, the spacecraft was taken to Los Angeles International Airport and loaded onto an Air Force C-17 cargo jet for transport to KSC, in anticipation of an ultimate launch on November 20 (for more on TDRS-J, see the article on page 21). Resident Office Bus Engineer Bing Joe is going to KSC to help the NASA team prepare for launch.

On Thursday October 17, 2002, there were no TDRS Spacecraft in the BSS Integrated Satellite Factory for the first time since 1996. This strange and unusual circumstance evokes mixed emotions: relief, sadness, thoughts about "what's next?" and "is this the beginning of the end for the NASA/TDRS Resident Office?" The answer is yes, but it is a happy ending. And there is still a lot of work to do to prepare to close the Resident Office in an orderly and efficient manner.

By Paul Nordin/TDRS Resident Office

For additional information, please contact the author via email (Paul.Nordin@HSC.com) or telephone (310-364-7405).

Crosscutting Activities

Ka-Band Transition Project Update

Over the past several months, the Ka-Band Transition Project (KaTP) team has been busy performing hardware integration and test activities in preparation for high data rate demonstrations scheduled for the end of this year. The project is currently implementing a new Ka-band ground station for the Ground Network (GN) at the Wallops Flight Facility (WFF), and modifying the Space Network (SN) ground stations at the White Sands Complex (WSC) to support high data rate Ka-band customers. When the implementation is complete this fall, the team will perform high data rate demonstrations (up to 600 Mbps) to assess the RF link performance via measurements of bit error rate and the signal spectra.

SN Modifications

The ground terminals at the WSC are being upgraded to take advantage of the new TDRS H, I, J spacecraft's 650 MHz-wide Ka-band space-to-space return link in the 25.25 GHz to 27.5 GHz band. Modifications are also being made to the existing 225 MHz-wide downconverters to enable Space Network Interoperability Panel (SNIP) frequency plan support. Compatibility with the SNIP frequency plan will allow for future cross-support with European Space Agency and Japan's National Space Development Agency (NASDA) missions.

To date, the KaTP team has completed all of the cabling and equipment installation at the WSC. This includes the installation of new waveguide equalizers, 650 MHz-wide downconverters, and an IF switch. Also, the implementation of a new dual frequency local oscillator for the existing 255 MHz-wide downconverters is nearing completion, and will allow SN compatibility with the Ka-band SNIP frequency plan.

All WSC software and firmware development has been accomplished for the KaTP, and delivery was planned for the end of October. Also, KaTP personnel have started system acceptance test data collection, which should be concluded by the end of November. Upcoming Shuttle missions and the on-orbit test schedule of TDRS-I and J have been driving the KaTP implementation, test, and demonstration schedules.

New GN System

A GN demonstration system with the capability to support S-Band command (2025 to 2120 MHz), S-band telemetry (2200 to 2300 MHz), and Ka-Band telemetry (25.5 to 27.0 GHz) has been installed at WFF. The ground station will be used for test and demonstration purposes only, and therefore will be implemented with limited remote monitor and control capabilities.

After engineers overcame some problems with the Ka-band antenna feed that affected the autotrack performance, antenna installation and testing proceeded smoothly. The antenna and radome installation is complete, and initial tests on the antenna indicate good performance. The electrical cabling between the antenna and the WFF KaTP laboratory/Radio Room was installed in mid-October. The WFF KaTP laboratory/ Radio Room is located within a few hundred yards of the antenna, and contains all the hardware for S-band Telemetry, Tracking, and Command (TT&C), Ka-band telemetry, and antenna control and monitoring. System checkout and acceptance testing of the GN ground station is expected to conclude by the second week of November.

Radome Installation for the WFF 5.4-meter Ka-Band Antenna

High Data Rate Demonstrations

Upon completion of KaTP SN and GN equipment acceptance tests, the team will perform high data rate demonstrations to prove the networks' capability to support Low Earth Orbiting spacecraft operating at data rates up to 600 Mbps. A high data rate test modulator (600 Mbps, SQPSK), procured by the KaTP project, will be used in conjunction with the GSFC-developed (Code 564) high data rate receiver and a WFF-procured commercial receiver to support the demonstrations.

SN/GN demonstration plans and procedures are complete, and the GN demonstration is scheduled to begin the third week of November. A bit error rate (BER) demonstration will be performed first using a bore site tower located a few miles from the antenna. The Ka-band antenna acquisition and tracking demonstration will follow, using a Ka-band transmitter mounted on a helicopter to simulate the angular velocity of a low earth orbit Ka-band spacecraft.

It is expected that the GN BER demonstration should take about one week, after which the high date rate modulator and demodulator equipment will be shipped to WSC for the SN demonstration. The three-week SN demonstration is tentatively scheduled to begin the first week in December. The first week and a half will be devoted to Medium and Long Loop tests that do not require TDRS time. The second half of the demonstration will use the TDRS-8 spacecraft for end-to-end BER measurements.

Data collection and analysis will be performed throughout the SN and GN demonstrations. The KaTP team will publish a demonstration report that captures the results and conclusions.

By Mark Burns/ITT Industries

For further information contact Yen Wong (301-286-7446)

DSMC Completes Final Operations Transition

The Data Service Management Center (DSMC) at the White Sands Complex (WSC) is now responsible for scheduling the full operations workload for NASA's Space Network (SN) and Ground Network (GN). The relocation of these functions to the DSMC was completed with the June 25, 2002 transition of SN schedule, control, and status functions, and the September 9-30 transition of GN scheduling for the automated 11-meter antenna sites.

Since the transition of the SN Network Control Center Data Systems (NCCDS), the DSMC team has successfully supported one Shuttle mission and three Expendable Launch Vehicle (ELV) launches. Subsequently, the Auxiliary Network Control Center (ANCC) system was relocated to the White Sands Ground Terminal (WSGT) at the WSC. The ANCC system was successfully tested, and a completion review was held on October 15, 2002. The ANCC is now available to support SN customer testing needs. In the event of a catastrophic failure of the NCCDS at the Second TDRSS Ground Terminal (STGT), the ANCC can be configured to support operations.

The Operational Readiness Review for the GN automated 11-meter transition was held on August 28, 2002. The team received the go-ahead, and

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began the transition process on September 9. The scheduling weeks were phased over one by one, and on September 30, the DSMC became the prime scheduling entity for all GN assets.

The final activity remaining in the DSMC project is to relocate one last suite of equipment to the STGT Software Maintenance and Training Facility (SMTF) for use as a test and training suite. The equipment was shipped to WSC on October 18, and is currently being installed and configured. A final completion review to bring the DSMC project to an end is planned for November 26, 2002.

By Cathy Barclay/HTSI

GSFC Personnel Participate in CCSDS Activities

The Consultative Committee for Space Data Systems (CCSDS) is an international organization, whose members seek to exchange technical information regarding common space data transport and information interchange problems. CCSDS members work to agree upon optimized solutions (called CCSDS recommendations) to such problems, and to promote the implementation of these solutions. These recommendations are established and approved as ISO international standards, too. In this article, we summarize the recent CCSDS activities of GSFC personnel.

GSFC personnel supported the **CCSDS Fall Series and SpaceOps Conference** in Houston, Texas, from September 30 to October 11. They presented several technical papers and staffed the CCSDS booth.

Work accomplished by **Panels 1A/1F (Protocols/Advanced Orbiting Systems)** includes: development of state tables to ensure timely validation of the logic and reliable delivery of telemetry data when very high speed links are involved, development of software implementation for COP-P (Communication Operations Procedure for the Proximity Link protocol) sender and receiver logic, generating and editing executive summaries for all Proximity-1 documents, and also developing testing techniques to demonstrate/implement these standards. [Technical Representative Tim Ray/GSFC Code 584]

Panel 1C (Data Compression) presented the technical paper "Implementation of CCSDS Lossless Data Compression for Space and Data Archive Applications" at SpaceOps Conference Track #5, Standardization and Enabling Technologies. [Technical Representative Pen-Shu Yeh/GSFC Code 564]

Panels 1B/1E (Channel Coding/Modulation): P1B's Houston Meeting was very successful for Goddard. GSFC representatives presented a white paper proposal for two new high coding rate bandwidth efficient Low Density Parity Check codes. We had researched these codes for a few years, and had reached a point where the performance of these two candidate codes was strong enough for proposal. After the presentation, we achieved consensus among panel members that all agencies would study the codes for the next meeting to see if the codes met their needs. We also reached a consensus on the Data Randomization wording for the Channel Coding Blue Book and the TC/TM Synchronization and Channel Coding Red Books. In the joint P1A/B/E meeting, GSFC presented Application Profiles for Goddard Missions. These profiles will be the basis of a new CCSDS recommendation, whose goal is to offer customers a set of standards for a particular mission profile. There is much work to do in this effort and this is only the beginning. There will be a follow-on joint meeting in Annapolis, MD (in late October) where P1E will meet to further develop these profiles. [Technical Representative Wai Fong/GSFC Code 564]

Panel 1J (Navigation) completed the internal panel review of the Orbit Data Messages Red Book, in response to all review item dispositions (RID) from the CCSDS agency wide review conducted this summer. Following this panel review, this Recommendation is ready for promotion to blue book level, subject to the new updates. [Technical Representative Felipe Flores-Amaya/GSFC Code 453]

Panel 2 (Information Interchange Standards) presented the technical paper "Towards an Overall Space Information Architecture" at SpaceOps Conference Track #5, Standardization and Enabling Technologies. [Technical Representative Donald Sawyer/GSFC Code 633]

Panel 3 (Cross Support Operations) presented the technical paper "CCSDS Space Link Extension (SLE) Services. Overview and Progress Report" at SpaceOps Conference Track #5, Standardization and Enabling Technologies. [Technical Representative James Pritchard/GSFC Code 586]

In addition, NASA is the primary author of the initial **Space Link Extension (SLE) Service Management/Service Request Specification**. Initial drafts of the Operations Concept and XML material were drafted prior to, and reviewed at the recent CCSDS Panel 3 Workshop held in Houston, Texas. NASA strongly focused the scope of the document so that it will support current cross-support missions such as the European Space Agency's Rosetta and the Institute of Space and Astronautical Science's Muses-C. The first version of the Specification is general enough to apply to at least the NASA Ground Network. Ideally, it could also apply to the NASA Space Network and other CCSDS member agency networks.

For further information, please contact Felipe Flores-Amaya, GSFC Data Standards Manager, at 301-286-9068, or visit the CCSDS web pages (http://www.ccsds.org).

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http://msp.gsfc.nasa.gov/integrator/.

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