White Sands Complex Operations & Maintenance

Code 452 Space Network Project Office
Second TDRS Ground Terminal (STGT)
WSC Operations

Resources
- The TDRS Operations Control Center (TOCC) is the focal point of the Space Network.
- Space Network Operations professionals organized into 24X7 crews and support staff chartered to operate the NASA Space Network.
- The Operations team conduct Space Network (SN) operations at the WSC which includes the White Sands Ground Terminal (WSGT), Second TDRS Ground Terminal (STGT). The WSC also conducts remote operations of the Guam Remote Station (GRS), the Blossom Point Remote Station (BPRS), and the Australian TDRS Facility (ATF).

Mission
- The SN operates a constellation of geosynchronous TDRS and associated ground systems designed to provide service to customer platforms operating in a low earth orbit (LEO). These services include S-band and K-band communications and tracking services for user satellites or spacecraft, launch vehicles, airborne vehicles, and ground-based systems.

Initiatives
- As the SN evolves operations personnel are provided training and familiarization for each new TDRS satellite as it is prepared for launch and initialization. TDRS-M is planned for a August 2017 launch.
- Similarly, as the SN ground system evolves with the SN Ground Segment Sustainment (SGSS) project, operations personnel provide critique to on-going development. They are also being afforded the opportunity to train on new domain knowledge areas required in the SGSS era.

TDRS Operations Control Center Cadre
- Operations Supervisor (OS)
- Site Specialist (SS)
- Satellite Controller (SatCon)
- Communications Services Controller (CSC)
- Real-time Scheduler
- Forecast Scheduler
- Resource Scheduler
- TDRS Analyst (TA)
- TDRS Operations and Analysis (TO&A)
OPERATIONS SUPERVISOR (OS) RESPONSIBILITIES:

- Responsible for the management, integration, and coordination of real-time operational activities and to ensure the safety of the personnel assigned to their crew.
- Responsible for the overall operations of all SN ground stations and the health and welfare of the TDRS constellation.
- Primary point of contact for the site concerning anomaly notification and responsible to monitor, direct, and coordinate anomaly resolution efforts.
- Responsible for the execution of the Operations Manager’s objectives, work plans, schedules, and ensures resources are available for the completion of established assignments.
- The OS performs and/or delegates administrative activities including: forecasting, scheduling, and tracking crew member vacations/coverage to balance and reduce overtime, maintaining crew member training records, assigning trainers, and overseeing the certification process.
- Notifies the NASA Station Director and Site Management of any issues concerning health & safety of the site personnel, significant SN System anomalies, issues with the health & welfare of the TDRS constellation, significant data outages with customer support.
- Develops and distributes Significant Event Reports (SER) and the Daily Operations Summary (DOS).
SITE SPECIALIST (SS) RESPONSIBILITIES:

- Technical Lead and Subject Matter Expert (SME) for the operational site assigned and is responsible to the OS for running the technical operations.

- Responsible for each Tracking, Telemetry, and Command (TT&C) asset and all user services running at the assigned site.

- Responsible to monitor all the Data Interface Systems (DIS), the Common Time and Frequency System (CTFS), Demand Access System (DAS), WSC Transmission Control Protocol (TCP)/Internet Protocol (IP), Data Interface Service Capability (WDISC), SN Gateway (SNG), and the Space Link Equipment (SLE).

- The SS is also responsible for monitoring the operation of the Extended TDRS Ground Terminal (ETGT) and the Australian TDRS Facility (ATF) and works with the Line Maintenance Technicians (LMT) to monitor the TDRS Digital Signal Distribution (TDSD).

- The SS makes recommendations for system configurations and possible paths for troubleshooting system anomalies and works closely with the OS and LMT’s to direct troubleshooting and restoration efforts.

- Maintains certification and technical proficiency by participating in required training and self-initiated study and review of procedures and other available documentation.
**COMMUNICATION SERVICES CONTROLLER (CSC) RESPONSIBILITIES:**

- Responsible to the OS and SS for ensuring the health of the TDRS Telemetry, Tracking and Command (TT&C) link and must have the ability to quickly resolve system anomalies and interfaces with the Satellite Controller (SATCON) to resolve TT&C issues.
- Responsible for the quality of each customer support on their assigned Space-to-Ground Link (SGLT) and interfaces with each Mission Operations Control Center (MOCC), monitoring each support from the scheduled service download, setup and acquisition of signal (AOS) to loss of signal (LOS).
- Responsible for responding appropriately to user support anomalies providing Ground Change Message Request (GCMR) support (when needed) and advice to the MOCC.
- The CSC works in concert with other controllers in the TOCC and the LMT’s assisting them in resolving anomalies that cross between the Data Interface System (DIS) and the SGLT.
- The CSC also interfaces with the WSC Scheduling Operator. While not a subject matter expert, the CSC should be well versed in common procedures like handovers, antenna switchovers, and Software deliveries.
- Maintains certification and technical proficiency by participating in required training and self initiated study and review of procedures and other available documentation.
SATellite CONTROLLER (SatCON) RESPONSIBILITIES:

- Responsible for continuously monitoring the health and welfare of the on orbit constellation of Tracking & Data Relay Satellites (TDRS).
- Development and execution of established Local Operating Procedures (LOP), command plans, and TDRS Special Instructions (TSI) such as eclipse operations and battery management.
- Responds to anomalies and makes prompt decisions while adhering to established guidelines. Performs initial investigation of spacecraft anomalies and effectively works with TDRS spacecraft engineers through resolution including follow up reporting and Root Cause Analysis.
- Responsibility also includes assisting with and providing on-console training to other personnel as assigned.
- Maintaining certification and technical proficiency by participating in required training and self initiated study and review of procedures and other available documentation.
**Real-Time Scheduler Responsibilities:**

- The Real-time Scheduler is responsible for the coordination of all requests for SN segment resources from the customer community.
- The Real-time Scheduler commits SN segment resources based on customer requests and resource availability, performs and assists in conflict resolution with customers and disseminates schedules to the SN and other support elements.
- Coordinates all conflict resolution with customers, based on FDF requirements, schedules Bilateral Ranging and Transponder System (BRTS) supports, and monitors customer scheduling activities to insure configurations are compatible with support requirements.
- In emergencies and when TDRS handover requirements dictate, the SN Scheduler Maps NCCDS SN resources and customer parameters.
- Monitors customer's demand access system (DAS) scheduling and can modify the DAS events to minimize data loss or reschedule to TDRS legacy events when customers are unavailable to schedule.
- Ensure Scheduling Orders (SHOs) are accepted at the ground terminals as well as at the SNG and WDISC.
RESOURCE SCHEDULER RESPONSIBILITIES:

- Coordinates with all internal (SN) and external customers and network elements to schedule activities on any Space Network operational system.
- The Resource Scheduler and the requester will review the activity requirements and the current SN schedule to determine possible impacts and the most appropriate timeframe in which to conduct the requested activity.
- Maintains and updates the SN Daily Schedule and the SN Long Range Calendar.
- Coordinates with the SN Forecast Scheduler to schedule all test and maintenance activities requiring SN ground assets and TDRS resources with as little impact to the customer community as possible.
- Responsible for negotiating and de-conflicting SN resource contention in the most efficient and professional manner such that customer needs and requests are met.
- Performs other scheduling duties as assigned.
**FORECAST SCHEDULER RESPONSIBILITIES:**

- SN Customers are required to schedule the Space Network resources in advance, and based on the weekly SN customer Schedule Add Requests (SARs), the Forecast Scheduler has to meet customer support requirements in accordance with the SN Priority List and as specified in the customer Project Service Level Agreement (PSLA).

- Responsible for negotiating and de-conflicting customer schedule contention in the most efficient and professional manner such that customer needs and requests are met.

- Coordinates with the SN Resource Scheduler to schedule all test and maintenance activities requiring SN ground assets and TDRS resources with as little impact to the customer community as possible.

- Executes TDRS mapping requirements.

- Performs other scheduling duties as assigned.
TDRS Analyst (TA) Responsibilities:

- Responsible for the management of the health and safety of the TDRS constellation by monitoring attitude control and spacecraft subsystems.
- Perform TDRS Attitude Control System (ACS) and other system analysis.
- Perform TDRS Momentum management, Battery management and reconditioning, and eclipse and intrusion management.
- Plan, coordinate and execute TDRS station-keeping maneuvers and relocations.
- Maintain TDRS system configuration to ensure availability.
- Perform TDRS Trending and State of Health analysis.
- On-Call for TDRS anomaly resolution and spacecraft recovery.
- Respond to spacecraft anomalies, determine root cause and implement corrective actions to effect a return to mission.
- Provide TDRS Systems and ACS training to the SN SatCons.
SN Spacecraft Operations

- Prime responsibility for Flight operations is to monitor the health and safety of the TDRS fleet.
- Three Satellite Controllers control and monitor 9 TDRS
- Monitoring function includes executing procedures to save the TDRS in case of an anomaly. Spacecraft Engineering is called in to resolve anomaly.
- Spacecraft housekeeping activities are conducted on a non-interference basis to ongoing customer tracking services. Some of these activities include:
  - Momentum unloads
  - Station keeping / Orbit determination
  - Battery management
  - Ephemeris uploads
- SatCon executes procedures to save the TDRS in event of an anomaly.
- Operations perform via alternate command/telemetry system:
  - TDRS 1-7 (1st Generation) recovery performed via RTMS
  - TDRS 8-10 (2nd Generation) recovery via RTMS
  - TDRS 11, 12, M (3rd Generation) recovery via RCTS

We operate two different types of spacecraft buses on the same systems.
TDRS Operations Control Center

TDRS Operations and Analysis (TOA) Responsibilities:

- Provide technical interface for SN customers to ensure their mission success and resolve any technical issues they encounter.
- Perform data loss analysis with customers.
- Supports operations for critical customer events.
- Provide technical and operational expertise for Expendable Launch Vehicles and Human Space Flight missions.
- Provide mission integration and test support of new functions and discrepancy fixes ensuring seamless transition into Operations.
We require ISO certification to ensure ISO standards are inherent in all of our processes.

We utilize the following processes for Space Network Operations:

- **Certified Operators**: Extensive Training and Certification program.
- **Procedures**: WSC employs Local Operating Procedures (LOPs) that are used whenever keyboard ground or spacecraft commanding is required. Procedures are also utilized for fault isolation, handover of TDRS from one resource to another (including DSN and GN), and maintenance activities. All LOPs are developed and controlled locally.
- **Two person verification**: Critical keyboard commanding to ground or TDRS requires a second person verifier.
- **Software Automated processes**: We employ automated fault detection software for both the ground and space segments.
- **Anomaly Identification and Resolution**: We utilize procedures for anomaly resolution and utilize a Comprehensive Discrepancy Reporting system to document and correct anomalies for customer and WSC related issues.
- **Root Cause Corrective Action**: In the event of a system failure or operator error we activate our RCCA process. “Drill down”
- **Report Generation**: We provide reports on a daily, weekly, monthly, and semi-annual basis.
“Overview Classes” are approximately 7 – 10 Days in duration:

- **WSC System Overview:** A top level introduction to the WSC and its functions in the SN.
- **WSC Hardware Overview:** Provides a good foundation in principles of the WSC hardware interrelationships.
- **Software Overview:** Provides a foundation in principles of the WSC Legacy ADPE, SNAS, and NCCDS.
- **Operations Overview:** Covers responsibilities of each of the SN TOCC positions.
- **TDRS Level I:** An overview of the TDRS. Usually provided after certification.
- **TDRS Level II:** Detailed discussion of the TDRS. This course provided for SatCon only.
Hardware Maintenance Depot (HMD)
Resources
- The Hardware Maintenance Depot (HMD) is the Depot Repair facility for the Space Network.
- The Line Maintenance Technicians conduct first response troubleshooting at the White Sands Complex (WSC) which includes White Sands Ground Terminal (WSGT), Second TDRS Ground Terminal (STGT) and the Extended TDRS Ground Terminal (ETGT). LMT’s are also assigned to the remote operations at the Guam Remote Station (GRS) and the Blossom Point Remote Station (BPRS).

Mission
- Perform operations and maintenance of all ground systems.
- Identify, diagnose, and repair system failures from level one to depot level maintenance.
- Maintain spares to ensure system operational availability.
- Track and control maintenance actions for reliability and maintainability factors.

Initiatives
- Cross training and certification to improve staffing flexibility
- Maximize proficiency and availability of the SN.
- Improve work through processes and procedure standardization.
- Foster intradepartmental synergy via HMD and Hardware Engineering staff teaming.

SN Hardware Maintenance Depot Cadre
- Line Maintenance Technicians (LMT)
- HMD Engineers
  - RF
  - High Power Amplifiers (HPA)
  - Analog
  - Digital
- Maximo Database Administrator
Hardware Maintenance Depot (HMD) Responsibilities:

- Responsible for all Hardware in the Ground Control Equipment (GCE) area associated with each Space-to-Ground Link (SGLT) up to and including the antennas at the WSC.
- Responsible for all Automated Data Processing Equipment (ADPE) in the Control and Display Computer Network (CDCN) area.
- The LMT’s are the first responders to any hardware anomaly for SN operations.
- Responsible for the operations, maintenance, and repair of the International Space Station (ISS) VHF equipment.
- Responsible for the Earth Observing System Ground Station Interface Facility (GSIF) repair.
- First response for Line Replaceable Unit (LRU) replacement.
- Depot Repair to component level for all SN hardware including GRS, BPRS, and the ATF.
Hardware and Computer Technician Training:

- **General Skills Catalog Training:** Approximately 45 days.
- **TDRS Overview Class:** A top level introduction to the WSC and its functions in the Space Network.
- **TDRS 880 Class:** A technical overview of the TDRS and all of its subsystems.
- **Computer Technician OJT:** Perform ADPE corrective and preventive maintenance and understand the roles and responsibilities of all TOCC positions.
- **Hardware Technician OJT:** Perform corrective and preventive maintenance on the Data Interface System (DIS), TT&C, USS, etc.
- **Certification:** Once all of the skill sets have been mastered, the final certification determination is made by the HMD Manager.
Equipment Inventory

- ~963 Racks of Equipment between WSGT and STGT
- ~4,815 Chassis – Most are unique and custom built
- 47 Alpha Clusters and 564 workstations
- ~1,163 Test Equipment Items
- 26 Antennas:
  - 3 – 19m Dual S/K Band antennas (STGT)
  - 3 – 18.3m Ku-Band antennas (WSGT)
  - 2 – 10m S-Band antennas (STGT/WSGT)
  - 5 – 4.5m Dual S/K Band End-to-End Test antennas (3 STGT / 2 WSGT)
  - 2 – 1.8m Ka-Band End-to-End Test antenna (STGT/WSGT)
  - 1 – 9.2m S-Band antenna (ETGT)
  - 1 – 6.2m S-Band antenna (ETGT)
  - 2 – 16.5m Dual S/K Band antennas (GRS)
  - 1 – 11m Dual S/K Band antenna (GRS)
  - 2 – 4.5m Dual S/K Band End-to-End Test antennas (GRS)
  - 2 – 20m Dual S/K Band antennas (BPRS)
  - 1 – 5.5m Dual S/K Band End-to-End Test antenna (BPRS)
  - 1 – 11.2m S-Band antenna (ATF)
SN Operations New Hire Training

SN Proficiency

SN Proficiency Trend

Yearly Support Comparison

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23