Space Communications Customer Forum #13 (SCCF-13)

http://scp.gsfc.nasa.gov/sccf/

March 23, 2006

Building 3 Goett Auditorium
NASA/Goddard Space Flight Center
Greenbelt, Maryland

Sponsored by:
Customer Commitment Office, Code 451
(Space Communications Program, Code 450)
NASA/Goddard Space Flight Center
Greenbelt, Maryland

Space Communications Customer Forum (SCCF) #13
Briefing Book Contents

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Space Communications Customer Forum #13

Space Communications Program (SCP)
Space Communications Customer Forum (SCCF) #13
March 23, 2006, Building 3 Goett Auditorium
(NASA/Goddard Space Flight Center)

Agenda

Note: Splinter Group meetings with SCP service providers (GN/SN/CCO); NISN; DSMC (SN & GN) Operations Interfaces personnel; and other topics may be arranged (on request). Please contact Mr. Michael Booth (301.286.6192; e-mail: Michael.Booth@gsfc.nasa.gov)

Timeline (approx.)	Subject / Topic	Speaker / Presenter
1:00pm	WELCOME & INTRODUCTIONS	Allen J. Levine/GSFC
1:05pm	OPENING REMARKS	Roger J. Flaherty/GSFC
1:15pm	ITEMS / NOTES OF INTEREST	Allen J. Levine/GSFC
1:20pm	MISSION / PROJECT UPDATES (Organizational Overviews; Current/Future Missions; Issues & Selected Items of Interest; Areas for More Work)	
	• Earth Science Mission Operations (ESMO)	Angelita C. Kelly/GSFC
	• Space Science Mission Operations (SSMO)	Patrick L. Crouse/GSFC
	• Human Space Flight (HSF) Missions	Cheryl R. Smith/NENS
2:05pm	STATUS UPDATES (Significant activity in Space Communications Program [SCP] offices and our Partners)	
	• Space Network (SN) Project	Keiji K. Tasaki/GSFC Jon Z. Walker/GSFC
	• Ground Network (GN) Project	Roger N. Clason/GSFC
	• JPL/Deep Space Network (DSN)	Scott Riley/JPL
	• NASA Integrated Services Network (NISN)	Jerry Zgonc/GSFC
	• Flight Dynamics Facility (FDF)	Susan L. Hoge/GSFC
	• Exploration Communications And Navigation Systems (ECANS) Project	Jason A. Soloff/GSFC
4:00pm	OPEN FLOOR	Allen J. Levine/GSFC

Welcome & Introductions

Allen J. Levine, Service Planning Manager, Customer Commitment Office

Opening Remarks

Roger J. Flaherty, Deputy Program Manager, Space Communications

Items/Notes of Interest

Allen J. Levine, Service Planning Manager, Customer Commitment Office

Code 428
Earth Science Mission Operations Activities

Angelita C. Kelly
March 23, 2006
NASA Goddard Space Flight Center

Code 428

- **Constellation Management**
  - CloudSat / CALIPSO Launch
  - Glory Added to Constellation
  - Inclination Maneuver Coordination
- **SN & GN Support for Terra, Aqua, & Aura**
- **EDOS Reengineering**
- **MODIS Imagery**

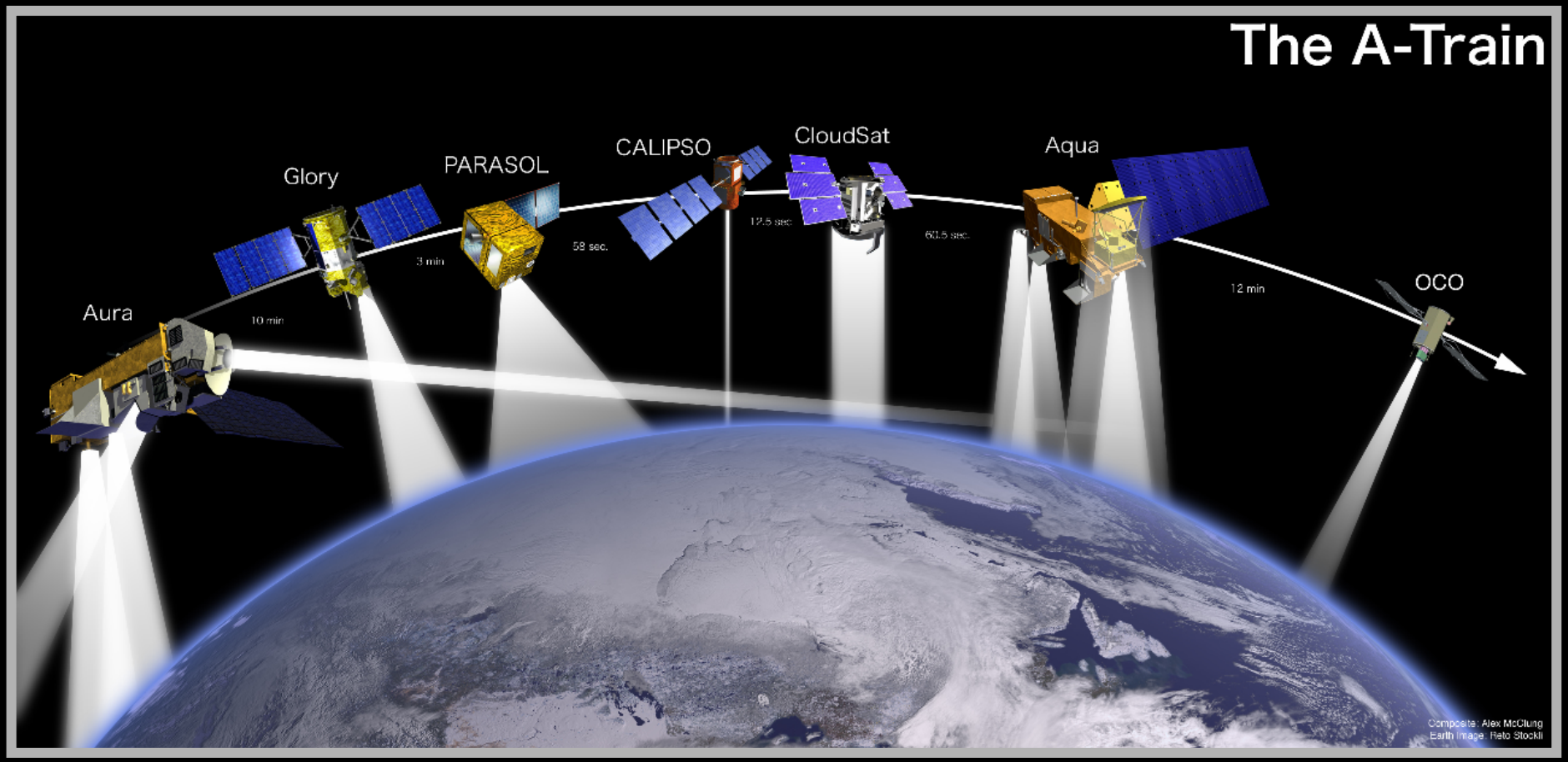
Earth Observing Constellations

- **Morning Constellation**
  - All 4 satellites are on-orbit (Landsat-7, EO-1, SAC-C, and Terra)
  - Descending equator crossing times near 10:00 Mean Local Time (MLT)

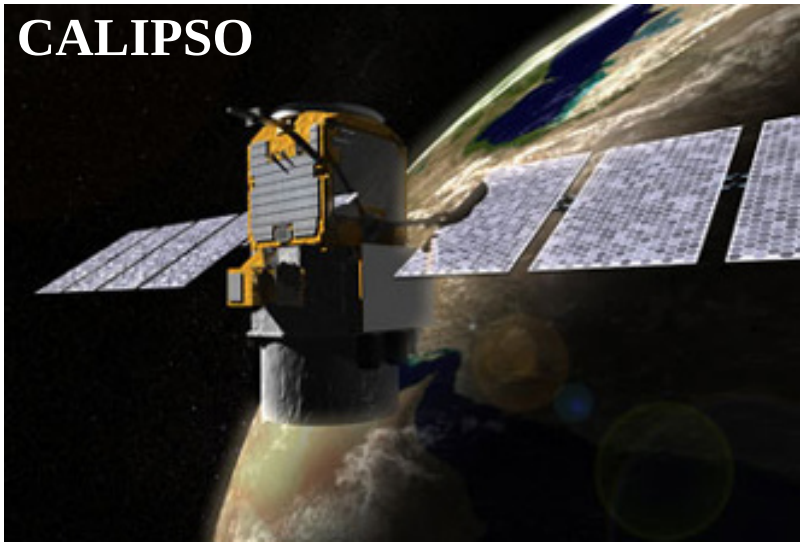
- **Afternoon Constellation ("A-Train")**
  - EOS-Aqua, EOS-Aura and PARASOL are members currently on-orbit.
  - Other missions will follow: CloudSat, CALIPSO, Glory, and OCO.
  - Ascending equator crossing times near 13:30 MLT

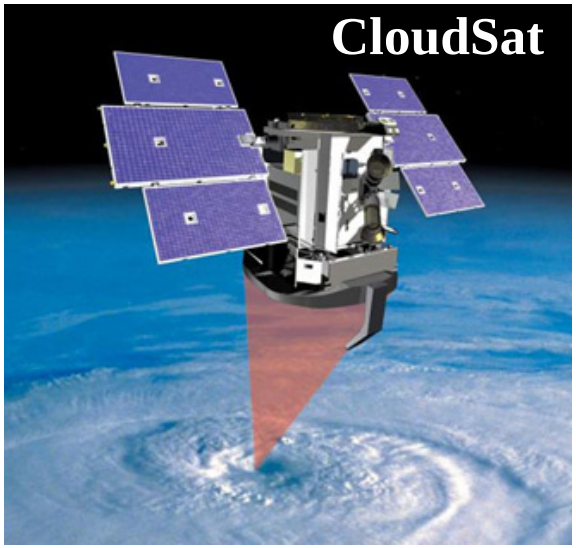
Earth Science Morning Constellation

Earth Science Afternoon Constellation



Afternoon Constellation
CALIPSO/CloudSat Launch





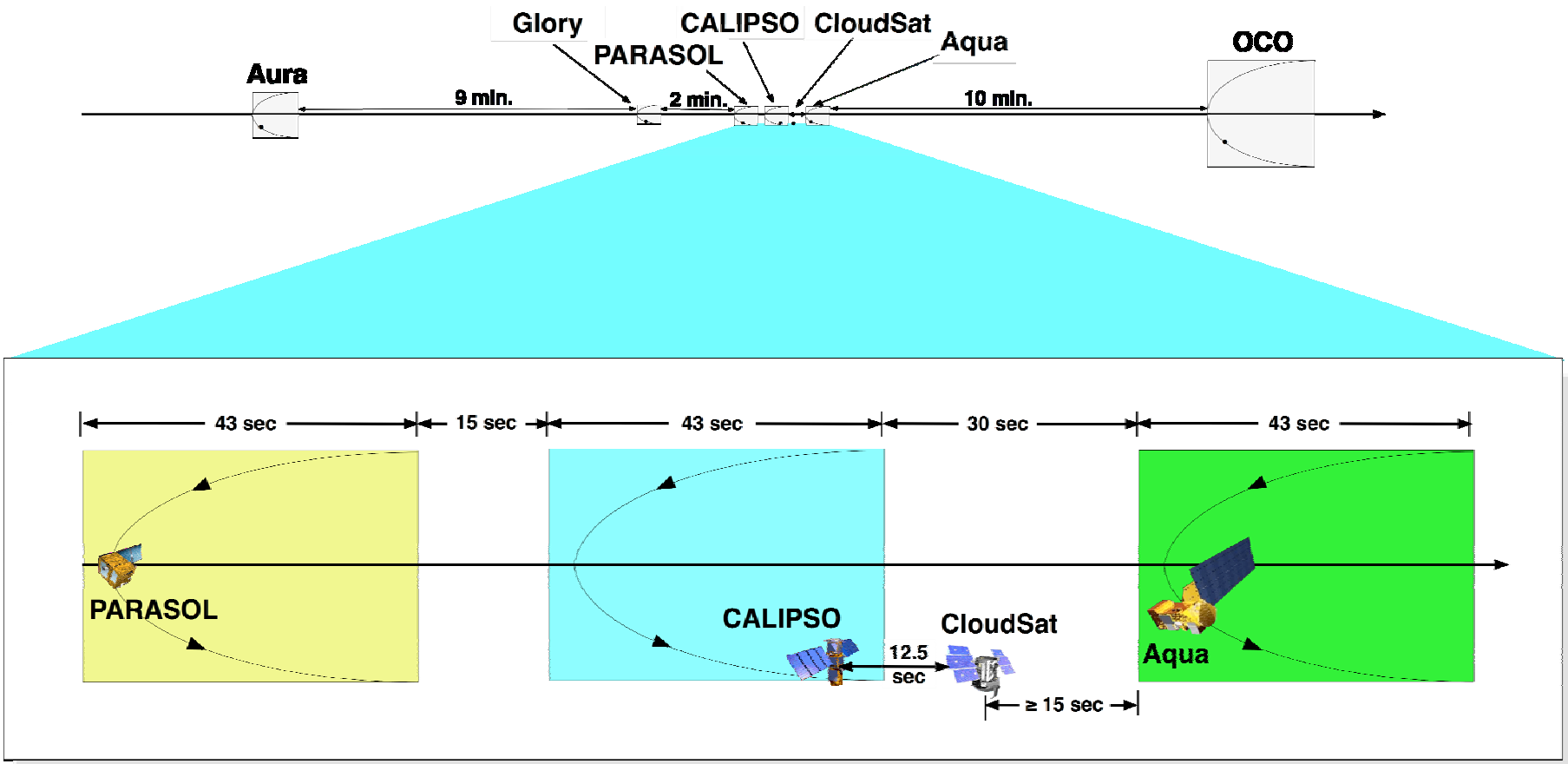
- Dual launch of two satellites from Vandenberg on a single Delta rocket
- Launch was delayed several months:
  - Boeing strike (ended on February 1).
  - Delta range safety battery (replaced with similar battery from an ATLAS).
- CloudSat & CALIPSO plan to exercise a paper simulation of ascent phase
- Expected Launch date: **April 20**

Afternoon Constellation
New Mission: Glory

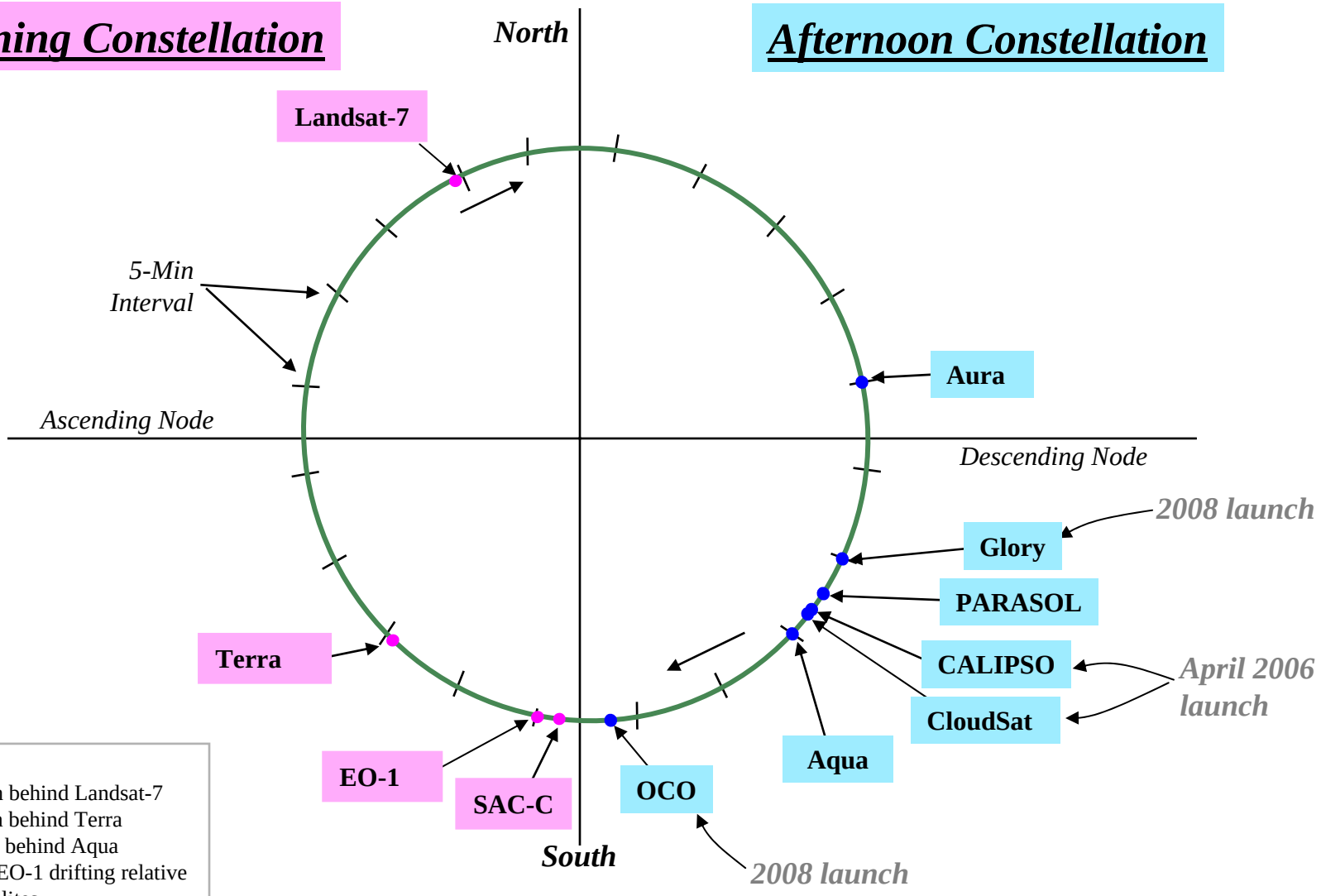
Background:

- **Originally planned to join NPP at 824 km**
- **Lifetime: 3 year requirement; 5 year goal**
- **Managed by GSFC; Integration by Orbital Sciences**
- **Mission Operations at OSC/Dulles facility**
- **Project Scientist: Dr. Michael Mishchenko**
- **Mission Objectives:**
  (1) Collect data on the chemical, microphysical, and optical properties, and spatial and temporal distributions of ***aerosols***; and
  (2) Continue collection of **total solar irradiance** data for the long-term climate record.
- **Two instruments:**
  – Aerosol Polarimetry Sensor (APS)
  – Total Irradiance Monitor (TIM) (SORCE heritage)
- **Reviews:**
  – Spacecraft PDR (August 2005)
  – Confirmation Review (October 26, 2005)
  – Mission CDR (June 2006)

Afternoon Constellation Orbital Configuration with Glory



Morning & Afternoon Constellations Relative Positions of Satellites (one orbit) (From Ground Station Perspective)



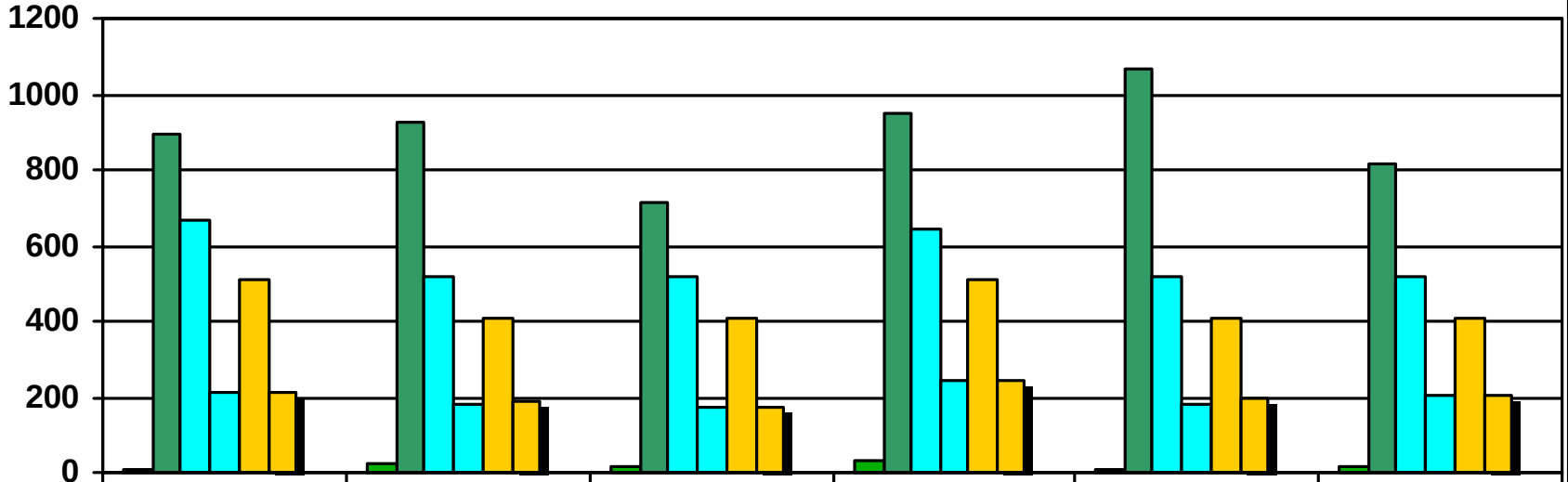
Notes:
- Terra 30 min behind Landsat-7
- Aqua 25 min behind Terra
- Aura 15 min behind Aqua
- SAC-C and EO-1 drifting relative to other satellites

Afternoon Constellation Inclination Maneuvers Coordination

- **Background**
  - Aqua is required to do inclination change by Spring 2007
    - Science requirement is driver
  - All Afternoon Constellation missions must follow Aqua
    - Coordination is necessary
- **Plans**
  - Aqua inclination maneuvers planned for late summer / early fall 2006
    - One burn per week for 6 weeks (starting the week of August 21)
    - An extra week at the end scheduled as backup
    - Total delta-i of approximately -0.0633 deg (8.49 meters/second)
  - Rest of Constellation to match Aqua's maneuvers
    - CALIPSO, CloudSat, and PARASOL working out the details

SN & GN Support for Terra, Aqua, & Aura

Contacts Supported During the Most Recent 6 Months



	Sep	Oct	Nov	Dec	Jan	Feb
Terra EPGN	11	22	17	30	10	17
Terra SN	893	925	717	947	1067	812
Aqua EPGN	667	519	515	643	519	520
Aqua SN	208	178	174	241	184	202
Aura EPGN	513	411	408	512	408	410
Aura SN	213	189	175	246	194	205

SN & GN Support for Terra, Aqua, & Aura

During this 6-month period, the 3 EOS Missions conducted a total of …

13,922 events !

(EPGN & SN combined)

Of these, there were only 156 documented anomalies related to either site or network issues.

<u>That calculates to a **98.9**% success rate.</u>

EDOS Reengineering
2005 Activities

- **Deployed new systems at the remote sites:**
  - EDOS data capture systems provided by Kongsberg Spacetec
  - EDOS Ground Station Interface Facility (GSIF) at the Wallops Flight Facility for Aqua, Aura, and EO-1.
  - Autonomous X-band data capture system (data logger) at White Sands for Terra
    - No more tape operations.
- **Migrated from clock/data lines to IP data transfers (Norway and Wallops only).**

EDOS Reengineering Plans for 2006

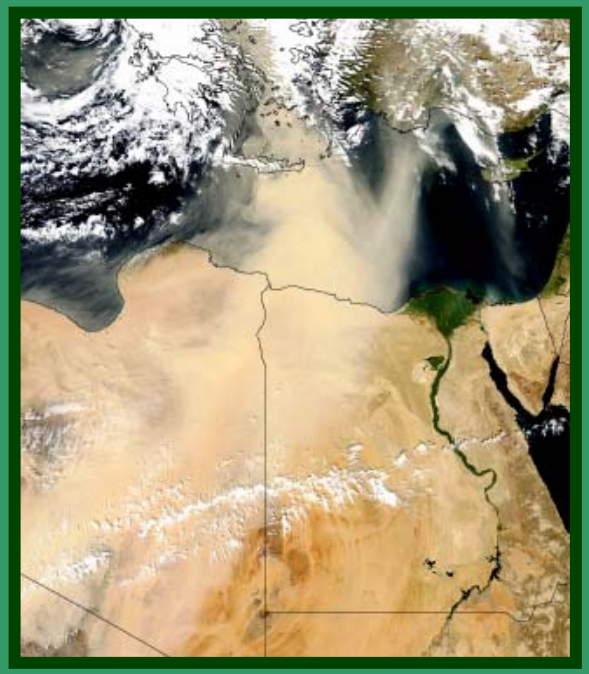
- Complete migration from clock/data lines to IP data transfers for Alaska & White Sands (DONE - March 2006)
- Implement Data-Driven concept
  - Current method relies on schedules
- Implement “EDOS-in-a-Box” architecture
  - Provides option to deliver near-realtime data sets (and in special cases, production data sets) directly from the remote sites.
  - Supports the remote control center concept for data production in case of a GSFC emergency.
  - Supports dump rates greater than 150 MBPS
  - Enables full automation

MODIS Imagery

Hurricane Katrina

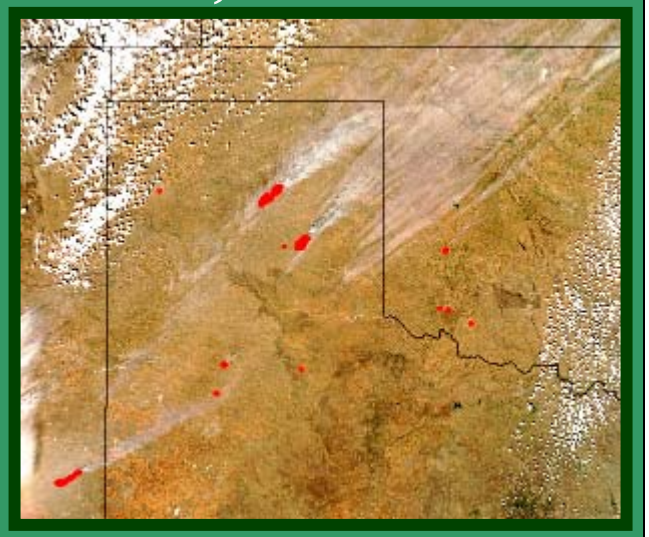
August 27, 2005

Dust storm in north Africa



February 24, 2006

Fires in Oklahoma, Texas, & New Mexico



March 12, 2006

Space Science Mission Operations Project (Code 444)

Patrick Crouse
Project Manager (Acting)
Vacant
Deputy Project Manager

Bonnie Matters
Mission Business Manager

Joseph Fainberg
Senior Project Scientist

March 23, 2006

SSMO Significant Events

- IMAGE Loss of Contact
- Senior Science Review
  - Sun Solar System Connections (S^3C)
  - The Universe
- FUSE Return to Science Operations
- Swift Science Highlights
- Upcoming Launches

IMAGE Loss of Contact

IMAGE successfully completed 2-Year prime mission and >3.5 years of extended operations

- Launched March 25, 2000
  - Successfully completed 2-year prime mission phase and >3.5 years of extended operations
- Last nominal contact was on December 18 from 0640 to 0740z at station DS34. All commands and responses verified as nominal
- Scheduled contact on December 18 at 1515z at DS34 was a negative acquisition with no RF detected. Switched to DS44 with same result
- Commands were repeatedly sent in the blind to reconfigure the RF system at different data rates and antenna configurations, all with no success. The spacecraft Power Distribution Unit (PDU) was commanded reset. Allowed the 72-hour hardware timer to expire which would reboot the spacecraft, with no change. Used a 70-meter antenna, still no RF signal detected
- Currently executing tests to attempt to isolate the fault
  - Air Force assets used to verify spacecraft spin rate and skin temperature
  - Sent commands to increase spacecraft spin rate
  - Subsequent observations have been impacted by weather
- Review Board findings are scheduled to be presented on 4/21/2006

Senior Science Review

- **Sun Solar System Connections (S^3C) Senior Science Review**
  - **Considered the science proposals for 13 missions**
  - **Provided guidance for continued operations based on:**
    - Scientific Merit
    - Relevance to the S^3C Roadmap
    - Spacecraft and instrument health and status,
    - Data availability and accessibility, education and public outreach (E/PO)
    - Cost

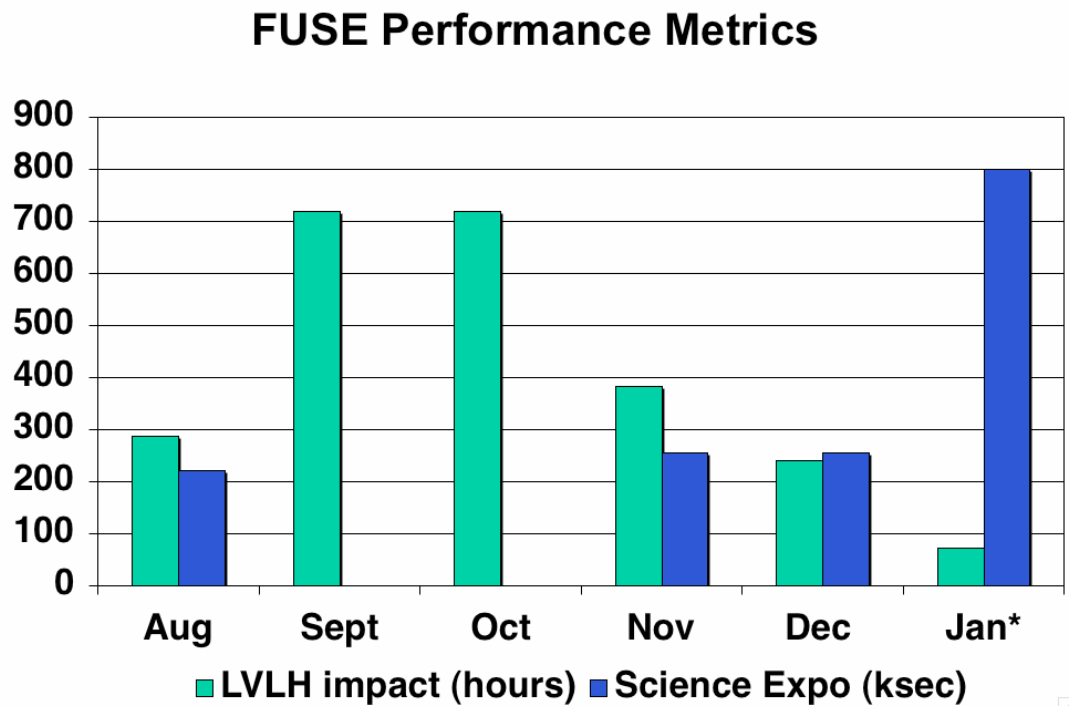
Mission	Scientific Merit	Roadmap Relevance	Operations Guidance
ACE	Excellent	Compelling	2010
Cluster II	Compelling	Compelling	2010
FAST	Excellent	Excellent	2008
Geotail	Excellent	Excellent	2008
Polar	Excellent	Excellent	2007
RHESSI	Compelling	Compelling	2010
SOHO	Excellent	Compelling	2010*
TIMED	Excellent	Excellent	2010
TRACE	Excellent	Compelling	2009
Wind	Excellent	Excellent	2010

Senior Science Review

- The Universe Senior Science Review
  - Assess scientific merit of eight missions
    - FUSE, GALEX, RXTE, Swift, WMAP
    - US Components on INTEGRAL, Suzaku, and XMM-Newton
  - Proposals were due March 20, 2006
  - Panel will convene April 26-28, 2006
  - Results will be announced June – July, 2006

FUSE Returned to Science Operations

- Observing efficiency increasing since science operations resumed November 1, 2005
  - Observation time in January was at a level consistent with the average for the life of the mission
  - Time spent in Local Vertical Local Horizontal (LVLH) mode has been reduced significantly
- Further improvements in one-wheel science operations are expected
  - Target planning software that considers spacecraft momentum management
  - Development of a Momentum Management Intervention mode (done)



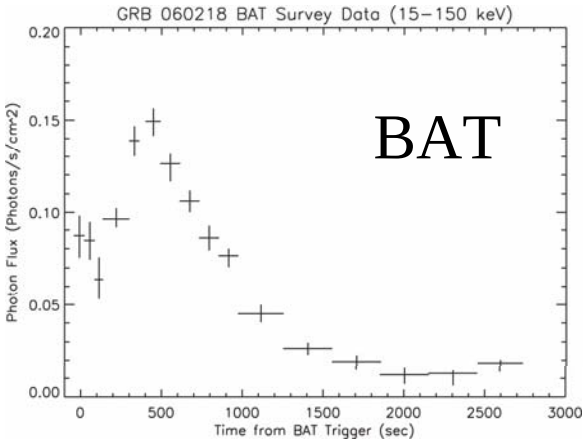
Swift Science Highlights

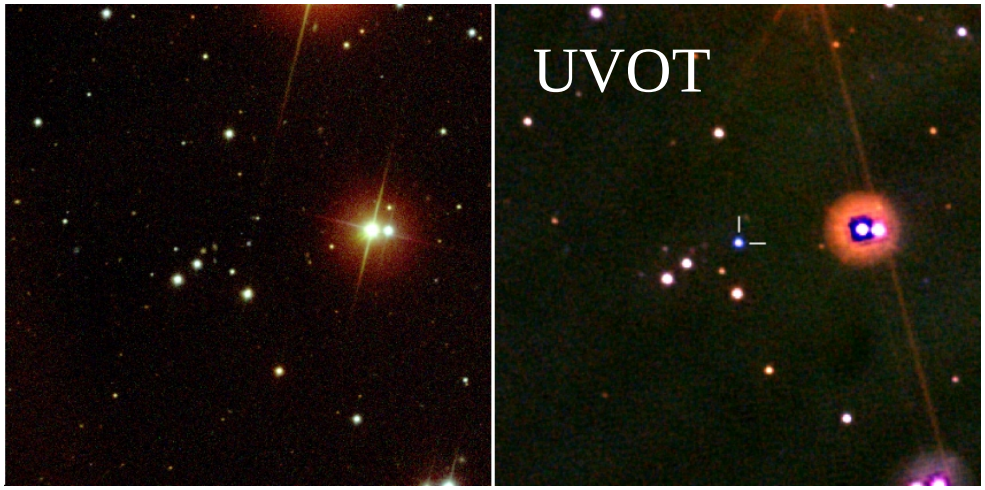
"Best of What's New 2005" Popular Science magazine

- Detecting about 100 GRBs per year
- Discovered the farthest GRB ever seen
- Identified counterparts to short GRBs
- Explored a brand new time interval in GRB light curves (which revealed the unpredicted phenomena of GRB flares and rapid X-ray afterglow declines)

Swift GRB 060218

- Swift detected a remarkable GRB on Feb. 18
  - Longest burst ever seen: 35 mins (c.f. 20 sec typical)
  - More X-rays than gamma rays
  - Nearest Swift GRB by factor 25 (distance 400 million lt yrs)
- Supernova SN2006am was discovered coincident with the GRB
- More than 30 observatories are monitoring this unusual Type Ib/c "hypernova"
- Extensive press coverage in print, TV and radio





Upcoming Launches

- **Communication/Navigation Outage Forecasting System (C/NOFS)**
  - The launch of the Communication/Navigation Outage Forecasting System (C/NOFS) has slipped indefinitely due to an issue with the solar arrays on the spacecraft.
    - The C/NOFS Program Cooperative effort between NASA Code S and AFRL and SMC/Det 12. The primary objective of C/NOFS is to develop the capability to forecast the onset of equatorial ionospheric irregularities causing scintillations that degrade the performance of communication, navigation, and surveillance systems that rely on Trans-ionospheric radio wave propagation.
    - C/NOFS will utilize the "DAS ALL" MA return service on a 24/7 basis at 20 kbps to receive science data in real-time.
- **Space Technology-5 (ST-5)**
  - The Space Technology-5 (ST-5) is a new Millennium Project with a primary mission to provide a technology demonstration of various spacecraft subsystems and constellation technologies including the use of a new technology X-band transponder. These technologies will lead towards constellations of smaller and lower power spacecraft. The ST-5 constellation will consist of three identical spin-stabilized spacecraft following the same orbital path.
    - The Deep Space Network and McMurdo will provide X-band support to the mission that is scheduled to launch on March 22nd.

Upcoming Launches

- **Solar TErrestrial RElations Observatory (STEREO)**
  - The third mission in NASA's Solar Terrestrial Probes program (STP). This two-year mission will provide a unique and revolutionary view of the Sun-Earth System.
  - Currently scheduled to launch aboard a Delta II from the Cape NET July 22nd
- **Aeronomy of Ice in the Mesosphere (AIM)**
  - The AIM satellite mission will explore Polar Mesospheric Clouds (PMCs), also called noctilucent clouds, to find out why they form and why they are changing.
  - AIM is currently scheduled to launch on a Pegasus from VAFB on September 29th.
- **Time History of Events and Macroscale Interactions During Substorms (THEMIS)**
  - THEMIS answers fundamental outstanding questions regarding the magnetospheric substorm instability, a dominant mechanism of transport and explosive release of solar wind energy within Geospace.
  - Currently scheduled to launch on a Delta II from the Cape NET October 19th.
- **SOLAR-B**
  - A joint cooperative between NASA, JAXA and the United Kingdom will perform imaging of the Sun. The mission consists of a coordinated set of optical, EUV and X-ray instruments that will investigate the interaction between the Sun’s magnetic field and its corona.
  - Currently scheduled to launch from Japan with a window from September 23 - 30, 2006

Human Space Flight (HSF) Integrated Network Status

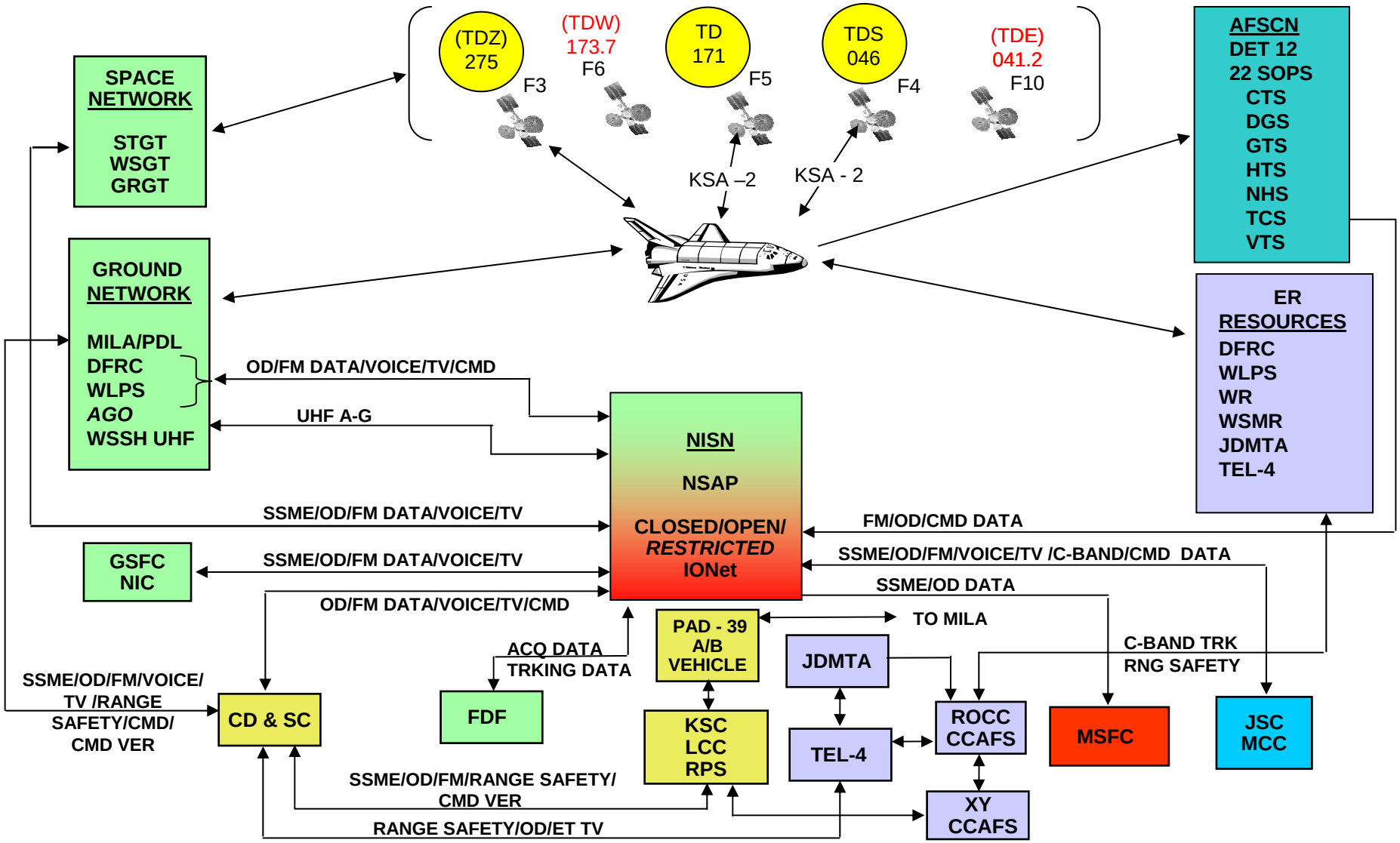
March 23, 2006

Cheryl Smith
Advanced Mission Planning
Human Space Flight Team
Honeywell Technology Solutions Inc.
NASA/Goddard Space Flight Center

Agenda

- **Integrated Networks Overview**
- **STS Support Plans**
  - **Upcoming STS Missions**
  - **Ground Network Changes and Upgrades**
  - **Space Network Changes and Upgrades**
  - **TDRS Constellation**
  - **External Integrated Elements**
- **International Space Station (ISS) Status and Plans**
  - **Soyuz 12 Early Orbit Contingency Support**
  - **Space Video Gateway Testing**
  - **Visiting Vehicle Status/JEM**
  - **NASA VHF Support**

Space Shuttle Integrated Networks Overview



STS Support Plans

- **Upcoming STS Missions (dates are No Earlier Than [NET])**
  - **STS-121/ISS ULF-1 NET 07/01/06**
    - **11 day mission for Discovery**
    - **Augment the Station crew, a third astronaut from the European Space Agency (ESA)**
    - **Multi-Purpose Logistics module (MPLM) (Leonardo) logistic replenishment mission**
    - **3 EVA's scheduled**
    - **Test the robotic arm as a work platform**
    - **Work with the adhesive for tile repair on purposely damaged tiles**
    - **Test techniques for inspecting and repairing the reinforced carbon-carbon segments of the nose and wing leading edge**
    - **ORR tentatively scheduled for 5/17/06**

STS Support Plans (cont'd)

– **STS-115/ISS 12A NET 08/28/06**

- **11 day mission for Atlantis**
- **Primary payload two new truss segments and two new solar arrays**
- **4 EVA's scheduled to install the new truss segments and solar arrays**

STS Support Plans (cont'd)

- **Ground Network Changes and Upgrades**
  - **Dryden Flight Research Center (DFRC)**
    - **Aeronautical Tracking Facility (ATF)-1 and 2 upgrades (7-meter systems) include replacing pedestals, upgrading LNAs/RF switches/uplink amps, and adding UHF/VHF antennas**
    - **ATF-3 upgrade (4-meter rooftop antenna) includes adding command capability**
    - **ATF-1 and 3 planned to support a 07/06 STS-121 launch**
    - **ATF-3 upgrade in progress now, scheduled for completion by 05/06**
    - **ATF-2 upgrade scheduled to start in 07/06 and ATF-1 scheduled for 09/06**
  - **Wallops (WPS)**
    - **9-meter antenna scheduled for deactivation end of this fiscal year**
    - **11 meter system being upgraded to support Shuttle**
      - **Successful RF testing occurred the week of 02/13/06**
    - **Nominal support configuration will be used for a 07/06 STS-121 launch**
      - **9-meter antenna will be prime for STS-121, 7.3-meter antenna will be backup**
    - **11-meter will "shadow" the STS-121 launch and on-orbit engineering test passes will be supported with JSC during the mission**

STS Support Plans (cont'd)

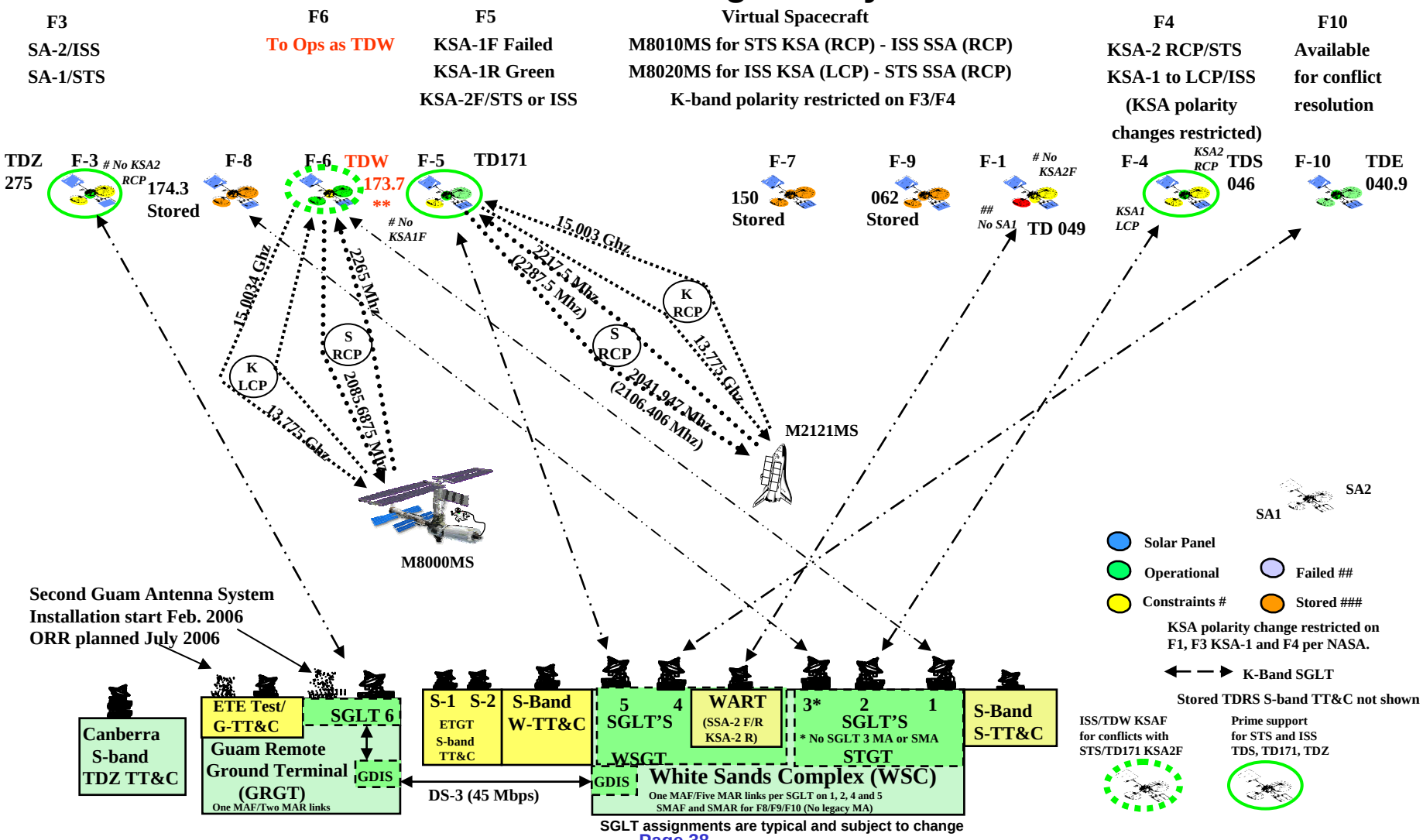
- **Ground Network Changes and Upgrades (cont'd)**
  - **Santiago (AGO)**
    - **9-meter system will be used to provide FM dumps/commanding (via PTP)**
    - **Successfully supported on-orbit engineering test (downlink only) during STS-114; data was played back to JSC at reduced rate due to bandwidth limitations**
    - **Implementation of T-1 interface on Restricted IONET currently in work (tentative completion date of 06/06)**
    - **Pending implementation of T-1 may support on-orbit engineering test passes with JSC during the STS-121 mission**
  - **NTR (NSAP Technology Refresh)**
    - **Network verification/validation testing will be completed with each site post-transition**
    - **Once all sites have transitioned, plan to perform Integrated Network Launch/Landing simulation**
      - **Coordinating with NISN to include forced failovers/re-routing during testing)**

STS Support Plans (cont'd)

- **Space Network Changes and Upgrades**
  - **TDRS-6 to replace TDRS-8 as TDW**
    - **SN ORT to be scheduled with JSC to validate the change**
    - **TDRS-6 had been TDS until 05/05, has supported prior STS/ISS missions**
  - **GDISR (Guam Data Interface System Replacement) installation planned for 05/06**
    - **Current GDIS is a single point of failure for circuitry between Guam and WSC as well as being obsolete**
    - **New design will have A and B sides, configured for data on both DS-3's simultaneously and will also include the encryption capability**
    - **For STS-121, Shuttle video will remain on legacy system; data may be on GDISR**
    - **GUAM ORT to be scheduled with JSC to validate the change**

TDRSS Constellation

TDRS STS/ISS Coverage – July 2006 Plan



SGLT assignments are typical and subject to change

STS Support Plans (cont'd)

- **External Integrated Elements**
  - **OAS to Schriever Transition**
    - **Implementation of interface underway, 3 T-1s and 2 SCDs (prime and backup) have been installed to date**
    - **Connectivity beyond carrier demarcation point has not taken place due to contractual issues**
    - **Expect to support 07/06 STS-121 launch with existing interface through OAFS**
  - **Kennedy Forward/Return Link (KFRL)**
    - **New system will be installed at KSC/LCC (Kennedy Space Center/Launch Control Center)**
    - **Replacement for MILA processing of commands and telemetry**
    - **Supports KSC Launch and Landing operations, testing, and Emergency Mission Control Center capability for Space Shuttle when required**
    - **Vendor factory acceptance testing utilizing the PSS (Portable Spacecraft Simulator) may occur if schedule allows; currently scheduled for first two weeks in 06/06**

International Space Station Status (ISS) Status and Plans

- **Soyuz 12 early orbit contingency support**
  - **Launch scheduled 3/30/06**
  - **Docking 4/01/06**
  - **Expedition 13 crew to replace Expedition 12 crew and deliver fuel/supplies**
- **Space Video Gateway (SVG) Testing with JSC ESTL via TDRS**
  - **Several on-board cameras including a high definition camera will downlink as a single packetized stream on one channel of the HRFM (High Rate Frame Multiplexer) utilizing the ISS K-band downlink for transmission via the IDEA Network**
  - **Successful testing conducted on 3/16/06 and 3/17/06**

International Space Station Status (ISS) Status and Plans (cont'd)

- **Visiting Vehicle Status**
  - **ATV (Automated Transfer Vehicle)**
    - **SVT 5 (System Validation Test) will be conducted one month prior to launch**
    - **Launch scheduled for NET 05/07**
  - **HTV (H-II Transfer Vehicle)**
    - **HTV Category 2 TDRSS Compatibility Testing utilizing the HTV simulator (at GSFC) NET 04/07**
    - **HTV Ground Segment Data flow (simulator at GSFC) NET 10/07**
- **JEM/ICS (Japanese Expansion Module/Inter-Orbital Communication System)**
  - **Waiting for the program decision to continue Ku/Ka support options**
  - **If program decides to continue, next opportunity for testing is in the 10/07 time frame (when module is at KSC)**

International Space Station Status (ISS) Status and Plans (cont'd)

- **CEV (Crew Exploration Vehicle)**
  - **Expect to start Advanced Mission Planning activities in the fall**
  - **Waiting for communications requirements to be defined**
- **NASA VHF Stations Emergency Communications Support Equipment Enhancement**
  - **Modular Receiver/Transmitter (MRT) module upgrade to improve frequency response and audio clarity**
  - **To be installed (WSC/DFRC/WLPS) after Soyuz 12 mission**

Space Network (SN)

Keiji Tasaki and Jon Walker
Space Network Project
Code 452
NASA/Goddard Space Flight Center

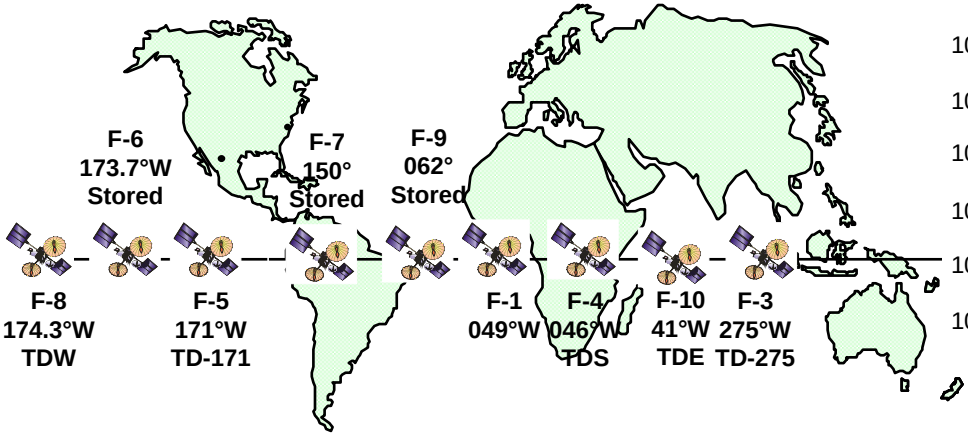
Space Network
Code 452

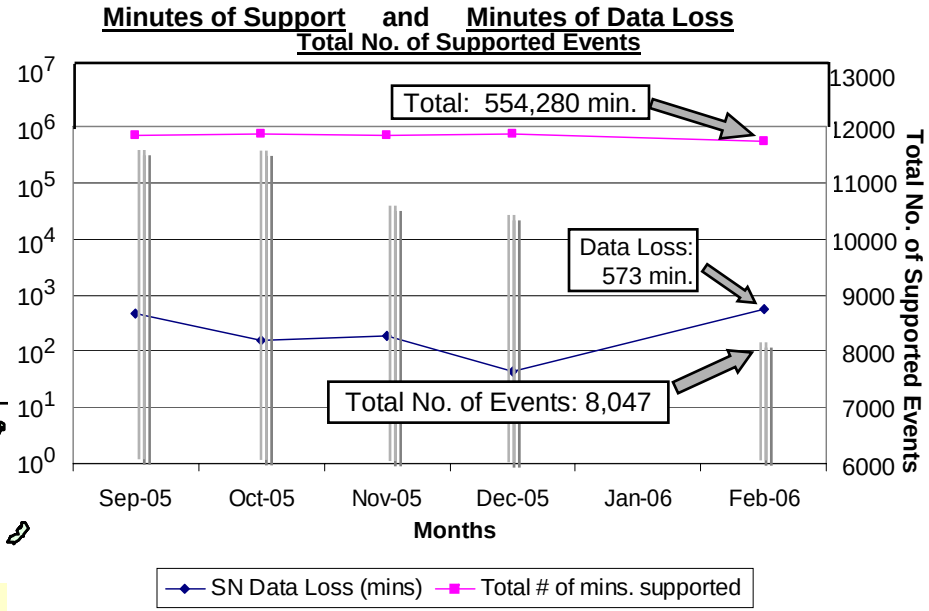
Project Manager:	Keiji Tasaki
Deputy Project Manager:	Jon Walker
Mission Business Manager:	Paula Tidwell
Prime Contractor:	Honeywell Technology Solutions, Inc. (HTSI)

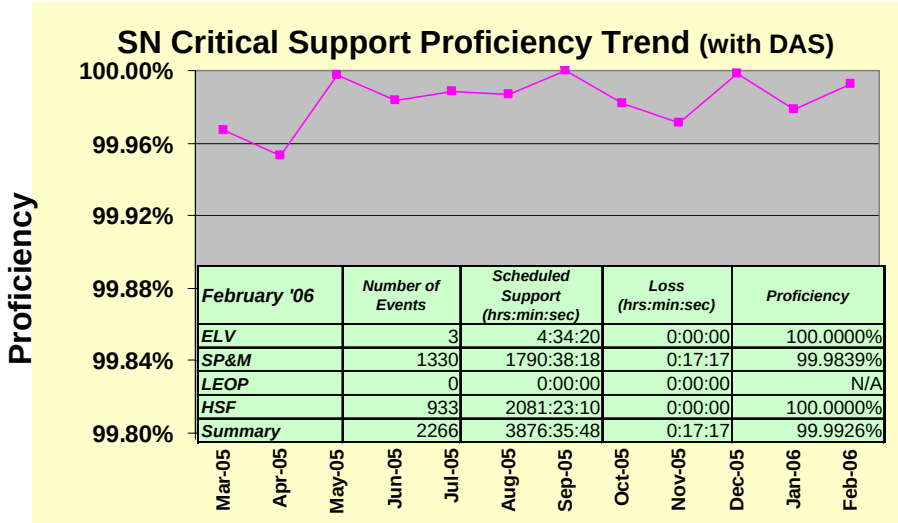
March 23, 2006

Service Metrics Summary

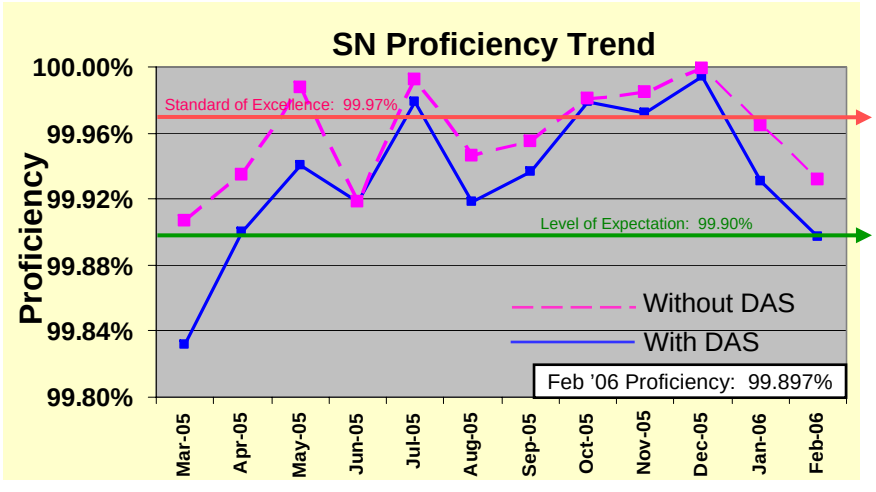
- **Space Network at a Glance**







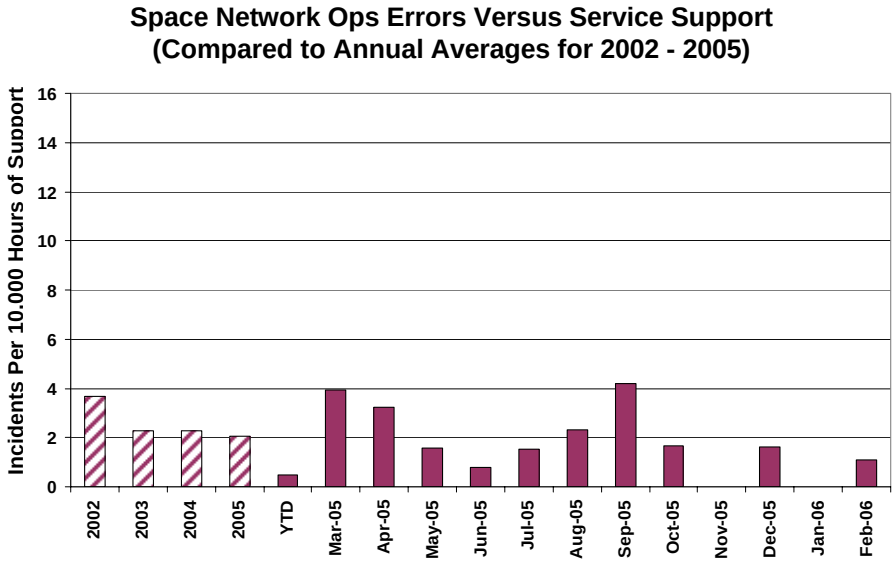
February '06	Number of Events	Scheduled Support (hrs:min:sec)	Loss (hrs:min:sec)	Proficiency
ELV	3	4:34:20	0:00:00	100.0000%
SP&M	1330	1790:38:18	0:17:17	99.9839%
LEOP	0	0:00:00	0:00:00	N/A
HSF	933	2081:23:10	0:00:00	100.0000%
Summary	2266	3876:35:48	0:17:17	99.9926%

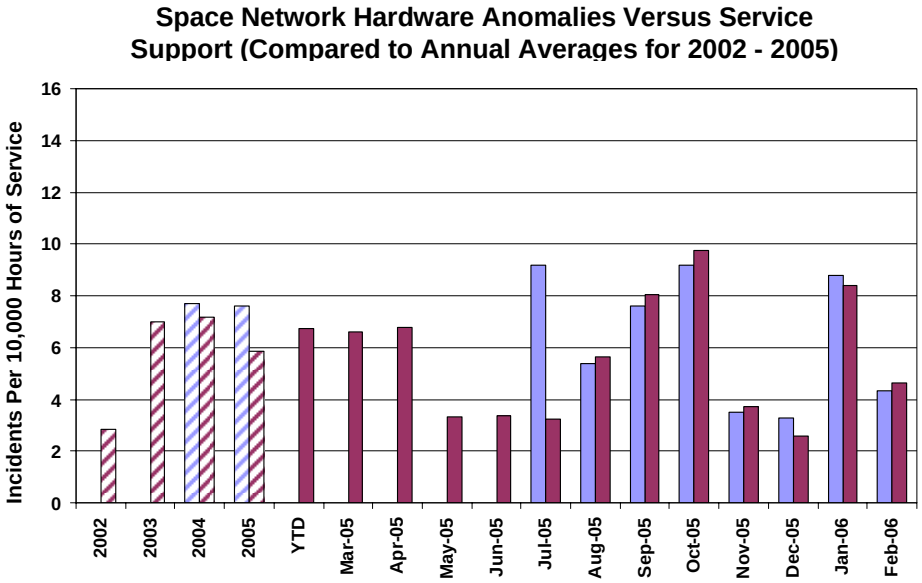


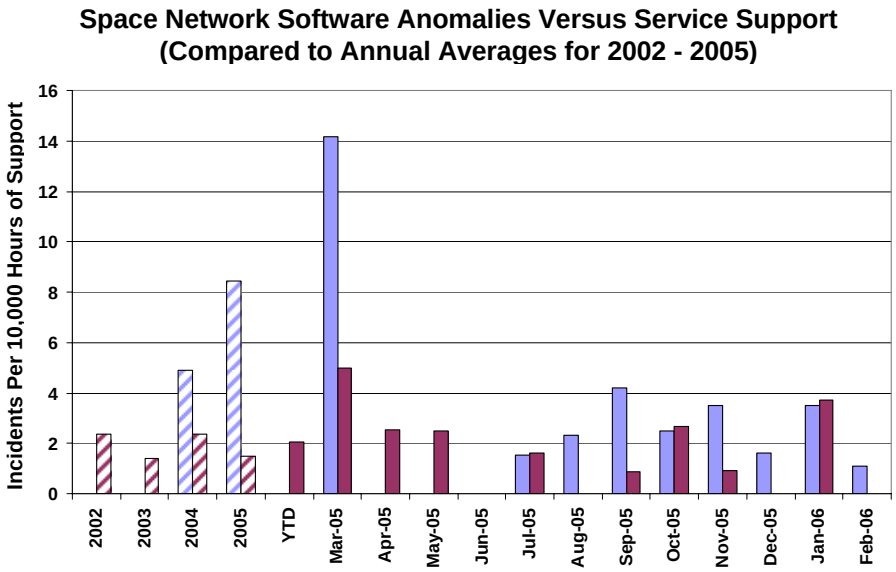
Missions	Total No. of Supported Events	Service Stat.	Proficiency (%)	Standard of Excellence (%)
Aqua, Aura, FUSE, GP-B, HST, ISS, L-5, L-7, SP&M, SPTR, Swift, TERRA, TRMM, XTE	8,047	9,247 hrs. sched 9,238 hrs. actual 9 hrs. 33 min. lost	99.90%	99.97%

Error Anomaly Trends

- **Space Network Error/Anomaly Trends**
  - Data loss errors only
  - Only three error/anomaly types used
    - Operator error
    - Software anomaly
    - Hardware anomaly
  - Normalized to 10,000 hours of support
  - Metrics applicable to historical data
  - The first four bars are for 2002, 2003, 2004, and 2005 respectively



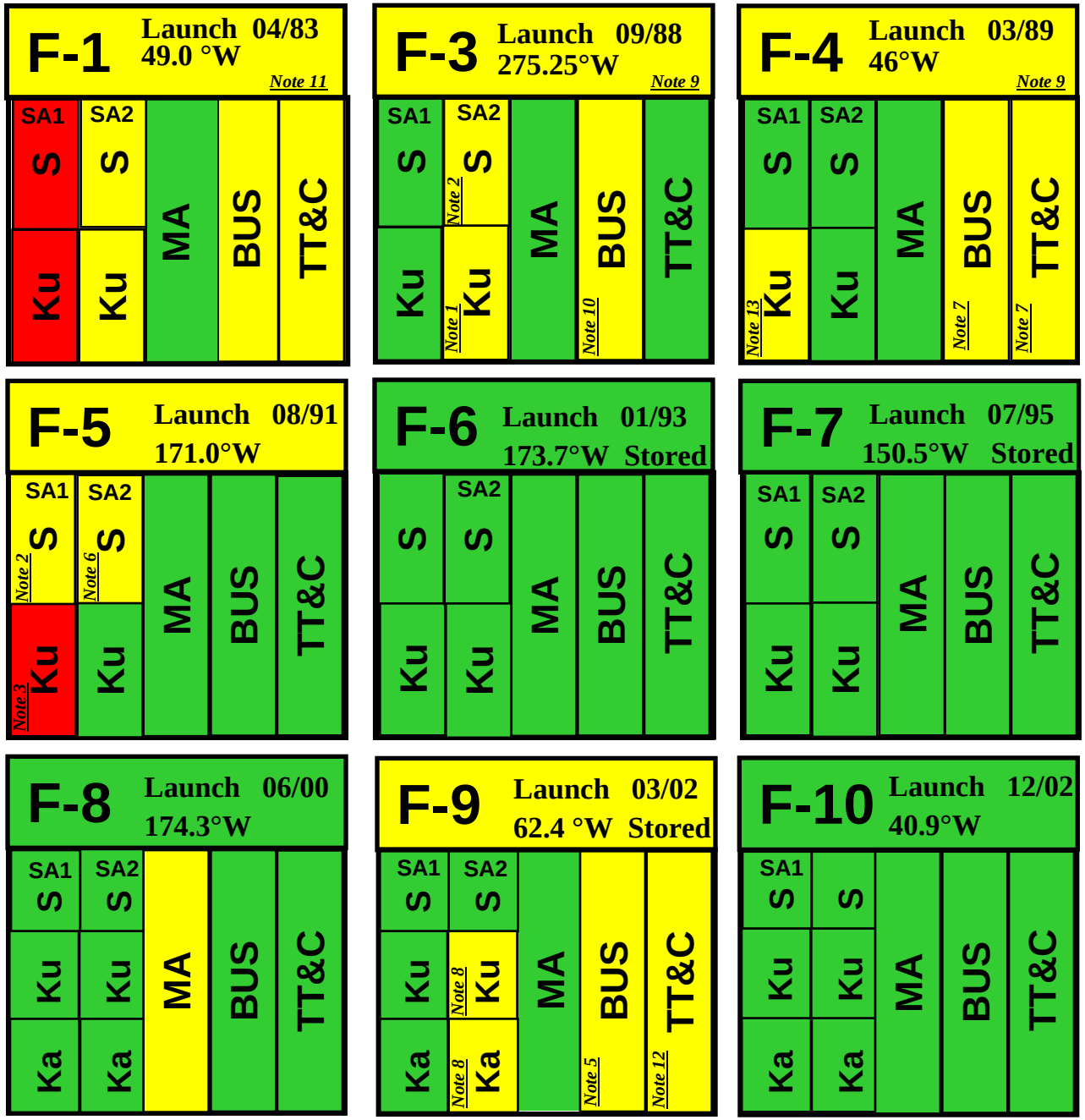




Anomalies without DAS

Anomalies including DAS

TDRS Constellation Health (As of 3/10/2006)



Indicates Updates & Changes

Indicates fully operational

Indicates backup unit(s) in use

Indicates failed subsystem

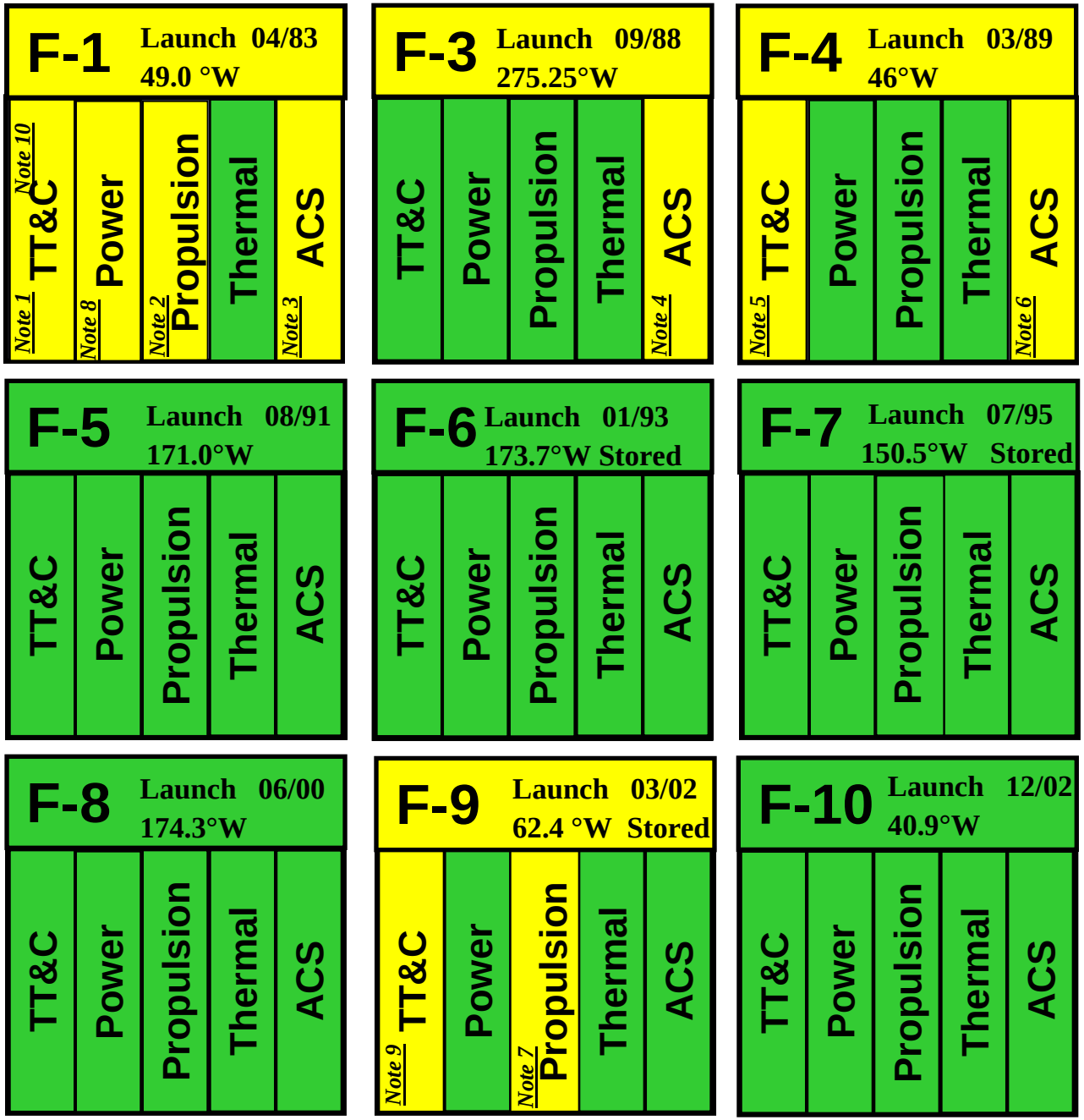
General Notes:

- One spare SGL TWTA on F-3 & F-4
- Ten-year design life for F-1 - F-7, 11 years for F-8 - F-10 and four years for on-orbit storage

Notes:

1. F-3 KSA2 polarization restricted to LCP, KSAR2 low performance; Redundant Ku-Band paramp selected to recover from switch anomaly
2. S-Band TWTA failed on F-3 (SSAF2), F-5 (SSAF1)
3. Both Ku-Band TWTA units on F-5 failed (KSAF1); Return available
4. F-8 MAR G/T shortfall
5. F-9 propulsion anomaly: failure of A-3 and W-2 thrusters
6. SSAR2 parametric amplifier failure on F-5
7. F-4 ESA and MFG LO failures
8. F-9 LO failure KSAR2
9. KSA Polarization services restricted on F-3 & F-4
10. F-3 Primary Coarse Sun Sensor Failure
11. F-1 SA2 SSAR & SSAF, KuSAR2 operational using WART
12. F-9 Primary Central Telemetry & Command Unit failure
13. F-4 KSA1F TWTA failure

TDRS Constellation Bus Health (As of 3/10/2006)



**Indicates Updates & Changes

Indicates fully operational

Indicates backup unit(s) in use

Indicates failed subsystem

General Notes:

- Ten-year design life for F-1 - F-7, 11 years for F-8 - F-10 and four years for on-orbit storage

Notes:

1. F-1: Transponder A unusable; no spare TWTA
2. F-1: A-side thruster manifold and –Roll thruster failed
3. F-1: CPE-A failed; Gyro 1/2 failed
4. F-3: Coarse Sun Sensor – A failed
5. F-4: MFG-A Tlm LO failed
6. F-4: ESA-A failed
7. F-9: Thrusters A3 & W2 failed
8. F-1 High Rate Charge capability from Battery 1 failed
9. F-9 Primary Central Telemetry & Command Unit failure
10. F-1 Telemetry Processor C/RCTU B failure

TDRS Constellation Status/Plans

1. Transition of a 2nd generation spacecraft to SNE
   - F-8 to transition in early May 2006, at which point F-6 will become operational for customer support
   - SGLT-7 testing with F-8 will start in June 2006
   - F-8 spacecraft needed at 271°W by August 2006
   - Until transition, F-8 will continue to provide user support
2. New Services/Testing
   - TDRS HIJ DAS testing (F-10) begins May 2006
   - TASS Demonstration (F-1) to begin in May 2006
   - JEM Ka-band testing delayed to Fall 2006 by customer

SGLT-7 & ECANS Status

- **Space Ground Link Terminal (SGLT) -7**
  - Part of the SN Expansion
  - Critical Design Review (CDR) 3/14-15/2006
  - Operational Readiness Review (ORR) 8/28/2006
  - Phased transitions complete 11/21/2007

- **Exploration, Communications and Navigation Systems (ECANS)**
  - The SN is defining upgrades and/or accommodations required for ECANS mission support
  - We expect significant work beginning in late FY06 and extending through FY07, FY08, and FY09
  - Intend to fold requirements into other SN sustaining and upgrade efforts

TDRSS High-rate Equipment Replacement and Enhancement

- Enhance the TDRSS KSA 225 MHz Return data service by adding the capability to process bandwidth efficient signal designs
  - OQPSK/TPC or LDPC - 150 Mbps to 410 Mbps
  - 8PSK/TPC or LDPC - 410 Mbps to 625 Mbps
  - Single Access Antenna Autotrack for new signal designs
- Replace Equipment nearing obsolescence
  - KSAR High Rate Equipment and High Rate Switches

1. SRR was held on 4/27/2005
2. WSC site visits by six potential vendors successful
3. Procurement to begin in FY07 and continue to FY08

BRTS Replacement Status

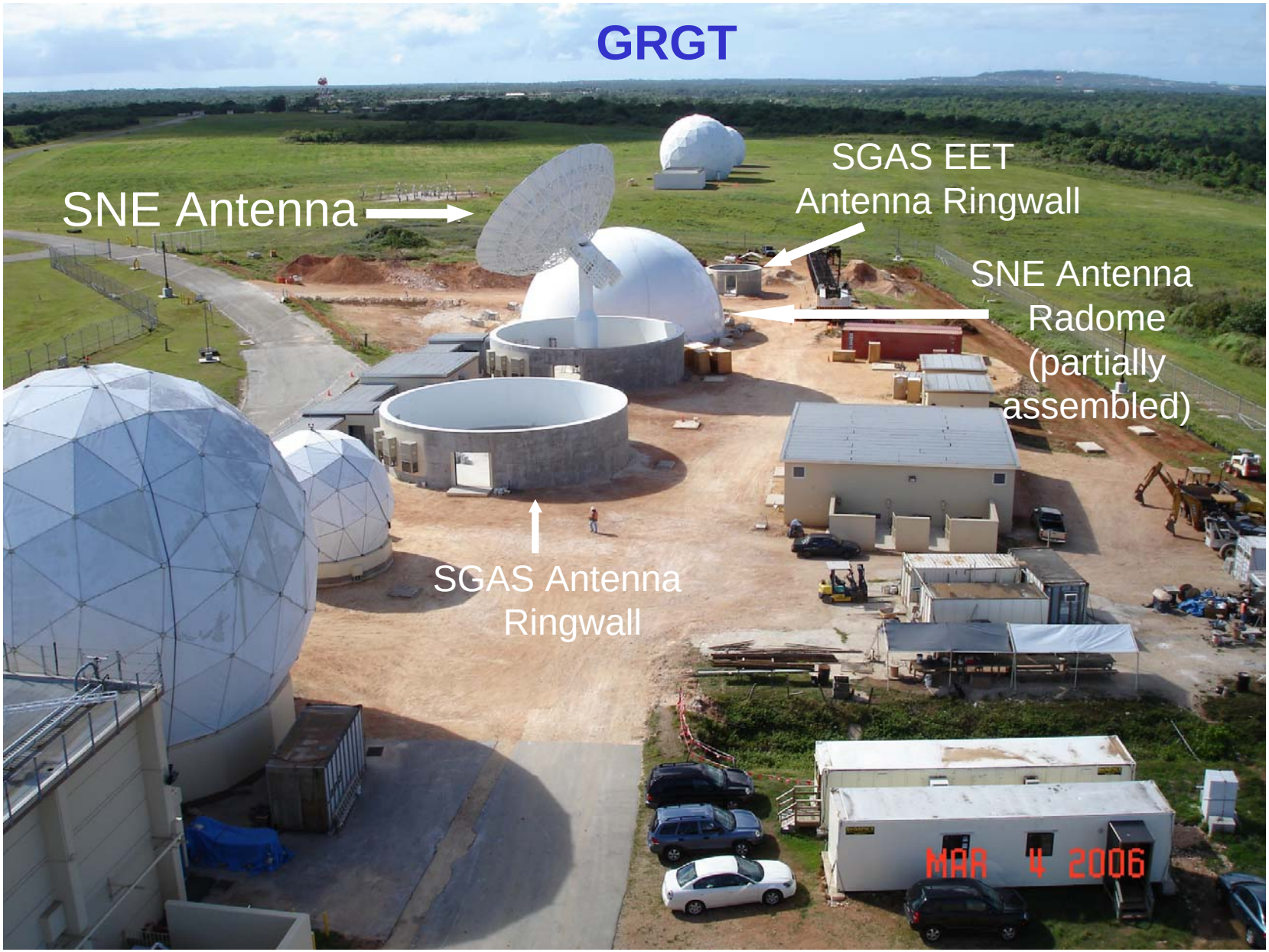
- Status
  - NASA directed NENS to purchase 3 units with option to buy 4 additional units
  - PDR was successfully held yesterday, March 22
- Schedule
  - System Requirements Review 3/3/2004
  - NENS Task Start 4/2005
  - Preliminary Design Review 3/22/2006
  - Critical Design Review 9/2006
  - Test Readiness Review 5/2007
  - Operations Readiness Review 7/2007

Second Guam Antenna System (SGAS) Status

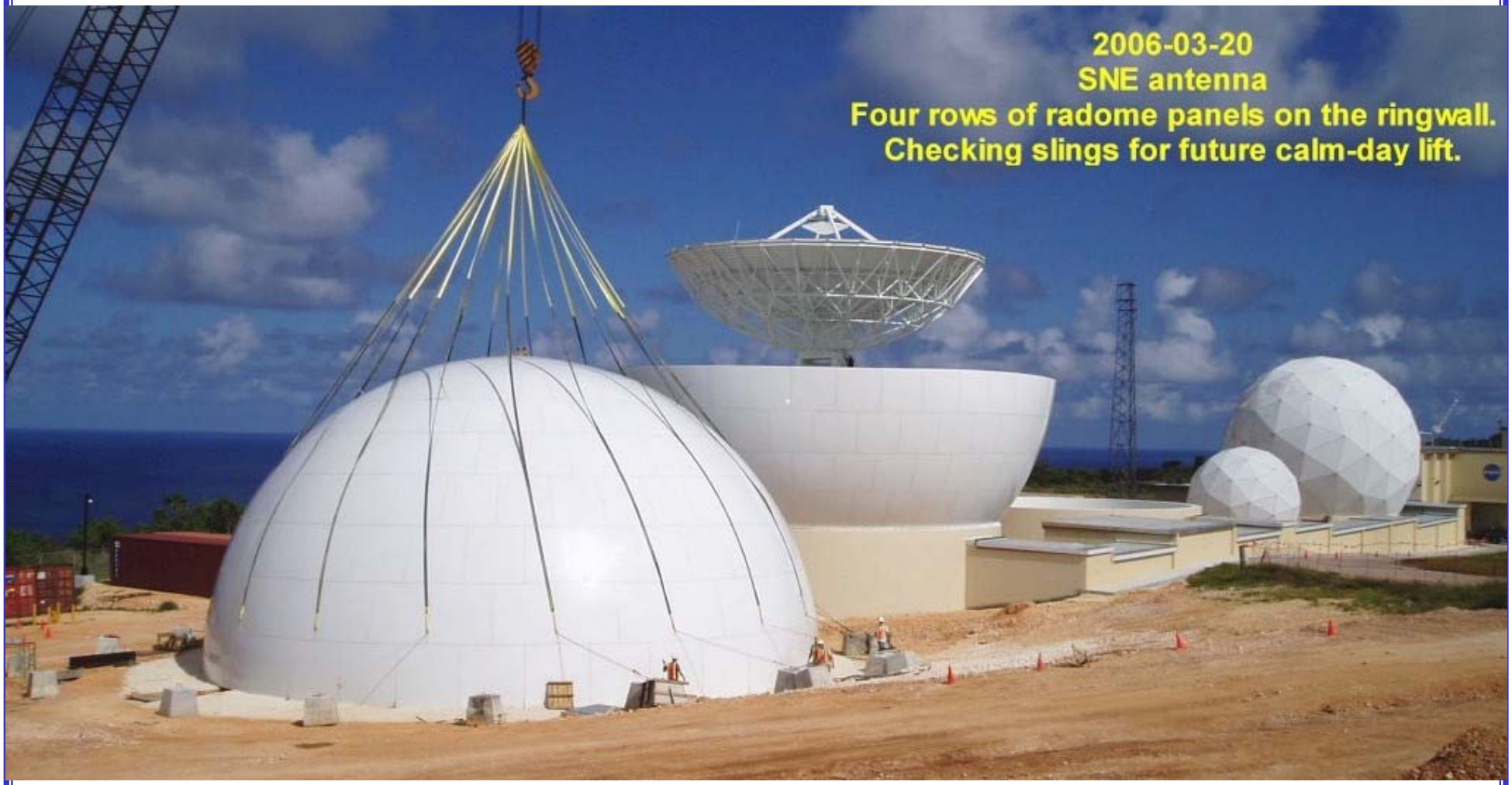
- **Status:**
  - Phase 1 Facilities mods - completed
  - Phase 2 Facilities construction - 93% complete
  - SGAS antenna and pedestal successfully completed pre-ship review and have been shipped to Guam
  - Working issue with radome not meeting 200mph wind spec
- **Schedule**
  - Phase 1 mods complete — June 2005
  - Phase 2 mods complete — June 2006
  - Installation/test of 16-m
  - Installation/test of 5-m
  - SGAS ORR

  } Weather hold

GRGT


SNE Antenna
SGAS EET
Antenna Ringwall
SNE Antenna
Radome
(partially
assembled)
SGAS Antenna
Ringwall
MAR 4 2006

SNE Antenna Radome



SNAS Objectives

- Provide a fully capable, low cost, easily integrated SN scheduling and real-time service monitoring and control interface
- Provide a network-based system incorporating features from the User Planning System (UPS), the SN Web Services Interface (SWSI) and other SN customer-required functionality
- Detailed presentation to follow

SNAS Status

• SRR	4/28/2005
• PDR	9/12/2005
• CDR	5/4/2006
• Implementation	8/2007
• ORR	12/2007

SNIS & Fast Forward Status

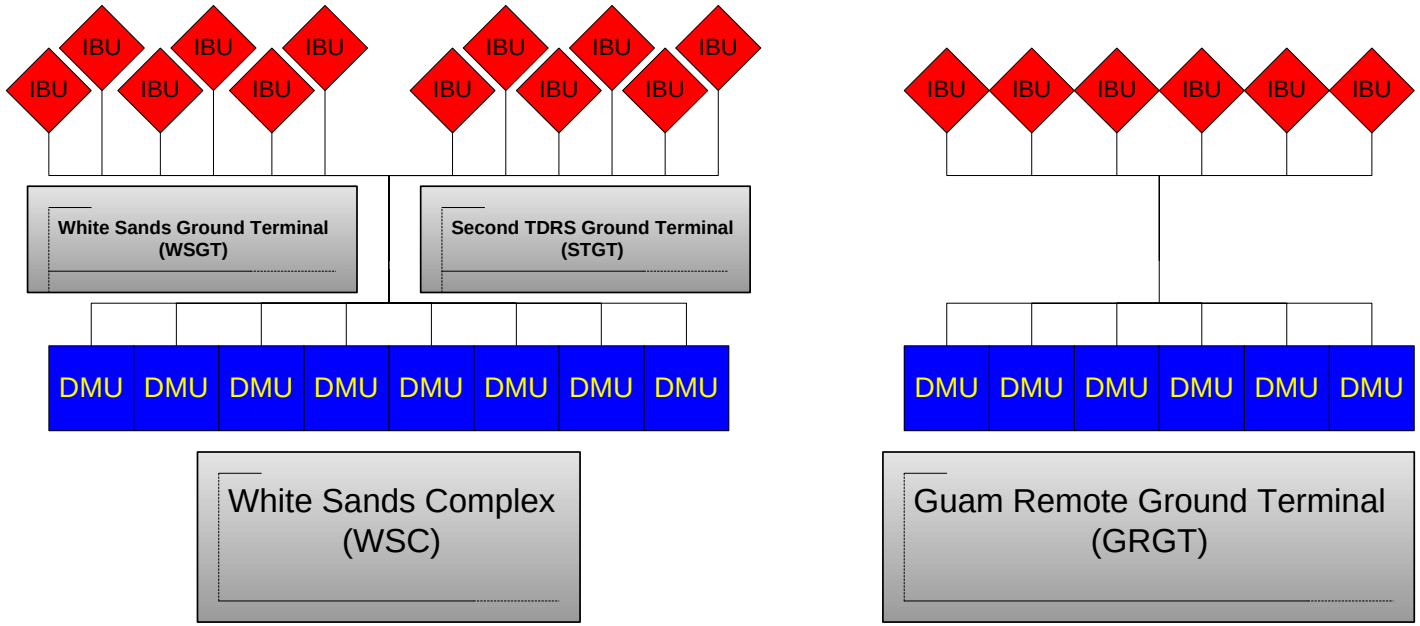
- **Space Network IP Services (SNIS) Product**
  - Systems Requirements Review (SRR): 3/30/05
  - Target Operational Date: TBD due to lack of funds
  - http://snis.gsfc.nasa.gov

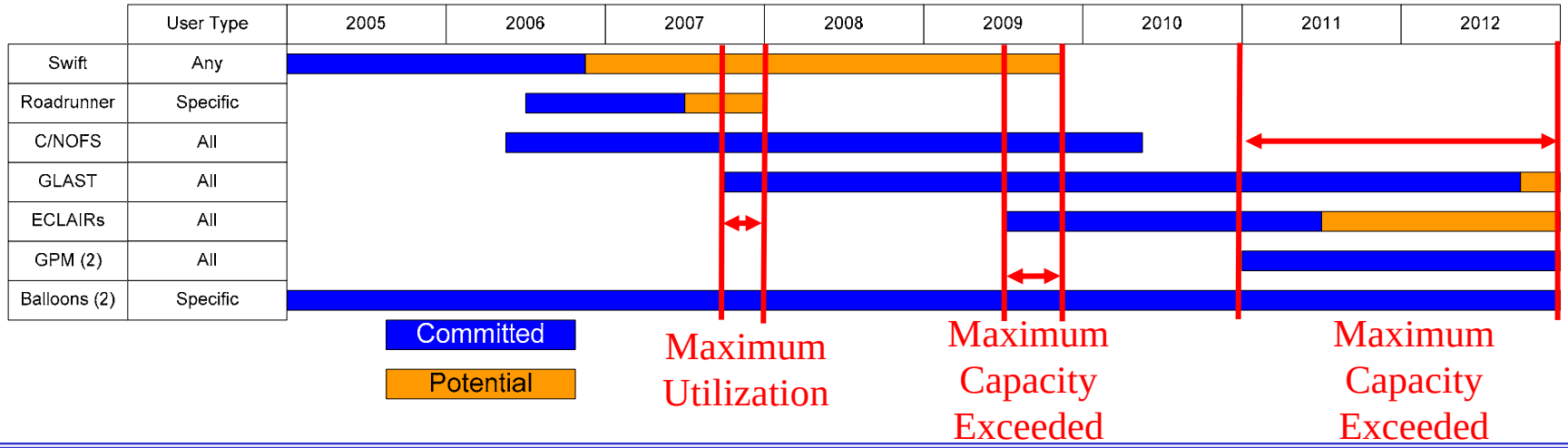
- **MA Fast Forward**
  - Concept Review : 7/26/05
  - System Requirements Review (SRR): 2/15/2006
  - Draft System Requirements Document 3/8/2006
  - Draft Operations Concept Document 3/13/2006
  - Target Operational Date: TBD due to lack of funds
  - http://fastforward.gsfc.nasa.gov

Demand Access System (DAS) Status

- DAS proficiency in support of Swift for February was 99.49%, lower due to occasional problems with the interface to the Programmable Telemetry Processor (PTP).
- Procurement of spares and the Guam replacement unit is in progress.
- Support of multiple/simultaneous missions will be a challenge, i.e., Swift and C/NOFS, plus balloons.
- Funding for the procurement of expansion units was put in FY07 and FY08 budget. DAS capacity maxes out in 2007, 2009, and 2011 on out.

DAS Architecture & User Timeline





Education & Public Outreach

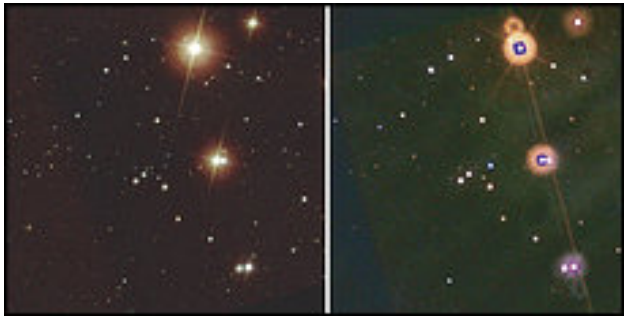
Demand Access System (DAS) at Work

A Cosmic Sequence Never Seen Before

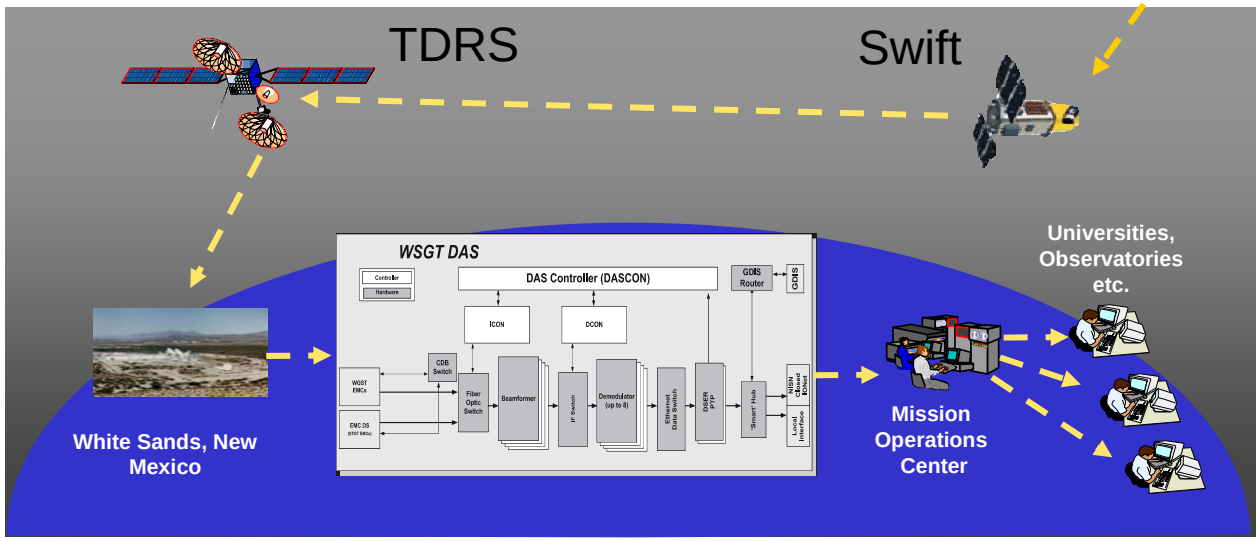
Gamma Ray Burst, Supernova Observed

By Guy Gugliotta
Washington Post Staff Writer
Tuesday, February 28, 2006; Page A06

An unusually long-lasting blast of radiation from a galaxy about 470 million light years away has given astronomers an unprecedented opportunity to view a supernova -- a cosmic explosion marking the collapse of a "supermassive star" -- from start to finish. This spectacular cosmic sequence began Feb. 18 when NASA's Swift satellite detected a jet of radiation, known as a long-duration gamma ray burst, coming from a galaxy in the constellation Aries. Within minutes, astronomers throughout the world had trained telescopes on the spot.



NASA's Swift satellite detected on Feb. 18 a jet of radiation known as a long-duration gamma ray burst. "Before," left, and "after" images are shown above. (Left, Sloan Digital Sky Survey Via Reuters; Right, NASA)



Education & Public Outreach

Space Operations Learning Center

The **Space Operations Learning Center** is a joint effort between two organizations at NASA Goddard Space Flight Center:

- The Educational Flight Projects Office (Code 870) provided the management oversight of the overall design and development of SOLC.
- The Space Network Project (Code 452) provided most of the funding and resources for the SOLC development.

Other organizations such as the Real-time Software Engineering Branch (Code 584) and the Goddard Education Office (Code 130) provided tremendous technical and consultation supports to this development effort.

We also work very closely with the Education Flight Projects Office and NASA Explorer Schools Office at NASA Headquarters.

SOLC Partners

Special thanks to Analytical Graphics, Inc. (AGI) for their generous supports. AGI provided the 3-D animations, software tools (such as STK, and AGI viewer), as well as technical supports at no cost to NASA.

http://solc.gsfc.nasa.gov

Space Network Access System (SNAS)

Space Communications

Customer Forum - 13

SN Project and the Customer Commitment Office
Damon Smith, *Booz | Allen | Hamilton*

SNAS Agenda

- SNAS Background
- SNAS Physical Architecture
- SNAS System Comparison with UPS and SWSI
- Project Schedule and Milestones
- Current Project Status
- Documentation Status
- Customer Liaison

SNAS Background

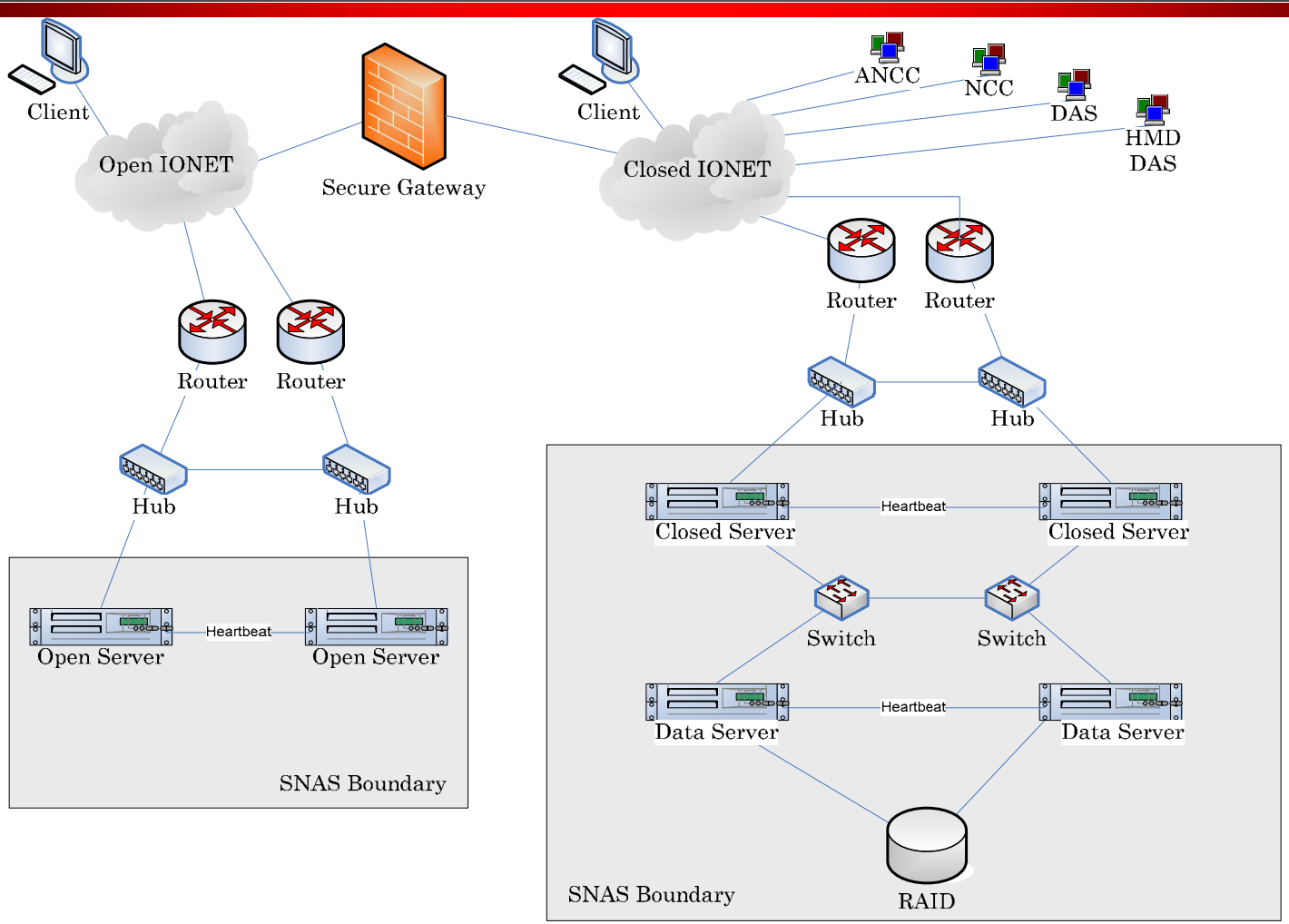
SN Vision:

- SNAS is envisioned as a network-based system providing a singular interface to SN for comprehensive NCCDS & DAS services
  - Planning/scheduling and real-time monitor & control
- Intended to provide a replacement for the User Planning System (UPS) and SN Web Services Interface (SWSI)

Major SNAS System Features:

- Distinct MOC Client and O&M Client applications
  - Written in Java for platform independence
  - Highly configurable interface to MOC External Processing Systems (EPS) to support existing operations and components
- SNAS Servers are collocated at WSC:
  - Local interfaces with NCCDS and DAS
  - Support customers on Open, Restricted, and Closed IONet
  - Web Server to provide TUT data access

SNAS Physical Architecture



The SNAS Architecture Supports High Availability Requirements & Provides Mission Data Assurance

Near Earth Networks Services

SNAS System Comparison with UPS and SWSI

Function	UPS	SWSI	SNAS
1 Process Schedule Messages	Yes	Yes	Yes
2 Process Real Time Messages	--	Yes	Yes
3 Accept external TSW Message	Yes	Yes	Yes
4 Create TSW from FDF orbital data	Yes	--	Yes
5 TDRS Unscheduled Time Message	Yes; graphically, filtered on TSW	Yes; simple text list	Yes; graphically, filtered on TSW
6 Support SGLT normal services	Yes	Yes	Yes
7 Support SGLT Shuttle Services	Yes	--	Yes
8 Support DAS services	--	Yes	Yes
9 Process Batch Schedule Requests	Yes	Yes	Yes
10 Schedule Generation engine	Yes	--	Yes
11 Schedule Conflict Resolution	Yes	--	Yes
12 Schedule Evaluation Tools	Limited	Limited	Yes; robust
13 Display Schedule Requests	Yes; graphical & textual, combined display of schedule requests/events	Yes; text only, separated into requested & confirmed windows	Yes; graphical & textual, combined display of all scheduled requests/events
14 Display TSW	Yes; graphical & textual	--	Yes; graphical & textual
15 Display potential conflicts	Yes; graphical & textual	--	Yes; graphical & textual
16 Support Type 1-8 vectors	--	Yes	Yes
17 Support Closed IONet missions	Yes	Yes	Yes
18 Support Open IONet missions	--	Yes	Yes
19 Support Restricted IONet missions	--	--	Yes
20 Syntax Validation	Yes	Limited	Yes
21 Support External Processing System	Yes	--	Yes
22 Support Lights Out functionality	--	--	Yes
23 Support GMSEC functionality	--	--	Yes*

*Note: Future development currently under study

Near Earth Networks Services

Project Schedule and Milestones

Milestone	Schedule
SRR	Completed 04/28/05
PDR	Completed 09/12/05
CDR	Scheduled 05/04/06
Implementation	August 2007
ORR	December 2007

Current Project Status – CDR Preparation

Major Detailed Design Activities:

- Integrated SWSI functions, UPS functions, and customer requested SNAS features
- Designed and prototyped the user interface
- Characterizing message content for internal interface
- Developing object classes – property, method, relationship
- Delineating database structure and schema

New SNAS Design Documentation:

- Composing System Design Specifications
- Drafting User's Guides

Documentation Status

SNAS Program Documents

System Requirements Document…….CCB Approved*

System Operations Concept Document……. CCB Approved*

System Security Plan…….....2nd draft in development**

DAS / SNAS Interface Control Document…….2nd draft in development**

EPS / SNAS Interface Control Document……...1st draft in development**

System Test Document……1st draft developed

Acceptance Test Document……1st draft developed

Customer Liaison Plan…….. NENS Approved

** DCNs will be issued prior to CDR to reflect changes due to delta-SRR & PDR RFA's*

*** To be boarded at CCB prior to CDR*

Customer Liaison - *Approach*

Requirements: End users were involved early to address customer requirements and to support:

- MOC operations
- Legacy MOC components
- Various MOC configurations
- O&M operations

Design: The SNAS prototype was presented to illustrate and negotiate design features

- Solicited design options during customer demonstrations

Testing: Planning to include customers in beta testing

- Validate EPS interfaces with existing MOC components

Customer Liaison – *Collected Inputs*

Group Customer Interface Meetings

- CIM #1 – April 13, 2005
- CIM #2 – June 14, 2005
- CIM #3 – August 25, 2005
- CIM #4 – January, 2006

Meetings with Individual Missions

- JSC, TX (HSF, Shuttle, ISS)
- JAXA (JSC Missions Coordination)
- GSFC & APL (GPM, R-XTE, EOS, TRMM, HST & STSCI, SP&M, GLAST)
- Raytheon, CO (NPOESS & Aura)
- Stanford University, CA (GP-B)
- WSC, NM (O&M Operations)

Meetings with Programs

- GMSEC, Restricted IONet, TKUP, SNIS, Security

Formal Customer Requests (RFAs)

- SRR, Delta-SRR on April 2005, PDR on September 2005

Customer Liaison – *Future Inputs*

Future Meetings with SNAS Community

- Seeking interested parties for beta testing (EPS interface, GMSEC interface)
- Supply advanced copies of the SNAS User's Guide for review
- Collect inputs for the Implementation Plan (build content and release version)
- Offer SNAS user training
- Provide assistance with MOC Client configuration (EPS setup)

Customer Liaison - *Contact*

If you are interested in SNAS and would like to be involved in future SNAS engagements please visit the website and follow the Customer Input link.

Available on the SNAS website at http://snas.gsfc.nasa.gov

- **Download a prototype of the SNAS user interface**
- **Download current SNAS documentation**
- **Provide feedback**

Backup Slides

Acronym and Abbreviation List

Acronym and Abbreviation List (1 of 2)

ANCC	Auxiliary Network Control Center
BAH	Booz, Allen, Hamilton
CA	Certificate of Authority
CDR	Critical Design Review
CIM	Customer Interface Meeting
CLP	Customer Liaison Plan
CNE	Center Network Environment
COCOMO	Constructive Cost Model
COTS	Commercial-Off-the-Shelf
DAS	Demand Access System
DBMS	Database Management System
DSI	Delivered Source Instruction
EPS	External Processing System
EU	Electronic User
FTP	File Transfer Protocol
FP	Function Points
GCM	Ground Control Message
GCMR	Ground Control Message Request
GMSEC	GSFC Missions Services Evolution Center (Code 581)
GUI	Graphical User Interface
HTSI	Honeywell Technology Solutions Inc.
HTTP	Hypertext Transfer Protocol
ICD	Interface control Document
IIRV	Improved Inter Range Vector
IONet	Internet Protocol Operational Network
IT	Information Technology
ITT	ITT-SNAS System Engineering Contractor
JSC	Johnson Spaceflight Center
MOC	Mission Operations Control
NASA	National Aeronautics and Space Administration
NCCDS	Network Control Center Data System
NENS	Near Earth Network Services
NISN	NASA Integrated Services Network
NPOESS	National Polar-orbiting Operational Environmental Satellite System
O&M	Operations and Maintenance
OCD	Operations Concept Document
PAAC-II	Program Analysis and Control
PDR	Preliminary Design Review
PE	Prototype Event
PSAT	Predictive Satellite Acquisition Table
RCTD	Return Channel Time Delay

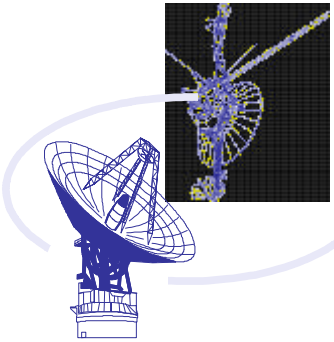
Acronym and Abbreviation List (2 of 2)

RFA	Request For Action
RR	Replace Request
RV	Requirement Volatility
SAR	Schedule Add Request
SCP	Space Communications Program
SDIF	SNAS DAS Interface
SDR	Schedule Delete Request
SHO	Schedule Order
SIC	Spacecraft Identification Code
SN	Space Network
SNAS	Space Network Access System
SNIF	SNAS NCCDS Interface
SP	Security Plan
SP&M	Special Projects and Missions
SPSR	Service Planning Segment Replacement
SRD	Systems Requirement Document
SRM	Schedule Result Messages
SRR	System Requirements Review
SRR	Schedule Result Request
SSC	Service Specification Code
SSL	Secure Socket Layer
SUPIDEN	Support Identifier
SV	State Vector
SWSI	Space Network Web Services Interface
TAE	Transportable Application Executive
TCP/IP	Transmission Control Protocol/Internet Protocol
TCW	TDRSS Communications Window
TDRSS	Tracking and Data Relay Satellite System
TRMM	Tropical Rainfall Measuring Mission
TSW	TDRSS Satellite Window
TTM	Time Transfer Message
TUT	TDRSS Unscheduled Time
UAV	User Antenna View
UPD	User Performance Data
UPS	User Planning System
WSC	White Sands Complex
UPDR	User Performance Data Request
UPS	User Planning System
USM	User Scheduling Message
WLR	Wait List Request

Service Preparation Subsystem (SPS)

Allen L. Berman, Manager
Service Management Office

GSFC Customer Forum — March 23, 2006



Service Preparation Subsystem (SPS)

AGENDA

- ***Current System—Network Support Subsystem (NSS)***
- ***NSS Replacement—An Urgent Imperative***
- ***New System—Service Preparation Subsystem (SPS)***
- ***SPS Improvements and Benefits***
- ***SPS User Portal***
- ***SPS Project Interface Responsibilities***
- ***SPS Delivery Schedule***

Service Preparation Subsystem (SPS)

Current System — Network Support Subsystem (NSS)

- ***The NSS generates the operational support products used within the DSN***
- ***The current DSN Operations Support Products Environment is a complex, manually-driven process, which is subsequently very labor intensive***
- ***User Input Products required by the NSS are sent to DSN Operations Personnel via a multitude of communications devices and paths***
- ***The NSS uses a "just-in-case" strategy of producing and storing support products on-site 3-days prior to their actual need and use***

Service Preparation Subsystem (SPS)

NSS Replacement — An Urgent Imperative

- *The NSS is more than 20 years old, and has reached (more likely exceeded!) the end of its planned service life*
- *The NSS software is 15 years old. The DSN is now looking at significantly increased costs for software maintenance and adding needed capabilities*
- *Complicated mission scenarios are difficult (or impossible) for the NSS to support*
- *Outdated prediction generation algorithms are unable to execute high accuracy trajectory scenarios*

Service Preparation Subsystem (SPS)

NSS Replacement — An Urgent Imperative, Cont'd

- NSS hardware replacements have become practically (or actually) impossible because the original NSS vendors no longer exist
- Input products required by the NSS are sent to DSN Ops by a multitude of devices and paths, such as dedicated servers, other subsystems, email, fax, phones, etc.
- High level of manual operational processes drives DSN increased cost and reduced capacity

Service Preparation Subsystem (SPS)

New System — Service Preparation Subsystem (SPS)

- ***The SPS is a modern Information Technology (IT) Graphical User Interface (GUI)-based system for generating all required support data products to be used within the DSN***
  - ***All DSN Support Products Capabilities now aggregated into a <u>single entity</u>***
- ***The SPS uses modern IT Software Tools such as Sun, Intel and AMD, Solaris, Linux, C++, JAVA, Oracle, Network Appliance, XML Data Representations, and Network Communication Protocols***
- ***The SPS uses modern Sun Hardware and Equipment, such as Sun Enterprise Servers, Dual Redundant Sun Fire 4800 Cluster Computers, Redundant Array of Inexpensive Computers (RAIC), and Sun Blade Workstations***

Service Preparation Subsystem (SPS)

New System — Service Preparation Subsystem (SPS), Cont'd

- SPS hardware will be installed at the NOCC, DSN O&M Facility [Monrovia, CA], and the DSCCs
- The SPS Portal Interface will be extended to the user's desktop for easy access and submittal of input products to begin the support data generation process
- The SPS is focused on providing all the requirements and capabilities that will allow a complete NSS Replacement
- The SPS will provide the necessary support data products and tools that are required by the DSCCs and link controllers to execute and provide DSN operational supports
- The SPS utilizes a “just-in-time” philosophy of support data generation

Service Preparation Subsystem (SPS)

SPS Improvements and Benefits

- Provides DSN Ops Support Personnel with new IT-based tools and procedures that will help improve the support data generation process and provide better support to DSN customers
- Provides a major leap forward in computational performance in prediction generation times
  - 10 hours of NSS computation time is reduced to approximately 10 minutes of SPS computational time
- Provides a new schedule request format through a Web Portal
- Provides increased frequency prediction accuracy

Service Preparation Subsystem (SPS)

SPS Improvements and Benefits, Cont'd

- ***Provides a new view period generation capability***
- ***Provides the opportunity to phase out legacy subsystems that are obsolete, unreliable, poorly integrated, manually intensive, and resource-constrained***
- ***Provides a single-user interface portal as the service window for DSN Users and Customers***

Service Preparation Subsystem (SPS)

SPS User Portal

- Will be the single-point-of-entry for DSMS Customers seeking DSN Support Services
- Will be an easy access point to submit the required schedule requests and input files that will initiate the support data generation process
- Provides a File Uploader Application for inputting files
- Portal Interface is documented in the DSN Detailed Interface Design Document, 820-13 0168-Service_Mgmt
- SPS Portal User Guide, 887-117

Service Preparation Subsystem (SPS)

SPS Project Interface Responsibilities

- ***Need Project Personnel to learn the SPS Portal and the SPS System***
- ***SPS Training will be provided by the SPS Development Task in early summer 2006***
- ***Project Users who submit products into the DSN as part of support product generation process will need to ensure they have JPL LDAP* accounts***
  - ***TMS Managers are assisting the Projects in this***
- ***Need Projects to participate in Project Interface Tests (PITs)***

* LDAP = Lightweight Directory Access Protocol (An Internet protocol that email and other programs use to look up information from a server)

Service Preparation Subsystem (SPS)

SPS Project Interface Responsibilities, Cont'd

- ***Need Projects to establish their preferred interface when submitting or retrieving support products from Portal***
  - ***https://spsweb.fltops.jpl.nasa.gov/portalappsops/Main.do***
  - ***Reference 820-13, 0168-Service_Mgmt Interface Document***
  - ***Reference 887-117, SPS Portal User Guide***
  - ***The documents are accessible from the Portal front page***
  - ***System requirements (JDK 1.4 or JRE 1.4) to run SPS Portal applications is accessible from the SPS Functional Tab "Developer Resource"***

JDK = Java Development Kit (if you want to develop Java to interface with SPS Portal Applications)
JRE = Java Runtime Environment (minimum requirement to run SPS)

Service Preparation Subsystem (SPS)

SPS Delivery Schedule

- ***Major SPS Delivery Milestones:***

10/27/05 – 3/24/06:	**Pre-Acceptance Testing**
3/28/06:	**Test Readiness Review**
3/29/06 – 7/19/06:	**Acceptance Testing**
7/20/06:	**DSMS Delivery Review**
7/21/06 – 9/20/06:	**Formal Transition Period ***
9/20/06:	**Delta DSMS Delivery Review**
9/25/06:	**SOAK [Operational in the Network]**

* Will run SPS in parallel with NSS

NISN & GSFC Code 701 STATUS UPDATES

NISN Customer Interface Group (CIG) Points-Of-Contact

GSFC/Code 701 Customer Support Office

NISN Customer Forum Information

Mission Operations Voice Enhancement (MOVE) Project

NSAP Technology Refresh (NTR)

Jerry Zgonc
NISN Service Manager (NSM)
Code 731
NASA/Goddard Space Flight Center

NISN Customer Interface Group (CIG)
NISN Service Manager (NSM)

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- Mike.Richter@nasa.gov
- (Office of Science Missions) DFRC, JPL, VAFB (ELVs)

- Kim Wright, 256-544-0936
- Kimberly.A.Wright@nasa.gov
- (Space Operations Mission Directorate) ISS, JSC, KSC, MSFC, MAF,
- WSTF (Institutional)

- Seaton Norman, 301-286-8676
- Seaton.B.Norman@nasa.gov
- (Space Operations Mission Directorate) STS, ISS, JSC, KSC, MAF/WSTF
- MSFC, DFRC (Shuttle)

- Jerry Zgonc, 301-286-7160
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- (Office of Science Missions) WSC, LaRC, GSFC (Institutional)

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- TRISH PERROTTO, 301.805.3106: Office of Science Mission Directorate (previously Code Y) perrotto_trish@bah.com

MSFC UNITeS CIG TEAM

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- JOE FINNEY, 256.961.9443: joe.finney@msfc.nasa.gov
- MICHAEL BRADLEY, PROJECT LEAD, 256.961.9492: michael.j.bradley@msfc.nasa.gov

GSFC/Code 701 Customer Support Office

- Obtain administrative and mission requirements for all GSFC projects and codes
- Includes Mission Voice/Data/Video, Administrative Voice/Data (CNE) Wireless, Pagers, Cell Phones, Two-Way Radio Systems, Common Carrier Services, Cable Plant (Fiber/Copper)
- Coordinates requirements for implementations internally at GSFC and/or with NISN (WAN), if required

Points-of-Contact:

Code 100	Bob Freitas x6-8461
Code 200	Mary Collins x6-4515
Code 300 & 700	Debra Richmond x6-0923
Code 400, 460 & 490	Duc Dang x6-3572
Code 410, 420, 450, 480	Tea Taylor x6-2052
Code 440, 500	Denise White x6-3438
Code 600	Tara Holby x6-7574

NISN CUSTOMER FORUM

The 11th NISN Customer Forum is scheduled for May 22-26 in San Antonio, TX. The goals of the forum are to provide customers with status on ongoing projects, upcoming initiatives and to provide ample opportunities for customers to interface with the NISN team. The forum pre-registration website is now available.

The website provides information on accommodations, transportation, agenda topics, and registration capabilities for the upcoming NISN Customers' Forum.

The site may be found by going to http://nisn.nasa.gov , click on the "What's New" section.

MOVE Project Status

The purpose of the Mission Operations Voice Enhancement (MOVE) Project is to replace existing mission voice systems with Commercial Off-the-Shelf (COTS) products suitable to meet the mission voice conferencing and voice recording requirements at NASA Centers and location.

- **Funded by Space Operations Mission Directorate**
- **MOVE Project Manager – Dan Duffy(GSFC/Code 721)**
- **Basic Sites: GSFC, JSC, and MSFC (15 additional sites included)**
- **Original MOVE RFP released – 7/29/2005**
- **Additional Discussion phase required**
- **GSFC MOVE Contract award – 3rd. Quarter 2006**
- **GSFC Switch delivery – 3rd. Quarter 2007**
- **MOVE website at: http://move.nasa.gov**

NSAP Technology Refresh (NTR)

- Replacement of existing NSAP/Paradyne equipment in the Mission Network
- Current H/W equipment and S/W platforms have reached “end of life”
- Will combine the point-to-point Mission T-1 services into higher aggregate bandwidth , over a MPLS platform which will support higher capacity service
- A transition from existing carrier equipment to new equipment will be required for all locations
- AT&T NTR installations began October/2005
- Tentative completion date December 2006
- NTR Project Manager: Vicki Stewart (NISN/GSFC Code 731)
- NTR Project Engineer: Scott Douglas (NISN/GSFC Code 722)

Flight Dynamics Facility

S. Hoge

Flight Dynamics Facility

- During calendar year 2006, the FDF will
  - Support 12 ELVs
  - Support 9 TDRS
  - Support 14-16 spacecraft
  - Support at least 1 STS mission
  - Complete transition to new OS
  - Complete installation of Oracle upgrade and new database servers
  - Install GMSEC based system monitoring
  - Begin process re-engineering analysis

FDF System Changes

- Database upgrade from ORACLE 7.3.2 to ORACLE 9i
  - Requires 13 software packages to be upgraded and/or recompiled
  - No functional changes will be made to the software packages
  - Scheduled to move to shadow operations in late March 2006
  - With a July STS launch, will move to operations in late May.

- Moved to three tiered network
  - Closed/Open IONet tiers for operations and software development
  - CNE for administration
  - Network management now being done by Code 700 (old 290)

- Upgrade UNIX workstation operating system from HP-UX 10.2 to HP-UX 11i
  - All UNIX software packages will be recompiled to run on 11i
  - No functional changes will be made to the software packages
  - Multiple FDF satellite missions are currently running on 11i
  - Tracking Data Evaluation software is currently running on 11i
  - STS support software will be transitioned to 11i in late May for a July launch

FDF System Changes

- Hardware
  - Two new HP Itanium servers have been added to the Closed IONet network to replace the existing database servers.
  - Two new dual-monitor PC's were installed in December 2005 in the MOR
  - Several servers have been upgraded to HP-UX 11i operating system to support the transition to a complete 11i environment.
  - Switches for the closed IONET routers will be replaced in mid-March 2006
  - Two new general purpose computing machines added
    - Allow for retirement of old machines

Ground Network Accomplishments & Plans

Roger Clason

Ground Network Project Manager

March 23, 2006

AGENDA

Ground Network Overview

Recent Accomplishments

GN Evolution Plans

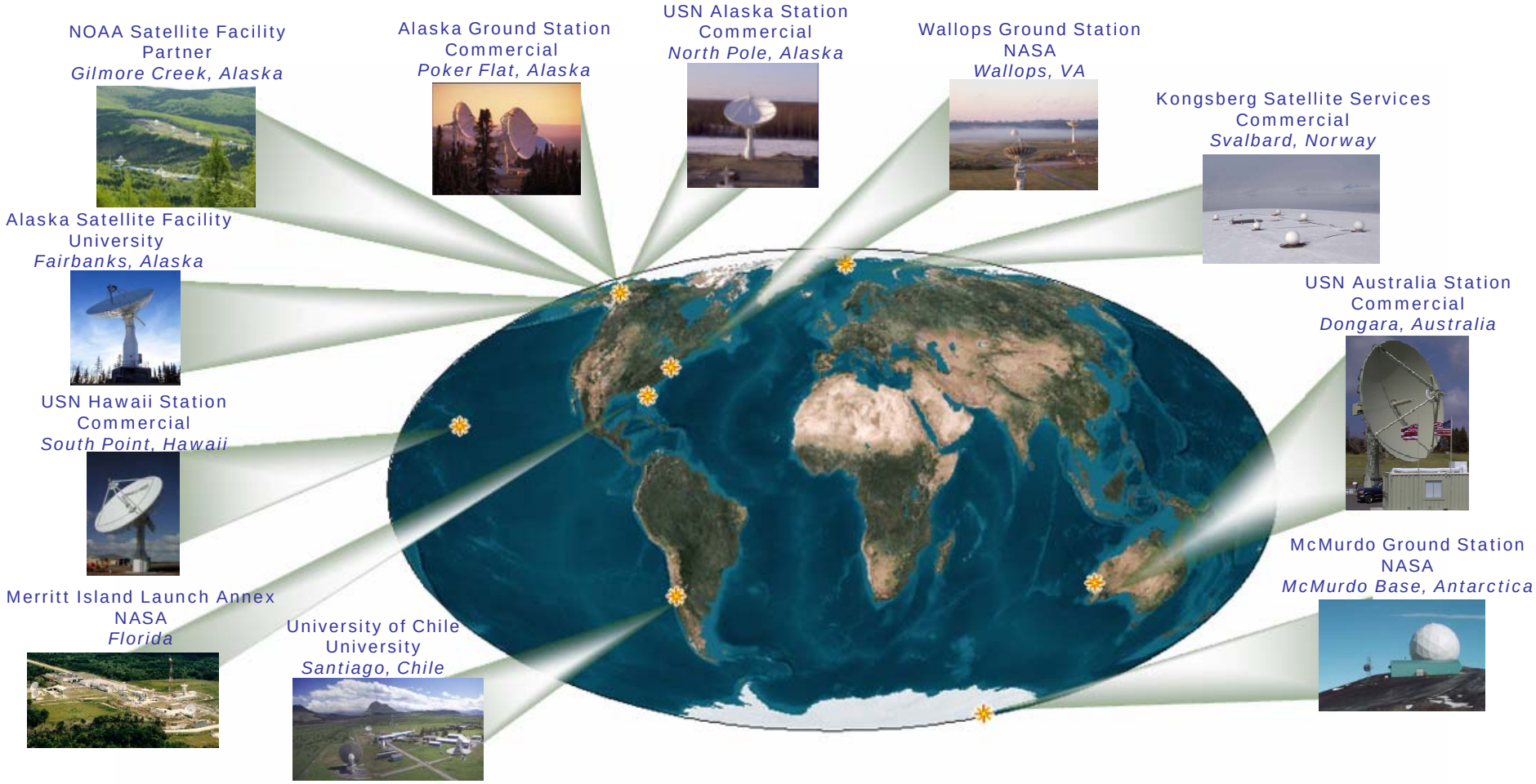
Summary

Mission and Objectives

- Mission
  - Provide best value communications and tracking services to NASA missions operating in the near earth region
- PCA Objectives

1. Mission Safety: acquire, maintain and operate GN systems to achieve NASA and flight program objectives in a safe and reliable manner
2. Mission Assurance: provide GN services to missions, as agreed and documented in Project Service Level Agreements
3. Mission Commitment: work pro-actively to avoid or resolve service problems
4. Program Management: manage the GN Program to best value, consistent with the above goals

Ground Network Project – Current Stations



Customers, Sponsorship, & Partnerships

Science Mission Directorate

Space Communications Sponsorship
- ***Ground Network***
- ***Deep Space Network***

GN Customers
- ***Earth Science Division***
- ***Heilophysics Division***
- ***Astrophysics Division***

Other NASA Mission Directorates

Exploration Systems Mission Directorate

Space Communications Sponsorship
- ***ECANS***

GN Customers
- ***Robotic Lunar Exploration Program***
- ***Constellation***

Space Operations Mission Directorate

Space Communications Sponsorship
- ***Space Network***

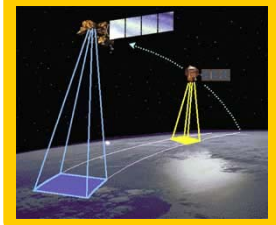
GN Customers
- ***Space Shuttle***
- ***International Space Station***

Other Government Agencies

National Science Foundation

National Oceanic and Atmospheric Administration

Department of Defense



United States Geological Survey

AGENDA

Ground Network Overview

Recent Accomplishments

GN Evolution Plans

Summary

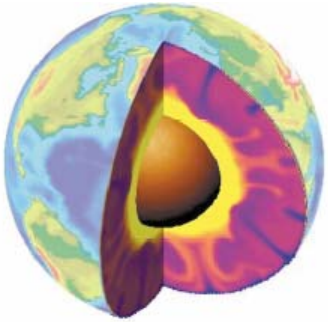
Delivered Communications & Tracking Service to Operational Missions

- Provided 130 passes/day to over 27 operational earth and space science missions
  - Provide Prime services to about 40% of NASA earth-orbiting spacecraft
  - Provide Contingency services to another 34% of NASA earth-orbiting spacecraft
  - Large polar capacity to meet earth observing requirements

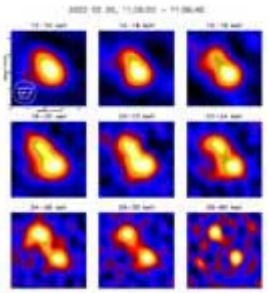
- Provided Services to most earth science disciplines and several space science disciplines

EARTH SCIENCE	SPACE SCIENCE
Climate change and variability	Sun
Earth surface and interior	Aurora
Carbon cycle and ecosystems	Magnetosphere
Atmospheric composition	Interstellar clouds and particles
Water and energy cycle	
Weather	

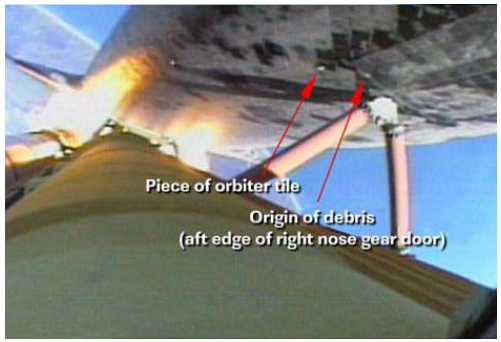
- Provided services to all Shuttle missions phases and backup voice services to Station



Dynamics of the Earth's interior are understood through consistent, long-term observation



X-ray images of a solar flare taken by RHESSI tell us what is happening at the core of the flare



External Tank TV Images show the condition of the Shuttle after launch

Addressed Antenna Failure Trend- Established Low Cost Contingency Capacity

- Experienced seven significant mechanical antenna failures since November 2001
  - Primarily due to materials and design flaws
  - Failures all occurred significantly before end of component and antenna design life
- Mitigated consequence of failures by increasing contingency capacity
  - Increased from sufficient capacity for single failure and routine loads to sufficient capacity for dual failure or failure during surge loads
  - Evaluated all capacity increase options for business and technical considerations
- Upgraded Alaska Satellite Facility (ASF) 11m system for QuikSCAT support
  - Upgraded ASF receivers and telemetry processors to support QuikSCAT formats
  - February 2004 certification for operational support
- Upgraded Svalbard 13m (SG3) system for Aqua and Aura support
  - SG3 is owned by KSAT
  - Integrated new receiver to support Aqua and Aura formats
  - December 2003 certification for operations

Addressed Antenna Failure Trend- Established Low Cost Contingency Capacity

- Established NOAA Fairbanks (Gilmore Creek) support for Aqua and Aura
  - Proposed and negotiated Inter-agency agreement for contingency services (non-reimbursable)
  - No significant upgrades required (NOAA had specified EOS formats in prior receiver procurement)
  - June 2004 certification of initial 13m system
  - April 2005 certification of second and third 13m systems
- Upgraded Svalbard 13m system (SG3) for ICESat, and QuikSCAT support
  - Upgraded local area network systems to meet security requirements
  - December 2004 operational certifications
- Configured Svalbard 13m antenna (SG4) for Aqua and Aura support
  - SG4 is owned by NPOESS
  - Temporarily connected SG4 13m antenna to SG1 processing systems
  - June 2005 operational certification
- Procured contingency support from Universal Space Network (USN) for SMEX missions
  - Triggered by mothballing of Poker Flat and Wallops 8m (TOTS) systems
  - Using South Point Hawaii, North Pole Alaska, and Dongara Australia 13m systems with no significant systems changes
  - January 2005 operational certification for SWAS, SWIFT, FAST, FUSE, GALEX, TIMED, & WIRE
  - March 2006 certification for TRACE (North Pole, South Point 13m certification complete)

Addressed Antenna Failure Trend- Repaired Failed ViaSat Antennas

- Repaired Svalbard and Poker Flat ViaSat 11m antennas after concurrent failures
- Svalbard ViaSat 11m (SG1)
  - Failure – 4/5/2005
  - Return to Operations – 8/1/05
  - Replacement Gearing – DSN Goldstone 11m
- Poker Flat ViaSat 11m (AGS)
  - Failure – 4/15/2005
  - Return to Operations – 8/29/05
  - Replacement Gearing – DSN Madrid 11m
- Effect on GN sustaining budget
  - Delayed obsolescence replacement of S-Band receiver/combiner/digital processing components for Svalbard and Poker Flat 11m ViaSat systems

Addressed Antenna Failure Trend- Determined Root Cause of ViaSat Failures

- Conducted formal Failure Review Board for the ViaSat antenna failures in October 2005

- Engaged:
  - GSFC Electro-Mechanical Systems Branch
  - GSFC Materials Engineering Branch
  - Independent Forensic Experts
  - NOAA Fairbanks Station Director
  - DSN Antenna Mechanical & Structural Engineering lead

- Root Cause:
  - Broken teeth on pinion gears in elevation drive assembly due
  - Premature metal fatigue on pinion gears caused by
  - Gear manufacturer's failure to meet pinion gears hardness specification

- First order analysis:
  - If pinions are not hardened to specs
  - And 11m antennas are operated at default max slew rates
  - Pinions will fail due to metal fatigue after 10s of K cycles
  - Rather than M cycles design life

Classic Tooth Root Bending Fatigue

Addressed Antenna Failure Trend – Corrective Actions

- Reduced slew rate on ViaSat 11m antennas
- Evaluating slew rate reduction on 10m ViaSat antennas
  - Requires replacement of obsolete Antenna Control Units
- Including gear sparing and replacement proposal in budget
  - Procure two sets of elevation gearing
  - Keep first set as spare
  - Replace McMurdo 10m gearing with second set at next opportunity (no cost estimate yet)

Antenna	Location	Vintage	Pinion Gear Status	Slew Rate	Cycles
AGS-11m	Poker Flat	1997	Replaced 8/05*	Reduced 1/03	2K
SGS-11m	Svalbard	1997	Replaced 8/05*	Reduced 1/05	3K
WGS-11m	Wallops	1996	Replaced 10/02*	Reduced 8/02	60K
ASF-11m	Fairbanks	1996	Original	Reduced 8/05	25K
ASF-10m	Fairbanks	1988	Original	Default	75K
MGS-10m	McMurdo	1993	Original	Default	25K
AGS-8m	Poker Flat	1994	Original	Default	n/a (mothballed)
WGS-8m	Wallops	1994	Original	Default	n/a (mothballed)

* Replaced with cannibalized, low cycle gearing

Reduced Costs – Reductions Planned

- GN Independent Assessment Panel February 2005 report to SMD recommends, "Shutdown of more expensive antennas at Wallops and Fairbanks"
  - Conducted cost and load studies to determine which antennas to shutdown
  - Mothballed Poker Flat 8m and Wallops 8m (TOTS) systems in December 2005
    - Transitioned load to other GN antennas
    - Eliminated one 24/7 operations position at each site
    - Eliminated all GN sustaining requirement for 8m (TOTS) systems
  - Decommissioned five Wallops VHF (SATAN and SCAMP) systems in December 2005
    - Eliminated Wallops IMP-8 commanding requirement
    - Transferred equipment to NOAA
    - Eliminated all GN sustaining requirement for SATAN and SCAMP systems
  - Removing Wallops 9m from service
    - Supporting Shuttle & GOES-N through FY06
    - Transferring all other support to other GN systems by March 2006
    - Eliminates three 24/7 operations positions
    - Eliminates sustaining requirement for Wallops 9m system

- GN Independent Assessment Panel also recommended, "reassessment of current business model - purchase of passes 'by the yard'"
  - Explored change of contract structure with current service providers and prime contractor
  - Determined change in model now would result in increased prices (No current competitive pressure)

- Implementing capabilities to allow most cost-effective use of service providers
  - Implemented uplink capability to ASF 11m to support FAST and QuikSCAT
  - Allows keeping Poker Flat and Svalbard contracts at minimums

Integrating with DSN

- Supporting DSN 26m decommissioning by supporting near earth mission set
  - (Re)certifying MILA 9m and Santiago 9m systems for HST support
  - Scrubbing requirements and developing support plans for other LEO and GEO customers
    - Most support is occasional - Emergency and LEOP
  - Including support plan in budget
  - Costs will include:
    - Compatibility Upgrades
    - Certification Testing
    - Proficiency Passes
    - Capacity Retainer
  - Evaluating options for other near-earth missions
- Participating in Deep Space Mission LEOP Services working group
  - Evaluating technical and cost aspects of options to support early mission critical events

	Mission	Launch Date	DSN 26m Support Type*
LEO	HST	04/24/90	E
	LANDSAT 5	03/01/84	E
	NOAA 15 (K)	05/13/98	E
	NOAA 16 (L)	09/21/00	E
	NOAA 17 (M)	06/24/02	E
	NOAA 18 (N)	05/20/05	LEOP/E
	NOAA-N'	03/01/08	LEOP/E
	RadarSat 1	11/04/95	Routine-B
GEO	GOES 09 (J)	05/22/95	E
	GOES 10 (K)	04/25/97	E
	GOES 11 (L)	05/03/00	E
	GOES 12 (M)	07/24/01	E
	GOES 13 (N)	02/06/06	LEOP/E
	GOES 14 (O)	04/01/07	LEOP/E
	GOES 15 (P)	10/01/08	LEOP/E
	GOES-R	09/01/12	LEOP/E
	GOES-S	04/01/14	LEOP/E
	TDRS-01	04/04/83	E
	TDRS-03	09/29/88	E
	TDRS-04	03/13/89	E
	TDRS-05	08/02/91	E
	TDRS-06	01/13/93	E
	TDRS-07	07/13/95	E
	TDRS-08	06/30/00	E
	TDRS-09	03/08/02	E
	TDRS-10	12/05/02	E

26m LEO & GEO customer set

Developing New Capabilities

- Upgraded McMurdo 10m system to provide essential services to ST5
  - Requirement triggered by orbit change due to selection of Pegasus launch vehicle
  - Implemented Deep Space X band and service reconfiguration capabilities
  - Currently supporting initial operations
- Implementing three Ka/S band 18m systems at White Sands
  - Two systems primarily allocated to SDO during mission lifetime
  - Third system (WS1) will initially support LEO/GEO missions, LRO, and potentially RLEP 2
  - Designing systems to maximize multi-mission utility
- Integrating complete communications and tracking virtual network for Lunar Reconnaissance Orbiter (LRO)
  - Providing science down link (Ka band) services and house keeping (S band) services with WS1
  - Procuring housekeeping services from commercial stations providers
  - Providing precision laser ranging services with upgraded SLR prototype
  - Arranging contingency housekeeping services from DSN 34m's
  - On schedule and budget

AGENDA

Ground Network Overview
Recent Accomplishments
GN Evolution Plans
Summary

Integrated Near-Earth Network Vision

GN Evolution Vision

- Integrate communications and tracking services to provide best value virtual networks for NASA near earth missions
  - Provide integration functions in cooperation with other near earth service providers
  - Use best value provider (GN or other) for each individual service requirement

- Procure routine services from independent service providers
  - Benefits
    - Incur costs based on service quantity rather than infrastructure capitalization and sustaining requirements
    - Establish continual competitive pressure to minimize costs
    - Leverage commercial market and expertise in LEO/GEO services
  - Risk Management
    - Consequence of service loss - loss of science data
    - Maintain sufficient capacity to transfer services from provider that fails technically or financially
    - Implement financial performance incentives and penalties

- Provide critical and/or unique services with NASA owned and controlled systems
  - Risk management
    - Consequence of service loss - loss of communications with humans and/or loss of critical information required for post event analysis
    - Maintain technical expertise, insight, and control
  - Benefits
    - Maintain NASA core competency in Space Communications

Integration Evolution

- Integration of tuned service provision components provides best value to NASA's Mission Directorates
  - Service provision components are designed to provide best value balance of capability, capacity, performance, and cost for targeted regime
  - Virtual networks are established comprising one or more service provision components based on mission specific requirements
  - Integration functions meld service provision components into functioning virtual networks

- Key Integration Functions
  - Planning
    - Specify integrated near earth network architecture – capability, capacity, and performance requirements
    - Derive mission specific communications and tracking requirements
    - Design mission specific virtual network
  - Pre-mission Testing
    - Test component compatibility
    - Test end-to-end data flows
    - Validate operations procedures
  - Mission Operations
    - Schedule services
    - Monitor services
    - Reconfigure services
    - Isolate problems

Integration Evolution

- Current Key Integration Capabilities
  - Planning
    - Network Planning and Analysis System (NPAS) – loading analysis
    - Satellite Tool Kit (STK) – loading analysis
    - Communications Link Analysis and Simulation System (CLASS) – RF link analysis
  - Pre-mission Testing
    - Compatibility Test Van (CTV) – component compatibility testing
    - RF Simulations Operations Center (RF SOC) – component compatibility testing
    - Portable Spacecraft Simulator (PSS) – component compatibility testing
    - Communications Center – End-to-End testing
  - Mission Operations
    - Wallops Orbital Tracking Information System (WOTIS) (now located at White Sands) – service scheduling
    - Mission Operations Support Area Replacement (MOSAR) system – service monitoring/fault isolation
    - Network Integration Center (NIC) – service monitoring
- Evolve capabilities to integrate new and existing service provision components
  - Developing integration evolution white paper
  - Planning scheduling system replacement
  - Planning Ka band compatibility testing capability

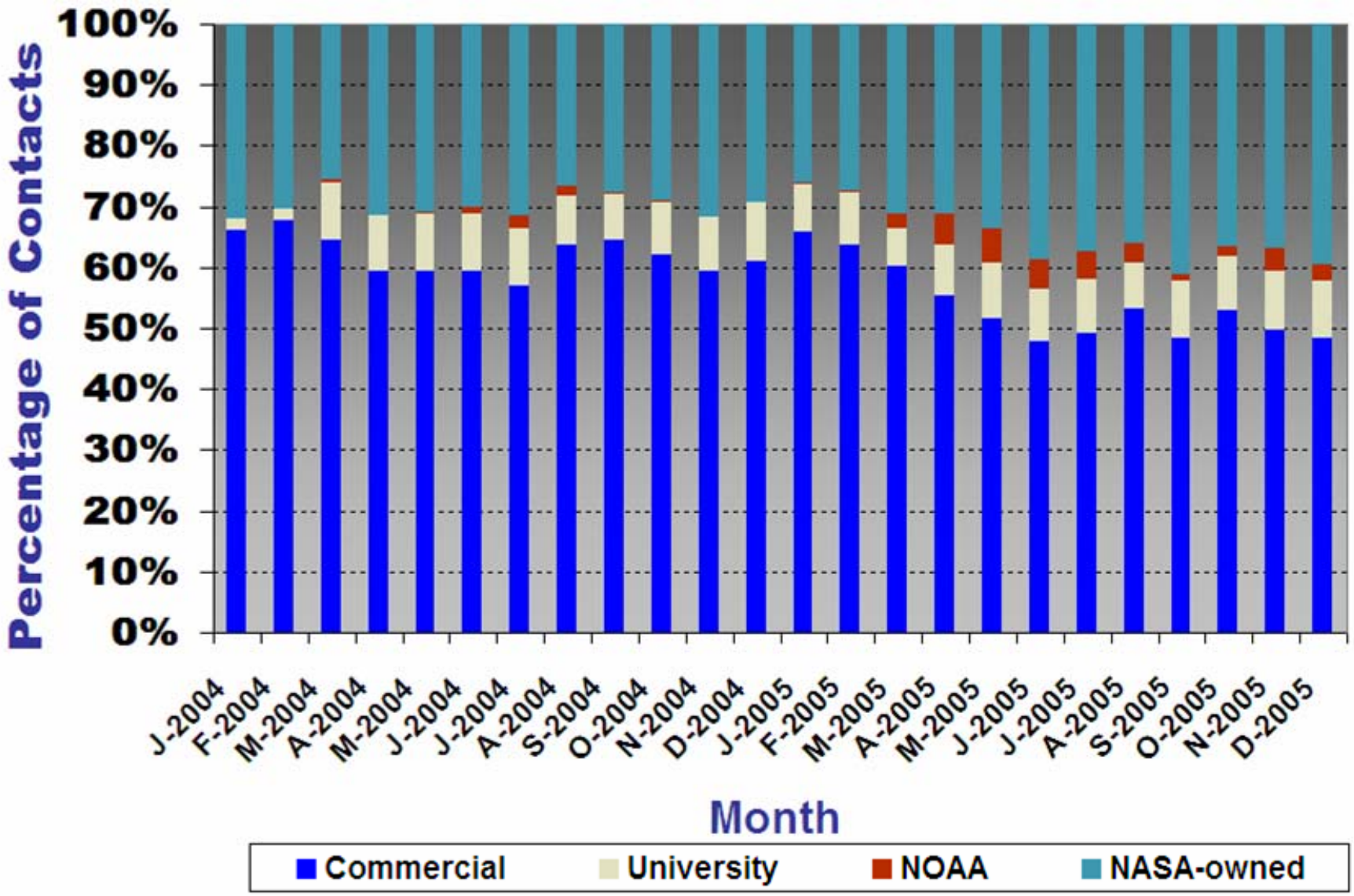
Current Service Provider Profile

- Poker Flat
  - Operations and maintenance
    - DataLynx subcontract on NENS
    - Price/pass
    - 36 passes/day minimum
    - Volume discounts
    - Performance incentives and penalties
  - Ownership and sustaining
    - L3/ESSCO 11m (PF2) (currently in repair) - DataLynx
    - ViaSat 11m (AGS) - NASA
    - Datron 7.3m (PF1) – Datalynx
    - Datron 5m (LEOT) - NASA
- Alaska Satellite Facility
  - Operations and maintenance
    - University of Alaska subcontract on NENS
    - 24/7 Operations
  - Ownership and sustaining
    - ViaSat 11m - NASA
    - ViaSat 10m - NASA
- Svalbard
  - Operations and maintenance
    - KSAT subcontract on NENS
    - Price/pass
    - 30 passes/day minimum
    - Volume discounts
    - Performance incentives and penalties
  - Ownership and sustaining
    - ViaSat 11m (SG1) - NASA
    - Datron 11m (SG2) - KSAT
    - Datron 13m (SG3) – KSAT
    - Datron 13m (SG4) - NPOESS
- Santiago
  - Operations and maintenance
    - University of Chile subcontract on NENS
    - Price/pass
    - 4 passes/day minimum
  - Ownership and sustaining
    - Collins 9m - University of Chile

Current Service Provider Profile

- Wallops
  - Operations and maintenance
    - NENS
    - 24/7 Operations
  - Ownership and sustaining
    - ViaSat 11m (WGS) - NASA
    - Datron 5m (LEOT) - NASA
- McMurdo
  - Operations and maintenance
    - NENS
    - 24/7 Operations
  - Ownership and sustaining
    - ViaSat 10m - NASA
- MILA/PDL
  - Operations and maintenance
    - NENS
    - 16/5 Operations
  - Ownership and sustaining
    - Assorted Systems - NASA
- Universal Space Network (USN)
  - Operations and maintenance
    - USN subcontract on NENS
    - Price/pass
  - Ownership and sustaining
    - Datron 13m North Pole Alaska - USN
    - Datron 13m South Point Hawaii – USN
    - Datron 13m Dongara Australia - USN

Current Service Provider Profile



Independent Service Provider Evolution

- Decommission excess NASA owned capacity
  - Poker Flat and Wallops 8m (TOTS) systems – complete
  - Greenbelt 9m system - removal complete
  - Wallops VHF (SATAN and SCAMP) systems - complete
  - Wallops 9m system – in process
  - Wallops 6m system – decommissioned and removal in process
  - Wallops 18m ADAS system – decommissioned and removal in process
  - Wallops 7.3m METEOSAT system - planned for July
  - Poker Flat and Wallops 5m system – under analysis

- Establish new capacities and capabilities via contracts for service rather than procurement of systems
  - Stable or slightly reducing routine service (S and X band LEO) load for the next five to ten years
  - Potential new high rate missions may require new Ka band capacity
    - Providing Ka-Band services concepts and cost estimates for LandSat Data Continuity Mission communication trade analysis

- Increase independent service provider usage in NENS follow-on contract (10/08)
  - Shed sustaining responsibility for NASA owned systems at independent service provider sites
  - Establish (sub)contracts with max number of independent service providers for price/pass services
  - Evaluate business case for decommissioning remaining NASA owned assets
  - Integrate independent service providers with other service provision components via NENS follow-on prime contractor

- Developing GN procurement strategy for NENS follow-on
  - Evaluating contract mechanisms with GSFC Procurement and Legal
  - Solicit feedback from commercial providers (e.g., RFI) in the near term (next six months)

New Capability Potential – Exploration Ground Stations

- Conducting pre-formulation activities for Constellation launch head ground stations
  - Optimizing for best value pre-launch and critical assent services
  - Potential best value service provision component of virtual networks for other mission
- Conducting trades over broad solution space
  - Ground based services - Space based (SN) services
    - Antenna blockage and multi-path
    - SN resources allocation to pre-launch activities
    - Telemetry delay to Range Safety function
    - Of-nominal trajectory tracking
  - New component development – MILA/PDL components reuse
    - New required capabilities
    - Development costs, recurring costs
    - Antennas, electronics, facilities
  - Pre-launch/assent dedicated – multipurpose
    - Incremental costs
    - Exercise station between Constellation missions
- Supporting pre-formulation activities for other earth antennas required for Exploration

New Capability Potential – Equatorial Ground Antennas

- Analyzed ability of 18m system to support JWST
  - Nominal mode links close with:
    - Cooled receiver
    - Enhanced coding
    - Limit elevation mask to 20 degrees (instead of 10)
    - Decrease availability to 90%
    - Utilize TDRSS signal format
  - Potential best value solution ESMD funds core 18m S/Ka band service component
- Arraying of the 18m assets could be a viable option for missions with higher data rate requirements (e.g., JDEM)

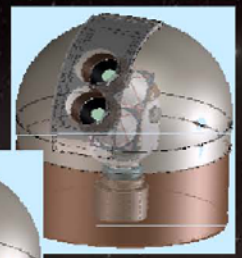
Image of JWST

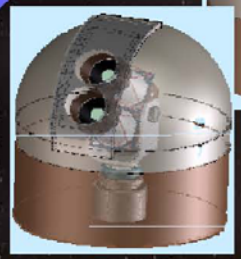
Image of Supernova/Acceleration Probe (SNAP), a concept for the Joint Dark Energy Mission

Proposed RLEP Demo

Demonstrate utility of optical communications to NASA missions

4 x 20-cm transmit array

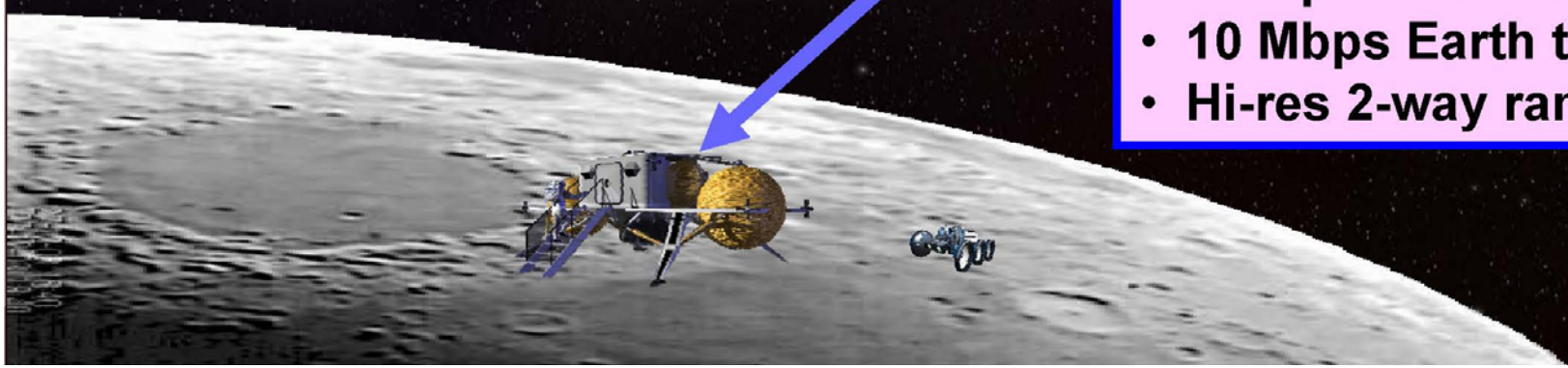




4 x 0.8-m receive array

Lander-terminal
30 lbs
30 Watts
1 ft^3

- 1 Gbps Moon to Earth
- 10 Mbps Earth to Moon
- Hi-res 2-way ranging



New Technology – Optical Communications Demo

Technology Comparison

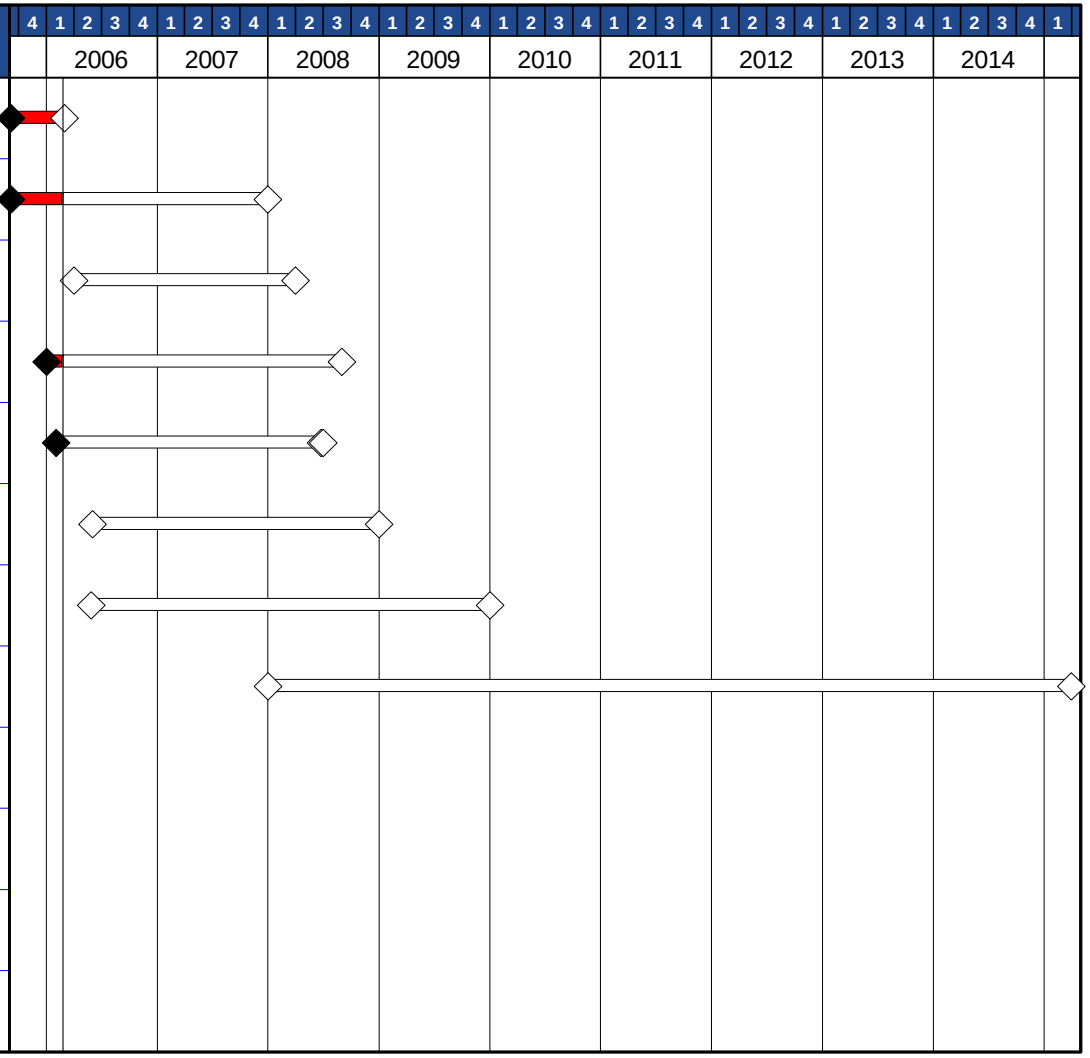
	Supported Data rate (Mbps)	TerminalMass (kg)	Total Terminal Power (W)	Power Amplifier Output (W)	Transmit Aperture Diameter (cm)	Ground Receive Aperture Diameter (m)
RLEP2 Optical Proposal (1.5 μm)	1,000 (7,000)	< 14 (< 16)	< 30 (< 85)	0.25 (4.00)	3.5	1.6
LRO (S-band)	1	11	45	5	75	18
LRO (Ka-band, inc. HGA)	125	10.7	120	40	75	18

AGENDA

Ground Network Overview
Recent Accomplishments
GN Evolution Plans
Summary

Notional Schedule

	Task
1	Excess Capacity Reduction
2	26M Mission Set Support
3	McMurdo Gearing Replacement
4	Integration Capability Upgrades
5	White Sands 18M Systems
6	Increase Independent Service Provider Support
7	Launch Head Ground Station
8	Constellation Ground Stations



Planned

OPEN FLOOR

CLOSING REMARKS