



Space Communications Customer Forum #15

Space Communications Customer Forum (SCCF)

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

March 15, 2007

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

Sponsored by:

**Networks Integration Management Office, Code 450.1
(Exploration and Space Communications Projects Division, Code 450)
NASA/Goddard Space Flight Center
Greenbelt, Maryland**



Space Communications Customer Forum #15

Space Communications Customer Forum (SCCF) #15 Briefing Book Contents

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Exploration and Space Communications Projects Division (ESC)

Space Communications Customer Forum (SCCF) #15

March 15, 2007, Building 3 Goett Auditorium
(NASA/Goddard Space Flight Center)

Agenda

Note: Splinter Group meetings with ESC service providers (GN/SN/NIMO); 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@gssc.nasa.gov)

Timeline (approx.)	Subject / Topic	Speaker / Presenter
1:00pm	WELCOME & INTRODUCTIONS	Allen J. Levine/GSFC
1:05pm	OPENING REMARKS	Scott A. Greatorex/GSFC
1:20pm	ITEMS / NOTES OF INTEREST	Allen J. Levine/GSFC
1:35pm	FEATURED TOPIC	
	<ul style="list-style-type: none"> Advanced Technology Demonstration Program 	Gary J. Scalzi/AFRL/SNHA John S. Schwartz/Scitor
1:55pm	MISSION / PROJECT UPDATES (Organizational Overviews; Current/Future Missions; Issues & Selected Items of Interest; Areas for More Work)	
	<ul style="list-style-type: none"> Human Space Flight (HSF) Missions 	Fred G. Pifer/NENS
	<ul style="list-style-type: none"> Space Science Mission Operations (SSMO) 	Patrick L. Crouse/GSFC
	<ul style="list-style-type: none"> Earth Science Mission Operations (ESMO) 	Chris Wilkinson/GSFC
2:40pm	STATUS UPDATES (Significant activity in ESC offices and our Partners)	
	<ul style="list-style-type: none"> Ground Network (GN) Project 	Roger N. Clason/GSFC John T. Jackson/GSFC
	<ul style="list-style-type: none"> NASA Integrated Services Network (NISN) 	Jerry Zgonc/GSFC
	<ul style="list-style-type: none"> Space Network (SN) Project 	Jon Z. Walker/GSFC
	<ul style="list-style-type: none"> Deep Space Network (DSN) Status Service Subsystem 	Allen L. Berman/JPL
	<ul style="list-style-type: none"> Space Communications and Navigation Systems Constellation Integration Project (SCIP) 	Allen J. Levine/GSFC
4:20pm	OPEN FLOOR	Allen J. Levine/GSFC
4:30pm	CLOSING REMARKS	Allen J. Levine/GSFC



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Welcome & Introductions

Allen J. Levine
Service Planning Manager
Networks Integration Management Office
NASA/Goddard Space Flight Center



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Opening Remarks

Scott A. Greateorex
Chief
Networks Integration Management Office
NASA/Goddard Space Flight Center



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Items/Notes of Interest

Allen J. Levine
Service Planning Manager
Networks Integration Management Office
NASA/Goddard Space Flight Center



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Projected ELV Launches for 2007

Falcon/Demosat	3/19/07 																				
Textron Minuteman-III	4/11/07 																				
Minotaur/NFIRE	4/21/07 																				
Pegasus/P-3/AIM	4/25/07 																				
Delta IV/DSP	NET 4/25/07 																				
Atlas V/NROL-30	5/3/07 																				
HII-A/Selene	NET 6/2007 																				
Sea Launch	NET 6/2007 																				
Atlas V/WGS F1	6/28/07 																				
Unmanned Aerial Vehicle	NET 7/2007 																				
MDA-DST-FTG04	NET 8/2007 																				
Delta IV/GOES-O	 3 rd QTR 2007																				
SOAREX	10/2007 																				
Delta IV/WGS	 4 th QTR 2007																				
	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC										



**Advanced Technology
Demonstration Program:
The Geodesic Dome
Phased Array Antenna
(GDPA-A)**



Gary Scalzi
Air Force Research Laboratory
Sensor Directorate
Antenna Technology Branch
gary.scalzi@hanscom.af.mil
(781) 377-0216

John Schwartz
Air Force Space Command
Plans and Requirements
Scitor SETA support
jschwartz@scitor.com
(719) 380-4137



Outline

- Introduction – Identification of the problem
- **GDPAA Concept – AFRL Solution**
- **Technology Development - Build hardware**
- **Critical Experiment – Verify feasibility of solution**
- **Advanced Technology Demonstration (ATD) Program**
- **ATD Objectives**
- **GDPAA Demonstration at Schriever AFB**
- **Communications Configuration - PUGPU**
- **Recommendations**



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Air Force Satellite Control Network (AFSCN)

A worldwide Network for Satellite Tracking, Telemetry, and Commanding

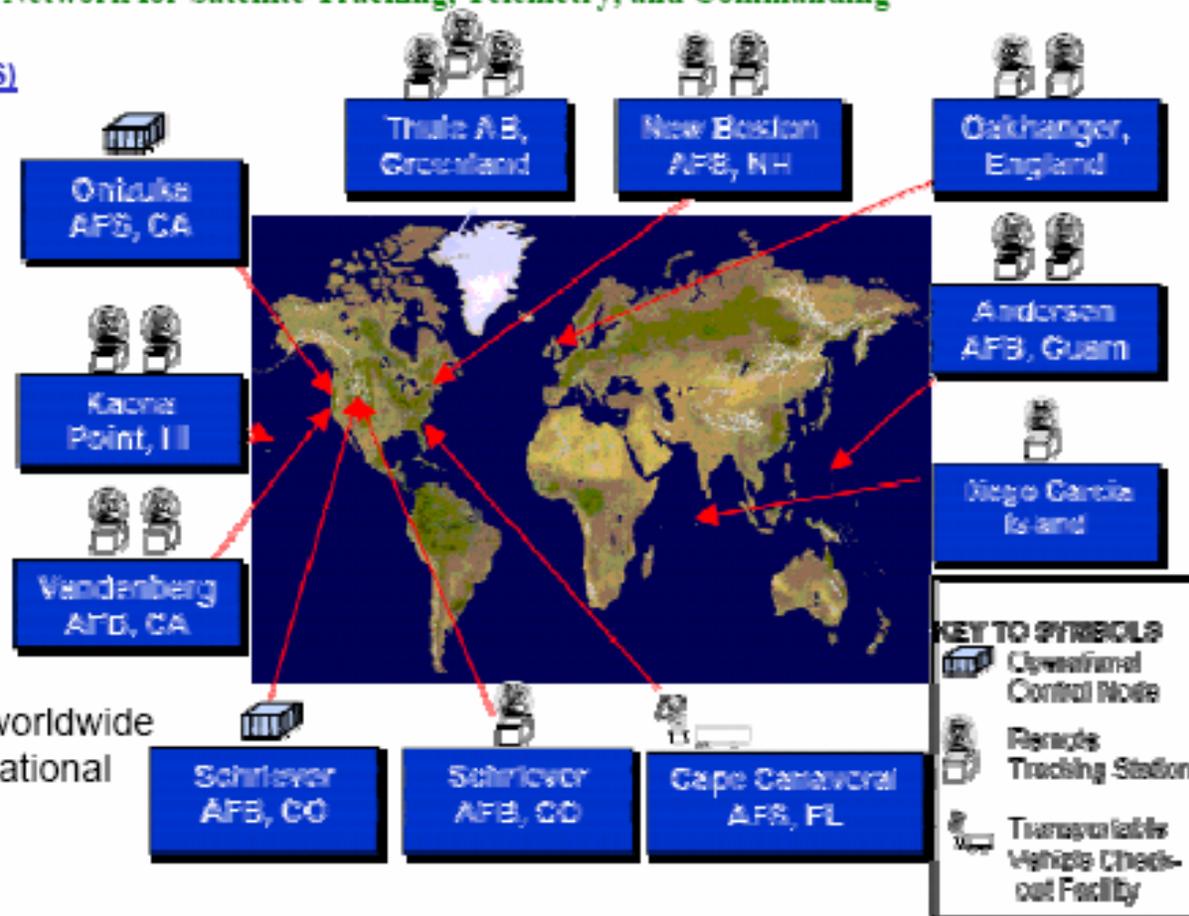
Space Ground Link System (SGLS)

- Uplink Commanding
 - 21 4MHz channels
 - Frequency 1755 to 1855 MHz
- Downlink Telemetry
 - 20 5MHz channels
 - Frequency 2200 to 2300 MHz

Unified S-Band (USB)

- Uplink Commanding
 - Frequency 2025 to 2120 MHz
- Downlink Telemetry
 - Frequency 2200 to 2300 MHz

16 antennas located at eight worldwide locations linked with two Operational Control Nodes (OCNs).



Provides TT&C to over 140 US DoD, national, civil, and allied, satellites using mechanically steered parabolic dish antennas.



GDPAA Concept – AFRL Solution

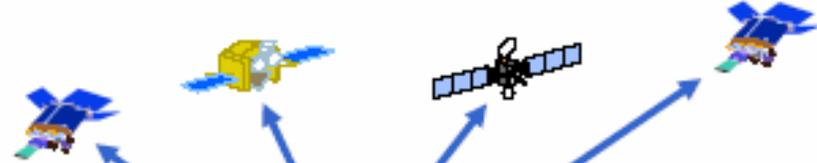
AFSCN Problem



4x capacity multiplier

Conceived, Designed, and Developed by AFRL/SNHA

AFRL Solution



Geodesic Dome Phased Array Antenna

- 1 contact per antenna
- Mechanical scan/Keyhole effect
- Fixed gain
- Operator intensive/Manual
- High O&M cost

- Up to 4 contacts (8 beams) per antenna
- Electronic scan/No keyhole
- Variable gain on demand
- Remote operation/Programmable
- Low O&M cost
- Flexible to new concepts



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GDPAA Concept – AFRL Solution

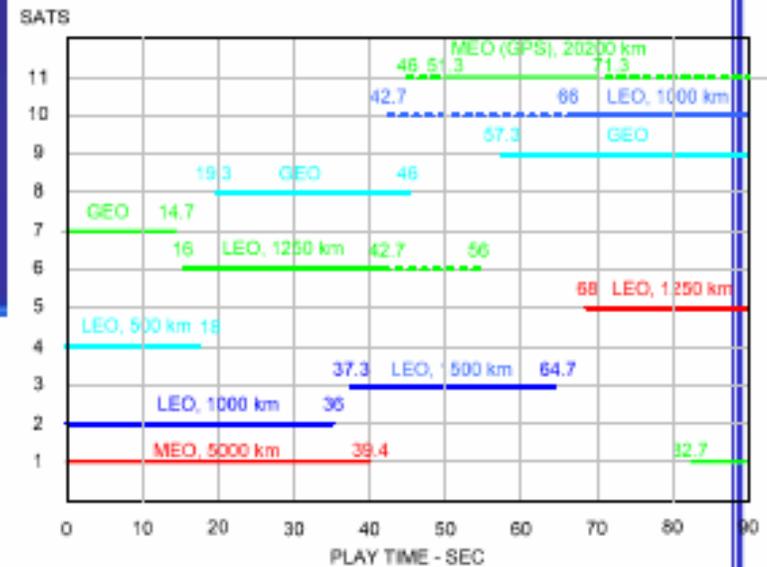


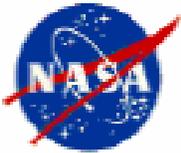
Video illustrates several GDPAA features

- Beam arbitration
- Gain on demand – varying spot size
- Dynamic number of beams – going from 4 beams down to one beam
- Anomaly resolution – full aperture and back to normal (spinning satellite)

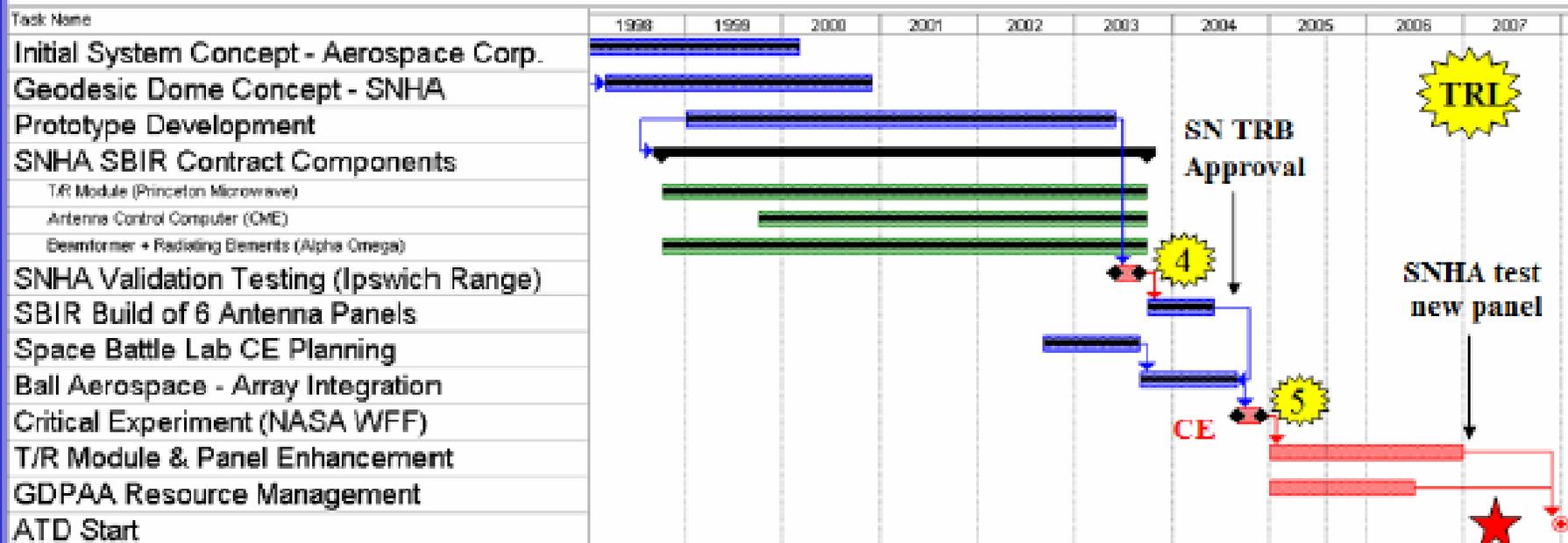
Matlab code used to generate this movie could in principle be used to control an operational GDPAA

- For a given scenario and required G/T for each satellite, code computes respective active areas on the dome (active spots), points beams and tracks the satellites.





Technology Development



- From concept to ATD in 8 years.



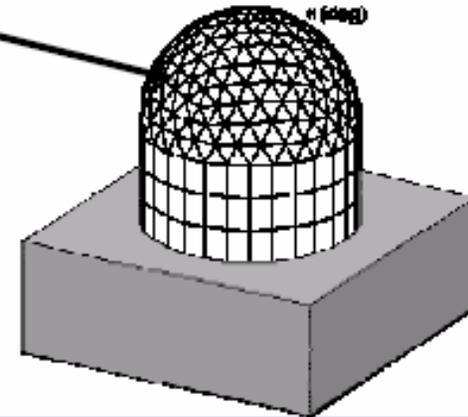
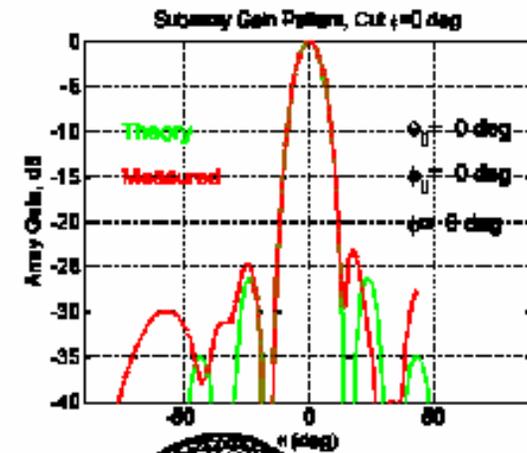
Technology Development

78-Element Subarray - GDPA-ATD Basic Building Block

AFRL (SN and IF) SBIR contracts

- TR Modules
- Beamformer & radiating element
- Beamsteering computer

78 element subarray assembled and tested at SNHA Ipswich Antenna Range





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Critical Experiment – Phased Array for TT&C (PAT)



CUSTOM MANUFACTURING & ENGINEERING, INC.



PmT

Pride in Performance

1 Tx Beam: EIRP=81 dBm

2 Rx Beams: G/T~4 dB/K

99 contacts with LEO satellites over 15 days

Proven Capabilities:

- SGLS and USB functions:
- Telemetry and Tracking
- 2 Simultaneous contacts

- NASA & DoD Spacecraft

EIRP = Effective Isotropic Radiated Power dBm

G/T = gain/noise temperature dB/K

SGLS = S-band used by DoD satellites

USB = S-band used by NASA and NOAA- required for new DoD satellites

Sponsor:
AF Space Battlelab



NASA Flight Facility, VA



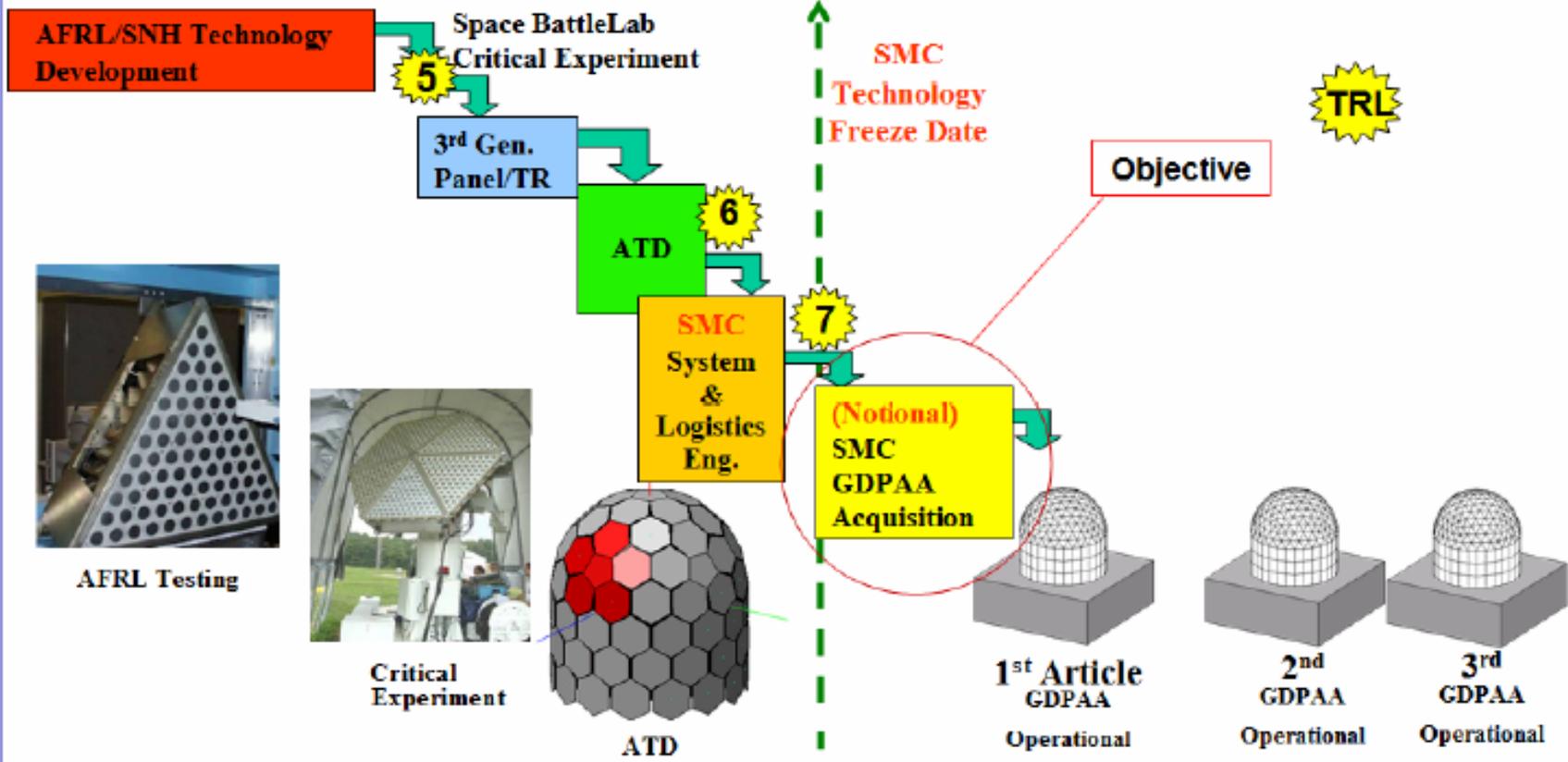


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ATD – Mature technology to TRL 6

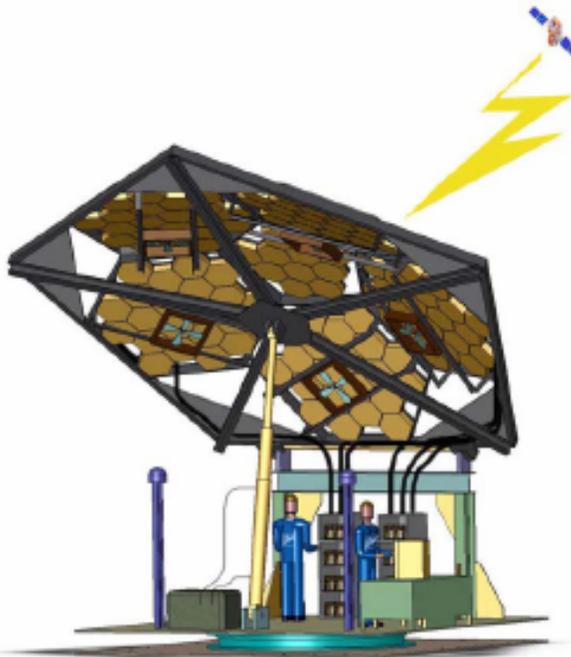
FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21
Concept & Arch Development						Technology Demo & Risk Reduction						Acquisition and Operations Support										



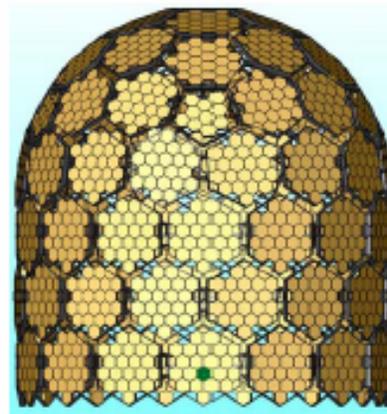


ATD Contract

- Contract Awarded to Ball Aerospace 11/03/06
- Kickoff Meeting 11/29/06



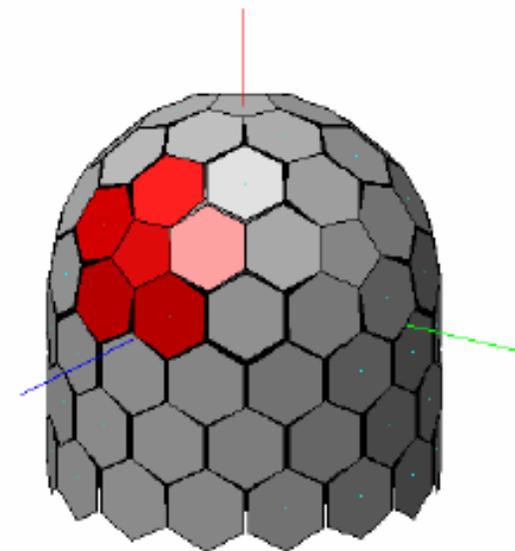
ATD test configuration



ATD Validates GDPA-ATD Performance:

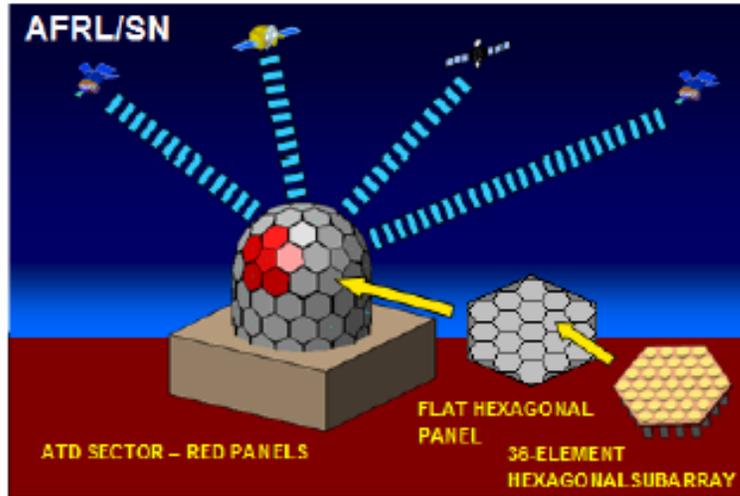
- G/T ~ 16 dB/K
- EIRP ~ 107 dBm
- 4 Simultaneous Beams

GDPA-ATD – Full Dome

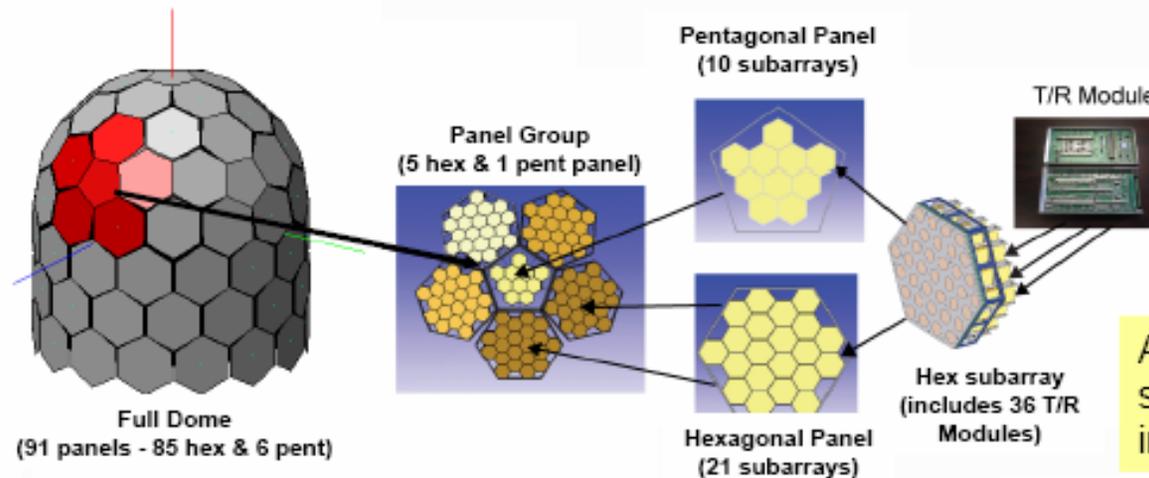
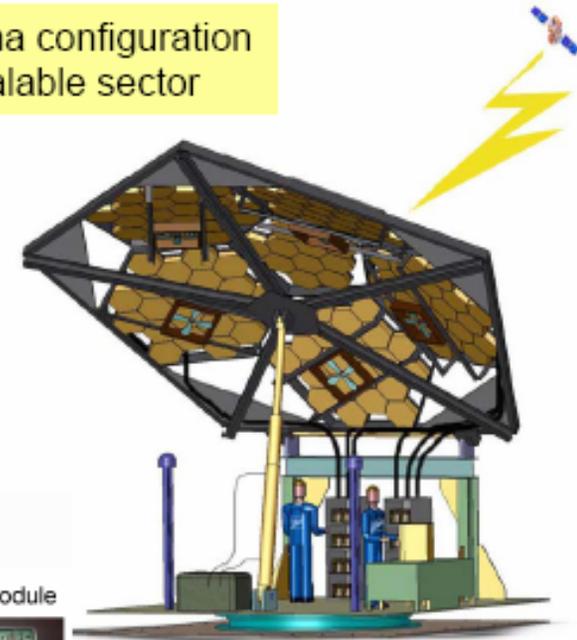




ATD Antenna – Ball Aerospace Approach



ATD Test Antenna configuration is a full dome scalable sector



ATD will demonstrate multiple simultaneous satellite contacts in an operational environment



Demonstration Objectives

- **“Transparent” S-Band and L-Band Functions**
 - Telemetry
 - Commanding
 - Tracking
 - **SGLS Ranging**
- **Target Search**
- **Antenna Resource Management (ARM)**
- **Gain-On-Demand**
- **Walking Beams**
- **Multiple Simultaneous Dual-band Contacts**
- **Antenna Status Monitoring/Reporting**
- **Demonstration of “Hot” Maintenance Concepts**



Phased Array Demonstration at Schriever AFB, CO

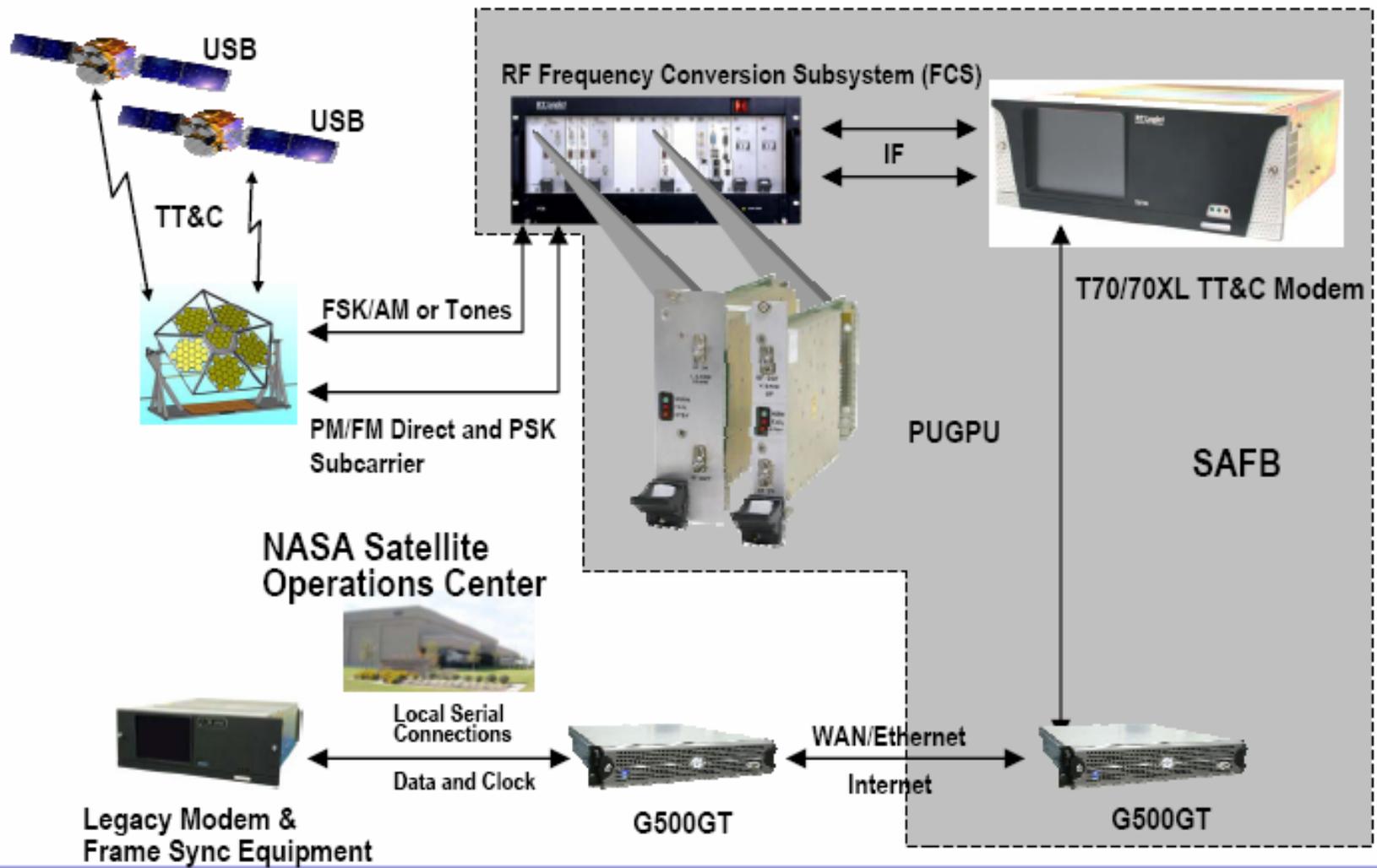
- **Operational Demo Co-located with AFSCN Remote Tracking Station**
 - Shadow supports
 - Primary supports
- **Use of Legacy, Next-Generation and Portable Ground Systems**
- **Standard AFSCN Space Operations Center and Comm Interfaces**
- **Bent-pipe operations with NASA Mission Control Centers and Comm Interfaces (desired)**
- **Demo Schedule**
 - Checkout Ops: Aug-Dec 08
 - “Run-for-record” Ops: Jan-May 09



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Possible Scheme to Demonstrate USB Contact





PUGPU Background

- Portable Universal Ground Processing Unit (PUGPU)
- Composed of all COTS components
 - \$250K per system depending on configuration
- Currently fielded over several DoD/NASA programs
 - NENS Solar Dynamic Observatory (SDO) and Lunar Reconnaissance Orbiter (LRO)
 - AFSCN Remote Block Change (RBC) upgrade
 - Kirtland AFB DET12 Deployables
 - SQPSK SBIR Waveform
 - Advanced EHF
- Support for Unified S-Band (USB), NASA Universal Tracking Data Format (UTDF), LEO-T Commanding and Telemetry, Space Link Extension (SLE), and CCSDS formats
- PUGPU developed under contract F30602-03-C-0049 with AFRL/IFGE

PUGPU Rack Configuration



**For More Information
Please Contact:**

Paul J. Oleski, AFRL/IF
Rome, New York
315-330-1485
Paul.Oleski@afrl.af.mil

Bill Asiano, Real Time Logic
Colorado Springs, CO
719-884-6357
basiano@rtlogic.com



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- PUGPU Contains RF Frequency Conversion and Multiple TT&C Modems In A Self-Contained Transportable Case
- Modular Components Allow for Simultaneous Reception/Transmission Across Multiple RF Bands (Ku-, X-, S-, or L-Band)
- TT&C Modems Can Be Configured To Independently Process Telemetry and Commanding Using Many Different Waveform Modulation Schemes
- T7070XL Telemetry Tracking and Command (TT&C) Modem Features:
 - Telemetry Downlink Processing
 - Three IF Inputs per T7070XL
 - One IF Input Dedicated To Ranging
 - Rates to 20Msps (40Mbps QPSK)
 - PM/FM/B/Q/SQPSK Demods
 - Up to 2 Subcarriers per T7070XL
 - Commanding Processing
 - SGLS and USB Command Generation
 - Rates to 2Mbps (Commanding)
 - Downlink Simulation to 20Mbps
 - Ranging
 - SGLS and USB Ranging Supported
 - Time Tagged Range Estimates 1/sec.
- Frequency Conversion Subsystem (FCS) Features:
 - Multi-Band RF Processing
 - Simultaneous Frequency Conversion
 - Hot Swappable Conversion Units
 - Block and Agile Tuning
 - Different Intermediate Frequency (IF) Options
 - Support for both low and high rates
 - 70 to 720 MHz
 - Telemetry or Mission Data
 - Remotely Controlled IF Matrix Switch
 - Routing of IF waveforms to different TT&C modem units
 - Extended I/O Interface
 - Both TCP/IP and Serial WAN supported
 - Remote & local Ethernet Control & Status





Recommendations

- **FY07 - Explore NASA Participation in Phased Array ATD**
 - NASA USB Spacecraft
 - NASA “Bent-Pipe” Operations
 - Use of Portable Remote USB Ground Station (PUGPU)
 - Early Pathfinder for Interoperable Satellite Control Network (ISCN)
 - TCP/IP Net-centric communications/services
 - Federated Scheduling
- **FY08 – FY09 - Include NASA Programs in Phased Array Demonstration**
 - Communicate NASA interest in Phased Array Technology to DoD



Human Space Flight (HSF) Integrated Network Status

March 15, 2007

**Fred G. Pifer
Human Space Flight
Honeywell/NENS
Goddard Space Flight Center**



Integrated Networks

- **Integrated Network is comprised of diverse NASA and DOD assets which provide the critical end-to-end communications link between the JSC MCC and STS/ISS**
 - Space Network (SN)
 - Ground Network (GN)
 - NASA Integrated Services Network (NISN)
 - Flight Dynamics Facility (FDF)
 - KSC Communications Distribution & Switching System (CD&SC)
 - Dryden Western Aeronautical Test Range (WATR)
 - Eastern Range (ER)
 - Air Force Satellite Control Network (AFSCN)

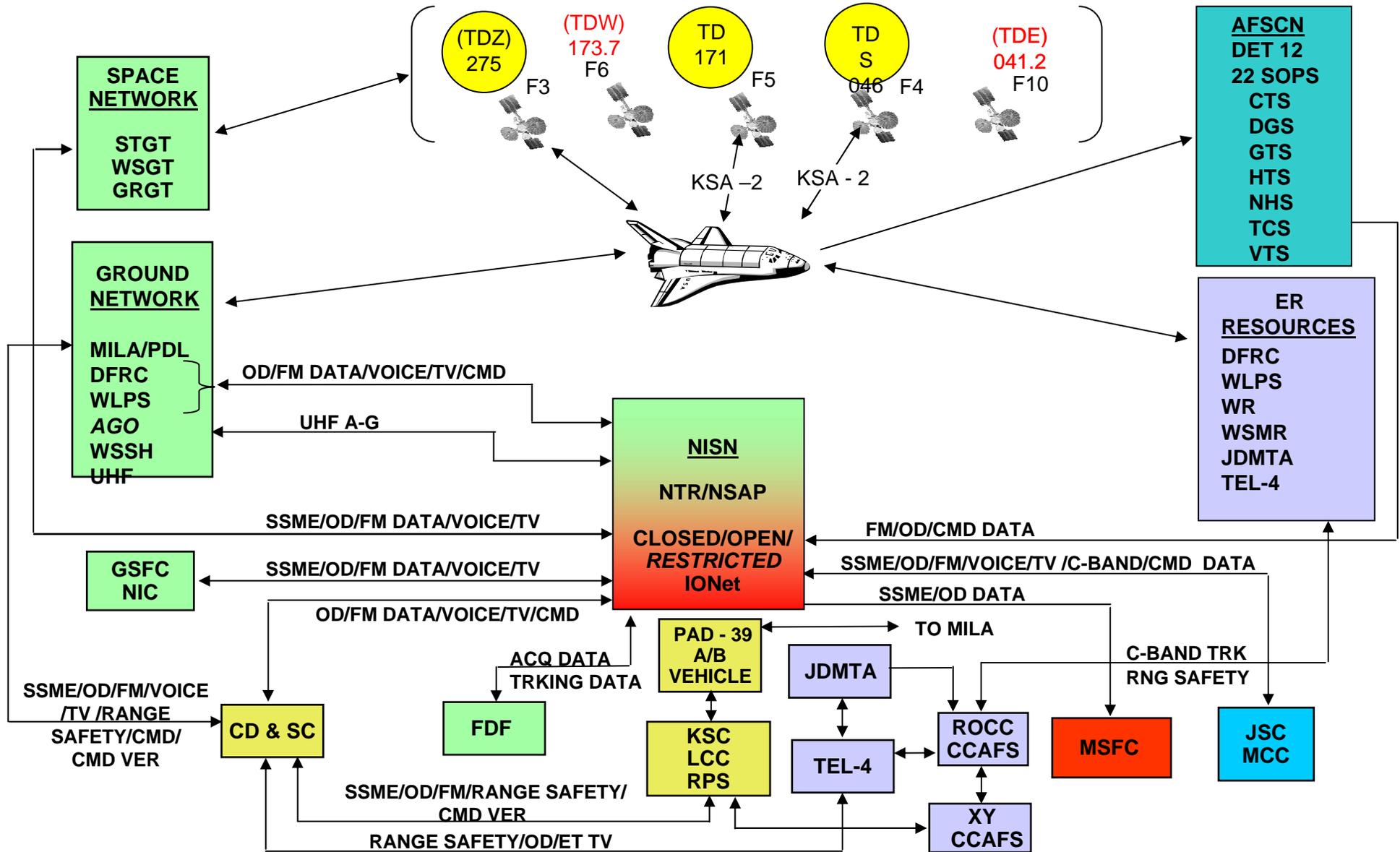


NENS Human Space Flight (HSF) Team

- **Primary role for NENS HSF Team is integration of Network Resources to provide Tracking Data Acquisition and Communications services for the HSF Missions by coordinating support in the following areas:**
 - Advanced Mission Planning
 - Requirements Management
 - Mission Documentation Development/Maintenance
 - Mission Support Planning
 - Mission Integration, Test, and Verification
 - Sustaining Engineering Services
 - Operations and Maintenance (WSSH UHF)

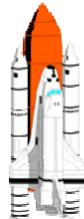
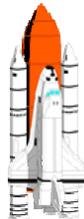


Space Shuttle Integrated Networks Overview





Upcoming Human Spaceflight Missions

April '07	May '07	June '07	July '07	August '07	September '07
  Soyuz 14 04/07/07  STS-117 NET 04/22/07		  ISS EVA 06/01/07  ISS EVA 06/07/07  STS-118 06/28/07	  ISS EVA 07/24/07  ATV "Jules Verne" 07/25/07		  STS-120 09/06/07



Flight Assignment Working Group (FAWG) Planning Manifest



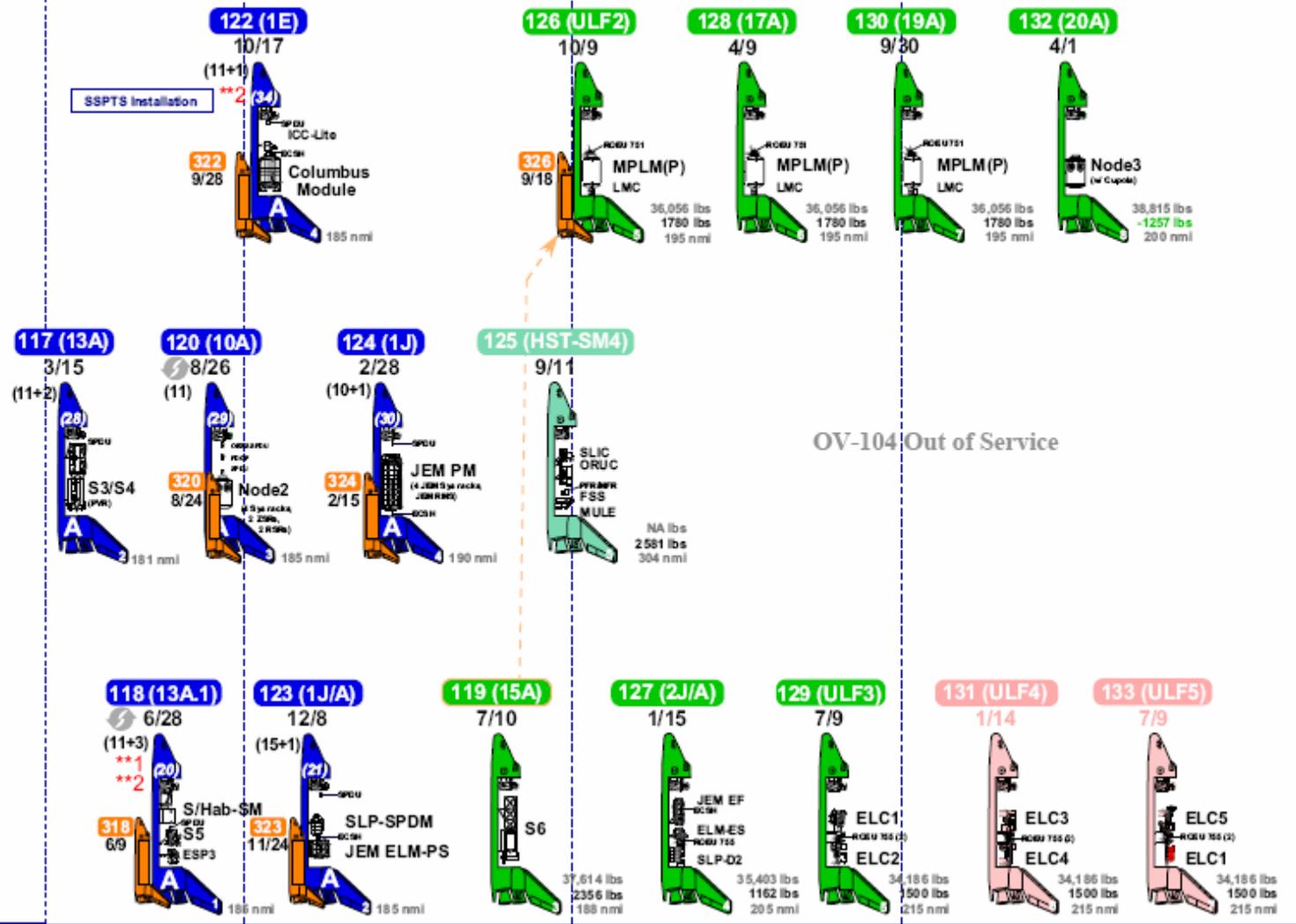
CY2006					CY2007					CY2008					CY2009					CY2010				
FY2006					FY2007					FY2008					FY2009					FY2010				

103
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This chart represents cargo bay configurations approved by the JCAWG



OV-104 Out of Service

Flight Rate	FY4 / CY-4					FY-5 / CY-5					FY-6 / CY-4					FY-3 / CY-3												
Launches	12	11	12	7	9	5	5	5	5	5	5	1	5	28	31	26	5	18	8	16	7	14	31	1	17	12	7	11
Launches/Space Shuttle	5	5	5	5	5	5	5	5	5	5	5	1	5	28	31	26	5	18	8	16	7	14	31	1	17	12	7	11
Launches/Space Shuttle	5	5	5	5	5	5	5	5	5	5	5	1	5	28	31	26	5	18	8	16	7	14	31	1	17	12	7	11

Contingency Logistic Flights (CFL) (Empty Cargo Bay)

Contingency Shuttle Crew Support (CSCS) (Empty Cargo Bay)

FRD Launch Date (based) → Launch Date

Mission duration → Crew Rotation

of times the OV has flown → Assessed launch date

Crew Augmentation → Cargo Bay Element(s)

Launch Pad → Launch Pad

Not baselined in the FRD

ISS Cargoable weight (lbs) APM (lbs)

Randomness altitude (nmi)

- New Capabilities: (JMIBC controlled)**
- Avionics Bay 1, 2 & 3A Enhanced Cooling (Rear Air-Breathing) Capability
 - Station/Shuttle Power Transfer System (SSPTS) Capability - extends flight duration 15 days (STS-118 (13A.1) & subs except OV-104 flights)

Legend:
 * Under Review
 Green APM#: Flight specific vehicle & launch month
 Black APM#: Generic specific vehicle & launch month



Recent Changes

- **Santiago (AGO) added as STS Support Requirement (12/06)**
- **Wallops (WPS) 11-Meter System provides STS Support; 9-Meter Antenna System has been decommissioned (12/06)**
- **Dryden (DFRC) ATF-2 and ATF-3 antenna systems have been upgraded and certified; ATF-1 planned to be upgraded post STS-117**
- **NISN has migrated a majority of their STS/ISS Services from NSAP to NTR backbone**
 - Services transitioned have been thoroughly tested and are working well
 - NSAP circuits have been decommissioned for services which have successfully supported a Shuttle Mission
 - Tiger Team has been formed to investigate unexplained errors on MILA Command Lines



Upcoming Changes

- **ISS Front End Processor Replacement (FEP-R)**
- **Kennedy Forward / Return Link (KFRL) will replace MILA command and telemetry processing**
- **Wallops will be replacing their Ground Station Hardware with an Integrated Enertec System**
- **Shuttle Services on AMC-6 Transponder 5 will be digitized, allowing edgebands to be utilized for Live Interview Media Outlet (LIMO) and ICE/MER Video**
- **ISS / Soyuz VHF Emergency Communications Services upgrade to improve frequency response and audio clarity**
- **Transition of data interface for AFSCN services from Onizuka Air Station to Schriever Air Force Base in works**
- **Transition of NORAD Services from Cheyenne Mountain to Vandenberg AFB in works**



Visiting Vehicle Status

- **European Space Agency's (ESA) Automated Transfer Vehicle (ATV)**
 - SN Scheduling test completed 02/09/07
 - Launch scheduled for NET 07/25/07
- **Japanese Space Exploration Agency's (JAXA) H-II Transfer Vehicle (HTV)**
 - Launch scheduled for NET 02/09



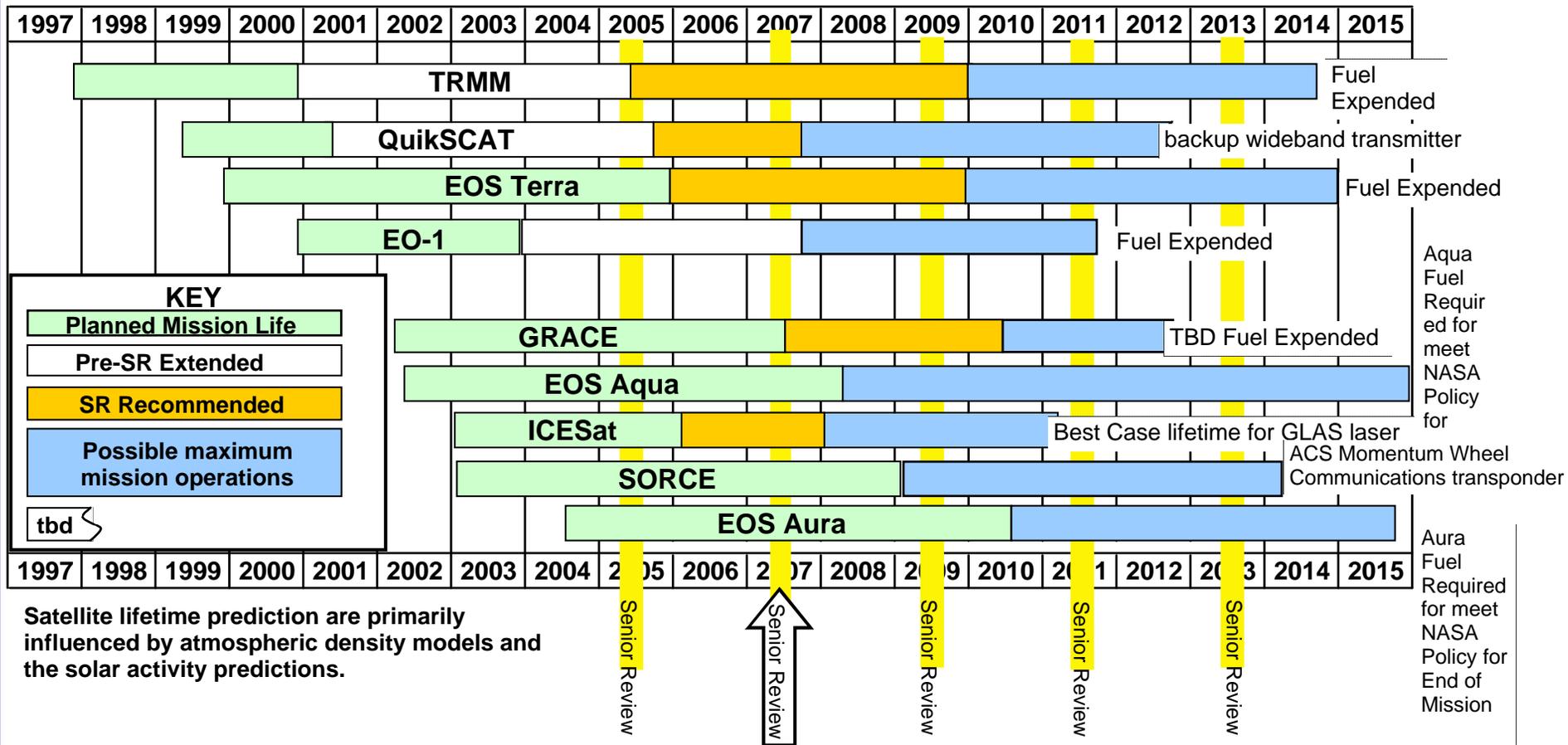
Earth Science Mission Operations (ESMO) Status

Chris Wilkinson
Deputy Project Manager
Earth Science Mission Operations/428
NASA/Goddard Space Flight Center



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Mission Life



Satellite lifetime prediction are primarily influenced by atmospheric density models and the solar activity predictions.



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Terra 2006 Summary

Spacecraft Subsystem Status:

EPS – Nominal CDH – Nominal
 TCS – Nominal COMM – Nominal
 GNC – Nominal FSW - Nominal

Instrument Status:

ASTER – SWIR Temp Increasing
 CERES – Nominal MODIS – Nominal
 MISR – Nominal MOPITT – Nominal

Maneuvers:

MODIS Roll Maneuvers (Qty: 9)
 1/19/06, 2/17/06, 6/15/06, 7/15/06,
 8/13/06,
 9/11/06, 10/11/06, 11/9/06, 12/9/06
 Drag Make-Up Maneuvers (Qty: 4)
 1/18/06, 5/24/06, 10/14/06, 12/6/06
 Inclination Maneuvers (Qty: 2)
 11/14/06, 11/21/06

Special Activities Performed:

Thruster Gain Change – 5/15/06
 NAV Drag Model Update – 6/21/06
 DDL Testing – 8/17/06, 9/2/06, 9/4/06
 Configure NAV to use TDE instead of 275
 during reduced TDRS availability

Anomalies:

MDA BITE Failure (Qty: 145)
 SSR/ASTER Missed EDU (Qty: 3)
 SSR Command Bit Flip (Qty: 23)

2007 Planned Activities:

SWIR CPHTS Set-point reduction –
 1/24/07
 SWIR Cooler Stroke Change – May
 2007
 DDL Testing – April 2007
 Automation – May 2007
 Inclination Maneuvers – Dec 2007
 Drag Make Up Maneuver – as needed
 MODIS Roll Maneuvers – monthly
 Configure NAV to use TDE instead of
 275 during shuttle mission

Month	Logged Tbits	Tbits/ Day	% Captured	Cause of Significant Loss
Jan.	41.9	1.35	100.00%	No Loss
Feb.	36.6	1.31	99.99%	MDA2
Mar.	41.6	1.34	99.87%	WSC H/W Issue
Apr.	40.2	1.34	99.99%	MDA2
May	42.3	1.36	99.96%	EPGN Misconfiguration, ASTER Missed EDU
5/31-6/25	35.3	1.36	99.98%	CMD I/F Bit Flip
6/26 – 7/23	38.2	1.36	99.99%	MDA2
7/24 – 8/27	46.9	1.34	99.98%	MDA2/ WSC H/W Issue /Scheduling Error
8/28 – 9/24	38	1.36	99.99%	Ops Error/VNIR1 Corruption
9/25 – 10/22	37.7	1.35	100.00%	No Loss
10/23 – 11/26	47.2	1.35	99.95%	SKS CMD Problem – SSR Full
11/27 – 12/31	47.1	1.35	99.97%	KSAM-2 Anomaly & ASTER Skipped EDU

Captured Tbits	Avg Tbits/day	Avg % Data Captured
493.04	1.35	99.97%

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TDRSS	1067	812	1004	803	804	816	757	767	831	834	1091	646	10232
EPGN	10	17	21	16	28	17	26	5	15	15	16	9	195
Total	1077	829	1025	819	832	833	783	772	846	849	1107	655	10427
Data Loss	0	1	1	1	2	2	1	1	1	0	2	0	12
MIRs	35	18	28	22	28	25	32	20	19	24	16	18	285



Space Communications Customer Forum #15

EOS-Aqua 2006 Summary

Aqua Mission Profile:

Launch: May 5, 2002, delta 7920-10L, VAFB
 Orbit: 705km, sun-synch., 98.2° inc., 1:30PM desc.
 Node, WRS controlled 10km, leads A-Train

Spacecraft:

Size: 15.8ft x 54.8ft x 26.4ft deployed
 Attitude: 3-axis stabilized, Earth pointing

Instruments:

6 Nadir pointing Earth resources specializing in the
 Earths Water Cycle
 AMSR-E, AIRS, AMSU-A, CERES, HSB, MODIS

Data Handling:

Gathered constantly @ 15Mbps
 Stored on SSR with 2 orbit capacity
 Dumped at polar GNs
 Data Latency of < 3hours
 Near-Constant Direct Broadcast of Real-Time Science

Maneuvers:

MODIS Lunar Cal. Roll Maneuvers (Qty: 10)
 01/09, 02/08, 03/09, 04/08, 05/08, 06/07, 07/06, 11/01, 12/01,
 12/30
 Drag Make-Up Maneuvers (Qty: 4)
 02/01, 04/19, 06/14, 11/15
 Inclination Adjust Maneuvers (Qty: 4)
 08/22, 08/29, 09/07, 09/12

Special Activities:

Auto-Ops development / validation
 Increased Direct Broadcast to N. Hemisphere
 2 Solar Eclipses

Anomalies

Non-CM Load to Spacecraft [AR-06-061]
 CTC Machine Faults (x3) [AR-06-079]
 SSR Single Bit Error Increase (mem module) [AR-06-100]
 Norway Lines Data Loss #1 [AR-06-158]
 Norway Lines Data Loss #2 [AR-06-186]
 Uncorrectables Data Loss [AR-06-273]

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
EPGN	519	520	523	642	517	521	577	592	555	575	504	516	6561
TDRSS	184	202	210	266	211	217	217	218	227	212	216	229	2609
Total	703	722	733	908	728	738	794	810	782	787	720	745	9170
HR Data Loss	0	0	1	0	0	1	1	0	2	1	0	0	6
Duration			0:00:12			3:39:22	6:26:04		0:09:26	0:21:04			10:38:18
									0:02:10				



Space Communications Customer Forum #15

Aqua/Aura Auto-Ops

- **Concept:**
 - Removes ground commanding for all normal operations
 - » SSR Playback & Flight Software Log Dumps
 - » Eliminates the dependence on a command link to perform science ops
 - SSR Playback can occur prior to establishment of Command Link
 - More efficient use of contact duration; time not wasted waiting for command lock
 - SSR Playback can still occur if ground station has problems with S-Band or data lines
 - Earlier dump start allows for full playback every orbit (less latency)
- **Mechanics:**
 - » Utilizes On-Board Logic to “sense” a GN contact by X-Band rate
 - » Configures SSR & Commands nominal “last orbit dump”
 - » Begins S/C log dump
 - » Configured X-Band back to Direct Broadcast following PB completion
 - » SSR Dump / FSW Log Dump can individually be switched ON or OFF
- **Progress:**
 - » FOT successfully developed, tested & uplinked the logic to Aqua & Aura
 - » FOT successfully developed SOPs & trained the Online Team
 - » FOT successfully validated the logic on orbit
 - » Currently operating for ~7 months dumping S/C Log only



Space Communications Customer Forum #15

Aura 2006 Summary

Significant Events/ Accomplishments

- Fall Inclination Maneuvers
- OMI FMM Anomaly & Resolution
- Auto-Ops Development
- Security Incident/DMZ usage
- Norway Line Outage (3.75 orbits)
 - June Event = 1.35 orbits
 - July Event = 2.40 orbits

Future Plans

- Auto-Ops Implementation (for playbacks)
- Move Aura 7-8 mins behind Aqua (vs. 15 mins)

2006	
Drag Make Up Maneuvers	4
Inclination Adjusts	4
Attitude Maneuvers	5
NASA Anomalies	6
SOAR Anomalies	6
Mission Impact Reports	96
FSW Loads	50
FSW Patches	21
Instrument Activities (Excl Act)	103
Misc. Activities	4
Stored Command Loads	365
GN Contacts	5324
SN Contacts	2685
Data Volume (Tb)	54.8 Tb
Data Capture %	99.97%

Aura												
	Jan	Feb	Mar	Apr	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
EPGN	408	410	511	407	516	409	417	515	414	498	411	5324
TDRSS	194	205	270	217	263	204	198	268	193	248	205	2685
Total	602	615	781	624	779	613	615	783	607	746	616	8009
Data Loss	0	0	0	0	1	1	0	0	0	0	0	2



Space Communications Customer Forum #15

TRMM Status 2006 Summary

Spacecraft Subsystem Status:

CDH	Nominal	RF	Nominal
ACS	Nominal	Thermal	Nominal
Electrical	Nominal	RCS	Nominal
Power	Nominal	Deployables	Nominal

Instrument Status:

CERES	Powered off :5/2001	
TMI	Nominal	
VIRS	Nominal	
PR	Nominal	
LIS	Nominal	

Maneuvers:

Delta V Maneuvers	8 Total
Jan. 9, 2006	
Feb. 24, 2006	
Apr. 11, 2006	
May 11, 2006	
Jul. 3, 2006	
Sep. 2, 2006	
Oct. 19, 2006	
Nov. 28, 2006	
Yaw Maneuvers	15 Total
Jan. 13, 2006	
Feb. 13, 2006	
Mar. 3, 2006	
Mar. 29, 2006	
Apr. 25, 2006	
May 13, 2006	
Jun. 14, 2006	
Jul. 30, 2006	
Aug. 16, 2006	
Sep. 12, 2006	
Oct. 7, 2006	
Oct. 27, 2006	
Nov. 27, 2006	
Dec. 11, 2006	

TRMM 2006 SUMMARY

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TDRSS	500	500	500	510	510	510	510	500	510	510	510	500
Problem SN	0	0	2	0	8	0	1	1	3	0	3	0
Event Reports	0	0	2	0	4	0	1	1	3	0	3	0



Space Communications Customer Forum #15

ICESat

- **Conducted three 33-day laser campaigns per year**
 - Feb/March, May/June, Oct/Nov
- **Receives extra support from GN in preparing for laser campaigns**
- **Routinely receives 4 passes per day**
- **Will be requesting NASA Headquarters to extend mission until June 2011**



Space Communications Customer Forum #15

TOMS

- **Downlink telemetry failed in Dec 2006**
- **Currently attempting one pass per day**
- **End of Mission Plan submitted to HQ for approval**
- **Will passivate TOMS when GSFC Code 300 and NASA Headquarters approves plan**
 - **within couple of months**



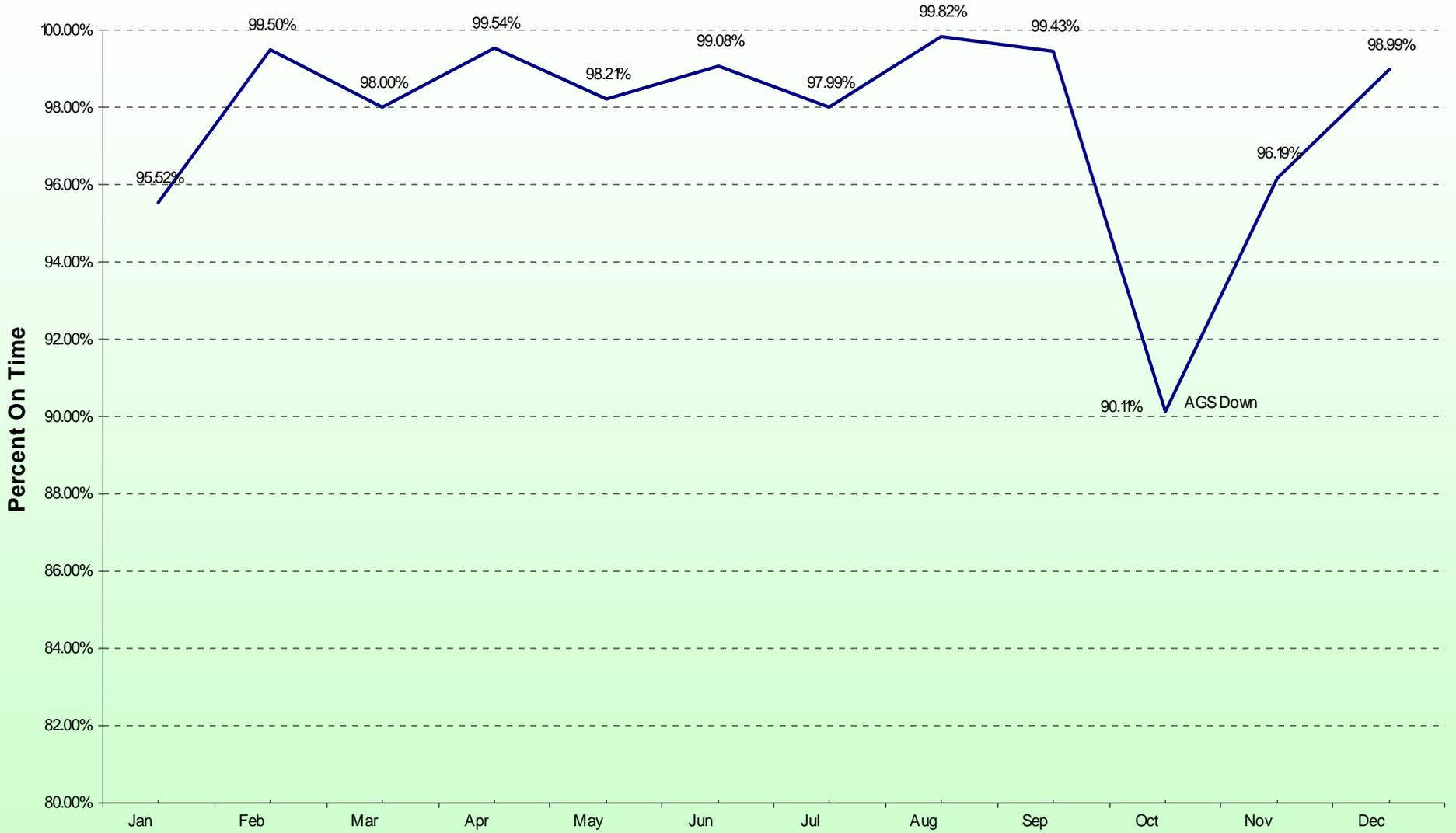
Space Communications Customer Forum #15

EDOS 2006 Review

- **Connectivity from Ground Stations**
 - All EDOS Ground Station Interface Facilities (GSIFs) are now connected to GSFC via a high rate IP network for data transfer to GSFC in the 50 Mbps range
- **Short-term Data Storage**
 - All captures of raw data are now stored on hard drives using Storage Area Network (SAN) technology at each ground station for 30 days replacing Ampex tape storage
- **Automated Re-delivery of Level Zero Products**
 - Implemented a solution to automatically redeliver products missed at the customers sites by using an existing product disposition interface
- **Added a Checksum to all Science Products**
 - Every RBD and PDS has an option to be delivered with a checksum which can be used to certify data integrity after transmission
- **Data Driven Phase I**
 - The EDOS data capture front-end processors at each ground station were re-designed to operate without the need of a pre-pass schedule or pre-pass configuration
 - Each capture system is dedicated to an antenna and is actively monitoring X-band signals until it detects a supported mission which initiates a capture session
 - Autonomous processing of captured data with no operator intervention for all nominal events, including transfer to GSFC, LZPF processing and delivery of RBD and PDS

EDOS Performance

January 2006 Through December 2006



Note: C5.0 Installed June 13, 2006

Monthly

— % on Time



Space Communications Customer Forum #15

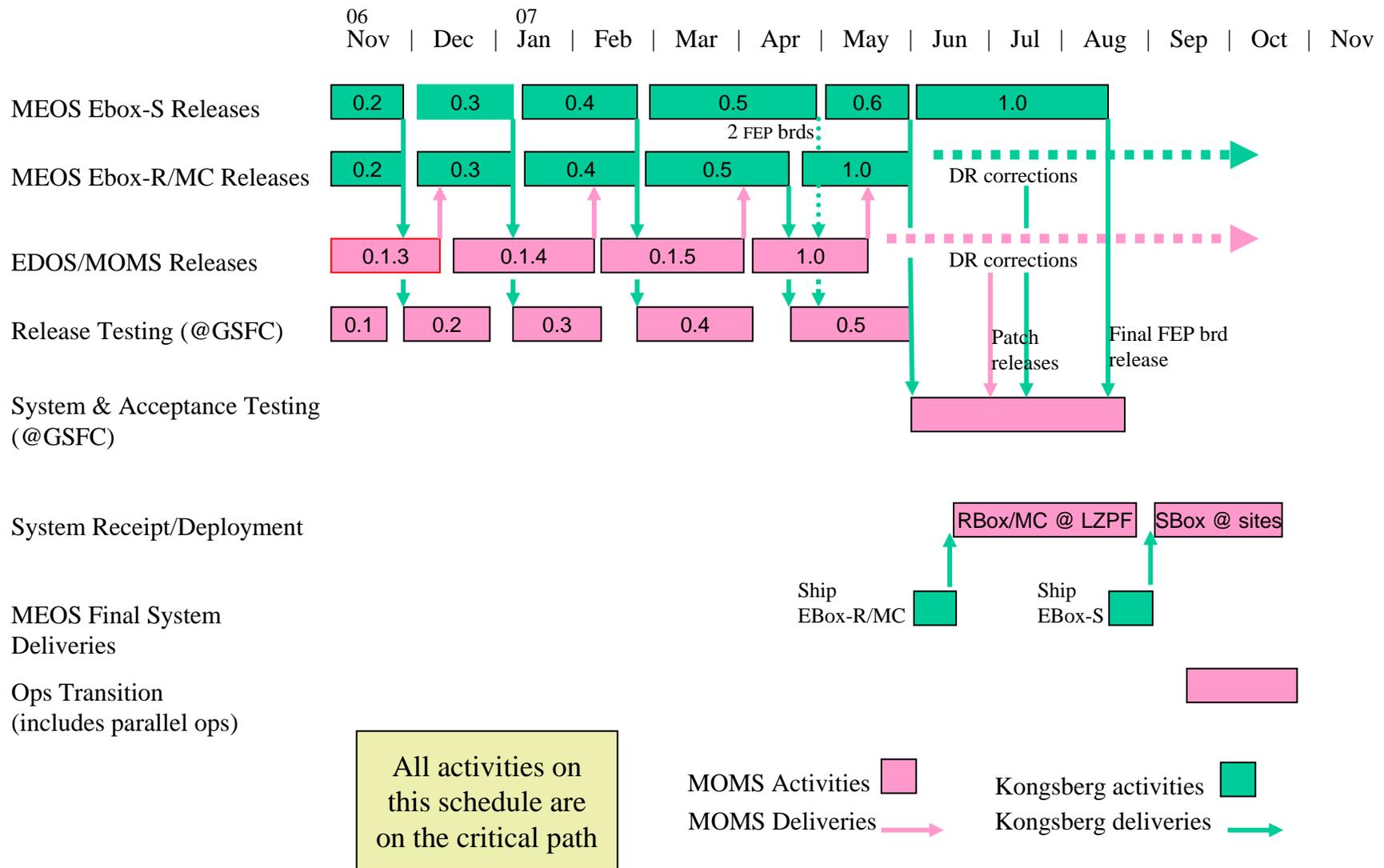
EDOS Data Driven 2007 Autonomous Operations (Phase II)

- **Phase II (Release C5.1) adds on to the successes of Phase I:**
 - Standardizes all EDOS operator screens based on JAVA and accessible through a web browser
 - A diverse set of custom GUIs developed in Teleuse, the use of Kongsberg proprietary GUIs, and a long list of Unix scripts will now reside in a complete set of GUIs without the need to use command-line entries for routine operations
 - A single computer running a web browser is all the operator needs instead of a \$10K workstation
 - An additional external web server will allow the ground stations, FOT, and science teams to non-intrusively observe the EDOS capture and production status at any time
 - Incorporates a brand new FEP that increases EDOS spacecraft downlink capture rate up to 500 Mbps and allows in-system upgrades via FPGA image files
 - Allows the option to create Level Zero Products right at the ground station and option to deliver data in real-time; “EDOS-in-a-Box” capability to support Remote Science Processing for disaster recovery
 - Consolidates the High Rate Service Processors and the Production Data Processors into single units, reducing the amount of hardware, replaces old SGI technology and SGI IRIX OS with new HP Proliant hardware and a single operating system (LINUX) throughout the whole system to optimize system administration and maintenance
 - Integrates EDOS status with the Terra automation GMSEC by way of a “bridge”
 - Upgrades hardware on all ground stations to the latest technology reducing hardware obsolescence risks
 - Automates Session and Product Status reporting



Space Communications Customer Forum #15

C5.1 Integrated Schedule

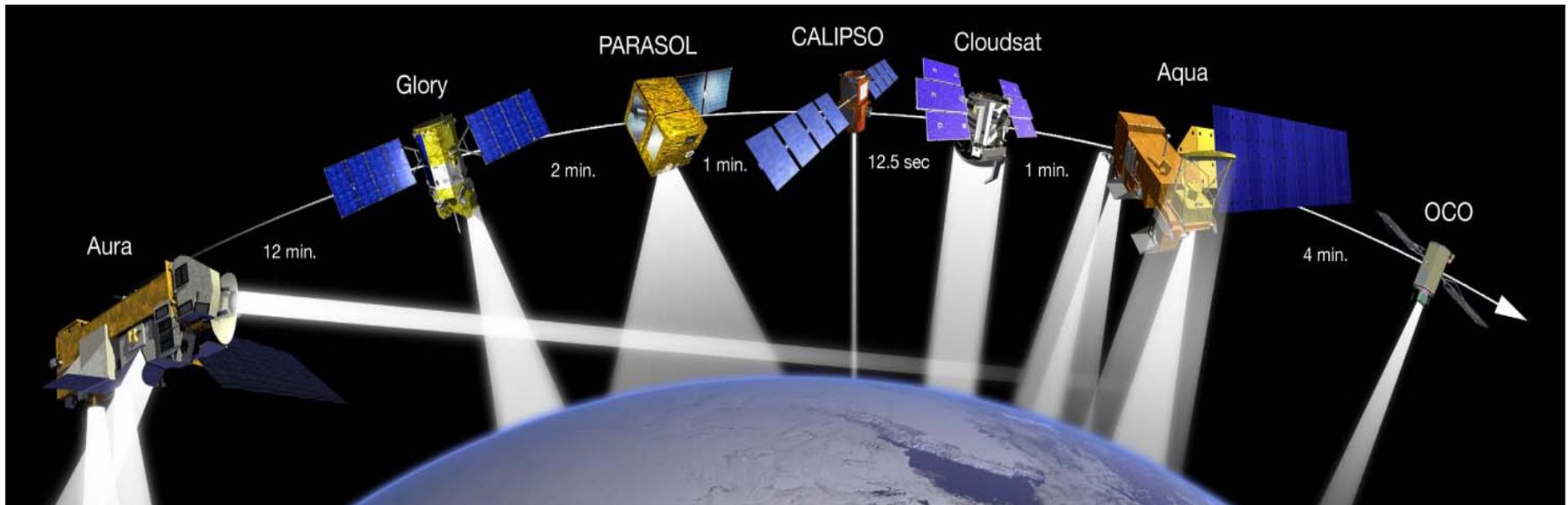




Space Communications Customer Forum #15

The Afternoon Constellation

- CALIPSO and CloudSat joined the A-Train in May 2006. Orbiting Carbon Observatory (OCO) and Glory are scheduled to launch in late 2008.
- The Spring 2007 inclination maneuver series started on March 6 with the first of 4 CloudSat inclination maneuvers. Aqua and Aura will each conduct 4 inclination adjust maneuvers (IAM)s in Spring 2007.
- ESMO has a task with Cheyenne Mountain Operations Center which provides conjunction assessment analyses for the EOS Morning and Afternoon Constellations.
- Conjunction assessment personnel are developing a process and procedures for coordinating the various missions whenever they receive a warning about a near-term potential close approach with an object or debris. GSFC and LaRC are working with HQ to resolve issues associated with sharing data with the International Partner.





Space Communications Customer Forum #15



Space Science Mission Operations Project (Code 444)

Patrick Crouse
Project Manager
Vacant

Deputy Project Manager

Barb Vargo
Financial Manager

Joseph Fainberg
Senior Project Scientist

March 15, 2007



SSMO Significant Events

- **Current Missions Status**
 - Heliophysics
 - Astrophysics
- **IMAGE, IMP-8, SAMEPX, SWAS, WIRE, CHIPS**
- **Recent and Upcoming Launches**



Heliophysics Operations Guidance

- **Polar** **September 2007**
- **FAST** **July 2008**
- **Geotail** **July 2008**
- **TRACE** **November 2008**
- **STEREO** **February 2009 (end of Prime)**
- **THEMIS** **March 2009 (end of Prime)**
- **Cluster II** **~ 2010**
- **ACE** **> 2012**
- **RHESSI** **> 2012**
- **SOHO** **> 2012**
- **TIMED** **> 2012**
- **WIND** **> 2012**



Astrophysics Operations Guidance

- FUSE September 2008
- RXTE March 2009
- WMAP September 2009
- GALEX > 2010
- Swift > 2010



Space Communications Customer Forum #15

IMAGE, IMP-8, SAMPEX, SWAS, WIRE, CHIPS

- **IMAGE**
 - Expect to conduct data flow tests with DSN in September 2007
 - Will attempt to recover the satellite in Mid-Late October 2007 following deep shadow
- **IMP-8**
 - Lost signal in October 2006
 - Will command to increase power loads on March 16
 - Anticipate spacecraft shadow on March 20
 - Hope will result in a hard reset
 - Attempt to re-establish communications
- **SAMPEX**
 - Continue operations from Bowie State University
 - Providing “hands on” experience for students in a professional setting
 - Providing space weather products to the broader community in conjunction with Aerospace



IMAGE, IMP-8, SAMPEX, SWAS, WIRE, CHIPS

- **SWAS**

- LCROSS mission is interested in SWAS observing the Lunar impact in 2009
- Strong interest has been expressed by IV&V Facility to partner on an activity with Bowie State University and West Virginia University
- Discussions are currently in progress to finalize agreements

- **WIRE**

- In process of turning WIRE over to the Ground Network to use as a test satellite

- **CHIPS**

- Discussions in progress between the Berkeley and AMES



Recent Launch Activity

- **Time History of Events and Macroscale Interactions during Substorms (THEMIS)**
 - THEMIS will determine the causes of the global reconfigurations of the Earth's magnetosphere, that are evidenced in auroral activity. THEMIS consists of five small satellites which carry identical suites of electric, magnetic, and particle detectors, that will be put in carefully coordinated orbits
 - Liftoff occurred at 2301Z on DOY 048 February 16, 2007 aboard a Boeing Delta II from the Cape. TDRS had first contact - successfully covering separation of Probe A at 0012Z.
 - BGS conducted a round robin support of all 5 probes shortly after separation and noticed lower than expected signal levels. A spacecraft emergency was declared at approximately 0330Z on DOY 50 after negative acquisitions of all 5 probes at WGS, HBK, AGO, and BGS.
 - Additional support was requested from SN and GN stations. Request for support by the DSN 26 meter stations at Madrid and Canberra was granted by JPL with very short turn-around. FDF was able to update vector and successful contact was made at 1345Z. Termination of spacecraft emergency occurred on DOY 051 at 1145Z after reliable contact of all five probes was established
 - The operation of all five probes are nominal and all probes are in a good state of health.



Recent Launch Activity

- **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.
 - Successfully launched on September 22, 2006 at 2136Z. L&EO support was provided by both AGO and WGS during the first two orbits to verify solar array deploy and spacecraft status.
 - Solar-B has been re-named Hinode (E-no-day) meaning sunrise.

- **STEREO (Solar TERrestrial RELations Observatory)**
 - STEREO is the third mission in NASA's Solar Terrestrial Probes program (STP). STEREO consists of two space-based observatories - one ahead of Earth in its orbit, the other trailing behind. With this new pair of viewpoints, scientist will be able to see the structure and evolution of solar storms as they blast from the Sun and move out through space
 - The twin STEREO spacecraft were launched Wednesday, October 25th, at 8:52 p.m. EDT on a Delta II 7925-10L rocket from Cape Canaveral Air Force Station in Florida.



Upcoming Launches

- **Aeronomy of Ice in the Mesosphere (AIM)**
 - The AIM satellite mission will explore Polar Mesospheric Clouds (PMCs) and the environment in which they form in order to determine the connection between PMCs and the meteorology of the polar mesosphere. The increased appearance of noctilucent, or Night Shining Clouds (NLC), which are a manifestation of PMCs, has been suggested as an indicator of global climate change.
 - AIM is currently scheduled to launch on a Pegasus from VAFB NET April 25, 2007.
- **The Gamma-ray Large Area Space Telescope (GLAST)**
 - GLAST is a next generation high-energy gamma-ray observatory designed for making observations of celestial gamma-ray sources in the energy band. GLAST will afford astronomers a superior tool to study how black holes pull matter in and accelerate jets of gas outward at fantastic speeds, Physicists the ability to study subatomic particles at energies far greater than those seen in ground-based particle accelerators, and cosmologists will gain valuable information about the birth and early evolution of the Universe.
 - GLAST is currently scheduled to launch on a Delta-II from Cape Canaveral Air Force Station in Florida NET October 7, 2007



Ground Network Overview

**Roger Clason
GN Project Manager
March 15, 2007**



Mission

▶ Mission

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

▶ Objectives

- Provide services to assigned customer mission set
- Provide services of sufficient quantity and quality to meet customer mission requirements
- Provide services as inexpensively as possible
- Quantitative targets
 - Critical Service Availability – 100%
 - Critical Services Proficiency – 100%
 - Routine Services Availability – 100%
 - Routine Services Proficiency – 99.1%

▶ Inherent Characteristics

- No flight systems
- Short link distances
- Large customer/provider community

▶ Derived Attributes

- Short planning cycles
- Full COTS usage
- Shared fixed costs
- Low cost & low risk



Approach - Integration

▶ Definition

- Functions required to allow a set of service provision capabilities (virtual network) to effectively and efficiently provide all communications and tracking services required by a mission
- Excludes communications and tracking service provision

▶ Examples

- Pre-mission planning and analysis
- Pre-mission testing
- Network level monitoring and coordination
- Service scheduling
- Pointing data distribution
- Contract management

▶ Approach

- Integrate communications and tracking services to provide virtual networks for individual missions
- Provide integration functions in cooperation with SN and DSN
- Use best value service provider for each individual service requirement

▶ Virtual Network Example – Lunar Reconnaissance Orbiter

- Providing science down link (Ka-band) services and house keeping (S-band) services from WS1
- Procuring housekeeping services from commercial provider
- Providing LEOP (S-band) services from SN
- Providing LEOP and high gain housekeeping services from DSN
- Providing precision laser ranging services from upgraded Satellite Laser Ranging prototype



Approach – Standard Services

- ▶ Definition – Standard Service are communications and tracking services:
 - Optimized for a large customer set and
 - Compatible with provision from independent service providers

- ▶ Examples
 - S-Band services for unmanned LEO & GEO missions (large customer/provider community)
 - X-Band services for unmanned LEO & GEO missions (large customer/provider community)

- ▶ Approach
 - Procure majority of standard services from independent service providers
 - Provide standard services from NASA owned systems where excess capacity exists

- ▶ Benefits
 - Incur costs based on service quantity rather than infrastructure capitalization and sustaining requirements
 - Establish continual competitive pressure to minimize costs
 - Share fixed costs with other customers



Approach – Unique Services

- ▶ Definition – Unique Services are communications and tracking:
 - Optimized for NASA specific requirements or
 - Incompatible with commercial service provision

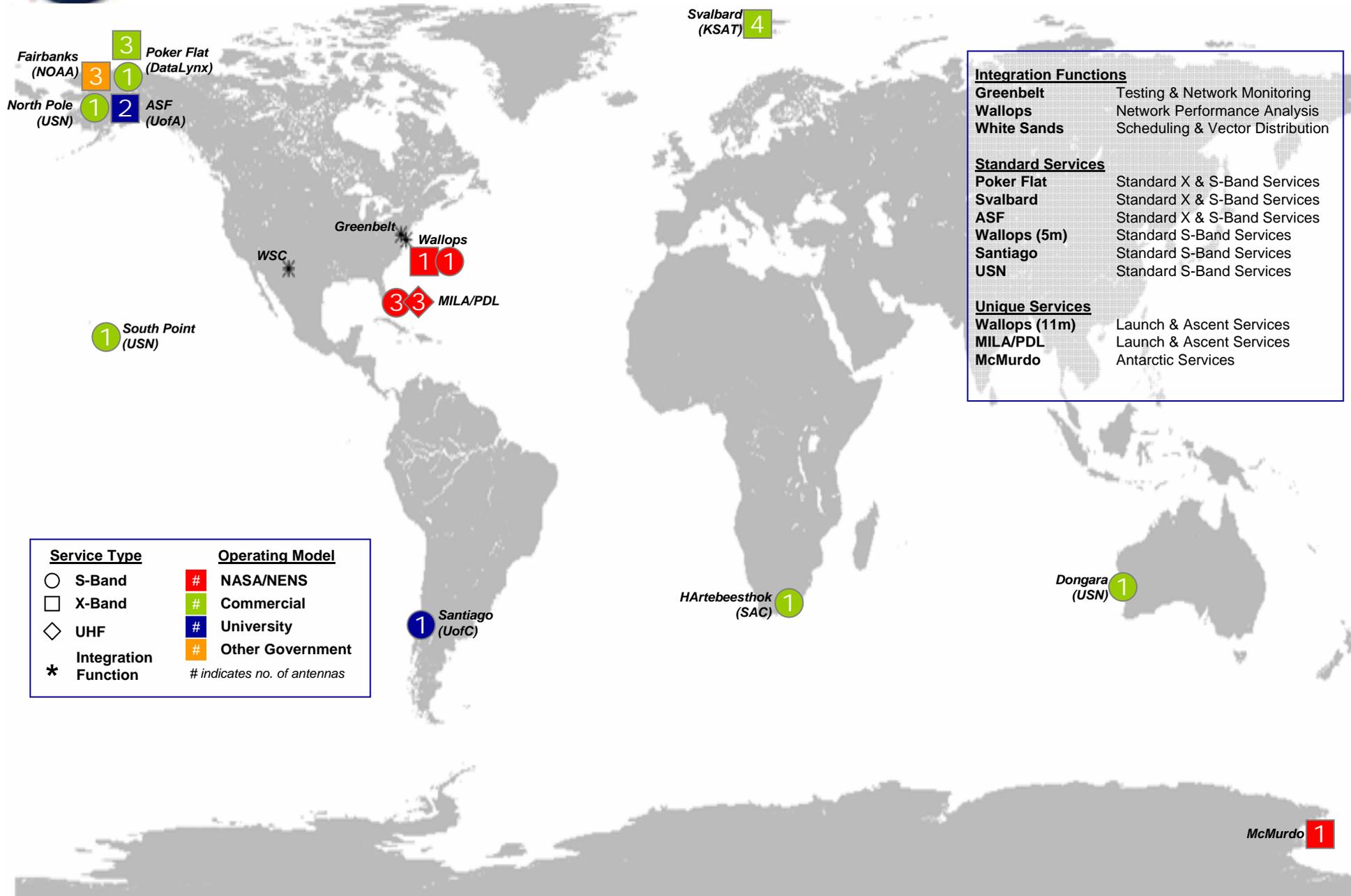
- ▶ Examples
 - Launch and ascent services for manned missions (optimized for NASA specific requirement)
 - High rate lunar services (optimized for NASA specific requirement)
 - Antarctic services (incompatible with commercial service provision)

- ▶ Approach
 - Provide unique services with NASA owned and controlled systems
 - Allow commercial service providers to sell services from NASA owned systems if business case warrants

- ▶ Benefits
 - Maintain technical control of NASA's most critical services
 - Provide services cost effectively where commercial business case doesn't close



Current Configuration

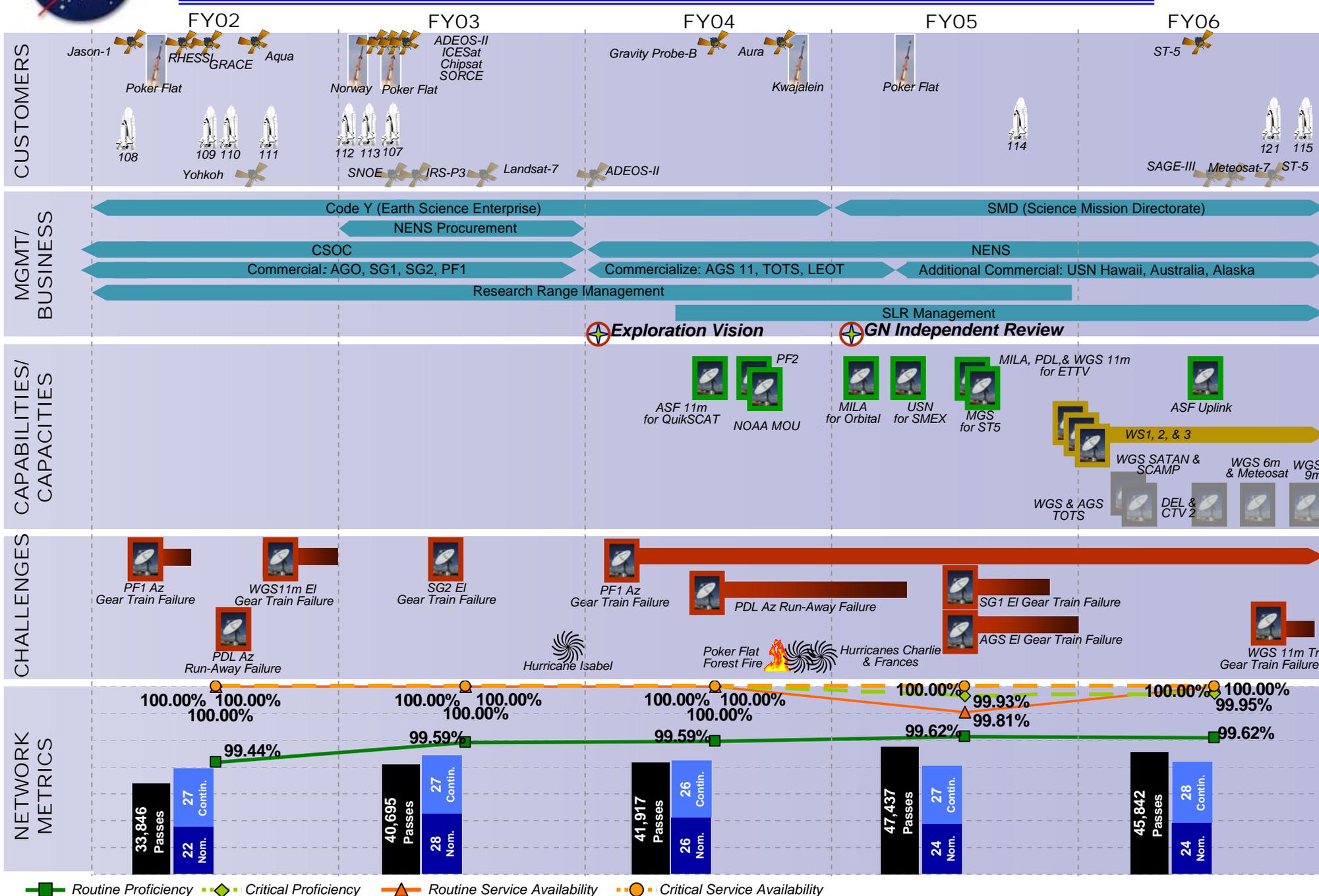


Integration Functions	
Greenbelt	Testing & Network Monitoring
Wallops	Network Performance Analysis
White Sands	Scheduling & Vector Distribution
Standard Services	
Poker Flat	Standard X & S-Band Services
Svalbard	Standard X & S-Band Services
ASF	Standard X & S-Band Services
Wallops (5m)	Standard S-Band Services
Santiago	Standard S-Band Services
USN	Standard S-Band Services
Unique Services	
Wallops (11m)	Launch & Ascent Services
MILA/PDL	Launch & Ascent Services
McMurdo	Antarctic Services

Service Type	Operating Model
○ S-Band	# NASA/NENS
□ X-Band	# Commercial
◇ UHF	# University
* Integration Function	# Other Government
	# indicates no. of antennas



Record of Success





Record of Success

▶ Fiscal Years 2002 & 2003

- Transitioned EOS Polar Ground Network to robust operation
- Ramped-Up to full orbital network load
- Supported busy Shuttle manifest
- Pioneered large scale use of commercial services
- Addressed unforeseen antenna failures

▶ Fiscal Years 2004 & 2005

- Established low-cost/no-cost contingency capacity
- Supported Shuttle return to flight
- Increased use of commercial services
- Addressed continued high rate of antenna failures

▶ Fiscal Year 2006

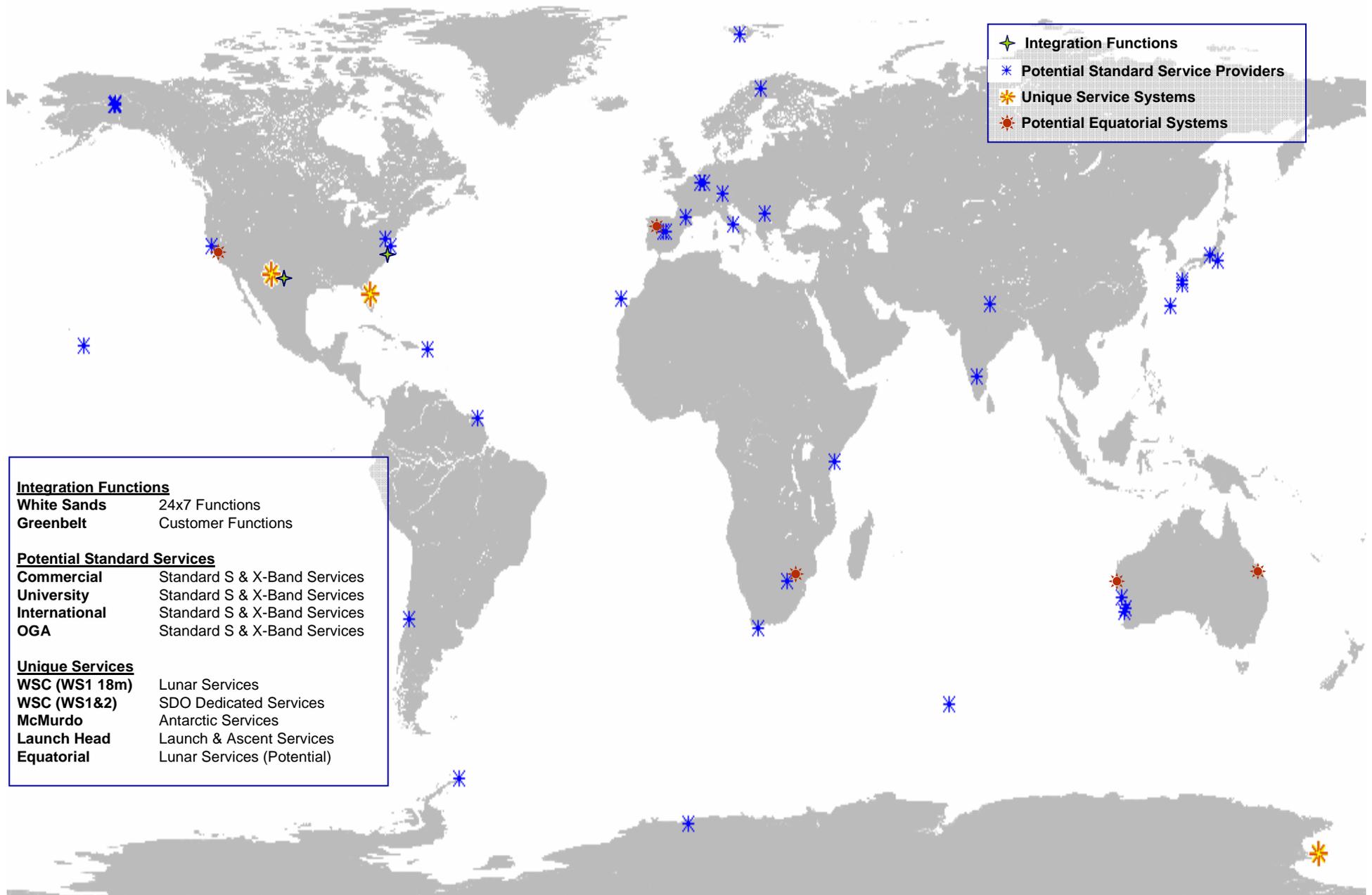
- Responded to Exploration Vision
 - Planned & began implementation of LRO support
 - Began planning Constellation support
 - Planned Shuttle support phase-out
- Responded to Independent Review Panel recommendations
 - Eliminated excess capacity

▶ All Five Years

- Established minimum budget consistent with acceptable risk (in close coordination with sponsoring HQ entity)
- Performed within established budget
- Provided services sufficient to allow all customers to meet mission goals

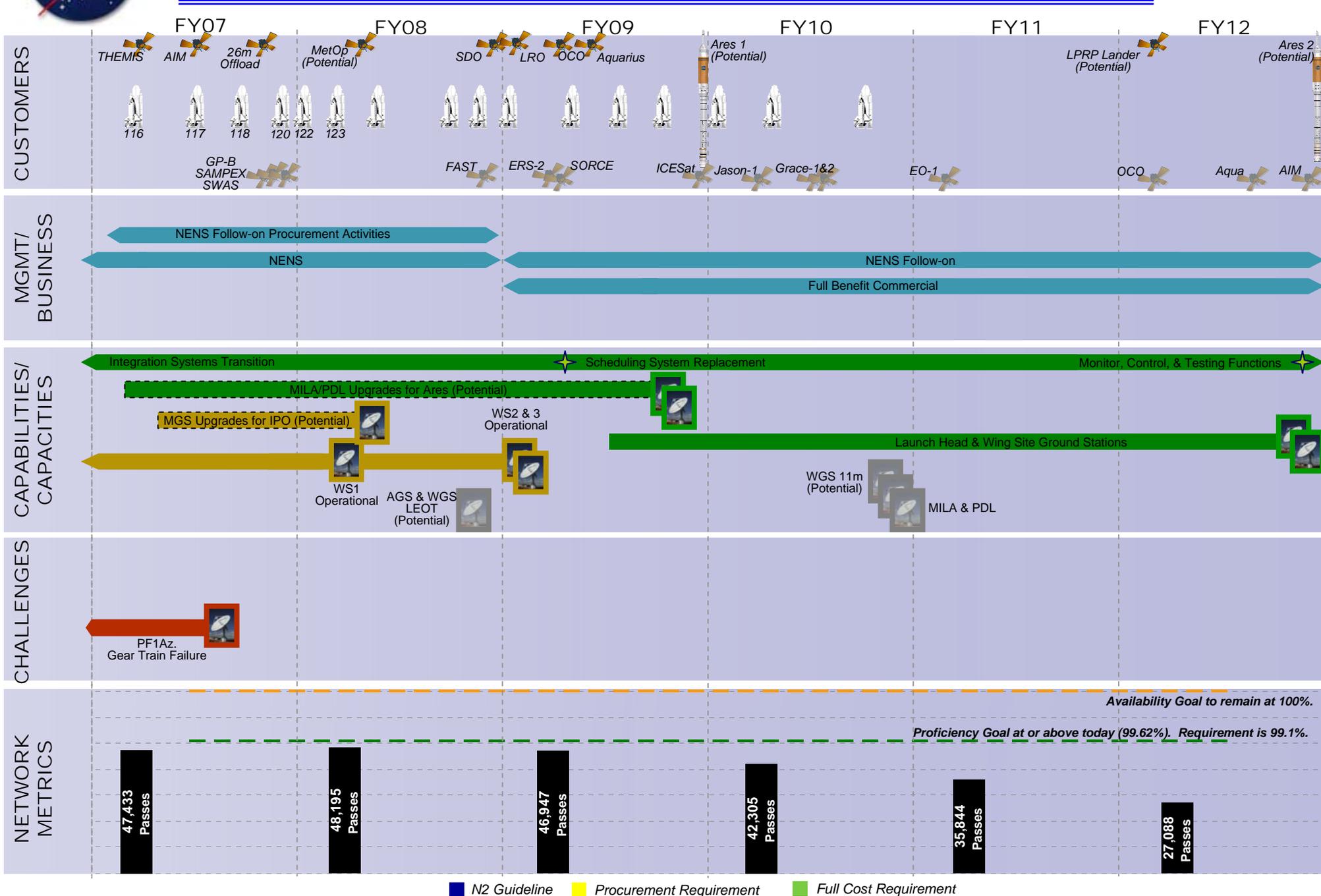


Vision Forward





Forward Vision



■ N2 Guideline ■ Procurement Requirement ■ Full Cost Requirement



Evolution - Integration

- ▶ Transition from Shuttle era systems to sustainable capabilities optimized for future vision
 - Upgrade pre-mission test systems (CTV/CTL/SOC)
 - Discontinue sustaining of Shuttle optimized components
 - Decommission Shuttle optimized components in 2010
 - Implement support for new service formats (e.g., Ka-Band, QPSK, CCSDS SLE)
 - Address heterogeneous virtual networks composed of multiple independent service providers
 - Replace network monitoring and coordination systems (NIC/Comm Center)
 - Discontinue sustaining of Shuttle optimized and teletype components
 - Decommission Shuttle optimized components in 2010
 - Establish new network monitoring and coordination capability to support critical mission phases in the exploration era
 - Replace scheduling and pointing data distribution system (WOTIS)
 - Address heterogeneous virtual networks composed of multiple independent service providers
 - Integrate with SN and DSN scheduling capabilities to the maximum extent possible
 - Procure COTS scheduling engine
 - Develop CCSDS SLE interfaces to Constellation era systems
 - Develop proxy interfaces to legacy systems



Evolution – Standard Services

- ▶ Realize full potential of commercial standard services to maximize flexibility and minimize costs
 - Decommission remaining NASA operated system standard service system (Wallops LEOT) (potential)
 - Increase competition between independent service providers
 - Ensure contractor teaming does not inhibit efficient access to any independent service provider
 - Buy passes (not integrated networks)
 - Shed sustaining responsibility for NASA owned, commercial operated systems (Poker Flat ViaSat 11m & Datron 5m, Svalbard ViaSat 11m)
 - Level minimum passes/day, retainer fees, and performance incentives/penalties
 - Maximize use of GN by NASA missions for commercial services integration
 - Best value to missions – maximum options and informed risk management
 - Best value for NASA – volume discounts
 - Modify Agency process to ensure value of GN integration is accurately understood by stakeholders and decision makers



Evolution – Unique Services

- ▶ Implement and upgrade NASA owned systems to provide unique services in the Constellation era
 - Complete WSC 18 meter systems (WS1, WS2, & WS3) on schedule and within budget
 - Implement capabilities to provide pre-launch, launch, and ascent services to Constellation vehicles
 - Build new station within KSC security perimeter to provide launch head services to Orion missions
 - Build new capacity at PDL site to provide wing site services Orion missions
 - Partner with NPOESS IPO (NOAA & DoD) and NSF at McMurdo to provide best value Antarctic services to all agencies (potential)
 - Upgrade MGS to provide IPO services (routine near-term, contingency long term)
 - Leverage IPO bandwidth and contingency capacity to realize full potential of the Antarctic location for NASA
 - Provide development and maintenance services to IPO systems to leverage GN expertise
 - Converge to standard components across systems to minimize operations, maintenance, and sustaining costs
 - Establishing WS 1 as model
 - Leveraging SN and Air Force procurements
 - Decommission MILA, PDL systems, and Wallops 11m when Shuttle program completes



Ground Network Orbital Accomplishments & Plans

John T. Jackson

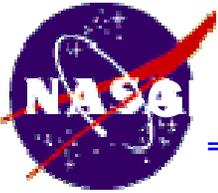
Ground Network Orbital Manager

March 15, 2007

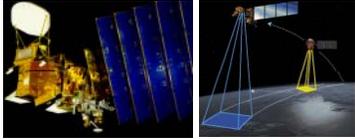


AGENDA

Ground Network Orbital Overview
Recent Accomplishments
Summary



Earth Science Missions



Space Science Missions



Shuttle Launch and Landing



Sub-Orbital Missions



NASA Communications



Partner Station:
NOAA Satellite Facility
Gilmore Creek, Alaska



Alaska Ground Station
Poker Flat, Alaska



USN Alaska Station
North Pole, Alaska



Wallops Ground Station
Wallops, VA



Kongsberg Satellite Services
Svalbard, Norway



Alaska Satellite Facility
Fairbanks, Alaska



USN Hawaii Station
South Point, Hawaii



Merritt Island
Launch Annex
Florida



University of Chile
Santiago, Chile



Satellite Applications Center
Hartebeesthoek, Africa

USN Australia Station
Dongara, Australia



McMurdo Ground Station
McMurdo Base, Antarctica



■ NASA

■ University

■ Commercial

■ Other Government Agency



AGENDA

Ground Network Orbital Overview
Recent Accomplishments
Summary



GN Stations

Santiago, Chile (AGO)



Mission set includes: GOES, RHESSI, HST, IMP-8, LANDSAT-5, SOLAR-B, SORCE, TOMS-EP, SHUTTLE, THEMIS, and TDRS

Recent Achievements:

- Certified for Shuttle and successfully provided 21 STS-116 on-orbit supports
- Certified for TDRS second generation support
- Built and tested Landsat-5 Real Time configurations required for DSN offload support. Awaiting certification passes for science data support
- Installed and certified a GSFC supplied backup NT PTP
- Installed and interfaced new XP Programmable Telemetry Processor (PTP)
- Certified and provided operational support for THEMIS 1-5

FY07 Plans:

- Certify RADARSAT-1 completing DSN 26m offload at AGO
- Certify the XP PTP for S-band mission set
- Certify site for Landsat-5 science data
- Potential missions for certification in '07 include GRACE 1 and GRACE 2



GN Stations

Hartebeesthoek, Africa (HBK)



GN Mission set includes THEMIS 1-5

Recent Achievements:

- Completed certification for THEMIS spacecraft 1-5 and provided operational support following launch on 02/17/07.

FY07 Plans:

- Continue to provide TT&C Support for Launch & Early Orbit Phase (L + 30), Ops Check-out and Verification Phase (through L + 60), On-Orbit Phase (through L+ 90) and 2 years of Contingency for the THEMIS mission.



GN Stations

Alaska Satellite Facility



Station mission set includes: AIM,
ERS2, FAST, QUIKSCAT,
RADARSAT-1, SCISAT

Recent Achievements:

- Completed integration and on-site testing of the Tracking Data Formatter (TDF) and Carrier Doppler Measurement System (CDMS) into the ASF 11-meter
- Submitted application for an FDF tracking data account and received approval from FDF
- Certified ASF 11-meter for AIM

FY07 Plans:

- Certify Tracking Data at FDF
- Certify SAMPEX & TRACE
- Support AIM launch and on-orbit support



GN Stations

Poker Flat Ground Station



Station mission set includes: AIM, ACRIMSAT, AQUA, AURA, CALIPSO, CHAMP, ELV, EO-1, FAST, GP-B, GRACE-1&2, ICESAT, JASON-1, LANDSAT-5, LANDSAT-7, QUIKSCAT, SAC-C, SAMPEX, SWAS, TERRA, TOMS-EP, TRACE, WIRE

Recent Achievements:

- Completed RF testing of PF2-11m under radome
- Certified PF2, 11-meter for QuikSCAT
- Certified AGS, 11-meter for AIM
- AGS, 11-meter successfully supported Lessard rocket launch
- PF1 7.3-meter certified for Landsat-5 for DSN 26m offload

FY07 Plans:

- Complete certification PF2-11m for all missions previously certified on that antenna; GRACE 1&2 and CHAMP in progress
- Integrate two EOS Ground Station Interface Processors (GSIP's) into PF2-11
- Provide AIM launch and on-orbit support
- Certify AGS 11-meter for RADARSAT For DSN 26m offload



GN Stations

Universal Space Network



Recent Achievements:

- Completed certification for the GOES series.
- Supported TDRS certification testing, encountered problems requiring restart of certification

FY07 Plans:

- Certify HST, and TDRS in support of DSN 26m offload

USN mission set includes: FAST, FUSE, GALEX, SWAS, SWIFT, TIMED, TRACE, WIRE, GOES-11&13,



GN Stations

Svalbard Ground Station



Station mission set includes:
ACRIMSAT, AIM, AQUA, AURA,
CHAMP, EO-1, FAST, GP-B,
GRACE-1&2, ICESAT, LANDSAT-7,
QUIKSCAT, SAC-C and TERRA

Recent Achievements:

- Certified SG1 11-meter to provide AIM support

FY07 Plans:

- Certify SG2 11-meter for AIM
- Provide AIM launch and on-orbit support
- Certify SG1 11-meter for NOAA for DSN-26m offload support



GN Stations

McMurdo Ground Station (MGS)



Station mission set includes: COSMIC, EO-1, ERS-2, ELV, FAST, GOME, GP-B, GRACE-1&2, ICESAT, Landsat-7, QUIKSCAT, RADARSAT-1, SAC-C, SAMPEX, SWAS, TRACE, WIRE

Recent Achievements:

- Completed removal of all ST5-specific equipment, retained interface cabling and feed for possible future needs
- Supported the Crevasse Detection Demonstration radar interference testing in Dec. '06.
- Supported the ANITA Balloon project in Jan. '07.
- Completed six COSMIC engineering passes in Jan. '07 and provided data to the project.
- Certified for EO-1 S-band support

FY07 Plans:

- Install Enertec systems providing upgraded capabilities including QPSK (on hold) Requires frequency converters
- Complete QuikSCAT certification



GN Stations

Wallops Ground Station



Station mission set includes: ACRIMSAT, AIM, AQUA, AURA, CALIPSO, CHAMP, CHIPSAT, ELV, EO-1, FAST, FUSE, ELV, GOES, GP-B, GRACE 1&2, HESSI, ICESAT, ISS, JASON-1, QUIKSCAT, STS, SAC-C, SAMPEX, SEAWIFS, SOLAR-B, SORCE, SOYUZ, SWAS, THEMIS, TOMS-EP, TRACE, & WIRE

Recent Achievements

- Terminated support service on the 9m antenna 10/0806.
- Completed 11-meter SCC upgrade acceptance testing and transitioned to sustaining engineering on 02/07/07.
- Installed and certified the Programmable Telemetry Processors (PTPs) to replace the 11-meter Wallops Front End Processors (WFEP)
- Completed re-certification of the 11-meter for ACRIMSAT, AQUA, AURA, CHAMP, CHIPSAT, GRAVITY PROBE-B, GRACE 1&2, and SAC-C. Certified QUIKSCAT normal operations TR codes
- Certify the 11-meter for the AIM
- Certified 11m for THEMIS 1-5; providing on orbit support (S/C below threshold due to antenna aspect angle)
- Supported the TACSAT /Minotaur launch 12/16/06, meeting all mission requirements.
- Successfully supported the STS-116, 12/10/06, launch and 22 on-orbit supports
- Completed Central Standard Autonomous File Server (CSAFS) upgrade ahead of schedule 02/02/07

FY07 Plans:

- Recertify the 11-meter for ICESat and the remaining QuikSCAT contingency support configurations
- Certify the 11-meter for Landsat-5, HST, RADARSAT and TDRS in support of DSN 26m offload
- Complete Enertec Installation and Acceptance
- Complete equipment relocation from 11-meter pedestal to shelter
- Support the AIM, (2)ATLAS-V, STS-117/18, (2) SOYUZ TACSAT and NFIRE launches



AGENDA

Ground Network Orbital Overview
Recent Accomplishments
Summary



Summary

The Ground Network continues to streamline operations through:

- **The reduction of government-owned antenna systems and assets**
- **Increased usage of commercial service providers**
- **The redistribution of missions' support by certification of missions on remaining assets**



Space Communications Customer Forum #15

NASA Integrated Services Network (NISN) & GSFC Code 731 Status Updates

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

GSFC/Code 731 Customer Support Office

**NISN Mission Communications Working Group (MCWG) &
Customer Forum**

Mission Operations Voice Enhancement (MOVE) Project

NSAP Technology Refresh (NTR)

NISN Mission Requirements Template

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



Space Communications Customer Forum #15

NISN Customer Interface Group (CIG)

NISN Service Manager (NSM)

Jerry Zgonc, 301-286-7160

Gerald.R.Zgonc@nasa.gov

- (Science Directorate/Earth) WSC, GSFC (Institutional)
- CIG co-lead

Elizabeth Sudderth 256-544-2856

Elizabeth.Sudderth@nasa.gov

- (Aeronautics Research Directorate) DFRC, GRC, LaRC, NSSC
- CIG co-lead

- **Mike Richter, 301-286-6376**

Mike.Richter@nasa.gov

- (Science Directorate/Space) JPL, GSFC Re-imbursable Projects

- **Kim Wright, 256-544-0936**

Kimberly.A.Wright@nasa.gov

- (Exploration Systems Directorate) - Constellation
- (Space Operations Mission Directorate) STS, ISS, JSC, KSC, MSFC, MAF, SSC
- WSTF (Institutional)

- **Seaton Norman, 301-286-8676**

Seaton.B.Norman@nasa.gov

- (Space Operations Mission Directorate) STS, ISS, JSC, KSC, MAF/WSTF, SSC
- MSFC, DFRC (Shuttle), ELV's(KSC & VAFB)

- **Stan Rubin (301)286-4230**

stanley.D.Rubin@nasa.gov

- (Exploration Systems Directorate) - Space Communications and Navigation Systems (SCAN)
- HECC, BCTC



Space Communications Customer Forum #15

GSFC UNITEs CIG TEAM

- **MICHAEL BRADLEY, 256.961-9492: GOES, POES, and Re-imbursables**
michael.j.bradley@nasa.gov
- **MICHAEL ALLEN, 301.902-6015: Space Operations Mission Directorate (previously Code M) & Exploration** **michael.j.allen@nasa.gov**
- **MICHAEL EDER, 301.902-6014: Office Of Science Mission Directorate (previously Code S)** **michael.j.eder@nasa.gov**
- **TRISH PERROTTO, 301.805-3106: Office of Science Mission Directorate (previously Code Y)** **perrotto_trish@bah.com**
- **WANDA NORWOOD, NISN/UNITES CUSTOMER SERVICE MGR., 256.961-9331:**
Wanda.O.Norwood@nasa.gov



Space Communications Customer Forum #15

GSFC/Code 731 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/GSFC for Wide Area Network (WAN) services
- Points-of-Contact;
Brad Butts (301)286-3266
Diane Teets (301)286-5535
Tammy Tuttle (301)286-4883



Space Communications Customer Forum #15

NISN MISSION COMMUNICATIONS WORKING GROUP (MCWG) & THE CUSTOMER FORUM'S

The NISN Customer forum is currently scheduled for the week of May 21, 2007 in San Diego, Ca.

The NISN Mission Communications Working Group (MCWG) Forum is tentatively scheduled for the Kennedy Space Center (KSC) in the mid-Nov/2007 time frame.

Please visit the NISN website at <http://www.nisn.nasa.gov> under "What's New!" for additional information and to complete the pre-registration forms for either forum.



Space Communications Customer Forum #15

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 locations. The project is funded by the Space Operations Mission Directorate (SOMD) at HQs. The basic portion of the contract includes GSFC, MSFC and JSC. There are also 15 optional sites included.

- MOVE Project Manager – Dan Duffy (GSFC/Code 732)
- MOVE Contacts
 - Doug Fooshee/MSFC, ARC, GRC, Michoud
 - William “Al” Wylie/JSC
 - Katie Poole/GSFC, WSC, WFF, Mila, HQ, JHU
 - Others located on MOVE web site (<http://move.nasa.gov>)
- Contract award start date February 1, 2007 - Frequentis, USA (FUSA).
- - Technical Interchange Meeting completed February 14-15, 2007.
- - SDR scheduled for March 26-30, 2007.
 - Steps are being taken to finalize the schedule and proposed cost increases associated with the 7 month protest delay. This will become Mod #1 to the contract. Pending Mod #1 approval, the GSFC switch delivery is scheduled for the 3rd. quarter of 2008.
 - Once Mod #1 is in place, MOVE will start working with the GSFC projects to discuss schedule, keyset costs, transition plans, etc.
- MOVE website at: <http://move.nasa.gov>



Space Communications Customer Forum #15

NSAP Technology Refresh (NTR)

- **AT&T NTR installations began October/2005**
- **Transition of Mission services began October 2, 2006, with the major focus on Human Space Flight (HSF) services.**
- **Closed IONeT Services were successfully supported on NTR for STS-116, with the legacy network (NSAP) available for failback. Post STS-116 disconnect orders were issued for the NSAP circuits.**
- **Additional services are currently being transitioned to NTR and will be used to support STS-117.**
- **As of 3/1/07, 55.16% of NSAP services have been transitioned to NTR.**
- **Transition is tentative scheduled for completion by July 2007.**
- **NTR project manager: Vicki Stewart (NISN/GSFC Code 731)**
- **NTR Project Engineer: Scott Douglas (NISN/GSFC Code 722)**



Space Communications Customer Forum #15

NISN Mission Requirements Template

- Mission Requirements template designed as an adobe acrobat .pdf file
- Fill in required information and then click on “submit to NISN”
- Contact any NISN Service Manager or Customer Service Representative to receive a copy of the requirement template or to answer any questions concerning completing the form
- Template designed to be completed by all NASA projects & programs for any NISN communications requirements (voice/data/video/custom)
- Contains information that NISN will require to actually move forward in implementing a communications service for our customers
- Customers are requested to provide any comments/suggestion to the Requirement template – currently in an evaluation mode by NISN



Space Communications Customer Forum #15

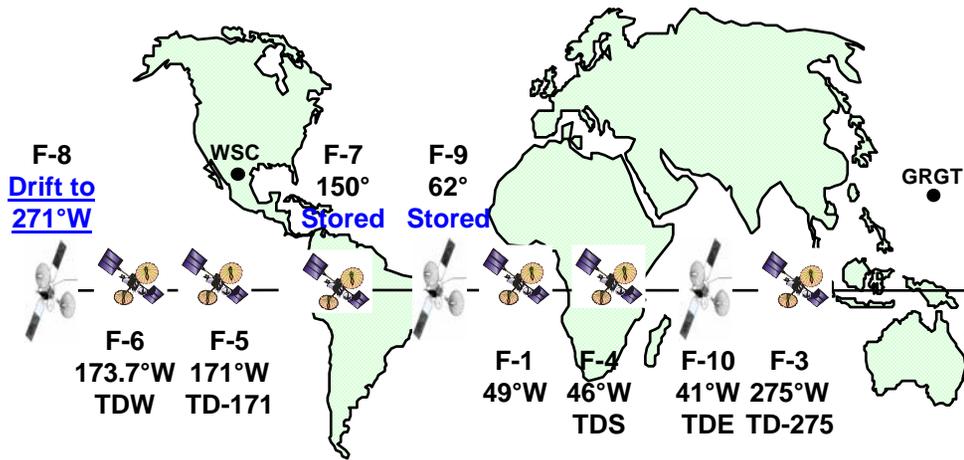
Space Network Code 452

Project Manager:	Roger Flaherty
Deputy Project Manager (Ground):	Keiji Tasaki
Deputy Project Manager (Space):	Jon Walker
Systems Engineer:	Mike Rackley
Financial Manager:	Paula Tidwell
Prime Contractor:	Honeywell Technology Solutions, Inc. (HTSI)

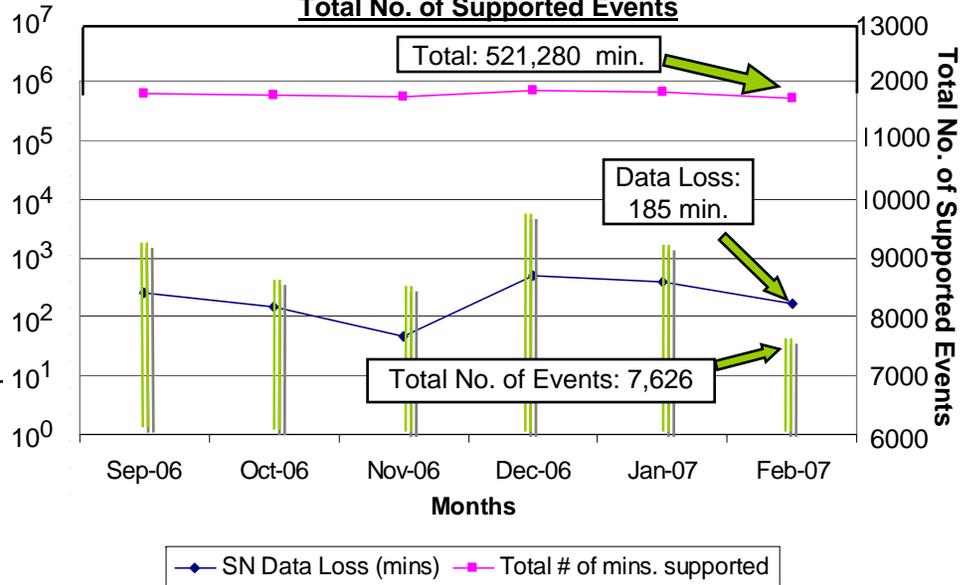
March 15, 2007

Service Metrics Summary

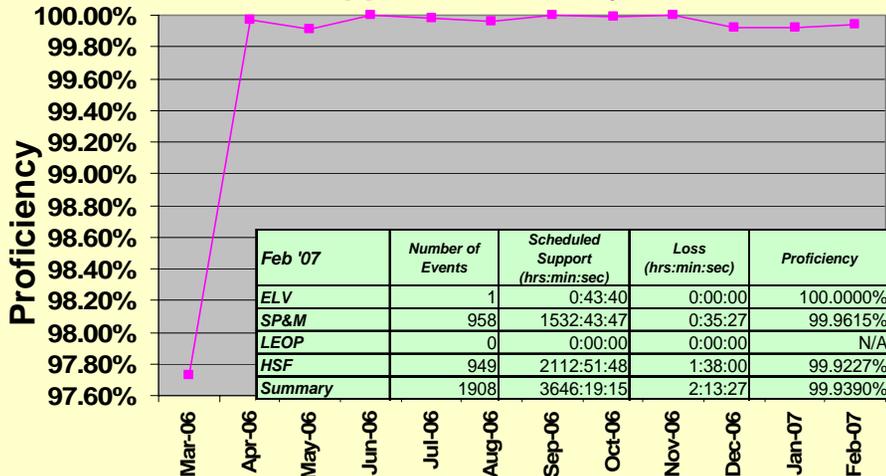
Space Network at a Glance



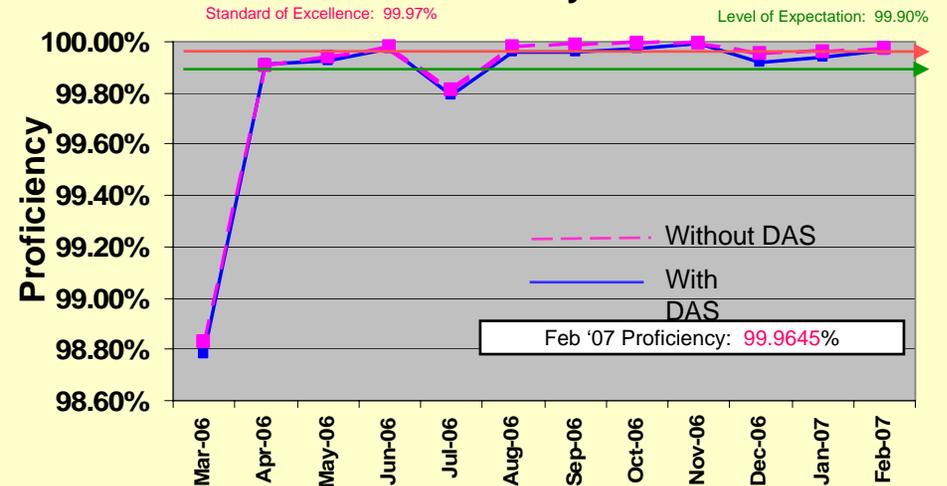
Minutes of Support and Minutes of Data Loss



SN Critical Support Proficiency Trend (with DAS)



SN Proficiency Trend

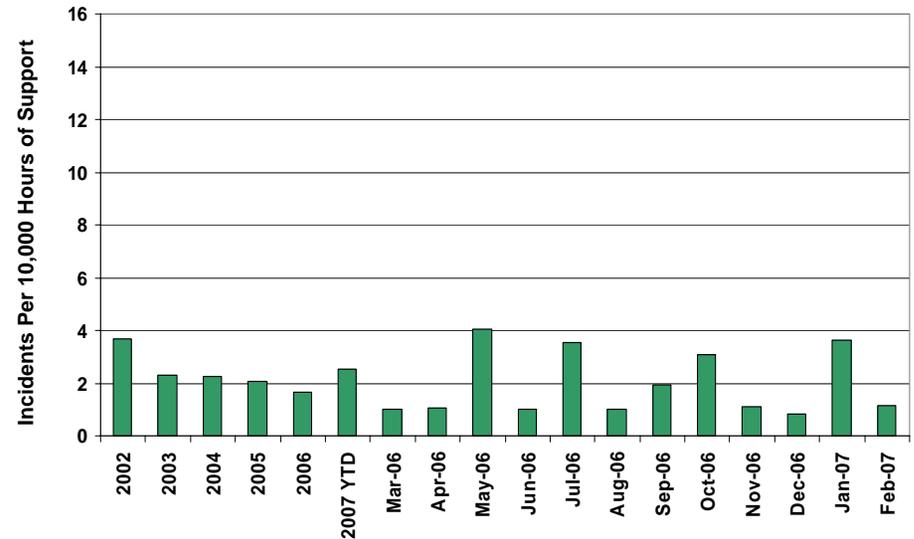


Missions	Total No. of Supported Events	Service Stat.	Proficiency (%)	Standard of Excellence (%)
Aqua, Aura, FUSE, GP-B, HST, ISS, L-5, L-7, SP&M, SPTR, Swift, TERRA, TRMM, ULDBP, XTE	7,626	8,691 hrs. sched 8,688 hrs. actual 3 hrs.5 min. lost	99.96%	99.97%

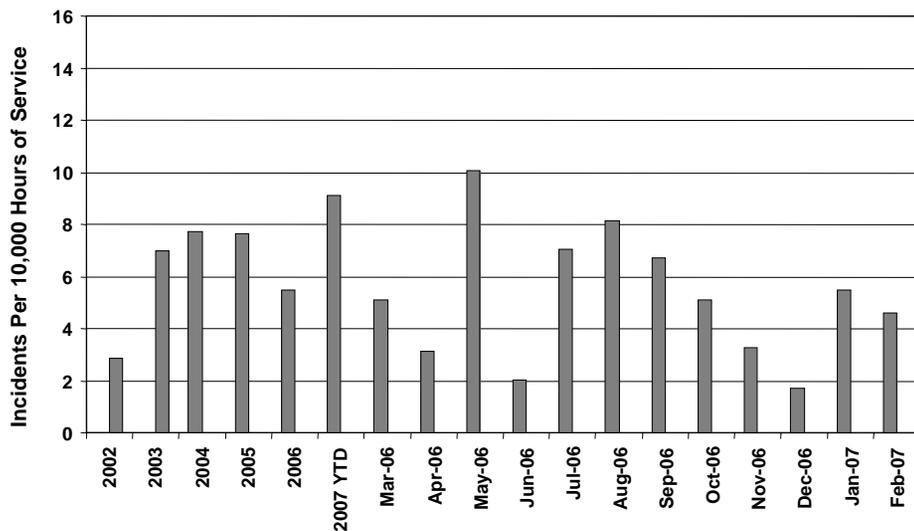
Space Network Error/Anomaly Trends

- 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 five bars are for 2002 through 2006.

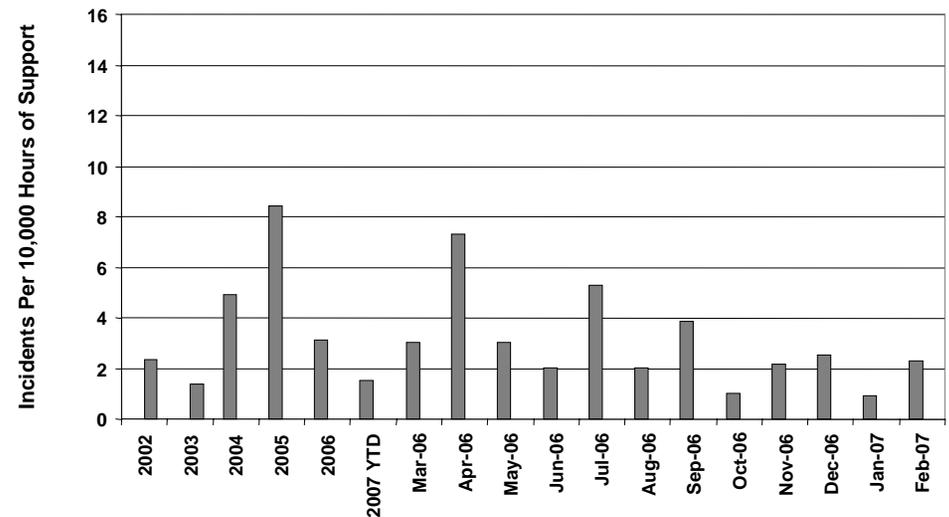
Space Network Ops Errors Versus Service Support
(Compared to Annual Averages for 2002 - 2006)



Space Network Hardware Anomalies Versus Service Support
(Compared to Annual Averages for 2002 - 2006)



Space Network Software Anomalies Versus Service Support
(Compared to Annual Averages for 2002 - 2006)



TDRS Constellation Health (as of 2/28/07)

F-1 Launch 04/83 49.0 °W 0 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			

F-3 Launch 09/88 275.25°W 1 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			

F-4 Launch 03/89 46°W				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			

F-5 Launch 08/91 171.0°W 2 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			

F-6 Launch 01/93 173.7°W 2 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			

F-7 Launch 07/95 150.5°W Stored 4 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			

F-8 Launch 06/00 Drift to 271°W 2 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			
Ka	Ka			

F-9 Launch 03/02 62.4 °W Stored 2 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			
Ka	Ka			

F-10 Launch 12/02 40.9°W 2 spare SGL TWT				
SA1	SA2	MA	BUS	TT&C
S	S			
Ku	Ku			
Ka	Ka			

- Indicates fully operational
- Indicates backup unit(s) in use
- Indicates failed subsystem

TDRS Constellation Bus Health (as of 2/28/07)

F-1 Launch 04/83 49.0 °W TT&C Power Propulsion Thermal ACS	F-3 Launch 09/88 275.25°W TT&C Power Propulsion Thermal ACS	F-4 Launch 03/89 46°W TT&C Power Propulsion Thermal ACS
F-5 Launch 08/91 171.0°W TT&C Power Propulsion Thermal ACS	F-6 Launch 01/93 173.7°W TT&C Power Propulsion Thermal ACS	F-7 Launch 07/95 150.5°W Stored TT&C Power Propulsion Thermal ACS
F-8 Launch 06/00 Drift to 271°W TT&C Power Propulsion Thermal ACS	F-9 Launch 03/02 62.4 °W Stored TT&C Power Propulsion Thermal ACS	F-10 Launch 12/02 40.9°W TT&C Power Propulsion Thermal ACS

-  Indicates fully operational
-  Indicates backup unit(s) in use
-  Indicates failed subsystem



Space Communications Customer Forum #15

TDRS Constellation Status

- **Transition of a 2nd generation TDRS to SN Expansion**
 - User services transitioned to F-6 (from F-8) on May 10, 2006
 - F-8 began drifting on February 20, 2007 and expected at 271°W on April 14, 2007

- **TDRS-K, -L**
 - TDRS Project funded in FY07 for the start of procurement activities
 - Draft RFP released to industry on February 19, 2007
 - RFP expected to be released at the end of March 2007



Space Communications Customer Forum #15

Space-to-Ground Link Terminal-7 (SGLT-7) at Guam Remote Ground Terminal (GRGT)

- SGLT-7 / TDRS-8 combination will not be available for general use
- SNE Spiral 0 $\xrightarrow[\text{Transition}]{\text{M\&O}}$ SGLT-7 occurred on 2/9/07 after a successful ORR
- Contract modification to include M&O into NENS core is about to be signed by the contracting officer
- The Spiral 1 system is being installed and tested at GRGT
- Schedule
 - Spiral 1 ORR June 2007
 - Spiral 2 ORR October 2007



Space Communications Customer Forum #15



Blue Mesa Implementation

- Planned users include TDRS, SDO, and LRO projects



Blue Mesa collimation tower and equipment shelter (with USBP shelter/tower in background)



Space Communications Customer Forum #15

Second Guam Antenna System (SGAS)

Status

- SGAS reflector is assembled and the pedestal is ready
- High trade winds, crane suitability for reflector lift, and priority given to SDO have all delayed the SGAS reflector lift

Schedule

- | | |
|----------------------------------|--------------------|
| – Installation and test of 16.5M | March - April 2007 |
| – Installation of Radome | April - June 2007 |
| – Testing of 16.5M and 5M | August 2007 |
| – L5 Testing | September 2007 |
| – ORR | October 2007 |



Space Communications Customer Forum #15

Progress at GRGT



SGAS reflector complete



SGAS pedestal and 140 ton crane



[left] SNE radome panel removed for investigation into visual aberrations.

[right] Observed deteriorating washers, also removed for investigation.





Space Communications Customer Forum #15

TDRSS High-rate Equipment

- **Replace and enhance the TDRSS KSA 225 MHz Return data service by adding the capability to process bandwidth efficient signal designs**
 - **OQPSK/LDPC - 150 Mbps to 410 Mbps**
 - **8PSK/LDPC - 410 Mbps to 625 Mbps**
 - **Single Access Antenna Autotrack for new signal designs**
 - **Optionally Ka-band for up to 1.5 Gbps data rate via the 650MHz channel**
- **WSC site visits last summer by six potential vendors successful**
- **Demonstration Requirements Review held August 2, 2006**
- **Demonstration Proposal Evaluation Review held February 2, 2007**
 - **Two vendors to demonstrate the basic requirements in December 2007**
 - **The two vendors to also demonstrate the Ka-Band at 1.5Gbps option**



Space Communications Customer Forum #15

BRTS Replacement

- **Status**
 - NENS awarded contract to General Dynamics for 9 units
 - 11 antennas have been purchased and are being tested in GSFC Building 25 RF Systems Lab
 - 1st antenna successfully tested
 - Remainder to be tested with delivered transponders
- **Schedule**
 - System Requirements Review 3/3/2004
 - Preliminary Design Review 3/22/2006
 - NENS Task Start 4/2005
 - Critical Design Review 10/26/2006
 - Delivery of 1st unit May 2007
 - Test Readiness Review August 2007
 - Delivery of final (spare) unit October 2007
 - Operations Readiness Review November 2007



Space Communications Customer Forum #15

SNAS Objectives

- Provide a fully capable, low cost, easily integrated SN service request system with real-time service monitoring and control interface
- Provide a network-based system which will replace the User Planning System (UPS) and SN Web Services Interface (SWSI)
- Deleted Constellation-related requirements due to lack of funds

SNAS Status and Schedule

- | | |
|-----------------------|----------------|
| • SRR | 4/28/2005 |
| • PDR | 9/12/2006 |
| • CDR | 5/4/2006 |
| • TRR | July 2007 |
| • Release 1 Acc. Test | September 2007 |
| • Transition to ops. | Oct – Dec 2007 |
| • Release 1 ORR | December 2007 |



Space Communications Customer Forum #15

Demand Access System (DAS)

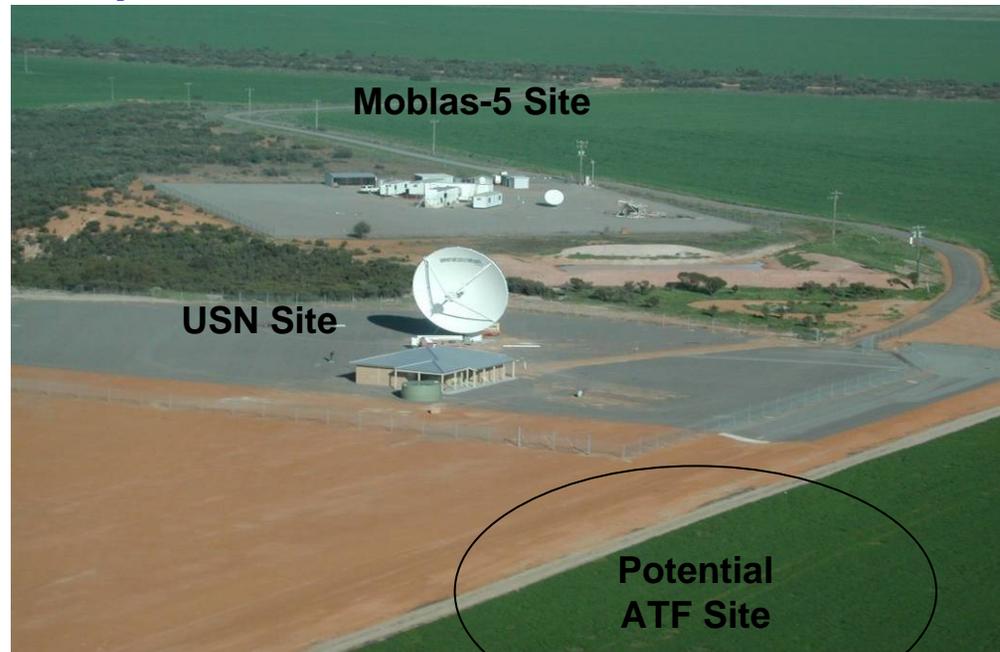
- **DAS proficiency in support of Swift for February was 99.88%, largest outage due to DASCON software process failure.**
- **Support of multiple/simultaneous missions will be a challenge, i.e., Swift and C/NOFS, plus balloons.**
- **Funding for the procurement of expansion units was put in FY08 budget.**
- **SN looking at various capacity expansion options to meet DAS demand.**



Space Communications Customer Forum #15

Australian TDRS Facility

- Limited motion TT&C facility to track drifting/stored TDRS
- Also provide contingency TT&C support (no user service) for Indian Ocean Region TDRS
- Located in western Australia; co-located with Moblas-5 and USN sites
- Site survey trip occurred on February 12 – 15
- 11m antenna ready for delivery in April 2007
- Planned to be operational in Summer 2007





Deep Space Network (DSN) Service Preparation Subsystem (SPS) Status

Allen Berman, Manager
Service Management Office 921
DSN Development, Operations & Services Office
Interplanetary Network Directorate
Jet Propulsion Laboratory



Space Communications Customer Forum #15

- **The Service Preparation Subsystem (SPS) provides all Support Products to the DSN, and a Portal for worldwide DSN Scheduling Functionality**
 - Replaces the Network Support System (NSS)
- **SPS went into operations on January 16, 2007**
 - "SOAK" was successfully completed 30 days later, on February 14
 - Telemetry Data Losses were essentially zero during SOAK
 - Some early operational hiccups/missteps—fully expected for introduction of a very large scale hardware and software system
 - NSS "Dual Submissions" discontinued at completion of SOAK



Space Communications Customer Forum #15

- **Elimination of Anomaly Reports (ARs) and associated workarounds is the focus of the remainder of this fiscal year (FY07)**
 - **First (re)Delivery is the TIGRAS Assembly only (D1.0.9) — which addresses only scheduling ARs and their associated workarounds**
 - **28 ARs fixed**
 - **Includes Launch Contingency Scheduling AR**
 - **SPS D1.0.9 DSN Delivery Review (DDR) successfully conducted on March 9; SOAK began on Monday, March 12**



Space Communications Customer Forum #15

- **A more general, major, multi-assembly (re)Delivery (D1.1) planned for early May**
 - **Must be completed before DSN Launches currently scheduled this summer (Dawn, SELENE, Phoenix)**
 - **A few items need to be added for the New Missions**
 - **Otherwise, will tackle the most severe ARs/workarounds Systemwide**
 - **Target Dates for SPS D1.1**
 - **Test Readiness Review (TRR) — April 16**
 - **Project Interface Tests (PITs) — 2nd half of April**
 - **DSN Delivery Review (DDR) — May 3**
 - **SOAK Start — May 7**
 - **SOAK Complete — June 6**



Space Communications Customer Forum #15

- **GSFC Flight Dynamics Facility (FDF) Provision of Spacecraft Ephemeris Data to SPS**
 - DSN agreed to fund the JPL Navigation inputting of FDF Spacecraft Ephemeris Data into the SPS Portal, until March 31, 2007
 - FDF has committed to full input of all FDF Spacecraft Ephemeris Data directly into the SPS Portal, on or before March 31, 2007



Space Communications & Navigation Constellation Integration Project

SCIP

Introduction to the SCaN - Constellation Integration Project (SCIP)

Ron Miller - Project Manager

Steve Townes - Deputy PM

John Hudiburg - Systems Engineering Manager





SCaN - Constellation Integration Project (SCIP)

SCIP

- **SCIP will develop for ESMD a seamless integrated communications and tracking network infrastructure from existing networks, and new communications and tracking elements as required, in support of:**
 - Orbital Flight Tests
 - Crew Exploration Vehicle (CEV) to International Space Station (ISS)
 - Lunar Campaign
 - Future Destinations

- **SCIP will work closely with Constellation (Cx) Systems Engineering & Integration (SE&I), Cx Operations Integration Office and Cx Test and Verification organizations**
 - Supporting CSI, Flight Performance, and Operations System Integration Groups (SIGs)
 - Similar Lunar Precursor Robotic Program (LPRP) Interface to be established once LPRP/SCaN/Cx HQ policy established





Focus on CEV-ISS Implementation

SCIP

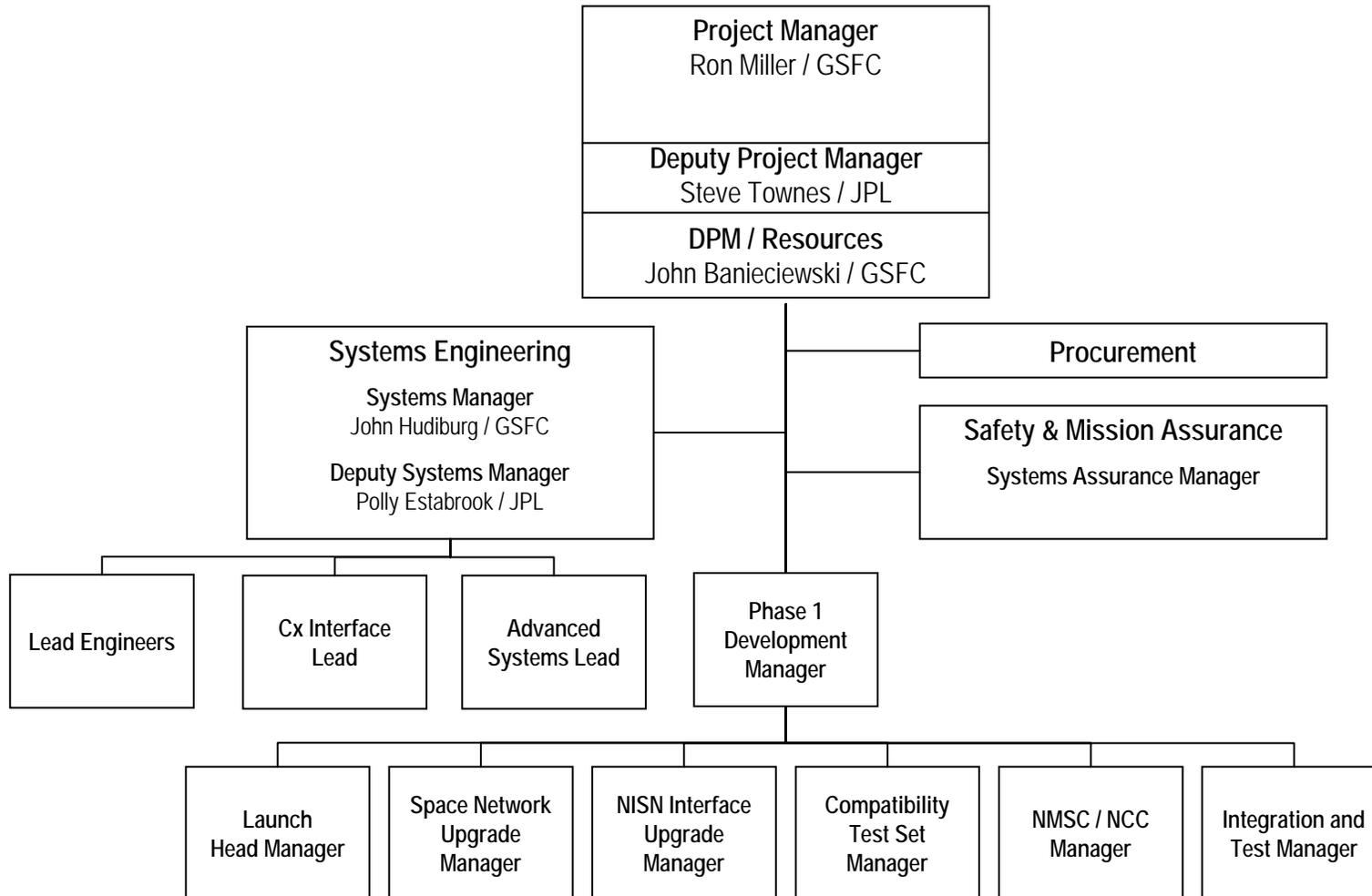
- **Conducting necessary systems trade studies and requirements definition for Cx driven Network upgrades**
 - Working with multiple Cx organizations to understand and help shape CTN requirements.
- **Focus initial support for early test flights and CEV to ISS**
 - Launch and early orbit support
 - NISN Upgrades
 - SN Upgrades
 - Network Test Sets
 - Re-entry & Recovery (if required)
- **Provide integrated network monitoring and scheduling interface**
 - Focal point for network fault isolation
 - Monitor network security





SCIP Organization

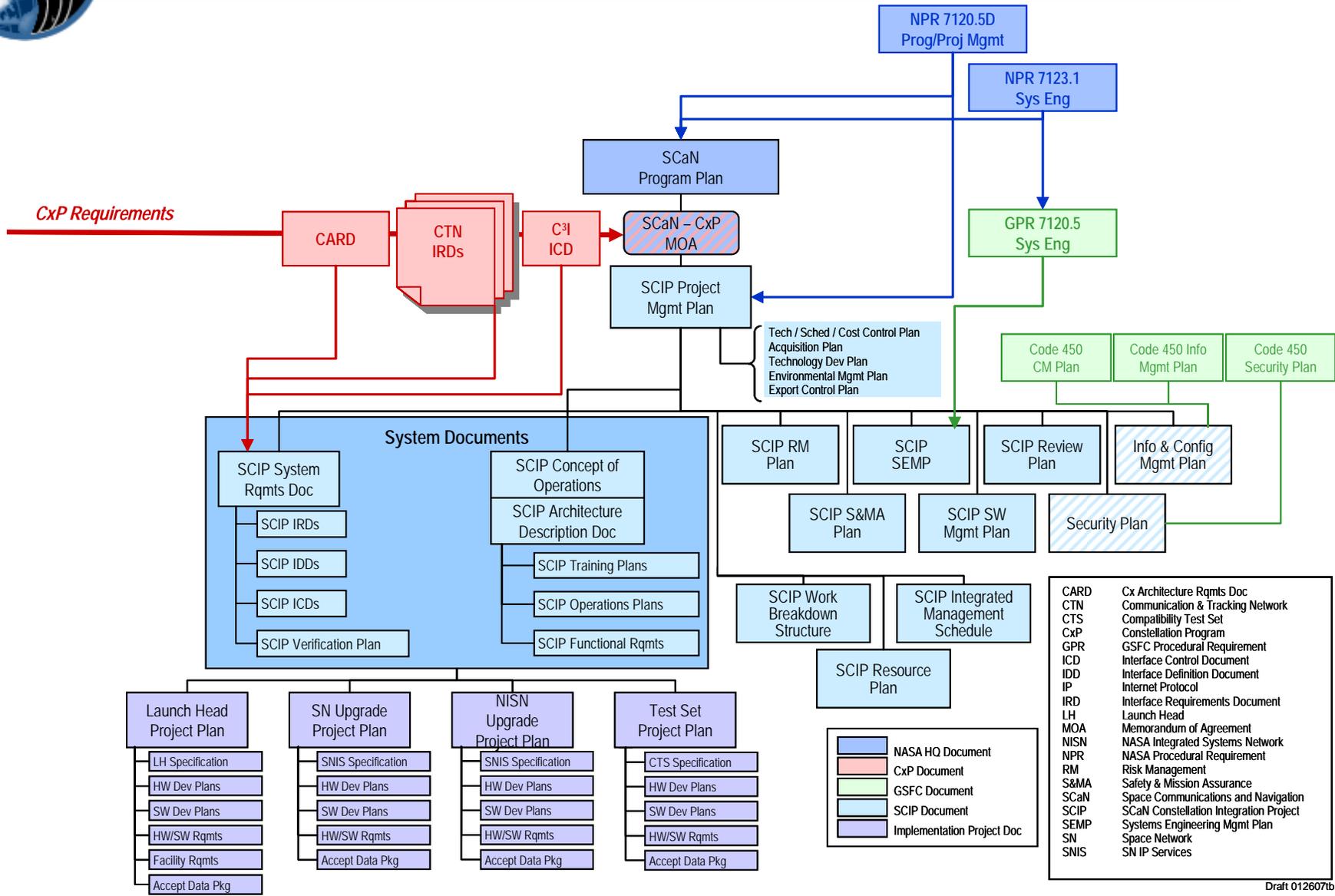
SCIP





SCIP Document Structure

SCIP



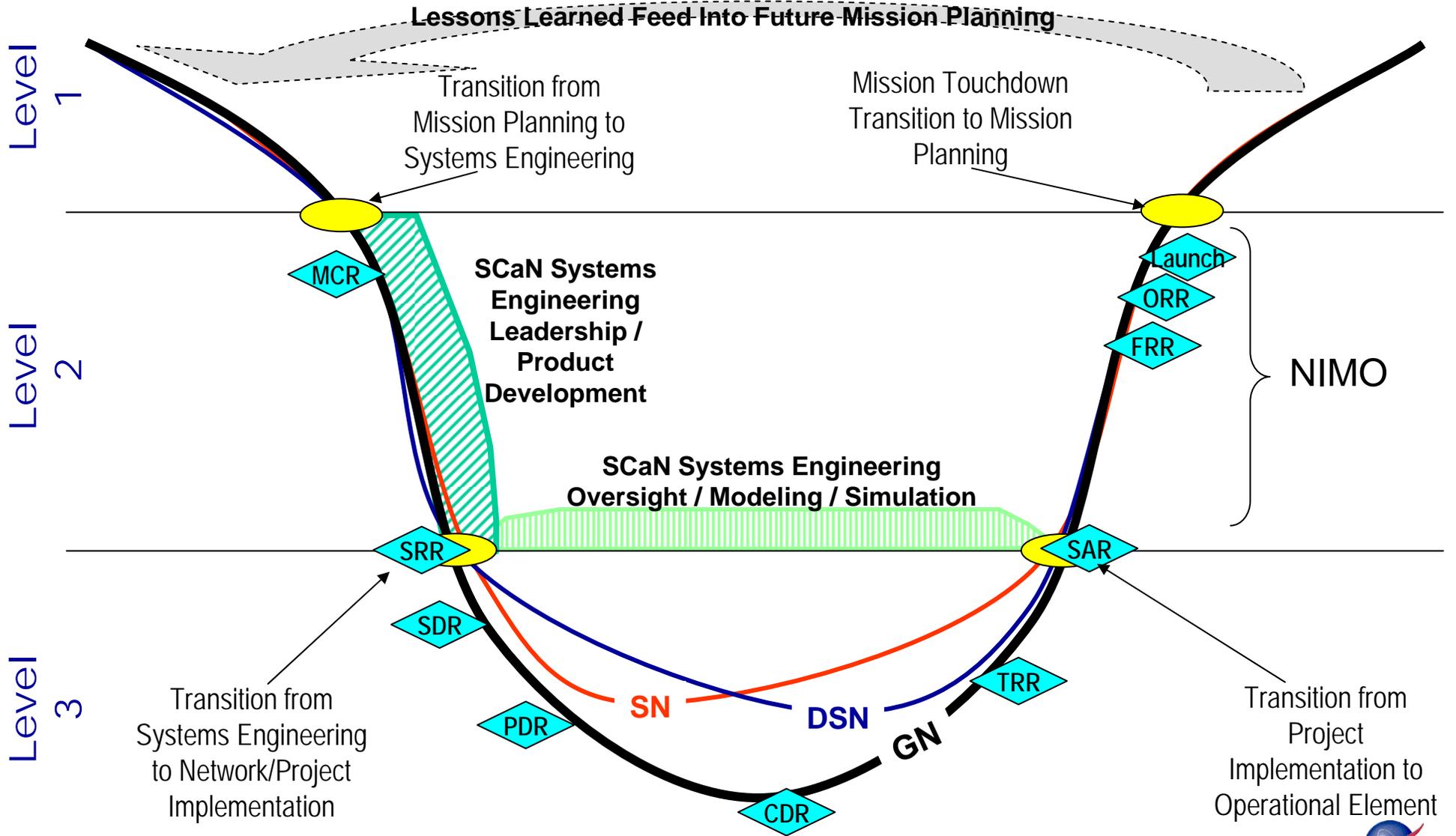
Draft 012607b





Office of Primary Responsibility Transition Process throughout Project Life Cycle

SCIP





Space Communications & Navigation Constellation Integration Project

SCIP

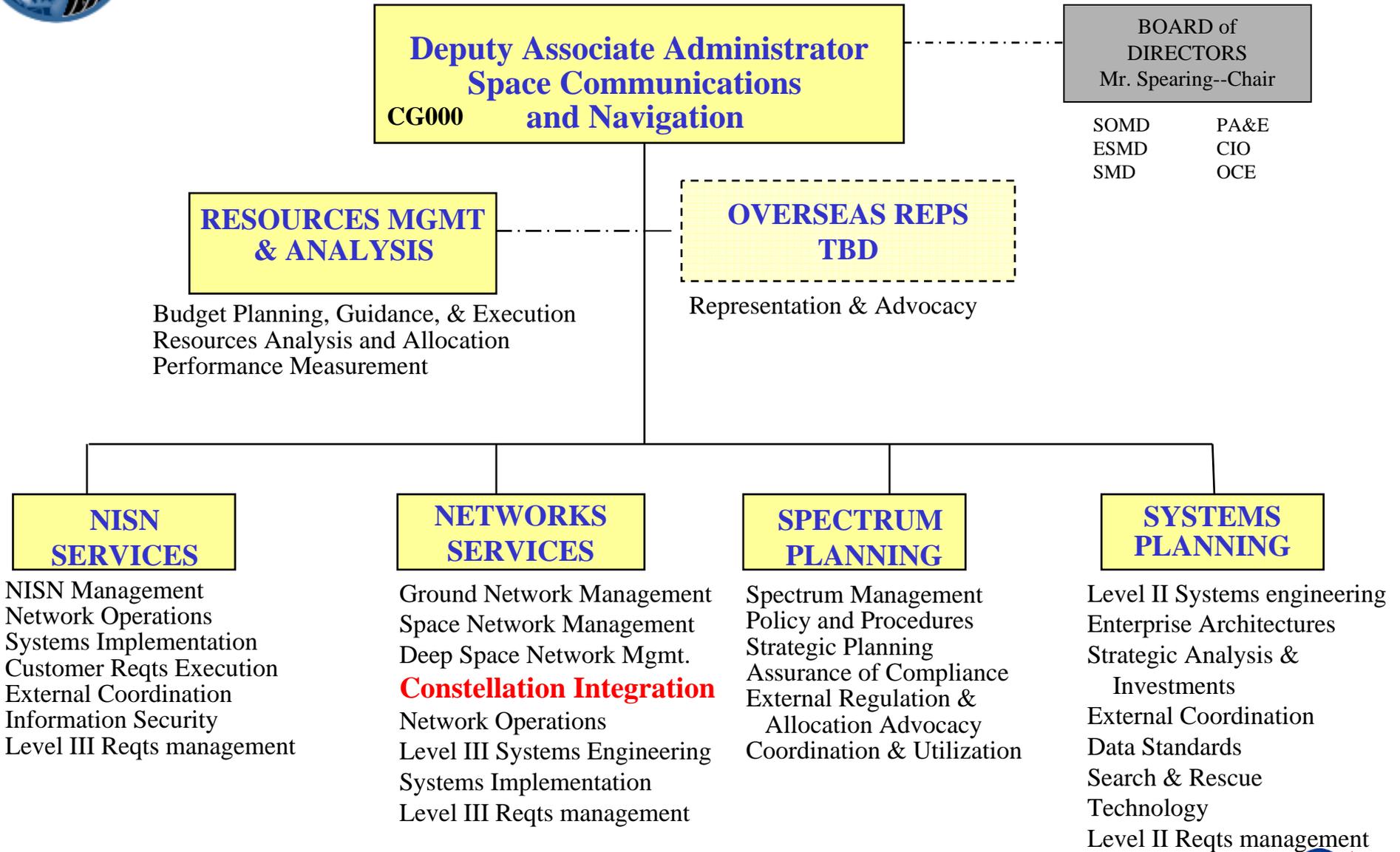
The Space Communication and Navigation (SCaN) Program





SCaN Org Chart

SCIP





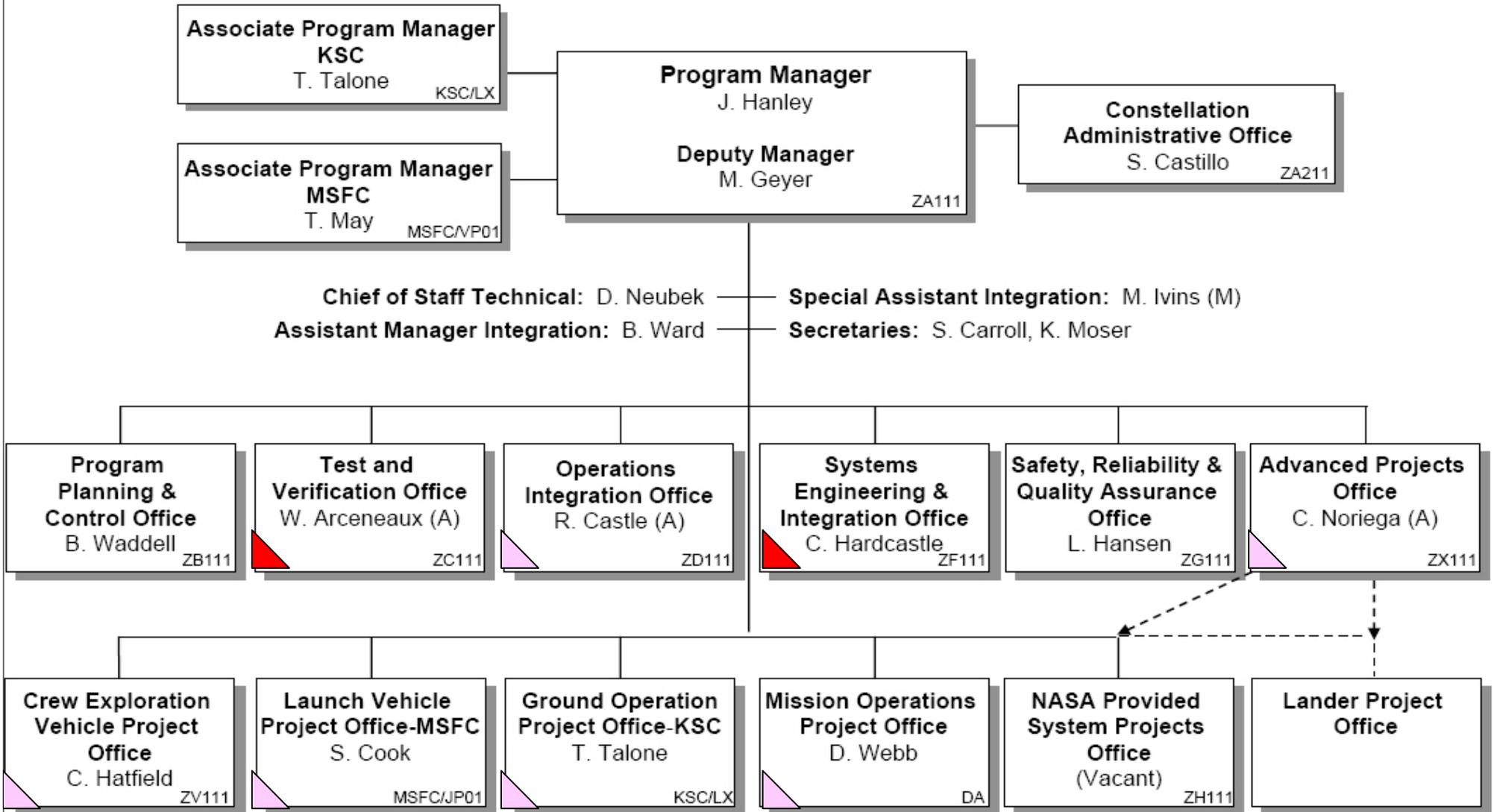
Space Communications & Navigation Constellation Integration Project

SCIP

Constellation - Our Customer



Constellation Program



Strong Interaction with SCA N



Occasional Interaction with SCA N

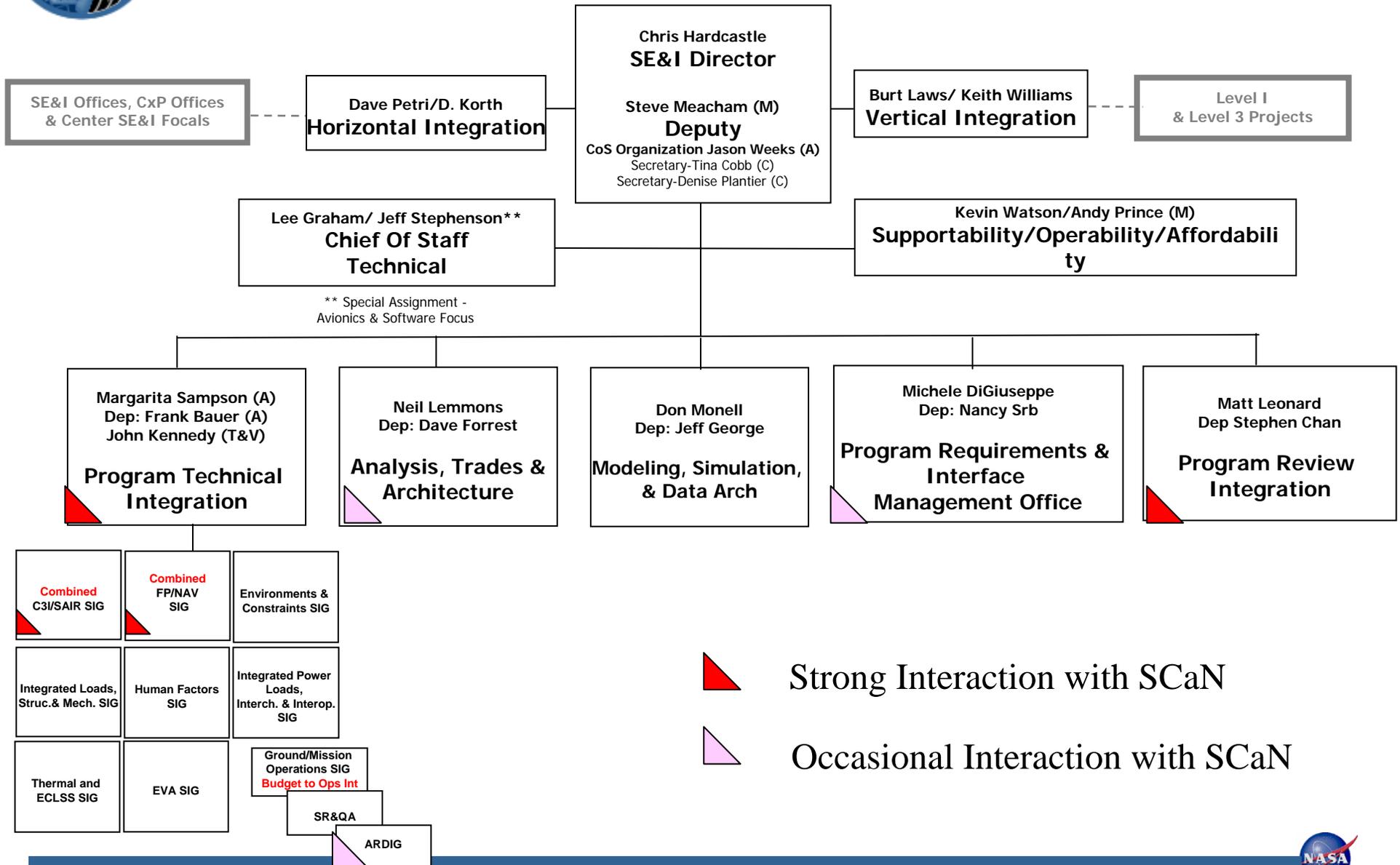
M - Matrix
A - Acting

Jeffrey M. Hanley
 Jeffrey M. Hanley
 Manager
 3/21/06
 Date



Systems Engineering and Integration (SE&I) Organization Chart

(per All Hands 12/14/06)



Strong Interaction with SCA_N



Occasional Interaction with SCA_N

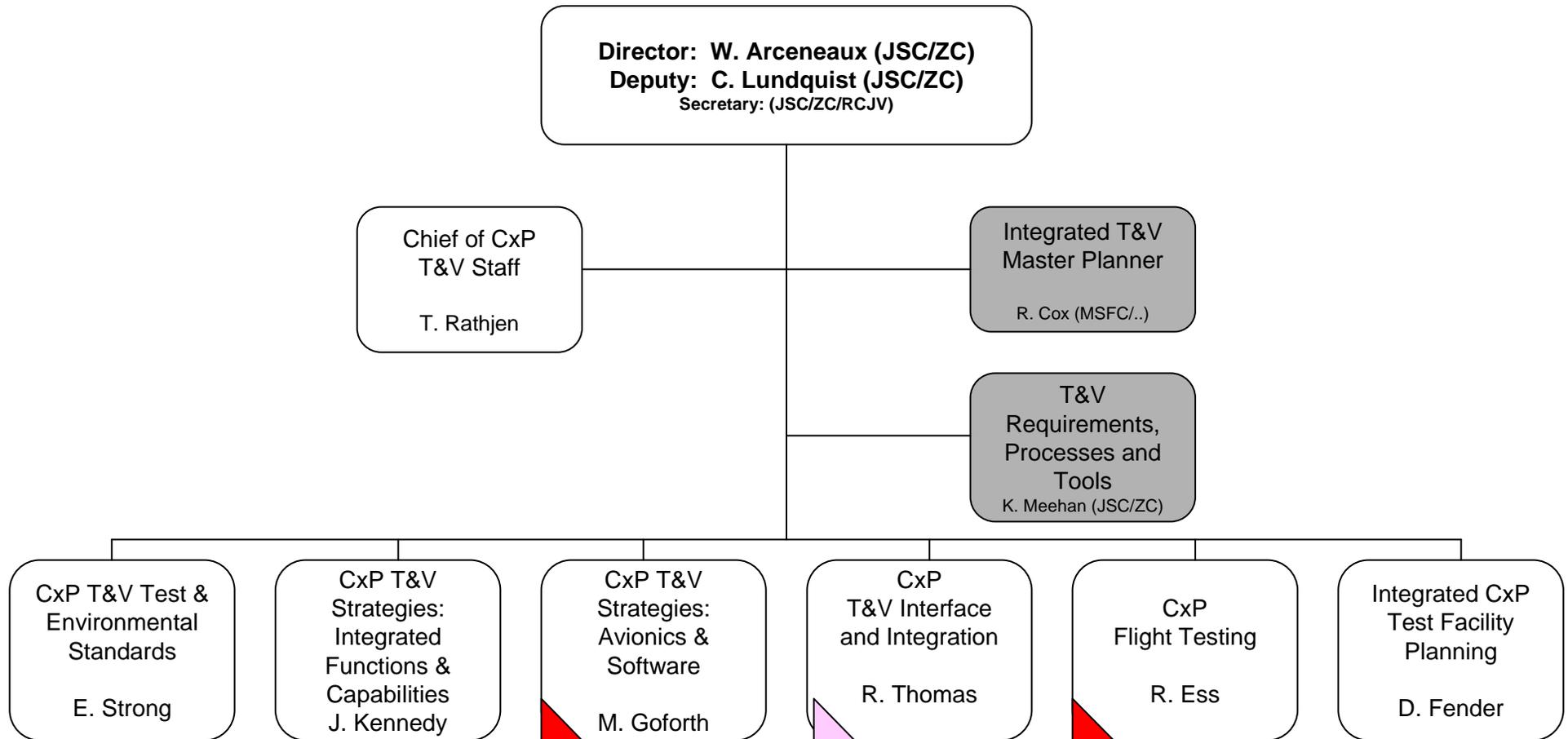




Constellation Test & Verification Organization Chart

(Updated 1/4/07 and Simplified)

SCIP



▲ Anticipated Strong Interaction with SCIP ▽ Anticipated Occasional Interaction with SCIP





Space Communications Customer Forum #15

[Open Floor]

Allen J. Levine
Service Planning Manager
Networks Integration Management Office
NASA/Goddard Space Flight Center



Space Communications Customer Forum #15

[Closing Remarks]

**Allen J. Levine
Service Planning Manager
Networks Integration Management Office
NASA/Goddard Space Flight Center**