



AGENDA

- INTRODUCTION TO TDRSS AND THE SPACE NETWORK
- SPACE NETWORK ELEMENTS
- TDRSS SERVICES
- ONLINE RESOURCES



Space Network Concept

- THE SPACE NETWORK (SN) WAS ESTABLISHED TO REPLACE NASA'S WORLDWIDE NETWORK OF GROUND TRACKING STATIONS
- THE SN DRAMATICALLY INCREASED TRACKING AND DATA ACQUISITION (T&DA) COVERAGE FROM 15% TO 85% PER ORBIT OF LOW EARTH ORBITING SPACECRAFT AS WELL AS DECREASED OPERATIONAL COSTS
- ADDITION OF THE GUAM REMOTE GROUND TERMINAL IN 1998 FURTHER INCREASED T&DA COVERAGE TO 100% FOR ALL CUSTOMERS BY PROVIDING CLOSURE TO THE TDRSS ZONE OF EXCLUSION
- THE SN OPERATES AS A CUSTOMER DRIVEN BENT PIPE RELAY SYSTEM FOR TRACKING, TELEMETRY, AND COMMAND DATA



MISSION SERVICES PROGRAM OFFICE

THE MSPO IS RESPONSIBLE FOR PROGRAM PLANNING, DIRECTION, AND OPERATION OF NASA'S SPACEFLIGHT TRACKING AND DATA NETWORK (STDN):

- MANAGEMENT OF THE TRACKING/DATA COMMUNICATIONS FACILITIES AND SYSTEMS, PROVIDING DAY-TO-DAY SUPPORT OF LAUNCH AND ORBITAL ACTIVITIES
- ICD/MOA/INOSP DEVELOPMENT
- IMPROVEMENTS AND UPGRADES OF PRESENT NETWORKS SYSTEMS TO IMPROVE CURRENT USER SERVICE CAPABILITIES
- ESTABLISHMENT OF LONG RANGE TECHNOLOGY INITIATIVES TO MEET FUTURE USER SERVICE REQUIREMENTS
- PROVISION OF NETWORKS INSTITUTIONAL SUPPORT
- CONTROL OF 530-SNUG (SPACE NETWORK USERS GUIDE)



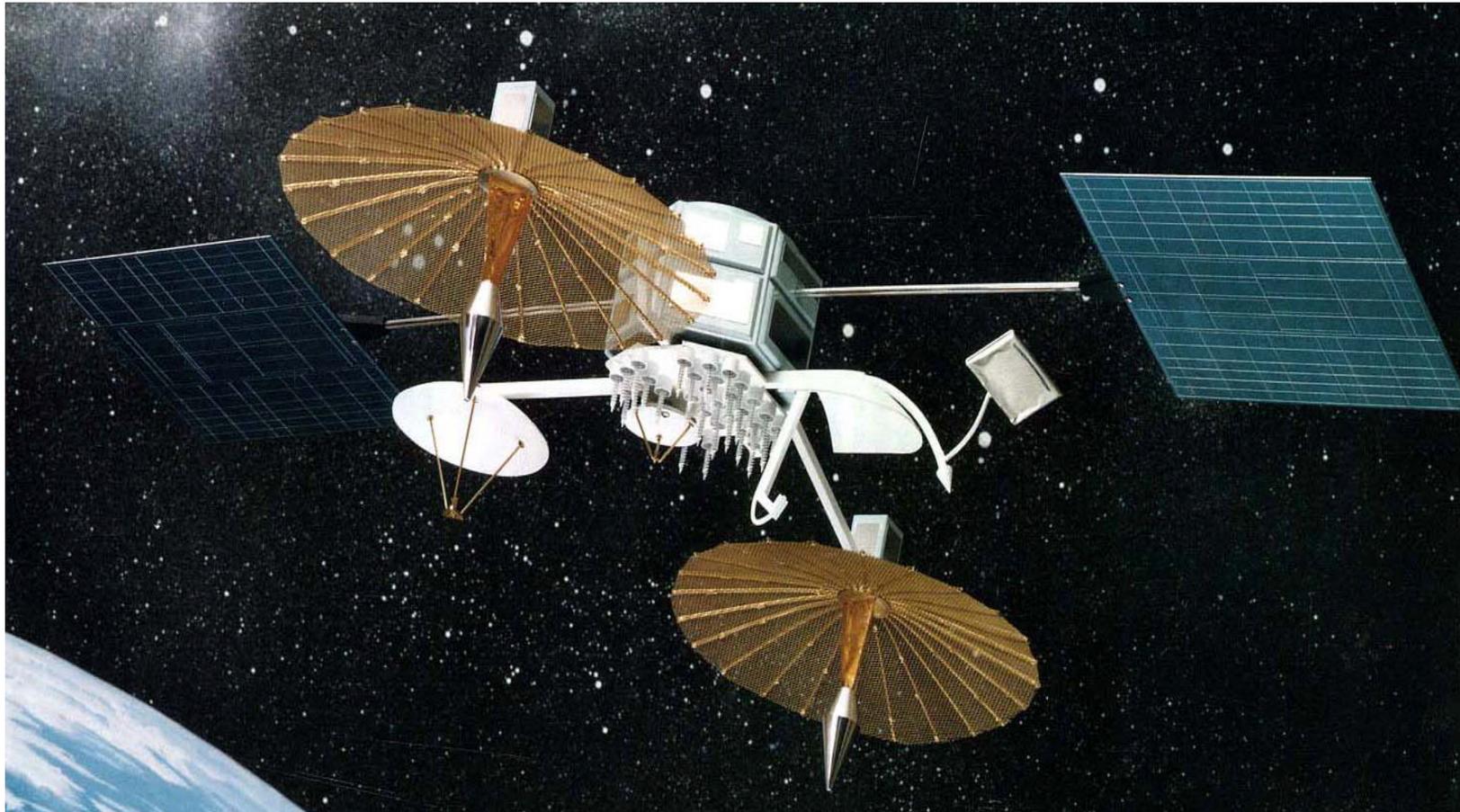
CURRENT TDRS FLEET

	Launched	Geosynchronous Orbit	In-Orbit Checkout Complete	Utilization
TDRS-1	April 4, 1983 STS- 6 (Challenger)	June 29, 1983	- December 28, 1983 - One Satellite System Acceptance April 1985	- Currently At 49°W - Providing South Pole Support
TDRS-3	September 29, 1988 STS- 26 (Discovery)	September 30, 1988	- January 15 1989 - Two Satellite System Acceptance July 1989	- Currently At 275°W Designated As TDZ
TDRS-4	March 13, 1989 STS- 29 (Discovery)	March 14, 1989	June 9, 1989	- Currently At 41°W Designated As TDRSEast
TDRS-5	August 2, 1991 STS -43 (Atlantis)	August 3, 1991	October 7, 1991	- Currently At 174°W - Designated As TDRS West
TDRS-6	January 13, 1993 STS- 54 (Endeavor)	January 14, 1993	March 4, 1993	- Currently At 46°W - Designated As TDS
TDRS-7	July 13, 1995 STS -70 (Discovery)	July 14, 1995	August 22, 1995	- Currently At 171° W

TDRS-2 LOST JANUARY 28, 1986 ABOARD STS-51L (CHALLENGER)



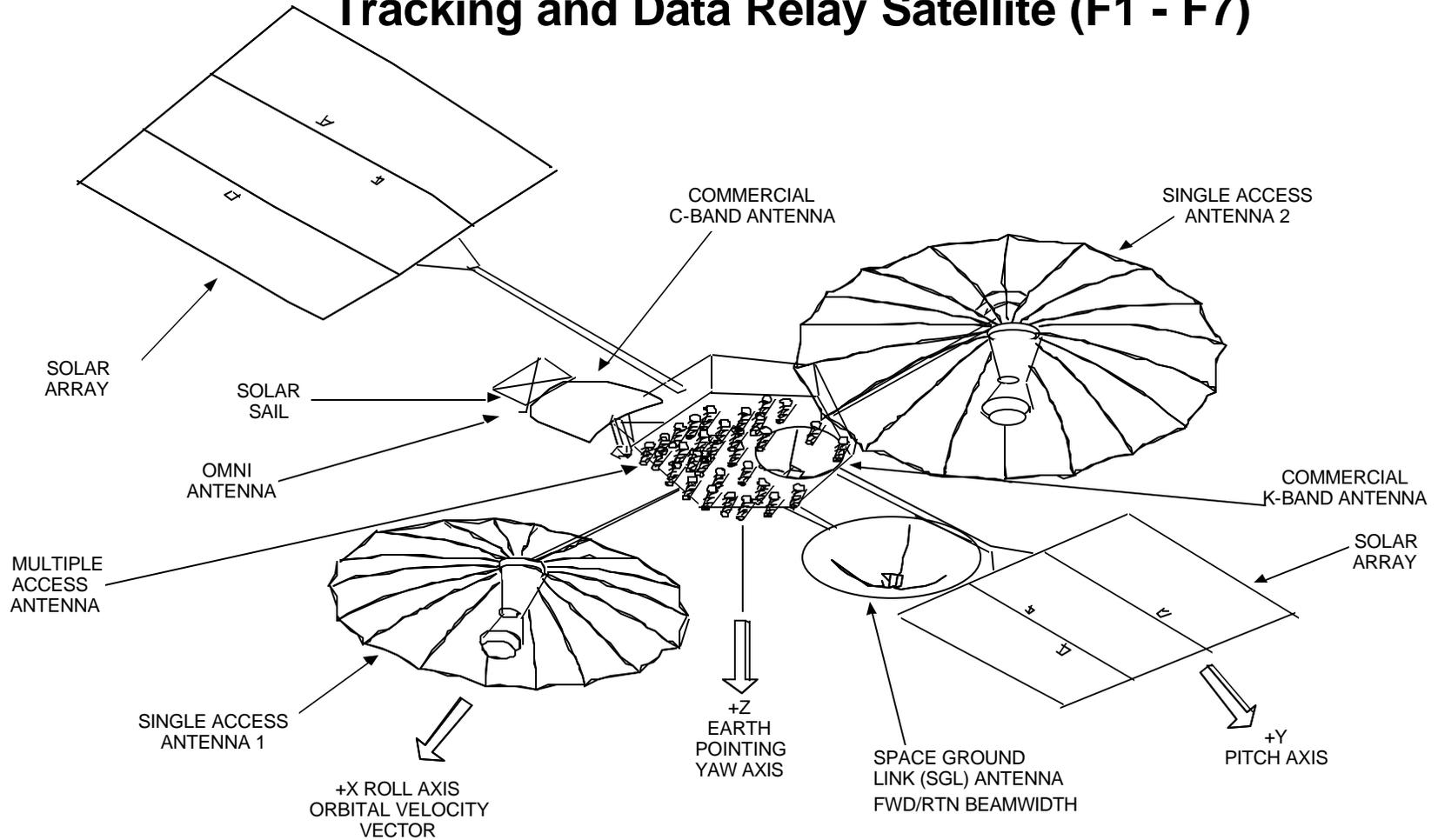
Tracking and Data Relay Satellite



SPACE NETWORK OVERVIEW



Tracking and Data Relay Satellite (F1 - F7)



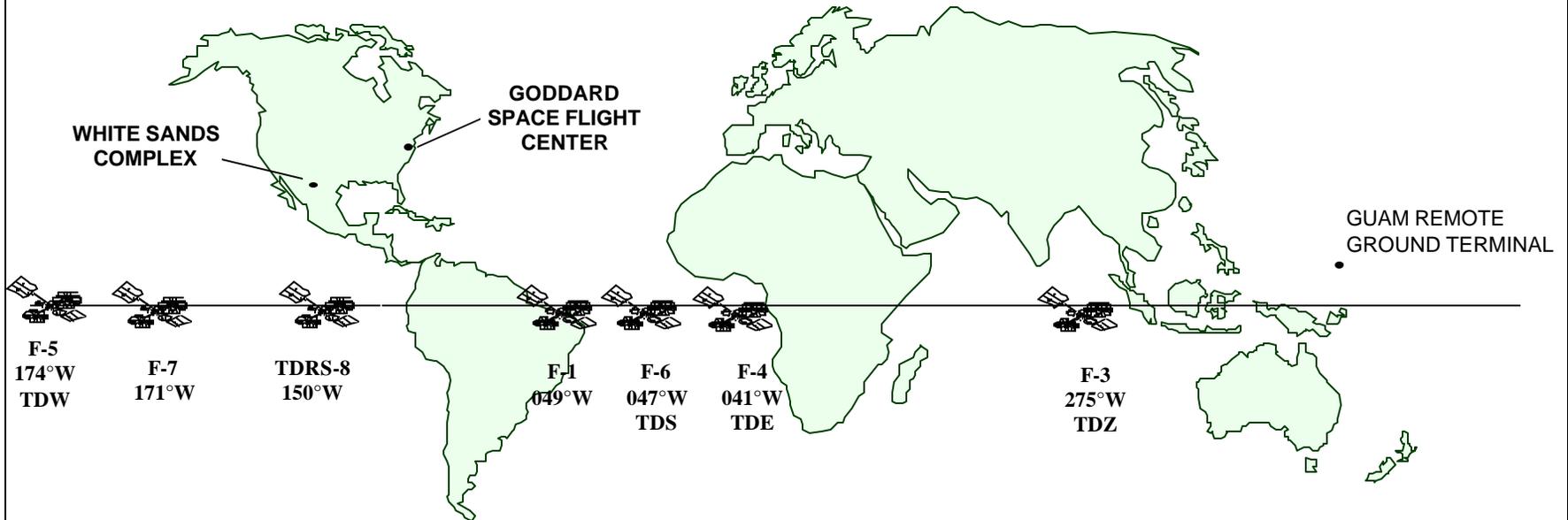


TDRS-H



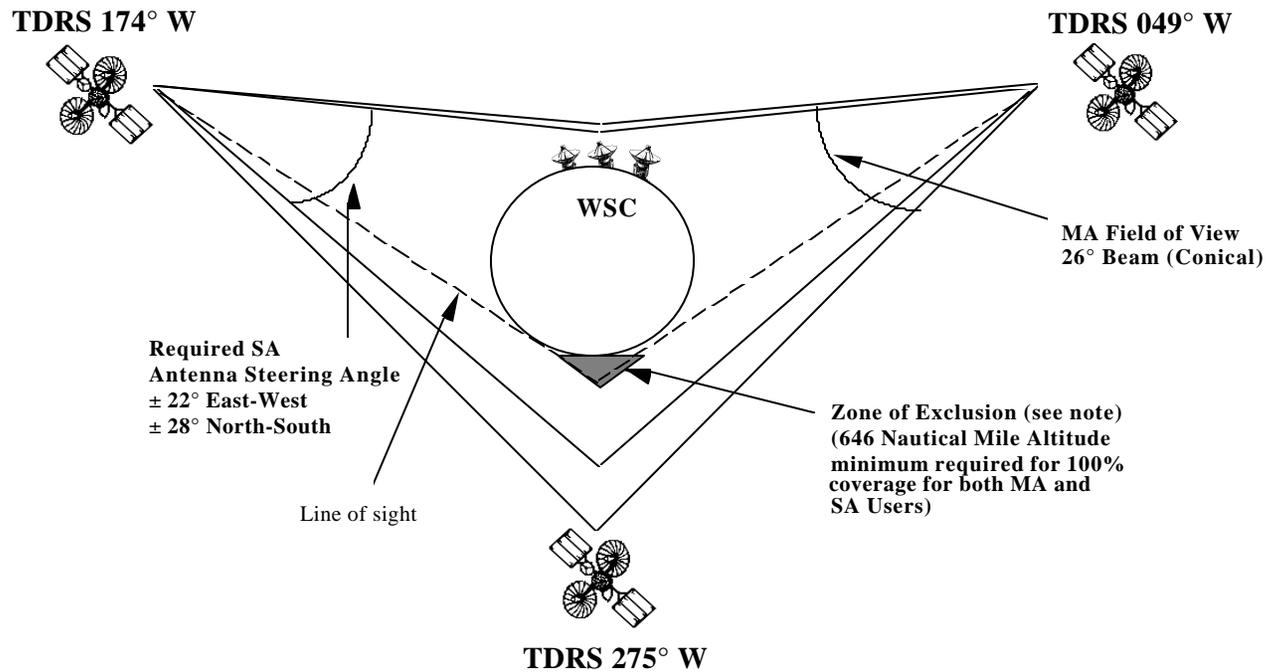


PRESENT TDRS CONSTELLATION





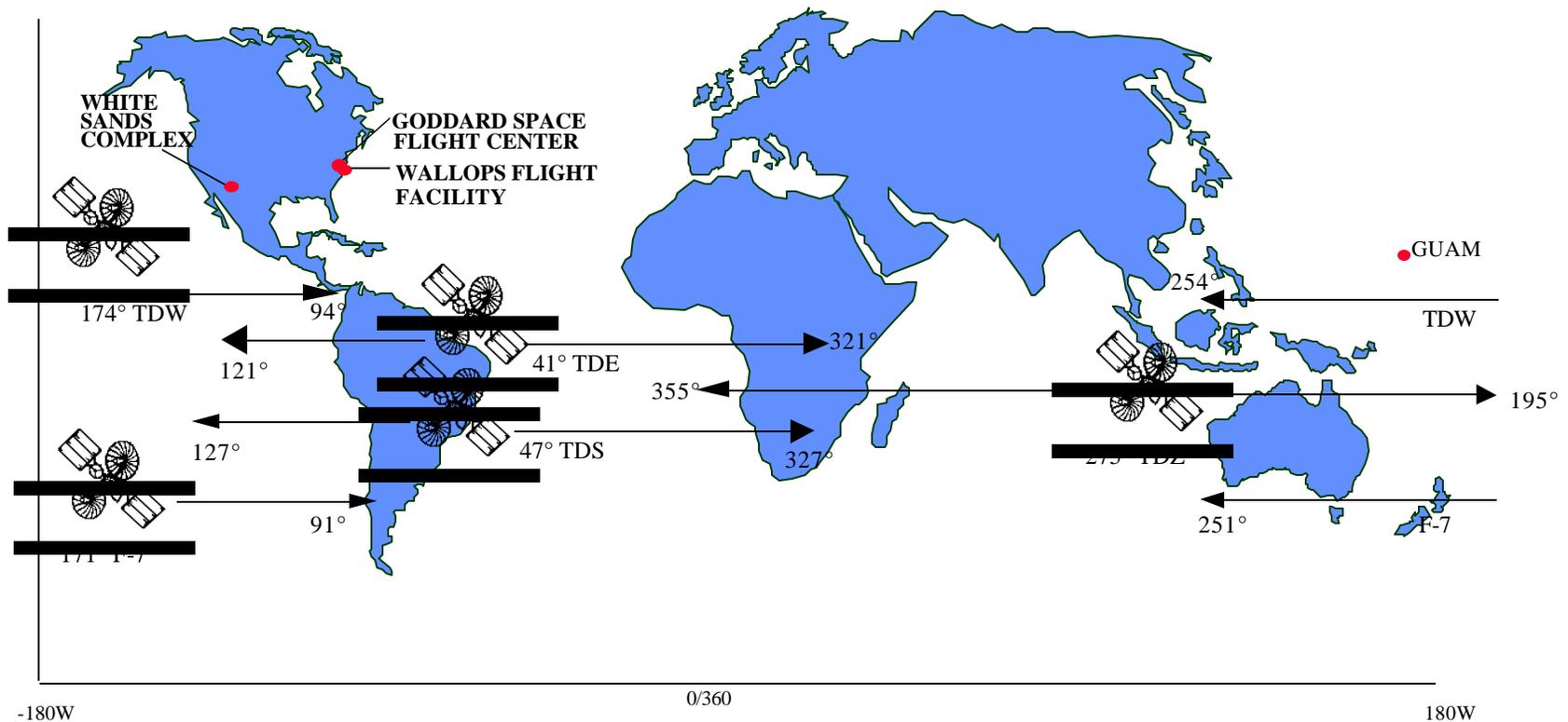
Operational Coverage



NOTE:
ZOE exists for a 2 TDRS constellation. Coverage using 174°/49°/275° effectively closes the ZOE and provides capability for 100% in view coverage



TDRSS FIELDS OF VIEW



TDRS VIEWS BASED ON 600KM USER ALTITUDE AT THE EQUATOR



CUSTOMER SUPPORT 1999-2004

ON-ORBIT DECEMBER 1999

ERBS
EUVE
CGRO
HST
LANDSAT
STS
TOMS-EP
TOPEX
UARS
RXTE
LDBP
STARLINK
RADARSAT
TRMM
LANDSAT-7
SPACE STATION

NEW MISSIONS

EOS-AM1
EOS-PM1
EOS-CHEM1
STS PAYLOADS
RELATIVITY

LAUNCH/SPECIAL SUPPORT

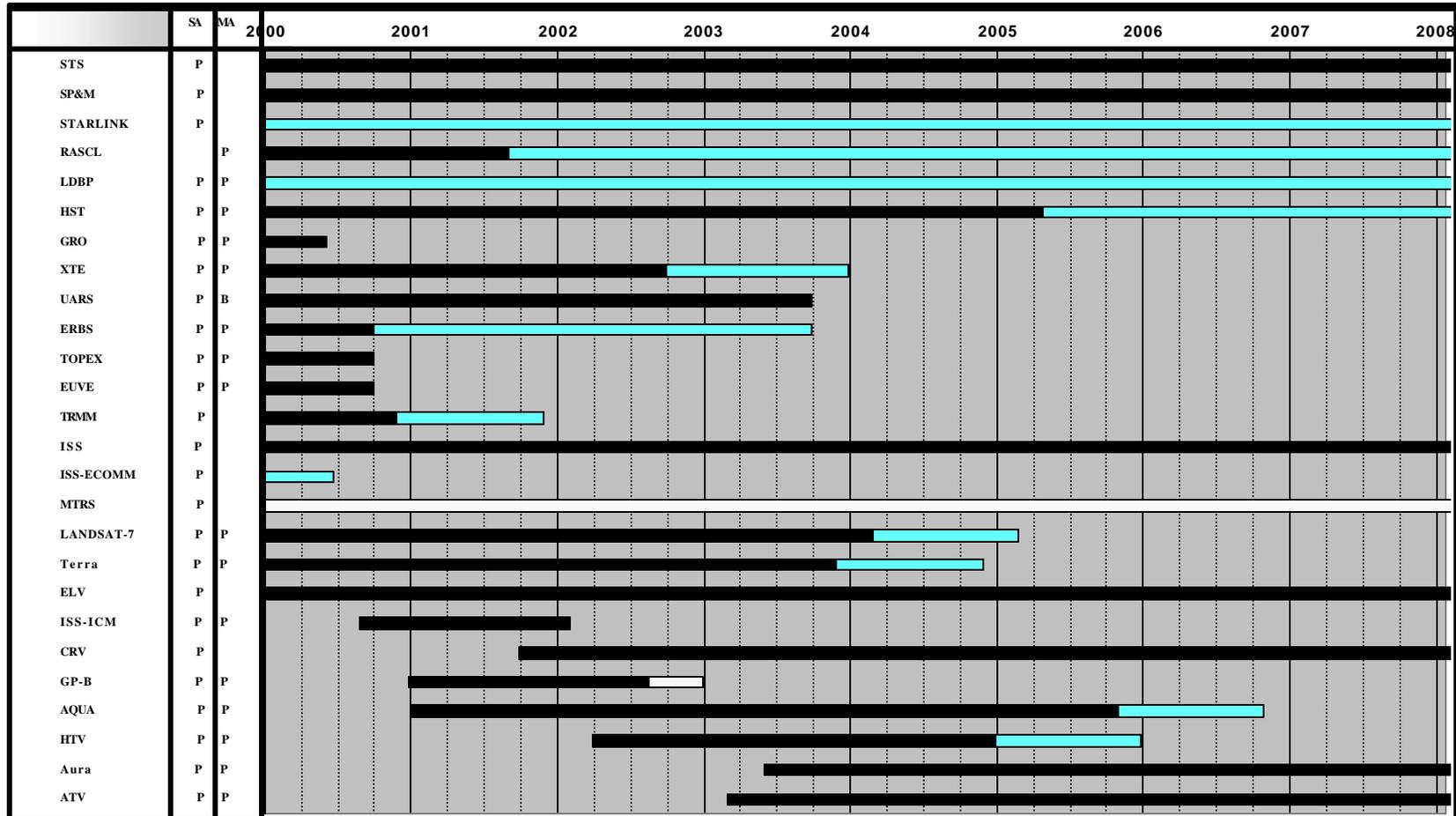
ATLAS/CENTAUR
DELTA
NOAA
NSF
PEGASUS
SEA LAUNCH
STS/IUS
STS PAYLOADS
TAURUS
TITAN/CENTAUR
TITAN/IUS

- In a typical month TDRSS supports between 5,500 and 6,000 scheduled customer service events



SN Mission Model

Mission



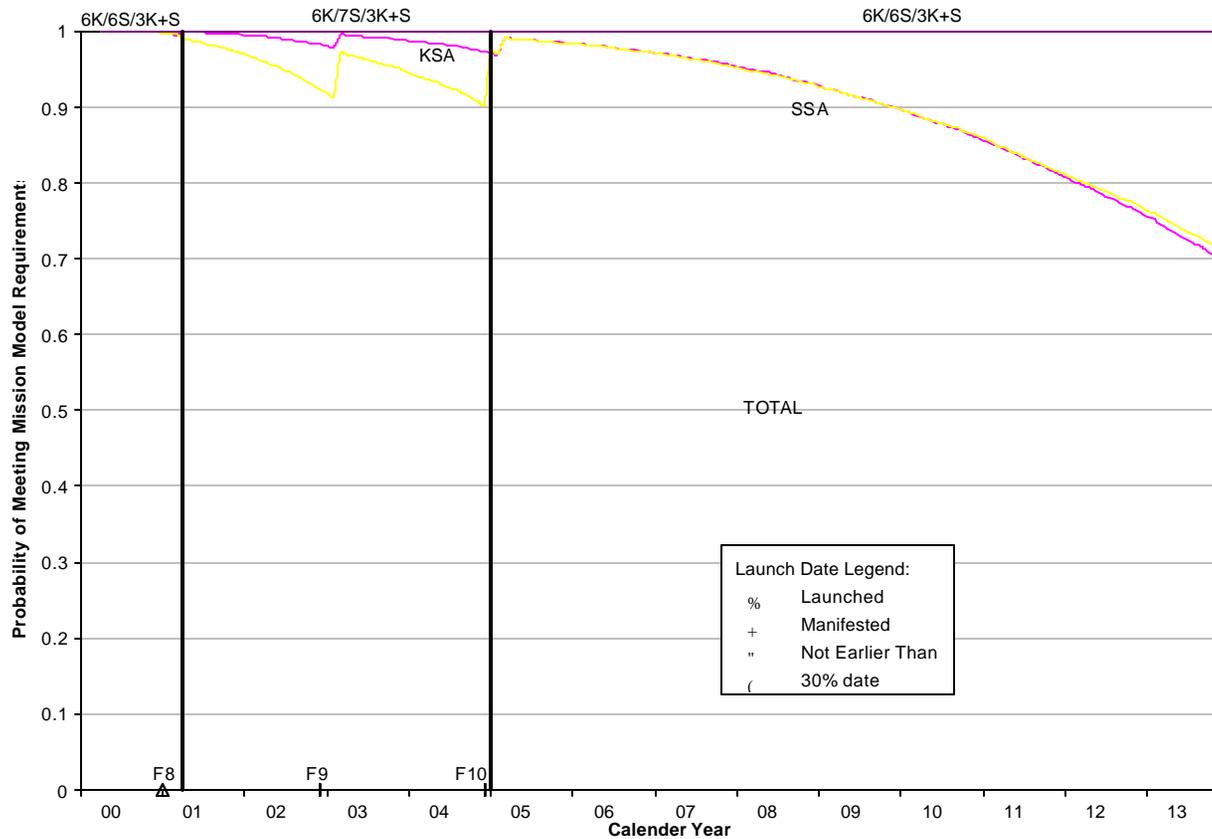
P - Prime support, B - backup

■ Committed □ Extended □ Potential

Note: ATV support runs on for 6 months and off for 12 months



TDRSS RELIABILITY/REPLENISHMENT



This graph shows the probability that the TDRS constellation will be able to meet the specified user requirements for each type of Single Access service (KSA and SSA) The Total curve reflects the probability that TDRSS will be able to satisfy all specified user requirements.

SPACE NETWORK OVERVIEW

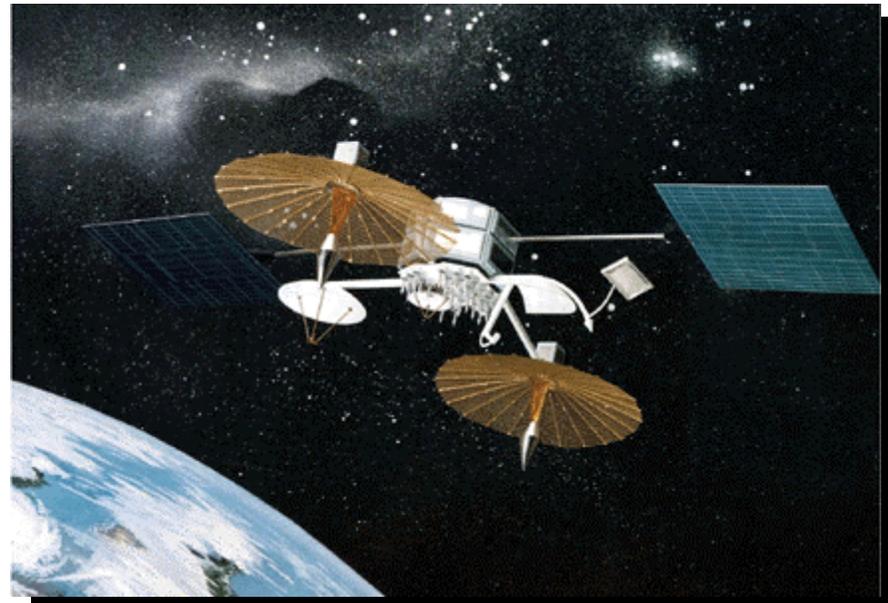


Space Network Elements



Space Segment

- TDRSS = TRACKING AND DATA RELAY SATELLITE SYSTEM
- NASA'S ORBITING COMMUNICATION SATELLITE CONSTELLATION
- PROVIDES GLOBAL COVERAGE FOR NASA, OTHER GOVERNMENT, AND COMMERCIAL USERS





GROUND SEGMENT

- NETWORK CONTROL CENTER
 - OPERATIONAL HUB LOCATED AT GODDARD SPACE FLIGHT CENTER FOR COORDINATING ALL SPACE NETWORK ACTIVITIES

- WHITE SANDS COMPLEX (WSC)
 - TWO INDEPENDENT, FUNCTIONALLY IDENTICAL TDRS GROUND STATIONS LOCATED NEAR LAS CRUCES, NM FOR CONTROLLING THE TDRS
 - WSC ALTERNATIVE RESOURCE TERMINAL (WART) FOR TDRS-1 IN SUPPORT TO NSF

- GUAM REMOTE GROUND TERMINAL
 - PROVIDES ZOE CLOSURE USING TDZ





NETWORK CONTROL CENTER FUNCTIONS

- SERVICE PLANNING
 - NCC DATABASE MANAGEMENT
 - ACRS (FORWARD AND RETURN LINK MUTUAL INTERFERENCE PREDICTION)

- SCHEDULING
 - FORECAST PERIOD
 - ACTIVE PERIOD
 - CONFLICT RESOLUTION

- MISSION OPERATIONS SUPPORT
 - EVENT MONITORING
 - REAL TIME FAULT ISOLATION



WHITE SANDS COMPLEX

- TWO FUNCTIONALLY IDENTICAL, GEOGRAPHICALLY SEPARATED GROUND TERMINALS AT THE WHITE SANDS TEST FACILITY
- THE WSC HAS FIVE SPACE TO GROUND LINK TERMINALS (SGLTs)
 - A SIXTH SGLT HAS BEEN INSTALLED AT THE REMOTE GROUND TERMINAL ON GUAM AS AN EXTENDED WSC SGLT
- THE WSC ALTERNATIVE RESOURCE TERMINAL (WART) FUNCTION IS USED TO COMMAND AND CONTROL TDRS-1 AND PROVIDES S-BAND (SSAF/SSAR) AND K-BAND (KSAR) SERVICES TO NSF ONLY
 - SERVICES UNABLE TO SUPPORT ON-ORBIT USERS



WSGT





STGT





WHITE SANDS COMPLEX (WSC) OPERATIONS

- SPACE SEGMENT OPERATIONS
 - TDRS TT&C
 - SPACECRAFT ENGINEERING

- GROUND SEGMENT OPERATIONS
 - CUSTOMER OPERATIONS
 - EQUIPMENT MAINTENANCE
 - SYSTEMS ENGINEERING
 - SOFTWARE MAINTENANCE and TRAINING FACILITY
 - LOGISTICS AND FACILITIES



SPACE SEGMENT OPERATIONS

- TDRS TT&C
 - SATELLITE CONTROLLERS PERFORM OPERATIONS AND MONITOR DAILY TDRS HOUSEKEEPING ACTIVITIES (BATTERY MANAGEMENT, MOMENTUM WHEEL DUMPS, STATIONKEEPING)

- SPACECRAFT ENGINEERING
 - MANEUVER PLANNING
 - ANOMALY INVESTIGATION AND RESOLUTION
 - CONDUCT PERIODIC PERFORMANCE (PAYLOAD AND PLATFORM) TESTS TO ESTABLISH/MAINTAIN TREND DATA



GROUND SEGMENT OPERATIONS

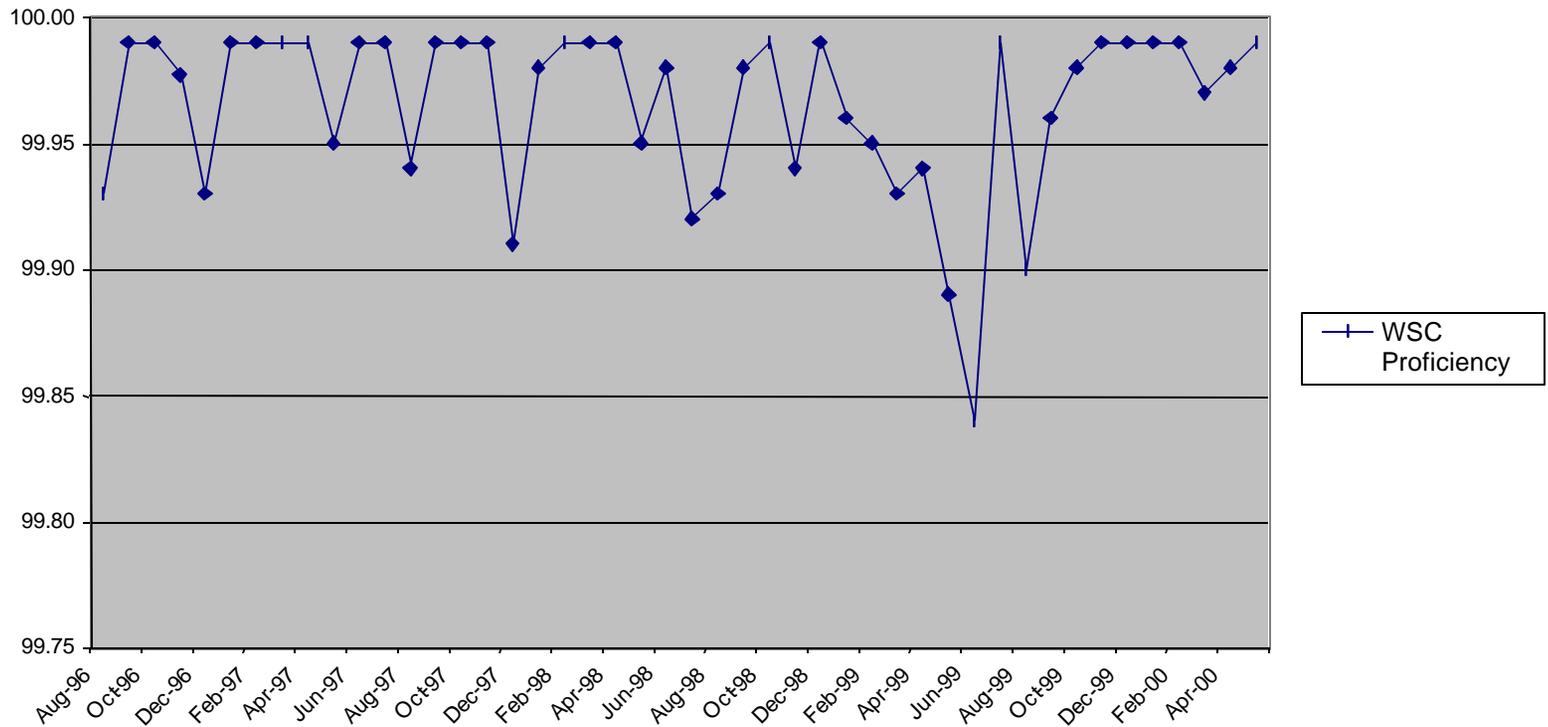
- CUSTOMER OPERATIONS
 - IN RESPONSE TO SCHEDULED EVENTS, GROUND EQUIPMENT IS CONFIGURED AND OPERATED AUTOMATICALLY

 - SERVICE IS MONITORED BY THE COMMUNICATIONS SERVICES CONTROLLER IN THE TOCC AT EACH GROUND TERMINAL AND WHEN ANOMALIES OCCUR EFFECT EQUIPMENT FAILOVERS TO REDUNDANT EQUIPMENT



CODE 450

WSC Proficiency





TDRSS Services



TDRSS SERVICES

- MISSION PLANNING
 - REQUIREMENTS DEFINITION, ENGINEERING, AND INTEGRATION

- COMMUNICATIONS LINK ANALYSIS AND SIMULATION SYSTEM (CLASS)
 - END-TO-END RF SYSTEMS ANALYSIS

- TESTING
 - CHARACTERIZATION, AND VERIFICATION/VALIDATION TESTING FOR EVALUATING MISSION READINESS
 - INTERFACE COMPATIBILITY TESTING FOR RF AND GROUND DATA INTERFACES



TDRSS SERVICES (CONT'D)

- OPERATIONS PLANNING
 - DEVELOP AND COORDINATE THE IMPLEMENTATION OF APPROVED NETWORK ENHANCEMENTS TO SUPPORT NEW AND EVOLVING REQUIREMENTS
 - ENSURE SN ELEMENTS ARE PREPARED TO SUPPORT MISSION REQUIREMENTS. IMPLEMENT NECESSARY DATABASE CONNECTIVITIES.

- PRE LAUNCH SUPPORT
 - PAYLOAD & LAUNCH VEHICLE RF CHECKOUT

- LAUNCH SUPPORT
 - TRACKING AND DATA ACQUISITION VIA TDRSS



TDRSS SERVICES (CONT'D)

- COMMAND
 - COMMANDS TRANSMITTED DIRECTLY VIA NISN TO WSC
 - WSC UPLINKS COMMANDS TO TDRS FOR RF TRANSMISSION TO CUSTOMER S/C

- TELEMETRY
 - CUSTOMER DATA RECEIVED VIA TDRS AT WSC
 - WSC DOWN CONVERTS, DEMODULATES, BIT SYNCHRONIZES, CONVOLUTIONALLY DECODES, RECORDS DATA, AND SENDS ASYNCHRONOUS DATA TO NISN EQUIPMENT FOR TRANSMISSION TO CUSTOMERS IN IP OR ENCAPSULATED 4800 BIT BLOCK FORMAT



TDRSS SERVICES (CONT'D)

- TRACKING
 - ONE-WAY DOPPLER FOR FREQUENCY DETERMINATION
 - RANGE USING DG-1 PN CODE AND 2-WAY DOPPLER TRACKING

- CONTROL/STATUS
 - TDRSS LINK CONTROL MESSAGES AND PERFORMANCE MONITORING DATA



SERVICE SUMMARY/SYSTEM CAPACITY

	FREQUENCY	SERVICE	MAX. DATA RATE	SERVICES PER TDRS*	WSC CAPABILITY	GUAM CAPABILITY
SINGLE ACCESS S BAND	2020.4 MHz - 2123.3 MHz	FORWARD	300 kbps	2	10	2
	2200 MHz - 2300 MHz	RETURN	6 Mbps	2	10	2
K BAND	13.747 GHz - 13.802 GHz	FORWARD	25 Mbps	2	10	2
	14.887 GHz - 15.119 GHz	RETURN	300 Mbps	2	10	2
MULTIPLE ACCESS S BAND	2103.1 MHz - 2109.7 MHz	FORWARD	10 kbps	1	4	1
	2284.5 MHz - 2290.5 MHz	RETURN	100 kbps	5	20	2

* Fully operational S/C
2 way ranging and Doppler tracking available



TDRSS/TDRS-H,I,J Baseline Service Comparison

SERVICE			TDRSS	TDRS - H,I,J	NOTES
SINGLE ACCESS	S-BAND	FWD	300 kbps	300 kbps	NO CHANGE
		RTN	6 Mbps	6 Mbps	
	Ku-BAND	FWD	25 Mbps	25 Mbps	
		RTN	300 Mbps	300 Mbps	
	Ka-BAND	FWD	N/A	25 Mbps	23/25-27 GHz frequency band
		RTN	N/A	800 Mbps*	
NUMBER OF LINKS PER SPACECRAFT			2 SSA 2 KuSA	2 SSA 2 KuSA 2 KaSA	FOR TDRS H,I,J SIMULTANEOUS OPERATION OF S & Ku AND S & Ka SERVICES VIA A SINGLE SA ANTENNA ARE REQUIRED
MULTIPLE ACCESS	NUMBER OF LINKS PER S/C	FWD	1 @ 10 kbps	1 @ 10 kbps (8 dB over TDRSS)	ANTICIPATED SSA USERS LESS THAN 3 Mbps OFFLOADED TO TDRS H,I,J MA
		RTN	5 @ 150 kbps LIMITED BY GROUND EQ. ONLY	6 @ 3 Mbps (ONBOARD BEAMFORMING)	
CUSTOMER TRACKING			150 meters 3 sigma	150 meters 3 sigma	NO CHANGE

* Beyond 300 Mbps requires Ground Station Modification



ADVANTAGES OF SN SUPPORT SERVICES

- SPACE-BORNE PLATFORM
 - READY ASSET
 - GLOBAL COVERAGE

- QUICK DROP LOCK REACQ TIME

- REDUNDANT PATHS (GROUND)

- LOW MAINTENANCE & OPERATIONS COST



Online Resources



ONLINE RESOURCES

- TDRSS ONLINE INFORMATION CENTER
 - A COMPREHENSIVE ONLINE RESOURCE WITH CURRENT AND DETAILED INFORMATION ON ALL ASPECTS OF TDRSS AND THE SPACE NETWORK
 - <http://nmsp.gsfc.nasa.gov/tdrss/>

- DOCUMENT AND DATA CONTROL SYSTEM ONLINE LIBRARY
 - A WEBSITE WHICH PROVIDES EASY ACCESS TO MSPO TECHNICAL DOCUMENTATION
 - <http://csoc-ddcs.csoonline.com/library/>

- CENTER CUSTOMER COMMITMENT HOMEPAGE
 - <http://somo.gsfc.nasa.gov/cmsm>