Space Communications and Navigation (SCaN) Overview
Explorer Pre-Proposal Conference

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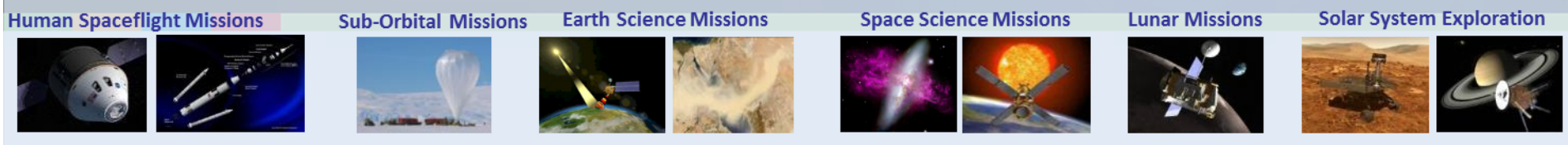
National Aeronautics and Space Administration

SPACE COMMUNICATIONS SCaN AND NAVIGATION

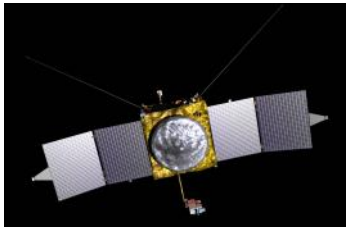
Three Networks Span the Globe

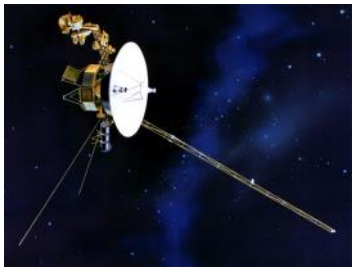


Overview of the Three Networks

Deep Space Network

Large, slow-tracking antennas located ~ 120 degrees apart around the Earth – optimized for tracking spacecraft beyond Geosynchronous Orbit (GEO)





Near Earth Network

Small, fast-tracking antennas in many locations – optimized for short-pass tracking of Low Earth Orbit (LEO) spacecraft

Space Network

Downward-looking Earth-orbiter-based antennas – optimized for highly-capable LEO spacecraft, including human spaceflight

Deep Space Network (DSN)

Canberra Deep Space Communications Complex

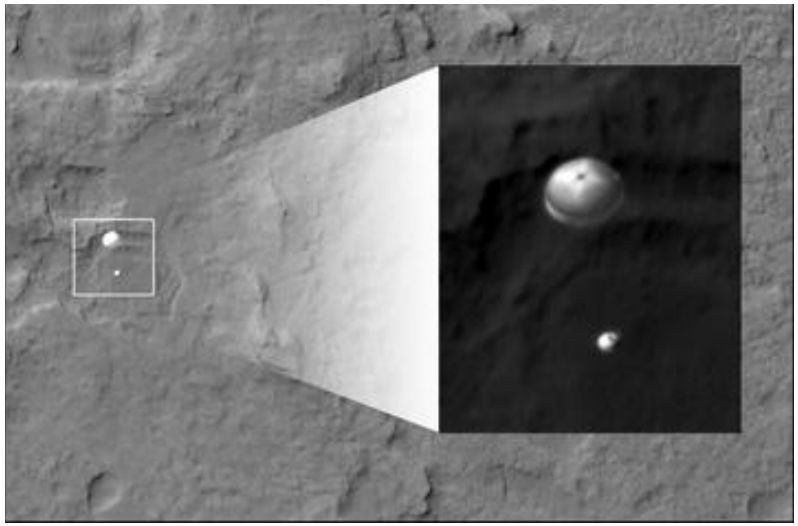
Madrid Deep Space Communications Complex

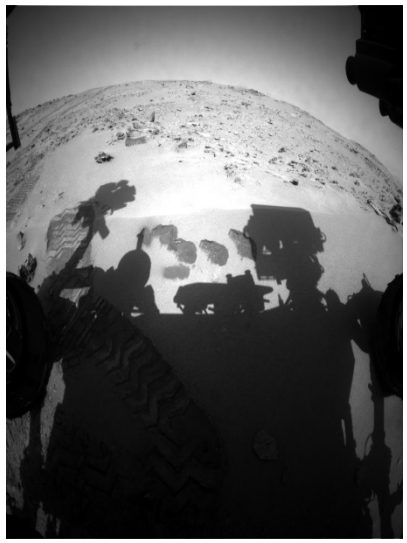
Goldstone Deep Space Communications Complex

NASA's Deep Space Network (DSN) was established in December 1963 to provide a communications infrastructure for all of NASA's robotic missions beyond Low Earth Orbit.

Curiosity Supported by the DSN

- The Mars Reconnaissance Orbiter (MRO) captured pictures of Curiosity's parachute.
  - MRO is supported by the Deep Space Network.
- Curiosity's first images of Mars were transmitted by the DSN. The DSN continues to support Curiosity as it makes new discoveries.





Near Earth Network (NEN)

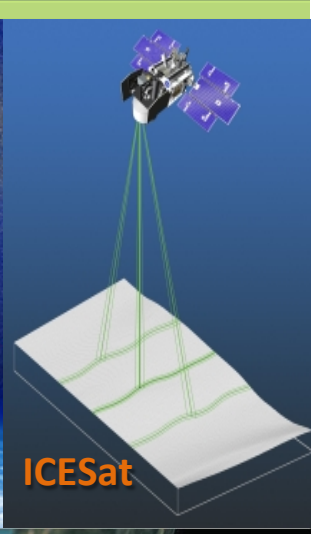
Svalbard Ground Station

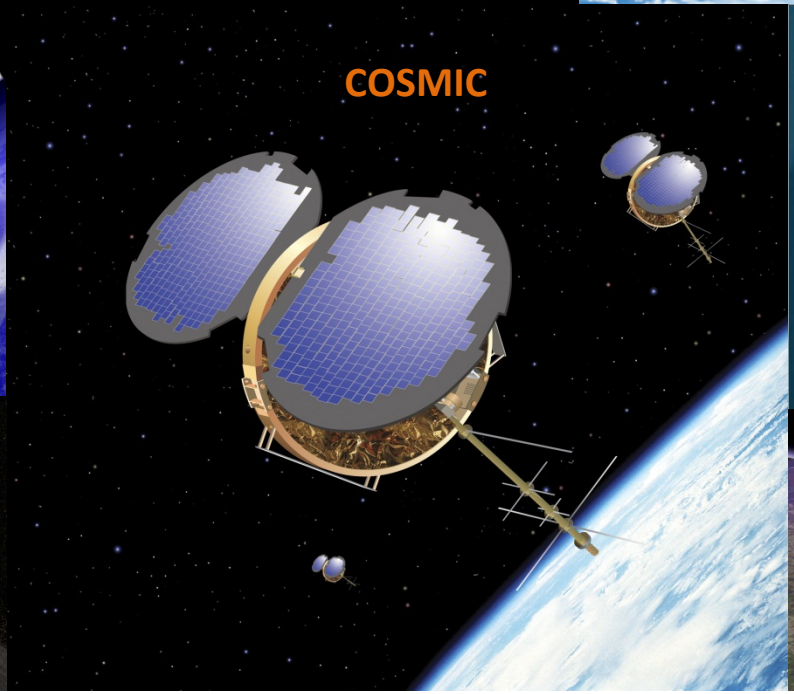
McMurdo Ground Station

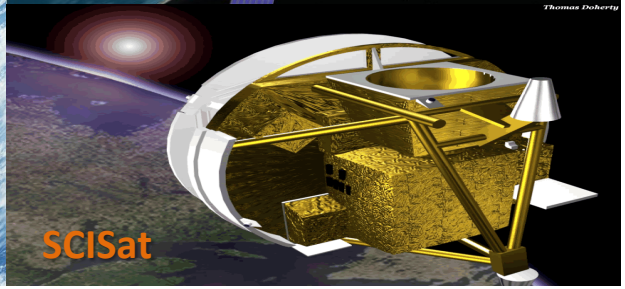
WS1 Antenna at White Sands

Wallops Ground Station (WGS)

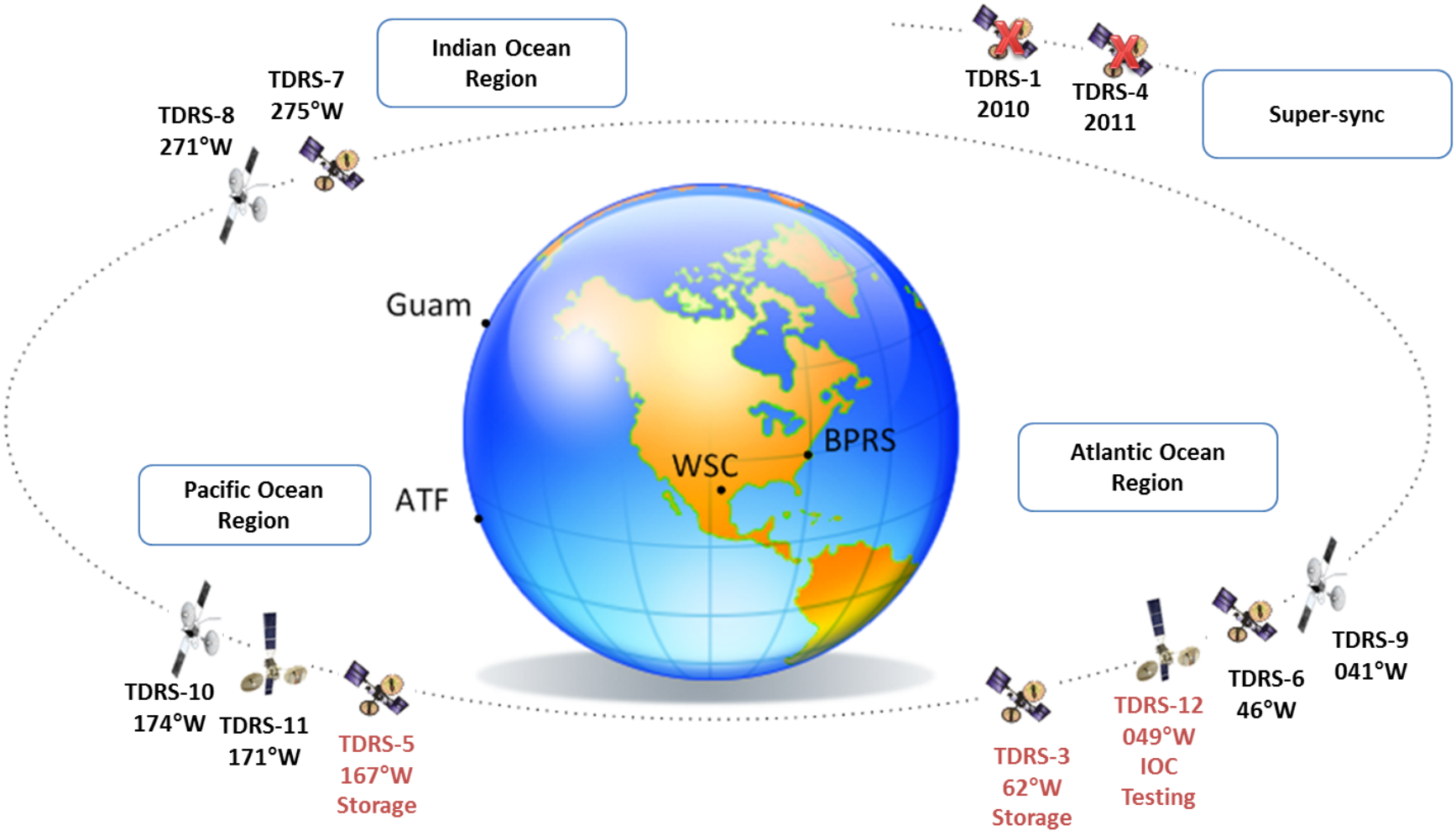
Near Earth Network Missions





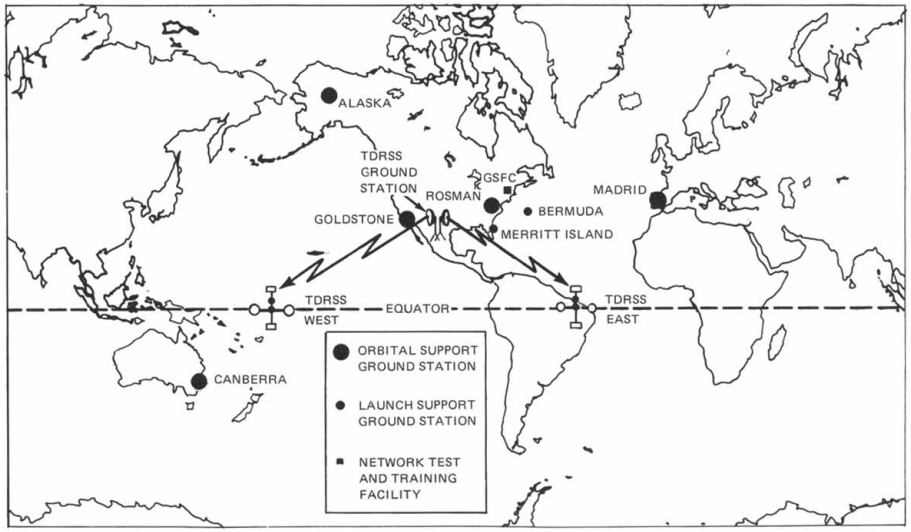


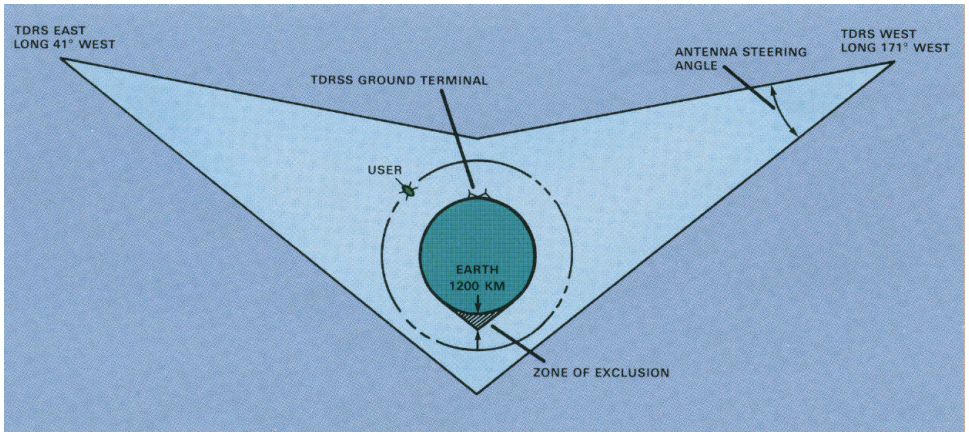
Space Network: Tracking and Data Relay Satellite Fleet



Original Space Network Concept: 1970's

- Spacecraft
  - Two geosynchronous operational locations at 41°W and 171° W.
  - One on-orbit spare
  - Zone of Exclusion, 15° (Indian Ocean)
  - Customer driven "bent pipe" relay system for tracking, telemetry, and command data
  - Increased tracking and data acquisition coverage from 15% to 85% per orbit of low earth orbiting spacecraft, as well as decreased operational costs
  - Two bands in the upper spectrum: S- and Ku-bands
- Ground
  - Ground station at White Sands, NM
  - Flight Dynamics Facility and Network Control Center at Goddard Space Flight Center





Space Network Evolution

White Sands, New Mexico (STGT)

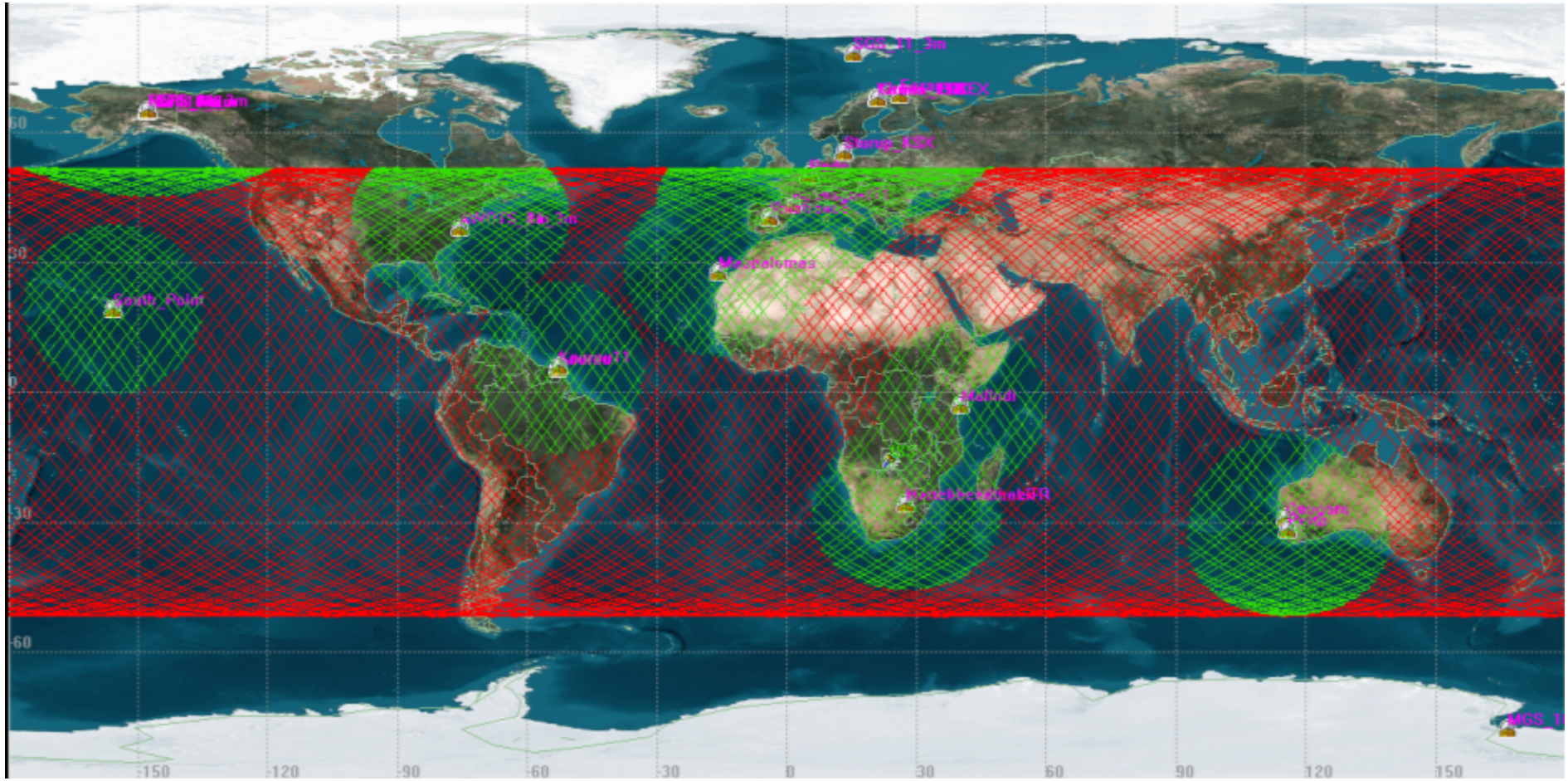
- Added the Guam Remote Ground Terminal in 1998 for achieving 100% coverage for virtually all customers
- Added Ka-band from TDRS-8 onward.
- Increased fleet size from two to six operational space crafts to meet growing demand and added Second TDRSS Ground Terminal.

White Sands, New Mexico (WSGT)

Guam Island (GRGT)

ISS Coverage is Limited

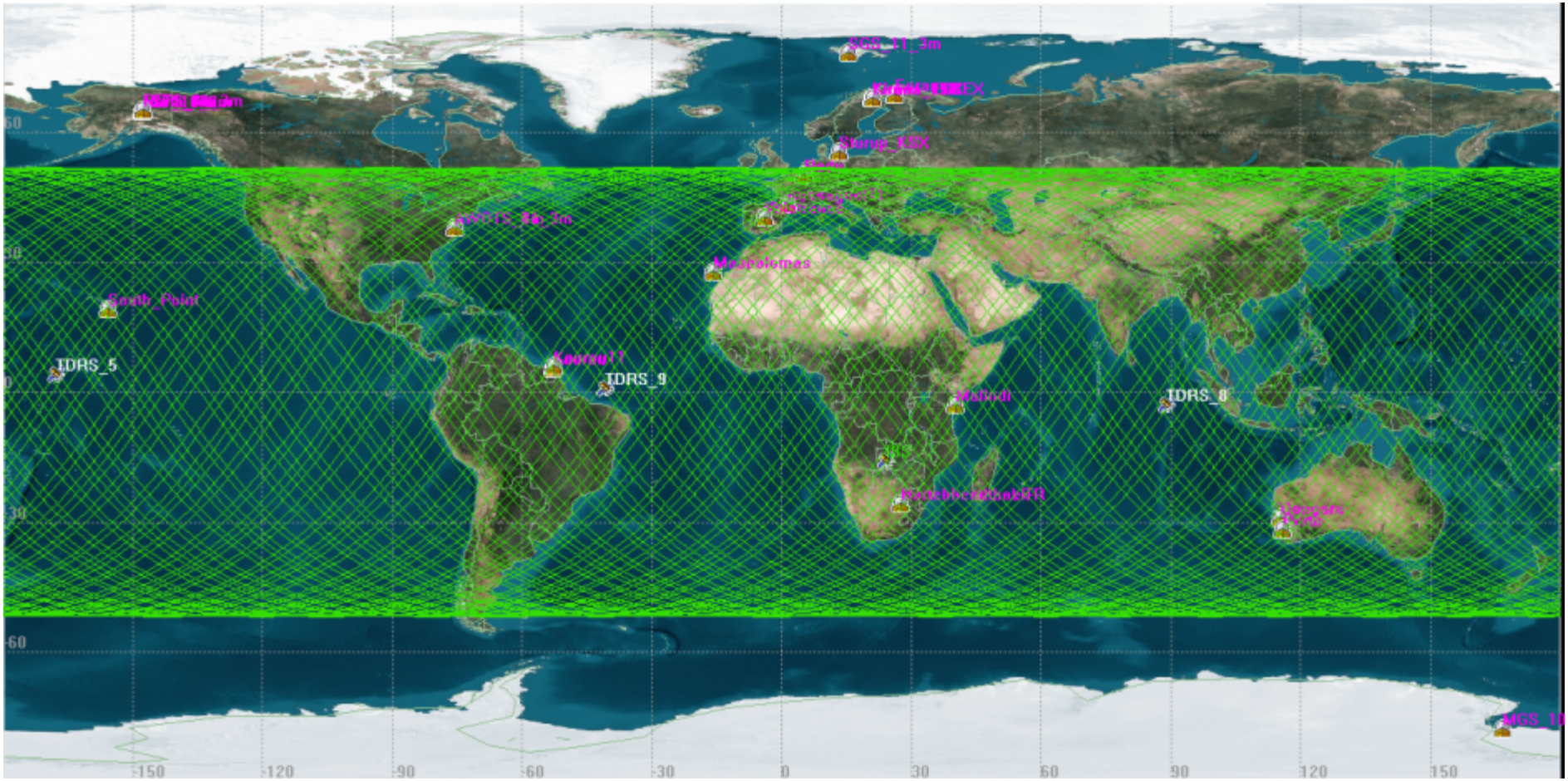
Typical ISS flight path coverage for 1 week without TDRS



Tracks in green indicate possible ISS support from ground antennas
Tracks in red indicate unsupportable portions of flight path
Note: Does not meet human spaceflight (HSF) redundant comm requirements

ISS Coverage is 100% with TDRS

Typical ISS flight path coverage for 1 week using 3 TDRS's



TDRS
Launch History and Plans

TDRS	Launch Date
TDRS-A (TDRS-1)	April 4,1983 *(Retired Fall 2009, Disposal June 2010)*
TDRS-B	Destroyed January 28, 1986 in Challenger explosion
TDRS-C (TDRS-3)	September 29, 1988
TDRS-D (TDRS-4)	March 13, 1989 *(Retired December 2011, Disposal April 2012)*
TDRS-E (TDRS-5)	August 2, 1991
TDRS-F (TDRS-6)	January 13, 1993
TDRS-G (TDRS-7)	July 13, 1995 (replacement for TDRS-B)
TDRS-H (TDRS-8)	June 30, 2000
TDRS-I (TDRS-9)	March 8, 2002
TDRS-J (TDRS-10)	December 4, 2002
TDRS-K (TDRS-11)	January 30, 2013
TDRS-L (TDRS-12)	January 23, 2014
TDRS-M (TDRS-13)	Available for launch in 2016

TDRS 1 – 7 were delivered via Space Shuttle

TDRS 8 – 13 were/will be launched by EELVs

TDRS-K: Launched January 30, 2013
TDRS-L: Launched January 23, 2014


TDRS-K


TDRS-L


TDRS-K


TDRS-L

NASA Telecommunications Policy

- NASA Policy Directive 8074.1, Management and Utilization of NASA's Space Communication and Navigation Infrastructure, states NASA Mission Directorates (MDs) shall:
  - Use SCaN networks to meet their communication and navigation requirements for human and robotic space missions
  - Where appropriate and cost-effective for the Agency, MDs, in coordination with the SCaN Program Office, may use pre-existing infrastructure external to NASA for this purpose, as long as no new facilities are constructed using NASA funds
  - Not design or develop space Communications & Navigation infrastructures independent of SCaN

Note: This policy is currently undergoing the renewal process and is under final review.

NASA Telecommunications Requirements

- Announcement of Opportunity Explorer 2014

  Telecommunications, Tracking, and Navigation

- NASA's Mission Operations and Communications Services (MOCS) document in Explorer Program Library and posted on the AO web site.

  – Network Support Costs
  – Required Proposal Information
  – Points of Contact

SCaN Customer Commitment Offices

- JPL/DSN Commitments Future Planning Office
  - Deep Space Network mission design, proposal support, service agreements and compatibility testing
  - http://deepspace.jpl.nasa.gov/advmiss

- GSFC/Network Integration Management Office (NIMO)
  - Space Network and Near Earth Network mission design, proposal support, service agreements and compatibility testing
  - http://scp.gsfc.nasa.gov/nimo

SCaN Points of Contact

- SCaN Program Office/NASA HQ
  - Gary A. Morse/SCaN Mission Commitment Manager
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- JPL/DSN Commitments Future Planning Office
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  - (818) 354-3416
- GSFC/Network Integration Management Office (NIMO)
  - Scott Greatorex/Chief, NIMO
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