TDRS-K Social

Badri Younes, Deputy Associate Administrator for SCaN
Human Exploration and Operations Mission Directorate
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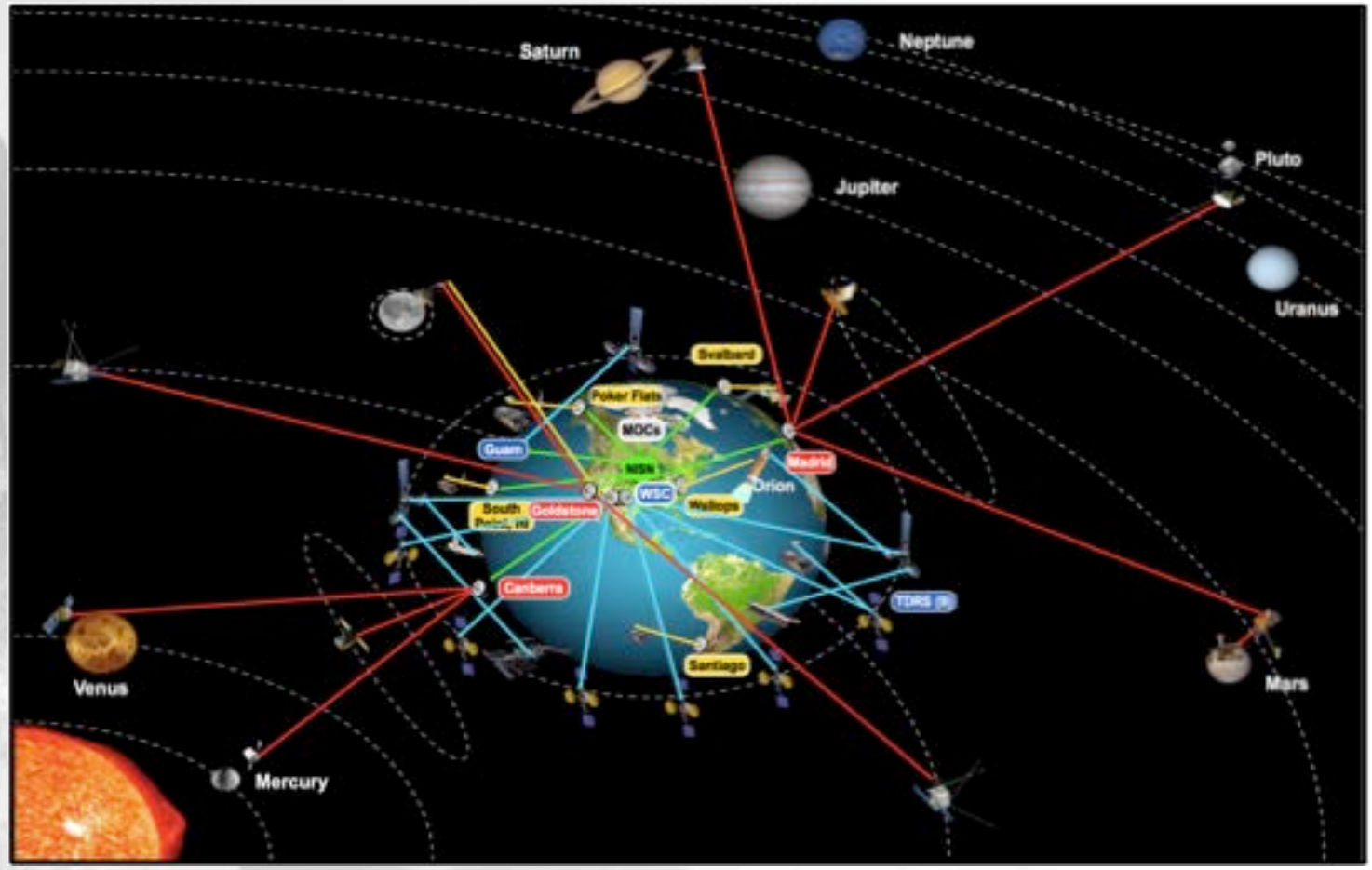
SCaN is a Program Office at NASA HQ

- Responsible for Agency-wide operations, management, and development of all NASA space communications capabilities and enabling technology.
- Integrate all NASA's Communications and Navigation assets into a single fully integrated and unified network.
- Expand SCaN capabilities to further enable robotic and human explorations.
- Manage Spectrum and represent NASA on national and international Spectrum management programs.
- Develop space communication standards as well as Positioning, Navigation, and Timing (PNT) policy.
- Represent and negotiate on behalf of NASA on all matters related to Space Telecommunications in coordination with the appropriate offices and flight mission directorates.

What Do We Do?

We connect spacecraft with Earth through world-class communication and navigation capabilities.

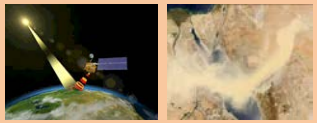


SCaN's Three Networks Span the Globe

Human Spaceflight Missions

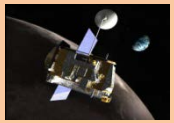
Sub-Orbital Missions

Earth Science Missions

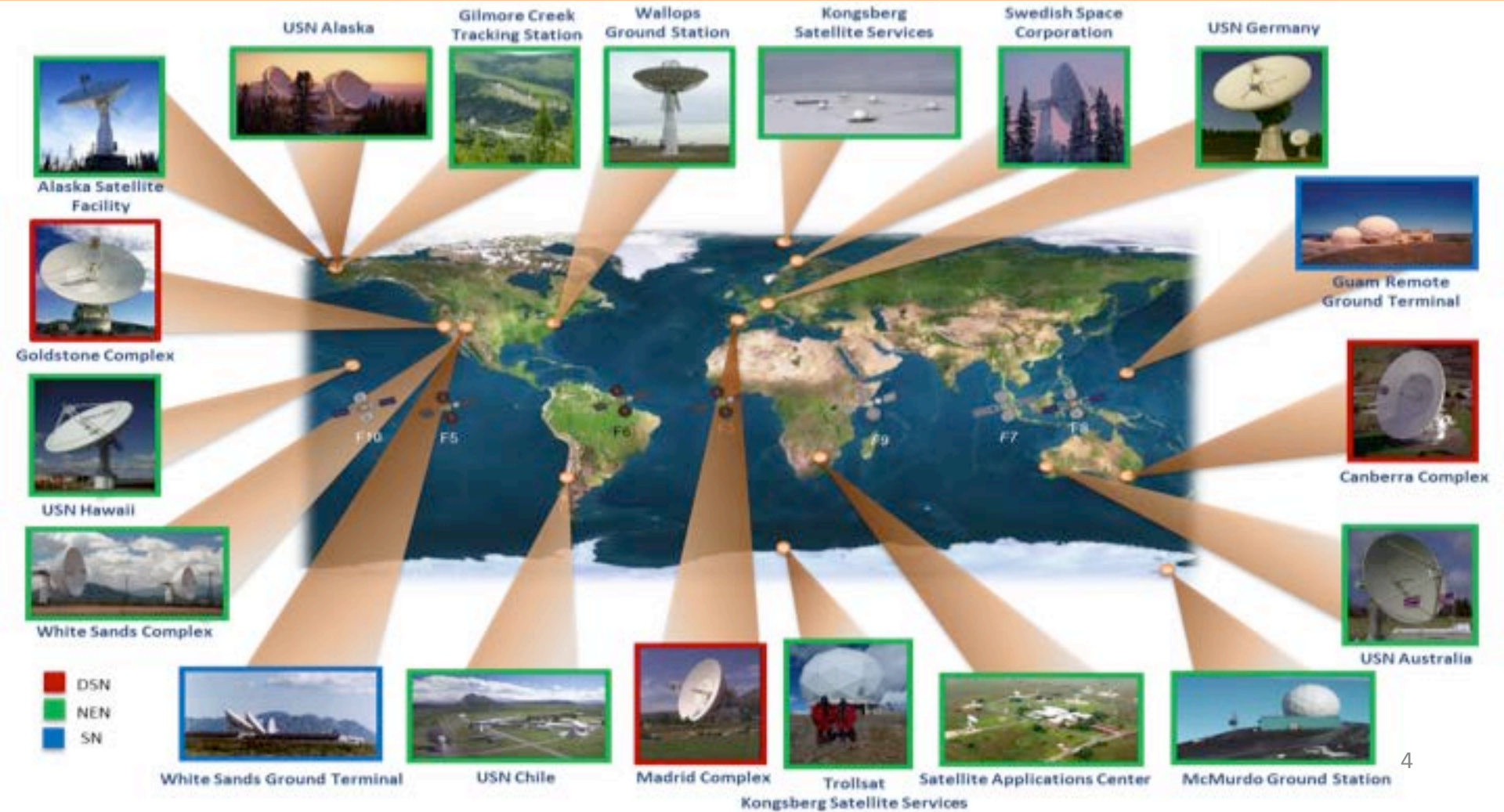


Space Science Missions

Lunar Missions



Solar System Exploration

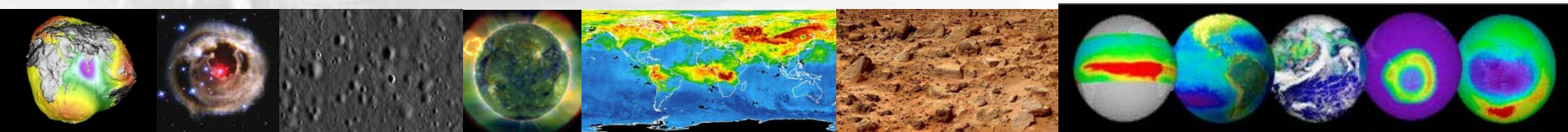


SCaN Supports Human Spaceflight and Launch Vehicles

- SCaN supports human spaceflight
  - The TDRS fleet gives 24x7 communication, data and voice support to the International Space Station
  - SCaN is updating its infrastructure and ground assets to meet the new demands of the future crewed missions and human exploration.
- SCaN supports virtually all US launch vehicles from Cape Canaveral and Vandenberg
  - SCaN also supports the new commercial vehicles like SpaceX's Dragon and Falcon.

Other SCaN Supported Missions

- SCaN supports over 100 space missions in the three networks.
- Some missions study the Earth and observe changes:
  - Aqua –changes in Earth's water cycle
  - Aura –changes in Earth's stratosphere and greenhouse gases
  - GRACE (Gravity Recovery and Climate Experiment) –observes gravity changes
- Some missions study the Sun and observe changes:
  - SDO (Solar Dynamics Observer) – sun's behavior and activity
  - STEREO (Solar Terrestrial Relations Observatory) – Sun and Earth activities
- Some missions look at the Moon and planets:
  - LRO (Lunar Reconnaissance Orbiter) – mapping out the lunar surface
  - MRO (Mars Reconnaissance Orbiter) – mapping the Martian surface
  - MSL (Mars Science Laboratory) – active laboratory on the surface of Mars
  - MESSENGER – mapping the surface of Mercury
- Some missions look at the origins of the universe:
  - HST (Hubble Space Telescope) - studying the age of the universe



NASA Requirements for SCaN

- To develop a unified space communications and navigation network infrastructure capable of meeting both robotic and human exploration mission needs.
- To implement a networked communication and navigation infrastructure across space.
- To evolve its infrastructure to provide the highest data rates feasible for both robotic and human exploration missions.
- To assure data communication protocols for Space Exploration missions are internationally interoperable.
- To provide the end space communication and navigation infrastructure for Lunar and Mars surfaces.
- To provide communication and navigation services to enable Lunar and Mars human missions.
- To continue to meet its commitments to provide space communications and navigation services to existing and planned missions.

SCaN's Vision

To build and maintain a scalable integrated mission support infrastructure that can readily evolve to accommodate new and changing technologies, while providing comprehensive, robust, cost effective, and exponentially higher data rate space communications services to enable NASA's science, space operations, and exploration missions.

Overview of the Three Networks

Deep Space Network

Near Earth Network

Space Network

DESCRIPTION

Three station global network of large-scale antennas

Focused on detecting and differentiating faint signals from stellar noise

Optimized for data capture from deep space distances orders of magnitude above near Earth

World-wide network of stations

Evolved from fully NASA-owned to portfolio of owned assets and procured commercial services (greater than 50%)

Surge capability through partnerships (e.g., NOAA)

Optimized for cost-effective, high data rate services

Global orbital satellite communications fleet with ground control stations

Optimized for continuous, high data rate communications

Critical for human spaceflight safety and critical event coverage

Essential for all US government launches

SAMPLE MISSIONS

Kepler, Cassini

Mars Rovers and Orbiters ,

Mars Science Laboratory (Curiosity)

Voyagers 1 and 2, Spitzer Space Telescope

Aqua, Aura,

Lunar Reconnaissance Orbiter,

Landsat, Radiation Belt Storm Probes

International Space Station

ISS Resupply: NASA CoTS, ESA ATV, JAXA HTV

Hubble Space Telescope

Terra, Fermi Gamma-ray Space Telescope

Deep Space Network (DSN)

Canberra Deep Space Communications Complex

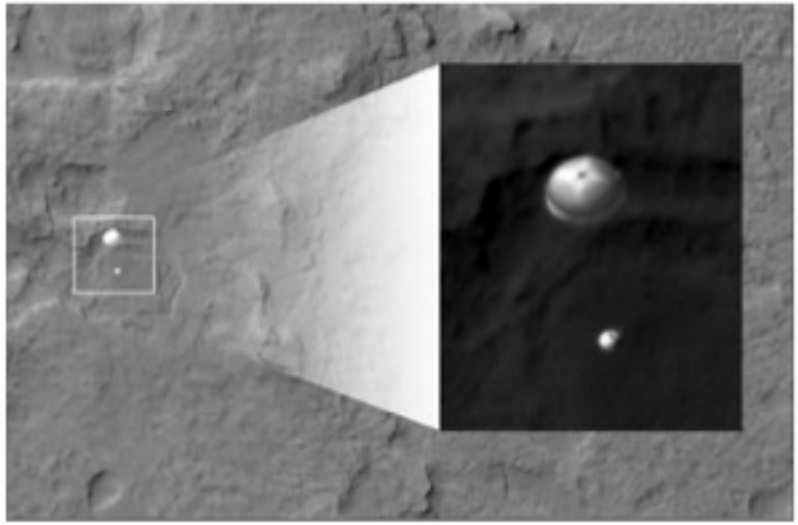
Madrid Deep Space Communications Complex

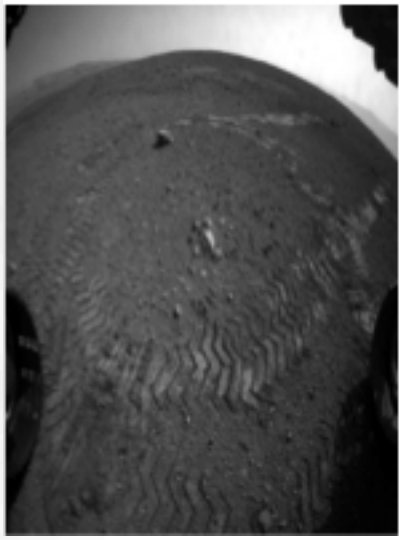
Goldstone Deep Space Communications Complex

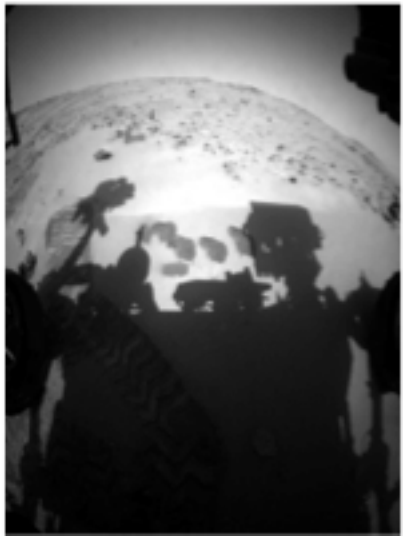
NASA's Deep Space Network (DSN) was established in December 1963 to provide a communications infrastructure for all of NASA's robotic missions beyond Low Earth Orbit.

Curiosity Supported by the DSN

- The Mars Reconnaissance Orbiter (MRO) captured pictures of Curiosity's parachute.
  - MRO is supported by the Deep Space Network (DSN).
- 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)

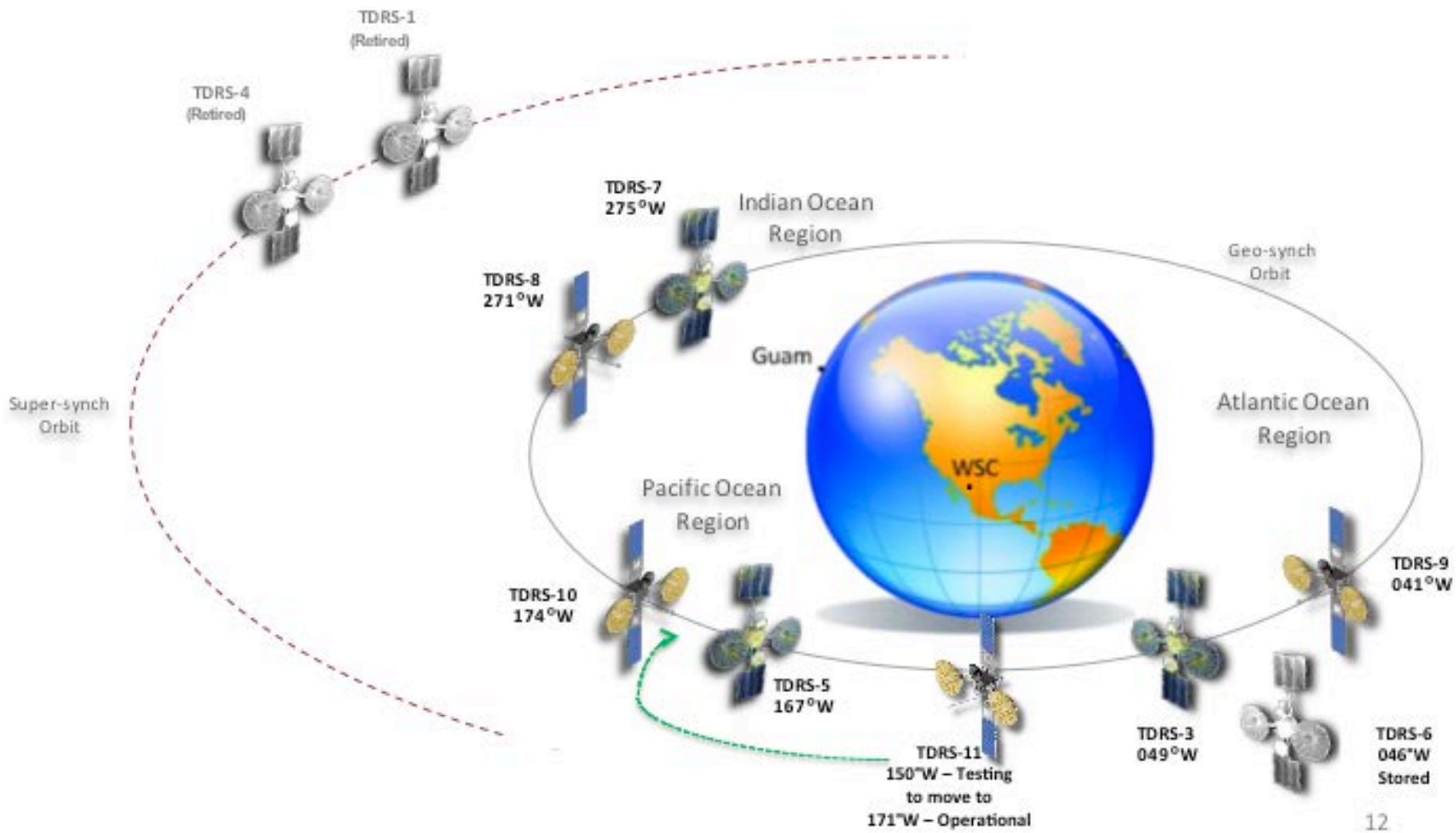
Svalbard Ground Station

McMurdo Ground Station

WS1 Antenna at White Sands

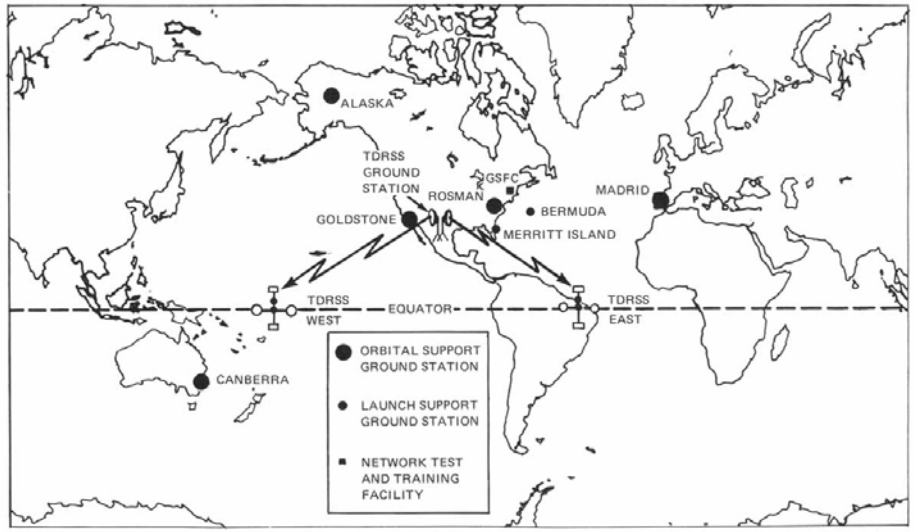
Wallops Ground Station (WGS)

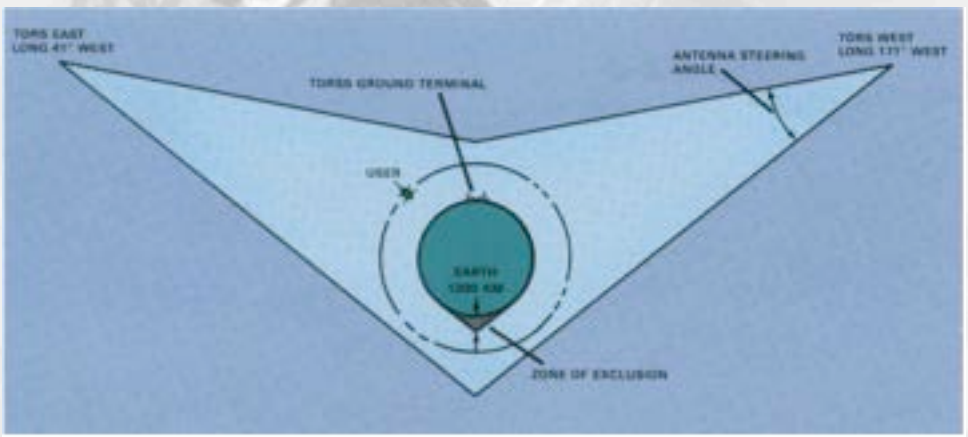
Space Network:
Tracking and Data Relay Satellite Fleet



Space Network Concept: 1980's

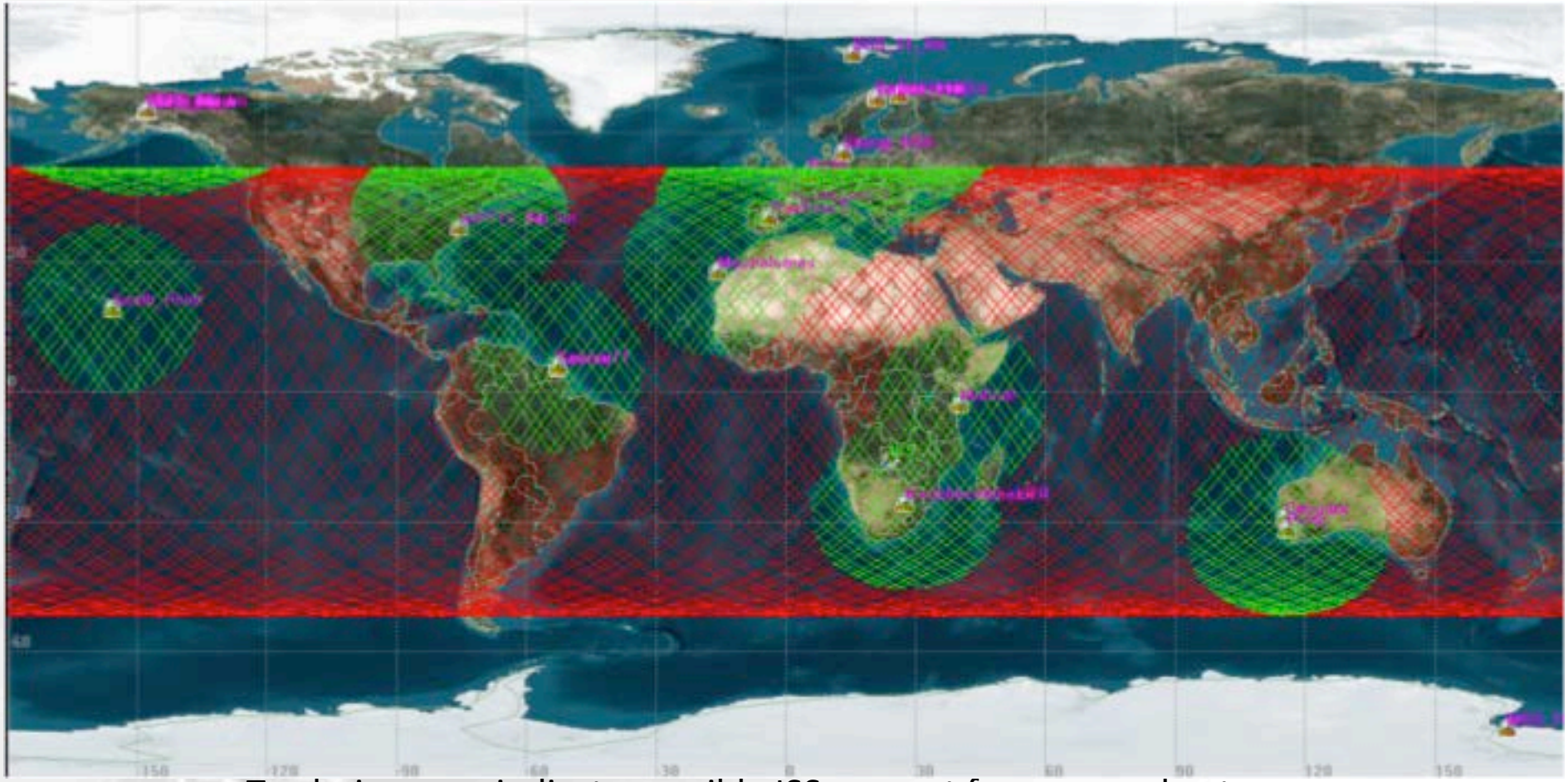
- Spacecraft
  - Two geosynchronous operational locations at 41°W and 171° W.
  - One on-orbit spare
  - Zone of Exclusion, 15° (Indian Ocean)
  - Customer driven "bent pipe" relay system for tracking, telemetry, and command data
  - Increased tracking and data acquisition coverage from 15% to 85% per 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





Example: Without TDRS ISS Coverage Would Have Been Limited

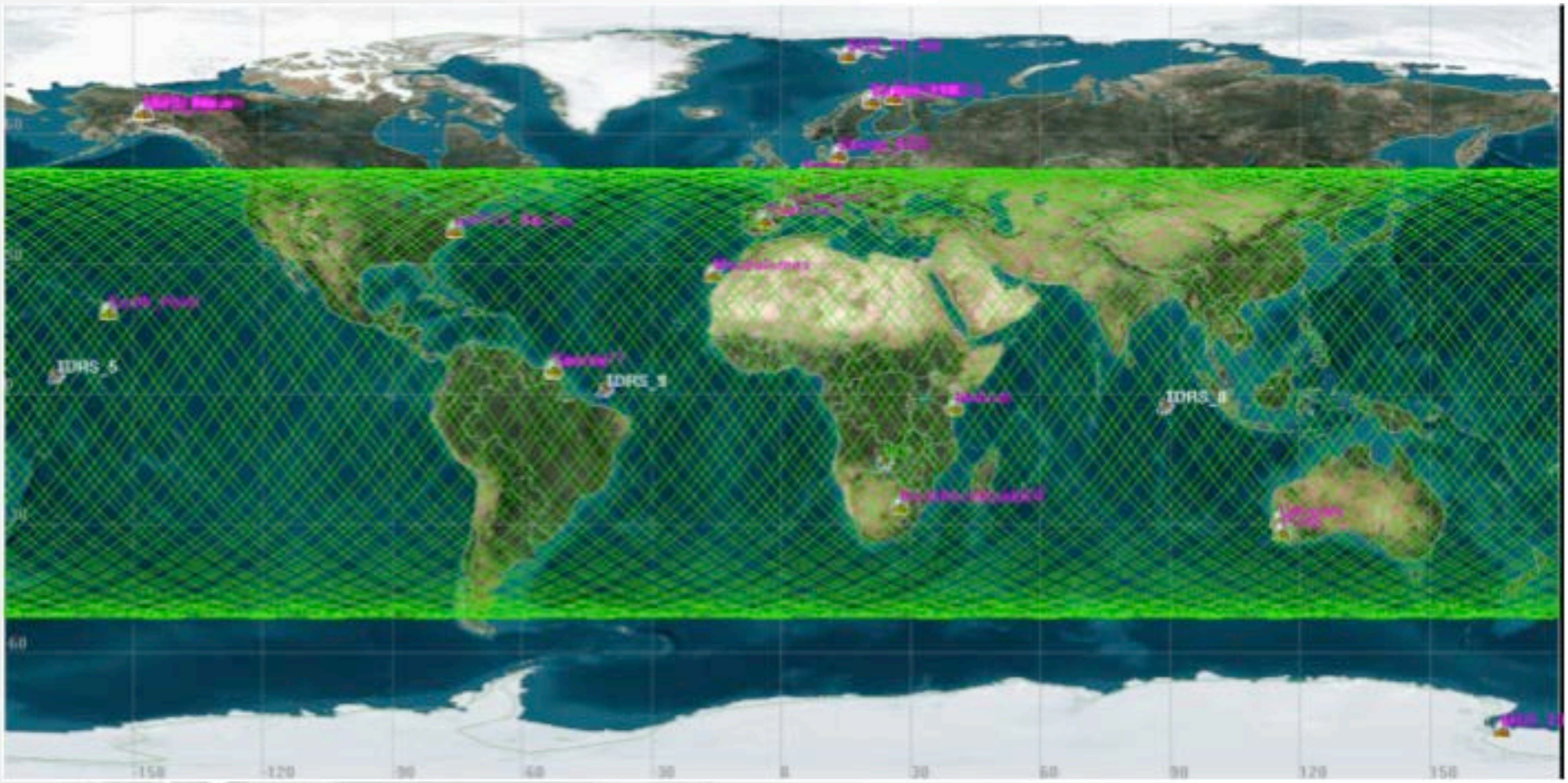
Typical ISS flight path coverage for 1 week



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



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)

TDRS
Launch History and Plans

TDRS	Launch Date
TDRS-A (TDRS-1)	April 15,1983 *(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)	Scheduled to launch in January 30, 2013
TDRS-L (TDRS-12)	Scheduled to launch in CY 2014
TDRS-M (TDRS-13)	Available for launch in CY 2015

TDRS 1 – 7 were delivered via Space Shuttle

TDRS 8 – 13 were/will be launched by EELVs

Summary

- SCaN provides the vital connection between spacecraft and Earth
- SCaN is a well-balanced Program between operations, technology, communication standards and spectrum management
- SCaN is an example of efficiency within the Agency – doing more with a lot less.
- For more information visit NASA:
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