Space Communications and Navigation (SCaN) Overview
Explorer 2016 AO Bidders Conference

National Aeronautics and Space Administration

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Agenda

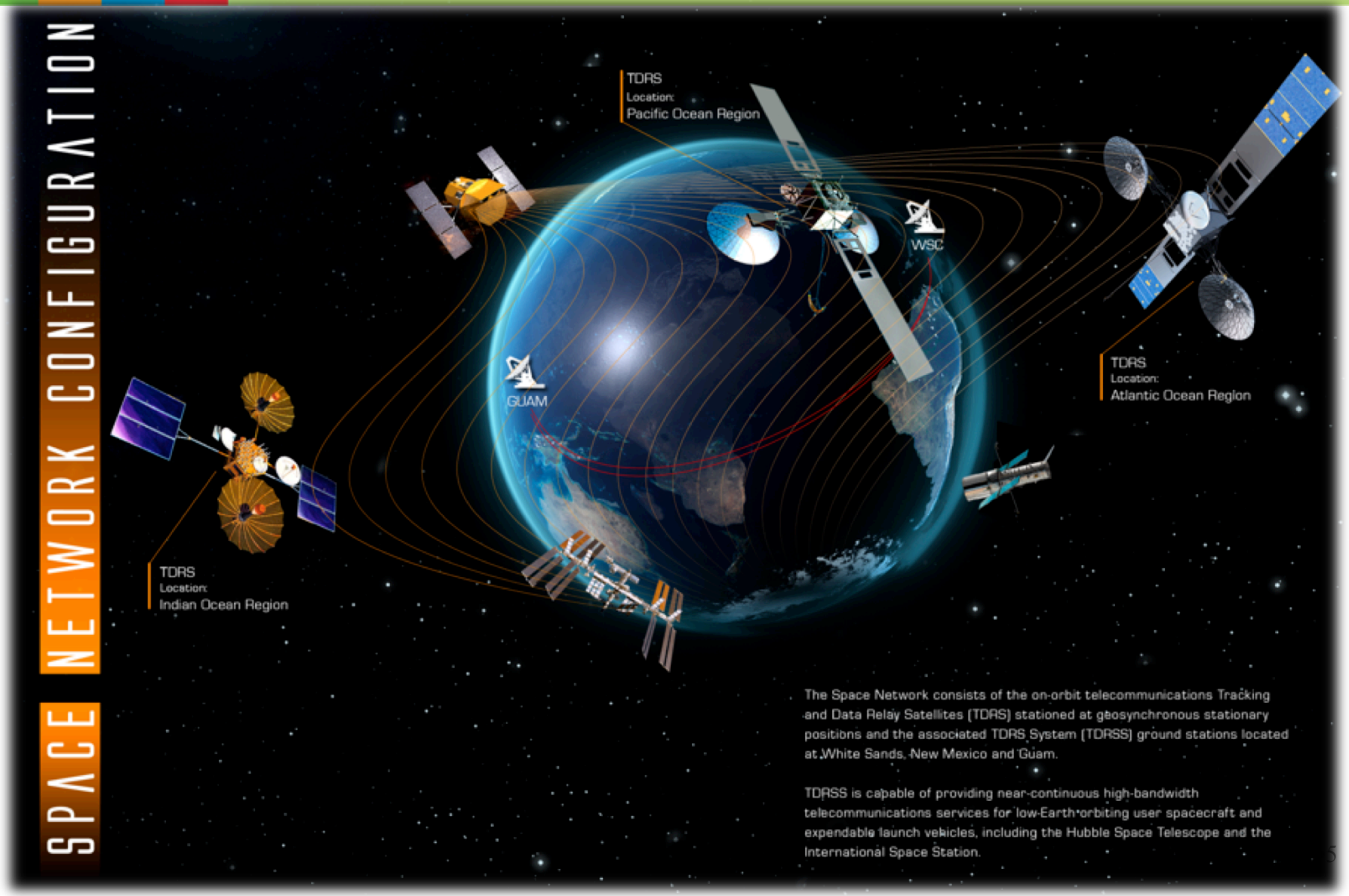
- Space Communications and Navigation (SCaN) overview
- AO considerations
- Points of contact

SCaN is Responsible for all NASA Space Communications

- Responsible for Agency-wide operations, management, and development of all NASA space communications capabilities and enabling technology.
- Expand SCaN capabilities to enable and enhance robotic and human exploration.
- 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.

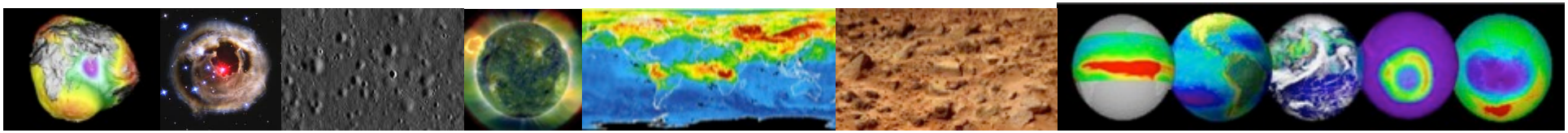
Three Networks Span the Globe

Space Network



Supporting Over 100 Missions

- SCaN supports over 100 space missions with the three networks.
  - Which includes every US government launch and early orbit flight
- **Earth Science**
  - Missions that look down at the Earth and observe changes
  - Aura, Aqua, Landsat, Global Precipitation Mission (GPM), Orbiting Carbon Observatory (OCO-2)
- **Heliophysics**
  - Missions that observe the Sun and its impact on the Earth
  - Solar Dynamics Observer (SDO), Solar Terrestrial Relations Observatory (STEREO)
- **Astrophysics**
  - Missions that look at the origins of the universe
  - Hubble Space Telescope, Chandra X-ray Observatory, WFIRST
- **Planetary**
  - Missions that look at the planets and their composition
  - Voyagers-1/2, JUNO, New Horizons, Mars Atmosphere and Volatile Evolution (MAVEN)
- **Human Space Flight**
  - Missions that carry humans (Exploration missions, Soyuz, Commercial crew)
  - International Space Station (ISS) and Visiting vehicles (Soyuz, SpaceX, Boeing, Sierra Nevada)




Formulation
Implementation
Primary Ops
Extended Ops
XMM-Newton (ESA)
12/10/1999
Swift
11/20/2004
Suzaku (JAXA)
7/10/2005
Fermi
6/11/2008
Euclid (ESA)
2020
Spitzer
8/25/2003
Hubble
4/24/1990
Kepler
3/6/2009
Astro-H (JAXA)
2015
JWST
2018
Chandra
7/23/1999
NICER (on ISS)
2016
NuSTAR
6/13/2012
TESS
2017
LISA Pathfinder (ESA)
2015
SOFIA
Full Ops 2014
RapidSCAT (ISS)
SMAP
CATS (ISS)
OCO-2
GPM
Landsat 8
(USGS)
Suomi NPP
Aquarius
OSTM/Jason 2
Aura
CALIPSO
CloudSat
Aqua
SORCE
GRACE (2)
Terra
EO-1
QuikSCAT
TRMM
Landsat 7 (USGS)
Juno
Lunar Reconnaissance Orbiter
MESSENGER
Deep Impact
New Horizons
Rosetta (ESA)
Cassini (NASA/ESA)
Dawn
BepiColumbo (ESA)
JUICE (ESA)
OSIRIS-REx
LADEE
MRO
MAVEN
ExoMars 2016 (ESA)
Mars Express (ESA)
Mars Odyssey
ExoMars 2018 (ESA)
Opportunity Rover
Curiosity Rover
InSight
Mars Rover 2020
STEREO (2)
RHESSI
SOHO–ESA
Cluster–ESA (4)
ACE
SDO
GOLD
ICON
AIM
IBEX
Solar Probe
CINDI
Van Allen Probes (2)
TIMED
Voyager (2)
THEMIS (3)
TWINS (2)
Hinode–JAXA
Solar Orbiter–ESA
WIND
Geotail–JAXA
ARTEMIS (2)
MMS (4)
SET-1
IRIS

Overview of the Three Networks

Deep Space Network

Three global ground stations providing services to missions from Geostationary Earth Orbit (GEO) to beyond our solar system.

Focused on detecting and differentiating faint signals from stellar noise

Near Earth Network

Set of world-wide NASA and commercial ground stations providing services to missions in Low Earth Orbit (LEO), High Earth Orbit (HEO) including the Moon, L1 and L2.

Space Network

Fleet of Tracking and Data Relay Satellites (TDRS) and their ground stations providing services to missions in Low Earth Orbit (LEO)

Optimized for continuous, high data rate communications

Critical for human spaceflight safety and critical event coverage

Deep Space Network

LOCATION: Tidbinbilla, ~35 km southwest of Canberra, Australia

Managed and operated: Commonwealth Scientific Industrial Research Organization (CSIRO)

Operational Antennas: one 70 m, one 34 m HEF, two 34 m BWG, one 34 m BWG under construction

COMPLEX SIZE: roughly 0.425 square kilometers

STAFF: approximately 100

LOCATION: Fort Irwin, ~55 km northeast of Barstow, CA

Operated: ITT Exelis Corp
Managed: NASA Jet Propulsion Lab

Operational Antennas: One 70 m, three 34 m BWG, one 34 m HEF, one 34 m HSB, one 34 m R&D antenna, two 34 m educational antennas

COMPLEX SIZE: roughly 134 square kilometers

STAFF: approximately 165

LOCATION: Robledo de Chavela, ~60 km west of Madrid, Spain

Operated: Ingeniería de Sistemas para la Defensa de España (ISDEFE)
Managed: Instituto Nacional de Técnica Aeroespacial (INTA)

Operational Antennas: one 70 m, one 34 m HEF, two 34 m BWG, one 34 m educational antenna

COMPLEX SIZE: roughly 0.490 square kilometers

STAFF: approximately 105

Near Earth Network

NASA Stations

- Alaska Satellite Facility, Alaska (two 11 meter, one 10 meter antennas)
- McMurdo Grounds Station, Antarctica (one10 meter antenna)
- Wallops Ground Station, Virginia (one 5 meter, one 11 meter antennas)
- White Sands Complex, New Mexico (one 18 meter antenna)

Commercial

- Dongara, Australia (Universal Space Network) (one 13 meter antenna)
- Hatebeesthoek, Africa (Satellite Application Center) (one 18 meter antenna)
- Kiruna, Sweden (Swedish Space Corporation – SSC) (two 13 meter antennas)
- North Pole, Alaska (Universal Space Network) (four antennas – 5.4, 7.3, 11, and 13 meter)
- Santiago, Chile (Swedish Space Corporation – SSC) (one 12 meter, one 13 meter antennas)
- Singapore, Malaysia (Kongsberg Satellite Services – KSAT) (one 9 meter antenna)
- South Point, Hawaii (Universal Space Network) (two 13 meter antennas)
- Svalbard, Norway (Kongsberg Satellite Services – KSAT) (two 11 meter, one 13 meter antennas)
- TrollSat, Antarctica (Kongsberg Satellite Services – KSAT) (one 7.3 meter antenna)
- Weilheim, Germany (Universal Space Network) (two 15 meter antennas)

Partner

- Gilmore Creek, Alaska (National Oceanic and Atmospheric Administration – NOAA) (three 13 meter antennas) and International space agencies (ESA, JAXA, CNES, ASI, ISRO, EIAST ,KARI and SANSA)

Near Earth Network (NEN)

Svalbard Ground Station

McMurdo Ground Station

WS1 Antenna at White Sands

Wallops Ground Station (WGS)

Space Network
Ground Terminals

White Sands Ground Terminal

Location: White Sands, NM

Operated by: Harris Corporation

Antennas: three 18.3 meter, one 10 meter, two 4.5 meter, one 1 meter

Area: ~90,000 square feet (16 buildings)

Second TDRS Ground Terminal

Location: White Sands, NM

Operated by: Harris Corporation

Antennas: three 19 meter, one 10 meter, three 4.5 meter, one 1 meter

Area: ~80,000 square feet (5 buildings)

Space Network
Remote Stations and Backup Facility

Guam Remote Station

Location: Guam Island

Operated by: Harris Corporation

Antennas: one 11 meter, two 16.5 meter, one 4.5 meter, one 5 meter

Blossom Point Remote Station

Location: near La Plata, MD

Operated by: Harris Corporation

Antennas: two 20 meter, one 5.5 meter

Australian TDRS Facility

Location: Dongara, Australia

Maintained by: Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Antenna: one 11 meter

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-14)	Available for launch in 2017

TDRS 1 – 7 were delivered via Space Shuttle

TDRS 8 – 14 were/will be launched by EELVs

AO considerations

- 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

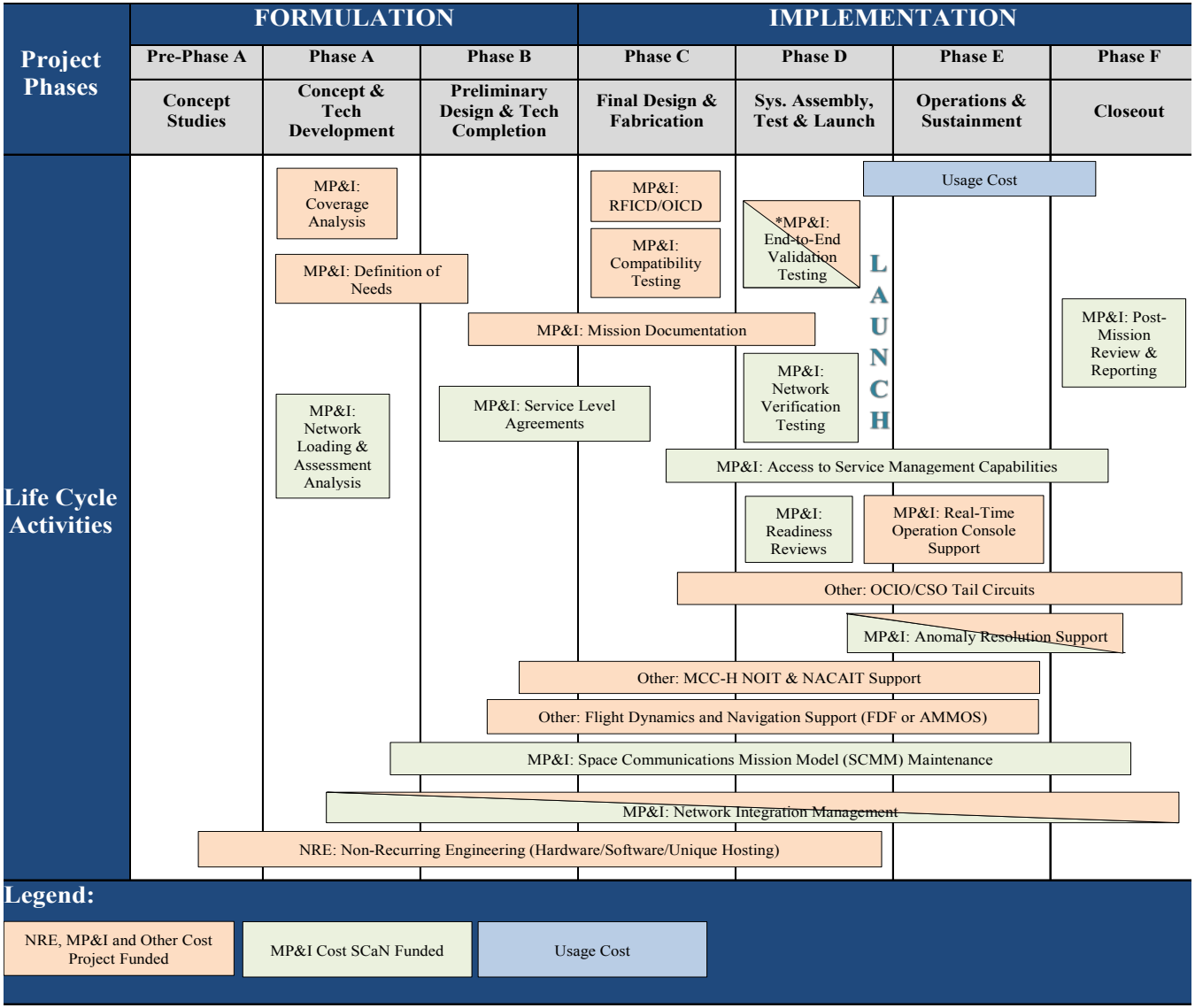
NASA Telecommunications Requirements

- Announcement of Opportunity Heliophysics Explorer 2016
  Telecommunications, Tracking, and Navigation

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

  - Network Support Costs (breakout on next chart)
  - Usage fee calculated value
  - AO focused information
  - Required Proposal Information
  - Points of Contact

NASA/SCaN – SMD Cost Model



SCaN Customer Commitment Offices

- GSFC/Network Integration Management Office (NIMO)
  - Space Network and Near Earth Network mission design, proposal support, service agreements and compatibility testing
  - http://esc.gsfc.nasa.gov/space-communications/nimo.html
- JPL/DSN Commitments Future Planning Office
  - Deep Space Network mission design, proposal support, service agreements and compatibility testing
  - http://deepspace.jpl.nasa.gov/advmiss

SCaN Points of Contact

- SCaN Program Office/NASA HQ
  - Gary A. Morse/SCaN Mission Integration & Commitments Manager
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- GSFC/Network Integration Management Office (NIMO)
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- JPL/DSN Commitments Future Planning Office
  - Stefan Waldherr/Commitments Engineer
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