• 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
The Space Network consists of the on-orbit telecommunications Tracking and Data Relay Satellites (TDRS) stationed at geosynchronous stationary positions and the associated TDRS System (TDRSS) ground stations located at White Sands, New Mexico and Guam. TDRSS is capable of providing near-continuous high-bandwidth telecommunications services for low-Earth orbiting user spacecraft and expendable launch vehicles, including the Hubble Space Telescope and the International Space Station.
Suppor-ng 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)
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

**Canberra**
- **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

**Goldstone**
- **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

**Madrid**
- **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 (one 10 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

<table>
<thead>
<tr>
<th>TDRS</th>
<th>Launch Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDRS-A (TDRS-1)</td>
<td>April 4, 1983 (Retired Fall 2009, Disposal June 2010)</td>
</tr>
<tr>
<td>TDRS-B</td>
<td>Destroyed January 28, 1986 in Challenger explosion</td>
</tr>
<tr>
<td>TDRS-C (TDRS-3)</td>
<td>September 29, 1988</td>
</tr>
<tr>
<td>TDRS-D (TDRS-4)</td>
<td>March 13, 1989 (Retired December 2011, Disposal April 2012)</td>
</tr>
<tr>
<td>TDRS-E (TDRS-5)</td>
<td>August 2, 1991</td>
</tr>
<tr>
<td>TDRS-F (TDRS-6)</td>
<td>January 13, 1993</td>
</tr>
<tr>
<td>TDRS-G (TDRS-7)</td>
<td>July 13, 1995 (replacement for TDRS-B)</td>
</tr>
<tr>
<td>TDRS-H (TDRS-8)</td>
<td>June 30, 2000</td>
</tr>
<tr>
<td>TDRS-I (TDRS-9)</td>
<td>March 8, 2002</td>
</tr>
<tr>
<td>TDRS-J (TDRS-10)</td>
<td>December 4, 2002</td>
</tr>
<tr>
<td>TDRS-K (TDRS-11)</td>
<td>January 30, 2013</td>
</tr>
<tr>
<td>TDRS-L (TDRS-12)</td>
<td>January 23, 2014</td>
</tr>
<tr>
<td>TDRS-M (TDRS-14)</td>
<td>Available for launch in 2017</td>
</tr>
</tbody>
</table>

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
• 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

**Project Phases**

<table>
<thead>
<tr>
<th>Pre-Phase A</th>
<th>Phase A</th>
<th>Phase B</th>
<th>Phase C</th>
<th>Phase D</th>
<th>Phase E</th>
<th>Phase F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Studies</td>
<td>Concept &amp; Tech Development</td>
<td>Preliminary Design &amp; Tech Completion</td>
<td>Final Design &amp; Fabrication</td>
<td>Sys. Assembly, Test &amp; Launch</td>
<td>Operations &amp; Sustainment</td>
<td>Closeout</td>
</tr>
</tbody>
</table>

**Legend:**

- **NRE, MP&I and Other Cost Project Funded**
- **MP&I Cost SCaN Funded**
- **Usage Cost**

**Life Cycle Activities**

- **FORMULATION**
  - MP&I: Coverage Analysis
  - MP&I: Definition of Needs
  - MP&I: Network Loading & Assessment Analysis
  - MP&I: Mission Documentation
  - MP&I: Service Level Agreements
  - MP&I: Space Communications Mission Model (SCMM) Maintenance
  - MP&I: Network Integration Management
  - NRE: Non-Recurring Engineering (Hardware/Software/Unique Hosting)

- **IMPLEMENTATION**
  - MP&I: RFICD/OICD
  - MP&I: Compatibility Testing
  - MP&I: End-to-End Validation Testing
  - MP&I: Network Verification Testing
  - MP&I: Readiness Reviews
  - MP&I: Real-Time Operation Console Support
  - MP&I: Anomaly Resolution Support
  - Other: OCIO/CSO Tail Circuits
  - Other: MCC-H NOIT & NACAIT Support
  - Other: Flight Dynamics and Navigation Support (FDF or AMMOS)
  - MP&I: Post-Mission Review & Reporting
  - Usage Cost
• GSFC/Network Integration Management Office (NIMO)
  – Space Network and Near Earth Network mission design, proposal support, service agreements and compatibility testing

• JPL/DSN Commitments Future Planning Office
  – Deep Space Network mission design, proposal support, service agreements and compatibility testing
SCaN Points of Contact

• SCaN Program Office/NASA HQ
  – Gary A. Morse/SCaN Mission Integration & Commitments Manager
  – Gary.a.Morse@nasa.gov
  – (202) 358-0504
• GSFC/Network Integration Management Office (NIMO)
  – Scott Greatorex/Chief, NIMO
  – Scott.A.Greatorex@nasa.gov
  – (301) 286-6354
• JPL/DSN Commitments Future Planning Office
  – Stefan Waldherr/Commitments Engineer
  – Stefan.Waldherr@jpl.nasa.gov
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