NASA’s Near Space Network (NSN) empowers user missions with critical communications and navigation services, enabling the transmission of science and exploration data to and from space. Through space relays and ground-based antennas, the NSN provides data delivery and satellite tracking services, transmitting an average of almost 15 terabytes of critical data daily. As a single point of interface for missions in the near-space region, the NSN orchestrates services through a robust blend of government and commercial service providers.

The network leverages a broad spectrum of government and commercial capabilities and services, negotiating with providers on behalf of all missions to lower the costs of mission services. Users can confidently rely on the proficiency and expertise of NASA’s Goddard Space Flight Center, which has a 60-year legacy of excellence in managing NASA communications services.

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**OUR REGIME**

```
L1  Cislunar  GEO  NEAR SPACE REGION  ≤ 2,000,000 km  L2
```

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**NETWORK MAP**

Current Near Space Network Resources
- Direct-to-Earth Ground Stations
- Radar Tracking Stations
- Tracking and Data Relay Satellites

www.nasa.gov
The NSN provides four main services to mission customers:

1. Mission Integration: development of service agreements, interfaces, documentation, support of reviews, etc.
2. Mission Planning and Scheduling: performing link and loading analyses, supporting service requests, and generating and implementing operational schedules
4. User Mission Data Transfer: spacecraft forward command and return telemetry data
### Radiometric Tracking Services

**Spacecraft Metric Tracking Capabilities**

- **Tone or PN Ranging, 1-way or 2-way Doppler, Antenna Angle Data**
- **C-band (5.4-5.9 GHz) Single Object**
- **X-band (10.499 GHz) Multi Object**

**Velocity:** ≤ 11.6 km/s free flight, ≤ 15 km/s powered flight; **Acceleration:** ≤ 14.8 m/s² free flight, ≤ 50 m/s² powered flight; **Jerk:** ≤ 0.02 m/s³ free flight, ≤ 2 m/s³ powered flight

**C-Band:** 212-245 (227 typical)
- **X-Band:** 246 (nominal)

### Radiometric Measurement Accuracy

**Range:** S/X-band: ≤ 1 m systematic; 5 m noise, 1σ
- **Doppler (Range-Rate):**
  - S-band 1-way: ≤ 3 mm/s, 1σ
  - S-band 2-way: ≤ 1.5 mm/s, 1σ
  - X-band 1-way: ≤ 0.7 mm/s, 1σ
  - Ka-band 1-way: ≤ 0.2 mm/s, 1σ
- **Antenna Angles (From Ground):**
  - S: 0.03°, X: 0.05°
  - Ka: 0.01° (auto), 0.05° (program)

**Relative Dynamics**

- **Velocity:** ≤ 11.6 km/s free flight, ≤ 15 km/s powered flight
- **Acceleration:** ≤ 14.8 m/s² free flight, ≤ 50 m/s² powered flight
- **Jerk:** ≤ 0.02 m/s³ free flight, ≤ 2 m/s³ powered flight

### Terrestrial Link Data Transport Capabilities

**Data Storage**
- Station storage: 5-30 days; Cloud-based: Mission-driven

**Network Data Rate**
- Mission-driven (up to 1.2 Gbps)

**SLE Protocols**
- F-CLTU, EF-CLTU (Forward), RAF, RCF, ROCF (Return)

**SLE Versions Supported**
- CCSDS 910.4, CCSDS 911.1, CCSDS 911.2, CCSDS 911.5, CCSDS 912.1, CCSDS 912.11, CCSDS 912.3, CCSDS 913.1

**Offline-Data Transfer**
- CFDP, SFTP

**Security**
- Trusted networks (access controls, firewalls, authentications, etc.)

### Optical Communications Capabilities (Demonstration Only)

**Wavelength**
- 1550 nm

**Max Forward Data Rate**
- 20.4 Mbps

**Max Return Data Rate**
- 261 Mbps

**Modulation**
- PPM (Order 16 or 32)

**Encoding**
- SCC (Rate 1/3 or Rate 2/3)

**Framing**
- Ethernet

**Optimetrics**
- Optical ranging capabilities and accuracy TBD

### Frequency Bands (Near-Earth Use)

- **S-band:** 2025-2110 MHz
- **X-band:** 7145-7235 MHz
- **Ka-band:** 22.55-23.15 GHz

- **S-band:** 2025-2110 MHz
- **Ku-band:** 13.775 GHz
- **Ka-band:** 22.55-23.55 GHz
### Interfaces and Capabilities (continued)

<table>
<thead>
<tr>
<th>INTERFACE/CAPABILITY</th>
<th>DIRECT TO EARTH</th>
<th>SPACE RELAY</th>
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<tbody>
<tr>
<td><strong>4</strong> Forward (Command) Communications (continued)</td>
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</tbody>
</table>
| **Maximum Bandwidth** | S-band: 5 MHz  
X-band: 10 MHz  
Ka-band: 40 MHz (Typical) | S-band: 6 MHz  
Ku-band: 50 MHz  
Ka-band: 50 MHz  |
| **Forward Max Data Rate (prior to encoding)** | S-band: 5 Mbps  
X-band: 10 Mbps (5 Mbps Typical)  
Ka-band: 40 Mbps | S-band MA: 300 Kbps  
S-band SA: 4.2 Mbps  
Ku-band: 50 Mbps  
Ka-band SA: 50 Mbps  |
| **Antenna System EIRP (dBW)** | S-band: 51-81 (56 typical)  
X-band: 85-86  
Ka-band: 89 | S-band MA: 42  
S-band SA and Ku-band SA: 48.5  
Ka-band SA: 63  |
| **Modulation** | PM, FM, PCM, PCM/PM, PCM/PSK/PM, BPSK, QPSK, OQPSK, UQPSK, Filtered OQPSK | Spread spectrum: BPSK or UQPSK  
Non-spread: BPSK, QPSK, OQPSK, PCM/PM, or PCM/PSK/PM  |
| **Encoding** | Uncoded, or LDPC 1/2 or 7/8 | Uncoded, Rate 1/2 Conv., Reed-Solomon, Concatenated (1/2 Conv. + RS), LDPC 1/2 or 7/8  |
| **Polarization** | Circular (LHC, RHC) | Circular (RHC, LHC only for MA services)  |

<table>
<thead>
<tr>
<th>4</th>
<th>Return (Telemetry) Communications</th>
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</thead>
</table>
| **Frequency Bands (Near-Earth Use)** | S-band: 2200-2300 MHz  
X-band: 8025-8500 MHz  
Ka-band: 25.5 – 27 GHz | S-band: 2200-2290 MHz  
Ku-band: 15.0034 GHz  
Ka-band: 25.25 – 27.5 GHz  |
| **Maximum Bandwidth** | S-band: 5 MHz  
X-band: 375 MHz  
X-band (SRS): 10 MHz  
Ka-band: 1500 MHz | S-band (MAR & SAR): 6 MHz  
Ku/Ka-band: 225 MHz  
Ka-band (Wide): 650 MHz  |
| **Return Max Data Rate (prior to encoding)** | Rates will vary – examples:  
S-band: 2.2 Mbps (PACE)  
X-band: 220 Mbps (ICESat-2)  
X-band (SRS): 13.1 Mbps (IRIS)  
Ka-band: 3.5 Gbps (NISAR) | S-band MA: 1 Mbps  
S-band SA: 14.1 Mbps  
Ku/Ka-band: 600 Mbps  
Ku-band (Wide): 1200 Mbps  |
| **Antenna System G/T (dB/K)** | S-band: 19.1-29.6 (21 typical)  
X-band: 30.5-39 (32 typical)  
Ka-band: 38-47.5 (41.3 typical) | S-band MA: 3.2 (for LEO)  
S-band SA: 9.5 (for LEO)  
Ku-band: 24.4 (for LEO)  
Ka-band: 26.5 (for LEO)  |
| **Modulation** | PM, FM, PCM, PCM/PM, PCM/PSK/PM, BPSK, QPSK, OQPSK, Filtered OQPSK  
Uncoded, or LDPC 1/2 or 7/8  
Uncoded, Rate 1/2 Conv., Reed-Solomon, Concatenated (1/2 Conv. + RS), LDPC 1/2 or 7/8  |
| **Encoding** | Circular (LHC, RHC)  
Circular (RHC, LHC only for MA services) |

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**Services and performance levels depend on many factors and are not uniform across network assets. Contact us for assessment of mission design, network performance, signal design compatibility, orbital design, antenna considerations, angles/off-pointing, atmospherics, etc. Maximum rates and bandwidths are given in accordance with system limitations, though higher rates may be possible. Confirmation of support depends upon many factors including mission planning & analyses performed by the NSN.**

**Additional capabilities could be supported. Contact us for more information.**

**In-progress and future upgrades will allow increases in network capability. NASA may consider adding capabilities with technologies not currently on its roadmap. Contact us for information on future capabilities.**

**LEGs only.**

**These values are based on a 1-second measurement integration interval.**

**Free flight values apply to S, X, Ku, and Ka-band. Powered flight values apply to S and X-band.**

**These are preferred capabilities. Additional legacy capabilities exist, as shown on Page 2.**

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**CONTACT US**

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