NSN Interfaces & Capabilities

Interface/ Capability[1]	Direct to Earth	Space Relay
③ **Terrestrial Link Data Transport Capabilities**		
Data Storage [1]	Station Storage: 5-30 days Cloud-based: Mission-driven	7 days
Network Data Rate [1]	Mission-driven (up to 1.2 Gbps)	
SLE Protocols	F-CLTU, EF-CLTU (Forward) RAF, RCF, ROCF (Return)	
SLE Versions Supported [2]	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.)	
④ **Spacecraft Navigation Tracking Capabilities**		
Radiometric Tracking Services [1]	Tone Ranging 1-way or 2-way Doppler Antenna Angle Data	Spread Spectrum Ranging 1-way or 2-way Doppler Antenna Angle Data
Radiometric Measurement Accuracy [1]	Range: S-band: < 5 meters, 1σ Doppler (Range-Rate): S-band 1-way: ≤ 30 mm/s, 1σ S-band 2-way: ≤ 15 mm/s, 1σ X-band 1-way: ≤ 7 mm/s, 1σ Ka-band 1-way: ≤ 2 mm/s, 1σ Antenna Angles: S: 0.03°, X: 0.05° Ka: 0.01° (auto), 0.05° (program)	Range: ≤ 2.73 meters, 1σ Doppler (Range-Rate): 1-way ≤ 1.55 mm/s, 1σ 2-way ≤ 3.1 mm/s, 1σ Antenna Angles: ≤ 0.1°
Radar Tracking Service Bands	C-band (5.4-5.9 GHz) Single Object X-Band (10.499 GHz) Multi Object	N/A
Radar Tracking Loop Gain (dB)	C-Band: 212-245 (227 Typical) X-Band: 246 (nominal)	
Other [1]	Ground Antenna Slew Rate:	Time Transfer Measurement:
	Azimuth and Elevation: ≥ 10°/sec (10°/sec²) * Train: ≥ 5°/sec (5°/sec²) * WS1 18-m system ≥ 2°/sec (1°/sec²)	User Spacecraft Clock Calibration System: ≤ ±5 µs Return Channel Time Delay: ±25% of a bit period

③ Optical Communications Capabilities (Demonstration Only)		
Wavelength	1550 nm	
Max Forward Data Rate [1 2]	20.4 Mbps	1.244 Gbps
Max Return Data Rate [1 2]	261 Mbps	1.244 Gbps
Modulation [2 3]	PPM (Order 16 or 32)	PPM (Order 16) or DPSK
Encoding [2 3]	SCC (Rate 1/3 or Rate 2/3)	SCC (Rate 1/2)
Framing	Ethernet	AOS, Ethernet

Demonstration Only

NSN Interfaces & Capabilities

Interface/ Capability[1]	Direct to Earth	Space Relay
② **Service Management, Planning and Scheduling**		
Monitoring	Real-time Monitoring and Reporting	
Scheduling	Advanced and on-demand scheduling via web-based interfaces.	
Service Accounting	Provides proficiency statistics, reporting of total support time.	
① **Mission Integration and Operational Support**		
Customer Mission Engineering and Support Services [3]	Requirements Development, Mission Planning, Analysis and Design, Integration and Network Compatibility Testing, Operational Scheduling, Launch & Commissioning Support, Mission Operations Support, Monitor and Control, Tracking & Orbit Determination, Critical Event Support (Maneuvers, EOL Disposal, etc.), Data Storage and Distribution, Readiness Reviews, Post Launch Reports and Lessons Learned Reviews.	

1. Services and performance levels (Data Rates, EIRP, G/T, etc.) are dependent on many factors and are not uniform across all network assets. Contact the NSN for assessment of mission design and the network's performance, compatibility with the mission's signal design, orbital design, antenna considerations, angles/off-pointing, atmospherics, etc. Maximum rates are given in accordance with both system limitations as well as maximum bandwidths as stated, though higher rates may be possible. Confirmation of support is dependent upon link and coverage analyses by the NSN.
2. Additional capabilities above those listed here could be supported as well. Systems are compliant with most CCSDS recommendations. Contact the NSN for more information.
3. Additional future and in-progress network upgrades will allow increases in network capability. NASA may also consider adding capability by incorporating technologies that are not currently on its roadmap. Contact the NSN for more information on future capabilities.
4. 2nd and 3rd Generation TDRS only.

Contact Us

Web: esc.gsfc.nasa.gov
Missions: gsfc-missiononboarding@mail.nasa.gov
Commercial Providers: NASA-commercialsynergies@mail.nasa.gov

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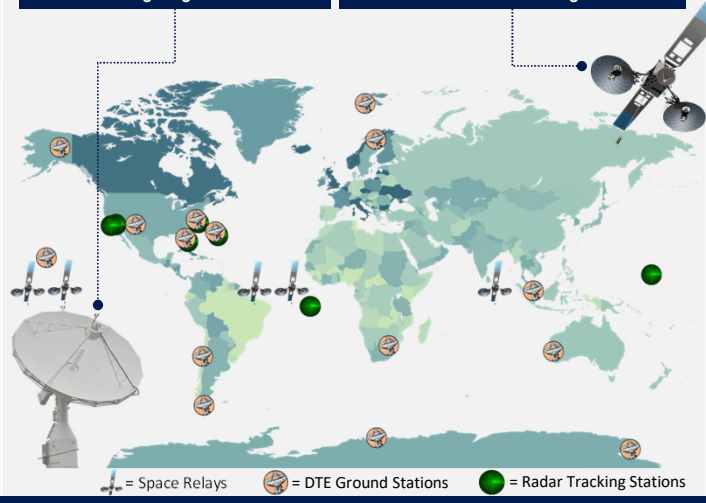
National Aeronautics and Space Administration

NEAR SPACE NETWORK

At NASA's Goddard Space Flight Center, the Exploration and Space Communications (ESC) projects division oversees the operations, maintenance and advancement of the Space Communications and Navigation (SCaN) program office's Near Space Network (NSN). Operating at a high-level of reliability and proficiency, the NSN provides communications and navigation services for missions within 2 million kilometers of our planet, bringing down an average of almost 30 Terabytes of critical data daily. Through space relays and ground-based assets, The NSN provides data delivery and satellite tracking services, empowering new discoveries about the universe and our home planet.

The NSN provides Direct-To-Earth (DTE) services via a global system of commercial and NASA-owned ground stations that provide line of sight communications and tracking services to missions ranging from low-Earth orbit and extending to Sun-Earth Lagrange Points 1 & 2.

The NSN also provides Space Relay services via relay satellites in geosynchronous orbit, which relay critical mission data between satellites and ground stations. The strategic placement of the relays can provide LEO and MEO missions with continuous coverage for communications and navigation.



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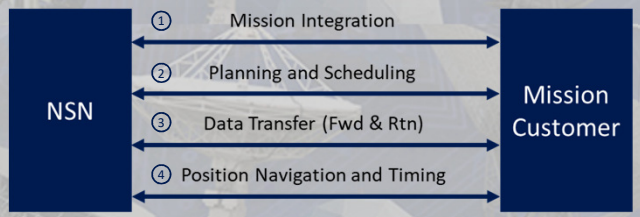
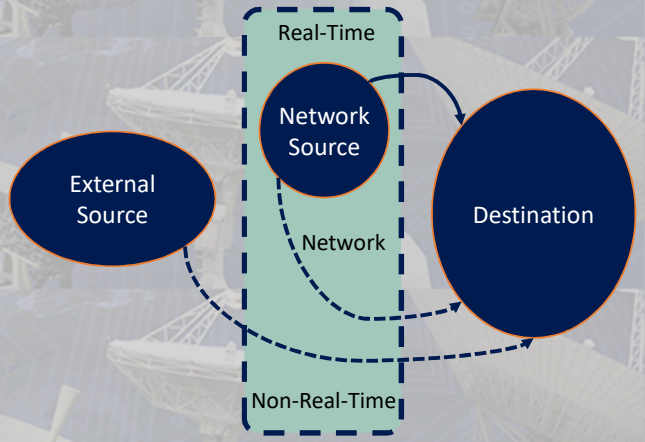
NEAR SPACE NETWORK Services

The NSN provides four customer services:

1) Mission Integration – This includes development of service agreements, interfaces, documentation, support of reviews, etc.
2) Mission Planning and Scheduling – This includes performing link and loading analyses, supporting service requests, and generating and implementing operational schedules.
3) User Mission Data Transfer – This includes primarily spacecraft forward command and return telemetry data.
4) Position Navigation and Timing (PNT) – This includes navigation information and tracking data measurements and messages.

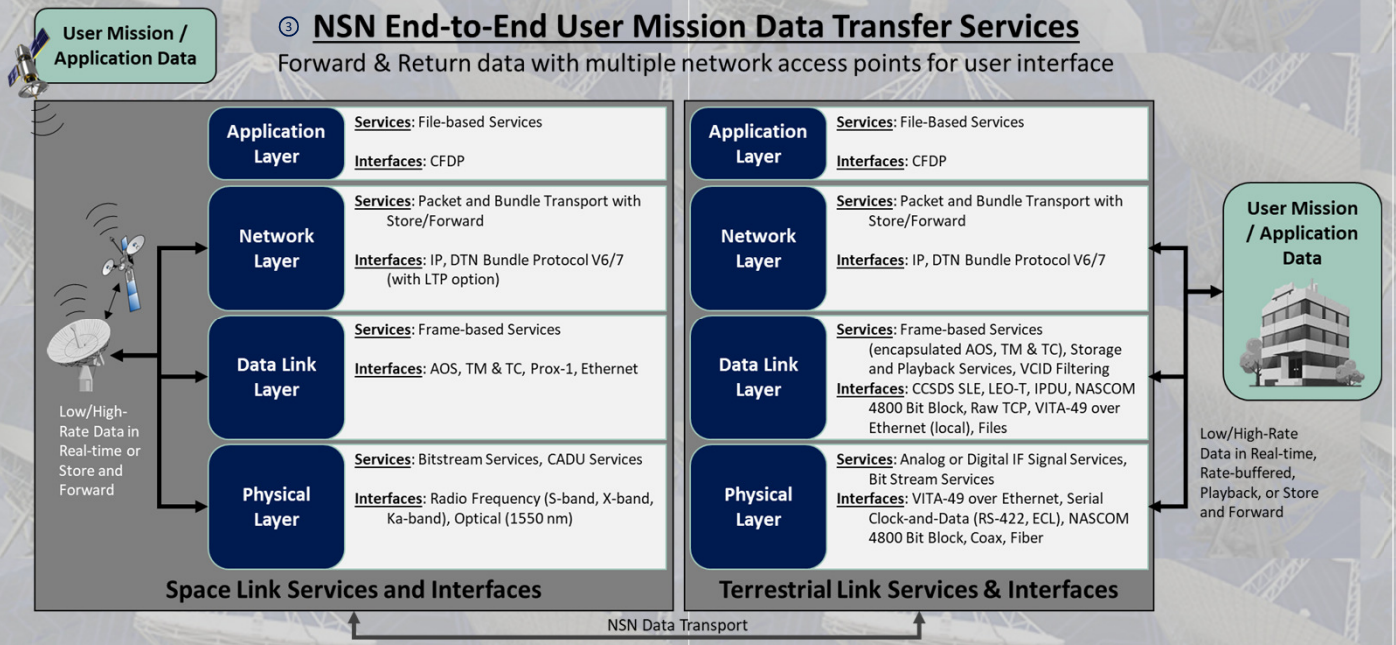


④ PNT Services & Interfaces Diagram



③ NSN End-to-End User Mission Data Transfer Services

Forward & Return data with multiple network access points for user interface



NSN Interfaces & Capabilities

Interface/ Capability[1]	Direct to Earth	Space Relay
③ **Forward (Command) Communications**		
Frequency Bands (Near-Earth Use)	S-band: 2025-2110 MHz X-band: 7190-7235 MHz	S-band: 2025-2110 MHz Ku-band: 13.775 GHz Ka-band: 22.55-23.55 GHz [4]
Maximum Bandwidth	S-band: 5 MHz X-band: 10 MHz	S-band: 6 MHz Ku-band: 50 MHz Ka-band: 50 MHz [4]
Forward Max Data Rate [1 2] (prior to encoding)	S-band: 5 Mbps X-band: 5 Mbps	S-band MA: 300 Kbps S-band SA: 4.2 Mbps Ku-band: 50 Mbps Ka-band SA: 50 Mbps [4]
Antenna System EIRP (dBW) [1]	S-band: 51-81 (56 Typical) X-band: 85-86	S-band MA: 42 [4] S-band SA: 48.5 [4] Ku-band SA: 48.5 [4] Ka-band SA: 63 [4]
Modulation [2 3]	PM, FM, PCM, PCM/PM, PCM/PSK/PM, BPSK, QPSK, OQPSK, UQPSK	Spread spectrum: BPSK or UQPSK Non-spread: BPSK, QPSK, OQPSK, PCM/PM, or PCM/PSK/PM
Encoding [2 3]	Uncoded, or LDPC ½ or 7/8	Uncoded, Rate ½ Conv., Reed-Solomon, Concatenated (½ Conv. + RS), LDPC ½ or 7/8
Polarization	Circular (LHC, RHC)	Circular (LHC, RHC) (LHC only for MA services)
③ **Return (Telemetry) Communications**		
Frequency Bands (Near-Earth Use)	S-band: 2200-2290 MHz X-band: 8025-8400 MHz X-band (SRS): 8450-8500 MHz Ka-band: 25.5 – 27 GHz [4]	S-band: 2200-2290 MHz Ku-band: 15.0034 GHz Ka-band: 25.25 – 27.5 GHz [4]
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 [4] Ka-band (Wide): 650 MHz [4]
Return Max Data Rate [1 2] (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 [4] Ka-band (Wide): 1200 Mbps [4]
Antenna System G/T (dB/K) [1]	S-band: 19.1-29.6 (21 Typical) X-band: 30.5-37.8 (32 Typical) Ka-band: 38-45 (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) [4]
Demodulation [2 3]	PM, FM, PCM, PCM/PM, PCM/PSK/PM, BPSK, QPSK, OQPSK, AQPSK, SQPN, 8PSK	Spread spectrum: BPSK or OQPSK Non-spread: BPSK, QPSK, OQPSK, 8PSK PCM/PM, or PCM/PSK/PM
Decoding [2 3]	Uncoded, Rate ½ Conv. and/or Reed-Solomon, LDPC ½ or 7/8, or Turbo Rate ½	Uncoded, Rate ½ Conv., Reed-Solomon, Concatenated (½ Conv. + RS), LDPC ½ or 7/8, Rate 7/8 TPC
Polarization	Circular (LHC, RHC)	Circular (LHC, RHC) (LHC only for MA services)

Baseline 05/2021