MOREHEAD STATE UNIVERSITY

Ronald G. Eaglin
Space Science Center

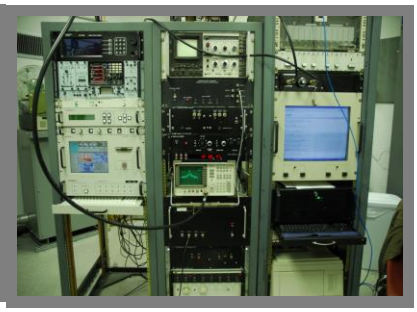
Morehead State University Space Science Center
21 Meter Space Tracking Antenna
(Latitude: 38° 11 30.773 N,
Longitude: 83° 26 19.948 W) U.S.A

FUNCTION	PERFORMANCE
Antenna Diameter	21 Meter
Receive Polarization	RHCP,LHCP,VERT,HORZ
Travel Range	AZ +/- 275 degrees from due South (180 deg) EL -1 to 91 degrees POL +/- 90 degrees
Velocity	AZ Axis = 3 deg/sec EL Axis = 3 deg/sec POL Axis = 1 deg/sec
Acceleration	AZ = 1. 0 deg/sec/sec min EL = 0.5 deg/sec/sec min
Display Resolution	AZ/EL = 0.001 deg POL = 0.01 deg
Encoder Resolution	AZ/EL = 0.0003 deg (20 Bit)
Tracking Accuracy	<= 5% Received 3 dB Beamwidth (0.028 deg RMS L-band) (0.005 deg RMS Ku-Band)
Pointing Accuracy	<= 0.01 deg rms

21 M Space Tracking Antenna-Deep Space Station-17

The **Morehead State University** Space Science Center 21 meter antenna system provides telemetry, tracking, ranging and commanding services for LEO, MEO and "near Earth" deep space missions independently and as an affiliated node on NASA's Deep Space Network.

21 M Antenna Operations Center



Customized Uplink/Downlink Systems

21 M Antenna System Radio Frequency Operating Regimes*

Band Designation	Deep Space Bands		Near Earth Bands	
	Uplink (MHz)	Downlink (MHz)	Uplink (MHz)	Downlink (MHz)
S-band	2110-2120	2290-2300	2025-2110	2200-2290
X-band	7145-7190	8400-8450	7190-7235	8450-8500

*Frequency bands listed are ranges in which the 21 m system has capabilities, not for which the system is licensed. Note that all missions must acquire an FCC/NTIA license or license from their governing organization along with spectrum coordination (with IARU) for both the spacecraft and the ground station.

DSS-17 Performance Characteristics (X-Band)

Performance Measure	Performance Value
X-band Uplink Range*	7.145 – 7.235 GHz
X-band Downlink Range*	8.350 – 8.500 GHz
LNA Temperature	20 K
System Temperature T_{sys}	90 K
Antenna Gain	62.7 dBi (@8.4 GHz)
System Noise Spectral Density	-178 dBm/Hz
G/T at 5° Elevation	42.0 dBi/K
Time Standard	H- MASER (1ns/day)
EIRP	93.7 dBW (nominal)
HPBW	0.1150 deg
SLE Compliant	Yes
CCSDS Capable	Yes
Forward Error Coding	Reed Solomon/Convolutional, Turbo, Low Density Parity Check
Radiometric	Angle, Doppler, Sequential Tone and PN Ranging (2-Way and 3-Way)
Ranging Precision	+/-1 range unit (0.94 ns) 1 m (1 sigma Accuracy)

For Scheduling or Cost Structure contact:
Dr. Ben Malphrus (606) 783-2212 b.malphrus@moreheadstate.edu

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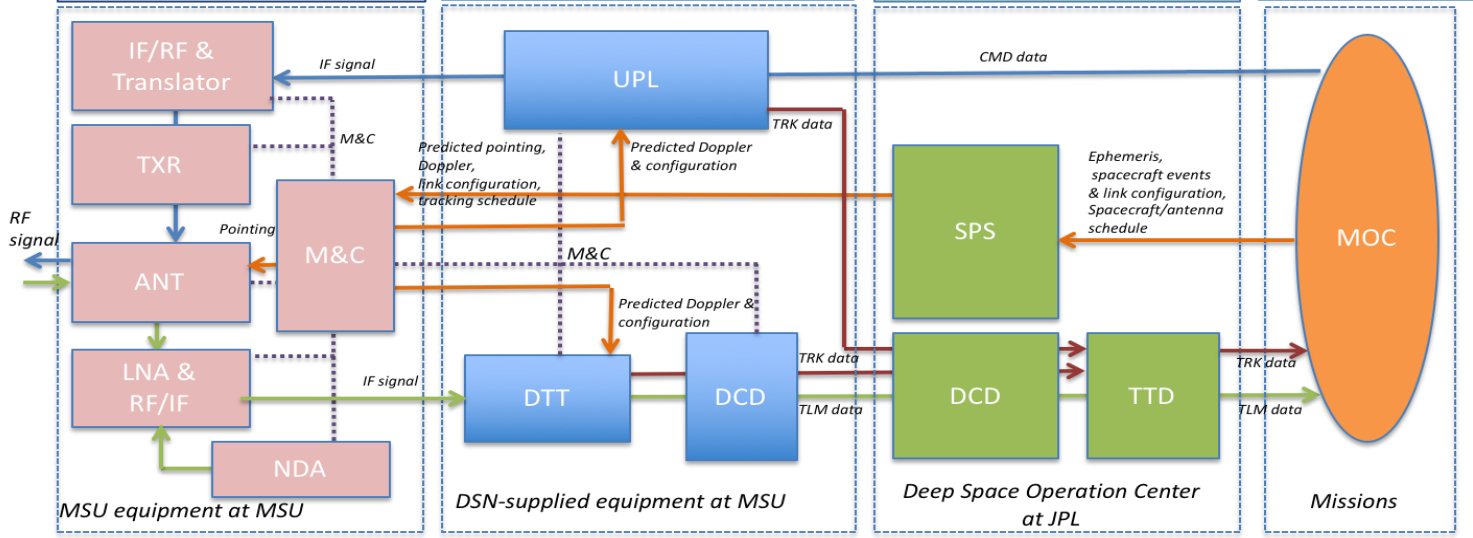
DSS-17 Station and Network Architecture for X-Band Deep Space Missions

- IF/RF – Intermediate Frequency/Radio Frequency Upconverter
- TXR – Transmitter
- ANT – Antenna
- LNA – Low Noise Amplifier
- RF/IF DC – Radio Frequency/Intermediate Frequency Downconverter
- NDA – Noise Diode Assembly
- M&C – Monitor & Control

- UPL – Uplink
- DTT – Downlink Tracking & Telemetry
- DCD – Data Capture & Delivery

- SPS – Service Preparation Subsystem
- DCD – Data Capture & Delivery
- TTD – Tracking & Telemetry Delivery

- MOC – Mission Operation Center
- CMD – Command
- TRK – Tracking
- TLM - Telemetry



21 Meter Antenna: S-Band Mission Support

21 m Performance Characteristics (S-Band)

Performance Measure	Performance Value
S-Band Downlink Range*	2.2 – 2.7 GHz
S-band Uplink Range*	2.02 to 2.12 GHz
LNA Temperature	~85K
System Temperature T_{sys}	~150 K
Antenna Gain	52 dBi (@2.2 GHz)
G/T at 5° Elevation	29.5 dBi/K
Time Standard	H- MASER (1ns/day)
Transmitter Output Power	100 W
HPBW	0.37 deg
Data rates	100 bps to 20 Mbps
Line Coding	NRZ-L, NRZ-M, NRZ-S, Biphase-L, Biphase-M, Biphase-S, RZ
Modulation/ Demodulation	PM, BPSK, QPSK, SQPSK, DQPSK-Normal, DQPSK-Alternative, FSK, GFSK, GMSK, MSK
Decoding	Viterbi/ convolutional rate ½, Reed Solomon (255, 223)
Front end processing	CCSDS compatible, stores data on system, transmit data via TCP/ IP, FTP. Space Link Extension (SLE) modules

Continued Support for S- Band Missions

The 21 m station continues support for S-band missions when time is available, i.e. during times that are not devoted to the primary mission of X-band deep space operations. The 21 m is operated at X-band either as DSN affiliated node DSS-17 on the NASA Mission Backbone as a DSN station (scheduled through the DSN Commitments and Scheduling Office for NASA missions) or as an independent station for NASA and non-NASA missions. At S-band, the current configuration supports operations as an independent station offering direct connection from the mission's operation center (MOC) to the 21 m Station Operations Center (SOC). The S-band system is primarily used for LEO mission support (uplink and downlink) with ranging not currently implemented. Future plans are to add S-band ranging capabilities to support deep space operations at S-band. S-band support is scheduled by Morehead State University.

For Additional Information:
https://www.moreheadstate.edu/ssc/
Scheduling or Cost Structure contact:
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