

DESCRIPTION OF TESTING AND COORDINATION

Testing

The STA will cover tests to be conducted at the Johns Hopkins University Applied Physics Laboratory's Satellite Communications Facility (SCF). The 18.3 meter diameter antenna will be used to transmit the test signals. These tests will be implemented by the same personnel that routinely operate the SCF.

Signals of various modulation schemes will be transmitted intermittently within the January-June 2019 timeframe. Each individual test transmission will be directed at a low earth orbit (LEO) "calibration sphere". These "calibration spheres" are routinely used for tests by radar developers and operators. The specific calibration spheres have not yet been selected. Each individual test should not exceed 30 minutes of transmission. The transmitted signals will be circularly polarized and not to exceed an EIRP of 80 dBW. The elevation angle of the transmit antenna should be above 15 degrees to minimize impact on terrestrial receivers.

Coordination

We will coordinate prior to testing with Mr. Vincent Scott Galbraith, Spectrum Manager at NASA Goddard Space Flight Center, as well as with the local Society of Broadcast Engineers, Inc. (SBE) frequency coordinator.

Sincerely,

Mr. Eliud Bonilla
Professional Staff
Johns Hopkins University - Applied Physics Laboratory
11100 Johns Hopkins Road
Laurel, MD 20723

[Please see the attached SCF Data Sheet below.]

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Satellite Communications Facility

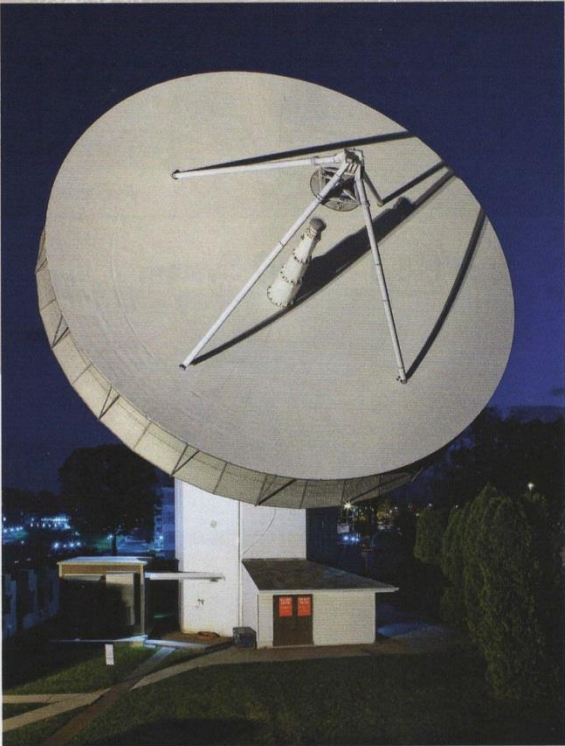
The Satellite Communications Facility (SCF) at the Johns Hopkins University Applied Physics Laboratory (APL) traces its genesis to the early days of Sputnik. Since the first signal from space, APL has provided the nation with global timing and positioning solutions, world class space and planetary science, robust and reliable spacecraft, and precise navigation, commanding and communications to ensure mission success.

Quality and Cost-effective Support

Established in 1961 to support the command and telemetry requirements of the world's first satellite navigation system under contract to the U.S. Navy, the APL station has provided more than 50 years of ground contact support to our sponsors. The station has conducted over 100,000 satellite contacts in the last 15 years alone. With available, on-call technical support, the station has been conducting attended and unattended spacecraft tracking operations since 1995.

Assets at APL include two independent operational antenna systems. Our mid-latitude station can be configured to support a wide variety of missions ranging from Low Earth Orbit (LEO) through Deep Space, with a variety of data formats, including TDM and CCSDS. Current capabilities include support for L-band, S-band, and X-band communications.

Recent system improvements and technology enhancements enable these systems to provide future sponsors with advanced capability at cost-effective rates. APL's concept of a Shared Service, Multi-mission Ground System makes the remote scheduling and data transfer capabilities of these systems highly attractive



Station Details	
Location	39:10 N, 76:53 W
Antenna	5-meter, 60-foot (18.3-meter)

for government, academia, and commercial operations on a non-exclusive basis. While currently these systems are conducting routine daily contacts, their availability for additional contacts is still over 60%. Portions of these facilities are owned by the U.S. government and some restrictions on their use may apply.



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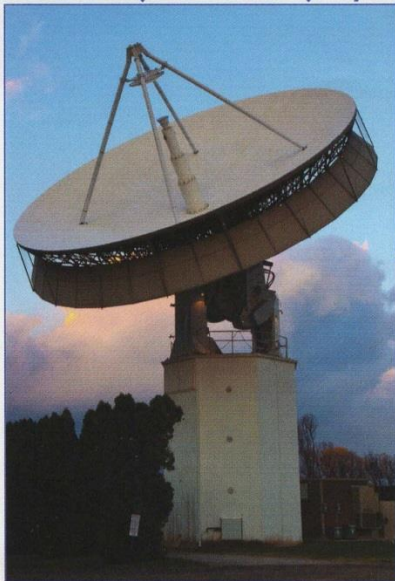
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5-Meter System



Downlink	L-band	S-band	X-band
Frequency Range	1650-1750 MHz	2200-2300 MHz	8000-8500 MHz
Polarization	RHC	RHC	RHC
G/T	>11.2 dB/K	>13.6 dB/K	>24.1 dB/K
Beamwidth	2.5 deg	1.8 deg	0.5 deg
Antenna Pointing Control			
Program track (TLE, Spice-SPK, Chebychev Polynomials. RA/DEC)			

60-Foot (18.3-Meter) System



Downlink	S-band	X-band
Frequency Range	2200-2400 MHz	8400-8500 MHz
Polarization	Simultaneous RHC and LHC	Simultaneous RHC and LHC
G/T	>28.3 dB/K	>38.5 dB/K
Beamwidth	0.5 deg	0.13 deg
Uplink	S-band	
Frequency Range	2025-2120 MHz	
Polarization	"On-the-fly" Selectable LHC or RHC	
Beamwidth	0.5 deg	
EIRP	>80 dBW	
Transmitter	2000 W Klystron (dual redundant)	
Antenna Pointing Control		
Program track (TLE, Spice-SPK, Chebychev, RA/DEC), S-band Autotrack, S/X-band Steptrack		
CCSDS Compliant		
Command, Ranging, Doppler & Telemetry, including Turbo (r1/2, 1/3, 1/4, 1/6), Convolutional (r1/2), Reed-Solomon, and Conv/R-S; Wide variety of modulation formats; Space Link Extension "SLE" (Fwd CLTU, RAF, & RCF services)		

With a legacy of more than 50 years of crafting high-quality, reliable space solutions, APL can craft a solution for your ground station requirements.

Bill Dove

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