STEREO MOC Status Report
Time Period: 2017:296 - 2017:302

STEREO Ahead (STA) Status:

1. The following Ground System anomalies/events occurred during this reporting period:

   - On day 296, during the DSS-35 support, the transmitter tripped off-line at 0925z, 10 minutes before EOT. All SSR data was received. See DR# C112987 for more information.

   - On day 297, during the DSS-35 support, telemetry binds dropped at 0621z. Telemetry binds were re-established at 0814z. This anomaly resulted in the loss of 2 hours of real-time telemetry and monitor data. All SSR data was received.

   - On day 297, during the DSS-55 support, command and telemetry binds dropped again at 1642z. Telemetry binds were re-established at 1708z. This anomaly resulted in the loss of 26 minutes of real-time telemetry and monitor data. All SSR data was received.

   - On day 298, before the DSS-55 support began, telemetry binds dropped again at 1008z and 1237z. The NASCOM RIONet links between GSFC and APL were switched to the primary circuit at 1232z. Telemetry and command binds were re-established at the nominal times for the track. All SSR data was received.

   - On day 299, during the DSS-35 support, turbo decoder lock was lost intermittently at 0454z through 0550z due to heavy rain at the Canberra complex. This anomaly resulted in the loss of 24,090 frames of real-time telemetry and SSR data. See DR #C112997 for more information.

   - On day 300, during the DSS-35 support, acquisition of signal was 17 minutes late due to network issue at the Canberra complex. This anomaly resulted in the loss of 183 frames of real-time telemetry and SSR data during the subsequent transition for one-way to two-way communications. See DR #C113000 for more information.

- On day 300, during the DSS-25 support, turbo decoder lock was lost intermittently beginning at 2222z through 2254z. This anomaly resulted in the loss of 94 frames of real-time telemetry and SSR data.

2. The following spacecraft/instrument events occurred during this week. The Ahead observatory operated nominally during this week.

   - On day 296, the SECCHI instrument reset at 19:32:07z. The SECCHI team reconfigured the instrument to operational mode by 298-0000z. This was the 46th reset of SECCHI on the Ahead observatory.

   - The average daily science data return for Ahead was 4.5 Gbits during this week.

STEREO Behind (STB) Status:

1. Detailed status of the recovery activities this week to restore operations is listed below.

   - On day 296, during a 3.1 hour 4 kHz battery recovery search pattern support with DSS-14, commanding from the MOC was delayed by 22 minutes due to a configuration issue at the station. The issue was resolved at 1324z and 279 commands were transmitted during the support. Due to this anomaly, 2 of 7 points on the pattern were not covered twice.

   - On day 297, during a 2.5 hour 1 kHz battery recovery support with DSS-63, 189 commands were transmitted for battery state of charge recovery. Due to the duration of the support, only 21 of the 36 frequency segments were commanded.

   - On day 298, the scheduled 3.5 hour 1 kHz carrier recovery support with DSS-14 did not occur as the transmitter was declared red on day 297.

   - On day 299, the scheduled 3 hour 4 kHz carrier recovery search pattern support with DSS-14 did not occur as the transmitter was declared red on day 297.

   - On day 300, during a 4 hour 4 kHz carrier recovery support with DSS-14, the command uplink was delayed 21 minutes due

to network issue at the Goldstone complex. Later in the support, command bind was lost at 1702z and re-established at 1714z due to a network issue at JPL. See DR# G118593 for more information. 340 commands were transmitted during the support. No carrier was detected by either the DSN station or the radio science receiver team after attempting to power on the TWTA for 30 minutes. Transitioned to battery recovery operations for the remainder of the support which consists of repeatedly sweeping a 4 kHz uplink range and sending commands for IEM switched power and PDU 1553 interface bus off.

- On day 301, during a 3 hour 4 kHz carrier recovery support with DSS-14, 320 commands were transmitted during the support. No carrier was detected by either the DSN station or the radio science receiver team after attempting to power on the TWTA for 30 minutes. Transitioned to battery recovery operations for the remainder of the support which consists of repeatedly sweeping a 4 kHz uplink range and sending commands for IEM switched power and PDU 1553 interface bus off.

- On day 302, during a 3 hour 4 kHz carrier recovery support with DSS-14, 320 commands were transmitted during the support. No carrier was detected by either the DSN station or the radio science receiver team after attempting to power on the TWTA for 30 minutes. Transitioned to battery recovery operations for the remainder of the support which consists of repeatedly sweeping a 4 kHz uplink range and sending commands for IEM switched power and PDU 1553 interface bus off.

2. The Behind loss of communication anomaly occurred on October 1, 2014 from simultaneous failures of star tracker and IMU. Post superior solar conjunction, recovery operations resumed on November 30, 2015. By implementing the NASA Failure Review Board recommendations, the first recovery attempt began with carrier detection by the DSN on August 21st, through September 23, 2016. At a spacecraft range of ~2 AU, the observatory was found to be rotating slowly about its principal axis of inertia for which the uncontrolled attitude allowed some solar array input and continuous uplink and downlink communications on the LGA at emergency data rates. Over the next 22 continuous days, significant obstacles to recovery were overcome with a collaborative effort of the JHU/APL engineering team, NASA GSFC, DSN, FDF, SSMO scheduling, and Mission Operations teams. This consisted of:

- Reliably commanding a rotating spacecraft with uncontrolled attitude at a distance of 2 AU
- How to power on the spacecraft that was never designed to be off without collapsing the battery voltage
- Acquiring telemetry at 35 bps from a spacecraft that is rotating with an uncontrolled attitude
- Warming a frozen propulsion subsystem with a degraded battery and limited solar array input with an uncontrolled attitude
- Configuring, loading, and verifying EA, C&DH, and G&C parameters and macros with very limited telemetry
- Conducting an autonomous momentum dump in the blind and transitioning to C&DH standby mode and successfully receiving telemetry on the HGA indicating star tracker lock and decreasing system momentum.

However, system momentum level remained above the threshold for re-establishing attitude control with the reaction wheels. Due to the uncontrolled attitude, communication degraded and the last detection of the carrier was on September 23, 2016.

Behind Observatory Status – From the last telemetry received on September 18, 2016 and the telemetry assessment review held on February 24, 2017, main bus voltage is low, 3 out of 11 battery cells are bypassed, attitude remains uncontrolled, rotating about its principal axis of maximum moment of inertia. While likely all ~42 kg of hydrazine remains and is frozen, both pressure transducers are not functioning. EA mode is enabled and autonomy is disabled. The battery charge rate is C/10. RF is configured for the +Z LGA at emergency data rates and the range of the expected best lock frequency (BLF) is known. Necessary macro sequences have been tested to allow the peak power tracker in C&DH standby mode to protect the battery. These macro sequences will be loaded to EEPROM when the communications supports longer commands.

Based on G&C geometric analysis and GSFC modeling, daily recovery efforts began on August 21st, and will continue through November 5$^{th.}$ With significant support of the DSN, three different acquisition sequences are being utilized weekly to re-establish communications with STEREO Behind using a 70m track:

1. 4 kHz Sweep – consists of repeatedly sweeping a 4 kHz uplink frequency range for which the BLF was found during

the first recovery attempt. Commands are sent to power on the transmitter for 30 minutes. If no carrier signal is detected, the transmitter is powered off and battery recovery commands are sent consisting power off the IEM switched power and PDU 1553 interface bus. This acquisition sequence is used 3 times each week.

2. Frequency Segmented 1 kHz – To ensure command reception, the original faster frequency segmented acquisition sequence is used 2 days each week. This consists of an 18 kHz frequency range divided into 18, 1 kHz segments, each swept at a 1 kHz rate, stepping down in frequency and them back up again. During each segment, the MOC sends battery recovery commands on the first day and on the second day, carrier recovery commands. This was the acquisition sequence that originally detected the Behind downlink in August 2016.

3. 4 kHz Sweep with Search Pattern – The DSN created a diamond shaped search pattern with 7 steps of 0.037 deg, dwelling 10 min & 49 sec/step. There are two diamond patterns of 4 steps to cover the area of the estimated ephemeris error. The starting point is offset 0.02 deg for 100% uplink optimization. Repeating each diamond pattern accounts for the 30 minute RTLT. This search pattern acquisition sequence is used twice weekly during 3 hour supports, sending battery recovery commands at each step during the first day and on the second day, sending carrier recovery commands at each step.