STEREO MOC Status Report
Time Period: 2018:015 – 2018:021

STEREO Ahead (STA) Status:

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

   - On day 015, during the DSS-34 support, turbo decoder lock
     was lost briefly at 0747z and 0912z. This anomaly resulted
     in the loss of 3 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.

   - The average daily science data return for Ahead was 7.1
     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 016 during a 3 hour 4 kHz carrier recovery search
     pattern support with DSS-63, lost command bind as well as
     all telemetry binds on all command workstations for Ahead
     and Behind at 015-2037z due to a network issue between GSFC
     and APL. Command and telemetry binds were re-established
     at 016-1108z. 120 commands were transmitted during the
     support for carrier recovery. No carrier was detected by
     either the DSN station or the radio science receiver team.
     This anomaly resulted in the loss of 2 hours of commanding.
     Only 6 points on the pattern were covered. Three commands
     must be received sequentially to power on the transmitter.

   - On day 018, the scheduled DSS-14 recovery support did not
     occur to allow for emergency maintenance on the station.

- On day 020, during a 4 hour 1 kHz carrier recovery support with DSS-63, antenna brakes were set at 1206z. The antenna was reset and the uplink resumed at 1213z. This anomaly resulted in the loss of one command segment. See DR# M110439 for more information. Overall, 420 commands were sent for transmitter carrier recovery. No carrier was detected by either the DSN station or the radio science receiver team. Due to the duration of the support and the increased commands for each step, only 21 of the 36 frequency segments were commanded. Three commands must be received sequentially to power on the transmitter.

2. The Behind loss of communication anomaly occurred on October 1, 2014 from simultaneous failures of the star tracker and the 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.

After 2.5 months of daily recovery efforts that began on August 21, 2017, to date the downlink signal has not been detected by the DSN block V receivers or the RSR team. With significant support of the DSN, two 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. 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.