STEREO MOC Status Report
Time Period: 2016:053 – 2016:059

STEREO Ahead (STA) Status:

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

   - On day 053, during the DSS-26 support, turbo decoder lock was lost intermittently beginning at 1915z through 2233z. This anomaly resulted in the loss of 26 frames of real-time and SSR playback data.

   - On day 054, the 2nd PN ranging demonstration was conducted during the DSS-15 support. There was no instrument commanding or SSR playback as the DSN track services were not committed. At 00:00:35z, a range measurement was set to zero due to no valid uplink range phase. The new PN ranging system transmits all of the tones at the same time, reducing the cycle time for acquiring range lock, and thus increases the number of range points collected during a support. PN ranging is also easier to use because only one navigation-centric variable is needed: integration time, instead of T1 and T2. See DR# G116971 for more information.

   - On day 055, during the DSS-55 support, telemetry lock was lost intermittently beginning at 1643z through 1648z due to heavy rain at the Madrid complex. This anomaly resulted in the loss of 4991 frames or 4.7 minutes of spacecraft SSR playback and real-time data. See DR# M109228 for more information.

   - On day 055, during the DSS-25, the transmitter tripped off-line at 2228z due to a network issue. This anomaly resulted in the loss of 331 frames of real-time data during the transition from two-way to one-way. While the transmitter became operational at 2320z, to avoid further real-time data loss, MOps elected to remain one-way for the remainder of the track. See DR# G116974 for more information.

   - On day 056, during the DSS-26 support, turbo decoder lock was lost briefly at 057-0000z. This anomaly resulted in the loss of 1 frame of SSR playback data.

- On day 057, during the DSS-63 support, turbo decoder lock was lost intermittently beginning at 1340z through 1345z. SSR pointers were repositioned to minimize data loss. Later in the track, turbo decoder lock was again lost intermittently between 1517z and 1551z. This anomaly resulted in the loss of 16,234 frames or 3.3 minutes of real-time and SSR playback data. Both anomalies are attributed to bad weather conditions at DSS-63. See DR #M109231 for more information.

- On day 057, the planned DSS-24 support was switched to use DSS-15 and shortened by 55 minutes off the end with a new duration of 2.5 hours to assist the SOHO mission with their warm start recovery. DSS-14 shadowed this entire support to test predicts.

- On day 059, prior to the DSS-65 support, the primary Ahead MOC workstation hung due to a hardware anomaly, preventing the telemetry bind from occurring. The backup command workstation also failed the telemetry bind. MOC staff remotely monitoring detected the issues. The primary command workstation was manually rebooted prior to the next support and the command and telemetry application was restarted on the backup workstation to resolve the anomalies. This resulted in no real-time telemetry being received in the MOC as well as no commanding throughout the entire track (1415z/1745z). No data loss resulted from these anomalies since the DSN continued to transmit IDR files into the archive throughout the MOC outage.

2. The following spacecraft/instrument events occurred during this week. The Ahead observatory operated nominally during this week on the center of the HGA main lobe. The HGA feed assembly was at 113 degrees C and decreasing with the HGA angle at 8.4 degrees and increasing, with respect to the spacecraft-Sun line.

   - On day 053, the 85th momentum dump was executed successfully at 2200z, which imparted an estimated delta V of 0.103 m/sec. This was the 4th momentum dump that did not use the IMU. After thruster operations completed, there was a 2.9 degree of roll angle error which was dampened out over the next 20 minutes. Fine pointing stabilized 1.9 minutes after completion of the momentum dump.

- On day 055, the G&C control bandwidth (Ctl.Bw) parameter for science pointing was adjusted in RAM at 1215z. While the roll error has improved, performance throughout a momentum cycle will be monitored. This update is attempting to minimize the increase in roll error that has affected SECCHI HI images intermittently since exiting solar conjunction.

- The average daily science data return for Ahead was 5.2 Gbits during this week.

STEREO Behind (STB) Status:

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

   - On day 057, during the DSS-26 34m support, using the 80 kW transmitter to minimize 70m contentions, 297 commands were sent for battery state of charge recovery.

   - On day 058, during the DSS-26 34m support, using the 80 kW transmitter to minimize 70m contentions, 189 commands were sent for battery state of charge recovery.

   - On day 059, during the DSS-43 70m support, 440 commands were sent for transmitter carrier recovery. No downlink signal was detected by the DSN. Due to the duration of the support and the increased commands for each step, only 22 of the 36 frequency segments were commanded. Three commands must be received sequentially to power on the transmitter.

2. Detailed status of the recovery activities to restore operations from the Behind loss of communication anomaly, which occurred on October 1, 2014, are listed below. Recovery operations resumed on November 30, 2015.

   - The Behind observatory entered superior solar conjunction at the 2.0 degree SPE angle on January 22, 2015. Recovery efforts resumed post solar conjunction on May 4th through June 27, 2015, as the spacecraft had cleared solar interference for LGA communications. The Failure Review Board recommendations were implemented consisting of battery state of charge recovery and powering on the downlink carrier. The Green Bank Radio Telescope and the

Arecibo Observatory also observed the carrier recovery tracks. No downlink signal has been detected. Due to Behind's retrograde motion causing it to re-enter the region of solar interference, recovery operations were suspended from June 28th through November 29, 2015. The Green Bank Radio Telescope and the Allen Telescope Array will also observe the carrier recovery tracks depending on availability. While the Arecibo Observatory is willing also assist, the Behind observatory is not in view until April 2016.

- The Failure Review Board's recommended faster frequency segmented acquisition sequence was tested with the Ahead observatory on September 29, 2015. All 18 one kHz frequency steps were tested twice. While stepping down through the 1 kHz segments, on segment #9 going down in frequency, the transponder locked to the BLF and accepted 9 no-op commands as expected. An interesting finding, but not unexpected, was that the transponder continued to follow the moving carrier and accept all commands sent for the remaining 27 segments.

- As commands must be received to recover the Behind observatory, testing of the DSN uplink arraying capability using the Ahead observatory continued on February 19th with the 6th uplink array test successfully conducted for STEREO using DSS-24, 25, and 26. The new configuration consisted of incorporating the frequency segmented acquisition sequence with the three 34m stations using the 80 kW and two 20 kW transmitters with the MOC commanding. An approximate 12 dBm increase in received uplink power, as compared to a single 34m, was again demonstrated. 28 one kHz frequency segments were tested sending 9 commands each testing the battery recovery procedure with all expected no-op commands being received correctly using the 7.8125 bps uplink rate. This capability will provide four times the uplink received power as a 70m station. The uplink array capability is scheduled for Behind recovery operations on a monthly basis beginning on March 17th.

- With time the spacecraft range improves RF communications and the ability for other assets to acquire data on Behind. While the STEREO RF link was not designed to be closed beyond 2 AU, as the Earth range is decreasing, the LGA uplink margin returns to nominal, 6 dB for the 7.8 bps rate, in March and the LGA downlink margin returns to nominal, 3 dB for the 12 bps rate, in December.

Significant findings to date:

1. Analysis of the three DSN extracted telemetry frames from the carrier signal just before the planned observatory reset/anomaly occurred on October 1, 2014 showed nominal performance of the spacecraft, i.e., no anomalies, IMU off, and the star tracker providing an attitude solution.

2. Post reset, from the very limited telemetry, three packets, extracted from the carrier signal by the DSN, the X-axis gyro on IMU-A had failed. Unfortunately, this telemetry contained only G&C anomaly data and no spacecraft summary data, i.e., the state of the RF, G&C, fault protection and other subsystems is not known at the time of the anomaly. With a failed IMU and the star tracker being off-line for an undetermined duration, the sun sensors will keep the observatory pointed at the Sun, though the G&C will not have any roll knowledge, and cannot roll the observatory as part of the safing configuration to re-establish communications on the LGAs. From analysis of this telemetry and initial G&C simulations, it is highly suspected that the observatory is rotating about the principal axis of inertia due to an autonomous momentum dump initiated by highly biased gyro data flagged good by the IMU, but this has not yet been confirmed.

3. At least two anomalies occurred post reset, the star tracker not promoting to AAD mode and the X-axis gyro failure. Unfortunately, due to the number of possible combinations, the STEREO fault protection system is not designed for simultaneous failures.

Once communications are restored and the anomaly resolved, the Behind observatory will be returned to nominal science data collection as soon as it is safely possible.