STEREO MOC Status Report
Time Period: 2016:060 - 2016:066

STEREO Ahead (STA) Status:

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

   - On day 060, during the DSS-45 support, turbo decoder lock was lost intermittently beginning at 0756z through 0800z. This anomaly resulted in the loss of 85 frames of real-time and SSR playback data.

   - On day 060, during the DSS-26 support, the MOC lost command bind and spacecraft transponder lost command lock for 40 seconds due to the station transmitter modulation anomaly at 2329z. Command bind was re-established at 061-0031z. All commands and telemetry data were received. See DR# G116985 for more information.

   - On day 062, during the DSS-65 support, turbo decoder lock was lost intermittently beginning at 1118z through 1139z. This anomaly resulted in the loss of 4 frames of real-time and SSR playback data.

   - On day 063, during the DSS-54 support, turbo decoder lock was lost briefly at 1730z. This anomaly resulted in the loss of 6 frames of real-time and SSR playback data.

   - On day 064, during the DSS-65 support, turbo decoder lock was lost intermittently beginning at 1727z through 1737z. This anomaly resulted in the loss of 31 frames of real-time and SSR playback data.

   - On day 066, during the DSS-55 support, turbo decoder lock was lost briefly at 1400z. This anomaly resulted in the loss of 3 frames of real-time and SSR playback data.

   - On day 066, during the DSS-25 support, turbo decoder lock was lost intermittently beginning at 2024z through 2335z. This anomaly resulted in the loss of 78 frames of real-time and SSR playback data. See DR# G116991 for more information.

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 112 degrees C and decreasing with the HGA angle at 8.5 degrees and increasing, with respect to the spacecraft-Sun line.

   - The average daily science data return for Ahead was 5.4 Gbits during this week.

STEREO Behind (STB) Status:

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

   - On day 063, during the DSS-26 34m support, using the 80 kW transmitter to minimize 70m contentions, 324 commands were sent for battery state of charge recovery.

   - On day 064, during the DSS-26 34m support, using the 80 kW transmitter to minimize 70m contentions, 279 commands were sent for battery state of charge recovery.

   - On day 066, during the DSS-43 70m support, 380 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 19 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 using the LGA, as the Earth range is decreasing, the LGA uplink margin returned to nominal, 6 dB for the 7.8 bps rate, on March 3rd 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.