STEREO MOC Status Report
Time Period: 2016:025 - 2016:031

STEREO Ahead (STA) Status:

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

   - On day 026, during the DSS-43 support, turbo decoder lock was lost briefly at 0834z during the final minute of SSR playback. This anomaly resulted in the loss of 33 frames of real-time and SSR data.

   - On day 028, during the DSS-54 support, turbo decoder lock was lost briefly at 1011z. This anomaly resulted in the loss of one frame of real-time and SSR data.

   - On day 030, during the DSS-26 support, turbo decoder lock was lost intermittently between 1732z through 031-0015z. This anomaly resulted in the loss of 572 frames of real-time telemetry and SSR data.

   - On day 031, during the DSS-45 support, initial telemetry lock was delayed 12 minutes at 0547z due to heavy rain at the Canberra complex. This anomaly resulted in the loss of 1202 frames of spacecraft SSR playback and real-time data. See DR# C111776 for more information.

   - On day 031, a TTC version 1.1 demonstration was conducted during the DSS-55 support. There was no instrument commanding or SSR playback as the DSN track services were not committed.

   - On day 031, during the DSS-25 support, turbo decoder lock was lost intermittently between 2151z through 2304z. At 2305z, the antenna was stowed due to sustained high winds. After the winds subsided, telemetry lock was re-established at 2326z. The track continued one-way only for the remaining 1.3 hours. This anomaly resulted in the loss of 21 minutes of real-time telemetry, commanding, tracking data and SSR data. See DR# G116930 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 116 degrees C and decreasing with the HGA angle at 7.7 degrees and increasing, with respect to the spacecraft-Sun line.

- The average daily science data return for Ahead was 4.1 Gbits during this week.

STEREO Behind (STB) Status:

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

   - On day 027, during the DSS-26 34m support, using the 80 kW transmitter to minimize 70m contentions, 270 commands were sent for battery state of charge recovery.

   - On day 028, during the DSS-26 34m support, the 80 kW transmitter tripped off-line at 1949z and was placed back on-line at 2006z. 256 commands were sent for battery state of charge recovery. The anomaly resulted in not commanding one frequency segment. See DR# G116923 for more information.

   - On day 030, 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. To date, no downlink signal has been detected from the Behind observatory since the anomaly occurred. 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 January 14th with the 5th uplink array test successfully conducted for STEREO using DSS-24, 25, and 26. The new configuration consisted of three 34m stations using the 80 kW and two 20 kW transmitters with the HGA main lobe and with the MOC sending no-op commands. An approximate 12 dBm increase in received uplink power, as compared to a single 34m, was demonstrated with all 10 no-op commands being received correctly using the 7.8125 bps uplink rate. This will provide four times the uplink received power as a 70m station. The final test configuration will add the frequency segmented acquisition sequence to the uplink array, scheduled for February 19th. When the uplink array capability is ready, it will be used to increase the spacecraft received signal power to assist with Behind recovery commanding.

- 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 now decreasing, the LGA uplink margin returns to nominal, 6 dB for the 7.8 bps

rate, in March 2016 and the LGA downlink margin returns to nominal, 3 dB for the 12 bps rate, in December 2016.

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 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.