STEREO MOC Status Report
Time Period: 2015:362 - 2016:003

STEREO Ahead (STA) Status:

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

   - On day 362, during the DSS-63 support, telemetry lock was lost intermittently between 1227z through 1309z due to heavy rain at the Madrid complex. This anomaly resulted in the loss of 3.1 minutes of real-time and SSR data. See DR #M109135 for more information.

   - On day 001, during the DSS-63 support, telemetry lock was lost intermittently between 0936z through 1009z. This anomaly resulted in the loss of 2 minutes of real-time and SSR data. See DR #M109141 for more information.

   - On day 003, during the DSS-65 support, turbo decoder lock was lost intermittently between 1543z through 1552z. This anomaly resulted in the loss of 115 frames of real-time and SSR data.

   - On day 003, during the DSS-43 support, telemetry lock was lost intermittently between 2044z through 2108z due to heavy rain at the Canberra complex. This anomaly resulted in the loss of 1.2 minutes of real-time and SSR data. See DR #C111648 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 which was at 119 degrees C with the HGA angle at 7.1 degrees, with respect to the spacecraft-Sun line.

   - On day 362, the prime science downlink rate of 720 kbps was resumed during 70m supports as the HGA returned to the center of the main lobe for daily communications.

   - The average daily science data return for Ahead was 4.2 Gbits during this week.

STEREO Behind (STB) Status:

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

   - On day 364, during the DSS-43 70m support, 225 commands were sent for battery state of charge recovery.

   - On day 365, during the DSS-14 70m support, 189 commands were sent for battery state of charge recovery.

   - On day 001, during the DSS-14 70m support, 440 commands were sent for transmitter carrier recovery. The DSN did not detect the downlink signal. 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 day 2014-274, are listed below. Recovery operations resumed on November 30th.

   - The Behind observatory entered superior solar conjunction at the 2.0 degree SPE angle on day 022. Recovery efforts resumed post solar conjunction on day 124, May 4th through day 178, June 27th, 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 29th. 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 will 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 day 272, September 29th. 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 day 323, November 19th, with the 4th uplink array test successfully conducted for STEREO using DSS-26 and 25. The new configuration tested consisted of two 34m stations utilizing the 80 kW transmitter on DSS-26 and the 20 kW transmitter on DSS-25 with the HGA main lobe, riding along a one degree offset, with the MOC sending no-op commands. An approximately 3 dBm increase in received signal power was demonstrated when the DSS-25 uplink was phased to the DSS-26 uplink at the spacecraft with all 20 no-op commands being received correctly using the 7.8125 bps uplink rate. The 5th uplink array test is scheduled for January 14th, testing the use of three 34m stations using the 80 kW and two 20 kW transmitters with the HGA main lobe. This should provide twice the uplink received power as a 70m station. 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 day 2014-274, October 1st, 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.