

STEREO MOC Status Report  
Time Period: 2016:018 - 2016:024

STEREO Ahead (STA) Status:

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

- On day 018, a PN ranging demonstration was conducted during the DSS-15 support. There was no instrument commanding or SSR playback as the DSN track services are not committed. At 2254z, telemetry lock was lost due to receiver issue. A second receiver was placed on-line at 2321z. The DSN reported partial success for this demonstration. 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# G116896 and G116898 for more information.
- On day 021, MOps was alerted that DSS-35 had been declared red due to an X-band receiver issue with an ETRO of day 027-0542z. The on board timetags for the scheduled day 023 support were deleted to prevent SSR data loss. This anomaly resulted in the loss of 5.2 hours of commanding and two-way tracking data. See DR# C111709 for more information.
- On day 023, during the DSS-54 track, real-time telemetry and monitor data were not received in the MOC between 1337z and 1650z (EOT) due to the SLE telemetry bind being dropped as a result of a network issue at JPL. Post pass, it was noticed that no IDR files were created during the outage period. The DSN created the IDR files and all SSR data was recovered. This anomaly resulted in the loss of 3.2 hours of real-time telemetry and monitor data. See DR# N110230 for more information.
- On day 023, during the DSS 26 track, a transmitter glitch caused the command system to abort at 2359z. This anomaly had no impact, as it occurred after the commanding window had expired, approaching EOT. See DR# G116910 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 7.6 degrees and increasing, with respect to the spacecraft-Sun line.
  - On day 021, the 84<sup>th</sup> momentum dump was executed successfully at 2300z, which imparted an estimated delta V of 0.110 m/sec. This was the 3<sup>rd</sup> momentum dump that did not use the IMU. After thruster operations completed, there was a 1.1 degree of roll angle error which was dampened out over the next 20 minutes. Fine pointing stabilized 2.2 minutes after completion of the momentum dump.
  - The average daily science data return for Ahead was 5.0 Gbits during this week.

STEREO Behind (STB) Status:

1. The following Ground System anomalies/events occurred during this reporting period:
  - On day 018, during the DSS-43 70m support, 342 commands were sent for battery state of charge recovery.
  - On day 019, during the DSS-26 34m support, using the 20 kW transmitter as the 80 kW transmitter was red, 234 commands were sent for battery state of charge recovery. See DR# G116903 for more information.
  - On day 020, during the DSS-14 70m support, 380 commands were sent for transmitter carrier recovery. The Allen Telescope Array observed concurrently, however, no downlink signal was detected by them or 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 4<sup>th</sup> 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 28<sup>th</sup> 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 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 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 14<sup>th</sup> with the 5<sup>th</sup> 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 19<sup>th</sup>. 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.