

STEREO MOC Status Report
Time Period: 2016:123 - 2016:129

STEREO Ahead (STA) Status:

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

- On day 124, during the DSS-26 support, turbo decoder lock was lost briefly at 125-0049z. This anomaly resulted in the loss of one frame of SSR data.
- On day 125, during the DSS-55 support, turbo decoder lock was lost briefly at 0849z and again at 0908z. This anomaly resulted in the loss of 3 frames of SSR data.
- On day 126, during the DSS-26 support, a power glitch at the station during pre-track calibration activities resulted in a late uplink sweep. Data lost due to the late sweep was recovered as all SSR pointers were repositioned once the uplink was established. See DR# G117085 for more information. Two subsequent power glitches occurred at 1655z and 2127z. SSR pointers were again repositioned following both anomalies. See DR#s G117089 and G117094 for more information. Telemetry and command binds were dropped from 1850z through 1859z due to a network glitch between Goddard and JPL. See DR# N110284 for more information. These anomalies resulted in the loss of only a few frames of SSR data.
- On day 127, during the DSS-25 support, the maser receiver was declared red at BOT. Since the station could not consistently hold turbo decoder lock on the scheduled 240 kbps downlink using the XHEMT receiver, MOps commanded the downlink to 160 kbps, with lock occurring at 1632z. Once the uplink was established, all SSR pointers were repositioned and the SSR restarted at the 160 kbps downlink rate. See DR# G117100 for more information. A power glitch at the station resulted in a loss of the services between 2051z and 2149z. SSR pointers were again repositioned following the anomaly. These anomalies resulted in the loss of only a few frames of SSR data. See DR# G117101 for more information.

- On day 128, during the DSS-65 support, turbo decoder lock was lost briefly at 1142z. This anomaly resulted in the loss of one frame of SSR data.
- On day 128, during the DSS-14 Return to Service engineering demonstration support, there was no SSR playback or instrument commanding. During the setup period, the station reported that the microwave interface was not working. The BOT/AOS was delayed by 13 minutes and the uplink by 20 minutes. DR# G117121 was opened to document the problem. The downlink was acquired successfully. All 4 CLTUs sent were received successfully by the spacecraft. Conscan was enabled after the 2-way mode with the observed offsets of 1.8 mdeg in AZ and 1.0 mdeg in XEL indicating that DSS-14's pointing model was good.
- On day 128, during the DSS-35 support, turbo decoder lock was lost briefly at 129-0339z. This anomaly resulted in the loss of one frame of SSR data.
- On day 129, during the DSS-55 support, turbo decoder lock was lost intermittently between 0817z and 1452z due to heavy rain at the Madrid complex. This anomaly resulted in the loss of 3648 frames of real-time and SSR data. See DR# M109348 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 101 degrees C and decreasing with the HGA angle at 10.5 degrees and increasing, with respect to the spacecraft-Sun line.

- The average daily science data return for Ahead was 5.5 Gbits during this week.

STEREO Behind (STB) Status:

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

- None as recovery tracks are every other week.

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.
- 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. Weekly recovery operations resumed on November 30, 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 only in view mid-April through mid-September. Recovery operations were reduced to every other week beginning on March 21st to minimize the impact on DSN resources.
 - 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, the first use of the newly developed DSN uplink arraying capability for Behind recovery operations occurred on March 17, 2015. The uplink array capability provides four times the uplink received power as a 70m station. The uplink array consists of using an 80 kW and two 20 kW transmitters from three 34m Goldstone stations, DSS-24, 25, and 26, with each uplink being precisely phase shifted to create a constructive interference. From testing with STEREO Ahead, an approximate 12 dBm increase

in received uplink power, as compared to a single 34m, has been successfully demonstrated each time. As the Behind observatory may be rotating, a frequency segmented acquisition sequence will be used with the uplink array. For each use of the uplink array, as transponder feedback is required, the Ahead observatory is first used to calibrate the phased uplink array then the three stations are switched to point to the Behind observatory sending commands for recovery. The uplink array will be used twice monthly within a three day period, once for battery recovery and again for carrier recovery. The next use of the uplink array is scheduled for May 13th and 14th.

- As time goes by, the ephemeris error increases degrading DSN antenna pointing. However, with time the spacecraft range also decreases improving RF communications and the ability for other assets to acquire data on Behind. Analysis indicates that the total RF gain change is significant and the probability of command success increases with time.

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.