

## DISCUSSION CONCLUDING AAS 13-509

CHRIS TUASON asked STEVE MALYS if the National Geospatial-Intelligence Agency (NGA) had gotten user feedback on the GPS SVN59 anomaly. MALYS replied that NGA has people on station at the U.S. Air Force's GPS Control Segment and there is constant coordination to make sure that further anomalies do not happen. As far as direct feedback from the general population of GPS users, NGA does not receive this. The U.S. Coast Guard is set up to handle that; they have a public interface with GPS users and get comments from that community. However, no word had been received from the U.S. Coast Guard regarding this particular anomaly.

During his presentation, MALYS mentioned that a less-experienced operator had incorrectly responded to a system prompt asking if a leap second should be applied. JOHN SEAGO therefore asked if there was a way to eliminate the human element as it relates to the application of leap seconds. MALYS pondered the question, and then replied that, from his perspective, it is important to always have a human in the loop to monitor what is happening. The same is true for tracking data, which comes in continually. It was not necessarily desirable to trust automated algorithms to discover all potential anomalies. Therefore, people monitor terminals and look for outliers "to make sure that things are okay." There will always be a need to have people involved; the only questions are how many and working out redundancy, which depends on the mission and its level of importance. GPS is probably one of the world's most-visible satellite systems, and one would not want a computer deciding for itself that an anomaly is taking place. MALYS explained that the young officers from the 2nd Space Operations Squadron (2SOPS) operating the Global Positioning System have very detailed information available to them; if something comes up "red" on their screens they pay very close attention. The interface is designed to make sure that they pay attention to anything that might be anomalous; they are highly trained. MALYS does not see people being out of the process.

TUASON asked about simulation as a quality-assurance (QA) step. MALYS said that simulations do occur, and although this kind of thing is difficult to simulate, it could be done. If some change is made to UTC—say, future leap seconds go away—lots of simulations would be performed to ensure that everything would work correctly as UTC diverged from UT1. There would need to be lots of simulations to capture all the steps in the chain of events. TUASON wondered if a simulator would have shown this satellite being rejected before the flawed data was uploaded. MALYS replied this particular anomaly could have been simulated, but it was not a scenario that had ever been simulated up to that time.

During his presentation, MALYS showed the ground-track of SVN59 over the Sahara Desert during the broadcast anomaly. ROB SEAMAN commented that if one is out in the middle of the Sahara Desert, then one has either a very high, or very low, need for terrestrial coordinates. SEAMAN's remark produced some laughter, after which SEAMAN continued that he was "flabbergasted that you detected it and corrected it in under half an hour." MALYS said that another analyst in his office made the detection. She knew to call the Air Force to tell them that a mistake had been made and that further space-vehicle uploads should be suspended until NGA sends them corrected files. "The personal relationships between these people are important; they learn to trust

each other and learn to work with each other.” That is part of the reason why the correction happened so fast.

GEORGE KAPLAN said that by the time the actual leap second occurred, it seemed that GPS handled it without any problem. MALYS affirmed this, saying that leap-second procedures are very well documented and that NGA has dealt with leap seconds many times. The people who are experienced at handling leap seconds are very good at making sure that things go smoothly; extra eyes will look at the files that go back and forth before implementation. This was the first issue related to a leap second that has occurred in very many years; leap seconds have gone smoothly for about as long as MALYS could remember.