General John Hyten

Interview with U.S. Air Force Space Commander

Since Gen. John E. Hyten assumed leadership of Air Force Space Command in August 2014, he has been wrestling with a host of challenges including delays in the modernization programs for the GPS space segment and GPS military user equipment.

Moreover, this summer, the Air Force declared a critical Nunn-McCurdy breach for the Next Generation Operational Control System (OCX), the new

CYGNSS To Use GPS Signals for Weather Prediction Project

NASA plans to launch its Cyclone Global Navigation Satellite System (CYGNSS), aboard a Pegasus XL rocket, on November 21 at Cape Canaveral Air Force Station, Florida.

CYGNSS will consist of eight small satellites shot into orbit on a single launch vehicle.

The mission will allow researchers to examine the relationship between ocean surface properties, moist atmospheric thermodynamics, radiation, and convective dynamics. The information will determine how tropical cyclones form — and whether or not they will strengthen — to allow better forecast and tracking of the storms. NASA postponed the mission from an earlier launch date of October 17.

While in orbit, the satellites will receive both direct and reflected signals from GPS satellites. The satellites will use GPS signals to study how tropical cyclones grow stronger over warm ocean waters. The direct signals pinpoint CYGNSS observatory positions, while the reflected signals respond to ocean surface roughness, from which wind speed is retrieved.

NASA said that the CYGNSS satellites have successfully completed functional and environmental testing at the Southwest Research Institute (SwRI) in San Antonio, Texas. The tests simulated harsh space and launch environments, with all of the spacecraft were placed in a vacuum chamber and cycled through the extreme hot and cold temperatures they will face in orbit.

Air Force Disposes of Last GPS IIA Satellite

The U.S. Air Force’s 2nd Space Operations Squadron (2SOPS) at the 50th Space Wing, Schriever Air Force Base, Colorado, has moved the longest-serving GPS satellite, space vehicle number (SVN) 23, into a disposal orbit several hundred miles above the operational GPS constellation.

According to Capt. Aaron Blain, 2SOPS flight commander, the current configuration of the satellite is as follows: vehicle spinning at 25 rpms, all components powered down, batteries cannot hold charge, and defueled.

All of these actions place the vehicle in its safest configuration for this vehicle type, Blain says. The spinning allows for a uniform exposure to the sun, while the defueling (done via a depletion burn) and battery configuration limit the risk of an explosion or rupture.

As part of the disposal, the satellite was raised about 1,000 kilometers (620 miles) above the operational orbit of the GPS constellation, but also well below the Galileo and BeiDou constellations. During the burns, extra care is taken to minimize eccentricity to circularize the orbit and limit perturbations.

A Lengthy, But Checkered History

SVN23, which was launched on November 26, 1990, had a rough start. After early-orbit operations and initial stabilization in December 1990, SVN 23’s solar array stopped working.
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The program to acquire GPS III Space Vehicles 1–10 has adapted to new technological developments such as upgraded solar arrays and Li-Ion batteries.

GPS ground system. This determination that the OCX development effort is running seriously beyond its planned budget boundaries means cancellation of the program is now automatic unless Secretary of Defense Ashton Carter certifies to Congress the necessity for OCX and describes how the Pentagon will bring its costs and schedule back in line.

With the fresh start of a new federal fiscal year just weeks away, Gen. Hyten wrote about the plans he has for the GPS program in response to a series of questions from Inside GNSS.

GPS is a worldwide enabler that billions of users depend on, and it’s critical to keeping the United States in the forefront of position, navigation, and timing (PNT) services across the globe. To do that, we need to get OCX through the Nunn-McCurdy process. Once the Department makes its decision on the way forward, we’ll need to move out smartly on a supportable baseline.

On the space side, the GPS III satellites are moving closer to launch availability. We have a few technical issues to sort through, but that’s to be expected on a first-of-a-line satellite. I was very encouraged with GPS III Space Vehicle-1 successfully completing thermal-vacuum testing in just two and half months. That’s quite a feat for a first article. We’re also moving forward this next year toward the full production of GPS III; so, it’s really important that we lock in the requirements and set to give it a solid foundation.

I shouldn’t forget about GPS User Equipment. We have a big acquisition milestone coming up in October and are working through some tough challenges to get Military-Code (M-Code), the most secure anti-jam & anti-spoof navigation and timing capability ever provided, delivered to the Services. It’s vital to delivering reliable military GPS capability to the Services.

A critical factor for all these programs is a stable budget picture that will ensure we can accomplish all of this next year and set us on a path for success. An equally important goal in achieving modernization is taking care of our people. Air Force Space Command has some of the world’s preeminent experts in PNT supporting the program. GPS is a “global utility” and, while we have some tough challenges ahead of us, my entire government and contractor team is incredibly committed to the mission. I’m equally committed to providing them the tools and support they need to be successful.

Inside GNSS: What goals do you want to see the GPS program achieve over the coming fiscal year? What factors could impact the GPS program’s chances of achieving those goals?

Gen. Hyten: My main goal this next year is stabilizing modernization of the GPS Enterprise. GPS is a worldwide enabler that billions of users depend on, and it’s critical to keeping the United States in the forefront of position, navigation, and timing (PNT) services across the globe. To do that, we need to get OCX through the Nunn-McCurdy process. Once the Department makes its decision on the way forward, we’ll need to move out smartly on a supportable baseline.

Inside GNSS: The Air Force has put contingency plans into place in case the OCX system, as now envisioned, cannot be completed successfully. What is the long-term plan if the current OCX program cannot be fully executed? Must the Air Force start over on developing a new ground system or are those contingency plans potentially the foundation for a permanent solution?

Gen. Hyten: It would be premature for me to speculate on long-term plans based on a final decision on OCX. I can say that the Air Force has already made the decision to implement GPS III Contingency Operations (COps) to mitigate OCX delays. Our work on this COps capability is in parallel with OCX Block 0. It will allow Air Force Space Command to launch and fly the GPS III constellation at a capability level commensurate with GPS IIF and maintain constellation reliability. We expect OCX Block 0 delivery by May 2017 and COps delivery by April 2019. (See related article on page 6.)

Inside GNSS: Efforts to speed development of new M-code capable cards for the Military GPS User Equipment (MGUE) program have hit some snags. What changes, if any, is the Air Force considering for the MGUE program?

Gen. Hyten: The basic strategy of the MGUE program is not changing. We are working closely with our industry partners, L-3, Raytheon, and Rockwell Collins, in a competitive marketplace environment to deliver next-generation, secure M-Code capability. We’ve put a lot of emphasis in testing our prototypes to characterize performance and provide feedback to industry. The Air Force is also working hard with the services to ensure a common understanding of requirements for Increment 1, our first delivery, and to support integration into lead weapon system platforms across the Department of Defense.

Inside GNSS: What changes, if any, is Space Command considering for the GPS III program — perhaps to reflect
program shifts, take advantage of technological advances, or to address the evolving threat to space assets?

Gen. Hyten: The program to acquire GPS III Space Vehicles 1–10 has indeed adapted to new technological developments such as upgraded solar arrays and Li-Ion batteries. In the next block of GPS III satellites (Space Vehicles 11–32), Air Force Space Command remains committed to delivering unparalleled space-based position, navigation and timing services, and will assess the evolving threats, generate requirements responsive to meet those threats, with balance against the reality of ever-tightening budgets. We recently also began a Production Readiness Feasibility Assessment to better understand if industry has production ready designs to meet our requirements.

Inside GNSS: There has been interest expressed in the past about incorporating the signals of non-GPS satellite navigation constellations into military user equipment and operations. Where does work on that idea stand and what kind of potential do you see for this concept?

Gen. Hyten: Incorporating the capability to track signals from other Global Navigation Satellite Systems (GNSS) into military user equipment provides the possibility of improving resilience to jamming, spoofing, and operations in obstructed terrain. The challenge for Air Force Space Command would be ensuring the integrity of the foreign signals.

There is extensive work going on within the GPS community to develop approaches to assess multi-GNSS integrity. The Department of Transportation is taking the lead on the main effort, known as Advanced Receiver Autonomous Integrity Monitoring (ARAIM), with support from the Space and Missile Systems Center (SMC) and PNT experts from academia. Once the technical aspects are well understood, the Command will ensure that potential approaches are communicated and coordinated throughout the PNT community.
New Products & Company News @ ION GNSS+

NovAtel Launches Next-Generation OEM7 GNSS

Today at ION GNSS+ 2016, NovAtel Inc. (Booth B) unveiled its new OEM7 positioning engine. Leveraging previous generations of precise positioning technology, the OEM7 incorporates new capabilities and features designed to substantially enhance GNSS-based positioning reliability, accuracy, and availability, the company says.

The OEM7 family expands the receiver options open to system integrators with five GNSS receiver cards available, including the new OEM7600, the company’s smallest, lightest dual-frequency receiver card ever developed, according to NovAtel.

All cards have 555 available channels, are multi-constellation– and multi-frequency–capable, and provide advanced interference awareness and mitigation capabilities. Moreover, every OEM7 card can receive satellite-based TerraStar precise point positioning (PPP) correction data, offering centimeter-level positioning worldwide, NovAtel says. A new compact enclosure, the PwrPak7, houses OEM7 receiver technology and offers...
16-gigabyte onboard data storage, built-in Wi-Fi and serial, USB, CAN, and Ethernet for ease of integration.

NovAtel says that a cornerstone of the OEM7 platform is the Interference Toolkit, which can be used to detect sources of interference and intentional and unintentional jamming and then mitigate such occurrences using proprietary NovAtel filters. Integrators can take advantage of a spectrum analysis function that identifies which GNSS frequency is experiencing the interference. Further, it can also detect electromagnetic interference caused by other components in an integration project, allowing developers to implement the filter and eliminate the problem.

NovAtel’s SPAN technology is supported on every OEM7 receiver, providing tightly coupled GNSS/inertial technology incorporating a variety of available inertial measurement units (IMUs) to provide continuous 3D positioning, velocity, and attitude even through periods of blocked or unavailable GNSS signal reception.

**Spirent Shows Interference Detection and Analysis Unit**

Spirent Communications plc’s Positioning Technology Unit (Booth A) has announced the GSS200D Interference Detection and Analysis solution, developed as part of Spirent’s partnership with Nottingham Scientific Limited.

The GSS200D comprises field-based hardware and a secure data server for automatic capture and analysis of GNSS radio frequency interference. According to the Paignton, UK–based company, deployments of GSS200D probes provide users with a thorough understanding of the RF interference (RFI) environment at sites of interest.

Operating simultaneously on GPS, GLONASS, and Galileo in the L1 band, the GSS200D’s functionality enables a wide range of users, such as critical infrastructure communications, broadcast and power distribution, civil aviation, road user charging and autonomous vehicles to detect, characterize, and classify RFI sources that may affect their services, the company says.

Captures of RFI events are logged and stored on PT Cloud, Spirent’s secure cloud infrastructure, allowing the end user confidential access to the results via a web portal. Advanced analytics and reporting features include visualization of both spectrogram and spectrum, as well as characterization of the type and priority of interferences, enabling monitoring over time and in-depth trend analysis, according to Spirent. On-premise server options are also available.

Spirent has already detected thousands of disruptive GPS L1 interference events with its global network of GSS100D detectors. By adding support of additional frequencies and constellations, as well as improving the analysis and reporting, the company is targeting the GSS200D at critical infrastructure and civil aviation customers. Spirent will demonstrate the GSS200D at its booth during ION GNSS+ 2016.

**Inside GNSS magazine and exhibit**

Visit the Inside GNSS exhibit (Booth 409) and meet its 10-member contingent, including new managing editor Kevin Dennehy and new business development manager Steve Copley. Other Inside GNSS-ers attending ION GNSS+ 2016 include Brussels correspondent Peter Gutierrez; Washington, D.C., editor Dee Ann Divis; art director Gwen Rhoads, editor and publisher Glen Gibbons, publisher and business development director Richard Fischer, web editor Sierra Robinson, director/co-owner Eliza Schmidkunz, and graphic artist Christine Waring.

ION GNSS+ 2016 exhibitors with company news for the Show Daily, which Inside GNSS produces for the ION, may drop off information at the booth, too.

**GPS Networking Introduces Dual Antenna Rack Splitter**

GPS Networking has introduced its dual-antenna rack mount splitter that is ideal for timing and testing applications, the company said. The unit features two antenna inputs, 16 outputs, flat group delay, and high-isolation option. In addition, the splitter’s frequency response covers the GPS L1 and L2 bands with excellent gain flatness, GPS Networking said.

Earlier this year, GPS Networking was selected by Oshkosh Corporation to participate in the U.S. Defense Department’s $6.7 billion Joint Light Tactical Vehicle (JLTV) program.

**IFEN Launches NCS TITAN GNSS Simulator**

At ION GNSS+ 2016 today, IFEN (Booth 208) is announcing its NCS TITAN multi-GNSS, multi-frequency and multi-RF output simulator.

With up to 256 channels and up to four RF outputs per channel, the TITAN design avoids the extra complexity and cost of using additional signal generators or intricate architectures involving several hardware boxes, IFEN says, which improves reliability without compromising functionality.

THE NCS TITAN’s supports all GNSS signals, according to the company, has the flexibility to reassign channels to different RF outputs and reconfigure simulated signals, and can be upgraded in the field.
Kendall Decision By End of September

Whitney: No Immediate GPS OCX Work Stoppage

A funding shortfall will not halt work on the new GPS ground system this month, although a decision expected in the next two weeks may signal major changes in the program.

Increased personnel costs on the Global Positioning System Next Generation Operational Control System (OCX) program had eaten up the fiscal year 2016 budget and were poised to force managers to stop work on September 15. The Pentagon had requested Congress to allow $39 million to be reprogrammed to bridge the gap but lawmakers left for the summer recess without approving the change.

The shortage emerged after the program boosted its staffing by some 25 percent to meet a new schedule set for it by Frank Kendall, the under secretary of defense for acquisition, technology, and logistics. OCX had gone through a “Deep Dive” review before Kendall in December, getting its new marching orders and a two-year extension that came with built-in quarterly reviews to ensure it was hitting its marks.

The new schedule, however, was going to force a temporary work stoppage that Pentagon budgeteers said would cost the Air Force another $90 million plus an additional four months delay on the schedule.

The last congressional committee signed off on the reprogramming on September 7, Col. Steve Whitney, the director of the GPS Directorate, told the Civil GPS Service Interface Committee (CGSIC) meeting in Portland, Oregon, on Tuesday. That money is also two-year money, he told Inside GNSS; so, it can be used to support work into fiscal year 2017, which starts October 1.

The funding should last until mid-October, according to Whitney. That happens to be about the time that Secretary of Defense Ashton Carter must decide whether or not to continue with some sort of revised version of the OCX program or allow the development effort to be cancelled.

The latest deadline is the result of serious cost growth in the OCX program. On June 30 the Secretary of the Air Force declared the program had experienced a critical Nunn-McCurdy breach — a level of cost overrun that leads to automatic cancellation unless the secretary of defense certifies the need for the program to Congress and lays out a plan for getting it back in line.

That review leading up to a possible certification is being led by Kendall, the Pentagon’s leading acquisition official. He has been holding weekly meetings, Whitney told the CGSIC, co-located with the ION GNSS+ 2016 meeting, and plans to make his recommendation by the end of September.

Secretary Carter then has until October 13 to certify the program to Congress and avoid closure.

Col. Steven Whitney

Four Galileo Satellites Ready for November Launch

Four Galileo satellites have been delivered to French Guiana for a November 17 Ariane 5 launch that officials say should enable the constellation’s initial operational services.

The satellites were flown from the European Space Agency’s technical center in Noordwijk, Netherlands.

Until launched, the satellites, space vehicles (SVs) 15 to 18, will be stored at the European Guiana Space Center. The modified Ariane 5 rocket, which will launch the satellites from Kourou, also recently arrived in the country.

The Galileo constellation currently has 14 operational satellites. Previously, the satellites have been launched two at a time by a Soyuz rocket from French Guiana. Two more four-satellite Ariane 5 Galileo launches are planned in the next two years.
The problem stemmed from an erroneous software upload as SVN 23 was taken offline. Fifteen operational GPS satellites reportedly were affected by the flaw.

Although SVN 23 had a long life, and much of its time was marred by technical difficulty, it wasn’t the worst Block IIA satellite, Czopek said. “SVN 23 was difficult, but the ‘bad boy’ of the Block, IIAs is SVN 28 — whose navigation payload ceased to function at four-and-a-half years, which was less than the contractual requirement of six years,” he said.

SVN 28’s failure triggered the first space accident investigation board done by the 50th Space Wing, Czopek said. “There is a tie for runner-up between SVN 29 and SVN 33. SVN 29 ignored ground commands to stay in the same spot; so, it was allowed to wander in its orbital plane until it was disposed.

As for SVN 33, the valve that connected the two tanks on the spacecraft failed; so, propellant would not equalize during thruster firings. “When the disposal was carried out, a wobble developed because of the failed valve. It was difficult to get both [satellites] into disposal orbits; so, my hat goes off to the crew and the contractor for getting them out of the way,” Czopek said.

SVN 23 outlasted all of its predecessors — and even others launched after it. With the implementation of a new launch, anomaly resolution, and disposal operations system (LADO), operators with 2SOPS and the 19th Space Operations Squadron at Schriever successfully disposed of SVN 29 in November 2007.

“The successful disposal of SVN-23 marks the end of decades of skillful engineering, meticulous planning, and flawless space operations,” said Lt. Col. Peter Norsky, 2SOPS commander.

Further investigation revealed an issue in the GPS ground software that affected the time on legacy L-band signals. This glitch appeared when SVN 23 was removed from the constellation.

As Inside GNSS reported earlier this year, SVN 23, the last operational GPS Block IIA satellite, was involved in two major anomalies in late January as the Air Force decommissioned the satellite. One was systemic and the other delayed the launch of the final Block IIF satellite.

For the next 14 years, in a technique called scissoring, Air Force crews and contractors manually commanded the solar arrays to move back and forth during orbit dawn and dusk, the Air Force said. More than 11 years ago, a decision was made to allow normal operations on the B side of the solar array drive, which the Air Force said “miraculously” allowed the satellite to work for its remaining 11 years of life.

“The difficulty was caused by the crews having to manual-position the arrays on a frequently basis. This went on for 15 years or so until some crew commanded auto-track function enable,” Czopek said. “It took many months to discover the arrays were tracking the sun, and since it was operating nominally, they decided to leave it in auto-track mode.”

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