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Spacecraft To Forecast Outages Impacting U.S. Military Communication Links

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The communication/navigation outage forecasting system satellite will enhance prediction of the effects of ionospheric scintillation on Dept. of Defense satellite data

At **General Dynamics**, Spectrum Astro Space Systems, Gilbert, Ariz, testing progresses on the communication/navigation outage forecasting system (C/NOFS) satellite, which when launched in February 2006, will serve as the premier mission into the heavens dedicated to forecasting ionospheric scintillation and its impact on America's military information systems.

Originated in the late 1990s, the C/NOFS program involves a partnership between two Kirtland Air Force Base, N.M., organizations, the Air Force Research Laboratory's Space Vehicles Directorate and the Space and Missile Systems Center's Detachment 12, which manages the DOD Space Test Program.

In addition, the directorate's Battlespace Environment Division, located at Hanscom Air Force Base, Mass., provides physics-based modeling and operates the C/NOFS data center.

"The C/NOFS satellite is unique because this is the first time any organization has the right suite of instruments in the right orbit for understanding and forecasting ionospheric scintillation," Dr. Laila Jeong, C/NOFS program manager, said. "The satellite will forecast outages in DOD satellite communication links that are caused by ionospheric scintillation."

During its planned one year demonstration operations in space, C/NOFS will fly in a low-earth orbit of approximately 375 by 710 kilometers, and the six onboard sensors, including a neutral wind monitor, ion velocity monitor, radio beacon, global positioning system receiver for remote ionospheric sensing, vector electric field instrument and planar langmuir probe, will provide data products to be used by the joint warfighter on the ground.

At the end of its scheduled 12-month demonstration mission, the satellite's capability will transition to the Air Force Space Command for the remainder of its estimated lifetime of four to five years.

Forecasting where and when ionospheric scintillation will occur represents the primary benefit of the C/NOFS spacecraft. With this cutting edge technology, however, researchers will also be able to predict when DOD communication satellites will experience disruptions, which impact military information systems. Ionospheric scintillation, a nighttime phenomenon, occurs most frequently 20 degrees above and below the equator.

After completing testing and evaluation at the contractor facility in Arizona, the spacecraft will be mated with the Orbital Sciences' Pegasus launch vehicle at Vandenberg Air Force Base, Calif., and then will be placed on the belly of a specifically modified L1011 aircraft for transport to the U.S. Army's Reagan Test Site, U.S. Army Kwajalein Atoll, Republic of the Marshall Islands, located approximately 2,135 miles southwest of the Hawaiian Islands.

Unlike most satellites, which are launched into the cosmos from a landbased facility, C/NOFS will be placed into orbit by the Pegasus rocket, which will be released from a center pod positioned on the same L1011 jet while in flight.

Almost six years will have transpired from program approval to scheduled launch, but the idea for C/NOFS came to fruition in the late 1990s when researchers serving with the Space Vehicles Directorate developed an idea to combine space measurements and ground-based data of the ionosphere with cutting-edge physics to forecast scintillation in the ionosphere which is located in the lower part of space from about 100 to 800 kilometers above the earth.

In 2000, the Space Vehicles Directorate entered into a memorandum of agreement with the SMC's Space Test Program regarding the C/NOFS project. As a result, AFRL would provide the satellite's scientific instrumentation and the STP would supply the spacecraft bus and launch vehicle.

Testing and evaluation of the C/NOFS six sensor payload occurred at Kirtland Air Force Base, and the payload was later integrated into the spacecraft at **General Dynamics'** facility in Gilbert, Ariz.

The C/NOFS project has encountered some setbacks such as a major delay to rebuild the spacecraft harness. Nevertheless, the space vehicle has been constructed and appears ready for launch in the next few months.

"C/NOFS is the first ever space mission dedicated to forecasting ionospheric scintillation and its impact to DOD communication systems," Dr. Jeong said. "We have also had a very dedicated effort developing our physics-based forecasting models, which were developed primarily by

Space Vehicles Directorate scientists."

Once launched, SMC Det 12's Space Vehicle Operations Directorate will manage flight operations for the year-long space demonstration mission. In addition, the C/NOFS data center, located at Hanscom AFB, will receive satellite, ground-based, and geophysical data, as well as will generate forecasting products for use by the joint warfighter. The data center facility has been operating since October 2004.

The future of predicting scintillation effects on America's military communication links has been advanced with the upcoming launch and operation of the communication/navigation outage forecasting system spacecraft.

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