Orbiter
November 2017

Certain Change, Uncertain Outcomes for the National Security Space Enterprise

by **Gabriel A Spera**
November 29, 2017

Frank Rose, the newly appointed chief of government relations, gave a briefing on Tuesday, Nov. 28, describing the broad, dynamic changes affecting the national security space enterprise — and their inevitable effect on Aerospace.

Frank Rose briefs Aerospace employees on changes in the national security space enterprise. (Photo: Elisa Haber)

One significant development began right here at Aerospace, when the board of trustees granted permission for the corporation to lobby Congress for an exemption to the STE (staff years of technical effort) ceiling to support the strategic nuclear modernization effort. Aerospace convincingly argued that an increase in the ceiling was vital to the country's national security interest, Rose said. As a result, both the House and Senate drafted language increasing the STE ceiling by 250 and 322, respectively.

The proposed ceiling change was the first in nearly 20 years, said Rose — but that's not the end of the story. The Senate has not approved its version, and the prospects of that happening grow slimmer each day. More likely, said Rose, some form of ceiling increase will be rolled into an omnibus spending bill —but there's no predicting when that would happen. Rose remains optimistic that the coming year will bring a modest increase in STE, though he is quick to point out that any such increase would not apply exclusively to Aerospace, but would be distributed among a number of FFRDCs. "The initial increase would be a good first step," he said, "but it would not be sufficient for the national security space challenges we face."

Members of the audience pay close attention to Frank Rose's briefing. (Photo: Elisa Haber)

Even larger changes have been set in motion by the latest National Defense Authorization Act (NDAA), which contains "some of the most sweeping changes to the national security space enterprise in nearly 25 years," said Rose. The House version of the bill would have established a new "Space Corps" within the Department of Defense, but the Senate version did not, and that provision was stripped out in conference. Instead, the final legislation grants significant new authority to the commander of Air Force Space Command, who will serve a six-year term and have sole authority over a number of key areas relating to space acquisitions and operations. The Principal DoD Space Advisor position will be eliminated, and the newly created Space Operations directorate A11 has been disbanded. The Operationally Responsive Space office has been renamed as the Space Rapid Capabilities Office and placed under the direct authority of Air Force Space Command. The bill also directs the Department of Defense to engage an FFRDC to assess the possibility of a separate military department responsible for national security space activities. (Rose does not expect that work to involve Aerospace, because the legislation specifically calls for an organization that is not closely associated with the Air Force.)

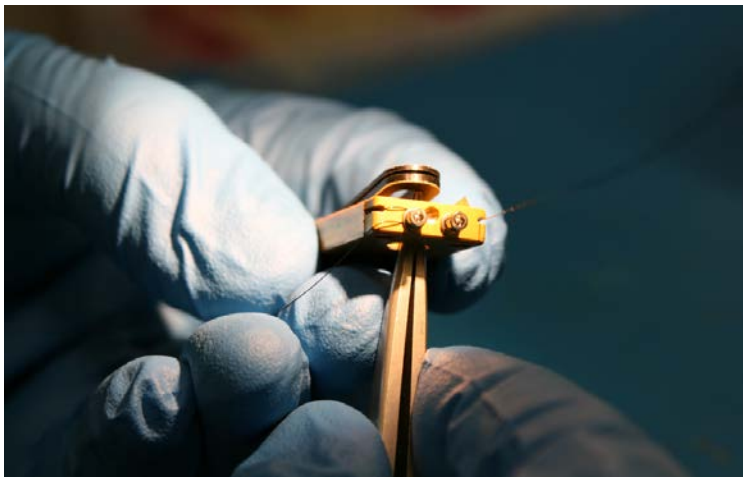
The new directives have “big implications,” said Rose, while adding, “There are a lot of unknowns at this point.” Overall, he says, the NDAA shows a broad consensus on the need to change how the government manages national security space.

On another hot topic, Rose considered the prospects for a government shutdown in the near future. Congress has until Friday, Dec. 8, to pass a new Continuing Resolution. Rose spent several years as a Congressional staffer, but even that experience is no crystal ball when it comes to Capitol Hill. Congress is pressing forward with a complex tax overhaul, and it’s unclear how the negotiations surrounding that effort will affect the current budget process. “A government shutdown is a very real possibility,” he said. “Everything is up in the air.”

Using Shape-Memory Alloys to Enhance Small Satellite Reliability

by **Gabriel A Spera**
November 07, 2017

Ideally, every critical mechanism on a spacecraft would be thoroughly tested before flight. In practice, that’s not always possible — especially for CubeSats and other small spacecraft.

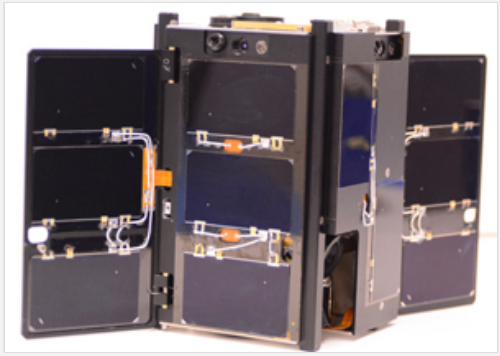


A shape-memory actuator will release solar arrays on the upcoming Optical Communications and Sensor Demonstration mission. (Photo: Aerospace)

For example, many satellites employ an actuating mechanism known as a meltwire, which uses an electrically heated wire or resistor to melt through a restraining element, thereby releasing a deployable element such as a solar array or instrument boom. Thanks to their low development cost and simplicity, they are commonly used on small spacecraft — but they have some significant drawbacks. By design, they can only be used once, which means that the actual flight unit cannot be tested before flight. As a result, developers must spend a considerable amount of time and expense to repeat the actuation tests enough to ensure reliability. This can lead to undertesting.

Jerry Fuller of Small Satellite Development and Operations has been investigating reliable alternatives to meltwires, particularly for small satellites. His current research has focused on the use of shape-memory alloys such as nickel-titanium (nitinol). These materials can change shape in response to a change in temperature, which makes them potentially quite useful for applications requiring precise and reliable movement. Moreover, they can be used and reset many times, so the actual flight article can be the one that gets tested.

Nitinol actuators for spacecraft are not new, but they have been largely overlooked by the CubeSat community—despite their unique benefits. For example, these mechanisms can be designed to be “nearly two-dimensional,” Fuller says, which should make them highly desirable for applications that can’t afford much mass or volume.



The OCSD/AeroCube 7 spacecraft. (Photo: Aerospace)

Fuller is exploring various design options. The most basic approach replaces the meltwire with a length of nitinol wire. When heated (by means of an electrical current), the wire contracts, removing a restraint. This approach exploits an unusual property of nitinol: it can be made to shrink—rather than expand—when heated.

To create such a mechanism, Fuller says, a length of wire is “trained” during fabrication to be a certain length. “If you stretch it a little bit, then heat it up (usually to about 90 degrees Celsius), it will contract to its original, trained, length.” The trick, he says, is to design a mechanism that can reliably take advantage of that small, precise contraction to do something useful. “Generally, this means mechanisms that are over an inch in length.” Typical designs involve “tiny wires, about six thousandths of an inch in diameter,” he says. These wires can deliver a pull force greater than a Newton (about a quarter of a pound).

Many of these mechanisms also take advantage of the “superelastic” properties of nitinol. “We often use superelastic nitinol in place of a steel spring,” Fuller explains. “You can bend it more sharply before it exceeds its elastic limit.”

Actuators made from shape memory alloys have flown on several CubeSats built by Aerospace and are scheduled to fly on upcoming missions as well. There are even commercial off-the-shelf units on the market. The devices are well-suited to space applications, as they are light and simple and can be employed in tight spaces. Even on large spacecraft, these small actuators can play a useful role. They can often be designed without lubrication, and they don't suffer from residual magnetism (as electric motors or solenoids do). They can be tested and reset with ease and can often be adapted to new situations where other devices wouldn't fit. "We've used shape-memory wire actuators to release solar arrays, deorbit-drag devices, antennas … Virtually any one-time-use actuator can be designed as a shape-memory wire actuator," Fuller says.

Although Fuller has been focusing mostly on CubeSats, actuators made from shape-memory alloys will ultimately improve the reliability of spacecraft across a range of mass classes. "Shape-memory actuators will allow developers to build mechanisms that deploy antennas, solar arrays, or instruments that can be tested much more conveniently than other release devices that must be replaced with each test."

Press Release: Aerospace CubeSats launched for NASA's Optical Communications and Sensor Demo Mission

November 13, 2017

EL SEGUNDO, Calif. (Nov. 12, 2017) – Two innovative 1.5-unit CubeSats designed and built by The Aerospace Corporation (Aerospace) were successfully launched today from NASA's Wallops Flight Facility in Va. aboard Orbital ATK's Cygnus spacecraft.

Both CubeSats were developed for NASA Ames Research Center's second Optical Communications and Sensor Demonstration (OCSD) mission. This mission focuses on two significant capabilities of value for future small spacecraft missions: high-speed optical transmission of data and proximity operations between two small satellites–both capabilities not previously demonstrated in spacecraft of this size.

"Our primary mission for OCSD is to demonstrate laser communications by using a laser on the spacecraft to downlink data to our optical ground station on Mt. Wilson in California," said Richard Welle, Aerospace senior scientist and one of the principal investigators for OCSD. "This is the first CubeSat laser communications system that will demonstrate an optical downlink. This compact laser package with its potential for much higher rates proves a promising future for CubeSat-scale laser communications."

Welle notes that each spacecraft is equipped with ultra-small star trackers, critical for precision pointing of the laser communications hardware–the laser is hard-mounted to the individual CubeSat body, with the beam pointed by controlling the orientation of the entire spacecraft.

"This innovative approach, combined with expected improvements in attitude control, will eventually enable CubeSats to downlink data at rates in excess of 1 gigabit per second," said Welle. "The precision attitude control system in OCSD is expected to enable pointing to an accuracy of better than .05 degrees, supporting 200 megabits-per-second downlinks."

The second OCSD mission, proximity operations, will involve the two satellites approaching and maneuvering around one another, within a range of 200 to 2000 meters. Welle adds that the operations will involve relative position measurements using cameras, beacons, laser rangefinders, and relative maneuvering using variable drag and propulsion.

The novel propulsion system on OCSD uses water as a propellant, which is exhausted as steam. Capabilities in proximity operations will enable multiple small spacecraft to operate cooperatively during future scientific or space exploration missions.

Also included in this launch is the Cubesat Multispectral Observation System (CUMULOS), an experimental remote-sensing payload developed by Aerospace, which flies on the NASA Jet Propulsion Laboratory Integrated Solar Array and Reflectarray Antenna (ISARA) CubeSat mission. CUMULOS is a compact, 3-camera system that will study the utility of passively cooled commercial infrared cameras for weather and environmental monitoring missions. CUMULOS is composed of a visible wavelength camera, a short-wavelength infrared camera, and a long-wavelength infrared, microbolometer camera.

About Aerospace CubesSats

Researchers at The Aerospace Corporation have pioneered the development of nanosatellites (1–10 kilograms) and picosatellites (0.1–1 kilograms) for the past two decades. These technologies can save money while increasing accessibility to space. Aerospace's development program in miniature satellites began in 1992, and the flight program in 1999. Aerospace flew a pair of 250-gram picosatellites in 2000 that measured just 1 x 3 x 4 inches. Up until 2013, these spacecraft were the smallest active satellites ever flown.

Since 1999, Aerospace has flown 29 nano- and picosatellites, with four more scheduled to launch in 2018. Aerospace is currently operating 10 CubeSats, called AeroCubes, in orbit.

Aerospace Observes Veterans Day and Native-American Heritage Month

by **Kimberly Locke**
November 13, 2017

U.S. military veterans and Native Americans were at the forefront of the corporation's West and East Coast observances of Veterans Day and Native-American Heritage Month held Nov. 8 and 9, respectively. Both events opened with a presentation of colors.

Jerry Elliott-High Eagle shares his experiences at NASA as well as thanks veterans during the El Segundo program. (Photo: Elisa Haber)

At the Nov. 8 combined observance of Native-American Heritage Month and Veterans Day, the Aerospace American-Indian and Alaskan-Native Council and Aerospace Military Veterans, two of eight employee resource groups at Aerospace, paid tribute to the contributions of U.S. armed forces veterans and the service and varied efforts of Native Americans throughout history.

Steve Isakowitz, Aerospace president and CEO, acknowledged the contributions of veterans, and in particular, Native-American veterans, during the event held at the corporation's El Segundo offices.

"We salute the extraordinary sacrifices of nearly 20 million living U.S. veterans and their families for our nation's well-being," said Isakowitz. "We also recall the heroism of a unique intersection of these two groups: Native-American and Alaskan-Native veterans. By one estimate, there are more than 135,000 such veterans in the U.S.," he added.

Steve Isakowitz, left, and Jerry Elliott-High Eagle share a light-hearted moment following the event. (Photo: Elisa Haber)

Retired Air Force Maj. Gen. Robert "Rosie" Rosenberg discusses the evolution of the NRO at the East Coast Veterans Day observance. (Photo: Kelly Hart)

Isakowitz also introduced guest speaker Jerry Elliott-High Eagle, who spoke on the theme, "Nations Within a Nation." Elliott-High Eagle, who has had a long and distinguished career at NASA, shared some of his space program experiences including playing a pivotal role in returning the Apollo 13 crew safely back to Earth following a critical mission failure.

For his efforts on Apollo 13, Elliott-High Eagle was presented the Presidential Medal of Freedom. He also gave some insights into how diversity of thought and ethnicity play important parts in ensuring the optimum approaches to problem solving are explored.

He concluded his remarks by underscoring the significant work being done by the American-Indian Science and Engineering Society (AISES), a national, non-profit organization focused on substantially increasing the representation of American Indians, Alaska Natives, Native Hawaiians, Pacific Islanders, First Nations and other indigenous peoples of North American in science, technology, engineering and math (STEM) studies and careers. Elliott-High Eagle is an AISES founder.

Retired Maj. Gen. Robert “Rosie” Rosenberg, whose 30 year service in the U.S. Air Force included serving as deputy director and then acting director for the National Reconnaissance Office (NRO) Staff from 1974 to 1976, was the guest speaker at the Nov. 9 East Coast observance held in Chantilly, Virginia.

He spoke on the topic, “National Reconnaissance from the ’50s, I Was There at the Start.” Rosenberg shared how NRO programs have evolved since the 1950s with emphasis on the early days of the NRO.

The Aerospace Brass Band performed a variety of patriotic songs during the program.

A wreath-laying ceremony in honor of all those military who served and gave all concluded the East Coast observance.

Kelly Hart contributed to this story from Chantilly.

Program Office Reaches Out to ETG

November 16, 2017

On Tuesday, Nov. 14, Space Program Operations (SPO) and the Aerospace Career Development Club hosted the first outreach event in a series of events aimed at demystifying SPO for employees in the Engineering and Techology Group (ETG).

Kevin Bell, vice president of SPO, provided a short overview of the Space Warfighting Construct (SWC) as well as SPO’s role in its support. This was followed by a panel discussion featuring individuals from SPO and ETG who discussed the day-to-day realities of working in a program office, while also addressing and dispelling some misconceptions about the program office.

Audience questions were taken after the panel session, at which time representatives from each SPO division were on hand to answer questions about working in SPO.

— Eric Cheevers

Panelists discussed working in a program office. (Photo: Elisa Haber)

November 2017 Obituaries

by **Jessie Ding**
November 01, 2017

Sincere sympathy is extended to the families of:

Delbert Bakeman, member of technical staff, hired Dec. 1, 1960, retired April 1, 2016, died Oct. 10, 2017
Michael Bonaventura, member of administrative staff, hired Feb. 24, 1981, retired Oct. 1, 1993, died Oct. 21, 2017
Lloyd Deffenbaugh, member of administrative staff, hired July 10, 1967, retired April 1, 1979, died Sep. 9, 2017
Daniel G. Emdee, member of technical staff, hired June 11, 1990, retired Nov. 1, 1993, died Sep. 10, 2017
Helen C. Houle, office of technical staff, hired Oct. 3, 1960, retired Nov. 1, 1994, died Oct. 1, 2017
William L. James, member of technical staff, hired Aug. 15, 1967, retired Oct. 1, 1996, died Oct. 17, 2017
Karen A. Karvelas, office of technical staff, hired Aug. 19. 1991, retired April 1, 2008, died Sep. 2, 2017
Donald H. Kienle, member of technical staff, hired Nov. 20, 1972, retired Nov. 1, 1993, died Oct. 21, 2017
Robert Mack, member of technical staff, hired Nov. 23, 1968, retired Nov. 1, 1991, died Oct. 17, 2017
James O'Leary, member of technical staff, hired May 26, 1969, retired March 1, 1997, died Oct. 5, 2017
Edward S. Ozaki, member of technical staff, hired Jan. 14, 1962, retired Oct. 1, 1993, died Sep. 27, 2017
Allen Saiget, member of administrative staff, hired Oct. 3, 1960, retired March 1, 1983, died Oct. 14, 2017
Arlene T. Stern, office of technical staff, hired June 29, 1970, retired June 1, 2003, died Oct. 7, 2017

To notify Aerospace of a death and have it included in the Orbiter, please contact People Operations at (310) 336-5107

These articles are reprinted from The Orbiter, a publication of
The Aerospace Corporation
2310 E. El Segundo Blvd.
El Segundo, CA 90245-4691

310-336-5000
www.aerospace.org

Orbiter staff: orbiter@aero.org
Editor: Lindsay Chaney, 310-336-0961, lindsay.d.chaney@aero.org