NASA Goddard network maintains communications from space to ground

March 1 2016

NASA's Goddard Space Flight Center in Greenbelt, Maryland, will monitor the landing of NASA astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko from their Year in Space Mission. Goddard's Network Integration Center, pictured above, leads all coordination for space-to-ground communications support for the International Space Station and provides contingency support for the Soyuz TMA-18M 44S spacecraft, ensuring complete communications coverage through NASA's Space Network. The Soyuz 44S spacecraft will undock at 8:02 p.m. EST this evening from the International

Space Station. It will land approximately three and a half hours later, at 11:25 p.m. EST in Kazakhstan. Both Kelly and Kornienko have spent 340 days aboard the International Space Station, preparing humanity for long duration missions and exploration into deep space. Credit: NASA/Goddard/Rebecca Roth

Spending nearly a year in space, 249 miles from Earth, could be a lonely prospect, but an office at NASA's Goddard Space Flight Center in Greenbelt, Maryland, made sure astronaut Scott Kelly could reach home for the entire 340-day duration of his mission. Not only could Kelly communicate with mission control in Houston, but Goddard's Network Integration Center connected him with reporters and even family.

Reliable space-to-ground communication is critical to all missions - when astronauts venture outside the International Space Station to install new equipment and perform important maintenance, as well as for any other on-orbit needs.

Data collected in space, like video transmission of a spacewalk, travel as radio signals from antennas on spacecraft to much larger antennas on Earth, some with diameters up to 230 feet. From there, they travel via cables underground, or even under the ocean, to data centers around the world where scientists collect and analyze the data.

With hundreds of satellites operating in orbit around Earth and elsewhere in the solar system, it's easy to imagine that communication channels might become overwhelmed with data from the satellites. To prevent this, NASA manages and maintains three large communications networks. A spacecraft's distance from Earth decides which network it will use. Spacecraft in the far reaches of our solar system, such as New Horizons, just past Pluto, communicate via the Deep Space Network, while spacecraft closer to home, such as the ISS, use the Space Network

or the Near Earth Network. Spacecraft utilizing the Space Network communicate using a constellation of geosynchronous Tracking and Data Relay Satellites known as TDRS. The Near Earth Network consists of ground-based stations located around the Earth. While the Space Network generally services spacecraft in low Earth orbit, the Near Earth Network can service spacecraft in low-Earth orbit, geosynchronous orbit and even in orbit around the moon.

Goddard's Networks Integration Center, pictured here, coordinated the communications support for both the Orion vehicle and the Delta IV rocket during Exploration Flight Test 1, ensuring complete communications coverage through NASA's Space Network and Tracking and Data Relay Satellite. Credit: NASA/Goddard/Amber Jacobson

The Space Communications and Navigation Program office is located at NASA Headquarters in Washington. Engineers and technicians at Goddard Space Flight Center in Greenbelt, Maryland, are primarily responsible for the management and operation of the Space Network and the Near Earth Network. The Deep Space Network is managed at NASA's Jet Propulsion Laboratory in Pasadena, California.

Goddard's Network Integration Center (NIC) is the primary operations center for coordinating the communications for missions using the Near Earth Network and Space Network. Capabilities include robotic satellite missions as well as all human spaceflight missions. Service capabilities typically begin with the preflight testing of a spacecraft's communications systems prior to launch and culminates with the launch and initial in-orbit activities of the spacecraft.

Human spaceflight missions are the NIC's specialty. The center has been operational in one form or another since Project Mercury, NASA's first human spaceflight program. Maintaining communications with human-occupied spacecraft is essential for mission success regardless of whether it is in low-Earth orbit or beyond. Today the NIC is involved in all human space missions and regularly supports the ISS and the visiting cargo and crew transport vehicles that service the space station. The NIC will provide similar communication and navigation to the new commercial crew spacecraft being built by Boeing and SpaceX.

Communication and navigation for most spacecraft in low-Earth orbit is relatively straightforward, said Human Spaceflight Network Director Mark Severance, who manages the communications services from all networks during human spaceflight missions. Most low-Earth-orbit spacecraft connect with and maintain communications with one or two NASA communications networks. Future exploration missions will be more complicated.

"Typically when you fly a mission beyond Earth orbit, you launch and go around Earth a couple times, and you communicate through the Near Earth Network and the Space Network," Severance said. "Then you do a big rocket firing, you depart from Earth orbit and you're not going to return. You're then on the Deep Space Network forever. However, the return trips of human missions will require not only network handovers as the spacecraft leaves Earth, but return handovers between networks as well."

Because of this, future exploration missions will use all three of NASA's space communication's networks at various times during the mission. Not only must the NIC team ensure that all networks are functioning correctly, but that the handovers between networks are orchestrated to maintain communications between the spacecraft and mission control as it leaves Earth or approaches on its return journey. These plans can change rapidly due to in-flight complications, leaving the team to coordinate a new handover plan between the networks.

A preview of this type of mission capabilities occurred during the Orion Exploration Flight Test-1 (EFT-1) in December 2014. The flight orbited Earth twice to test NASA's new Orion spacecraft, designed to carry astronauts to destinations in deep space, including an asteroid and Mars. EFT-1 flew the Orion capsule to more than 15 times further from Earth than the International Space Station, about 3,600 miles above the planet's surface. Data collected during the flight will help finalize Orion's designs and show how the capsule performs during, and returns from, deep-space journeys. This includes testing Orion's communications capabilities with the Space Network, which was overseen by Severance's team in the NIC.

The NIC Human Space Flight team at Goddard is already planning the communications for Exploration Mission-1, the first flight of the agency's new Space Launch System rocket and Orion spacecraft to

demonstrate the integrated system performance prior to the first crewed flight. Severance said this mission would be the biggest communications challenge moving forward into the next several years.

As NASA soars into space beyond Earth orbit once more, a legacy of space communications that began at Goddard more than 50 years ago continues.

Provided by NASA's Goddard Space Flight Center