Making history at Mars: Proximity-1, key to Mars communications

Photo courtesy of ESA-D. DUCROS

by Dr. John D. Kelley, Chief of Staff, Transformational Communications Office at NASA Headquarters, Office of Space Communications, and Secretariat of ISO TC 20 /SC 13, Space data and information transfer systems

Cooperation in space is nothing new, but it has grown and matured over recent decades. The Consultative Committee for Space Data Systems (CCSDS) is one of several foundational elements that led to international cooperation in space. Founded more than 20 years ago by 10 of the world's largest space agencies, the CCSDS has grown to include space communications experts from 28 countries, all committed to the standardization of space-related information technologies.

Over the years, this commitment at the CCSDS has led to the development of well engineered standards and protocols that have enabled communications on more than 300 space missions, and the number continues to rise.

As international cooperation in space communications and operations has grown, so has the need for international standards. Subcommittee 13 (SC 13, *Space Data and Information Transfer Systems*) of ISO technical

committee 20 (TC 20, *Aircraft and Space Vehicles*) was formed to address the global standardization of data/information systems associated with space instruments, vehicles and supporting ground facilities.

Cooperation on a global scale

Today, the CCSDS is considered the technical arm of ISO TC 20/SC 13 and the subcommittee meets every six months in conjunction with the CCSDS Management Council meeting, in part to consider CCSDS-developed recommendations that have been submitted for approval as ISO International Standards. The meeting also provides a mechanism for international information sharing that ensures cooperation on space communications technologies occurs regularly on a global scale. Its success is measured by a rise in the worldwide acceptance of CCSDS standards, as well as by an increase in the development of CCSDS-compatible products by the commercial space industry.

Photo courtesy of NASA Jet Propulsion Laboratory

Above – *Artist's concept of Rover on Mars.*

Preceding page – *Mars Express, artist's view.*

About the author

Dr. John D. Kelley is the Chief of Staff in the Transformational Communications Office at NASA Headquarters, Office of Space Communications. With decades of leadership experience in the development of information systems and operations programmes for scientific data, communications and engineering, Dr. Kelley serves in dual roles within the Consultative Committee for Space Data Systems (CCSDS) as both the Chairperson of its Management Council and as Secretariat. In addition, Dr. Kelley is the Secretary of ISO/TC 20/SC 13. As the NASA and United States representative for data and information standards, he heads a delegation focused on space communications standards that enhance interoperability, reduce costs and promote the use of shared space applications. Most recently, Dr. Kelley was elected to the board of directors of the Object Management Group.

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This successful partnership between ISO and the CCSDS is also evidenced at Mars, where all spacecraft have implemented standard data communications protocols developed by the CCSDS and accepted by ISO on their long-haul links back to Earth. Last month, during the CCSDS bi-annual meeting being held in Toulouse, ISO TC 20/SC 13 considered CCSDS's latest newsmaker at Mars, a specialized communications protocol called Proximity-1.

During demonstrations sponsored by NASA and the European Space Agency (ESA) in February 2004, Proximity-1 was instrumental in establishing the first in-orbit communication between NASA and ESA spacecraft, as well as the first working international communications network around a planet other than Earth.

Prior to the development of Proximity-1, earlier missions like Mars Pathfinder had to transmit data directly from the Martian surface millions of miles to Earth. Because of the great distance between the two planets, as well as the rover's limited transmitter, transmission signals using this communications path were weak and data reliability was limited.

Mars mission planners had long recognized the advantage of transmitting data from rover to orbiter, then sending the data from orbiter back to Earth using the orbiter's more powerful transmitter. Until early last year, however, the path was largely untested and mission planners cautiously refrained from making it the primary path of communication.

Helping to make history

In February, using Proximity-1, a short-haul delivery protocol developed by NASA's Jet Propulsion Laboratory (JPL) along with its international partners within the CCSDS, researchers were able to establish a communications link, negotiate data rate and communications mode, and

reliably deliver data during short rover-to-orbiter link opportunities. Proximity-1 not only helped make history during this international demonstration at Mars, it gave researchers a more reliable, efficient and proven communications path.

Soon afterwards, Proximity-1 was enabling Mars Exploration Rovers (MERs) Spirit and Opportunity to send data to the Mars Odyssey orbiter at a transmission rate twice as fast as the planned maximum. Scientists began receiving an average of three times more data than originally expected and relay links enabled by Proximity-1 became responsible for over 90 percent of all the data returned from the rovers.

More Proximity-1 successes followed throughout the year. As part of a series of interplanetary networking demonstrations in August, ESA's Mars Express flew over NASA's MER Opportunity and successfully received data that had been previously collected and stored by the rover. ESA's Mars Express relayed pictures from one of NASA's Mars rovers for the first time. NASA orbiters Mars Odyssey and Mars Global Surveyor have relayed much of the data produced by the rovers since they landed last January and transmission rates have continued to set new records for international networking around a planet other than Earth.

The success of these internationally sponsored demonstrations has been credited to the fact that both rover and orbiter use the same communications protocol, Proximity-1. We expect that Proximity-1, the first space communications protocol to operate reliably in the proximate environment between a Mars-bound asset and an orbiter, will be the next ISO-accepted CCSDS standard and the next sign of an era of successful international cooperation in space.

New possibilities for cooperation

The CCSDS became a pioneer in international cooperation in space by providing an environment that fosters collaboration and information sharing among the world's space agencies. New possibilities for cooperation will continue to emerge as delegates to both SC 13 and the CCSDS Management Council remain committed to growing strong relations between their respective national space agencies and government organizations and those of other delegates.

By continuing its partnership with ISO, CCSDS will move forward in supporting the efforts of NASA, ESA and other space agencies to use joint communications assets in future missions like the mission to Mars. And, as it has for more than 20 years, the CCSDS will continue to develop new protocols to advance both commercial and governmental interoperability in space. ■