Description of the Deep Space Network

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The facilities, functions, and operations capabilities of the Deep Space Network are summarized. Network activities in support of planned future as well as ongoing deep space missions are described as are activities in support of radio astronomy experiments and the Astronomical Radio Interferometric Earth Surveying (ARIES) Network.

I. General

The Deep Space Network has facilities in the California desert near Barstow, in the mountain area west of Madrid, Spain, and in the mountain area west of Canberra, Australia, each facility consisting of several large-antenna space communication stations. These sites are approximately 120° in longitude apart, which allows for continuous communication between the earth and the spacecraft exploring the solar system.

The Network is developed, implemented, maintained and operated by the Jet Propulsion Laboratory for the Office of Space Tracking and Data Systems of NASA. Much of the implementation and operations activities are contracted to industry. The Network carries out several functions in providing communications to spacecraft – it transmits commands, receives scientific and engineering telemetry data, and generates radio science and navigation data.

The Network maintains communication with 11 spacecraft in various orbits. Four of these spacecraft are on trajectories which will cause them to leave our solar system during the next decade. Two of them, Pioneers 10 and 11, are the responsibility of the Ames Research Center, with JPL being responsible for commands to and telemetry from the spacecraft and for navigation using data generated by the network. Both spacecraft flew by Jupiter, with Pioneer 11 also encountering Saturn, on their way out of the solar system. The other spacecraft are Voyagers 1 and 2, which flew by Jupiter and Saturn. Voyager 2 is now on a trajectory for an encounter with Uranus in 1986 and Neptune in 1989.

Pioneers 6 through 9, also the responsibility of Ames, were launched in the 1960's and continue to provide data as interplanetary solar monitors. Pioneer 12 is orbiting Venus and making measurements of that planet.

The Helios Project is a joint NASA-West Germany venture exploring the Sun. The one remaining spacecraft continues to investigate the solar wind, the magnetic field, solar and galactic cosmic rays, electromagnetic waves, micrometeoroids, and zodiacal light. The Project is managed by the Goddard Space Flight Center for NASA. Of the four Viking spacecraft launched to Mars and originally the responsibility of the Langley Research Center, one continues to return meteorological data on the surface of Mars, and data generated by the Network are providing increased knowledge on Earth-Mars dynamics.

The Network is actively engaged in preparations for the support of the Galileo mission to Jupiter and its satellites and for the joint NASA-European Space Agency International Solar Polar Mission. The latter mission will examine the unexplored polar regions of the Sun.

The Network will provide support to the European Space Agency for Giotto, which will intercept Halley's Comet, and the Network is negotiating with Japan's Institute of Space and Aeronautical Sciences for support of the Planet A and MS-T5 missions to Halley's Comet.

The Network is undergoing a major implementation which will result in the consolidation of its ground stations with those of the Space Flight Tracking Data Network of the Goddard Space Flight Center. It will then be the only NASA ground-based network providing support to those missions which cannot be supported by the Tracking and Data Relay Satellite System.

Primarily using the facilities at Goldstone, California, the Network supports planetary radar astronomy experiments. These experiments provide information on the topography and character of the surfaces of the planets, asteroids, and comets.

Because it works at the state-of-the-art of deep space communications, the Network provides unique experiment capabilities in radio astronomy. These experiments study the character of pulsars and compact radio sources. In the latter case, the angular resolution of the long baseline between the deep space stations provides new information on the structure of these radio sources.

II. Astronomical Radio Interferometric Earth Surveying (ARIES) Network

The ARIES Network consists of several sites in Southern California that are visited by mobile VLBI (very long baseline interferometry) facilities which use extragalactic radio sources to provide vector baseline determinations between the sites. The changes of these baselines are expected to provide direct evidence of plate motion and the relationship of crustal strain to earthquakes. Each mobile VLBI facility consists of a transportable instrument which conducts radio interferometric observations at microwave frequencies. JPL has three of these transportable instrument systems which visit the sites and operate with the fixed telescopes of the DSN at Goldstone and the Owens Valley Radio Observatory of the Caltech Radio Astronomy group.