Prospects for a Next-Generation Deep-Space Network

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***Abstract*— When it comes to making a long-distance call, it's hard to top NASA's Deep Space Network. Its the largest and most sensitive scientific telecommunications system in the world. so our objective is (1) To archive knowledge of operations procedures. (2) provide a capability to assist in execution monitoring; (3) Provide a capability for automatically Constructing the plan to be executed and monitored. This paper describes the application area of DSN antenna operations, describes the plan to reduce the distance.**

I. INTRODUCTION

The Deep Space Network - or DSN - is NASAs international array of giant radio antennas that supports interplanetary spacecraft missions, plus a few that orbit Earth. The DSN also provides radar and radio astronomy observations that improve our understanding of the solar system and the larger universe. The antennas of the Deep Space Network are the indispensable link to explorers venturing beyond Earth. They provide the crucial connection for commanding our spacecraft and receiving their never before seen images and scientific information on Earth, propelling our understanding of the universe, our solar system and ultimately, our place within it.

II. FUNCTIONAL AREA OF DEEP SPACE NETWORK

A. Domain Area of DSN

The Deep Space Network, or DSN, is much more than a collection of big antennas. It is a powerful system for commanding, tracking and monitoring the health and safety of spacecraft at many distant planetary locales. The DSN also enables powerful science investigations that probe the nature of asteroids and the interiors of planets and moons

B. DSN Complexes

Each of the three Deep Space Network, or DSN, sites has multiple large antennas and is designed to enable continuous radio communication between several spacecraft and Earth. All three complexes consist of at least four antenna stations, each equipped with large, parabolic dish antennas and ultra-sensitive receiving systems capable of detecting incredibly faint radio signals from distant spacecraft.

The DSN's large antennas are focusing mechanisms that concentrate power when receiving data and when transmitting commands. The antennas must point very accurately towards the spacecraft, because an antenna can "see" only a tiny portion of the sky not unlike looking at the sky through a soda straw.

I would like to Express my Thanks to
Mr.Darmendra Sir Faculty of United college of Engineering and Research ,Allahabad U.P.

III. TELECOMMUNICATIONS DEEP SPACE NETWORK

The main terminal of the DSN is located at JPL (Jet PropulsionLaboratory) headquarters in Pasadena, California. There are three primary antennas, spaced equally on a great circle that slants around the world. All three are large paraboloid (dish) antennasthat can be used for transmitting and receiving signals over a wide range of radio frequencies. One antenna is located in California, another is in Spain, and another is in Australia. Theantennas are located in such a way that all existing operational spacecraft can be monitored and controlled, and communications maintained with them, almost 100 percent of the time. This is true of both earth-orbiting satellites and interplanetary space vehicles.

Signals transmitted and received by DSN equipmentinclude satellite control and telemetry, e-mail (including text,graphics, video, programs, and sound attachments), communicationswith the Space Shuttles, and radio-frequency emanations fromdistant celestial objects.

A. Radio Astronomy Deep Space Network - Radio Astronomy

Radio Astronomy and the role of the DSN in exploring the Universe using radio waves. Color illustrations on the front show radio images of a galaxy and of Jupiter's radiation belts. The reverse side describes how we can use radio astronomy to further our understanding of the Solar System and the Universe

B. Speaking in Phases - a Classroom Activity

- How do spacecraft put actual information into the radio signals they send back to Earth? Beat out rhythms on drums or desks and send messages using the same principles used in space exploration.
- Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.
- Related disciplines: physics (EM wave modulation), math (binary codes), space technology, music! Activity: Entire class, indoor, game-type demonstration.

C. Long-Range Planning

While there are many similarities between the mid- and long-range planning and scheduling functions for DSN, there are also significant differences. Underlying both is the set of current and future DSN assets, including antennas and equipment, some coming into service and others being decommissioned. Both are based on DSN usage requirements from a varying mission set with a wide range of time-dependent tracking and navigation needs. Both are charged with arriving at an ultimately feasible allocation of DSN resources by balancing user needs and resolving periods of resource contention.

D. long-range planning significant differences from mid-range:

- unpredictable spacecraft locations for some missions and trajectory types, leading to uncertainties in visibility times from the different DSN antennas.
- unknown science targets beyond some time horizon in the future
- uncertainties in the mission set, due to funding changes, launch date changes, or mission extensions.
- In your paper title, if the words that uses can accurately replace the word using, capitalize the u; if not, keep using lower-cased.
- Be aware of the different meanings of the homophones affect and effect, complement and compliment, discreet and discrete, principal and principle.
- The prefix non is not a word; it should be joined to the word it modifies, usually without a hyphen.
- The abbreviation i.e. means that is, and the abbreviation e.g. means for example.
- A graph within a graph is an inset, not an insert. The word alternatively is preferred to the word alternately (unless you really mean something that alternates).

IV. Space Networking:

Future missions will make more use of multiple spacecraft and planetary relays. If we continue to operate as we do now, the human cost of managing data flow will become prohibitive. Disruption-Tolerant Networking (DTN), an advanced store and forward protocol, extends the services provided by the terrestrial Internet into deep space and can recover from outages due to weather, eclipses, etc. without loss of data. Information sent from a spacecraft can automatically route itself through other science spacecraft, relays, and DSN antennas. At each stage, custody of the information is updated so that the storage on the originating spacecraft can be re-allocated to new science observations. DTN has been demonstrated with the EPOXI spacecraft and it is in a fast development at NASA. Negotiations are also underway to make DTN an international standard.

A. Radio and Radar Science

A powerful radar transmitter exists at the Gold stone 70m antenna for studies of solar system objects, with the reflected signal being received either at that antenna, other antennas at Goldstone, radio astronomy observatories, or some combination. Signals transmitted from the Arecibo radar can also be received at the Gold stone 70m antenna. Many solar system missions use this DSN radar facility to observe their target objects, both to enhance mission science and for engineering purposes (e.g., landing site characterization). Radar studies of near-Earth asteroids provide precision

We suggest that you use a text box to insert a graphic (which is ideally a 300 dpi TIFF or EPS file, with all fonts embedded) because, in an document, this method is somewhat more stable than directly inserting a picture.

Fig. 1.

trajectory data and high-resolution structural information, which are key to predicting and mitigating possible threats of Earth collision. Enhancements of the radar system are possible over the next decade.

B. Optical Communications:

Optical communications is, perhaps, the most exciting and game changing development that will occur over the next decade. NASA is committed to the operational use of optical communications within 10 years. As such, NASA plans to fund the development of a deep space optical terminal (DOT). NASA has a dedicated 1m optical communications ground station at Table Mountain Observatory in California. This facility has already been used for experiments with foreign Earth-orbiting spacecraft optical tests.

The existing DSN plan will address the requirements implied by NASAs current model of the future mission set (the AMPM). Substantial additional capability is possible, if desired and advocated by the science community. We are seeking the Committees consideration of the following as functions of time.

V. CONCLUSIONS

The DSN stands ready to play its part enabling future planetary missions. Plans already in place will result in significant improvements allowing scientists to expand their scientific horizons and develop new mission concepts. NASA looks forward to working with the science community to ensure appropriate investments are made to maximize the productivity of the exploration of the solar system.The most important aspect of this technology is how we use all this technology that was invented or used in these facilities for commercial use like our cell phones, radar guns and GPS devices. Development of transport protocol for deep space communication is a highly challenging task. The research challenges and issues related to this field have been brought out in this paper.

ACKNOWLEDGMENT

Authors would like to thanks , Mr.Dharmendra Sir Head Of Department United College of Engineering and Research for their constant encouragement towards the realization of this work.

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