Satellite communications for antarctic science

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A joint National Science Foundation/National Aeronautics and Space Administration (NASA) effort in Antarctica has demonstrated a space-age communication scheme which could be used to solve long-standing communications difficulties unique to the South Polar region. Two new ground stations placed in operation in December 1984 are now using some existing satellites routinely to send error-free data from South Pole and McMurdo Stations to U.S. universities. The antarctic ground stations are linked via the NASA satellites ATS-3 and Nimbus-7 and the National Oceanic and Atmospheric Administration (NOAA) Landsats 4 and 5 satellites. Other in-orbit commercial and international, as well as U.S. Government satellites with appropriate transponders on-board, could be used for polar communications. These kinds of systems could also be used to provide communications to any of the international antarctic stations. Scientists and engineers are interested in using these new capabilities to communicate with instruments in the field in near real time from their personal computers in the continental United States. This capability, referred to as *telescience*, is a key objective of the space and ground-based science communities in general, but until now it has not been possible to project its availability in Antarctica. The satellite data link in operation at the South Pole works like this. (See figures 1 and 2.) The station science computer (PDP 11/23) organizes data from all users into designated files and periodically transfers the entire set onto a disk in the communications system. The polar-orbiting satellites in use now are visible from the Pole for about 15 minutes every orbit. During any 10-minute window of co-visibility between the two ground stations, data can be transferred from disk to disk at a 9.6 kilobits per second rate. Nominally, 20 passes per day have been allocated for this link, using either the Landsats or Nimbus satellites. The data is stored in the communications computer upon arrival at McMurdo Station and is available on disk either for the investigators' use there or for relay to the United States via the INMARSAT system. The National Science Foundation has chosen to install a commercial geosta-

tionary satellite link from the edge of Antarctica at both McMurdo and Palmer Stations. The long-term availability of these links is commercially insured and as such considered cost-effective.

Although the geostationary satellites are not visible at the high latitudes, they work well in tandem with the polar link. Data on a disk at McMurdo Station is manually transferred to the INMARSAT communications system and uplinked to the Earth Station in the United States. It is available to the user via a dial-up service from the Gateway in Denver, Colorado. The process is reversed for data transmissions from the United States to Antarctica. This initial service was provided to demonstrate an evolutionary technique that could grow as the benefits it provides are developed. Immediate enhancements of this service would enable data rates approaching 100 kilobits per second in a half duplex mode. More ground stations could be installed anywhere on the continent, at manned or unmanned sites. As the science community begins to take advantage of the services, more satellites would be engaged, leading to the development of a dedicated transponder package for any future spacecraft of opportunity. As soon as a dedicated flight package can be justified, it would be optimized to provide full duplex service with higher data rate capability, and would guarantee long-term availability indefinitely. Furthermore, a separate capability for two-way voice and low-rate data collection from mobile units using simple non-directional antennas could be incorporated. This feature would enable data and/or voice links to remote field parties, aircraft, and balloons, as well as data collection from unmanned instruments at more than 2,400 bits per second, for 10 minutes every orbit.

To date polar links cost nothing to use. The only pay-as-you-go charges are for the use of the commercial links. A temporary but most effective geosynchronous link via ATS-3 was also installed between the South Pole and the United States. It provides 300 bits per second full duplex service with dial-up access for about 4 hours per day (cost free) and it is in full use now. Because $100 million for a replacement satellite is not feasible, the practical solution for the long-term future is the Polar/INMARSAT system.

Proposals involving highly interactive space/ground-based science and near real time data sharing can now be considered. Such proposals for multiple auroral imaging stations deployed around Antarctica (each generating 60 megabits per day) have been considered quite feasible, given a full-size communciation network. Linking the composite data from these stations into the National Science Foundation's supercomputer network and cooperating with similar data bases of remote sensing images from NASA and NOAA, are projected. During the 1985–1986 austral summer, a field test will be conducted to demonstrate how the Polar/INMARSAT system has already enabled Antarctica to be included in the Global Search and Rescue System. If warranted, another field demonstration using in-orbit UOSAT 1 and 2 satellites (United Kingdom) to link aircraft and mobile field parties to the South Pole Station is also possible.

This effort is being managed by the National Science Foundation with technical support from NASA/Goddard Space Flight Center, the University of Texas at Austin: Applied Research Lab, the U.S. Geological Survey, NOAA, ITT/Antarctic Services, and Bendix Field Engineering Corporation.

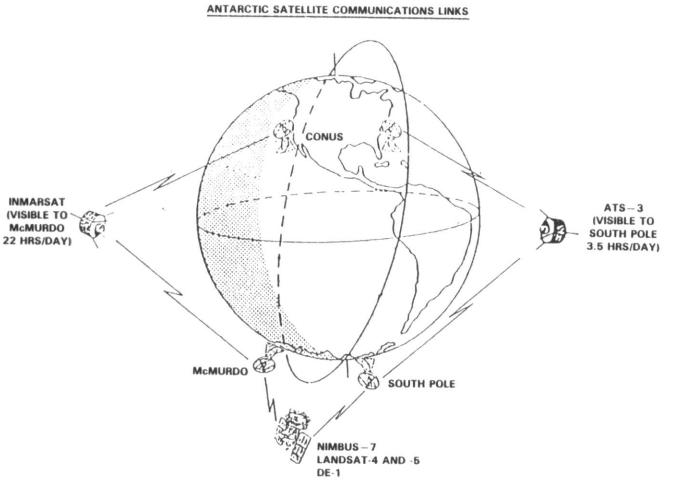

Figure 1. Antarctic satellite communications links. ("CONUS" denotes continental United States.)

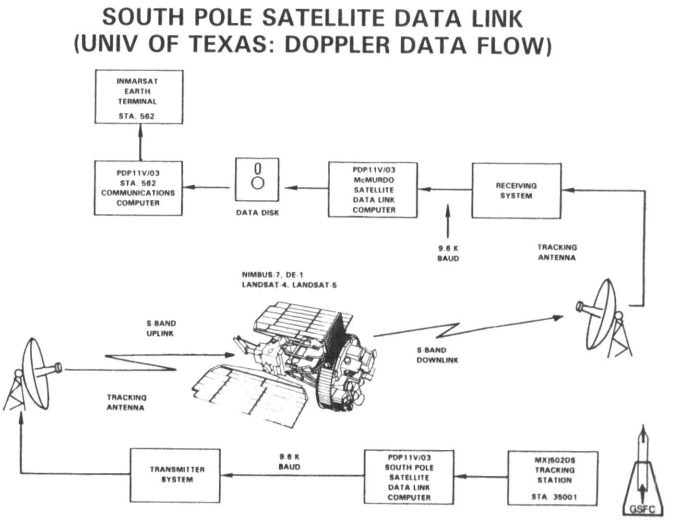

Figure 2. South Pole satellite data link.