RESEARCH PAYS OFF

Meteor Burst Communication

Nevada Research Uses Falling Stars for Data Transmission

Even in today's world of sophisticated communication technology, there are still some remote locations that are not serviced by a communication system. In most cases, this situation does not present a problem. For those responsible for data collection from these distant sites, however, the lack of a suitable communication system can be a major drawback.

Problem

The Nevada Department of Transportation (NDOT) collects traffic-related data at remote locations over an area of 110,540 square miles. Fortunately, only a small part of this area is not serviced by either telephone lines or a cellular communication network. NDOT's problem lies in the fact that it locates its traffic-related data-collection sites based on need instead of the availability of a communication system. The manpower required to collect data at these sites taxes the department's resources with an annual cost in excess of 1,000 man-hours. The Meteor Burst Project began with the awareness of this problem and the desire to find an effective solution. Although Meteor Burst Communication (MBC) has been used for 30 years in military applications and for various types of remote environmental data collection, it had never been used in this application.

Solution

MBC is based on the phenomenon whereby radio waves at VHF (very high frequency) are reflected by trails of ionized particles left by meteors entering the earth's atmosphere. Typical meteors range from the size of a small pea to, more commonly, a grain of sand. The total number of these small meteors in the earth's atmosphere is estimated to be 1 trillion per day, although relatively few of them have the required size, speed, and orientation to earth to make them useful for meteor scatter propagation.

Each meteor leaves an ionization trail up to 12 miles long, but lasting no longer than several milliseconds in the upper atmosphere. "Handshaking" and data transfer between the master MBC station and the remote MBC station take place during the short duration of this trail. MBC is effective for distances between 150 and 1,200 miles.

Application

Working together, NDOT and the Electrical Engineering Department of the University of Nevada-Reno developed a self-contained, roadside MBC station. In addition to the existing data-collection devices, this station consisted of a solar panel, a rechargeable 12-volt battery power supply, the meteor burst transmission unit, an interface board, and a five-

element yagi antenna (Figure 1). This remote roadside station is completely controlled by the interface board, a microprocessor-based unit that acts as the brains of the system. This board is designed to connect multiple traffic-monitoring devices to a single transmitter/receiver. It can also perform duties such as automatically downloading data from the traffic-recording devices before their memory storage overflows, or downloading data at programmed intervals. Once these data are in the interface board, they are reformatted and compressed before copies of the data are transferred to the meteor burst transmitter. A status report of the system can also be transmitted in order to alert operators that repair or service is required.

During NDOT's research, the data were sent to an MBC master station located in Bozeman, Montana. The data were then forwarded to a data center in Kent, Washington, via telephone lines, where they were reformatted back to their original configuration and finally sent to the NDOT headquarters in Carson City, Nevada.

Benefits

On completion of this study, NDOT continued to use MBC to retrieve data at one remote station for four months, saving the department approximately 150 man-hours. At that time, the cellular communication network serving Nevada was expanded, eliminating the benefits of MBC for current NDOT traffic data-collection sites. However, NDOT is currently reviewing MBC for data collection in conjunction with FHWA's continuation of the SHRP anti-icing study.

The results of this research project have served to break new ground in the area of data transmission and should provide a base of technical knowledge that will stimulate use for a variety of transportation-related data transmission throughout remote areas of the world.

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Suggestions for "Research Pays Off" topics are welcome. Contact G.P. Jayaprakash, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 (telephone 202-334-2952).

FIGURE 1 Roadside Meteor Burst Communication station.