MSAT News
No. 10 Winter 1994

TMI Communications formed to carry out MSAT project

The MSAT project is back on track following a brief pause last April when Telesat Mobile Inc. filed for bankruptcy protection.

Over the summer, BCE Inc., Canada's largest telecommunications company, stepped in to found a new business called TMI Communications to assume responsibility for the project. "As a result of the support and confidence shown by our creditors, suppliers, business partners and BCE Inc., we have been able to establish a new organization with the financial support to complete construction of the MSAT Network," says Bob Ferchat, Chairman of TMI Communications. "Construction of the network to provide satellite communications across North America will be completed by early 1995."

BCE Inc. expects to invest $120 million in TMI Communications over the next few years.

As a result of the restructuring, the pre-MSAT services that were offered as part of the trials program of mobile satellite services have been discontinued. The pre-MSAT field trials were a source of much valuable data that will be incorporated into the final MSAT services offered by TMI Communications.

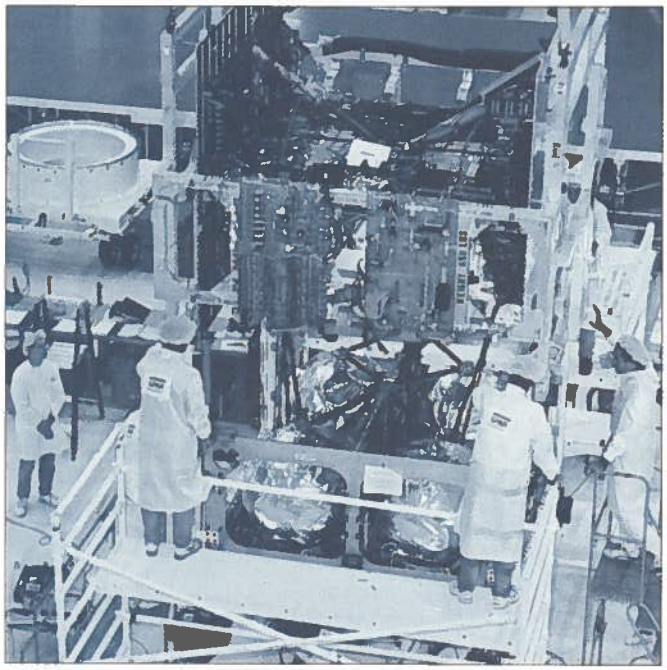
Other important milestones for the MSAT project since the last issue of *MSAT News* are summarized below.

- Integration and testing of the Canadian and U.S. MSAT satellites is well under way at the David Florida Laboratory (DFL) in Ottawa by Spar Aerospace.

  The DFL has been preparing for this stage for more than a year. New equipment has been procured and, where necessary, existing equipment has been updated, says Charly Geier of the DFL.

  The spacecraft consist of two parts — a "bus", which is the basic structure, and a communications "payload", which includes all of the equipment added to the bus to allow the spacecraft to perform its special functions. Two buses and one payload arrived over the summer. The final payload was delivered in October.

  Both satellites will provide coverage of all of North America. The satellite that will provide services to Canadian subscribers, no matter where they are located in North America, is owned by TMI Communications. The satellite providing coverage to U.S. end users is owned by American Mobile Satellite Corporation.



Employees of Spar Aerospace with the complete U.S. mobile communications satellite at the Canadian Space Agency's David Florida Laboratory (DFL). The upper portion of the assembled structure is the communications payload and the lower part is the satellite bus. Both the U.S and the Canadian satellites are undergoing final testing and assembly at DFL.

  "The critical task of all-up spacecraft testing (testing of the complete satellite) can now begin," explains Geier. Over the next year, the two satellites will be subjected to a rigorous period of qualification and verification analysis at the DFL. This testing will include thermal vacuum/thermal balance tests as well as vibration and radio frequency measurements.

- The ground-based portion of the MSAT Network is being built by Westinghouse Electric Corporation. The ground portion refers to the hardware required on earth to interact with the two satellites. This includes items such as earth stations and interfaces with the public telephone network. The actual mobile terminals that will be used by MSAT customers will be manufactured by Westinghouse and Mitsubishi.

- The TMI Communications satellite will be launched by Arianespace from their facility in French Guiana in late 1994.

Inside

A message from the Director of the MSAT Program

There have been two major developments in the MSAT Program since the last publication of this newsletter. The first was the reorganization of Telesat Mobile Inc. (see "TMI Communications formed to carry out MSAT project", page 1). The new organization is different from its predecessor in its intended service-delivery scope.

More precisely, TMI Communications intends to remain as the system operator and wholesaler of air time and to seek strategic alliances with other companies that will provide end-user and value-added services. This means that the services to be delivered to government users, as part of the $126.5 million Lease Agreement with TMI, may have to be procured from a number of service providers instead of from a single source.

The second major program development is a transfer of some responsibilities within the federal government. Under the new arrangement, the MSAT Directorate (DMSAT), which reports to Industry Canada's Communications Research Centre (CRC), will maintain the overall management and administration of the MSAT Program. This includes the following:

- supporting applications and technology development;
- conducting trials;
- providing manufacturing and service industry support;
- providing a friendly regulatory and licensing environment;
- representing MSAT interests nationally and internationally; and
- providing general program advocacy.

DMSAT remains the primary interface for Canadian industry and non-government users and will keep administrative control of the $126.5 million service lease with TMI Communications.

However, DMSAT has transferred the responsibility of managing the marketing and service-delivery functions, for government users, to the Government Telecommunications and Informatics Services (GTIS) — formerly the Government Telecommunications Agency. GTIS is preparing a business plan, which is expected to be completed in early 1994, intended to stimulate federal user interest, maximize the recovery of prepaid lease funds, identify specialized applications for government users, set service tariffs and offer service initiatives.

GTIS expects to offer introductory price incentives to encourage departments to develop MSAT applications for their needs. Ongoing service charges, to all government users, should compare very favourably with the lowest retail prices available to large commercial users. DMSAT and GTIS will keep government users fully informed through a series of group or one-on-one presentations and the publication of appropriate service information as it becomes available.

While I am unquestionably conscious of the negative impact of the events stemming from TMI's restructuring proceedings, I feel confident that the program has finally cleared all major obstacles. Through the close co-operation of TMI Communications, GTIS and DMSAT users will be offered a high level of service at a very reasonable cost.

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Personal communications via satellite top agenda at IMSC '93

Personal communications over satellite-based networks was the theme of the third International Mobile Satellite Conference (IMSC '93).

IMSC '93, held in Pasadena California from June 16-18, 1993, drew 300 people from 20 countries. It was co-sponsored by American and Canadian organizations, including NASA, the Jet Propulsion Laboratory in the United States, Communications Canada and the Communications Research Centre. The next conference, IMSC '95, is scheduled for June 6-8, 1995 in Ottawa.

More than 100 technical papers were presented in 12 sessions during the two-and-one-half day conference. Sessions on technology, systems, markets and regulatory environments associated with mobile and personal satellite communications were held. Highlighting IMSC '93 was an afternoon-long plenary session on the second day, during which top executives of international mobile satellite organizations, including David Carlin, Vice President, Sales and Marketing, TMI Communications, gave brief presentations of their systems and responded to questions.

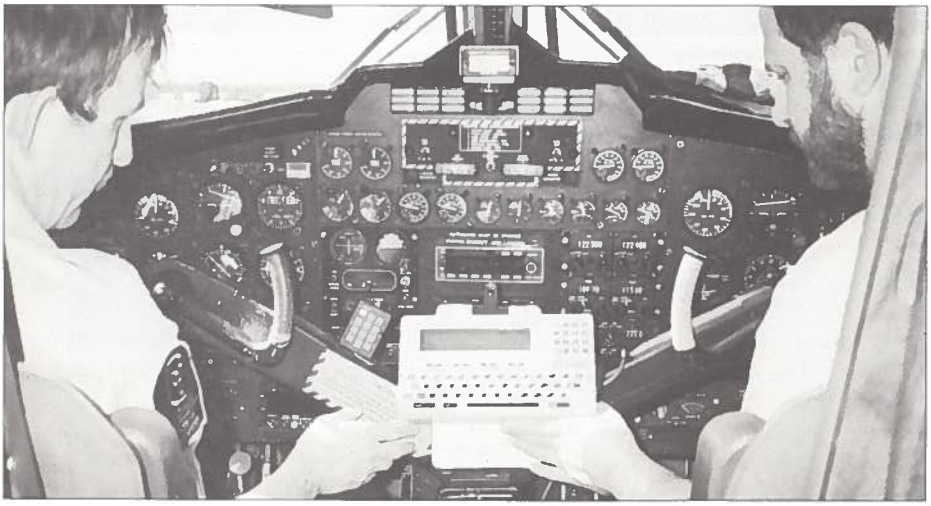
Other highlights included presentations on the proliferation of both LEO- and MEO-planned systems, and the continuing problems of regulatory action in the United States. An industry exhibition in which several commercial companies and government research and development institutions displayed their products was also held during the conference. These included a booth displaying mobile satellite terminal and antenna technology developed at the Communications Research Centre.

Pre-MSAT trials take to the air

The first trials of domestically provided mobile data services for aeronautical use took place in the spring of 1993 using radios supplied by the Communications Research Centre.

The first end-user field trial involved the installation of a CAL Corporation radio in a Twin Otter operated by the Ontario Ministry of Natural Resources (MNR). The radio was connected to a small bubble antenna that measured 16 cm across and 4 cm high. Using TMI Communications' pre-MSAT mobile data service, the CAL radio provided two-way low-speed data communications and position reporting; position reports were automatically transmitted to MNR's dispatch centre in Timmins, Ontario every four minutes.

The field trial participants quickly recognized the potential economic and safety benefits of the overall system, says Allister Pedersen, Manager, MSAT Trials Planning and Co-ordination. "Ontario MNR does a lot of low-level flying in remote areas and the existing terrestrial-based radio systems used for flight watch provide only limited coverage, especially at low attitudes," he explains. Using traditional radio systems, a pilot doing a wildlife survey often has to climb from 500 to 6,000 feet twice every hour to transmit a position report to the dispatch centre.



Pilot Robert Seguin of the Ontario Ministry of Natural Resources reviews the CAL keyboard display in the cockpit of a Twin Otter with Ian Galton of Gralen Communications.

The pre-MSAT system increases the safety margin for MNR pilots by automatically providing reliable and accurate position reports at frequent intervals without taking the time and attention of the pilot, says Pedersen. The aircraft's position is determined by using the highly accurate Global Positioning Satellite (GPS) system. Each GPS report contains the following information: date and time (UTC), latitude and longitude, horizontal and vertical velocity, altitude and bearing relative to true North. The system can also visually or audibly alert the dispatcher if a regularly scheduled position report is not received, an indication that something may have gone wrong with the aircraft.

A system using the MSAT network will have even greater capabilities because it will not have to operate within the restrictions of the limited duration data service provided during pre-MSAT trials, says Pedersen.

During the tests, an MNR dispatcher in Timmins monitored a computer graphics map that continuously showed the location of the Twin Otter to an accuracy of 100 m. The dispatch system, which is called FLAG (Fleet Locating and Graphics) and was developed by Utimateast Data Communications in St. John's, can also display historical data about the aircraft's position during the previous few hours, days or weeks. The system offers audible and visual alerts of incoming messages, an important feature for emergency messages. FLAG also allows for incoming messages to be automatically printed on receipt.

Before the MNR tests, the CAL radios were installed in a Cessna 377 Skymaster for initial proof-of-concept trials and a Cessna 177 for a beta plus trial. The system was also temporarily installed in an Aerospatiale Astar 350 series light single-engine helicopter for a trial that determined that helicopter rotors do not cause transmission problems. The installation of all trials systems was done by Gralen Communications of Ottawa. ■

A note to our readers

In the past, the emphasis of *MSAT News* has been on pre-MSAT services and trials, and on technical developments undertaken by the Communications Research Centre. As the 1995 implementation of MSAT services approaches, the emphasis will shift to providing service-related information such as features, service dates and charges, and equipment availability — in general, the parameters that will influence a user's decision to subscribe to MSAT services. In light of this, the MSAT Directorate is examining the format of *MSAT News* in order to ensure it best meets emerging user information needs. Readers will be informed of any changes.

In line with this new emphasis, the newsletter will now employ the term MSAT in a more specialized way. Previously, the term "MSAT" has been used to refer both to the pre-MSAT trials program and to the MSAT satellite and related services that will be offered in 1995. It is more accurate to refer to the trials and services initially provided by TMI Communications using leased capacity on the INMARSAT satellite as "pre-MSAT". From now on, "MSAT" will refer only to hardware and services relating to the spacecraft and network currently under construction. ■

Feature article

SCADA: As good as being there

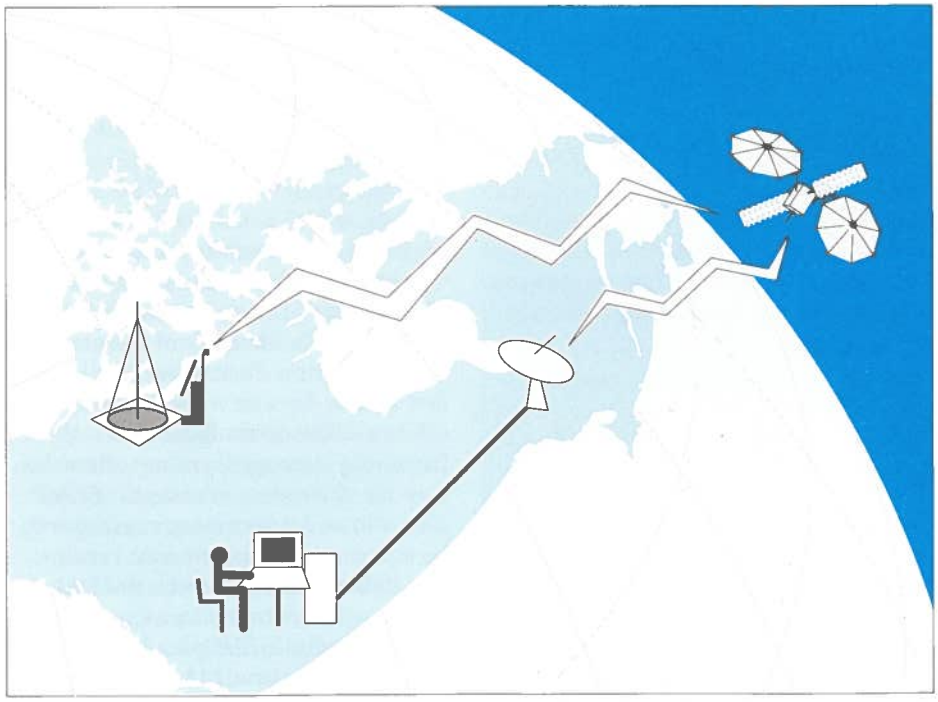
Although mobile voice communication is what captures people's imagination when they first hear about the MSAT program, some of the more interesting applications of satellite communications involve the transmission of data to and from remote sites and from mobile systems.

Many of these applications can use SCADA (Supervisory Control and Data Acquisition) devices to allow people to operate equipment and read recorded data at locations that are thousands of miles away. As much as 40 percent of the federal government's satellite air time may be used for these applications when the MSAT satellite is launched.

SCADA makes it possible for a number of electronic devices to be linked together and controlled from a single remote location. For example, an entire weather station located in the North could be operated from a university in a major metropolitan centre — allowing many students the chance to do research on Arctic weather without having to travel there.

Two sophisticated applications of SCADA using mobile satellite communications that have been developed by Canadian companies to solve very different kinds of problems are discussed below. One proposed system will monitor oil wells, and a second is a system to monitor and evaluate the quality and supply of ground water.

Other applications of SCADA include automatic weather stations, monitoring systems for radio transmitter sites, devices to record lightning strikes, systems for ensuring that navigational aids are properly positioned and are functioning, and methods for counting traffic on country highways and keeping tabs on inland water hatcheries. In addition, SCADA applications could monitor environmental conditions such as water pollution or oil and gas leaks in remote areas.



Information from remote sites is sent via satellite to a central earth station and then to a final user. This information, such as records of water level and temperature, flow rates or pollution, can be transmitted once a day or once an hour depending on the user's requirements. For example, if the data from the monitoring system indicates that the water level at the head of a river is starting to rise rapidly, the user could then forecast the possibility of flooding further down the river, and could instigate appropriate preventative measures before the flooding occurs. The measurements are automatically recorded at the remote site by the SCADA terminal, which operates using a photovoltaic battery system and can function for months without maintenance.

How SCADA works

All SCADA systems have a data bus — a communications link between a computer/controller and a number of input/output devices — that allows, for example, a single ground station to transmit to several remote locations or to control a number of devices at the same site. SCADA's central controller sends and receives messages from different parts of the system in the same way that a computer interacts with several pieces of equipment attached to a network (e.g. printers, disk drives and modems).

In both cases, the goal is to set up a system that will allow the computer to send instructions to the right devices, and only to the right devices. This is achieved by having the computer send out information in discrete units called packets. The first part of every packet is the "address" of the device for which the instructions are intended — a coded prefix that only the appropriate device will recognize and respond to. The rest of the packet is the command itself.

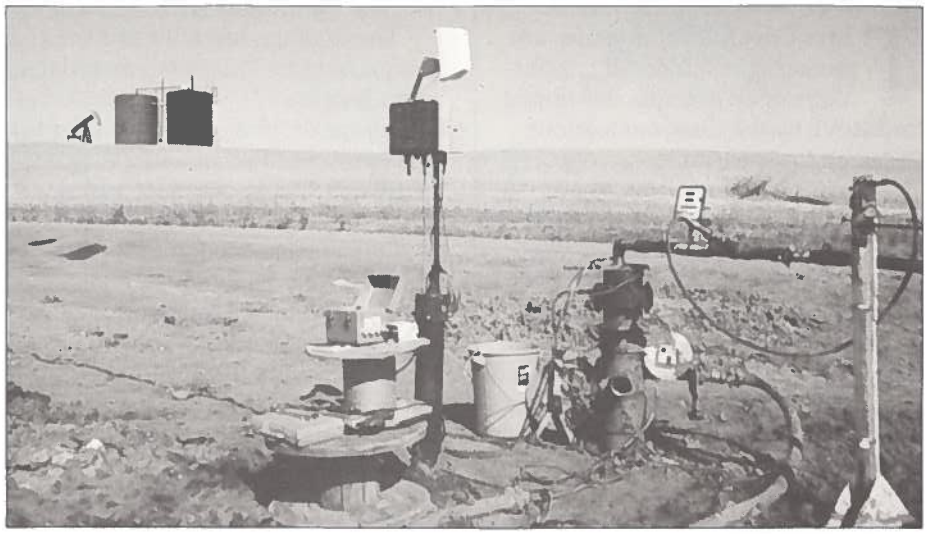
SCADA can also be used for complicated procedures that require several devices to work together. In these cases, commands are sent to each machine along with instructions to recognize a "key" — a special code that tells the device to "start now". After everything is set up, the key is sent to each device when it is time to perform its task.

Feature article

Ground water evaluation and management

Mow-Tech Limited is a company with expertise in ground water evaluation and management that is looking to SCADA to help them use their expertise more effectively.

Mow-Tech recently experimented with SCADA devices through satellite communications to monitor conditions in 11 remote sites. They used the service to perform two types of tasks — the evaluation of ground water to determine whether development at a site is feasible, and the management of that water supply after development is complete.



A SCADA installation that is used to monitor ground water quality and supply.

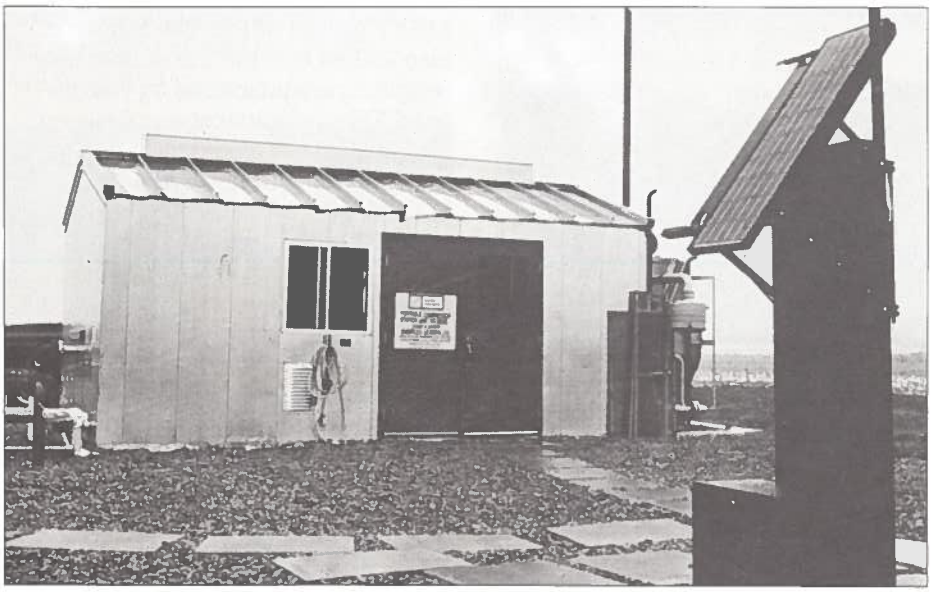
Physical conditions limit where developers can locate water wells. As a result, some wells are drilled in places where there are no existing services, such as electrical power or telephone, nearby. In addition, the evaluation of wells calls for extensive data monitoring — sometimes 24 hours a day.

Flying a hydrogeologist into each site to interpret the data collected by Mow-Tech's instruments is expensive. Where it is impossible to use other communications systems, satellite communications can ship reliable data in electronic form that can be loaded directly into a computer for analysis.

Did you say remote?

Last winter, Dan Fehr, who works for Interprovincial Satellite Services Ltd. (INTERSAT), spent a lot of time leaning out of a hovering helicopter in -50°C temperatures at an oil well site some 80 km north of Fort Nelson, British Columbia.

Fehr was participating in a field test of communications services to the Canadian oil patch conducted by Ainsworth Remote Inc., in cooperation with INTERSAT and TMI Communications. "The potential for the use of satellite communications to monitor and control remote oil wells is tremendous, — we are doing things that were previously not possible," says Ainsworth Remote Inc.'s president Jim Knight.



SCADA unit beside a natural gas compressor at one of Ainsworth Remote's sites.

The location of many oil wells requires a system with the capabilities of MSAT, adds Fehr. "At this site, there are no power lines or communications available, and no roads. On my first trip, I found two timber wolves dining on a downed caribou about 45 m from the well."

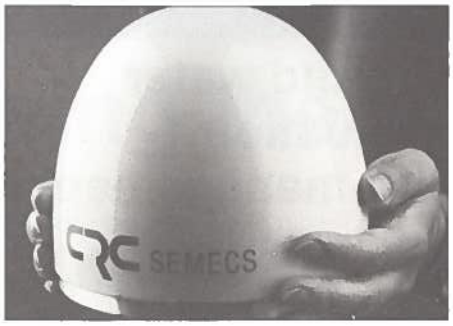
During the tests, data from monitoring equipment at the site was sent by a mobile data terminal to a hub facility in Ottawa. From there, the data was taken over high-speed digital land lines to Ainsworth Remote's operations centre in Calgary, where it was interpreted and routed to customers. ■

SEMECS antenna attracts industry interest

Three Canadian companies are pursuing commercial applications of an antenna developed for MSAT by the Communications Research Centre (CRC).

The SEMECS antenna is only 15 cm in diameter and 14 cm high but is still able to simultaneously meet MSAT northern and southern coverage requirements for medium-gain antennas. SEMECS, which stands for Single Element Mechanically Steered, uses a patented magnetic compass developed at CRC by Martial Dufour to remain pointed at the MSAT satellite as a vehicle turns.

The antenna has attracted the interest of MSAT terminal manufacturers because of its small size and the ease with which it can be adapted to mass production, says John Sydor, the SEMECS project leader and inventor. "The antenna could have been made even smaller, but we were limited by the related technology required for MSAT applications," he adds. CRC estimates the antenna can be commercially produced in large quantities for approximately $200 to $300. CRC has filed for two patents in order to protect the SEMECS technology. ■



A model of the CRC-developed SEMECS antenna.

Reliable communications for Saskatchewan conservation officers

Reliable communications are not easily achieved in many areas of "treeless", "flat" Saskatchewan.

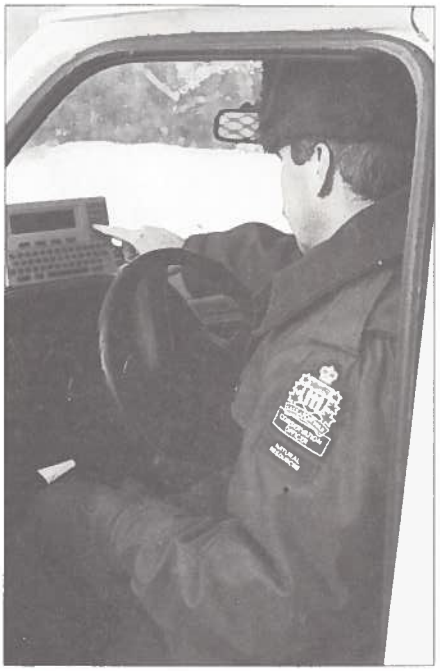
Saskatchewan is, in fact, more than 53 percent forested and much of its terrain is rolling hills. As a result, there are dead spots in the VHF blanket where no communication is possible. In northern Saskatchewan, relatively unreliable high-frequency radios are still in use.

Saskatchewan Natural Resources tested two trials system mobile earth terminals in 1992 to see if they would improve the safety and efficiency of its 180 full-time conservation officers.

These employees travel across the province, managing natural resources and enforcing provincial wildlife and fisheries laws. With winter temperatures often dropping to -40°C, equipment failure or injury in a remote location can be life-threatening. Conservation officers are also often the first, and sometimes the only, government officials to arrive at emergency situations in northern regions.

The testing of the two units clearly demonstrated that 24-hour-a-day communication is attainable. The units proved reliable and easy-to-use when transmitting information between the Provincial Dispatch Centre and the conservation officers. The Loran-C location function received many favourable comments from field officers as well.

"In the future, resource management and enforcement agencies across the country may be examining their communications systems from a new angle — outside the earth's atmosphere," says Dave Harvey, Saskatchewan's provincial enforcement co-ordinator. ■



A Saskatchewan Natural Resources conservation officer tests a mobile earth terminal from his truck.

Quebec government actively involved in mobile satellite trials

In 1991 and 1992, Quebec government agencies participated in a test program oriented towards the development of new applications for mobile satellite communications.

Bell Mobility and the Quebec Ministry of Communications co-ordinated the tests with help from TMI Communications. Participating ministries included those responsible for transport, energy and resources, forests, hunting and fishing, public security and the environment, as well as Hydro-Québec and the provincial auto insurance administrator.

The Ministry of Communications conducted extensive experiments using four mobile earth terminals loaned by the trials office run by the MSAT project office. The Ministry also looked into the use of briefcase terminals manufactured by Narrowband Telecommunications Research Inc. to allow its technicians to maintain contact with head office in Quebec City while they are visiting remote Inuit villages in the North.

In another experiment, which began in the spring of 1992, Quebec's Ministry of Forestry (MFO) used the trials satellite system to conduct remote monitoring of environmental data such as spruce budworm activity, and factors that make forest fires likely. After a dry run at MFO's home office, a solar-powered remote station was set up in June 1992. The system continued to deliver important environmental data through the winter. ■

Marine trials report

CCMC completes Arctic trials

The Canadian Centre for Marine Communications (CCMC) has completed a series of highly successful tests of mobile satellite communications equipment in the Arctic.

During the summer of 1992, CCMC and the Canadian Coast Guard carried out a field trial of satellite communications aboard the Canadian Coast Guard ship *Sir John Franklin* as she cruised in the eastern Arctic.

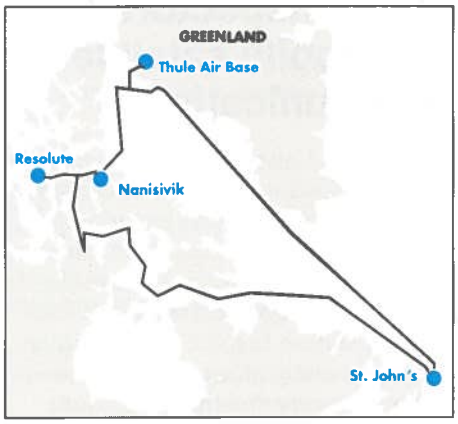
Two systems were evaluated during the trial, a SkyWave Mobile Earth Terminal (MET) — manufactured by SkyWave Electronics Inc., now Calian Communications Systems Ltd., a division of Calian Technology Ltd. — that was connected to an electronically steered Adaptive Array Antenna developed at the Communications Research Centre, and a CAL Corporation MET. The SkyWave MET, capable of voice and data communications, was linked to a data acquisition system to obtain measurements of satellite signal strength. The CAL MET was evaluated to determine its suitability for data communication.

The satellite link and equipment were also evaluated with a wide range of elevation angles and environmental conditions, and records were kept of the reliability of data transmission and reception.

The Canadian Coast Guard ship Sir John Franklin *carried an electronically steered Adaptive Array Antenna (on the large pole) for voice communication. The smaller antennas were used for data communication.*

The CAL MET performed well for the entire trip, surpassing expectations. Voice communications over the SkyWave MET were maintained during the first part of the trip, but the associated antenna was not designed for low-angle marine applications. The most northerly call was made from the Northwest Passage.

Data messaging and vessel tracking was possible far beyond the limit of voice communications. Satellite signal strength data was provided as far north as Thule and as far as the ship's most westerly position (Resolute) despite pre-trial speculation that, because the test satellite was low on the horizon at these northern latitudes, the unit might not function properly. Signal lock with the satellite was even maintained in the inlets of northern Baffin Island, which are ringed with high cliffs. ■



The route the Sir John Franklin *took in the summer of 1992.*

Reliable results at low elevation angles

During the summer of 1992, the Department of Fisheries and Oceans (DFO) took part in mobile satellite field trials that proved that highly reliable communications can be achieved using mobile terminals, even in areas of low satellite elevation angles.

Initially, DFO officials were concerned that transmissions using the five degree look angle of the trials satellite (the angle from the horizon to the satellite) would not be reliable. This concern does not apply to the actual MSAT system because it will have a significantly higher look angle. The experiments were conducted on Great Slave Lake in the Northwest Territories where DFO officers conduct patrols and inspections. Because the lake is longer than either Lake Erie or Lake Ontario, the officers often find themselves beyond the reach of existing radio communications, sometimes for several days.

A mobile terminal was installed for testing on the *Tucho Mariner*, a 15-metre DFO patrol craft. During the early part of the trial, automatic position location messages were regularly transmitted. The experiments confirmed that, for this type of application, five degrees is the practical limit for satellite coverage. Of the 318 messages sent, 275, or 86.5 percent, were received. At the extreme west end of the lake where elevation is lowest, some 500 miles away, 51 of 65, or 78 percent, of the messages were received. The motion of the antenna on board the test vessel, which had been a concern for DFO officials, did not adversely affect results.

The actual MSAT satellite will provide significantly better service in Northern Canada because it will be positioned to serve continental North America. The INMARSAT spacecraft used during the trials was positioned for oceanic users. So, for example, the elevation angle for INMARSAT at Yellowknife is about four degrees while it will be 16 degrees for MSAT. For end users, higher elevation angles mean there is less chance of the terrain blocking or shadowing the communications link between the user and the satellite.

In addition to the position reports, text messages were sent to and from the test vessel and the central control station in Burlington, Ontario. All these messages were successfully sent and received with no significant delays. ■

Radio inspectors try out mobile satellite communications

Industry Canada radio inspectors in the northern regions of Ontario and Quebec recently experimented with mobile satellite communications. These inspectors, involved in radio spectrum management activities such as radio station inspections and interference investigations, travel extensively in severe weather conditions and across vast areas beyond VHF repeater or cellular coverage. "It is often extremely difficult for inspectors to contact or be contacted by the district office for emergency assistance or even for a personal conversation that reduces the feeling of isolation or loneliness during long road trips into remote areas," says Doug Slomke of the Ontario North District Office in Sault Ste. Marie.

Mobile data terminals were installed in the Ontario North District Office's fleet of vehicles based at Thunder Bay, Sault Ste. Marie, Kenora and Sudbury; the Quebec City District Office installed mobile terminals in two of its vehicles. In addition to the mobile satellite communications equipment, these vehicles are fitted with spectrum analyzers, communications receivers, service monitors, cellular phones, laptop computers and antenna systems.

Inspector Ricci Burton demonstrates a mobile earth terminal in Sault Ste. Marie.

Hundreds of messages were exchanged between inspectors in the field and the dispatch centre. Some messages dealt with urgent situations, such as assignments to find activated Emergency Locator Transmitters or to seek out and halt radio interference on safety communication systems. During the trials, district office employees were able to improve service to clients and to eliminate some trips that would otherwise have been necessary. The satellite communications link permitted district office staff to redirect their field inspectors as new information became available.

In addition to transmitting messages, satellite communications also allowed inspectors to contact head office quickly in case of emergency. For example, the Quebec City District Office connected a land station to a computer that relays received messages over electronic mail. An alert was incorporated into the receiver to ensure that users would know to check their electronic mailbox as soon as a message was received.

An e-mail system was not the best choice for emergency applications because of the delays involved between transmission and reception of messages, says Gérard Filion, a radio inspector responsible for the experiment. "The message could take up to 10 minutes to arrive in some cases," he explains. "It would be better to have a system that allows the same response time as telephone communications do." MSAT will of course offer a full range of voice and data services, with call setup taking less than five seconds.

One minor drawback inspectors found during the tests was that department vehicles were sometimes mistaken for taxicabs due to the similarity of the antenna that was used for the trials to a taxi sign. On one cold, snowy morning in Sioux Lookout, an Ontario North District Office vehicle was actually entered by a local resident who casually tossed his bag into the back seat and asked to be taken to the airport! ■

For further information

If you would like further information about any of the subjects discussed in this newsletter please contact the sources listed below.

MSAT Project at Industry Canada
Allister Pedersen (613) 998-2011 — pre-MSAT trials program information, government MSAT service information and general information
Michel Ouellet (613) 998-8532 — pre-MSAT trials program — general information
Hugh Reekie (613) 990-4099 — *MSAT News* — comments, back issues

TMI Communications
Janis Downey (613) 742-0000 — general information — MSAT services and TMI Communications

GTIS — Government Telecommunications and Informatics Services
Al Kingan (613) 991-6684 — government MSAT service information

CAL Corporation
Katherine Wong (613) 820-8280 — general information on CAL products for mobile satellite communications
Keith Hooey (613) 820-8280 — technical information on new generation mobile data terminals

Calian Communications Systems Ltd., a division of Calian Technology Ltd. (formerly SkyWave Electronics Inc.)
Peter Rossiter (613) 592-0908 — SkyWave mobile earth terminals

Narrowband Telecommunications Research Inc.
Mahmoud El Banna (604) 294 8577 — SCADA terminals for satellite communications

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