Online Journal of Space Communication

Volume 2
Issue 4 *Satellite Communication in Canada (Spring 2003)*

Article 8

May 2021

Historical Development: MSAT Program

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MSAT Program

Introduction

As early as 1967, Canadian researchers had been involved in trials with the U.S. on the use of UHF satellites for mobile services primarily for defence operations. The use of UHF frequencies, with satellites such as LES-5, LES-6 and TACSAT offered the possibility of small lightweight mobile or transportable terminals, and several demonstrations were carried out in the land, maritime, and aeronautical environment. The world's first direct aircraft-to-aircraft voice communications via satellite was carried out May16, 1970 between two Canadian DND aircraft.

And while the Canadian Department of National Defence (DND) continued to use U.S. satellites, a military UHF mobile satellite system was never implemented in Canada. However, the early Canadian activities led to a proposal, which was never implemented, to include a UHF transponder on the Hermes spacecraft, and the concept of a DND MUSAT (Mobile UHF Satellite) eventually resulted in a proposal for a civilian MSAT. In the following decades there were technical, regulatory, and business hurdles to overcome. Technical feasibility was proven by the use of NASA and other satellites. Regulatory issues were addressed in the U.S., Canada, and at worldwide conferences. A UHF band was allocated internationally to the mobile satellite service, but in the U.S., pressures by commercial and public service entities caused it to be diverted for terrestrial use.

In 1984, Telesat completed a detailed commercial viability assessment of a mobile satellite system (MSAT) for the federal government. The study indicated that an MSAT service had the potential to be commercially viable in the long term. The first generation system would require considerable government support, and Telesat also recommended working with an American counterpart interested in developing a similar service and thereby sharing non-recurring development costs and providing in-orbit backup to each other.

By 1986, the Canadian and U.S. governments had still failed to reach accord on allocating radio frequency spectrum necessary to proceed with the proposed mobile satellite service. Meanwhile, Telesat had made modifications to the basic system concept to expand its capabilities by adding L Band (1,600 MHz) communications to the original Ultra High Frequency (800 MHz) design.

Eventually, an L-band allocation for aeronautical mobile satellites was modified to include maritime and land use in the U.S. and Canada, but only after years of acrimonious international debate. When the debate was over, the U.S. and Canadian governments authorized generic satellite systems in the L-band. More than two years of vigorous competition for the license in the U.S. was finally resolved by requiring applicants to form a consortium that became the American Mobile Satellite Corporation (AMSC). In Canada, the process was more straightforward. Telesat Mobile Inc. was established by Telesat Canada and

several other investors to implement MSAT on a commercial basis, following an undertaking by the Canadian government to purchase a significant amount of its capacity.

In 1988, Telesat signed a formal agreement with American Mobile Satellite Consortium (AMSC) to cooperate in the joint procurement and operation of satellites and ground stations for compatible mobile satellite systems. Telesat also concluded a shareholder agreement for its newly established MSAT company (TMI Inc.) in which it maintained 50 percent ownership.

In 1995, AMSC launched the first MSAT satellite and commercial services commenced the following year. In 1996, less than a decade after it was created, TMI launched its first satellite (the second MSAT satellite) and began offering mobile communications services to customers across Canada.

In 1998, AMSC acquired the ARDIS company in order to expand their product line with ARDIS's terrestrial network. The company changed its name to Motient in 2000 to solidify the consolidation of the two companies. In December 2000, Aether Systems, Inc. acquired Motient's tranportation division. Motient then divested its satellite business unit in November 2001, which joined forces with TMI Communications to form a new entity, Mobile Satellite Ventures (MSV). The union allows these two companies, both leaders in the satellite communications industry, to combine their strengths and knowledge to build a system capable of taking North American satellite communications into the future.

The Satellite

On April 20th,1996, the MSAT satellite-the most technologically advanced and most powerful satellite ever built for commercial mobile communications-was launched and TMI Communications began offering mobile communications services to customers across Canada.

The MSAT spacecraft has sufficient capacity to support up to 3,200 radio channels depending upon the type of mobile antenna used and the bandwidth allocated. Both the MSAT and AMSC spacecraft have two large 5-metre by 6-metre mesh reflectors, each illuminated by separate transmit and receive L-band cup dipole feed arrays.

With an operational life of 10 to 12 years, both satellites cover all of Canada and the entire U.S., including Alaska, Hawaii, Puerto Rico, the Virgin Islands, 200 miles of Canadian and U.S. coastal waters, and have the capacity to cover Mexico. TMI and AMSC each initially constructed and operate one satellite. Together these satellites have established an integrated North American mobile communications system providing voice and data service to mobile terminals throughout Canada and the United States. Under a Joint Operating Agreement signed by TMI and AMSC in April 1990, the two companies provide complementary mobile telephone, radio and data service to land, aviation and maritime users. The companies also provide one another with back-up and restoration capacity.

Government Program and Services

There were two program objectives governing the Canadian Government's MSAT Program:

1. provision of efficient and diverse mobile communication services in underserved areas of Canada; and
2. creation of the necessary conditions under which the Canadian domestic industry can develop and market effectively MSAT services and products domestically and internationally.

The several market studies that were carried out identified the types of services tha were required and the size of the market for a wide area mobile satellite system. The services identified included the following:

1. Mobile Radio Service (MRS) which provides voice and data communications between a mobile terminal and base stations or between mobile terminals in a closed user group.
2. Mobile Telephone Service (MTS) - a full duplex voice communications service which provides direct access for mobile terminals to the Public Switched Telephone Network (PSTN).
3. Mobile Data Service (MDS) - a service which provides a communications path for the bi-directional transfer of data between a mobile terminal and a data hub station in a packet switched mode.

These services were provided in the land, air and marine environment. Another service that was provided although not mobile was in the Supervisor Control and Data Acquisition (SCADA) field.

Government's MSAT Field Trial Program

The purpose of the MSAT Filed Trial Program was to support the MSAT Program objectives the DOC /CRC by providing a multi-year program for the implementation of trials which provided market stimulation, applications

development and early use of the Phase I MSAT service by government departments and agencies. This was a pre-launch service using an Inmarsat satellite. It was anticipated that government departments would be a major user of mobile satellite services and the trails program provided an opportunity for those users to evaluate the system, to develop their specific applications and to reach a decision on whether to subscribe with commercial service when available on the MSAT satellite.

Shown are some of the uses of the L-Band briefcase terminal, which was the first terminal of its kind in the world.

DOC/CRC provided various mobile and fixed earth terminals developed by Canadian manufacturers, the satellite capacity and technical expertise to end-user trial participants. The end-user generally provided the vehicle or platform that would support or house the equipment. The Phase I service provided for low speed packet switched data communications and a limited two-way voice communication service. The equipment that was available for trial participants is shown in the following table:

Functions of Equipment Terminals	Land Mobile	Service	Features	Manufacturer
Land Mobile	300	Low speed data	GPS or Loran C	CAL Corp.(EMS)
Aeronautical	5	Low speed data	GPS	CAL Corp.(EMS)
SCADA	30	Low speed data	Low power consumption	Narrowband Telecomm
Portable Briefcase	5	Low speed data		CAL Corp. & Narrowband
Portable Briefcase	10	Duplex voice	Capable of data transmission	Skywave Electronics

One particular SCADA application was a monitoring system set up in a remote lighthouse on the north shore of Lake Erie at Long Point, Ontario. The Ontario Ministry of Culture and Communications required a surveillance system at the Canadian Coast Guard (CCG) station location on the tip of Long Point. The surveillance was for salvagers intent on disturbing a heritage shipwreck, the Atlantic, which is located in Lake Erie 5.18km from the CCG station. The surveillance site is unique in that while it is located in the most populous area of

Ontario the CCG site is 20km from any telephone or prime power sources. To equip the site with AC power, telephone line or microwave backhaul link to send back surveillance alarms would have been prohibitively expensive. A cost-effective solution utilizing a marine radar, solar energy and satellite communications was deployed.

The surveillance system used a commercial X-Band marine radar for the detection of anchored vessels. The radar was modified for this specific application in order to reduce the prime power requirements. As the shipwreck site is fixed the radar antenna does not scan but is fixed pointing at the target site. The antenna beamwidth of 4° and range-gating techniques allowed the radar to detect targets within a 200-metre radius of the target site. The radar operates in a sleep mode, again to conserve power, and transmits only every five minutes. When a target is detected after 2 consecutive transmissions, an alarm condition will exist. Because of the depth of the shipwreck it would take divers several hours to access and leave the site.

The radar system and the satellite earth station installed on the lighthouse at Longpoint

The alarm condition is transferred to a satellite SCADA earth terminal. The SCADA terminal transmits the alarm to a satellite and then to Telesat Mobile Inc's hub in Ottawa. The alarm message is then sent via the normal Public Switch Telephone Network (PSTN) to an on-line personal computer located in an Ontario Provincial Police (OPP) detachment office. The OPP detachment then initiates an appropriate response.

Conclusions

As a result of the MSAT system, mobile users throughout North America have access to a wide array of integrated voice and data services using small, compact terminals similar to cellular phones. Services include voice, fax, positioning and data communications to users on land, sea and in the air. With beams that cover all of North America, the system serves the 85% of Canada and the United States that lies outside the range of terrestrial two-way radio systems.

A portfolio of mobile communications services have been successfully introduced, including voice, dial-up data, fax, dispatch radio, and packet data services. In November 2001, TMI Communications joined forces with the satellite division of Motient Corporation (originally AMSC) to form a new entity, Mobile Satellite Ventures.

For more information see the following links and references:

- The Friends of CRC Association
- Communications Research Centre (CRC)
- Halayko, W. David (1992) The Canadian MSAT field trials program. 1992 IEEE International Conference on Selected Topics in Wireless Communications. June 25-26. Vancouver B.C.
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