Emergency Beacons to the Rescue!

A true international 911.
Don't leave home without one!

Canada's vast wilderness and oceans have always presented a daunting challenge for the search and rescue community. In the late 1960s, researchers had developed emergency beacons for aircraft and ships that emitted an emergency "SOS" signal. This relatively low power (50-100 mW, 121.5/243 MHz) signal was picked up by aircraft – if they happened to be near the distress scene. If you were fortunate enough to be "heard" in time, the search and rescue forces would home-in on your signal to locate you. Unfortunately, this operation could sometimes take too long.

"Space age" technology came to the rescue in the mid-1970s. Researchers at the Communications Research Centre (CRC) in Ottawa, and others from France, Russia, and the United States, conducted experiments showing that low earth orbiting (LEO) satellites, circling the globe at 1000km, could pick up these low-power distress signals and relay them to a ground station. Using a technique known as the Doppler shift effect, these scientists could provide a rough location of the signal's position to within 20 km. These experiments were so successful that the four countries signed an agreement in 1979 creating an international satellite aided search and rescue system known as COSPAS-SARSAT.

The first actual rescue occurred on 9 September 1982, when a Russian COSPAS satellite detected a plane's distress signal from a crash in northern British Columbia. The signal was relayed to an experimental ground station in Ottawa, and the crash location was determined. Fortunately, searchers found the airplane and all three injured survivors were rescued.

The satellite system had improved search capabilities immensely, but the 121.5/243 MHz beacon was not originally designed to operate optimally with the satellite. To improve performance, CRC initiated a research project with Canadian industry to develop a beacon using 406 MHz technology. This new prototype would be more powerful (5 W), more precise (2 km accuracy), and most importantly would be designed with digital capability permitting each beacon to be programmed with a unique identification code. The code assists in the confirmation of a real or false alarm. This alarm resolution capability is only realized if the beacon owner has registered the beacon information with the appropriate national administration (in Canada, the National Search and Rescue Secretariat (NSS)).

The results of this new project were very successful and the CRC decided to continue research by developing a 406 MHz Personal Locator Beacon (PLB) that can be used by wilderness hikers and campers.

At this point, Transport Canada's central R&D organization, the Transportation Development Centre (TDC), was invited to participate in the PLB project review meetings. Could not this new technology be used by aviation enthusiasts in an Emergency Locator Transmitter (ELT), or by the mariner in an Emergency Position Indicating Radio Beacon (EPIRB)? TDC provided guidance and expertise to ensure that the technology being developed was adaptable for these other applications.

Several project review meetings resulted in the development of a chip that could be used for a PLB, ELT, or EPIRB. With support from the National SAR Secretariat, TDC continued to support the industry's development of various 406 MHz ELTs and EPIRBs using this new chip. Follow-on research led to the development of a "smart beacon" with an integrated GPS receiver that would not only transmit its unique identification code, but also its position determined by the internal GPS receiver. This ground-breaking technology won an award for the first commercially produced GPS-Beacon in the world.

During this time, the CRC was continuing research to enhance satellite detection. In the mid-80s, CRC conducted experiments using a geo-stationary (GEO) satellite to detect the new 406 MHz beacons. These GEO satellites provided a very fast alert capability measured in minutes, as compared to the 30-minute to two-hour wait time of the LEO satellites. Additionally, these high altitude (36,000 km) GEO satellites provided a huge coverage area, thereby reducing the number of satellites required to cover the globe. GEO satellites can detect the unique beacon identification code and, if the device has an integrated GPS receiver, the location coordinates of the beacon can also be determined. The GEO satellite experiments proved extremely successful, and by the mid-1990s the GEO satellites with search and rescue capability became operational.

What does the future hold?

Due to the high false alarm rate and poor performance of the older beacons, COSPAS-SARSAT has decided to cease satellite processing of these beacons as of February 2009 (www.cospas-sarsat.org).

Beacon users are encouraged to replace their older beacons with the newer units. TDC, with support from the NSS, is undertaking R&D aimed at reducing the cost of the 406 MHz beacon, and examining new testing technologies to make it even more reliable. CRC and scientists in Europe and the United States are conducting research on the use of medium earth orbit (MEO) satellites for search and rescue. These satellites orbit the globe at approximately 20,000 km above the earth. The MEO satellite SAR system would further reduce the alert wait time to seconds, provide continuous improved global coverage, and be capable of letting beacon owners know that they have been located.

After more than 20 years of operation, COSPAS-SARSAT has proven itself as a model of international cooperation, working toward the development of space technologies for the benefit of humanity. Canada should be very proud of its involvement in this effort. FL

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