Appendix A
SEARCH AND RESCUE SATELLITES

A newly operational satellite-borne search and rescue system now markedly increases the chances of being rescued when lost at sea or in remote land areas. Until recently an experiment' in space technology development and international cooperation, COSPAS/SARSAT has been responsible for saving nearly 400 human lives and 10 dogs, since the first rescue took place in September 1982, The participants in the experiment were the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) for the United States, the Department of Communications of Canada, the National Center for Space Studies (CNES) of France, and the Soviet Ministry of Merchant Marine (MORFLOT). In the Operational phase, NOAA has the lead for the United States.

The United States, Canada, and France have spent about $53 million on satellite equipment and ground stations to operate the Search and Rescue Satellite (SARSAT) **system.** Canada and France supply the SARSAT receiver. The United States supplies the spacecraft on which it flies and the testing and integration. A Soviet system, COSPAS, is designed to interoperate with SARSAT. The first two satellites to be equipped with receivers for emergency search were low-altitude Soviet navigation satellites. Beginning with NOAA-8, the advanced TIROS-N series of NOAA polar orbiting meteorological satellites now also carry search and rescue receivers. z

Receivers on board the satellites detect the emergency radio beacons (operating at 121.5 MHz) from downed aircraft or ships and boats in distress. The beacon's signal is re-transmitted to a ground station, which analyzes the signal to determine the location of the beacon. The small frequency shift caused by the relative velocity of the orbiting satellite and the emergency radio transmitter on Earth (the so-called Doppler effect), enables system operators to determine (within 12 to 15 miles accuracy) the position of the emergency radio transmitter. Search and rescue teams can then be dispatched to the area from which the distress signal was sent.

The type of beacon used so far for rescues is carried by over 200,000 aircraft and 7,000 vessels in the United States alone.[3] The signal from this common beacon is only usable when the satellite is in the line of sight of both the beacon and the ground station. An experimental system on the satellites (operating at 406 MHz) uses a more sophisticated emergency beacon that carries a code identifying the type of aircraft or ship, the nature of the distress, the elapsed time since the accident, the registry number, and beacon identification. In addition to direct relays, the more sophisticated one can be subjected to signal-processing on board the satellite, stored, and re-transmitted to a ground station later on. The higher frequency signal will also permit higher accuracy location (1 to 3 miles) of the emergency transmitter. The first rescue using the 406 MHz transmitter took place early in 1985.

Norway and the United Kingdom participate in the program by providing a ground station. Bulgaria, Denmark (MOU in process), and Finland participate as experimenters, with no indigenous ground stations. Other countries, including Argentina, Australia, Brazil, Chile, the People's Republic of China, Saudia Arabia, Singapore, Taiwan, Thailand, and Venezuela have expressed interest in the program.

The four original nations–the United States, Canada, France, and the Soviet Union–are discussing means by which the system could gain still broader international acceptance after 1990, when its transitional operational period ends. The possible means include: operating the system through an existing international organization; creating a new organization specifically to operate the system; or continuing the present four-party arrangement. At the present time, the countries favor expanding to a total of 10 to 15 parties in a new organization after the current MOUs expire in 1990,

The chief near-term problem faced by the COSPAS/SARSAT project has been posed by Administration policy on the polar-orbiting system on which the SARSAT transponder flies. The frequent global coverage planned for the system was predicated on keeping the necessary equipment aboard four satellites at a time—two Soviet and two U.S. The two Soviet satellites are in orbit. The Office of Management and Budget (OMB) has repeatedly attempted to limit NOAA **to** operating one polar-orbiting meteorological satellite at a time, although Congress has each year restored the necessary funds in its yearly authoriza-

[1] Development ot COSPAS/SARSAT was begun in 1977. In October 1984 the United States, Canada, France, and the Soviet Union signed an agreement to begin the operational phase of COSPAS/SARSAT in 1985 and to extend the program through 1990 See "SARSAT/COSPAS to Operate Through 1990,'" *Aviation Week and Space* Technology, Oct. 15, 1985, pp. 24-25

[2] Although NOAA-8 has experienced serious operational difficulties over the past year, it is now operational again and the SAR package is now working satisfactorily.

[3] A major problem with the system so far has been a vast number ot false alarms—about 97 percent of the signals received.

tion and appropriations procedures. However, in signing the agreement with the other principal countries in Leningrad in October 1984, the United States has now committed itself to maintain two SARSAT receivers in orbit. AS OMB has made clear, this does not necessarily commit the United States to maintaining both polar-orbiting meteorological satellite. It could fly the instrument on another polar-orbiting satellite, for example, on one of the Air Force Defense Meteorological Satellite Program spacecraft-an option earlier rejected because of a desire to keep the international segments of the project entirely civilian in character. It could also be flown on a small dedicated satellite at a cost of approximately $30 million for the first copy and about $15 million for subsequent models.[4]

Another technical-economic problem is to bring about conversion from the present emergency beacon equipment on aircraft and ships to the more sophisticated (and perhaps costlier) equipment needed for the most effective operation of the COSPAS/SARSAT system. In 1970 Congress passed a law requiring that general aviation aircraft carry an Emergency Locator Transmitter; in 1972 the National Transportation Safety Board recommended that the Coast Guard and the Federal Communications Commission (FCC) require ocean-going vessels to carry an Emergency Position-Indicating Radio Beacon. These are the beacons now usable by COSPAS/SARSAT satellites when they are in the line of sight both of the craft in distress and the ground station. There is so far no plan either for U.S. regulations or for international standards to require the new, more sophisticated beacon.

Efforts are underway to make use of the new beacons on a voluntary basis. It would be difficult to mandate carriage of 406 MHz for general aviation and small boats. It is likely to become mandatory for large ships (1 ,600 gross tons and above) operating under International Maritime Organization (IMO) convention. The Radio Subcommittee of IMO voted 17-4 in favor of 406 MHz for the frequency to be used in the float-free emergency procedures required by IMO in the Future Global Maritime Distress and Safety System.

[4]Source: Preliminary study by Applied Physics Laboratory, Johns Hopkins University for NASA,