Steering Clear of Sakhalin

Advanced air navigation schemes might prevent another disaster like the one that befell the Korean airliner; Congress promotes Navstar as the solution

Technology can do nothing about incompetence and brutality, both of which helped bring down Korean Airlines flight 007 on 1 September. But new technology could improve navigation and ensure that the mistakes that led to the airspace incursion over Sakhalin Island would not happen again. Three satellite schemes may be useful in this regard, although none has received much support from the airline companies. The three are a defense system called Navstar; a system already in use by the maritime industry called Inmarsat; and a novel idea called Geostar being promoted by an independent entrepreneur, Gerard K. O'Neill.

Navstar, also called the Global Positioning System (GPS), is supposed to begin running in 1988. Chief of the Federal Aviation Administration (FAA) J. Lynn Helms and White House spokesman Larry Speakes recently indicated that the Navstar program will be transformed into a civilian-military project. And on 26 September Senator Charles Percy (R–Ill.) introduced a joint resolution in Congress that would open Navstar immediately to civilian users and do away with a plan to tax them for using it. Percy also wants to speed up the pace, so that Navstar will be ready by 1985. Representative Dan Glickman (D–Kans.), who chaired hearings on this idea in the House science subcommittee on aviation on 19 September, plans to introduce a bill complementing Percy's.

Inmarsat is already working, but was not designed for aeronautical use and has not won the support of the air industry. However, last spring the International Civil Aviation Organization agreed to investigate uses for Inmarsat.

Geostar, a more remote scheme with a narrower scope, is presently designed to be used only in the continental United States in a limited version planned for 1987. Later versions could have a global reach, although the poles and the equator would always be in poor reception zones.

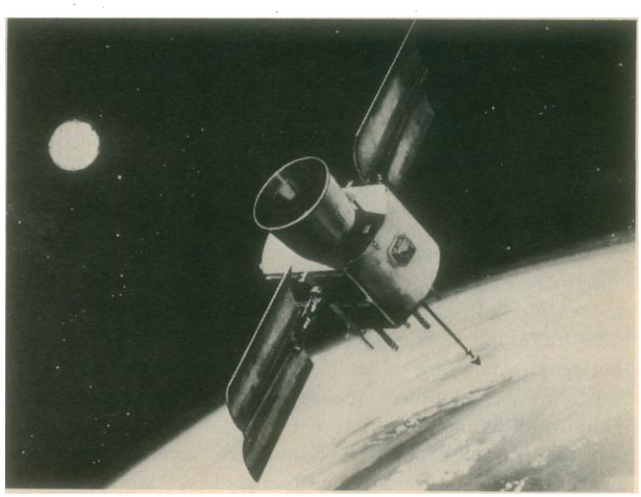
The Reagan Administration and several congressmen have fixed on Navstar as the best answer to the Korean navigational disaster. As has been reported, the plane wandered 300 miles off course on its way from Anchorage to Seoul and traveled for over 2 hours in Soviet air space. The plane's "black box" with its record of flight data remains lost. No one knows how flight 007 drifted so far astray. The common theory is that a pilot entered the wrong coordinates into cockpit computers. Navigation experts at the FAA agree that this is possible.

As one specialist explained, airplanes on long-distance flights may rely on many redundant navigational systems. But this redundancy can be defeated, and has been in the past, although never on such a grand scale.

In the Korean case, the automatic pilot probably was set to navigate by the gyroscopic inertial navigation system (INS), says an FAA official. INS is reliable, but for extra confidence, airliners typically carry three of them. One inherent weakness is that INS tends to drift over time (at a rate of 1 mile per hour), and so must be updated with new coordinates from radio beacons on the ground. It is also updated before takeoff. To save effort, the computers are rigged so that the pilot can punch in the coordinates once and reset all three INS devices simultaneously. Rarely at takeoff, more commonly partway through a long trip, the pilot may make a typing error putting the coordinates into the computer. The mistake may go unnoticed until the pilot updates the coordinates again or until a ground station sees that the plane is straying and alerts the pilot. In the Korean case, the pilot must have made an error early in the Pacific segment of the flight and never noticed it at any of the checkpoints along the way. On the other hand, says Representative Glickman's expert, Scott Crossfield, "The odds against this happening are astronomical." The 300-mile error thus remains a mystery.

An airplane over the ocean has no direct communication with any air controller. The pilots at sea talk over high frequency radio to a "communicator" who relays messages by telephone or teletype to and from the distant control center. Neither the communicator nor the control tower can observe the plane directly or fix its location, so everyone relies on the pilot to provide accurate navigational data.

One attraction of satellites is that they could provide a direct link at all times between the airplane at sea and the control tower. This would eliminate the need for communicators and allow for quick, repeated, nonvoice transmission of flight data. Inmarsat already provides a link for ships at sea, and its owners have proposed sharing the next generation satellite with the airlines in 1988. Canada and the European Space Agency have begun experimenting with digital data links for planes at sea. Meanwhile, an American company supported by the U.S. airlines is considering a nonsatellite, radio data link. These schemes would improve communication and allow for more ground-based computer



Navstar

Senator Percy wants to speed up the deployment of this $2.5-billion Air Force navigation system and open it free of charge to civilian users.

checking of flight data but would not independently check on a plane's location at sea.

Navstar, an Air Force satellite project, might be able to provide an independent check anywhere on the earth's surface. It is supposed to enable a ship or plane, or even a soldier fitted with a special backpack, to use its precise atomic-clock signal to fix the receiver's location by triangulation to within 100 meters—or with better equipment, within tens of meters. As happens with military gadgets, this one has proved more expensive than originally planned. For this reason and because Navstar could be used or attacked by enemies, the Defense Department briefly lost interest in it. Navstar was put far down on the Pentagon's wish list. In 1981 the House Armed Services Committee zeroed it out of the budget. Then Navstar was rescued in 1982, partly because congressmen like Glickman were interested in its civil uses.

In saving it, the military authorization bill of 1982 imposed some new requirements. It asked the Pentagon to open Navstar to civilians and redesign the system to include a user's tax. One goal was to shift some of the costs out of the Defense budget. If allowed to stand, this decision would make Navstar the only U.S. navigation system for which there is a fee. In addition to spending $10,000 to $20,000 per vehicle for receiving equipment, airlines and others would pay several thousand dollars per year per receiver. This prospect and the fact that the signal was going to be "fuzzed up" to discourage unauthorized use seemed likely to kill commercial interest.

In the aftermath of the Korean disaster, however, Congress seems ready to give the concept a new push. If Percy's resolution is approved, all taxpayers will foot the Navstar bill. It will not be small.

Seven experimental satellites are now aloft. The full system will require about 18 operational spacecraft, three orbiting spares, and seven spares on the ground. The primary contractor, Rockwell International, 2 months ago won approval from the Air Force to begin producing the satellites, for a price of $2.5 billion. Launching and operating them will cost extra. Six years ago, the U.S. airlines shot down a civilian proposal known as Aerosat, which would have aided navigation and communication at sea, because it seemed too expensive at less than one-tenth this price.

In the meantime, a private company in Princeton, New Jersey, is trying to establish itself in the very same marketplace. This is Geostar, headed by Gerard O'Neill, a particle physicist, advocate of space industrialization, author of the book *2081*, and president of the Space Studies Institute in Princeton. With self-assurance, he says that Geostar—still a concept more than a tangible thing—will not compete with Navstar because it will be so much better and cheaper.

O'Neill is reluctant to discuss his project just now, for he has applied to the Federal Communications Commission (FCC) for a special allocation of radio frequencies, and the period of public comment is still running. When the docket closes later this fall, he plans to hold a press conference and announce the (presumably favorable) results of a test in California intended to simulate the Geostar system.

As disclosed in the FCC docket, Geostar would consist of three satellites in geostationary orbit, a ground station with massive computing facilities, and thousands of small transponders operating at microwave frequency. The latter would be used not just by airplanes (O'Neill thinks this will be less than 10 percent of the market) but by rail cars, trucks, and ordinary autos. The fundamental difference between this system and Navstar is that Navstar requires very sophisticated, nontransmitting analytical equipment in each receiver, while Geostar puts all the sophistication into the ground station. Users would communicate with the station through "stupid" but noisy transponders, each costing in the range of $200 to $400, according to O'Neill. Another important distinction is that Navstar would tell the receiver its own location, while Geostar would give this information to the receiver and a central tracking office.

As valuable as these satellite systems could become, right now they face major obstacles, some of which are nontechnical. For example, the FAA in December 1981 adopted a sweeping air traffic control scheme, the "National Airspace System Plan," and in 1982 won authorization to begin buying equipment to carry it through the end of the century. The plan does not include Navstar or any space-based scheme for guiding aircraft.

The reason for the omission, says an FAA official, is that no such system is available now. It would be irresponsible for the government to count on something that has not been tested. The logic is sound, but there may be another bureaucratic rationale at work here as well, the logic of inertia. If so, it has been reinforced by the airlines' reluctance to get involved with what they apparently view as a 21st-century luxury.

—**ELIOT MARSHALL**

New CDC Director Is Named

James O. Mason, executive director of the Utah Department of Health, has been named the new director of the Centers for Disease Control (CDC) in Atlanta, Secretary of Health and Human Services Margaret Heckler announced last week. Mason will replace current director William Foege, who last spring announced his intention to resign after 6 years as agency chief. Foege plans to spend more time on research and international programs at CDC.

Mason, 55, received his medical degree from the University of Utah and a doctorate in public health from Harvard. He is quite familiar with the workings of CDC. Mason served 11 years at CDC from 1959 to 1970, working in epidemiology and the bureau of laboratories. He was CDC deputy director from 1969 to 1970 under David Sencer's directorship. Mason has directed the Utah Department of Health for 4 years.

Mason's appointment is being well received by J. Donald Millar, head of the National Institute of Occupational Safety and Health, a branch of CDC. Millar, who was himself a front runner for the job, said that Mason is "an excellent choice." According to Millar, Mason was one of the first scientists in the United States to link contaminated shellfish with development of hepatitis in humans.—**MARJORIE SUN**

A PAC for Star Wars

The innumerable political action committees already gearing up for Campaign 84 were joined last week by a new one: the American Space Frontiers Committee (PAC), dedicated to making a program of space-based missile defense known as the High Frontier strategy "the prime defense issue in the 1984 elections."

The new PAC intends to help finance the campaigns of people who support its goals. The High Frontier strategy, which was conceived well before President Reagan's "Star Wars" speech of 23 March, is the brainchild of retired Army Lieutenant General Daniel O. Graham, former