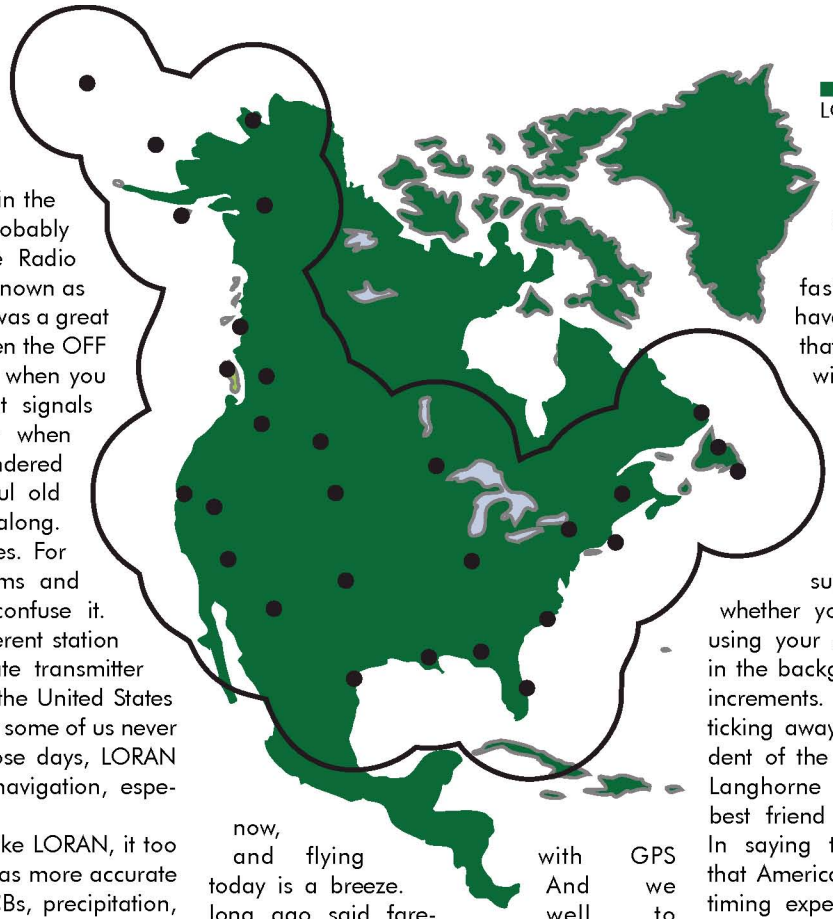
Déjà Vu All Over Again

LORAN is making a respectable comeback as a back-up navigation system.

By David Greenville



This map shows coverage of LORAN-C in North America.

If you were flying back in the 1980s and '90s, you probably remember Long-Range Radio Navigation, otherwise known as LORAN-C. In its day, it was a great navigation system. Even when the OFF flag appeared on the VOR, when you got below its line of sight signals or flew out of range, or when the ADF needle just wandered around the dial, the faithful old LORAN just kept plodding along. True, it had its idiosyncrasies. For instance, local thunderstorms and precipitation static could confuse it. Also, having to dial up different station combinations of its separate transmitter chains when flying around the United States required keyboard skills that some of us never did master. But back in those days, LORAN was a major advance in navigation, especially at low altitude.

Then along came GPS. Like LORAN, it too worked everywhere, but it was more accurate and totally unaffected by CBs, precipitation, or static. With GPS you could fly clear across the country without ever having to dial up a single new station. Hardly missing a beat, LORAN manufacturers promptly transplanted new GPS innards into their units.

Generally, the transition from LORAN to GPS went well, but there were some peculiarities. When the satellites were in a poor configuration for positioning, most of the new units displayed messages like "Revert to Dead Reckoning." (Oddly, one receiver even stated a warning that said "Return to Factory.") More peculiarities followed when much more powerful computer memory chips arrived. Programmers, lacking aviation savvy, came up with 100-page instruction manuals packed with ways to solve navigation problems we didn't recall ever having. There were also helpful hints, like the one where the computer flashed "FUEL TANKS EMPTY," just in case we hadn't noticed things had suddenly gotten quiet.

Of course, those things are behind us now, and flying with GPS today is a breeze. And we long ago said farewell to LORAN, right? Well, not exactly. It never actually went away. First, let's examine why, and then we'll look at how LORAN could fit into the future scheme of things. Why LORAN never went away is summed up in one word—redundancy. It's now generally accepted that GPS is not going to be a sole means navaid, and the rules are always going to require a backup. Wouldn't a second GPS provide that? In the case of a unit failure, yes. But if the satellites are not optimally arranged to give you an accurate position—due to those so-called "RAIM holes"—or when some sort of interference is affecting their signals, even 10 extra GPS receivers won't help.

The need for a GPS backup is not exclusive to aviation either. A large number of fixed objects, like power dams, TV and radio stations, cell phone control centers and even the whole of Wall Street, also depend on the high accuracy timing signals from GPS. They need backups, too. In fact, much of the nation's critical civil and military infrastructure, including air traffic control, relies on GPS timing. Without it, those services go downhill, fast. Consequently, most of them have a GPS backup, and invariably that is LORAN. In fact, LORAN, along with GPS and the National Bureau of Standards time laboratory in Boulder, Colo., make up the only three sources capable of meeting the nation's exacting Stratum 1 precision timing specifications, through their separate, super-accurate atomic clocks. So, whether you're flying, or watching TV, or using your ATM card, GPS is ticking away in the background, in billionths of a second increments. More often than not, LORAN is ticking away behind that GPS. As the president of the International Loran Association, Langhorne Bond, stated, "LORAN is the best friend satellite navigation ever had." In saying this, Bond underlines the fact that American and overseas navigation and timing experts agree LORAN is the hands down best backup available for GPS. The Europeans have already included LORAN as a core technology in their future navigation plan. Its long range, ground-hugging, low frequency signals extend from the surface to far above jet altitudes, and though its basic accuracy is less than GPS, correction factors can bring it close. The experts also point out that the American LORAN network is significantly cheaper to operate than the FAA's VOR/DME/NDB infrastructure. Loran's major benefit lies in its powerful, essentially unjammable, signals. Low power GPS signals—equal to one thousandth of a small Christmas tree light—are extremely vulnerable to accidental or deliberate interference. Indeed, a rudimentary GPS jammer can be built from Radio Shack parts for less than $100, and how-to instructions are readily available on the Internet. (If you have $250 to blow, you can buy smaller, more sophisticated components for your jammer and the whole thing can then fit inside a cigarette pack.)

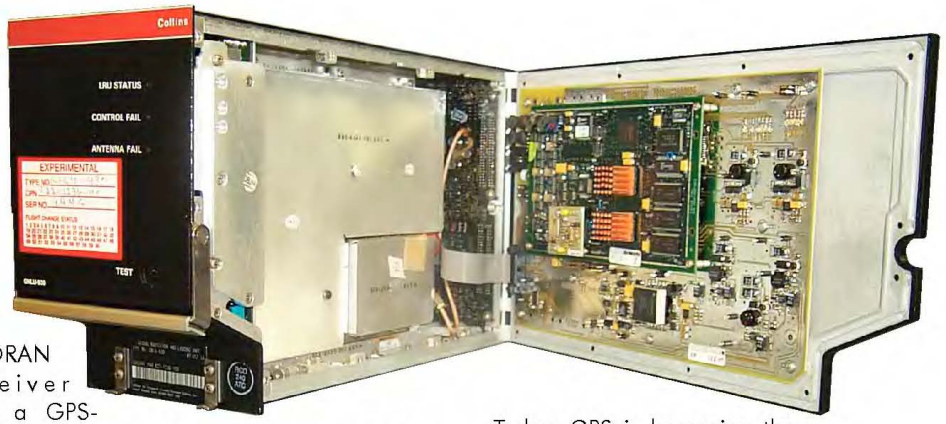
Fitted with intermittent timers to make detection difficult, jammers can also be remotely activated by cell phone. That's critical in this day and age. Whether in the hands of pranksters or terrorists, these home-built devices could conceivably wipe out GPS satellite signals for over 50 miles. And the effect would be the same on Europe's Galileo satnav, whose signals are GPS compatible.

Interestingly, USAF specialists in GPS jamming countermeasures routinely bombard new military receivers with different types of jamming transmissions to prove their operational fitness. Last year, several LORAN receivers went through the same tests and were completely unaffected.

So, is Anything Else New with LORAN?

Actually, almost everything. Just as GPS, cell phone and home computer designers have used new technologies to shrink equipment sizes and costs while dramatically increasing capabilities, so have LORAN engineers. The resulting new system is called e-LORAN, where "e" stands for "enhanced."

Enhanced means several things. For one, precip static and other weather effects have been eliminated through new technology antennae—some of which are combined with GPS. Additionally, the chains of local LORAN stations can now become a nationwide network of independent transmitters where, instead of pilots having to select three local stations, the



e-LORAN receiver uses a GPS-like "all in view" technique to automatically track every LORAN station within reception range, sometimes out to a thousand or more miles. Then, again like GPS, it selects the best combination for navigation. During a three-year FAA LORAN evaluation, flight tests of prototype receivers built by Rockwell Collins and others had as many as 30 LORAN signals to choose from.

What's more, e- LORAN requires no cockpit space. In Rockwell's multi-mode GPS/ LORAN receiver, the unit simply occupied a circuit board inside the GPS, operating without pilot inputs. Turning on the GPS also turned on the LORAN system, with both then tracking along separately. Should GPS be jammed, or fail for other reasons, LORAN would automatically take over navigation. When the GPS signals returned, LORAN would revert to its backup mode.

Today, GPS is becoming the virtual backbone of air navigation, with GPS-supported ADS-B set to eventually replace radar for surveillance and traffic awareness (see p. 60, Vertical, Jan 05-Feb 06). But while all agree that such a single thread concept requires an independent backup, there's no consensus on what it should be. The FAA wants urgently to reduce its costly VOR network and is leaning towards multiple DME stations—that require expensive scanning DME airline avionics—for traffic above 18,000 feet. There's uncertainty, though, about what to use in lower altitudes, where multi-DME wouldn't be practical, particularly offshore and in the Gulf of Mexico. Advocates clearly feel the future e-LORAN could meet this need in a successful and economically viable way.