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By Graham Warwick

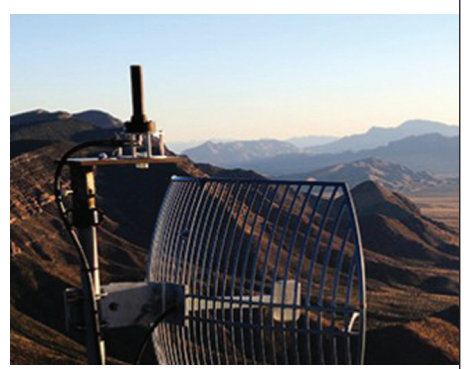
Managing Editor-Technology
Graham Warwick blogs at:
AviationWeek.com
warwick@aviationweek.com

COMMENTARY

Synchronicity

Is a ground-based positioning system now being fielded the answer to GPS's vulnerabilities?

How does a squadron charged with testing navigation and guidance systems in extreme jamming know where its aircraft and weapons are and how they are performing when GPS is jammed? The answer from next year on will be by using a local positioning system that has the potential to back up GPS wherever jamming or spoofing could have disastrous results, such as critical infrastructure, airports or guiding unmanned aircraft in civil airspace.



LOCATA

The U.S. Air Force is to deploy a ground-based non-GPS positioning system, developed by small Australian company Locata, over 2,500 sq. mi. of the White Sand Missile Range, N.M., to provide a highly accurate, sub-meter, reference for "navigation warfare" testing by the 746th Test Sqdn. The LocataNet system works like GPS, but on a different frequency and at much higher power, so it works when GPS is jammed.

But LocataNet is more than just a positioning system, say its creators. "This is a new form of synchronization. Navigation is just the first application," says CEO Nunzio Gambale. The precise timing provided by GPS's system of space- and ground-based atomic clocks is crucial to synchronizing networks from banking to power and telecommunications—and vulnerable to interference, intentional or unintentional, with the extremely faint satellite signals.

Gambale says LocataNet is the first ground-based position, navigation and timing system able to replicate GPS, making it easy to integrate into satellite navigation receivers as a back-up for when GPS is erratic or unavailable. The system is based on a network of ground-based transmitters, LocataLites, that synchronize themselves to within a nanosecond and broadcast GPS-like precisely timed ranging signals that enable receivers to determine their position.

"The signal goes through buildings. If you attach an amplifier, it has 100-mile range. It's a powerful, hard-to-jam signal you can deploy in hot spots and strategic areas [as a backup to GPS]," Gambale says. Locata receivers can be incorporated into GPS chips in the same way receivers for Russia's Glonass and Europe's Galileo are being built in now.

Already Leica Geosystems is producing "GPS+L" receivers for use in the mining industry, to provide precise positioning where GPS signals cannot penetrate, and it is working to miniaturize the electronics for use in surveying. The Insurance Institute for Highway Safety's Vehicle Research Center near Washington will use the system for vehicle collision-avoidance work. Locata's next step is to develop a time-based antenna to remove indoor multipath effects to allow the system to navigate a forklift in a warehouse with centimeter accuracy.

"Today a Locata receiver is 5 inches square, an inch deep and power hungry. Within five years it will cost just $2 to incorporate Locata into a GPS receiver," Gambale predicts, as the system can keep pace with the rapid advances in electronics technology. Where GPS is tied to a signal structure developed in the 1970s, "Locata can work at any power, any frequency, and we can do it next week," he says.

"GPS civil signals are not encrypted, which is a serious liability as we see more automation, such as UAVs in controlled airspace and automated cars," Gambale says, noting that spoofing of navigation systems—broadcasting GPS-like signals to draw a vehicle off its path—is emerging as a threat. While there is talk of adding encryption to civil GPS, the task is enormous and would take years to field, while "Locata can be encrypted anyway you like, and changed daily," he says.

Gambale emphasizes that Locata is designed to augment, not replace, GPS. "It has everything of GPS but the 'G.' We are not ever trying to be global. But you can set up a local constellation and have your own GPS. It can run quietly in the background, then, when GPS fails, ramp up the signal," he says. Locata's business model is to "license the technology to everyone. We are not for sale. There are no exclusive deals. It has to be available to everyone."

Gambale and co-founder David Small "were university drop-outs—no-one wanted to fund us, so we sold and mortgaged everything," he says. First demonstrated in 2001, "time-lock synchronization to a billionth of a second is really hard to do," he says, and the company has met with skepticism from the GPS community. "What confounds them is how we can synchronize to less than a nanosecond without an atomic clock. They are taught that time is everything and we are proving it is not. Time has nothing to do with synchronization. They are absolutely separate."

After 15 years of working on the technology, Locata came out of "stealth mode" in October with the Air Force and Leica Geosystems as partners. "Our technology is now validated to the point no one can argue," Gambale says.