US approval set to put Locata in top spot

A Canberra-based geolocation company has received critical approval from the US Air Force for its breakthrough positioning system which is complementary to and in many ways outdoes GPS. **Christopher Jay** reports.

An Australian ground-based backup for satellite global positioning systems is set to provide an urgently needed complementary alternative to the ubiquitous but fragile satellite-based positioning, navigation and timing arrangements which permeate the modern world economy.

After 17 years of research and development and 92 patents, Canberra-based company Locata is celebrating final acceptance of its system as a "gold standard" reference positioning system for the US air force.

The US imprimatur is set out in a 12-page feature article in the May-June issue of the authoritative US geospatial magazine "Inside GNSS". The piece is by Desiree L. Craig, the chief program manager for the 746th Test Support Squadron and the 46th Test Group at Holloman Air Force Base, New Mexico.

This tests and sets standards for air force equipment and procedures – these include a flight test squadron, high speed test track, the national radar cross section test facility, survivability and landing gear test facilities, and the central inertial and GPS test facility.

Among its assignments is how to handle interruptions to or denial of GPS tracking and navigation systems, and provision of what is called the Ultra High Accuracy Reference System (UHARS).

Following highly promising tests around Cooma, in southern NSW, the Locata technology was tested at the Holloman base at White Sands, New Mexico, over seven days from October 24, 2011, after a prior 11 days setting up the receivers.

One published result from the voluminous tracking data was for aircraft position to an accuracy of 6 cm horizontally and 15 cm vertically flying 195 knots at 25,000 feet. Given a fast-moving target in flight, this is unheard of accuracy. It would allow more direct tracking of airlines, with noticeable fuel and time savings, over regularly trafficked routes once Locata was installed.

For the US Air Force, Locata will provide the new non-GPS-based positioning system (NGBPS) component of the next generation Ultra High Accuracy Reference System. This represents a gold-plated endorsement, along with actual deployment in mining and partnerships with firms like Leica Geosystems of Switzerland.

For global positioning measurements, US satellite designers have striven for absolute accuracy, with three or four atomic clocks on board each satellite, monitored daily and corrected if necessary from a massive master ground control centre at the US Air Force Consolidated Space Operations Centre in Colorado when each satellite passes overhead.

The great insight of Locata inventor and co-founder David Small was that the key was not the absolute time accuracy, valuable though it is, but the synchronisation of the signal sources, so that positioning units could identify the signals from various receivers for their particular calculations.

When a Locata network is switched on, the master unit sends out a time signal, which can be cascaded through slave units if it doesn't have line of sight to every station in the network. In 30 to 60 seconds the network (which can be a single mine, or an entire city) is synchronised to one or two nanoseconds, that is, one or two billionths of a second.

Patented as TimeLoc, this system keeps the network fully synchronised. A low cost crystal oscillator for the master clock is sufficient, though if the operators want to run to a GNSS time, the Greenwich Mean Time successor Coordinated Universal Time or an atomic clock feed, the system can actually run to very high absolute levels of accuracy as well.

For medium powers such as Australia, which could not afford a fullscale GNSS (global navigation satellite system), Locata offers an much more robust and powerful system for a fraction of cost. Where applicable, many of the network units could be strung on existing mobile phone towers.

The Federal Minister assisting for Industry and Innovation, Senator Kate Lundy, sees Locata as an important potential addition to the Australian geospatial inventory. "It's significant from a broad cyber security point of view because it provides a backup to GPS systems," she said on Friday.

"It's very essential, we think. There's this general reliance on geospatial data, which is essential for response to natural disasters."

Importantly, Locata compensates for many of the deficiencies and gaps in coverage, and the absolute fragility of typical GNSS systems. Locata CEO and co-founder (with David Small), Nunzio Gambale likens it to filling in the holes in a Swiss cheese. For such a ubiquitous technology, much more widely used than most people realise, GNSS signals are extraordinarily vulnerable. Powered by solar panels, by the time the signals get down to ground level, they are weaker than background cosmic radiation.

That is why GNSS is typically intermittent or even unavailable in city centres, with their canyon-like thoroughfares, in shopping malls, in warehouses, in concrete data centres, underground car parks, mines and anywhere else that doesn't have a wide view of the sky.

The far more powerful terrestrial signals from Locata would fill in the holes. They could provide precision location for automated warehouse, automated mining, position data for people in underground car parks, mapping data for people inside large shopping malls, position data for people using contactless, stored value cards or mobile phones for public transport ticketing.

It would not be as universal as GNSS, which would still provide position data at sea, over sparsely populated areas and act as a universal, all-areas facility where good views of the sky are available. But eventually, one could see a very high proportion of the populated sections of the Australian landmass provided with Locata coverage.

A looming additional problem for existing GNSS is increasing availability of a plethora of inexpensive electronic jammers, referred to as "personal privacy devices".

Recently America's Federal Aviation Authority and Honeywell took several months to find out why the approach-and-landing system at Newark Airport, New Jersey was being intermittently jammed. It turned out to be truck drivers on a nearby freeway, using "personal privacy devices" to mask their locations from employer tracking systems.

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Senator Kate Lundy

All countries will need insurance against accidental interference to signals, intentional jamming or malicious spoofing (deliberate manipulation of signals to provide false information) as these dangerous devices become more common. The much more powerful Locata system would require an entire truck full of jamming equipment, making it easy to locate, identify and apprehend offenders.

There are more than 100 different ground-based wireless augmentation arrangements for GNSS in various stages of planning or development worldwide. The Locata edge is that it can provide a wide-area time-synchronised network of cross-referenced ground stations, which can be slotted into the existing arrangements as the equivalent of an additional, more powerful ground-based quasi-GPS constellation.

Locata will provide an alternative system to typical GPS systems such as this. Photo: REUTERS

Americans the most down to Earth

■ The US Navstar GPS satellites date from 1973, first from Rockwell International, then Lockheed Martin, and presently Boeing. Fleet size fluctuates as the expired are retired and the newly called are installed. The minimum is 24 working satellites, the preference is for 30 or even 33 for maximum reliability. They orbit the Earth twice a day at 17,700 km out, corrected daily as they pass over the US Air Force Consolidated Space Operations Centre in Colorado.

■ China has the partially built Compass system, or Beidou-2 (meaning Big Dipper constellation). By 2020 it is planned to have five satellites in geosynchronous Earth orbit (GEO), three more in inclined geosynchronous Earth orbit (IGSO) and 27 in medium Earth orbit (MEO).

■ The Europeans finally got two satellites launched on October 21, 2011 to kick off their much-delayed €20 billion Galileo system, with a couple more due for 2012. The initial two were named for the winners of children's colouring competitions. A total of 27 operating satellites, each named after a competition-winning child from European Union members (plus three hot spares) is scheduled by 2019, including emergency rescue location.

■ The Russian GLONASS system completed in 1995, and allowed later to fall into disrepair, was made generally available in 2007 and restored to its full 24 operating satellites in October, 2011 – the same month the Europeans finally got their first two satellites off. GLONASS stands for Globalnaya Navigatsionnaya Sputnikovaya Sistema or Global Navigation Satellite System. The Russians pioneered eccentric orbits, initially for Molniya ("Lightning") communications satellites. These travel high and relatively slowly over the Russian part of the globe, with a typical dwell time from eight to 12 hours, before swooping low and fast over the other side of the world to transit the null zone as quickly as possible and get back on station.

■ India is planning to enlist the Molniya orbit for an Indian Regional Navigational Satellite System with a accuracy of better than 10 metres over land, and better than 20 metres for 2000 km around the sub-continent, particularly much of the Indian Ocean. Of seven satellites, with seven-year lives, four will have highly elliptical orbits, travelling high and relatively slowly over India, at an apogee of 24,000 km and then swooping low over the opposite side of the globe at a perigee of just 250 km to traverse the non-productive part of their orbits as quickly as possible. The remaining three satellites will be geostationary. The Indians would like to have their seven satellites all operational by 2014.

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