WHITE PAPER

SBAS: CRITICAL INFRASTRUCTURE FOR ALL AUSTRALIANS

Authors:

Professor Andrew Dempster, University of New South Wales
Jack Scott, Thales Australia

Summary

The SIAA recognizes the importance of global navigation satellite systems (GNSS) and their ability to delivery greater productivity throughout our society. In 2012, it was estimated[1] that $2.3-3.7billion was added to Australia's GDP by GNSS, and that will rise to $7.8-13.7billion by 2020. The recent Satellite Utilization Policy identifies satellite navigation as "critical to Australia's smart infrastructure and social, economic and national security"[2]. SBAS, as a space based augmentation of GPS, has the ability to provide greater accuracy, availability and integrity of GPS signals to all Australians, increasing the productivity and corresponding economic benefits for all its users. In particular, SBAS would enhance the lives and productivity of rural Australians. Safety of life services such as the Royal Flying Doctor Service, supply of remote settlements when roads are cut off during the rainy season, delivery of critical materials and crew changes to remote mines, providing greater accuracy to the construction industry, precision farming and automated mining are some of the many activities from which rural Australia would benefit if SBAS was available across the nation.

SBAS was originally developed to support aviation, providing efficiencies and safety of life services. It can now provide enhanced services for all GPS users, particularly in areas where technology will play a central role in the next decade, such as intelligent transport systems (ITS). As a space based service, the same level of service available in urban areas will be available in remote locations. The core system should incorporate New Zealand and other countries in South East Asia and the Pacific. New Zealand has shown considerable interest in partnering with Australia providing an inclusive cross-Tasman solution.

Because an Australian/New Zealand SBAS will be built to the International Civil Aviation Organisation (ICAO) standard it will be fully interoperable with WAAS in the United States, EGNOS in Europe, MSAS in Japan, SDCM in Russia and other systems. Thus aircraft flying from the United States to Australia will be fully compatible with SBAS Australia. Similarly, the numerous commercial devices designed for use with WAAS and EGNOS will be fully operable.

[1] See ACIL Allen Consulting, "The value of augmented GNSS in Australia", June 2013, http://www.acilallen.com.au/cms_files/ACIL_GNSS_positioning.pdf , page i
[2] See Australian Government, "Australia's Satellite Utilisation Policy", June 2013, page 9

The case for aviation is strong. Both WAAS funded by the FAA and EGNOS funded by the European Union have delivered Safety of Life systems for aviation and its millions of passengers. This is especially evident in achieving reductions in Controlled Flight into Terrain (CFIT) which is one of ICAOs principal objectives. Efficiencies and cost benefits have resulted from reductions in delays, diversions and cancellations.

The SIAA recommends that the Australian government, in partnership with New Zealand, invest in SBAS as a critical infrastructure project to be implemented for the benefit of all Australians, particularly rural and aboriginal Australians.

SBAS

A satellite-based augmentation system (SBAS) is used in a particular geographic region to improve the performance of satellite navigation systems, such as the Global Positioning System (GPS). An SBAS can improve the accuracy of GPS from about 10m to about 1m. It is also able very quickly to inform a receiver if GPS is unreliable.

An Australian SBAS will work by employing an extensive ground network of stations that provide three types of information: i) the reliability of each satellite signal, ii) the errors experienced by GPS measurements, so they can be used to correct receiver measurements, and iii) the location of the SBAS satellite so it can be used like an extra GPS satellite.

Benefits

Benefits to all users

- The service will be available country-wide, with no distinction between remote and urban areas. All airports and aerodromes across the country will have the same level of this infrastructure support.
- In Europe, a GDP increase of €2.4B euro is expected from the use of its SBAS, EGNOS, for aviation applications alone[3] . Similarly, yet to be published results in New Zealand show a benefit-to-cost ratio (BCR) of 0.7 for aviation alone. When other applications are taken into account, particularly agriculture and intelligent transport systems that will come on-line in the next decade, a BCR of well over 1 is a reasonable expectation.

Benefits to aviation users[4]

- SBAS-assisted approaches are eight times safer than alternatives (GNSS approaches are 25 times safer in general). Approaches account for 63% of controlled flights into terrain (CFITs) and 75% of those happen in poor visibility or hilly terrain.
- Substantial amounts of fuel are saved with these approaches.
- The proposed alternative system is ground-based and installed at only 198 of 300 aerodromes in Australia and 85% of aircraft do not have the requisite equipment installed.

[3] See LEK Consulting, "EGNOS Cost Benefit Analysis in Aviation", 27 July 2009, page 7

[4] See P Collier et al, "Space Based Augmentation System for Australia: A Proposal to Add Payload to the NBN Satellites to Enhance Australia's Position Navigation and Timing Capabilities", CRC for Spatial Information, Nov 2010 (updated Oct 2011) and Australian Government, DOIT, "Satellite Based Augmentation Systems: A case for further review", submission to ICAO, 2013

- Approaches to all airfields and airports, regardless of size, look the same to the pilot. This makes airports currently using other instrumentation much more accessible: the 42% of aerodromes in regional Australia, plus those in the region with difficult terrain (NZ, PNG, Indonesia, Timor Leste, SW Pacific)
- Two rural aerodrome users to benefit most are emergency services, and mining. The costs of airport closure to mining companies with "fly-in-fly-out" operations are significant.
- Replacement of old ground-based navigation aids, costed at $106M, can be avoided.
- Australia would fully meet its commitment to ICAO Resolution 36 - 23
- Improved GNSS navigation performance in low-cost receivers (accuracy, availability and integrity).

Benefits to road users[5]

- In the coming decade, automation will be increasingly important for road transport, and cooperative intelligent transport systems (C-ITS) will emerge. The aim is to improve road safety and efficiency. In North America, Europe and Japan, C-ITS systems assume the use of SBAS to provide lane-level accuracy and high integrity.
- If Australia did not commit to SBAS but did commit to C-ITS, an alternative, possibly ground-based augmentation to GPS will be required, a more expensive option. More likely is that Australian drivers would be denied the capabilities of their driving compatriots in the northern hemisphere.

Benefits to maritime users

- Currently the Australian Maritime Safety Authority (AMSA) operates a differential GPS system. This could be replaced by the SBAS service, freeing up its beacons or even that spectrum for other purposes. The SBAS receiver should be simpler and cheaper than that required at present.

Other sectors to benefit from improved positioning

- Utilities
- Construction
- Agriculture
- Mining
- Surveying

Costs

A fully Australian-owned and operated system has been costed for four scenarios[6] ranging from $190M to $300M. The SBAS payload, if installed on an existing geostationary satellite mission is estimated at $30M. CASA is currently investigating alternatives.

For a short time in 2010/11, there was an opportunity for Australia to install an SBAS payload on the NBN satellites for $30M. New secondary payload opportunities must now be identified. Possibilities include Inmarsat.

[5] See Austroads report AP-R431-13 "Vehicle Positioning for C-ITS in Australia (Background Document)" , https://www.onlinepublications.austroads.com.au/items/AP-R431-13

[6] See Collier, Op. cit., page iv

Capability development

The procurement of an Australian SBAS coincides with the strategic aims of the SIAA in several ways. Specifically, it will address two objectives of the SIAA: to promote and assist the development of a viable and self-sustaining commercial space sector in Australia and to ensure that the interests of the commercial space sector are taken into account by governments. It will also achieve wider aims:

- Capability will be built in program management, system engineering, and operation of a significant national space asset.
- Important space infrastructure (GPS) will be augmented such that it provides a more accurate, higher integrity service.

References

P Collier et al, "Space Based Augmentation System for Australia: A Proposal to Add Payload to the NBN Satellites to Enhance Australia's Position Navigation and Timing Capabilities", CRC for Spatial Information, Nov 2010 (updated Oct 2011)

Austroads report AP-R431-13 "Vehicle Positioning for C-ITS in Australia (Background Document)" , https://www.onlinepublications.austroads.com.au/items/AP-R431-13

ACIL Allen Consulting, "The value of augmented GNSS in Australia", June 2013, http://www.acilallen.com.au/cms_files/ACIL_GNSS_positioning.pdf

Australian Government, "Australia's Satellite Utilisation Policy", June 2013

Australian Government, DOIT, "Satellite Based Augmentation Systems: A case for further review", submission to ICAO, 2013

LEK Consulting, "EGNOS Cost Benefit Analysis in Aviation", 27 July 2009

August 2015

Email: contactus@spaceindustry.com.au

Website: www.spaceindustry.com.au