

EGNOS FACT SHEET

14: SBAS - INTEROPERABILITY EXPLAINED - DELIVERING A GLOBAL SERVICE

Satellite-also being Based Augmentation System (SBAS) is the generic term for systems like EGNOS that are developed in the US, Japan and elsewhere. In previous articles we have concentrated on issues associated with EGNOS and the EGNOS System Test Bed (ESTB). But EGNOS is more than just a European regional SBAS that augments GPS – it is the European component of a global initiative that aims to deliver a global, seamless, safety-of-life navigation service. So, in this issue, we are going to talk about the other SBAS systems, and how they are used to augment GPS, and we will see how interoperability between them brings benefits to users.

Why should I be interested in systems other than EGNOS? Let's remind ourselves about what SBAS systems do. Each broadcasts a GPS look-alike signal modulated with Wide Area Differential (WAD) and integrity data from dedicated geostationary satellites. If you are in the European EGNOS coverage area with an SBAS receiver, you will track at least two additional GPS look-alike signals and these will improve positioning availability. You will also receive and use the WAD and integrity data. The former will improve positioning accuracy, while the latter improves quality of service and is important for safety of life users.

So, why should you be interested in SBASs other than EGNOS?

Well, firstly, if you find WAAS-compatible rather than EGNOS-compatible receivers in the shops, you may want to know whether these will work with EGNOS. Secondly, your receiver might track GPS look-alike signals from other SBASs, particularly if you are near the edge of the EGNOS coverage area (e.g. the European

Atlantic coast). Should you use these satellites and are their WAD corrections valid in Europe? Finally, will your SBAS receiver work normally if you travel outside Europe? These questions are answered later on.

What other SBAS's are there?

In the mid-1990s, three regions took up the gauntlet to develop SBAS systems: Europe, the US, and Japan. We have already written extensively about EGNOS in previous issues and so interested readers should visit the ESTB News archive on the ESA web site.

In the United States of America, the Federal Aviation Administration has taken the lead for developing its Wide Area Augmentation System or WAAS. The WAAS signal was made available for non-aviation users in 2000. It currently delivers accuracies of one meter horizontal and two meters vertical and supports aviation precision approach (APV-1) performance. An Initial Operational Capability (IOC) for aviation use started in July 2003 and its Full Operational Capability (FOC) is planned for the end of 2007.

Japan is developing an SBAS founded on its Multi-function Transport Satellite (MTSAT) called the MTSAT Satellite Augmentation System or MSAS. The first phase based on single geostationary satellite coverage is planned for 2005 while the second phase based on dual geostationary satellite coverage is planned for 2006. We expect MSAS to deliver a Non Precision Approach capability, and this could be enhanced to provide precision approach performances (e.g. APV-1).

Other regions are also interested in providing SBAS services although their plans are less advanced than Europe, the US and Japan. NAV Canada's SBAS (known as CWAAS) strategy is based on an extension of the US WAAS coverage by deploying a network of reference stations and linking these to the US WAAS master control stations. India's SBAS, GAGAN (GPS and GEO Augmented Navigation), is being co-ordinated by the Indian Space Research Organisation and the Airports Authority of India. They are planning for an initial operational capability in 2006/7.

EGNOS	European Geostationary Navigation Overlay Service
WAAS	US Wide Area Augmentation System
MSAS	Japanese MTSAT Satellite Augmentation System
CWAAS	Canadian WAAS
SNAS	Chinese Satellite Navigation Augmentation System

SBAS Definitions

ESA Navigation Web Page:
www.esa.int/navigation

ESA EGNOS Web Page:
www.esa.int/EGNOS/

ESA EGNOS for Professionals Web Page:
www.esa.int/navigation/egnos-pro

ESA ESTB Web Page:
www.esa.int/ESTB

ESA EGNOS Help Desk:
EGNOS@esa.int

ESA Galileo Web Page:
www.esa.int/Galileo

EC Galileo Web Page:
http://europa.eu.int/comm/dgs/energy_transport/galileo/

FAA GPS Product Team:
<http://gps.faa.gov/>

Galileo Joint Undertaking:
www.galileoju.com

The People's Republic of China is deploying its Satellite Navigation Augmentation System (SNAS). There is also a high level of interest in Brazil and the African continent.

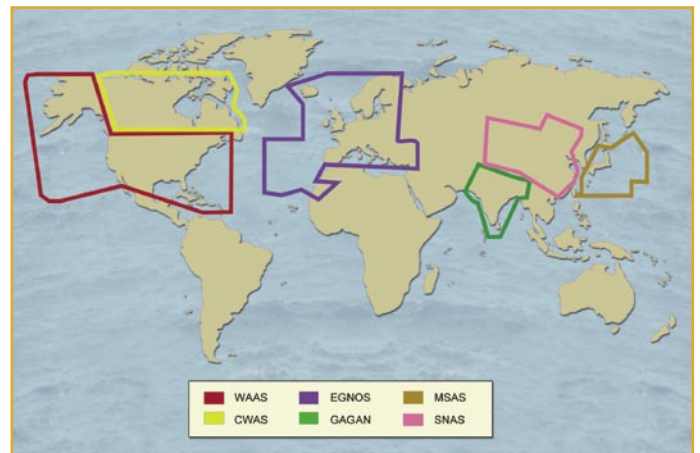
How will SBAS services evolve over time?

Let's start by stressing that there is a future for SBAS services even after GPS has been modernised and Galileo has become operational. SBAS will still be an important source of differential corrections, and their integrity information will still be crucial for safety-of-life users. Perhaps the first thing to discuss is when the different SBAS services will become available. SBAS services for safety-related users in the US, Europe and Japan should be available by 2005/6. We should soon hear which other regions or countries are going to provide SBAS services, and these will probably be introduced in the 2008-2015 timeframe. Future SBAS system upgrades really depend on GPS and GEO modernisation and the introduction of new Galileo services.

Looking at the GPS modernisation plans, we will have a second civil signal at the L2 frequency (1227.6 MHz) (first launched planned 2005 and IOC in 2009). This will be followed by a third civil signal at a new L5 frequency (1176.42 MHz) (first launch planned 2006 and IOC in 2012). Galileo services are planned to be available from 2008. New GEO satellites with a dual frequency L1/L5 capability are going to be available as early as 2005. We could see SBAS upgraded as soon as 2007 to benefit from the GEO L1/L5 signals, 2008/9 for the GPS L2 and Galileo signals, and 2010-12 for the GPS L5 signals. These will enhance the system accuracy and availability, and users with dual frequency receivers may have some form of extended coverage. The upgrades will be backwards compatible so if you buy an SBAS receiver today, it will still work once the systems have been upgraded. Looking to the future, joint GPS/SBAS/GALILEO receivers will offer aviation users a unique and exciting opportunity to achieve GNSS "sole means" navigation. We will also see SBASs expanded to cover the inhabited regions of the world.

The SBAS Interoperability Working Group

The SBAS interoperability has always been a pre-requisite for delivering a global seamless safety-of-life service. This was recognised early on by SBAS developers and air traffic services providers, and they have worked closely together to co-ordinate their activities at ICAO and in



System Service Volumes (Illustrative)

the Interoperability Working Group (IWG). One of their key activities has been to assist ICAO and RTCA in the development of standards: Standards and Recommended Practices (SARPS) for system developers; and Minimum Operational Performance Standards (MOPS) for receiver manufacturers. The IWG has also been a useful forum for learning lessons that have an impact on safety and programme schedule.

So what does interoperability do for me?

First of all, there are many SBAS receivers on the market, but if you buy a receiver that is compliant with the latest version of the GPS/WAAS MOPS (DO-229C), then you can be confident that your receiver will work with any SBAS signal. So, a receiver that is WAAS-compatible and compliant with DO-229C is also EGNOS-compatible. Secondly, if you are in the EGNOS coverage area, then your receiver will be able to track the GPS look-alike signals from other SBAS satellites (e.g. WAAS). Range measurements from the WAAS satellite are valid provided that the satellite is monitored by EGNOS. However, it is important to recognise that each SBAS optimises the WAD corrections and integrity data for its own coverage area, and hence only EGNOS WAD corrections and integrity information will be valid in the EGNOS coverage area. Finally, your SBAS receiver will also work normally outside Europe. If you are in SBAS coverage, your receiver will track both GPS and GEO satellites and deliver the service provided by the operator. Otherwise, your receiver should function normally in a GPS-only mode.