ESTB/EGNOS FAQ

Update May 2006

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1. How does an SBAS (Satellite Based Augmentation System) system work?

SBAS systems improve the performances of GPS with the objective to make it useable for safety critical services. This is accomplished by providing, by means of separate (geostationary) signals of a set of corrections that improve the position and time calculation performed by the user satellite receiver. EGNOS provides these corrections not only for GPS but also for GLONASS.

Generally speaking, an SBAS system is based on the principle of the spatial and temporal correlation of measurement errors that arise when making distance measurement from a space born source. The difference between the theoretical and the real measurement performed in a known position can be found, with similar values, in other real measurements performed in the nearby of the known position. In other words this principle says that the distance measurements made in a small geographical area may be affected by the same errors. Once you know the measurement error in one place, it can be used as a correction for the distance measurements made in nearby places. In a scenario where several reference points are available, a wide area correlation law, which models the difference in distance measurements, can be derived. These data collected by a network of reference stations are processed and then transmitted to the users, by means of geostationary satellites, on a signal having the same frequency as GPS (L1=1575.42 MHz) and a different data format. The information contained in the navigation message modulated on L1, the additional ranging capability offered by the geostationary satellites and the complexity of ground processing and checks, are able to improve the accuracy, the integrity and the reliability of GPS and GLONASS.

2. Where can I find general information on SBAS? What is the reference documentation on SBAS developments?

There are several SBAS developments ongoing: EGNOS in Europe, WAAS in U.S.A., MSAS in Japan, and others (Canada and India). Information can be found on the following web sites:

http://www.esa.int/navigation

http://gps.faa.gov/programs/index.htm

http://www.mlit.go.jp/koku/04_hoan/e/mtsat/role/01.html

Or please consuls the following publications:

- RTCA MOPS DO-229C available for sale at: www.rtca.org
- Guidelines for the Introduction and Operational Use of the GNSS - ICAO 30/12/99 Circular 267-AN/159 available for sale at: www.icao.org

3. What is the difference between the ESTB and EGNOS architecture?

ESTB (EGNOS System Test Bed) is a reduced version of EGNOS using dedicated monitoring stations and processing devices. Since February 2000, it offers an experimental signal having the purpose to help navigation equipment manufacturers and application developers to test their products and allowing users to familiarise with the system. The ESTB will also allow testing the possibility of expanding the EGNOS system outside Europe.

EGNOS and ESTB are two independent systems making use of its own ground segment infrastructure and different GEOs. EGNOS and ESTB broadcast two different signals.

The ESTB signal cannot and does not provide the availability and integrity that EGNOS will provide. Therefore it shall not be used in any safety critical application.

More information on the ESTB can be found under:
http://www.esa.int/estb

More information on EGNOS architecture can be found under:
http://www.esa.int/egnos

4. What is the status of the ESTB system in Africa?

At the time of writing, 8 ESTB Operational RIMS stations are deployed in Africa and 9 are deployed in Europe.
The ESTB SIS is for the time being, usable in the Western Africa and South Africa Region. Additional RIMS are currently being deployed in the Eastern African region.
Information on the ESTB SIS status and performances (APV-1 service) computed in near real time are available at www.esa.int/estb

5. Which satellites are being used to broadcast the ESTB and EGNOS signal?

Since June 2005, the ESTB SIS is broadcast by Inmarsat AOR-E (PRN120) geostationary satellite and available via SISNET. PRN 120 is located at 15.5 ° West.

The EGNOS SIS is broadcast by the ESA satellite ARTEMIS (PRN 124), and IOR-W (PRN126). EGNOS satellites are located at 21.5 ° East (PRN 124) and 25 ° East (PRN 126)

Due to the experimental nature of the ESTB, the signals are broadcast without any guarantee of service as it is stated in the disclaimer available at www.esa.int/estb

The signal broadcast by the EGNOS satellites (via PRNs 124 & 126) is for the time being exclusively used for EGNOS testing purposes or EGNOS initial operations. It cannot be used for safety of life applications as indicated in the disclaimer available at
http://www.esa.int/navigation/egnos-pro

6. I wish to know more on EGNOS and on the ESTB; where can I obtain related publications?

ESA keeps an updated website where papers are available giving further information about the EGNOS system, ESTB status/evolutions and the trials that have been carried out. Publications can be downloaded from the web site:
http://esamultimedia.esa.int/docs/egnos/estb/publication.htm

7. Where can I find real time information on EGNOS/ESTB broadcast status and performances?

EGNOS real time Information is available from the EGNOS for Professionals Website at

http://www.esa.int/navigation/egnos-pro

In addition, ESTB real time information is available from the ESTB website
http://www.esa.int/estb

8. What are the EGNOS/ESTB performances?

EGNOS has been designed to meet the demanding performance requirements for landing aircraft:

- Accuracy is improved to about 2-4 meters vertical and 1-3 meters horizontal through the broadcast of wide-area differential (WAD) corrections;
- Integrity (safety) is improved both through the high degree of redundancy in the system and by alerting users within 6 seconds if some system degradation occurs to EGNOS, GPS or GLONASS;
- Continuity is improved in order to keep the system working during the next 150 seconds from the beginning of any intended operation
- Availability is improved by broadcasting GPS look-alike signals from [three] geostationary satellites.

EGNOS measurements already confirm that accuracy will be in the order of 2-4 meters vertical and 1-3 meters horizontal inside the ECAC area.

9. What is the status of the EGNOS system and what is the current planning?

Status Today

The status of the EGNOS system is that two of the EGNOS GEO satellites (PRN 124 and PRN 126) have been connected to the EGNOS computing platform and are used in the following way:

- The signal broadcast by the EGNOS satellite IOR-W (PRN126) is for the time being used for final technical tests of the EGNOS system.
- The signal broadcast by the EGNOS satellite ARTEMIS (PRN 124) is used for EGNOS Initial Operations.
- The signal broadcast by satellite AOR-E (PRN 120) contains ESTB corrections, which are at present widely utilised by Garmin users because it contains a MT0/2.

The use of EGNOS signals from Q1 2005 prior to formal announcement of system availability for non-safety of life service allows users to benefit from excellent accuracy performance, however temporary discontinuation of EGNOS broadcast from one or several GEO satellite cannot be excluded.

Near future (Quarter 3 2006)

The full handover of AOR-E form ESTB to EGNOS will be complete and the

operation ESTB will be stopped. In addition the full integration of MT0/2 into EGNOS will be complete. The continual development of the system will require one EGNOS satellite to be used for testing; the broadcast regime will be as follows:

- The signal broadcast by the EGNOS satellite IOR-W (PRN126) will contain MT0/2, and is scheduled to broadcast continually for the remaining period of 2006.
- The signal broadcast by the EGNOS satellite ARTEMIS (PRN 124) will contain the EGNOS UP test signal.
- The signal broadcast by the EGNOS satellite AOR-E (PRN 120) will also contain MT0/2 and is scheduled to broadcast continually for the remaining period of 2006.

The addition of MT0/2 into the system is a significant milestone in the development of EGNOS for users of non-safety of life services. The use of MT0 excludes certain users form being able to benefit from EGNOS corrections, since a large number of receiver are unable to process MT0. MT0/2 will allow all receiver units to process and use the corrections broadcast by EGNOS for multi-modal non-safety of life applications.

Longer term Future (2006/2007)
After MT0/2 technical upgrade is achieved, the EGNOS Open Service could be declared at the discretion of the authorising bodies (specifically the GSA and the European Commission). It is expected that an announcement will be made in 2006. It is also foreseen that during 2007, the EGNOS Safety-of Life Service could be declared available following the certification process

10. In the SBAS operational context, will a receiver be able to process EGNOS, MSAS and WAAS signals?

Yes, all receivers compliant with RTCA/DO-229C MOPS will work with any SBAS. All SBAS service providers meet on a regular basis to ensure signal compatibility and system interoperability.

11. Is there a list of SBAS receivers?

Yes, please visit the web site
http://esamultimedia.esa.int/docs/egnos/estb/SBAS_receivers.pdf

12. What is the ESTB/EGNOS signal structure?

EGNOS uses the same frequency (L1 1575.42 MHz) and ranging codes as GPS does but it has a different data message format. The Signal in Space (SIS) content is organised in 64 possible messages. 21 of these are already allocated for information like: integrity, propagation corrections, clock corrections, satellite almanacs and so on. Further information may be found in the document RTCA MOPS DO-229C or by downloading the fact sheet 12.
http://esamultimedia.esa.int/docs/egnos/estb/Publications/fact.htm

13. What are the different ESTB transmission modes?

A set of broadcasting modes has been defined to indicate the messages and the functions being broadcasted. These vary from ”internal test”, where only test messages are broadcasted, to “GIC/WAD corrections & ranging”, where all possible data is provided. Further information is given in

http://ravel.esrin.esa.it/docs/egnos/estb/schedule.htm

14. What is the in brief the message type 0/2? When will the ESTB and EGNOS transmit the message type 0/2?

The message type 0, or MT0, is used to indicate that the system is on test and is not usable for safety critical applications. Receipt of a message type 0 will normally prompting the receiver to terminate the use of any ranging data and all other messages. The typical format of such message type 0 is a sequence of zeros. It is important to notice that, according to the RTCA DO 229C, there is another possibility to use the message type 0 during tests. It consists in overlapping a message type 2 on the frame reserved for the message type 0. This still indicates that the system is on test but it also optimises the use of the SIS data capacity. This solution is currently applied for the WAAS system.

The ESTB has applied the message type 0/2 from 1 April 2003 onwards.

EGNOS is planned to apply the message type 0/2 at the end of 2005.

15. Is there a map showing the ESTB/EGNOS coverage area?

The ESTB coverage area can be found under:

http://ravel.esrin.esa.it/docs/egnos/estb/broadcast.htm

The EGNOS expected service area can be downloaded (fact sheet no.1) from

http://esamultimedia.esa.int/docs/egnos/estb/Publications/fact.htm

16. What is the EGNOS implementation time schedule?

- System design started in 1997;
- Preliminary Design Review: end of 1998;
- Critical Design Review: early 2002;
- Factory Qualification Review: completed in July 2004
- Operational Readiness Review: held in May 2005

17. When the ESTB to EGNOS handover take place, will the ESTB service be interrupted?

The handover from ESTB to EGNOS should be transparent to users with no interruption of service. It is currently intended to continue the ESTB transmissions until at least end Q1 2006, such as to allow for a soft transition into EGNOS operations.

18. Can the EGNOS service area be extended?

At present EGNOS is the European solution for the European (ECAC) requirements. However, the design allows extending the services to other areas visible form the geostationary satellites. Such extensions are realisable through adding additional monitoring stations without interrupting the EGNOS signal. Regions that could benefit from such extensions comprise Africa, South America and Asia.

19. Can EGNOS provide an accurate time reference?

The second mission of EGNOS is the real time distribution of UTC time for the benefit of time/frequency users. The EGNOS receiver processing is referred to the EGNOS time (ENT). The ENT is broadcasted with an accuracy of 1.5 ns. The estimated offset between ENT and UTC is disseminated with a special message.

20. Is EGNOS signal encrypted or affected by interference?

EGNOS signal is neither encrypted nor should normally be affected by interference. There is a constant monitoring on EGNOS signal to prevent that interferences may have a significant impact on the system operations.

21. Are the WAAS signals usable over the EGNOS coverage area?

Like EGNOS, the WAAS GEO satellites transmit correction and integrity data modulated on a GPS like L1 signal. Each SBAS service optimises its corrections and integrity information for its own coverage area, and so users in Europe should only use correction and integrity data broadcast by the EGNOS satellites.

In practise, a user in Europe will find that the WAAS data are incomplete, containing neither a complete set of corrections for all satellites in view nor an ionospheric grid model for Europe. The range measurements taken from WAAS are normally usable provided that they are monitored by EGNOS.

22. Why does the ESTB sometimes not improve the accuracy of GPS?

There will be 34 Reference and Integrity Monitoring Stations (RIMS) in the operational EGNOS system. These will ensure that each GPS and GEO satellite in view of the EGNOS service area (ECAC) is monitored by EGNOS, and that ionospheric information is provided for all the ionospheric model grid points in view of ECAC.

In some contrast, the ESTB exploits less number of RIMS for the same service area. Consequently, there are occasions when some of the GPS satellites in view are not declared as “monitored” by the ESTB. When this occurs, those receivers that only use WAD-corrected satellites in their position solution (i.e. they do not use GPS that are not monitored by the ESTB) may experience a degradation of geometry and a corresponding loss of accuracy.

23. GPS is being modernised. Will this affect SBAS (e.g. EGNOS) systems?

EGNOS is conceived to be operational for 15 year without interruption of service. For that it will follow the necessary modernisation steps to adapt to the GPS and standardisation evolutions. ESA is already studying in the context of the GNSS Support program, the possible modernisation of the EGNOS architecture, in order to augment the future GPS L5 frequency and for an adequate integration in a common Galileo/EGNOS strategy. These EGNOS evolutions will be done without service interruption thanks to the EGNOS built-in upgradeability means. At the same time, ESA, together with the Galileo Joint Undertaking, and key European Industries and civil aviations, is actively working in the development of future SBAS L5 standards. International cooperation is also actively pursued with WAAS and MSAS to maintain full SBAS interoperable systems and common receiver standards.

24. In which applications could EGNOS be used?

EGNOS/ESTB are and will be of benefit to a large multiplicity of users. Today civil aviation, high sea and inland waterway navigation, personal navigation, car navigation, rail transport, offshore exploration, farming, fisheries, surveying activities, patrol services, search and rescue are just some examples of what is possible.

25. What is SISNeT? How can I get information on SISNeT?

SISNeT allows users to access the EGNOS signal-in-space over the Internet in real-time, improving the availability of EGNOS data in urban and other challenging environments.

Information on SISNET can be found on http://www.esa.int/navigation/sisnet .

26. Where and when can I obtain the EGNOS User Interface Document?

The UID will be available shortly from the following location:
http://esamultimedia.esa.int/docs/egnos/estb/egnos_uid.htm

27. What are the benefits of broadcasting the Ionospheric Grid Point (IGP) Band 9 message?

Band – 9 is an additional row of Ionospheric grid points that will improve EGNOS performance for users at Northern latitudes. For these users Ionospheric corrections will be more accurate. EGNOS will soon include this new feature.