



**Organización de Aviación Civil Internacional
Oficina Regional Sudamericana**

**TERCER TALLER/REUNIÓN DEL GRUPO DE IMPLANTACIÓN SAM (SAM/IG/3)
PROYECTO REGIONAL RLA/06/901**

Lima, Perú, 20 al 24 de abril de 2009

**Cuestión 3 del
Orden del Día: Implantación de la navegación basada en la performance (PBN) en la Región
SAM**

**CONSIDERACIONES SOBRE EL MONITOREO DE LA PERFORMANCE DE LAS
OPERACIONES DE NAVEGACION AEREA BASADAS EN ABAS**

(Nota presentada por la secretaria)

RESUMEN

Esta nota de estudio describe consideraciones sobre la provisión de un sistema terrestre para el monitoreo en tiempo real de los satélites GPS en las operaciones ABAS y las funciones del RAIM.

Referencia:

Notas sobre Monitoreo GNSS (Preparada por la Sección CNS de la OACI para la Comisión de Aeronavegación (ANC)).

1. Introducción

1.1 Las operaciones de navegación aérea basadas en GNSS requieren de sistemas que verifiquen la integridad de la señal en el espacio de los sistemas de posicionamiento global (GPS). A este respecto, para garantizar los parámetros de integridad de la señal en el espacio de los GPS, para las operaciones de navegación aérea en ruta, aproximación de no precisión y área terminal basadas en ABAS se tiene la disposición de un receptor GPS con un sistema de Supervisión Autónoma de la Integridad (RAIM).

1.2 Una aeronave equipada con receptores GPS con RAIM certificados (TSO C129a, E/TSO-C146) cumplen con el monitoreo de los parámetros de precisión, integridad y continuidad especificado en el Anexo 10, Vol. I, Tabla 3.7.2.4.1 - *Requisitos de actuación de la señal en el espacio*, para operaciones en ruta, en ruta terminal y aproximaciones de no precisión.

1.3 Para el monitoreo de los parámetros de actuación (performance) indicados en el párrafo anterior, algunos proveedores de servicios de navegación aérea han considerado la implantación de un sistema independiente de monitoreo en tierra en tiempo real. A este respecto, muchos Estados se han preguntado la necesidad o no de implantar este tipo de sistemas tomando en consideración las funciones de RAIM.

2. **Análisis**

2.1 Con el fin de dar orientaciones a los Estados sobre requerimientos de provisiones de monitoreo de la performance para las operaciones de navegación aérea basadas en ABAS, la Comisión de Aeronavegación (ANC) de la OACI solicitó a la Oficina de Navegación Aérea (ANB) de Montreal la elaboración de una nota aclaratoria, considerando que los requerimientos de monitoreo del estado de las ayudas a la navegación aéreas, incluyendo el GNSS, están previstos en el Anexo 10, Volumen I.

2.2 La nota fue elaborada y presentada a la ANC, la cual consideró que la misma se incluyera en la página WEB de la OACI en la sección de la PBN (www2.icao.int/en/pbn). En el **Apéndice** a la presente nota de estudio con la información elaborada al respecto.

3. **Analisis**

3.1 Se invita a la Reunión:

- a) Tomar nota de la información presentada;
- b) Analizar las consideraciones sobre el monitoreo de la performance para las operaciones apoyadas con el ABAS que se presentan en el Apéndice a la presente nota de estudio y formular una conclusión al respecto; y
- c) Analizar otras consideraciones al respecto que la Reunión considere necesario.

ICAO requirements for status monitoring of radio navigation aids, including GNSS, are provided in Annex 10, Volume I. The requirements have recently been updated (Amendment 83 to Annex 10, applicable on 20 July 2008). In particular, section 3.7.6 of Volume I, which contained specific requirements for GNSS status monitoring, has been deleted. GNSS requirements are now included in the following general Standard addressing provision of information on the operational status of radio navigation services (Annex 10, Volume I, 2.8.1):

“Aerodrome control towers and units providing approach control service shall be provided with information on the operational status of radio navigation services essential for approach, landing and take-off at the aerodrome(s) with which they are concerned, on a timely basis consistent with the use of the service(s) involved.”

This Standard refers to approach control service only (as opposed to ATC service in the whole airspace) and the previous requirement (pre-Amendment 83) to provide information “without delay” is replaced by a more open requirement to provide information “on a timely basis consistent with the use of the service(s) involved”.

With specific regard to the requirement to provide status monitoring for ABAS operations, the official interpretation of the standard is provided in ICAO Document 9849 (GNSS Manual), para. 5.6.5.7:

“A decision on whether or not to develop a status monitoring and NOTAM system for ABAS operations should be made by taking into account the nature of ABAS approvals. In many cases ABAS operations are predicated on having a full complement of traditional NAVAIDs available for back-up when ABAS cannot support service.”

Even when status monitoring and NOTAMs need to be provided, there is no requirement to have a real-time ground based status monitoring system. NOTAMs can be based on the status information that is provided by the satellite operator and can be obtained by the State authorizing the operation, as can the information on scheduled outages. Additional real-time information to ATC could be provided by pilots reports based on status information provided by the avionics.

More generally, real time monitoring of GNSS performance is an ABAS (or SBAS/GBAS/GRAS) function and no real time monitoring to ATC is required to ensure safe operations.

A State could use an independent real-time ground based system as one resource-intensive way to provide status information to ATC, but in that case, a number of issues may arise. Specifically for Basic GNSS (ABAS) systems, that is systems equipped with aircraft based augmentation system based on RAIM (Receiver Autonomous Integrity Monitoring), the key issue with generating NOTAMs based on a real-time status monitoring system is the fact that all the following factors can differ between aircraft:

- the receiver RAIM algorithms of different receivers can be different;
- the satellites in view can be a different set;
- the receiver mask angle can vary;
- integration with other sensors/aids (DME/DME, baro, inertial) may or may not be available to the navigation system;
- by definition, status monitoring system cannot provide scheduled outage information, and hence even a State operating such system ultimately needs to rely on information provided by the GNSS operator.

It should be recognized that use of ground-based monitoring tools to provide real-time information to ATC may have some “psychological” advantages insofar as the air navigation service provider may feel more in control of the situation. However, this perception should not obscure the following facts:

- RAIM availability is user specific (as discussed above) and cannot be generalized;
- monitoring per se does not change anything – it is just information which cannot be projected forward (it is not a prediction);
- conflicting status information between ground-based status monitoring and avionics could create a human factors issue insofar as pilots would have to decide which source to trust;
- if, in order to resolve the conflict, pilots were asked always to trust the avionics in case of conflict, the ground-based system would be effectively proven to be useless;
- if, on the other hand, the ground based system information should be made to prevail, integrity and/or availability could be affected depending on whether the ground-based system overestimates or underestimates the quality of the signals at the aircraft’s location and the capabilities of on-board navigation system.

Thus, in addition to being resource-intensive, the use of a ground-based monitoring system to provide real time information to ATC is potentially problematic insofar as it could conceivably worsen the actual performance of the overall navigation system, without providing any improvement with respect to the on-board monitoring capabilities provided by ABAS.

Finally, notwithstanding these considerations, it is noted that Annex 10, Volume I, 2.4.3 contains Recommended Practices addressing recording and retention of GNSS data, for which the use of a ground-based monitoring system is of course an option. A possible alternative (which has been adopted by at least one State) would be to make use of existing national geodesy/surveying networks (if available).

Additional uses of ground-based monitoring systems include monitoring and archiving of GNSS data to support historical data analyses and establish technical familiarity and confidence in GNSS core constellation performance.