Centralised Service 7-3
Network Infrastructure Performance Monitoring and Analysis Service

The Monitoring and Prediction of Satellite Navigation Service
Satellite navigation has already changed the landscape of air navigation services over the last decade. With new constellations coming up, it will revolutionise it!

The EUROCONTROL initiative to establish a “centralised monitoring of satellite navigation services” can contribute to an extensive use of combined satellite constellations in the aviation domain, as their performances will be monitored on a European scale.

I shall follow with interest the progress of this initiative, as it is one of the potential drivers for a wide-spread use of our European systems - EGNOS and Galileo.

Lowri Evans
Director General of the Directorate-General for Internal Market, Industry, Entrepreneurship and SME, European Commission
BACKGROUND

Navigation relies on space-based infrastructure

The ICAO PBN concept consists of three components: the navigation application, the navigation specification and the navigation infrastructure.

Unlike 50 years ago, the navigation infrastructure is now both ground and space-based. The space-based navigation infrastructure is known as Global Navigation Satellite System (GNSS). The GNSS includes core constellations and augmentation systems.

GNSS: a multi-constellation system

GNSS is essential to the introduction of PBN. Positioning and timing information provided by GNSS is used to support many CNS systems and applications (e.g. ADS-B). With the objective of mitigating the growing dependency on GPS and getting the best from GNSS-based applications, the EUROCONTROL policy on GNSS and the European ATM Master Plan set a vision based on GNSS multi-frequency and multi-constellation (like GPS, GLONASS and the future Galileo and BeiDou).

Need for RAIM availability prediction

Some applications rely on systems monitoring the integrity of the position solution using redundant information. This can be done by the receiver itself and is known as Receiver Autonomous Integrity Monitoring (RAIM).

Part of a pilot’s duty is to check whether required navigation facilities will be available before the flight departure. This becomes a little more complicated if the navigation aid is orbiting in space, therefore the need to have access to the information either through NOTAM or through a web-based application predicting the availability during a flight.

Need for GNSS core constellation recording

ICAO Annex 10 Volume I 2.1.4.2 recommends that “A State that approves GNSS-based operations should ensure that GNSS data relevant to those operations are recorded.”

Need for GNSS core constellation performance assessment

The 12th ICAO Air Navigation Conference (November 2012) recommended that for future use of multiple constellations, States publish information specifying the global navigation satellite system elements that are approved for use in their airspace. In order to do this, States would need to have a clear understanding of the performances of these signals with respect to related standards (extract from ICAO GNSS manual – DOC 9849 – approved at the NSP panel end 2015).

GNSS is the basis for new navigation and the majority of the PBN navigation specifications
The scope of CS7-3, the Monitoring and Prediction of Satellite Navigation (SAT-NAV) Network Infrastructure Performance Monitoring and Analysis Service (NIPS), is:

- To provide airspace users with a tool to predict the GPS RAIM availability before operation in European airspace, and to generate NOTAM proposals when asked by local authorities.

- To monitor the performance of the GNSS satellite core constellations used to provide air navigation service in the EUROCONTROL Member States’ area:
  - **Function 1**: the monitoring of the performance of signals of approved constellations (currently GPS L1).
  - **Function 2**: collection of statistical data on technical elements to support decisions for operational approvals in Europe based on new GNSS signals and/or constellations (such as GPS L5, GLONASS, BeiDou and Galileo).

- To perform legal recording of core constellation data signal to support post-incident/accident investigations.

CS7-3 will provide an off-line monitoring (performance not available in real time) of existing and new signals of GPS, GLONASS, Galileo with a possible extension to BeiDou. This will allow verifying the performance of core constellations that are used by RAIM algorithms of the GNSS receivers to meet the integrity levels defined by ICAO. This will also support safety assurance provided by ANSPs and supervised by competent authorities.

CS7-3 is a European solution for the monitoring and recording data of Global navigation satellite systems to help States in their approval of GNSS operation in their airspace.

CS7-3 GPS RAIM availability tool will be accessible for all airspace users

CS7-3 = a solution to cover the ICAO GNSS Manual (DOC 9849) – new section 7.8
- GNSS performance (off-line activity)
- GNSS recording

CS7-3 is a solution to cover the ICAO GNSS Manual (DOC 9849) – new section 7.8
COMPONENTS OF THE CS7-3 SERVICE

CS7-3 will use two different tools to support the service.

A GPS RAIM availability tool accessible to aircraft operators through the web

The GPS RAIM Availability Prediction will provide one function per type of operation:

- The “en-route” function for B-RNAV routes (RNAV 5).
- The “terminal” function for TMA where GPS-based P-RNAV procedures are published (RNAV 1).
- The “approach” function for airports where RNP APCH to LNAV minima procedures are published.

In addition, the system will be able to generate NOTAM proposals to States that have registered to the service.

A European GNSS monitoring component

This system will collect data from different existing networks of GNSS receivers complemented with some additional receivers as necessary to ensure optimal coverage.

The system will automatically calculate the performance of the different GNSS core constellations as described in the ICAO documents.

The results will be accessible to ANSPs, EASA and national authorities through a web application and detected anomalies will be manually investigated by GNSS expert.

GNSS performance assessment is a periodic off-line activity to verify that the signal in space (SIS) conforms to the relevant Annex 10 standards (ICAO DOC 9849 Dec 2015)
ROLES AND RESPONSIBILITIES

The CS7-3 service provider will:
- provide and maintain a GPS RAIM availability prediction tool accessible to any aircraft operators through the web;
- collect GNSS data available through different networks of GNSS receivers;
- provide and maintain a GNSS core constellation monitoring system that will perform automatic calculation of GNSS core constellation performance;
- investigate and report on specific anomalies;
- publish periodic reports;
- provide storage of GNSS data and retrieve information for investigation in case of incident.

The Network Manager (NM) will:
- ensure that the service provider delivers the service;
- manage the users’ group;
- investigate the necessary actions to take in case of GNSS underperformance or anomaly detected in EUROCONTROL’s Member States.

Aircraft operators will:
- have a remote access to the GPS RAIM prediction tool.

ANSPs, EASA and national supervisory authorities will:
- have access to the measured performance of GNSS core constellations;
- be able to request GNSS data for investigation of accident.

CS7-3 is a service contributing to:
- a smooth implementation of GNSS applications in Europe
- a safe and efficient operation of GNSS applications

EUROCONTROL was entrusted by its Member States with developing a Demonstrator for CS7-3 in 2014

The Calls for Tenders were launched in January 2015 to those organisations that were accepted as a result of the CFI

The purpose is to ensure participation of the CS7-3 users in the governance process. In the tradition of the EUROCONTROL organisation, transparency is key.

A users’ group will be established in order to ensure that the voice of the CS7-3 customers is heard.
A training course on Centralised Services is offered by the Institute of Air Navigation Services (IANS), our Training Centre in Luxembourg.

The course describes the overall concept of Centralised Services, its business model, governance and management. This course is designed for anyone who is looking to gain a deep understanding of the Centralised Services approach. More info on the ‘Discover Centralised Services’ course is available in the EUROCONTROL training zone: http://trainingzone.eurocontrol.int

**GLOSSARY**

- **APCH** Approach
- **AMC** Acceptable Means of Compliance
- **ANSP** Air Navigation Service Provider
- **BeiDou** Chinese satellite navigation system
- **B-RNAV** Basic Area Navigation
- **CSS** European ATM Information Management Service (EAIMS)
- **ICAO** International Civil Aviation Organization
- **EASA** European Aviation Safety Agency
- **Galileo** European Satellite Positioning Constellation
- **GLONASS** Global Navigation Satellite System (Russian)
- **GNSS** Global Navigation Satellite System
- **GPS** Global Positioning System
- **GSA** European GNSS Agency
- **LNAV** Lateral Navigation
- **NANU** Notice Advisory to NAVSTAR Users
- **NAVCEN** Navigation Centre (U.S. Coast Guard)
- **NIPS** Network Infrastructure Performance Monitoring and Analysis Service
- **NOTAM** Notice to Airmen
- **NSP** Navigation Systems Panel
- **PBN** Performance Based Navigation
- **P-RNAV** Precision Area Navigation
- **RAIM** Receiver autonomous integrity monitoring
- **RNAV** Area Navigation
- **RNP** Required Navigation Performance
- **SARPS** Standards and Recommended Practices

**EUROCONTROL** will select the consortium to develop the Demonstrator by mid-2016.

**The contractor will develop a Demonstrator over a period of 12 months.**

**The CS7-3 will provide the service for a period of six years.**

**GO/NO-GO for service**
For more information on CS7-3, please contact:
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