GNSS NOTAM

Aline Troadec
RNAV approach specialist
EUROCONTROL

AI Operations-9
27-28 November 2013
3 topics on which AI expertise and advices are needed:

1. The updated GNSS NOTAM concept document and in particular new EGNOS warning NOTAM
2. Applicability of current ICAO standards for Aeronautical information to PBN operations
3. NOTAM on GPS Radio Frequency Interference (RFI)
TOPIC # 1

The updated GNSS NOTAM concept & the controversial additional type of EGNOS NOTAM (EGNOS Warning NOTAM)
GNSS NOTAM services in Europe

**GNSS NOTAM services**

- for GPS (based on AUGUR)
- 4 countries have subscribed
- 3 additional countries have expressed interest
- No GPS RAIM NOTAM proposal has been issued since the beginning of the service

- for EGNOS (by ESSP)
- 6 countries have subscribed (for about 60 airports)
- 5 more countries are ready for the service (to start with 1st LPV published)

**State of the Art (according to the upgraded EGNOS NOTAM service)**
- Includes new EGNOS Warning NOTAM on which no agreement can be obtained
- Warning: the use of Warning NOTAM could be extended in the future to other cases

**GNSS NOTAM concept (mature version)**
- AI Operations #5 agreed to be submitted it to AIM SWIM Team for adoption as a reference
- Adoption compromised by unexpected EGNOS degradations

**GNSS NOTAM concept (1st version)**
# The GNSS NOTAM State of the Art
- what’s new and controversial in the document

<table>
<thead>
<tr>
<th>Type of NOTAM</th>
<th>Information inside the NOTAM</th>
<th>Operational impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNSS predictions</td>
<td>NOTAM for predicted unavailability</td>
<td>Based on a mathematical model (about predictable and scheduled unavailability)</td>
</tr>
<tr>
<td></td>
<td>Based on observations (service degrades and higher but non predictable risk of unavailability foreseen)</td>
<td>GNSS-based operation <strong>CANNOT</strong> be planned (an alternate procedure is planned)</td>
</tr>
<tr>
<td>GNSS forecasts</td>
<td>Warning <strong>NOTAM</strong></td>
<td>From observations (service degrades and higher but non predictable risk of unavailability foreseen)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GNSS-based operation <strong>CAN</strong> be planned (NO operational impact)</td>
</tr>
</tbody>
</table>

**NEW**
• As described in the document:
  ➢ Compliance with **ICAO formatting**
  ➢ NOTAM and NOTAM proposal **N** and **C**
  ➢ Details on content for **Item Q, A, B, C, D and E**
  ➢ Q code used: **QGAAU, QGAXX and QGAAK**

**NOTAM proposal**

```
Q) LFBB/ QGAAU/ I/ NBO/ A/ 000/ 999/ 4100N00200E005
A) LFBO
B) 0908240145
C) 0908250225
D) 24 0145-0230 0630-0645 25 0155-0225
E) 0011/09 NOTAMPN
EGNOS UNAVBL FOR LPV
```

**Official NOTAM**

```
A1234/09 NOTAMN
Q) LFBB/ QGAAU/ I/ NBO/ A/ 000/ 999/ 4100N00200E005
A) LFBO
B) 0908240145
C) 0908250225
D) 24 0145-0230 0630-0645 25 0155-0225
E) EGNOS UNAVBL FOR LPV
```
Focus on the new EGNOS Warning NOTAM

An EGNOS NOTAM for predicted unavailability:
A1234/09 NOTAMN
Q)LFBB/QGAUU/I/NBO/A/000/999/4100N00200E005
A)LFBO
B)0908240145
C)0908250225
D)24 0145-0230 0630-0645 25 0155-0225
E)EGNOS IS NOT AVAILABLE FOR LPV

An EGNOS Warning NOTAM:
A1234/09 NOTAMN
Q)LFBB/QGAUU/I/NBO/A/000/999/4100N00200E005
A)LFBO
B)0908240000
C)0908302359

{ } 1 week, no Item D

E) BE AWARE OF POTENTIAL EGNOS UNAVAILABILITIES:
- LPV FLIGHT PLANNING STILL POSSIBLE
- FOR MORE INFORMATION, PLEASE REFER TO XXXX

EGNOS warning NOTAM specificities:
- Valid for an entire week
- Only New NOTAM
- No Item D
- Same Q code as for any new NOTAM
- Harmonised text for Item E
- NOF is expected to add reference to other docs, if any, on EGNOS degradations and expected pilot’s behaviour under these conditions
- One proposed format for all ANSP provided with EGNOS NOTAM proposal service
Questions to AI Operations:

• What are your views on EGNOS Warning NOTAM?

• Is a “warning” relevant information for a NOTAM?
TOPIC # 2

Applicability of current ICAO standards for Aeronautical Information to PBN operations
A NOTAM shall be originated and issued whenever the following information is of **direct operational significance**: … the establishment or withdrawal of electronic and other aids to air navigation and aerodromes. This includes: interruption or return to operation, … irregularity or unreliability of operation of any electronic aid to air navigation.

*ICAO Annex 15, Chapter 5*

**Status monitoring and NOTAM**

3.7.6.1 Changes in the current and projected status of GNSS space and ground elements that **may have an impact on user performance or operational approvals** shall be reported to relevant air traffic service units.

Note 1: Additional information is provided in Attachment D, 9

Note 2: To assess the operational impact of changes in status a service prediction tool may be required

*ICAO Annex 10, Aeronautical Telecommunications (Chapter 3)*
Status monitoring and NOTAM

9.1 System status

9.1.2 Degradation of core satellite constellation(s) or SBAS usually has not only local effects, but additional consequences for a wider area, and may directly affect en-route operations. System degradation of these elements is to be distributed as area-related information. An example is a satellite failure.

9.1.3 Information is to be distributed to indicate the inability of GNSS to support a defined operation. For example, GPS/SBAS may not support a precision approach on a particular approach. This information can be generated automatically or manually based upon models of system performance.

9.2 Information on type of degradation

The following information is to be distributed:

- Non-availability of service
- Downgrade of service, if applicable; and
- Time and expected duration of degradation

9.3 Timing of notification

For scheduled events, notification should be given to the NOTAM authority at least 72 hours prior to the event. For unscheduled events, notification to the NOTAM authority should be given within 15 minutes. Notification should be given for events of 15 minutes, or longer, duration.

ICAO Annex 10, Attachment D
Applying standards to PBN and GNSS-based operations

- GNSS is different from conventional navigation
- The information on the system itself is not readily usable by airspace users (need for models)
- There is not a unique prediction model which is representative of all aircraft performances (need for multiple predictions models)
- Impact of a particular service degradation is very difficult to predict (inaccurate models)

- As a result, the provision of NOTAMs indicating predicted GNSS unavailabilities has been abandoned by the FAA (replaced by online prediction tools)
The following information is provided in forms of NOTAM:

- GPS satellite unavailability (from NANUs)
- WAAS information in case of extreme events:
  - Geo failure
  - Operating on single Geo
  - Scheduled events that remove the entire WAAS service
  - Extreme Storm detector trips
  - SE757 IGPs with high GIVEi
- Predicted unavailability of WAAS-based procedures
- GPS RAIM predicted outages
- GPS Interference (see 3rd part of this presentation)

- NOTAM service
- Online tool
Online tools for GNSS predictions

Airports or maps with predicted GPS RAIM loss (FAA, Japan, ECAC, APAC)

Airports with predicted loss of WAAS approach capability (VOLPE)
Current ICAO standards and PBN - Recommendations

The members of the AI Operations are invited to:

• Contribute to the discussion on the applicability of current ICAO standards for Aeronautical information (including NOTAM) to GNSS-based and PBN operations.

• Provide their views on whether Europe should evolve towards services like the ones provided in the USA?

Note: The GNSS NOTAM concept document has become the GNSS NOTAM State of the Art. This allows segregating between the pure description of GNSS NOTAM services in Europe and discussion on other means of information to airspace users than NOTAM for GNSS.
TOPIC # 3

The lack of harmonisation on NOTAM for GPS Radio Frequency Interference (RFI)
NOTAM on GPS interference
- Introduction

• Initial objective was to quantify GNSS Radio Frequency Interference (RFI) vulnerability based on a search for such events reported in NOTAM
• 3 years of EAD data were analysed
• Results were presented to NSG 18th meeting (IP17)

• About 1900 NOTAM referring to GPS RFI were found:
  ➢ 1850 in the USA (using a standard format for Item E)
  ➢ 10 in Europe from UK and France about planned military jamming events (nb is much smaller than expected, some known events were not reflected).
  ➢ 25 from other regions of the world (referring to unplanned jamming events in conflict areas like Iraq, Afghanistan and South Korea)
NOTAM on GPS interference
- Examples

G0329/09 NOTAMN
Q) EGGX/QGWLF/IV/NBO/E /000/400/5800N01413W186
A) EGGX B) 0911181100 C) 0911181500
E) GPS JAMMING EXER NW SCOTLAND AFFECTING SHANWICK AREA:
56N010W 61N010W 61N018W 56N018W. SFC TO 40000FT AMSL.
DURING EXER GPS SIGNALS MAY BE LOST FOR PERIODS UP TO UP TO 15MIN.

A2080/10 NOTAMN
Q) LFBB/QGWXX/IV/NBO/E /000/230/4545N00213E020
A) LFBB B) 1004260730 C) 1004301800
D) 0730-1800
E) GPS DISRUPTION WITHIN A 20NM RADIUS CYLINDER CENTERED
ON 45 45 26N 002 13 07E LOCATED ON LA COURTINE MILITARY
CAMP FM SFC UP TO FL230

Q) KXXX/QGWLT/IV/NBO/E/000/400/3339N07522W447
A) KZBW KZNY KZMA KZJX B) 0807210100 C) 0807290300
D) 0100-0300
E) GPS UNRELIABLE AND MAY BE UNAVAILABLE WITHIN A
447NM RADIUS OF 333900N 752200W AT FL400, DECREASING
IN AREA WITH DECREASE IN ALTITUDE TO 402NM RADIUS AT
FL250, 340NM RADIUS AT 10000FT AMSL AND 301NM RADIUS
AT 4000FT AGL.
F) SFC G) FL400
Conclusions from the assessment:

- GNSS RFI events in Europe are probably not systematically notified by a NOTAM
- Notification via NOTAM is not made in a harmonised way

The members of the AI Operations are invited to:

- Note the outcomes of the analysis made on RFI events notified via NOTAM, and
- propose a way forward for a harmonised practice in Europe.
Recommendations (Recap)

The members of the AI Operations are invited to:

a) Take note of the content of the paper.

b) Express their views on **Warnings** and in particular on whether this is a notion **relevant for a NOTAM**

c) Contribute to the discussion on the **applicability of current ICAO standards** for Aeronautical information (including NOTAM) to **PBN operations**

d) Note the outcomes of the analysis made on **RFI events** notified via NOTAM and propose a way forward for harmonised practice in Europe
Thanks for your attention

Aline TROADEC

RNAV Approach Specialist
DSR / CMN / NAV

Email. aline.troadec@eurocontrol.int
Tel. +33 (0)1 6988 7274