

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical navigation issues

- 6.1 Global navigation satellite system (GNSS) development status based on
: reports from States, service providers and industry organizations**

GNSS IMPLEMENTATION IN SWITZERLAND: STATUS AND PRIORITIES

(Presented by Switzerland)

SUMMARY

This paper describes the status of GNSS implementation in Switzerland and discusses associated challenges and priorities.

Action by the conference is in paragraph 5.

1. INTRODUCTION

1.1 Switzerland is a small state with two major international airports (Zurich and Geneva) and mountainous terrain. While the rationalisation of ground infrastructure plays only a minor role, the key motivation for introducing global navigation satellite system (GNSS) services lies with the availability of new services to solve airspace issues and increase the availability of instrument flight procedures. Maintaining precision approach services also plays an important role.

2. GNSS IMPLEMENTATION STATUS

2.1 General status

2.1.1 While a number of GNSS projects are ongoing, the authorized usage of GNSS in Switzerland today is limited to GNSS supporting B-RNAV and overlay non-precision approaches. However, a number of projects implementing GNSS augmentation services are under way.

2.2 ABAS

2.2.1 A project leading to an operational approval for aircraft-based augmentation system (ABAS) NPA's with FMS-managed continuous descent using baro-VNAV is under way with one operator, Swiss International Air Lines. While users with high-end avionics achieve excellent performance, it is more interesting for service provision if the majority of aircraft (including low-end avionics) are capable to fly APV procedures using satellite-based augmentation system (SBAS).

2.3 SBAS

2.3.1 Switzerland participates in the European Geostationary Navigation Overlay Service (EGNOS) project through its service provider, skyguide. A reference station (RIMS) has been installed at Zurich airport. Recent trials using the EGNOS system test bed (ESTB) in Sion, a regional airport in an alpine valley, have shown that corrections from geostationary satellites can be received despite significant terrain masking and that therefore operations are feasible in locations that today are largely restricted to visual meteorological conditions (VMC) operations. Sion, and other regional airfields in Switzerland are too constrained to install an instrument landing system (ILS) and area navigation (RNAV) procedures are needed for guidance to the final approach fix and for missed approach and departure.

2.3.2 Another interest in SBAS lies with the helicopter emergency medical service (HEMS). The capability of SBAS (and ground-based augmentation system (GBAS) within VHF data broadcast (VDB) coverage) to enable point-to-point routes below icing, dedicated approaches to medical centres and airports, and the separation of helicopter traffic from fixed wing operations in instrument meteorological conditions (IMC) are significant operational and safety benefits. However, in order to make progress with the implementation of such SBAS procedures, critical airspace issues need to be solved, such as separation from visual flight rules (VFR) traffic in marginal VFR conditions.

2.3.3 SBAS and GBAS are also seen as enablers for comprehensive RNAV coverage in terminal control areas (TMAs). Geneva in particular is surrounded by several mountains, which constrains the options for the placement of ground NAVAIDs. If, for example, more distance measuring equipments (DMEs) would be installed on top of nearby mountains, the provision of good omnidirectional coverage and geometry could be optimized. However, coverage then does not extend to the TMA airspace below the DMEs. On the other hand, if additional DMEs would be installed in the valleys at the same height as the airport, the geometric distribution of NAVAIDs would be insufficient to support terminal area RNAV operations. Hence, SBAS and GBAS are the logical choice to provide RNAV coverage all the way down to the ground and enable RNAV operations below minimum safe altitude (MSA) or in early stages of the departure.

2.4 GBAS

2.4.1 A project to install a Cat I GBAS ground system at Zurich airport (ZRH) has been ongoing for over two years, and is supported by all stakeholders (service provider skyguide, regulator, user airline, airport). The projects primary motivation is the introduction of ILS-look-alike procedures at non-equipped runways. Civil works approvals are in progress, while the installation of recording equipment is planned for this year. A full ground system will be installed as soon as certified systems are available.

2.4.2 GBAS Cat I is seen as an important stepping stone towards GBAS Cat III, due to the challenge to maintain ILS Cat III capabilities in a continuously developing environment. Hence, the potentially

long implementation timeline to reach GBAS Cat III capability is a particular concern. An installation of microwave landing system (MLS) is not desired, but may be necessary. GBAS is preferred because of its additional capabilities and tremendous flexibility.

2.4.3 Furthermore, it is desired that the additional capabilities of GBAS be developed swiftly. For example, all approach descent minima at ZRH are limited by terrain in the missed approach. Providing missed approach guidance and reducing obstacle clearance requirements reflecting the true nature of GBAS sensor errors (instead of ILS) would bring a reduction in low visibility conditions. Another priority is the provision of advanced procedures using GBAS. Due to political circumstances, maximum flexibility in TMA operation and design is desired. In particular, GBAS should support final approach sequencing in areas other than the extended runway centerline. This is only possible if track keeping accuracy and velocity is the same for all users during curves, such that separation can be maintained. Uplinked GBAS paths are preferred because they avoid aircraft database path point saturation and integrity problems associated with traditional, FMS-guided RNAV procedures.

3. GENERAL IMPLEMENTATION CHALLENGES

3.1 GNSS spectrum protection

3.1.1 Interference detection and localization capabilities are being implemented. However, various recent cases of radio frequency interference (RFI) have had their origin outside of Switzerland. While it has been found that the range of RFI detectability is generally much greater than the range of actual receiver vulnerability, it can still take a long time until RFI sources are turned off after identification if it involves another state. With increasing dependence on GNSS operations this can become a significant operational issue. Therefore, aircraft should have a maximum of resistance to interference using currently available technology. Switzerland consequently advocates better integration of inertial navigation systems (INS) to protect against GNSS vulnerability. Better INS integration should also benefit GBAS Cat II/III development, allowing that additional core constellation capabilities can be used to primarily increase the robustness of GNSS.

3.2 GNSS complexity and resources

3.2.1 For a small state such as Switzerland, GNSS implementation presents a significant challenge due to the complexity of the technology itself and also because involvement in all the relevant ICAO and European bodies developing GNSS is not possible due to resource constraints. It is therefore necessary that GNSS and associated RNAV services be defined as clearly and simply as possible, and that meeting papers and reports are made available to interested stakeholders.

4. CONCLUSION

4.1 In summary, GNSS implementation is progressing in Switzerland, but slowly, just as in other areas of the world. These long implementation timelines make it difficult to justify investments where benefits accrue only after many years. Therefore, GNSS development at ICAO needs to focus on updating standards and procedures to realize as many GNSS operational and safety benefits as efficiently as possible.

5. ACTION BY THE CONFERENCE

5.1 The conference is invited to:

- a) note the contents of this paper; and
- b) agree on the resulting recommendations for the definition of future work programmes of GNSSP, Obstacle Clearance Panel (OCP), and other bodies as appropriate:

Recommendation 6/x — GNSS/INS integration

That ICAO develop standards for the better integration of INS in order to reduce the vulnerability of GNSS to RFI and advance the development of GBAS Cat II/III. This should include the establishment of coasting times that can be taken into account by service providers.

Recommendation 6/y — Advanced GNSS procedure design

That ICAO further develop SBAS and GBAS procedures for both fixed and rotary wing aircraft, enabling RNAV procedures to lower minimas in obstacle rich environments. This should include a reduction of current containment areas by taking full advantage of GNSS sensor performance (collision risk model for GNSS) and an evaluation of options to further reduce flight technical error (FTE).

Recommendation 6/z — Curved GBAS RNAV procedures

That ICAO further develop GBAS procedures for fixed wing aircraft, providing RNAV procedures with high track and velocity keeping accuracy through curves to enable flexible approach line-ups.

5.2 These recommendations are generally in line with European positions, but reflect in particular the needs of a resource constrained, small State with significant terrain and dense terminal airspaces.

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