International Civil Aviation Organization

**WORKING PAPER**

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# ASSEMBLY — 38TH SESSION

## TECHNICAL COMMISSION

**Agenda Item 32: Air Navigation — Policy**

## MANDATES FOR EQUIPAGE OR USE OF SPECIFIC GNSS CORE CONSTELLATIONS OR AUGMENTATION SYSTEMS

(Presented by the International Air Transport Association)

**EXECUTIVE SUMMARY**

The evolution of GNSS offers many benefits to the aviation community and will be one of the main enablers for the Aviation System Block Upgrades (ASBU).

However, these benefits can be eroded when inadequate regulatory or institutional policies are applied.

Mandates for equipage or use of specific GNSS core constellations or augmentation systems can become very costly to comply with and create inefficiencies.

**Action:** The Assembly is invited to encourage States:

a) to abstain from issuing mandates for international airlines to use any particular global navigation satellite system (GNSS) core constellation or augmentation system; and

b) to allow international operators to use any global navigation satellite system means available, provided that the required navigation performance is met, thus realizing the full benefits of performance-based navigation (PBN).

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| *Strategic Objectives:* | This working paper relates to the Safety and Environmental Protection and Sustainable Development of Air Transport Strategic Objectives. |
| *Financial implications:* | Mandates for specific GNSS elements could result in significant costs for users due to cost and complexity of tailored receivers; additional cockpit controls and procedures; crew training and maintenance support. It will also impact States of design and manufacturers. |
| *References:* | Doc 10007, *Report of the Twelfth Air Navigation Conference* (AN-Conf/12)<br>Doc 9750, *Global Air Navigation Plan* |

## 1. INTRODUCTION

1.1 The Global Navigation Satellite System (GNSS) has been in a continuous state of evolution since the advent of satellite navigation concepts in the 1960s. Today, GNSS is one of the main enablers for achieving the operational improvements outlined in the Aviation System Block Upgrades (ASBU).

1.2 As technology matures, the evolution is accelerating with additional States developing and offering new core constellations and augmentation systems.

1.3 The redundancy provided by more than one satellite constellation gives further robustness to the system.

1.4 However, if not dealt with carefully, the advent of multiple core constellations in conjunction with the proliferation of augmentation systems can create a fragmentation of navigation services and reduce much of the value of GNSS from the end-user perspective.

1.5 This problem can be compounded if specific GNSS elements are mandated or excluded by regulation.

## 2. DISCUSSION

2.1 As described in A38-WP/1, the Aviation System Block Upgrades targets efficiency-related infrastructure and procedure modernization requirements into a series of operational improvement modules with flexible implementation timelines. This will allow States and aviation stakeholders to achieve global-harmonization, increase safety, capacity, and environmental efficiency at the right pace within specific regional requirements, accommodating air traffic growth around the world in an evolutionary manner.

2.2 GNSS is one of the main enablers for the operational improvements specified in the Aviation System Block Upgrades. The use of signals from multiple constellations broadcasting on multiple frequencies improves GNSS technical performance and reduces the likelihood of loss of service and increases service coverage.

2.3 The degree of interoperability between signals of different GNSS constellations will directly influence the complexity and cost of avionics. Ideally, satellites from multiple constellations would be interchangeable, enabling a receiver to combine all satellites into a single solution, which would provide a significant improvement in performance.

2.4 Nevertheless, the complexity and related cost of receivers is a significant technical challenge. Although it is theoretically possible to design an integrated receiver that uses all the core constellation signals (e.g. GPS, GLONASS, Galileo and BeiDou) and augmentation signals (e.g. WAAS, EGNOS) that will be available, such a receiver would require many modes of operation.

2.5 While industry with time will undoubtedly rise to this challenge, early development and certification of new receiver designs would be an expensive proposition. This is particularly true for air transport class avionics where development and certification costs combined with the number of units to be produced, would not make it economically practicable.

2.6 Mandates for equipage or use of specific GNSS elements (e.g. a particular core constellation or augmentation) could force such early development of receivers before requirements and standards for other GNSS elements have reached maturity. Restrictions or mandates related to GNSS operation can therefore result in serious impact to operators, State of Design and manufacturers.

2.7 During the ICAO Twelfth Air Navigation Conference, the meeting's attention was also drawn to the additional difficulties that would necessarily arise if different mandates for specific GNSS elements were introduced in different States or regions. In particular, it was noted that such a situation could also result in significant costs for users in terms of additional cockpit controls and procedures; crew training and maintenance support, and possibly raise human factors concerns.

2.8 It is also possible that a State may decide to authorize the use of some GNSS elements but restrict the use of other GNSS elements. Restrictions on the use of GNSS elements are unnecessary and counterproductive when compared to systems that are integrated in a manner that supports the performance-based navigation (PBN) concept.

2.9 PBN is considered in Doc 9750, *Global Air Navigation Plan*, as the highest priority element for implementation. Performance requirements are identified in PBN navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet those performance requirements. Operators have the ability to choose the most cost-effective technology and navigation services to meet the required performance, rather than be bound by a mandated solution.

## 3. CONCLUSION

3.1 The evolution of GNSS offers many benefits and is a cornerstone for the successful implementation of the Aviation System Block Upgrades. However, regulatory or institutional policies could jeopardize GNSS operation. Examples of those which can be most damaging are mandates for equipage or use of specific GNSS core constellations or augmentation systems, as well as restrictions on the use of other core constellations and systems.

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