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WORKING PAPER

THIRTEENTH AIR NAVIGATION CONFERENCE

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COMMITTEE A

Agenda Item 2: Enabling the global air navigation system
2.2: Integrated CNS and spectrum strategy

CONCERNS ON MANDATES FOR EQUIPAGE AND USE OF SPECIFIC GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS) ELEMENTS

(Presented by the International Coordinating Council of Aerospace Industries Associations (ICCAIA), and the International Air Transport Association (IATA))

REVISION NO. 1

EXECUTIVE SUMMARY

This paper discusses consequences, including on safety and efficiency, arising from mandates for equipage or use of specific GNSS elements, signals, and/or services, as well as from any State precluding the use of specific GNSS elements within its airspace.

Action: The Conference is invited to agree to the recommendation contained in paragraph 5.1.

1. INTRODUCTION

1.1 Global Navigation Satellite Systems (GNSS) have a profoundly positive impact on civil aviation. GNSS has transformed navigation by providing a ubiquitous and seamless global capability with unprecedented performance. Satellite navigation technology goes back to the 1960's and was introduced into civil aviation in the 1990's. GNSS navigation has continued to evolve and mature. More States are developing and will be offering new core constellations and augmentation systems for use (AN-Conf/13-WP/15– *Global Navigation Satellite Systems (GNSS) Evolution*, presented by the ICAO Secretariat, refers). AN-Conf/13-WP/15 discusses the evolution of GNSS towards the introduction of dual-frequency, multi-constellation (DFMC) services. The WP outlines the current standardization process; the expected benefits; the long-term goal of seamless global acceptance of dual frequency/multi-constellation (DFMC) GNSS; the challenges in achieving the goal, and presents a way forward for ICAO and States to meet those challenges. This paper discusses in greater depth the challenges associated with the introduction of DFMC, in particular if specific GNSS elements are mandated or prohibited, and proposes a way forward.

1.2 While the planned evolution of GNSS will provide benefits to the users via an improved robustness of navigation capabilities, there may also be negative consequences. Many of these are

[1] English, Arabic, Chinese, French, Russian and Spanish versions provided by ICCAIA and IATA.

discussed in the referenced working paper on GNSS evolution in section 2.6 “Medium Term Challenges”. These challenges were recognized and explored at length within the ICAO GNSS Panel and now in the Navigation Systems Panel (NSP). Some of the negative consequences resulting from the fragmentation of GNSS systems and services are described in AN-Conf/12-WP/131 – *Negative Consequences of Mandating Equipage of Specific GNSS Elements*, presented by the International Coordinating Council of Aerospace Industries Associations (ICCAIA) and the International Air Transport Association (IATA). Other organizations have also recognized the potential problems arising from imposed mandates or from the prohibition of specific GNSS elements and services as evidenced in AN-Conf/12-WP/74 – *The Need for Performance-Based, Free GNSS without System Specific Mandate*, presented by the United States. In lieu of imposing such mandates and prohibitions, States are urged to continue their AN-Conf/12 commitments on using a performance-based approach, which is in line with the ICAO performance-based navigation (PBN) concept.

1.3 The PBN concept represents the shift from sensor-based to performance-based navigation. It includes performance requirements under navigation specifications, and enables the benefits by providing choices of navigation sensors and equipment that can meet the performance and safety requirements. Operators must have the ability to choose the safest and most cost-effective technology and navigation services to meet their needs and required performance, rather than having to operate multiple configurations caused by mandated solutions.

2. IMPACT OF CHALLENGES ASSOCIATED WITH FRAGMENTATION OF SATELLITE NAVIGATION SERVICES ON STANDARDS DEVELOPMENT

2.1 DFMC GNSS systems, albeit with potential safety benefits, naturally present challenges for avionics and aircraft integration as well as aircraft operations. These challenges arise from the complexity of the combined services themselves and the consequential integration into aircraft systems and operations. The challenges can however multiply if inappropriate or unnecessary regulatory or institutional policies are applied indiscriminately, resulting in hardware or software developments being more complex and costly. The policies that can be most damaging are mandates for equipage or use of specific GNSS core constellations or augmentation systems without acceptable safety and operational rationales. These challenges were discussed in detail in AN-Conf/12-WP/131 and in Appendix B of AN-Conf/12-WP/21 – *Global Navigation Satellite System (GNSS) Implementation Issues*, presented by the Secretariat. Recognizing that the problems raised are real and have significant consequences, the Conference is invited to recall that ANConf/12 resolved the following:

Recommendation 6/6 – Use of multiple constellations

That States, when defining their air navigation strategic plans and introducing new operations:

a) take advantage of the improved robustness and availability made possible by the existence of multiple GNSS constellations and associated augmentation systems;

b) publish information specifying the global navigation satellite system elements that are approved for use in their airspace;

c) adopt a performance-based approach with regard to the use of GNSS, and avoid prohibiting the use of GNSS elements that are compliant with applicable ICAO SARPs;

d) carefully consider and assess if mandates for equipage or use of any particular GNSS core constellation or augmentation system are necessary or appropriate; and

That aircraft operators:

e) consider equipage with GNSS receivers able to process more than one constellation in order to gain the benefits associated with the support of more demanding operations.

2.2 A concept of operations (CONOPS) was prepared by the ICAO NSP to progress ANConf/12 Recommendation 6/5 (a companion to Recommendation 6/6). An ICAO Secretariat working paper AN-Conf/13-WP/15, prepared in cooperation with CONOPS, summarised the main aspects in the CONOPS and proposed some recommendations.

2.3 Albeit, after several years of NSP efforts, no discernable progress was made on a core issue. There is a fundamental conflict between allowing user equipment to be simple, economical, and therefore operationally attractive, and the desire of some States to mandate or preclude the use of certain GNSS elements in their airspaces. Very little progress has been made on solving the political and institutional issues that are driving fragmentation. There has been discussion on potential technical solutions, but these solutions appear to be cost prohibitive at best, and could decrease the safety of GNSS at worst. Concepts such as “geofencing” to select certain GNSS elements to use in an airspace may reduce safety by introducing complex pilot and maintenance procedures and would require a significant investment to develop and would have a high operating cost.

2.4 Ensuring global interoperability and safety of GNSS should be the main objective of ICAO GNSS activities. However, it has become evident that in order to enable a more effective use of ICAO resources, ICAO technical panels may not be the best place to address non-technical issues which derive from certain political desires and institutional requirements.

2.5 The NSP CONOPS mentions the long-term expectation where every State recognizes and authorizes the use of all GNSS elements that perform according to ICAO SARPs, for the intended operations. This expectation is highly supported by aircraft manufacturers and operators. However, during the medium term, the CONOPS still postulates that some States will not authorize the use of some specific GNSS elements in their airspace. In fact this condition exists today to some extent and results in stifling the market and adoption of equipment for certain GNSS elements. It could also be argued that more States will have a desire to mandate the use and equipage of specific constellations or augmentation systems in their airspace in the medium term. This approach naturally contradicts with the States’ commitment in performance-based approach for GNSS.

2.6 Development and certification of GNSS receivers is complex and expensive. Integration of GNSS receivers into a modern aircraft is also an expensive challenge as GNSS information is used in a large variety of ways. Seemingly minor changes in a receiver’s performance or behaviour could have significant effects on other airplane systems. Conditional use of GNSS elements will impact other aircraft systems outside the GNSS receiver and could drive significant implementation costs at the airplane level as well as to flight and maintenance operations. For each evolutionary change, a significant amount of work will be required at both the receiver and potentially at the airplane integration level. A long period of chaotic development is impractical and its impact will become more evident if each incremental capability can only be used in limited regions. This situation will delay the uptake of DFMC GNSS, as most operators will prefer to wait until the long-term expectation of the NSP CONOPS becomes a stable norm so that the implementation of DFMC GNSS capabilities will not result in a negative business case.

3. THE UNDESIRABLE CONSEQUENCES OF MANDATES AND PROHIBITIONS

3.1 Different types of mandates are under consideration. Each type introduces costs for the aircraft manufacturers and operators. Mandates by one State may also introduce costs to other States, particularly to the State of design, the State of manufacturer, or the State of the operator.

a) *Equipage-only mandates (State mandates some or all operators to carry equipment capable of using a particular GNSS element):* These mandates are expensive for the manufacturer and the operator as the mandates will result in premature or unnecessary iterations of GNSS receiver designs. The mandates will also increase the cost to States by requiring them to develop a means for verifying compliance.

b) *Mandating operational use of a specific GNSS element within a given airspace:* These mandates are expensive for all the reasons listed above. The mandates may also introduce extra costs associated with the control of the sensor and will affect cockpit annunciations to ensure the mandated system is actually being used. They will imply extra pilot training to ensure that the pilots understand when the mandated GNSS element is in use, and how to react if the mandated element is not. Operational complications and impacts can also extend to ANSPs and ATC operations if they are required to comply with the mandate or to ensure operators' compliance to the mandate. These undesirable impacts are worse in airspace forming international traffic flows and networks.

c) *Operational prohibition:* A State deciding to authorize the use of some GNSS elements, while prohibiting the use of others even when they are SARPs compliant would be counterproductive. This selective prohibition would introduce similar operational complexities and costs as noted above, placing extra burdens on operators and air traffic management (ATM) systems.

4. SUMMARY AND CONCLUSIONS

4.1 DFMC GNSS can offer many safety and efficiency benefits. However, mandating or prohibiting operators to equip and/or use specific GNSS elements is counter-productive, threatens to raise costs to an unbearable level, and fragments satellite navigation services. These mandates and prohibitions will extend the operators' break-even periods, delay the investment on DFMC GNSS, and unfortunately stall the benefits that could otherwise be brought sooner.

5. RECOMMENDATIONS

5.1 The Conference is invited to agree to the following recommendation:

Recommendation 2.2/xx – Implementation of GNSS in accordance to the PBN Concept

That States:

a) commit and deliver in a timely manner the long-term expectations in the NSP CONOPS in which every State recognizes and authorizes the use of all GNSS elements thus creating a positive environment for DFMC GNSS;

b) commit to the principle that any requirements on position, navigation and timing should be performance based and driven by operational needs not specific technological solutions;

c) abstain from mandating equipage or use of any particular GNSS core constellation or augmentation system;

d) refrain from precluding the use of any GNSS elements available if they perform according to ICAO SARPs and can meet all safety requirements for the intended operations; and

e) encourage further developments to deliver incremental operational benefits of DFMC GNSS.

— END —