APPENDIX

ELEMENTS TO BE ADDRESSED IN A WORLDWIDE STRATEGY ON THE USE OF SATELLITE NAVIGATION SYSTEMS BY AVIATION

1. TECHNICAL, OPERATIONAL AND SAFETY REQUIREMENTS

1.1 Demonstration of the sole service concept feasibility regarding safety requirements

1.1.1 The objective presented in paragraph 4 of the main paper could be achieved only if the demonstration of the feasibility of the sole service concept is acceptable from a safety point of view. This is a prerequisite that conditions the economical interest of global navigation satellite system (GNSS) strategy. Studies must be undertaken in order to progress on this essential matter. It is clear that the economical interest of a GNSS solution is tightly linked to the feasibility of the concept. It must be noted that a sole service concept implies that the Global Positioning System (GPS) and Galileo system are considered as complementary and not as alternatives. On the basis of this feasibility demonstration, a safety case should be developed with a worldwide application as recommended in Annex 11 — *Air Traffic Services*. The safety case will be the basis of the GNSS certification process.

1.2 Level of service

1.2.1 GNSS and its augmentations must be part of a worldwide system serving all user categories and all phases of flight down to CAT II/III operations, where required. The deployment strategy for GNSS must clearly demonstrate that it can evolve to support CAT II/III operations and that the GNSS service provider(s) are bound to such evolution.

1.3 Aviation users

1.3.1 The interest of all aviation user categories shall be considered appropriately while developing the technical, operational and safety requirements and preparing the transition plan and the implementation.

1.4 Geographical differences for the level of service

1.4.1 While GNSS must provide a common worldwide level of service, its architecture must recognize regional operational needs. Certain areas will require CAT II/III capabilities, while others may require only CAT I or NPA/APV capabilities or less. The system architecture and the deployment of the infrastructure must consider these issues from the very beginning in order to avoid over- or under-specification. The system must be kept open for further improvement as requirements may progressively change in the future.

1.5 Interoperable and complementary GNSS

1.5.1 The aviation community requires cohesive satellite navigation infrastructure planning that will lead to the creation of a worldwide seamless system. They require a worldwide navigation satellite system rather than regional systems developed in an uncoordinated manner. As Galileo and GPS Block IIF are currently planned, their development should be done in a coordinated manner and aviation must be reassured that there will be total interoperability between the two systems permitting seamless equipment and certification.

1.5.2 In order to achieve the final goal, that is, the utilization of GNSS as the sole service navigation system for provision of positioning and timing data, for all phases of flight, aviation must be reassured that sufficient redundancy exists between Galileo and GPS IIF, providing the required level of system reliability and avoiding common failure modes.

1.5.3 In addition, the system must be sufficiently robust to external interference to avoid the need for ground-based navaids to be retained as a back-up.

2. INSTITUTIONAL REQUIREMENTS

2.1 Global institutional issues

2.1.1 There is an urgent need to solve, on a worldwide basis, GNSS institutional issues. This will require a strong action at the ICAO level and will imply, in addition to the requirements detailed above:

a) development, validation and approval of global Standards and Recommended Practices (SARPs);

b) authorities, the owners of the GNSS infrastructure, the GNSS service providers, the air traffic services (ATS) providers, the avionics manufacturers, the aircraft manufacturers, the airspace users, etc; and

c) a worldwide transition plan must be developed to ensure both the phasing out of unnecessary conventional ground-based aids and aircraft equipment, including a time schedule.

2.2 Guarantees from the GNSS service providers

2.2.1 The GNSS service provider(s) must offer sufficient guarantees to third party service providers, e.g. ATS providers and airspace users, that his obligations are being fulfilled. The acceptable formulation of these guarantees is also a prerequisite for the resolution of the safety issues presented in paragraph 1. These obligations cover, amongst other things:

a) level and quality of service;

b) maintaining the service provision; and

c) maintaining the agreed operating costs and pricing.

3. COST ALLOCATION AND CHARGING REQUIREMENTS

3.1 Cost allocation

3.1.1 The European Organisation for the Safety of Air Navigation (EUROCONTROL) has developed a methodology for determining the appropriate proportion of costs that should be borne by aviation in a multi-modal GNSS, based on an index for each navigation requirement. It was expected that a figure of around 1 per cent should be recovered from aviation users for a constellation of satellites offering a CAT I landing capability. This is in recognition of the fact that aviation is only one potential user of GNSS-based products and should be treated in a fair and non-discriminatory manner in the provision of a multi-modal service. The methodology has been proposed for worldwide acceptance, resulting in the development of a legal structure that recognizes the multi-modal nature of GNSS.

3.1.2 Aviation charges for GNSS should be based on actual level of service, should not discriminate against airspace users, should be competitive and set in a transparent manner. Airspace users should be protected in the case where GNSS service providers are not capable of collecting the expected level of user charges from non-aviation users.

3.2 Transition planning

3.2.1 During a transition period, that would start only after the demonstration of the sole service concept feasibility and the confirmation of its cost-beneficial aspect, conventional ground-based aids will be used alongside the space-based aids. During this transition period and after, the aviation community will only pay their fair share of costs for GNSS (as it applies to any system or component of systems of navigation by satellite, be it Galileo, GPS and their various augmentations like European Geostationary Navigation Overlay Service (EGNOS), wide area augmentation system (WAAS), or any ground-based augmentation system (GBAS) system) provided that GNSS will have been demonstrated to be cost-beneficial.

3.2.2 The transition to GNSS will only be successful if all stakeholders have formalized a firm transition plan, detailed by phases of flight, with binding commitment, at all appropriate levels, for implementing the relevant avionics on board all airspace users' aircraft and, at the same time, for the decommissioning of the non-necessary ground-based navaids

3.2.3 To take into account the regional dimension of the planning, the transition plan mentioned above must be regional. In order to achieve the worldwide objective, it is, however, necessary that these regional transition plans (as it is the case today with the ICAO communications, navigation, and surveillance/air traffic management (CNS/ATM) regional transition plans) are tightly coordinated in order to validate the economical aspects used as the justification of these plans.

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