



WORKING PAPER

THIRTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 9 to 19 October 2018

COMMITTEE A

Agenda Item 5: Emerging issues

5.1: Operations above Flight Level 600

SPACEFLIGHTS AND HIGH LEVEL OPERATIONS

(Presented by the United Arab Emirates)

EXECUTIVE SUMMARY

This paper discusses the development of space operations, and suggests several areas of study that should be considered to enable these space operations, and support efficient interaction with the existing ATM system.

Action: The Conference is invited to agree to the recommendation in paragraph 3.1.

1. INTRODUCTION

1.1 The entry of private enterprise into the business of space activities has significantly increased the level of activities, and prompted development in areas that were not traditionally considered by State governments. Increases in activities above the usual 'cap' of FL600 necessitates a need for study and consideration of many factors to ensure these space activities can be enabled, while maintaining safety and security. Additionally, the efficiency of the existing air traffic management (ATM) system must be considered, as the introduction of new flight types without supporting procedures may have a negative impact on the flexibility of the system.

2. DISCUSSION

2.1 Until recently, most space activities had been either performed directly by, or under the management and oversight of State governments or military authorities. The proliferation of private companies entering the market will necessitate the expansion beyond this, therefore requiring a more robust international legal framework.

2.2 **Jurisdiction**

2.2.1 The nature of space operations is such that there is a clear need to have a harmonised approach to all regulatory requirements, as the speed and lateral trajectory of such operations would make sovereign based regulation unwieldly and impractical.

2.2.2 The *Convention on International Civil Aviation* (Doc 7300), in Article 1 states:

“The contracting States recognize that every State has complete and exclusive sovereignty over the airspace above its territory.”

However, the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, in Article II states:

“Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”

Clearly, in order to adequately define regulatory requirements, oversight accountabilities, and legal authority there is a need to define a boundary between the ‘*airspace*’, and ‘*outer space*’.

2.2.3 There are several issues of a technical nature that will need to be investigated, particularly related to communication, navigation, and surveillance. Some of the core fundamentals used for civilian aviation are unreliable, unusable, or inappropriate for high level/space operations.

2.3 **Communication**

2.3.1 The use of traditional very high frequency (VHF)/ultra high frequency (UHF) radio communication used in aviation will be unreliable at high altitude due to frequency overlap and curvature of the earth. Additionally, the speed of such aircraft will render the existing practice of using single air traffic control (ATC) frequencies impractical. An alternative system, possibly based on satellite-based datalink and VOIP technologies could be used, and may also serve as a long term replacement for the existing aviation communication.

2.4 **Navigation**

2.4.1 It is expected that navigation systems will be based on some form of global navigation satellite system (GNSS) or inertial technologies. For altitude determination, the current use of barometric altitude will be unusable at such heights. There is a need to transition to an alternative form of altitude determination such as geo-height and corresponding ‘space levels’ to be defined if necessary. There will also need to be a transition layer, in a similar fashion to altitude flight level (ALT/FL).

2.5 **Surveillance**

2.5.1 Ground-based surveillance systems will most likely be inadequate for high level or space operations. There are technical limitations to secondary surveillance radar (SSR) at such high altitudes, and the line of sight distance from that altitude may cause flooding of the 1090mhz band if the traffic

level increases significantly. Again, a long term solution should be developed that includes mitigations for such factors, and also encompasses cybersecurity.

2.6 Separation

2.6.1 The complexities of communications, navigation, and surveillance mentioned above, will render traditional separation method unusable; new performance based vertical and horizontal minima must be defined in accordance with acceptable levels of safety.

2.6.2 Traditional forms of tactical separation, such as altitude changes or vectors, will more than likely be unfeasible at high speed. Similarly, the ability to alter the direction or altitude of such aircraft would have a corresponding impact on fuel and may modify the trajectory to a point where it has an impact on mission sustainability. It would therefore be likely that most separations would need to be performed at a strategic level, through pre-evaluated trajectory based operations, and any tactical changes would need to be performed in consultation with the operators and other airspace management agencies.

2.7 Compatibility

2.7.1 Regardless of the systems and procedures in use for the areas above FL600, there remains a need for there to be some compatibility with the existing ATM system. The existing practices rely primarily on airspace reservation to transit from ground to high altitudes and this will be unsustainable as a long term solution. For the expansion of commercial space activities, and proliferation of 'spaceports', it is essential that the existing ATM system is provided with mechanisms to support these operations without any significant adverse impact on the efficiency of existing aviation operations. It is unreasonable to utilise airspace restrictions on multiple civil aircraft operations to enable a single commercial space operation; there should be a 'level playing field'.

2.8 Safety

2.8.1 It will be necessary to define how these operations fit into the safety management system (SMS) and to what standard of safety they shall maintain. The lessons learned of the last 100 years of aviation, and 50 years of space operations will serve as a solid baseline for commercialised space operations, however there are undoubtedly many more lessons to learn.

2.9 Provision of services

2.9.1 Returning to the question of where to draw the line between airspace and space, there is a need to determine who or what will be providing the services, and what those services are, in 'space'. The existing activities are managed internally by the industry, but this may not be sustainable with continued growth of the industry. There may be the need to harmonise and or centralise the provision of such services, the patchwork nature of State based service provision will be impractical and inefficient.

2.10 Space weather

2.10.1 The impact of space weather on the communications, navigation, and surveillance (CNS) infrastructure must be ascertained and factored into the separation minima and associated procedures. There will need to be some coordination with 'space junk' tracking authorities to incorporate strategic/tactical avoidance measures into the operations.

2.11 **Ground Infrastructure**

2.11.1 To avoid investment in inappropriate facilities, it would be beneficial to have some broad guidance on ground based infrastructure required ('spaceports'), similar to aerodromes in Annex 14 — *Aerodromes*.

2.12 **Other issues**

2.12.1 The Warsaw convention and associated protocols on passenger rights should be reviewed on their applicability to space operations. As should the legal jurisdiction of such operations.

2.13 **Future expectations**

2.13.1 Judging by the exponential growth in modern technology, it is reasonably foreseeable that there will be significant investment in the future of commercial space operations. The aviation industry must take a proactive role and provide a flexible yet managed environment to enable the growth of the commercial space industry, while ensuring operations occur in a clear regulatory framework, and are integrated to the extent possible with the existing ATM system.

3. **CONCLUSION**

3.1 In light of the above, the Conference is invited to agree on the following recommendations:

Recommendation 5.1/xx –

That the Conference:

- a) note the contents of the working paper, in particular those raised in points 2.3-2.13;
- b) identify other issues that should be addressed to enable efficient and harmonious space operations in cooperation with the existing air traffic management (ATM) system;
- c) request ICAO in collaboration with other applicable organisations, to develop a harmonised regulatory and operating environment above traditional 'airspace'; and
- d) request ICAO to provide guidance, or other provisions as necessary, to support high level operations.

— END —