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WORKING PAPER

ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives

ADDITIONAL EFFORTS FOR THE RESILIENCE OF CNS/ATM SYSTEMS AND SERVICES

(Presented by Japan)

EXECUTIVE SUMMARY

This working paper emphasizes the need for a comprehensive review of the resilience of the communications, navigation, and surveillance/air traffic management (CNS/ATM) systems, in addition to the individual considerations by each expert group under the ICAO framework, in order to ensure the safety and efficiency of air navigation services. When examining CNS/ATM resilience, the increasing interdependency among its components should be taken into account. For example, the Global Navigation Satellite System (GNSS) is a critical factor that affects all CNS domains.

This working paper proposes establishing a comprehensive review framework to ensure the overall resilience of CNS/ATM systems and services. This will lead to the identification of the necessary requirements for CNS/ATM resilience to provide safe and efficient air navigation services in unforeseen circumstances.

Action: The Assembly is invited to:

a) recognize the need for a comprehensive review of CNS/ATM resilience;
b) establish a comprehensive review framework to ensure the overall resilience of CNS/ATM systems and services;
c) urge States to actively contribute to ICAO's efforts; and
d) adopt the proposed revision to Assembly Resolution A41-8, as presented in the Appendix.

Strategic Goals:	This working paper relates to *Every Flight is Safe and Secure, Aviation Delivers Seamless, Accessible, and Reliable Mobility for All* and *No Country Left Behind*.
Financial implications:	The activities referred to in this paper will be undertaken subject to the resources available in the 2026-2027-2028 Regular Budget and/or from extra budgetary contributions and/or voluntary contributions.
References:	Doc 10209, *Report of the Fourteenth Air Navigation Conference* Doc 10184*, Assembly Resolutions in Force (as of 7 October 2022)*

1. INTRODUCTION

1.1 The communication, navigation and surveillance/air traffic management (CNS/ATM) systems are essential enablers for the provision of safe and efficient air navigation services. As CNS/ATM systems continue to evolve, so too do the associated threats and vulnerabilities, in particular, Global Navigation Satellite System (GNSS) Radio Frequency Interference (RFI), which has become an urgent issue. This issue is recognized in line with the Assembly Resolution A41-8 "Consolidated statement of continuing ICAO policies and practices related to a global ATM system and communications, navigation and surveillance (CNS)/ATM systems, Appendix C, Ensuring the resilience of ICAO CNS/ATM systems and services".

1.2 At the Fourteenth Air Navigation Conference (AN-Conf/14), held at ICAO Headquarters in Montreal from 26 August to 6 September 2024, the Secretariat presented proposals for a series of major updates to the strategic and technical levels of the Seventh Edition of the Global Air Navigation Plan (GANP, Doc 9750). These updates are presented for endorsement by the 42nd Session of the ICAO Assembly, as the eighth edition of the GANP. One of the key elements of the proposed updates is the inclusion of a new focus area on resilience.

2. DISCUSSION

2.1 The resilience of CNS/ATM systems has been discussed within expert panels under the ICAO framework, including the Communications Panel/Data Communication Infrastructure Working Group (CP-DCIWG), Navigation Systems Panel (NSP), Surveillance Panel (SP), and Frequency Spectrum Management Panel (FSMP), alongside the development of Standards and Recommended Practices (SARPs) for CNS/ATM systems. For example, in the field of communications, new requirements are being incorporated into the SARPs to address notification and communication procedures in the event of major satellite communication failures. Within the NSP, concepts such as Minimum Operational Network (MON) and alternative positioning, navigation, and timing (APNT) are being considered to mitigate the impacts of GNSS RFI. Furthermore, efforts are underway to advance these discussions toward new concepts, such as Resilient Operational Network (RON) and complementary positioning, navigation, and timing (CPNT).

2.2 Conventional CNS systems have provided the individual functions through separate system architectures in each domain, contributing to air navigation services in a cooperative manner. However, as technology evolves, system interdependencies are increasing. As a result, bottlenecks have emerged within CNS/ATM systems, indicating that assessing resilience in each domain separately may no longer be sufficient.

2.3 Considering the possibility of simultaneous functional failures in the communications, navigation, and surveillance fields, there is a risk that the system may not function properly during actual contingencies in providing air navigation services, as discussions within the CNS expert panel may not sufficiently take operational perspectives into account under the current ICAO framework.

2.4 As a prerequisite for considering CNS/ATM resilience, it is necessary to assume various contingencies, including GNSS RFI, natural disasters, cyber-attacks, and large-scale system failures. When identifying resilience requirements for each contingency, a comprehensive review should be conducted to assess whether CNS/ATM resilience is sufficient to ensure the provision of air navigation services under each circumstance.

2.5 CNS systems are radio frequency-based systems. Therefore, RFI can have a significant impact on several domains beyond GNSS interference. For example, the L-band frequency spectrum is one

of the most efficient frequency bands for aviation applications and is used across all CNS fields. If interference occurs in this frequency band, multiple components of CNS systems could be simultaneously taken out of service. From a cybersecurity perspective, the threat of spoofing is not limited to data link communications; it also poses risks to GNSS-based navigation services and surveillance services such as automatic dependent surveillance — contract (ADS-C).

2.6 In the event of a disruption to the CNS/ATM systems, operational actions will be taken using the remaining facilities that are still capable of providing services. It is necessary to assume specific contingencies, identify operational procedures for each situation, and determine the CNS requirements needed to support those operations. This highlights the need for a comprehensive review of CNS/ATM resilience that takes operational responses into account. To ensure sufficient CNS/ATM resilience for the safe and efficient provision of air navigation services during contingencies, a comprehensive review framework should be established in cooperation with a wide range of experts, including air traffic controllers and aircraft operators.

3. CONCLUSION

3.1 This working paper emphasizes the need for a comprehensive review, taking into consideration how to enhance the resilience of the CNS/ATM systems to ensure safe and efficient air navigation services. It also proposes an update to Assembly Resolution A41-8, as presented in the Appendix, noting that a comprehensive review framework for CNS/ATM resilience should be established in cooperation with both technical and operational personnel.

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APPENDIX

DRAFT RESOLUTION FOR ADOPTION BY THE 42ND SESSION OF THE ASSEMBLY

A42-X:	**Consolidated statement of continuing ICAO policies and practices related to a global air traffic management (ATM) system and communications, navigation, and surveillance/air traffic management (CNS/ATM) systems**

Whereas it is considered desirable to consolidate Assembly resolutions on the Organization's policies and practices related to CNS/ATM in order to facilitate their implementation and practical application by making their text more readily available and logically organized;

The Assembly:

1. *Resolves* that the Appendices attached to this resolution constitute the consolidated statement of continuing ICAO policies and practices related to CNS/ATM, as these policies exist at the close of the ~~41st~~ 42nd Session of the Assembly;

2. *Resolves* to continue to adopt, at each ordinary session of the Assembly for which a Technical Commission is established, a consolidated statement of continuing ICAO policies and practices related to CNS/ATM; and

3. *Declares* that this resolution supersedes ~~A35-15~~ A41-8.

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APPENDIX C

Ensuring the resilience of ICAO CNS/ATM systems and services

Whereas the CNS/ATM systems are evolving and so are the associated CNS threats and vulnerabilities;

Whereas the occurrences of interference against satellite-based CNS systems and global navigation satellite system (GNSS), in particular, have significantly increased;

Whereas CNS resiliency to interference needs to be addressed at a global level with a holistic approach, ensuring an efficient and coordinated evolution between the infrastructure architecture, improved technological capabilities, civil and military operational procedures, radio regulatory authorities and civil military coordination;

Recognizing the increasing interdependence of CNS/ATM systems as per the technology evolve;

Recognizing that resiliency to interference needs to be improved by maximizing the integration of all suitable ground infrastructure, space infrastructure and airborne components in a complementary and cooperative manner, to be as robust as possible to cases of satellite-based service disruption or environments where false or deceptive signals are present;

Recognizing that both the aircraft on-board and ground infrastructure complementing the satellite-based CNS systems need to be adapted to include, where appropriate, interference detection, mitigation and reporting functions to support the resolution of operationally encountered performance anomalies;

Believing that, combined with the use of the appropriate legal framework, such capabilities and measures will allow for the relevant authorities to act upon harmful interferences caused by the illegal operation of transmitters and avoid the proliferation and the use of such illegal transmitters and the misuse of test and maintenance equipment;

Believing that, with appropriate coordination and application of best practices, military and State authorities can conduct GNSS-related testing and other interventions using radio equipment as necessary and without causing an undue impact on civil aviation;

Believing that civil-military coordination should facilitate the sharing of relevant information with airspace users, especially when flying in the vicinity of a conflict zone; and

Acknowledging that loss of crew's situational awareness from malicious origin is classified as a cybersecurity threat and cannot be tolerated in civil aviation; and that intentionally sending misleading signals to replace the accurate signal is a far more serious threat to flight safety than the loss of this signal.

The Assembly:

1. *Encourages* States to transition towards optimized, secure CNS systems based on complementary integration of suitable and independent aircraft capabilities, satellite- and ground-based infrastructure which maximize resiliency and robustness to any type of interference;

2. *Encourages* standardization bodies and industry to develop appropriate interference detection, mitigation and reporting capabilities for the aircraft on-board, satellite- and ground-based CNS system components, in order to ensure higher CNS resiliency, continuity of operations and prevent any cascading effects from the use of compromised position, velocity or time data;

3. *Encourages* States to ensure that sufficient terrestrial CNS capabilities remain available to ensure safe operations and complement aircraft-level integration of position, velocity and time with independent surveillance information;

4. *Invites* ICAO to develop high-level principles on how to integrate CNS ground, space and on-board systems and capabilities to obtain more resilient positioning and timing services;

5. *Invites* ICAO to establish a comprehensive review framework to enhance the CNS/ATM resilience;

6. *Urges* States to apply necessary measures to avoid the commercialization/proliferation and the use of illegal transmitters such as jammers and the misuse of test and maintenance equipment which may impact CNS systems;

7. *Urges* States to ensure close collaboration between aviation authorities, military authorities, service providers, radio regulatory and spectrum enforcement authorities to put in place any special measures required to ensure that the spectrum used by all CNS systems, and GNSS in particular, is free from harmful interference;

8. *Urges* States to refrain from any form of jamming, or spoofing affecting civil aviation;

9. *Urges* States to coordinate and notify to the maximum extent possible in advance with the air navigation services provider (ANSP) responsible for the affected airspace in case of military or other State-authorized security or defence-related operations or training, potentially causing any form of jamming, or spoofing affecting civil aviation; and

10. *Urges* States and operators, when assessing the interference risks associated with conflict zones, to consider that the use of satellite-based CNS systems can potentially be impacted beyond those zones.

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