International Civil Aviation Organization

MIDANPIRG/23 & RASG-MID/13 Meetings

(Cairo, Egypt, 14 – 18 June 2026)

Agenda Item 5.7: CNS

MIGRATION TO AN IP-BASED AERONAUTICAL COMMUNICATION NETWORK (ACN): A RESILIENT, STANDARDS-BASED FOUNDATION FOR ATM COMMUNICATIONS

(Presented by Saudi Arabia)

SUMMARY

The Kingdom of Saudi Arabia, through Saudi Air Navigation Services (SANS), presents the modernization of its National ANS Network through an IP-based Aeronautical Communication Network (ACN) built on SD-WAN technology over private, engineered terrestrial and satellite circuits, covering 63 CNS sites across the Kingdom and supporting ATS voice over IP in accordance with EUROCAE ED-138. The migration replaces a legacy single-provider TDMA architecture with a network engineered on up-to-date technology and architecture, centralized management and visibility, traffic security and segmentation, performance and reliability, safety-assured migration, compliance and governance, cross-border and regional interoperability, contingency resilience, and scalability and future readiness, sustaining availability for safety-critical ATM voice and data services. The initiative aligns directly with ASBU thread COMI (Communication Infrastructure) and, specifically, element COMI-B1/1 (Ground-Ground ATN/IPS) of the ICAO Global Air Navigation Plan (GANP, Doc 9750) and supports the aeronautical fixed service and ATN/IPS migration provisions of the MID eANP, Volume II, Part III (CNS). The paper may be considered as a reference for States in the MID Region modernizing ATM ground communication networks.

Action by the meeting is at paragraph 4 of this paper.

REFERENCE

- Annex 10 — Aeronautical Telecommunications, Volume II (Communication Procedures) and Volume III (Communication Systems).
- ICAO Annex 11 — Air Traffic Services; ICAO Annex 19 — Safety Management.
- ICAO PANS-ATM (Doc 4444).
- Safety Management Manual (Doc 9859).
- ICAO Aviation Cybersecurity Strategy and Cybersecurity Action Plan (Doc 10084).
- ICAO Global Air Navigation Plan (GANP), Doc 9750; ASBU thread COMI / element COMI-B1/1.
- MID eANP, Volume II, Part III — Communications, Navigation and Surveillance (CNS).
- EUROCAE ED-138 — Network Requirements and Performances for VoIP ATM Components.

1. INTRODUCTION

1.1 Ground communication networks within ANSPs carry the safety-critical voice and data services that underpin the delivery of Air Traffic Management. Their availability, integrity, and ability to evolve with new CNS systems directly influence the continuity and capacity of air navigation services, consistent with the aeronautical fixed service requirements of the MID eANP, Volume II, Part III (CNS).

1.2 The National ANS Network of SANS carries operational ATM voice and data across 63 CNS sites distributed across the Kingdom of Saudi Arabia, including the Area Control Centre (ACC), approach facilities (APP), aerodrome control towers, Remote Communication Air-Ground (RCAG) stations, and radar sites. The legacy network was a TDMA-based wide-area network delivered by a single service provider; the equipment had reached end-of-life and the capacity profile could not support new CNS systems including the Voice Communication and Switching System (VCSS) and ATM modernization initiatives.

1.3 This paper presents the migration to the Aeronautical Communication Network (ACN), an IP-based network built on SD-WAN technology that supports ATS voice over IP in accordance with EUROCAE ED-138, and the design outcomes achieved across the dimensions relevant to ANSPs modernizing their ground communications.

2. DISCUSSION

2.1 **Up-to-date technology and architecture.** The ACN replaces obsolete TDMA transport with current, IP-based, SD-WAN architecture utilizing diversified terrestrial and satellite services from multiple providers. The SD-WAN overlay operates over private, engineered circuits (not public Internet), preserving deterministic transport characteristics for ATS operational traffic. The network is dedicated to ATM operational voice and data and aligns with the technology baseline expected of modern ANSP ground communications, providing a coherent foundation for current and future ATS applications, in line with the migration to IP-based ground networks foreseen in the MID eANP, Volume II, Part III (CNS).

2.2 **Centralized management and visibility.** The SD-WAN architecture delivers centralized orchestration, configuration, and monitoring across all CNS sites from a single management plane. End-to-end visibility of circuits, devices, and application traffic enables proactive fault detection, rapid incident response, and consistent policy enforcement: capabilities not achievable on the legacy network and aligned with aeronautical fixed service and network management provisions of ICAO Annex 10, Volume II, and the MID eANP, Volume II, Part III (CNS).

2.3 **Traffic security and segmentation.** ATM operational traffic is logically segmented across the network, with separation between voice, surveillance, and supporting data flows. Encrypted transport controlled inter-zone communication, and the replacement of unsupported legacy devices with a current, patchable technology base close the cybersecurity exposure associated with end-of-life equipment and establish a defensible posture aligned with the ICAO Aviation Cybersecurity Strategy, the Aviation Cybersecurity Action Plan, and ICAO Doc 10084.

2.4 **Performance and reliability.** Provider and media diversity, combined with SD-WAN dynamic path selection over engineered underlays, deliver a high-availability, multi-path resilient architecture with sub-second failover for safety-critical traffic. Quality-of-service policies are engineered to preserve the latency, jitter, and packet-loss characteristics required for ATS voice over IP in accordance

with EUROCAE ED-138, sustaining operational performance under degraded transport conditions. The transition from TDMA frame-based transport to IP-based SD-WAN delivers a structural improvement in end-to-end latency and removes the single point of failure inherent in the legacy single-provider design, supporting the engineering principle in the MID eANP that ATS speech and data links should avoid the simultaneous loss of both circuits.

2.5 **Additional Resilience through Satellite Backup** to further strengthen network resilience and ensure continuous availability of safety-critical ATM communications, a fully redundant Very Small Aperture Terminal (VSAT) platform has been implemented across several CNS sites, with particular emphasis on remote and rural locations. The platform comprises geographically separated main and backup hub stations operating in a fully redundant configuration. This satellite-based infrastructure provides an additional independent communication path, establishing a third layer of connectivity alongside the primary and secondary terrestrial links delivered through the SD-WAN underlay. In the event of degradation or outage affecting local telecommunications service providers, the VSAT platform ensures continuity of IP traffic transport for operational voice and data services. This implementation enhances overall network availability, improves service continuity in geographically diverse environments, and reinforces the ANSP's resilience against multi-point or provider-related failures

2.6 **Safety-assured migration.** The transition from legacy TDMA to IP transport was executed as a managed safety case under the SANS Safety Management System, with hazard identification, mitigation, and acceptance prior to each cutover phase. The migration was conducted progressively, site by site, with parallel operation of legacy and ACN transport during transition windows, ensuring continuity of live ATM voice and data services throughout. This approach is consistent with ICAO Annex 19 and Doc 9859 expectations and demonstrates that fundamental communications infrastructure can be modernized without operational disruption to ATS.

2.7 **Compliance and governance.** The ACN supports ATS voice over IP in accordance with EUROCAE ED-138 and is operated under SANS' established Safety Management System and change-management governance, ensuring that network modifications are assessed for safety and security impact prior to deployment. The architecture supports the ANSP's regulatory obligations under GACAR and aligns directly with ASBU element COMI-B1/1 (Ground-Ground ATN/IPS) under the communications Infrastructure thread of the ICAO GANP, the purpose of which is to provide a more modern, efficient, cost-effective, and robust data communications network infrastructure. The ACN further enables forthcoming services under the Communications Services (COMS) thread, including ED-138-based ATS voice.

2.8 **Cross-border and regional interoperability.** The IP-based, standards-conformant architecture provides the foundation required for future cross-border ATM data and voice exchanges with neighboring FIRs, including evolution of AIDC, SWIM connectivity, and IP-based ATS coordination. Standards conformance and IP transport are preconditions for regional interoperability under the GANP, and the ACN positions Saudi Arabia to participate in MID Region initiatives that depend on a modern communications baseline, including the Required ATN Infrastructure Routing Plan and ATS Direct Speech Circuits Plan of the MID eANP, Volume II, Part III (CNS).

2.9 **Contingency resilience for ATS communications.** The combination of multi-provider terrestrial and satellite transport with SD-WAN dynamic path selection provides structural mitigation against the loss of any single communications path or provider. The architecture therefore strengthens the

ANSP's communications contingency posture in line with ICAO Annex 11 and Doc 4444 obligations, reducing reliance on procedural fallbacks during communications-degraded scenarios.

2.10 **Scalability and future readiness.** The IP-based, high-bandwidth design provides headroom beyond current and forecast capacity requirements and retires the need for project-based interim circuits. The ACN is positioned to support the next generation of ATM services, including ground-ground and air-ground voice over IP, System Wide Information Management (SWIM), trajectory-based operations data exchanges, and additional surveillance integrations. The result is a long-life communications foundation for the ANSP.

2.11 **Outcomes for the ANSP.** Collectively, these design properties deliver improvements in operational continuity and security posture across all migrated CNS sites, and a reduction in recurring communication-circuit operating expenditure driven by improved circuit utilization and consolidated circuit management, replacing a fragmented, project-driven circuit estate with a managed, scalable infrastructure aligned with international ANSP practice.

2.12 **Implementation considerations.** The migration surfaced practical considerations relevant to other ANSPs undertaking comparable modernization:

a) phased, site-by-site cutover with parallel transport operation was essential to preserve ATS continuity and is recommended over flag-day approaches;

b) early coordination with telecommunications providers, covering circuit provisioning timelines, demarcation, and operational interfaces, is a critical-path dependency;

c) clear separation must be maintained between safety-validated operational network segments and supporting administrative segments, with governance to prevent scope drift;

d) competency development for network operations staff transitioning from TDMA-era skill sets to IP and SD-WAN operations should commence in parallel with deployment, not after; and

e) change-management governance and SMS integration must be established before the first cutover, not retrofitted during the program.

3. CONCLUSION

3.1 The migration to the IP-based ACN has modernized SANS' national ATM communication infrastructure across all CNS sites, replacing an obsolete, single-provider legacy network with a resilient, secure, and standards-conformant foundation. The outcome establishes a future-ready communications baseline for current and planned ATM services in the MID Region in alignment with ASBU element COMI-B1/1 under the ICAO GANP Communications Infrastructure thread and with the CNS provisions of the MID eANP, Volume II.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a) note the migration to the IP-based ACN presented by Saudi Arabia;

b) note the network design, safety, security, governance, and implementation practices applied, as a reference for States in the MID Region modernizing ATM ground communication networks; and

c) encourage States to provide updates on IP/ATN-based ground communication infrastructure to allow the ICAO MID Office to update the MID eANP, Volume II, Part III (CNS), Tables CNS II-1, CNS II-2 and CNS II-3 as required.

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