# 61ST CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGION

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AGENDA ITEM 4: AIR NAVIGATION

# A COORDINATED ANS MODERNISATION APPROACH FOR THE ASIA AND PACIFIC REGION TO MANAGE FUTURE TRAFFIC GROWTH

(Presented by Singapore)

**SUMMARY**

The Asia and Pacific (APAC) region faces rapidly growing and increasingly complex air traffic demand where current fragmented air navigation systems and modernisation approaches, characterised by differing technologies, procedures, and uneven capabilities across States, are unable to handle efficiently. To support global air traffic to nearly triple by 2050, and recognising that air traffic management operates as an interconnected network, this paper calls for a coordinated regional approach to ANS modernisation to improve efficiency and capacity while ensuring safety. The paper highlights the need for regional collaboration to jointly develop rules, procedures and processes for the use of artificial intelligence (AI) in regional Air Traffic Flow Management (ATFM) and traffic synchronisation through arrival management and metering, and improving communications through Connected Aircraft and Air-Ground information exchange between flight deck and ground stations for non-safety critical data. This would not only help to address systemic inefficiencies but also enable the region to manage future traffic growth in a more integrated and sustainable manner.

**A COORDINATED ANS MODERNISATION APPROACH FOR THE ASIA/PACIFIC REGION TO MANAGE FUTURE TRAFFIC GROWTH**

## 1. INTRODUCTION

1.1 ICAO projects global air traffic to nearly triple by 2050, with APAC region at the forefront of growth; this presents tremendous opportunities for States and the aviation industry. To meet demand, States are building capacity at airports as airlines continue to expand. In parallel, we also need to build capacity in the skies to match capacity on the ground, to support growth, avoid congestions and meet passenger, airlines and national expectations. While we make our respective investments, we can all achieve better results by coordinating our modernisation efforts. A more integrated and seamless skies with interoperable systems and procedures will help deliver greater capacity, safety and efficiency for all.

1.2 In 2025, the 42nd ICAO Assembly agreed to develop the Minimum Implementation Path (MIP) – a clearly defined baseline set of essential elements that all States should implement to ensure global interoperability, harmonization, and readiness for future air navigation modernisation. The MIP will allow States to exchange flight and aeronautical information. When integrated, these (currently fragmented) information will provide a shared understanding of the air situation, enabling collaborative decision making among ANSPs and airspace users.

1.3 As the fastest growing and one of the most diverse region in terms of number of States and FIRs, APAC States are well placed to serve as a pathfinder for translating global priorities into practical regional implementation in two ways:

a) supporting implementation of the ICAO MIP in the APAC region; and

b) piloting new technologies and Concept of Operations (CONOPs) in APAC region, that can subsequently be scaled and adapted for implementation in other regions.

## 2. DISCUSSION

2.1 This paper presents three projects which States can voluntarily work on as pathfinder initiatives. States may elect to participate in one, two, or all three projects:

a) Artificial Intelligence (AI)-enabled regional air traffic flow management (AI-ATFM);

b) traffic synchronisation through arrival management and metering; and

c) improving communications through Connected Aircraft (CA).

<u>AI-enabled Regional Air Traffic Flow Management (AI-ATFM)</u>

2.2 ATFM is a key building block for ANS modernisation and ICAO will mandate implementation by 2030. ATFM is key to balance network level air traffic demand and capacity; while many APAC States have implemented ATFM capabilities, these are largely national in scope. Without cross-border coordination, flow management measures imposed by one State can inadvertently create inefficiencies elsewhere within the network. In this aspect, AI could be leveraged to help States optimise flow across the network.

2.3 AI offers possibilities and opportunities to augment the decision-support capabilities available to flow managers. AI-enabled systems can improve demand and capacity forecasting by integrating a wide range of information such as traffic schedule, actual trajectory information and meteorological data. AI can continuously assess operating conditions and update the demand and capacity forecast. With the forecast, AI can then support and recommend flow control measures.

2.4 In the absence of a centralised flow management unit comparable to the EUROCONTROL Network Manager or the FAA ATM Command Center, a cloud-based regional AI-ATFM agent could provide a practical and scalable model to manage air traffic flows across the network. This cloud-hosted AI-enabled regional ATFM capability offers participating States an opportunity to replace a physical ATFM unit with a virtual capability that could generate non-binding ATFM measures in a transparent, data-driven way. States could voluntarily participate in this project in varying capacity, starting from:

a) basic information exchange for enhanced regional situational awareness; to

b) generation of ATFM measures for domestic traffic; and finally

c) AI-assisted ATFM decision support tools for all traffic within the regional network – please see **Appendix A** for more details.

AI-enabled Traffic Synchronisation through Arrival Management and Metering

2.5 Traffic synchronisation (TS) complements ATFM (operating in the strategic and pre-tactical timeframe) by addressing capacity constraints at the aerodrome and during the airborne phase of the flight. TS requires arrival management and metering "to optimise traffic sequencing to achieve maximisation of aerodrome throughput" (ICAO Doc 9854, *Global Air Traffic Management Operational Concept*), issuing interventions while aircraft are already airborne and converting arriving traffic into a safe, efficient, and orderly runway sequence.

2.6 AI can augment current arrival management and metering processes by providing more accurate forecasts of demand and capacity numbers in both airspace and aerodrome, taking into account of the projected meteorological, airspace, and traffic conditions. AI can also help in optimising arrival sequence, considering the aircraft type and variations of arrival sequence.

2.7 Metered arrivals produce more predictable flight profiles, reduce controllers' workload and fuel burn, and support ICAO's Long-Term Aspiration Goal (LTAG) goal of net-zero carbon emissions by 2050. States could participate in this project in three stages (see **Appendix B**), starting from a co-development and joint validation of CONOPs, to the validation of AI-tools to assist in the generation of TS advisories, to conduct of human-in-the-loop simulations and operational trials.

Improving Communications through Connected Aircraft and Air-Ground Information Exchange

2.8 Modernisation of ANS is intrinsically linked to communication capability. APAC currently relies predominantly on VHF voice for controller-pilot communications, a technology constrained by limited spectrum, frequency congestion, and communication error risk. The Connected Aircraft (CA) concept, under development by ICAO, addresses this by enabling continuous digital exchange of operational information between aircraft and ground systems.

2.9 This project (see **Appendix C**) aims to explore and demonstrate the capability to exchange non-safety critical information between the flight deck and ground stations in a continuous, high-fidelity manner using commercial links. With a constant exchange of information between aircraft and ground stations, aircraft are now active connected nodes within the ATM network and would be able to share information (e.g. trajectory intent, timing constraints) to improve the demand and capacity forecast of ATM systems. This directly supports traffic synchronisation and ATFM.

2.10 States are invited to develop, test, and validate an application that utilises developments in commercial air-ground connectivity and data link technologies for non-safety critical information exchange. States can start with developing operational use cases for such non-safety critical information exchanges and thereafter work with identified industry partners to come up with technical and operational requirements of the application, before trialling this prototype. The results of this project could help to support future CA concept development in ICAO.

Call for Closer Collaboration in the Region

2.11 The three projects outlined in this paper are mutually reinforcing. Together, these projects provide a practical pathway towards a more integrated, efficient and future-ready air navigation system for APAC by:

a) improving availability and quality of operational information exchanged using CA; leads to

b) enhancing information sharing to enable more effective regional ATFM; resulting in

c) improving management of flights at a network level, facilitated by a more effective arrival management and traffic synchronisation.

2.12 Progress in these projects will require continued collaboration among States, ANSPs, airports, airlines, research institutes and industry partners. States should work together and consider utilising existing platforms such as the AAC to facilitation such collaborations.

## 3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to:

a) support a coordinated regional approach to air navigation services modernisation to support future traffic growth in the APAC region;

b) acknowledge the strategic importance of AI-enabled Regional Air Traffic Flow Management, AI-enabled Traffic Synchronisation through Arrival Management and Metering, and improving communications through Connected Aircraft and Air-Ground Information Exchange as key enablers of future ATM performance;

c) encourage interested States/Administrations and industry partners to participate in these projects through voluntary collaboration, operational trials, concept development and capability validation activities; and

d) task existing regional coordination platforms, including the AAC, to facilitate collaboration, share lessons learnt, and identify opportunities to accelerate the development and implementation of these initiatives across the region.

— END —

## Appendix A – AI-enabled Regional ATFM Coordination

**Problem:** Many Asia-Pacific States have implemented national Air Traffic Flow Management (ATFM), however these capabilities are predominantly national in scope. As traffic demand continues to increase, national optimisation alone cannot deliver optimum network performance because measures implemented in one Flight Information Region (FIR) may unintentionally affect operations elsewhere in the region.
**Concept:** Managing demand and capacity at a regional level through an integrated operational approach that utilises predictive analytics to consider a network-wide view of demand and capacity, allowing imbalances to be addressed ahead of time.
**A cloud-hosted virtual platform provides regional optimisation across multiple FIRs with State sovereignty preserved through voluntary participation and non-binding outputs and removes the need for a physical centralised coordination facility. It also allows for differing levels of State participation, from situational awareness and information exchange, through to full implementation of regional ATFM measures. States without a national ATFM capability can utilise the virtual centre to generate national ATFM measures on an ad hoc basis for weather events, natural disasters etc.**

### Key Features

**AI Brain (Virtual Central Node)**

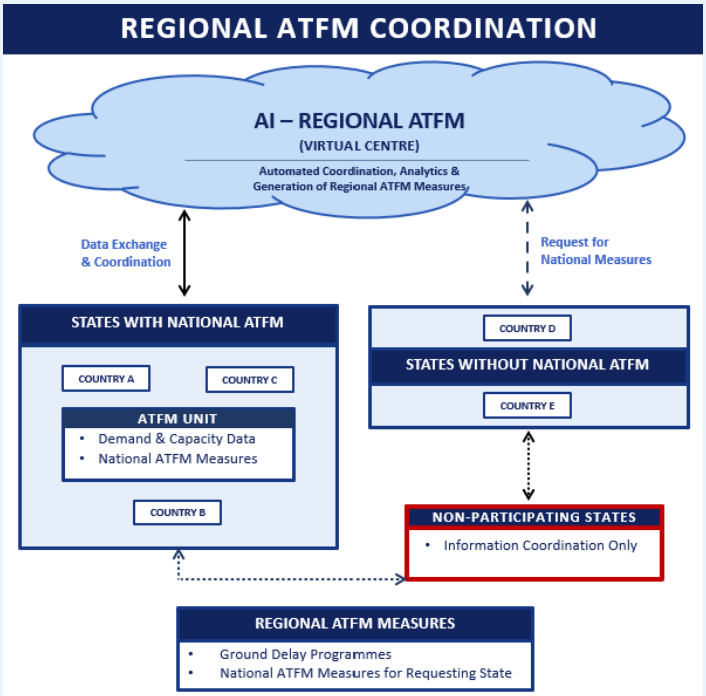
- An AI-enabled Regional ATFM capability operating as a cloud-hosted virtual coordination platform supporting voluntary participation by States
- Aggregates regional data to predict bottlenecks and demand-capacity imbalances across FIRs
- Provides a regional/ network-wide view of constraints, rather than isolated FIR-level perspectives

**Automated Measure Engine**

- Generates transparent, data-driven allocation of delay (e.g. ground delay programmes)
- Ensures equitable (fair-share) distribution across airlines, airports, and States

**3 Levels of Participation**

- Voluntary participation and non-binding outputs
- Level 1 – regional situational awareness and information exchange
- Level 2 – ad hoc generation of national ATFM measures when required
- Level 3 – full regional ATFM support



## Appendix B – AI-enabled Traffic Synchronisation

**Concept:** Cross-border sequencing of arrivals at extended distances (e.g. up to several hundred nautical miles). Time-based sequencing utilising coordination between ANSPs to allow aircraft to operate in a continuous, time-sequenced stream across FIR boundaries with delays absorbed through speed and trajectory optimisation rather than holding or vectoring.
Coordination is based on existing tools and agreements between ANSPs and does not require system or equipment procurement.

### Key Features

**Collaborative Bilateral Extended-AMAN**

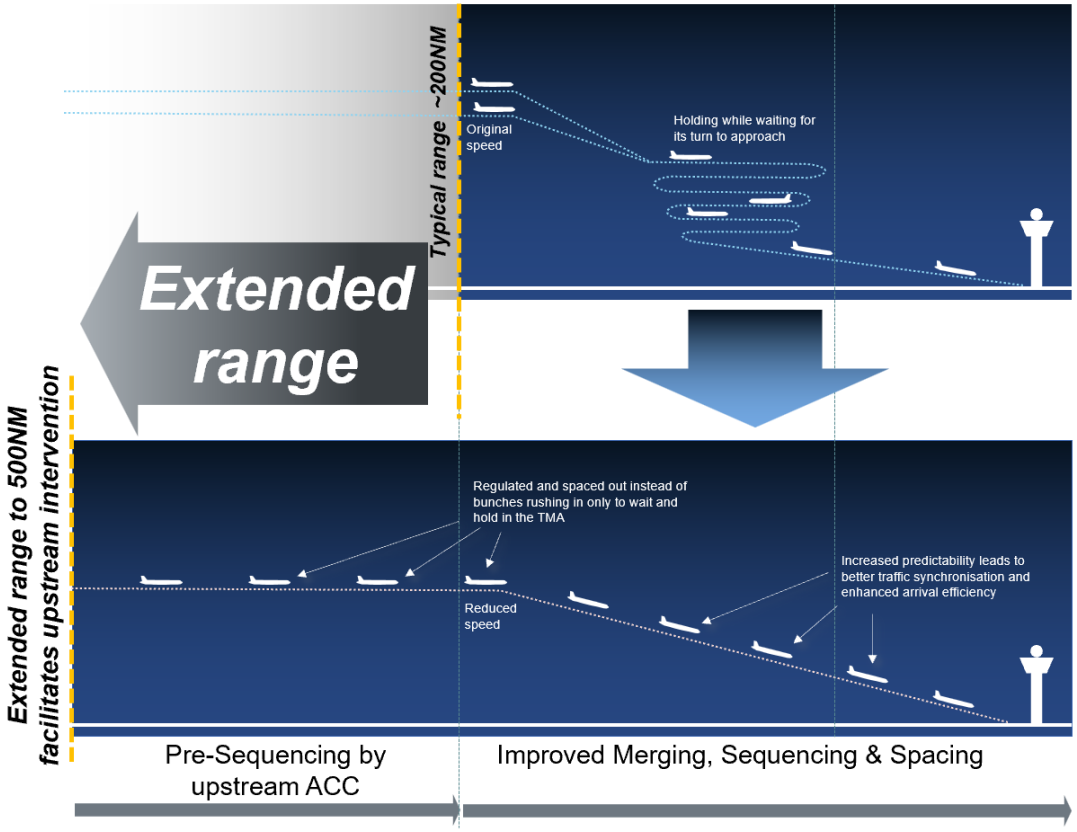
- Coordination between ANSPs to enable cross-border sequencing of arrivals at extended distances (e.g. up to several hundred nautical miles)

**Traffic Synchronization**

- Complements pre-tactical ATFM by managing aircraft already airborne, converting strategic flow decisions into efficient, safe and predictable arrival sequences across multiple FIRs.

### Outcomes

- Aircraft operate in a continuous, time-sequenced stream across FIR boundaries
- Delays are absorbed through speed and trajectory optimisation rather than holding or vectoring
- Reduced ATC workload and simplified arrival sequencing
- Improved runway throughput and airspace utilisation



## Appendix C – Connected Aircraft and Air-Ground Information Exchange

**Concept:** Routine, non-time and non-safety critical operational information is exchanged using improvements in commercial air-ground connectivity currently focused on the cabin. This approach allows routine coordination to shift away from voice, reserving it for tactical or time-critical interventions.

### Key Features

**Commercial Air-Ground Connectivity**

- Utilises improvements in connectivity currently focused on the cabin to enable scalable, cost-effective, high-frequency, high fidelity, exchange of non-time-critical data
- Significant bandwidth improvements over current channels such as CPDLC and ACARS

**Multiple 2-way Air-Ground Communication Pathways**

- ATC – profile information including top of descent and preferred approach, ability to meet RTAs, runway state, weather, traffic issues
- Airport – gate info, delay/disruption management
- Airline Ops – flight planning, dispatch issues, delay/disruption management, maintenance, crew/roster management

**Future Ready**

- Future-ready architecture supporting ICAO modernisation initiatives bridging the gap to future concepts such as SWIM, FF-ICE, and TBO
- Provides an easily implementable, low-cost solution that addresses immediate operational needs

**Outcomes**

- More timely and accurate operational information exchange
- Aids traffic synchronisation by providing visibility on aircraft trajectory preferences and ATM needs/expectations
- Reduced reliance on voice communication and manual coordination