International Civil Aviation Organization

The Third Meeting of the APANPIRG ATM Sub-Group (ATM /SG/3)

Bangkok, Thailand, 03-07 August 2015

Agenda Item 4: ATM Systems (Modernisation, Seamless ATM, CNS, ATFM)

AIR TRAFFIC FLOW MANAGEMENT STEERING GROUP OUTCOMES

(Presented by the SECRETARIAT)

SUMMARY

This paper presents the outcomes of the 4th and 5th Meetings of the Asia/Pacific Region Air Traffic Flow Management Steering Group (ATFM/SG), including the draft Regional Framework for Collaborative ATFM for review and endorsement by the meeting.

1. INTRODUCTION

1.1 The Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG) was reconvened by APANPIRG/24 (Bangkok, Thailand, 24 to 26 June 2013) under the following Conclusion:

> ***Conclusion 24/15: Asia/Pacific ATFM Steering Group***
>
> *That, States participate in, and support the Asia/Pacific ATFM Steering Group to develop a common Regional ATFM framework, which addresses ATFM implementation and ATFM operational issues in the Asia/Pacific region.*

1.2 Four meetings of the Air Traffic Flow Management Steering Group (ATFM/SG) have been held since APANPIRG/24. ATFM/SG/4 was held in Bangkok, Thailand, from 1 to 5 December 2014, and ATFM/SG/5, also in Bangkok, Thailand, from 30 March to 3 April 2015.

1.3 The primary outcome of the ATFM/SG meetings was the finalization of the draft Regional Framework for Collaborative ATFM (the draft Framework, **Attachment A**).

1.4 Other outcomes relate to:

- the formation of the ICAO ATFM Sub-Panel of the ATM Ops Panel;
- Airport Collaborative Decision-Making;
- the Bay of Bengal Cooperative Air Traffic Flow Management System (BOBCAT);
- the North Asia Regional ATFM Harmonization Group (NARAHG);
- a Regional Concept of Operations for distributed multi-nodal, networked ATFM and planning and commencement of the associated collaborative operational trial; and

- the multi-partite Collaborative ATFM Operational Trial;
- a Regional ATFM Concept of Operations; and
- ATC sector capacity assessments.

1.5 Other items discussed at ATFM/SG/4 and ATFM/SG/5, including State ATFM updates, are not included in this paper but may be viewed in the meeting report on the ICAO Asia/Pacific Regional Office website.

2. DISCUSSION

ICAO ATFM Sub-Panel

2.1 The newly formed ATFM Sub-Panel, operating under the ICAO ATM Ops Panel, was briefly discussed by ATFM/SG. Participants were urged to ensure that their State was represented on the new body, which would be working on further guidance to be included in ICAO Doc 9971 – *Manual on Collaborative ATFM.*

Airport Collaborative Decision Making

2.2 ATFM/SG was informed of the outcomes of the Third Meeting of the ICAO Aerodrome Design and Operations Panel (Montreal, Canada, April 2014) including the formation of the Airport Collaborative Decision-Making (A-CDM) Task Force, to develop A-CDM guidance material forming a new PART III of ICAO Doc 9971 – Manual on Collaborative ATFM. The tentative date for delivery of the draft guidance material was September 2015.

2.3 The ATFM/SG Terms of Reference (TOR) include a linkage to the Aerodromes Operations and Planning Working Group (AOP/WG) which would take responsibility for regional activities relating to A-CDM implementation. Harmonization of ATFM/A-CDM interfaces and terminologies would be coordinated between AOP/WG and ATFM/SG.

BOBCAT Operational Update

2.4 Thailand presented an analysis and overview of operational westbound flights through the Kabul FIR associated with the BOBCAT program. The information was provided in response to discussion at the 5th Meeting of the South Asia/Indian Ocean ATM Coordination Group (SAIOACG/5, Bangkok, Thailand, 6-9 March 2015), and related *inter alia* to poor addressing of aircraft movement messages and poor on-time performance of aircraft participating in the BOBCAT program.

2.5 States had been invited to ensure that flight plans and other relevant movement messages for flights operating under BOBCAT were addressed to the Bangkok ATFM unit. **Figure 1** illustrates the percentage of flights for which DEP messages were correctly received, per (selected) departure airport.

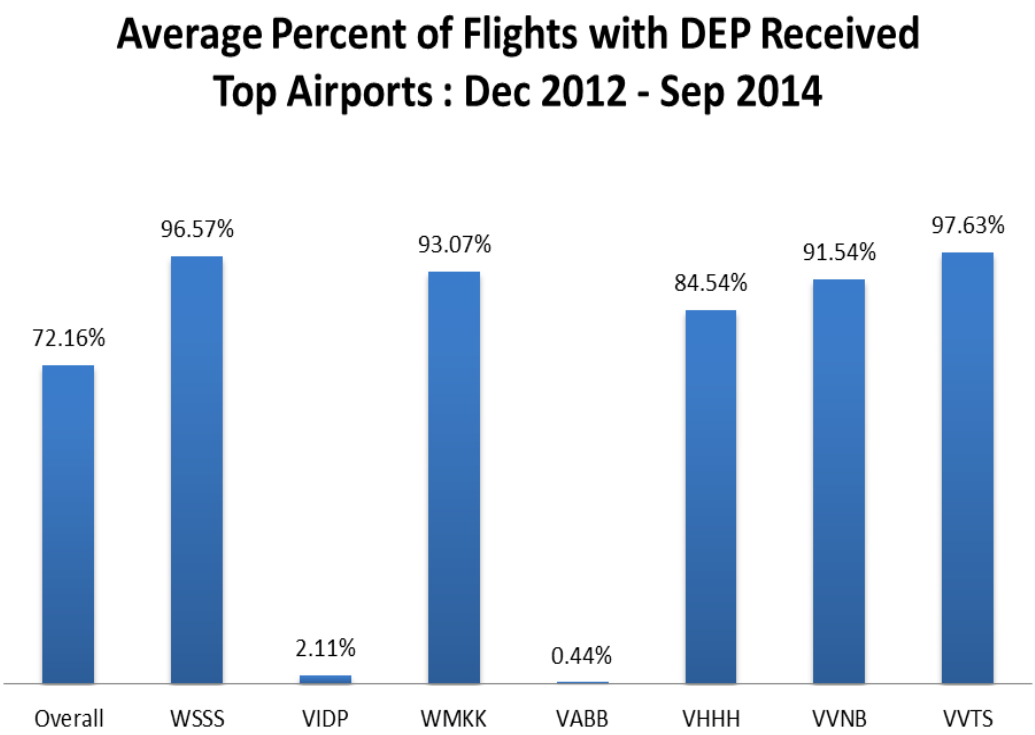

Figure 1: DEP Messages Received by ATFM Unit.

2.6 Poor departure punctuality was identified as a major cause of flights not transiting the Kabul FIR at their slot-allocated flight level (28%). **Figure 2** illustrates the average departure punctuality at the selected airports.

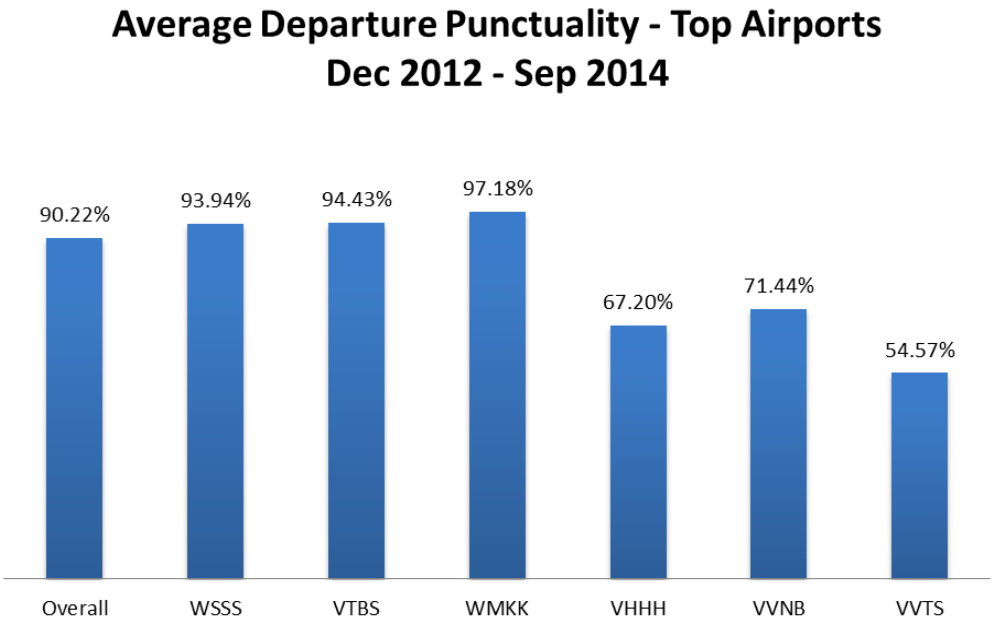

Figure 2: Average Departure Punctuality – TopAirports

2.7 Correct and timely addressing of aircraft movement messages conforming with the requirements of ICAO Doc 4444 – *Procedures for Air Navigation Services – Air Traffic Management (PANS/ATM)* is a key component of ATFM processes, as is the collaborative achievement of departure punctuality for aircraft subject to ATFM measures, particularly ground-delay programs.

North Asia Regional ATFM Harmonization Group

2.8 The North Asia Regional ATFM Harmonization Group (NARAHG) was established by China, Japan and Republic of Korea, facilitated by the ICAO Asia/Pacific Regional Sub-Office (RSO). NARAHG noted that ATFM information exchange between the 3 States would be dependent on a consistent ATFM data exchange format.

2.9 It was proposed that more States could join NARAHG, and ATFM/SG noted the need for collaboration between NARAHG and the Collaborative ATFM Operational Trial (paragraphs 2.20 – 2.23 refer).

2.10 Outcomes from NARAHG meetings included agreement on:

- principles of cooperation forming initial guiding principles and cooperative framework;
- provision of details on the reasons for ATFM measures, and examining the improved notification lead time;
- provision of general data 4 times per year and detailed data 2 times per year;
- addition of Shanghai ACC – Fukuoka/Incheon ACCs to post operations analysis;
- development of a consistent format for the ATFM daily plan and its means of exchange;

2.11 ATFM/SG discussed the provision of post-operational analysis data at the stated intervals. It was noted that best practice dictated that post-operations analysis should be conducted daily, while the scenarios and outcomes were still readily recalled and discussed. It was suggested that this should be considered in the next round of NARAHG discussions.

Collaborative Air Traffic Flow Management (ATFM) Operational Trial

2.12 ATFM/SG was provided with updates by the administrations and organizations participating in the Collaborative ATFM Operational Trial[1], using the concept of the distributed multi-nodal ATFM network which was also supported by a number of airlines and airports.

2.13 The distributed multi-nodal ATFM network concept forms the foundation for the operational trial, which was planned to commence in June 2015.

2.14 ATFM/SG agreed that the Collaborative ATFM Operational Trial outcomes would be used to further refine the Regional ATFM Concept of Operations and, over time, provide a more definitive capability requirement for regional implementation of cross-border ATFM. This would effectively contribute towards the comprehensive later revision and update of the Framework.

2.15 A full update on the progress of the Collaborative ATFM Operational Trial is provided by the participating Administrations and International Organizations in ATM/SG/3-WP/10.

[1] Australia, Cambodia, China, Hong Kong China, Indonesia, Malaysia, Philippines, Singapore, Thailand, Viet Nam, CANSO, IATA and IFATCA

Distributed Multi-Nodal ATFM Concept of Operations

2.16 In accordance with ***Decision ATFM/SG 3/1: Distributed Multi-Nodal Networked ATFM Concept***, ATFM/SG reviewed a draft *Regional ATFM Concept of Operations* (CONOPS) based on a CONOPS proposed by Singapore[1] for inclusion in the draft Framework.

2.17 Key concepts were:

- Regional stakeholders interconnected via a virtual communication framework;
- The specification of capacity and prediction of demand based on automated and/or manual inputs of ATM automation system data and AFTN data, and a web-based interface for input of information from Flow Management Positions (FMPs) and Flight Operations Centres (FOCs);
- Stakeholder roles, including Aircraft Operator options for the absorption of ATFM delay either on the ground or in the air, or in a combination of both;
- Essential requirements for success, including:
  - regional acceptance of the concept;
  - agreements on business rules;
  - participation of more than 70% of aircraft operating at or in the constrained airport or airspace; and
  - common agreements for sharing data among stakeholders

2.18 ATFM/SG/4 noted that the formulation of the original CONOPS had involved expert input from a broad variety of APAC and other States experienced in ATFM, with a view to enabling cross-border ATFM. The concept did not impose any requirement on States with respect to their domestic flow management programs.

2.19 It was further noted that the original CONOPS appeared to be fundamentally aimed at cross-border ATFM in response to airport capacity constraints on arrival flights at airports, and through further refinement it would also address airspace capacity constraints.

2.20 The CONOPS was expected to continue to develop as knowledge and experience was gained through ATFM implementation activities, primarily the Collaborative Air Traffic Flow Management (ATFM) Operational Trial.

2.21 ATFM/SG/4 agreed that while key points from the CONOPS should be included in relevant sections of the draft Framework, the CONOPS document itself would form an appendix. However, it is now proposed by the Secretariat that the *Regional ATFM Concept of Operations* (**Attachment B**) should be made separately available on the ICAO Asia/Pacific Regional Office website, with a hyperlink to the document included in the Framework, when approved by APANPIRG.

[1] *Regional Air Traffic Flow Management Concept of Operations – Application of Regional ATFM in Singapore Airspace and Asia Pacific* (7 February 2014)

2.22 The Regional ATFM Concept of Operations should replace the earlier *APAC ATFM Regional Concept of Operations (2011)*, the contents of which have been subsumed into ICAO Doc 9971 – *Manual on Collaborative ATFM* and the draft Framework.

2.23 Similarly, the *Air Traffic Flow Management (ATFM) Communications Handbook for the Asia/Pacific Region* should also be removed from the ICAO Asia/Pacific Regional Office website when APANPIRG approves the uploading of the Framework document.

ATC Sector Capacity Assessment Workshop

2.24 ATFM/SG/4 was provided with an update on proceedings at an ATC Sector Capacity Assessment workshop held in Bangkok, Thailand, on 26 and 27 November 2014. The information highlighted that a correct understanding of the capacity of sectors/airports is a vital input for any decision on the application of ATFM measures.

2.25 The EUROCONTROL ATC Capacity Analyser (CAPAN) methodology and Re-Organized ATC Mathematical Simulator (RAMS) had been used to describe the various steps in a capacity assessment process and conduct fast-time simulations.

2.26 The information provided included a simplified description of the steps required to carry out a standard capacity assessment methodology. It was noted that a capacity assessment methodology should use a simulation engine which allowed reproduction of the ATC environment, and should follow a reiterative process of validation involving active ATC staff. The total time required for setting up the capacity assessment model, conducting workshops with ATC, running the simulation and verifying the results would take 8 to 11 days.

2.27 ATFM/SG noted that the capacity assessment methodology could also be used to determine the benefits in capacity terms of ATM system capability improvements such as ATS Inter-facility Data Communications (AIDC) or improved reliability and availability of surveillance and communications systems. It was also important to note that while fast-time simulator applications may be readily available, the success of the capacity assessment required the necessary fast-time simulator operation and ATC knowledge and skills.

Development of the Regional ATFM Framework

2.28 The following information provides an overview of significant items considered by ATFM/SG in the development of the Draft Regional Framework for Collaborative ATFM.

IATA Regional ATFM Study

2.29 ATFM/SG/4 was provided with the report of the IATA study which had been undertaken under ***Decision ATFM/SG 2/2: Asia/Pacific Region ATFM Study***, to establish a regional baseline view of ATFM capability and interoperability and develop recommended implementation strategies for collaborative Regional and Sub-Regional ATFM.

2.30 The study had identified the regional benefits of ATFM implementation in terms of direct fuel savings only (**Table 1**).

	2014	2019
Regional ATFM	USD250-300 million	USD600-800 million
Regional and Domestic ATFM	USD660-810 million	USD1.1-1.4 billion

Table 1: Regional Benefits of ATFM Implementation (IATA Study)

2.31 The survey of States and organizations conducted under the study had determined that:

- most States had plans to implement or had implemented domestic ATFM;
- very few States were planning cross-border ATFM;
- significant effort would be required to establish a seamless, network based approach to regional ATFM.
- budgetary and planning commitments must be made in 2015 to meet the 2018 timelines for ASBU and the APAC Seamless ATM Plan.
- the ATFM Steering Group and ICAO had a critical leadership role to ensure coordination and development of the key initiatives that would lead to regional ATFM implementation.

2.32 It was also noted that only 5 States had indicated that they currently declared sector capacity, which may indicate the difficulty States were experiencing in establishing capacity data. Capacity analysis and declaration and the pre-tactical and tactical monitoring of demand were critical elements in ATFM. The ATFM/SG/4 meeting was advised that the Asia/Pacific Seamless ATM Plan online reporting program should result in additional reporting of capacity and ATFM implementation during 2015.

2.33 The study report's recommendations were:

1. Adoption of the multi-nodal ATFM concept of operations (developed by Singapore, in collaboration with Hong Kong China and Thailand) as the APAC concept of operations/implementation strategy for cross border ATFM;
2. Support for the multi-nodal ATFM operational trial program commencing June 2015;
3. Formal State commitment to regional cross border ATFM including budgetary and planning commitment for regional implementation;
4. Regional commitment to 2018 timeline for implementation;
5. State planning, procurement and resource commitment for expanded participation during Phase Two of the Collaborative ATFM operational trial program.

2.34 The condensed results of the IATA study were included in the Current Situation section of the draft Framework.

2.35 ATFM/SG/4 agreed to the following Decisions and Draft Conclusion:

Decision ATFM/SG/4-1: Asia Pacific Regional ATFM Concept of Operations and timeline:

That, the Asia Pacific Air Traffic Flow Management Steering Group:

- Adopts the Multi Nodal ATFM Concept of Operations as the foundation for the Regional Concept of Operations/Implementation strategy for regional cross border ATFM implementation; and

- Confirms 8 November 2018 as the target date for regional cross border ATFM implementation, for inclusion in the performance objectives of the Regional Framework for Collaborative ATFM, in alignment with ASBU and the APAC Seamless ATM Plan;

Draft Conclusion ATFM/SG/4-2: Regional cross border ATFM implementation support:

That, to support regional cross-border ATFM progress and implementation, States are urged to:

- support the multi-nodal ATFM operational trial program commencing June 2015;

- ensure timely completion of planning, procurement and resource allocation to enable participation in the multi-nodal ATFM operational trial program.

- implement cross-border ATFM in accordance with the performance objectives of the Regional Framework for Collaborative ATFM.

Decision ATFM/SG/4-3: IATA Asia Pacific Regional Air Traffic Flow Management Project – Phase Two:

The Asia Pacific Air Traffic Flow Management Steering Group agrees to support Phase Two of the IATA Regional Air Traffic Flow Management Project that will:

- develop a regional cross-border ATFM implementation plan in harmonization with existing cross-border ATFM implementation projects for consideration by the ATFM Steering Group and States at ATFM/SG/5; and

- develop in cooperation with ICAO a program to advocate for and educate stakeholder groups on cross border regional ATFM through a series of workshops partially funded by IATA (provision of SMEs) and logistically supported by States (e.g. venue provision).

ATFM Terminology and Communications

2.36 Global development of ATFM had largely been undertaken in isolation by individual ANSPs, EUROCONTROL, ICAO Sub-Regions or other informal groups of States, or by ATFM system vendors. This had resulted in differences in concept development and in the technical terms used for operational and technical coordination of ATFM information.

2.37 ATFM/SG/3 had agreed to develop a standardized ATFM terminology to promote harmonization and interoperability of CDM/ATFM systems and procedures. The work was undertaken by an ad hoc group led by CANSO and Thailand, and including India, Japan and Singapore.

2.38 The terms and definitions were determined in consultation between the ad hoc group and ICAO Regional Office, and were drawn from those used by Australia, Canada, EUROCONTROL, Japan, South Africa and USA, and those in the *Flight Information Exchange Model*[1] (FIXM) data dictionary. The proposed terminology was presented at the Global ATFM Conference held in Cancun, Mexico, in November 2014.

2.39 The terms and definitions agreed by the meeting are included in the draft Framework, with the expectation that they will be used by Asia/Pacific States for cross-border ATFM and for interfaces between ATFM, ATM, Arrival Manager (AMAN), Departure Manager (DMAN) and A-CDM systems and processes.

2.40 Information on ATFM communications, communications capability and protocols for inclusion in the Framework was also considered by ATFM/SG.

2.41 The CONOPS advocated web-based interfaces as the primary communications medium for the coordination of ATFM information.

2.42 ATFM/SG agreed that Flight Information Exchange Model (FIXM) version 3.0, and version 4.0 when available, as extended for Asia/pacific Regional requirements, should be the regional ATFM information exchange model.

2.43 ATFM information could also be shared via other communications media including dedicated voice communications channels, public telephone networks or AFTN.

2.44 ATFM/SG discussed the need for both an operational requirements document for ATFM information, and a common interface control document (ICD) for technical ATFM communications solutions including the communications media identified in the Framework. The meeting agreed to the following Decision:

> **Decision ATFM/SG/5-1 – ATFM Information Requirements Small Working Group (ATFM/IR/SWG)**
>
> That, recognizing the need for the development of operational and technical requirements for the exchange of ATFM information in the cross-border, multi-nodal ATFM network, a small working group comprised of China, Hong Kong China, India, Indonesia, Japan, Singapore, Thailand and ICAO, be established to draft:
>
> 1. An Operational Requirements document for the exchange of and interaction with ATFM information; and
>
> 2. A technical interface control document (ICD);
>
> in accordance with the terms of reference at **Attachment C**.

[1] FIXM is part of a suite of data exchange formats including Aeronautical Information Exchange Model (AIXM) and Meteorological Information Exchange Model (WXXM) intended to provide a global standard for information exchange. More information can be found at www.fixm.aero.

Meteorological Product Requirements for ATFM

2.45 The meteorological service provided for the aerodrome and terminal area needs to evolve to fill the gap between traditional products in ICAO Annex 3 and user requirements to support the global ATM system. The ability to accurately perform pre-tactical and tactical demand-capacity assessment is reliant on the predictability of events that will impact capacity. In the case of weather-related constraints, the traditional Annex 3 services in support of aerodrome operations and FIR/Global operations do not fully address the needs of ATFM.

2.46 In particular, weather affecting the airspace in the vicinity of the primary holding areas and initial approach fixes could have a significant impact on the delivery of flights into the approach airspace and onto the runway.

2.47 Some states have developed ATM-tailored meteorological information for use in sophisticated ATM decision support tools. **Figure 3** shows an example of initial approach fix (IAF) and holding stack prediction based on weather intensity and coverage area.

2.48 The ICAO Air Navigation Commission (ANC) has approved a proposal for the establishment of the Meteorology Panel (METP). It was envisaged that expert groups determined by METP would assist the Secretariat in the development of global provisions such as SARPS and amendments in Annex 3 relating to meteorological information to support ATM and Meteorological services in the terminal area.

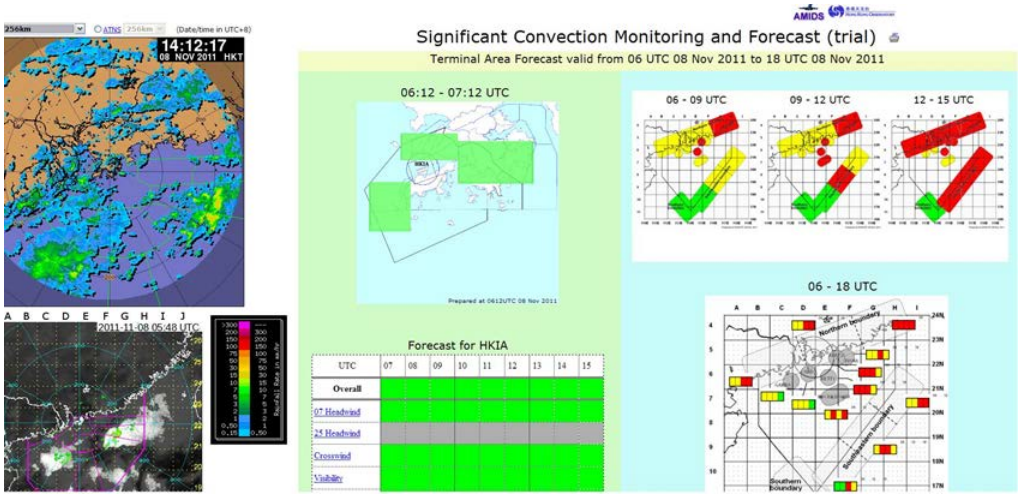

Figure 3: IAF and Holding Stack Prediction Tools

2.49 The Draft Regional Framework for Collaborative ATFM includes guidance, primarily developed by Hong Kong, China, for the development of the MET services required to support ATFM and the collaboration between ATFM service providers and MET providers in developing MET products.

2.50 ATFM/SG noted that the development of specialized MET products would incur costs. Such products should therefore only be defined for situations where there was an established need, such as demand exceeding capacity or growing traffic demand nearing capacity.

2.51 The Asia/Pacific Region Meteorological Requirements Task Force (MET/R TF) has been tasked to evaluate requirements for meteorological information in support of ATM/ATFM and to assist States to develop meteorological services to meet the requirements. It was envisaged that as the global provisions develop, regional implementation of meteorological services to support ATM in the terminal area would be facilitated through the appropriate regional group/s. In the meantime, the MET/R TF would continue to promote coordination between the MET and ATM communities to enhance the level of understanding of the requirements and the capabilities for meteorological information in support of ATM, including ATFM.

ATFM Training Requirements

2.52 ATFM/SG was provided with an ATFM Training Requirements document prepared by the European Union (EU) - Association of South East Asian Nations (ASEAN) Air Transport Integration Project (AATIP), supported by and in coordination with AEROTHAI, Thailand. While presented as an EU-AATIP deliverable, when the document reached an acceptable level of maturity it would also be submitted to ICAO as draft material for inclusion in a future version of ICAO Doc. 9971.

2.53 The document noted that an ATFM service must be staffed by personnel with sufficient knowledge and understanding of the ATM system they support, and the potential effects of their work on the safety and efficiency of air navigation. Doc. 9971 recognized the requirement for training all stakeholders in an ATFM service including airspace users and ATS personnel, in addition to those directly responsible for ATFM functions.

2.54 The training requirements document facilitates the tailoring of training, dependent on the role or function of the individual being trained

2.55 ATFM/SG discussed whether there was any requirement for licensing of ATFM personnel, and noted that this was a matter for State regulators. ICAO SARPS did not require licensing. Australia and South Africa, for example, issue a Certificate of Competency supported by a robust program of regular competency assessment. The USA does not license ATFM or ATC personnel, who in both cases are certified to carry out their functions.

2.56 It was also noted that while personnel could be selected for ATFM training from a broad range of related backgrounds such as ATC, pilots, airline operations and airport operations, in certain ATFM analysis and execution roles it was necessary that they have significant experience in ATC operations and a deep understanding of what may be operationally achievable when preparing an ATFM program, and of the potential operational impacts.

2.57 To ensure where practicable the alignment of the Training Requirements document with current regional practices States were requested to provide information on their current ATFM selection and training practices and guidance material through the Secretariat, for further development and enhancement of the training requirements document. Additional information provided by Japan at the ATFM/SG/5 meeting was also included in the finalized training requirements document, which now forms an appendix to the Draft Regional Framework for Collaborative ATFM.

Structure of the Draft Regional Framework for Collaborative ATFM

2.58 The draft Framework is structured to align with the Asia/Pacific Seamless ATM Plan, and includes:

- Scope of the framework;
- Development and Objectives;
- Executive Summary;
- Abbreviations and Acronyms;
- Background Information;
- Analysis of the current situation;
- Performance improvement plan;
- Research and future development;
- Milestones, timelines, priorities and actions; and
- Appendices.

2.59 The performance improvement plan includes performance objectives that supplement or expand upon the objectives of the Seamless ATM plan. The Framework's performance improvement plan is structured in phases also aligned, where practicable, with those of the Seamless ATM Plan. Having considered the short time frame between the endorsement of the Framework by APANPIRG and the Phase I expectations of the Seamless Plan, Regional ATFM Capability is expected to be implemented in the following phases:

- Phase IA, expected implementation by 12 November 2015;
    - *(aligned with Seamless ATM Plan Phase I)*
- Phase IB, expected implementation by 25 May 2017; and
- Phase II, expected implementation by 08 November 2018.
    - *(aligned with Seamless ATM Plan Phase II.)*

2.60 Regional ATFM Capability Phase IA introduces early/introductory ATFM capability improvements including State ATFM regulations, strategic and pre-tactical capacity and demand monitoring and analysis, preparation and distribution of ATFM daily plans (ADP), and post-operations analysis.

2.61 Phase IB expectations include those related to ATFM systems, capacity improvement, strategic airport slot allocation, expansion of pre-tactical capacity and demand monitoring and analysis, CDM/information-sharing implementation, tactical capacity and demand monitoring, implementation of tactical ATFM measures for arrivals at constrained airports, and expansion of post-operations analysis.

2.62 Phase II further expands information monitoring, distribution capability and interactivity, further expands pre-tactical and tactical capacity and demand monitoring and analysis, introduces MET services to support ATM in the terminal area, and extends ATFM measures to aircraft operating through constrained airspace sectors.

2.63 As in the case of the Seamless ATM Plan, none of the above phases or any element of the Framework is binding on any State, and they should be considered as a planning framework. It is important to note that, like the Seamless ATM Plan, the Framework's Phase commencement dates are planning targets. They should not be treated as a 'hard' date such as the example of Reduced Vertical Separation Minimum (RVSM) implementation. In that case there was a potential major regional problem if all States did not implement at the same time by the specific agreed date, which is clearly not the case for the start of the Framework Phases.

Endorsement of the Regional Framework for Collaborative ATFM Version 1.0

2.64 Having considered and reviewed each of the sections of the Draft Regional Framework for Collaborative ATFM, the ATFM/SG/5 agreed to the following Draft Conclusion for consideration by ATM/SG and subsequent APANPIRG endorsement:

> **Draft Conclusion ATFM/SG/5-2: Asia/Pacific Regional Framework for Collaborative ATFM**
>
> That, the Asia/Pacific Regional Framework for Collaborative ATFM Version 1.0 attached as **Appendix X to the Report** be endorsed, and made available on the ICAO Asia/Pacific Regional Office web site.

2.65 However, noting the proposals to also replace 2 existing documents on the Regional Office web site with the Framework and, separately, the CONOPS, and to provide for consistency of expression with similar Draft Conclusions relating to other Regional plans and guidance being considered by ATM/SG/3, the following amended Draft Conclusion is proposed by the Secretariat:

> **Draft Conclusion ATFM/SG/5-2: Asia/Pacific Regional Framework for Collaborative ATFM**
>
> That, regarding the Asia/Pacific Regional Framework for Collaborative ATFM Version 1.0 attached as **Appendix X** to the Report, and the Regional ATFM Concept of Operations Version 1.0 attached as **Appendix X** to the Report, ICAO be requested to:
>
> a) make the Framework and the Concept of Operations available on the ICAO Asia/Pacific Regional Office web site, replacing the earlier APAC ATFM Regional Concept of Operations and ATFM Communications Handbook for the Asia Pacific Region; and
>
> b) reference the Framework within the Asia/Pacific Seamless ATM Plan.

2.66 Given the need to familiarize stakeholders with the Framework, and recognizing the ICAO Regional Sub-Office focus on ATFM implementation, ATFM/SG agreed to the following Draft Decision for ATM/SG and APANPIRG endorsement:

Draft Decision ATFM/SG/5-3: ATFM Seminars/Workshops

That, ICAO be urged to facilitate Asia/Pacific ATFM Seminars/Workshops for Asia/Pacific and trans-regional States, to:

1. familiarize stakeholders with the Asia/Pacific Regional Framework for Collaborative ATFM;

2. assist implementation of ATFM; and

3. act as a forum for further development of the Asia/Pacific Regional Framework for Collaborative ATFM, and the associated ATFM Information Requirements document and Interface Control Document (ICD).

2.67 ATM/SG/3-IP/11 provides information on ATFM/CDM workshops being conducted in 2015 by ICAO/IATA.

Continuance of the ATFM/SG

2.68 ATFM/SG/4 was presented with the outcomes from the *ATFM Workshop Asia/Pacific*, held at the ICAO Asia/Pacific Regional Sub-Office, Beijing, China, from 27 to 30 October 2014. , including the recommendation that ICAO considers forming or assigning a regional body to oversee and support ATFM/CDM and A-CDM implementation.

2.69 ATFM/SG noted that the developmental nature of the distributed multi-nodal ATFM concept of operations, being dependent on lessons learned in the multi-partite collaborative ATFM operational trial, would lead to further refinement of the Regional Framework for Collaborative ATFM. The Framework document itself is iterative in nature, and will require further development and updating as experience is gained in operational trials of the distributed multi-nodal ATFM network concept.

2.70 ATFM/SG participants were firmly of the view that ATFM/SG had an ongoing function to perform in the region beyond the production of version 1 of the Regional Framework for Collaborative ATFM. The view of the group was that, in accordance with its TOR (**Attachment D**), ATFM/SG should continue to oversee and coordinate the development of the concept and subsequent amendment of the Framework, facilitate the coordination and alignment of CDM/ATFM programs being conducted within the Region, and review the effectiveness of existing and planned ATFM programs. The meeting is invited to note that the ATFM/SG TOR do not include any indication of a limited life for the group.

2.71 An important project being conducted by the ATFM/SG is the development of a Regional Operational Requirements Document and an Interface Control Document (ICD) for ATFM, which are expected to be completed for consideration by ATFM/SG, and then presented to the ATM Sub-Group of APANPIRG in August 2016.

2.72 The ATFM/SG task list includes a number of outstanding or ongoing tasks including those transferred to ATFM/SG by SAIOACG and the South-East Asia ATS Coordination Group (SEACG), at their meetings held between 3 and 12 March 2015.

2.73 Ongoing and future research and development to be considered by ATFM/SG include the ATFM operational requirements and ICD, further development of the delay absorption intent concept, development of any necessary FIXM extension, application of ATFM to long range flights, collaborative trajectory options, network collaborative decision-making and the harmonization of multiple programs of ATFM measures.

2.74 A Statement on the future role of ATFM/SG, prepared by the ATFM/SG Co-Chairs and IATA, is provided at **Attachment E**.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) discuss and agree to the following Draft Conclusions and Draft Decisions:

- *Draft Conclusion ATFM/SG/4-2: Regional cross border ATFM implementation support;*
- *Draft Conclusion ATFM/SG/5-2: Asia/Pacific Regional Framework for Collaborative ATFM;*
- *Draft Decision ATFM/SG/5-3: ATFM Seminars/Workshops*;

c) Discuss the continuance of ATFM/SG; and

d) discuss any relevant matters as appropriate.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

D R A F T

ASIA/PACIFIC REGION

FRAMEWORK

FOR

COLLABORATIVE AIR TRAFFIC FLOW MANAGEMENT

DRAFT Version 1.0 MONTH YEAR

This Plan was developed by the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG)

Approved by APANPIRG/XX and published by the
ICAO Asia and Pacific Office, Bangkok

CONTENTS

SCOPE OF THE FRAMEWORK

Regional Air Traffic Flow Management

1.1 The 24th Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/24), held in June 2013, considered that with the strong growth of air traffic in the Asia Pacific Region there was a need to effectively manage demand and capacity, particularly at major international air hubs and in the associated major traffic flows (MTF).

1.2 The airspace of the Asia/Pacific Region, particularly that of South East Asia, is characterized by relatively small FIRs with corresponding low flight transit times. Any demand management process applied unilaterally in one FIR had a knock-on effect in multiple 'downstream' FIRs, and procedures applied are therefore structured around the lowest capability along any particular route/flow. 'Flow Management' in the region has tended to be limited to rudimentary traffic spacing measures imposed by individual FIRs, rather taking a wider network view that optimizes available capacity and manages demand, only when necessary, on a sub-regional basis.

1.3 The Asia/Pacific Seamless ATM Plan provides a blueprint for coordinated Regional development, including capability improvements described in the ICAO Aviation System Block Upgrades (ASBU) roadmap. Air Traffic Flow Management (ATFM) taking a network view, is a key module in ASBU Block Zero. **B0-NOPS** – *Improved Flow Performance through Planning based on a Network-Wide view* has since been identified by APANPIRG as one of ten priorities for the Asia/Pacific Region.

1.4 While the concept of a single ATFM entity to serve a region works well in Europe and North America, a centralized ATFM Unit (ATFMU) approach is not yet practicable for the Asia/Pacific region. The need for a regional ATFM framework focusing on sub-regional, multi-State implementation, rather than individual FIR-based programs, was recognized by APANPIRG/24 in its adoption of the following Conclusion:

Conclusion 24/15: Asia/Pacific ATFM Steering Group

That, States participate in, and support the Asia/Pacific ATFM Steering Group to develop a common Regional ATFM framework, which addresses ATFM implementation and ATFM operational issues in the Asia/Pacific region.

1.5 This document, the *Asia/Pacific Region Framework for Collaborative ATFM* (the Framework) is intended to provide a common Regional framework that addresses ATFM implementation and ATFM operational issues in the Asia/Pacific region. Further discussed in later sections, a core concept of the Framework is the *distributed multi-nodal ATFM network*, envisaged as interconnected States and/or sub-Regional groups operating in an ATFM network without the need for any central, physical facility providing the network management function. The concept, untried elsewhere, originated in the *Regional ATFM Concept of Operations*, developed as a collaborative effort between Singapore and industry partners, later expanded to involve Hong Kong China, Malaysia and Thailand. The Framework will, in its future versions, be expanded and adjusted where necessary as the concept matures and experience is gained from operational implementation of cross-border, network-based ATFM and its supporting technology.

1.6 Doc 9971 states that *in its initial application, ATFM need not involve complicated processes, procedures or tools. The goal is to collaborate with system stakeholders and to communicate operational information to airspace users, air navigation service providers, and to other stakeholders in a timely manner*. Version 1.0 of the Framework includes near to medium term performance objectives to prepare and guide States in the implementation of collaborative, cross-border ATFM, providing for regionally harmonized ATFM concepts, communications and practices.

Framework Structure

1.7 The Framework, developed by the Asia/Pacific ATFM Steering Group (ATFM/SG), forms part of a suite of global and regional air navigation planning documents relevant to the Asia/Pacific Region.

1.8 Global vision and strategy perspectives are provided by the *Global ATM Operational Concept* (Doc 9854), *Global Air Navigation Plan* (GANP, Doc 9750), and *Global Aviation Safety Plan* (GASP, Doc 10004). The GANP includes the Aviation System Block Upgrade (ASBU) framework, its Modules and its associated technology Roadmaps.

1.9 Beneath this level is regional planning primarily provided by the *Asia/Pacific Basic Air Navigation Plan* (BANP, Doc 9673) and the *Asia/Pacific Seamless ATM Plan* which, together with its contributory documents, including this Framework, define goals and the means of meeting State planning objectives.

1.10 Now incorporated within the Seamless ATM Plan are the earlier *Asia/Pacific ATFM Concept of Operations* and *Air Navigation Concept of Operations.* The Framework draws upon and aligns with the guidance and recommendations of ICAO Doc 9971 *Manual on Collaborative ATFM*, and with the regional performance improvement expectations of the Seamless ATM Plan.

1.11 The Framework includes analysis of the current situation, a performance improvement plan, and considerations for research and future development.

1.12 The performance objectives of the Framework are expected to be implemented in phases aligned, where practicable, with those of the Seamless ATM Plan. Having considered the short time frame between the endorsement of the Framework by APANPIRG and the Phase I expectations of the Seamless Plan, Regional ATFM Capability is expected to be implemented in the following phases:

- Phase IA, expected implementation by 12 November 2015;
  - *(aligned with Seamless ATM Plan Phase I)*
- Phase IB, expected implementation by 25 May 2017; and
- Phase II, expected implementation by 08 November 2018.
  - *(aligned with Seamless ATM Plan Phase II.)*

1.13 None of the above phases or any element of the Framework is binding on any State, and they should be considered as a planning framework. It is important to note that, like the Seamless ATM Plan, the Framework's Phase commencement dates are planning targets. They should not be treated as a 'hard' date such as the example of Reduced Vertical Separation Minimum (RVSM) implementation. In that case there was a potential major regional problem if all States did not implement at the same time by the specific agreed date, which is clearly not the case for the start of the Framework Phases.

1.14 In that regard, although it would be ideal if all States achieved capability on day one of Phase I, this is probably not realistic. States should, however, consider the impact on stakeholders and on the needed improvements in cross-border ATFM and the ATM system overall that would result from not achieving target implementation dates. The Seamless ATM Plan Phase dates, and hence the Framework dates, were chosen as being an achievable target for the majority of States. However the dates were not designed to accommodate the least capable State, otherwise the region as a whole would fall behind the necessary urgent ATM improvements required by the Directors General of Civil Aviation and APANPIRG.

Document Review

1.15 The Framework is intended, as a minimum, to be first reviewed coincident with the first planned review of the Seamless ATM Plan in 2016 and thereafter each three years, also coincident with the regular review of the Seamless ATM Plan. Earlier or more frequent review and amendment will be conducted as recommended by ATFM/SG and agreed by APANPIRG, through its Air Traffic Management (ATM) Sub-Group (ATM/SG).

DEVELOPMENT AND OBJECTIVES OF THE FRAMEWORK

Framework Development

2.1 The Asia Pacific Region Air Traffic Flow Management Steering Group (ATFM/SG) was formed by the Asia/Pacific Region Air Navigation Planning and Implementation Regional Group (APANPIRG) to *inter alia*, develop a common Regional ATFM framework which addresses ATFM implementation and ATFM operational issues in the Asia/Pacific Region.

2.2 The Framework was developed over four meetings of the ATFM/SG, supported by offline work by a team of specialists drawn from within the Steering Group. The Framework was endorsed by the 26th Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/26, Bangkok, Thailand, 7 to 10 September 2015).

2.3 The Framework draws on relevant experience gained in Asia/Pacific States, and in other Regions. Key concepts used or adapted in the Framework include:

- A distributed multi-nodal cross-border ATFM network rather than a regionally centralized facility;
- An agreed model for ATFM information exchange;
- An agreed suite of ATFM terminologies for use in ATFM systems and processes, and in interfaces with other complementary systems;
- Meteorological forecasting information tailored for ATFM purposes;
- *Delay absorption intent*, allowing aircraft operators to flexibly distribute their total ATFM delay across various phases of flight.

2.4 The performance objectives of the Framework are, wherever practicable, aligned with the ATFM-related objectives and implementation timelines of the Asia/Pacific Seamless ATM Plan. The

2.5 Further development of the Framework beyond this version will be guided by the concepts discussed in its Research and Future Development section, and by the experience gained in operational implementation and the maturing distributed multi-nodal ATFM network concept.

ATFM Framework Objective

2.6 Having considered relevant documents such as the Global Air Navigation Plan (Doc 9750), the Asia/Pacific Region Seamless ATM Plan and the Manual on Collaborative Air Traffic Flow Management (Doc 9971), the objective of the Framework is to provide a regionally agreed framework for the harmonized implementation of networked, interoperable, multi-FIR, multi-State, cross-boundary collaborative ATFM capability.

2.7 The Framework provides information, guidance and performance objectives including:

- ATFM principles;
- ATFM-related Aviation System Block Upgrades (ASBU), and relevant performance objectives from the Asia/Pacific Seamless ATM Plan;
- ATFM-related performance objectives of the Asia/Pacific Seamless ATM Plan;
- Collaborative decision-making (CDM);
- ATFM phases;
- Airspace and airport capacity improvement, planning, assessment and declaration;
- ATFM daily plan;
- ATFM terminology, communications and information distribution;
- Meteorological information for ATFM;
- Distributed multi-nodal ATFM network concept;
- Training and competencies for ATFM personnel;
- Analysis of current ATFM capability in the Region
- A performance improvement plan; and
- considerations for research and future development.

EXECUTIVE SUMMARY

The Need for a Regional Framework for Collaborative ATFM

3.1 The Asia-Pacific (APAC) region is the world's largest market for air transport. In 2012 it accounted for 33% of the global air transport market[1]. This was expected to grow to 37% by 2017. Three of the top ten airports (passenger movements) and four of the top ten (air cargo tonnage) in 2013 were in the Asia/Pacific Region[2].

3.2 While recognizing that the first response to increased demand should always be an increase in capacity, the growing demand/capacity imbalance in the Region has resulted in increasing congestion, delays, costs and potential safety risks.

3.3 The need for a regional, network-based response to the challenges of increasing demand was recognized by APANPIRG/24 (June 2013) in its adoption of **Conclusion 24/15: Asia/Pacific ATFM Steering Group**, re-convening the ATFM/SG to develop a common Regional ATFM framework addressing ATFM implementation and ATFM operational issues in the Asia/Pacific Region. It was further recognized in the inclusion of the ASBU module **B0-NOPS** – *Improved Flow Performance through Planning based on a Network-Wide View* among the ten priorities and targets for the Asia/Pacific Region[3].

3.4 The scope of work of the ATFM/SG was further expanded by new terms-of-reference, endorsed by APANPIRG/25 (September 2014), which require the Steering Group to research and recommend appropriate ATFM guidance, and maintain an overview and review the effectiveness of Asia/Pacific CDM/ATFM programs.

Distributed Multi-Nodal ATFM Network Concept

3.5 Of central importance to Framework is the concept of cross-border ATFM utilizing a distributed multi-nodal ATFM network. Previously untried, the concept as detailed in this document will develop further with experience gained, particularly in the ongoing multi-partite trial program, with operational trials planned to commence in June 2015. This program, with the active participation of 8 Asia/Pacific Region administrations and 2 international organizations, is expected to contribute significantly to the knowledge and experience necessary for the ongoing work of ATFM/SG and the further development of the regional ATFM framework.

Interoperability is the Key

3.6 The Framework takes into account the ATFM development initiatives undertaken by various States to balance demand and capacity within their airspaces. Recognizing the need to adopt a network wide view for improving the flow performance across the APAC region, the Framework has been developed in line with ATM performance improvement elements of Asia Pacific Seamless ATM Plan.

3.7 A key consideration in the development of Version 1.0 of the Regional Framework for

[1] IATA Asia/Pacific Region ATFM Study 2014

[2] Airports Council International (ACI) 2013 World Airport Traffic Report

[3] Conclusion APANPIRG 25/2 – APAC Regional Air Navigation Priorities and Targets

Collaborative ATFM was the interoperability of systems, procedures and practices to ensure not only regionally harmonized ATFM, but also the effective, complementary operation of other systems forming part of the gate-to-gate chain of air traffic management. It is vital that all systems and processes use common information, terminology and communications protocols to ensure common understanding and optimal outcomes. In particular, the interoperability of ATFM, Airport Collaborative Decision-Making (A-CDM), Arrival Manager (AMAN) and Departure Manager (DMAN) systems, and airspace user and ATM automation system interfaces, is critical to the success of a regional ATFM program and the optimized use of available capacity. ATFM/SG addressed these issues in the development of harmonized ATFM terminology and the specification of automated system communications protocols, and through its linkage to the ICAO Asia/Pacific Region Aerodromes Operations and Planning Working Group (AOP/WG).

ABBREVIATIONS and ACRONYMS

Abbreviations and Acronyms

Note: Abbreviations and acronyms for ATFM-specific terminology developed for the Asia/Pacific Regional Framework for Collaborative ATFM are listed separately in an appendix to Section 5, Background Information - Terminology and Communications.

AAR	Aerodrome Arrival Rate or Airport Acceptance Rate
ATM	Air Traffic Management
ABI	Advanced Boundary Information (AIDC)
ACAS	Airborne Collision Avoidance System
ACC	Area Control Centre
ACP	Acceptance (AIDC)
ADOC	Aircraft Direct Operating Cost
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
AFS	Aeronautical Fixed Service
AIDC	ATS Inter-facility Data Communications
AIGD	ICAO ADS-B Implementation and Guidance Document
AIM	Aeronautical Information Management
AIRAC	Aeronautical Information Regulation and Control
AIRD	ATM Improvement Research and Development
AIS	Aeronautical Information Service
AIXM	Aeronautical Information Exchange Model
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
AN-Conf	Air Navigation Conference
AOC	Assumption of Control (AIDC)
AOM	Airspace Organization and Management
APAC	Asia/Pacific
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APCH	Approach
APEC	Asia Pacific Economic Cooperation
APSAPG	Asia/Pacific Seamless ATM Planning Group
APV	Approach with Vertical Guidance
APW	Area Proximity Warning
ASBU	Aviation System Block Upgrade
ASD	Aircraft Situation Display
ASEAN	Association of Southeast Asian Nations
ASMGCS	Advanced Surface Movements Guidance Control Systems
ATC	Air Traffic Control
ATCONF	Worldwide Air Transport Conference
ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information Service
ATS	Air Traffic Services
ATSA	Air Traffic Situational Awareness
ATM	Air Traffic Management
CANSO	Civil Air Navigation Services Organization
CARATS	Collaborative Actions for Renovation of Air Traffic Systems
CDM	Collaborative Decision-Making
CCO	Continuous Climb Operations
CDO	Continuous Descent Operations
CFIT	Controlled Flight into Terrain

CLAM	Cleared Level Adherence Monitoring
COM	Communication
CONOPS	Concept of Operations
CNS	Communications, Navigation, Surveillance
CPAR	Conflict Prediction and Resolution
CPDLC	Controller Pilot Data-link Communications
CPWG	Cross-Polar Working Group
CSP	Communication Service Provider
CTA	Control Area
CTR	Control Zone
DARP	Dynamic Airborne Re-route Planning
DGCA	Conference of Directors General of Civil Aviation
DMAN	Departure Manager
DME	Distance Measuring Equipment
EST	Coordinate Estimate
FAA	Federal Aviation Administration
FDPS	Flight Data Processing System
FIR	Flight Information Region
FIRB	Flight Information Region Boundary
FL	Flight Level
FLAS	Flight Level Allocation Scheme
FLOS	Flight Level Orientation Scheme
FRMS	Fatigue Risk Management System
FUA	Flexible Use Airspace
GANIS	Global Air Navigation Industry Symposium
GANP	Global Air Navigation Plan
GASP	Global Aviation Safety Plan
GBAS	Ground-based Augmentation System
GDP	Gross Domestic Product
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
GPI	Global Plan Initiative
HF	High Frequency
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IMC	Instrument Meteorological Conditions
INS	Inertial Navigation Systems
IO	International Organizations
IPACG	Informal Pacific ATC Coordinating Group
ISPACG	Informal South Pacific ATS Coordinating Group
ITP	In-Trail Procedure
KPA	Key Performance Area
LNAV	Lateral Navigation
LVO	Low Visibility Operations
MET	Meteorological
METAR	Meteorological Aerodrome Report
MLAT	Multilateration
MSAW	Minimum Safe Altitude Warning
MTF	Major Traffic Flow
NextGen	Next Generation Air Transportation System
OPMET	Operational Meteorological
OLDI	On-Line Data Interchange
OTS	Organized Track System

PACOTS	Pacific Organized Track System
PARS	Preferred Aerodrome/Airspace and Route Specifications
PASL	Preferred ATM Service Levels
PBN	Performance-based Navigation
PIA	Performance Improvement Areas
PKP	Passenger Kilometres Performed
PVT	Passenger Value of Time
RAIM	Receiver Autonomous Integrity Monitoring
RAM	Route Adherence Monitoring
RANP	Regional Air Navigation Plan
RPK	Revenue Passenger Kilometres
RNAV	Area Navigation
RNP	Required Navigation Performance
RVSM	Reduced Vertical Separation Minimum
SAARC	South Asian Association for Regional Cooperation
SATVOICE	Satellite Voice Communications
SAR	Search and Rescue
SBAS	Space Based Augmentation System
SCS	South China Sea
SESAR	Single European Sky ATM Research
SHEL	Software, Hardware, Environment and Liveware
SID	Standard Instrument Departure
SIGMET	Significant Meteorological Information
SPECI	Special Weather Report
STAR	Standard Terminal Arrival Route or Standard Instrument Arrival (Doc 4444)
STCA	Short Term Conflict Alert
STS	Special Handling Status
SUA	Special Use Airspace
SUR	Surveillance
SWIM	System-Wide Information Management
TAF	Terminal Area Forecast
TAWS	Terrain Awareness Warning Systems
TBO	Trajectory Based Operations
TCAC	Tropical Cyclone Advisory Centre
TCAS	Traffic Collision Avoidance System
TOC	Transfer of Control
UAS	Unmanned Aircraft Systems
UAT	Universal Access Transceiver
UPR	User Preferred Routes
VHF	Very High Frequency
VMC	Visual Meteorological Systems
VNAV	Vertical Navigation
VAAC	Volcanic Ash Advisory Centre
VMC	Visual Meteorological Conditions
VOLMET	Volume Meteorological
VOR	Very High Frequency Omni-directional Radio Range
VSAT	Very Small Aperture
WAFC	World Area Forecast Centre

BACKGROUND INFORMATION

ATFM Principles

5.1 The major areas of Collaborative ATFM principles are mainly aligned with those of the Asia/Pacific Seamless ATM Plan; People (human performance), Facilities (physical equipment), and Technology and Information. The 35 principles as agreed by ATFM/SG and endorsed by APANPIRG are included at **Appendix A.**

ATFM-Related Aviation System Block Upgrades (ASBU)

5.2 The ICAO ASBU initiative, detailed in Doc. 9750 – Global Air Navigation Plan (GANP), describes a way to apply the concepts defined in Doc 9854 – Global Air Traffic Management Operational Concept (GATMOC), with the goal of implementing regional and global performance improvements. They are intended to provide a set of aviation system solutions or upgrades that exploit current aircraft equipage and capability, and to establish a transition plan enabling global interoperability. The ASBUs comprise a suite of modules organized into flexible and scalable building blocks where each module represents a specific, well-bounded improvement. The modules may be introduced and implemented in a State or region depending on the need and level of readiness. It is recognized that all the modules are not required in all airspaces.

5.3 The 25th Meeting of the Asia/Pacific Region Air Navigation Planning and Implementation Regional Group endorsed ten regional priorities (and performance indicators), including five ASBU modules directly related to regional collaborative ATFM.

B0-NOPS – Improved Flow Performance through Planning based on a Network-wide View.

APAC ATFM Notes: Inter-linked and networked cross-FIR ATFM capability both within and between ANSPs, and having harmonized interfaces with AMAN/DMAN and A-CDM systems using common reference points and information exchange, should be developed to serve various sub-regions. (Refer Doc 9971 Manual on Collaborative Air Traffic Flow Management)

B0-FICE – Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration.

APAC ATFM Notes: ATS Inter-facility Data Communications (AIDC). AIDC application exchanges information between ATS units in support of critical ATC functions, including notification of flights approaching a Flight Information Region (FIR) boundary, coordination of boundary-crossing conditions, and transfer of control. AIDC application improves the overall safety of the ATM system, as well as increasing airspace capacity, as it permits the controller to simultaneously carry out other tasks. AIDC provides for the necessary improvements in the accuracy and update of aircraft position and estimate information that permit earlier inclusion in sequence planning and application of ATFM measures.

B0-FRTO – Improved Operations through Enhanced En-route Trajectories.

APAC ATFM Notes: Flexible Use Airspace (FUA), User Preferred Routes (UPR), Dynamic Airborne Re-route Planning (DARP) and CDM. These will allow the use of airspace which would otherwise be segregated, along with flexible routing adjusted for specific traffic patterns for greater routing possibilities, reducing flight time and fuel burn.

B0-ASUR – Initial Capability for Ground Surveillance

APAC ATFM Notes: E.g. ADS-B, MLAT. Recognizing the principle that increasing capacity is central to the management of increased demand, this module provides States with the means to improve ATC capacity in en-route airspace sectors through the application of PANS/ATM-defined surveillance-based separation standards. Earlier surveillance of aircraft also provides real-time updates of ATFM system information. ADS-B data may be readily shared between neighbouring ATSUs, enhancing safety, increasing capacity and efficiency and facilitating seamless ATM and collaborative ATFM operations.

B0-TBO – Improved Safety and Efficiency through the Initial Application of data Link En-route.

APAC ATFM Notes: Automatic Dependent Surveillance-Contract (ADS-C), Controller Pilot Data-link Communications (CPDLC). Data-link application for ATC surveillance and communications supports flexible routing, optimized separation (and thus increased capacity) and improved safety in areas where technical constraint or cost-benefit analysis does not support the use of ground-based surveillance (SSR, ADS-B or MLAT). In these cases ADS-C and CPDLC provide for greater accuracy and update in aircraft position and estimate information for aircraft outside the coverage of ground-based surveillance systems than is provided in voice AIREP, and automated update of ATC information, facilitating earlier inclusion in sequence planning and application of ATFM measures and the timely, reliable and accurate transmission of ATFM measure instructions to such aircraft.

<u>Other ATFM-Related ASBU Block-0 Modules</u>

B0-ACDM: (Priority 2) – Improved Airport Operations through Airport CDM

APAC ATFM Notes: Airport CDM improves the outcomes of collaborative ATFM by facilitating the timely positioning of aircraft in order to comply with ATFM measures such as Calculated Take-Off Time (CTOT), where harmonized with ATFM and AMAN/DMAN systems using common reference points and information exchange.

B0-AMET: (Priority 2) Meteorological Information Supporting Enhanced Operational Efficiency and Safety

APAC ATFM Notes: Global, regional and local meteorological information including aerodrome warnings, SIGMETs, and other operational meteorological (OPMET) information, including METAR/SPECI and TAF, supporting flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning. Meteorological information other than the OPMET information currently defined in Annex 3 provide optimized decision-making information to support ATFM.

B0-CCO: (Priority 2) – Improved Flexibility and Efficiency Departure Profiles – Continuous Climb Operations.

APAC ATFM Notes: Continuous Climb Operations (CCO). These procedures improve ATFM outcomes by segregating departing/climbing traffic from inbound/descending traffic, and facilitating higher runway departure rates by segregating the departure routes of aircraft having different speed and climb performance characteristics.

B0-CDO: (Priority 2) – Improved Flexibility and Efficiency Departure Profiles – Continuous Climb Operations.

APAC ATFM Notes: These arrival procedures allow aircraft to fly their optimum descent profile, taking into account airspace and traffic complexity, and permit the maximum use of aircraft capability to meet Calculated Times-Over (CTO) Arrival Fixes (AFIX) and Calculated Times of Arrival (CTA) during the descent and approach phases of flight.

B0-RSEQ: (Priority 2) Improved Traffic Flow through Sequencing (AMAN/DMAN).

APAC ATFM Notes: Arrival Manager (AMAN) and Departure Manager (DMAN) procedures and tools are designed to provide automation support for synchronisation of arrival sequencing, departure sequencing and surface information, and optimization of runway capacity. Collaborative, harmonized development of AMAN/DMAN, ATFM and Airport CDM systems should be undertaken, using common reference points and information exchange protocols.

B0-SURF: (Priority 3) Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)

APAC ATFM Notes: Advanced Surface Movements Guidance Control Systems (A-SMGCS), where warranted by weather conditions and capacity. While Implementation of A-SMGCS may not be a high priority in the Asia/Pacific except at high density aerodromes where the cost benefits are positive, it improves ATC capability to ensure the efficient positioning of aircraft to comply with ATFM measures and DMAN-generated departure sequencing, and improves the flow of aircraft to and from aprons and terminal gates under A-CDM.

ATFM-Related Performance Objectives of the Seamless ATM Plan

5.4 The Asia/Pacific Seamless ATM Plan specifies performance objectives under *Preferred Aerodrome/Airspace and Route Specifications* (PARS) and *Preferred ATM Service Levels* (PASL), to be implemented in two phase:

- PARS/PASL Phase I – expected implementation by 12 November 2015; and
- PARS/PASL Phase II – expected implementation by 08 November 2018.

5.5 ATFM-related performance objectives of the Seamless ATM Plan, summarized as follows, were taken into account in the formulation of Regional ATFM performance objectives specified in this Framework:

- PARS/PASL Phase I

7.1 All High density international aerodromes (100,000 scheduled movements per annum or more) should

a) provide apron management service to regulate entry of aircraft into and coordinate exit of aircraft from the apron.

c) Conduct regular airport capacity analysis including a detailed assessment of passenger, airport gate, apron, taxiway and runway capacity.

7.2 All High Density Aerodromes operate an A-CDM system serving MTF and busiest city pairs, with priority implementation for the busiest Asia/Pacific Aerodromes.

7.3 CCO and CDO operations should be considered for implementation at all high density international aerodromes after analysis, based on a performance-based approach.

7.4 All international high density aerodromes should have RNAV 1 (ATS surveillance environment) or RNP 1 (ATS surveillance and non-ATS surveillance environments) SID/STAR.

7.25 All high density aerodromes should have AMAN/DMAN facilities.

7.26 All high density aerodromes should provide meteorological forecasts, aerodrome warnings and alerts that support efficient terminal operations.

7.27 High density FIRs supporting the busiest Asia/Pacific traffic flows and high density aerodromes should implement ATFM incorporating CDM to enhance capacity, using bi-lateral and multi-lateral agreements.

- PARS/PASL Phase II

7.13 All high density aerodromes should have a declared airport terminal and runway capacity based on a capacity and efficiency analysis, to ensure the maximum possible efficiency of aircraft and passenger movement

7.43 ATM system design should be planned and implemented to support optimal aerodrome capacity expectations for the runway(s) concerned.

7.44 All terminal ATC sectors should have a nominal aircraft capacity figure based on a scientific capacity study and safety assessment to ensure safe and efficient aircraft operations.

7.45 All AMAN systems should take into account airport gates for runway selection and other aircraft departures from adjacent gates that may affect arriving aircraft.

7.50 To ensure the safety and efficiency of aircraft operations a nominal aircraft capacity figure based on a scientific capacity study and safety assessment should be available for all en-route ATC sectors.

5.6 The regional ATFM performance objectives specified in Section 7 of this framework – Performance Improvement Plan, complement and where necessary expand upon the performance objectives of the Seamless ATM Plan.

Collaborative Decision Making

5.7 ICAO Doc 9971 defines Collaborative Decision Making:

A process focused on how to decide on a course of action articulated between two or more community members. Through this process, ATM community members share information related to that decision and agree on and apply the decision-making approach and principles. The overall objective of the process is to improve the performance of the ATM system as a whole while balancing the needs of individual ATM community members.

5.8 The planning and implementation of cross-boundary, networked ATFM requires new levels of collaborative decision-making among multi-national stakeholders. While current ATFM CDM processes and ATFM systems are oriented towards local or national demand and capacity balancing, the maturing of ATFM systems and expansion across national boundaries will lead to a CDM environment of multilateral decision-making with complementary individual goals.

5.9 Cross-border ATFM should have the following characteristics:

- an inclusive process – Participation by States and other Stakeholders is the key;
- a transparent process – Simple business rules to ensure compliance and build trust will be necessary;
- allows Sharing of information between all partners through a common network to improved efficiency and operational decision making; and
- achieve common situational awareness for all partners, taking into account the data-sharing capability of stakeholders.

5.10 Cross-border ATFM/CDM should provide opportunities for the efficient exchange of operational and strategic information for all stakeholders, ensuring strategic cooperation towards achieving the objectives of seamless ATM and optimization of traffic flows across the region.

5.11 The challenges in establishing a regional ATFM framework include the establishment of transparent, easily understood and flexible procedures, compliance, participation and demonstration of proven benefits to educate and encourage change among stakeholders

5.12 CDM partners and stakeholders should include:

- States, establishing regulations and overseeing safety and compliance;
- ANSPs, implementing ATFM capability;
- International Organizations such as ACI, CANSO, IATA and IFATCA;
- International ATFM Organizations (to share tactical flight data through ATFMU) – EUROCONTROL, FAA;
- Airport operators; and
- CDM-participating airlines.

5.13 Each State will develop ATFM capability according to its needs and requirements, and the overarching goal of seamless ATM across the Asia/Pacific Region.

5.14 The Regional concept for cross border ATFM is based on a *distributed multi-nodal ATFM network* concept. Under this concept each State/Administration participating collaboratively in cross-border ATFM will form a node of the multi-nodal network, and should be led by an agreed ANSP as the Node Leader.

5.15 Within an ATFM node there may be a number of airport operators and airspace users with access to the node arranged by the Node Leader, facilitating their participation in the cross-border ATFM initiative.

5.16 The Node Leader should be responsible for engagement with the various Node stakeholders and ensuring the Node is ready and able to participate in the Regional Cross Border ATFM process. The processes within a node to enable this readiness may vary from node to node, and be applicable to the particular environment within the State(s). However, the readiness to engage with the regional cross border multi nodal system should be in accordance with the Regional Framework for Collaborative ATFM and its underlying distributed multi-nodal ATFM network concept, and any specific procedures identified and agreed by the multi-nodal participants. The Node Leader is responsible for ensuring compliance and therefore readiness to participate in the APAC cross-border multi-nodal ATFM initiative.

5.17 ANSPs and airspace users may participate in transition or trial participation leading to their full participation in the multi-nodal ATFM network. An example of tiered trial participation levels for ANSPs and airspace users is provided at **Appendix B**.

ATFM Phases

5.18 ICAO Doc 9971 describes three phases of ATFM execution; *strategic*, *pre-tactical* and *tactical*, illustrated in **Figure 1**.

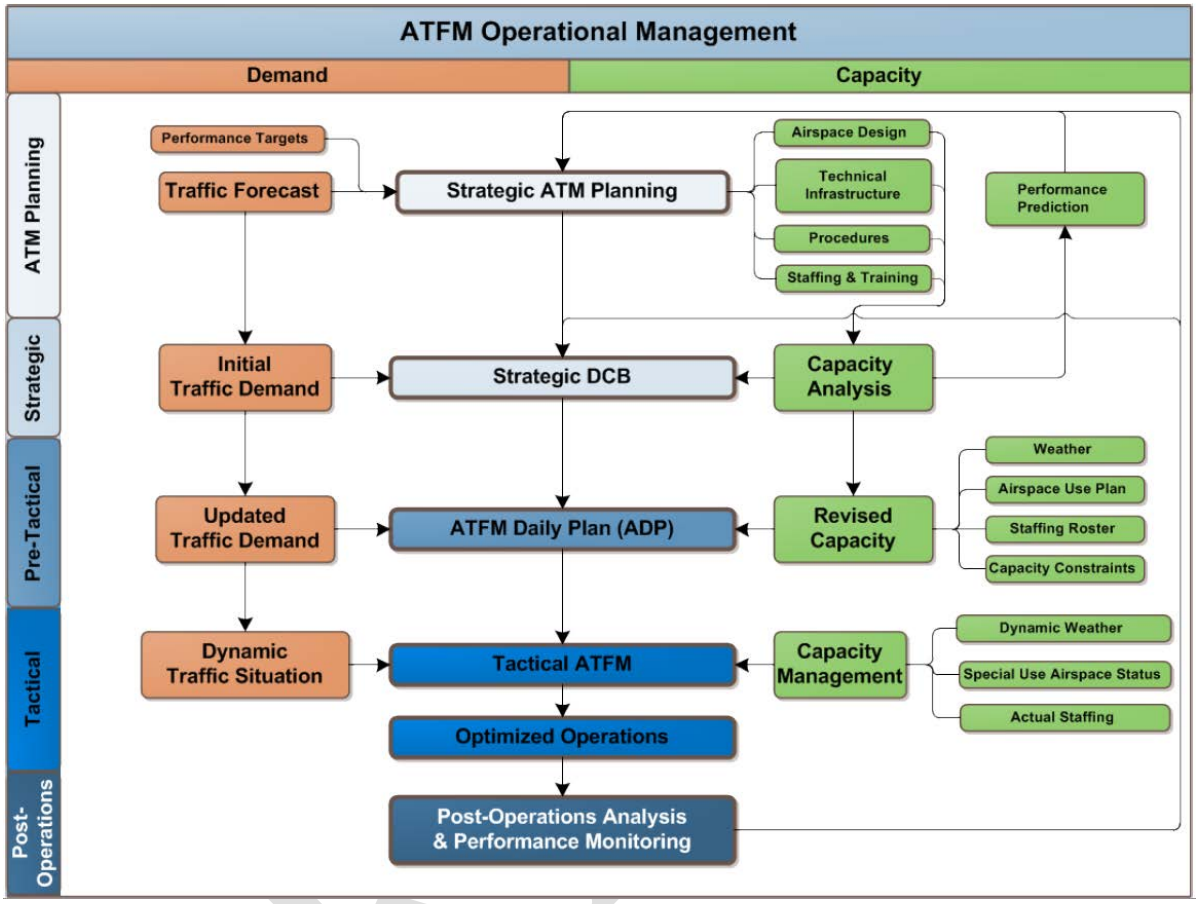

Figure 1: ATFM Operational Management and Phases

5.19 The **Strategic ATFM phase** encompasses measures taken more than one day prior to the day of operation. Much of this work is accomplished two months or more in advance. Strategic ATFM includes the planning and execution of long-term demand and capacity balancing including arrival slot allocation at Coordinated Airports.

5.20 The **Pre-Tactical ATFM phase** encompasses measures taken up to one day prior to operations, with the main objective of optimizing capacity through an effective, dynamic organization of resources. Effective Pre-Tactical ATFM is normally dependent on collaborative decision-making (CDM) processes established between all stakeholders, and in the broader network sense requires significant network communications and information processing capability. The necessary inter-State network capability in the Asia/Pacific Region is under development, and its final form may be determined by the outcomes of sub-regional collaborative trial projects.

5.21 **Tactical ATFM** measures are taken on the day of operation, managing traffic flows and capacities in real time. Tactical ATFM practices, procedures and competencies supported where necessary by Arrival Manager (AMAN) and Departure Manager (DMAN) capability should be the first priority for ATFM implementation. These are critical to the real-time operational response to demand/capacity imbalance, and the improvement and maintenance of safety in the management of operational situations where traffic demand exceeds capacity. Experience has demonstrated that inclusion of at least 70% of flights is necessary for ATFM programs to deliver benefits.

5.22 The timely application of measures in all three ATFM phases requires a fundamental understanding of airport and airspace capacity, and the continuous assessment of capacity and the factors that impact upon it.

Airspace and Airport Capacity Improvement

5.23 Increased capacity is the primary and central method for managing increasing demand. Capacity increases may be achieved by improvements in infrastructure, airspace and ATS route design, procedures and stakeholder behaviours.

5.24 Airspace capacity improvements may be achieved by:

- Improved ATS route design including segregation of inbound, outbound and overflight traffic flows and, where supported by a business case, mandating of RNP specifications for ATS routes;
- Civil-military cooperation, including increased use of FUA to replace SUA;
- Improved ATC sectorization to more evenly apportion workload, including the capability for dynamic sector configuration;
- Segregation of SIDs and STARs in terminal areas to reduce ATC and pilot workload;
- ATM automation system enhancements including automated coordination and hand-off of aircraft between systems (AIDC) and sectors, and transition from paper flight progress-strips to automated, integrated electronic displays and flight plan interfaces;
- Implementation or extension of ATS surveillance services, and surveillance based separations specified in ICAO Doc 4444 (PANS-ATM);
- Implementation of RNP-based separations (RNP 4 or better) in non-surveillance airspace;

5.25 Airport capacity improvements may be achieved by:

- Improved airport design including additional runways, taxiways and appropriately positioned rapid-exit taxiways;
- Harmonized AMAN, DMAN and A-CDM systems;
- Analysis and improvement of runway occupancy times through enhancement of procedures and associated pilot practices;
- Implementation of precision approaches to all runways.

5.26 The Seamless ATM Plan includes performance objectives aimed to improve airspace and airport capacity in the Asia/Pacific Region. The Performance Improvement Plan of this Framework includes capacity improvement objectives that are complementary to or expanding upon those of the Seamless Plan.

Capacity Planning, Assessment and Declaration

5.27 Annex 11 to the Convention on Civil Aviation (Air Traffic Services) defines declared capacity as a measure of the ability of the ATC system or any of its subsystems or operating positions to provide service to aircraft during normal activities. It is expressed as the number of aircraft entering a specified portion of airspace in a given period of time, taking due account of weather, ATC unit configuration, staff and equipment available, and any other factors that may affect the workload of the controller responsible for the airspace.

5.28 The primary areas of capacity assessment and declaration for ATFM are Airport Acceptance Rate (AAR), Airport Departure Rate (ADR), and airspace sector capacity. AAR and ADR are usually expressed in terms of landings or departures per hour. Sector capacity may be expressed in terms of occupancy count and/or entry count.

5.29 ICAO Doc 9971 – Manual on Collaborative ATFM provides the following guidance on capacity planning and assessment:

- Chapter 4 – Capacity, Demand and ATFM Phases;
- Appendix C – Determining Airport Acceptance Rate - A simplified methodology for determining the acceptance rate at an airport, based on scientific processes developed by the USA.
- Appendix D – Determining Sector Capacity – An example of a simplified methodology for determining sector capacity at an ACC, based on the scientific process developed by the USA.
- Appendix E – Capacity Planning and Assessment Process – Information developed by EUROCONTROL related to the ATFM capacity and planning assessment process.

5.30 Detailed, high quality assessments of ATC sector capacity may also be conducted using fast-time simulations to analyse relevant data and the effects on capacity of proposed ATS changes or improvements. Data inputs include static infrastructure data, traffic data, ATC logic, procedures and task definition, and aircraft performance data.

5.31 Steps in a sector capacity assessment methodology utilizing fast-time simulations include:

1. Collect the necessary airspace and traffic data;
2. Verify (with the support of local controllers) the traffic sample routes and the procedures used on a flow-by-flow basis;
3. Correct, refine and insert the information into the model (done by the simulation experts). This includes the ATC procedures used in the sector, standard controller tasks, simulation parameters and aircraft performance parameters;
4. Run an initial test-run of the model;
5. Verify flight profiles. The knowledge of local controllers is used to adapt aircraft performance to local conditions, to define and verify sector specific controller tasks together with simulation parameters including conflict detection and resolution mechanisms;
6. Consolidate a final model which is used to calculate results for all simulation scenarios, e.g. different sector configurations, different traffic samples, etc.;
7. Verify the simulation scenarios and the initial results, and if so required, do a fine-tuning of parameters.

5.32 A fast-time simulation capacity assessment methodology should use a simulation engine that reproduces the ATC environment, and should follow a reiterative process of validation involving licensed ATC staff currently active on the sector/s under assessment.

ATFM Daily Plan

5.33 ICAO Doc 9971 – Manual on Collaborative ATFM states that the organization and structure of the CDM process depends on the complexity of the ATFM system in place, and must be structured to ensure that the affected stakeholders, service providers and airspace users can discuss airspace, capacity and demand issues through regular meeting sessions and formulate plans that take all pertinent aspects and points of view into account.

5.34 Frequent tactical briefings and conferences can be used to provide an overview of the current ATM situation, discuss any issues and provide an outlook on operations for the coming period. They should occur at least daily but may also be scheduled more frequently depending on the traffic and capacity situation (e.g. an evolving meteorological event may require that the briefing frequency be increased). Participants should include involved ATFM and ATS units, chief or senior dispatchers, affected military authorities and airport authorities, as applicable.

5.35 The output of these daily conferences should be the publication of an ATFM daily plan (ADP) and should include subsequent updates. The ADP should be a proposed set of tactical ATFM measures (e.g. activation of routing scenarios, miles-in-trail (MIT)) prepared by the ATFM unit and agreed upon by all partners concerned during the planning phase. The ADP should evolve throughout the day and be periodically updated and published.

5.36 Feedback and review of the ADP received from ANSPs, AUs, and from the ATFM unit itself represent very important input for further improvement of the pre-tactical planning. This feedback helps the ATFM unit identify the reason(s) for ATFM measures and determine corrective actions to avoid reoccurrence. Systematic feedback from AUs should be gathered via specifically established links.

5.37 In addition to the daily conferences, the ATFM unit should consider holding periodic and event-specific CDM conferences, with an agenda based on experience. The objective should be to ensure that the chosen ATFM measures are decided through a CDM process and agreed to by all affected stakeholders.

5.38 An ADP should include the following items of information:

- Aerodrome or Airspace Sector identification;
- AAR;
- Description of constraints;
- Time frame
- Proposed ATFM measures; and
- Remarks/other relevant information.

5.39 A template for the ATFM daily plan is provided at **Appendix C**.

5.40 An important component of the CDM process is post-operations analysis, including consideration of feedback from airspace users, airports operators, ATS and other ATFM units. Daily post-operations analysis conferences should be held, supplemented where necessary by conferences called to assess the outcomes of programs of ATFM measures responding to non-normal situations.

ATFM Terminology

5.41 Recognizing the lack of a current, globally standardized ATFM terminology, ATFM/SG considered the terminologies used by States and organizations advanced in ATFM implementation, both within and external to the Asia/Pacific Region.

5.42 The Global development of ATFM has largely been undertaken in isolation by individual ANSPs, EUROCONTROL, ICAO Sub-Regions or other informal groups of States, or by ATFM system vendors. This has resulted in differences in concept development and in the technical terms used for operational and technical coordination of ATFM information.

5.43 ATFM/SG developed a standardized ATFM terminology for the Asia/Pacific Region to promote harmonization and interoperability of CDM/ATFM systems and procedures.

5.44 The terms and definitions were drawn from those used by Australia, Canada, EUROCONTROL, Japan, South Africa and USA, and those in the *Flight Information Exchange Model* (FIXM) data dictionary.

5.45 The Asia/Pacific Region ATFM terminology for use in ATFM communications is provided at **Appendix D**.

ATFM System Communications

5.46 Regional and Global interoperability of communications is critical to the implementation of effective, network-based cross-border ATFM.

5.47 The Flight Information Exchange Model (FIXM) is part of a suite of data exchange formats, including Aeronautical Information Exchange Model (AIXM) and Meteorological Information Exchange Model (WXXM), intended to provide a global standard for information exchange. FIXM is a data interchange format for sharing information about flights throughout their lifecycle.

5.48 **Figure 2** illustrates the data-level interoperability among domains achieved by FIXM.

Figure 2: FIXM Interoperability among Domains

5.49 FIXM is referenced in Global Air Navigation Plan ASBU modules and roadmap:

- **ASBU B1-FICE –** Increased Interoperability, Efficiency and Capacity through Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1)[4] application before Departure;

  - Introduces FF-ICE, Step 1 providing ground-ground exchanges using a common flight information reference model (FIXM) and extensible markup language (XML) standard formats before departure.

- **ASBU B1-DATM** – Service Improvement through Integration of all digital ATM Information Implements the ATM information reference model, integrating all ATM information, using common

  - Implements the ATM information reference model, integrating all ATM information, using common formats (UML/XML and WXXM) for meteorological information, FIXM for flight and flow information and Internet protocols.

[4] ICAO Doc 9965 – Manual on Flight and Flow – Information for a Collaborative Environment (FF-ICE) describes the FF-ICE concept.

- **Roadmap 2** – in the Blocks 1 and 2 time frame:
  - FIXM will be introduced as the global standard for exchanging flight data.
- **Roadmap 8** – in the Blocks 1 and 2 time frame:
  - FIXM will propose a global standard for exchanging flight information.

5.50 FIXM version 3.0 (or later), extended where necessary to accommodate additional regional requirements, is the agreed ATFM information exchange model for exchanging ATFM data between ATFM systems in the Asia/Pacific Region.

5.51 More information on FIXM is available at www.fixm.aero.

ATFM Information Distribution

5.52 ATFM Daily Plans and ATFM Measures for individual aircraft may be distributed between ATFM units, ATS units and airspace users by the following means:

- Networked, web-based interface at ATFMU, ATSU and airspace user locations, each forming a node of a distributed multi-nodal ATFM platform;
- Web-based interface at ATFMU, ATSU and airspace user locations, providing access directly to ATFM information provided by the ATFMU responsible for the initiation of ATFM measures for the destination airport or constrained airspace; or
- AFTN messages distributed to individual ATSUs (ATFM measures);
- Email distribution (ATFM Daily Plan); or
- Voice Coordination

5.53 Considering the scope and performance objectives of this version of the Framework, and the stage of development of the multi-nodal ATFM network concept, **Table 1** outlines the minimum items of ATFM information that ATFM systems and processes should share.

The multi nodal ATFM network concept is described in paragraphs 5.72 to 5.73.

Estimated	Calculated	Actual	Applicable
EOBT		AOBT	Terminal Gate
	CTOT	ATOT	Departure Runway
ETO	CTO	ATO	RFIX or AFIX
ELDT	CLDT	ALDT	Arrival Runway
Other			
ADP			

Table 1: Minimum ATFM Information for Distribution and Sharing

ATFM Communications by AFS

5.54 Recognizing that States' needs for ATFM may vary, where necessary ATSUs may participate in collaborative ATFM without having the need for dedicated ATFM systems or terminals. The Aeronautical Fixed Service (AFS) may provide a suitable method for distribution of ADP and ATFM measure information to such ATSUs.

5.55 The *EUROCONTROL Specification for ATS Data Exchange Presentation* (ADEXP) provides a format for use in on-line, computer to computer message exchange and for message exchange over switched messaging networks. It is used in current generation ATM automation and supporting systems, and was used in the development of FIXM.

5.56 The ADEXP model provides machine-readable information that is also human-readable, rendering it useable for the distribution of ATFM information on computer-based displays and in text form via AFS.

5.57 ADEXP version 3.1 is the agreed format for ATFM message exchange in the Asia/Pacific Region in cases where an ATFM network interface has not been established, and ATFM information is distributed by AFS. More information is available on the EUROCONTROL website[5].

ATFM Phrase

5.58 ATFM phrases for use in ATFM coordination, and in air-ground communications, are also included in **Appendix D.**

Note: The ATFM phrases are for use as an interim procedure, pending development of globally standardized ATFM-related phraseology.

Meteorological Information for ATFM

5.59 The accuracy of pre-tactical and tactical demand and capacity assessment is reliant on the predictability of events that will impact capacity. In the case of weather-related constraints, the traditional Annex 3 services in support of aerodrome operations and FIR/Global operations do not fully address the needs of ATFM. While globally, MET authorities are working steadily towards the institutional provision of Meteorological Services to support the Terminal Area (MSTA), there is a greater urgency for ATFM providers to collaborate closely with Met service providers to develop products that bridge the gap between the traditional information.

5.60 When predicting the capacity of an airport with regard to forecast meteorological conditions, it is important to not only consider the runway/s and immediate airport surroundings, which are covered by the Aerodrome Forecast (TAF) to a distance of 8km, but to also take into consideration the ability for air traffic to flow via the terminal area on the normal arrival routes and instrument approach procedures to that airport. In particular, weather affecting the airspace in the vicinity of the primary holding areas and initial approach fixes can have a significant impact on the delivery of flights into the approach airspace and onto the runway.

[5] https://www.eurocontrol.int/publications/ats-data-exchange-presentation-adexp-specification

5.61 The current Annex 3 provisions do not include provisions for meteorological information that specifically support the determination of weather impact on capacity. OPMET information is typically pilot and/or tactical ATC oriented, with limited ATFM orientation. , and are largely produced in coded text format, which makes rapid interpretation difficult for ATM officers.

5.62 ICAO Annex 3 requires that each Contracting Sate shall determine the meteorological service which it will provide to meet the needs of international air navigation, and that this shall consist of the provision of meteorological information to users that is necessary for the performance of their respective functions. Therefore, to enable rational and quantifiable capacity determination, ANSPs and Meteorological service authorities should collaborate closely to define meteorological services to be provided to support ATM and ATFM decisions, based on specific impact to operations. Such targeted MET information should address key thresholds for various weather criteria which have a quantifiable impact on airport and terminal airspace capacity, such as headwind, crosswind, visibility, ceiling, wind shear, and convective weather at the initial approach fix (IAF) or in the vicinity of critical arrival fixes, holding points and sequencing areas. An example of the simple type of matrix that could be produced, with intuitive colour coding for quick recognition by ATM staff, is shown in **Figure 3**. In terms of the wider Terminal area, similar defined criteria, thresholds and colour coding can enable rapid interpretation of impact on operations.

Detailed Terminal Area Forecast for the next 9 hours

Issue time: 220734Z

Time (UTC)	0730	0800	0900	1000	1100	1200	1300	1400	1500	1600
Overall										
Wind TEMPO	290/05 –	290/05 –	290/05 –	290/05 040/10	040/10 –	040/10 –	040/10 –	040/10 –	040/10 –	040/10 –
07 Headwind (kt) TEMPO	4 –	4 –	4 –	4 9	9 –	9 –	9 –	9 –	9 –	9 –
25 Headwind (kt) TEMPO	4 –	4 –	4 –	4 -9	-9 –	-9 –	-9 –	-9 –	-9 –	-9 –
Crosswind (kt) TEMPO	N 3 –	N 3 –	N 3 –	N 3 N 5	N 5 –	N 5 –	N 5 –	N 5 –	N 5 –	N 5 –
Visibility TEMPO	3300 m –	3300 m –	3300 m –	4500 m 7000 m	7000 m –	7000 m –	7000 m –	7000 m –	7000 m –	7000 m –
Ceiling (ft) TEMPO	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –

Notes:

(i) The forecasts are normally updated every half an hour.
(ii) The colours highlighted are based on the thresholds in the following Table. TEMPO group, when given, will also be used when determining the colour levels.

Level	Head wind	Cross wind	Visibility	Ceiling
1	=< 20 kt	< 30 kt	> 1000 m	> 400 ft
2	21 - 40 kt	30 - 35 kt	600 – 1000 m	200 – 400 ft
3	> 40 kt	> 35 kt	< 600 m	< 200 ft
-	<-5 kt	-	-	obscured sky

(iii) The winds are for the central part of the North Runway. "G" refers to gust. "07" and "25" indicate respectively Runway 07 and Runway 25.
(iv) Grey colour will be shown under "Headwind" in cases when the headwind is less than -5 kt (i.e. tailwind greater than 5 kt).
(v) "N" and "S" in crosswind represent northerly crosswind and southerly crosswind respectively.
(vi) "---" in cloud ceiling means no cloud or cloud ceiling above 5000 ft. Obscured sky will be indicated by grey colour.
(vii) Gusts (G) will not be indicated in the headwind or crosswind row in view of their nature. Instead, a symbol "#" will be displayed.
(viii) Winds which are highly variable in wind direction will be displayed as VRB. VRB winds will be indicated in the headwind and crosswind in full strength.

Figure 3: Example Colour-Coded Matrix of Met Information

5.63 An example of IAF and holding stack prediction based on weather intensity and coverage area is shown in **Figure 4**, using similarly defined criteria and thresholds to facilitate rapid interpretation of the impact on operations.

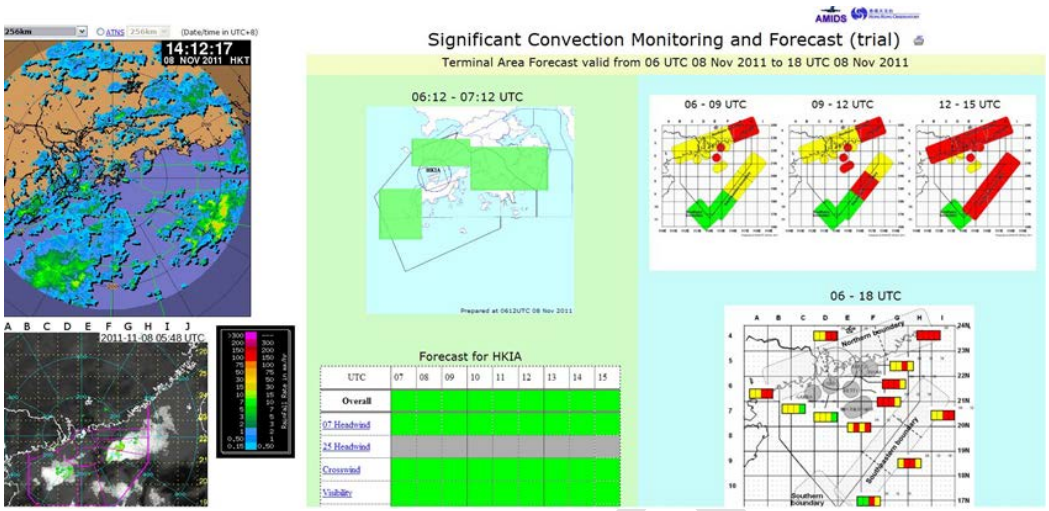

Figure 4: IAF and Holding Stack Weather Prediction.

5.64 When identifying criteria to be used in determining MET services, consideration should be given to thresholds for meteorological elements that result in a change of runway operating mode, such as:

- a change of runway dependency;
- a change of spacing between arriving aircraft;
- a change in nominal aircraft approach speeds;
- an exceedance of aircraft operating limitations for significant numbers of aircraft (eg maximum crosswind component);
- an inability to commence an approach via the IAF; or
- an inability to hold in the primary published holding areas, etc.

5.65 When considering the lead time requirements for such forecast products, it is necessary to strike a balance between the desired probability and accuracy and the target ATFM aircraft population.

5.66 Given the direction towards Regional ATFM through ground delay programs, it is therefore desirable that the forecast period cover at least 6-8 hours ahead to encompass the majority of regional length flights with notification of ATFM measures an acceptable time before estimated off blocks time (EOBT).

5.67 In accordance with Annex 3 requirements, including the requirement that close liaison shall be maintained between those concerned with the supply and those concerned with the use of meteorological information on matters which affect the provision of meteorological services for international air navigation, States should ensure that the MET service provides sufficient detail and accuracy. .

Asia/Pacific Region ATFM Implementation Study

5.68 At the first meeting after its reconvention, ATFM/SG/2 supported a project funded by IATA that studied current and planned ATFM initiatives to establish a regional baseline view of ATFM capability and interoperability, and to develop recommended implementation strategies for collaborative Regional and sub-Regional ATFM.

5.69 Key outcomes of the study were:

- Most States had plans to implement or had implemented domestic ATFM;
- Very few States were planning cross-border ATFM;
- Significant effort would be required to establish a seamless, network based approach to regional ATFM.
- Budgetary and planning commitments must be made in 2015 to meet the 2018 timelines for ASBU and the Asia/Pacific Seamless ATM Plan.
- The ATFM Steering Group and ICAO have a critical leadership role to ensure coordination and development of the key initiatives that will lead to regional ATFM implementation.

5.70 Recommendations arising from the study were:

1. Adoption of the *Regional ATFM Concept of Operations* as the APAC concept of operations/implementation strategy for cross border ATFM;
2. Support for the multi-nodal operational trial program commencing June 2015;
3. Formal State commitment to regional cross border ATFM including budgetary and planning commitment for regional implementation;
4. Regional commitment to 2018 timeline for implementation;
5. State planning, procurement and resource commitment for expanded participation during Phase Two of the multi-nodal operational trial program.

5.71 ATFM/SG subsequently agreed to support Phase 2 of the IATA Regional ATFM Project, to develop a proposal for a regional cross-border ATFM implementation plan.

Asia/Pacific Region ATFM Operational Concept

5.72 The concept of the distributed multi-nodal ATFM network, conceived through the collaborative development of the *Regional ATFM Concept of Operations* (a research project by Singapore, together with industry partners and operational inputs from Malaysia, Hong Kong China, Thailand and other stakeholders), was adopted by ATFM/SG as the foundation for a Regional ATFM concept and implementation strategy, with an implementation target date of 8 November 2018 in alignment with the Seamless ATM Plan.

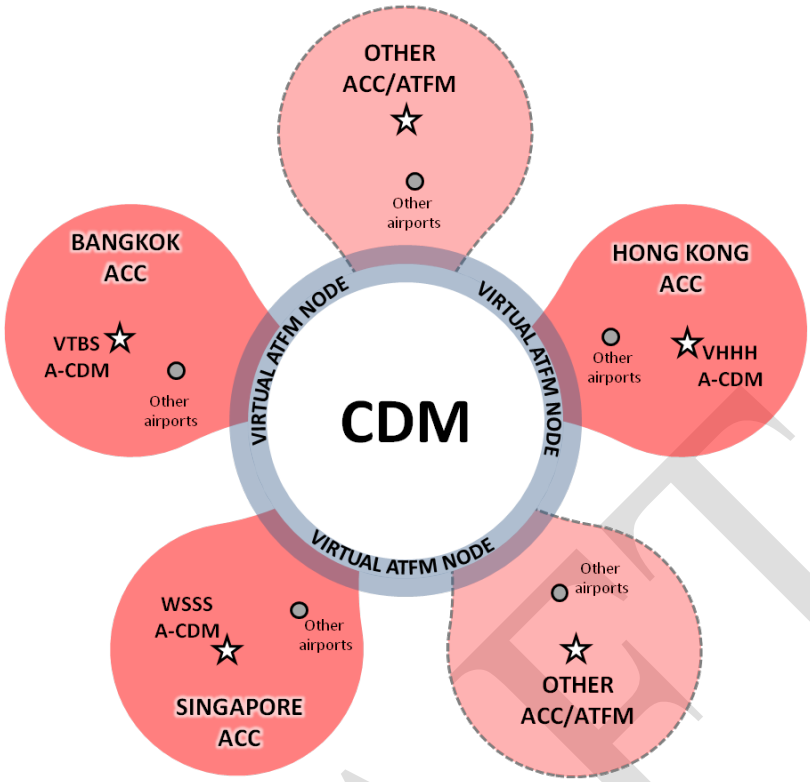

Figure 5: A Distributed Multi-Nodal ATFM Network

5.73 The concept recognizes that a centralized ATFM Unit (ATFMU) approach is not yet practicable for the Asia/Pacific region. At the centre of the concept is the distributed multi-nodal ATFM network, illustrated in **Figure 5**:

5.74 The *Regional ATFM Concept of Operations* document is available at **[TBA]**.

Training and Competencies for ATFM Personnel

5.75 An ATFM service must be staffed by personnel with sufficient knowledge and understanding of the ATM system they are supporting and the potential effects of their work on the safety and efficiency of air navigation. To ensure this and within the framework of their training policy, States and ANSPs should establish training plans to ensure that ATFM service staff are properly trained.

5.76 ICAO Doc 9971, Manual on Air Traffic Flow Management, recognizes the requirement for training all stakeholders in an ATFM service, i.e. those directly operation and ATFM function and all other ATFM stakeholders including airspace users and ATS personnel.

5.77 **Appendix E** provides generic guidance on ATFM training requirements, which States may consider for inclusion in any existing or planned ATFM training programs.

CURRENT SITUATION

The IATA ATFM Study

6.1 This analysis of the current state of ATFM implementation and capability in the Asia/Pacific Region is extracted from the IATA *Asia-Pacific (APAC) Regional Air Traffic Flow Management – Phase 1 Final Report* (21 November 2014). The study was commissioned to establish a baseline view of ATFM capability and interoperability, and to develop recommendations for a cohesive and flexible approach for achieving integrated and coordinated ATFM capabilities within the Asia/Pacific Region.

The Benefits of Networked, Cross-Border ATFM

6.2 An interoperable network approach for the region will result in system-wide Demand Capacity Balancing. This approach enhances the safety and optimizes the efficiency of airports and available airspace.

6.3 As the Asia-Pacific region, the world's largest market for air transport, continues to grow, it becomes essential to optimize the use of available capacity through ATFM. In 2013, the Asia/Southwest Pacific Region was the fastest growing region by passengers in the world (**Table 2**). The region's passenger growth was 8.5%. Individual countries with notable passenger growth include: China (11.8%), Indonesia (20.4%), and Thailand (16.4%).

6.4	**Passenger Volume**	**Annual %**
Indonesia	92,534,902	20.4
Thailand	62,831,288	16.4
China	404,174,939	11.8
Singapore	42,438,276	7.6
Malaysia	51,821,210	7.5
Japan	148,450,196	4.9
India	97,677,318	4.4
Hong Kong	44,399,060	3.9
Korea, Republic of	62,166,163	1.2
Australia	81,983,309	0.6
Asia/Southwest Pacific	1,075,572,893	8.5

Table 2: Top Asia/Pacific Passenger Countries 2013

6.5 Throughout the Asia Pacific region, individual States' ATM and ATFM equipment, services, procedures, airspace design, communications, and resources have a wide disparity in capabilities. These limitations often result in a less efficient operational environment. Prevalent throughout the study region are excessive miles-in-trail restrictions (MITs), fuel burn, carbon dioxide (CO_2) emissions, aircraft departure holding on the ground, airborne holding, and delays.

6.6 Weather and other system constraints increase schedule buffer, delayed flights, cancellations, and missed connections. Flight delays add costs to airlines, passengers, airport operators, and States. Aviation inefficiencies have trickle-down impacts on other sectors due to lost time and productivity. As traffic demand increases, delays will also increase if resource capacity is not increased.

6.7 An interoperable ATFM network of States will have potential benefits to airlines, passengers, airport operators, and States.

6.8 The IATA ATFM Study listed the substantial benefits of implementation of an interoperable cross-border ATFM network. Key benefits were in the domains of safety, and operating efficiency.

Safety Benefits

6.9 Standard ATM practices of separating and sequencing traffic by vectors, speed control, and airborne holding are carried out during un-metered peaks of traffic. These practices are proven safe and effective. However, during these peak periods, the workload on ATC and pilots can increase significantly, thereby reducing the margin for error. Through ATFM, a constant manageable flow of traffic is achieved, resulting in a more manageable workload and hence, a safer operation. A network approach to ATFM reduces sector/system saturation, increases efficiency and enhances safety.

6.10 Often with implementation of ATFM, States enhance their ability for severe weather detection. This earlier detection of weather is shared with airline operators and ANSPs, increasing situational awareness. In addition this is taken into account when determining capacity of resources, resulting in the correct ATFM measure being implemented, which can have a direct impact on safety.

6.11 Communication networks will improve between States with ATFM implementation so as to accommodate CDM. A resultant benefit will be reduced coordination errors, leading to enhanced safety.

Economic Benefits

6.12 Air traffic demand in Asia Pacific is expected to grow significantly in the next five to ten years. While the growth is predicted to increase by approximately 5.5% - 6% annually, such an increase in demand will eventually lead to unsustainable levels of congestion and delay within the region's airport and airspace operating environments, until capacity enhancements are operationally available. **Table 3** shows the expected fuel savings benefit expected from ATFM in 2014 and 2019, based on this projected traffic growth.

	2014	**2019**
Regional ATFM	US$250 – $300M	US$600M – $800M
Domestic & Regional ATFM	US$660 – 810M	US$1.1B - $1.4B

Table 3: Asia Pacific Annual Fuel Savings Benefit Projection

6.13 The benefit opportunity of a network-based Asia Pacific Regional ATFM implementation strategy is particularly significant in the following airport operating environments, where international arrival traffic accounts for 35-100% of the total demand, indicating that domestic ATFM deployments are not practical for demand/capacity balancing at these airports:

- China - Shanghai Pudong International
- Indonesia - Ngurah Rai International
- Hong Kong - Hong Kong International
- Japan - Narita International
- South Korea - Incheon International
- Malaysia - Kuala Lumpur International
- Philippines - Ninoy Aquino International
- Singapore - Changi International
- Taiwan - Taiwan Taoyuan International
- Thailand - Suvarnabhumi Bangkok International
- Vietnam - Tan Son Nhat International and Nội Bài International

6.14 Within the remainder of the major Asia Pacific airport operating environments, international arrival traffic currently accounts for 20-30% of the total demand. Achieving the benefit of fuel savings in these environments would be supported by domestic ATFM deployments and enhanced through the Regional ATFM implementation strategy.

Summary of Asia/Pacific Region Collaborative ATFM Capability

6.15 A comprehensive survey was conducted in mid-2014 of current ATFM initiatives within the Region. **Figure 6** summarizes the results:

		ATFM Structure			ATFM Demand and Capacity Balancing							Interoperability						
		Regulatory & Operational Requirements	Organizational Structure	Infrastructure	Airport Capacity Declaration	Airspace Capacity Declaration	CDM Processes - Situational Awareness	CDM Processes - Procedures and Tool	Demand and Capacity Balancing - Strategic	Demand and Capacity Balancing -PreTactical	Demand and Capacity Balancing -Tactical	ATFM LOAs with Adjoining ANSP	Message Exchange wkh Adjoining FIR	Exchange AAR/ADR with Adjoining FIR	TMI Documented in External LOA	External TMI Communication	ATFM Initiatives Planned Internally	ATFM Initiatives Planned with Adjoining FIR
States	Australia	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1	1	4
	Bangladesh	1	4	4	4	4	4	4	4	4	1	4	1	4	4	4	4	4
	China	1	2	2	1	4	1	1	1	1	1	4	4	4	4	1	1	4
	Hong Kong	1	2	2	1	4	2	2	1	1	1	1	1	1	1	1	1	1
	India	1	3	3	1	1	4	4	1	4	1	4	1	4	4	4	1	4
	Indonesia	4	3	3	1	4	4	4	1	4	1	4	4	4	4	4	1	4
	Japan	1	1	1	1	4	1	1	1	1	1	1	1	4	1	1	1	4
	Malaysia	1	3	3	1	4	3	4	1	4	1	1	1	4	4	1	4	4
	Maldives	4	4	4	1	4	4	4	4	4	1	4	1	4	4	4	1	4
	New Zealand	1	2	2	1	4	1	1	1	4	1	4	1	4	4	4	1	4
	Pakistan	1	3	3	1	1	4	4	1	4	1	4	1	4	4	1	4	4
	Philippines	1	2	2	1	4	2	2	1	1	1	4	4	4	4	1	1	4
	Singapore	1	3	3	1	4	3	4	1	4	1	1	1	1	4	1	1	1
	South Korea	1	3	3	1	1	4	4	1	4	1	1	1	4	4	1	1	4
	Taiwan	1	3	2	1	4	4	4	1	1	1	4	1	4	1	4	4	4
	Thailand	1	2	2	1	1	3	3	1	1	1	4	1	1	4	1	1	1
	Vietnam	4	4	3	1	4	3	4	4	4	1	4	4	4	4	4	1	1
	More Advanced	1		Yes														
		2																
		3																
	Less Advanced	4		No														

Figure 6: 2014 Asia/Pacific ATFM Survey – Summary of Results

6.16 It was observed that:

1. All respondent States recognized the requirement for ATFM;

2. Few States had well-established ATFM organizational structures;

3. There was a diverse range of ATFM capability infrastructure; only three States had mature ATFM systems, while others had little or no infrastructure;

4. CDM between States was minimal. While there was a common desire for better CDM, there was no standard for the region;

5. Airport capacities were declared for most major airports in the region, but only five States are declaring capacities for airspace.

6. Very few States were performing Demand Capacity Balancing (DCB) in the strategic phase of ATFM beyond allocating Airport Slots via the IATA World Scheduling Guidelines (WSG).

7. Only a limited number of States with mature ATFM systems were able to carry out DCB in the pre-tactical phase.

8. States without mature ATFM systems that were encountering DCB issues did not have any facility to monitor demand against capacity.

9. All of the States were performing DCB in the tactical phase, but only five States had the ability to issue ATFM Measures using allocated slot times to smooth traffic into airports.

10. There was no substantive interoperability between the States. There was very little formal ATFM procedure agreement between States.

11. The most prominent Regional development for cross-border ATFM implementation was the Singapore-initiated Regional ATFM Concept of Operations. Four States participated in the development of the concept with relevant stakeholder participation. The resultant operational trial of the distributed multi-nodal regional ATFM concept was being planned, with Australia, China, Hong Kong China, Indonesia, Malaysia, Thailand and Viet Nam participating.

Survey Scope

6.17 The survey was distributed to 22 States, of which 17 responded (**Table 4**).

6.18 Most of the responses were comprehensively completed. The States that have more mature ATFM capabilities were able to respond in a higher level of detail. Generally, the responses directly answered the survey with the possibility of limited misunderstanding. Any misunderstanding does not appear to have impacted the results of the study.

	State	Survey Sent	Response Received
1	Australia	Yes	Yes
2	Bangladesh	Yes	Yes
3	China	Yes	Yes
4	Hong Kong, China	Yes	Yes
5	India	Yes	Yes
6	Indonesia	Yes	Yes
7	Japan	Yes	Yes
8	Republic of Korea	Yes	Yes
9	Malaysia	Yes	Yes
10	Maldives	Yes	Yes
11	New Zealand	Yes	Yes
12	Philippines	Yes	Yes
13	Singapore	Yes	Yes
14	Taiwan	Yes	Yes
15	Thailand	Yes	Yes
16	Vietnam	Yes	Yes
17	Pakistan	Yes	Yes
18	Lao PDR	Yes	No
19	Nepal	Yes	No
20	Cambodia	Yes	No
21	Sri Lanka	Yes	No
22	Unites States Of America	Yes	No(Not relevant)
23	Papua New Guinea	No	No
24	Myanmar	No	No
25	Fiji FIR	No	No
	Organizations		
1	IATA	Yes	Yes
2	EU (AATIP)	Yes	Yes
3	ICAO	Yes	Yes
5	CANSO	Yes	Yes

Table 4: State Responses to Survey

6.19 All States were requested to supply supporting documentation; Australia, Singapore, Philippines, and India did so.

Regulatory Requirements

6.20 Thirteen States had regulatory requirements for ATFM in their FIR. Vietnam, Indonesia, and Malaysia, while having no regulatory requirement, had plans to implement ATFM.

Annex 11 to the Convention on Civil Aviation States: Air traffic flow management (ATFM) shall be implemented for airspace where air traffic demand at times exceeds, or is expected to exceed, the declared capacity of the air traffic control services concerned.

ATFM Infrastructure

6.21 ATFM infrastructure was assessed against each ANSP's human resources commitment and personnel, dedicated positions and equipment available to perform ATFM, and the existence of internal and external stakeholder ATFM Letters of Agreement (LOAs). **Figure 7** illustrates the assessed ATFM infrastructure of the 17 respondents. Two States had mature ATFM structures and six States had developing ATFM structures. Six States had an Air Traffic Flow Management Unit (ATFMU). Seven States had some ATFM functionality, which was carried out from existing supervisory and/or Air Traffic Control (ATC) positions. Two States had no infrastructure. All respondents had plans to implement ATFM.

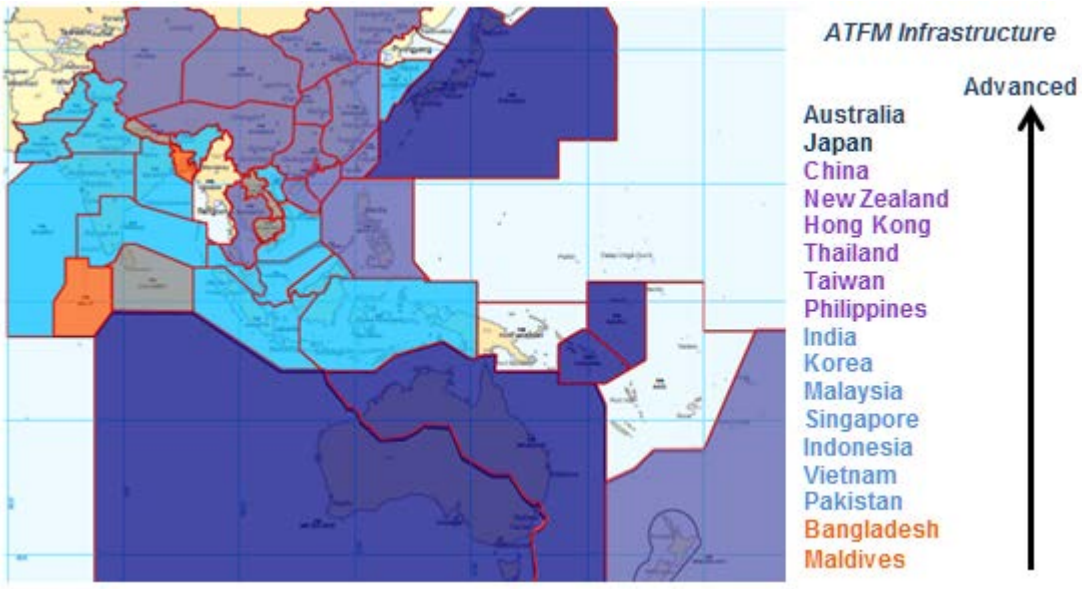

Figure 7: ATFM Infrastructure

CDM Infrastructure and Processes

6.22 Several States with mature ATFM infrastructure had implemented domestic CDM, but CDM between States was minimal. Some ad-hoc CDM was taking place across FIR boundaries when resources were constrained. Cross FIR CDM between Hong Kong, Thailand, Malaysia, and Singapore was under development on a trial basis, establishing initial cross-border procedures and communication. **Figure 8** illustrates CDM capability.

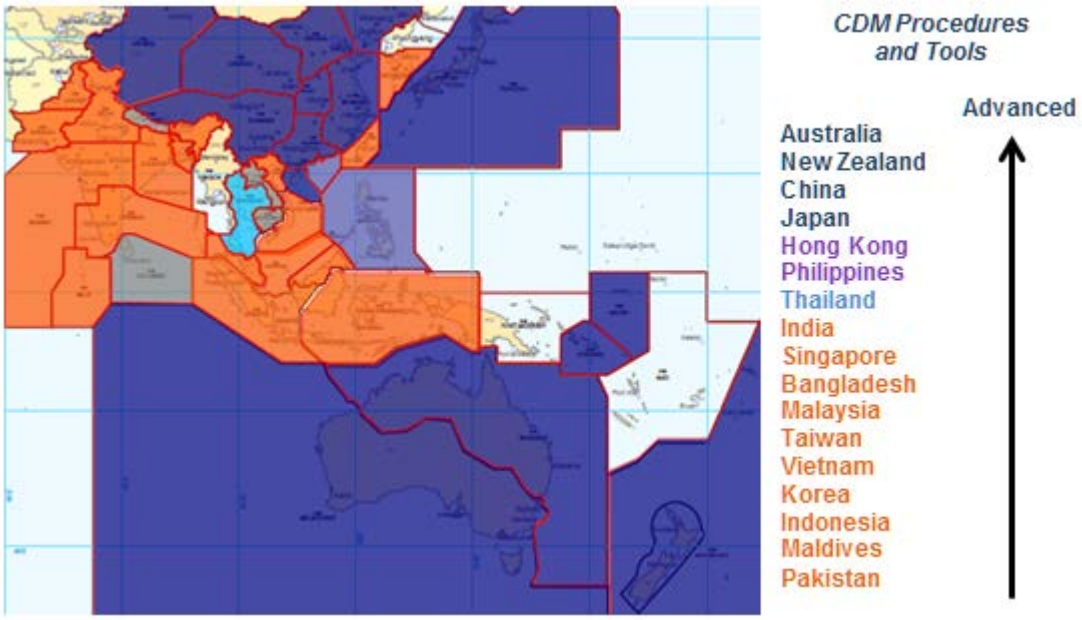

Figure 8: CDM Processes – CDM Procedures and Tools

ATFM Training

6.23 Some training was taking place in States; mostly in-house, but with some States having sent staff to EUROCONTROL and the USA for training. There was an initiative between the EU AATIP and Thailand to develop criteria for ATFM personnel and an ATFM training syllabus.

6.24 The experience of the survey consultant was that that many States in the region needed assistance in general ATFM education and training in all levels of their organizations, and that airline operators in the region had limited knowledge and training in ATFM and CDM.

Airspace and Airport Capacity Declaration

6.25 Defining airport and airspace capacity is fundamental to a domestic ATFM system, and to an interoperable cross-border network. Accurate airport and airspace capacity declarations provide targets for the development of collaborative planning.

6.26 Capacity had been declared for most of the large airports in the region, as they were *slot controlled* airports. Five States had declared capacities for airspace. Airspace capacity (terminal and en-route airspace) declaration needed to be promoted. Many States did not have the ability or knowledge of how to determine airspace capacities.

Strategic Demand and Capacity Balancing (DCB)

6.27 Thirteen States were allocating airport slots to balance demand against capacity in the strategic time frame. Three States included military operations in strategic planning. Apart from these, little strategic ATFM was being undertaken domestically and no formal cross-border strategic ATFM was in place.

Pre-tactical DCB

6.28 Seven States are performing some pre-tactical ATFM. Lack of decision support tools was hampering States from carrying out pre-tactical ATFM. States needed to understand the importance of Pre-tactical ATFM and establish procedures and decision support capabilities to enable it to take place. Very little cross-FIR pre-tactical ATFM was taking place.

6.29 **Figure 9** shows the respondent States performing pre-tactical ATFM.

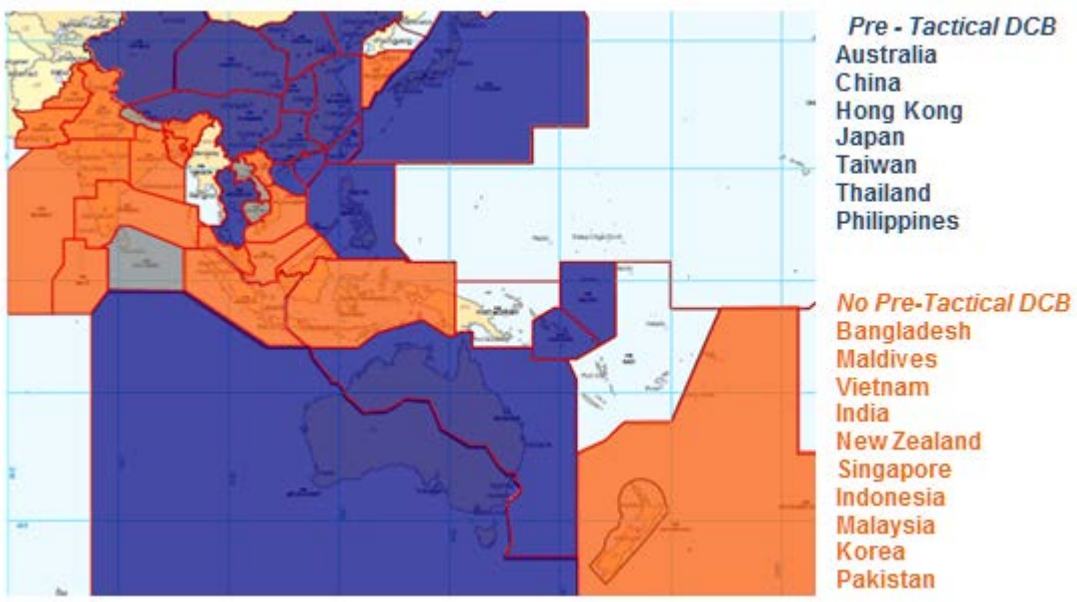

Figure 9: Pre-Tactical Demand and Capacity Balancing

Tactical DCB

6.30 All respondents were performing ATFM in the tactical phase in at least a rudimentary form. However, five States were using ATC slot allocation to balance demand capacity at airports. No ANSP was using ATC slot allocation to perform DCB in terminal or en-route airspace, even though sectors of airspace were capacity constrained.

6.31 Five States had dedicated resources implementing ATFM Measures, and nine States had plans to dedicate resources to implement ATFM Measures in the future.

Interoperability

6.32 A major focus of the study was to establish the interoperability between States with regard to ATFM. The analysis revealed that, while there were initiatives in the early stages of development, there was no substantial interoperability currently taking place. However, interoperability was a key consideration of the multi-nodal ATFM concept trial.

Air Traffic Service (ATS) Message Exchange with Adjoining FIR

6.33 Detailed databases of fundamental ATS routes, route systems, navigation aids (NavAids), airports, airspace status, sectors, and arrival and departure procedures were necessary to support ATFM interoperability.

6.34 The majority of States had automated ATS message exchange capability. The survey consultant's experience suggested that those States that responded in the negative may have misunderstood the question. Current Regional ATFM initiatives required a minimum ATS message exchange capability.

Sharing Airport Acceptance Rate (AAR)/Airport Departure Rate (ADR) and Airspace Capacity

6.35 The stakeholder decision making process associated with DCB for an airport is dependent upon accurate AAR/ADRs. Advanced coordination with stakeholders and implementation of appropriate ATFM Measures based upon AAR/ADR as demand exceeds capacity results in efficient ATFM processes.

6.36 Only three Administrations (Thailand, Singapore, and Hong Kong, China) were AAR/ADR. While the majority of States did not share the AAR/ADR, there are times when an ANSP would ask an adjoining ANSP to reduce the flow of traffic as a result of the AAR being exceeded. No State was sharing airspace capacities with adjoining FIRs, and few States are declaring airspace capacity.

6.37 Operational information exchange of ATFM Measures is fundamental to ATFM. LOAs provide the ability to improve preplanning, reduce tactical coordination, and standardize actions and initiatives.

6.38 A low count of States having ATFM in LOAs with adjoining States was expected as a result of the lack of existing operational initiatives between States (**Figure 10**). The States where LOAs existed had advanced ATFM systems or had a requirement to meter traffic crossing FIRs as a result of demand exceeding capacity at resources. As more cross-FIR ATFM initiatives are implemented, LOAs will need to be developed or further developed.

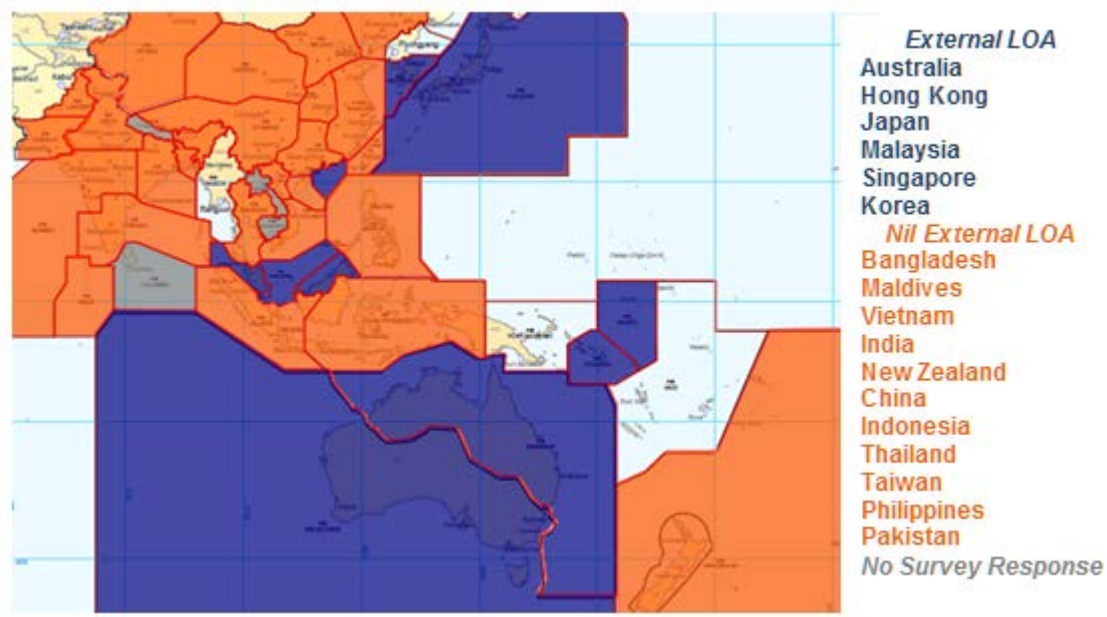

Figure 10: ATFM Measures Communicated in External LOA

External ATFM Measure Communication

6.39 An interoperable network approach necessitates external ATFM Measure communication. While there were only three States with LOAs in place, there was ATFM Measure communication taking place between nine States, including two that had automated communications (China and Republic of Korea). This communication was predominantly in the tactical time frame of ATFM on an as-needed basis, and was expected to increase as initiatives were implemented. Since these communications were not supported by formalized agreements (LOAs), there was little standardization of procedures.

ATFM Initiatives Planned with Adjoining FIRs

6.40 An interoperable network will be driven by stakeholder engagement and operational needs between States. Constraint management can be best achieved through the CDM process. Formal ATFM initiatives between States are often needed because of the widespread effects on the flow of air traffic.

6.41 While States were currently implementing ATFM Measures, which occasionally required adjoining FIR participation, there was only one initiative planned to include multiple FIRs in ATFM Measures, with seven States and four international organizations participating. **Figure 11** illustrates the States with external ATFM initiatives planned.

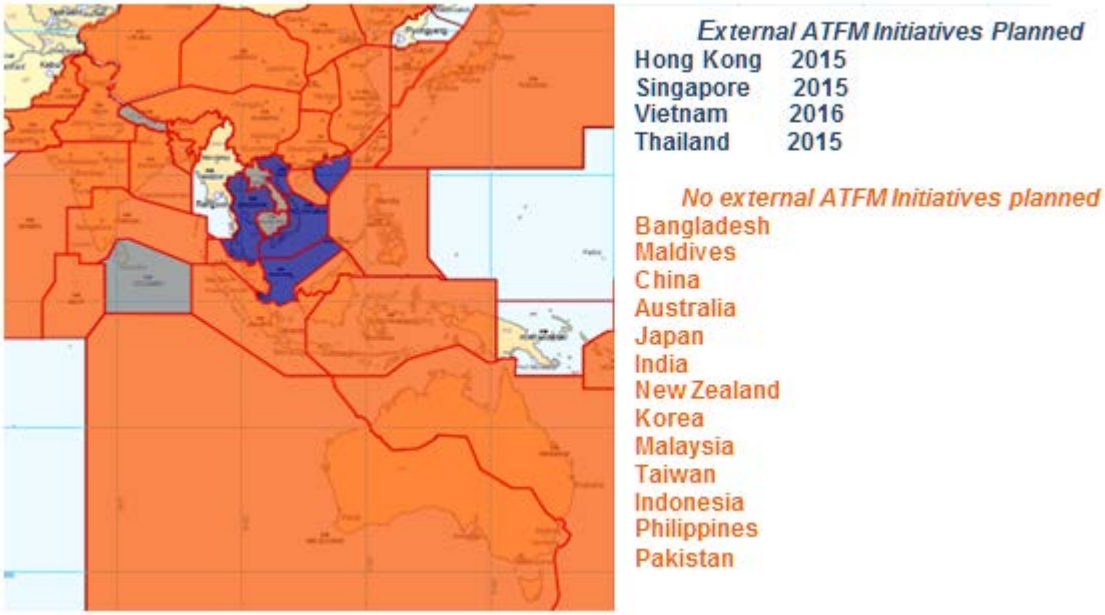

Figure 11: External ATFM Initiatives Planned

ATFM Systems

6.42 All of the advanced ATFM systems implemented in the APAC region were commissioned prior to the publication of ICAO Doc 9971. The systems installed in Japan and Philippines were developed by Japan. New Zealand and China had also developed their own systems. The Australian system was similar to systems in the USA, Canada, and South Africa.

6.43 Many of the States had direct involvement in the compilation of Doc 9971 and all States are now familiar with Doc 9971. It was therefore assumed that future implementations would be in line with recommendations from that document. The *Regional ATFM Concept of Operations* includes participation from individuals with experience in the FAA, EUROCONTROL, South African and Australian ATFM systems.

ANSP Initiatives

6.44 Most of the States, as a result of operational, ASBU and Seamless ATM Plan requirements, had initiatives to implement ATFM in the future. All the States were at various stages of planning, procurement, or implementation. **Figure 12** provides a timeline indicating current and planned ATFM initiatives.

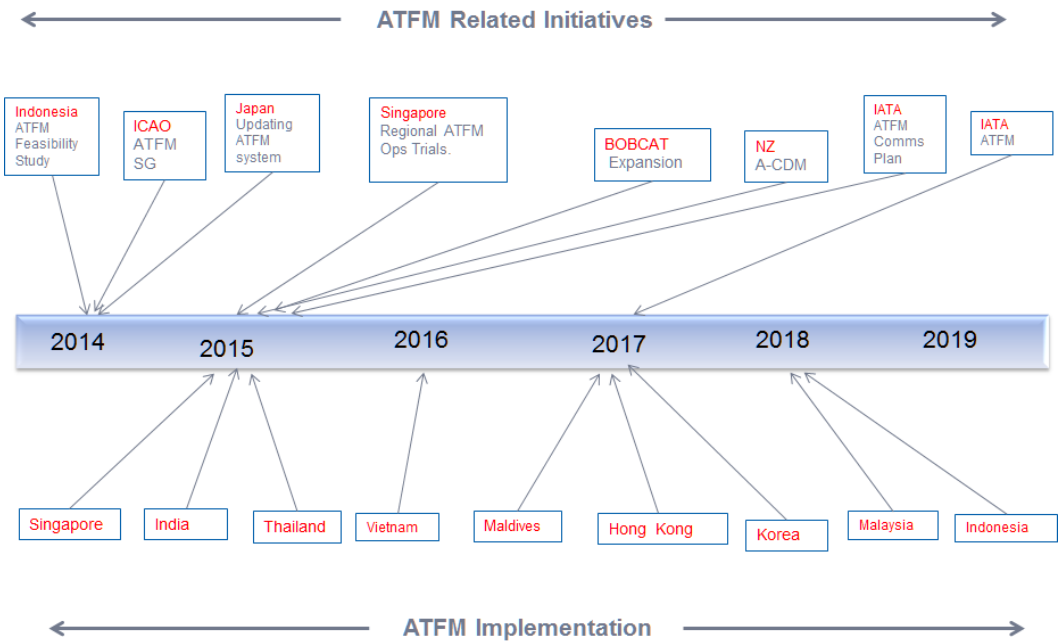

Figure 12: ATFM Implementation Timeline

Opportunities for Integration

6.45 The distributed multi-nodal ATFM concept has been widely accepted as a potential solution for the region, and eight States had joined the plan for an operational trial of the concept starting in June 2015. The trial may be expanded to additional States as feedback is received on the viability of the concept.

6.46 Australia and New Zealand, both having mature ATFM systems, were a possibility for integration. It was understood that discussions had taken place to incorporate traffic from New Zealand into ATFM Measures in Australia. The ATFM system in Australia had the ability to include international traffic into ATFM Measures.

PERFORMANCE IMPROVEMENT PLAN

Note: prior to implementation, ATFM systems and procedures should be verified by safety assessment under State Safety Management Systems.

Structure of the Performance Improvement Plan

7.1 Regional collaborative ATFM performance objectives are arranged in *Regional ATFM Capability* phases aligned, where practicable, with Phases I and II of the Seamless ATM Plan's Preferred Aerodrome/Airspace and Route Specifications (PARS) and Preferred ATM Service Levels (PASL):

- PARS/PASL Phase I – expected implementation by 12 November 2015; and
- PARS/PASL Phase II – expected implementation by 08 November 2018.

7.2 Recognizing the short lead time between the finalization of the Framework and PARS/PASL Phase I, Regional ATFM Capability Phase I is divided into sub-phases A and B, with expected implementation 12 November 2015 and 25 May 2017 respectively.

7.3 Performance objectives are presented under the following general structure for each Regional ATFM Capability Phase, where relevant:

- ATFM Regulations
- ATFM Systems
- (Strategic ATFM, Pre-Tactical ATFM or Tactical ATFM)
  - Capacity and Demand Monitoring and Analysis
  - Capacity Improvement
  - ATFM Execution
  - ATFM Measures
  - Post-Operations Analysis

ATFM Program Airports

7.4 *ATFM Program Airports*, referenced in the performance objectives, are:

- The busiest Asia/Pacific Region aerodromes as defined in the Asia/Pacific Region Seamless ATM Plan;
- Airports where strategic slot allocation is implemented under these performance objectives; and
- All other airports designated by the relevant authority as requiring or potentially requiring ATFM implementation.

Note: prior to implementation, ATFM systems and procedures should be verified by safety assessment under State Safety Management Systems.

REGIONAL ATFM CAPABILITY PHASE IA

Expected implementation by 12 November 2015

ATFM Regulations

7.5 All States where air traffic demand at times exceeds, or is expected to exceed declared capacity, should enact regulations for the implementation of ATFM.

Annex 11 to the Convention on Civil Aviation section 3.7.5 refers.

Strategic Capacity and Demand Monitoring and Analysis

7.6 A regular program of bi-annual strategic airport and airspace capacity and demand analysis should be implemented for all international airports and associated terminal area airspace, and for all en-route ATC sectors supporting the busiest Asia/Pacific city pairs[6] (**Figure 13**), including consideration of:

- CNS systems;
- ATC resources and capability;
- ATC separation standards and techniques;
- runway occupancy times;
- seasonal schedules; and
- historical traffic data and traffic growth forecasts

[6] The Asia/Pacific Seamless ATM Plan lists the busiest Asia/Pacific aerodromes:

- Australia (Sydney, Melbourne);
- China (Beijing, Shanghai Pudong and Hong Jiao, Guangzhou, Hong Kong, Xi'an, Shenzhen, Chengdu, Kunming);
- India (New Delhi, Mumbai);
- Indonesia (Jakarta);
- Japan (Haneda, Narita);
- Malaysia (Kuala Lumpur);
- Philippines (Manila);
- Republic of Korea (Incheon);
- Singapore (Changi); and
- Thailand (Suvarnabhumi).

7.7 Where strategic analysis indicates that demand does not yet exceed capacity, preparation for the implementation of ATFM capability should be based on careful analysis of current traffic and expected growth in the next 5 years;

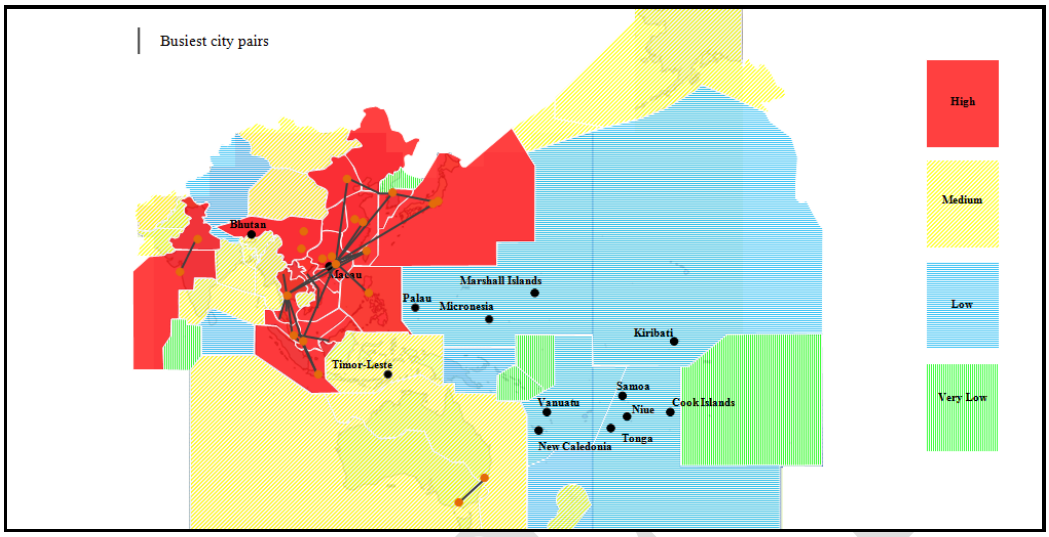

Figure 13: Asia/Pacific High Density FIRs, showing Busiest City Pairs
(Source: Asia/Pacific Seamless ATM Plan)

Pre-Tactical Capacity and Demand Monitoring and Analysis

7.8 Daily pre-tactical airport and airspace capacity and demand analysis should be conducted for all ATFM Program Airports and associated terminal area airspace, and for all en-route ATC sectors supporting the busiest Asia/Pacific city pairs, including consideration of:

i. expected runway and airspace configurations;

ii. forecast meteorological phenomena;

iii. ATC resources, facilities and equipment;

iv. other known or expected capacity constraints; and

v. updated flight schedule and flight plan information.

Pre-Tactical ATFM Execution

7.9 ATFM Daily Plan (ADP) for all ATFM Program Airports and associated terminal area airspace, including airport and airspace capacity declarations and related background information, should be prepared and distributed to all relevant stakeholders.

ADP should be distributed to stakeholders by either:

i. Web-based ATFM network; or

ii. Web-pages hosted by each participating ANSP; or

iii. Email distribution.

Relevant stakeholders include:

iv. Neighbouring ATFMUs or, where not provided, ATSUs

v. ATSUs supported by the originating ATFMU;

vi. Relevant airport operators; and

vii. Participating aircraft operators.

7.10 ADP should be coordinated by the responsible ATFMU or ATSU and agreed with all relevant stakeholders, through chairing and/or participation in scheduled and, where necessitated by changes in airport or airspace capacity or other events, ad-hoc ATFM conferences for pre-tactical ATFM planning.

Post-Operations Analysis

7.11 The accuracy and effectiveness of capacity and demand analyses and ADP preparation and distribution, including supporting information listed in paragraph 7.7, should be verified through comparison with operational outcomes observed, and rectification of discrepancies included in planning for system and process improvements.

REGIONAL ATFM CAPABILITY PHASE IB

Expected implementation by 25 May 2017

ATFM Systems

7.12 Operational FPL and ATS message distribution systems and processes should be analysed and, where necessary, modified to ensure that FPL, CHG, DEP, DLA and CNL messages are originated, distributed and processed in accordance with the requirements specified in ICAO Doc. 4444 PANS-ATM.

7.13 Requirements should be published in all relevant State AIP, specifying that FPL for flights operating to ATFM Program airports should be submitted not less than 3 hours prior to EOBT.

The requirement for FPL submission not less than 3 hours prior to EOBT is currently stipulated in other Regions for ATFM purposes. However, it should be noted that some airspace user flight planning systems are limited to maximum prior submission less than 3 hours.

7.14 A DLA message should be transmitted when the departure of an aircraft, for which basic flight plan data FPL has been sent, is delayed by more than 15 minutes after the estimated off-block time contained in the basic flight plan data.

7.15 Where the delay is the result of a GDP, the DLA message should be sent by the ATFMU responsible for the destination airport, addressed to the ATS unit serving the departure aerodrome for subsequent transmission in accordance with the provisions of ICAO Doc 4444 *PANS-ATM.*

7.16 Appropriate procedures should be implemented to ensure that FPL are not discarded from other ATM systems as a consequence of ATFM delay.

7.17 ATFM, AMAN/DMAN and A-CDM systems should be integrated through the use of common fixes, terminology and communications protocols to ensure complementary operations.

FIXM version 3.0 or later, extended where necessary is the agreed format for exchange of ATFM information in the Asia/Pacific Region.

Where full ATFM network communications capability is not yet established, ATFM messages conforming to ADEXP version 3.1 may be used for distribution of ATFM measures.

Capacity Improvement

7.18 Airport and terminal airspace capacity should be increased through optimized ATC separation standards and techniques and reduced runway occupancy at all ATFM Program Airports and in associated terminal area airspace.

7.19 Where necessitated by demand, and using a performance-based approach, terminal area ATS route structure improvements including CCO/CDO should be implemented to reduce ATC and pilot workload and enable better use of aircraft capability to meet ATFM measures.

Strategic ATFM Execution

7.20 Implement strategic airport slot allocation at all international airports, for periods where demand significantly exceeds the airport's capacity.

Pre-Tactical Capacity and Demand Monitoring and Analysis

7.21 Pre-tactical modelling of expected airport and airspace configuration and traffic demand, and the effect of ATFM measures, should be implemented for all ATFM Program Airports and associated terminal area airspace.

Pre-Tactical ATFM Execution

7.22 CDM capability should be implemented, enabling the sharing of all relevant information with all stakeholders, providing continuous availability of information and common reference material for daily and ad-hoc ATFM conferences.

Tactical Capacity and Demand Monitoring and Analysis

7.23 Dynamic update of airport and airspace capacity constraints, capacity calculation, demand information using schedule, flight plan and ATS messaging, and ATM system information and modelling of tactical ATFM programs should be implemented.

7.24 Tactical ATFM at ATFM Program Airports should be implemented using:

i. Ground Delay Programs (CTOT) for aircraft inbound from:

   a. domestic airports;

   b. international airports sufficient to ensure participation of more than 70% of total inbound traffic;

ii. Minutes in trail (MINIT) or miles in trail (MIT) for aircraft inbound from airports where CTOT may not be applied.

7.24 CTOT for individual aircraft should, where necessary, be revised, cancelled, suspended or de-suspended.

7.25 Tactical ATFM should be implemented for operations through constrained airspace sectors, only during periods affected by the constraint.

7.26 As far as practicable, individual aircraft should not be subject to more than one tactical ATFM measure per flight.

Post-Operations Analysis

7.26 Procedures and agreements should be developed to ensure post-operational analysis of cross-border ATFM programs, including the canvassing and consideration of feedback from airspace users, airports operators, ATS and other ATFM units. Daily post-operations analysis conferences should be held, supplemented where necessary by ad-hoc conferences called to assess the outcomes of programs of ATFM measures responding to non-normal situations.

7.27 The results of post-operations analyses should be used for planning ATFM, airspace and ATS route improvements.

ICAO Doc 9971 – Manual on Collaborative ATFM Part II-4-8 provides guidance on post-operations analysis

REGIONAL ATFM CAPABILITY PHASE II

Expected implementation by 08 November 2018

ATFM Systems

7.28 Distributed multi-nodal ATFM information distribution capability utilizing FIXM version 3.0 (or later) should be implemented, including:

i. Sharing of ADP and dynamically updated demand and capacity data for all ATFM program airports, and for en-route airspace supporting the busiest city pairs and high density major traffic flows;

ii. Slot allocation information for all flights subject to ATFM programs, including as a minimum CTOT, CTO and CLDT information;

iii. Authorized user functions for slot amendment, cancellation or suspension (ATFMU), and slot-swapping (aircraft operator and ATFMU); and

iv. Automated slot compliance monitoring and reporting, supplemented where necessary by authorized inputs by ATFMU, ATSU or airspace operator.

7.29 Full interoperability of cross border ATFM, A-CDM, AMAN, DMAN, ATM automation and airspace user systems should be implemented, utilizing FIXM 3.0 (or later) , to provide seamless gate-to-gate collaborative ATFM operations.

Pre-Tactical Capacity and Demand Monitoring and Analysis

7.30 Automated modelling of expected airport and airspace configuration and traffic demand, and the effect of ATFM measures, should be implemented for all ATFM Program Airports and associated terminal area airspace and, where possible, en-route airspace supporting the busiest Asia/Pacific Region city pairs and high density major traffic flows.

Tactical Capacity and Demand Monitoring and Analysis

7.31 Meteorological services to support ATM in the terminal area (MSTA) should be implemented, including near-term or *now-casting* forecasts of convective weather activity at or affecting ATFM Program Airports and associated instrument approach procedures, terminal area ATS routes and holding points and other significant locations.

Note: Annex 3 requires that States ensure the quality management of meteorological information.

Tactical ATFM Measures

7.32 ATFM measures including MIT, MINIT and, where necessary, CTO at AFIX or RFIX, should be applied to flights through constrained airspace.

7.33 Ground Delay Programs utilizing CTOT should be applied to:

i. aircraft destined for constrained ATFM Program Airports, that have not yet departed; and

ii. aircraft planned to operate through constrained airspace where tactical ATFM measure CTO at RFIX or AFIX is in place, that have not yet departed.

7.34 ATFM systems should have the capability to take into account long haul flights.

7.35 Systems should be in place to ensure the timely update of estimate information for airborne aircraft.

RESEARCH AND FUTURE DEVELOPMENT POSSIBILITIES

Research and Development

8.1 Version 1.0 of the Regional Framework for Collaborative ATFM provides the initial framework for implementation of a distributed multi-nodal ATFM network, as envisaged in the *Regional ATFM Concept of Operations*. This concept, being untried elsewhere, will continue to develop as experience is gained through trials and subsequent operational implementation. The Framework is therefore iterative in nature, and will require regular update in the medium term.

8.2 Further research and development of the distributed multi-nodal ATFM network concept will largely be conducted by ATFM/SG participating States through their operations trial programs, consistent with Principle 36 of the Asia/Pacific Seamless ATM Plan Principle 36 – *'Clustering' for the research, development and implementation of ATM projects.* The outcomes of trials and lessons learned from operational deployment will be considered by ATFM/SG for the improvement and updating of the Framework.

ATFM Interface Control Document

8.3 The ATFM Information Requirements Small Working Group (ATFM/IR/SWG) will develop an operational requirements document and an ICD for networked, cross-border multi-nodal ATFM information exchange, to be delivered to ATFM/SG for consideration before then being referred to the 4th Meeting of the ATM Sub-Group of APANPIRG (ATM/SG/4) in August 2016.

Collaborative ATFM Concept Developments

8.4 The following concepts should be researched, and developed, for implementation in the Asia/Pacific Region:

8.5 **Delay Absorption Intent** – included in the *Regional ATFM Concept of Operations*, provides aircraft operators with the flexibility to choose how to distribute the delay assigned by an ATFM measure to various phases of flight. Not yet included in the ATFM Performance Improvement Plan, this concept has the potential to improve outcomes by increasing the number of aircraft participating in the program, through the application of ATFM delays to longer distance flights that are currently exempt from ground delay programs. The development of this concept will be undertaken in trials before then being potentially included in the broader Framework.

8.6 **FIXM Extension** – may be required for implementation of any Asia/Pacific region ATFM practices or procedures that are not covered in FIXM version 3.0 or later versions deployed by States.

8.7 **Application of ATFM Measures to Long Range Flights** – will improve equity in ATFM processes, and contribute to better outcomes in those ATC sectors where long range flights are currently exempt from all but minimal en-route delays. This will require further development of ATFM measures the CTO ATFM measure, and the formulation of regionally agreed limits on the total ATFM+AMAN delay that may be applied to long range and ultra-long range flights.

8.8 **Interoperability of ATFM, AMAN/DMAN and A-CDM systems** – will require ANSPs and airport operators to collaboratively develop their local operational letters-of-agreement to incorporate procedures and practices optimizing gate-to-gate flow management of flights.

8.9 **Collaborative Trajectory Options** – provide for flexible routing options that permit aircraft operators to elect to re-route flights via longer trajectories to avoid constrained airspace and take advantage of the reduction or removal of ground delay (or en-route delay, where implemented) that would be imposed if the flight continued through the constrained airspace. A collaborative trajectory options program would significantly improve the safety and efficiency of ATM in cases of large scale weather deviations (LSWD) such as those experienced in the cyclonic weather season in the Bay of Bengal and South China Sea areas, and contingency operations including the avoidance of airspace that is either unsafe (e.g. volcanic ash cloud) or unavailable. A collaborative trajectory options program would first require a full understanding of airspace capacity, which should be supported by a comprehensive study.

8.10 The development of a collaborative trajectory options program in the Asia/Pacific Region, particularly in South East Asia, will require a coordinated multi-partite effort to improve the regional ATS route network and ATS surveillance/communications infrastructure, and to provide sufficient ATS route options for the program. ATS route specification and implementation of surveillance and communications infrastructure are included in the performance objectives of the Seamless ATM Plan.

8.11 **Network Collaborative Decision-Making** – to provide mechanisms within the distributed multi-nodal ATFM network for the formulation of executive flow management decisions in the event of competing stakeholder priorities. This will require research and development of network-suitable automated decision-support tools and associated business rules. Operational experience in the distributed multi-nodal ATFM network environment will be key to identifying the potential challenges, and formulating and testing strategies.

8.12 **Harmonization of Multiple Flow Management Programs –** will ensure that all ATFM measures applied are collaboratively managed to ensure that individual flights are not unduly penalized by multiple measures in one flight, and that ATFM network outcomes are more predictable. Currently aircraft may be subject to independently applied en-route and airport ATFM delays, resulting in potentially unreasonable cumulative delay over the course of a flight. A significant amount of research is being conducted, and needs to be conducted, into the effects and harmonization of multiple flow programs in multiple FIRs.

MILESTONES, TIMELINES, PRIORITIES AND ACTIONS

Milestones and Timelines

9.1 Section 7 (Performance Improvement Plan) provides milestones and timelines for a number of elements generally aligned with the Asia/Pacific Seamless ATM Plan PARS and PASL Phase I and II, being effective 12 November 2015 and 09 November 2018 respectively:

Regional ATFM Capability Phase	Expected Implementation
Phase 1A	12 November 2015
Phase 1B	25 May 2017
Phase 2	08 November 2018

9.2 States that have not yet implemented collaborative ATFM, or having implementations that are not in accordance with the provisions of this Framework, should commence planning from the date of its approval by APANPIRG.

9.3 It should be noted, however, that the ATFM capability outlined in the Framework should be implemented as early as possible. The Framework timelines should under no circumstances be interpreted as limiting or deferring ATFM implementation where there is a current or expected need for it in an earlier timeframe than outlined.

Priorities

9.4 While it is a matter for each State to determine priorities in accordance with its own economic, environmental, safety and administrative drivers, States should be aware of the Asia/Pacific Regional Priorities adopted by APANPIRG, including ASBU **B0-NOPS**, and the Annex 11 requirement for States to implement ATFM where there is a current or expected imbalance of demand and capacity.

Actions

9.5 This Plan is iterative in nature, and will require further development as experience is gained in operational trials of the distributed multi-nodal ATFM network concept. ATFM/SG, under its terms of reference, should continue to oversee and coordinate the development of the concept and subsequent amendment of the Framework, facilitate the coordination and alignment of CDM/ATFM programs being conducted within the Region, and review the effectiveness of existing and planned ATFM programs. An important project being conducted by the ATFM/SG is the development of a Regional Interface Control Document (ICD) for ATFM, which is expected to be completed for consideration by ATFM/SG, then presented to the ATM Sub-Group of APANPIRG in August 2016.

APPENDIX A: COLLABORATIVE ATFM PRINCIPLES

General Principles

1. Increased capacity is the primary and central method for management of increasing demand.

2. FIR boundaries should not limit the delivery of ATFM messages and the coordination and application of ATFM measures.

3. Collaborative Decision-Making (CDM) to achieve optimum ATFM network outcomes while taking into account stakeholder goals.

4. An emphasis on delivery of ATFM services based where practicable on CNS capability, resulting in flexible, dynamic systems delivering optimal ATFM network outcomes while providing equity of access.

5. Regional distributed multi-nodal network model of inter-connected sub-regional ATFM networks or State ATFM systems, based on system-wide CDM, serving the busiest terminal airspace and major sub-Regional traffic flows.

6. Harmonized regional ATFM rules and guidelines based on the ICAO Manual on Collaborative Air Traffic Flow Management (Doc 9971).

People: Aviation Regulations, Standards and Procedures

7. Regionally harmonized methodology for the continuous monitoring and declaration of airport and airspace demand and capacity, the dynamic updating and sharing of capacity information, and for daily post-operations analysis.

8. Prioritization of ATFM implementation for high density airports and the busiest city pairs and FIRs.

9. Demand and Capacity inputs from automated data feeds including ATM automation systems, ATN/AFTN, and from FMPs and FOCs using web-based manual ATFM interfaces.

10. The minimum necessary ATFM Measures applied, for the shortest necessary time period and only to operations at or in capacity constrained airports or airspace.

11. Pre-tactical and tactical coordination of airport and airspace capacity constraints and proposed ATFM programs and measures with all affected Stakeholder organizations, before the independent execution of the program or measure in the ATFM system of the responsible ANSP.

12. Participation by at least 70% of aircraft operating in or to the constrained resource.

13. Aircraft operator options for delay absorption through the flexible distribution of total ATFM measure delay per aircraft to gate hold, surface hold and/or airborne delay.

14. Except in the case of flexible aircraft operator options for absorption of delay, separate ATFM measures should not be cumulatively applied to a flight.

15. Harmonized ATFM, runway sequencing (AMAN/DMAN) and A-CDM processes using common reference points and information exchange.

16. Exemption from ATFM measures of emergency, humanitarian, declared medical evacuation, search and rescue, and Head-of-State flights, and other flights as determined by the State authority.

17. Direct coordination between aircraft operator and airport operator to determine maximum gate delay and surface delay.

18. Direct input of delay absorption intent into the ATFM system by aircraft operators.

19. Pilot-in-command responsibility for adherence to operational procedure for requesting speed, route or level changes where flexible delay option is exercised.

20. Continuous monitoring of compliance with ATFM measures, supported by procedures for the real-time and post-operational management of non-compliance.

21. Bi-lateral or multilateral agreements where necessary to support common business rules for departure, destination and en-route ANSPs and airport operators.

22. Development of manual processes and skills to promote practical knowledge and understanding of ATFM before implementing technology based solutions, and as a contingency response capability.

23. The use of high-fidelity simulators to train controllers and ATFM personnel in ATFM procedures and techniques.

ATM Coordination

24. The prioritization of integrated AIDC systems for timely ATM and ATFM system updates of trajectory data, including preferred implementation of advanced AIDC messaging and configuration of systems for early delivery of AIDC messages.

Facilities: Aerodromes

25. Encouragement for aerodrome operators to actively participate in ATM coordination in respect of A-CDM development and operational planning, including aerodrome complexity and capacity.

ATFM Systems

26. Collaboration by ANSPs for evaluation and planning of harmonized ATFM facilities.

27. Optimization of ATFM facilities through automated, networked, central flow management centres and units or equivalent virtual platforms.

28. Independent FMP/ATFM systems operated by each ANSP, connected to the sub-regional or regional ATFM network.

29. Continuous supervision, operation, adjustment, monitoring and executive control of ATFM systems and their output by dedicated ATFM or designated ATC personnel.

30. ATFM communications via existing internet/telecommunications networks, or via the Asia/Pacific Common Regional Virtual Network when implemented.

31. Preference for relevant ATFM data and notifications from each ANSP, including slot assignments, distributed to stakeholders via web interfaces.

32. Collaborative development of A-CDM, ATFM, AMAN and DMAN capability.

33. Encourage the real-time sharing of dynamic air traffic data relating to flights operating or intending to operate in civil-controlled airspace, between military ATM systems and civil ATM/ATFM systems.

ATM Modernization Projects

34. Inter-regional and sub-regional cooperation (‘clustering’) for the research, development and implementation of ATFM projects.

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APPENDIX B: CDM/ATFM TRIAL TIERED PARTICIPATION LEVELS

Air Navigation Service Providers

Note: Outside ATFM Ops Trial ANSPs may already have been asked to support ATFM Operations through Minimum Departure Intervals between flights or providing longitudinal separation between flights such as Miles-in-Trial or Minutes-in-Trail

Level 1 – Observe Trial

- Participate in CDM/ATFM Meetings
- Participate in Operational Trial Planning process

Level 2 – Facilitate CTOT for Departures (includes Level 1)

- Receive CTOT for departure to other Demand-Capacity imbalance airports
- Facilitate airline operator CTOT compliance for departing flights

Level 3 – Demand-Capacity Balancing Capability (includes Levels 1 and 2)

- Evaluate Traffic Demand
- Evaluate and update Airport Acceptance Rate (AAR)
- Distribute CTOT to airline operators and ANSPs

Aircraft Operators

Level 1 – Participate in the Trial

- Receive CTOT for departure to other Demand-Capacity imbalance airports
- Manage flight operations and coordinate with ATCs and Airport Operators to achieve CTOT compliance for departures
- Participate in the ATFM / CDM Operational Trial Project and Focus Group meetings
- Participate in the Operational Trial planning process

Level 2 – Slot Swapping and CTOT User Inputs (includes Level 1)

- Optimize flight operations through slot swapping and CDM process
- Provide CTOT User to ATFM portal (advanced Operational Trial – later phase)
- Evaluate and update on outcomes of ATFM measures
- Refine CDM process for optimized flight operations

APPENDIX C: ATFM DAILY PLAN SAMPLE TEMPLATE

ATFM Daily Plan	[Name of ATFM Unit]	[UTC DATE] [APPLICABLE TIME]

CAPACITY and CONSTRAINTS			
Location (AD or SECT)	**Applicable Period**	**AAR (landings per hour)**	**CONSTRAINT/REMARK**

ATFM MEASURES			
Location (AD or SECT)	**Applicable Period**	**AAR (landings per hour)**	**CONSTRAINT/REMARK**

POSSIBLE/DEVELOPING ISSUES		
Location (AD or SECT)	**APPLICABLE PERIOD**	**MEASURE REMARKS**

EXAMPLE ATFM DAILY PLAN

ATFM Daily Plan	RJJJ	1504022000 - 1504031959

CAPACITY and CONSTRAINTS			
Location (AD or SECT)	**APPLICABLE PERIOD**	**AAR (landings per hour)**	**CONSTRAINT/REMARK**
RJCC	2100 – 2300	04 – 06	LVP
RJTT	0200 – 0300	10	RWY34L/16R CLSD 0200 – 0245 CONST
RJTT	0300 – 0500	14	FLTCK RWY22 ILS
SECT 1	0130 – UFN	-	Developing CB

ATFM MEASURES		
Location (AD or SECT)	**APPLICABLE PERIOD**	**MEASURE REMARKS**
RJTT	2330 – 0140	CTOT DEST RJCC
SECT 12	2300 – 0005	3 MINIT DEP RJAA/RJTT
SECT 12	0130 – UFN	G585 8 MINIT AT [WAYPOINT] WB FOR ZMUB REGARDLESS OF FL

POSSIBLE/DEVELOPING ISSUES		
Location (AD or SECT)	**APPLICABLE PERIOD**	**MEASURE REMARKS**
RJAA	0300 – 0500	15 MIT, 250KT AT [WAYPOINT] [WAYPOINT]
RJTT	0300 – UFN	CTOT

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APPENDIX D: ATFM TERMINOLOGY AND COMMUNICATIONS

ATFM Terminology - General

Acronym	Term	Definition
AAR	Airport Acceptance Rate	Arrival capacity of an airport normally expressed in movements per hour
ADR	Airport Departure Rate	Departure Capacity of an airport normally expressed in movements per hour
ASD	Aircraft Situation Display	ATC Aircraft/Traffic Situation Display
AFIX	Arrival Fix	A waypoint during the arrival phase of a flight. In the context of ATFM it could a waypoint where an ATFM Measure may be applied
CDM	Collaborative Decision-Making	Process which allows decisions to be taken by amalgamating all pertinent and accurate sources of information, ensuring that the data best reflects the situation as known, and ensuring that all concerned stakeholders are given the opportunity to influence the decision. This in turn enables decisions to best meet the operational requirements of all concerned.
CDR	Conditional Route	ATS route that is available for flight planning and use under specific conditions
DFIX	Departure Fix	The first published fix/waypoint used after departure of a flight.
DMAN	Departure Manager	A planning system to improve the departure flows at an airport by calculating the Target Take-Off Time (TTOT) and Target Startup Approval Time (TSAT) for each flight, taking multiple constraints and preferences into account
FCA	Flow Constrained Area	An sector of airspace where normal flows of traffic are constrained, which could be caused by weather, military exercise etc.
FMP	Flow Management Position	A position in any ATCC that monitors traffic flows and implements or requests ATFM measures to be implemented"
GDP	Ground Delay Program	ATFM process where aircraft are held on the ground in order to manage capacity and demand in a specific volume of airspace or at a specific airport. In the process departure times are assigned and correspond to available entry slots into the constrained airspace or arrival slots into the constrained airport

Acronym	Term	Definition
GS	Ground Stop	A tactical ATFM measure where some selected aircraft remain on the ground
MINIT	Minutes in Trail	A tactical ATFM measure expressed as the number of minutes required between successive aircraft. It is normally used in airspace without air traffic surveillance or when transitioning from surveillance to non-surveillance airspace, or even when the spacing interval is such that it would be difficult for a sector controller to measure it in terms of miles
MIT	Miles in Trail	A tactical ATFM measure expressed as the number of miles required between aircraft (in addition to the minimum longitudinal requirements) to meet a specific criterion which may be separation, airport, fix, altitude, sector or route specific. MIT is used to organize traffic into manageable flows as well as to provide space to accommodate additional traffic (merging or departing) in the existing traffic flows. It will never be less than the separation minima.
RFIX	En-route Fix	A waypoint during the en-route phase of a flight. In the context of ATFM it could a waypoint where an ATFM Measure may be applied
SUB	Slot Swapping	The ability to swap departure slots gives AUs the possibility to change the order of flight departures that should fly in a constrained area
-	ATFM Measure	ATFM Measure which will balance demand against capacity or assist in the safe expeditious flow of traffic

ATFM Terminology – Phase of Flight

Acronym	Term	Definition
SOBT	Scheduled off Block Time	The time that an aircraft is scheduled to depart from the parking position
EOBT	Estimated Off Block Time	The estimated time that an aircraft will start movement associated with departure
TOBT	Target Off - Block Time	The time that an aircraft Operator or Ground handler estimates that an aircraft will be ready to startup/pushback immediately upon reception of clearance from the tower.
TSAT	Target Start Up Approval Time	The time provided by ATC taking into account TOBT, CTOT and/or the traffic situation that an aircraft can expect start up/push back approval
COBT	Calculated Off Block Time	A time calculated and issued by ATFM Unit, as a result of tactical slot allocation, at which a flight is expected to pushes back / vacates parking position so as to meet a CTOT taking into account start and taxi time.
AOBT	Actual Off Block Time	The time the aircraft pushes back / vacates parking position (Equivalent to Airline / Handlers ATD – Actual Time of Departure & ACARS=OUT)
STOT	Scheduled Take Off Time	The estimated take off time derived from an aircraft operators schedule, typically based on a standard taxi-out time
PTOT	Planned Take Off Time	Time aircraft is expected to take off derived from the flight plan.
TTOT	Target Take Off Time	The Target Take off Time taking into account the TOBT/TSAT plus Estimated Taxi-Out Time
CTOT	Calculated Take off Time	A time calculated and issued by ATFM Unit, as a result of tactical slot allocation, at which a flight is expected become airborne
ETOT	Estimated Take Off Time	The Estimated take off time taking into account EOBT plus Estimated Taxi-Out Time
ATOT	Actual Take Off time	The time that an aircraft takes off from the runway (Equivalent to ATC ATD–Actual Time of Departure, ACARS = OFF)
SEET	Scheduled Estimated En-route Time	The estimated elapsed time of a flight derived from the aircraft operators schedule
ETO	Estimated Time Over	Estimated time at which an aircraft would be over a fix, waypoint or particular location typically where air traffic congestion is expected

Acronym	Term	Definition
CTO	Calculated Time Over	Time calculated and issued by ATFM Unit, as a result of tactical slot allocation, at which flight is expected to be over a fix, waypoint or particular location typically where air traffic congestion is expected (referred to in FIXM 2.0 as "Airspace Entry Time - Controlled")
PLDT	Planned Landing Time	The expected landing time of a flight derived from the flight plan
SLDT	Scheduled Landing Time	Scheduled time aircraft is expected to land on a runway, typically based on Scheduled In-Block Time (SIBT) and a standard taxi-in time
TLDT	Target Landing Time	Targeted Time from the Arrival Management process at the Threshold, taking runway sequence and constraints into account; Progressively refined planning time used to coordinate between arrival and departure management processes
CLDT	Calculated Landing Time	A landing time calculated and issued by ATFM unit, as a result of tactical slot allocation at which a flight is expected to land on a runway
ELDT	Estimated Landing Time	The estimated time that an aircraft will touch-down on the runway (equivalent to ETA)
ALDT	Actual Landing Time	Actual time an aircraft lands on a runway (Equivalent to ATC ATA –Actual Time of Arrival = landing, ACARS=ON)
SIBT	Scheduled In Block Time	The Time that an aircraft is scheduled to arrive at its first parking position.
CIBT	Calculated In Block Time	An in block time calculated and issued by ATFM unit, as a result of tactical slot allocation at which a flight is expected to be at its first parking position.
AIBT	Actual in block time	The time that an aircraft arrives in-blocks (Equivalent to Airline/Handler ATA –Actual Time of Arrival, ACARS = IN)

ATFM Terminology Map

Phase of Flight	Scheduled	Flight Plan	Target (Airline)	Target (ANSP)	ATFM Measure	Estimated	Actual
Off-Block Time (OBT)	SOBT	EOBT	TOBT	TSAT	COBT		AOBT
Take-Off Time (TOT)	STOT			TTOT	CTOT	ETOT	ATOT
Time Over (TO)					CTO	ETO	ATO
Landing Time (LDT)	SLDT			TLDT	CLDT	ELDT	ALDT
In-Block Time (IBT)	SIBT				CIBT		AIBT

ATFM Phraseology

Note: The following phrases are suggested for use as an interim procedure, pending the development of globally standardized ATFM –related phraseology

Circumstance	Phraseology
Calculated take-off time (CTOT) delivery resulting from a slot allocation. The CTOT shall be communicated to the pilot at the first contact with ATC.	SLOT (*time*)
Change to CTOT resulting from a Slot Revision.	REVISED SLOT (*time*)
CTOT cancellation resulting from a Slot Cancellation	SLOT CANCELLED, REPORT READY
Flight suspension until further notice.	FLIGHT SUSPENDED UNTIL FURTHER NOTICE, DUE (*reason*)
Flight de-suspension.	SUSPENSION CANCELLED, REPORT READY
Start-up requested too late to comply with the given CTOT.	SLOT EXPIRED, REQUEST A NEW SLOT
Denial of-Start-up when requested too late to comply with the given CTOT. (Where supported by State regulation or procedure)	UNABLE TO APPROVE START-UP CLEARANCE DUE SLOT EXPIRED, REQUEST A NEW SLOT
Start-up requested too early to comply with the given CTOT.	REQUEST A NEW SLOT

Circumstance	Phraseology
Denial of Start-up when requested too early to comply with the given CTOT. (Where supported by State regulation or procedure)	UNABLE TO APPROVE START-UP CLEARANCE DUE SLOT (*time*), REQUEST START-UP AT (*time*)

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APPENDIX E: ATFM TRAINING REQUIREMENTS

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INTRODUCTION

General

Air traffic Flow Management is an enabler of Air Traffic Management efficiency and effectiveness contributing to the safety, efficiency, cost effectiveness and environmental sustainability of an ATM system. ATFM aims at enhancing safety by ensuring the delivery of safe densities of traffic and by minimising traffic surges. Its purpose is to balance traffic demand and available capacity.

As traffic grows, an increasing number of States are moving towards the implementation of an ATFM service. Although this is a positive development, it also generates another challenge. Because of its effect on neighboring airspaces, ATFM needs to be coordinated between States. ATFM systems therefore need to be compatible and interoperable. In this respect, the development of coordinated and harmonised training requirements is a first step in ensuring a harmonised application of ATFM.

Once demand start to reach the levels of available ATC capacity, a functioning ATFM service becomes a vital component of safe and efficient provision of Air Traffic Control services. Therefore this service needs to be staffed by personnel with sufficient knowledge and understanding of the ATM system they are supporting and the potential effects of their work on the safety and efficiency of air navigation.

To ensure this and in the frame of their training policy, States and ANSPs should establish training plans to ensure that ATFM service staff are properly trained in order to ensure the availability, continuity, accuracy and integrity levels requested for the service provided.

ICAO Doc 9971, Manual on Air Traffic Flow Management recognizes the requirement for training all stakeholders in an ATFM service, i.e. both those directly operation and ATFM function and all other ATFM stakeholders including airspace users and ATS personnel (ref. Doc 9971 section 3.3).

Due to the complexity of the issues at hand when setting out to balance demand against available implementation options, the provision of an efficient ATFM service requires that training is approached in a systematic manner.

This document addresses the need to provide for a set of training requirements to be introduced in support of a harmonised and effective ATFM function. The document describes the requirement for training for staff having responsibilities with regard to the ATFM function. It addresses the requirement for the various levels of staff in an ATFM Unit, as well as those stakeholders affected by ATFM measures. The proposed training requirements are designed to support local application of ATFM at the same time as it prepares States for a regional application of ATFM.

It is assumed that each State and/or ANSP that will set out to train ATFM service staff will have to consider the type of equipment used in their area of operation. The material in this document is made very general when it comes to training required to operate the system that is used, and will have to be detailed based on the tools used in that particular area in support of ATFM services.

ICAO and EUROCONTROL sources were consulted for the development of the training concepts and methodology presented herein. The proposed training syllabus is derived with the support of in-depth ATFM service expertise.

Background

Regional networked Air Traffic Flow Management forms a major part of the ICAO ASBU framework since Block 0 (2013) through B0-NOPS. In support of the B0-NOPS module, ICAO enlisted a group of experts from States, ANSPs, and International Organizations with ATFM experience (ATFM Manual Coordination Team) to develop the ICAO Manual on Collaborative ATFM (Doc 9971), providing guidance on Collaborative ATFM implementation (published 2014).

Meanwhile, ICAO Asia-Pacific moved forward to develop ICAO Asia/Pacific Seamless ATM Plan, including provision on CDM/ATFM development to support Seamless ATM Operations in the region. Version 1.0 of the Seamless ATM Plan was endorsed by APANPIRG/24 meeting in June 2013. APANPIRG/24 meeting approved Conclusion 21/15 that States participate in and support the Asia/Pacific ATFM Steering Group to develop a common Regional ATFM framework, which addresses ATFM implementation and ATFM operational issues in the Asia/Pacific region.

The ATFM/SG/2 meeting in Hong Kong, China in September-October 2013 made the decision to form the ATFM Specialist Team of experienced ATM/ATFM specialist and other stakeholders to develop the Asia/Pacific Framework for Collaborative ATFM APANPIRG/26.

Purpose and Scope of the Document

The purpose of this document is to define a training process and specify training guidelines in order to have a common level of training for staff that operate and/or “experience” ATFM services.

In many cases an individual may already possess the required competence and experience in a particular domain and may not need to follow a formal training course on this subject. Nevertheless a process of confirm the individuals competence should still be followed. The document addresses the following:

- Who is to be trained?
- What pre-requisite skills are required or can be obtained?
- What are the job responsibilities and required competencies?
- What is the required content of ATFM training?
- What is the level of training depending on the level of responsibilities to be exercised?

Structure of the Document

The ATFM Training Requirement Guidelines consist of 5 Chapters, and 2 Appendices:

Chapter 1: Introduction

Chapter 2: ATFM Training Structure

Chapter 3: From job responsibilities via competencies to training requirements

Chapter 4: Ab-Initio ATFM Training

Chapter 5: Basic training

Appendix A: Glossary *(to be included)*

Appendix B: List of Abbreviations *(to be included)*

ATFM TRAINING STRUCTURE

A model of ATFM training

By means of ATFM training, it is expected that staff of an ATFM unit will obtain the appropriate skills to operate and maintain an ATFM function in an appropriate manner and consequently provide harmonised, homogenous and consistent ATFM services in the entire region.

In addition to the staff of the ATFMU itself, there are several other units/areas/entities where staff needs to be aware of ATFM services provided and the specific roles and responsibilities they carry in this process. Units where ATFM is exercised or directly experienced and where staff therefore needs training include:

- ATC
- Aircraft Operators
- Pilots
- Airport Operators
- Military, both service providers and users
- Regulatory bodies (CAAs and equivalent)

An ATFM service is provided at different levels, each with its own training requirements. The different levels of ATFM responsibilities considered include the operations management and supervision levels, planning and execution of the service and essential support staff. In addition, there are different support functions, CDM partners and general ATM personnel that need to be considered when developing training requirements.

This guidance document proposes a six level (taxonomy levels) set of training objectives for each ATFM population grouping depending on the level of responsibility to be exercised by each group.

- Level 0: To be aware of
- Level 1: A basic knowledge of the subject. It is the ability to remember essential points, to memorise data and retrieve it.
- Level 2: The ability to understand and to discuss the subject matter intelligently in order to represent and act upon certain objects and events.
- Level 3: A thorough knowledge of the subject and the ability to apply it with accuracy. The ability to make use of the repertoire of knowledge to develop plans and activate them.
- Level 4: The ability to establish a line of action within a unit of known applications following the correct chronology and the adequate method to resolve a problem situation. This involves the integration of known applications in a familiar situation.
- Level 5: The ability to analyse new situations in order to elaborate and apply one or other relevant strategy to solve a complex problem. The defining feature is that the situation is qualitatively different to those previous

(source: EUROCONTROL Specification for the ATCO Common Core Content Initial Training)

This guidance proposes that a matrix should be constructed to determine the level of training and competency required for each group in the ATFM population. A partial matrix template is shown below. This is developed further in the document. The levels are shown for illustrative purposes only.

Subject	Operations management	Supervision	Planner	Execution	Support	CDM partner	General ATM personnel
ATM	2	2	2	2	2	1	1
ATFM	2	3	4	3	2	2	1
ATC	2	2	2	1	1	1	1
Airport operations	2	2	2	2	1	1	1
Aircraft operations	2	2	2	2	1	1	1
Meteorology	2	2	3	3	2	1	1
ICAO	3	2	2	2	2	1	1
ATFM tools	2	2	3	3	3	2	1
Capacity assessment	2	2	2	1	1	1	1
Airspace design	2	2	2	1	1	1	1

Phases of ATFM training

General

ATFM training can be divided into a number of phases. This document concentrate on training requirements for Ab-Initio and Basic training, other phases are only discussed briefly.

Ab-Initio Training

Ab-initio training is intended to ensure that new ATFM staff possesses the necessary contextual knowledge in order to follow the more detailed job related training. In many cases staff may already possess this knowledge (e.g. ATC staff will possess the necessary ATC knowledge, Airline operations personnel the necessary aircraft operations knowledge). The possession of the necessary ab-initio subject knowledge should be assessed upon recruitment / assignment. In cases where staff possess the necessary contextual knowledge these staff may be exempted in whole or part from elements of ab-initio training.

Basic Training

Basic training is the main phase where the core ATFM and associated operational topics are covered in a comprehensive fashion. Basic training also covers more detailed knowledge of subjects related to ATFM than in ab-initio training. At the successful completion of basic training the staff member should have all the relevant knowledge to proceed to on the job training before performing his role in the ATFM operation.

On the Job Training

ATFM, in common with many other operational occupations requires a substantial amount of practical application of the occupation under appropriate supervision in order to ensure that the acquired knowledge from the basic training course(s) can be applied in an autonomous manner. The purpose is to reinforce formal training and support the achievement of competency standards. If appropriate, OJT phases can also follow advanced or refresher training.

Advanced Training

As ATFM functions develop, a number of advanced ATFM analysis and application techniques are used. Secondly some staff involved in the execution of ATFM will require a higher level of skills and advance training modules will be required for both such cases. The purpose of advanced training is to augment the skills and knowledge of ATFM personnel in dealing with either more specific, complex problems or a wider breadth of issues.

Recurrent/Refresher Training

It is essential that ATFM personnel update his or her competencies in accordance with the latest operational requirements, and new methodology/technologies applied. Regular recurrent training should therefore be planned. It is important to maintain the current skills of ATFM personnel. Some ATFM techniques are applied only in very rare situations (contingency, exceptional events). ATFM personnel can be absent from their core operational function for extended lengths of time. For these three reasons recurrent/refresher training modules will be required.

Training requirements for ATFM instructors

To ensure efficient training, the trainers have to be in possession of the necessary skills. Apart from a thorough knowledge of the subject to be taught, the trainers also need to demonstrate the ability to convey the knowledge in a pedagogic and structured way. It is recommended that the trainers have attended Classroom Techniques training courses.

In cases where a State is implementing an ATFM service for the first time, and thereby do not have the expertise needed to perform the training available in their country, different solutions could be considered. In cases where a system is procured to support the application of ATFM, the inclusion of a package for training of the trainers should be considered. For more in-depth knowledge of the procedures and processes involved, it may be necessary to send the staff responsible for the training to attend courses given by trainers having the experience required to train staff on the application of ATFM.

FROM JOB RESPONSIBILITIES VIA COMPETENCIES TO TRAINING REQUIREMENTS

General

Introduction

The first steps in the process of designing detailed training requirements, are to:

- Identify job responsibilities and associated performance and measurement criteria;
- Identify the competencies required to meet these job responsibilities and performance.

With full understanding of job responsibilities, it is possible to determine what the competencies are of a fully competent staff member. Items that may be needed to perform this analysis include:

- the specific job or position description or summary;
- specific ATFM organization performance requirements or competencies; and
- standard operating procedures that apply to an individual's position or responsibilities.

When the pre-requisites described above are identified and analysed, it is possible to design the training required to address the gaps through the development of the learning objectives for each competency that needs to be addressed. Based on the identification of the learning objectives, a curriculum can then be designed.

The link between ATC and ATFM

Before looking at the details of the job responsibilities of an ATFM Unit, there is a requirement to understand its links with ATC. ATFM is a cross-domain activity, and even if the focus have shifted from the early task of protecting ATC from overload to a more comprehensive demand/capacity balancing activity, there are still very strong links between ATC and an ATFM service.

The ATC Supervisor is accountable for the provision of ATC services for enroute and TMA operations within the FIR`s for which this service is being provided. As part of that responsibility, he/she is normally also accountable for all strategic and tactical ATFM decisions. In a smaller ACC the supervisor may keep that responsibility, but in a larger ACC this is often delegated to an "Airspace Manager", either being the Flow Management Position (FMP) in the ACC or the ATFM Unit (ATFMU) Supervisor.

To be able to take strategic and tactical decisions related to the application of ATFM, there is a requirement for a large measure of ATC knowledge, and when the responsibility to take these decisions is delegated to an FMP and/or ATFMU Supervisor it normally requires that the staff manning these positions have an ATC background. As management knowledge is passed on and complexity issues in sectors and at airports are documented and understood by the ATFMU, there may not be a need for this pre-requisite. However, it is important that the training provided is such that the FMP and/or supervisor of the ATFMU are able to fully understand and discuss ATC operations so that the expected outcomes can be achieved.

Over time, the objective should be to develop the ATFMU to become an integral part of ATC so that it is seen as the manager of the airspace, ensuring the delivery of the right amount of demand in the right shape to achieve maximum capacity.

Tasks and Competencies

Main tasks for an ATFM Unit

The objective when defining the tasks of an ATFM Unit should be to ensure that the ATFMU become the focus for an effective management of airspace availability and capacity. The ATFMU should manage and coordinate actions associated with optimising demand against the capacity of the airspace, ensuring that the complexity of traffic does not exceed the capability of the control service.

The ATFMU should maintain a strategic and tactical overview of the network (airspaces and airports within and adjacent to its area of responsibility), being responsible for the development of tactical ATFM strategies, and for managing network responses to demand and capacity issues.

The main tasks of a service provided by an ATFM unit include:

- Receive and analyse all ATFM data and associated parameters;
- Plan and coordinate capacity adjustment for next day's operation;
- Plan and coordinate ATFM Daily Plan for the next day's operation;
- Manage proper execution of ATFM Measures on day of operation based on ATFM Daily Plan;
- Coordinate tactical capacity adjustment on ATM resources with the local ATC Supervisors;
- Monitor and execute ATFM Measures on day of operation as required based on ATFM Daily Plan;
- Ensure proper integration of traffic demand inputs;
- Ensure proper configuration of ATFM automation support systems;
- Ensure optimisation of resources through an efficient CDM process;
- Provide focus and specialist expertise for planning, coordinating and implementing measures for capacity management and contingency operations;
- Conduct post operations analysis of previous days ATFM operation.

Competencies for staff executing ATFM

To perform ATFM tasks, staff needs to be trained to possess a number of competencies. They need to have full knowledge of the FIR and/or airports for which the service is applied. They also need to understand the factors that impact on the capacities for the various parts of airspace and airports, and they need to be fully aware of the impact on the provision of ATC that the different actions they propose to implement may have. In order to be effective, the ATFMU needs to coordinate and cooperate closely with ATC, airports and civil and military airspace users.

The required competencies include the ability to:

- Determine an accurate picture of air traffic demand;
- Receive, verify, evaluate, enter and store all relevant ATFM data;
- Monitor the evolution of demand versus capacity identifying all shortfalls and opportunities for optimisation;
- Determine the need for ATFM measures in all phases of ATFM;
- Draw up and publish ATFM plans and any changes to the plan (understand what Information to be published);
- Create, maintain, monitor and adjust all relevant ATFM scenarios and measures;
- Ensure that AOs are provided with advice and guidance for minimising delays and disruption;
- Know and adhere to all relevant operational instructions, operations manuals and letters of agreement (actively locate, read and follow instructions).

ATFMU Operational Staff Job Descriptions

General

The job descriptions of staff operating an ATFM facility will depend on the chosen organization. For the purposes of this document the following job descriptions are proposed. Depending on the local organization responsibilities may be delegated or not, and functions may be combined or subdivided.

- ATFM Unit Operations Manager
- ATFM Unit Supervisor
- ATFM Unit Planner
- ATFM Unit Office (executive)
- ATFMU Support Assistant
- ATFMU CDM partner

ATFM Unit Operations Manager Job description

Each ATFM unit should have a clearly designated line manager directly responsible for the overall operation of the unit. He is the immediate hierarchical superior of the ATFMU supervisors. Although not normally involved in the direct execution of ATFM it is recommended that the Operations Manager be subject to an appropriate form of training and competency assessment.

The job description of the Operations Manager is not defined in this document as this will vary according to the organization management structure. However it is strongly recommended that the Operations Manager acquire and maintain level 2 (ability to **understand** and to discuss the subject matter intelligently in order to represent and act upon certain objects and events) competence in all the subjects contained in the basic training content.

ATFMU Supervisor Staff Job Descriptions

The duties of the supervisor/manager of an ATFM service function include:

- Ensure self-briefing and that all ATFM staff are fully briefed on all aspects of the operation;
- Plan and coordinate with ATC supervisor capacity adjustment for next day's operation ;
- Plan and coordinate ATFM Daily Plan for the next day's operation;
- In coordination with local ATC supervisor manage local and network resources to optimise capacity and minimise delays within their areas;
- Supervise the proper execution of ATFM Measures on day of operation based on ATFM Daily Plan;
- Organize, chair and conduct all necessary CDM conferences;
- Proactively use their experience and authority in an appropriate manner, be creative and use initiative in the resolution of problems that may arise using an inclusive collaborative process;
- Execute all appropriate staff management duties fairly and transparently in accordance with local procedures and processes;
- Manage disruption and contingency procedures and ensure appropriate escalation;
- Ensure ATFMU management is aware of all significant events;
- Ensure accurate log keeping and recording of all significant occurrence.

ATFMU Planner Staff Job Descriptions

The duties of the planning function of an ATFM service include**:**

- Manage and execute the short term strategic and pre-tactical operational processes and post operational evaluation;
- Maintain a good level of coordination with the ATC Supervisor in order to negotiate the best possible pre-tactical solutions including negotiating improved capacity, applying ATFM regulations where necessary and proposing & implementing the optimum ATFM measures for the network;
- Create and continuously adapt plans and to propose new solutions taking into consideration ever changing circumstances;
- Proactively provide all reasonable assistance to the airspace users in order to facilitate them to optimise their operations;
- Endeavour to maintain the principles of network optimisation and collaborative decision making during all ATFM processes;
- Coordinate ATFM solutions with other operational functions (tactical, AMC, Flight Planning);
- Ensure that the ATFM network plan and all changes are fully communicated with Aircraft Operators, Airports and Air Traffic Control Centres;
- Evaluate execution of the ATFM plan in order to determine lessons learnt and issues for future attention.

ATFMU Officer Job Descriptions

The duties of the ATFM Officer function of an ATFM service include**:**

- Execute the tactical flow management operational process from a network perspective;
- Constantly monitor traffic loads on all ATFM resources;
- Monitor any potential and actual changes in capacity (e.g. staffing, weather, airport infrastructure, etc.) and implement appropriate measures;
- Maintain a good level of co-ordination with the ACC/airport in order to negotiate the best possible tactical solutions including negotiating improved capacity, applying measures where necessary and proposing & implementing re-routing scenarios;
- Continuously adapt plans and to propose new solutions taking into consideration ever changing circumstances;
- Proactively provide all reasonable assistance to the airspace users and air navigation service providers in order to allow them to optimize their operations;
- Endeavour to maintain the principles of network optimization and collaborative decision making during all relevant ATFCM processes;
- Coordinate tactical capacity adjustment on ATM resources;
- Ensure the promulgation of all measures taken.

ATFMU Support Assistant Job Description

The duties of the ATFM Support Assistant function of an ATFM service include**:**

- Coordination with external clients (airspace users, ATS units, military) under the supervision of planning and executive staff;
- Reception, validation and input of ATFM data;
- Ensure proper integration of traffic demand inputs;
- Maintenance of operational documentation;
- Responding to routine queries from external clients, providing standard information and referring issues to planner and officer where appropriate.

Note: The duties of the Support Assistant function will depend on which executive position the support function is assigned to. It is suggested that the same basic training curriculum is followed for support and executive staff, but that the level of knowledge and competency required be at a lower level.

CDM partner Job Description

The duties of CDM partners are not defined in this document. It is suggested that the training authority selects the appropriate subject and competency levels for each CDM partner group based on the detailed training requirements below.

Ab initio ATFM training

Ab-initio training is intended to ensure that new ATFM staff possesses the necessary contextual knowledge in order to follow the more detailed job related training. In many cases staff may already possess this knowledge (e.g. ATC staff will possess the necessary ATC knowledge, Airline operations personnel the necessary aircraft operations knowledge)**.**

Basic Requirements

The possession of the necessary ab-initio subject knowledge should be assessed upon recruitment / assignment. In cases where staff possess the necessary contextual knowledge these staff may be exempted in whole or part from elements of ab-initio training.

There are several basic requirements or pre-requisites for the successful conduct of ATFM training. These include:

- Pre-requisite skills and experience (e.g. experience in ATM, aircraft, airport operations)
- Complementary skills (IT skills, written and oral communication skills, operations analysis, statistics experience)
- Medical requirements
- Language requirements

Normally these competences and requirements form part of the recruitment requirements. The definition of these general requirements is beyond the scope of this document. However, material is readily available in the public domain from other ATM related functions that can assist those responsible for recruitment and training to draw up appropriate general competency and experience requirements.

ATFM Ab-initio training content

The subjects contained in the modules below need to be covered in the Ab-Initio Training phase. It is recommended that the appropriate taxonomy level for ab-initio training is between level 1 (basic knowledge) and 2 (understand and discuss).

Level 1: A basic knowledge of the subject. It is the ability to remember essential points, to memorise data and retrieve it.

Level 2: The ability to understand and to discuss the subject matter intelligently in order to represent and act upon certain objects and events.

ATFM as described by ICAO is a collaborative process between ATC and the Airspace User facilitated by the ATFM units. Airport operations authorities are also an essential ATFM partner. It is therefore suggested that these partners should be closely associated with the training content development and delivery. The ab-initio training should include facilitated visits of the operations units of these stakeholders.

The modules that need to be covered during the Ab-Initio Training Phase can be found at **Attachment A** to this guidance.

Basic ATFM training

Basic training is the main phase where the core ATFM and associated operational topics are covered in a comprehensive fashion. At the successful completion of the class room training part of the basic training the staff member should be fully prepared to begin his/her period of OJT in the pre-tactical and/or tactical area. He/she should have achieved all the relevant knowledge and skills and be able to understand the concept of ATFM, the operating procedures in place and the use of related equipment.

The start of the training should be preceded by an information session providing the training aims and the overall planning for the entire training. As part of the informative session, trainees would be informed about the design of the training modules, and their expected involvement during the training. Depending on the background of the trainees, it may be beneficial to consider involving the participants in a workshop style environment, encouraging them to develop their own ideas and to motivate them into thinking how the role of the ATFMU can be developed to support the overall objectives of the ATFMU.

The following modules need to be covered during the Basic Training phase:

1. Foundational objectives and principles of ATFM
2. ATFM Institutional and Regulatory background
3. The CDM Process in the context of ATFM
4. ATM Planning
5. ATFM Phases
6. ATFM Demand
7. ATFM Measures (Traffic Management Initiatives)
8. ATFM Contingency Procedures
9. ATFM Data and Tools

This document does not provide a detailed curriculum for ATFM training since this has to be individually prepared based on the pre-requisites for that particular training course. When deciding on training content for a specific Basic Training course, it is important to consider:

- the position that the trainees are going to be trained for, i.e. the job responsibilities;
- the competencies required to carry out the tasks; and
- the background of the trainees, i.e. the competency level.

Based on those three criteria and the training requirements they indicate, the content of the modules described at **Attachment B** to this guidance can be adapted to fit the needs of a specific course.

At **Attachment C** is a description of how one State (Japan) has organized its training for ATFM positions. The attachment includes a sheet where the details of what needs to be covered during the OJT period is listed, items against which the trainee has to demonstrate an acceptable level of knowledge and understanding.

Appendix E Attachment A: Modules to be covered during the Ab-Initio training phase:

Aviation Law and Institutional Background

Phase	Ab-Initio
Subject	Aviation Law and institutional Background
Objective	**Understand** the national and international regulatory context of ATM in general and ATFM.

Content	Reference Documents
• International Aviation Structure and Organizations	Chicago Convention, Annex 11, Local legislation and rules, Doc 4444. Doc 9971,
• National Aviation Structure	
• National Aviation regulations	
• Structure of ANS and ATS	
• Institutional international and national background of ATFM	
• Safety Management Principles	

Air Traffic Management

Phase	Ab-Initio
Subject	Air Traffic Management
Objective	Learners shall **understand** the basic principles of air traffic management and be able to **discuss** basic operational procedures.

Content	Reference Documents
• Air Traffic Control Service (Aerodrome, Approach, En-route, Oceanic)	Annex 11, Doc 4444, Doc 9971, Doc 7030, ATFM Manuals introduction Local ASM rules Annex 2, Doc 7910 local rules
• Flight Information Service and Advisory service	
• Alerting Service	
• ATFM Introduction	
• Airspace Management	
• Altimetry and Level allocation	
• Separations	
• ATM Data o ICAO designators o Other designators	
• Flight Plan processing	

Air Traffic Flow Management

Phase	Ab-Initio
Subject	Air Traffic Flow Management
Objective	Learners shall **understand** the basic principles and origin of air traffic flow management and be able to **discuss** basic operational procedures.

Content	Reference Documents
• Objectives of ATFM	Doc 9971
• Benefits of ATFM	
• Principles of ATFM	

Aircraft and Flight Efficiency

Phase	Ab-Initio
Subject	Aircraft
Objective	Learners shall **understand** the basic principles of the theory of flight and aircraft characteristics and how these influence ATS and ATFM operations.

Content	Reference Documents
• Principles of flight	Local airline SOP Doc 4444, EUROCONTROL ERNIP (flight efficiency section)
• Aircraft Engines	
• Aircraft Systems and Instruments	
• Aircraft categories	
• Factors affecting aircraft performance	
• Aircraft performance data	
• Flight efficiency concepts (economic, environmental)	

ATM Equipment and Systems

Phase	Ab-Initio
Subject	ATM Equipment and Systems
Objective	Learners shall **understand** the basic working principles of equipment that is in general use in ATC;

Content	Reference Documents
• Radio communications	Local ATM System Manuals
• Radar, Primary, secondary, mode S, CPDLC	
• ADS	
• AFTN, OLDI, AIDC	
• AMAN, DMAN, ASMGS	

Airport Operations

Phase	Ab-Initio
Subject	Airport Operations
Objective	Learners shall **understand** the operations related functions carried out at airports.

Content	Reference Documents
• Aerodrome infrastructure	IATA Slot allocation guidelines Local Airport documentation
• Airport capacity	
• Airport scheduling, coordination. Airport slot allocation	
• Management of maintenance	
• Management of disruptive events	

Airline Operations

Phase	Ab-Initio
Subject	Airline Operations
Objective	Learners shall **understand** the ATM operations related functions carried out by aircraft operators.

Content	Reference Documents
• Airspace Users operating models (hub, point to point, major carriers, low fare sector…)	Local Airline Operations Manuals
• The airlines operations Centre	
• Airspace Users (scheduled, non-scheduled, business, general aviation, military)	

ATFM and CDM

Phase	Ab-Initio
Subject	ATFM and CDM
Objective	Learners shall **understand** the fundamental CDM concepts underlying effective ATFM

Content	Reference Documents
• ATC v ATFM	Doc 9971
• ATFM; bridging the gap between ATC and airline operations	
• CDM competencies	
• CDM skills	

Meteorology

Phase	Ab-Initio
Subject	Meteorology
Objective	Learners shall **<u>understand</u>** how meteorology affects ATS operations and aircraft performance and limits ATFM capacity.

Content	Reference Documents
• Basic introduction to meteorological phenomena	Local MET Manuals
• Aviation meteorological forecasts and observations	
• Understand the meteorological hazards to aviation.	
• Weather and capacity	

Appendix E Attachment B: Modules to be covered during the Basic Training phase:

Foundational objectives and principles of ATFM

Phase	Basic
Subject	Foundational objectives and principles of ATFM
Objective	• understand the philosophy of air traffic flow management, including the objectives and principles of ATFM; • know how the ATFM service operates; • know the terms and definitions used; • know the structure and organization of the ATFM service function, including the roles and responsibilities of the stakeholders in the ATFM service; • understand the training requirements for stakeholders in the ATFM service.

Content	Reference documents
• Objectives and principles • Benefits of ATFM • How the ATFM service operates • Systems, processes and operational data that supports the application of ATFM • Basics of a CDM process • Link to ASM, Civ/Mil coordination • Organizational structure • Roles and responsibilities	• ICAO Doc 4444, • ICAO Doc 9971, • Local ATFM doc.

Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	5	5	4	3	2

ATFM Institutional and Regulatory Background

Phase	Basic					
Subject	ATFM Institutional and Regulatory background					
Objective	• know the regulatory background, both global and local, for the application of an ATFM service.					
Content				Reference documents		
• ICAO standards and recommended practices (Annex 11, Annex 15) • ICAO procedures (Doc 4444, doc 7030) • Local rules and procedures (AIP, Letters of Agreement, local procedures, Start-up procedures, departure sequence)				• ICAO Annex 11 and 15 • Doc 4444 • AIP and other local documentation		
Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	5	5	4	3	2

The CDM Process in the context of ATFM

Phase	Basic
Subject	The CDM Process in the context of ATFM
Objective	• Full knowledge of the process to communicate and exchange operational information among stakeholders on a real-time basis. • Understanding of how the CDM process allow decisions to be taken to best meet the operational requirements of all concerned.

Content	Reference documents
• CDM organization and structure o Support to ATFM stakeholders • Means of communication o Communications in tactical operations; e-conf, tele-conf etc. • Stakeholder roles and responsibilities • understanding of the interaction with other stakeholders at the various stages of the process o ATFM Operations and airports o ATFM Operations and aircraft operations o ATFM Operations and meteorology • CDM requirements and benefits • Link to A-CDM	• Doc 4444 • Doc 9971 • Local ATFM documentation

Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	5	5	4	3	2

ATM Planning

<table>
<tr><td>Phase</td><td colspan="6">Basic</td></tr>
<tr><td>Subject</td><td colspan="6">ATM Planning</td></tr>
<tr><td>Objective</td><td colspan="6">• understand the process to optimize available capacity, and how to use other available capacities;

• be aware of factors impacting capacity.</td></tr>
<tr><td>Content</td><td colspan="4">• ATM Planning
o Quantify imbalance between demand and capacity
o How to address the imbalance at the strategic phase
• Capacity assessment models
o Monitoring values
o Intervention values
• ATC Capacity
• Staffing schedules and opening schemes of the component ATC Units
• Capacity optimisation
• Factors reducing capacity
• Coordination with ASM</td><td colspan="2">• ICAO Doc 4444
• ICAO Doc 9971
• Local ATFM doc</td></tr>
<tr><td>Role</td><td>Operations management</td><td>Supervision</td><td>Planner</td><td>Execution</td><td>Support</td><td>CDM partner</td></tr>
<tr><td>Level</td><td>2</td><td>5</td><td>5</td><td>4</td><td>3</td><td>2</td></tr>
</table>

ATFM Phases

Phase	Basic
Subject	ATFM Phases
Objective	understand the main principles for how the ATFM processes are applied during the different phases in order to balance demand and capacity within a given area.

Content	Reference documents
• Strategic Phase o Strategic to pre-tactical • Pre-tactical Phase o Pre-tactical processes o Building a pre-tactical plan o The concept of a rolling plan o Airport role during pre-tactical o Aircraft operator role during pre-tactical o Special events planning o Slot allocation process, incl. principles, computer assisted or manual allocation process, and change process • Tactical Phase o Re-routing flights o Manual actions on a flight o Tactical management of the daily plan o • Post-Ops o Requirements for a good post-ops analysis o Feedback and evaluation o Operational feedback o Incident reporting	• Doc 4444 • Doc 9971 • Local ATFM documentation

Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	5	5	4	3	2

ATFM Demand

Phase	Basic					
Subject	ATFM Demand					
Objective	• know the process of organizing demand into traffic volumes based on particular reference locations; • understand the configurations used and the establishment of pre-defined scenarios; • understand how traffic demand, the tactical traffic situation and met forecasts can be used to optimise capacity; and • understand issues related to occupancy.					
Content	• Establishing demand o Establishing demand for a sector/airport o Establishing demand along predefined major traffic flows • Determining Traffic Volumes based on defined demand o Determine reference locations o Occupancy counts/duration o Define major traffic flows in a traffic volume • Implementation and management of pre-defined scenarios • Set up and run simulations • Forecasts • Schedules and flight plans, including missing flight plans • Airport slots • Flight positions			• Local ATFM doc		
Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	4	5	4	3	2

ATFM Measures

Phase	Basic					
Subject	ATFM Measures (Traffic management Initiatives)					
Objective	• know the different measures available and how to apply them in the ATFM service; • understand the role of the stakeholders in the process.					
Content	• Apply, modify and cancel ATFM measures • Capacity Optimisation measures (sector/airport management, complexity reduction) • Demand distribution measures (routing scenarios, level capping, advancing traffic, balancing arrivals/departures, Ground delay) • Demand regulation/reduction measures(Airborne delay/holding, minimum departure intervals, miles in trail, policy, out of area traffic, adherence) • Exemptions and exclusions (compliance monitoring, reporting) • Slot adherence • Slot swapping and slot extensions, policy • Delay causes and attribution • Use tools to support the processes • Compliance monitoring				• Doc 4444 • Doc 9971 • Local ATFM doc	
Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	5	5	4	3	2

ATFM Contingency procedures

Phase	Basic					
Subject	ATFM Contingency procedures					
Objective	Full understanding of procedures to be applied in the case of a contingency.					
Content	• Contingency procedures o Management of industrial actions o Non-availability of airspace/airports • Adverse weather situations o Convective weather o Low visibility o De-icing conditions			• Local ATFM documentation		
Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	5	3	3	2	1

ATFM data and tools

Phase	Basic					
Subject	ATFM Data and Tools					
Objective	• ensure full knowledge of the function and use of tools providing support to the application of ATFM; and • understanding of the need for sharing of data.					
Content	• ATFM Support tools o Main functionalities of tools used o Pre-tactical tools used o Building a plan in a pre-tactical tool • Environmental data in ATFM support tools o Static, semi-static and dynamic data • Flight data in ATFM support tools o Traffic load monitoring (types of traffic counts) o Flight activation monitoring o Data exchange and sharing			• ICAO Doc 9971 • Local ATFM documentation		
Role	**Operations management**	**Supervision**	**Planner**	**Execution**	**Support**	**CDM partner**
Level	2	4	5	4	3	1

Appendix E Attachment C: ATFM Training for ATM Officers in Japan

The Air Traffic Management Center (ATMC), is the organization of Japan Civil Aviation Bureau (JCAB) providing ATFM services to the aircraft flying Fukuoka FIR. As soon as transferring into ATMC, a rookie ATM officer starts initial training for an assistant position. The training course includes, but are not limited to:

- Concept of Air Traffic Management
- Organizational structure and regulatory bases of ATMC
- Outline of ATM services (i.e. ASM, ATFM, Oceanic ATM, and CDM)
- Knowledge and understanding of the present ATM environment (i.e. FIRs, Sectors of ACCs, TMAs, ATS routes, Training/Restricted areas, Navigational aids, Operations and performances of aircraft, Information processing system/tool/network related to ATM services, Communication procedures, etc.)

The special training for ATFM positions is scheduled following the above-mentioned initial training. The ATFM training consists of two parts. The first part is classroom lectures and practical simulator trainings. The second part is on-the-job trainings.

The ATFM training starts from the classroom lectures and practical simulator trainings, which are typically programmed as follows:

Day 1: ATFM system and other associated equipment (*management and coordination procedures of standard routes and alternative routes*)
Day 2: Capacity value calculation procedures (*weather and ATFM*)
Day 3: Monitoring and prediction of traffic volume (*flow control procedures*)
Day 4: Algorithm of Expected Departure Clearance Time (EDCT) calculation (*handling procedures related to diversions at major airports*)
Day 5: Cross border ATFM (*characteristics of traffic flow and ATC operating procedures in ACC sectors*)
Day 6: Specifications of airports/aerodromes and ATC operating procedure (*ATM operations plan (OP) and CDM*) (*simulator: extracting relevant information/lists, setting capacities*)
Day 7: Regulations and agreements on ATFM (*simulator: flow management of ACC sectors*)
Day 8: In-house operating procedures (*simulator: flow management of RJTT/RJAA*)
Day 9: Recently introduced/amended procedures (*simulator: flow management of international ATS routes*)
Day 10: Case studies (*final checks*)

The on-the-job training (OJT) is phased and standardized. The trainee and the training supervisors are supposed to use “OJT check sheet” so that the trainee can master a required skill for ATFM services systematically. The check sheet used in Japan is described below.

OJT check sheet

phase A・B・C

month

Starting date of the phase: A: | B: | C:

ATFM	crew	graduating class	name

phase	Monitoring traffic volume	Number of mark "4" earned by previous month (4)	d1 date hour SV	d2 date hour SV	d3 date hour SV	d4 date hour SV	d5 date hour SV	d6 date hour SV	d7 date hour SV	d8 date hour SV	d9 date hour SV	d10 date hour SV	d11 date hour SV	d12 date hour SV	d13 date hour SV
A	able to manipulate FMW and display necessary information timely														
A	able to calculate workload value of sectors per aircraft														
A	able to extract relevant departure flight plans for flow control initiatives														
A	able to evaluate EDCT flow controls before starting/ending the initiatives														
B	able to evaluate EDCT flow controls including a groundstop														
B	able to evaluate flow controls thru assignment of departure intervals														
B	able to evaluate flow controls thru assignment of inflow intervals														
B	able to except particular aircraft from flow controls or demand tallying process before/during initiatives														
B	able to monitor airports/sectors with traffic flow characteristics taken into account														
B	able to analyze flight plans correctly														
B	checking combine/decombine status of sectors and conditions of inflight aircraft by manipulating FPVD														
B	able to plan and input the pre-tactical operation of variable sectors														
C	able to perceive RWY operation patterns of RJTT/RJAA and input correctly														
C	able to input capacity values correctly in accordance with present MET conditions or RWY in use														
C	able to change capacity values in accordance with expected scenarios														
C	able to predict the change of traffic demand graph and cope with it when traffic is surged against prediction														
C	able to evaluate intended flow controls with the initiatives planned in the other ATFM position taken into account														
C	able to cope with the unexpected, such as RWY closure														

		Flow control procedures
A		able to figure out and input FROM-TO of EDCT flow controls
A		able to figure out and input START-END of EDCT flow controls
	B	able to coordinate about the start of flow controls with related ATC facilities
	B	Conveying just enough information (i.e. flow controlled area, measure, start time, end time, FROM-TO, max demand value, capacity value) to an ATM supervisor before starting initiatives timely
	B	able to make flow controls on inflight aircraft (i.e. assigning inflow intervals, specifying airspeed/altitude/route, assigning airborne holding)
	B	able to make flow controls on departures by assigning departure intervals
	B	able to figure out appropriate FROM-TO of flow controls on airports
	B	able to figure out appropriate FROM-TO of flow controls on sectors
	B	able to figure out appropriate FROM-TO of flow controls on ATS routes
	B	able to adjust EDCT appropriately as needed
	B	balancing the amount of delay of EDCT and arising no reverse in departure sequence in the respective airports
	B	able to evaluate and decide the end time of flow controls appropriately
	B	able to coordinate about the end of flow controls with related ATC facilities
	B	able to cope with the change in ending time of flow controls (including input timing of "TO")
	B	able to cope with EDCT exceeding the ending time of flow controls
	C	able to cope with reversed departure sequence arisen by the capacity change during EDCT flow controls
	C	able to make flow controls on departures by using the groundstop feature
	C	able to conduct time frame coordination
	C	able to make a judgement on whether ongoing ATC restrictions should be changed to ATFM initiatives, and able to cope with the change

[Marks] 1: incapable/unknowing 2: lack of skill/understanding 3: barely able 4: able 5: well enough

The mark "4" indicates 70-80%, and "5" indicates beyond 80%, which are acceptable level.

When marking "5", the training supervisors should fill in own initials to the right colomn. The "5" marked training items will be exempted in the subsequent OJT.

The training items rarely happen can be substituted by oral tests in the OJT. The mark through oral tests shall be expressed by an encircled number.

Acquiring "4" three times or more, or acquiring "5" can complete the training item. After completing all the training items of the phase, the OJT moves on to the next phas

[Abbreviations] FMW: Flow Management Workstation, EDCT: Expected Departure Clearance Time, FPVD: Flow Plan View Display
CCW: Traffic Control Condition Supervised Workstation, SSW: Strategic Statistics Workstation, SAW: Statistic Analysis Management Workstation

ATFM

phase		4	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13
	Cross Border ATFM														
A	able to extract aircraft groups bound for particular destination via particular ATS route														
B	able to adequately communicate with foreign ANSPs														
B	able to make a judgement on whether the ATFM initiatives are consistent with the stipulations of LOA (i.e. flow controlled airport, reason, lead time for coordination, measure)														
B	able to coordinate with related ATC facilities about the flow controls on G585 (SAPRA) requested from Incheon ACC														
B	able to coordinate with related ATC facilities about the flow controls requested from Taipei ACC														
C	able to cope with the unexpected or any change in ATFM initiatives requested by foreign ANSPs														
	Operating procedures for handling diversions														
A	able to notify facilities concerned without omission in accordance with the phase of diversions														
A	able to input start/end to CCW														
A	able to display number of spots available all day in the phase 1														
B	able to allocate airports for diversion appropriately in response to requests														
B	able to manage the case when aircraft request diversion to RJOO														
B	able to manage the case when the width or length of diverting aircraft is unclear (including A346, B777, B773, B77W, etc)														
B	able to manage the case when aircraft request diversion to RJTY or RODN														
C	able to manage the case when aircraft request diversion to airports not registered in CCW														
C	able to manipulate CCW when aircraft canceled diversion														
C	able to make a judgement and coordination about ending respective phases of diversion														

		Acquiring/providing adequate information
A		able to extract necessary NOTAMs quickly
A		able to display MET data of particular airports
	B	Keeping good watch on the situations being faced in the other ATFM positions
	B	able to get information about restricted areas, training/testing areas, etc
	C	able to exchange information with the other ATFM positions that will be affected by the own flow controls decided and being started shortly
		Handling SAW/SSW
	B	able to manipulate SSW and get daily statistical information
	C	able to make coordination with AO thru SSW about flight planned routes for the next day
	C	able to confirm and input the information about the cancellation of a flight thru SSW
		Miscellaneous
	B	able to take over the ongoing ATFM services accurately
	C	able to handle rarely happened situations

[Marks] 1: incapable/unknowing, 2: lack of skill/understanding, 3: barely able, 4: able, 5: well enough

The mark "4" indicates 70-80%, and "5" indicates beyond 80%, which are acceptable level.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

D R A F T

ASIA/PACIFIC REGIONAL

AIR TRAFFIC FLOW MANAGEMENT

CONCEPT OF OPERATIONS

DRAFT Version 1.0 MONTH YEAR

This document was developed by the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG)

Approved by APANPIRG/XX and published by the
ICAO Asia and Pacific Office, Bangkok

Table of Contents

1. Overview

Concept Development

1.1 This Asia/Pacific Regional Air Traffic Flow Management (ATFM) Concept of Operations, hereinafter referred to as the CONOPS, was initially developed under a collaborative effort involving the Civil Aviation Authority of Singapore and research and industry partners, and further developed through expansion of the stakeholder group to include other ANSPs (AEROTHAI, Department of Civil Aviation Malaysia, Hong Kong Civil Aviation Department), IATA and major airlines.

1.2 The Concept was tested in a series of Human-in-the-Loop (HITL) simulation exercises held at the Singapore Aviation Academy. It is based upon operationally proven *ATFM Measures* or Traffic Management Initiatives (TMIs), used to more efficiently manage delays incurred by all aircraft arriving at a constrained resource, such as an airport or a sector of airspace, regardless of their point of departure and including flights controlled by ANSPs outside the control authority of ATC at the constrained resource.

Fundamental Concept of ATFM

1.3 Central to this CONOPS is the fundamental concept of balancing air traffic demand and capacity. While ANSPs and airport operators should strive to increase and optimize airspace and airport capacity to meet demand, traffic growth, surges in traffic and capacity constraining events cause imbalances. TMIs that may be utilized include *inter-alia* strategic landing slot allocation, miles/minutes in trail, level capping, re-routing and tactical airport slot allocation.

1.4 Implementation of effective ATFM improves predictability, reduces fuel burn and operating costs, reduces pilot and ATC workload, and improves and maintains safety.

ATFM and Collaborative Decision-Making

1.5 The Collaborative Decision Making (CDM) process, a key enabler of ATFM, allows all of its subscribing members, called CDM stakeholders, to participate in decisions that affect them after all relevant information has been made available to them. This applies to all types of decisions in the strategic, pre-tactical, and tactical phases.

1.6 **Figure 1** illustrates the integration of CDM into ATFM functions. The flow shows the independent evaluation of capacity and demand for the resource, the monitoring of the demand and capacity, the evaluation of TMIs, the involvement of stakeholders through CDM, and the execution and updating of the TMI. Core functions of shared situational awareness and post-operations analysis are supported across all functions.

1.7 Using the available data, demand and capacity are monitored throughout the day with close communication with other resource managers to identify any imbalances. Flow Managers have tools in order to evaluate various TMIs before implementation. Once a TMI is implemented, Aircraft Operators perform CDM actions, such as substitutions, to optimize their operations while the Flow Manager monitors the effectiveness of the TMI.

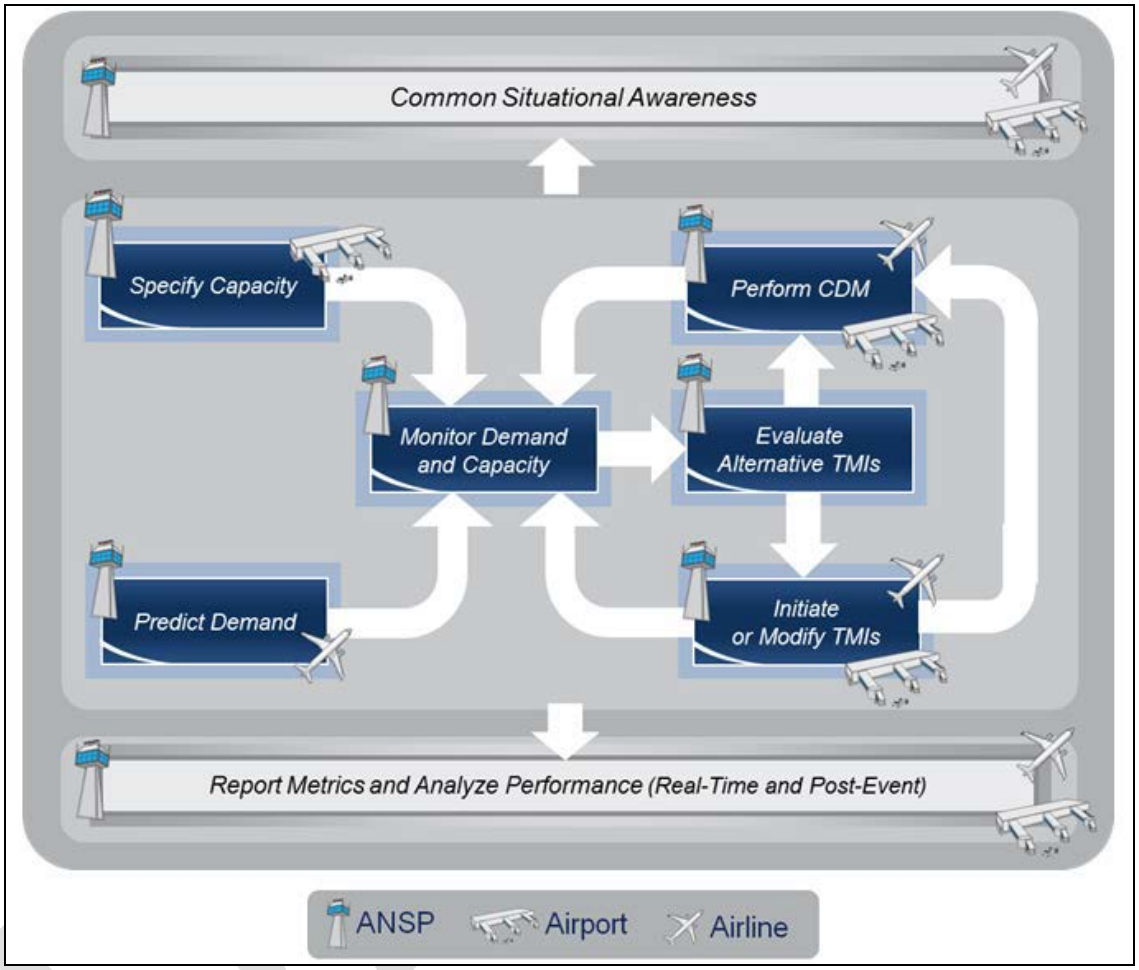

Figure 1: ATFM/CDM Functions

2. Scope

2.1 This document presents the Asia/Pacific Regional ATFM Concept, supporting demand and capacity balancing for airports and airspace within the Asia/Pacific Region. The Concept includes existing ATFM/CDM principles, and a new Traffic Management Initiative (TMI) concept that complements conventional Ground Delay Programs (GDPs). Collaborative Decision-Making

2.2 (CDM) is a key component of the Concept and is covered throughout the document. The Concept may be applied to any airport or airspace within the Asia Pacific region or elsewhere, especially in those airports or airspace servicing significant numbers of international flights.

Document Overview

2.3 The document first discusses current operations, providing the justification for the Regional ATFM Concept. The proposed concept is then provided, followed by an operational scenario illustrating the concept, and finally the expected benefits.

2.4 The concept will affect each stakeholder differently. The specific roles of each stakeholder group are detailed; Flow Management Position (FMP), Aircraft Operators, Airport Operators, the ATC Tower, and the ATC Area Control Center roles are explained in Section 4.

The document has the following Sections:

- **Section 3 - Current Operations**, describes the current state of ATFM operations in Asia Pacific and the associated need for improvement.

- **Section 4 - Proposed Concept – Regional ATFM**, provides a detailed description of the concept, including assumptions, core capabilities, stakeholder responsibilities, and policy considerations. The section first describes the parts of the concept that must be consistent for any implementation of Regional ATFM. Implementation considerations, adaptable according to the needs of individual ANSPs are also described.

- **Section 5 - Operational Scenario**, illustrates an example of the step-by-step procedures for handling a given capacity reducing event, following the Regional ATFM Concept.

- **Section 6 - Expected Benefits of Proposed Concept**, presents a summary of the expected benefits resulting from the implementation of the proposed concept.

3. Current Operations in the Asia/Pacific Region

3.1 ANSPs in the Asia/Pacific region currently have limited ATFM/CDM procedures in place to manage the traffic flows within their areas of responsibility. There are also very few regional agreements to manage traffic flows between ANSPs. Asia/Pacific stakeholders do have some tools and processes to monitor and predict resource utilization, but the predictions are not always accurate, automated, or shared among regional stakeholders.

3.2 Strategic balancing of capacity at airports in the region is currently undertaken through the airport slot allocation process. During the pre-tactical and tactical ATFM phases[1], balancing of arrival demand with the available capacity at airports is mostly reactive in nature.

[1] Strategic, Pre-Tactical and Tactical ATFM Phases are defined in ICAO Doc 9971 – *Manual on Collaborative Air Traffic Flow Management*

Planning TMIs ahead of time is difficult because the demand data are not generally accurately predicted and there is limited control of departures. As a result, most of the demand balancing is carried out by ANSPs within their own area of responsibility through tactical flow management with the support of arrival management systems (AMAN). This reactive management of demand often results in inefficient means of balancing flows, such as airborne holding and vectoring.

3.3 A challenge in terms of implementing more advanced ATFM systems within the region is the high percentage of international traffic. This characteristic poses a challenge to implementation because initiatives such as Ground Delay Programs (GDPs) assign flights Calculated Take Off Times (CTOTs) with which they must comply. In current ATFM implementations, flights departing from airports outside of the ANSP's controlling authority operate as they originally intended, without absorbing all of the delay. Because of the unique characteristics of the Asia Pacific region a new cross-FIR boundary concept is proposed to overcome this challenge and effectively apply ATFM measures to flights operating into constrained airports and airspace, while operating from airports or in the airspace of a different control authority.

3.4 There are, however, several ANSPs in the region with significant domestic traffic, such as in Australia and Japan, where GDPs are effective with only domestic traffic operating in accordance with assigned slots. International collaboration for demand and capacity balancing has been demonstrated by such initiatives as the Bay of Bengal Cooperative Air Traffic Flow Management System (BOBCAT).

Bay of Bengal Cooperative Air Traffic Flow Management System (BOBCAT)

3.5 BOBCAT is a secure web-based computer system used to manage westbound aircraft operating through Afghanistan airspace from South and Southeast Asia to Europe during the busy nighttime period.

3.6 As a result of the lack of Communication Navigation Surveillance (CNS) facilities and military operations aircraft flying through this airspace are subject to restrictive separation requirements. In 2006 ICAO, upon request of IATA, formed a task force to implement a solution to the restrictions placed on aircraft flying through Afghanistan airspace. AEROTHAI consequently developed a web-based solution which was implemented in July 2007.

3.7 BOBCAT assigns take-off times (departure slots) and levels for flights crossing the Kabul FIR based on Aircraft Operator requests. The request period is specified and the slot allocation occurs based on the existing requests. Aircraft Operators can request adjustments to the slot allocations based on their operational need and availability.

3.8 Some of the benefits realized since implementation of BOBCAT are:

- Regularity of departures
- Orderly Afghanistan entry
- Optimal FL achieved (80 – 90% in Afghanistan)
- Reroutes and technical stops eliminated
- Reduction of Air Traffic Control Officer and flight crew workloads
- Environmental Outcomes (Annual, based on IATA estimates in 2007):
  - Estimated Airline Cost Savings: US$86 million
  - Estimated Fuel Savings: 85,000 metric tonnes

- Estimated Emissions Savings: 356,000 metric tonnes

ATFM in Australia

3.9 Airservices Australia has an automated ATFM system where projected demand and capacity are balanced through the implementation of TMIs, predominantly GDPs, and the assignment of ATFM slot times to aircraft. Aircraft Operators are advised of flight-specific off-block times at the domestic departure airports. These off-block times are calculated to deliver aircraft to the destination airport at the allocated arrival slot time. The ATFM system is used for pre-tactical and tactical planning and managing the arrival flows associated with the major Australian airports of Sydney, Melbourne, Brisbane, and Perth. The system offers effective pre-tactical and tactical decision support for managing demand-capacity imbalances and reducing air traffic saturation. CDM is supported through flight schedule updates, shared situational awareness, and schedule management (e.g., substitutions and cancellations).

ATFM in Japan

3.10 In 2005 the Japanese Civil Aviation Bureau (JCAB) established the Air Traffic Management Center (ATMC) by recomposing the existing ATFM Center to act as the leading and central function in order to drive forward Japanese Air Traffic Management (ATM). Through this office they are developing and implementing typical ATFM measures such as GDPs with slot swapping capability, re-routing, miles/minutes in trail, and Specifying Calculated Fix Departure Time for Arrival Spacing Program (SCAS). The ATMC has implemented CDM practices through twice yearly stakeholder meetings and making available dynamic capacity changes every hour using web-based information sharing.

4. Concept – Regional ATFM

4.1 The regional concept was developed specifically for ANSPs in the Asia Pacific region, but could also be implemented in other regions. The Asia/Pacific region is comprised of independent ANSPs, each with ATM authority for their respective FIR and no overarching authority for the entire region such as EUROCONTROL in Europe. The ATFM Concept for the Asia/Pacific Region is based on a model of distributed authority throughout the region. Each individual ANSP will be responsible for issuing TMIs to balance demand with capacity for airports and airspace within their FIR. Aircraft Operators will adhere to the ATFM policies, rules, and guidelines as defined by the ANSP. Other stakeholders support each ANSP's ATFM measures as further described in this CONOPS.

4.2 The Concept is described from the perspective of a single ANSP managing the flow of traffic to their arrival airports. These individual ATFM systems will communicate to ATFM systems in other ANSPs, providing the stakeholders with network-wide information.

Concept Overview

4.3 ICAO Doc 9971 – Manual on Collaborative Air Traffic Flow Management is the foundation of the Regional ATFM concept. While this document provides guidance for harmonizing ATFM concepts across the world, different States and Regions still have the flexibility to devise policies and procedures to suit their individual circumstances. The concept for Regional ATFM considers the unique characteristics of the Asia/Pacific Region, such as high international traffic volume from a wide variety of aircraft operators, and the large number of small FIRs.

4.4 Within the region there is a need to balance demand against capacity at airports with a high concentration of international traffic (e.g., Changi in Singapore, Chek Lap Kok in Hong Kong, and Bangkok-Suvarnabhumi) during the pre-tactical and tactical phases. In the majority of ANSPs that have advanced ATFM capabilities implemented, GDPs are used to effectively match the demand

with the airport capacity by redistributing the demand by issuing departure times to flights operating within the control authority of the ANSP. This trades airborne holding for ground delay, which is the fundamental benefit of a GDP. The Regional ATFM concept adopts the GDP as the foundation of operations, but with several key differences.

4.5 One of the parameters for a GDP is the scope of non-exempt and exempt flights. Exempt flights are considered in the demand but are not expected to respond to an ATFM control time. Reasons for exempting flights include flights departing outside of a certain distance or international flights1. The longer flights are typically exempted when a GDP is implemented due to a capacity reducing event that has potential to be cancelled early; if many flights are airborne at the time the TMI is cancelled, they will have absorbed delay that cannot be recovered. International flights are normally exempted from GDPs because ANSPs do not have the authority to delay flights departing from airports outside of their control, and due to the fact that international flights generally travel longer distances. However, the Regional ATFM concept, which aims to address cross-border ATFM, includes short- and long-haul international flights to achieve optimised demand/capacity balancing at constrained resources.

4.6 When a GDP is implemented, exempt flights are assigned to slots first, followed by non-exempt flights—meaning exempt flights will receive minimal delay. Even though exempt flights are issued a slot, they are not required to absorb any delay assigned by the GDP. As a result, it is important to have sufficient “participation” (i.e., a high volume of non-exempt flights) in order to implement a fair and effective GDP.

4.7 ANSPs set the rules by which flights are exempted based on agreements with airlines, ANSPs, or airports. One of the main challenges for the Asia Pacific region is achieving agreements with enough stakeholders to issue effective GDPs. ATFM/CDM models in other parts of the world only include domestic traffic in TMIs (GDP and ground stop [GS]). In the case of Singapore, Hong Kong, and other major hubs in Asia Pacific, where all traffic is international, this model cannot be applied.

4.8 Data analysis studies were conducted for Singapore’s Changi Airport to estimate the percentage of non-exempt traffic needed to implement effective programs. Based on the analysis and operational experience in the U.S., South Africa, and Australia, a participation level of 75% is desirable for effective and equitable AFTM using existing GDP principles (see Attachment B for a summary of the Singapore participation case study).

4.9 The Regional ATFM concept consequently requires participation from many departure airports, ANSPs, and airlines to achieve a high level of non-exempt flights. For this reason, one of the fundamental principles of the Regional ATFM concept is providing Aircraft Operators (i.e., airlines) the ability to specify their delay absorption intent between ground delay and airborne flying time adjustments to achieve their assigned ATFM arrival slot. This overall flexibility is expected to increase participation by giving long-haul flights the ability to take their delay in the air, where the delay can be recovered if the program is canceled early. Also, flights that are airborne at the time the program is implemented will be able to absorb program delay in this concept, further increasing participation.

Delay Absorption Intent

4.10 One unique aspect of the Regional ATFM concept is that instead of flights being required to take all of the delay on the ground, Aircraft Operators can choose how to distribute the delay assigned by the TMI throughout various phases of flight. The three delay intent fields are described below.

- **Gate Delay Intent:** Delay intended to be taken while parked at the gate. By default, pre-departure flights are assumed to take all program delay at the gate. Before the flight pushes back, the Aircraft Operator has the ability to move all or a portion of the delay to the Airport Surface Delay Intent and/or the Airborne Delay Intent.

- **Airport Surface Delay Intent:** Delay intended to be taken between pushback and takeoff. This allows for flights to plan taking additional ground delay in cases where the airport or ATC requires the parking stand to be vacated prior to the absorption of all intended ground delay.

- **Airborne Delay Intent**: Delay intended to be taken efficiently during the cruise portion of flight. For flights that are airborne or will soon be airborne when the TMI is implemented, all of the program delay is assigned to the Airborne Delay Intent. The ability to absorb program delay in the air is not part of any current operational ATFM system.

4.11 **Figure 2** illustrates the opportunity for absorbing delay in various phases of flight.

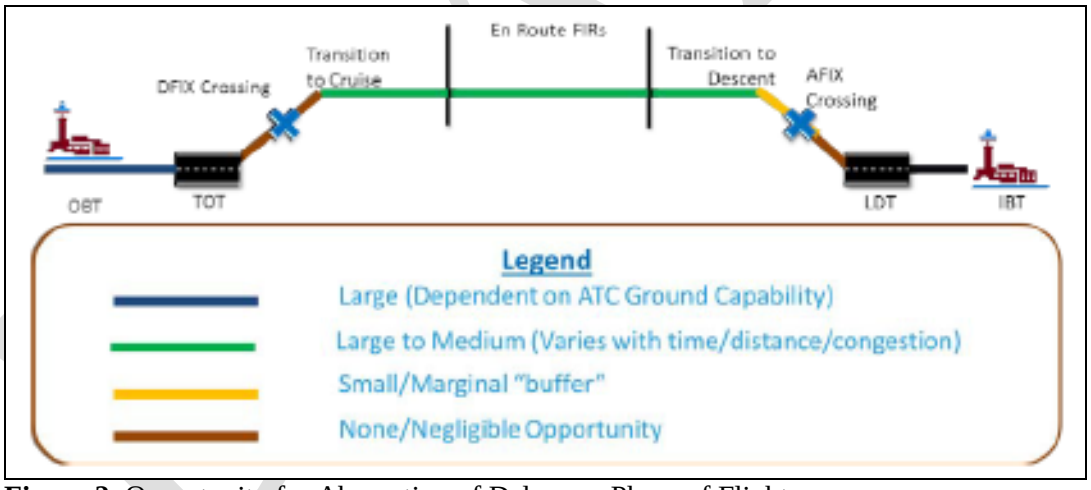

Figure 2: Opportunity for Absorption of Delay per Phase of Flight

4.12 Permitting flights to absorb ATFM program delay in the air can increase the number of flights participating in the program. In current ATFM systems GDPs generally exempt longer distance flights (e.g., flights traveling more than 2000 NM) due to risk of such flights taking unrecoverable delay; these flights could absorb delay on the ground, depart, and then the constraint at the arrival airport does not materialize, meaning that the flight absorbed delay unnecessarily.

4.13 Under the Regional ATFM concept these longer flights can fly at a slower speed without any increase in fuel burn. For example, one study has shown that a flight between Rome and Paris can decrease its cruise speed by about 6% without changing altitude or fuel burn (**Figure 3**). The risks of long haul flights either taking unrecoverable delay or not participating in the ATFM program are decreased.

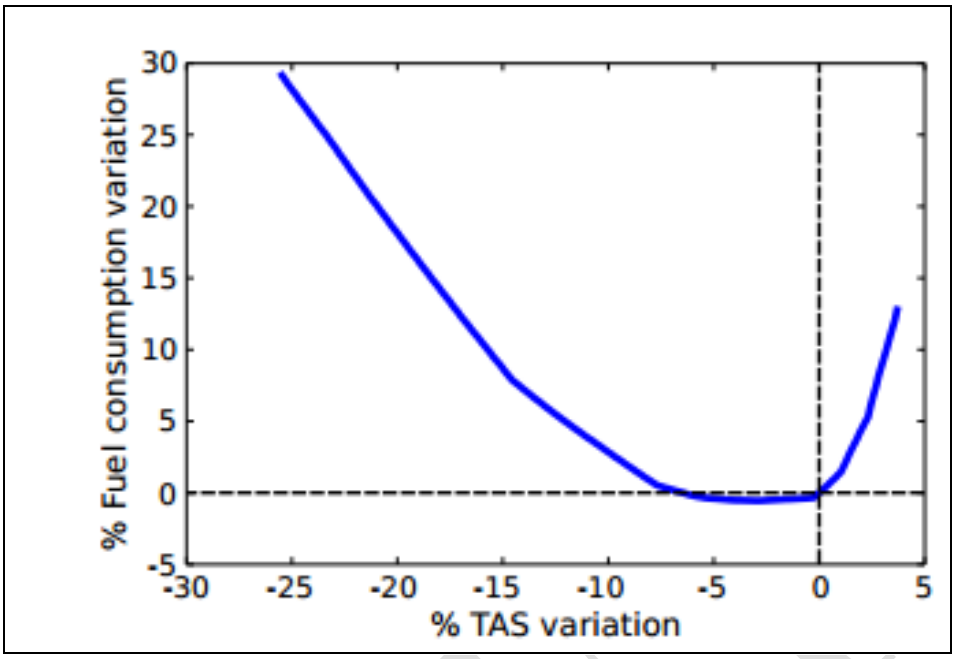

Figure 3: Fuel consumption variation for A320 Rome-Paris, F320, Mach 0.78, Cost Index 25 [Muñoz 2013]

4.14 Aircraft Operators may notify their delay intent by using one of two methods:

- via a web-based interface; or
- via a new flight plan or flight plan amendment.

4.15 When using the web interface, the Aircraft Operator directly enters the delay intent fields demonstrated in **Figure 4**. The aircraft operator may apportion some or all of the total delay to any of the three fields.

4.16 If the flight plan method is used the ATFM system infers the Intended Gate Delay and Intended Airborne Delay based on the filed Estimated Off-Block Time (EOBT) and filed Estimated Elapsed Time (EET) extracted from the new or amended flight plan.

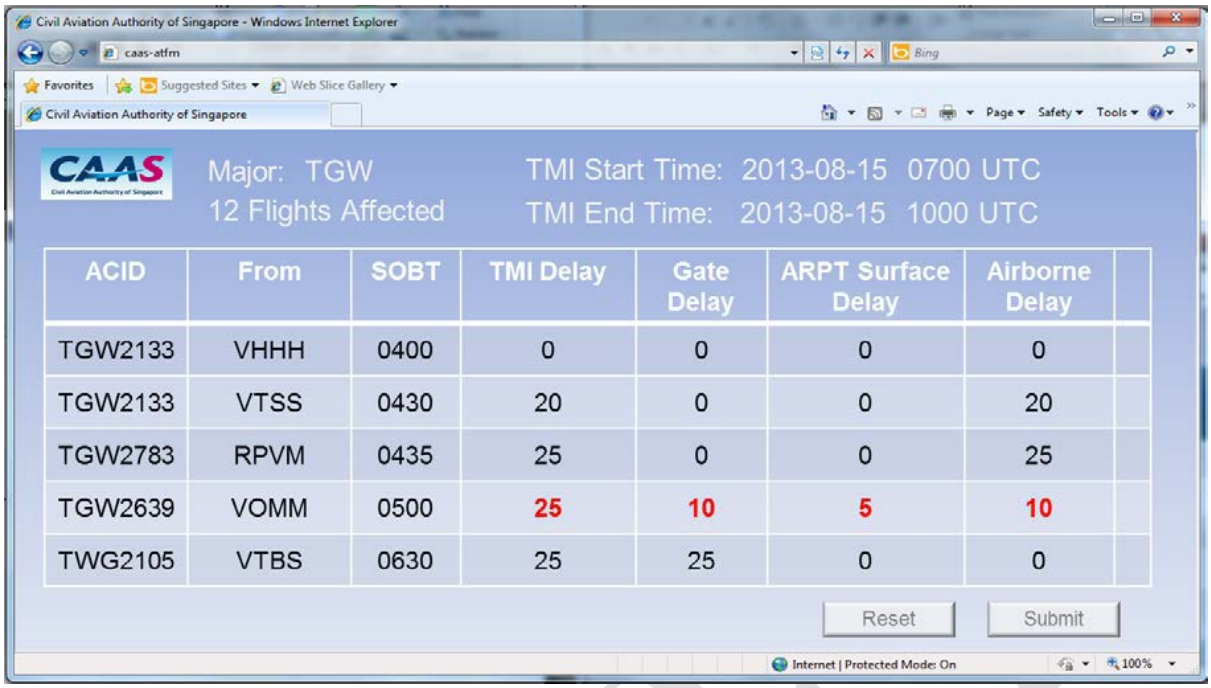

Figure 4: Example of web-based interface for delay absorption intent.

4.17 If the flight plan method is used to submit delay intent, en-route ATC will be aware of the flight-planned cruise speed and will control the flight appropriately. Flights that specify airborne intent via the web interface are expected to communicate their intended cruise speed to en route ATC as a request per current ATC procedures. ATC will continue to control the flight as done in current operations but may assist the pilot in meeting their intended airborne delay. This approach minimizes the required training and involvement of en-route ATC for deployment of this Regional ATFM concept. Involvement of en-route ATC is a future consideration for the concept.

4.18 Since many of the major airports in the APAC region are IATA level 3 Slot Controlled Airports, much of the work to balance demand and capacity in the strategic ATFM phase is already taking place. This process requires a rigorous analysis of the airport operations in order to determine the capacity of the airport. The scheduled demand is usually coordinated during bi-annual IATA Slot Conferences.

4.19 Airport Strategic Slot information is used by the ATFM process to transition from the strategic plan to the pre-tactical plan, then to the tactical plan on the day of operations. The flight data from the Strategic Slots is loaded in the ATFM System by the Aircraft Operators or ANSP at least one day prior to the day of operations. Figure 5 shows a sample of the type of demand graph that should be available to the relevant stakeholders to easily identify periods of demand-capacity imbalances and decide whether or not an initiative must be implemented.

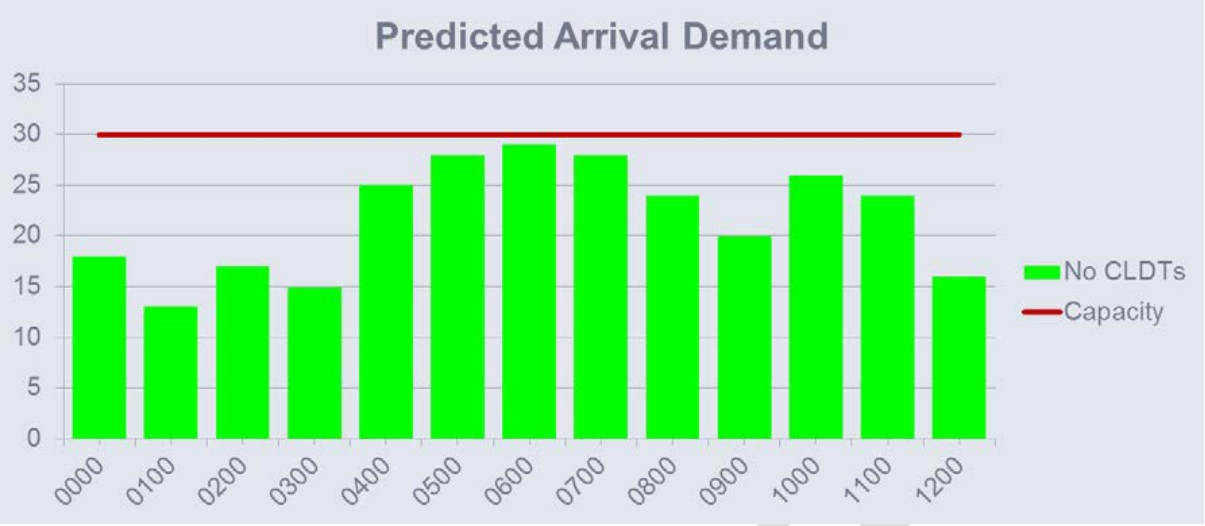

Figure 5: Example of capacity and demand

4.20 The stated capacity may change throughout the day due to operational factors or forecast weather. Capacity rates can be loaded into the ATFM system to reflect the capacity during a certain time period. For example, runway configuration changes could vary the rates in a predictable manner.

Initiating a TMI

4.21 The Flow Management Position (FMP) continuously monitors the demand and capacity. When the current or predicted demand exceeds the capacity, the FMP will determine whether or not an ATFM program is needed based on the severity of the demand-capacity imbalance as well as feedback from CDM stakeholders. Prior to implementing TMIs under an ATFM program, the FMP and CDM stakeholders will have the ability to model with different parameters, including:

- TMI start and end time
  - Flights with estimated landing times within the start and end time of the program will receive ATFM slots
  - Non-exempt and exempt flight criteria
- Exemption criteria by: airline, airport, distance from arrival airport, or flight
  - Airborne Exemption Horizon: Flights that are airborne when the program is initiated and expected to land within the Airborne Exemption Horizon are exempt from the program
- Airport Acceptance Rate (AAR)
  - Number of aircraft that can land at the airport in a given time bin based on the predicted conditions

- Required Notification Time

    - When a TMI is run, pre departure flights that are expected to depart sooner than the Required Notification Time will have a default delay intent to absorb all of their delay in the air

4.22 The FMP will evaluate if the demand is sufficiently smoothed and also consider the average delay, maximum delay, and number of affected flights to determine the impact of the ATFM program. Once the optimal parameters are set, the FMP runs the program and slot times are sent to Aircraft Operators, air traffic control towers, and other stakeholders.

Maximum Delay

4.23 Included in the concept it is the acknowledgement that certain flights will have a limited amount of delay that can be absorbed. For example, an active flight cannot absorb any delay on the ground and will only be able to efficiently absorb a limited amount of delay in the air based on remaining flying time. Also, flights may have a limited amount of delay they can absorb on the ground due to constraints of the departure airport. For example, if some airports have very high gate utilization and very few holding areas, the amount of ground delay for a flight will be limited.

4.24 To address this, the concept includes a component termed Maximum Delay. Maximum Delay is made up of three parameters: *Maximum Gate Hold*, *Maximum Surface Hold*, and *Maximum Airborne Adjustment*. The Maximum Gate Hold can be provided by the associated departure Airport Operator and the Maximum Surface Hold can be provided by the departure tower. Both of these parameters can be set by time frame and by departure terminal. The Maximum Airborne Adjustment is estimated by the ATFM system considering the distance between the departure and arrival airports or remaining flying time for airborne flights.

4.25 The use of the Maximum Delay concept can be tailored for implementation based on the needs of individual ANSPs. The considerations for the use of Maximum Delay are presented in paragraphs 4.76 and 4.77.

Collaborative Decision-Making

4.26 A key benefit of the Regional ATFM concept is an increase in collaboration that must take place in order to have an efficient and effective Regional ATFM concept. Through the ATFM System, stakeholders will be given a broader view of system constraints that might affect their operation with enough lead time to create a plan of action. This increased situational awareness will facilitate stakeholder collaboration in deciding a course of action.

4.27 Aircraft Operators are given the flexibility to manage their allocated ATFM delays in order to best meet their business objectives. Aircraft Operators will have the capability to substitute slots between any two flights that they operate. This can be done to reduce the delay of a high priority flight or move a delayed flight (e.g., mechanical delay, crew delay, or delay from a prior flight segment) into a slot that it can meet.

4.28 Aircraft Operators also have the ability to substitute flights into a later slot even if they don’t have another flight that they operate to swap into the earlier slot. This is called an Inter-operator Slot Exchange. The flight requesting a later slot submits the earliest time that it can operate and the system automatically selects one or more flights to move forward. Notifications are then sent to the Aircraft Operators that have flights which had their delay reduced, known as *bridged flights*.

Compliance

4.29 Non-exempt flights will be measured for compliance based on their allocated slot

times versus actual time of operation. Medium and long range flights which have the ability to absorb some delay in the air are measured for compliance with reference to the calculated time over (CTO) an arrival fix (AFIX). Short haul flights that do not have the ability to efficiently absorb a significant amount of delay in the air may instead be measured for compliance with either their actual off-block time (AOBT) or actual take-off time (ATOT).

4.30 For ATFM measures relating to airspace demand and capacity balancing, compliance may be measured against the CTO at an en-route fix (RFIX).

4.31 Compliance is measured at a fix rather than at landing as flights have more control over meeting a fix crossing time prior to initiated tactical ATC sequencing into the arrival airport. ANSPs specify the fixes that are to be used both for TMIs and measuring compliance. Flights will attempt to arrive at this fix within a compliance window.

4.32 Exempt flights are not considered for compliance measurement. These exempt flights are determined by the FMP for a given program and could include flights outside a given radius, flights departing from certain airports, and special case flights, for example very-very important person (VVIP) flights. These flights will be assigned a slot time, which may involve some delay, but the flights will not be expected to comply with their assigned delay.

4.33 Additionally, flights will be filtered from compliance consideration in cases where the Aircraft Operator is not at fault. For example, if the pilot does everything in their control to meet assigned slot times yet the flight arrives early or late due to an ATC constraint, then the flight will not be considered non-compliant.

4.34 ANSPs have flexibility to develop their own policy and procedures for the handling of non-compliant flights. The considerations for the alternatives are explained in paragraphs 4.71 to 4.75.

4.35 Measuring and sharing of compliance statistics must be part of every implementation of the Regional ATFM concept.

Post-Operations Analysis

4.36 A key component of the ATFM system as a data-sharing platform is the analysis capability enabled to study the effectiveness of ATFM programs and TMIs, and to establish trends over time. Post-operational analysis is indispensable for the FMPs to improve the parameters in the TMIs to achieve the desired outcome. The results of these analyses can be shared among FMPs in the region and “best practices” can be established.

4.37 The metrics used for post operations analysis are listed in the tables below. **Table 1** lists the general scenario metrics, which are used to measure the severity of events that occurred, the TMI parameters selected to resolve the issues, and the impact of the TMI on stakeholders during a given time period. **Table 2** lists the CDM action metrics, which are used to determine how active the Aircraft Operators were in managing their flights.

Metric	Description	Type
Number of Flights	The total number of flights that received calculated times	TMI Parameter
Start/Stop Time	The Start and End time of the TMI. The time period when the FMP wanted to control the demand	TMI Parameter
Lead Time	The number of minutes the TMI was implemented before the Start Time	TMI Parameter
Number of Exempt/ Non-Exempt flights	The number of flights that were exempt from the TMI according to the parameters specified by FMP	TMI Parameter
Number of TMI Events	The number of FMP actions that reassigned flights in the TMI (i.e., number of revisions and compressions)	Operational Activity
Total Assigned Delay	The sum of the delay assigned by the TMI	Operational Impact
Max/Average Assigned Delay	The maximum and average delay	Operational Impact
Total Gate/Surface/Airborne Delay	The total actual delay taken at the gate, on the airport surface, and in the air	Operational Impact
Number of Cancellations	The number of flights canceled and were part of a given TMI	Operational Impact
Number of Unexpected Flights	The number of flights that appeared after the TMI was already implemented	Operational Impact

Table 1: General Scenario Metrics

Metric	Description
Number of Substitutions	Total number of flights that were substituted
Number of Inter-Operator Slot Exchanges	Total number of ISEs
Number of Bridged Flights	The number of flights that were bridged
Number of Cancellations	Total number of canceled flights for a given time period
Substitution Savings	The amount of the savings in minutes of flights that move forward as a result of a substitution
Bridging Savings	The amount of the savings in minutes of flights that move forward as a result of being bridged

Metric	Description
Number of Delay Modifications	Number of modifications made by the Aircraft Operator to their flight event times to show flight would be delayed
Number of Delay Intent Modifications	Number of modifications made by the Aircraft Operator to their delay intent values

Table 2: CDM Action Metrics

4.38 Compliance metrics are useful for reviewing the effectiveness of a TMI and finding systemic hindrances on the effectiveness of TMIs. There are many ways that users can view compliance metrics. For example, in **Figure 6** compliance is compared at various points in flight progress. The different colors in the pie chart show different levels of compliance, where orange and red are different degrees of late and blue and dark blue are different degrees of early.

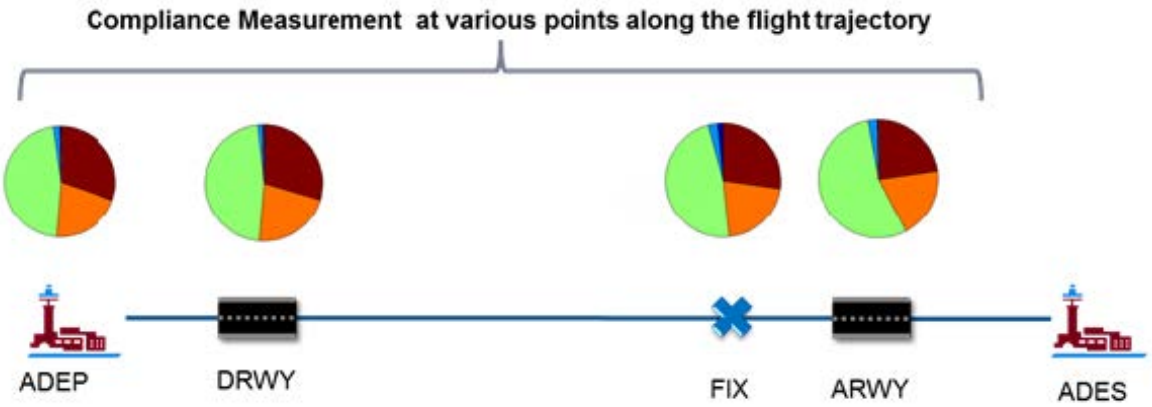

Figure 6: Compliance Metrics

Stakeholder Roles and Responsibilities

4.39 With the exception of the FMP, Regional ATFM stakeholders are the same as in the flight and ATM operations, but with added roles. First of all, stakeholders will collaborate on a daily basis in order to ensure the smoothest operations. This communication is done by sharing data with the ATFM System as well as during teleconferences chaired by the FMP. This communication will lead to a common view of the most accurate demand and resource capacities. When multiple ANSPs have implemented this concept, the teleconferences may exist at one or more levels of stakeholder participation to provide the necessary information to all stakeholders in the region.

4.40 In addition to increased communication among the stakeholders, each stakeholder group has specific changes that result from the concept, described as follows:

Flow Management Position

4.41 Upon implementation of Regional ATFM, an FMP position will need to be established within each ANSP. FMPs will be part of a new flow management unit that is responsible for managing the operation of the ATFM system and the associated CDM processes within the ANSP.

4.42 The main responsibility of the FMP is to monitor the demand by viewing flight data from the ATFM System and comparing that to the arrival capacity of the airport(s) in their jurisdiction. The FMP collaborates with relevant stakeholders to update the capacity (i.e., AAR) when there is a constraint such as predicted weather or resource maintenance/outage. Whenever the predicted demand exceeds the capacity, the FMP must determine the best solution for the problem, which will likely involve implementing a TMI. The FMP will have the ability to model various initiatives to smooth the imbalance and, in coordination with local stakeholders, select the solution that causes the least operational impact. Additionally, if multiple ANSPs in the region have an ATFM system, the FMP may coordinate with FMPs of other ANSPs to establish the best regional solution taking all the regional requirements into consideration. While ANSPs may have different ATFM systems, they will transmit and receive data in a common way, thereby enabling all regional FMPs to share the same operational information.

4.43 Once the ATFM program is run, the FMP will monitor the performance of the program. The FMP has the ability to revise a program if any of the parameters need to be changed.

The FMP also has the ability to perform a compression (optimizing slot allocation) on a program to reassign flights to slots and to fill in any empty slots. Both of these actions involve having new slot times assigned and sent to the Aircraft Operators; therefore, these FMP actions are limited to operational need based on updated flight data or capacity information.

4.44 The FMP will also be responsible for chairing scheduled and ad hoc teleconferences. Scheduled teleconferences will likely be held daily in the morning and afternoon. The daily airspace plan will be discussed and could include: demand anticipated during the day, weather forecasts and constraints, resource availability/non-availability, special use of airspace, Aircraft Operator operations, proposed TMI modeling and implementation, and post-event analysis. Ad hoc teleconferences can also be held should circumstances dictate a need.

Aircraft Operators

4.45 Aircraft Operators will see changes in the way they manage their flights due to the redistribution of inevitable delay. When a demand and capacity imbalance is predicted, an ATFM program will shift the delay from the more costly airborne holding delay to the more efficient ground delay or airborne adjustment. Both the Flight Operations Center (FOC) and pilot need to be aware of the assigned TMI and work to comply with it in order for the concept to be effective and equitable.

4.46 An additional role of the Aircraft Operator is to provide the demand inputs into the ATFM System in the pre-tactical and tactical time frame. These data could include flight schedule uploads and flight plans. As the time to operate the flight approaches, the Aircraft Operator can update flights' EOBT (e.g., flights delayed due to mechanical issue) through the ATFM System, making the changes visible to all stakeholders.

Note: Delay information input to the ATFM system does not replace the aircraft operator or pilot-in-command obligation to file delay, amendment, or cancellation and new FPL information, as specified in ICAO Doc 4444 PANS-ATM and State AIP.

4.47 When an ATFM program is implemented, Aircraft Operators have the flexibility to prioritize flights within the pool of slots they have been assigned and to specify the intended delay distribution for their flights. The FOC will communicate this delay intent to pilots and the flights will be measured for compliance with the slot times, as described in paragraphs 4.71 to 4.75.

Airport Operators – Departure Airports

4.48 Airport Operators will be impacted by implementation of a TMI as a departure flight may elect to take ground delay at the gate or between pushback and departure, which affects gate allocations and movement area and apron and taxiway usage. The Airport Operators' main involvement in the regional concept is to coordinate with Aircraft Operators for absorbing delay on the ground whenever necessary.

4.49 Where airport terminal (gate) capacity is constrained Airport Operators may submit Maximum Gate Delay values to the ATFM system, as described in paragraphs 4.24 to 4.26.

Airport Operators – Arrival Airports

4.50 Airport Operators will be responsible for advising the FMP on capacity constraints predicted at the airport. They will be expected to participate in scheduled and ad hoc teleconferences. The Airport Operator will advise the FMP should the TMI have an adverse effect on operations at the monitored airport.

Airport Collaborative Decision Making (A-CDM) Interface

4.51 A-CDM systems should interface with the ATFM system, using the Regionally agreed terminologies relevant to both ATFM and A-CDM; CTOT and calculated landing time (CLDT).

ATC – Departure Tower

4.52 The Tower ATC can facilitate compliance with ground delay intent as far as operational constraints allow. With access to the flight-specific intended takeoff time, Tower ATC staff can assist flights to have a compliant departure.

4.53 In addition, the Departure ATC Tower can coordinate where to best place the flights if the aircraft are to be held on the movement area in order to absorb the ground portion of the delay.

4.54 Lastly, the Tower can submit Maximum Surface Delay values to the ATFM system, as described in paragraphs 4.24 to 4.26. The ATFM system should flag Maximum Surface Delay values input by ATC to identify where ATC or airport surface capacity constraint results in non-compliance with a TMI.

ATC – Arrival Tower

4.55 The ATC Tower supervisor will be required to keep the FMP advised of constraining events at the airport. The Tower supervisor will be required to participate in teleconferences so as to add to the pre-tactical and tactical CDM processes. In addition the tower supervisor will be required to tactically determine the AAR and advise the FMP if any change in the AAR is required.

ATC – Area Control Centre (ACC)

4.56 En-route ATC units and centres will have no requirement to change their operational procedures to accommodate flights subject to a TMI. Pilots may request an altitude or speed change in order to comply with their delay intent distribution. The ATC will follow normal ATC operating procedures before approving these changes. Education on the fundamental principles of the Regional ATFM concept will serve to increase controllers' awareness.

4.57 Terminal Area (TMA) ATC unites in certain implementations of ATFM may have the authority to de-prioritize non-compliant flights. This model can be adopted but requires compliance status of flights being available to ATC. Adding this function to the terminal ATC depends on the ANSP's decision made in terms of compliance handling described in paragraphs 4.71 to 4.75.

Proposed Changes Resulting from Implementation

4.58 The following Technology and Policy changes supporting the implementation of the Regional ATFM Concept are proposed.

Technology Changes

4.59 Stakeholders will able to perform demand and capacity balancing during the pre-tactical and tactical phases with the ATFM system. Through this system the FMP can model ATFM programs with various parameter values to optimize the solution. When the TMI is acceptable to the FMP, the TMI is run and the slot times are automatically calculated and sent to the appropriate Aircraft Operators.

4.60 Common situational awareness for all the stakeholders is essential for implementing effective TMIs; the ATFM system will bring this situational awareness to ANSPs, Aircraft Operators, Airport Operators, and other stakeholders. The ATFM system will integrate various data sources with the most accurate and up-to-date operational information. Users can connect to the ATFM system to view pertinent information as well as update any changes to their operations. Efficient sharing of more accurate data leads to better decision making in a timely manner. A CDM platform is required where Aircraft Operators are able to carry out advanced CDM processes to optimize schedules.

4.61 Users will be able to access stored data for post-operations analysis. Stakeholders will be able to view metrics for any previous day of operations (for a list of metrics, refer to paragraph 4.37 Tables 1 and 2). Statistical analysis of post operations data will help identify shortfalls in operations and methods to improve operations.

Policy Changes

4.62 Policy changes associated with Regional ATFM include involvement in teleconferences, which will increase information sharing compared with current day operations. CDM stakeholders may participate in scheduled teleconferences to discuss the plan for the day as well as to review operations on the previous day. The stakeholders calling into the scheduled teleconferences include the FMP, Aircraft Operators, neighboring ANSP facilities, the ATC tower(s), and the local Airport Operator. If necessary, the FMP will coordinate with the FMPs of other regional ANSPs in a separate teleconference. The FMP may also convene and chair ad hoc teleconferences to handle unforeseen demand and capacity imbalances.

4.63 Policy in terms of data sharing will have to change with the implementation of ATFM, since sharing of data is the foundation of CDM. Aircraft Operators will have the ability to view delay metrics associated with their flights as well as aggregate metrics for all flights. ATC stakeholders will have unlimited situational awareness with regard to slot assignments. Access, security, and data integrity must all be addressed in single ATFM System instances and in the connectivity and data sharing between multiple ATFM System instances.

4.64 Aircraft Operators and third-party agencies generally measure on-time performance (OTP) by comparing flights' actual off-block times (AOBT) with their scheduled off-block times (SOBT). With the implementation of ATFM, the policy for measuring OTP should consider flights impacted by a TMI. For these flights, on-time performance should be determined by comparing flights' actual off-block times and actual landing times with their intended off-block times. This is a challenge for ATFM systems, since Aircraft Operator on-time performance is often defined by legislative action. To date, the impact of an ATFM initiative on a departure OTP metric has not been formalized.

Justification for Changes

4.65 Table 3 summarizes the major changes resulting from the Concept, and their justifications.

Change	Justification
Introduce a Flow Management Position	• A smoother transition of strategic demand and capacity balancing to pre-tactical and tactical demand and capacity balancing • A means of evaluating proposed TMIs in collaboration with the stakeholders prior to implementation • A communication position within the ANSP to keep stakeholders apprised of the operational conditions
Assign slot times to flights to manage demand-capacity imbalances	• Reduced fuel burn • Reduced controller workload • Increased predictability of operations • Enhanced safety due to reduced congestion
Aircraft Operators share flight data with ATFM system	• Accurate and common picture of demand
FMP specifies capacity	• Accurate and common picture of capacity
Aircraft Operators specify delay absorption intent	• Increased participation improves TMI effectiveness and results in a more equitable delay assignment • Increased flexibility for Aircraft Operators to manage flights • Reduced risk of absorbing unrecoverable delay
International and airborne flights participate in TMIs	• Increased participation improves TMI effectiveness and results in a more equitable delay assignment
Aircraft Operators have the ability to substitute flight slots	• Flexibility for Aircraft Operators to manage flights based on their business models
Airport Operators and ATC Tower specify Maximum Ground Hold	• Increased situational awareness - Aircraft Operators: aware of flights which may have received more delay than they can absorb - FMP: more accurate picture of when flights will actually arrive at the terminal area
Measure compliance at a fix prior to landing	• Ensure a smooth flow of traffic to the constrained airport • Move Aircraft Operator compliance point beyond tactical terminal control area.

Change	Justification
Post-Operations Reporting	• Provide a means to discover ways to improve operations
Teleconferences	• Increased situational awareness

Table 3: Changes and their Justifications Arising from the Concept

Impacts During Deployment

4.66 The participation of stakeholders has contributed to the development of the concept of operations; this participation will need to continue for successful operational deployments. This participation would include:

- Participation in stakeholder meetings establishing business rules specific to an ANSP's implementation;
- Development of operational procedures;
- Training of staff;
- Participating in operational daily and ad hoc teleconferences; and
- Active participation in data sharing and TMI execution.

Multi-Nodal Concept

4.67 The Regional ATFM concept has been described in the above from the perspective of a single ANSP. The concept readily applies to multiple ANSPs in the same region all implementing this form of ATFM/CDM. A key to the concept is that each ANSP would be responsible for implementing ATFM programs to airports and airspace within their own FIR according to the concept illustrated in this document. Information sharing between the ATFM systems would allow the users of any of the systems to have access to network-wide information. This includes Aircraft Operator access to controlled flights arriving to airports within the areas of responsibility of multiple ANSPs, and air traffic control tower access to ATFM information on departure flights destined for airspace and airports within the areas of responsibility of multiple ANSPs with CTOT and CTO reflecting delay intent from their respective TMIs. Details of the concept and procedures could be customized in each ANSP based on their individual operational requirements, but it is strongly recommended to keep the concept as consistent as possible across the region. Refer to paragraphs 4.70 to 4.78 for the details that can be adapted. **Figure 7** provides an example of three networked ATFM nodes under the Regional ATFM concept.

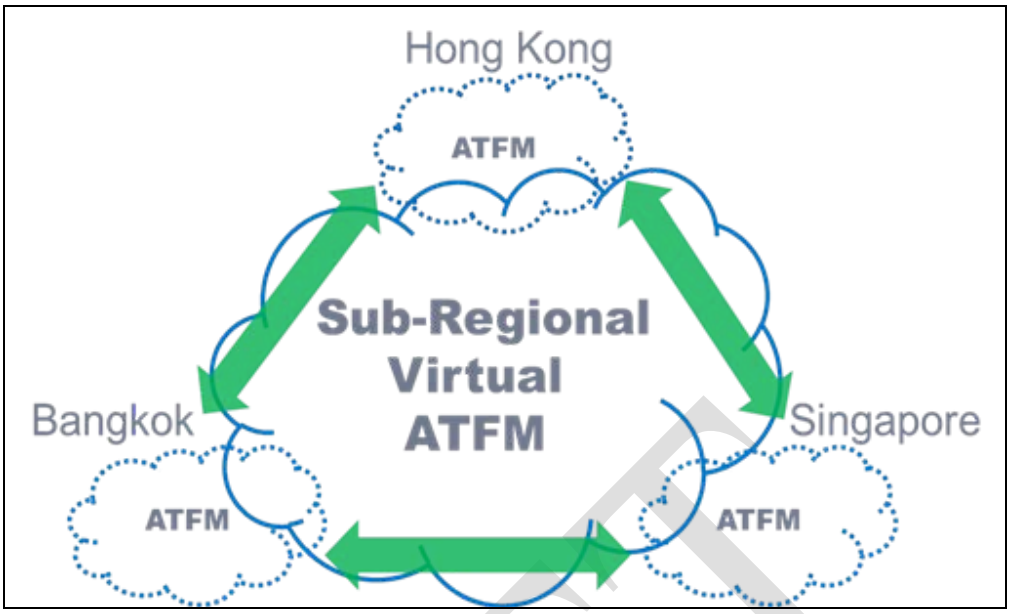

Figure 7: Distributed Multi-nodal ATFM Network

Implementation Considerations

4.68 The following concept elements can be addressed to meet the needs of a specific ANSP. The variations on the elements are described below to provide the full breadth of the concept without indicating a preference for a specific implementation.

Compliance Handling

4.69 High levels of compliance are critical for TMIs to have a predictable and efficient flow of traffic. Non-compliant flights could cause bunching in the arrival flow, requiring ATC to impose airborne holding or other tactical interventions on compliant flights. Non-compliance could consequently result in loss of trust among Aircraft Operators in the efficiency and equity of the Concept.

4.70 In current ATFM implementations ANSPs have developed a range of procedures for preventing non-compliance. The options, together with their advantages and disadvantages, ar: are presented below along with their advantages and disadvantages. Note that the options are not mutually exclusive.

- Sharing of compliance statistics with stakeholders

  - Advantages

    - Promotes CDM principles through the transparency of data;

    - Aircraft Operators will strive for high compliance to maintain/improve the airline's reputation;

    - Flights that are unable to absorb delay (e.g. VVIP flights and medical emergencies) will not be penalized for non-compliance.

  - Disadvantages

- No direct consequences for non-compliance

- Departure ATC prevents pushbacks or departures if flights will be non-compliant with their assigned CTOTs

  - Advantages

    - Little if any non-compliance with CTOTs

  - Disadvantages

    - Increased workload for ground movement controllers

    - Operational challenges associated with pilots absorbing delay at a holding pad

    - No penalty for non-compliance with intended airborne delay

- Deprioritize non-compliant flights in the arrival airspace

  - Advantages

    - Equitable amounts of delay taken for compliant and non-compliant flights

    - Compliant flights are not penalized when other flights are non-compliant

  - Disadvantages

    - Technical and procedural challenges associated with integrating ATFM system and AMAN

    - Increased workload for approach controllers

4.71 Tactically deprioritizing flights in the approach airspace would require the ANSP to define fixes outside of the approach area that would be used to measure the compliance. If the ANSP has an AMAN, it would be best to measure compliance prior to the AMAN handoff point. This would ensure smooth delivery of the flow into the AMAN, which would then be used to sequence flights to the runway. It would also provide sufficient time for a Flow Manager or supervisor to decide which flights to deprioritize if the ANSP decides to deprioritize non-compliant flights. Due to the unique geometry of the airspaces, the distance from the airport at which compliance is measured will be adapted to each ANSP.

4.72 The size of the window at which flights are considered compliant is dependent on implementation and stakeholder involvement. An asymmetric (e.g. -5, +10 minutes) window could be used because Aircraft Operators have more control over not arriving early than not arriving late. In other words, Aircraft Operators could be late due to a variety of reasons such as weather deviations or an ATC constraint. Pilots generally have enough control over the flight to prevent an early arrival.

4.73 Individual ANSPs in the region will set compliance standards within their areas of responsibility; however, a standard procedure for handling non-compliance is recommended in the region for operating consistency.

Performance Metrics and Post-Operational Analysis

4.74 The metrics for post-operations analysis described in paragraps 4.37 to 4.39 should be applied to all the ANSPs in the region because they are metrics related to the broader Regional ATFM concept and not the specific implementations. The common set of metrics will help the international ATFM community develop a method for comparison with operations around the world. In addition to those metrics, the concept allows for ANSPs to develop their own metrics and statistics particular to their operations. Some possible metrics/statistics to consider are:

- Program Delivery – Shows how effective the TMI was at balancing the capacity and demand. It compares the expected demand after the TMI was implemented with the actual demand. This is useful in identifying periods of non-compliance.
- On-Time Performance Metrics – Typically ATFM only considers whether TMIs were successful in balancing demand with resource capacity. On-Time performance represents another aspect of national airspace operations that is a good indicator of efficiency and is directly tied with impacts to the passengers. It is important to track the impacts to passengers because it gives an insight whether TMIs were able to give benefits to more passengers rather than more aircraft.
- Environmental Metrics – Shifting air delay to ground delay has a positive impact on the environment through emissions reduction. Fuel burn metrics could be developed to study and track positive impacts of implementing a TMI. The metrics could also support achieving the environmental goals any government may have.

Additional metrics could delve deeper into airport and airspace operations. They would be useful in identifying root causes of inefficiencies that have been exposed by higher-level aggregate metrics.

Maximum Delay

4.75 The implementation of the Maximum Delay to flights will be determined by each ANSP. Three options are:

1. Added as a parameter for the Aircraft Operators to compare to assigned delay
2. Incorporated into FMP demand predictions
3. Maximum Delay is incorporated in slot assignment

4.76 The first use will help Aircraft Operators manage their flights by ensuring the assigned delay is not greater than the Maximum Delay via delay intent adjustments and substitutions. The second use will help the FMP determine the effectiveness of a modeled TMI. For example, if many flights are receiving more delay than their Maximum Delays, the FMP could increase the participation to reduce the average delay of participating flights. Maximum Delay during slot assignment could limit the delay assigned to flights such that their assigned delay is less than or equal to their Maximum Delay. This approach is not recommended for an initial implementation, because it requires very accurate calculations of Maximum Delay.

Future Considerations – Role of En-route ATC

4.77 **Role of En-Route ATC**: The Concept of Operations states that the FOC will communicate delays associated with TMIs to their pilots. If the pilot needs to absorb some delay in the air in order to be compliant, the pilot will request speed and altitude changes to ATC, and the controller will approve the request if possible. With this approach, en-route ATC will operate under the same procedures used currently.

4.78 Increasing the involvement of en-route ATC is possible based on ANSP involvement, controller training, and the desire to be actively involved in supporting airborne adjustments. For example, the en-route ATC could be aware of controlled flights' calculated times and actively direct flights to ensure compliance. This involvement increases the workload of en-route controllers, but increases the likelihood that flights are compliant with the ATFM assigned delays. Due to the required time to add this role and the large number of stakeholders impacted, this role is not considered for the current concept, but may be considered in the future.

4.79 **Additional TMIs**: Current implementations of ATFM in the U.S. and in Europe have additional TMIs such as Ground Stops, Airspace Flow Programs, and Departure GDPs. Ground Stops were discussed during stakeholder sessions as a means to balance demand and capacity for capacity reducing events that are predicted with little to no lead time. During Ground Stops, certain flights are held at their departure airports for a specified amount of time. Ground Stops were not included in the initial concept of operations because they would be used less frequently than the TMI described in this document, but may be considered in the future.

5. Operational Scenario

5.1 The initial conditions for this scenario are illustrated in **Figure 8**. The FMP views the demand and capacity predictions at the arrival airport. The FMP sets the runway configuration and AAR after coordinating with the tower and terminal supervisors. The pre-tactical demand is lower than the nominal capacity, so there is no need for any arrival airport TMIs.

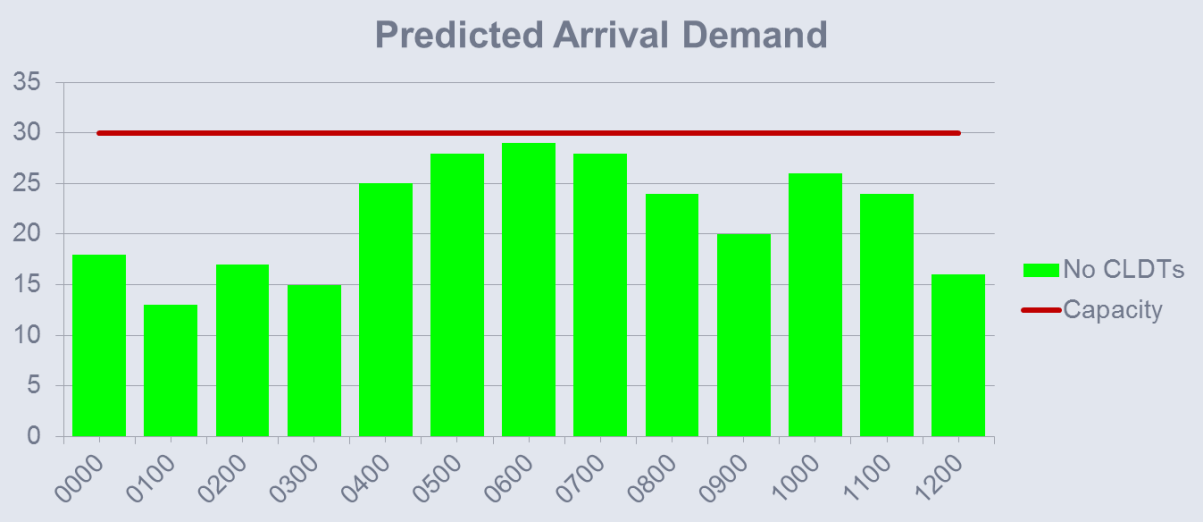

Figure 8: Demand and Capacity Prediction

5.2 At 0000 UTC, the military informs the FMP of a military exercise that will impact the operations at the airport. The reduced capacity will likely cause a demand and capacity imbalance, which can be managed by running a TMI. The parameters for the TMI are selected such that the capacity reducing event will have the least possible impact on all of the stakeholders. The result of the modeled TMI is shown in Figure 9, with the parameters listed below:

- AAR based on the capacity reducing event: 25 between 0500 and 1100 UTC
- TMI start time: 0500
- TMI end time: 1100
  - Flights with estimated landing times between the start and time of the program will receive a slot, or Calculated Landing Time (CLDT), at the

arrival airport.

- Non-exempt flights: 15 major airlines from the region
  - The major airlines in the Asia Pacific region will attempt to comply with their assigned slot times, regardless of their departure airport.
  - The few remaining flights from other airlines are exempt and will receive priority in slot assignments.
  - Exempt/Non-exempt status can also be set for specific airports and flights and based on distance.
- Active Flight Exemption Horizon: 1 hour
  - Airborne flights estimated to land within the next hour will be exempt from the program and receive priority in slot assignments because they will not be able to efficiently absorb any delay.
- Required Notification Time: 1 hour
  - The default intent for pre-departures that are estimated to depart within the next hour is to absorb all of their delay in the air because the FOCs require approximately one hour to notify pilots of the TMI.

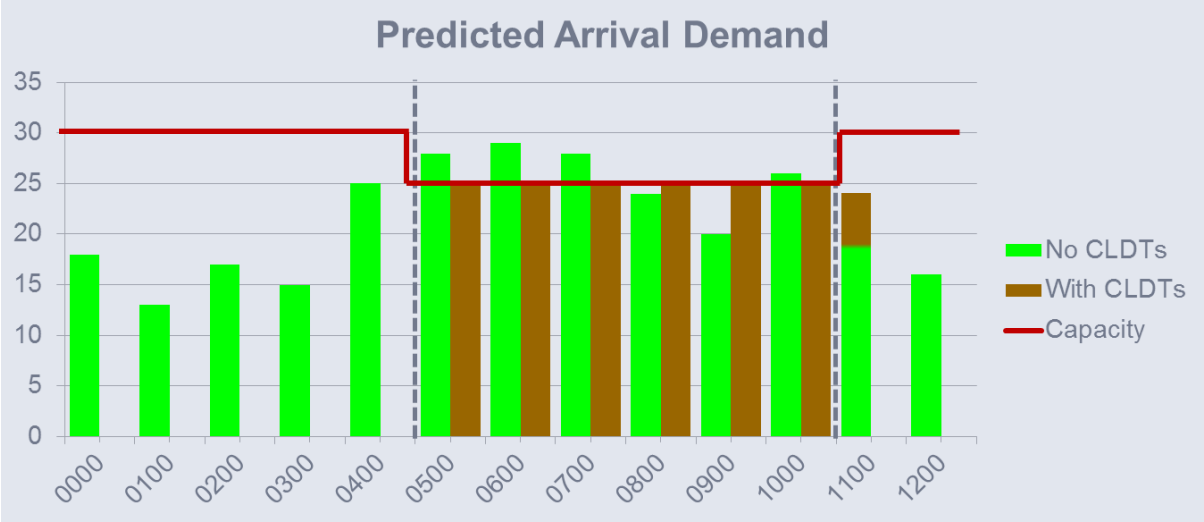

Figure 9: Modeled ATFM program

5.3 The FMP coordinates with CDM stakeholders via teleconference to coordinate the potential impact of implementing the TMI. While all stakeholders can provide input on the program parameters and suggest alternative solutions, the FMP is the ultimate decision maker.

5.4 The FMP runs the proposed TMI and slot assignments are sent to Aircraft Operators. The slot assignment event times are prefixed with the letter C for Calculated and include:

- Calculated Off-Block Time (COBT)
- Calculated Take Off Time (CTOT)
- Calculated Over Fix Time (COFT) (used for compliance measurement)

- Calculated Landing Time (CLDT) (arrival slot time)

- Calculated In Block Time (CIBT)

5.5 Aircraft Operators have the flexibility to distribute the delay intent of pre-departure flights into three attributes: Intended Gate Delay, Intended Surface Delay, and Intended Airborne Delay. In certain cases, Aircraft Operators will coordinate gate and surface delay intents with the Airport Operator to manage gate turnaround times and gate conflicts.

5.6 The Thai Airways FOC decides to absorb a portion of the assigned delay of flight THA641 in the air (**Figure 10**). Of the 20 minutes of assigned delay, THA641 intends to absorb 10 minutes at the gate and 10 minutes in the air. The FOC submits the delay intent to the ATFM system via the web interface. The FOC then informs the pilot of the intended delay.

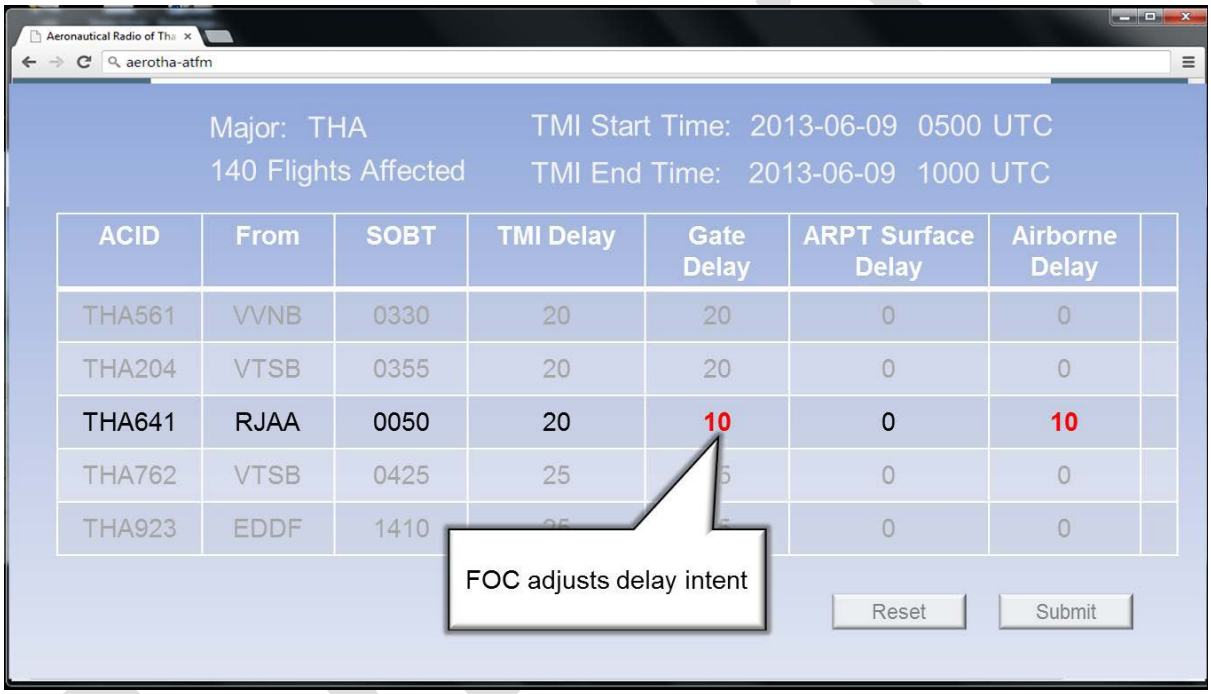

Figure 10: Delay Absorption Intent

5.7 The event times associated with the intended delay are prefixed with the letters “DL”. For flights that intend to absorb some delay on the airport surface or the air, their DL Off-Block Time (DLOBT) and DL Take Off Time (DLTOT) will be different from the Calculated “C” times associated with the slot. **Table 3** shows the updated DL-times for THA641 based on ten minutes of gate delay and ten minutes of airborne delay. Notice the DLOBT and DLTOT are both ten minutes earlier than the COBT and CTOT because the flight intends to make up that additional ten minutes delay in the air.

ACID	DLOBT	COBT	DLTOT	CTOT	DLLDT	CLDT
THA641	0100	0110	0110	0120	0600	0600

5.8 Aircraft Operators also have the ability to substitute flight slots in order to meet their business objectives. For example, CPA713 is a high-priority flight, so the Cathay Pacific FOC substitutes it with CPA739. The CLDTs of the two flights are swapped and the CTOTs are

recalculated based on the new slot times. The result of the substitution is shown in **Figure 11**.

Pre-Substitution

ACID	ADEP	CTOT	ATOT	SLDT	CLDT	TMI Delay
CPA739	VHHH	0345	----	0705	0710	5
CPA713	VTBS	0455	----	0710	0720	10

Post-Substitution

ACID	ADEP	CTOT	ATOT	SLDT	CLDT	TMI Delay
CPA739	VHHH	0355	----	0705	0720	15 (+10)
CPA713	VTBS	0445	----	0710	0710	0 (-10)

Figure 11: Pre- and Post- Flight Substitution

5.9 Pilots request pushback clearance at the departure airport at the Delayed Off-Block Time (DLOBT). Following the departure airport's procedures, flights receive clearance for pushback. At certain departure airports, procedures may be altered such that flights can only receive pushback approval if the request is within a compliance window.

5.10 Approach and en-route controllers will operate as they do in current operations and may have a basic understanding of the Regional ATFM concept. Flights that intend to absorb some delay in the air may request speed and or altitude changes en-route in order to meet the intent. The en-route controller may accept or reject the speed or altitude request based on ATC operational requirements.

5.11 Arriving flights will be measured for compliance at an AFIX prior to landing. If a flight's actual time over (ATO) the fix is within the compliance window of the flight's CTO for the fix, the flight will be considered compliant. In addition, flights that are late to the fix due to an ATC constraint will not be considered non-compliant.

6. Expected Benefits of the Concept

6.1 There are many expected benefits with the implementation of the Regional ATFM concept. The major areas of improvements upon the current procedures include:

- A smoother transition of demand and capacity balancing from strategic to pre-tactical and tactical phases of ATFM.
- Reduced fuel burn and emissions.
- Accurate and common view of demand and capacity predictions.
- A means of modeling and evaluating proposed TMIs in collaboration with the stakeholders prior to implementation.
- Flexibility for Aircraft Operators to optimize their schedules through a web-based CDM platform.
- Flexibility for flights to absorb inevitable delay on the ground or efficiently through the en route portion of the flight rather than by holding in the terminal area.

- A more reliable data source of stakeholder intent—this applies to Aircraft Operators sharing how they intend to operate the flights, as well as ANSPs and airports sharing any resource constraints.

- Enhanced safety by ensuring safe traffic densities.

- A data platform that integrates various flight data sources and provides common situational awareness to the stakeholders.

- An environment in which TMIs and other operational procedures can be improved through post-operational trend analysis.

Attachment A: ATFM Background

ATFM Initiatives

There are a wide variety of ATFM measures that resolve demand-capacity imbalances by shifting demand either spatially or temporally. These measures can be classified into the following four groups [ICAO 2012].

- Spacing Restrictions—Require consecutive flights in a common flow to be separated by a specified time or distance.
  - Miles-in-Trail (MIT)
  - Minutes-in-Trail (MINIT)
  - Minimum Departure Intervals
  - En route Sequencing Program
- Rerouting—Shifts demand around a weather constraint to create a spatially balanced flow of traffic.
  - Fix balancing
  - Collaborative Trajectory Options Diversion of flows
  - Level capping (i.e., restricting the altitude of certain flight plans)
  - Alternative routings
- Ground Holding—Shifts predicted airborne holding delays to ground holding at the departure airport by controlling flights' departure times.
  - Ground Delay Program (GDP)
  - Airspace Flow Program (AFP)
  - Ground Stop (GS)
- Airborne Holding—In general, airborne holding is more costly than other methods, but Air Traffic Managers may plan for airborne holding when delays are predicted to be low.

ICAO Guidance on ATFM

The ICAO Manual on Collaborative Air Traffic Flow Management (document 9971 AN/485) provides recommendations for ATFM implementation. ATFM should be implemented in phases in order to build stakeholder knowledge as operations become more complex. It is also important for procedures to be developed in a harmonious manner among states in the region to reduce operational differences. The ICAO also recommends three communication methods for information sharing: scheduled telephone or web conferences, tactical telephone conferences, and an automated web page or ATFM operational information system.

Attachment B

The list below is a summary of the ICAO document's suggested initial steps to implement ATFM:

- Establish objectives, project management plan, and oversight of ATFM
- Identify personnel who will lead the development of ATFM
- Brief stakeholder groups on ATFM principles
- Define the ATFM structure that will be established
- Consider the facilities and equipment that will need to be procured
- Develop model for establishing AAR
- Identify points of contact for dealing with ATFM issues
- Define the elements of common situational awareness including: ▪ Meteorological information
- Traffic display tools
- Identify the appropriate means of ATFM communication
- Develop Letters of Agreement between adjacent FIRs
- Develop user manuals and training materials

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Attachment B: Participation Analysis – Changi Case Study

This following is a summary of an analysis conducted to determine a required participation level for effective implementation of TMIs.

A fast-time simulation was created to simulate the impact of various participation levels on TMI effectiveness, using scheduled takeoff times were from Changi arrival data on 3 March, 201. The flight progress was simulated with GDPs implemented with various reduced capacities at two participation levels. 1400 NM and 2400 NM radii around Changi provide approximately 50% and 75% participation levels, respectively. The map in **Figure B1** shows the airports that are included in the two radii explored.

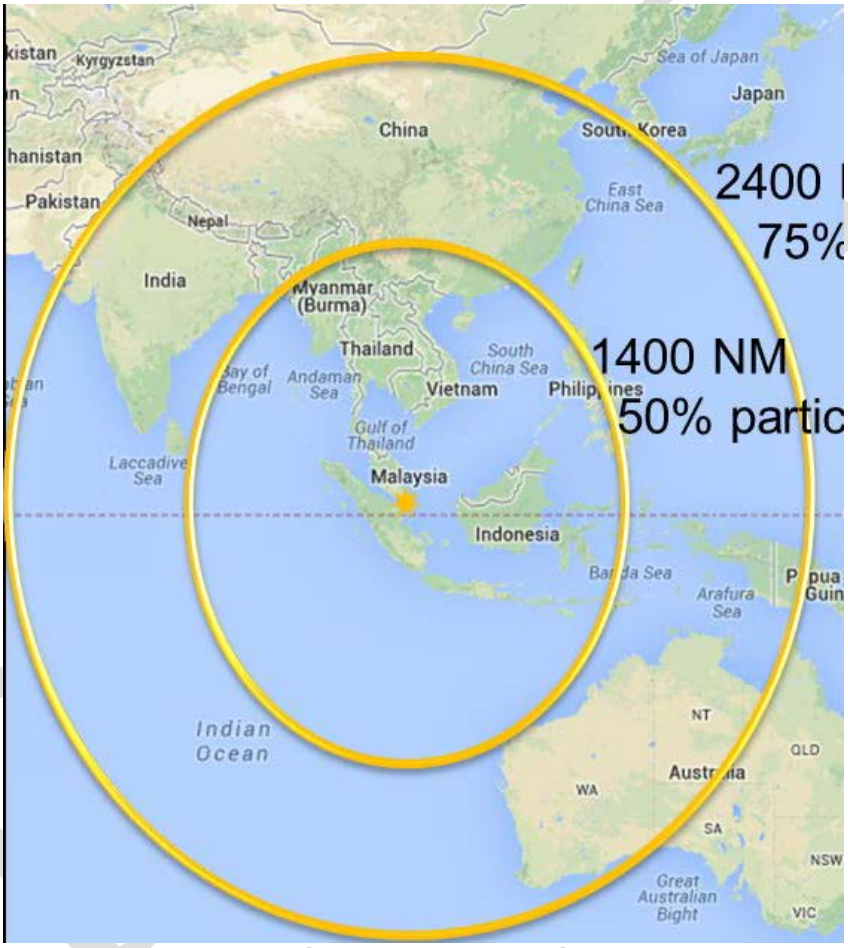

Figure B1: Airports within Participation Radius

The results for the two participation levels are compared in **Figure B2**. As indicated by the plots, the total delay increases exponentially as the capacity is reduced. In the severe case of a 16 flights/hour airport capacity (about half of the nominal arrival capacity), participating flights receive an average of 2.3 hours of delay when participation is 50% and about 1.6 hours of delay when participation is 75%. Therefore, increasing the participating flights reduces the delay per participating flight by 0.7 hours. The reason for this reduction is that there are fewer exempt flights that get priority in the slot assignment.

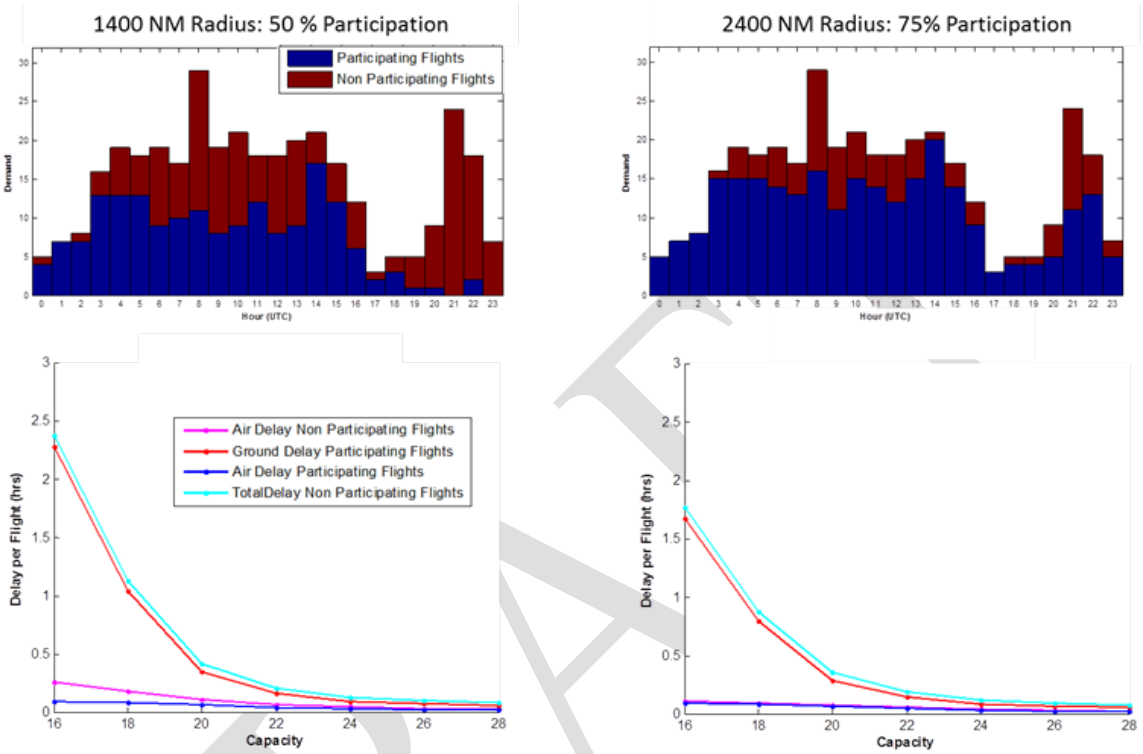

Figure B2: Participation Analysis

The delays for the non-participating flights are also reduced when the participation level is increased. In the example below, the airborne delay for non-participating flights is reduced from 0.3 hours to about 0 hours when increasing participation from 50% to 75%. This is because the demand of participating flights is generally lower than the capacity of 16 when the participation is 75%, whereas when the participation level is 50% there are a significant number of non-participating flights that need to be delayed in order to bring the total demand below capacity.

When the capacity reduction is less significant, the difference between the two participation levels is less pronounced. For example, when capacity is reduced to 20, the average delay for participating flights is reduced from 0.4 hours to 0.3 hours for 50% and 75% participation, respectively. The reason for this reduction in difference between the two participation levels is due to the fewer flights that receive delay. As shown in **Figure B2**, the demand is below 20 for most of the day, meaning a TMI is not needed for most of the day.

Based on these results and knowledge from currently implemented ATFM systems, high participation (>75%) is necessary to manage the flow of traffic during events with a relatively high reduction in capacity. If the capacity reducing event induces minor delays, the flow may be able to be managed with less than 75% participation.

Terms of Reference

ATFM Information Requirements Small Working Group (ATFM/IR/SWG)

Recognizing that:

The Draft Regional Framework for Collaborative ATFM will be presented to APANPIRG/26 for endorsement; and

The ongoing development of the Regional ATFM Concept and the understanding of operational requirements for information distribution are dependent on experience to be gained in trial programs and operational deployments:

1. The ATFM/IR/SWG, reporting to ATFM/SG, will develop a draft operational requirements document detailing:

    a) Items of ATFM information, such as ADP, ATFM measures and compliance information to be distributed and dynamically updated to each of the following stakeholder domains:

        i. ATFMU;

        ii. ATSU (ACC/APP/TWR);

        iii. Airspace User; and

        iv. Airport Operator

    b) Access levels and authorizations for stakeholders;

    c) Items of ATFM Information that authorized users may add or amend, including but not limited to:

        v. ADP;

        vi. ATFM measures;

        vii. Collaborative ATFM interaction;

        viii. Cancellation, suspension and de-suspension of ATFM measures;

        ix. Compliance monitoring information such as ATOT and ATO;

    d) Network and/or node administrator arrangements;

    e) Required reliability and availability of the distributed multi-nodal network and its interfaces.

    f) Notification parameters guidance for ATFM measure implementation.

2. ATFM/IR/SWG will, in cooperation with the ACS ICG, develop an interface control document (ICD) for cross-border ATFM described in the Regional Framework for Collaborative ATFM and the Regional ATFM Concept.

Terms of Reference

AIR TRAFFIC FLOW MANAGEMENT STEERING GROUP (ATFMSG)

1. Having considered relevant documents such as the *Manual on Collaborative Air Traffic Flow Management* (Doc 9971), regional air traffic data and the Asia/Pacific Region city pairs and associated airspace and ATS routes experiencing the most significant traffic demand, and noting the Asia/Pacific Seamless ATM Plan provisions for structural airspace capacity increasing measures, develop an Asia/Pacific Regional ATFM Framework which addresses ATFM implementation and ATFM operational issues in the Asia/Pacific Region;

2. Identify, research and recommend appropriate guidance regarding:

   a. capacity assessment and adjustment mechanisms;

   b. regular review for all aerodromes and ATC sectors where traffic demand is expected to reach capacity, or is resulting in traffic congestion;

   c. mechanisms for ATFM data gathering, collation and sharing between States, International Organizations and ICAO, which may include;

      i. capacity assessments, including factors affecting capacity such as special use airspace status, runway closures and weather information;

      ii. traffic demand information which may include flight schedules, flight plan data, repetitive flight plan data as well as associated surveillance updates of flight status; and

      iii. ATFM Daily Plan;

   d. compliance by airspace users with ATFM measures; and

   e. any other guidance relevant to the Regional ATFM Framework.

3. Maintain an overview of CDM/ATFM programs being conducted within the Region, with a view to facilitating their coordination and alignment.

4. Review the effectiveness of existing and planned ATFM programs in the Asia and Pacific Region, and make specific recommendations regarding ATFM, including any adjacent airspace affecting the Asia and Pacific Regions, and research and recommend appropriate mechanisms for the on-going review of such programs.

5. The Group has linkages to the Aerodromes Operations and Planning Working Group (AOP/WG), Regional ATM Contingency Plan Task Force (RACP/TF) and the Meteorological Requirements Task Force (MET/R TF).

6. The Group reports to the ATM Sub-Group.

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STATEMENT ON THE FUTURE ROLE OF THE ATFM STEERING GROUP

(Presented by ATFM Steering Group Co-Chairs & IATA)

SUMMARY

This statement presents the strong viewpoints expressed by the member states during the 5th ATFM steering group meeting which states that, in its present form the ATFM STEERING GROUP must continue to hold meetings at regular intervals appropriate to its tasks leading to ATFM development needs of the Region and not concluding after merely producing the first version of the Framework document.

As agreed in ATFM/SG-05 meeting, the statement was prepared by the Co-Chairs along with IATA which recommends the continuation of the ATFM STEERING GROUP in guiding, facilitating and ultimately ensuring harmonized ATFM implementation across the Region in accordance with the APAC Seamless ATM Plan and updating of the Framework document as appropriate for the consideration of ATM/SG,

1. INTRODUCTION

1.1 In response to the rapid growth of traffic demand within the Asia Pacific Region and with ATFM becoming one of APANPIRG's Key Priorities, APANPIRG/20 adopted the following ATFM related Conclusion:

> ***Conclusion 20/11 – ATFM Steering Group and Concept of Operations***
>
> *That a regional ATFM Steering Group be constituted and tasked with preparing an Asia/Pacific Regional ATFM Concept of Operations based on analysis of regional data and traffic flows. The ATFM Steering Group should consider the outcomes and recommendations from the October 2008 ATFM Seminar/Workshop (Fukuoka, Japan) and information about the CAR/SAM ATFM Project contained in IP/3 to APANPIRG/20 as guidance in deriving its Objectives and Terms of Reference.*

2. DISCUSSION

ATFM Steering Group Inception and TOR

2.1 In accordance with this Conclusion, the 1st Meeting of the Air Traffic Flow Management Steering Group (ATFM/SG/1) was held in Tokyo, Japan in December 2010.

2.2 The meeting determined the Group's own Terms of Reference (TOR) and then broadly discussed the current Status of ATFM initiatives within the Region, ATFM priorities, the need for Civil/Military coordination and the role of Airport Operators in ATFM Collaborative Decision Making.

2.3 While the TOR developed by the meeting included the development and maintenance of the Regional ATFM concept and communications documents, mechanisms for ATFM data gathering, support for the development of integrated sub-regional ATFM systems, and development of CDM processes, with no outstanding tasks at the close of the meeting, it was uncertain whether the Group would need to convene again.

Development of the ATFM Steering Group and Revised TOR

2.4 Following discussions within the ATFM Small Working Group at the combined SAIOCG/3 and SEACG/20 meeting, which centered on the increasing prevalence of uncoordinated and compounding cross-border ATFM measures, APANPIRG/24 adopted several ATFM-related Conclusions regarding ATFM initiatives, capacity assessments and information sharing, resulting in the re-convening of the ATFM/SG.

2.5 Prior to the reconvening of ATFM/SG, collaborative efforts between several States had resulted in the recognition that a Centralized ATFMU concept did not lend itself readily to the Region's diverse multi-State model and recognizing the need to research and develop a CDM/ATFM concept that could be implemented at a sub-regional level, a sub-regional ATFM concept comprised of independent virtual CDM/ATFM Nodes supported by an interconnected information sharing framework had been developed.

2.6 ATFM/SG was reconvened in late 2013, after a hiatus of almost 3 years, during which the Region had seen accelerated rates of traffic growth, resulting in more widespread usage of unilaterally-imposed and unharmonized cross-border ATFM measures, causing compounding and often unquantified delays.

2.7 Noting these developments and the subsuming of ATFM-relevant provisions of global and Asia/Pacific Region-specific documents into the (then) draft Doc 9971, the Conclusions adopted by APANPIRG 24 and its adoption of the Seamless ATM Plan, revised TOR for ATFM/SG were proposed to ATFM/SG/2 by the Secretariat.

2.8 In addition to the adoption of revised global reference material, (e.g. the recently released DOC 9971) there was a fundamental change in TOR, from not just developing a Concept of Operations but;

a) to develop an ATFM Framework addressing ATFM **implementation** and **operational** issues;

b) a requirement to research and recommend guidance regarding compliance by airspace users with ATFM measures; and

c) a requirement for the coordination and **alignment** of cross-border CDM/ATFM program

2.9 Based on the collaborative work already carried by a number of States in developing a workable and scalable ATFM concept for the Region, SG/4 delivered the following Decision:

ATFM/SG Decision 4/1: Asia Pacific Regional ATFM Concept of Operations and timeline:

That, the Asia Pacific Air Traffic Flow Management Steering Group:

• Adopts the Multi Nodal ATFM Concept of Operations as the foundation for the Regional Concept of Operations/Implementation strategy for regional cross border ATFM implementation; and

• Confirms 8 November 2018 as the target date for regional cross border ATFM implementation, for inclusion in the performance objectives of the Regional Framework for Collaborative ATFM, in alignment with ASBU and the APAC Seamless ATM Plan;

2.10 During discussion on the TOR and the Task List at SG/5, the meeting also discussed the subject of the continuation of the Steering Group.

2.11 The TOR, as updated and agreed by APANPIRG/25, included a number of tasks requiring the continuation of the group. It was also acknowledged that the Regional Framework for Collaborative ATFM itself would require regular updating as experience was gained in the operational trialling and implementation of the distributed multi-nodal ATFM network concept. It was noted that, in reviewing the Task List, 4 tasks had been closed and 13 completed, 6 remained open, 4 open tasks were transferred to ATFM/SG by other groups, and 12 new tasks were identified.

2.12 ATFM/SG/5 expressed the strong view that the ATFM/SG, in its present form must continue beyond merely producing the first version of the Framework document and meetings should be held at intervals appropriate to its tasks and the ATFM development needs of the Region.

The Future of the AFTM Steering Group

2.13 Harmonized cross-border ATFM is still in its infancy in the Asia Pacific Region. It will take concerted efforts by all States to meet the goal of regional cross border ATFM implementation by 8 November 2018.

2.14 States have so far acknowledged the high priority needed to be afforded to ATFM in the Region and proven their strong support by providing consistent ATFM/SG meeting participation, continuity of knowledgeable subject matter experts and a strong sense of collaboration.

2.15 Operational Trials have only recently commenced between a small number of participating ANSPs, Aircraft Operators and Airport Operators but already the interest to join by others has been significant.

2.16 The Steering Group sees its future firmly involved in moving forward from the Framework document, to guiding, facilitating and ultimately ensuring harmonized ATFM implementation across the Region in accordance with the APAC Seamless ATM Plan.

3 ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the development of the ATFM Steering Group and its TOR;

b) note the outstanding tasks of the Group and the challenges ahead for the Region in implementing cross border ATFM; and

c) consider and discuss the future role of the ATFM Steering Group.

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