PART II

AIR TRAFFIC FLOW MANAGEMENT (ATFM)
FOREWORD

This guidance material contains information on how air traffic flow management (ATFM) should be implemented and applied by using collaborative decision-making (CDM) processes in order to balance capacity and demand within different volumes of airspace and airport environments. It highlights the need of close cooperation among different stakeholders by providing flexibility in the use of the airspace and airport resources.

The following guidance is intended to for the following stakeholders:

a) air navigation service providers;
b) airspace users;
c) airline operation centres;
d) airport operators;
e) airport ground handlers;
f) airport slot coordinators;
g) regulators;
h) military authorities;
i) security authorities;
j) meteorological agencies; and
k) industries related to aviation.

Key objectives of this guidance material are to:

a) establish globally consistent ATFM planning and operating practices;
b) encourage a collaborative and harmonized approach to ATFM between States and regions; and
c) encourage a systemic approach to ATFM, including all ATM community members.

This guidance material is designed to provide answers to the following questions:

a) What is the starting point regarding the development of an ATFM service? (Chapter 1);
b) What are the foundational objectives and principles of ATFM? (Chapter 1);
c) What are the benefits of implementing an ATFM service? (Chapter 1);
d) How does an ATFM service operate? (Chapter 2);
e) How is an ATFM service structured and organized? (Chapter 3);
f) What are the roles and responsibilities of the stakeholders in the ATFM service? (Chapter 3);
g) How is the capacity of an airspace sector and airport determined? (Chapter 4);
h) How are ATFM processes applied in order to balance the demand and capacity within its area of responsibility? (Chapter 4);
i) How is an ATFM service implemented? (Chapter 5);
j) What are ATFM Measures and how are they established and applied? (Chapter 6);
k) What data and information are exchanged in an ATFM service? (Chapter 7);
l) What terminology/phraseology is used in ATFM? (Chapter 8); and
m) What resources are available to States regarding the various aspects of ATFM? (Appendices).
Table of Contents

Glossary

Chapter 1. Introduction
Chapter 2. The ATFM service
Chapter 3. ATFM structure and organization
Chapter 4. Capacity, demand and ATFM phases
Chapter 5. ATFM implementation
Chapter 6. ATFM measures
Chapter 7. Data exchange
Chapter 8. ATFM communication

Appendix A. Sample of international ATFM operations planning telephone conference format
Appendix B. Sample of ATFM data exchange agreement
Appendix C. Determining airport acceptance rate
Appendix D. Determining sector capacity
Appendix E – Example of capacity planning and assessment process
Appendix F – Example of planning process for ATFM implementation
Appendix G – Template of letter of agreement between flight management units
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAR</td>
<td>Airport acceptance rate</td>
</tr>
<tr>
<td>ACC</td>
<td>Area Control Centre</td>
</tr>
<tr>
<td>ADP</td>
<td>ATFM daily plan</td>
</tr>
<tr>
<td>A-CDM</td>
<td>Airport-CDM</td>
</tr>
<tr>
<td>AIM</td>
<td>Aeronautical information management</td>
</tr>
<tr>
<td>ANM</td>
<td>ATFM notification message</td>
</tr>
<tr>
<td>ANSP</td>
<td>Air navigation service provider</td>
</tr>
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<td>AO</td>
<td>Aircraft operator</td>
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<td>AOBT</td>
<td>Actual off-block time</td>
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<td>ASM</td>
<td>Airspace management</td>
</tr>
<tr>
<td>ATFM</td>
<td>Air traffic flow management</td>
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<tr>
<td>ATFMU</td>
<td>Air traffic flow management unit</td>
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<tr>
<td>ATFCM</td>
<td>Air traffic flow and capacity management</td>
</tr>
<tr>
<td>ATM</td>
<td>Air traffic management</td>
</tr>
<tr>
<td>ATOT</td>
<td>Actual take-off time</td>
</tr>
<tr>
<td>ATS</td>
<td>Air traffic services</td>
</tr>
<tr>
<td>AU</td>
<td>Airspace user</td>
</tr>
<tr>
<td>CDM</td>
<td>Collaborative decision-making</td>
</tr>
<tr>
<td>CEF</td>
<td>Capacity enhancement function</td>
</tr>
<tr>
<td>CFMU</td>
<td>Central flow management unit</td>
</tr>
<tr>
<td>CGNA</td>
<td>Air navigation management centre</td>
</tr>
<tr>
<td>CTA</td>
<td>Calculated time of arrival</td>
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<tr>
<td>CTO</td>
<td>Calculated times over</td>
</tr>
<tr>
<td>CTOT</td>
<td>Calculated take-off time</td>
</tr>
<tr>
<td>EOBT</td>
<td>Estimated off-block time</td>
</tr>
<tr>
<td>ETA</td>
<td>Estimated time of arrival</td>
</tr>
<tr>
<td>ETD</td>
<td>Estimated time of departure</td>
</tr>
<tr>
<td>ETO</td>
<td>Estimated time over a reference point</td>
</tr>
<tr>
<td>ETOT</td>
<td>Estimated take-off time</td>
</tr>
<tr>
<td>FAP</td>
<td>Future ATM profile</td>
</tr>
<tr>
<td>FMP</td>
<td>Flow management position</td>
</tr>
<tr>
<td>FMU</td>
<td>Flow management unit</td>
</tr>
<tr>
<td>GDP</td>
<td>Ground delay programme</td>
</tr>
<tr>
<td>GS</td>
<td>Ground stop</td>
</tr>
<tr>
<td>IATA</td>
<td>International Air Transport Association</td>
</tr>
<tr>
<td>IFR</td>
<td>Instrument flight rules</td>
</tr>
<tr>
<td>LOA</td>
<td>Letter of Agreement</td>
</tr>
<tr>
<td>MDI</td>
<td>Minimum departure interval</td>
</tr>
<tr>
<td>NAVAIDs</td>
<td>Navigation aids</td>
</tr>
<tr>
<td>MIT</td>
<td>Miles-in-trail</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development</td>
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<tr>
<td>TMA</td>
<td>Terminal control area</td>
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<tr>
<td>ToD</td>
<td>Top of descent</td>
</tr>
<tr>
<td>VFR</td>
<td>Visual flight rules</td>
</tr>
<tr>
<td>VMC</td>
<td>Visual meteorological condition</td>
</tr>
</tbody>
</table>
REFERENCES

Global Air Traffic Management Operational Concept (Doc 9854)
Manual on Air Traffic Management System Requirements (Doc 9882)
Manual on Global Performance of the Air Navigation System (Doc 9883)
Manual on Flight and Flow – Information for a Collaborative Environment (Doc 9965)
Civil/Military Cooperation in Air Traffic Management (Cir 330-AN/189)
Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)
Chapter 1

INTRODUCTION

1.1 Air traffic flow management philosophy

1.1.1 Air traffic flow management (ATFM) is an enabler of air traffic management (ATM) efficiency and effectiveness. It contributes to the safety, efficiency, cost effectiveness, and environmental sustainability of an ATM system. It is also a major enabler of global interoperability of the air transport industry. It is important to recognize that, over time, two threads of events are going to appear simultaneously:

a) local ATFM implementations, conducted all around the world are going to shape a global ATFM; and

b) standardized ATFM processes will be implemented globally.

1.1.2 What is the starting point regarding the development of an ATFM service?

1.1.2.1 The level of an ATFM service required in a given setting will depend on a number of factors that will be addressed in this manual. An ATFM service may be simple or complex, depending on the environment and its requirements. It is, however, important to note that even relatively simple ATFM services can, when properly designed and implemented, be as effective as complex ATFM services and thus enable air navigation service providers (ANSPs) to effectively provide the required service.

1.1.2.2 One key to the successful implementation of an effective ATFM service is achieving a robust coordination among aviation stakeholders. It is envisioned that ATFM is performed as a collaborative decision-making process where airports, ANSPs, Airspace Users (AUs), military entities, and other stakeholders work together to improve the overall performance of the ATM system. It is likewise envisioned that such coordination will take place within a Flight Information Region (FIR), between FIRs, and ultimately, between regions.

Note.— For the purpose of this guidance the term airspace user includes, but is not limited to, airline, air taxi, charter, general aviation, and military operators.

1.1.2.3 ATFM and its applications should not be restricted to one State or FIR because of their far-reaching effects on the flow of traffic elsewhere. The Procedures for Air Navigation Service – Air Traffic Management (PANS-ATM, Doc 4444) recognises this important fact, stating that ATFM should be implemented on the basis of a regional air navigation agreement or, when appropriate, as a multilateral agreement.

1.2 Air traffic flow management objectives and principles

1.2.1 What are the foundational objectives and principles of ATFM?

1.2.1.1 The objectives of ATFM are to:

a) enhance the safety of the ATM system by ensuring the delivery of safe traffic densities and minimizing traffic surges;

b) ensure an optimum flow of air traffic throughout all phases of the operation of a flight by balancing demand and capacity;

c) facilitate collaboration among system stakeholders to achieve an efficient flow of air traffic through multiple volumes of airspace in a timely and flexible manner that supports
the achievement of the business or mission objectives of airspace users and provides optimum operational choices;

d) balance the legitimate, but sometimes conflicting, requirements of all AUs, thus promoting equitable treatment;

e) reconcile ATM system resource constraints with economic and environmental priorities;

f) facilitate, by means of collaboration among all stakeholders, the management of constraints, inefficiencies, and unforeseen events that affect system capacity in order to minimize negative impacts of disruptions and changing conditions; and

g) facilitate the achievement of a seamless and harmonised ATM system while ensuring compatibility with international developments.

1.2.1.2 The principles of ATFM are to:

a) optimize available airport and airspace capacity without compromising safety;

b) maximize operational benefits and global efficiency while maintaining agreed safety levels;

c) promote timely and effective coordination with all affected parties;

d) foster international collaboration leading to an optimal, seamless ATM environment;

e) recognize that airspace is a common resource for all users and ensure equity and transparency, while taking into account security and defence needs;

f) support the introduction of new technologies and procedures that enhance system capacity and efficiency;

g) enhance system predictability, help to maximise aviation economic efficiencies and returns, and support other economic sectors such as business, tourism and cargo; and

h) evolve constantly to support an ever-changing aviation environment.

1.3 Air traffic flow management benefits

1.3.1 What are the benefits of implementing an ATFM service?

1.3.1.1 The benefits of ATFM lie in various domains of the ATM system:

a) operational:

1) enhanced ATM system safety;

2) increased system operational efficiency and predictability through collaborative decision-making processes;

3) effective management of capacity and demand through data analysis and planning;

4) increased situational awareness among stakeholders and a coordinated, collaborative development and execution of operational plans;
5) reduced fuel burn and operating costs; and

6) effective management of irregular operations and effective mitigation of system constraints and consequences of unforeseen events;

b) societal:

1) improved quality of air travel;

2) increased economic development through efficient and cost-effective services to the projected increased levels of air traffic;

3) reduction of aviation-related greenhouse gas emissions; and

4) mitigation of the effects of unforeseen events and situations of reduced capacity along with coordinating effective and rapid solutions to recover from them.
Chapter 2

THE ATFM SERVICE

2.1 How does an ATFM service operate?

2.1.1 It is essential to understand that, from a systemic perspective, ATFM concerns every stakeholder involved in ATM.

2.1.2 The guiding principles of “first come, first served” and “equitable access to airspace” have traditionally been very important to the ATM system. The global ATM system is however, evolving, to incorporate, in its guiding principles, net results in terms of overall system efficiency, the environment, and operating costs. To support this evolution, ATFM service may have to evolve and to integrate other priorities such as “most capable aircraft” in order to achieve optimum ATM system performance. Likewise, equitable access to airspace may be viewed on a longer time scale than the short term “first come, first served” model.

2.1.3 ATFM service relies on a number of supporting systems, processes and operational data in order to function effectively. The maturity level of these systems and processes will determine the level of ATFM service that is established. Some elements to be considered to operate an ATFM service are:

a) ATM resources: ATFM recognizes that airspace and airports are common resources shared by all AUs and that equity and transparency must be maintained to the highest standard;

b) traffic demand: A timely, accurate depiction of predicted flight activity for all flights utilizing an ATM resource (e.g., airport, en route sector, etc.). Data should be aggregated from all available operational data sources (e.g., airline schedules, flight plan data, airport slot management systems, ATM operational systems, and AU intentions);

c) the tactical, dynamic traffic situation: Accurate data derived from surveillance and flight information, to increase the accuracy of short to medium term prediction;

d) the forecast and dynamic meteorological situation: The integration and display of a variety of meteorological data for ATFM planning and operational execution;

e) the airspace status and the availability of restricted or reserved airspace resources that affect the flows of air traffic;

f) shared ATFM tools and data interoperability: Tools that enable common situational awareness through the sharing of data and operational information among stakeholders. ATFM tools draw from a variety of databases to accurately display meteorological and air traffic information; and

g) institutional arrangements: Formalized agreements between all ATFM stakeholders in the relevant area and appropriate arrangements with adjacent ATFM units.

2.1.4 Whenever measures to control the flows of air traffic have to be applied in the form of delays, AUs should be notified by ATC while the aircraft are on the ground rather than in flight. A strategy should collaboratively be agreed upon, in advance, by the ATFM units, the affected ATS facilities and AUs. Its aim should be to safely and efficiently balance ground and airborne delays.
2.1.5 AUs should be informed as early as possible of the nature and location of ATM constraints. This will allow them to integrate that information into their operational flight planning.

2.1.6 In addition to airborne holding, the management of airborne delays can be accomplished by slowing aircraft well before top of descent (ToD) and making use of required time of arrival (RTA) aircraft capabilities in order to reduce operating costs, environmental impact, and ATC workload.

2.1.7 When ATFM measures are necessary to manage a constraint, they should be applied in a timely manner and only for the period when expected air traffic demand exceeds the capacity in the constrained area. ATFM measures should be kept to the minimum and, whenever possible, be applied selectively only to that part of the system that is constrained.

2.1.8 Information on anticipated overload situations should be provided to affected AUs as soon as possible.

2.1.9 ATFM measures should be established and coordinated so as to avoid, if at all possible, having cumulative or contradictory effects on the same flights.

2.1.10 Automated tools should be implemented and utilized to allow for effective collaboration and dissemination of ATFM information.

2.1.11 CDM should be utilized to manage flows of traffic through all components of the ATM system. CDM should also occur within and between regions where significant traffic flows force them to interact with each other.

2.1.12 The most efficient utilization of available airspace and airport capacity can be achieved only if all relevant elements of the ATM system have been considered during the planning stage. Moreover, ATFM planning should, as much as possible, focus on regional ATFM and be prioritized for the appropriate major traffic flows.

2.1.13 ATFM traffic data analysis can yield significant strategic benefits, especially when used in conjunction with airspace and ATS route planning, in terms of future ATM systems and procedure improvements. This is part of a continuous safety and service improvement loop (see Figure 1).
2.1.14 States may choose to prioritize or exempt certain classes of flight from ATFM measures. Examples of such flights include but are not limited to:

a) flights experiencing an emergency, including aircraft subjected to unlawful interference;

b) flights on search and rescue or fire fighting missions;

c) urgent medical evacuation flights specifically declared by medical authorities;

d) flights with ‘Head of State’ status; and

e) other flights specifically identified by State authorities.

Note.– After medical flights have completed their mission they should be subject to ATFM measures. Scheduled passenger transfer flights are, by their nature, non-urgent and should not be given priority under normal operational situation. Notwithstanding any exemption from ATFM measures, exempted aircraft are included in the airport/airspace demand estimation.

2.1.15 Appropriate automated tools can be used to enable and enhance the effective application of ATFM.

2.2 Collaborative decision-making (CDM) in the context of ATFM

2.2.1 CDM is the 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.

2.2.2 The CDM process is a key enabler of an ATFM strategy allowing the sharing of all relevant information between the parties involved in making decisions and supporting an on-going dialogue between the various stakeholders throughout all phases of flight. This enables the various organisations to update each other continuously on events from the strategic level to real-time.

2.2.3 CDM is a supporting process applied to activities such as airspace management and demand/capacity balancing and can be applied at any time from strategic planning to tactical operations. CDM is not an objective in itself, but rather a way to reach the performance objectives of the processes it supports. These performance objectives are expected to be agreed upon collaboratively.

2.2.4 Although information sharing is an important enabler for CDM, the sharing of information is not sufficient to realize CDM and the objectives of CDM. Successful CDM also requires agreed-upon procedures and rules to ensure that collaborative decisions will be taken expeditiously and fairly.

2.2.5 CDM ensures that decisions are taken transparently and are based on the best information available as provided by the participants in a timely and accurate manner.

2.3 CDM organization and structure

2.3.1 The organization and structure of the CDM process depends on the complexity of the ATFM system in place. The structure must be designed to ensure that the affected stakeholders, service providers and airspace users alike, 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.
2.3.2 Frequent tactical briefings and conferences can be used to provide an overview of the current ATM situation, discuss any issues and provide an outlook of operations for the coming period. Traffic patterns and the severity of the envisaged ATFM events will dictate the frequency of those meetings. They should occur at least daily but may also be scheduled to occur 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.

2.3.3 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, etc.) 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.

2.3.4 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.

2.3.5 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.

2.4 CDM requirements and benefits

2.4.1 Through the application of a transparent CDM process, the involved stakeholders will gain the necessary situational awareness. This will ensure that the optimum measures are applied in any given situation. CDM will also create an environment where stakeholders better understand the issues of all concerned.

2.4.2 Regular CDM conferences provide stakeholders with the opportunity to propose enhancements from which they could benefit, to follow up on any issue, and to monitor the equity of the flow management process.

2.5 ATFM, CDM, and civil/military coordination

2.5.1 ATFM principles are equally applicable to both civil and military flights operated in accordance with civil rules. Civil/military coordination will provide more flexibility to AUs, thanks to the greater availability of both information and airspace. It is, however, essential to realize that some missions will remain incompatible with civil aviation. These missions may include military operations, operations conducted in support of security requirements, live weapons firing, space operations or others. National policies will establish the degree of civil/military coordination in terms of air traffic management within each State. Military participation in a regulated aeronautical information infrastructure will therefore remain subject to national considerations.

2.5.2 The processes related to flexible use of airspace involve optimum sharing of airspace under the appropriate civil/military coordination in order to achieve the proper separation between civil and military flights, thus reducing the need for permanent airspace segregation.

2.5.3 Benefits of civil/military coordination include:

a) operational savings for flights due to reduced flight time, distance flown and fuel consumption;
b) route network optimization for the provision of ATS and the associated sectoring, which enable ATC capacity increases and reduced delays;

c) more efficient air traffic flow separation procedures;

d) reduced ATC workload through a reduction of airspace congestion and of the number of choke points;

e) real-time provision of capacity in line with AUs operational requirements; and

f) definition and use of temporary airspace reservations designed to bring an optimal response to military operational requirements.

2.5.4 It is recommended that States and/or service providers develop and document a collaborative process with users of restricted airspace volumes. This should increase efficiency by enabling the use of these airspace volumes by civilian traffic whenever they are not used by the primary airspace user.

2.5.5 When applicable, such agreements and procedures should be established on the basis of a regional air navigation agreement. The agreements and procedures related to flexible use of airspace should specify, inter alia:

a) the horizontal and vertical limits of the airspace concerned;

b) the classification of any airspace made available for civil air traffic;

c) units or authorities responsible for the airspace;

d) conditions for transfer of the airspace to/from the ATS unit concerned;

e) periods of availability of the airspace;

f) any limitations on the use of the airspace concerned;

g) the means and timing of an airspace activation warning if not permanently active; and

h) any other relevant procedures or information.
Chapter 3

ATFM STRUCTURE AND ORGANIZATION

3.1 How is an ATFM service structured and organized?

3.1.1 It is understood that different levels of ATFM oversight will exist. The main concept, however, relies on the fact that States assign responsibilities for oversight and execution of ATFM services. Each State shall therefore assign responsibility for the collection and dissemination of ATFM related information, as well as for the monitoring and surveillance of ATFM activities within its respective FIR(s). This will ensure that all stakeholders have timely and efficient access to applicable ATFM information.

3.1.2 Each State will ensure that an ATFM organizational structure that meets the needs of the aviation community is developed. This structure should, at least, allow the management and oversight of:

a) the air traffic flow management service; and

b) the coordination and exchange of information, both internally and externally;

The structure should also ensure:

c) the existence of a line of authority for the implementation of decisions; and

d) compliance with the mission requirements that have been assigned to the ATFM services.

3.1.3 A line of authority to support the ATFM service is therefore required. It may include the following:

a) a manager of the ATFM service;

b) the flow management unit (FMU) that provides ATFM service for a specific set of ATS units; and

c) flow management positions (FMPs) at specific ATS units responsible for the day-to-day ATFM activities.
3.1.4 An ATFM service could be designed bearing in mind the following:

a) an aerodrome control tower can be served by an FMP. This duty can be assigned to an existing position or it may require a dedicated position. The control tower FMP coordinates with the FMP at the approach control unit;

b) an approach control unit can be served by an FMP. This duty can be assigned to an existing position in the approach control unit or it may require one or more dedicated positions, depending on the workload. The approach control unit FMP coordinates with the FMP at an area control centre (ACC);

c) an ACC can be served by a FMU. This ATFM structure in an ACC is more complex and may consist of a number of traffic management coordinator positions to meet the needs of the ACC and its subordinate units. The following functions at an ACC FMU may require dedicated staff, depending on the workload induced by:

1) approach control coordination;
2) departure control coordination;
3) enroute coordination;
4) meteorological briefing/forecasting coordination;
5) airspace user liaison;
6) military liaison;
7) airport coordination;
8) post-operations analysis; and
9) additional support functions that may be required, such as administrative and information technology coordination. The additional functions of crisis management coordinator may also be required, as applicable;
d) a group of ACCs can be served by a national or an international ATFM centre. This is one of the most complex ATFM structures and includes multiple functions. Each function may, depending on the workload, be combined or require dedicated. The functions may include:

1) traffic management coordination;
2) traffic planning;
3) meteorological briefing/forecasting coordination;
4) NOTAM/messaging coordination;
5) flight calibration/flight check coordination;
6) airspace user liaison;
7) military liaison;
8) information technology coordination and operational data management;
9) technical operations coordination (concerning infrastructure and systems such as NAVAIDs, radar, VHF communication sites, etc.);
10) crisis management coordination; and
11) operations analysis; and

Note – Depending on the size of the unit and on the traffic density encountered in the ACC, some of the functions above may be combined.

e) the national or international ATFM centre is responsible for the dissemination of information and for the coordination among the facilities located in its area of responsibility for national, intra-region and interregional coordination.

3.1.5 The purpose of the coordination methodology implemented with ATFM is to establish a protocol to ensure that each level of the organization is informed of ATFM in a timely and accurate manner. This method was extracted from a generic organizational model that can be modified to meet the needs of each specific environment.

3.1.6 Letters of agreement (LOA) or other appropriate documentation should be developed in order to ensure the necessary standardization.

3.2 Roles and responsibilities of the stakeholders in an ATFM service

3.2.1 What are the roles and responsibilities of the stakeholders in an ATFM service?

3.2.1.1 Flow management unit/flow management position (FMU/FMP)

3.2.1.1.1 FMUs/FMPs monitor and balance traffic flows within their areas of responsibility in accordance with air traffic management directives. They also direct traffic flows and implement approved traffic management measures. As mentioned in paragraph 3.1.1, their operations are overseen by the appropriate authority. FMU/FMP duties may include:
a) creating and distributing the ATFM daily plan (ADP) based on prior consultation and collaboration with the designated facilities and stakeholders;

b) collecting all relevant information, such as meteorological conditions, capacity constraints, infrastructure outages, runway closures, automated system outages, and procedural changes that affect ATS units. This may be accomplished through various means available, such as teleconferences, e-mail, internet, automated data gathering, etc.;

c) analysing and distributing all relevant information;

d) documenting a complete description of all ATFM measures (for example, ground delay programs, miles-in-trail) in a designated log. It should include, among other data, for each measure, the start and end times, the affected stakeholders and flights, and its justification;

e) coordinating procedures with the affected stakeholders;

f) creating a structure for information dissemination (such as a website, for example);

g) conducting daily telephone and/or web conferences, as required; and

h) continuously monitoring the ATM system, make service delivery adjustments where necessary, manage ATFM measures and cancel them when no longer required.

3.2.1.2 Airspace users

3.2.1.2.1 AUs participate in the ATFM process by providing and updating flight plan or airspace utilization information as well as by participating in CDM processes (e.g., discussing ATFM strategies to improve flight efficiency and participating in user driven prioritisation processes). The participation of AUs in the ATFM process will be supported by CDM telephone conferences and/or web-based interfaces.

3.3 Training requirements for the stakeholders in an ATFM service

3.3.1 FMU/FMP personnel

3.3.1.1 Personnel performing ATFM functions will require standardized and recurrent training in order to maintain their competency level in a constantly changing environment. A detailed ATFM training plan will ensure that personnel maintain an optimized level of operational efficiency in their respective FMU/FMP. This will allow ATFM personnel to successfully face the important changes in their operational environments and provide the highest level of service.

3.3.2 Other ATFM stakeholders

3.3.2.1 All stakeholders involved in the ATFM system must be given the training required to enable the provision of an efficient ATFM service. ATS personnel, as well as AUs, must have the knowledge required to carry out their respective responsibilities.
Chapter 4
CAPACITY, DEMAND AND ATFM PHASES

4.1 How is the capacity of an airspace sector and airport determined?

4.1.1 The capacity of an ATM system depends on many factors, including traffic density and complexity, the ATS route structure, the capabilities of the aircraft using the airspace, weather-related factors, and controller equipment and workload. Every effort should be made to provide sufficient capacity to cater for both normal and peak traffic levels; however, in taking any actions to increase capacity, the responsible ATS authority shall ensure that safety levels are not jeopardized.

4.1.2 The number of aircraft provided with air traffic control service shall not exceed that which can be safely handled by the ATS unit concerned under the prevailing circumstances. In order to define the maximum number of flights which can be safely managed, the appropriate ATS authority should assess and declare the ATC capacity for control sectors (en route and terminal control area) and for airports.

4.1.3 ATC capacity should be expressed as the maximum number of aircraft that can be accepted over a given period of time at an ATM resource (airspace sector, waypoint, airport, etc.).

4.1.4 ATC capacity for an airspace sector is normally defined as an entry count (maximum number of aircraft entering an airspace sector in a given period of time). A complementary measure is occupancy count (maximum number of aircraft within an airspace sector in a given period of time) as well as other possible units. Studies have shown that occupancy count can be used to complement entry counts, and allow higher values for such entry counts, where accurate and frequent live surveillance data updates are included in the ATFM system and that these are available well in advance of flight entry into the given airspace sector and are constantly updated. In certain cases, occupancy count capacity can be described in terms of number of aircraft in a given airspace sector at an instance or number of aircraft in a given airspace sector over the average time a typical aircraft spends in a sector as well as other possible representations.

4.1.5 ATC capacities are not static values. They vary with traffic complexity and other factors. Consideration should be given to tolerance thresholds around standard capacity values that may vary in either direction. Figure 3 illustrates the various elements that are usually taken into account when defining airspace capacities. Figure 4 illustrate the main factors affecting airport capacity.

4.1.6 Capacity measurement and calculation methodologies should be developed according to the requirements and conditions of their operational environment. Calculation methodologies have already been established by States in various ICAO regions and the various methods have different levels of complexity. Examples are provided in Appendices C, D and E.
Figure 4-1. Factors affecting airspace capacity
Figure 4-2. Factors affecting airport capacity
4.2 Balancing demand and capacity

4.2.1 How are ATFM processes applied in order to balance the demand and capacity within a given area?

4.2.1.1 In order to minimize the effects of ATM system constraints, a methodology to balance demand and capacity should be developed. This can be accomplished through the application of an “ATFM Planning and Management” process. This is a collaborative, interactive capacity and airspace planning process, where airport operators, ANSPs, AUs, military authorities, and other stakeholders work together to improve the performance of the ATM system (see Figure 4-3).

![ATFM Operational Management Diagram](image)

Figure 4-3. ATFM operational management

4.2.1.2 This CDM process allows AUs to optimize their participation in the ATM system while mitigating the impact of constraints on airspace and airport capacity. This also allows for the full realisation of the benefits of improved integration of airspace design, airspace management (ASM), and ATFM. The process contains three equally important phases: ATM planning, ATFM execution, and post-operations analysis.

**ATM planning**

4.2.1.3 In order to optimize ATM system performance in the ATM planning phase, available capacity is established and then compared to the forecasted demand and to the established performance targets. Measures taken in this step include:

a) reviewing airspace design (route structure and ATS sectors) and airspace utilisation policies to look for potential capacity improvements;

b) reviewing the technical infrastructure to assess the possibility of improving capacity. This is typically accomplished by upgrading various ATM support tools or enabling
navigation, communication or surveillance infrastructure;

c) reviewing and updating ATM procedures induced by changes to airspace design and technical infrastructure;

d) reviewing staffing practices to evaluate the potential for matching staffing resources with workload and the eventual need of adjustments in staffing levels; and

e) reviewing the training that has been developed and delivered to ATFM stakeholders.

4.2.1.4 Such an analysis will quantify the magnitude of any possible imbalance between demand and capacity. Mitigating actions may then be needed to correct that imbalance. However, before they are implemented, it is very important to:

a) establish an accurate picture of the expected traffic demand through the collection, collation, and analysis of air traffic data, bearing in mind that it is useful to:

1) monitor airports and airspaces in order to quantify excessive demand and significant changes in:

i) forecast demand; and

ii) ATM system performance targets;

2) obtain demand data from different sources, such as:

i) comparison of recent traffic history (e.g., comparing the same day of the previous week or comparing seasonal high-demand periods);

ii) traffic trends provided by national authorities, user organizations (e.g., IATA), etc.; and

iii) other related information (e.g., air shows, major sports events, large scale military manoeuvres); and

b) take into account the complexity and cost of these measures in order to ensure optimum performance, not only from a capacity point of view but also from an economic (and cost effectiveness) perspective.

4.2.1.5 The next phase, ATFM execution, is built on declared ATC capacity. It aims at facilitating the delivery of optimal ATM services.

**ATFM execution**

4.2.1.6 ATFM execution consists of three phases: strategic, pre-tactical, and tactical. These phases should not be considered as discrete steps, but rather as a continuous planning, action and review cycle that is fully integrated with the ATM planning and post operations processes. It is important that operational stakeholders are fully involved in each phase.

**Strategic**

4.2.1.6.1 The ATFM strategic 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.
This phase applies the outcomes of the ATM Planning activities. It takes advantage of the increased dialog between AUs and capacity providers, such as ANSPs and airports, in order to analyse airspace, airport and ATS restrictions, seasonal meteorological condition changes and significant meteorological phenomena. It also seeks to identify, as soon as possible, any discrepancies between demand and capacity in order to jointly define possible solutions which would have the least impact on traffic flows. These solutions are not to be frozen in time, but may be adjusted according to the demand foreseen in this phase.

The strategic phase includes:

a) a continuous data collection and interpretation process that involves a systematic and regular review of procedures and measures;

b) a process to review available capacity; and

c) a series of steps to be taken if imbalances are identified. They should aim at maximizing and optimizing the available capacity in order to cope with projected demand and, by way of consequence, at achieving performance targets.

The main output of this phase is the creation of a plan, composed of a list of hypotheses and of resulting capacity forecasts and contingency measures. Some elements of the plan will be disseminated in aeronautical information publications. Planners will use them to resolve anticipated congestion in problematic areas. This will, in turn, enhance ATFM as a whole as solutions to potential issues are disseminated well in advance.

Pre-tactical

The ATFM pre-tactical phase encompasses measures taken one day prior to operations.

During this phase, the traffic demand for the day is analysed and compared to the predicted available capacity. The plan, developed during the strategic phase, is adapted and adjusted accordingly.

The main objective of the pre-tactical phase is to optimize capacity through an effective organization of resources (e.g., sector configuration management, use of alternate flight procedures, etc.).

The work methodology is based on a CDM process established between the stakeholders (e.g., FMU, airspace managers, AUs).

The tasks to be performed during this phase may include the following:

a) determine the capacity available in the various areas, based on the particular situation that day;

b) determine or estimate the demand;

c) study the airspace or the flows expected to be affected, the airports expected to be saturated, calculating the acceptance rates to be applied according to system capacity;

d) conduct a comparative demand/capacity analysis;

e) prepare a summary of ATFM measures to be proposed and submit them to the ATFM community for collaborative analysis and discussion; and

f) at an agreed-upon number of hours before operations, conduct a last review consultation involving the affected ATS units and the relevant stakeholders, in order to fine-tune and
determine which ATFM measures should be published through the corresponding ATFM messaging system.

4.2.1.7.5 The final result of this phase is the ATFM daily plan (ADP) that describes the necessary capacity resources and, if needed, the measures to manage the traffic. This activity is based on hypotheses developed in the strategic phase, refined to the expected situation. It should be noted that the time limits of the pre-tactical phase may vary, as they depend on the precision of the forecasts, on the nature of operations within the airspace and on the capabilities of the various stakeholders.

4.2.1.7.6 The ADP must be developed collaboratively and aims at optimizing the efficiency of the ATM system and balancing demand and capacity. The objective is to develop strategic and tactical outlooks for a given airspace volume or airport that can be used by stakeholders as a planning forecast.

4.2.1.7.7 It is recommended that the ADP should cover, as a minimum, a 24-hour period. The plan may, however, cover a shorter period, provided mechanisms are in place to update the plan on a regular basis.

4.2.1.7.8 The operational intentions of AUs should be consistent with the ADP (developed during the strategic phase and adjusted during the pre-tactical phase).

4.2.1.7.9 Once the process has been completed, the agreed measures, including the ATFM measures, should be disseminated using an ATFM message, which may be distributed using the various aeronautical communication networks or any other suitable means of communication, such as internet, email, etc.

**Tactical**

4.2.1.8 During the ATFM tactical phase, measures are adopted on the day of the operation. Traffic flows and capacities are managed in real time. The ADP is amended taking due account of any event likely to affect it.

4.2.1.8.1 The tactical phase aims at ensuring that:

a) the measures taken during the strategic and pre-tactical phases actually address the demand/capacity imbalances;

b) the measures applied are absolutely necessary, and that unnecessary measures are avoided;

c) capacity is maximized without jeopardizing safety; and

d) the measures are applied taking due account of equity and overall system optimization.

4.2.1.8.2 During this phase, any opportunity to mitigate disturbances shall be used. The need to adjust the original ADP may result from staffing problems, significant meteorological phenomena, crises and special events, unexpected opportunities or limitations related to ground or air infrastructure, more precise flight plan data, the revision of capacity values, etc.

4.2.1.8.3 The provision of accurate information is of paramount importance in this phase, since the aim is to mitigate the impact of any event using short-term forecasts. Various solutions may be applied, depending on whether the aircraft are already airborne or about to depart.

4.2.1.8.4 Proactive planning and tactical management require the use of all information available. It is of vital importance to continuously assess the impact of ATFM measures and to adjust them, in a collaborative manner, using the information received from the various stakeholders.
Post operations analysis

4.2.1.9 The final step in the ATFM planning and management process is the post-operations analysis phase.

4.2.1.9.1 During this phase, an analytical process is carried out to measure, investigate and report on operational processes and activities. This process is the cornerstone of the development of best practices and/or lessons learnt that will further improve the operational processes and activities. It shall cover all ATFM domains and all the external units relevant to an ATFM service.

Note. – A best practice is a method, process, or activity that, upon evaluation, demonstrates success, has had an impact, and can be repeated. A lesson learnt documents the experience gained during an event, and provides valuable insight with respect to identifying method, process, or activity that should be used or, to the contrary, avoided in specific situations.

4.2.1.9.2 While most of the post-operations analysis process may be carried out within the ATFM unit, close coordination and collaboration with ATFM stakeholders will yield better and more reliable results.

4.2.1.9.3 Post-operations analysis should be accomplished by evaluating the ADP and its results. Reported issues and operational statistics should be evaluated and analysed in order to learn from experience and to make appropriate adjustments and improvements in the future.

4.2.1.9.4 Post-operations analysis shall include analysis of items such as anticipated and unanticipated events, ATFM measures and delays, the use of predefined scenarios, flight planning and airspace data issues. They should compare the anticipated outcome (where assessed) with the actual measured outcome, generally in terms of delay and route extension, while taking into account performance targets.

4.2.1.9.5 All stakeholders within the ATFM service should provide feedback, preferably in a standardized electronic format, enabling the information to be used in the post-operations analysis in an automated manner.

4.2.1.9.6 In complex areas, and in order to support the post-operations analysis process, the use of an automated replay support tool, with graphical display, can be useful.

4.2.1.9.7 Post-operations analysis may be used to:

a) identify operational trends or opportunities for improvement;

b) further investigate the cause and effect relationship of ATFM measures to assist in the selection and development of future actions and strategies;

c) gather additional information with the goal of optimizing ATM system efficiency in general or for on-going events;

d) perform analysis of specific areas of interest, such as irregular operations, special events, or the use of reroute proposals; and

e) make recommendations on how to optimize ATM system performance and to minimize the negative impact of ATFM measures on operations.

4.2.1.9.8 It is important to ensure that the relevant ATFM stakeholders are made aware of the results. The following process is recommended:
a) collection and assessment of data including comparison with targets;

b) broad review and further information gathering at a daily briefing;

c) weekly operations management meeting to assess result and recommend procedural, training and system changes where necessary to improve performance; and

d) periodic operations review meetings with stakeholders.

Figure 4-4 below provides an overview of the post-operations analysis cycle.

Figure 4-4. The cycle of post-operations analysis
Chapter 5

ATFM IMPLEMENTATION

The following chapter details, in a sequence, the different steps that should be undertaken to establish an ATFM structure. The degree of effort spent on each step will depend on the nature of the structure (from a local unit operating from a single airport to a major international entity). The second part of the chapter focuses on the steps necessary to set up an international structure.

5.1 How is an ATFM service implemented?

5.1.1 The ATFM implementation strategy should be developed in phases in order to ensure maximum utilization of the available capacity and to enable all concerned parties to gain sufficient knowledge and experience.

5.1.2 Over time, and in order to maximize the operational efficiency of airspaces and airports, consideration should be given to the establishment of international ATFM centres to centralise ATFM service provision and/or oversee/coordinate the activities of local ATFM centres (ACC or airport). Further guidance on implementing an international air traffic flow management unit can be found in part 5.2.

5.1.3 ANSPs can, however, introduce basic ATFM processes without the immediate need for a national or international centre.

5.1.4 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 AUs, ANSPs, and to other stakeholders in a timely manner.

5.1.5 In its initial applications, ATFM can be performed via point-to-point telephone calls designed to exchange information of operational significance and to relay information on factors affecting capacity, on system constraints and on significant meteorological conditions. The information could, for example, include: planned runway closures, equipment serviceability or maintenance, staffing issues, volcanic activity, airspace constraints and any mitigation measures. This basic level of ATFM provides an opportunity to discuss and coordinate operations and allows significant benefits to be achieved very rapidly.

5.1.6 In any case, it is important that the procedures applied during the implementation process be developed in a harmonized manner among the various States to avoid risks to operational safety and efficiency. This entails defining a national and international strategy to facilitate and harmonize the implementation process.

5.1.7 Any ATFM system must be supported by formal international and national agreements (letters of agreement, etc.). The aeronautical information related to ATFM must be published in accordance with Annex 15 — Aeronautical Information Services. ATFM procedures must be consistent with Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)

5.1.8 ATFM development: Initial steps

5.1.8.1 Detailed guidelines on the structures and the organisation of an ATFM service can be found in chapter 3. This section focuses on the sequence of steps that should be taken. To implement an ATFM service, one should:

   a) establish the objectives, project management plan, and oversight of ATFM, bearing in mind that:
1) a project management approach is required. It shall define clear tasks for each stakeholder and contain milestones; and

2) that the oversight of the implementation process should be carried out by the ANSP in collaboration with the relevant oversight authorities;

b) identify the personnel who will lead the development of ATFM bearing in mind that:

1) best practices indicate that the ANSP usually takes the lead; and that

2) key stakeholders from the airspace users, airport operators, and military authority should be involved in the planning, development and implementation of ATFM;

c) identify the stakeholders among:

1) en route centre supervisors and controllers;

2) approach control supervisors and controllers;

3) control tower supervisors and controllers;

4) ATM planning and procedure experts;

5) airline operations centre supervisors and dispatchers;

6) meteorological office supervisors and specialists;

7) appropriate military authorities;

8) general aviation operations centre managers;

9) airport operations centre managers;

10) airline chief pilots;

11) regulator; and

12) others as identified.
Figure 5-1: Sample set of ATFM stakeholders per sector of activity

d) brief the stakeholders on:

1) the purpose and objectives of the project;
2) the important terms and definitions used in the project;
3) the plan for developing the ATFM service; and
4) their respective roles and responsibilities;

e) define the ATFM structure that is needed (detailed principles on ATFM structure and organization can be found in Chapter 3, 3.1.2). It usually involves the following stakeholders:

1) manager of the ATFM organization;
2) supervisor of the flow management unit (FMU);
3) traffic management supervisors, from en route centre, terminal and tower control;
4) airline operations centre supervisors and/or dispatchers;
5) meteorological office supervisors and specialists;
6) military flight operations centre commanders;

7) general aviation operations managers; and

8) airport operations managers;

f) establish the CDM processes that will be used in ATFM (for guidelines on CDM, see Part 1, 2.6.);

g) develop or adopt, and apply a model for establishing the airport acceptance rate (AAR) at the relevant airports. A sample method is presented in appendix C;

h) develop or adopt and apply a model for establishing en route sector and terminal sector capacity; sample models are presented in Appendixes D and E;

i) identify the appropriate locations for FMUs and FMPs;

j) identify the personnel in charge, the means of contact and the operational phone numbers for each stakeholder identified in the ATFM management structure;

k) define the elements of common situational awareness (see figure 5-2);

1) identify the type and the format of the information related to airport situation and airspace capability.

2) identify the meteorological information that can be used collaboratively to assess the impact of weather on capacity. The information could come from:

i) aerodrome routine meteorological report (in meteorological code form) (METAR) and aerodrome forecast (in meteorological code form) (TAF);

ii) forecast websites and charts;

iii) satellite websites and charts; and

iv) meteorological radar;

3) identify and use the tools that can be used collaboratively to display traffic and geographical information;
l) identify the appropriate means of communication that will be used for ATFM:
   1) telephone conferencing systems;
   2) web-based conferencing systems;
   3) web-based information dissemination and discussion portal similar to a blog format;
   4) electronic chat to support tactical discussion;
   5) operational information web pages; and
   6) any other appropriate mean;

m) develop the applicable ATFM operational Letters of Agreement (LoA); Appendices F
   and G respectively, provide a template of LoA between a FMU and an ACC and between
   ANSP;

n) develop the procedures and training materials for FMUs, FMPs and stakeholders;

o) develop the procedures and training materials for stakeholders;

p) evaluate the need to apply safety management system processes when new ATFM tools
   and procedures induce a significant change to existing procedures, in line with existing
   provisions in PANS-ATM, 2.6.1.1;
q) discuss and develop the ATFM measures that will be applied in order to balance air traffic demand and capacity;

r) establish an implementation date for the ATFM service;

s) train the appropriate personnel with regards to the processes and procedures necessary for ATFM implementation;

t) implement the processes and procedures; and

u) evaluate the results and coordinate changes as necessary, through a collaborative working arrangement that will ensure periodic review and provide feedback from users and stakeholders.

5.2 How can an international ATFM service be implemented?

5.2.1 What is an international ATFM service?

5.2.1.1 International ATFM aims at maximizing the efficiency and effectiveness of air traffic management across the area of responsibility of more than one ANSP. It therefore contributes directly to the objectives, principles and benefits of ATFM defined in chapter 1. More specifically, it aims at achieving, over a region or sub-region, the seamless ATM environment that would exist if the entire ATFM service was provided from single ATFM centre, such as is envisaged in Chapter 3, 3.1.4 d). International ATFM contributes to enhancing the safety, efficiency, cost effectiveness, and environmental sustainability of ATM. It is also a major enabler of the global interoperability of the air transport industry.

5.2.1.2 The main objectives of international ATFM are those outlined in Chapter 1, 1.2.1.1. However, the specifically international dimension will bring a special focus on global efficiency, international collaboration, and system predictability across a wide area. Finally, it should also be noted that, thanks to international ATFM, important operational synergies and economies of scale can be achieved.

5.2.1.3 ATFM centres collaborate with their stakeholders to provide their own service. However, there are circumstances where one single ATFM centre may not be effective in providing optimum ATFM service. In those cases, international ATFM becomes necessary. Such cases include, but are not limited to:

a) airports or airspaces which handle large proportions of international flights; and

b) airports or airspaces located in small sized States or regions.

5.2.2 How can international ATFM be developed and implemented?

5.2.2.1 It is challenging to achieve the ideal international ATFM setup right from the beginning. International ATFM can, however, be the shortest path to achieving an efficient ATFM environment, provided it is designed with this final goal in mind at all times. Staying focused on the final objective will also prevent wasteful investments. The ideal international ATFM will be described in 5.2.3 and the way to implement it step by step, in 5.2.4.

5.2.2.2 The sequence of ATFM implementation described in 5.1 remains valid. But, as is described in this section, the whole process must simply be envisaged in a larger setup, induced by the coordination between many air traffic service units located in several countries.

5.2.3 The ideal international ATFM

5.2.3.1 The ultimate goal of international ATFM is to achieve, over a region or a sub-region, the
creation of a seamless ATM service.

5.2.3.2 An essential aspect of the ideal end stage of international ATFM is the exchange of real time ATFM information. The systems of all local ATFM centres must therefore be connected to each other, as well as to the systems of the relevant stakeholders. To spread awareness of the present situation, and to be able to predict future situations, the information that should be exchanged includes, (but is not limited to):

a) ATC capacity, specified by airport or airspace volume;

b) meteorological information and forecasts impacting capacity;

c) traffic demand: flight schedule, flight plans, surveillance updates; and

d) other information impacting ATC capacity (such as military activities, route availability).

5.2.3.4 While each local ATFM centre could retain the authority to decide on the kind of measures it would like to implement when demand exceeds capacity, it is paramount that the ATFM centres possess a common view of the situation, and that the impact of each measure, required by a local ATFM centre, is collectively assessed at the level of the region or sub-region. In the ideal setup, all centres involve, through CDM, the relevant stakeholders, and collaboratively decide to implement the ATFM measures that are needed over their sub-region.

5.2.3.5 ATFM centres must continuously monitor the situation. Through that constant monitoring, a global supervision is established, to oversee the effects of ATFM measures, to measure their efficiency and their effectiveness. The global difference between the actual and predicted situations is monitored in order to balance demand and capacity at international level.

5.2.3.6 In the framework of that permanent monitoring, should an ATFM centre detect a discrepancy between the predicted and the actual situation, it should take the appropriate actions to mitigate the effect of that difference on traffic. It shall, however, take due account of the necessary reaction time of each stakeholder.

5.2.3.7 In the ideal international setup, the ATFM service is therefore similar to the one that would be delivered by a single international unit. While that may not always be possible, it is however paramount that each ATFM centre considers the impact of the ATFM measures it envisages on the operations of other ATFM centres. It shall do so with equity, transparency, and with the aim of achieving the greatest overall efficiency.

5.2.4 Implementation of international ATFM in a phased manner

5.2.4.1 Step Zero (recognize the need for international ATFM)

5.2.4.1.1 Should data show, for example, frequent delays recorded in a specific airport or indicate that interval separation has increased for in-bound traffic in a specific airspace block, a state should start to investigate the cause of those delays and increased separation. Meanwhile, it should start to prepare for ATFM by identifying the following:

a) ATC capacity;

b) air traffic demand and main traffic patterns and features, including city pairs;

c) ATFM systems and procedures in adjacent states or regions; and

d) any other reason that could explain why the delay or the spacing interval increased:
1) weather impact;
2) increased demand;
3) reduced capacity; and
4) operational procedures.

5.2.4.1.2 The State shall then determine if actions limited to the scope of an ATFM centre can resolve the issue. But if, for example, much of the traffic originates from outside the area of responsibility of one of its ATFM centre, or if the investigation shows that the remedial actions go beyond the area of responsibility of a single ATFM centre, then it is time to consider regional ATFM.

5.2.4.2 Step One (Information Sharing)

5.2.4.2.1 Once the investigation has highlighted that cooperation with adjacent states and regions is necessary to tackle the problem generating congestion and delays, the states shall initiate cooperation with adjacent states, regions or subregions.

5.2.4.2.2 The first action is to implement mechanisms to share information, by email, point-to-point telephone, fax, teleconference, or any appropriate mean of telecommunication. Various communications protocol should be established, such as:

- a) a framework detailing the ATFM information to be exchanged in case of exceptional disruptions or unexpected difficulties;
- b) a framework detailing the ATFM information that should be exchanged on a regular basis; and
- c) a framework detailing the ATFM data that should be exchanged for periodic post-operational analysis.

5.2.4.2.3 The following items are examples of data elements (the list is non-exhaustive) that would be relevant for international ATFM:

- a) conditions or capabilities of the main airports;
- b) actual and forecast weather condition and anticipated impact on ATC capacity;
- c) expected runway closures;
- d) airspace or route closures, relevant military activity; and
- e) ATM system or CNS disruptions having an impact on capacity.

5.2.4.2.4 When establishing international ATFM, one of the main elements to be recognized is the element of early notice that must be given to the associated facilities and ATM units. As an example, increasing the separation between inbound traffic is one of the most frequently used ATFM measures in case of overload. That measure has, however, a very significant impact over the area control centre – and the local ATFM centre – that has to implement it. For that specific measure, as for any other ATFM measures, the first notion to integrate, when establishing international ATFM, is the notion of advanced notice to neighboring facilities. It must be integrated in the coordination procedures set up between adjacent facilities. It should be noted, at this point, that the appropriate CDM processes will also spread the benefits of that advance notice to the operators, as well as to all the relevant stakeholders.
5.2.4.2.5 In Step 1, all the ATFM units of a subregion therefore share data, and maintain a common regional awareness. Every ATFM unit informs the other units and the various stakeholders of the ATFM measures that will be used in its area of responsibility. AUs are involved in the decision making process thanks to ongoing CDM processes.

5.2.4.3 Step Two (Notify expected traffic management measures in advance)

5.2.4.3.1 In the second phase of the implementation of international ATFM, if an ATFM centre plans to implement traffic management measures, it must coordinate the measures before their actual implementation. The coordination should involve the other units and the relevant stakeholders of its region or sub-region. This allows the envisaged set of measures to be further improved as all stakeholders are involved in the decision making process, thus increasing the robustness of the chosen set of measures.

5.2.4.3.2 Once the appropriate coordination has been conducted, at the international level, and with the appropriate stakeholders, each ATFM centre then publishes its ADP. Further guidance on ADP can be found in 2.3.3.

5.2.4.3.3 This coordinated and cooperative approach ensures that the solutions that are chosen are understood, and implemented in the most effective manner.

5.2.4.3.4 Automated information exchange is an important enabler of international ATFM. Automated exchange systems ensure constant updates, and contribute to maintaining the situation awareness of all the relevant stakeholders. It should be pointed out, though, that the existence of those systems, involving a wide range of stakeholder, further emphasizes the importance of standardizing the format of the messages exchanged in the ATFM processes.

5.2.4.3.5 Step 2 of international ATFM is therefore a phase where all the ATFM units of a region or sub-region pool their resources to collectively agree on and implement a common ATFM action plan, therefore providing a seamless ATFM service for their region or subregion.

5.2.4.4 Key elements of international ATFM

5.2.4.4.1 International ATFM ensures that all the relevant stakeholders gain the adequate awareness of ATFM planning, during strategic, tactical and pre-tactical phases.

5.2.4.4.2 International ATFM contributes to ensuring transparency of all ATFM activity for all stakeholders.

5.2.4.4.3 Post-operational analysis are a key element to improve ATFM in general. With international ATFM, post analysis are even more important, because the collected data and the lessons learnt can be rapidly shared throughout the entire region or sub-region in order to further enhance ATFM provision and its related policies.
Chapter 6

ATFM MEASURES

6.1 What are ATFM Measures and how are they established and applied?

6.1.1 ATFM measures are techniques used to manage air traffic demand according to system capacity. Some ATFM measures must be considered as control instructions or procedures.

6.1.2 ATFM measures are important initiatives for managing the flow of air traffic and should be used to manage traffic demand, but they have an impact on AUs. It is important to keep this in mind and to implement only those measures that are necessary to maintain the safety and efficiency of the system. In other words, air traffic management personnel should employ the least restrictive methods available in order to minimize, as much as possible, the impact on flight operations.

6.1.3 The ANSPs and the AUs should, using ATFM strategy conferences, collaborate in the identification and selection of the ATFM measures applicable to any given area. All the stakeholders would therefore understand, from the outset, the application parameters, processes and procedures. This would mitigate misunderstandings and prevent induced dysfunctions during operations. Such conferences could also allow discussions on foreseeable capacity reductions (due to, for example, scheduled runway maintenance) or on ways to address a significant demand increase in periods of time of limited capacity (especially in the case of special and/or unforeseen events).

6.1.4 ATFM measures may only be required during certain periods of time when demand exceeds capacity.

6.2 Types of ATFM measures

6.2.1 There are many types of ATFM measures. Their lifetime typically spans the pre-tactical and tactical phases of the ATFM time horizon. The list below is not exhaustive and provides guidance on where the various measures fall on the ATFM timeline. Figure 9 summarizes these ATFM measures.
6.2.1.1 **Miles-in-trail (MIT).** A tactical ATFM measure. It is expressed as the number of miles required between aircraft (in addition to the minimum longitudinal requirements), to meet a specific criterion. The criteria may be separation, airport, fix, altitude, sector, or route specific. MIT are 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.

6.2.1.2 **Minutes-in-trail (MINIT).** A tactical ATFM measure. It is 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.

6.2.1.3 **Fix balancing.** A tactical ATFM measure, aiming at distributing demand and avoiding delays. The aircraft is assigned a different arrival or departure fix than the one indicated in the flight plan. This can also be used, for example, during periods of convective weather where a standard instrument arrival (STAR) or a standard instrument departure (SID) is unusable.

6.2.1.4 **Rerouting.** A tactical ATFM measure. It consists of an ATC-assigned routing different from the one indicated in the filed flight plan. Rerouting can take a variety of forms, depending on the tactical situation.

6.2.1.4.1 **Mandatory Rerouting scenarios.** Mandatory diversion of flows to offload traffic from constrained areas.

6.2.1.4.2 **Level capping scenarios.** Carried out by means of flight level restrictions (e.g., flights from London to Paris TMA shall file below FL285, with departures limited to FL 245 until they exit the TMA).
6.2.1.4.3 **Alternative or advisory routing scenarios.** Routes which are made available to AUs on an optional basis to offload traffic from certain areas.

6.2.1.4.4 A rerouting is normally issued to:

a) ensure that aircraft operate along with a required flow of traffic;

b) remain clear of airspace under restrictions or reservations;

c) avoid excessively congested airspace; and

d) avoid areas of known meteorological conditions of such nature that aircraft have to circumvent it.

6.2.1.5 **Minimum Departure Intervals (MDIs).** A tactical ATFM measure. It is carried out when ATC sets a departure flow rate of, for example, 3 minutes between successive departures. MDIs are typically applied for no more than 30 minutes at a time and are typically applied when a departure sector becomes excessively busy or when capacity is suddenly reduced (e.g., equipment failure, meteorological conditions, etc.).

6.2.1.6 **Slot Swapping.** A tactical ATFM measure. It can be applied either manually or via automated means. The ability to swap departure slots gives AUs the possibility to change the order of departure of the flights that should fly in a constrained area. This measure provides AUs with the ability to manage and adapt their business model in a constrained environment.

6.2.1.7 **Collaborative Trajectory Options.** A strategic, pre-tactical, or tactical ATFM measure. It is composed of a set of collaboratively developed, published, pre-defined routes to address reoccurring route scenarios. The set of options is an assistance tool that allows efficient route coordination to be held during periods of system constraint.

6.2.1.8 **Ground delay programme (GDP).** A strategic, pre-tactical, or tactical ATFM measure. A GDP is an air traffic management 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. They correspond to available entry slots into the constrained airspace or arrival slots into the constrained airport. A GDP aims at, among others, minimizing airborne holding. It is a flexible programme, and its forms may vary depending on the needs of the air traffic management system. GDPs are developed in a collaborative manner and are typically administered and managed by a FMU or a national/international ATFM centre. When a GDP is scheduled to last for several hours, slots might have to be revised because of changing conditions. There must therefore be a system in place to advise pilots of departure slots and of any changes to the GDP.

6.2.1.9 **Ground stop (GS).** A tactical ATFM measure. Some selected aircraft remain on the ground. Due to the impact of a ground stop on AUs, alternative ATFM measures should be explored and implemented prior to a GS, time and circumstances permitting. The GS is typically used:

a) in cases where capacity has been severely reduced at airports due to significant meteorological events or due to aircraft accidents/incidents;

b) to preclude extended periods of in-flight holding; to preclude sector/centre reaching near saturation levels or airport grid lock;

c) in the event a facility is unable or partially unable to provide air traffic services due to unforeseen circumstances; and
d) when routings are unavailable due to severe meteorological or catastrophic events.

6.2.1.10 **Airborne Holding.** A tactical ATFM measure that has been designed strategically. It is a process that requires aircraft to hold at a waypoint in a pre-defined standard holding pattern. It is generally used to cope with short notice demand and capacity imbalances. It can also allow to establish an inventory of aircraft that would be in a position to take advantage of short notice, temporary increases in capacity such as the ones that occur during certain types of meteorological events.

6.2.1.10.1 During the strategic planning phase, stakeholders collaborate to determine suitable locations for the holding patterns. Analysis has shown that the optimal flight levels for airborne holding, from a fuel efficiency perspective, are FL200 – FL280. These flight levels strike the right balance between lesser fuel consumption for turbine-powered aircraft, and the size of the holding area. Although inefficient holds at low altitudes should be avoided, there are however cases where lower altitude holding areas can be designed to provide for a small ready supply of holding aircraft: they would be in a position to take advantage of a short notice opportunity. In any case, holding altitudes should be compatible with normal descent profiles in order to avoid excessive rates of descent and airspeeds.

6.2.1.10.2 Airborne holding is complementary to ground delay programmes and ground stops. Airlines may, in collaboration with the ANSP, choose to use it to keep a small inventory of holding aircraft, during periods of congestion, to maintain demand pressure on the approach. The supply of available aircraft can prevent losing opportunities when departure demand is not constant or when meteorological conditions vary.

6.2.1.10.3 Airborne holding generates high workload for air traffic controllers and pilots. Every effort must therefore be made to simplify the procedures and to minimize communications during the process. Consideration must also be given to reducing sector capacity during airborne holding periods.

6.3 ATFM measure approval authority

6.3.1 The coordination and approval of ATFM measures must be conducted in accordance with the CDM process established for the provisions of the ATFM service. Publication in national AIPs and/or regional supplementary procedures is recommended.

6.4 ATFM measures processing

6.4.1 Prior to implementation, the designated authority responsible for ATFM must identify the need for an ATFM measure, examine alternative options, and develop a justification for the ATFM measure. The ATFM authority will:

a) discuss and coordinate the proposed ATFM measure with the receiving facility and stakeholders prior to implementation;

b) notify affected facilities and stakeholders of the implementation in a timely and appropriate manner;

c) continuously monitor and assess the ATFM measures to ensure they are producing the desired results;

d) make any necessary adjustments, including the development of an exit strategy; and

e) coordinate with and notify affected facilities and stakeholders of modifications and cancellations in a timely and appropriate manner.
6.5 Application of ATFM solutions

6.5.1 ATFM continuously and pro-actively considers all possible air traffic flow management solutions through an iterative process that spans from the strategic planning phase to the execution of operations. Any new element of information can therefore be integrated immediately. Anticipating events makes it possible to minimize their impact on the ATM system. It also gives the chance to use every opportunity to refine and fine tune the plan further.

6.5.2 A variety of air traffic flow management solutions may have to be considered to resolve capacity shortfalls and improve the management of the system while minimising constraints. Examples are shown in Figure 6-2 below.
6.5.3 Once the declared and available capacities have been established, air traffic demand can be monitored and assessed. ATFM measures can be coordinated and implemented to strike a balance in the system.

6.5.4 The following example provides a general outline of the steps involved in the actions/analyses to optimize the use of the ATM system:

a) determine capacities: review/assess airport/airspace sector capacities for accuracy;

b) assess demand: determine forecasted demand for a specific time frame, 15-minute period(s), hour(s), etc.;

c) analyse and compare: demand and capacity levels shall be analysed and compared, focusing more specifically on the periods in which demand exceeds available capacity. Automated tools greatly enhance the ATFM analytical process;
d) apply the CDM model: communicate the situation to the facilities/parties involved through the means available, using the CDM processes;

e) determine the action required for mitigating a demand/capacity imbalance: after requesting and collecting information, determine the ATFM measures that are appropriate for the situation;

f) disseminate information: using the means of communication established to that end, inform the parties involved about the ATFM measures that will be applied;

g) monitor the situation: examine the situation periodically, as necessary, to make sure that the ATFM measure mitigate the consequences of the imbalance. If necessary, re-assess and make the corresponding adjustments; and

h) conduct a post event analysis: following the event, conduct an analysis to evaluate the effectiveness of the ATFM measure, and catalogue the best work practices. This analysis may be conducted by reviewing the weekly or monthly report of the FMU/FMP.

6.6 ATFM efficiency calculation

6.6.1 ATFM measures should be based on the principles set down in this guidance material. All parties of the ATFM system should abide by the same rules. They ensure that the ATM system capacity is optimized, to the greatest possible extent, in the safest and most efficient manner. For ATFM, efficiency encompasses fuel consumption and time factors. It should, however, be noted that, efficiency notwithstanding, there are cases where actions from ATFM units to balance capacity and demand will generate delays.

6.6.2 Delays have a great impact on AUs. Their route networks and schedules are built upon connections. The reliability of these connections enables passengers to board connecting flights, ensures that aircraft are available for the next leg of flight, and impact the gate availability for following aircraft. On-time performance is therefore crucial for AUs. Every minute counts and delays represent costs. Although this AU perspective is understandable, metering delays in terms of cost is not feasible nor useful from a global ATFM perspective. However, delays need to be accounted for and analyzed, as they clearly have an impact on the overall system performance.

6.6.3 As of yet, standardized ATFM delay calculation metrics across ANSPs have not been developed. This is due, on the one hand, to the difficulties of defining what constitutes a delay and on the other hand, to the difficulty of determining which party (ANSPs, airport authorities and AUs) has control over how delays are imposed or mitigated. In order to measure system efficiency and to identify issues affecting system performance over a specific area, a global effort is needed to harmonize the definition of delay and the methods of delay reporting. This effort should be a shared responsibility of the ANSPs, airports, AUs, and of the other stakeholders that form part of the ATFM process in the concerned area.

6.7 Principles of delay analysis

6.7.1 For practical and pragmatic reasons, the following considerations should be taken into account with regard to delays:

a) common definitions must be agreed upon across ANSPs and other stakeholders;

b) some ANSPs and airport authorities measure airlines on-time departure performance, which then makes that metric important; and

c) delays should be calculated for each phase of flight.
6.7.1.1 Departure:

a) all time in airline ramp/gate area should be measured;

b) taxi time should be measured including taxi-out duration, when it exceeds normal taxi-out time;

c) all time in penalty box, de-ice pads, etc. should be measured; and

d) all movement area delays should be measured.

6.7.1.2 Enroute:

a) all airborne holding delays should be measured;

b) linear hold (route extensions, use of RTA, etc.) delays need to be measured; and

c) sub-optimal routes imposed due to ATM infrastructure should be measured at a macro level and discussed during strategic CDM conferences.

6.7.1.3 Arrival:

a) on time arrival should be measured (it is, financially speaking, more relevant to airlines than on time departure);

b) consequential delays caused by cascading effects, if these can be determined, should only be measured once (e.g., flight 2 has a delayed departure due to the aircraft being delayed on the inbound leg should not count as an additional delay); and

c) all movement area delays should be measured, including taxi-in duration exceeding normal taxi-in time.

6.8 Attribution and accountability for ATFM measures

6.8.1 All ATFM actors must share a common understanding of the reasons for ATFM measures and of the entity that should be held accountable for them. (e.g. airport infrastructure, ANSP, external hazard, etc.). Appropriate and agreed definitions should be contained in local ATFM procedures. A set of reasons for ATFM measures and accountable agencies is provided below.

6.8.1.1 Factors under ANSP control:

a) flight calibration/flight check;

b) equipment maintenance or failure;

c) ANSP staffing;

d) availability of strategies to mitigate the impact of capacity reductions due to abnormal meteorological conditions;

e) flight arrival and departure sequencing; and

f) non-optimization of capacity and configurations.
6.8.1.2 Factors under State control:

a) activation of restrictions or reservations of airspace that affect capacity;

b) special events: airshow, VIP activity, special sports events; and

c) availability of special use airspace during periods of adverse meteorological conditions or other constraints.

6.8.1.3 Factors under airport control:

a) airport infrastructure and configuration;

b) airport construction affecting capacity;

c) runway closure;

d) taxiway closure;

e) de-icing delays (exceeding unimpeded normal processing time);

f) runway decontamination (sweeping, plowing);

g) runway capacity reduction caused by the airport operator failure to decontaminate;

h) delay in completing a flight (deplaning) due to gate unavailability; and

i) delay in completing a flight (deplaning) due to service unavailability (ground transport, handling, customs, etc.).

6.8.1.4 Factors under AU control:

a) inability to depart at ETD due to:

1) delayed inbound aircraft; and

2) flight preparation;

b) inability to depart at a controlled departure (slot) time that is at or later than ETD.

6.8.1.5 Uncontrollable: capacity reductions due to significant meteorological conditions or unforeseen events.

6.8.1.6 Delay classifications:

a) departure delay (actual versus planned departure time) e.g. ATOT minus ETOT or AOBT minus EOBT;

b) ATFM delay, e.g. first CTOT minus EOBT;

c) airline scheduling practices;

d) time spent waiting in queue for take-off;

e) total airborne holding minutes;
f) route extension in time and distance, by flight phase; and

g) arrival delay (actual versus planned arrival time).

6.9 Reporting

6.9.1 For reporting purposes, stakeholders should report delays on a monthly basis, at least, and include trend analyses. Delays should be broken down by reason and geographically to support analysis. ANSPs are encouraged to provide the data electronically in a format that would support further processing by stakeholders.

6.9.2 Following the publication of delay reports, ANSPs should meet with stakeholders to discuss the results and attempt to identify mitigations and corrective actions to improve performance.

6.9.3 Studies\(^1\) have shown that there is roughly a 4:1 difference in cost between applying ground delays versus applying delays via airborne holding.

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\(^1\) FAA Economic Information for Investment Analysis, dated April 19, 2012
Chapter 7
DATA EXCHANGE

7.1 What data and information are exchanged in an ATFM service?

7.1.1 As a key enabler to support the global development and further harmonization of ATFM, the cooperation and coordination of ATFM activities between States must be enhanced. Therefore States should ensure that operational data from ANSPs (e.g. traffic and flight data information, capacity information, delay information, meteorological information which have to be derived from a valid and authoritative source) are exchanged not only within their ICAO regions but also across ICAO regional boundaries, so that more efficient traffic flows can be achieved.

7.1.2 Data exchange is the sharing of information required for the effective provision of ATFM service. As depicted in Figure 11 below, the data to be shared include information related to the flight plan, capacity, demand, and ATFM measures for the purpose of cooperation and coordination of air traffic flow management activities between ATFM stakeholders.

![ATFM - Data Requirements Diagram](image)

Figure 7-1. Data requirements.

7.1.3 The requirement for data sharing covers many different areas. As described earlier in this manual, there is a requirement for the ATFM function to be constantly updated with information on the overall ATM resource (e.g., airspace status and airport infrastructure).

7.1.3.1 Many established ATFM units rely on databases that contain comprehensive details of the ATS organisation in their areas of responsibility. These databases contain essential information to ATFM planning and daily operations including ATS routes and routing systems, airports, SIDs, STARs, navigational aids (NAVAIDs), ATC sectorization, etc.
7.1.3.2 Where such databases are available, the effectiveness of the ATFM service depends, to a large extent, on the completeness and accuracy of the associated information and on the timely exchange of data.

7.1.4 The ATFM unit also needs access to accurate and timely data with regards to ATC demand. Throughout the various stages of the ATFM planning horizon (strategic, pre-tactical, tactical), AUs must provide descriptions of all flights intending to operate in the area under the responsibility of the ATFM unit. Accurate aircraft performance characteristics and meteorological models are also required in order to be able to correctly assess the impact of various operations.

7.1.5 It is of critical importance that the ATFM unit is provided with current information on the dynamic airport and airspace traffic demand and capacity situation in order to increase the accuracy of the tactical prediction.

7.1.6 Data information exchanged among stakeholders is applied to facilitate:

a) strategic planning:
   1) evaluate air traffic flows patterns;
   2) evaluate capacity and demand problems and patterns;
   3) collaborate and communicate with operational stakeholders; and
   4) validate and implement strategic ATFM measures for future events;

b) pre-tactical planning:
   1) monitor air traffic flows;
   2) evaluate changing capacity and demand situations;
   3) collaborate and communicate with operational stakeholders; and
   4) implement, revise, or cancel ATFM measures;

c) tactical planning:
   1) monitor air traffic flows;
   2) evaluate changing capacity and demand situations;
   3) collaborate and communicate with operational stakeholders; and
   4) implement, revise, or cancel ATFM measures;

d) post-operational analysis:
   1) review and analyse operations from the previous days or hours; and
   2) support and improve future planning functions and processes.

7.2 Benefits of data exchange

7.2.1 Data sharing and exchange facilitates the collaboration and interaction between national, as well as international ATFM units and enables common situational awareness. It also allows for a coordinated and comprehensive system response to ever-changing conditions in the ATM system.

7.2.1.1 This leads, in turn, to increased safety and efficiency in air traffic operations, including: increased efficiency for traffic flows, reduced delays, enhanced predictability and reliability of AU schedules, and reduced impacts on the environment from greenhouse gas emissions and noise pollution.

7.2.1.2 It also optimizes contingency responses to unforeseen events and system disruptions.
7.3 Data exchange policy

7.3.1 The provision, retention and distribution of ATFM data should be covered by an ATFM data policy.

7.3.2 Whereas the widespread sharing of ATFM data is generally of benefit to the ATFM system and its operational stakeholders, appropriate safeguards for its correct use should be put in place. The provision of ATFM data will normally be subject to national freedom of information policies. In the case of international ATFM activities the ATFM data policy should reflect the data polices of all national entities involved.

7.3.3 ATFM data is normally supplied for operational ATFM purposes and an ATFM data policy should define

a) duration and backup arrangements of data storage for investigation and post operational purposes;
b) restrictions on the release of data to the general public and to commercial organisations;
c) provisions for the release of data to state, judicial and authorised investigative agencies;
d) restrictions on the use of ATFM data for other than operational ATM purposes;
e) provisions for cost recovery associated with the retrieval and supply of ATM data; and
f) restrictions regarding the provision of data on military and other special status flights

7.4 International data exchange specifications

7.4.1 To support the global development and harmonization of ATFM, ANSPs must ensure that the data shared comes from a valid and authoritative source. ANSPs should utilize methodologies capable of data exchange that are secure, efficient, and in compliance with all applicable identified and agreed upon standards.

7.4.2 Flight data information is provided to ATFM units and operational stakeholders for the purpose of air traffic management. Such data should not be released to third parties unless this is covered by a pre-defined data policy.

7.4.3 Specifications for connectivity should abide by existing standards for this type of data exchange and be documented by interface control documents.

7.5 Data type description and harmonization

7.5.1 Automated ATC information contained in ICAO message types is the foundation for data exchange programmes. Examples of the ICAO message types are:

a) flight plan
b) flight amendment;
c) flight plan cancellation;
d) flight departure;
e) flight coordination; and
f) flight arrival.

7.6 ATFM tools

7.6.1 Depending on the size and complexity of the ATFM service to be provided, a set of ATFM tools may be implemented to enable partial automation of ATFM. Figure 7-2 provides an overview of ATFM tools to support planning, prediction, execution and analysis of ATFM measures.

![ATFM Tools Table]

Figure 7-2. ATFM tools

Note. If available, it is recommended to couple ATFM execution tools with ATC sequencing and metering tools, such as arrival and departure management systems (AMAN/DMAN), to achieve further capacity and efficiency benefits.
Chapter 8

ATFM COMMUNICATION

8.1 Communication

8.1.1 The communication and exchange of operational information among stakeholders on a real-time basis forms the backbone of ATFM. This exchange may be accomplished by a variety of means including telephone calls, web conferences, e-mail messages, electronic data exchange and web page displays. The purpose of the information exchange is to increase stakeholder situational awareness, to improve operational decision-making, and to enhance the efficiency of the ATM system.

8.2 Stakeholder ATFM communication

8.2.1 An ATFM unit requires several layers of communication. As a basis for the exchange of information, NOTAM and AIP supplements could be used to distribute instructions relating to the application of ATFM measures. For example, strategic ATFM routing information and certain ATFM operating procedures could be published as a NOTAM or in the AIP Supplement.

8.2.2 As the functionality of an ATFM unit develops, consideration should be given to developing a more ATFM specific communication structure for the notification of ATFM measures.

8.2.2.1 For example, to facilitate AU awareness, the ATFM unit could produce and distribute the ADP on the day prior to the operation in order to provide a summary of the planned operations and of the ATFM measures in their area of responsibility. It could also give the chance to distribute any specific instructions or communications requirements associated with those measures. This communication could also be updated by ADP amendments.

8.2.2.2 In order to ensure that AUs and other stakeholders can properly use and apply this information, a standard format should be employed.

8.2.3 In addition to the production and distribution of ADPs, the ATFM unit could produce ATFM information messages to provide information and guidance.

8.2.3.1 These messages could be used for the initial publication of changes in the availability of runways, of ATS routes and airspace in the area, and serve as the vehicle for the initial publication of new and amended ATFM operating procedures which affect all users.

8.2.4 The ADPs and ATFM information messages could be transmitted via agreed-upon means to ATC units, AUs, and other stakeholders who wish to be included on the distribution list. These messages could also be made available on associated ATFM unit websites.

8.2.5 Each national AIP could include ATFM information on specific arrangements for dealing with ATFM issues and coordination matters. The AIPs could also include the telephone numbers of relevant ATFM units to contact for ATFM advice and information.

8.3 ATFM communication oversight

8.3.1 For consistency, the appropriate authority should ensure that a single office provides oversight of the dissemination of ATFM information and ATFM measures, and is responsible for monitoring, collecting, disseminating, that information. This oversight will ensure that applicable information is shared by all ANSPs and operational stakeholders in a timely and efficient manner.

8.3.2 Examples of applicable ATFM information include but are not limited to:
a) current airport runway configurations;
b) airport acceptance rates;
c) airport departure demand;
d) enroute sector demand and capacity imbalances;
e) runway closure or airport conditions;
f) NAVAID outages;
g) ATM infrastructure; and
h) activities on airspace under restrictions or reservations.

8.3.2.1 Specific categories of information will be determined by the ATFM unit in collaboration with stakeholders.

8.3.3 ATFM units should develop an internal operations manual for their respective facilities to address the ATFM measures process. For example, the operations manual could include provisions to:

a) coordinate and disseminate information related to the implementation of ATFM measures through specified means such as telephone calls, aeronautical messages, web pages, or any other suitable method;
b) disseminate information on the constant monitoring and adjusting of ATFM measures; and

c) disseminate information on the timely cancellation of ATFM measures.

8.4 Communicating ATFM information

8.4.1 There is a requirement for AUs and ATFM units to communicate and exchange information for the purposes of CDM and information dissemination.

8.4.2 Because the involvement of ATFM units and AUs may vary significantly, the tools for exchange of information must be geared to meet the stakeholder capabilities and requirements.

8.4.3 When selecting communication methods, consideration should be given to maximizing the value and content of the information and minimizing the time and workload required.

8.4.4 The following communication methods are offered as examples:

a) scheduled telephone (or web) conferences. This consists of defining times at which the ATFM units will hold daily operational conferences to exchange ATFM information and to meet their operational needs;
b) tactical telephone conferences. This consists of establishing a procedure to convene non-scheduled ATFM teleconference, held in real-time and at a tactical level, in order to make the necessary operational adjustments; and

c) automated web page or ATFM operational information system. ATFM units may create a web page or an information system, containing relevant ATFM information (e.g. ADP).
The purpose is to share information about the ATM system in order to develop a common situational awareness and minimize workload.

8.5 ATFM web pages

8.5.1 For ATFM units that elect to create web pages with relevant ATFM information, examples could include:

a) airport operational status information:
   1) current and planned active runway configuration;
   2) airport acceptance rate/departure rate;
   3) information concerning delays – duration and outlook;
   4) meteorological information;
   5) scheduled flight inspections/calibrations;
   6) ATFM measures;
   7) low visibility procedures;
   8) de-icing operations; and
   9) airport or runway closures;

b) airspace operational status information:
   1) actual and planned capacity by sector;
   2) anticipated demand by sector;
   3) meteorological conditions likely to affect capacity or demand;
   4) special use airspace status; and
   5) ATFM measures;

c) ATFM stakeholder planning teleconferences:
   1) schedules; and
   2) joining instructions;

d) ATFM strategic, pre-tactical, and tactical plans; and

e) links to ATFM-related information:
   1) weather websites;
   2) ACC and APP contact information;
   3) letters of agreement;
4) route information;
5) GNSS operational status;
6) ATFM-related NOTAMs; and
7) contingency plans.

8.6 ATFM terminology

8.6.1 What terminology/phraseology is used in ATFM?

8.6.2 One goal of this manual is to develop and promote standard terminology and phraseology for the exchange of ATFM telephone and automated messages. The information contained herein is intended to reflect the current use of plain language and provide a basis for harmonization.

8.6.3 ATFM operations should be conducted in a common language in a simple, concise, non-verbose manner. The use of local or regional colloquial terms or acronyms should be avoided as they could induce confusion.

8.6.3.1 Coordination with international stakeholders may impose the use of English language.

8.6.3.2 For international ATFM coordination, the English language should be used unless there is consensus to use another common language.

8.6.4 The use of standardized terminology as contained in this manual should be employed to guarantee global consistency on how ATFM messages are communicated among ATFM units. This includes the concept of modular and structured ATFM messages and defines the components of the message as who, what, when, where and why.

8.6.5 As with any communication model, it is the responsibility of both parties (sender and receiver) to ensure that the message is clear, concise, correctly understood and applied as requested.

8.6.6 Each ATFM coordination message should have five components (who, what, when, where, why) that contain plain language elements and that, when combined, provide a complete ATFM message.

a) **WHO**: This identifies the parties involved. Who is transmitting and receiving the message.

Examples:  
CGNA THIS IS COLOMBIA FMU  
CENAMER ACC THIS IS PANAMA ACC  
CCFMEX THIS IS ATCSCC  
JCAB THIS IS CFMU

b) **WHAT**: This identifies the objective to be achieved.

Examples:  
REQUEST 30 MILES IN TRAIL  
REQUEST 3 MINUTES IN TRAIL  
REQUEST GROUND STOP

c) **WHEN**: This identifies the time and/or duration of the ATFM objective to be achieved.

Examples:  
FROM NOW UNTIL 1700 UTC  
FROM 2000 UTC TO 2130 UTC
d) **WHERE**: This identifies the location of the ATFM objective to be achieved. It is often preceded by a modifying clause, indicating what aircraft or traffic the restriction will apply to. The modifying clause and the location combination are used to construct the “where” component.

Examples:  
- FOR ALL AIRCRAFT LANDING EL DORADO INTERNATIONAL AIRPORT 
- FOR ALL TRAFFIC LANDING CAIRO INTERNATIONAL AIRPORT 
- FOR ALL TRAFFIC FILED VIA B881

e) **WHY**: This identifies the reason for the ATFM objective.

Examples:  
- DUE TO SEVERE WEATHER OVER EL DORADO INTERNATIONAL AIRPORT 
- DUE TO A LONG-RANGE RADAR OUTAGE 
- DUE TO EXCESS SECTOR DEMAND 
- DUE TO AN AIRCRAFT INCIDENT

8.6.7 **Message example.** The following is an example of a complete message:

```
CGNA THIS IS COLOMBIA FMU. REQUEST 30 MILES IN TRAIL FOR ALL AIRCRAFT LANDING EL DORADO INTERNATIONAL AIRPORT FROM NOW UNTIL 1700 UTC DUE TO SEVERE WEATHER OVER EL DORADO INTERNATIONAL AIRPORT
```

8.6.8 **Message amendment.** The amendment of an ATFM message should include similar elements but with additional modifiers. These modifiers may include:

a) **CHANGE**;

b) **AMEND**;

c) **REDUCE**;

d) **INCREASE**; and

e) **DECREASE**.

8.6.8.1 **Message amendment example.**

```
GUAYAQUIL FMP THIS IS LIMA FMP, REDUCE YOUR MILES-IN-TRAIL TO JORGE CHAVEZ INTERNATIONAL AIRPORT FROM 30 MILES-IN-TRAIL TO 20 MILES-IN-TRAIL FROM 1400 UTC TO 1700 UTC DUE TO IMPROVING METEOROLOGICAL CONDITIONS AT JORGE CHAVEZ INTERNATIONAL AIRPORT
```

8.6.9 **Message cancellation.** The cancellation of an ATFM message should contain a cancelling word or phrase. Cancellation messages should also identify which message is being cancelled because several ATFM measures could be in place at one time. Normally, it is not necessary to state the reason for the cancellation, but it may be included. A cancelling word or phrase may include:

a) **CANCEL**;

b) **RESUME**;
c) RESUME NORMAL; and

d) RELEASE.

8.6.9.1 Message cancellation example.

CARACAS FMU THIS IS GEORGETOWN FMU, CANCEL THE GROUND STOP FOR CHEDDI JAGAN INTERNATIONAL AIRPORT DUE TO THE RUNWAY NOW OPEN
What resources are available to States regarding the various aspects of ATFM?

The information in the following Appendices pertains to the implementation of ATFM between 2006 and 2013. It relates to the experiences of some States/international organizations in the planning, implementation and application of ATFM. The appendices provide samples and examples of information that can be used as resources and are designed to be helpful information with regard to implementing an ATFM service.
Note.– This Appendix provides a sample format that can be used by an ATFM unit for facilitating an ATFM operations planning telephone (or web) conference.

Greeting and introduction

xxxxZ planning telcon
Covering the timeframe from xxxx UTC to xxxx UTC

Situation
The current situation is:

Issues
We will be discussing:

Common Weather Products – working from
1) the ICAO Area “_” Prog Chart, valid xxxx UTC for (Date)
2) the ICAO Area “_” IR Satellite photo, xxxx UTC for (Date)

Planning discussion – Recommend organizing the discussion by geographic areas (for example, from north to south, or east to west, in the regional airspace)

Significant meteorological and atmospheric conditions
Thunderstorm activity
Turbulence
Volcanic ash plumes

Terminal discussion
For select airports:
Airport/Sector Capacities
Projected terminal demand
Airport constraints, such as construction projects or NAVAID outages
Anticipated traffic management measures
Expanded miles-in-trail
Potential airborne holding
Potential ground stops

Enroute discussion
Enroute constraints, such as frequency outages or NAVAID outages
Route discussion and issues
Anticipated traffic management measures
Expanded miles-in-trail
Potential airborne holding

Additions to the plan, including any pertinent tactical updates.

Stakeholder input, comments, and questions

Next Planning Telcon: xxxxZ
APPENDIX B

SAMPLE ATM DATA EXCHANGE AGREEMENTS

Note.—This Appendix provides a sample format regarding an agreement for the exchange of ATM data between States.

AGREEMENT ZZZZ

BETWEEN

(State name)

AND

(State name)

THE EXCHANGE OF AIR TRAFFIC FLOW MANAGEMENT DATA

ARTICLE I - PURPOSE

The purpose of this Agreement is to establish the terms and conditions for cooperation between (State name) and (State name) in the exchange of non-critical radar and flight data information. The exchange of data will enhance the cooperation and coordination of air traffic management (ATM) activities between (State name) and (State name).

ARTICLE II - SCOPE OF WORK

A. (State name) and (State name) agree to exchange flight data and other information concerning international and domestic instrument flight rules (IFR) aircraft to enhance the cooperation and coordination of ATM activities. This data will be used by each for the following purposes:

1. Maintenance of a complete and reliable database for such information;

2. Dissemination to aviation users; and

3. Enhancement of cooperation and coordination of air traffic flow management activities between (State name) and (State name).

ARTICLE III - PROCEDURES

A. Purpose of Use -- The exchange of flight data and other information shall be exclusively for the purposes set forth in this Agreement. The use of the information and data for purposes beyond the scope identified in this Agreement, or the release of any information or data to a third Party not identified in this Agreement, must be authorized in writing by the party from which the information or data originated.

B. Coordination -- The Parties will meet at such times and places as may be requested by either Party to jointly review the program and consider new procedures or requirements. Activities to accomplish the objectives will be discussed at bilateral/multilateral meetings and documented by Chairpersons in reports of those meetings.

C. Scope of Data -- The flight data or information to be exchanged shall not include any sensitive data on flights exempted by either Party for security or safety reasons. The exchange of flight data or information applicable to sensitive State and military aircraft will be provided for those areas where the Parties have responsibility for provision of air traffic services. The data shall be formatted to be usable in each system and exchanged using data communications systems as mutually agreed.
D. Types of Data -- Types of data to exchange include non-critical radar and flight data information concerning international and domestic instrument flight rules (IFR) aircraft, including flight and flight plan modifications, cancellations, amendments and related changes.

E. Communications Protocol -- The information shall be exchanged using agreed data communications protocol. Communications protocol and other necessary requirements shall be arranged as mutually agreed. The Parties agree to provide, at the earliest possible date, notice of proposals for the development of changes to hardware, software and documentation applicable to traffic management data and supporting interfaces.

F. Responsibility of Provision -- Except for technical or operational reasons, information and data will be exchanged continuously as it becomes available. Each Party shall operate and maintain communication hub(s) and line(s) to be used for data exchange.

ARTICLE IV - RELEASE OF DATA TO THIRD PARTIES

A. Data on State and military aircraft shall not be released to a third Party, unless approved through mutual agreement by both Parties.

B. All data may be released by (State name) or (State name) to aviation stakeholders through programs under the same terms and conditions found in the agreements entered into between the (State name) or (State name). Air Navigation Service Providers, aircraft operators, national security or safety authorities and research and development (R&D) institutes for ATM improvement are defined as aviation stakeholders. (State name) and (State name) shall be responsible for data administration in the provision for those Parties.

C. Each Party shall make every effort to ensure that the other Party's air traffic flow management data is not released or re-broadcast through unrestricted, public access mass media communications technology, such as the internet, without the written consent of the other Party.

ARTICLE V - FINANCIAL PROVISIONS

Each Party shall bear the cost of any activity performed by it under this Agreement.

ARTICLE VI - IMPLEMENTATION

A. The designated points of contact between xxx andyyy for coordination and management of this Agreement are:

1. For (State name):
   Manager
   Address- phone-fax-e-mail

2. For (State name):
   Manager
   Address- phone-fax-e-mail

B. The designated points of contact between (State name) and (State name) for technical issues under this Agreement are:

1. For (State name):

2. For (State name):

ARTICLE VII - ENTRY INTO FORCE AND TERMINATION

This Agreement will enter into force upon the date of the last signature and remain in effect for the
duration of its associated Annex. Either Party may terminate the Agreement on six (6) months’ written notice to the other Party.

**ARTICLE VIII - AUTHORITY**

The (State name) and (State name) agree to the terms of this Agreement as indicated by the signatures of their duly authorized officers.

______________________________

(State name):__________________  (State name):__________________

By:___________________________  By:___________________________

Title:_________________________  Title:_________________________

Date:_________________________  Date:_________________________
APPENDIX C

DETERMINING AIRPORT ACCEPTANCE RATE

Note.—This Appendix provides an example of a simplified methodology for determining the acceptance rate at an airport. This methodology is based on the scientific process developed by the Federal Aviation Administration for establishing the acceptance rate, as outlined in FAA Order JO 7210.3, Facility Operation and Administration, Chapter 10, Section 7.

• Definitions:

1) **Airport Acceptance Rate (AAR):** A dynamic parameter specifying the number of arrival aircraft that an airport, in conjunction with terminal airspace, ramp space, parking space, and terminal facilities can accept under specific conditions during any consecutive 60 minute period.

2) **Airport Primary Runway Configuration:** An airport configuration which handles 3 percent or more of the annual operations.

• Administrative considerations:

1) Identify the organization responsible for the establishment and implementation of AARs at select airports.

2) Establish optimal AARs for the airports identified.

3) Review and validate the airport primary runway configurations and associated AARs at least once each year.

• Determining AARs:

1) Calculate optimal AAR values for each airport runway configuration for the following weather conditions:

   a) visual meteorological conditions (VMC) - weather allows vectoring for visual approaches;

   b) marginal VMC - weather does not allow vectoring for visual approaches, but visual;

   c) instrument meteorological conditions (IMC) – visual approaches and visual separation on final are not possible; and

   d) low IMC – weather dictates Category II or III operations.

2) Calculate the optimal AAR as follows:

   1) Determine the average ground speed crossing the runway threshold and the spacing interval required between successive arrivals

   2) Divide the groundspeed by the spacing interval to determine the optimum AAR

   3) **FORMULA:** Ground speed in knots at the runway threshold divided by spacing interval at the runway threshold in miles

   Note.—when the quotient is a fraction, round down to the next whole number

   Example: 130 KTS / 3.25 nm = 40 Optimum AAR = 40 arrivals per hour
125 KTS / 3.0 nm = 41.66 \quad \text{round down to 41}

Optimum AAR = 41 arrivals per hour

Or

Use table below

<table>
<thead>
<tr>
<th>Nautical miles between aircraft at the Runway Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Potential AAR</td>
</tr>
<tr>
<td>Ground Speed at the Runway Threshold</td>
</tr>
<tr>
<td>140 knots</td>
</tr>
<tr>
<td>130 knots</td>
</tr>
<tr>
<td>120 knots</td>
</tr>
<tr>
<td>110 knots</td>
</tr>
</tbody>
</table>

Table C-1. Optimum AAR

- Identify any conditions that may reduce the optimum AAR. Conditions include:
  
  1) intersecting arrival and departure runways;
  
  2) lateral distance between arrival runways;
  
  3) dual use runways – runways that share arrivals and departures;
  
  4) land and Hold Short operations;
  
  5) availability of high speed taxiways;
  
  6) airspace limitations and constraints;
  
  7) procedural limitations (noise abatement, missed approach procedures);
  
  8) taxiway layouts; and
  
  9) meteorological conditions.

- Determine the adjusted AAR using the previous factors for each runway used in an airport configuration.

  1) Add the adjusted AARs for all runways used in an airport configuration to determine the optimal AAR for that runway configuration.
2) Real-time factors may require dynamic adjustments to the optimal AAR. These include:

a) aircraft type and fleet mix on final;
b) runway conditions;
c) runway/taxiway construction;
d) equipment outages; and
e) approach control constraints.

3) Formula:

\[
\text{POTENTIAL AAR} - \text{ADJUSTMENT FACTORS} = \text{ACTUAL AAR}
\]

<table>
<thead>
<tr>
<th>RUNWAY CONFIGURATION</th>
<th>AAR for VMC</th>
<th>AAR for MARGINAL VMC</th>
<th>AAR for IMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>RWY 13</td>
<td>24</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>RWY 31</td>
<td>23</td>
<td>20</td>
<td>17</td>
</tr>
</tbody>
</table>

Table C-2. Actual AAR - Example
APPENDIX D

DETERMINING SECTOR CAPACITY

Note.– This Appendix provides an example of a simplified methodology for determining sector capacity at an ACC. This methodology is based on the scientific process developed by the Federal Aviation Administration for establishing the sector capacity.

1) Sector capacity is determined using the average sector flight time in minutes from 7am to 7pm Monday through Friday.

2) For any 15-minute time period.

3) The formula used to determine sector capacity is:

\[
\frac{(\text{average sector flight time in minutes}) \times (60 \text{ seconds})}{36 \text{ seconds}} = \text{Sector Capacity Value}_{\text{optimum}}
\]

4) Steps:

a) manually monitor each sector, observe, and record the average flight time in minutes.

b) after that time is determined:

1) multiply that value by 60 seconds in order to compute the average sector flight time in seconds;

2) then divide by 36 seconds because each flight takes 36 seconds of a controller’s work time; and

3) this is the sector capacity value (optimum).

5) Adjustments:

a) the optimum value for a sector is then adjusted for factors such as:

1) airway structure;

2) airspace volume (vertically and laterally);

3) complexity;

4) climbing and descending traffic;

5) terrain, if applicable;

6) number of adjoining sectors that require interaction; and

7) military operations.

Alternatively the table below can be used.
<table>
<thead>
<tr>
<th>Average sector flight time (in minutes)</th>
<th>Optimum sector capacity value (aircraft count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 minutes</td>
<td>5 aircraft</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
</tr>
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<td>7</td>
<td>12</td>
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<tr>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>12 minutes or more</td>
<td>18</td>
</tr>
</tbody>
</table>

Table D-1. Simplified method
APPENDIX E
CAPACITY PLANNING AND ASSESSMENT PROCESS

Note.– This Appendix provides information developed by EUROCONTROL to provide information related to the ATFM capacity and planning assessment process.

1. **A performance-driven process**

The overriding objective is to develop a capacity assessment process that contributes to the requirement to:

“provide sufficient capacity to accommodate the demand in typical busy hour periods without imposing significant operational, economic or environmental penalties under normal circumstances.”

To address this, an annual capacity planning and assessment process, a cyclical process that identifies and quantifies the capacity requirements for the short and medium-term, should be put in place.

To effectively determine future capacity requirements, it is necessary to monitor current capacity performance. The following indicators should be used:

- **Average ATFM Delay per flight**

  The average Air Traffic Flow Management (ATFM) delay per flight is the ratio between the total ATFM delay and the number of flights in a defined area over a defined period of time.

  The ATFM delay is described as the duration between the last take-off time requested by the aircraft operator and the take-off slot allocated by the ATFM function, in relation to an airport (airport delay) or sector (enroute delay) location.

- **Effective Capacity**

  “Effective capacity” is defined as the traffic volume that the ATM system in the area concerned could handle with one minute per flight average enroute ATFM delay. This capacity indicator is derived from a linear relationship between delay variation and traffic variation.

2. **Methodology to Assess Future Capacity Requirements**

The objective of a medium term planning and assessment exercise is to provide predictions of the capacity requirement for the ATM system. This can be done in different ways, but preferably through the use of a Future ATM Profile (FAP), a combination of different modelling and analysis tools.

FAP comprises ATFM simulation facilities as well as spreadsheet and macro-based analysis and reporting tools that assesses and quantifies how much capacity is delivered by specific airspace volumes within the current ATM system, and evaluates the current and future capacity requirements, at ACC and sector group level.

**Step 1:** In order to provide an accurate prediction of the capacity requirements of the concerned area, it is necessary to know the **current capacity offered.** FAP should establish a **capacity baseline** for each ACC and defined sector group.

**Step 2:** The next task is to provide a **prediction of the future demand** on each ACC (and defined sector group) over the next 5 years, according to the expected traffic growth and distribution over the future route network.

**Step 3:** FAP should carry out **an economic analysis**, balancing the cost of capacity provision and the cost of
delay, on the assumption that each ACC is operating at or close to its economical optimum, and that the target level of delay has been achieved.

**Step 4:** FAP should then produce, for each ACC in the area concerned (if more than one) and each of the defined sector groups, a **5 year capacity requirement profile.** Percentage increases with respect to the measured capacity baseline are provided.

Figure 2: Key FAP processes:

3. **Expected Demand on the Future Route Network**

3.1 Medium-term capacity requirements

Medium-term capacity requirements at ACC or sector group level can only be assessed once one have a picture of the expected traffic volume and distribution over the future route network in the area concerned.

The expected demand at ACC or sector group level should be assessed by the FAP tool, from:

- the forecast traffic growth;
- the future route network evolution and traffic distribution, simulated by an airspace modelling tool;
- airport capacity constraints, assessed from information gathered from various sources on current and planned airport capacities.

3.2 Future route network evolution and traffic distribution

The capacity requirement for an ACC or sector group is clearly dependent on the distribution of traffic over the network in the area concerned, horizontally and vertically. The demand to be accommodated in the future is determined, taking into account the desire of users to fly the most direct routes and optimum vertical profiles, in the context of the anticipated evolution of the route network.

Changes to the route network and traffic distribution can induce significant changes in terms of the demand (and therefore the required capacity) at individual ACCs, even during periods of reduced traffic growth.

It is assumed that aircraft will follow the shortest routes available on the network between city pairs according to the future route network, on essentially unconstrained vertical profiles. Nevertheless, some existing structural traffic distribution scenarios are retained. There is no ‘dispersion’ of flights between equivalent routes between city pairs.

Traffic flows respecting these assumptions should be simulated by the appropriate tools, and serve as an input to the FAP simulations. The result of these simulations should be a horizontal and vertical traffic distribution over the future route network, allowing the determination of the unconstrained demand in each ACC.

4. **Cost Data and Economic Modelling**

Capacity has a cost, but insufficient capacity, which in turn generates delay, has an even larger cost. Both capacity and delay costs are borne by airspace users. It is therefore necessary to determine the level of ATC capacity which can be justified from a cost point of view i.e. the optimum trade-off between delay and cost of ATC capacity.

The cost of capacity and the cost of delay are regional parameters depending on:
• total capacity provided
• marginal capacity cost (ATC complexity, price index, equipment, etc)
• total delay generated
• delay sensitivity (network effects, hourly traffic distribution)
• cost per minute of delay (traffic mix)

Consequently, each ACC has its own capacity cost and delay cost curves. These curves interrelate as network effects within the area concerned change according to changes in capacity offered at other ACCs.

The total cost curve (the sum of the delay cost and the capacity cost) determines the optimum cost model capacity for each ACC for the current traffic demand. However, to assess capacity requirements for the future, it is necessary to incorporate the future demand into the model in an updated total cost curve for each ACC.

4.1 Calculation of the Required Capacity Profiles

After the economic analysis or cost optimisation for the future traffic demand is carried out, the final step in the process takes place. FAP carries out another iterative ATFM simulation by increasing capacity at the ACC offering the best Return on Investment (ROI), until the overall delay target is reached.

When the agreed target delay is reached, the capacity target for each ACC is expressed in terms of the capacity increase that was necessary in order for the convergence to be achieved. Simulations are carried out for the final year of the planning cycle and for any year that there are changes to ACC or sector group configurations. Capacity levels are interpolated for intermediate years.

The capacity target level corresponds to the cost optimum delay for the ACC, to meet the overall delay target adopted by the appropriate authority, and represents the ACC capacity required to cover:

- the expected demand, and (if appropriate),
- the current capacity shortfall, i.e. the difference between the optimum capacity and the current capacity (as described in the previous section).

Figure 4 shows an ACC with a capacity surplus (blue), an ACC with a capacity shortfall (red) and an ACC with optimum capacity (green). For the ACC with optimum capacity, the requirement is only to cover the forecast traffic increase. For the ACC with a capacity shortfall, the requirement is to cover both the shortfall and the traffic increase, and for the one with a surplus, the requirement is to achieve the optimum capacity in the medium term, without costly over provision.

If the network delay is close to the target delay, the optimum delay at ACC level is an effective tool to identify areas that still have a capacity gap.
5. **The Capacity Planning Work Programme**

5.1 The table below describes the different phases of the annual work programme and lists the required actions and responsibilities.

<table>
<thead>
<tr>
<th>EVENT</th>
<th>ACTION ATFM Function</th>
<th>ACTION ANSPS</th>
</tr>
</thead>
</table>
| Oct-Dec Capacity planning meetings for the short- and medium-term | Provide all relevant data to enable the ANSP to prepare a first draft of the local capacity plan  
• as data becomes available, and  
• at least 2 weeks before the meeting | Prepare the draft capacity plan prior to the meeting with capacity enhancement function (CEF)  
Ensure the participation of both planning and operational staff at the meeting |
| Nov - Dec Completion of the capacity plan | Complete the capacity chapter  
• by the end of December | Finalize the capacity plan  
• by the end of November |
| Nov-Feb ATFM and capacity report for previous year | Coordinate and agree with ANSPs the content with respect to the analysis of ACC performance  
• by end January  
Finalize report  
• by end February | Review and agree the ACC performance analysis content provided by ATFM Function  
• by end January |
| January Agreement and development of the medium-term capacity profile scenarios | Prepare the airspace scenario data for profile calculation following coordination with ANSPs  
• by end February | Provide ATFM Function with details of configuration changes (planned or proposed) during the 5 year planning cycle for ACCs and requested sector groups  
• by the end of January |
<table>
<thead>
<tr>
<th>Month</th>
<th>Task Description</th>
<th>Details</th>
</tr>
</thead>
</table>
| **February** | Release of short- and medium-term traffic forecasts | Convene meetings and provide the forum for all relevant information to be included in the short- and medium-term forecast  
  • during the calendar year  
  Provide the new medium-term traffic forecast  
  • by the end of February  
  Merge the short- and the medium-term traffic forecasts | To attend the user group meetings and to ensure that all information relevant to the traffic forecast is provided to the ATFM Function  
  • by the end of December |
| **March** | Calculation of medium-term capacity profiles (including optimum delay per ACC) | Calculate the optimum delay for each ACC  
  • by mid-March  
  Calculate the capacity requirement profiles for ACCs and requested sector groups  
  • by mid-March | To agree the capacity profiles and optimum delay per ACC for use as a basis for the local capacity plan  
  • by end April |
| **March** | Calculation of the delay forecast for the coming vacation season and next 2 years | Make the delay forecast for the coming vacation season and the next 2 years  
  • by mid-March | To ensure that the local capacity plan is up-to-date and accurate and to communicate any changes to ATFM Function  
  • before mid-February |
| **March** | The annual meeting of a capacity planning task force | Organize the task force meeting, invite contributions, compile the agenda and write the report | To attend the meeting, with the appropriate planning and operational participation and be prepared to share best practice capacity planning |
| **April** | Publication of the operations plan for the coming vacation season | Incorporate the vacation capacity plans into the plans  
  by mid-March  
  Release the first version of the vacation plan  
  • by mid-March | To ensure that up-to-date capacity information for the coming vacation season is made available, and that any changes are communicated to the ATFM Function for inclusion in the plan  
  • by end February  
  • as they occur, throughout the vacation season |
| **May** | Coordination and agreement of medium term capacity profiles | Coordinate bilaterally with ANSPs and agree the profiles that will be used as the basis for local capacity planning in the medium-term  
  • by end March  
  Present the capacity profiles to the next meeting of the appropriate authorities for approval  
  • May meeting |  |
| June | Publication of the medium-term ATM capacity plan | Collect and consolidate all the local medium-term capacity plans and complete an analysis of the expected situation at network and local level  
• by end of April |
| July | ACC capacity requirement profiles published | To release document  
• by end of July |
| Jul - Aug | ACC/sector group capacity baseline assessment period | Inform ANSPs of the reference dates and request confirmation of data quality  
• by the end of June |
| | | Calculate the baselines for ACCs and requested sector groups, according to the airspace structure scenarios defined for the capacity profiles  
• by end August |
| | | In addition to the baseline assessment, calculate the capacity baselines using appropriate simulation and calculation tools  
• by end August |
| | | To confirm that fully accurate sector capacity and opening scheme data will be provided to the ATFM Function  
• 1 week before the reference period |
| Sep - Oct | ACC capacity baselines coordinated with the ANSPs | Communicate the baseline results to ANSPs on a bilateral basis for discussion and agreement  
• by mid-September  
• present the agreed ACC baselines to the next meeting of the appropriate authorities  
• October meeting |
| | | To agree the capacity baselines for the next planning cycle  
• prior to meeting of the appropriate authorities |

Table E-1. Actions, Deadlines and Responsibilities

5.2 Capacity Planning Meetings

Once per year, the ATFM Function should visit the majority of ANSPs in the area concerned to collect information on capacity plans for the next five years and the coming vacation season. It is essential to the improvement of ATM capacity at overall network level for each ACC to have a robust capacity planning process and a realistic capacity plan.

ANSP capacity plans for each ACC should be published in a local implementation plan, together with other relevant capacity information (e.g. capacity delivered during the previous vacation season, future capacity requirements, expected performance in the medium term and the current and expected capacity of major airports).

Prior to each meeting, the ATFM Function provides the ANSP with a set of data to enable them to prepare
the preliminary capacity plan, tailored to local conditions. The data set should include the following:

a) a report and analysis of capacity delivered during the previous vacation season;

b) the value of the (vacation) capacity baseline indicator for each ACC and requested sector group;

c) the optimum delay for each ACC, to meet the network target delay;

d) a set of 5-year ACC capacity requirement profiles for high, low and medium traffic growth (shortest available routes over the future route network) and for the current route network;

e) similar capacity requirement profiles for requested sector groups;

f) detailed medium-term traffic forecast;

g) the latest short-term traffic forecast per State;

h) short- and medium-term delay forecast for each ACC;

i) differences in demand between current routes and shortest routes and current routes and cheapest routes scenarios; and

j) other relevant capacity information

ANSPs prepare a first draft of the capacity plan for the meeting, which is discussed and updated in an interactive session, using appropriate simulation and calculation tools. To facilitate the discussion and ensure a realistic capacity plan, ANSPs should ensure the presence of both planning and operational staff.

The plan should detail the capacity enhancement actions planned each year of the capacity planning cycle, together with a realistic assessment of the contribution of these initiatives to the overall annual capacity increase.
Attachment A: Definitions of terms used in this Appendix

**Elementary Sector**: Primary component of the airspace structure, one or more of which may be combined to form a sector. In some cases the elementary sector can be the same as the operational sector; in other cases, the elementary sector is never open operationally without being combined with one or more other elementary sectors.

**Sector**: Primary operational component of the airspace structure that can be considered as an elementary capacity reference of the ATM system. A sector is made up of one or more elementary sectors.

**Sector Group**: Group of sectors that strongly interact with each other through close and complex coordination, satisfying the agreed concept of operations.

**Traffic Volume**: Airspace component based on traffic flow that serves as a reference to design the ATC sectors.

**Sector capacity**: The maximum number of flights that may enter a sector per hour averaged over a sustainable period of time (e.g. 3 hours), to ensure a safe, orderly and efficient traffic flow. Some ANSPs manage sector capacities tactically over a shorter period of time (e.g. 15 minutes). However, for global assessment purposes, the hourly figure is used as standard.

**Declared Sector Capacity or Monitoring Value**: The value the ANSP declares to the CFMU as the maximum number of flights per hour that can enter a sector before the application of an ATFM regulation becomes necessary. Several values may exist - depending on the ATC environment at the time (airspace, equipment, traffic pattern, staffing, weather etc.). The value can change according to the situation at the ACC.

**Declared Traffic Volume Capacity**: The capacity for a given period of time for a given traffic volume, as made known by the ANSP to the ATFM Function, so that it can provide the ATFM service. As with Sector Capacity, the value can change depending on the ATC environment at the time at the ACC.

**ACC/ Sector Group Capacity**: The theoretical maximum number of flights that may enter an ACC or sector group per hour, over a period of time (e.g. 3 hours), without causing excessive workload in any of the sectors. This capacity indicator is used for capacity planning and monitoring purposes and has no operational value. The indicator is calculated mathematically using a validated methodology.

**Capacity Baseline**: The value of the capacity indicator (see above) for the ACC and defined sector groups.

**Capacity Profile**: The evolution of required capacity over the five-year planning cycle, considering certain assumptions, for a specified volume of airspace (ACC or defined sector group), in terms of absolute demand (flights per hour) and annual percentage increases. These values are published annually and are used as a basis for local capacity planning by ANSPs.

**Network Effect**: The network effect is the phenomenon where regulations placed on parts of the network affect the demand structure observed in other parts of the network. Network effects range from simple interactions of cause and effect, to more complex interactions between groups of sectors, where causes are repeatedly re-triggered by effects, involving several oscillations before a stable equilibrium is reached. Affected sectors could be adjacent, in the same region, or distant sectors located on the far side of the ECAC zone.
APPENDIX F SAMPLE LOA BETWEEN FMU and ACC

LETTER OF AGREEMENT

BETWEEN

ANSP1 AIR TRAFFIC MANAGEMENT CENTER

AND

ANSP2 AREA CONTROL CENTER

Document Management

Table of Contents

<table>
<thead>
<tr>
<th>Topic</th>
<th>See Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document Management</td>
<td>1</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>1</td>
</tr>
<tr>
<td>Checklist of Effective Pages</td>
<td>1</td>
</tr>
<tr>
<td>Overview</td>
<td>2</td>
</tr>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Objective</td>
<td>2</td>
</tr>
<tr>
<td>Scope</td>
<td>2</td>
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<tr>
<td>Deviation</td>
<td>2</td>
</tr>
<tr>
<td>Responsibility</td>
<td>2</td>
</tr>
<tr>
<td>Effective Date</td>
<td>2</td>
</tr>
<tr>
<td>Policy and Definition</td>
<td>3</td>
</tr>
<tr>
<td>Policy</td>
<td>3</td>
</tr>
<tr>
<td>Definition</td>
<td>3</td>
</tr>
<tr>
<td>Co-ordination Procedures</td>
<td>4</td>
</tr>
<tr>
<td>Information Sharing</td>
<td>4</td>
</tr>
<tr>
<td>Flow Control Application</td>
<td>4</td>
</tr>
<tr>
<td>Flow Control Coordination</td>
<td>5</td>
</tr>
<tr>
<td>Subject</td>
<td>Pages</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Alternative Route Coordination</td>
<td>6</td>
</tr>
<tr>
<td>Communication Systems</td>
<td>7</td>
</tr>
<tr>
<td>Evaluation</td>
<td>7</td>
</tr>
<tr>
<td>Revision</td>
<td>8</td>
</tr>
<tr>
<td>Revision Conditions</td>
<td>8</td>
</tr>
</tbody>
</table>

Checklist of Effective Pages

<table>
<thead>
<tr>
<th>Subject</th>
<th>Pages</th>
<th>Issue Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter of Agreement</td>
<td>1-8</td>
<td>mm,dd,yyyy</td>
</tr>
<tr>
<td>Attachment 1– Commercial Telephone Numbers for ATFM Coordination</td>
<td>9</td>
<td>mm,dd,yyyy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Overview

Introduction  The following document is a letter of agreement between ANSP1 Air Traffic Management Center (ATMC) and ANSP2 Area Control Center (ACC) hereinafter referred to as both facilities. The letter of agreement details information sharing, flow control application, and flow control coordination procedures.

Objective  Statements of confirmed procedures are applicable between (STATE NAME 1) and (STATE NAME 2) ATS Units in respect of aircraft operating on routes between the ANSP1 and ANSP2 Flight Information Regions (FIRs).

Scope  The procedures contained in this operational letter of agreement supplement or detail those prescribed by ICAO Annex 2, Annex 10, Annex 11, PANS-ATM (Document 4444), Regional Supplementary Procedures (Document 7030), and local AIP and ATS instructions.

Deviation  In the event of unusual circumstances, duty watch supervisors of ANSP1 ATMC and ANSP2 ACC, by mutual consent, may modify the content of the letter of agreement on a time-to-time basis, for specific periods.

Responsibility  This letter of agreement is applicable to air traffic flow management service along the common FIR boundary between ANSP1 FIR and ANSP2 FIR.

Effective Date  This letter of agreement comes into effect at 0000UTC on MM DD, YYYY.

Once effective, this letter of agreement cancels and replaces the letter of agreement between ANSP1 Air Traffic Management Center and ANSP2 Area Control Center dated mm dd, yyyy.
Policy and Definition

Policy

- Both facilities recognize the following definitions prescribed in ICAO PANS-ATM, and introduce procedures according to the policy that flow control should be implemented to a minimum on condition that available ATC capacity is utilized to the maximum extent.

Definition

- **Air Traffic Flow Management (ATFM):** A service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

- **Flow control:** Measures designed to adjust the flow of traffic into a given airspace, along a given route, or bound for a given aerodrome, so as to ensure the most effective utilization of the airspace.
Coordination Procedures

Information Sharing:

- When ANSP1 ATMC or ANSP2 ACC recognizes an event which affects or might affect orderly traffic flow between the FIRs, the facility shall provide the other facility with the information, and both facilities should keep sharing information while the traffic flow is affected by the event. Events of which information should be shared mutually are as follows:

  (a) Capacity falls at defined international airports, caused by:

    1) runway closure;
    2) severe weather; or
    3) other adverse effects;

  (b) Malfunction of ATC systems, such as radar, flight data processing system (FDP), radar data processing system (RDP), or communication systems;

  (c) Flow control restrictions at the responsible facility’s request on aircraft destined for other FIR; or

  (d) Other adverse effects on international traffic flow.

- Paragraph (a) described above refers to the following airports:
  AIRPORT1 (AAAA), AIRPORT2 (BBBB), AIRPORT3 (CCCC), and AIRPORT4 (DDDD).

- Information is not necessarily provided with flow control coordination, but would be rather provided at the possible phase of flow control. Information provision should be made timely when the event is predicted and/or has begun/changed/dissolved.

Flow Control Application:

- Both facilities are able to implement flow control in the events previously cited and besides when:
  (a) excessive airborne holdings arise or are predicted; or
  (b) necessary to ensure the safety of aircraft operations.

- Flow control is implemented by specifying some of the following restrictions at the FIR boundary to the aircraft destined for the affected airport(s) or airspace:
(a) Minimum longitudinal interval by time or distance at the same altitude;
   e.g. “50 nm interval at the same altitude over FIX, FIX for AAAA airport.”
   e.g. “15 minutes interval at the same altitude over FIX, FIX for BBBB airport.”

(b) Minimum longitudinal interval by time or distance regardless of altitude;
   e.g. “50 nm interval regardless of altitude over FIX, FIX for CCCC airport.”
   e.g. “10 minutes interval regardless of altitude over FIX, FIX for DDDD airport.”

(c) The number of aircraft which is acceptable in a specific time frame; or
   e.g. “A rate of 5 aircraft per hour from 0200UTC until 0300UTC, over FIX for AAAA airport.”

(d) Limitation of acceptable altitude.
   e.g. “Flight levels 290, 310 and 390 are not available for northbound aircraft passing
       FIX on AIRWAY.”
   e.g. “Only FL360 and above are available.”

- Minimum separation prescribed in the letter of agreement between ANSP1-A ACC and
  ANSP2 ACC, ANSP1-B ACC and ANSP2 ACC shall be met in any case.
- The time interval is also applicable in radar hand-over circumstances.

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**Flow Control Coordination:**

- Flow control coordination should involve the following items:
  (a) The cause of flow control implementation;
  (b) Flow control restrictions;
  (c) Fixes/Waypoints or airways where restrictions are applied to;
  (d) Objects of restrictions (Objects of restrictions shall be only the aircraft which are
       destined for the affected airport or airspace.);
  (e) Start/end time (Effective time at paragraph (c)); and
  (f) Expected time of next coordination (if possible).

- Information provision or coordination should be periodically made while the flow control is
  applied.
- If urgent action is not necessary, flow control shall be requested at least sixty (60) minutes
  prior to the time when the restriction becomes effective to ensure that the accepting facility
  makes necessary coordination with other relative ATC facilities.
- Exempted aircraft
(a) The following aircraft which should be given priority over other aircraft or which should not be delayed for some kind of reason may be exempted from flow control restrictions. Coordination regarding this exemption is made between ANSP1 ATMC and ANSP2 ACC. Coordination between transferring/receiving ACCs is allowed in urgent case.

1) aircraft in a state of emergency
2) aircraft engaged in search and rescue missions
3) aircraft operating for humanitarian reasons
4) aircraft carrying the head of state/region or distinguished visitors of state/region
5) aircraft carrying a patient who needs urgent treatment

(b) Aircraft of which transfer control message has been transmitted before the flow control decision are exempted from flow control restrictions. Coordination regarding this exemption should be made between transferring/receiving ACCs.

- ANSP1 ATMC assumes the responsibility of making ANSP1’s ACCs fulfill the flow control restrictions which ANSP1 ATMC admits in the coordination with ANSP2 ACC.

Alternative Route Coordination:

- When ANSP1 ATMC and/or ANSP2 ACC require to change the route of inflow traffic between FIRs due to the outage of NAVAIDs, temporary airspace restrictions or other reasons, those routes should be mutually coordinated and confirmed prior to coming into operation. ANSP1 ATMC and/or ANSP2 ACC shall inform the alternative route each other at the earliest possible.

Communication Systems

- Use of communication systems for coordination shall be in the following order of priority:
  a. direct speech circuit. (DA)
  b. commercial telephone.

  (commercial telephone numbers are shown on page 9)
  c. Aeronautical Fixed Telecommunication Network (AFTN)
  d. any other means of communications available.
• ANSP2 ACC will initiate a test of the direct speech circuit on the first day of each odd numbered month at 0100UTC.

• ANSP1 ATMC will initiate a test of the direct speech circuit on the first day of each even numbered month at 0100UTC.

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**Evaluation**

• Both facilities shall record every flow control operation and evaluate the process of coordination and effectiveness of ATFM periodically and jointly for the purpose of ATFM operational improvement.
Revision

Revision Conditions

- This agreement shall be revised whenever a modification to ICAO Standards, Recommended Practices and/or Regional Supplementary Procedures and Japan and Taiwan operating procedures or instructions, which might affect the procedures contained in this agreement occurs, or when new communications facilities, or air traffic services which might affect these procedures, are commissioned.

- When less than thirty (30) days exist between an identified need to revise this agreement and the effective date of the revision, the respective Center Managers or their designated deputies shall confirm via telephone, followed by a confirming fax message signed by both parties, on the nature of the change and publish the change to staff by a suitable local unit instruction. Formal exchange of signed copies of the revised document shall take place as soon as practicable thereafter.

- As for the revision to the Attachment 1 (Commercial telephone numbers for ATFM coordination), one (1) week prior notice meets the revision conditions.

Signed in ANSP1 and ANSP2.

________________________________________________________________________________________

NAME1
Director
ANSP1 Air Traffic Management Center
ORGANAIZETION, STATE NAME1

NAME2
Director
ANSP2 Area Control Center
ORGANAIZETION, STATE NAME2
Commercial telephone numbers for ATFM coordination

(1) ATMC

(i) Tel :  XX-XX-XXX-XXXX (primary)  
           XX-XX-XXX-XXXX (secondary)

(ii) Fax :  XX-XX-XXX-XXXX (Operation Room)  
           XX-XX-XXX-XXXX (Office)

(2) Taipei ACC

(i) Tel :  XX-XX-XXX-XXXX (primary)  
           XX-XX-XXX-XXXX (secondary)

(ii) Fax :  XX-XX-XXX-XXXX (Operation Room)  
           XX-XX-XXX-XXXX (Office)
APPENDIX G

TEMPLATE LETTER OF AGREEMENT BETWEEN ANSP on flow management

LETTER OF AGREEMENT

EFFECTIVE DATE:

SUBJECT: AIR TRAFFIC FLOW MANAGEMENT COLLABORATION

ANSP 1 and ANSP 2 enter into this letter of agreement (LOA) to facilitate the safe and efficient movement of air traffic between and over both countries.

1. PURPOSE: The purpose of this LOA is to establish continuity of operations and air traffic flow management (ATFM) procedures between the flow management Unit 1 in (city/country) and flow management Unit 2 in (city/country). This LOA is not intended to replace any local agreements between ANSP 1 area control centres (ACCs) and ANSP 2 ACCs. This LOA will promote coordination and collaboration between flow management Unit 1 (FMU 1) and flow management Unit 2 (FMU 2) regarding traffic management measures and the routing of aircraft into and out of ANSP 1 and ANSP 2 airspace. FMU 1 and FMU 2 will be the primary points of contact for coordinating traffic management (TM) measures and operations between ANSP 1 and ANSP 2.

2. SCOPE: The procedures outlined are for use by FMU 1 and FMU 2 to provide normal air traffic services.

3. DEFINITIONS:
   a. ACC – area control centre
   b. ANSP – air navigation service provider
   c. ATFM – air traffic flow management
   d. CDM – collaborative decision-making
   e. FMU 1 – actual name of flow management Unit 1
   f. FMU 2 – actual name of flow management Unit 2
   g. OP – operations plan
   h. RVSM – reduced vertical separation minima
   i. TM – traffic management

4. BACKGROUND:
   a. ANSP 1 and ANSP 2 have established operational agreements creating cross-border communications and a seamless operational atmosphere. This agreement incorporates FMU 1 and FMU 2 operational procedures and practices.

   b. Traffic flow management continues to evolve as new procedures and technologies are developed. ANSP 1 TM measures may include departures from ANSP 2 airports. Likewise, ANSP 2 TM measures may include departures from ANSP 1 airports.

       (1) The TM measures coordinated by either FMU may include miles-in-trail, minutes-in-trail, ground delay measures, ground stops, and reroute initiatives.
Note.—This list is not all inclusive and other TM measures may be developed and coordinated to meet operational needs.

5. RESPONSIBILITIES:

   a. Responsibilities for FMU 1 operations:

      (1) FMU 1 is responsible for the flow management of traffic to ANSP 1 destinations and through ANSP 1 airspace.

         (a) FMU 1 will coordinate with FMU 2 before implementing TM measures that may impact ANSP 2 airports.

         (b) When ANSP 2 airports are included in a TM measure, advise FMU 2:

             1. Before implementing the TM measure;
             2. What the TM parameters are; and
             3. When the TM measure is cancelled.

         (c) FMU 1 will coordinate with FMU 2 before implementing aircraft reroutes affecting departures from ANSP 2 airports or airspace.

         (d) FMU 1 must include FMU 2 TM measures in the ATFM operations plan (OP) when it is likely that ANSP 1 stakeholders will be affected by these measures.

      (2) FMU 1 will ensure FMU 2 is informed of situations and conditions, in ANSP 1 airspace, that may require implementing TM measures affecting ANSP 2 traffic.

   b. Responsibilities for FMU 2 operations:

      (1) FMU 2 is responsible for the flow management of traffic ANSP 2 destinations and through ANSP 2 airspace.

         (a) FMU 2 will coordinate with FMU 1 before implementing TM measures that impact departures from ANSP 1 airports.

         (b) When ANSP 1 airports are included in a TM measure, advise FMU 1:

             1. Before implementing the TM measure;
             2. What the TM parameters are; and
             3. When the TM measure is cancelled.

         (c) FMU 2 must include FMU 1 TM measures in the ATFM OP when it is likely that ANSP 2 stakeholders will be affected by these measures.

         (d) FMU 2 must coordinate with FMU 1 before implementing aircraft reroutes impacting departures from ANSP 1 airports or airspace.

      (2) FMU 2 will ensure FMU 1 is informed of situations and conditions, in ANSP 2 airspace that may require implementing TM measures affecting ANSP 1 traffic.

   c. Responsibilities for FMU 1 and FMU 2:
(1) To streamline coordination, FMU 2 will be FMU1’s sole point of contact with ANSP 2 and FMU1 will be FMU 2's sole point of contact with ANSP 1 in regard to cross-border TM measures and routing of aircraft.

(2) FMU 1 and FMU 2 will implement and manage TM measures, as necessary, to relieve congestion and to ensure the orderly flow of air traffic consistent with an equitable distribution of delays.

(3) FMU 1 and FMU 2 will make every effort to limit the impact of TM measures on stakeholders and implement only those measures that will adequately address the system constraint.

(4) The principal TM measures to be implemented will consist of miles-in-trail, minutes-in-trail, reroutes, en route spacing measures, ground delay measures, and ground stops.

Note.– This list is not all inclusive and other TM measures may be developed and coordinated to meet operational needs.

(5) FMU 1 and FMU 2 will collaborate on the design of preferred routes and severe weather avoidance routes that involve the use of both ANSP 1 and ANSP 2 airspace or resources.

(6) FMU 1 and FMU 2 will provide feedback and share data on the impact and assessment of joint TM measures, as required.

6. IMPLEMENTATION: The procedures outlined in this letter of agreement will be implemented by operational personnel at FMU 1 and at FMU 2.

7. REVIEW PERIOD: FMU 1 and FMU 2 agree to participate in a yearly review of this document.

original signed by:

_________________________  ___________________________
ANSP 1  ANSP 2
Date: ________________  Date: ________________

_________________________  ___________________________
FMU 1  FMU 2
Date: ________________  Date: ________________
Appendix A

FMU 1

Phone number(s) 123 456 789

Appendix B

FMU 2

Phone number(s) 789 123 456

— END —