International Civil Aviation Organization

Tenth Meeting of the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/10)

Video Teleconference 04 – 08 May 2020

Agenda Item 4: Review of Current CDM/ATFM Operations and Problem Areas

NARAHG UPDATE

(Presented by NARAHG)

SUMMARY

This paper presents the activity status of NARAHG. The Concept of Operations (CONOPS) and interoperability with other ATFM groups are shared in this paper.

1. INTRODUCTION

1.1 China, Japan, Republic of Korea (ROK) agreed to establish NARAHG under ICAO RSO support in 2014 for implementation of efficient ATFM to respond to increase air traffic demand in North-east Asia region.

1.2 Recently several ATFM groups have been established due to the increase in traffic demand not only in the North-east Asia region but also in the entire region. Each group implements flow control according to the environment and situation, such as regional characteristics, establishment of air traffic management unit, introduction of ATFM system, and so on. Each ATFM group is required to implement harmonized ATFM in the region. In ATFM/IR/SWG, it has been discussing how to realize interoperability with recognizing the each difference in operation.

2. DISCUSSION

NARAHG CONOPS

2.1 NARAHG created CONOPS first version. (See **Attachment 1**) It describes the history of establishment, the implementation status of ATFM in each country, the issues within the group, the operational concept and so on. This is a slightly different operational concept from the regional concept, because three states have unique operation geographically. Since ATFM using own system is being implemented and the ratio of traffic flow related to the participating countries is high, this operation concept is adapted in NARAHG. Through CONOPS, the understanding of all stakeholders would be obtained, and in the future, it is believed that the operational concept will serve as a reference as one of the models for cross-border ATFM.

2.2 The characteristics of NARAHG includes the following:

a. ATFMUs have been established in the all participating countries, and ATFM is implemented based on each country's own ATFM system.

b. The ratio of international flights within participating country are commonly high, and these cross-border flights make very severe effect to all member country's traffic flow management.

c. NARAHG is planning to connect each ATFM system in the future and exchange flight data on FIR boundary.

d. ATFMU which is jurisdiction of FIR calculates and issues CTOT / EDCT and CTO for the affected flight based on the coordinated time at FIR boundary (ETO) which being shared by upstream ATFMUs.

2.3 It is not easy to predict traffic demand accurately and to adjust traffic volume to meet airspace capacity because information at each FIR boundary isn't shared in real time. We recognize it is a problem of current ATFM. In addition, in order to respond to excess airspace capacity due to increased traffic volume in the air space and to reduce airspace capacity due to bad weather, the necessary intervals on the FIR boundary increases as FIRs are crossed. Therefore, there are problems that the affected flight is delayed more than necessary and in some cases, a plurality of restrictions is imposed on a single flight.

2.4 It is assumed that connecting ATFM systems of each participating country will improve prediction of traffic demand from present situation to several hours ahead. When considering the implementation of flow control, it is expected that it brings an effective judgment as to whether the maximum effect can be obtained with the minimum restrictions if we implement it inside of the FIR or outside of the FIR, or the both.

2.5 In addition, the operation of NARAHG will be possible to conduct ATFM for both the airport and the airspace within each FIR by GDP based on the coordinated time on the FIR boundary. We are currently working on a project to establish ATFM by time management on the FIR boundary.

Interoperability in the APAC

2.6 As the first steps for interoperability, ADP exchange was agreed in ATFM/IR/SWG. Since the preparation status varies from country to country, the one when got ready started to respond sequentially. Japan started in September 2019, ROK started in April 2020. In addition, Japan have been coordinating with Hong Kong ATFMU to implement flow control for Hong Kong international airport. Since, both countries have already established air traffic management in their respective airspace, we aim to establish a simple operation scheme at the beginning. After it would be sure that there is no problem, we plan to improve it more efficient operation scheme. ROK is also planning similar experiment procedure design regard to CTOT exchange within ROK – HKCAD. We expect this experiment and cooperation among relevant ATFM facilities could be helpful to develop harmonization method between NARAHG and Multi-Nodal Group.

2.7 NARAHG recognizes the core concept of the APAC regional framework for ATFM collaboration. In the future it may be necessary to share the time on a FIR boundary or at a specific point across the region. In the changing environment and conditions, considering the increasing traffic volume in the Asia region, it is important to work together with other groups. Also, considering the future TBO (Trajectory Based Operation), it is believed that the time has come to conceive the operation of CTO. We would like to propose working together to be able to achieve beyond the ATFM group.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) discuss how we move forward to achieve interoperability for efficient ATFM;

b) note the information contained in this paper; and

c) discuss any relevant matters as appropriate.

…….

Northeast-Asia Regional ATFM Harmonization Group (NARAHG)
Concept of Operations (CONOPS)

Version 1.0
Published by NARAHG Small Working Group (SWG)

Northeast-Asia Regional ATFM Harmonization Group (NARAHG)
Concept of Operations (CONOPS)

DOCUMENT CHARACTERISTICS

TITLE			
NARAHG Concept of Operations			
Version Number	1.0	Version Validity Date	April 20, 2020

Abstract
This NARAHG Concept of Operations has been developed in line with the content and direction of NARAHG strategy plan. This version was drafted in NARAHG SWG and approved by NARAHG members through discussion. Subsequently, it was released as Version 1.0 on April 20, 2020.

Keywords			
ATFM/CDM	CROSS-REGION	HARMONIZATION	SEAMLESS
CRACP	DATA	AUTOMATION	POST-OPS ANALYSIS
INTEROPERABILITY	SWIM	FF-ICE	ADP
COORDINATION			

Authors
Small Working Group of Northeast Asia Regional ATFM Harmonization Group

POC		
Contact(s) Person	Tel	Unit
Sun Yi	+86-21-2232-0882	ATCC, ECATMB, ATMB, CAAC, CHINA
Shinobu Imamura	+81-92-608-8868	ATMC, JCAB, MLIT, JAPAN
Lee Gwang-Ho	+82-53-668-0459	ATMD, ATMO, MOLIT, ROK

STATUS, AUDIENCE, AND ACCESSIBILITY					
Status		Intended for		Accessible via	
Working Draft	☐	General Public	☑	Intranet	☐
Draft	☐	NARAHG Stakeholders	☐	Extranet	☐
Proposed Issue	☐	Restricted Audience	☐	Internet	☐
Released Issue	☑				

Northeast-Asia Regional ATFM Harmonization Group (NARAHG)
Concept of Operations (CONOPS)

DOCUMENT CHANGE RECORD

The following table illustrates the complete history of the successive versions of the present document.

Version	Date	Status	Update contents
0.1	12/12/2018	First draft	All
0.2-0.8	18/03/2019	Internal discussing	All
0.9	08/04/2019	Discuss on NARAHG/8	All
1.0	20/04/2020	Develop as the first version	All

REFERENCE MATERIAL

Annex 11 to the Convention on International Civil Aviation (Air Traffic Services) 13th Edition, 2001
Procedures for Air Navigation Services Air Traffic Management (PANS-ATM, Doc 4444) 16th Edition, 2016
Global Air Traffic Management Operational Concept (GATMOC, Doc 9854) 1st Edition, 2005
Global Air Navigation Plan (GANP, Doc 9750) Sixth Edition, 2019
Manual on Air Traffic Management System Requirements (Doc 9882) 1st Edition, 2008
Manual on Global Performance of the Air Navigation System (Doc 9883) 1st Edition, 2009
Manual on Flight and Flow-Information for a Collaborative Environment (FF-ICE, Doc 9965) 1st Edition, 2012
Manual on Collaborative Air Traffic Management (Doc 9971) 3rd Edition, 2018
Regional Supplementary Procedures (Doc7030) 5th Edition, 2008
Asia/Pacific Seamless Air Navigation Service Plan Version 3.0, 2019
Asia/Pacific Air Traffic Management Performance Measurement Framework Version 1.0, 2019
Asia/Pacific Regional Air Traffic Flow Management Concept of Operations Version 1.0, 2015
Asia/Pacific Framework for Collaborative Air Traffic Flow Management Version 3.0, 2017
Asia/Pacific Airport Collaborative Decision Making (A-CDM) Implementation Plan 1st Edition, 2019

*Note:

- In the CONOPS, the quotations from the above-stated documents are emphasized in italics.

TABLE OF CONTENTS

Northeast-Asia Regional ATFM Harmonization Group (NARAHG)
Concept of Operations (CONOPS)

EXECUTIVE SUMMARY

In 2014, to respond to the rapidly increasing demand for traffic in Northeast Asia, China, Japan and the Republic of Korea established a sub-regional ATFM group, "Northeast-Asia Regional ATFM Harmonization Group (NARAHG)". The International Civil Aviation Organization Asia Pacific Office (APAC) supports NARAHG through the APAC Regional Sub Office (RSO) in Beijing. After several meetings, NARAHG concluded a Memorandum of Cooperation (MOC) witnessed by ICAO APAC. It includes the Terms of Reference (TOR) and the Principals of Cooperation (POC). TOR describes the objectives and key activities. POC represents the cooperative principles of the group. Subsequently, the group continuously supports the safety and efficiency of air traffic in Northeast Asia through the implementation of ATFM/CDM in a harmonized manner.

To achieve the implementation of the ATFM/CDM procedures and practices across the borders, NARAHG shares necessary information on the traffic situation, considers solutions for various constraints in the sub-region, and develops mechanisms for post-operations analysis of cross-border ATFMs. In addition, NARAHG has been cooperatively working on one of the key activities listed in the TOR, "To develop the harmonized technical and operational communication protocols/procedures/tools to support the associated agreed ATFM/CDM operations."

One of the benefits of the introduction of technical tools is the real-time data exchange of all relevant flight on the FIR boundary. This results in the establishment of common situational awareness, accurate traffic forecast, and the implementation of ATFM to balance between demand and capacity. As a result, it leads to a seamless cross-border ATFM and supports the efficient Air Traffic Management (ATM) in the sub-region.

In general, ATFM involves more than just applying the ATFM measures. It also includes the implementation of an ATFM solution, which is a combination of capacity optimization and the ATFM measures. Before implementing the ATFM measures, it is necessary to have an accurate forecast of the expected traffic demand through the collection, collation, and analysis of air traffic data. Current cross-border traffic forecasts are not predictable and not stable due to the lack of accurate information on incoming flights from adjacent FIRs. The connection of the ATFM system at NARAHG is expected to solve this existing challenge and significantly contribute to the improvement of the predictability and stability within the ATFM network.

At the same time, the data exchange also realizes the implementation of a cross-border Ground Delay Programs and Airspace Flow Programs by making the most use of the precise flight position information on the FIR boundary through the ATFM system. When executing cross-border ATFM, NARAHG members work as a single node and fulfill the responsibility within its jurisdiction. NARAHG adopted the process mentioned above mainly because 1) the member's FIR is relatively large, and there are a large number of flights closed within NARAHG airspace, and 2) the member States have established their ATFM systems, ATFMUs, and internal ATFM operation.

Additionally, NARAHG is located in the east of the APAC region so that it is essential to keep in mind the seamless connection with other regions. In parallel with the study of regional interoperability, a step-by-step approach should be taken from a long-term perspective to achieve seamless interoperability without operational gaps from a global perspective across regions.

Meanwhile, the traffic demand in the APAC region remains higher than that of any other region. It is an ultimate and urgent mission to meet the expectations of stakeholders. The regional interoperability has been discussing as a concern in the region for a long time. Uni-State, sub-regional, and regional ATFMs are intricately correlated with one another and cannot be considered

independently. NARAHG focuses and pursues regional interoperability in a practicable manner, even without an ATFM system connection.

NARAHG will tackle regional and sub-regional challenges and evolve concertedly with other ATFM groups to improve ATM services while aiming for future operations in System-Wide Information Management (SWIM) environment with Flight and Flow-Information for a collaborative Environment (FF-ICE.) It hopes that this CONOPS will serve as a reference for all stakeholders and contribute to further consideration of regional interoperability.

Northeast-Asia Regional ATFM Harmonization Group (NARAHG)
Concept of Operations (CONOPS)

CHAPTER 1 INTRODUCTION

Objective

1.1 This document describes the operational concepts of the Northeast-Asia Regional ATFM Harmonization Group (NARAHG). The set of this document provides an overview of NARAHG and related aspects such as the concept, principles, characteristics, needs, and a common platform. It aims to establish a comprehensive understanding of the NARAHG concept and illustrates how Cross Region ATFM Collaborative Platform (CRACP) is designed and how it operates and promotes harmonized seamless cross-border ATFM among the members. It is an overall vision statement, not an operational or technical manual.

Scope

1.2 The NARAHG Concept of Operations (CONOPS) is limited to the Air Traffic Flow Management (ATFM) and Collaborative Decision Making (CDM) operation in NARAHG, which includes the envisaged future operation with system connection among the members. This means that ATFM/CDM in the sub-region is in the evolutionary process during a transition period.

Intended Audience

1.3 The target audience for this document includes all NARAHG members and stakeholders involved in the ATFM/CDM process.

Structure of the document

1.4 The document consists of the following chapters and appendices subsequently to this chapter, “INTRODUCTION”.

CHAPTER 2 NARAHG OVERVIEW

Background, objectives, the current status of ATFM/CDM, the sub-regional/regional challenges, the expectations for the future, etc.

CHAPTER 3 OPERATION CONCEPT

NARAHG operational principles and concepts

CHAPTER4 COMMON OPERATION PROCEDURES

Operation of NARAHG through all ATFM phases and operational scenarios

CHAPTER 5 CRACP OPERATION CONCEPT

Overview, fundamental use, and the phased approach of the common platform

APPENDICES

Supplementary information (ADP, ATFM coordination, Inter-system connection ICD)

List of Abbreviations

1.5 Descriptions of the abbreviations used in this document.

Abbreviation	Description
AAR	Airport Arrival/Acceptance Rate
A-CDM	Airport Collaborative Decision-Making
ADP	ATFM Daily Plan
AFP	Airspace Flow Program
AFTN	Aeronautical Fixed Telecommunication Network
ALDT	Actual Landing Time
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
AOBT	Actual Off Block Time
APAC	Asia/Pacific
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
ASBU	Aviation System Block Upgrade
ATC	Air Traffic Control
ATD	Actual Time of Departure
ATFM	Air Traffic Flow Management
ATFMU	Air Traffic Flow Management Unit
ATM	Air Traffic Management
ATO	Actual Time Over
ATOT	Actual Take Off Time
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
AU	Airspace User
BTO (*)	Boundary Time Overfly
CANSO	Civil Air Navigation Services Organization
CARATS	Collaborative Actions for Renovation of Air Traffic Systems
CDM	Collaborative Decision-Making
CLDT	Calculated Landing Time
COBT	Calculated off-block time
CONOPS	Concept of Operations
CRACP	Cross Region ATFM Collaborative Platform
CRV	Common Aeronautical Virtual Private Network
CTO	Calculated Time Over
CTOT	Calculated Take Off Time

DCB	Demand and Capacity Balancing
DMAN	Departure Manager
EDCT	Expected Departure Clearance Time
ELDT	Estimated Landing Time
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETO	Estimated Landing Time
ETOT	Estimated Take Off Time
FF-ICE	Flight and Flow-Information for a Collaborative Environment
FIXM	Flight Information Exchange Model
FMP	Flow Management Position
GANP	Global Air Navigation Plan
GDP	Ground Delay Program
GS	Ground Stop
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
KPI	Key Performance Indicator
MDI	Minimum Departure Interval
MINIT	Minutes in Trail
MIT	Miles in Trail
MTF	Major Traffic Flow
NOPS	Network Operation
PBN	Performance-Based Navigation
POA	Post-Operations Analysis
RTA	Required Time of Arrival
SMAN	Surface Manager
SWIM	System-Wide Information Management
TBO	Trajectory Based Operations
TMI	Traffic Management Initiatives
TOBT	Target Off-block Time
TSAT	Target Start-up Approval Time
TTOT	Target Take-Off Time

*Notes:
BTO: This is the coordination time of defined flights on the boundary of two adjacent ATFMUs. BTO is ETO plus the required delay.

Revision

1.6 Amendments and additions to this document will be discussed at the suggestion of NARAHG members and will be revised with the consent of all members. The revision record is written in the above section titled DOCUMENT CHANGE RECORD.

CHAPTER 2 NARAHG OVERVIEW

Background

2.1 To meet continuing growth in air traffic demand in Northeast Asia, the establishment of NARAHG was agreed by China, Japan, and ROK at the 3rd meeting of the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG) held in March 2014. International Civil Aviation Organization Asia and Pacific (ICAO APAC) Regional Sub-Office (RSO) was entrusted to support and nurture its harmonized ATFM/CDM implementation work program.

2.2 During the 1st meeting of NARAHG in August 2014 at the RSO office in Beijing, NARAHG members agreed on the Terms of Reference (TOR). This set forth the commitment of the three States and the various conditions and arrangements that subsequent discussions would be based upon. Afterward, at the 2nd meeting of NARAHG in March 2015 held in Fukuoka, the members agreed on the Principles of Cooperation (POC), which would form the cooperative framework and the guiding principles.

2.3 On its 3rd meeting in Shanghai in October 2015, the representatives of China, Japan, and ROK signed a Memorandum of Cooperation (MOC), including TOR and POC, witnessed by ICAO APAC RSO, thereby officially initiating the cooperation of NARAHG. The MOC includes improving the ability of the traffic management systems through data sharing, collaborative operation, such as ATFM Daily Plan (ADP) exchange, post-operations analysis, etc.


MEMORANDUM OF COOPERATION
between
CHINA
and
JAPAN
and
REPUBLIC OF KOREA
relating to the
NORTHEAST-ASIA REGIONAL
AIR TRAFFIC FLOW MANAGEMENT (ATFM)
HARMONIZATION GROUP
(NARAHG)
Witnessed by
International Civil Aviation Organization
Asia and Pacific Office

Figure 1 The MOC signed by China, Japan, and ROK in 2015

2.4 At the same meeting, China Air Traffic Management Bureau (ATMB) proposed a client-based data exchange platform “Cross Region ATFM Collaborative Platform (CRACP)” for data sharing to ensure the efficient and smooth ATFM/CDM process. The representatives of the three States agreed to set up a small working group to draw up a project plan and to develop the harmonized message format standard for trial purposes. NARAHG members agreed to the concept, and it developed a unified operating procedure and data exchange interface protocol through joint experiments in March 2017. The members of the States are currently exchanging ADP through CRACP clients and testing the functions of electronic ATFM coordination.

Scope and Objective

2.5 NARAHG activities are limited to the applications of ATFM/CDM. The objective is to achieve the implementation and harmonization of ATFM/CDM procedures and practices to support international flights in Northeast-Asia to promote regional air traffic safety, capacity, and efficiency with the development of a concrete operational improvement. To achieve this goal, NARAHG is mainly working on:

- Sharing relevant and necessary information on the current air traffic situation to increase common situational awareness, to improve operational predictability and maximize the use of airport/sector capacity, and to optimize data quality;

- Developing an operational mechanism to support cross-border ATFM harmonization including regular joint ATFM post-operations analysis;

- Developing a harmonized technical and operational communication protocol/procedures/tools to support the associated agreed ATFM/CDM operations; and

- Coordinating the development of a technical and operational communications document defining the protocols and procedures for ATFM operations.

2.6 Through the operation practice, the three States civil aviation continuously innovates the synergy concept of cross-regional ATFM and strives to further expand the forward-looking and coordinated effect of ATFM in the States through the optimization of the procedures and the advancement of technology, so as to continuously improve the quality of civil aviation industry.

Characteristics of NARAHG

2.7 NARAHG is located in the east of Asia and connects to the other region beyond the Pacific Ocean, and each State has some of the busiest air hubs in the world which play a geographically significant role. Compared to other States in the Asia/Pacific region, NARAHG members have relatively large FIR and consequently have a high ratio of domestic flights within its FIR. In addition, due to the geographical condition, the proportion of NARAHG-related flights is high among all international flights in each State.

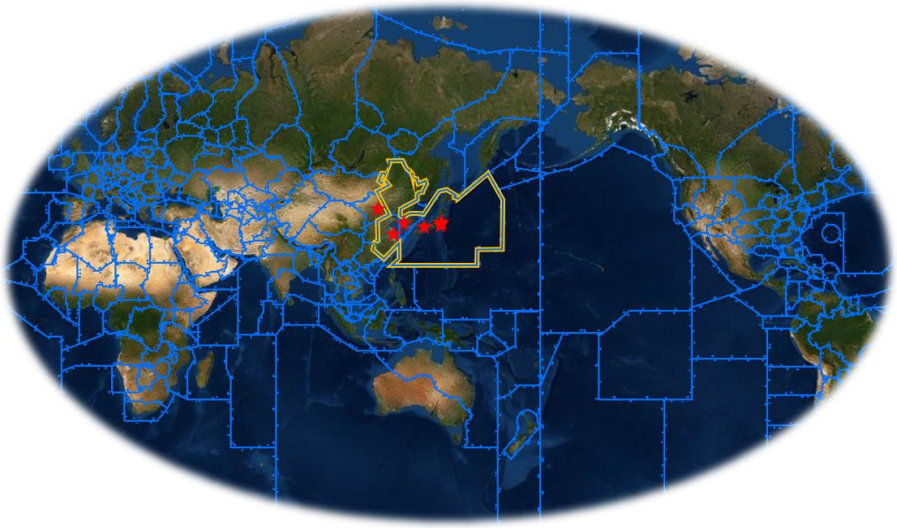

Figure 2 The location of NARAHG in the globe

2.8 NARAHG States have already established their own national ATFM organization, frameworks, and ATFM systems. China, Japan, and ROK have concluded bilateral ATFM agreements and/or trilateral NARAHG MOC with related parties based on article 3.7.5.2 of Chicago Convention Annex 11. The daily operations are implemented based on those agreements or documents.

> *3.7.5.2 Recommendation. — ATFM should be implemented on the basis of regional air navigation agreements or, if appropriate, through multilateral agreements. Such agreements should make provision for common procedures and common methods of capacity determination.*

2.9 The bilateral agreements stipulate a series of ATFM procedures, including responsibility, information sharing methods, ATFM coordination, and ATFM implementation. Under the agreement, the member States balance demand and capacity using ATFM measures such as MINIT (including conversion to GDP) and altitude restrictions.

ATFM situation in the Member States

- China -

2.10 ATMB started researching ATFM from 2006. ATMB has 7 regional bureaus, each regional bureau operating one single ATFM system from 2012. In 2020, the National ATFM system will online operating in Operation Management Center. All the ATFM operation in 7 regional ATMB will be intergraded by National system.

2.11 ATMB believed that the major task of ATFM is improving the capacity in the airspace. ATMB launched the project of RECAT, For the propose of operating efficiency, ATMB published the A-CDM data standard for Airports and Airliners, ATMB encourages all the units to implement Airport CDM (A-CDM) to achieve the data exchanging by minimum workload and time delay.

2.12 ATMB incorporates the cross-border ATFM in Civil Aviation ATM Modernization Strategy （CAAMS）. ATMB attaches great importance to the cooperation with Japan and ROK in cross region ATFM collaboration. ATMB has invested in the project of the CRACP (Cross Region ATFM Collaborative Platform) and successfully operated by the cooperation of Japan and ROK. ATMB organized East China Regional ATMB and North-east Regional ATMB to join the cooperation of NARAHG. According to the characteristics of operation in Northeast Asia, ATMB cooperates with NARAHG to design the new technical solution and security network to seamless connect three ATFM systems from three states. This is highly consistent with the SWIM, TBO and FF-ICE actively promoted by ICAO.

- Japan -

2.13 ATMC has been playing a leading role in ATM in Japan, based on ICAO's new CNS/ATM concept, since its establishment in 2005 through the reorganization of the existing ATFM Center. ATMC has an automated ATFM system where projected demand and capacity are balanced through the implementation of TMIs, such as GDPs with slot swapping capability and re-routing.

2.14 As of January 2020, Japan is proceeding with the integration of ATM systems, the reconstruction of the metropolitan airspace, and the reorganization of Area Control Centers to accommodate the increasing demand. In the reconstruction of the metropolitan areas, the introduction of Point Merge System (PMS) greatly improved the capacity at Haneda and Narita airport. With the reconstruction of ACCs, the existing en-route airspace will be horizontally divided into high and low sectors to optimize the limited airspace. Airport CDM (A-CDM) will be introduced at Haneda and Narita airport shortly following the A-CDM at Chitose Airport started in 2018.

2.15 ATFM/CDM in Japan continuously evolves in line with a package of a long-term vision for the future air traffic systems, Collaborative Actions for Renovation of Air Traffic Systems (CARATS). CARATS sets goals like the improvement of safety, correspondence to the growth in global air traffic demand, improvement of user-friendliness and operational efficiency, etc. The core of CARATS, “trajectory-based operations (TBO),” secures international interoperability. This package also includes the introduction of A-CDM in connection with arrival, departure, and surface management functions (AMAN/DMAN/SMAN), in the context of the system-wide information management (SWIM) concept.

2.16 In connection with internal CDM activity, ATMC holds annual ATM review conferences twice a year. The participants are ATM stakeholders, including air traffic managers, airline operators, ATC controllers, weather specialists, CAB administrators, military delegates, etc. Facts and data are reported and reviewed at the conference. The data and analysis presented in the conference are published as “Annual ATM Report” and shared by all the participant members. ATFM performance is regularly evaluated during the conference and through this process ATM procedures are always improving with gradual modification.

-ROK-

2.17 In ROK, Incheon Area Control Center (Incheon ACC) had performed as an air traffic flow management unit and provided limited Air Traffic Flow Management (ATFM) service within Incheon FIR, before opening of Air Traffic Command Center (ATCC).

2.18 In order to respond to rapid increase of the air traffic volume, to reduce traffic

congestion and maximizing airspace capacity, ROK decided to establish ATCC at Daegu city in 2014. ATCC was established in 2017 with the founding of ATMO (Air Traffic Management Office), From Jan 4 2018, ATCC started to provide ATFM service in Incheon FIR. For managing all relevant abnormalities about Air traffic management, ATCC has three major operational objectives.

a) Air Traffic Flow Management: ensuring safe densities of traffic

b) Airspace Management: maximizing the utilization of available airspace

c) Crisis Management: promptly recover from unexpected contingency situation

To achieve these goals, liaisons from Air Force and AMO are working with flow managers at ATCC operation room for information exchange and mutual coordination in real-time. And ATCC is conducting domestic CDM every day to share information and gather stakeholder's opinions. And managing ATFM measures like AFP, GDP or MIT (MINT) to handle international/domestic ATFM restrictions or requests.

2.19 For traffic capacity and ATC safety improvement of Incheon FIR, ROK established the 2nd Area Control Center, Daegu ACC. Incheon ACC and Daegu ACC have responsibility for east and west area of Incheon FIR, respectively.

2.20 With the implementation of centralized ATFM in ROK, A-CDM development for major airports is also in progress. Incheon Airport A-CDM has been implemented since December 2017. The operation of Incheon Airport A-CDM is planned to be divided into 3 phases, and started phase 2 from 2020.

a) Phase 1 (Dec. 2017 – Dec. 2019): Share basic time information with partners via A-CDM and implement system stabilization

b) Phase 2 (Jan. 2020 – Dec. 2024): Improve TTOT/TSAT and enlarge the scope to cover de-icing/anti-icing aircraft

c) Phase 3 (Jan. 2025 –): Implement automation of A-CDM and enhance the quality of information mutually shared with the Air Traffic Control Center

Besides, the needs of A-CDM at major domestic airports have been raised, so A-CDM implementation project for local major airports (Gimpo, Gimhae and Jeju) is underway. Initial development is finished at 2019, and expect to trial operation in Q3 2020.

2.21 Regard to international ATFM cooperation, ATCC has participated actively since 2017. ATCC installed CRACP client in 2018, and exchanging ADP with other NARAHG members, and regularly shares ATFM statistic data to all members for post-operation analysis. And, ATCC is making continuous effort to cooperate with Multi-Nodal Groups, including of trial operation between HKCAD.

2.22 For further improvement, ATCC is enhancing Post-operation process and relevant subsystems. And planning to develop integrated flight plan processing system to facilitate smooth integration between ATCC ATFMS and Airport-CDM system, in order to provide better ATFM service.

Sub-Regional Challenges

2.23 Currently, due to the absence of ATFM system connection among the members, there is a limit to accurately predict a traffic demand from adjacent FIRs. This inaccuracy cannot be overlooked as the percentage of international flights in the respective FIRs has been increasing year by year. Low accuracy in predicting incoming international flights leads to an inaccurate forecast of traffic demand in domestic airspaces, which can affect cross-border ATFM implementation and other factors profoundly. It is important to improve the accuracy of the prediction of cross-border traffic volume before implementing cross-border ATFM.

2.24 With respect to cross-border ATFM, as described in 2.9, NARAHG members generally implement MINIT (including conversion into GDP), level capping, or other appropriate measures depending on the actual situation. The traditional method, MINIT, is simple logic and flexible in terms of not requiring strict prioritization. However, it often causes serious problems if large separation is required between aircraft due to sudden weather condition deterioration. Specifically, the impact tends to get significant when the target aircraft passes through more than three FIRs or when multiple ATS routes converge into a single route within the downstream FIR.

Sub-Regional Solutions and Expected Benefits

2.25 Of the two main challenges cited above, the first one in 2.16 is expected to be improved by online data exchange on the FIR boundary in the near future as detailed in chapter 4. To achieve the optimal Demand and Capacity Balance (DCB) across FIR boundaries, it is necessary to build an ability to predict cross-border traffic demand through ATFM data exchange. Exchanging the latest ETO on FIR boundary of cross-border aircraft improves the accuracy of demand prediction in its FIR and, at the same time, establishes common situational awareness among the members. “RESEARCH AND FUTURE DEVELOPMENT POSSIBILITIES” of Asia/Pacific Seamless ANS Plan also states the following:

> *The need for concepts beyond current technology and systems had been reinforced at APANPIRG/23. With the end goal of a globally interoperable ATM system in mind, the region will have to consider planning for a long- term supporting concept and infrastructure. States should not overlook the need to include the development of future ATM concepts that will ensure the safety and fluidity of air transportation over the next few decades. The following are possible areas that should be considered for future development, in order to continue pursuance of Seamless ANS beyond ASBU Block 0 implementations and global interoperability:*
>
> *Sub-Regional ATFM - Inter-linked (data-sharing) ATFM units (which may be virtual offices) should be developed to serve various sub-regions. This concept is consistent with Seamless ANS Principle 8 (Sub-regional ATFM based on system-wide CDM serving the busiest terminal airspace and MTF). The Global ATM Operational Concept paragraph 2.4.3 states: Demand and capacity balancing will be integrated within the ATM system;*
>
> (The rest omitted.)

2.26 The second challenge discussed in 2.17 is expected to be solved by the adoption of a new method using BTO/CTO based on data exchange on the FIR boundary. The specific procedures of operation need further study and consideration including a possibility of using a phased approach. Thus, these two main changes enable the sub-region to implement a harmonized seamless ATFM by an appropriate DCB. Maintaining an optimal DCB will contribute to the ATM operation for all stakeholders.

Interoperability in APAC Region

2.27 Various ATFMs have been formed in the Asia-Pacific region, but the Asia/Pacific Region Framework for Collaborative ATFM is the standard in this region. The core concept of the Framework is the distributed multi-nodal ATFM network, envisaged as interconnected States and/or sub-Regional groups operating in an ATFM network without the need for any central, physical facility providing the network management function. APAC Regional ATFM Concept of Operations is also an approved document in the region that describes the details of the operation in the Framework. Both were formally endorsed by the 26th meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/26, Bangkok, Thailand, 7-10 September 2015.

2.28 Multi-Nodal ATFM Network is comprised of ATFM Nodes, which is led by ANSP. It is responsible for the ATFM operation within their respective FIR. They are supported by an interconnected information sharing framework. A node associated airports will be able to manage the demand and capacity through adjustments in aircraft calculated landing times (CLDTs) using relevant flight plans, which will, in turn, generate CTOTs for particular aircraft at the departure airport. It is considered an appropriate approach for the flights which have no other demand besides the airport AAR.

2.29 NARAHG operation also issues CTOT (GDP), the process of CTOT calculation is based on exchanging FIR boundary time computed by their own ATFM system. Instead of issuing a CTOT directly to accepting ATFMU, the initiating ATFMU coordinates the target time on the FIR boundary with the accepting ATFMU, and the accepting ATFMU issues a CTOT which is calculated based on the target time of the aircraft departing from its own FIR. Before issuing CTOT (GDP), NARAHG using the ETO which shared by upstream ATFMU to create the flight trajectory in their own ATFM systems. In this way, downstream ATFMU can analyze the demands both of airports AAR, airspace and airway capacity.

2.30 A pre-condition of this operation is that each ATFMUs has an ATFM system and the systems are connected. This method is considered as one of the ideal solutions in NARAHG considering the size of the FIRs and the number of related aircraft in the sub-region. There are still some other differences from the APAC Regional ATFM Concept of Operations. For example, NARAHG does not have the scheme of Delay Absorption Intent by Aircraft Operators and Maximum Delay for the present. Another major difference is the connection between ATFMUs. NARAHG intends to use the CRV network instead of AFTN.

2.31 The interoperability in the APAC region is a crucial and finding solution is very challenging. This requires a flexible and feasible approach which must also lead to future operations in the region. On a sub-region level, it is indispensable to consider and respond to what is possible as a single ATFMU from various viewpoints. .

2.32 When implementing a cross-border ATFM to secure DCB of an individual airport or airspace, a node needs to consider the effect on DCB outside of its own FIR. The aircraft being controlled is affecting the traffic in all relevant airspaces. Without information sharing and CDM, an optimized cross-border ATFM cannot be achieved. Avoiding the negative chain across the FIR, which would cause unnecessary flow controls by specific flow control, and establishing priorities for multiple cross-border ATFMs would be considered as remaining issues in the region.

Link with Global Plan and A-CDM

2.33 Each NARAHG member state progresses along with ICAO GANP referencing the Aviation System Block Upgrades (ASBU) methodology whose core concept is linked to four specific and interrelated aviation performance improvement areas. The ASBU framework sets the target implementation time frames for operational improvements, referred to as Modules, including ATFM and other various enablers of ATM components which facilitate efficiency and effectiveness.

2.34 ATFM is expressed as a Network Operation (NOPS) in ASBUs and an important capability to be implemented when necessary. The ASBU NOPS description in GANP then expands to include more complex ATFM techniques such as user-driven prioritization of ATFM solutions (Block 1, 2019), SWIM-based collaborative decision making (Block 2, 2025) and eventually towards full complexity management under the rich information environment of a SWIM-based ATM (Block 3, 2031) In addition to ASBU NOPS, ASBUs consist of A-CDM, which is the beginning and end portion of flight paths in the scope of ATFM.

2.35 Several airports in NARAHG have already implemented A-CDM and more airports are in the process or planning to implement A-CDM. To effectively formulate and develop the implementation of cross-border ATFM, A-CDM should be incorporated gradually into its implementation. Subsequently, there is a need for the States to work together to ensure system interoperability between ATFM and A-CDM implementations in the sub-region. A delay in one leg of an aircraft may affect the subsequent legs of that aircraft. Grasping that trend in the early phase will result in predictable ATFM throughout the day.

2.36 In the same way, the first version of the APAC A-CDM manual states the validity of interoperability between ATFM and A-CDM from the A-CDM perspective as follows.

.

> *.A-CDM can further optimise operations at the airport by taking into consideration ATFM programmes. The implementation of an integrated ATFM and A-CDM network will complement each other and together create a seamless air traffic environment.*
>
> *To assist in making the implementation of A-CDM more successful, it is recommended that a regional ATFM environment be established e.g. via a distributed multi-nodal ATFM network, which would enable a certain degree of harmonization and provide consistency for stakeholders.*
>
> *In line with the timeframe of ICAO ASBU, the outcomes from Block-0 implementations of A-CDM and ATFM could be leveraged to ensure the interoperability of equipment, procedures and practices among the pioneering aviation authorities and administrations in the Asia Pacific Region.*
>
> *An integrated A-CDM and ATFM network can provide the optimal operational predictability desired by CDM partners, improve airport and airline operations and enable seamless ATM.*

CHAPTER 3 OPERATION CONCEPT

Operation General Principles

3.1 Cross-region ATFM collaboration is the embodiment of the seamless air traffic management concept. China, Japan, and ROK have their own independent ATFM system, which can realize the unified management of all flights within the FIR. Therefore, the seamless integration of regulatory boundaries is the best model for cross-regional integration between the three States.

Basic Concepts

3.2 The basic concepts of NARAHG's operation are as follows:

a) ATFM measures in the respective FIRs are fully implemented by local ATFMUs.
b) Each FIR exchanges ADPs for cross-region information sharing.
c) CRACP is utilized as a means to share information and implement effective ATFM.
d) Operational trials are actively conducted to build more effective ATFM measures.
e) The data of the cross-region flights will be designed in a special format for the post-operations analysis of NARAHG members in order to continuously identify the deficiencies and improve the operational process.
f) NARAHG's data exchange with the other groups will be open and flexible, how and when to be implemented should be agreed by all members.
g) NARAHG will continue to practice, summarize and refine the operational recommendations for a wider range of applications. These recommendations will be submitted to ICAO in order to achieve the most consistent operational practices in the Asia/Pacific region.

CHAPTER 4 COMMON OPERATION PROCEDURES

ATFM Operational Phases and Collaboration Decision Making (CDM)

4.1 ATFM is one of the main components of the ATM that provides dynamic integrated management of air traffic and airspace, contributing to the safety, efficiency and cost-effectiveness of ATM and the sustainability of the environment. Networked cross-border ATFM planning and implementation also requires new levels of collaborative decision-making among multilateral stakeholders across all ATFM phases. The procedures applied to these ATFM/CDM implementation processes need to be developed in a harmonized manner to avoid risks to operational safety and efficiency.

4.2 To minimize the impact of ATM system constraints, methods must be developed to balance demand and capacity. This can be achieved by applying the "ATFM Planning and Management" process. This process involves three equally important phases: ATM planning, ATFM execution, and post-operation analysis. The planning processes may be divided into three major phases: strategy, pre-tactics, and tactics. The phases of ATFM execution should not be considered as concrete steps, but as a continuous planning-action-review cycle fully integrated into the ATM planning and post-operations process.

ATFM should be carried out in three phases:

a) strategic phase - generally encompasses measures taken more than one week prior to the day of operation. Much of this work is accomplished two months or more in advance.

b) pre-tactical phase - normally spans from one day to one week prior to operations.

c) tactical phase - solutions and measures are adopted on the day of the operation. Traffic flows and capacities are managed in real time.

4.3 The Manual on Air Traffic Management System Requirements (Doc 9882), developed as a set of ATM functional and operating requirements for a global ATM system, repeatedly expresses the need for CDM across all time horizons and concept components. In addition, CDM also plays an important role in the Air Navigation System Global Performance Manual (Doc 9883), which provides guidance on applying a performance-based approach to ATM decisions. The Asia/Pacific Framework for Collaborative ATFM states as follows:

The planning and implementation of cross-border networked ATFM requires a new level of collaborative decision-making among multinational stakeholders. While the current ATFM CDM process and ATFM systems are directed at regional or national demand and capacity balancing, the maturity and cross-border expansion of ATFM systems has led to multilateral decisions with complementary individual goals.

The cross-border ATFM / CDM offers all stakeholders an opportunity to efficiently exchange operational and strategic information to achieve seamless ATM objectives and optimize traffic flow across the region.

4.4 The CDM process is fully applied to the whole ATFM operational phases stated

above. It is getting much more significant to consider the related air traffic to/from the adjacent FIRs when implementing the demand and capacity balancing domestically. Continuous improvement is achieved not by a linear process, but by a cyclic process. The figure below describes a brief general concept and the operation in NARAHG for each of the key elements of the ATM phase. Through cooperative operation using the system connection, CDM in all phases can be performed efficiently and effectively with transparency.

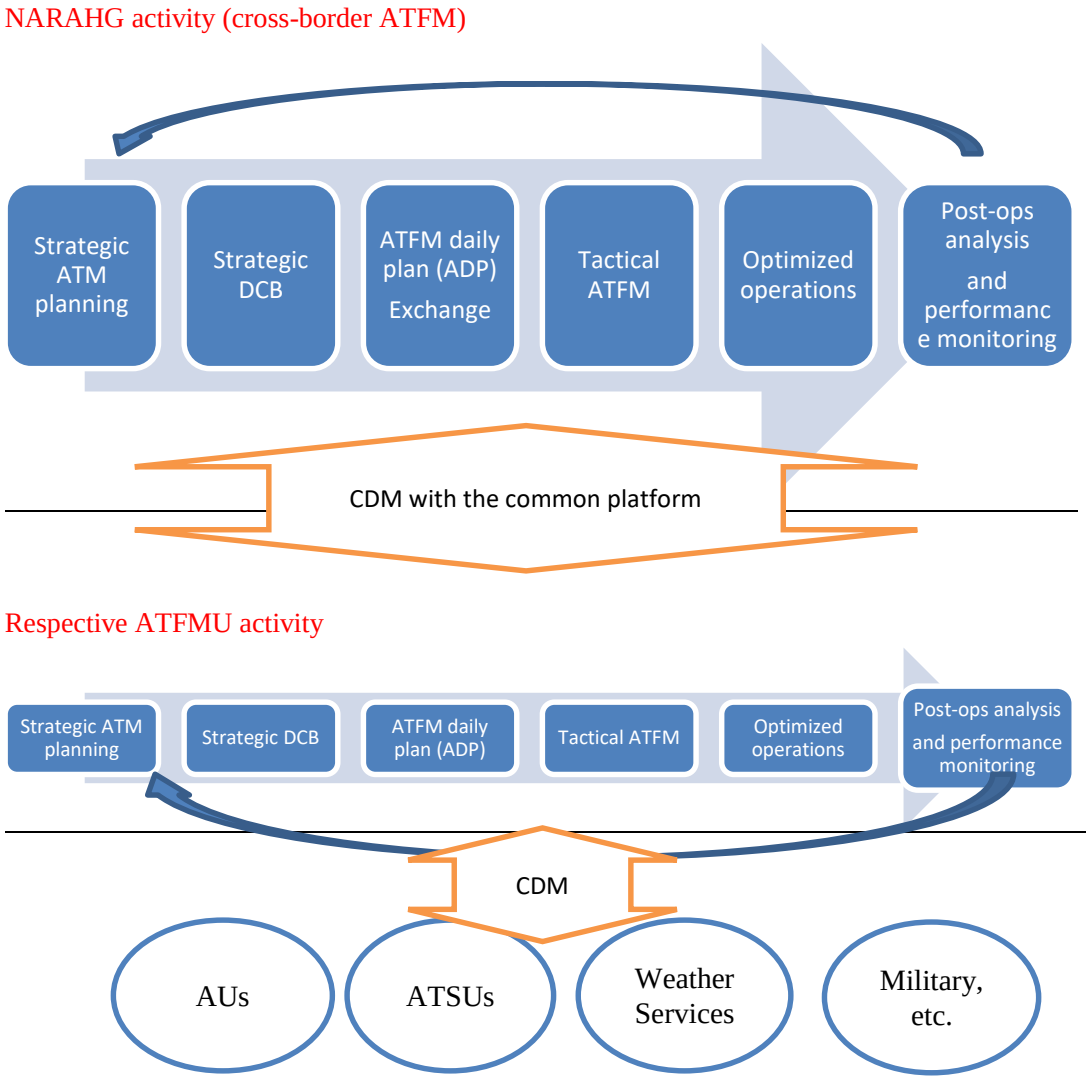

Figure 3 Image of domestic and international CDM links in each ATFM phase

ADP Exchange

4.5 ADP should be a proposed set of ATFM solutions prepared by the ATFMU with input from all stakeholders and published as an outcome of daily CDM conferences. It describes the necessary capacity of resources, the ATFM measures of implementation, or the possibility of implementation. ADP is developed collaboratively and aims to optimize efficiency while balancing demand and capacity. The objective is to develop strategic and tactical outlooks for given airspace or

airport that can be used by stakeholders as a planning forecast.

4.6 In cross-border ATFM, sharing advanced information about events that affect cross-border traffic flow is an important component. Particularly, to take accurate ATFM measures for long-haul international flights, it is necessary to share information several hours before implementing ATFM measures. The following information should be shared by ADP to establish common situational awareness. The information is updated in a timely manner in case of significant meteorological phenomena, unexpected events, or limitations that affect capacity values, etc.

a) Meteorological conditions/forecasts: based on METAR, TAF, SIGMET, VAA and forecasts for major airports (information from own national metrology institute), etc.
b) If possible, share numerical forecasts of airports or airspaces such as AAR.

4.7 Among NARAHG members, the ADP exchange started on an email basis from December 2015 using a standardized format based on the APAC Framework. After the transition period, all members exchange ADP online in a regular and timely manner (regularly twice a day). This online ADP exchange allows all members to share ADP and recognize the current cross-border ATFM, planned cross-border ATFM, and the constraints affecting cross-border ATFM. All the users logged in the CRACP clients are able to check updated ADPs in real time. An example of ADP on CRACP is shown in Appendix 1.

Cross-Border ATFM Data Sharing and Exchange

4.8 NARAHG exchanges flight data using a common ICD. As shown in Attachment 3, in phase 3 of the ATFM system connection using CRV, the secured connection allows us to exchange more confidential aircraft data online. Chapter 5 “ATFM service interfaces” in Manual on Collaborative ATFM (Doc 9971) states the following:

Interfaces associated with ATFM-service-to-ATFM-service deployment support cross-border ATFM. 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 network. This, in turn, leads to increased safety and efficiency in air traffic operations, and more specifically to:

a) increased efficiency for traffic flows;
b) reduced delays;
c) enhanced predictability and reliability of airspace users’ schedules; and
d) reduced impact on the environment from greenhouse gas emissions and noise pollution.

It also optimizes contingency responses to unforeseen events and network disruptions.

4.9 This data exchange will improve the accuracy of traffic forecasts and will enable new cross-border ATFM measures using aircraft data exchange. The following table shows the timing of data exchange and the items to be exchanged. The flight data is constantly updated regardless of the ATFM implementation.

Trigger	Items to be exchanged
Submitting FPL	Calculated FIR CTO (ETA) and CTOT using FPL message. CTOT is for reference.
Changing FPL	Recalculated FIR CTO(ETA) and CTOT using CHG/DLA message
Canceling FPL	Erase FIR CTO (ETA) messages
Assigning and updating CTOT	Recalculated FIR CTO (ETA) / new CTOT and reason for new CTOT (e.g., input TOBT, receive assigned CTO, update taxing time, and activate ATFM measure.)
Recognizing Take off (departure from own country)	ATOT / Recalculated FIR ETO (ETA) at the time the aircraft takes off
Recognizing pass through FIX before FIR boundary (including entry from another FIR)	Recalculated FIR ETO (ETA) when passing FIR FIX before FIR

Table 1 Updating Fight Data

ATFM Coordination (ATFM CDN)

4.10 NARAHG members make ATFM coordination based on the ATFM LOA which is concluded bilaterally and describe ATFM applications. When implementing cross-border ATFMs such as MINIT or level capping, the ATFMUs are currently making verbal ATFM coordination. In the future, this verbal coordination is planned to shift to online coordination through CRACP. This ATFM coordination function consists of five components (who, what, when, where, why) in line with Doc 9971. All required components are provided in the ATFM coordination window as shown in appendix 2.

4.11 Presently, the members are conducting trial operations for staff familiarization and function check. The expected advantages of online coordination are the following:

- Miscommunication is avoided between non-native English speaking staff;
- Coordination is short, simple and clear;
- Acquiring the records of coordination; and
- Referring to the history of coordination

4.12 The function of ATFM CDN and ADP exchange mentioned above will be integrated into each ATFM system as a new function after the establishment of the ATFM system connection.

ATFM Measures (Cross-region GDP/AFP)

4.13 As described in 2.8, NARAHG members currently have implemented conventional

ATFM measures, such as MINIT or level capping, based on bilateral agreements. This section does not include conventional ATFM measures, and instead describes a new ATFM measure by exchanging aircraft data after connecting each ATFM system.

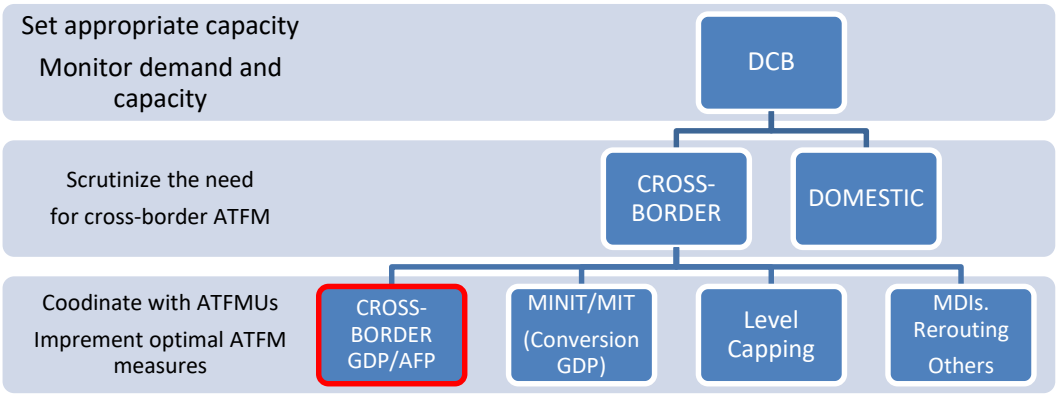

Figure 4 Selection of ATFM measures

4.14 Cross-region GDP/AFP begins with the monitoring of traffic by exchanging accurate individual aircraft information through the ATFM system connection. This accuracy is expected to be further enhanced by integration with A-CDM in the future. While monitoring traffic volume by exchanging accurate information including taxing time and/or ATFM delays due to other ATFM programs, sometimes an imbalance occurs. If an imbalance occurs in DCB at airports, airspace, etc., and there is a need to reduce traffic from adjacent FIRs, the action will be performed as follows:

a) For flights from/via upstream FIR to the downstream FIR, the upstream FIR is obliged to provide relevant operational information to the downstream FIR in real time so that the downstream ATFMUs can keep abreast of the operation situation.

b) The downstream ATFMUs can establish situational awareness based on the data provided by the upstream ATFMUs, and based on this to further evaluate and issue ATFM measures;

c) Cross-regional ATFM measures must be evaluated for effectiveness and agreed upon by the relevant ATFMUs before implementing;

d) The upstream and downstream units coordinate according to the time of the relevant flight at the waypoint of the FIR boundary. When a modification is needed, the BTO is adjusted according to the original the ETO time, and the relays are sequentially transmitted between different FIRs.

e) The implementation of cross-region ATFM is mainly for flights that are still on the ground. The ATFMU revises and releases the new departure time (CTOT/EDCT) according to the BTO. If necessary, the relevant ATFMU can specify the CTO time within a specific window for the flights already in the air, which will make the interval adjustment of the flight in the air more gradual and effective.

Post-Operations Analysis

4.15 Post-operations analysis is, in the ATFM planning and management process, the final phase which develops best practices and lessons learned that will further improve the operational processes and activities. Post-operations analysis has been one of the top priorities of NARAHG since its establishment, and it is an indispensable element of the ATFM planning and management process, especially for cross-border ATFM. Reviewing the results of ATFM initiatives with all stakeholders, including airspace users and air traffic service units, can enhance the CDM concept and gain the best practices and lessons learned to improve the operational process.

4.16 As a measurement of cross-border ATFM performance, NARAHG has been working on post-operations analysis of the conventional ATFM measures, MINIT/MIT. Its KPIs with details were proposed in the Air Traffic Flow Management Post Operations Analysis Framework APAC, which will be published shortly. In the future, post-operations analysis for cross-border GDP/AFP should be considered. Table 2 is a draft of KPIs presented in the 7th meeting of NARAHG.

① KPI	Ground Delay Impact
Objective	To assess the ground delay impact of departures
Units	Minutes, the number of aircraft
Data Requirement	CTOT, ETOT
Data Providers	Originating ATFMU (for dom. ACFT) Receiving ATFMU
Formula	CTOT-ETOT, count the number of ATFM related flight
Breakdown	By FIR, ADEP
Remarks	Average, Maximum
② KPI	CTOT compliance
Objective	To assess compliance of CTOT
Units	Minutes
Data Requirement	ATOT, CTOT
Data Providers	Originating ATFMU (for dom. ACFT) Receiving ATFMU
Formula	ATOT minus CTOT
Breakdown	By FIR, ADEP
③ KPI	CTO compliance
Objective	To assess compliance of CTO
Units	Minutes

Data Requirement	ATO, CTO
Data Providers	Receiving ATFMU
Formula	ATO minus CTO
Breakdown	By FIR, ADEP
④ KPI	Effectiveness of ATFM
Objective	To assess effectiveness of flow control to balance capacity and demand
Units	Percentage
Data Requirement	Expected AAR, actual number of landing, ALDT, ELDT
Data Providers	Originating ATFMU
Formula	Actual number of landing divide AAR, (or ALDT minus ELDT)

Table 2 the proposed KPIs for cross-border GDP/AFP

Operational Scenarios

4.17 To better understand NARAHG operation and further consider the interoperability of regional and global ATFM in the future, it is essential to illustrate how NARAHG operation can be applied consistent with its concept. The scenarios are expected to be desirable ATFM solutions for bottlenecks or specific operational needs of NARAHG.

4.18 However, the scenario described here is limited and also considered as a possible scenario presently because the operation with system linkage among NARAHG members has not yet started. It should be noted that the details may change as the members continuously adjust the operational requirements to the capability or accuracy of future systems.

4.19 Figure 5 shows a general overview of the cross-border ATFM process, and Figure 6 illustrates a flow of ETO and BTO/CTO exchange in cross-border GDP/AFP.

Northeast-Asia Regional ATFM Harmonization Group (NARAHG)
Concept of Operations (CONOPS)

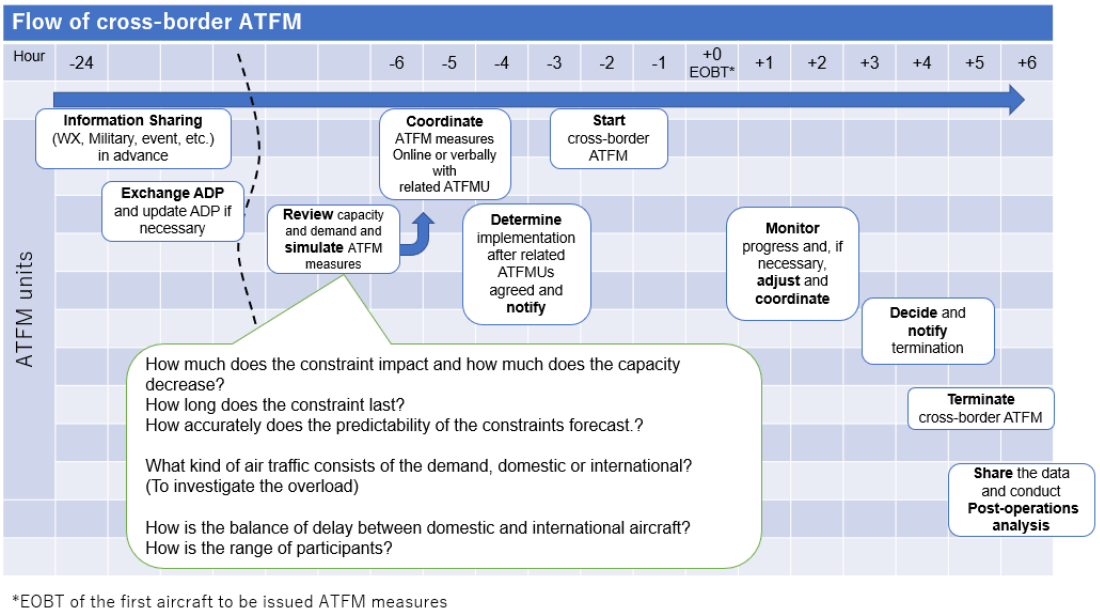

Figure 5 Process of Cross-Border ATFM

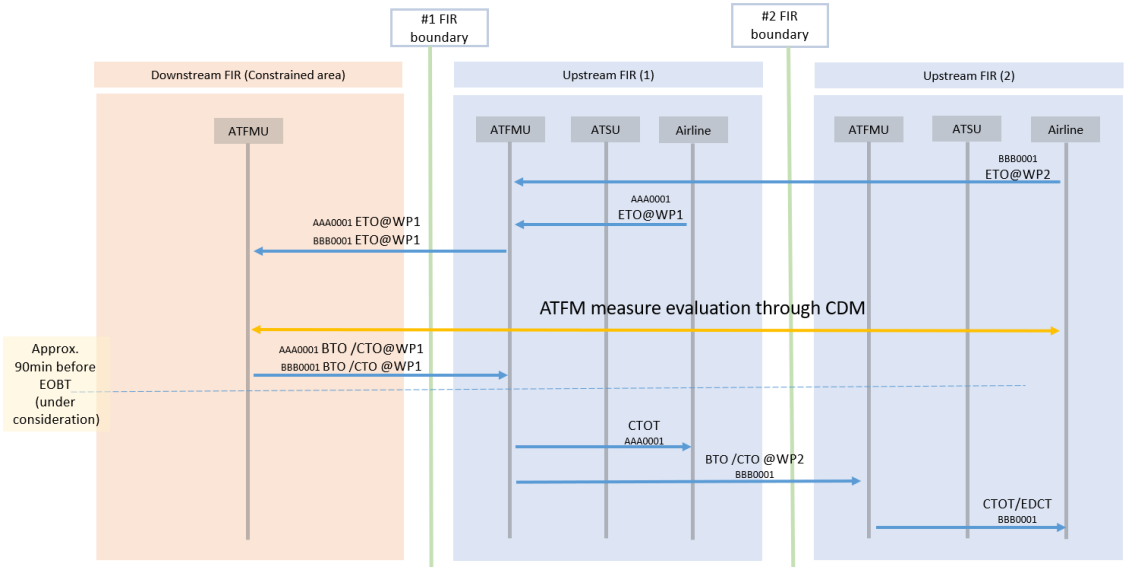

Figure 6 Flow of ETO and BTO/CTO Exchange

a) NARAHG members using own ATFM systems to share all outbound flights to other members.

b) The ETO of all outbound flights is the basic time for other ATFMU to calculate the overfly time or landing time in their FIR.

c) ATFMUs will update the ETO automatically in case of the deviation of ETO is greater than plus or minus specific minutes.

d) Downstream ATFMU modify the time of the ETO to upstream ATFMU by the name of BTO.

e) Upstream ATFMU using the BTO to calculate a new CTOT/EDCT to update the previous CTOT/EDCT.

f) If necessary, upstream ATFMU can inform related ACC units to issue the BTO as CTO to defined flights.

CHAPTER 5 CRACP OPERATION CONCEPT

General Principles

5.1 The evolution of the regional ATFM system connection with technology will meet the expectations of the ATFM community in the region. CRACP is a new cross-region ATFM operation concept designed for States that already have its ATFM systems and follows the principles below:

- CRACP is a solution to the ATFM/CDM process of cross-regional traffic management units on one platform.
- CRACP manages the exchange of information required by the ATFM/CDM process in the phases of pre-tactical, tactical and post-operations analysis.
- CRACP aims to balance the allocation of limited resources and consider the interests of all parties.
- CRACP operation attaches great importance to CDM cultural construction, the emphasis on CDM mechanism building and comprehensive utilization of traffic management methods.

5.2 This Cross-regional collaboration will shortly take place on platforms based on each State's ATFM system. Data transmission will use a dedicated security network with a standardized data exchange format and the operational coordination procedure. Through the operation practice, the three States civil aviation continuously innovates the synergy concept of cross-regional ATFM management and further expand the forward-looking and coordinated effect of ATFM in the States. The optimization of the procedure utilizing advanced technology continuously improves the quality of the civil aviation industry.

Governance

5.3 The governance of the system linkage is ensured through appropriate security mechanisms for the optimized implementation of ATFM requirements. All States have in place information security management, policies, and approaches to risk management which will ensure appropriate governance for the schemes.

5.4 Each ATFMU will integrate this architecture into its ATFM system infrastructure through structured migration management. All States conform to standardized requirements of data provision and data quality and incorporate the related processes locally.

Data Ownership

5.5 The exchange of data and other information will be exclusively for the purposes set forth within the NARAHG MOC. The use of the information and data for purposes beyond the scope identified in the NARAHG MOC or the release of any information or data to a third party must be authorized by the party from which the information or data originated.

Scope of Data

5.6 The flight data or information to be exchanged will not include any sensitive data on flights exempted by either party for security or safety reasons. The data shall be formatted to be usable in each system and exchanged using data communications systems as mutually agreed.

Architecture and Phase

5.7 The development of CRACP will serve the cooperation phase of NARAHG's entire cross region ATFM operation. The first phase will involve the exchange of fixed operation information. Operation coordination for cross region flights will be in the second phase while information exchange and backups will be the third phase.

- Prepare Stage: 2015-2017

  All NARAHG members study from each other and draft the roadmap of cooperation.

- Stage 1: 2018-2020

  All NARAHG members use CRACP via the internet to exchange the ADP and ATFM/CDN.

- Stage 2: 2020-2021

  All NARAHG members use CRACP via the internet to test additional functions for cross border ATFM operation.

- Stage 3: 2021-

  All NARAHG members use own ATFM system via CRV line by the same ICD to operate the cross region ATFM.

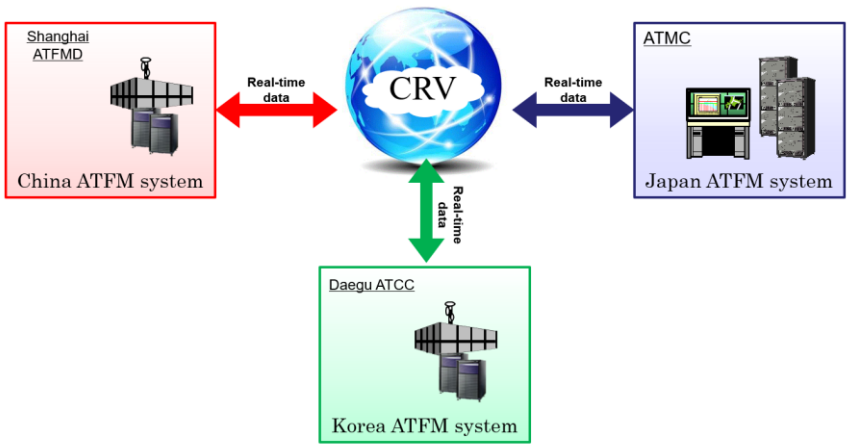

Figure 7 Image of CRV connection in stage3

APPENDIX 1 ATFM DAILY PLAN

The content and image of ADP on CRACP clients are shown below, which is made in line with the regional standard format.

* Relevant items are all included in the inter-system connection ICD

a) ADP issued unit: Unit name who issues this ADP
b) ADP effective period: Effective time period in UTC
c) Capacity and constraints: Capacity reduction and constraints concerned
   - Location: Location of airport or control sector
   - Applicable period: Effective time period of impact
   - AAR: Arrival aircraft in numbers per hour
   - Constraint/Remark: Constraint issued in airport or sector
d) Ongoing ATFM measures: Cross-border ATFM measures already implemented or determined to implement
   - Location: Location of airport or control sector
   - Applicable period: Effective time period of impact
   - Measure/Remark: ATFM measure that has implemented/determined
e) Possible/Developing Issues: Cross-border ATFM measures that will be possibly implemented in the near future
   - Location: Location of airport or control sector
   - Applicable period: Effective time period of ATFM measure
   - Measure/Remark: ATFM measure that will be issued

ATFM DAILY PLAN	NAME OF ATFM UNIT	[UTC DATE] [START TIME]	[UTC DATE] [END TIME]
	ATMC	☑ 2019/01/31 23:59	☑ 2019/02/01 05:45

CAPACITY AND CONSTRAINTS

LOCATION (AD OR SECT)	APPLICABLE PERIOD	AAR* (LANDINGS PER HOUR)	CONSTRAINT/REMARK
RJAA	2250-0400	10	A R/W CLOSED

ATFM MEASURES (ONGOING)

LOCATION (AD OR SECT)	APPLICABLE PERIOD	MEASURE/REMARK
RJAA	0100-0400	20MINIT AT MOLKA FROM RCTP
RJAA	0100-0400	20MINIT AT MOLKA FROM VHHH
RJAA	2325-0500	20MINIT AT LANAT FROM RKSI

POSSIBLE/DEVELOPINGISSUES

LOCATION (AD OR SECT)	APPLICABLE PERIOD	MEASURE/REMARK

Figure 8 ADP on CRACP client

APPENDIX 2 ONLINE ATFM COORDINATION

A standardized online communication will result in a smooth, clear and effective ATFM coordination which eliminates any unintentional discrepancies on verbal communication. This online function on CRACP is in line with the Use of ATFM terminology in ICAO Manual on Collaborative Air Traffic Flow Management (Doc 9971) 6.5.3. The five components (who, what, when, where, why) in the window cover a wide range of contents for daily use, as shown below.

* Relevant items are all included in the inter-system connection ICD

ATFM measure coordination message consists of the following components.

a) Who: The release ATFMU, receive ATFMU and staff initial in charge
b) What: The detail of cross-border ATFM
c) When: The effective time period of cross-border ATFM
d) Where: The waypoint of the FIR boundary
e) Why: The reason for cross-border ATFM
f) Remark: Any further information related to cross-border ATFM

Figure 9 ATFM CDN Function on CRACP client

APPENDIX 3 INTER-SYSTEM CONNECTION ICD

NARAHG developed a set of standard ICDs for CRACP, which is aligned with the format of the XML base, for future feasibility. These ICDs are roughly divided into three categories. The first category is the aircraft position information exchange, which is an essential element for achieving seamless cross-border ATFM. The second is for ATFM coordination, which includes not only flow control messages but information of ATFM Daily Plan and Predict Traffic Volume message (PTV). PTV shows traffic volume prediction of major airports, and so on. The last category is the ICDs for implementing CROSS-BORDER ATFM. These are used in cross-border ATFM measures mentioned in Chapter 4. FTM is a general-purpose ICD by a text-based message.

CATEGORY	TITLE	DESCRIPTION
Aircraft Position Information for accurate cross-border ATFM	CTG	Cross Boundary Time Message on Ground
	CTA	Cross Boundary Time Message in the Air
	FPM	Flight Position Message
Coordination on ATFM Measures	ADP	ATFM Daily Plan Message
	TFC	Tactical Flow Coordination Message
	TFR	Tactical Flow Coordination Reply Message
	TFM	Tactical Flow Management Message
	PTV	Predict Traffic Volume Message
Flow Management Cooperated with Multiple Facilities	ACT	Assigned Coordination Time Request Message
	ACR	Assigned Coordination Time Reply Message
	ACC	Assigned Coordination Time Cancel Message
Others	FTM	Free Text Message

Table 3 Message Title List

TITLE	TRIGGER
CTG	When 6 hours before EOBT of each flight When changed element “Flight Status” of each flight. Send when updated element “Calculated Crossing Time” at defined Common Gate Fix more than X minute(s) of each flight.
CTA	When changed element “Flight Status” of each flight. When updated element “Estimated Crossing Time” at defined Common Gate Fix more than X minute(s) of each flight.
FPM	Every 1minute interval of each flight during detected into own FIR.

Table 4 ICD for Position Information Exchange

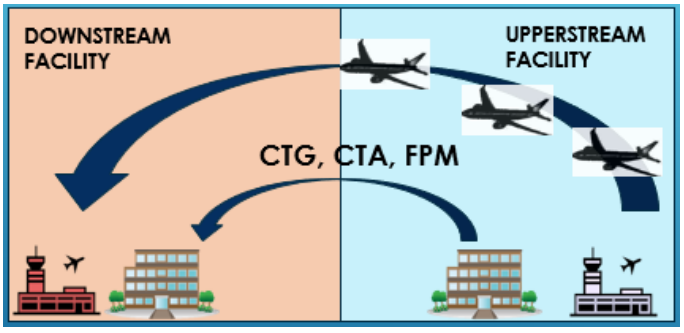

Figure 10 Image of Flight Information Exchange

TITLE	TRIGGER
ADP	At the regular scheduled time at the operator's instruction. Send new ADP message at operator's instruction when necessary to revise
TFC	At the operator's instruction which downstream facility wants to request ATFM Measures against the congestion area. Send again at operator's instruction when the downstream facility has to take action toward TFR message from upstream facility. Send a new TFC message at the operator's instruction when the downstream facility wants to amend ATFM Measure after agreement.
TFR	At the operator's instruction when the upstream facility has to reply TFC message from the downstream facility.
TFM	At the operator's instruction or automatically by the system after receiving TFR(Accept) for international ATFM Measure.
PTV	At hh:00UTC and hh:30UTC (every 30 minutes interval).

Table 5 ICD for Coordination on ATFM

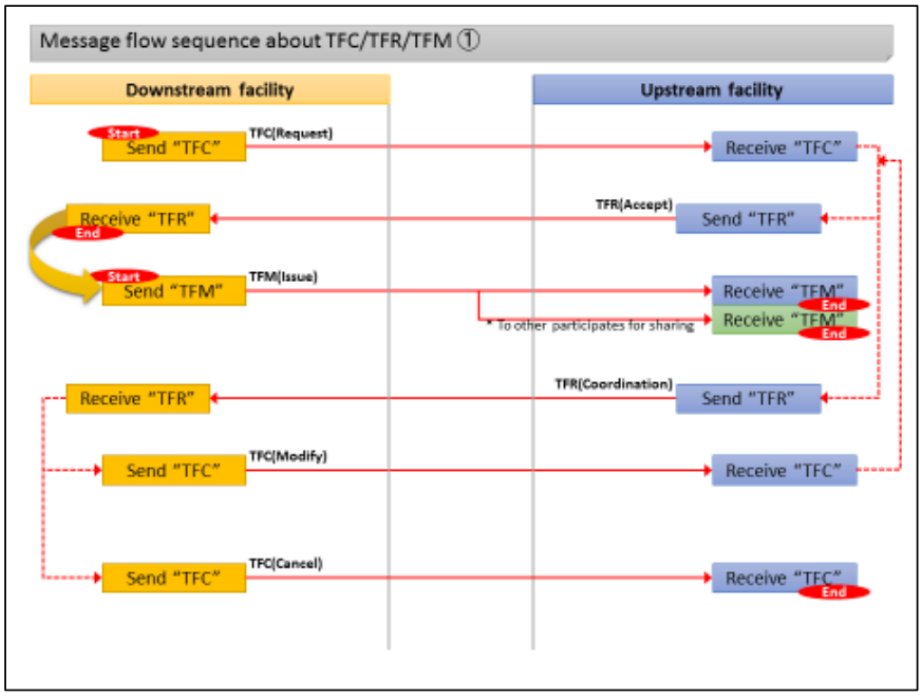

Figure 11 Image of Coordination on ATFM measures (1)

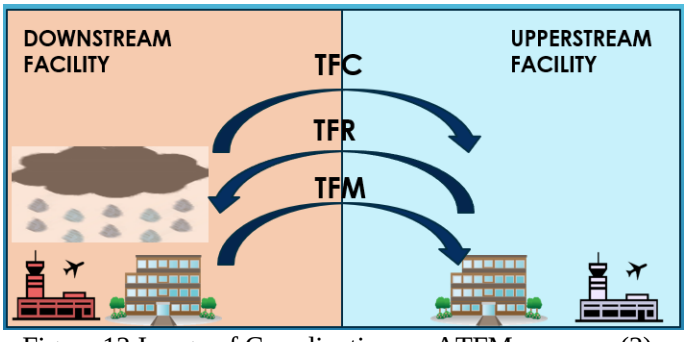

Figure 12 Image of Coordination on ATFM measure (2)

TITLE	TRIGGER
ACT	At the operator's instruction when the downstream facility wants to request BTO against specified flight. Send a new ACT message at the operator's instruction when the downstream facility wants to request a new BTO again after the agreement.
ACR	At the operator's instruction when the upstream facility has to reply ACT message from the downstream facility.
ACC	At the operator's instruction when downstream facility wants to cancel BTO against specified flight after agreement.
FTM	At the operator's instruction when necessary.

Table 6 ICD for Flow Management

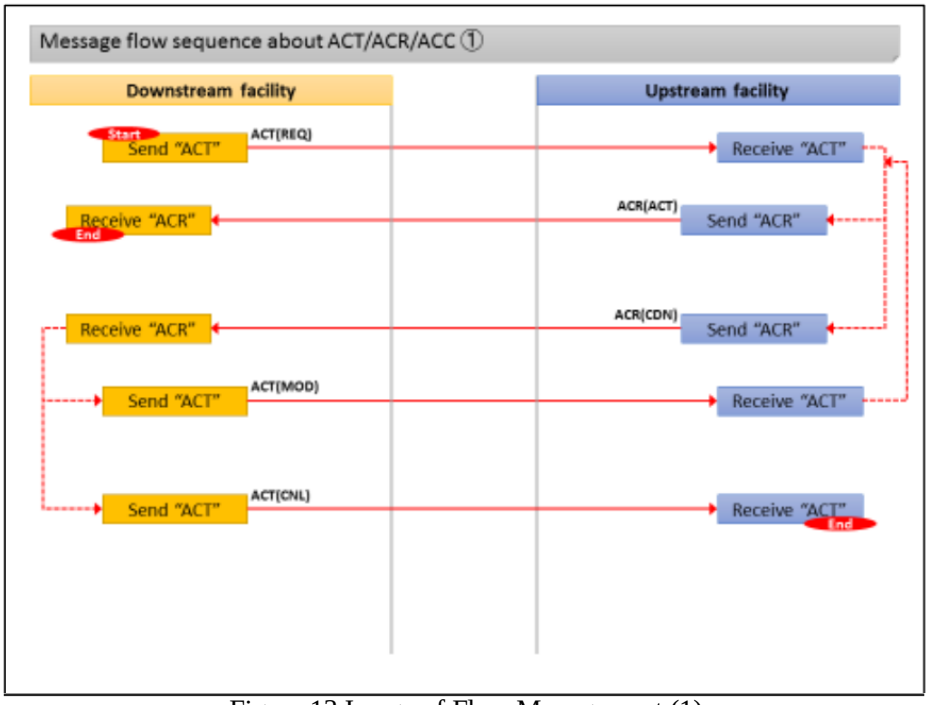

Figure 13 Image of Flow Management (1)

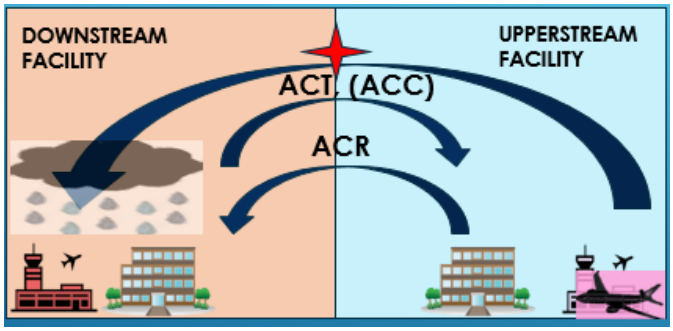

Figure 14 Image of Flow Management (2)