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Agenda Item 5: ATM Systems (Modernization, Seamless ATM, CNS, ATFM)

THE CONOPS OF COLLABORATIVE MULTI-CONSTRAINT CONVERSION PROGRAM (CMCP+)-ONE CTOT SOLUTION (OCS) ON CONFLICTING ATFM MEASURES

(Presented by China)

SUMMARY

This paper presents the CONOPS of Collaborative Multi-constraint Conversion Program (CMCP+) which is upgrading Collaborative MIT Conversion Program (CMCP) to CMCP+ based on the concept of One CTOT Solution (OCS) proposed by China. From "Conflicting" to "Harmonizing" ATFM measures, the CTOT of every flight can meet all constraints so that it is unnecessary to select or coordinate ATFM measures needed to be taken.

1. INTRODUCTION

1.1 With the gradual recovery of civil aviation in the Asia and Pacific region from the pandemic, flight volume will convert from the quick recover to the new high-speed growth. There are so many States and Administrations in Asia and Pacific, having a complex operating environment and various demands on ATFM. Demand capacity unbalancing will occur simultaneously in multiple areas with the increase of flight volume. In addition, multiple ATFM measures acted on the same traffic flow or the same flight will be taken at the same time. Therefore, conflicting ATFM measures will be a new issue which should be taken into account on the next stage of cross-border ATFM in the Asia and Pacific region.

1.2 Conflicting ATFM measures are one of hot topics in the field of ATFM at present. Some air navigation service providers (ANSPs) have their own solutions to solve problems, for example, judging most penalizing regulation (MPR), or choosing an ATFM measure based on coordination, or taking an ATFM measure through regulations (such as executing an ATFM measure which is issued earlier, or complying with an CTOT which has the maximum delay). These methods deal with conflicting ATFM measures to some extent, however, there are still hurdles because of so many ATFM measures or complex running environments. On the one hand, it is difficult to negotiate an ATFM measure especially when these measures are taken by different ANSPs. On the other hand, even though the best ATFM measure needed to be taken is selected, other ATFM measures could not be satisfied when many flights are trapped in choosing the ATFM measure needed to be taken.

1.3 Selectively executing part of conflicting ATFM measures will sharply decrease the efficiency of ATFM measures which are not selected, and this problem likely gets stuck in an infinite loop in complex situation, leading to the breakdown of the entire ATFM system. Therefore, to view conflicting ATFM measures from another perspective, the needs of constraints will be met by one or a series of methods to realize ATFM measures.

2. DISCUSSION

General idea: From “Conflicting” to “Harmonizing” ATFM measures

2.1 Why are there “conflicting” ATFM measures? The usual reason is that all constraints’ needs could not be met by a suitable way. Therefore, “conflicting” is actually a pseudo-proposition in another way to view “conflicting”. Changing the idea from the coordination of ATFM measures to be implemented to a solution satisfied all constraints, which can convert from “conflicting” ATFM measures to “harmonizing” ATFM measures.

2.2 Based on the concept of One CTOT Solution (OCS) proposed by China, upgrading Collaborative MIT Conversion Program (CMCP) to Collaborative Multi-constraint Conversion Program (CMCP+), the CTOT of every flight can meet all constraints so that it is unnecessary to select or coordinate ATFM measures needed to be taken.

2.3 CTOT is calculated by CMCP which is generally supported by the system and has high compatibility. Regarding to ATFMU without computing ability, it can take traditional measures including GDP, AFP, MIT, MDI, CTO, cherry picking, etc. When these ATFM measures (including dynamic ATC measures) or constraints go through ATFMU with computing ability on the limited traffic flow, this ATFMU can calculate the CTOT which meets all overlapped restrictions on this flow.

What is One CTOT Solution (OCS)?

2.4 When there are ATFM measures issued by multiple airspace (including airport) units on the same traffic flow and several ATFM measures act on the same flight, this flight is likely subject to several CTOTs issued by different ATFMUs, causing the aircraft to be unable to takeoff as required. Therefore, only one CTOT should be issued no matter how many ATFM measures act on the same flight. However, the traditional opinion is that one CTOT usually stems from an ATFM measure, one CTOT corresponds with multiple ATFM measures by OCS.

2.5 The limited airspace unit usually corresponds to ATFM measures in traditional way. When the airspace unit is limited, corresponding ATFM measures will be taken on the condition of demand capacity unbalancing in this airspace unit. However, OCS changes the direct correspondence between the airspace unit with demand capacity unbalancing and ATFM measures. For the limited airspace unit with demand capacity unbalancing, ATFM measures are not necessarily issued by the unit itself, the demand about balancing capacity and flow in the limited unit can be passed to other units to solve (such as MIT with 10 minutes, AAR with decrease to 15 and dynamic capacity with 30 per hour), the airspace unit that receives various limitations can comprehensively consider such requirements from other units and calculate one CTOT that satisfies all needs.

2.6 OCS changes the traditional relationship of direct correspondence among a limited airspace unit, ATFM measures based on such airspace unit and CTOT calculated by ATFM measures. As a result, one CTOT can correspond to multiple ATFM measures or limited airspace units.

How to achieve OCS？ Collaborative Multi-constraint Conversion Program (CMCP+)

2.7 *Phase I (2015-2022): Collaborative MIT Conversion Program (CMCP).* In the Asia and Pacific region, except AMNAC members, MIT is a common cross-border ATFM measure, which is widely implemented and is passed to some extent, it can be further used by split as well. When multiple MITs converge at the same waypoint, the influence of multiple MITs acted on flights on the traffic flow should be taken into account at the same time. Because there are blocks in coordinating MIT that needs to be implemented during cross-border ATFM, and there are many scenarios in which MIT is used, all flights need to simultaneously meet multiple MITs’ restrictions. Thus, CMCP calculates one CTOT that

meets all MIT requirements by overall considering multiple MITs which are based on the same basic point.

2.8 *Phase II (2023-202X): Collaborative Multi-constraint Conversion Program (CMCP+).* With the widespread use of ATFM measures based on capacity such as GDP and AFP, there are some new challenges for CMCP. Downstream FIRS on a traffic flow carry out GDP or AFP, which is not easy to convert to the same waypoint or airspace unit like MIT. Therefore, it is necessary to move measures or restrictions such as other areas' capacity (the capacity of GDP/AFP), MIT, CTO, MDI and other measures to the same waypoint or area, then all measures should be taken into account with the foundation of the waypoint or area.

2.9 CMCP figures out CTOT with the overall concern of multiple ATFM measures. CMCP+, the upgradation of CMCP, will calculate one CTOT that meets all needs through overall considering ATFM measures, the demand of capacity in other limited airspace units and other constraints. For example, an A330 aircraft will fly over a waypoint with MIT, an airspace unit with 50% capacity decrease, and the destination airport with the limitation of landing separation for heavy aircraft, CMCP+ will calculate the CTOT which satisfies three requirements mentioned above at the same time.

The CONOPS of Collaborative Multi-constraint Conversion Program (CMCP+)

2.10 Steps:

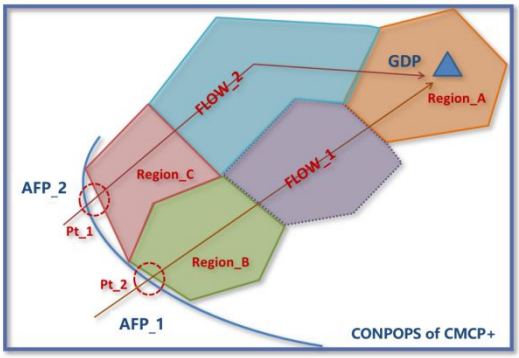
- Firstly, different ATFM measures on the same traffic flow, capacity used in this traffic flow in the airspace unit with capacity limitation, and other restrictions can transfer to the same point or area by translation, split or conversion, forming a common benchmark point or area.
- Secondly, CTOT that meets various restrictions will be calculated for the regulated flight by considering all requirements of the benchmark point or area.
- Thirdly, coordination about flights can be made by the Transit Units (TSU) of the benchmark point or area.

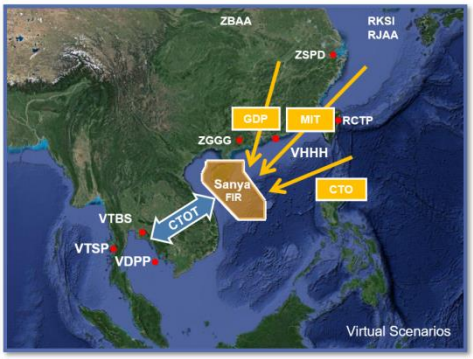
2.11 Algorithm: based on the idea of OCS and assisted by AI technology, the NTFM of China has functions to calculate unlimited ATFM measures, in other words, in regard to multiple constraints in the same traffic flow or the same flight, the optimal CTOT can be calculated to meet all limitations. Meanwhile, there is no limit for the quantities of multiple interacting restrictions that can be simultaneously calculated by the system, which can satisfy various restrictions of complex constraints at the same time.

2.12 Implementation: a regulated flight corresponds to one CTOT. Stakeholders including ATFMU, tower and airlines only focus on the CTOT that contains one or more constraints. Users can view all restrictions of the flight and the influence of each restriction as needed. Meanwhile, users only need to carry out the CTOT without concerns on the flight’s restrictions and the reasons of restrictions, which helps stakeholders to focus on CTOT so as to reduce workload, avoid coordination about ATFM measures among multiple ATFMUs, cut down the numbers of units needed to coordinate during operation and enhance the working efficiency of participants.

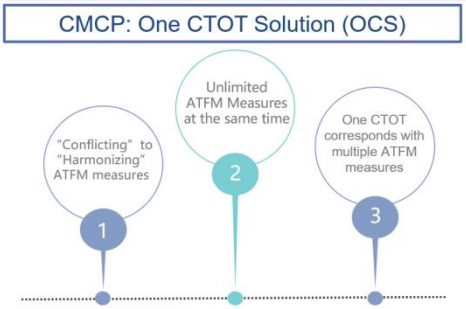
2.13 Application scenario: it is to be noted that ATFM needs to solve demand capacity unbalancing through an overall system, rather than simply hoping that a measure can deal with all issues. For example, in the scenario of better airspace environment, fewer coordination units and single limited airspace, GDP is one of the optimal ATFM measures. CMCP+ is a highly efficient solution in the face of conflicting ATFM measures. With the further complication of running environment and increase of flights, CMCP also needs to be employed in combination with other measures, such as rerouting or airborne holding.

2.14 For example, regarding to how to divide the GDP of a limited airport into two different traffic flows, there is a case as followed:





	GDP	AFP_1	AFP_2
Type of constraint	measures	information	information
Initiating unit	Region_A	Region_A	Region_A
Receiving unit	—	Region_B	Region_C
Constraint point	—	Pt_1	Pt_2
Regulated time period	9:00-12:00	7:20-10:20	7:40-10:40
Traffic stream	Regulation: domestic Exemption: FLOW_1 Exemption: FLOW_2	Regulation FLOW_1	Regulation FLOW_2
Requirement	—	20min MIT	2 aircrafts per 15min



CMCP operation in practice

2.15 Under the framework of AMNAC, Cambodia, China, Thailand and other States have collectively implemented CMCP since 2015. CMCP mainly solves the problems that MIT is transmitted inefficiently and used unfairly, and it is hard for the receivers to execute under the combined action of multiple MITs. CMCP calculates one CTOT to meet all kinds of limitations. CMCP has achieved the expected effect with the years of running experience of route A1 in the South China Sea.

2.16 In 2023, with the upgrade completion of CMCP+, not only is there the effective solution of conflicting ATFM measures, but also the various requirements of ATFMUs with differentiation will be considered. Meanwhile, CMCP+ can be used for reference and application in more regions by testing in practice.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) improve CMCP+ together so as to provide convenience for application in practice;

c) suggest considering CMCP+ as one of main ways to solve conflicting ATFM measures in the Asia and Pacific region;

d) suggest that CMCP be noted in the next amendment of "Asia Pacific Regional Framework for Collaborative ATFM" so as to make a convenience for reference and application by concerned States and Administrations;

e) discuss any relevant matters as appropriate.

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