

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1 Introduction and assessment of a global air traffic management (ATM) : operational concept

CONFLICT MANAGEMENT

(Presented by IFATCA)

SUMMARY

The International Federation of Air Traffic Controller Associations (IFATCA) is supportive of the work of ICAO in defining a global ATM Operational Concept. IFATCA is particularly interested in the concept's treatment of Conflict Management, but cautions that considerable work is still required, especially in the area of Separation Provision.

Action by the Conference is in paragraph 4.

1. INTRODUCTION

1.1 The air traffic control service is an important sub-set of air traffic management, both today and in the future. The ICAO Global Air Traffic Management Operational Concept ("the concept"); however, does not explicitly mention this service, but instead defines "concept components", including "conflict management" which includes a "separation provision service".

1.2 It is both valid and understandable for the ICAO Air Traffic Management Operational Concept Panel (ATMCP) to use a high level of abstraction and new terms when developing a future global ATM concept. However the limited detail in the Conflict Management section of the concept and the new terms raise some issues that IFATCA considers need to be addressed.

1.3 This paper compares the current definition of an air traffic control service with the concept's definition of conflict management. The paper then highlights issues that should be addressed in future work.

2. **DISCUSSION**

2.1 **Definitions**

2.1.1 Annex 11 to the Convention on International Civil Aviation defines an air traffic control service as "a service provided for the purpose of:

- a) Preventing collisions:
 - 1) Between aircraft, and
 - 2) On the manoeuvring area between aircraft and obstructions; and
- b) Expediting and maintaining an orderly flow of air traffic."

2.1.2 The concept paragraph 2.7 defines the function of conflict management as "to limit, to an acceptable level, the risk of collision between aircraft and hazards" and defines hazards that an aircraft will be separated from as "another aircraft, terrain, weather, wake turbulence, incompatible airspace activity, and when the aircraft is on the ground, surface vehicles and other obstructions on apron and manoeuvring area."

2.2 **Conflict management layers**

2.2.1 The concept takes a holistic and systemic view of air traffic management, which includes "all airspace as a useable resource" and everyone involved in activities in that airspace as members of the "ATM Community". IFATCA supports the systemic determination of ATM needs. The concept's approach extends to the apron (since the concept is gate-to-gate or enroute-to-enroute) but IFATCA notes that this does not necessarily imply provision of an air traffic control service on the apron, just that apron activities will be managed.

2.2.2 The concept paragraph 2.7.3.1 defines three layers of conflict management: that is the layers of:

- strategic conflict management,
- separation provision and
- collision avoidance.

IFATCA cautions that the design of the ATM system needs to respect the different nature of these layers and incorporate them appropriately in the system design. However, there is established in concept paragraph 2.7.3.2 the principle that "the conflict management process can be applied at any point along the conflict horizon". Whilst this is a guiding principle that IFATCA understands, in practise there needs to be clearly established principles of operation that do not lead to system users having to respond to conflicting and contrary demands. The Conflict Management process as described in the concept document will lose the hidden nature of the process that exists today, thus enabling the influences of more than one ATM user to collaboratively interact to achieve the best overall outcome for ATM as a whole. This attribute of

collaboration brings with it a responsibility on each user that needs to be characterised by cooperation and trust, not confrontation.

2.2.3 Strategic conflict management relates to issues of airspace organization and management, demand and capacity balancing and traffic synchronisation. The issue of airspace organization and management is addressed in another working paper from IFATCA. When future systems of air traffic management are discussed, there is a tendency to favour either strategic or tactical solutions; however, IFATCA considers that both have an important role and that they are interrelated and highly dependent today as well as in the future. Today, the nature of the dependencies and interrelationships are often little understood in terms of their effects across and within the ATM system. In the future, the principles of conflict management, as espoused in the concept, will substantially add to the complexity of interactions and dependencies. A concomitant of such a system is a greater tightening of the coupling between system components. It will be essential to the success of the concept that full consideration is given to supporting the coupling requirements of these system components to ensure resilience and smooth interactions. IFATCA therefore supports the concept paragraph 2.7.4.3 that states "strategic conflict management measures aim to reduce the need to apply the second layer — separation provision — to an appropriate level as determined by the ATM system design and operation." Strategic only solutions are not possible because the ATM system is not a system where all events are controllable; for example weather-related events cannot be controlled or always accurately predicted a sufficient time in advance. In addition, to achieve maximum efficiency, some flexibility is required to accommodate changes, such as the early release of airspace, missed approaches or late changes to an airspace user's mission.

2.2.4 Tactical conflict management, is discussed in detail below. In overview, the description of the separation process in concept paragraph 2.7.5.2 is highly simplistic as solutions are formulated to satisfy several goals, and this situation will still be extant during the operational life cycle of the concept.

2.2.5 Collision avoidance is a distinct and separate layer from separation. IFATCA supports the concept's statement in paragraph 2.7.6.1 that "collision avoidance systems are not included in determining the calculated level of safety required for separation". Separation minima should not be based on whether collision avoidance systems are available, in the air or on the ground. The purpose of collision avoidance systems is to act when separation has failed and so these systems must be distinct and independent from separation. In addition, collision avoidance systems should not activate when a valid separation minima is being applied, and further work is required in this area, especially when smaller separation minima are introduced. Additionally, IFATCA recommends that consideration be given to reviewing the requirements of safety nets in the light of the proposed changes in the ATM system, to ensure that the system agents who hold responsibility for safety are supported in the task.

2.3 Separation

2.3.1 When considering future systems of separation, there is sometimes the mistaken belief that separation is a form of "medium-term" collision avoidance system. Although the definition of an air traffic control service has included the phrase "preventing collisions between aircraft in the air", the air traffic service is much more than this. Collision avoidance is the last minute avoidance of an imminent threat, often requiring immediate trajectory changes, and does not consider other potential threats, only the imminent case or cases. The air traffic control service must not only avoid the collision in a timely manner, but also consider other potential threats and take into account the overall efficiency and management of the operations in that airspace. Air traffic control is much more than dealing with "conflict pairs". It is unacceptable for air traffic control to resolve an aircraft's conflict with another aircraft when the trajectory derived to solve a problem

subsequently creates other problems or inefficiencies. For example, it is unacceptable if the solution trajectory were to take the aircraft into airspace involving incompatible airspace activity (such as a live firing area), or unreasonably limits the activities of a significant number of other airspace users, or imposes a burden to the management to traffic flows to achieve orderly and expeditious flows of traffic (e.g. sequencing or metering into to terminal areas).

2.3.2 The concept's holistic approach to air traffic management in all airspace means that it must address all forms of separation provision. The concept has done this using a range of terms including separator, distributed separation and cooperative separation. The concept's paragraphs on separation form a basis for further work, but IFATCA cautions that considerable work is still required in this area. IFATCA has considerable disquiet at the volume of issues that need to be considered as a result of the concept extending the number of agents who can potentially influence executive control of an aircraft. Any limitations of separation provision need to be established, and clearly enshrined in procedures and followed accordingly by actors. The operational concept does recognise this need and refers to "separation modes". IFATCA posits that the amount of work required in developing and implementing these defined separation modes is considerable. Note also, that in extending the conflict management philosophy, particularly the separation provision function, there may be times when capacity will not be optimised because the needs for safety will subsume these.

2.3.3 One issue of particular concerns to controllers is the issue of legal liability in cases of "shared separation responsibilities". It is unacceptable for controllers to be responsible for decisions they did not make, or instructions that they did not issue. The concept's statements on separator should assist in this regard.

2.3.4 Another area of concern to IFATCA is the mistaken belief that controllers can somehow resume responsibility for separation at any time in cases where responsibility for separation provision has been delegated to another. In fact there will be cases where a controller cannot re-establish controller provided separation. Controllers will of course render assistance to an airspace user experiencing difficulty, but this does not necessarily mean automatic and full responsibility for separation. For example, if an airspace user has been responsible for separation, using a separation minima that is smaller than the separation minima than the controller can use, (perhaps due to the resolution available on the controllers surveillance screen), the controller may not even be able to establish the relative positions of conflicting aircraft and thus cannot be expected to provide meaningful instructions. There is also the issue of workload: that a controller should not endanger many aircraft because of workload overload in rendering assistance to one — a dilemma to be sure. Although difficult, these issues must be addressed. In this context IFATCA recommends, as a pre-requisite for the application of the concept that there be a review of the concept of control service, advisory service, flight information and alerting service, including defining their respective limits of acceptable use. IFATCA has seen a number of other concepts that have used the flight information and alerting service in an unacceptable way as a "quasi-control service" and thus a means to catch all situations that system designers cannot satisfy.

2.3.5 The concept's definitions of "conflict" and "hazard" will require the development of many new separation minima (or separation modes). This is important work, not only for separation provision itself, but also the development of tools that support airspace users or separation service providers. Just as an air traffic control service is more than just resolving conflict pairs, the tools that support separation provision have to take into account additional information other than just trajectory information of conflict pairs. For example, the tools not only need to assess additional hazards when avoiding another aircraft (for example, incompatible

airspace activities) but also the minima that the hazard must be avoided by. These minima will be specified in a separation mode which will have a number of conditions associated with the minima (for example, who the separator is or what equipment is available) and in selecting the separation mode the tools will need to take into account the status of each of the conditions listed in the separation modes being considered.

2.3.6 The establishment of separation modes is logical, but in application consideration needs to be given to a multiplicity of issues for a complex system to become manageable. There are significant human factors issues herein, such as the ability to manage multiple separation modes concurrently. (Human factors issues are covered in other papers by IFATCA.) Differing separation modes will require some differing functionalities, and inevitably, differing dependencies between system actors. Clarity in roles and procedures is essential for this to be operationally acceptable.

2.3.7 The concept does not explicitly mention transitions between separation modes, for example leaving a radar surveillance area. Moreover, the concept does not explicitly discuss when multiple separation modes may be applicable and which one should be used, or that when a particular separation mode is compromised, that another separation mode may be available without changes to any aircraft's trajectory. These should be included when there is further work on separation provision.

2.3.8 The inclusion of the "separation provision intervention capability" is very important. In various discussions of future air traffic management systems, it is often claimed that delegation of separation responsibility to the flight deck will result in higher airspace capacity. This is not automatically true; and one major reason for this is intervention capability. This intervention capability will depend on the workload of the human (or the machine). Separation minima today do not include issues such as workload of the controller, but it is a factor that determines safe application of separation. If separation is delegated to the flight deck during a busy phase of flight, then a larger separation minima may be required than if it was delegated during less busy phase of flight. During a high workload time, there will be less time available for the flight crew to "detect and solve conflicts". It may be that a separation service provider, whose sole task is separation, will be able to use a smaller separation standard than the flight crew, because the principal activity is "detect and solve conflicts".

2.3.9 Separation involves considerably more than conflict pair resolution. Today this is reflected in letters of agreements between air traffic control units, defined procedures with state aircraft, especially military operations, etc. The safe application of separation in a particular volume of airspace includes consideration of activation and deactivation of blocks of airspace; forecast hazardous weather, maintenance or repairs on surveillance and communications systems, etc. This information is constantly changing, and so the ability of airspace users, such as flight crews, to assimilate and apply all this information in real time, while monitoring the trajectories of all adjacent traffic including changes to trajectory, in a complex environment is not considered a particularly realistic expectation. There is concern that these separation activities will distract the crew flying the aircraft and the associated problem solving activities. There is a need to address the training and licensing issues for crews. There is a need to define the available workload capacity of the crew for additional task in all stages of flight. However there may be benefits from distributed or cooperative separation, where a defined separation task can be assigned to the airspace user. These benefits however must not be assumed, and must be proven.

2.3.10 The concept, under traffic synchronisation and ATM service delivery management, discusses 4-d trajectory management. This is an important area of work, and should be given significant priority. The approach to 4-d trajectories should be one of "4-d trajectory contracts" (not trajectory predictions) as

described in concept paragraph 2.8.3 and illustrated in the concept's Appendix I, paragraph 6.3.8. One consequence of negotiated 4-d trajectories should be a significant reduction in the number of tactical interventions. In addition, the concept of tolerances for compliance for each section of the 4-d trajectory should be considered. The strictest compliance would be where high traffic densities at that time require it. This would allow minor variations in compliance, due to weather or other effects — or permit a freedom of movement in less dense areas to optimise the airspace user's operation.

2.3.11 Much of the conflict management philosophy will need to be evaluated in terms of the minima that make the concept acceptable (to commonly agreed criteria). The derivation of the criteria, in IFATCA's belief is key to much of the suitability of the conflict management processes in operation. Just how many separation criteria are acceptable? For each of the separation modes, there will be, logically, differing separation values - but this will add to complexity of understanding of the system. The needs of conflict management therefore need to be set against the needs of safety and capacity optimisation to achieve a balanced system that is resilient and has longevity.

3. **CONCLUSION**

3.1 The ICAO ATM Concept should be supported as a basis for further work.

4. **ACTION BY THE CONFERENCE**

4.1 The Conference is invited to task ICAO to continue work on progressing the concept and, as part of that task, to address the issues raised in this paper.

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