

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 3: Air traffic management (ATM) performance targets for safety, efficiency and regularity and the role of required total system performance (RTSP) in this respect

3.2: The concept of RTSP

THE CONCEPT OF REQUIRED TOTAL SYSTEM PERFORMANCE (RTSP)

(Presented by the Secretariat)

SUMMARY

This paper analyses the feasibility of the concept of required total system performance (RTSP) as stipulated in the work programme of the Air Traffic Management Operational Concept Panel (ATMCP) and defines the relation of RTSP to other components of an overall framework to address ATM performance through a layered approach, beginning with the political and socio-economic expectations through to the definition of related elementary system components. This approach is consistent with the proposed ATM operational concept (AN-Conf/11-WP/4 refers) and is aimed at facilitating global interoperability of the future ATM system, as well as harmonizing regional planning and performance monitoring. The paper also provides the outline of the work needed to complement and validate the proposed approach.

Action by the Conference is in paragraph 6.

1. INTRODUCTION

1.1 Agenda Item 3.2 was included in the agenda of the Conference in order to provide a basis for the Conference to discuss the notion of required total system performance (RTSP). This notion was initially developed by the Air Navigation Commission to broaden the understanding of the concepts of required navigation performance (RNP), required surveillance performance (RSP) and required communication performance (RCP) as first conceived by the Special Committee on Future Air Navigation Systems (FANS) as part of its work on communications, navigation, and surveillance/air traffic management (CNS/ATM) systems.

1.2 The content of this paper represents the results of the work of the ATMCP to date on the subject of performance and RTSP. The panel identified air traffic management (ATM) performance, including the notion of RTSP, as a key aspect of the ATM operational concept and, therefore, decided to introduce RTSP in the operational concept (AN-Conf/11-WP/4 refers). The purpose of this paper is to provide the Conference with sufficient background information to enable its discussion on ATM performance and RTSP, with a view to clarifying and developing the next steps of RTSP development on the basis of the initial arguments related to the feasibility of RTSP as a method to measure performance of the ATM system.

2. NEED FOR PERFORMANCE ORIENTATION

2.1 ATM is a complex system, serving society. All stakeholders have expectations as to what ATM should deliver. These expectations form the basis for expressing requirements and, at a high level, correspond to how well the ATM system meets expectations. Performance is a complex notion in itself, with safety being the overriding aspect of performance in aviation and the subject of significant attention.

2.2 ATM has, historically, been defined by reference to some form of performance indicator, e.g. safe, regular and expeditious flow of traffic. ATM also contributes to economic activities which are increasingly discussed in terms of performance. The trends in world economy, in corporatization of ATM and towards a more structured ATM regulatory environment by States as well as by ICAO, are placing increasing pressure on accountability, not only for service provision, but also for business and safety cases, when making implementation decisions. At all levels, communicating performance goals and achievements facilitates positive dialogue between the parties involved.

2.3 In addition to the above service provision aspects, the design of ATM systems requires that the effect of any change or new feature of the system must be fully understood prior to engaging in implementation activities. In this context, it is essential that systems be developed in terms of goals rather than on the basis of adding new components to existing systems. Moreover, trial-error selection processes are becoming less affordable in medium- to large-scale projects for reasons of safety, operational efficiency and cost. Therefore, the absence of goals (performance objectives) at the appropriate level of abstraction on the one hand and a lack of understanding of the effect of changing the goals on the other, significantly hampers the decision-making process.

3. ATM PERFORMANCE CONCEPTS

3.1 General

3.1.1 An essential prerequisite for the development of any complex system is an understanding of the nature of the performance of the system and the performance relationship with the different aspects of the system.

3.1.2 Therefore, when considering future ATM performance concepts, it is proposed that a hierarchy of notions, as identified in the ATM operational concept be considered. The figure and definitions below are presented as a possible approach to this end.

3.1.3 Figure 1 indicates that performance should be seen from many perspectives, such as safety, cost, and other expectations, at various levels (e.g. societal, user, technical), as well as from the perspectives

of requirements, system design and specifications, and should include actual performance monitoring and assessment.

Hierarchical ATM Performance Concepts

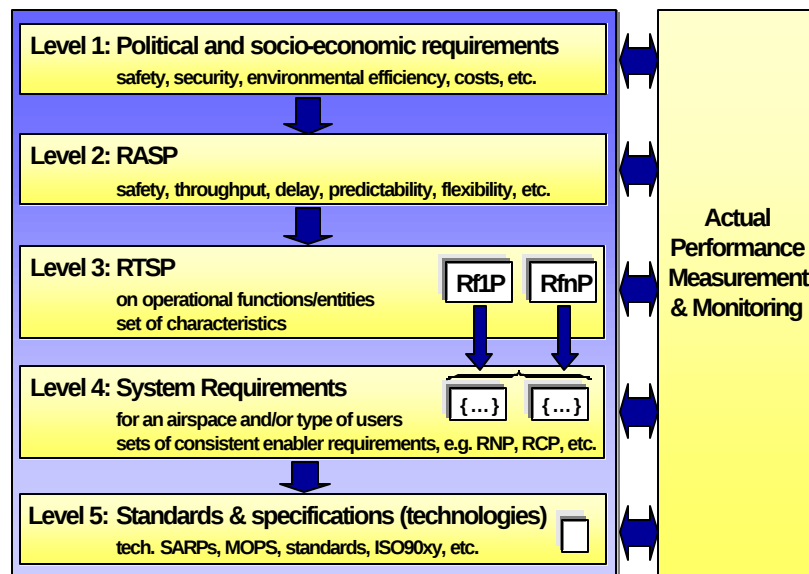


Figure 1. Notions of performance

3.2 Level 1

3.2.1 In an ideal world, the future ATM system would be totally safe and secure, would provide optimal operations with no delays or re-routes, have low costs, have totally seamless transitions with the adjacent regions and have no impact on the environment. Level 1 of the figure represents these high-level political and socio-economic expectations of society and/or the air transport sector, of a future ATM system. The measures necessary to meet these expectations should then govern the design of the system. More specifically, these general expectations address the technical, economic, environmental and other concerns relative to the effective operation of the ATM system and include, in particular, the areas of safety, security, environmental efficiency, cost-effectiveness, capacity, access and equity, general efficiency, flexibility, predictability, global interoperability and participation by the entire ATM community.

3.2.2 The expectations indicated above are difficult to meet. Therefore, compromises have to be negotiated throughout the development process of the ATM system, with a view to maximizing the relative advantages of that system for each of the stakeholders involved. Expectations regarding cost-effectiveness of the system can, however, only be assessed when the ATM system engineering process has reached the stage of a well-defined system architecture.

3.3 Level 2

3.3.1 This ATM performance specification level, entitled: the required ATM system performance (RASP) level, defines a second set of indicators of users' expectations which concern the overall ATM system's operational services provided at the users' interface level. These can be considered as indicators of sub-objectives of the Level 1 expectations from a specific ATM system operational performance perspective. Level 2 cannot, however, necessarily fulfil, on its own, certain aspects of expectations for political and socio-economic requirements (Level 1). For instance, ATM cannot be made responsible for all accidents and can do little about environmental conditions. Some of the Level 1 elements will not, therefore, translate directly into Level 2 internal parameters without considerations exceeding those of ATM.

3.3.2 In more general terms, RASP metrics should provide a set of high-level operational objectives for changing the global ATM system at its highest level of specification (e.g. operational objectives to double capacity, or to improve safety). Hence, RASP could be considered as a set of mission requirements for the ATM system aimed at achieving a top-level system operational objective.

3.4 **Level 3**

3.4.1 This level, which covers the overall performance metrics for the ATM core system functions specified at the highest level, is entitled: the required total system performance (RTSP) level. The ATM core system functions or concept components (e.g. airspace organization and management, aerodrome operations, demand/capacity balancing, traffic synchronization, airspace user operations, conflict management and ATM service delivery management), in turn, are parts of the entire ATM system divided into functions as independently as possible (ATM concept components — ATM Operational Concept, Appendix to AN-Conf/11-WP/4, Chapter 2, refers) and whose combination and integration represents the global ATM system.

3.4.2 RTSP is related to the performance of services provided by the ATM concept components. In this context, the term "service" refers to the implementation of a functionality of the ATM system (*a priori*, an ATM core system function) in a given environment. Requirements should be kept abstract enough to allow for flexibility in implementing choices, while preventing the proliferation of particular solutions. It is not, however, possible to address requirements independently from the different implementation options. So, RTSP is linked to system requirements (Level 4). To build this link, RTSP should provide indicators that will allow the assessment of the appropriate technical means for implementing operational scenarios, i.e. ways to realize implementation of concept components or other parts of the ATM system.

3.4.3 For RTSP, a formulation of the description of parameters can be, and has been made using the ISO 13236 document (Quality of Service Framework). A limited application has been made on an illustrative example which has shown that such an approach would likely be suitable and compatible with the current definitions of RNP and RCP.

3.5 **Level 4**

3.5.1 This level defines performance metrics for information management, data processing services or CNS operational services. This level is entitled: system requirements and allows, in particular, the introduction, within an appropriate architecture/hierarchy of system elements, of CNS performance concepts such as RCP. Other required performance measures could be identified, such as required monitoring performance (RMP) to specify the capability to monitor the traffic situation in a given environment, or required planning performance (RPP) to specify the capability of predicting the future position of aircraft.

3.5.2 Subject to further validation, Levels 3 and 4 could be modelled using an identical template of characteristics, to permit the combination or separation of functional elements as needed, thus allowing for the determination of the key requirements for RTSP, for a given environment and traffic level.

3.6 Level 5

3.6.1 This level deals with specific technologies and methodologies to implement Level 4.

4. USE OF RTSP FOR ICAO WORK PLAN ACTIVITIES

4.1 It is suggested that the above hierarchy and the overall performance model provides a suitable structure for discussing performance. At the same time, it should assist the organization of the work and individual contributions from various bodies and partners, such as States, regional bodies and the Secretariat with respect to establishing a harmonized and generally acceptable basis for the development of performance requirements.

4.2 Performance metrics should be developed by ICAO and agreement reached on the definition of metrics for the different goals to be reached for Levels 1 and 2, as well as on guidance material for setting targets at the global, regional and State levels. The overall framework and guidance material to apply RTSP should be further developed and maintained, preferably by a body which has ATM aspects in its work plan.

4.3 The definition of requirements for specific aspects of CNS/ATM, i.e. the individual elements of RTSP (Level 3) and lower layers, should be assigned to the relevant technical bodies, working in close coordination with each other as well as the body referred to in the preceding paragraph.

4.4 A further important phase, that of planning the implementation activities related to RTSP, is mainly within the purview of the planning and implementation regional groups (PIRGs) and States, with an overall coordination role for ICAO within the framework of the *Global Air Navigation Plan for CNS/ATM Systems* (Doc 9750). These activities would include the definition of performance targets at the appropriate level depending on the general policy adopted. Performance metric parameters for RTSP implementation would be selected either from a list defined at the global level or from locally-available options, as warranted by local traffic density. It is important in this respect that different regions follow identical definitions of the performance model; however, it is also recognized that the comprehensive definition of a common global framework will require some time. PIRGs and States should therefore be encouraged to begin moving to a performance driven planning process which will, however, have to be harmonized with globally-applicable definitions of the performance model as a common global framework, as they become available.

4.5 The same performance oriented logic can be applied not only to the future ATM system based on the operational concept, but also to the steps required towards achieving this vision. Planning the more elementary phases of the ATM transition will benefit from applying the common global performance framework, as it will allow the planners to relate a particular change to its effects on the services and their performance.

4.6 Monitoring should be addressed at the appropriate level. A harmonized global ATM safety oversight function is already part of the wider system safety approach proposed for the future operational concept (AN-Conf/11-WP/5 addresses both monitoring and safety oversight as part of a global approach to safety). Additionally, the ICAO Council has agreed to extend the ICAO Universal Safety Oversight Programme to, inter alia, ATM (AN-Conf/11-WP/32 refers). For other performance criteria, such oversight could be executed at the State level, in particular, when the decision as to the performance level is left to the State. Nevertheless, because effective monitoring provides an essential feedback which, on the basis of

lessons learned, can significantly improve performance via benchmarking and dissemination of good practices, guidance for measurements and standards for information disclosure and guidelines for monitoring should be established by ICAO and consistently applied by States.

5. **FUTURE WORK**

5.1 A performance orientation in ATM is fundamental, and it would be feasible to establish a performance framework which includes the concept of RTSP. However, these are new notions, and they address complex systems. Although it may be practicable to define the performance of a future ATM system by reference to a few classes, it would still be necessary to develop the different layers of the model as well as the different related functions and services in much greater detail in order to ascertain the validity of this classification. It would therefore be unrealistic to expect that the subject of ATM performance can be covered fully and with the desired clarity during the Conference.

5.2 More work is also needed to identify, inter alia, the main functions within individual concept components of the ATM operational concept, analyse which requirements would be imposed on them and how, collectively, they will meet expectations. It has to be established further how each operational function would be supported by technical functions, thus complementing the model with descriptions of interdependencies between the different functions. Moreover, the origins of expectations and functions must be clarified, what exactly meets their requirements, what would counteract their original intent and what are the dependencies and interactions between these issues. The development of a causation model dealing with these and other related issues is essential for providing a deeper system engineering understanding of ATM than is possible on the basis of currently available information.

5.3 The future work concerns all layers, from the understanding of future expectations suggested for Level 1 and how they can be met collectively, through to the preparation of the standardization material for the next generation of technical systems, governed by Level 5. Progress must be made simultaneously on all levels to some extent. However, priority should be given to the clarification of the issues of the upper layers of the hierarchy, the understanding of how the ATM system behaves and generates performance and to the definition of indicators and targets, as these aspects are currently not developed to sufficient maturity and because it is precisely this knowledge that will allow further decisions to be made for all other levels with greater confidence than in the past. This, in turn, would accelerate significantly the pace of modernization of ATM.

6. **ACTION BY THE CONFERENCE**

6.1 The Conference is invited to:

- a) re-affirm that the definition of the future global ATM system should be based on specific performance objectives to be met and monitored as well as on the related operational and technical requirements, which will aim at achieving the agreed performance; and
- b) agree to the following recommendation:

Recommendation 3/ — Performance framework

That ICAO:

- a) formulate the performance objectives and targets for a future global ATM system;
- b) continue the definition of related performance metrics and elementary characteristics in the context of the overall behaviour of the ATM system;
and
- c) harmonize all related contributions within the overall performance framework.

— END —