

AUTOMATIC DEPENDENT SURVEILLANCE PANEL (ADSP)

FIFTH MEETING

Montreal, 18 to 29 October 1999

Agenda Item 3: Development of the concept of required communication performance (RCP)

REPORT ON AGENDA ITEM 3

The attached constitutes the report on Agenda Item 3 and should be inserted at the appropriate place in the yellow report folder.

Agenda Item 3: Development of the concept of required communication performance (RCP)**3.1 INTRODUCTION**

3.1.1 At the fourth meeting of the Aeronautical Mobile Communications Panel (AMCP/4), held in Montreal, 25 March to 4 April 1996, the panel had recognized the desirability of comparing the mobile subnetwork expected performance against known operational requirements of current and future air-ground communication systems (Report on Agenda Item 2, AMCP/4).

3.1.2 However, the meeting had recognized the absence, in ICAO, of objective criteria to evaluate the communication performance requirements although it was noted that a concept for required communication performance (RCP) was under consideration. RCP, in its earliest form, was seen as a set of performance parameters on the availability, the residual error rate and the transfer delay of a communication system. The values of these parameters would determine the operational requirements for communication systems in the various phases of flight. Furthermore, the meeting agreed that there was an urgent need to assess the various technical options of communication systems against the RCP parameters.

3.1.3 Consequently, the Air Navigation Commission approved the recommendation (AMCP/4, Recommendation 2/2) that an appropriate ICAO body progress with urgency the development of RCP, and requested the ADS Panel to develop the concept with defined RCP parameters by 1999.

3.2 PROGRESS TO DATE

3.2.1 The meeting noted that Working Group B (WG/B) had expended considerable time and effort in developing an operational concept of RCP (Appendix to the Report on Agenda Item 3 refers). This included reviewing work performed by other groups as well as reviewing the guidance material pertaining to performance standards for data link applications already included in the *Manual of Air Traffic Services Data Link Applications* (Doc 9694). These activities were a prelude to the development of an operational concept, which could be applied to all air traffic services (ATS) communications, regardless of the technology.

3.2.2 It had been recognized that there was no obvious solution to the determination of communication performance. However, it was recognized that there was widespread acceptance of the need for an RCP concept which would provide a framework for the expression of the operational performance necessary for ATS communications. It was widely agreed that this concept should be technology independent and apply to existing communication methods as well as future methods. Using this as a baseline, the working group had initially investigated the idea that communication performance should be a unidirectional measure of the technology only. However, the working group had concluded that the operational response of the human receiving the ATS communication was an indispensable element in the quantification of overall communications performance. Consequently, the RCP concept should cover the complete communication process at the highest level of abstraction. At the next level, the concept should illustrate that the process could be divided into three components covering the sending and processing of the information and the applicable reply. However, it was recognized by the meeting that the concept should be flexible enough to exclude the human reaction time should that element not be necessary in a given context.

3.2.3 A number of examples were provided to the meeting that demonstrated the value and feasibility for response time to be included in the overall communication performance.

3.2.3.1 Information was presented on a report entitled *Time Required for Transmission of Time-Critical Air Traffic Control Messages in an En Route Environment*. The study reviewed forty-six hours of voice tapes from three different air route traffic control centres. An ATC exchange involving the “most important” of several time-critical ATC messages was singled-out for scrutiny. In the study, the mean total time required for message transmission was broken down into its component parts:

- a) duration of the controller’s message;
- b) time between the end of the controller’s message and the beginning of the pilot’s response;
and
- c) duration of the pilot’s acknowledgement.

3.2.3.1.1 It was noted that the study demonstrated that the three components could be defined in terms of the RCP concept so far developed, and that it was both valuable and feasible to include a communications performance parameter that considered human response time.

3.2.3.2 In another study, data was currently being collected on the time necessary to receive and process weather deviation requests in the Oakland and New York flight information regions (FIRs). Since these messages were high frequency (HF) voice messages relayed by radio operators, the time measurement was not an end-to-end measurement as it did not include the time needed for the radio operator to communicate with the aircraft. However, it did include the time needed for the radio operator to relay the request to the controller and for the controller to consider the response and send the message granting or denying the clearance back to the radio operator. This particular study was highlighted because the reaction time of the controller was being measured and was included in the measured communications time.

3.2.3.3 In the same way, guidance material contained in the *Manual on Airspace Planning Methodology for the Determination of Separation Minima* (Doc 9689) recognized that elements to be considered in the communication and controller intervention buffer included the time for the controller to recognize the potential conflict, the time to compose a message, and the time for the pilot to react and initiate an appropriate manoeuvre.

3.2.4 It was recognized that the current voice ATC environment used a very natural human-machine interface (HMI) whose characteristics were very well known. The HMI in the future ATS data environment had a much shorter history and its characteristics were much less well known. In order to make an orderly transition to the use of the ATS data communications, it was recognized that it was critical to understand the corresponding performance characteristics of these two environments. The development of RCP in an appropriate manner should provide a valuable tool for gaining that understanding.

3.2.5 Information was presented to the meeting that the joint RTCA Special Committee 189/EUROCAE Working Group 53 had embraced the progress completed to date. The joint group charged with documenting the safety and interoperability aspects of data link implementations had taken the draft RCP concept and developed methods for separating the various elements of the communication path,

allocating performance budgets to each element. This joint group was developing procedures so as to determine appropriate RCP types, certify equipment, and grant operational approval for ATS communications. The joint group had agreed that RCP must be an operational measure and, therefore, must include human performance elements. One sub-group (SG 3) had been assigned the task of developing a methodology for both determining RCP types to be imposed in various airspaces and for determining whether a given communication method met or exceeded a specified RCP type. Additionally, SG 3 had defined operational and functional communications domains which would permit RCP specifications to be allocated to communication system components, including the human element. The definition of such domains was seen as essential for defining a methodology for both certification and operational approval agencies to be able to effectively deal with RCP. It is recognized that RCP was not a monolithic parameter and the group was working to develop methods for the separate performance elements to be identified, specified, measured, and monitored.

3.2.6 Information was presented expressing the view that the human element should not be part of the RCP concept due to the following points:

- a) system parameters and human response time were unlike factors;
- b) human response time, if left to States to determine, could lead to different assumptions and values;
- c) certification and performance monitoring would not be practical;
- d) failure to meet performance cannot be traced to the human or to the communication system; and
- e) human factors and legal implications have not been properly addressed yet.

3.3 DISCUSSION

3.3.1 It was apparent from the discussion during the meeting that no consensus existed as to the appropriateness of including human performance within the concept. How, for instance, could integrity of human performance be calculated? On reflection, the panel recognized that some clarification was needed concerning what would be the limits to measuring human performance within the concept and what performance issues would need to be addressed outside of the RCP concept. It was not made clear in the concept, for example, that the measurement of human performance was limited to human reaction time and that the other parameters (integrity, availability and continuity of function) only applied to the technical delivery of the message.

3.3.2 Authorities in human factors considerations had concluded that both human factors (distraction, forgetting, failure to monitor, nonstandard procedures, and phraseology) and system factors (unavailability of traffic information, ambiguous procedures, and high workload) contributed to information transfer deficiencies. It was emphasized that complex messages could overtax pilots' working memory, and nonstandard procedures reduced the time devoted to checking mutual understanding and therefore interfered with the collaboration process between controllers and pilots. Whilst this had not been made clear in the present draft of the RCP concept, it was recognized by the meeting that these human factors considerations should be

addressed outside the RCP concept. Distractions such as noisy rooms, inappropriate lighting, or inappropriate behaviour at the operating position should not be factored into the human element of RCP. The view was expressed that clarifying this issue should also assist in assuring that there was no intent in producing a concept that ran counter to the work being progressed by the RGCSP. Moreover, it should be made clear that the concept should be made a useful tool which would facilitate their work.

3.3.3 Additionally, it was stressed that the undue emphasis placed on the work progressed in relation to required navigation performance created confusion in the minds of the reader.

3.3.4 The need to show the flexibility that was intrinsic in the concept, i.e. that it would permit an RCP value to be defined on several levels was seen to be of major importance. On the one hand, the concept would provide the flexibility to evaluate the RCP of a subnetwork and on the other, provide for the evaluation of the provision of a given service. The RCP concept, being a framework, would be a sum of many parts as well as a single value. Nevertheless, there had also been considerable debate as to whether there was a place for human performance consideration within the RCP concept at all.

3.3.5 It was also acknowledged that the concept should provide greater detail concerning the negative effects of not including human reaction time in the overall concept of RCP. It was recognized that implementing an exceptional technical system may not provide a given service when it was combined with a cumbersome human interface.

3.3.6 Other issues that needed to be progressed included:

- a) a more detailed description was required for each individual parameter so that a reasonable set of parameters may be specified under a set of conditions;
- b) timescales for implementation of RCP needed to be agreed;
- c) ATC and cockpit procedures, especially transition between airspaces with different RCP types, needed to be developed; and
- d) consideration should be given to the impact of RCP requirements on certification, performance monitoring and other approval processes.

3.3.6.1 The meeting noted that RTCA SC189/EUROCAE WG53 were progressing a number of these issues.

3.3.7 It was noted that coordination with relevant panels was on-going. Panel secretaries periodically received working group summaries of discussions and, of late, copies of the draft concept. However, it was recognized by the meeting that only with additional detail and clarification would the concept allow for critical review. Nevertheless, coordination with other panels and industry groups would continue. With respect to the latter, it was recalled that the work programme of RTCA SC189/EUROCAE WG53 included the development of safety and interoperability requirements for ATS, supported by data communication which included RCP. The mandate of the working group was to identify requirements in a technology-independent framework that would facilitate single and multiple technology solutions which would permit use of different systems, either

alone or in combination, to meet the specified RCP. Close coordination with this group had been maintained and should continue.

3.4 CONCLUSION

3.4.1 The meeting recognized that there appeared to be widespread acceptance of the need for a concept of RCP which would provide a framework for the expression of the operational performance necessary for ATS communications. It was agreed that human performance was an essential element of communication and needed to be addressed. That the concept should be technology independent and apply to existing communication methods as well as future methods was also agreed. However, to avoid any possible misunderstanding of the details in the concept, some clarification of its contents would need to be made. These included:

- a) the need to highlight the flexibility intrinsic in the concept, i.e. it could be applied to communications between systems and to communications between the human end-users;
- b) the need to better define the limits to what aspects of human performance that would be taken into account;
- c) the need to define the parameters' availability, integrity and continuity of function in greater detail;
- d) the need to highlight the fact that the "technical parameters" (availability, integrity and continuity of function) did not apply to the human element; and
- e) the need to continue the valuable coordination achieved to date and extend this coordination to other groups in recognition of the large number of disciplines and expertise that had an association with the task.

3.4.2 The meeting acknowledged the fact that the concept, as produced to date, well reflected the current state of the work completed. The question of whether there was a need to include the legal aspects as related to human performance had yet to be clarified. There was a general agreement in both the initial steps that had been taken in its development and that further work was required. The meeting also saw a very real need for States and international organizations to have the opportunity to review and comment on the concept; however, it would be premature to do this prior to completing the tasks specified in paragraph 3.4.1. It was not anticipated that this work would take an excessive amount of time to complete. Consequently, it was agreed that once these tasks had been completed and agreement had been reached on its content, appropriate material would be submitted to the Air Navigation Commission as soon as possible.

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