

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

**(DRAFT) REPORT OF COMMITTEE B
ON AGENDA ITEM 7**

The attached draft report on Agenda Item 7 is presented for approval by Committee B for submission to the Plenary.

Agenda Item 7 Aeronautical air-ground and air-to-air communications

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**7.5 FUTURE EVOLUTION OF CURRENT
AERONAUTICAL MOBILE COMMUNICATIONS****7.5.1 Future aeronautical mobile communication scenarios**

7.5.1.1 The meeting reviewed material developed by the AMCP discussing future aeronautical mobile communications scenarios as might develop over the following two decades, and presenting some of the issues to be investigated in connection with the scenarios. A set of diagrams summarizing the scenarios is included in the appendix to the report on this agenda item. The meeting concurred that the aeronautical mobile communication infrastructure had to evolve in order to accommodate new functions and to provide the adequate capacity and quality of services required to support evolving air traffic management (ATM) requirements within the framework of the global ATM operational concept. It also noted that a major constraint on the evolution of the infrastructure in high-density areas where the very high frequency (VHF) spectrum was already heavily congested, or was approaching congestion, was the limited availability of radiofrequency spectrum dedicated to aeronautical mobile communication services.

7.5.1.2 In its review of the AMCP material, the meeting observed that the scenarios were based on a three-step approach, whereby:

- a) the first step was the introduction or the expansion of the voice and data link systems that were already included in Annex 10 or which were already under development;
- b) the second step was the definition and implementation of new terrestrial and/or satellite systems that operated outside the VHF band. This step would be required only in some high-density areas, where the VHF spectrum is expected to experience saturation despite the introduction during the first step of more frequency efficient systems. This second step would provide capacity that was initially complementary to VHF. By taking over some communications services that were originally provided over VHF, this step would then reduce VHF congestion; and
- c) the third step was the introduction of a new global VHF system making use of the spectrum that had been made available by the second step. This step would be envisaged only in high-density areas, and only in the longer term.

7.5.1.3 The meeting took particular note of the fact that the second and third step were intended only to be applicable in high-density areas. The meeting also noted that, while the purpose of the scenarios was to reflect the likely evolution of the communication infrastructure over time for areas with different traffic density, they were not intended to replace or pre-empt the relevant ICAO planning process, but merely to provide a common basis for discussion of the way forward in the development of the infrastructure. Separate scenarios were defined for voice and data link services. Within the data link service, separate scenarios were defined for data link communications service and data link surveillance service. The data link surveillance

service in turn included automatic dependent surveillance — contract (ADS-C) and automatic dependent surveillance — broadcast (ADS-B). For each of the services, three operational situations with different constraints had been considered:

- a) oceanic and low/medium density areas where only a limited ground-based communication infrastructure can be efficiently deployed;
- b) low/medium density areas where a full ground-based communication infrastructures can be deployed; and
- c) high density terrestrial areas.

7.5.1.4 The meeting noted that in the course of the development of the scenarios a number of issues had been identified as requiring further consideration.

7.5.1.4.1 A critical element of the three-step evolution path, particularly in high density areas, was spectrum availability. During the first step, VHF spectrum needed to be made available for the introduction of new services; during the second step, the transfer of services from the VHF band to other bands was conditional on availability of appropriate spectrum in the new bands; during the third step, the introduction of new VHF services was conditional on availability of sufficient spectrum in the VHF band.

7.5.1.4.2 The suitability of the present and future communication systems considered in the scenarios to support the emerging ATM requirements and RCP levels needed to be assessed in quantitative terms as a function of the operational environment.

7.5.1.4.3 Systems using different operational modes might give rise to different ATS operational procedures that were optimized for system characteristics. As aircraft crossed boundaries between areas or regions that operated different types of systems, pilots would be required to manage these procedures. Human factors and human machine interfacing would have significant impacts on the efficiency and, ultimately, on the safety of these new procedures.

7.5.1.4.4 The coexistence of multiple communication systems within each scenario and across different scenarios posed technical, operational and economic challenges that needed to be addressed. In particular, the definition of an on-board architecture supporting the integration of multiple systems should be undertaken.

7.5.1.4.5 It was observed that the scenarios also included use of aircraft communications addressing and reporting system (ACARS). In this regard, the conference was provided with information on the increasing use of ACARS for digital ATIS and pre-departure/oceanic clearance as well as FANS-1/A avionics package for controller-pilot data link communications (CPDLC) and ADS. It was noted that approximately 1 200 long haul aircraft had already been equipped with FANS-1/A and that airframe manufacturers were considering the introduction of that technology to smaller single-aisle aircraft. It was recognized that real operational benefits were being accrued through the use of the above-mentioned systems, mostly in oceanic/low-density airspace and for specific type of operations.

7.5.1.4.6 It was also noted that the provision of ATS data link applications via FANS-1/A had not been subject to ICAO provisions. However, the Organization had promulgated to States its position on the early use of the package and its relationship to the envisaged end state via a State letter in December 1994. Similarly, guidance material on the operational accommodation of FANS-1/A aircraft in a system complying with the ICAO end state had been promulgated to States via another State letter in October 1998. It was noted that FANS-1/A continued to evolve through activities of relevant industry bodies.

7.5.2 Review of proposals on future development of air-ground communications

7.5.2.1 The meeting proceeded to consider a number of proposals addressing the future evolution of current aeronautical mobile communications, referring to the scenarios discussed above as required to assist in clarifying commonalities and divergences of the various proposals.

7.5.2.2 The meeting noted information supporting the definition of a future communications concept presented by EUROCONTROL. The contribution stressed that present global development plans could and should be harmonised in the near term through the use of multi-mode avionics capable of user-transparent and seamless operations in all ICAO Regions and that the pursuit of future communications solutions was best accomplished as a global activity. The future communications infrastructure should provide backward compatibility with the present infrastructure; be capable of both voice and data services; be able to operate in more than one band simultaneously in a spectrum efficient manner; be capable to provide expanded capacity as the needs of the aviation community dictate; have minimum economic impact on airspace users; and could potentially consist of more than one system (e.g. terrestrial and satellite).

7.5.2.3 Another contribution stressed the need for ICAO to discuss the most appropriate VDL system for ATS operation taking into consideration the future voice traffic and data link traffic within the limited VHF frequency band for AMS, and to develop a transition plan for VDL on a global basis, once the selection was made on VDL based on the technological advantages and cost/benefit analysis. Additionally, ICAO should assist the transition to AMSS and encourage the use of AMSS for ATS in oceanic and remote airspace. ADS/CPDLC trial operations through AMSS should also be promoted on a global basis, so that technical and operational problems can be identified to ensure the smooth transition to actual ATS operations through AMSS.

7.5.2.4 An approach emphasizing the need for an interoperable air/ground communications solution from an airspace user's perspective was introduced. It concluded that multi-mode avionics supporting ICAO standardized systems could provide seamless VHF communications operation for international airspace users. This approach would allow regions to mitigate spectrum congestion at a pace appropriate to their anticipated usage. By maximizing service life of the VHF spectrum, it would minimize future investment costs and increases availability of voice and data link communications options for service providers. The meeting was informed that, in the United States, it was projected that a VDL-3 implementation should exceed 30 years of life expectancy. It was anticipated that in other regions a minimum 20-year useful life extension for the VHF band could be achieved. Thus, the use of multi-mode avionics should provide an effective solution for the aviation community and would allow significant time for the aviation community to explore next generation communications options.

7.5.2.5 A proposal from the CAR/SAM Regions concerning the future development of air-ground aeronautical communications noted that, according to the studies conducted by GREPECAS, the implementation of VDL Mode 2 in the medium term was considered feasible to support data link applications, such as CPDLC. The implementation of VDL Mode 3 or 4 would be subject to regional agreements, together with other future data link options.

7.5.2.6 The meeting was apprised of the position of IATA on aeronautical air-ground communications needs, according to which future development of the VHF air-ground infrastructure should converge to a single globally harmonized, compatible and interoperable system to reduce the proliferation of solutions based on national or regional priorities. The meeting noted that IATA Member airlines did not support the implementation of VDL Mode 3 considering the uncertain benefits and limited capacity gain. They also did not support implementation of VDL Mode 4 as it would add to the proliferation of VHF system alternatives and delay the needed overhaul of the VHF system.

7.5.2.7 The meeting was informed about issues faced by the business aviation community in relation to the use of CPDLC/ADS. Specifically, it was stated that for business aviation there was no business case for equipage. Furthermore, the appropriate avionics (based on FANS-1/A or ATN technologies) were not yet available, and uncertainties associated with market and implementation plans of air navigation service providers were preventing their development for business aircraft. The meeting acknowledged the aforementioned problems and their relevance to planning and implementation of CNS/ATM.

7.5.3 Identification of common elements among the proposed approaches

7.5.3.1 The meeting noted that a variety of views had been presented with regard to the future evolution of aeronautical mobile communications. It was recognized that, while to a certain extent that variety could be attributed to different planning horizons being addressed by different contributions to the meeting, some differences remained even when comparable time frames were considered. For instance, within the scope of the first of the three potential evolutionary steps outlined in the AMCP scenarios, namely the introduction or expansion of the voice and data link systems already standardized by ICAO (Section 7.5.1.2 refers), a number of different approaches were currently being followed in different regions. When considering future evolution beyond the implementation of existing ICAO Standards towards the development of new generations of aeronautical communication technologies, additional potential divergences included matters as substantial as the proposed band of operation and the relative roles of terrestrial versus satellite technology and of commercial telecommunication technology versus purpose-developed aeronautical technology.

7.5.3.2 While the meeting acknowledged that each of the alternatives under consideration was valid and justifiable on its own terms, it was noted that the universally recognized benefits of harmonization and global interoperability of air ground communications should not be lost sight of when pursuing optimization of local solutions. Therefore, the meeting agreed that an effort must be made to identify common elements which could form the basis for a broad consensus on an evolutionary approach towards global interoperability. It was expected that a detailed strategy for future evolution could realistically be developed only by gradually building on such an evolutionary approach.

7.5.3.3 The meeting recognized that one such common element was the widespread recognition that in some high-density regions, after an initial period in which continued operation of current standard ICAO systems would be sustainable, saturation of the VHF band would become a real issue, and that measures should be taken with some urgency to address it. However, perception of the amount of urgency varied from region to region. In this regard, the meeting agreed that it would be useful if forecasts of anticipated saturation were conducted within ICAO to reach a consensus on the time frame in which it would occur. Another common element identified was that the successful gradual introduction of data communications should be continued to complement and replace voice for routine communications. The meeting also noted the emergence of multi-mode avionics, such as were being developed as a part of FAA validation and verification program of the VDL-3 technology. Availability of such equipment, complying with a wide range of ICAO Standards, could assist the transition towards global harmonization of air/ground communications (which remarked the ultimate goal of ICAO standardization), although it would not necessarily provide a generally applicable remedy to communication capacity problems.

7.5.3.4 On the basis of this understanding, the meeting developed the following recommendation:

**Recommendation 7/3 — Evolutionary approach for global
interoperability of air-ground communications**

That States:

- a) continue the use of currently implemented ICAO standardized systems for VHF band voice and data communications until such time as either saturation of the VHF band is approached or significant cost/benefit or safety advantages are expected from the implementation of other ICAO Standards;
- b) continue efforts in maximizing efficient use of existing aeronautical spectrum allocations through spectrum management measures;

- c) continue the progressive deployment of data communications on the basis of applicable ICAO Standards such as aeronautical telecommunication network (ATN) using VDL Mode 2 as dictated by evolving operational requirements with a view to complementing or replacing voice communications for most routine communications;
- d) provide a forecast of anticipated VHF band saturation in high-density regions;
- e) if saturation of the VHF band for voice communication is anticipated, consider transition to spectrally more efficient ICAO systems, and/or make increased use of data communications; and
- f) investigate multi-mode avionics as a transitional method of achieving interoperability of air/ground communications, where global harmonization is difficult to achieve.

7.5.3.5 Another common theme that the meeting recognized as emerging from various contributions was the need to investigate the development of a future communication infrastructure, although there was not full agreement on the time frame over which actual deployment of the infrastructure would be required. This activity should include an investigation of the feasibility of new technology alternatives, including solutions outside the VHF band and wide band communication systems based on evolving international telecommunications standards and satellite based systems. Exploration of such systems should include an assessment of costs required to meet the safety critical standards of aviation, including certification costs. Evolutionary developments of standardized ICAO systems should also be considered as candidates components of the future infrastructure. The meeting recognized that these activities should be guided by operational needs and be conducted within the framework of the global ATM operational concept.

7.5.3.6 The meeting therefore agreed to the following recommendation:

**Recommendation 7/4 — Investigation of future technology
alternatives for air-ground communications**

That ICAO

- a) investigate new terrestrial and satellite-based technologies, on the basis of their potential for ICAO standardization for aeronautical mobile communications use, taking into account the safety-critical standards of aviation and the associated cost issues;
- b) continue evolutionary development of existing standardized ICAO technologies with a view to increasing their efficiency and performance; and

- c) assess the needs for additional aeronautical spectrum to meet requirements for increased communications capacity and new applications, and assist States in securing appropriate additional allocations by the ITU.

7.5.4 Guidelines on standardization of new aeronautical communication technologies

7.5.4.1 In connection with its consideration of future technology alternatives, the meeting reviewed a proposed approach to ICAO standardization of new aeronautical communication technologies and agreed to the following recommendation:

Recommendation 7/5— Standardization of aeronautical communication systems

That, for new aeronautical communication systems, ICAO:

- a) continue to monitor emerging communication systems technologies but undertake standardization work only when the systems meet all of the following conditions:
 - 1) can meet current and emerging ICAO ATM requirements;
 - 2) are technically proven and offer proven operational benefits;
 - 3) are consistent with the requirements for safety;
 - 4) are cost-beneficial;
 - 5) can be implemented without prejudice to global harmonization of the CNS/ATM systems; and
 - 6) are consistent with the *Global Air Navigation Plan for CNS/ATM Systems* (Doc 9750)
- b) include in Annex 10 provisions ensuring that the introduction of mandatory carriage of new equipment be based only on appropriate ICAO regional and inter-regional coordination; and
- c) further limit SARPs for complex aeronautical systems to broad, system-level, functional and performance requirements and better capitalize on the work of other standard-making organizations so as to reduce the complexity/size of technical provisions.

7.5.4.2 The meeting also noted that aspects traditionally not fully taken into account in ICAO standardization activities could have a significant impact on the successful implementation of a standard. Such aspects included aircraft integration issues, cost and duration of the certification and operational approval process and the viability of business case for implementation from an avionics vendor/air frame manufacturer, airline and air traffic service provider perspective.

7.5.5 Use of VDL Mode 4 for point-to-point data communications

7.5.5.1 The meeting was informed of concerns with the use of VDL Mode 4 to support point-to-point data communications. It was recalled that ICAO State letter, AN 7/1.3.83-03/59, dated 27 June 2003, requested comments on a proposal for the amendment of Annex 10, Volume III. The proposed amendment included the deletion of existing Note 4 to paragraph 6.1 of Annex 10, which indicated that VDL Mode 4 SARPs apply to surveillance applications only. The letter noted that approval of the change would result in adding another point-to-point data link operating in the VHF band and that the use of VDL Mode 4 as a point-to-point data link would satisfy the same requirements and desirable features as were already included in the VDL Mode 3 data link, thereby introducing a proliferation of air/ground data links. The letter indicated that the matter might be addressed by the meeting, and that related recommendations from the meeting would be considered together with response from States to the letter.

7.5.5.2 The concerns presented to the meeting, in addition to those related to the potential proliferation of air/ground data links, included a number of technical issues/concerns and opposition from industry. In the discussion, the meeting noted that VDL Mode 4 would offer an air-to-air communication facility which went beyond the requirements and desirable features already satisfied by VDL Mode 3; that the ACP was working on the resolution of some of the technical issues highlighted; and that opposition from industry was less extended than reported.

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