RTCA, Inc.
1717 H Street, NW, Suite 655
Washington, DC 20006 USA

VHF Air-Ground Communication Technology and Spectrum Utilization

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Prepared by: SC-140
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RTCA, Inc.

Telephone: 202-833-9339
Facsimile: 202-833-9434
Internet: www.rtca.org

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F O R E W O R D

This Report was prepared by Special Committee 140 of the Radio Technical Commission for Aeronautics. It was approved by RTCA on July 20, 1979.

RTCA is an association of aeronautical organizations of the United States from both government and industry. Dedicated to the advancement of aeronautics, RTCA seeks sound technical solutions to problems involving the application of electronics and telecommunications to aeronautical operations. Its objective is the resolution of such problems by mutual agreement of its member and participating organizations.

The findings of RTCA are in the nature of recommendations to all organizations concerned. As RTCA is not an official agency of the Government of the United States, its recommendations may not be regarded as statements of official government policy unless so enunciated by the government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

EXECUTIVE SUMMARY

One of the recommendations of the RTCA Aviation Service Working Group (ASWG), set up at the Federal Communications Commission's request to coordinate nongovernment participation in the U. S. preparatory work for the International Telecommunication Union 1979 General World Administrative Radio Conference, was that an additional 2 MHz of VHF spectrum contiguous to the currently allocated 118-136 MHz band be assigned to the Aeronautical Mobile Service to help meet the expected demand for additional channels towards the end of the century. Special Committee 140 was given the task of developing a plan for the most effective use of this additional spectrum. Its terms of reference included instructions to consider the impact of this plan upon use of the present spectrum, with the objective of encouraging further increases in the efficiency with which this safety service utilizes this valuable resource.

The Special Committee found the new spectrum will, in addition to more channels, facilitate the implementation of a further reduction of channel spacing in the present spectrum. After a careful study of the alternatives, SC-140 recommends that reduced channel spacing (possibly 12.5 kHz) be employed in the new spectrum, with continued use of amplitude modulation. Significant economic and operational penalties, with no corresponding spectrum use benefits, would result from the adoption of other modulation techniques. A further benefit of retaining amplitude modulation is the minimization of the technical problems of any subsequent transition to reduced channel spacing in the existing spectrum.

The Special Committee also recommends that care be taken to avoid premature implementation of reduced channel spacing in the present spectrum. Ground administrations have not yet fully implemented the channels made available through the recent adoption of 25 kHz spacing. Much airborne and virtually all ground VHF communications equipment designed for 25 kHz channel spacing is only in the early part of its life cycle. Also, at least one more generation of such airborne equipment is scheduled to enter service with new aircraft in the early 1980's. Thus, the introduction of a further reduction in channel spacing must allow adequate time to fully amortize the newly installed equipment and develop a suitable replacement for Climax networks used in many parts of the world if an orderly transition is to be achieved. Only in this way can the unique needs of this safety service be fully satisfied.

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I. INTRODUCTION

In preparing for U. S. participation in the 1979 General World Administrative Radio Conference (GWARC), the Federal Communications Commission (FCC) established Radio Service Working Groups for the various services under its jurisdiction. The FCC acknowledged that the Radio Technical Commission for Aeronautics (RTCA) was the focal point for nongovernment aviation participation in such preparatory work and requested that RTCA act as the Aviation Service Working Group. To this end RTCA established Special Committee 129 (SC-129) to respond to the various FCC Notices of Inquiry (NOI) relating to aviation interests.

In its comments on the FCC Fifth NOI, the ASWG provided further justification for additional spectrum for Aeronautical Operational Control. The thrust was to urge the FCC to provide an adequate amount of contiguous spectrum to permit satisfying the operational control communication requirement.

In its response to the FCC Eighth NOI, the ASWG stated:

> "It is apparent from the data provided by the FCC 8th NOI that the probability of an adequate allocation to serve all operational control requirements cannot likely be made in the 136-960 MHz band."

Consistent with the previous view that contiguous spectrum should be allocated to permit use of a single aircraft system to be used for several purposes (air traffic control and operational control), the FCC was urged to reconsider the possibility of sharing the 136-138 MHz band between the present users in various ITU Regions and the Aeronautical Mobile and any other service presently recognized. It should be explained by an appropriate footnote that services other than Aeronautical Mobile would be phased out on a long-term basis.

The ASWG Report (RTCA Paper No. 128-78/SC129-66) suggested that use of the 136-138 MHz band be predicated on a plan which RTCA would prepare showing how reduced channel width, or perhaps different modulation techniques, would be employed to make improved use of the new (136-138) spectrum.

If encouraged by FCC, as a result of some FCC action toward making spectrum in the band 136-138 available for Aeronautical Mobile, it was indicated that RTCA would:

- Establish a Special Committee to study means and methods of transitioning to the use of new modulation techniques, or any other method, that would improve spectrum utilization efficiency, beginning in the band 136-138 MHz as well as investigation of the best means of accommodating SST aircraft on such narrow-band channels;

- Encourage FAA and other appropriate agencies to support studies of the type as outlined above;

- Develop a schedule for transitioning to improved spectrum utilization in the band 118-138 MHz based on the findings stated above.

Also contained in the ASWG's comments on the FCC's Eighth NOI was the statement that the aviation service has, throughout the years, improved its utilization of VHF spectrum. For example, commencing with 180 kHz channel separation, it has progressively reduced channel separation to 100, 50 and now 25 kHz separation.

It was also recommended that an additional 2 MHz of spectrum, specifically 136-138 MHz should be formally identified now by the U. S., and on a long-term basis, progressively be made available to permit aviation to begin still another transition to reduced channel separation or alternative modulation techniques in the VHF band for air-ground communication purposes.

The problem confronting users when reducing channel separation is, without question, more severe for the aviation service than any other. The aviation service is a safety service in which communications system effectiveness is of much greater significance than in other services. It is necessary that a desired channel is available to the pilot or controller when needed and that it is free of interference. Taxi cabs, police cars, fire trucks, or other parts of the mobile service, can, with proper planning, introduce reduced channel separation relatively easily since only a few other units generally are affected. Perhaps only a decision by a single fleet operator would be required to introduce reduced channel operation in a particular case. Any changes to aviation system standards need long and careful advance coordination if they are to be introduced without compromising the efficiency of the system as a whole.

Conversely, aviation has not only the problem of as many as 187,000 aircraft operating across state lines and also across U. S. borders into the territory of countries to the north and south, but a smaller number (perhaps 7-10,000 U. S. registry) of airline and business aircraft operating throughout the world. Thus the problem of introducing reduced channel separation or alternative modulation techniques in those aircraft could be most severe. Aviation users have experienced problems associated with introducing reduced channel separation numerous times in the past when transitioning to reduced channel separation using both older airborne equipments on channels having reduced channel separation and using airborne equipments on channels engineered for wider separation.

With this background, the RTCA agreed to investigate the possibility of using alternative modulation techniques and opera-

ting VHF air-ground communication systems with channel spacing less than 25 kHz. A Special Committee was established to commence identifying what is needed to be known about equipment problems, costs, and time required to transition. Thus, Special Committee 140 (SC-140) "VHF Air-Ground Communication Technology and Spectrum Utilization" was constituted.

II. TERMS OF REFERENCE

Special Committee 140 is requested to conduct a study and provide recommendations as how best to utilize a two MHz portion of the VHF spectrum contiguous to 118-136 MHz, in the Aeronautical Mobile Service.

The objective of the study will be to identify the best modulation technique to provide the most suitable air-ground voice communications. The study should include the possible use of data transfer on some channels. An important consideration is to permit satisfactory operation by new equipment -- if the user chooses to do so -- in both the new spectrum and as currently provided in the present 118-136 MHz portion of the spectrum.

As a corollary task, SC-140 shall develop recommendations for use in preparing the U. S. Position for GWARC concerning channel splitting in the 118-136 MHz band as proposed during the ICAO Sixth Communications Divisional Meeting. The proposal for channel splitting in the 118-136 MHz band was not adopted by ICAO (see ICAO Communications Divisional Meeting, Recommendation 3/2, Montreal 16 May - 9 June, 1978). In this regard, the technical feasibility and transition problems of any proposed channel splitting scheme shall be addressed.

Cost of airborne and ground equipment is a major concern. Therefore, SC-140 must carefully consider and report on the impact of introducing technology that will be expensive when the equipment is purchased or that will increase the cost of ownership. Today's costs are a reasonable goal.

It is expected that SC-140 will produce recommendations on a timely basis in relation to the preparatory work for the forthcoming ITU GWARC Meeting.