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NEXT GENERATION AIR/GROUND COMMUNICATIONS (NEXCOM) PRINCIPLES OF OPERATIONS VDL MODE 3

RTCA/DO-279
March 5, 2002

Prepared by SC-198
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FOREWORD

This report was prepared by Special Committee 198 (SC-198) and approved by the RTCA Program Management Committee (PMC) on March 5, 2002.

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- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

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EXECUTIVE SUMMARY

This Government/Industry NEXCOM Principles of Operations VDL Mode 3 document characterizes the operational use of VDL Mode 3 integrated voice and data system for air/ground communications in the U.S. NAS.

The NEXCOM communications principles defined in this document are for Air Traffic Control related air/ground communications services that apply to both voice and data operations in accordance with the NEXCOM Terms of Reference (TOR) for Special Committee (SC) SC-198. It was developed using the templates in RTCA SC-189 document, DO-264, Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications. It also corresponds to the Operational Services and Environment Description (OSED) as identified in DO-264 and is consistent with the Joint RTCA/EUROCAE SC-189/WG 53 position paper P-G6-03, Initial Continental OSED. The data link environment was derived from RTCA publication, NAS Concept of Operations, and RTCA SC-194 document, DO-269, Concepts for Services Integrating Flight Operations and ATM Management Using Addressed Data Link. Safety and performance products identified in RTCA DO-264 will be completed by a separate working group in a subsequent product. As an integrated voice and data communications system, NEXCOM must provide a capability to initiate and deliver "critical" safety-of-life services. All levels of voice and data service criticality must be accounted for.

Major milestones and a preliminary schedule for deployment are found in Section 1.

Stakeholders are identified in Section 2. They represent a broad spectrum of the aviation community with a particular emphasis on operations.

NEXCOM operational objectives, intentions and capabilities are found in Section 3 and form the basis for success criteria used to determine system acceptability. This section begins with a discussion on human factors. It suggests that VDL Mode 3 capabilities demonstrated in the scenarios and any others under consideration should be assessed in a laboratory environment. It also provides human-centered design principles that should serve as initial industry guidelines when introducing any NEXCOM enhancements to the NAS. Other objectives include increasing the number of voice channels available to Air Traffic Control (ATC), increasing system performance, remote maintenance monitoring and control of ground radios, and operation with legacy systems. They also include operationally integrated voice and data being used for aircraft separation, flight information services, emergency communications coordination, flight operations support service, airport lighting control at airports not staffed, enhanced communications security and situational awareness.

Section 4 provides a description of the operational communications services to be used to support Air Traffic operations. It uses operational scenarios to describe how the air traffic operations are supported by the communications services described. Differences among the services are described in terms of relative performance attributes. The services and the defined service attributes are applicable to either voice or data communications.

Section 5 provides a description of the environment within which NEXCOM is expected to operate. It includes a discussion of the impact of current operational realities and constraints on the environment as a result of the terrorist events of September 11, 2001.

The environment evolves from the NAS as a ground-based infrastructure to one that encompasses both ground and aircraft systems. The description is based upon the NAS Concept of Operations approved by the Free Flight Steering Committee in December 2000, and draws upon the environmental characteristic used for the PETAL IIe OSED. The environment as defined in Section 5 serves as the common base for the operational safety assessment and the operational performance assessment to be developed in the Safety and Performance document that will follow this product.

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1 INTRODUCTION

1.1 Purpose of NEXCOM Principles of Operation Document

This document characterizes the principles of operational use of the Very High Frequency (VHF) Digital Link (VDL) Mode 3 voice and data systems. Specifications for the VDL Mode 3 protocol are contained in RTCA DO-224A. The Principles of Operation document provides a high-level operational services and environmental definition (OSED) of the NEXCOM VDL Mode 3 system for the domestic NAS implementation. U.S. Airspace is planned for NEXCOM operation. The ideas presented in this document are intended to drive new NAS technology and lay the groundwork for NAS communication transitional segments.

Note: *In this document, the term "Service Provider" is used generically to refer to any air traffic service employee or DoD member who provides separation assurance, traffic management, infrastructure management, aviation information, navigation, landing, airspace management, search and rescue, or aviation assistance services for NAS users. The terms "user" and "NAS user" refer to any customer that uses the air traffic system, including commercial aviation, general aviation, and DoD aviation and commercial/DoD space vehicles. Some of these customers are differentiated by representation through Flight Operations Centers (FOCs) that provide any or all of the flight planning, dispatch, fleet management, or DoD tactical air control functions that support various user operations in the NAS. The Aeronautical Operational Control Centers (AOCC) used today by many air carriers are examples of FOCs that may be used in the future by a wide range of air carrier, general aviation, commercial space transportation, and DoD operators.*

This document follows the guidance of RTCA DO-264 for an OSED, and will serve as the basis for deriving the safety and performance requirements (SPR) products identified by RTCA DO-264. The SPR products will be developed in a subsequent RTCA SC-198 activity.

1.2 Scope

For the purposes of the committee's deliberations, the term NEXCOM is used in its broadest connotation and embraces all aspects of transitioning Air Traffic Control (ATC) communications from an analog voice communication system to a digital voice and data communication system in the VHF band. NEXCOM encompasses more than the acquisition of new air-ground (A/G) ATC radios. It includes all spectrum policy, procedure development, equipment acquisition, certification, training, facility and maintenance issues and/or considerations attendant with the transition to the enhanced ATC communications. Aircraft modifications and radio avionics upgrades to meet NEXCOM communications interoperability requirements are the responsibility of the service users.

RTCA DO-274 is the first document which identifies the operations aspects of the integrated digital voice and data system for the future National Airspace System (NAS) from a technology independent viewpoint. This technology specific document will supplement information in the earlier document to identify characteristics of the VDL Mode 3 digital voice and data A/G communications system to be used in the operation of the NAS. The NAS communications system provides communications between three primary stakeholders: the aircraft, the Air Traffic Services (ATS) provider, and the Flight Operational Control (FOC). The communications model forms a triad as shown in Figure 1-1.

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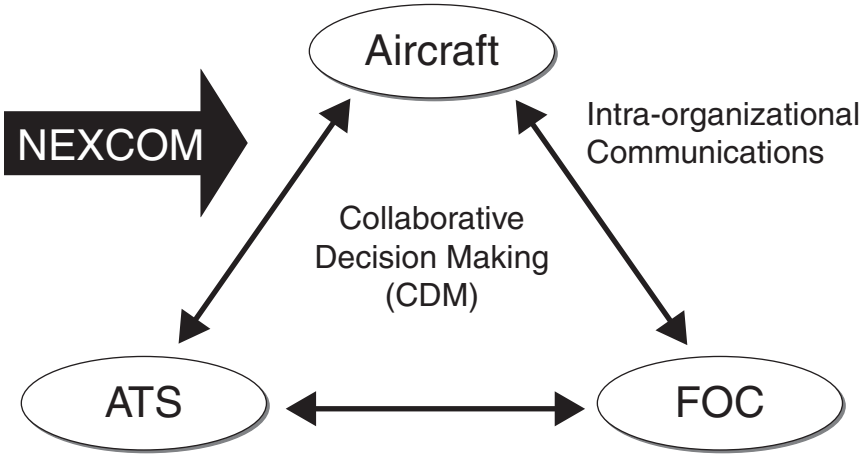


Figure 1-1 National Airspace System Communications Triad

The interaction among all three stakeholders is vitally important to the efficiency and safety of the NAS. Therefore, a robust and highly integrated communications system is required in order to support all the communications interactions that will occur. NEXCOM in this report applies only to the aircraft/ATS leg of the triad as depicted. However, the legacy and future communications systems that support the other two legs must be well understood when designing the NEXCOM leg. The systems must be complementary and provide for the high level of collaboration that will be required in the future NAS architecture.

1.3 Background

The development of operating principles is an important step in establishing aviation community consensus on the vision of the next generation communications system. The need for an expanded number of voice channel resources and limitations of the existing communications system motivate this work. Additionally, the economic demands facing aviation, an increasing amount of air traffic and the growing airport infrastructure demands are impinging on the available communications resources.

The Free Flight Concept suggests that, "…significant benefits can be achieved by…1) removal of constraints and restrictions to flight operations, 2) better exchange of information and collaborative decision making among users and service providers" [RTCA, National Airspace System Concept, December 13, 2000]. Therefore, to achieve these objectives, it is anticipated that the underlying initiatives are expected to put an increasing demand on the communications system and the available ATS spectrum. Some of the more demanding initiatives include the following:

- Increasing the number of available channels to satisfy requirements
- Expansion of user-preferred routing
- National airspace redesign
- ARTCC/TRACON growth and resectorization
- Decision support systems (DSS)
- Data link services (DLS)
- Runway expansion programs at many of the nation's airports
- Use of Precision Runway Monitor (PRM) for parallel approach operations

The existing analog communications system has met the needs of the aviation industry for generations. However, the system has inherent limitations that preclude the necessary

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