RTCA, Inc.
1828 L Street, NW, Suite 805
Washington, DC 20036-5133 USA

Next Generation Air / Ground Communications (NEXCOM) Principles of Operation

RTCA DO-274
October 12, 2001

Prepared by: SC-198
© 2001 RTCA, Inc.

Copies of this document may be obtained from

RTCA, Inc.

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

Please visit the RTCA Online Store for document pricing and ordering information.

FOREWORD

This report was prepared by Special Committee 198 (SC-198) and approved by the RTCA Program Management Committee (PMC) on October 12, 2001.

RTCA, Incorporated, is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus-based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- 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.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

Since RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U.S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

EXECUTIVE SUMMARY

This Government/Industry Principles of Operation document characterizes the operational use of an integrated voice and data communications system in the U.S. National Airspace System (NAS).

The NEXCOM communications 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 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 SC-189/EUROCAE 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. Additional work to complete the safety and performance products identified in RTCA DO-264 will be accomplished by future tasking of SC-198.

As an integrated voice and data communications system, NEXCOM must accept responsibility for “critical” safety-of-life services. All levels of voice and data service criticality must be accounted for.

NEXCOM operational objectives, intentions and capabilities are found in section three and form the basis for success criteria used to determine system acceptability. They include increasing the number of voice channels available to Air Traffic Control (ATC) more efficient use of the frequency spectrum, 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, pilot controlled lighting system, enhanced communications security and situational awareness.

Section four 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. The 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 five provides a description of the environment within which NEXCOM is expected to operate. The environment evolves from the NAS as a ground based infrastructure to one that encompasses both ground and airborne 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.

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 Purpose of NEXCOM Principles of Operation Document 1

1.2 Scope 1

1.3 Background 2

2 STAKEHOLDER IDENTIFICATION 5

3 OPERATIONAL OBJECTIVES, INTENTIONS AND CAPABILITIES 7

3.1 Frequency Spectrum Efficiency 7

3.2 ATS System Performance Improvements 7

3.3 Remote Maintenance Monitoring and Control of Ground Radios 7

3.4 Current CNS Systems 8

3.5 Integrated Voice and Data 8
3.5.1 Aircraft Separation 8
3.5.2 Flight Information Services (FIS) 8
3.5.3 Emergency Communications 8
3.5.4 Flight Operations Support Service 8
3.5.5 Airport Lighting Control 8
3.5.6 Enhanced Communications Security 9
3.5.7 Simultaneous Voice and Data 9
3.5.8 Situational Awareness 9

4 AIR TRAFFIC COMMUNICATIONS SERVICES DESCRIPTION 11

4.1 Communications Management Services 12

4.2 Planning Communications Service 14

4.3 Strategic Communications Service 14

4.4 Tactical Communications Service 16

4.5 Emergency Communications Service 17

4.6 Service Attributes and Technology Discussions 18

5 ENVIRONMENT DEFINITIONS 23

5.1 Overview of the National Airspace System — Concept of Operations 23
5.1.1 Introduction/Background 23
5.1.1.1 Evolution of the NAS 23
5.1.2 Near Term (Through 2005) 24
5.1.3 Mid Term (2005–2010) 25
5.1.4 Far Term (2010-2015) 27

5.2 Environment Definitions 27
5.2.1 Environmental Characteristics 27
5.2.2 Airspace Characteristics 28
5.2.2.1 Airspace Definition 28

5.2.2.2 Route Configuration 28
5.2.2.3 Type of Control 28
5.2.2.4 Airspace Management Structure 29
5.2.2.4.1 Sectorization 29
5.2.2.4.2 Special Use Airspace 29
5.2.2.5 Geographic Characteristics 29
5.2.2.5.1 Topography 29
5.2.2.5.2 Weather 30
5.2.2.6 Separation Minima 30
5.2.3 Traffic Characteristics 31
5.2.3.1 Sector Traffic Throughput 31
5.2.3.2 Track Occupancy 31
5.2.3.3 Minimum Required Navigation Performance 31
5.2.4 Aircraft Characteristics 31
5.2.4.1 Fleet Type Composition 31
5.2.4.2 Aircraft Type Performance Characteristics 31
5.2.4.2.1 Speed 31
5.2.4.2.2 Altitude 31
5.2.4.2.3 Climb/Descent 32
5.2.4.3 Level of CNS/ATM Equipage 32
5.2.4.3.1 Communication 32
5.2.5 Technical Characteristics 32
5.2.5.1 Ground Data Network Architecture 32
5.2.5.2 Air/Ground Subnetwork Architecture 32
5.2.5.3 Air Space User Traffic Volume Characteristics 33
5.2.5.4 Volume of ATC Transactions 33
5.2.5.5 Number of Participating Aircraft 33
5.2.5.6 Message Traffic Density 33

MEMBERSHIP 35

APPENDICES

Appendix A—ACRONYMS A-1

Appendix B—REFERENCE MATERIAL B-1

Appendix C—STAKEHOLDERS C-1

TABLE OF FIGURES

Figure 1-1 National Airspace System Communications Triad 2

TABLE OF TABLES

Table 4-1 Attributes Derived from DO-264 (Appendix F) and Adapted for SC-198 18
Table 4-2 Summary of Service Attributes 19

1 INTRODUCTION

1.1 Purpose of NEXCOM Principles of Operation Document

For the purposes of the committee's deliberations, the term Next Generation Air/Ground Communications (NEXCOM) is used in its broadest connotation and embraces all aspects of transitioning Air Traffic Control (ATC) communications from an analog voice communications system to a digital voice and data communications system in the Very High Frequency (VHF) band. NEXCOM encompasses more than the acquisition of new air/ground (A/G) ATC Radios. It includes all spectrum policy, procedural, 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.

The demand for air traffic services within the national airspace is projected to rise sharply in the 21st century. Air traffic management depends on timely and accurate transmission of information during all segments of the flight (gate to gate). With the projected growth in air traffic, today’s communications systems must be modernized to handle the additional demand. This modernization will require replacing outdated hardware, better use of the available very high frequency (VHF) spectrum, and integrating systems into a seamless network using digital technology. During the transition, NEXCOM will continue to support legacy A/G communications.

Technological advances in the areas of communication, navigation, surveillance (CNS) and decision support must be leveraged to evolve into a modernized National Airspace System (NAS). From a NAS service provider perspective, this modernized system must be seamless and fully integrated with the international global aviation community.

The NAS will migrate to a digital communications infrastructure to take advantage of new technology and the growing number of digital services. The communications infrastructure will also support current analog voice switches and legacy protocols.

This Principles of Operation document addresses domestic NEXCOM operations within the NAS exclusively.

1.2 Scope

This document characterizes the principles of operational use of integrated digital air/ground voice and data systems and provides a high-level Operational Services and Environmental Description (OSED) of the NEXCOM system for the domestic NAS implementation. Airspace will be designated for NEXCOM operations. The ideas presented in this document are intended to drive new NAS technology and lay the groundwork for NAS communications transitional segments subsequent to 2010. The 2010 time frame represents the first programmatic opportunity to incorporate fundamental changes in voice communications services based on technological capabilities (e.g., data link, initial flight information services) and operational initiatives (e.g., Free flight, NAS re-design) that are currently being refined.

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” refers 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 Cen-*

© 2001 RTCA, Inc.

ters (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 (AOC) utilized today by many air carriers are an example of the FOCs that may be utilized by a wide range of air carrier, general aviation, commercial space transportation, and DOD operators in the future.

The NAS communications system provides communications between three primary stakeholders as defined in DO-264. The communications model forms a triad as shown in Figure 1-1.

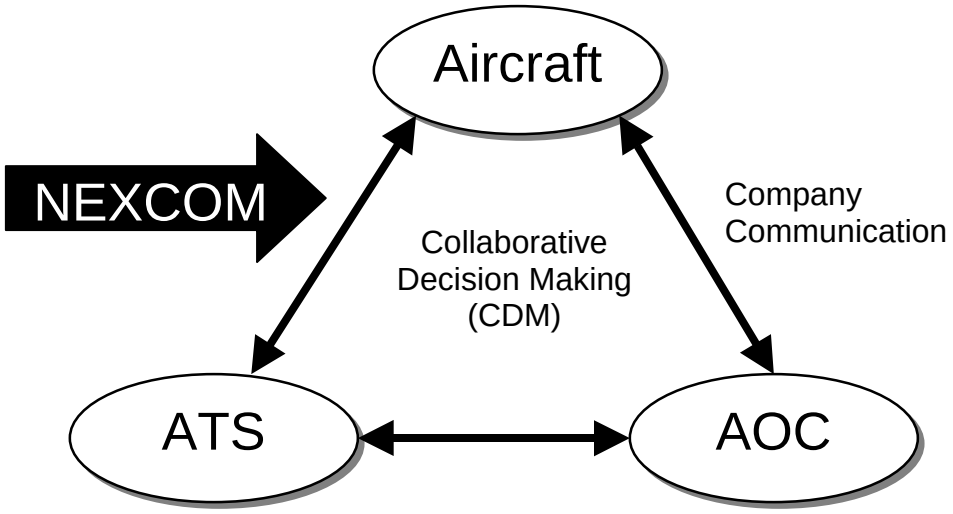


Figure 1-1 National Airspace System Communications Triad

The interaction between 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. NEXCOM in this document 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. This document follows the guidance of RTCA DO-264 for OSED, and will serve as the basis for deriving the Safety and Performance Requirements (SPR) products identified by RTCA DO-264. It is expected that the SPR products will be developed in a subsequent RTCA activity.

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 impacting 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" [National Airspace System Concept, Dec. 2000]. Therefore, to achieve these objectives, it is anticipated that the underlying initiatives are expected to put an increasing demand on the

© 2001 RTCA, Inc.