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**Command and Control (C2)
Data Link
Minimum Operational Performance
Standards (MOPS)
(Terrestrial)**

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Prepared by SC-228
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FOREWORD

This document was prepared by Special Committee 228 (SC-228) and reviewed by the RTCA Program Management Committee (PMC) on December 17, 2020.

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EXECUTIVE SUMMARY

With this update to DO-362, the RTCA continues to develop the minimum operational performance standards (MOPS) needed to support Unmanned Aircraft (UA) flights within the U.S. National Airspace System (NAS). This standard is envisioned to apply to unmanned aircraft operated under the 14 CFR Part 91 “General Operating and Flight Rules.” The standard is not intended for aircraft operated under 14 CFR Part 107 Small UAS rules.

In 2013, the RTCA initiated SC-228 to develop the MOPS needed for UAS detect and avoid (DAA) systems (focus of SC-228 Working Group 1) and terrestrial based Control and Non-Payload Communications (CNPC) Link Systems (focus of SC-228 Working Group 2).

CNPC Link Systems are unique to UAS. The International Telecommunications Union has identified multiple frequency bands, including aeronautical allocations in the L Band and C Band, as candidates for use for these CNPC Link Systems. DO-362 and its update DO-362A prescribe the MOPS for these, terrestrial based (i.e., non-satellite), UAS CNPC Link Systems that are intended to provide capabilities supporting the command and communication functions of the UAS. The DO-362A capability supports the UAS information exchanges that allow the remote pilot to safely control, monitor, and manage the UA utilizing the C band spectrum allocation. The CNPC Link System may also provide services that support other information exchanges associated with communication between the remote pilot and controller, as well as between the remote pilot and the detect and avoid, weather radar, and/or video systems carried in the UA.

The DO-362 MOPS, published in 2016, specified CNPC Terrestrial Link System characteristics that should be used by designers, manufacturers, installers, and users of the system. That MOPS document supported a wide range of UAS Command and Control architectures, from the simplest point-to-point radio line of sight application to more complex multi-aircraft and networked solutions.

In this update, DO-362A builds from the first MOPS to improve the use of the spectrum available by enhancing system performance in several areas. These improvements include the description of an additional waveform, support for multiple aircraft from a single ground radio system, a compatible high altitude airborne relay capability and support for significantly closer separation between ground radio systems than was available in the first MOPS. Additionally, DO-362A removes reference to use of the L Band as the US Government has determined that at this time, the use of L Band for CNPC poses an unacceptable risk of interference to incumbent systems in the band.

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1 PURPOSE AND SCOPE

1.1 Introduction

This document contains Minimum Operational Performance Standards (MOPS) for the Unmanned Aircraft Systems (UAS) Command and Control (C2) Data Link hereinafter in this document referred to as the Control and Non-Payload Communication (CNPC) Link System used to support the Command and Control functions of a UAS. The words “Non-Payload Communications” includes the CNPC Link System supporting remote pilot-to/from-ATC voice communications, also referred to as ATC relay. Payload communications specifically include communications associated with the UA mission payloads, which do not contain safety-of-flight information¹. Therefore, payload communications do not require the use of aviation safety protected spectrum² and are thus prohibited from using the CNPC Link System as described in this MOPS.

The focus of this MOPS is the technical standards describing how CNPC Link Systems can compatibly share the spectrum that has been allocated for their use yet remain waveform agnostic (i.e., unspecified). Through the flexibility afforded in this MOPS, manufacturers may select either the GMSK waveform standards in the GMSK waveform standard in Section 2.2.2 of this MOPS or the QPSK waveform standard in Section 2.2.3. Optional waveform modes aimed at supporting point to multi-point communications may be selected by manufacturers based on the selected waveform. These optional modes are found in Section 2.2.4 for GMSK Multiple Uplink Subframe and Section 2.2.5 for QPSK Multiple Uplink Subframe. Each UA’s CNPC Link System will need access to different amounts of spectrum depending on the functions being provided (command & control, ATC relay, DAA, onboard weather radar, and onboard remote pilot video). Therefore, the needed spectrum bandwidth will vary based on UA functions. In the development of this MOPS, efficient and effective use of the C Band spectrum allocated to UAS operations has been a primary consideration. This MOPS supports a wide range of UAS C2 Link Systems architectures, from the simplest point-to-point radio line of sight (RLOS) application to more complex multi-aircraft and networked solutions. These architectures are explained in Section 1.2.2, DO-377 [1], and potentially in a future revision of that document. DO-362A addresses spectrally efficient coexistence of different manufacturers C-Band systems but does not address interoperability between different manufacturers implementations.

These standards specify equipment characteristics that should be used by designers, manufacturers, installers, and users of a “terrestrial” based (i.e., not satellite-based) CNPC Link System. Compliance with these standards is recommended as one means of assuring that the equipment will perform its intended function(s) satisfactorily under the conditions specified herein. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

The word “equipment,” as used in this document, includes all components necessary for the CNPC Link System to properly perform its intended functions. This MOPS considers a CNPC Link System to consist of the following:

1. CNPC Link Airborne Radio System (ARS) consisting of
 - a. CNPC Link System Airborne Radio(s)

¹ Safety-of-flight information is any information/data sent to or received from the UA that is necessary to ensure the UAS is operated/operating in a manner that protects people and/or property from harm due to unintentional events.

² This portion of the spectrum is designated Aeronautical Mobile Route Service (AM(R)S) for use by safety critical systems.