

ED-276

GUIDANCE ON VDL MODE 2 AIR / GROUND INTEROPERABILITY

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SEPTEMBER 2020

FOREWORD

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CHAPTER 1

INTRODUCTION

1.1 PURPOSE

In the VDLM2 environment where the protocol and infrastructure are a challenge in terms of interoperability, it is important to provide recommendations about how the ground systems are expected to behave and what is the expected avionics answer.

This document aims at defining a coordinated understanding of the ground behaviors in addition to the MOPS which are more related to avionics systems. In particular some out of sync cases have been identified in operations, showing a need for interoperability improvement.

1.2 SCOPE

This document supplements DO-224 MASPS applicable to ground systems, and the requirements in MASPS still apply. For airworthiness and TSO/E-TSO approval the MASPS have precedence over this document and avionics requirements are defined in the MASPS.

The main focus of the document is VDLM2, but it also addresses specific issues above VDLM2 when they are related to the VDLM2 operations.

1.3 STRUCTURE OF THE DOCUMENT

The document is composed of the following sections:

1. Chapter 1: Introduction,
2. Chapter 2: Air-Ground Interoperability,
3. Chapter 3: Routing and Neighbor Discovery.

In potential next revisions of the document, additional chapters may be added to cover additional guidance.

1.4 RELATIONSHIP TO ICAO DOCUMENTS

This document supplements the document ICAO 9776 which defines VDL M2. The information provided in the current document does not supersede the ICAO definition but provides guidance on how the system should behave in compliance with the ICAO standards.

1.5 REFERENCES

The following documents are used as reference:

Document	Description
ICAO Doc 9776	ICAO Manual on VHF Digital Link (VDL) Mode 2 Part II, Edition 2 published in 2015
ICAO Doc 9705	Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN), Second Edition published in 1999
RTCA DO-224D	Signal-In-Space Minimum Aviation System Performance Standards (MASPS) for Advanced VHF Digital Data Communications including Compatibility with Digital Voice Techniques
RTCA DO-281C	Minimum Operational Performance Standards for Aircraft VDL Mode 2 Physical, Link, and Network Layer

EUROCAE ED-92C	Minimum Operational Performance Specification for an Airborne VDL Mode-2 System Operating in the Frequency Range 118-136.975 MHz
ARINC Specification 618-8	Air/Ground Character-Oriented Protocol Specification
ARINC Specification 631-8	VHF Digital Link (VDL) Mode 2 Implementation Provisions
ELSA Study	SESAR VDL Mode 2 Measurement, Analysis and Simulation Campaign (known as ELSA Study), published June 2016

1.6 MANDATING AND RECOMMENDATION PHRASES

1.6.1 “Shall”

The use of the word "Shall" indicates a mandated criterion; i.e. compliance with the particular procedure or specification is mandatory and no alternative may be applied.

1.6.2 “Should”

The use of the word "Should" (and phrases such as "It is recommended that...", etc.) indicate that though the procedure or criterion is regarded as the preferred option, alternative procedures, specifications or criteria may be applied, provided that the manufacturer, installer or tester can provide information or data to adequately support and justify the alternative.

CHAPTER 2

AIR-GROUND INTEROPERABILITY

2.1 LINK MANAGEMENT

This section provides link management guidance. The objective is to have a common understanding shared by the service providers that will ensure that the aircraft will have the appropriate answer.

The VDLM2 ground network Service Provider shall ensure that the same VSDA is reachable on all the channels it uses within the same area (as specified in ARINC SPECIFICATION 631, DO-224D and the ICAO Doc 9776 – Technical Manual).

2.1.1 DISC Usage

DO-224D, VDLM2 MASPS defines the use of the DISC frame as follows: “If a DLE is unable to continue to receive, it shall transmit DISC to terminate the current link.” Therefore, a DISC is an explicit command on actions to be taken. If the ground station is going off line or has failed, then other actions should also occur such as changing the GSIF parameter settings (e.g. no AOA and no ATN) or shutting down the transmitter.

2.1.1.1 DISC Sent by Ground Station

The ground station shall send a DISC when it needs to terminate the current link with an aircraft.

- Upon receiving a DISC from a ground station with which the CMU has a link then the CMU terminates the link with that ground station.
- After receiving a DISC, the aircraft may attempt to re-establish the link with that same ground station, downlinking a LE, or another one by downlinking an HO or LE. The ground station shall respond to the HO or LE based on its status.
- If the CMU does not have a link with a ground station when a DISC is received from that ground station, then the CMU ignores the DISC.

It is recommended to minimize the use of DISCs, especially in a system that supports ATN, because the DISC causes the ATN connectivity to be terminated and then numerous messages must be exchanged to re-establish ATN. The impact of a DISC in an AOA Only system exists but is not as significant as in an AOA/ATN environment.

The DSP/CSP should not expect the aircraft to drop to POA or switch VDLM2 frequencies (e.g. drop to CSC) when the aircraft receives a DISC. This may happen depending on the status of the aircraft and its PECT but should not be assumed. The aircraft may switch to a different VDLM2 DSP/CSP or the aircraft may attempt to establish a link with the ground station that sent the DISC.

2.1.1.2 DISC Sent by Aircraft

Upon receiving a DISC from an aircraft with which the ground station has a link then the ground station shall terminate the link with that aircraft, including the ISO8208 SVC and the IDRP adjacency. If the ground station subsequently receives a LE or HO from that aircraft, then the ground station shall respond to the LE or HO in a normal manor based on its current circumstances.

Ground LME

Row	Stimulus	ADM GS:none	LPM_pend GS:p	ABM_single GS:c	ABM_mult GS:o,n	HO_init_pend GS:c,p	HO_req_pend GS:c,p
4	DISC (GS-active)/P=0 1		A=delete link S=ADM	A=delete link S=ADM	A=delete relevant link, cancel TG5 S=ABM_single	if GS=p A=DI S=HO_init_pend if GS=c A=delete link S=ADM	if GS=p A=DI S=HO_req_pend if GS=c A=delete link S=ADM

FIGURE 2-1: DISC IN THE GROUND VDL M2 STATE DIAGRAM (SOURCE ICAO 9776)

If the ground LME is in the process of trying to establish a link, via sending a CMD_HO (either GIHO or GRAIHO), with an aircraft and a DISC is received from that aircraft by the proposed ground station (the ground station which is pending the link establishment) then the ground station shall ignore the DISC and continue pending the link establishment.

If the ground LME is in the process of trying to establish a link, via sending a CMD_HO (either GIHO or GRAIHO), with an aircraft and a DISC is received from that aircraft by the current ground station (the ground station which has a link with the aircraft) then the LME shall disconnect the link and terminate the link establishment with that aircraft. If the ground station does not have a link with an aircraft when a DISC is received from that aircraft, then the ground station should ignore the DISC.

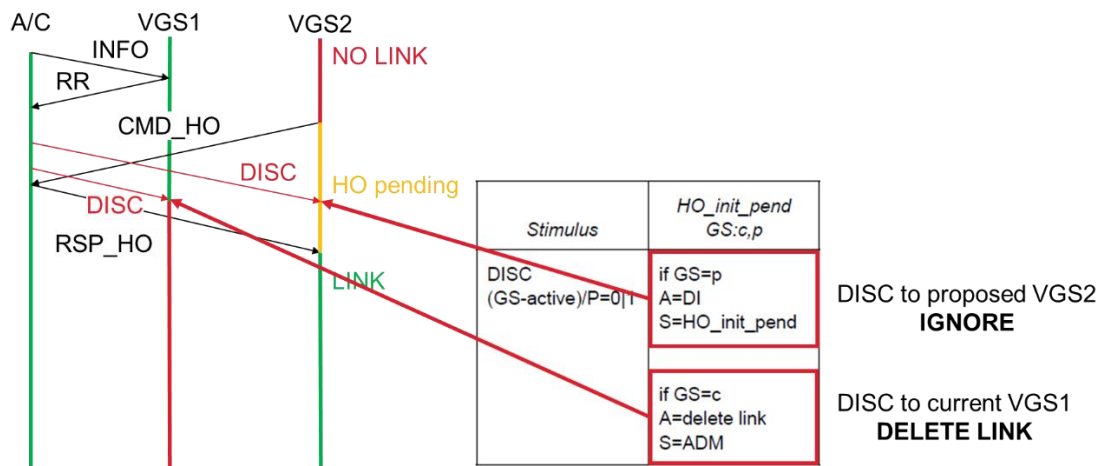


FIGURE 2-2: DISC DURING PENDING HO (GIHO) – STATE HO_INIT_PEND