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Study item on VHF Data Link Mode 2 ground-based equipment standardization optimization; Evolution of Data Link European Norms

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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1 Scope

The present document intends to investigate the improvements needed in the VHF Data Link Mode 2 European Norms (ETSI EN 303 214 [i.7], ETSI EN 301 841 parts 1 [i.4] to 3 [i.6]) in order to determine real-world compliance to relevant regulations, and if there is a need to align them with the relevant ELSA reports [i.12], [i.13], [i.14], [i.15] findings and further inputs from PATH1, PATH2 and other SDM/EASA mandates (e.g. CEF2017/IP1), as well as the relevant regulation.

The present document considers also some specific aspects addressing ATN Baseline 1 and Baseline 2 compatibility.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] LINK 2000+/LIT/ED120/PERF Interpretation of EUROCAE ED-120/RTCA DO-290 Performance Requirements.
- [i.2] Eurocontrol CFC/Datalink/ACSPGEN Generic Requirements for an ATN/VDL Mode 2 Air/Ground Communications Service Provider.
- [i.3] ETSI EN 300 113-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 1: Technical characteristics and methods of measurement".
- [i.4] ETSI EN 301 841-1 (V1.4.1): "VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 1: Physical layer and MAC sub-layer".
- [i.5] ETSI EN 301 841-2 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 2: Upper layers".
- [i.6] ETSI EN 301 841-3 (V2.1.1): "VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 3: Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.7] ETSI EN 303 214 (V1.2.1): "Data Link Services (DLS) System; Community Specification for application under the Single European Sky Interoperability Regulation EC 552/2004; Requirements for ground constituents and system testing".
- [i.8] EUROCAE ED-92C: "MOPS for an Airborne VDL Mode-2 System operating in the frequency range 118-136,975 MHz".

- [i.9] EUROCAE ED-120: "Safety and Performance Requirements Standard For Initial Air Traffic Data Link Services In Continental Airspace" (SPR IC)".
- [i.10] ICAO Doc 9705: "Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN)".
- [i.11] ICAO Doc 9880: "Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols".
- [i.12] ELSA D8, Edition 01.03.00: "Work Area 1 Final Report - VDL2 Performance analysis".
- [i.13] ELSA D9, Edition 00.03.04: "ELSA WA2 Final Report - Implementation Options for VDL M2 Multi-Frequency".
- [i.14] ELSA D10, Edition 01.12.00: "VDL Mode 2 RF Analysis & Avionics Interoperability Tests - Final Report".
- [i.15] ELSA D11, Edition 00.01.03: "VDL Mode 2 Measurement, Analysis and Simulation Campaign - Final Report".
- [i.16] ETSI EN 301 489-22: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 22: Specific conditions for ground based VHF aeronautical mobile and fixed radio equipment".
- [i.17] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.
- [i.18] Commission Regulation (EC) No 29/2009 of 16 January 2009 laying down requirements on data link services for the single European sky.
- [i.19] Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (interoperability Regulation), OJ L 96, 31.03.2004, p. 26 as amended by Regulation (EC) No 1070/2009, OJ L 300, 14.11.2009, p. 34.
- [i.20] ITU Radio Regulations 2016.
- [i.21] ICAO Convention on International Civil Aviation: "Annex 10 - Aeronautical Telecommunications, Volume III - Communication Systems, Part I - Digital Data Communication Systems, Second Edition, July 2007, incorporating Amendments up to 88A (applicable 14/11/13). Chapter 6 - VHF Air-ground Digital Link (VDL)".
- [i.22] ICAO Document 9776/AN970 (first edition, 2001): "Manual on VHF Digital Link (VDL) mode 2".
- [i.23] ARINC 631-6: "VHF Digital Link (VDL) Mode 2 Implementation Provisions".
- [i.24] ARINC 631-7: "VHF Digital Link (VDL) Mode 2 Implementation Provisions Standards".
- [i.25] EUROCAE ED-110B: "Interoperability requirements standard for aeronautical telecommunication network baseline 1 (ATN B1 Interop standard)".
- [i.26] EUROCAE ED-23C: "MOPS for airborne VHF receiver - transmitter operating in the frequency range 117.975-137.000 MHz".
- [i.27] ISO/IEC 8208: "Information technology - Data communications - X.25 Packet Layer Protocol for Data Terminal Equipment".
- [i.28] EUROCAE ED-92C: "Minimum Operational Performance Standard (MOPS) for an Airborne VDL Mode-2 System Operating in the Frequency Range 118-136.975 MHz".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 301 841-1 [i.4], ETSI EN 301 841-2 [i.5], ETSI EN 301 841-3 [i.6], ETSI EN 303 214 [i.7] and Commission Regulation (EC) No 29/2009 [i.18] apply.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACK	ACKnowledgement
ANSP	Air National Service Provider
AOA	Acars Over AVLC
AOC	Airline Operational Control
ATN	Air Traffic Network
ATS	Air Traffic Service
AVLC	Aviation VHF Link Control
CM	Context Management
CPDLC	Controller Pilot Data Link Communication
CSC	Common Signaling Channel
CSP	Communications Service Provider
CVME	Centralised VME
DISC	DISConnect (frame)
DL	Data Link
DLS	Data Link Service(s)
DM	Disconnected Mode (frame)
DP	Deployment Programme
DPMG	Data link Performance Monitoring Group
EASA	European Aviation Safety Agency
EC	European Commission
ED	EUROCAE Document
ELSA	Enhanced Large Scale ATN deployment
EMC	ElectroMagnetic Compatibility
EN	European Norm
ENR	EN-Route
FSL	Frequency Support List
GIHO	Ground Initiated HandOver
GRAIHO	Ground Requested Air Initiated HO
GSIF	Ground Station Identification Frame
ICAO	International Civil Aviation Organisation
ICS	Internet Communications Service
IDRP	Inter Domain Routing Protocol
LACK	Logical ACK
MF	Multi Frequency
MOPS	Minimum Operational Performance Specification
PAE	Park Air Electronics
PICS	Protocol Implementation Conformance Specification
RF	Radio Frequency
SDM	SESAR Deployment Manager
TRM	TeRMinal
TX	Transmitter
VCRM	Verification Cross-Reference Matrix
VDL	VHF Data Link

VDLm2	VHF Data Link mode 2
VGS	VDLm2 Ground Station
VHF	Very High Frequency
VME	VDLm2 Management Entity
XID	eXchange IDentification

4 Evolution of VHF Data Link Mode 2 European Norms

4.1 Overview

4.1.1 Relationships between the ETSI ENs

The ETSI specifications related to VDLm2 datalink are the following:

- ETSI EN 301 841-1 [i.4]: "VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 1: Physical layer and MAC sub-layer".

This European Norm provides functional specifications and test procedures for physical layer and MAC sub-layer.

- ETSI EN 301 841-2 [i.5]: "VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 2: Upper layers".

This European Norm provides functional specifications and test procedures for link and sub-network access layers.

- ETSI EN 301 841-3 [i.6]: "VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment; Part 3: Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

This European Norm contains requirements to demonstrate that "... *Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference*" according to the Directive 2014/53/EU [i.17].

- ETSI EN 303 214 [i.7]: "Data Link Services (DLS) System; Community Specification for application under the Single European Sky Interoperability Regulation EC 552/2004; Requirements for ground constituents and system testing".

This European Norm is applicable to the ground implementation of data link services, derived from the ICAO standard Context Management (CM) and Controller Pilot Data Link Communication (CPDLC) applications and provides presumption of conformity against the essential requirements of the interoperability Regulation EC 552/2004 [i.19].

- ETSI EN 301 489-22 [i.16]: "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Specific conditions for ground based aeronautical mobile and fixed radio equipment; Part 22: Specific conditions for ground based aeronautical mobile and fixed radio equipment".

This European Norm contains requirements to demonstrate that "... *Radio equipment shall be constructed so as to ensure an adequate level of electromagnetic compatibility as set out in Directive 2014/30/EU*" according to the Directive 2014/53/EU [i.17].

- The ETSI Data Link ENs refer also to ETSI EN 300 113-1 [i.3].

The links between these ETSI European Norms and other relevant specifications is shown in figure 1.

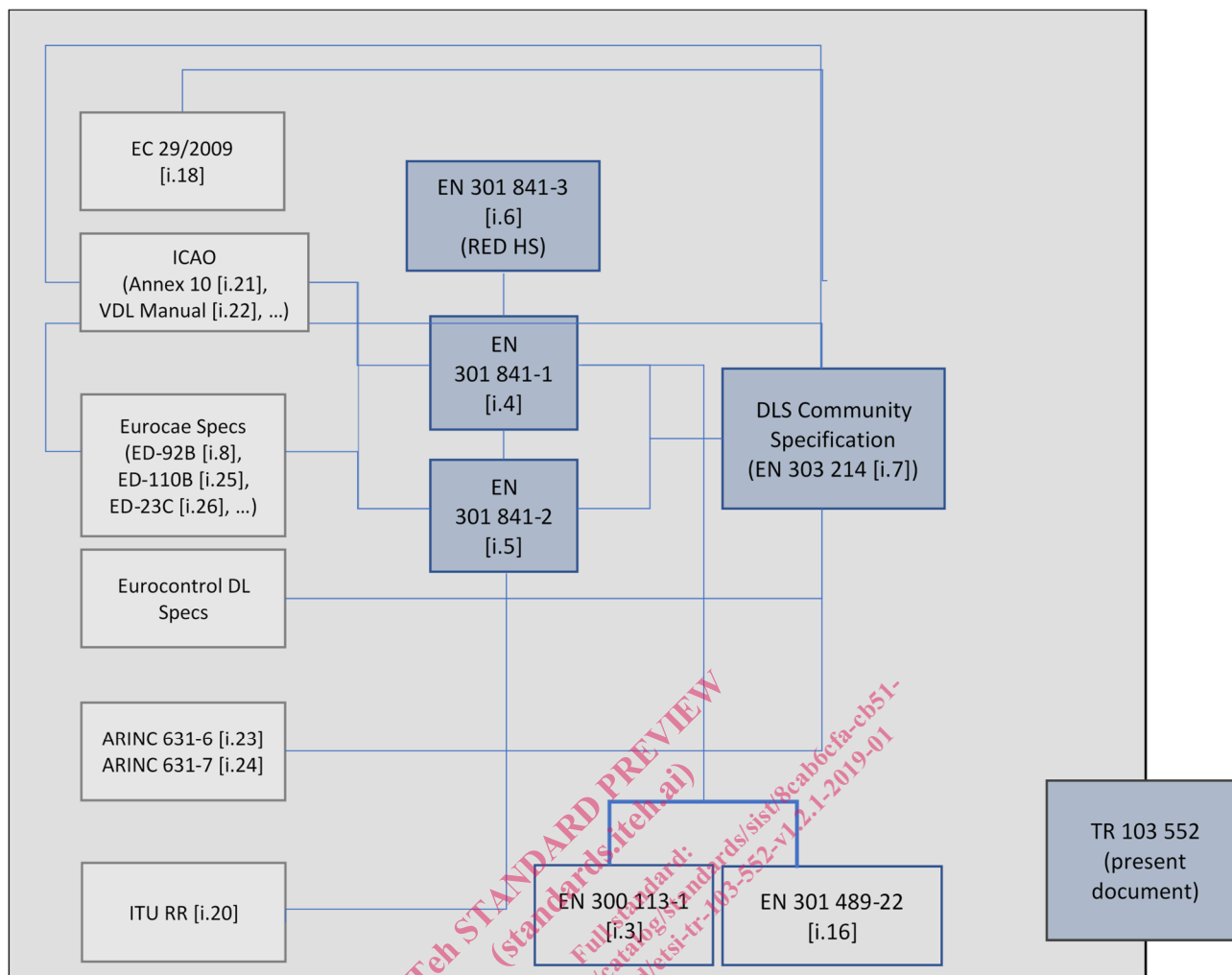


Figure 1: Data Link specifications and their relationship

As a result of ELSA and SDM reports and the mandatory implementation of the i4D services based on DataLink foreseen for year 2022, the above mentioned European Norms will be likely impacted.

The following will be taken into account in this investigation:

- the ELSA report recommendations for improvements to ground systems;
- the SDM Deployment Plan 2016 requirements (2017 is under definition);
- the results from PATH1, PATH2 Projects and operational experience, also considering the DPMG activities;
- end-to-end testing as specifically required by all the previously listed reports and projects considering the traffic load foreseen for AOC and ATS;
- updated references and recent developments;
- ensuring appropriate coverage of (and traceability to) the legislative requirements, and that the standard includes associated conformity assessment material which is necessary and sufficient for an ANSP to demonstrate compliance;
- the need for continual in-service monitoring of datalink performance to ensure ongoing compliance with legislative and operational requirements;
- other improvements and corrections as appropriate.

4.2 Update of References

Specifications normatively referenced might have been revised or even superseded.

In particular ICAO Doc 9705 Edition 2 [i.10] plus the identified defect resolutions contains the baseline technical provisions for the LINK 2000+ Programme [i.1] and remains the primary reference in the EUROCONTROL DLS Specification [i.2] and ETSI EN 303 214 [i.7]. However, it is not available in the current ICAO catalogue.

ICAO Doc 9705 Edition 3 [i.10] does incorporate the identified defect resolutions, but also includes many other additions and amendments. It is available in the current ICAO catalogue.

ICAO Doc 9880 [i.11] was intended to replace Doc 9705 [i.10]. It is available in the current ICAO catalogue as an "Advance Release". One of the identified activities when updating ETSI EN 303 214 [i.7] is to determine precisely which requirements from each document need to be met.

When updating the references to the applicable documents (e.g. ICAO, EUROCAE, etc.) it will be necessary to assess the applicable requirements and verify if they are unconditionally mandatory, or if they are conditional/optional/recommended.

EUROCAE ED-92C [i.28] revises/supersedes ED-92B [i.8].

4.3 Impact of ELSA Report and other relevant Projects/Frameworks

The ELSA final report [i.15] states: "*This (ELSA) comprehensive report indicates several interlinked problems, and provides a preliminary plan in form of concrete actions*". The preliminary plan should now be updated in the light of ongoing datalink deployments and incremental performance improvements.

For each recommendation in section 6 of the ELSA Final Report [i.15], the potential impact on ETSI European Norms is hereafter assessed, with recommendations for revisions where appropriate.

In addition, other relevant projects/frameworks are also assessed with recommendations for revisions of the ETSI Data Link European Norms as appropriate.

For each EN, the clauses that are expected to be impacted are also indicated. However it is understood that modifications could also have an impact to other clauses of the same specification.

NOTE: No impact on the EMC EN 301 489-22 [i.16] is expected.

ELSA Ground-01	Use a dedicated channel for transmissions at the airport in areas with high traffic levels in en-route.
Assessment:	
ETSI standards should cope with any future foreseen traffic level allowing the necessary equipment requirements and related tests. Tests need to demonstrate the capability of the equipment/systems to operate with the maximum number of frequencies. Appropriate end to end test need to be defined.	
Impact on ETSI EN 303 214 [i.7]: Possibly add text to clause 4.1.6 and test case to clause 5. Impact on ETSI EN 301 841-1 [i.4]: None. Impact on ETSI EN 301 841-2 [i.5]: None. Impact on ETSI EN 301 841-3 [i.6]: None.	

ELSA Ground-02	Progressively implement additional VDL2 frequencies in accordance with the traffic level.
Assessment:	
See comment on ELSA Ground-01 above. Appropriate end to end test need to be defined.	
Impact on ETSI EN 303 214 [i.7]: Possibly add text to clause 4.1.6 and test case to clause 5. Impact on ETSI EN 301 841-1 [i.4]: None. Impact on ETSI EN 301 841-2 [i.5]: None. Impact on ETSI EN 301 841-3 [i.6]: None.	