



TECHNICAL REPORT

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

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**Reference**

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RTR/ERM-TGAERO-64

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**Keywords**

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aeronautical, air traffic management, radio,  
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## Foreword

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

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## 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.

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## 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

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## 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].

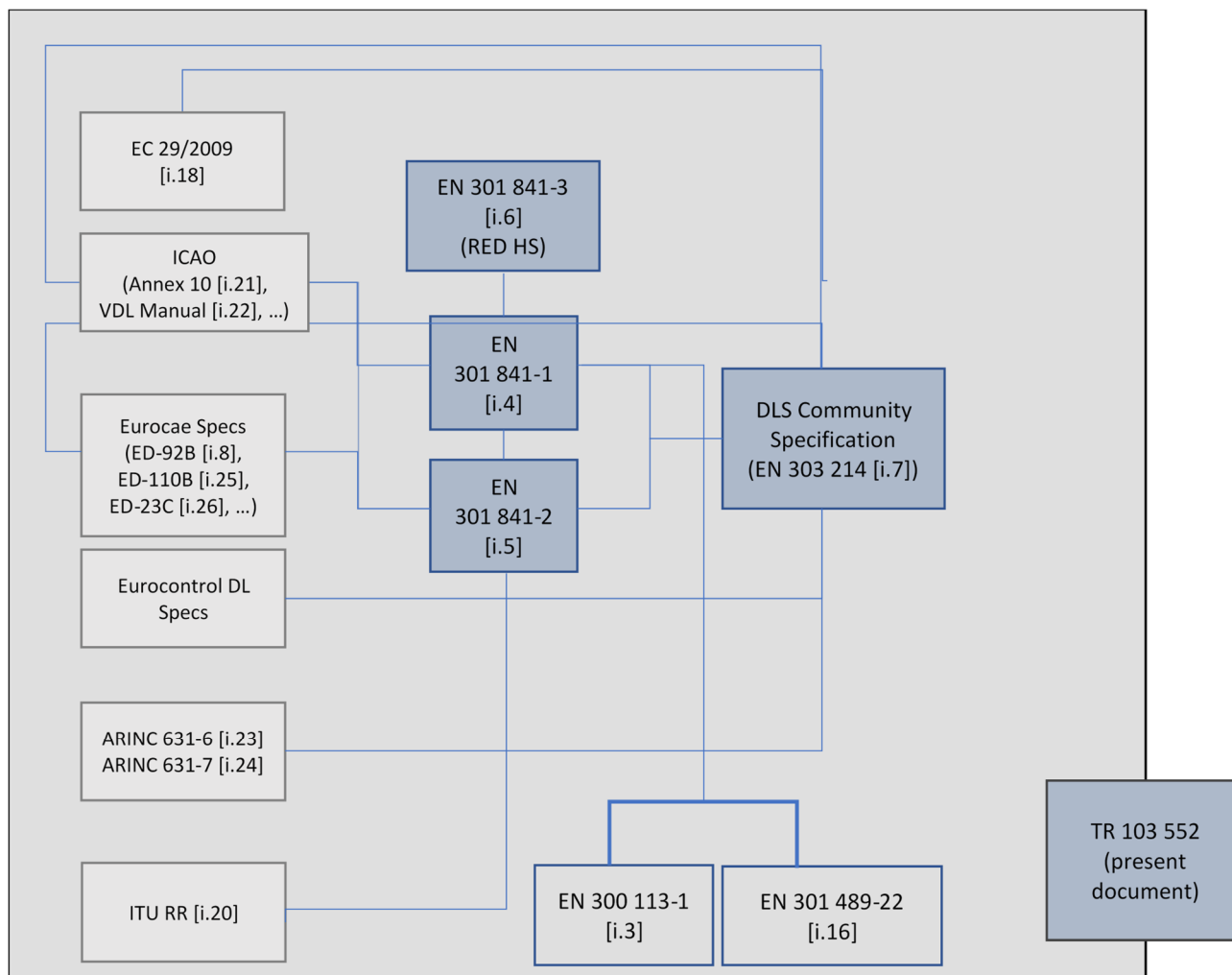
- ETSI EN 301 489-22 [i.16]: "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Specific conditions for ground based aeronautical mobile and fixed radio equipment; Part 22: Specific conditions for ground based aeronautical mobile and fixed radio equipment".

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.

<b>ELSA Ground-01</b>	Use a dedicated channel for transmissions at the airport in areas with high traffic levels in en-route.
<b>Assessment:</b>	
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.	

<b>ELSA Ground-02</b>	Progressively implement additional VDL2 frequencies in accordance with the traffic level.
<b>Assessment:</b>	
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.	

<b>ELSA Ground-03</b>	Optimize the en-route VGS network coverage.
<b>Assessment:</b> 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.	

<b>ELSA Ground-04</b>	Use the CSC as common control channel only, unless traffic level is very low.
<b>Assessment:</b> 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.	

<b>ELSA Ground-05</b>	Implement ELSA recommended protocol optimization: limit the AVLC frame size.
<b>Assessment:</b> The ELSA proposal is to reduce the maximum AVLC frame size for AOA to match the average ATN frame size, in order to reduce channel occupancy induced in case of retransmission, decreasing the probability of uplinks collisions. The proposed value of AVLC N1 parameter is 251 bytes. Therefore, the limitation of AVLC N1 parameter to 251 bytes should be evaluated, as recommended by ELSA.	
Impact on ETSI EN 303 214 [i.7]: Possibly add AVLC N1 parameter value in clause 4.1.6. Impact on ETSI EN 301 841-1 [i.4]: None. Impact on ETSI EN 301 841-2 [i.5]: Possibly update clause 5 (e.g. clauses 5.2.6 and 5.3.5) and 8 in accordance with updates in ETSI EN 303 214 [i.7]. Impact on ETSI EN 301 841-3 [i.6]: None.	

<b>ELSA Ground-06</b>	Ensure the availability of a fifth VDL2 frequency (at a minimum).
<b>Assessment:</b> This is needed in order to achieve a sufficient level of RF capacity.	
Impact on ETSI EN 303 214 [i.7]: None. 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.	

<b>ELSA Ground-07</b>	Favour alternative communications means for AOC, with a priority to the airport domain.
<b>Assessment:</b> ELSA advocates advancing the implementation of alternative (non-VDL/2) AOC communication means. This is not within the scope of ETSI EN 303 214 [i.7].	
Impact on ETSI EN 303 214 [i.7]: None. 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.	

<b>ELSA Ground-08/SDM DP Action Plan</b>	Implement the MF VDL2 target technical solution: in each Service area, one single RF network that operates reserved VDL frequencies supporting two -GSIF channels (see definitions in [i.13]).
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MODELS	VDL RF operating Networks	VDL RF Frequency Use	GSIF on each Frequency announced by each Network	Existing today	Note
A	MULTIPLE	COMMON	ONE	YES	Current Central EU model
B	MULTIPLE	RESERVED	ONE	NO	Target Short term evolution for central EU
C	SINGLE	RESERVED	TWO	YES	Current model deployed in a limited area
D	SINGLE	RESERVED	TWO	NO	Target Long term model for EU VDL network evolution

**Figure 2: DLS Model Description**

**Assessment:**

This ELSA recommendation addresses the implementation of the MF VDL2 target technical solution. The target "model D" is also addressed by the SDM Deployment Program Action Plan (2. Strategic View - paragraph 4). See figure 2.

Provision for the implementation of multiple GSIF announced on each frequency.

Consider Definition of Class D Station, together with a distinction between Model B and Model D Ground Stations, and appropriate test needs to be specified, in line with Regulation EC 29/2009 [i.18].

Impact on ETSI EN 303 214 [i.7]: Add text and test cases in clauses 4 and 5.

Impact on ETSI EN 301 841-1 [i.4]: None.

Impact on ETSI EN 301 841-2 [i.5]: Possibly add text, requirements and test cases in clauses 5.2, 5.3 and 8.

Impact on ETSI EN 301 841-3 [i.6]: None.

<b>ELSA Ground-09</b>	Fix the unbounded retry issue in certain VGSSs.
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**Assessment:**

ELSA noted that in some cases the VGS N2 retry value was unbounded. N2 is specified in ETSI EN 301 841-2 [i.5], so no additional specification is needed. ETSI EN 303 214 [i.7] does not specify any test cases corresponding to requirements in clause 4.1.6 for VDL/2 ground communications equipment. ETSI EN 303 214 [i.7] requires VDL/2 PICS to be completed; CSP declaration should be sufficient.

Impact on ETSI EN 303 214 [i.7]: None.

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.

<b>ELSA Ground-10</b>	Fix the Clear Request issue.
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**Assessment:**

ELSA notes that this issue is already addressed.

Impact on ETSI EN 303 214 [i.7]: None.

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.

<b>ELSA Ground-11</b>	Optimize the Disconnect Mode management.
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**Assessment:**

ELSA observed excessive downlink VDL/2 DM frames. The CSP indicated that an optimization was being implemented. This is out of scope of ETSI EN 303 214 [i.7].

Impact on ETSI EN 303 214 [i.7]: None.

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.

<b>ELSA Standards-01/SDM</b>	Define and implement an effective datalink end-to-end system certification process (including both ground and air components) and reference material for the ground network infrastructure (MOPS-like).
<b>Assessment:</b> Currently ETSI EN 303 214 [i.7] does not specify end-to-end performance tests, as the specified System Testing requirements in clause 5 do not currently cover real effects testing. All tests can be passed in the lab environment, or with a single grounded aircraft, but the real-world performance may still fall below requirements. For this reason, tests should take into account the real-world VDL2 deployment environment, e.g. simulating realistic channel loads to represent a real environment, taking in account the foreseen traffic increase.  Impact on ETSI EN 303 214 [i.7]: Possibly add requirements and test cases in clauses 4.1, 4.2, 4.3 and 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.	

<b>ELSA Standards-02</b>	Include the selected interoperability improvements and clarifications in the relevant standards, and implement the resulting changes.
<b>Assessment:</b> ELSA proposed some possible areas of enhancement to existing base standards, mainly the VDL/2 standards: A) Proposal to merge CPDLC LACK with TP4 ACK would appear to break protocol layering. In practice, CPDLC LACK seems to have been found not useful for ground systems, and appears to be redundant given that TP4 has the same function. B) Removal of IDRP from X25 traffic has been hypothesized, in order to get benefits in terms of capacity. However, there are drawbacks of IDRP Removal, on both Ground and Airborne side. This should be also evaluated and compared to benefits.  In addition to B) it is necessary to clarify the ambiguous definition of the optional/mandatory use of the IDRP in the air/ground routers as it is currently defined in ETSI EN 303 214 [i.7], ICAO Doc 9705 [i.10] and ICAO 9880 [i.11] using different and somehow contradictory definitions. ETSI EN 303 214 [i.7] currently states: "Note: Air-Ground Routers are not required to support the procedures for the optional non-use of IDRP." ICAO Doc 9880 [i.11] specifies ambiguous and contradictory requirements in "table 3.1 ATN Router classes" and "table 3.4 Air-ground route initiation" (same issue in ICAO 9705 [i.10] table 5.2-1 and paragraph 5.3.5.2.16.1.).  Impact on ETSI EN 303 214 [i.7]: to reflect updates to base standards as and when they are modified. To include test cases where appropriate. Possibly to add requirements and related tests for changes in LACK and IDRP usage in clauses 4 and 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.	

<b>ELSA Standards-03</b>	Include updates for MF interoperability in the relevant standards.
<b>Assessment:</b> ELSA [i.15] Recommendation Standards-03 includes a list of possible updates to datalink standards, mostly affecting avionics equipment. One standards recommendation for ground implementations is provided: "Ground stations that provide FSL in XID should advertise all {frequency / ground station} pairs that are available around the transmitter".  Impact on ETSI EN 303 214 [i.7]: Possibly add ELSA FSL XID recommendation in clause 4.1.6, if not covered by VDL/2 base standards. 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.	

<b>Interoperability-01 (operational experience)</b>	Harmonize Max VDL2 frame Size with Max ISO 8208 [i.27] Packet Size.
<p><b>Assessment:</b>          Today some interoperability problems exist, as in some cases GSs and avionics agree on maximum ISO 8208 [i.27] packet sizes not compliant with the agreed Maximum VDL2 Frame Sizes. This leads to interoperability issues (e.g. long frames are in some cases rejected by GSs, and this leads in the end to a/c link disconnection).          This topic correlates with the one related to N1 (N1 = 251 bytes). New requirement to be pointed to the ISO 8208 Max Packet Size.</p> <p>Impact on ETSI EN 303 214 [i.7]: Possibly update clause 5.          Impact on ETSI EN 301 841-1 [i.4]: None.          Impact on ETSI EN 301 841-2 [i.5]: Possibly update clauses 5.2.6, 5.35 and 6.          Impact on ETSI EN 301 841-3 [i.6]: None.</p>	

<b>Interoperability-02 (ELSA D9)</b>	Interoperability between different Service Areas.
<p><b>Assessment:</b>          The behaviour of the System (both airborne and ground side) during aircraft transitions between adjacent SAs with different number of operating channels, or different frequency function assignments (TRM/ENR), should be regulated by appropriate requirements and related test cases. This issue has been already analysed in ELSA D9, clause 4.1.6 "CSP interoperability and coordination".          The ATS need to be guaranteed to all equipped aircrafts whichever is the airborne registered CSP.</p> <p>The definition of the requirements in the MF environment will be the object of the VME/CVME definition process planned in the ongoing SDM projects in coordination with ETSI.</p> <p>Impact on ETSI EN 303 214 [i.7]: Possibly to add requirements and test cases in clauses 4.1, 4.2, 4.3 and 5.          To consider adding a statement /clause to cover the use of multiple CSPs to communicate with aircraft, and detail any additional requirements or notes associated with the use of multiple CSPs.          Impact on ETSI EN 301 841-1 [i.4]: None.          Impact on ETSI EN 301 841-2 [i.5]: Possibly add text, requirements and test cases in clauses 5.2, 5.3, and 8.          Impact on ETSI EN 301 841-3 [i.6]: None.</p>	

<b>Interoperability-03 (SDM)</b>	ATN Routing Ambiguity.
<p><b>Assessment:</b>          Interoperability issues are affecting aircraft flying through currently deployed Service Areas in Europe or at its borders. Verification of interoperability between different Service Areas needs to be introduced in order to solve the ATN Routing Ambiguity issues in handovers between different Service Areas. ETSI has to take in account results of SDM PATH1 and PATH2 on this matter in order to develop adequate requirements and test cases.</p> <p>Impact on ETSI EN 303 214 [i.7]: Possibly add requirements and test cases in clauses 4.1, 4.2, 4.3 and 5.          Impact on ETSI EN 301 841-1 [i.4]: None.          Impact on ETSI EN 301 841-2 [i.5]: Possibly add text, requirements and test cases in clauses 5.2, 5.3, 6, 7 and 8.          Impact on ETSI EN 301 841-3 [i.6]: None.</p>	

<b>Interoperability-04</b>	Quality Of Service Monitoring.
<p><b>Assessment:</b>          Regulation 29/2009 [i.18] requires in article 5.6: "ATS providers shall monitor the quality of service of communication services and verify their conformance with the level of performance required for the operational environment under their responsibility".          As soon as the performance requirements to be monitored will be defined by the appropriate system specifications (e.g. EUROCONTROL) the necessity of creating a specific EN will be evaluated.          ETSI EN 303 214 [i.7] will define the test to be performed to evaluate the conformance of those new requirements.</p> <p>Impact on ETSI EN 303 214 [i.7]: When requirements for ongoing service monitoring will be available it will be possible to evaluate the necessity of defining specific tests.          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.</p>	

<b>ETSI EN 303 214 Review 01</b>	ETSI EN 303 214 [i.7], clause 1 (p9), "should" statements or recommendations in the normatively referenced material (clause 2.1) are to be interpreted as fully normative ("shall").
<p><b>Assessment:</b> This statement has major implications. It requires the unconditional implementation of requirements which the developers of the normatively referenced documents had determined were not always necessary or appropriate. It should be clarified whether these optional requirements have been assessed to determine whether they are actually required for compliance. Some optional requirements may not be required to successfully implement CPDLC.</p> <p>Impact on ETSI EN 303 214 [i.7]: To consider adding a table to provide specific reference to any of the "optional" requirements in a normatively referenced document which are actually required for the presumption of conformity with the legislation. 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.</p>	

<b>ETSI EN 303 214 Review 02</b>	ETSI EN 303 214 [i.7], clause 2.1 Normative References.
<p><b>Assessment:</b> Whole documents or clauses are referenced, but only a subset of the referenced clauses may apply to the ANSP datalink systems. Some normatively referenced documents (e.g. ED-110B [i.25]) have to be reviewed in depth to determine the applicable requirements. Some of the requirements in the normatively referenced documents are ambiguous, such as SR-ACM-10 in ED-120 [i.9]. In the event of conflicting requirements, ETSI EN 303 214 [i.7] gives an order of precedence for documents, which makes determining the correct requirements time consuming and error prone.</p> <p>Impact on ETSI EN 303 214 [i.7]: Expanding on the proposal for Comment 1, consider adding an Appendix with tables detailing the specific clauses of each document that have to be met, effectively removing any duplicate or inconsistent requirements, and adding clarification of requirement intention where appropriate. 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.</p>	

<b>ETSI EN 303 214 Review 03</b>	ETSI EN 303 214 [i.7], clause 2.1 Normative References.
<p><b>Assessment:</b> ICAO Doc 9705 [i.10] was last updated in 1999 and is not being maintained. ICAO Doc 9880 [i.11] amended and replaced Doc 9705 [i.10], and it has the relevant amendments applied, making it much easier to work with. Current operational systems trace their requirements to Doc 9705 Ed 2 [i.10] plus specified amendments.</p> <p>Impact on ETSI EN 303 214 [i.7]: Clarify whether if it is acceptable to use (a subset of) Doc 9880 instead of Doc 9705 [i.10] with the PDRs. If so, provide traceability between Doc 9705 Ed 2 [i.10] (plus amendments) and Doc 9880 [i.11] (some work on this was done by ICAO ATN Panel). 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.</p>	

<b>ETSI EN 303 214 Review 04</b>	ETSI EN 303 214 [i.7], clause 4.2.3 CPDLC Message Elements.
<p><b>Assessment:</b> There are numerous uplink and downlink message types in ICAO Doc 9705 [i.10] that are not included in the tables in ETSI EN 303 214 [i.7]. Even if some of the conditional downlink messages in these tables have conditions listed, some are left as Optional. It is not clear in ETSI EN 303 214 [i.7] the reason why this set of optional messages has been identified, or if ANSPs can implement the message types in ICAO 9705 [i.10] that are not included in ETSI EN 303 214 [i.7].</p> <p>Impact on ETSI EN 303 214 [i.7]: To clarify the significance of the listed Conditional messages which have no associated condition (or to remove these messages if there is no significance and they are not actually required to meet the legislation). 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.</p>	

<b>ETSI EN 303 214 Review 05</b>	ETSI EN 303 214 [i.7], clause 4.2.3.3.2 UM19 "MAINTAIN".
<p><b>Assessment:</b> Pilot interpretation of the UM19 "MAINTAIN" instruction can be inconsistent, and there are some safety concerns around the use of this message. The UK has decided not to implement this message due to these safety concerns.</p> <p>Impact on ETSI EN 303 214 [i.7]: UM19 should be removed from the set of mandatory messages, possibly with a note added to detail the potential issue. 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.</p>	

<b>ETSI EN 303 214 Review 06</b>	ETSI EN 303 214 [i.7], clause 6 Conformity Assessment Materials.
<p><b>Assessment:</b> It is not clear what is expected for clause 6 (e.g. what should be put into the 'Implementation' column?). Completing the tables in this clause does not appear to demonstrate full compliance with all of the requirements in clause 4. ANSP will typically produce a verification cross-reference matrix linking the requirements to evidence. It is not clear if clause 6 requires anything further, or if an ANSP can simply reference a VCRM.</p> <p>Impact on ETSI EN 303 214 [i.7]: To clarify the purpose of clause 6 and how it is meant to be used. Potentially remove this clause or expand it to ensure it provides coverage of all requirements in clause 4. 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.</p>	

<b>ETSI EN 303 214 Review 07</b>	ETSI EN 303 214 [i.7], clauses 4.1.1.2 and 4.1.5.1.
<p><b>Assessment:</b> Clause 4.1.1 deals with G/G Routers, yet the text in clause 4.1.1.2 refers to upper layers and applications. This seems to be an error in importing text from Eurocontrol DLS Specification. Similar comment applies to clause 4.1.5.1.</p> <p>Impact on ETSI EN 303 214 [i.7]: Change text to refer only to ICS requirements. 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.</p>	

<b>ETSI EN 303 214 Review 08</b>	ETSI EN 303 214 [i.7], clause 4.1.1.6.
<p><b>Assessment:</b> The requirement in the referenced table 3 is very unclear and ambiguous. The text in clause 4.1.1.6 states "shall be implemented" but table 3 implies that the IDRPs Hold time value is Optional. And earlier it is stated that normative recommendations are to be interpreted as normative. So is it Mandatory for the ATN Router to implement IDRPs Hold time value of 90 s or not?</p> <p>Impact on ETSI EN 303 214 [i.7]: Clarify the requirement. 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.</p>	

<b>ETSI EN 303 214 Review 09 EASA/SDM</b>	Figure 1: "ATN Data Link System Architecture"
<p><b>Assessment:</b> Figure 1 does not represent correctly the real scenario where more CSP operators can serve the same final ANSP</p> <p>Impact on ETSI EN 303 214 [i.7]: Clause 4.1. Insert new picture defined within Path1 and Path2 projects. 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.</p>	



## 4.4 EUROCAE findings having an impact on ETSI DL ENs

The following list springs from EUROCAE WG-92 investigations.

<b>EUROCAE 01</b>	DISC usage
<b>Assessment:</b> Describe the expected usage of DISC by ground and avionics systems to ensure interoperability.	
Impact on ETSI EN 303 214 [i.7]: None.	
Impact on ETSI EN 301 841-1 [i.4]: None.	
Impact on ETSI EN 301 841-2 [i.5]: Possibly add text, requirements and test cases in clauses 5.2, 5.3, and 8.	
Impact on ETSI EN 301 841-3 [i.6]: None.	

<b>EUROCAE 02</b>	DM usage
<b>Assessment:</b> Describe the expected usage of DM by ground and avionics systems to ensure interoperability.	
Impact on ETSI EN 303 214 [i.7]: None.	
Impact on ETSI EN 301 841-1 [i.4]: None.	
Impact on ETSI EN 301 841-2 [i.5]: Possibly to add text, requirements and test cases in clauses 5.2, 5.3, and 8.	
Impact on ETSI EN 301 841-3 [i.6]: None.	

<b>EUROCAE 03</b>	GRAIHO usage
<b>Assessment:</b> Describe the expected usage of GRAIHO by ground and avionics systems to ensure interoperability.	
Impact on ETSI EN 303 214 [i.7]: Possibly to add test cases in clause 5.	
Impact on ETSI EN 301 841-1 [i.4]: None.	
Impact on ETSI EN 301 841-2 [i.5]: Possibly to add text, requirements and test cases in clauses 5.2, 5.3 and 8.	
Impact on ETSI EN 301 841-3 [i.6]: None.	

<b>EUROCAE 04</b>	GIHO
<b>Assessment:</b> Describe the expected usage of GIHO by ground and avionics systems to ensure interoperability.	
Impact on ETSI EN 303 214 [i.7]: Possibly to add test cases in clause 5.	
Impact on ETSI EN 301 841-1 [i.4]: None.	
Impact on ETSI EN 301 841-2 [i.5]: Possibly add text, requirements and test cases in clauses 5.2, 5.3 and 8.	
Impact on ETSI EN 301 841-3 [i.6]: None.	

<b>EUROCAE 05</b>	Grouped frames
<b>Assessment:</b> There is a misalignment between Air and Ground requirements. Maximum number of frames in a grouped frame in a transmission needs to be limited to 4.	
Impact on ETSI EN 303 214 [i.7]: None.	
Impact on ETSI EN 301 841-1 [i.4]: None.	
Impact on ETSI EN 301 841-2 [i.5]: Possibly to add text, requirements and test cases in clauses 5.2, 6 and 8.	
Impact on ETSI EN 301 841-3 [i.6]: None.	

## 4.5 Additional improvements (Phase 1+)

The list below identifies additional findings having an impact on the ETSI Data Link ENs.

<b>Interoperability-05 (EASA - SDM)</b>	DM 89 no more required by ICAO manual.
<b>Assessment:</b> DM 89 message has been deleted from ICAO material. An analysis leaded by EASA and SDM states that this message is not operational and  Impact on ETSI EN 303 214 [i.7]: Clauses 4.2 and 6.1. Possibly delete the message from 12 and from table 17. 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.	

<b>Interoperability-06</b>	CM Logon ATN B1/B2 interoperability
<b>EASA:</b> There are some inconsistencies related to the interoperability of Ground ATN B1 only infrastructures and ATN B1/B2 avionics.  Impact on ETSI EN 303 214 [i.7]: Clauses 4.1.2; 5.3 and 5.4. Update references, possibly improve test coverage. 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.	

<b>ETSI EN 303 214 Review 10 EASA</b>	Insert missing reference to ISO IEC 8208 [i.27]
<b>Assessment:</b> ISO IEC 8208 [i.27] is missing in reference list (references in Table 2 and Table 9).  Impact on ETSI EN 303 214 [i.7]: Insert reference to ISO IEC 8208 [i.27] in clause 2.1 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.	

<b>ETSI EN 301 841-1 Review 01</b>	TX intermodulation
<b>Assessment:</b> The default value of 70 dB specified for TX intermodulation in clause 6.1.7 is in excess with respect of real installation needs.  Impact on ETSI EN 303 214 [i.7]: None Impact on ETSI EN 301 841-1 [i.4]: Clause 6.1.7 value to be amended. Impact on ETSI EN 301 841-2 [i.5]: None. Impact on ETSI EN 301 841-3 [i.6]: None.	

## 4.6 Summary

Table 1 summarizes and details the topics, raised in ELSA and/or in other past or present frameworks, that need to be discussed for possible modifications of the impacted ETSI ENs. The table also indicates specific clauses of the ETSI Standards that are expected to be impacted. However it is understood that modifications could extend to other clauses, not listed here.

Whenever a clause is indicated in table 1, it is assumed that all of the sub-clauses are potentially included.

For each identified "item for DL improvement", a corresponding development phase is suggested as follows:

- Phase 1: the "item for DL improvement" has already been fully assessed and tested, which means that it can be implemented in the DL standards right away without any further investigation.

- Phase 1+: the "item for DL improvement" can be implemented in the DL standards right away without any further investigation since directly linked to Phase 1.
- Phase 2: the "item for DL improvement" has not been fully assessed and/or tested, which means that further investigations at system level are necessary before updating the DL standards.

Table 1: Summary of proposed improvements in ETSI Data Link European Norms

Reference	Document/Improvement	Summary of proposal	Impacted clauses of ETSI ENs				Proposed Development phase
			ETSI EN 301 841-1	ETSI EN 301 841-2	ETSI EN 301 841-3	ETSI EN 303 214	
ELSA	D11 Ground-01/02/03/04	ETSI standards will have to 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 tests need to be defined.			-	4.1.6; 5	Phase 2
ELSA	D11 Ground-05; D10 Ch.5.3	To evaluate the limitation of AVLC N1 parameter to 251 bytes, as recommended by ELSA.	-	5; 8;	-	4.1.6	Phase 1
ELSA, SDM	ELSA D11 Ground-08 SDM DP Action Plan	To introduce definition of "ELSA Model D VGS": multiple GSIF on each Frequency. To introduce distinction between Model B and Model D VGS, and specify appropriate test.	-	5.2; 5.3; 8	-	4; 5	Phase 1
ELSA, SDM	ELSA Standards-01	To evaluate feasibility of a robust and realistic method of end-to-end testing.	-	-	-	4; 5	Phase 2
ELSA, SDM	ELSA Standards-02	To evaluate the proposal to merge CPDLC LACK with TP4 ACK and evaluate impacts of IDRP removal from X25 traffic (benefits and drawbacks, Ground and Airborne side) and possibly update ETSI standards as appropriate.	-		-	4; 5	Phase 2
ELSA	ELSA Standards-03	Possibly to add ELSA FSL XID recommendation in ETSI EN 303 214 [i.7], if not covered by VDL/2 base standards.	-	-	-	4.1.6	Phase 2
Operational experience	Interoperability-01	To harmonize Max VDL2 frame Size with Max ISO 8208 [i.27] Packet Size.	-	5.2.6; 5.3.5; 8	-	5	Phase 1
ELSA/operational experience	Interoperability-02	To introduce verification of interoperability between different Service Areas, differing e.g. in number of operating channels, or frequency function assignments (TRM/ENR).	-	5.2; 5.3; 8	-	4.1; 4.2; 4.3; 5	Phase 2
Operational experience	Interoperability-03	To avoid ATN Routing Ambiguity issues in transitions between different Service Areas.	-	5.2; 5.3; 6; 7; 8	-	4.1; 4.2; 4.3; 5	Phase 2
ETSI EN 303 214 Review	ETSI EN 303 214 Review 01 - 06	Potential mistakes or ambiguities identified throughout ETSI EN 303 214 [i.7].	-	-	-	1; 2.1; 4.1; 4.2.3; 6; Clause B.1	Phase 2

Reference	Document/Improvement	Summary of proposal	Impacted clauses of ETSI ENs				Proposed Development phase
			ETSI EN 301 841-1	ETSI EN 301 841-2	ETSI EN 301 841-3	ETSI EN 303 214	
ETSI EN 303 214 Review	ETSI EN 303 214 Review 07 - 08	Potential mistakes or ambiguities identified throughout ETSI EN 303 214 [i.7].	-	-	-	1; 2.1; 4.1; 4.2.3; 6; Clause B.1	Phase 1
EUROCAE 01	DISC usage	To describe the expected usage of DISC by ground and avionics systems to ensure interoperability.	-	5.2; 5.3; 8	-	-	Phase 2
EUROCAE 02	DM usage	To describe the expected usage of DM by ground and avionics systems to ensure interoperability.	-	5.2; 5.3; 8	-	-	Phase 2
EUROCAE 03	GRAIHO usage	To describe the expected usage of GRAIHO by ground and avionics systems to ensure interoperability.	-	5.2; 5.3; 8	-	5	Phase 2
EUROCAE 04	GIHO usage	To describe the expected usage of GIHO by ground and avionics systems to ensure interoperability.	-	5.2; 5.3; 8	-	5	Phase 2
EUROCAE 05	Grouped frames	Some old generation VDRs are not able to decode long multi-frames. Maximum of 4 frames in a grouped frame in a transmission.	-	5.2; 6; 8	-	-	Phase 1
EASA	Interoperability 05	DM 89 no more required by ICAO manual. To delete DM 89 reference.	-	-	-	4.2;6.1	Phase 1+
EASA	Interoperability 06	CM Logon ATN B1/B2 interoperability. Update references, increase test coverage.	-	-	-	4,5	Phase 1+
EASA, SDM	ETSI EN 303 214 review 09	Figure 1: ATN Data Link System Architecture. Insert appropriate picture.	-	-	-	4.1	Phase 2
EASA	ETSI EN 303 214 review 10	To Insert missing reference to ISO IEC 8208 [i.27].	-	-	-	2	Phase 1+
PAE	ETSI EN 301 841-1 review 01	The default value of 70 dB specified for TX intermodulation in clause 6.1.7 is well above a real installation needs.	6.1.7	-	-	-	Phase 1+

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## History

<b>Document history</b>		
V1.1.1	June 2018	Publication
V1.2.1	January 2019	Publication