TEXT OF PROPOSED AMENDMENT TO

INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES

ANNEX 10

AERONAUTICAL TELECOMMUNICATIONS

VOLUME III –

COMMUNICATION SYSTEMS

TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

TABLE OF CONTENTS

CHAPTER 13 L-Band Digital Aeronautical Communications System (LDACS)

Insert new text as follows

INITIAL PROPOSAL 1

13.1 DEFINITIONS

Access network. A network that is characterized by a specific access technology.

Airborne station (AS). A station in the mobile service, usually an aircraft, intended to connect to the ground station.

Air/Ground communication service provider (ACSP). Service Provider that provides air-ground communication services via an access network.

Channel assignment. A logical assignment of forward link and reverse link center frequencies programmed to the ground station.

Class of Service (CoS). Represents a set of traffic that requires specific delay, loss, and jitter characteristics from the network. Conceptually, a Class of Service pertains to applications with similar characteristics and performance requirements. Service classes are used consistently within the IPS system.

Forward link (FL). The transmission direction from the LDACS ground station to the LDACS airborne station.

Frequency division duplex (FDD). A duplex scheme where forward and reverse link transmissions occur at different frequencies and may occur simultaneously in time.

Ground station (GS). A generalized equipment set providing connectivity, management, and control of the airborne stations.

L-band Digital Aeronautical Communications System (LDACS). A high capacity terrestrial data link supporting mobile communications in all airspace, i.e. en-route, terminal airspace, and airports.

LDACS handover. The process in which an LDACS airborne station migrates from the air-interface provided by one LDACS ground station to the air-interface provided by another LDACS ground station.

Message in transit. A message in route between source and destination.

Orthogonal frequency-division multiplexing (OFDM). A multi-carrier transmission technique, where the signal is distributed over a large number of orthogonal sub-carrier waves each individually modulated at low bandwidth.

Peak-to-average power ratio (PAPR). The ratio between peak power and average power of a transmission signal.

Reverse link (RL). The transmission direction from the LDACS airborne station to the LDACS ground station.

Secure channel. A path for transferring data between two entities or components that ensures confidentiality, integrity, and replay protection as well as mutual authentication between the entities or components.

Origin:	**Rationale:**
CP/DCIWG	The above definitions are specific to the L-band Digital Aeronautical Communications System (LDACS) and are provided in addition to the general definitions given in Chapter 1, Part 1 of Annex 10 Volume III.

INITIAL PROPOSAL 2

13.2 INTRODUCTION

Note 1.— L-band Digital Aeronautical Communications System (LDACS) is a high-capacity terrestrial data link supporting mobile communications, related to the safety and regularity of flight, in all airspace, i.e. en-route, terminal airspace, and airports.

Note 2.— LDACS is a cellular communications technology derivative with adaptations to meet

a) compatibility requirements to ensure coexistence with other aeronautical systems operating in L-band,
b) in flight communication service requirements for aeronautical telecommunications air-traffic services Baseline 2 (ATS-B2) and beyond, and
c) requirements for other critical services including Aeronautical Operational Control (AOC).

Note 3.— These SARPs list features which are mandatory for interoperability of LDACS equipment. Further details are provided in the LDACS Manual which is ICAO Document 10172.

13.3 GENERAL

13.3.1 LDACS shall support aeronautical mobile (route) service (AM(R)S) communications.

13.3.2 LDACS shall support air-ground communications.

13.3.3 LDACS shall support communications between LDACS ground station (GS) and LDACS airborne station (AS) at distances of up to 200 NM.

Note.— The coverage area of an LDACS GS is adjusted to operational needs and might differ from LDACS GS to LDACS GS. Especially, the coverage area might be smaller than 200 NM.

13.3.4 LDACS shall support a ranging functionality between LDACS ASs and LDACS GSs.

Note.— Each LDACS GS transmits continuously. The LDACS GS transmission signal is used at the LDACS AS to determine pseudo-ranges to the LDACS GSs from which transmissions originated. Further details on the LDACS ranging functionality are described in the LDACS Manual (Doc 10172).

13.3.5 LDACS shall support multiple levels of message priority.

13.3.6 LDACS shall process messages according to their associated priority.

13.3.7 LDACS shall support point to point communication on forward link (FL) and reverse link (RL).

13.3.8 LDACS shall support broadcast communication on FL.

13.3.9 LDACS shall offer acknowledged and unacknowledged bidirectional exchange of user data.

13.3.10 LDACS shall support multiple classes of service simultaneously.

13.3.11 LDACS shall support handover between different LDACS GS during AS movement or on link degradation.

13.3.12 LDACS shall support the global network mobility solution in a multilink environment.

Note.— Further details on the global networking mobility solution and the multilink environment are described in the LDACS Manual (Doc 10172).

13.3.13 LDACS shall be able to operate properly when the LDACS AS moves with a ground speed of up to 850 knots relative to the LDACS GS.

Note 1.— The ground speed value of 850 knots is derived from an aircraft speed of 600 knots plus a tailwind of 250 knots.

Note 2.— The relative movement between GS and AS induces frequency shifts due to the Doppler effect.

13.3.14 LDACS shall support aeronautical telecommunications network baseline 1 (ATN-B1) services.

Note.— ATN-B1 is detailed in EUROCAE documents ED-110B and ED-120.

13.3.15 LDACS shall support air-traffic services baseline 2 (ATS-B2).

Note 1.— ATS-B2 is detailed in EUROCAE documents ED-228A and ED-229A as well as RTCA documents DO-350A and DO-351A.

Note 2.— In addition to ATN-B1 and ATS-B2, LDACS will also cover additional services, e.g. air-traffic services baseline 3 (ATS-B3).

13.3.16 LDACS shall support aeronautical operational control (AOC).

13.3.17 LDACS shall support digital voice services.

Note.— LDACS digital voice will support the same operational procedures as the analogue terrestrial VHF voice services. Further details are provided in the LDACS Manual (Doc 10172).

13.3.18 LDACS shall support the exchange of AOC and ATS services via Aeronautical Telecommunication Network / Internet Protocol Suite (ATN/IPS).

Note.— The Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols (Doc 9896) provides additional information about ATN/IPS based communication.

13.3.19 **Recommendation.—** LDACS should be capable to support the exchange of AOC and ATS services via Aeronautical Telecommunication Network / Open Systems Interconnection (ATN/OSI) and Aircraft Communications Addressing and Reporting System (ACARS).

Note 1.— As LDACS native data traffic is IP-based, this can be achieved, e.g., via data encapsulation or conversion gateways.

Note 2.— The Manual on Technical Specifications for ATN using ISO/OSI Standards and Protocols (Doc 9880) provides additional information about ATN/OSI based communication.

Note 3.— ACARS is a data protocol defined in ARINC Specification 618, published and administered by Aeronautical Radio, Inc (ARINC).

13.3.20 LDACS shall support automatic dependent surveillance - contract (ADS-C).

13.4 RADIO FREQUENCY (RF) CHARACTERISTICS

13.4.1 General Requirements

13.4.1.1 LDACS shall keep total accumulated interference levels within limits defined by the International Telecommunication Union – Radiocommunication Sector (ITU-R) and as required by national/international rules on frequency assignment planning and implementation.

Note.— An AM(R)S system shall operate only in frequency bands which are appropriately allocated to the AM(R)S and protected by the ITU Radio Regulations.

13.4.1.2 LDACS shall limit its maximum equivalent isotropic radiated power (EIRP) as defined in the ITU-R Resolution 417.

Note.— This requirement ensures that LDACS GS and AS transmissions do not interfere with GNSS (Global Navigation Satellite System) systems operating in the band 1164-1215 MHz.

13.4.2 General Radio Characteristics

13.4.2.1 LDACS shall operate in frequency division duplex (FDD) mode.

13.4.2.2 LDACS shall suppport full duplex communications.

13.4.2.3 LDACS shall apply Orthogonal Frequency-Division Multiplexing (OFDM) as basic modulation scheme.

13.4.2.4 LDACS shall support adaptive coding and modulation.

Note.— Further details on the LDACS physical layer including OFDM, coding and modulation schemes are described in the LDACS Manual (Doc 10172).

13.4.2.5 LDACS antenna polarization shall be vertical for both AS and GS antenna.

13.4.2.6 LDACS shall be able to operate without guard bands between adjacent LDACS channels.

13.4.2.7 LDACS co-channel interference rejection shall be at least 14 dB.

Note 1.— This corresponds to a frequency reuse factor of 7.

Note 2.— The figure for co-channel interference rejection ensures that at least all adaptive coding and modulation types involving QPSK modulation fulfill the required bit-error ratio (BER).

13.4.3 Frequency Bands

13.4.3.1 LDACS equipment shall be capable of operating in the frequency band from 960 to 1164 MHz with channel spacing of 500 kHz.

13.4.3.2 LDACS FL shall be assigned to the frequency band 1110 – 1156 MHz.

Note.— ITU-R Resolution 417 restricts the EIRP of LDACS GSs using frequency channels above 1124.5 MHz to be lower than the maximum EIRP as defined in Section 13.4.4.6.

13.4.3.3 LDACS RL shall be assigned to the frequency band 964 – 1010 MHz.

Note 1.— Further details about LDACS RL frequency planning and assignment to ensure interoperability with other L-band systems are described in the LDACS Manual (Doc 10172).

Note 2.— Any LDACS RL channel can be paired with any LDACS FL channel. This allows for more flexibility in LDACS deployment.

13.4.3.4 LDACS nominal frequency of both FL and RL channels shall lie on a 500 kHz grid.

13.4.3.5 LDACS FL and RL channels shall have a unique channel number.

13.4.3.6 Each LDACS channel (LC#n) shall operate at a center frequency (DC subcarrier) as defined in Table 13.4-1.

Note 1.— Table 13.4-1 shows the mapping of all LDACS channels to frequencies.

Note 2.— The mapping scheme for LDACS channels covers the whole band from 960 to 1164 MHz. LDACS channel assignment, however, is restricted to the LDACS FL and RL frequency bands. Especially, no LDACS channels are assigned at 1030 MHz and 1090 MHz with a guard band of at least 20 MHz for both frequencies.

Note 3.— Further details about the LDACS channel assignment are described in the LDACS Manual (Doc 10172).

Table 13.4-1: LDACS channel number assignment

LDACS Channel	Center Frequency
LC#0	**960.0 MHz**
LC#1	960.5 MHz
LC#2	961.0 MHz
…	…
LC#8	964.0 MHz
…	…
LC#100	1010 MHz
…	…
LC#330	1125 MHz
…	…
LC#392	1156 MHz
…	…
LC#408	1164.0 MHz

13.4.4 Radiated Power

13.4.4.1 The EIRP averaged over continuous RL transmissions of an LDACS AS shall not exceed 41 dBm.

Note.— Per design, an LDACS AS is only allowed to transmits after detecting an LDACS GS and synchronizing to it. Thus, LDACS AS does not transmit in areas where there is no LDACS ground infrastructure.

13.4.4.2 LDACS AS shall transmit with a limited duty cycle.

Note 1.— The LDACS RL applies time-division multiple-access (TDMA), i.e. the time resource is divided among all aircraft served by the same LDACS GS. Thus, each aircraft can only transmit for a certain fraction of time.

Note 2.— The LDACS GS assigns resources to the LDACS AS and ensures during this process that no LDACS AS is able to transmit with a duty cycle higher than the maximum allowed duty cycle.

Note 3.— Further details about the LDACS AS duty cycle are described in the LDACS Manual (Doc 10172).

13.4.4.3 LDACS AS shall support power control.

Note.— Power control is applied by the LDACS AS equipment to adjust the transmit power according to the distance to the LDACS GS.

13.4.4.4 LDACS AS power control shall have a dynamic range not less than 50 dB.

13.4.4.5 **Recommendation.—** LDACS AS peak-to-average power ratio (PAPR) should not exceed 11 dB measured directly at the transmitter output.

Note 1.— LDACS is operating in a band where mainly pulsed systems are operating. An LDACS pulse with a peak power higher than 11dB above the average power occurs on average every 700 ms (14 pulses per 10 s) with a duration of less than 1.4 µs in more than 99.9% of the cases. Therefore, these pulses have a duty cycle of less than 0.0002%, if LDACS is transmitting continuously. The LDACS AS duty cycle is assumed to be less than 10% which further decreases the overall duty cycle correspondingly.

Note 2.— The occurrence of LDACS pulses with PAPR higher than 11 dB rapidly decreases. An LDACS pulse with PAPR higher than 13 dB, 15 dB and 17 dB occurs on average every 19 min, 4 years and 18 million years, respectively.

Note 3.— LDACS PAPR is limited by design to a maximum of 17 dB as the number of subcarriers is limited to 50.

13.4.4.6 The EIRP averaged over continuous FL transmissions of an LDACS GS shall not exceed 44 dBm.

Note 1.— The EIRP of an LDACS GS is typically lower than 44 dBm in terminal area and airport environments, since it is adjusted to the lowest required EIRP to cover the GS designated range of operation.

Note 2.— The EIRP of 44 dBm enables an LDACS coverage area of up to 200 NM. Further details about LDACS coverage including link budget calculations are described in the LDACS Manual (Doc 10172).

13.4.4.7 **Recommendation.—** LDACS GS PAPR should not exceed 11 dB measured directly at the transmitter output.

Note 1.— LDACS is operating in a band where mainly pulsed systems are operating. An LDACS pulse with a peak power higher than 11dB above the average power occurs on average every 700 ms (14 pulses per 10 s) with a duration of less than 1.4 µs in more than 99.9% of the cases. Therefore, these pulses have a duty cycle of less than 0.0002% for LDACS GSs which are transmitting continuously.

Note 2.— The occurrence of LDACS pulses with PAPR higher than 11 dB rapidly decreases. An LDACS pulse with PAPR higher than 13 dB, 15 dB and 17 dB occurs on average every 19 min, 4 years and 18 million years, respectively.

Note 3.— LDACS PAPR is limited by design to a maximum of 17 dB as the number of subcarriers is limited to 50.

13.4.5 Minimum Receiver Sensitivity

13.4.5.1 LDACS minimum receiver sensitivity shall ensure that the bit error rate (BER) after decoding is equal to or less than 1×10^{-6}.

Note.— The computation of the minimum receiver sensitivity for LDACS is described in the LDACS Manual (Doc 10172).

13.4.6 Receiver Selectivity

13.4.6.1 LDACS receiver selectivity shall comply with Table 13.4-2 and Figure 13.4-1.

Table 13.4-2: LDACS receiver selectivity values

Passband Ripple (±250 kHz)	within ± 1 dB
Attenuation @ ±300 kHz	> 6 dB
Attenuation @ ±400 kHz	> 40 dB
Attenuation @ ±500 kHz	> 70 dB
Attenuation @ ±750 kHz	> 80 dB
Attenuation @ ±1500 kHz	> 90 dB

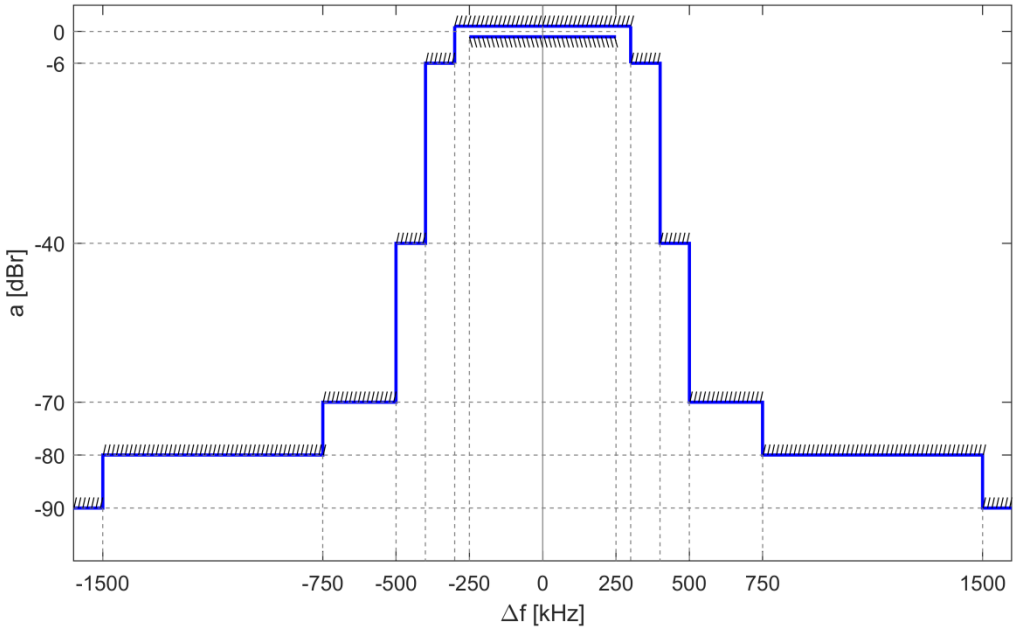

Figure 13.4-1: LDACS receiver selectivity.

13.4.7 Spectral Mask and Emissions

13.4.7.1 The power spectral density of the LDACS signal transmitted by an LDACS GS or an LDACS AS shall comply with the spectral mask as defined in Table 13.4-3 and Figure 13.4-2.

Table 13.4-3: LDACS transmit spectral mask

	A(Δ*f*,*a*)	B(Δ*f*,*a*)	C(Δ*f*,*a*)	D(Δ*f*,*a*)	E(Δ*f*,*a*)	F(Δ*f*,*a*)	G(Δ*f*,*a*)	
Frequency Offset Δ*f*	250.0	337.5	625.0	775.0	1250	2000	4000	>4000
Relative Attenuation *a*	0	34	53	59	69	76	90	90

Note 1.— Δf is the frequency offset in [kHz] measured from the LDACS center frequency.

Note 2.— a is the attenuation in [dBr] relative to the maximum possible LDACS passband power spectral density measured directly at the transmitter output. The maximum possible LDACS

*passband power spectral density is achieved by applying the LDACS transmit power which achieves the maximum EIRP as defined in Section 13.4.4.1 for LDACS AS and in Section 13.4.4.6 for LDACS GS, respectively. In addition, the full transmission bandwidth of 498.05 kHz (51*9.765625 kHz) spanning all 51 subcarriers is applied.*

Note 3.— The frequency coordinates of the points A,…,G are derived from the half channel bandwidth of an LDACS transmit signal, which is 250 kHz:

- *Frequency coordinate for point A [kHz]: 250*1*
- *Frequency coordinate for point B[kHz]: 250*1.35*
- *Frequency coordinate for point C[kHz]: 250*2.5*
- *Frequency coordinate for point D[kHz]: 250*3.1*
- *Frequency coordinate for point E[kHz]: 250*5*
- *Frequency coordinate for point F[kHz]: 250*8*
- *Frequency coordinate for point G[kHz]: 250*16*

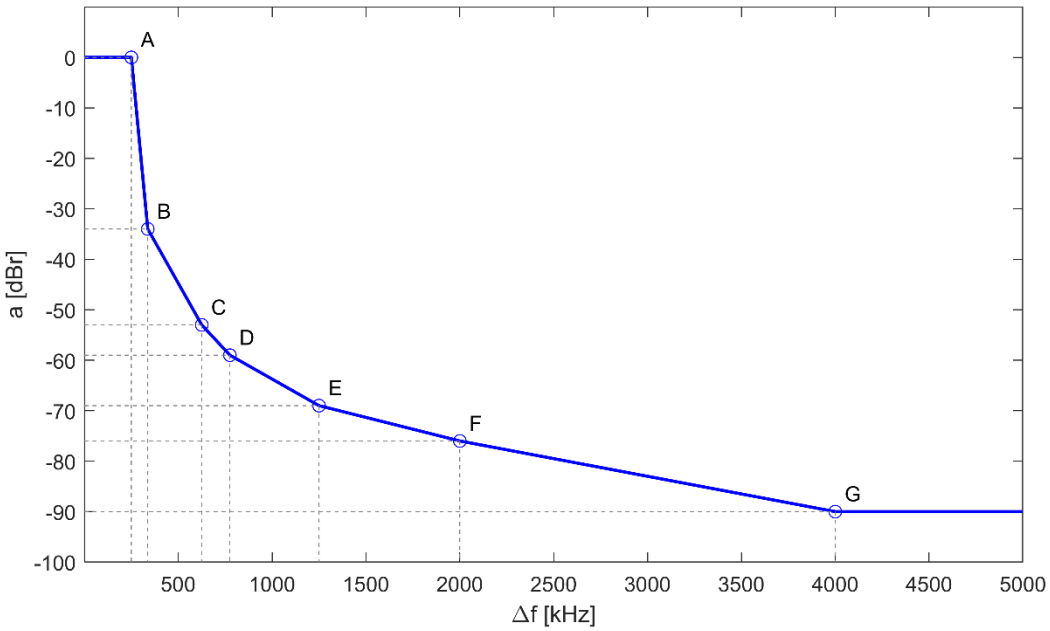

Figure 13.4-2: LDACS transmit spectral mask.

13.4.7.2 The level of any spurious signal produced by an LDACS signal transmitted by an LDACS GS or LDACS AS shall not exceed -36 dBm when measured directly at the transmitter output.

Note 1.— The spurious signal limit applies above 2.5 times the LDACS bandwidth of 500 kHz, which is at an offset of 1250 kHz from the carrier frequency, i.e., above point E of the spectral mask.

Note 2.— Spurious emissions should be measured according to ITU-R SM.329-12, i.e. with reference bandwidth of 100 kHz between 30 MHz and 1 GHz and with reference bandwidth of 1 MHz above 1 GHz.

Note 3. — Spurious signal emissions are evaluated in terms of mean power.

13.4.8 Frequency Tolerance

13.4.8.1 LDACS GS reference frequency accuracy shall be better than ± 0.1 ppm.

13.4.8.2 LDACS AS reference frequency accuracy shall be better than ± 1 ppm.

Origin:	**Rationale:**
CP/DCIWG	The notes in Section 13.2 explain the background of LDACS. Section 13.3 describes the basic function and purpose of LDACS. The requirements for RF characteristics in Section 13.4 ensure that LDACS: a) operates in the AM(R)S spectrum, b) is not affected by the RF transmissions of other aeronautical systems and general radio transmissions, c) does not interfere with other aeronautical systems and general radio transmissions, d) meets the performance requirements given in Section 13.7.

INITIAL PROPOSAL 3

13.5 SYSTEM CHARACTERISTICS OF THE AIRBORNE INSTALLATION

13.5.1 Compatibility With Onboard Equipment

13.5.1.1 Compatibility between LDACS and onboard equipment shall be ensured through proper onboard installation.

Note 1.— Further guidance about compatibility with onboard equipment which might be achieved, e.g., through antenna separation and filtering, is described in the LDACS Manual (Doc 10172).

Note 2.— Additional compatibility requirements are already given in Sections 13.4.1. They limit the LDACS interference levels according to ITU-R requirements in general and especially as defined in the ITU-R Resolution 417 for protection of GNSS operating in the band 1164-1215 MHz.

13.5.1.2 For protection of the Secondary Surveillance Radar (SSR) receiving at 1030 MHz the LDACS out-of-band power spectral density shall be lower than -104 dBm/MHz within the frequency range 1025-1035 MHz measured at the antenna end of the feeder cable of the SSR receiver.

*Note.— The power spectral density has been calculated based on a target I/N of I/N = -10 dB and an SSR receiver noise figure of 7 dB. As LDACS onboard transmission is considered, a duty cycle of at most 10% is assumed. This allows to increase the I/N by 10 dB according to the formula 10*log(duty cycle) for taking into account the reduced impact due to the low duty cycle.*

13.5.1.3 For protection of automatic dependent surveillance - broadcast (ADS-B) and the traffic collision avoidance system (TCAS) receiving at 1090 MHz the LDACS out-of-band power spectral density shall be lower than -113 dBm/MHz within the frequency range 1085-1095 MHz measured at the antenna end of the feeder cable of the ADS-B/TCAS receiver.

Note 1.— The -113 dBm/MHz value is considerably lower than the 1090 MHz transmitter inactive state leakage specified in RTCA documents DO-181 and DO-260 or EUROCAE ED102-A (ADS-B MOPS) and can be as high as -98dBm/MHz.

*Note 2.— The power spectral density has been calculated based on a target I/N of I/N = -10 dB and an SSR receiver noise figure of 4 dB. As LDACS onboard transmission is considered, a duty cycle of at most 10% is assumed. This allows to increase the I/N by 10 dB according to the formula 10*log(duty cycle) for taking into account the reduced impact due to the low duty cycle. As a result,*

interference up to -107dBm/MHz is acceptable. The chosen value of -113 dBm/MHz gives an additional margin of 6 dB.

13.5.1.4 Compatibility between LDACS and the onboard interrogator of the Distance Measuring Equipment (DME) shall be ensured through proper LDACS frequency planning and assignment.

Note.— Further details on frequency planning and assignment are described in the LDACS Manual (Doc 10172), Annex 10 Vol V, and ICAO Document 9718.

13.5.1.5 For protection of the Universal Access Transceiver (UAT) receiving at 978 MHz the LDACS out-of-band power spectral density shall be lower than -104 dBm/MHz within the frequency range 977-979 MHz measured at the antenna end of the feeder cable of the UAT receiver in geographic areas where UAT is operated.

Note.— Guidelines on achieving compatibility between LDACS and UAT in geographic areas where both systems are operated are given in the LDACS Manual (Doc 10172).

13.5.2 Maximal Tolerable Input Interference Power

13.5.2.1 LDACS AS receiver shall tolerate at its input a peak pulsed interference signal power of up to +30 dBm without damage.

Note.— Such a high interference power level may cause signal interruptions or any other performance degradation within the receiver.

13.6 SYSTEM CHARACTERISTICS OF THE GROUND INSTALLATION

13.6.1 Transmit Filtering

13.6.1.1 LDACS transmit filtering shall provide rejection to ensure a sufficient protection to L-band systems which are compliant to ICAO SARPs.

Note.— Further details on transmit filter rejection are described in the LDACS Manual (Doc 10172).

13.6.2 Receive Filtering

13.6.2.1 LDACS receive filtering shall provide rejection to ensure a sufficient protection from other relevant systems.

Note.— Further details on receive filter rejection are described in the LDACS Manual (Doc 10172).

13.6.3 L-band Compatibility for LDACS Ground Station Installations

13.6.3.1 Compatibility between LDACS GS and DME shall be ensured through proper LDACS frequency planning and assignment.

Note 1.— Further details on frequency planning and assignment are described in the LDACS Manual (Doc 10172), Annex 10 Vol V, and ICAO Document 9718.

Note 2.— Additional compatibility requirements are already given in Sections 13.4.1. They limit the LDACS interference levels according to ITU-R requirements in general and especially as defined in the ITU-R Resolution 417 for protection of GNSS operating in the band 1164-1215 MHz.

13.6.4 Timing Requirements for Ground Stations

13.6.4.1 LDACS GSs connected in an access network managed by the same air/ground communication service provider (ACSP) shall be synchronized among each other.

Note.— Details on the implementation of the LDACS GS network synchronization are described in the LDACS Manual (Doc 10172).

13.6.4.2 LDACS GS network synchronization error shall be less than 1.6 µs.

Note 1.— This requirement ensures that an LDACS AS can perform a seamless handover. Since no random access is performed during seamless handover, synchronization accuracy between the LDACS GSs involved in the handover process is required to be less than the OFDM guard time which is 4.8 µs. One third of the OFDM guard time is devoted to the LDACS GS network synchronization error.

Note 2.— LDACS GSs enabling the LDACS ranging functionality may require more stringent synchronization among LDACS GSs, i.e. may require a lower synchronization error than LDACS GS networks without LDACS ranging functionality. Further details on the LDACS ranging functionality are described in the LDACS Manual (Doc 10172).

Origin*:*	**Rationale:**
CP/DCIWG	The requirements in Section 13.5 are specific to the airborne installation and ensure that LDACS: a) is not affected by the RF transmissions of other on-board aeronautical systems, b) does not interfere with other on-board aeronautical systems, c) meets the performance requirements given in Section 13.7. The requirements in Section 13.6 are specific to the ground installation and ensure that LDACS: a) is not affected by the RF transmissions of other aeronautical systems and general radio transmissions, b) does not interfere with other aeronautical systems and general radio transmissions, c) maintains sufficient synchronization among ground stations, d) meets the performance requirements given in Section 13.7.

INITIAL PROPOSAL 4

13.7 PERFORMANCE REQUIREMENTS

13.7.1 LDACS Required Communications Performance (RCP)

13.7.1.1 LDACS shall comply with the technical communications requirements including the required technical communications performance (RTCP) associated with RCP400 and RCP240.

Note 1.— RCP400 and RCP240 as defined in ICAO DOC9869 – PBCS Manual, 2nd Edition.

Note 2.— LDACS has been demonstrated to meet the technical performance specified for RCP130 described in the EUROCAE/RTCA documents ED-228A/DO-350A.

Note 3.— LDACS will meet the technical performance specified for RCP60 as defined in SESAR P15.2.4 Future Data Link System Definition – Deliverable D04 QoS and CoS (P15.2.4-D04).

13.7.1.2 The time required for the log-on procedure of an LDACS AS to an LDACS GS shall be less than 10 s (95th percentile).

Note 1.— The log-on procedure starts with the cell entry request from the LDACS AS and is finalized after successful reception of the cell entry response and subsequent set-up of the requested security level.

Note 2.— The time requirement for the log-on procedure is defined in RTCA document DO-350A for RCP 130.

13.7.2 LDACS Digital Voice Performance

13.7.2.1 The total voice delay of the LDACS system shall be less than 200 ms.

Note.— This requirement is derived from the total voice delay as defined in RTCA document DO-224a. The LDACS system includes the LDACS ground infrastructure and the LDACS airborne system.

13.7.2.2 The voice transmission shall provide overall intelligibility performance suitable for the intended operational and ambient noise environment.

Note.— As an example, SATCOM MASPS (RTCA document DO-343D) refer to a mean intelligibility DRT (Diagnostic Rhyme Test) score of at least 85 when measured in accordance with ANSI/ASA S32-2009 in a jet transport aircraft noise environment.

13.7.3 LDACS Required Navigation Performance (RNP)

Note: The LDACS ranging functionality can be further developed to enable an LDACS navigation functionality. Required Navigation Performance (RNP) of an LDACS navigation functionality needs to be developed under the purview of and together with NSP. Further details on the LDACS ranging functionality are described in the LDACS Manual (Doc 10172).

13.7.4 LDACS Required Surveillance Performance (RSP)

13.7.4.1 LDACS shall comply with the technical surveillance requirements including the required technical surveillance performance (RTSP) associated with RSP400 and RSP180.

Note 1.— RSP400 and RSP180 as defined in ICAO DOC9869 – PBCS Manual, 2nd Edition.

Note 2.— LDACS has been demonstrated to meet the technical performance specified for RSP160 described in the EUROCAE/RTCA documents ED-228A/DO-350A.

Origin*:*	**Rationale:**
CP/DCIWG	The above performance requirements ensure that LDACS: a) supports communication services as main task, including digital voice, b) supports surveillance services, e.g., ADS-C, c) provides the required performance to achieve the appropriate RCP and RSP levels for the different services and applications.

INITIAL PROPOSAL 5

13.8 LDACS SECURITY

Note 1.— The terminology "provide a capability" is used for several of the LDACS security requirements in this Section. It means that LDACS must be able to fulfil this requirement through

respective hardware/software implementation, however, it is not mandatory to always use this provided capability.

Note 2.— Further details on LDACS security are described in the LDACS Manual (Doc 10172).

13.8.1 LDACS shall provide a capability to ensure the availability and continuity of the system.

Note.— The capability includes measures to ensure that the system and its capacity are available for authorized use during unauthorized events.

13.8.2 LDACS shall provide a capability to protect the integrity of messages in transit.

Note.— The capability includes cryptographic mechanisms to provide integrity of messages in transit.

13.8.3 LDACS shall provide a capability to ensure the authenticity of messages in transit.

Note.— The capability includes cryptographic mechanisms to provide authenticity of messages in transit.

13.8.4 **Recommendation.—** LDACS should provide a capability to protect confidentiality/privacy of messages in transit.

Note.— The capability includes cryptographic mechanisms to provide encryption/decryption.

13.8.5 LDACS shall provide a mutual authentication capability between the LDACS airborne and the LDACS ground subsystem.

Note.— The capability includes cryptographic mechanisms to provide mutual peer entity authentication and data origin authentication.

13.8.6 LDACS ground infrastructure shall provide a capability to establish a secure channel between the LDACS ground stations and access networks managed by the same ACSP.

Note.— This channel is used for control plane data exchange, e.g., secure handover and exchange of timing information.

13.8.7 LDACS shall provide a capability to authorize the permitted actions of users of the system.

Note.— The capability includes mechanisms to explicitly authorize the actions of authenticated users. Actions that are not explicitly authorized are denied.

13.8.8 If LDACS provides interfaces to multiple domains, LDACS shall provide a capability to prevent the propagation of intrusions within the LDACS access networks and towards external domains.

Note.— Examples for external domains are access networks provided by different service providers or the Air Traffic Services Unit (ATSU) domain.

13.8.9 LDACS services shall be protected against service attacks to a level consistent with the application service requirements.

13.8.10 LDACS shall provide a security event logging mechanism.

13.9 SYSTEM INTERFACES

13.9.1 LDACS shall provide a data service interface to the system users.

13.9.2 LDACS shall provide a voice service interface to the system users.

13.9.3 LDACS shall support notification of the status of communications.

Note.— Status of communications include, e.g. link quality, supported class of service, join and leave events, and loss of communications.

13.9.4 LDACS shall have a specific security interface for external key and certificate management as well as security indications and access to security logs.

Note.— The LDACS security interface is in line with ICAO Doc 10095.

13.9.5 LDACS shall provide a ranging service interface to system users.

13.10 APPLICATION REQUIREMENTS

13.10.1 LDACS shall support multiple classes of service for communication messages to provide appropriate service levels to communications applications.

13.10.2 If there is a resource contention, LDACS shall pre-empt services with a lower priority than those given in Annex 10 Vol II, 5.1.8.

Origin:	**Rationale:**
CP/DCIWG	The security requirements in Section 13.8 ensure that LDACS: a) provides access control through mutual authentication, b) provides confidentiality, integrity, and availability, c) provides a secure channel as required by ARINC 858. The system interface requirements in Section 13.9 ensure that LDACS: a) provides the necessary system interfaces for voice and data services, b) supports notification of the status of communications, c) provides a specific security interface, d) provides an interface for the ranging service. The application requirements in Section 13.10 ensure that LDACS: a) provides quality of service (QoS) to support the delivery of safety critical communication messages in a sufficiently reliable and timely manner, b) supports pre-emption of low-priority services.

— END —