# L-band Digital Aeronautical Communications System (LDACS)

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Abstract

This document provides an overview of the architecture of the L-band Digital Aeronautical Communications System (LDACS), which provides a secure, scalable and spectrum efficient terrestrial data link for civil aviation. LDACS is a scheduled, reliable multi-application cellular broadband system with support for IPv6. LDACS SHALL provide a data link for IP network-based aircraft guidance. High reliability and availability for IP connectivity over LDACS are therefore essential.

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# Chapter 6 – Requirements to LDACS (1)

- Application area: Communication related to flight safety & regularity

- Challenges:
  - Heavy regulation worldwide and spectrum scarcity
  - Data links **MAY** only use aviation licensed spectrum
  - Not enough bandwidth on terrestrical data links

- Idea/Plan:
  - Use of non-aviation specific data links → security issues exist
  - Aeronautical IP internetwork & Internet **SHOULD** be separated completely

# Chapter 6 – Requirements to LDACS (2)

- Objective of LDACS:
  - **Replace** legacy OSI stack and proprietary ACARS with industry standard IP technology
  - **Provide** a next generation terrestrial data link designed to support IP and provide much higher bandwidth

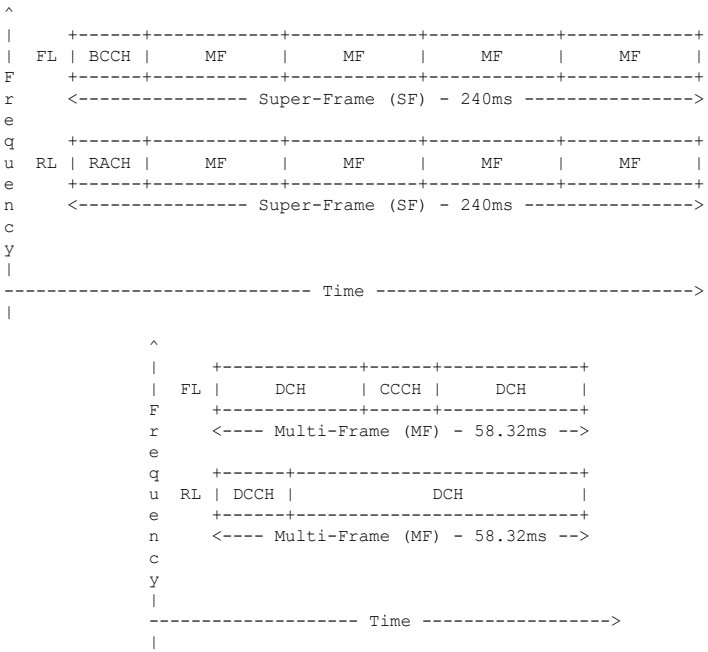
- Requirement for LDACS:
  - **Provide** a terrestrial high-throughput data link for IP internetworking in the aircraft
  - **Interoperability** with IP at the gateway connecting the LDACS network to other aeronautical ground networks is a **MUST**

# Chapter 8 – Reliability & Availability (1)

- PHY layer:
  - OFDM-based Frequency Division Duplex system
  - Deployed in aeronautical communications restrcted L-band with 500kHz bandwidth
  - Guard times allow operations in up to 200 NM range
  - LDACS FL physical layer is a continuous OFDM transmission
  - LDACS RL transmission is based on OFDMA-TDMA bursts
  - User data: Adaptive coding and modulation
  - Control data: most robust coding and modulation

# Chapter 8 – Reliability & Availability (2)

- MAC layer:
  - Static frame structure to support deterministic timer management
  - MAC: Always managed by Ground Station (GS)
  - GS: Handles resource management (Resource requests and allocation)
  - Resource requests: On demand or permanent
  - User data transmissions over LDACS always scheduled by GS
  - Control data uses statically (i.e. at cell entry) allocated recurring resources
  - GS handles cell load (e.g. can force handovers)



# Chapter 8 – Reliability & Availability (3)

- DLL layer:
  - ARQ providing reliable data transmission on layer 2
  - Selective repeat ARQ with transparent fragmentation and reassembly to the resource allocation size
  - Achieving low latency and low overhead without losing reliability
  - Ensuring correct order of packet delivery without duplicates
  - Identifies lost fragments with deterministic timers synced to the medium access frame structure and initiates retransmission
  - Priority mechanism of LDACS ensures the timely delivery of messages with high importance

# Chapter 10 – Security Considerations (1)

- Problem: Changed Threat-Landscape

- Consequences:
  - Future digital communications waveforms require embedded security features
  - Security features require sufficient bandwidth (beyond the capabilities of VHF narrowband communications system)
  - With progress of digitalization (automated procedures such as 4D-Trajectories allowing semi-automated en-route flying of aircraft)

- Strong cybersecurity measures are a **MUST** for LDACS

# Chapter 10 – Security Considerations (2)

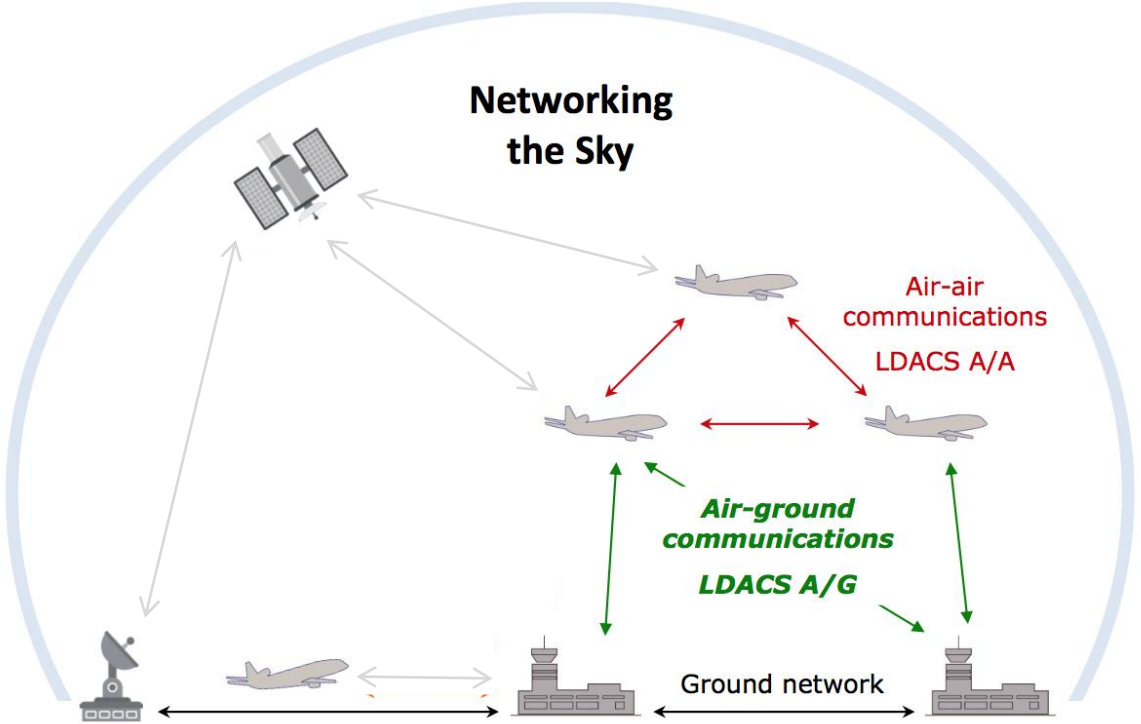
- LDACS's Security:
  - **SHALL** protect availability & continuity
  - **SHALL** protect the integrity of messages in transit
  - **SHALL** provide authenticity of messages in transit
  - **SHOULD** provide confidentiality of messages in transit
  - **SHOULD** provide non-repudiation for necessary messages in transit
  - **SHALL** provide mutual authentication
  - **SHALL** authorize the permitted actions of users & deny actions else
  - **SHALL** provide capability preventing the propagation of intrusions within LDACS domains & towards external domains

# Chapter 10 – Security Considerations (3)

- Resulting Security Architectural Details (Section 10.5):
  - Entities in LDACS Security Mode
  - Matter of
    - Trust in LDACS System
    - Entity Identification
    - Entity Authentication and Key Negotiation
    - Message-in-transit Confidentiality, Integrity and Authenticity

- Security Moduls (Section 10.6):
  - PKI with public key certificates incorporated in the PKI based chain-of-trust
  - Identity management based on aircraft identities & network operator identities
  - Certificates stored in the entities allowing
  - Mutual authentication & key exchange procedures
  - Key derivation mechanisms for perfect forward secrecy
  - User/control plane message-in-transit integrity & confidentiality protection

# Thanks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