



**INTERNATIONAL
CIVIL AVIATION
ORGANIZATION**



Future Communication Infrastructure (FCI)- LDACS

Mr. Michael Schnell

PT-T Rapporteur

Dr Soniya Nibhani

Regional Officer, Air Navigation Services (CNS) Implementation
International Civil Aviation Organization (ICAO)

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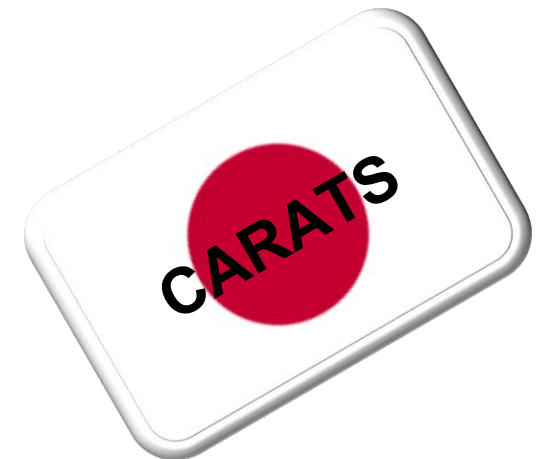
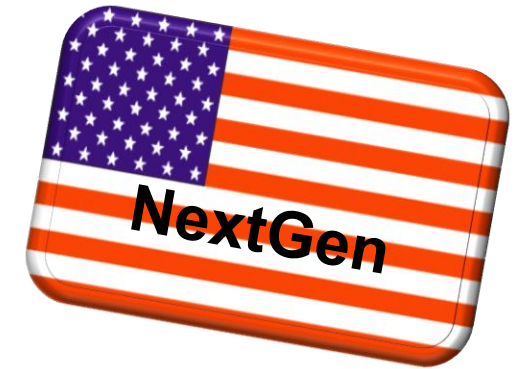
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Motivation

Worldwide ATM modernization

- For increased efficiency
 - Reduce overall ATM costs
- For increased safety and security
 - Stay number one in safety, harden against cyber attacks
- For increased capacity
 - Overcome airspace capacity challenge
- For greener air transportation
 - Higher and continuing public acceptance

Requires modernization of CNS technologies, especially improved and secure connectivity.



Motivation

New ATM concepts require modern data links

- New ATM operational concepts **improve airspace plannability**
- Trajectory-based operations (**TBO**)
 - Precise 4D flight paths for optimized flow
 - Requires continuous data exchange
- **Flight-centric** operation
 - Minimize sector handover overhead
 - Requires automatic connectivity mechanisms
- Existing datalinks have limitations in **bandwidth**, **reliability**, and **security** to support these concepts
- Datalink capacity is key: Modern datalinks and data services are enabler of new ATM operational concepts

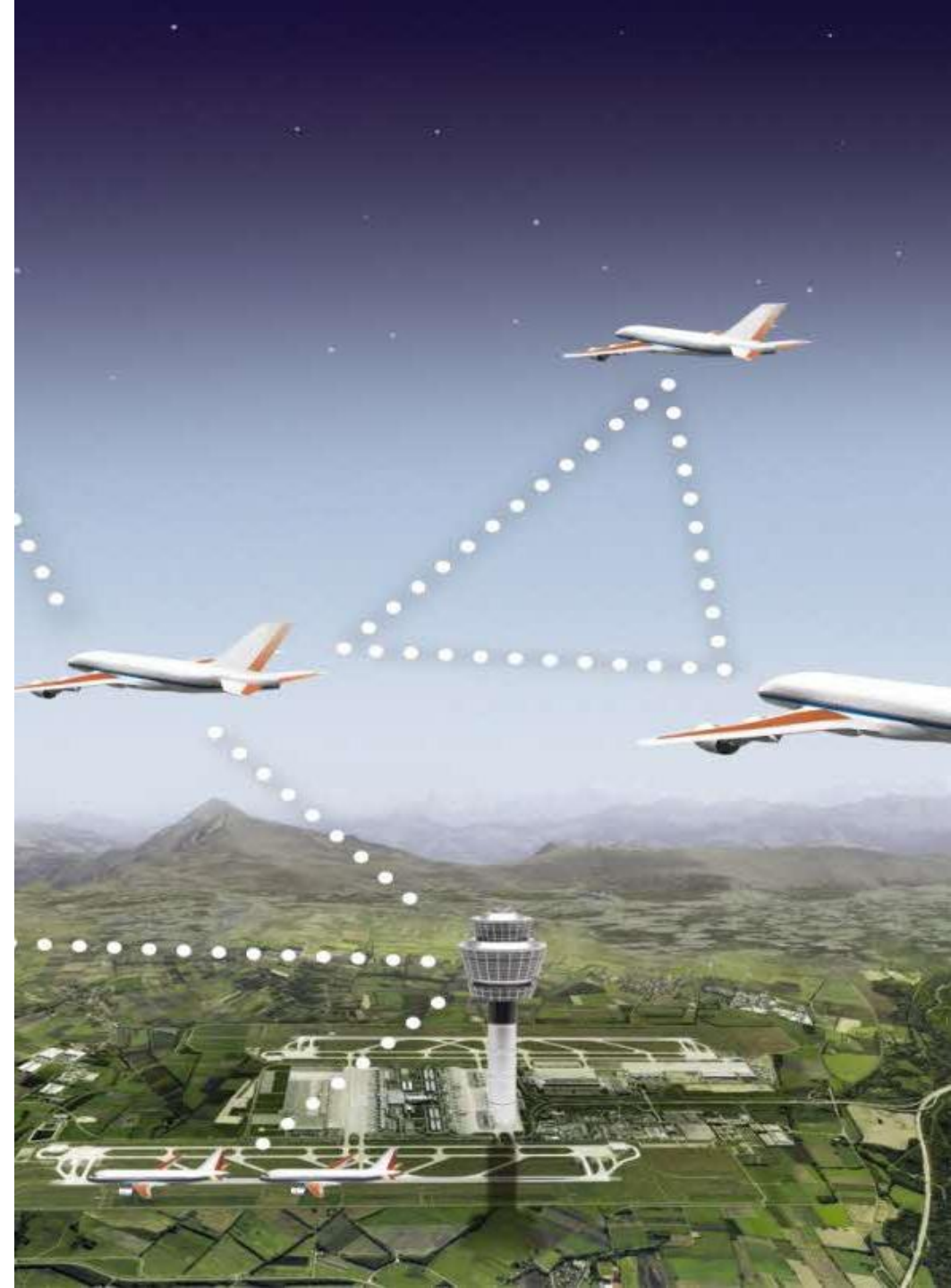


What is LDACS?

Key details

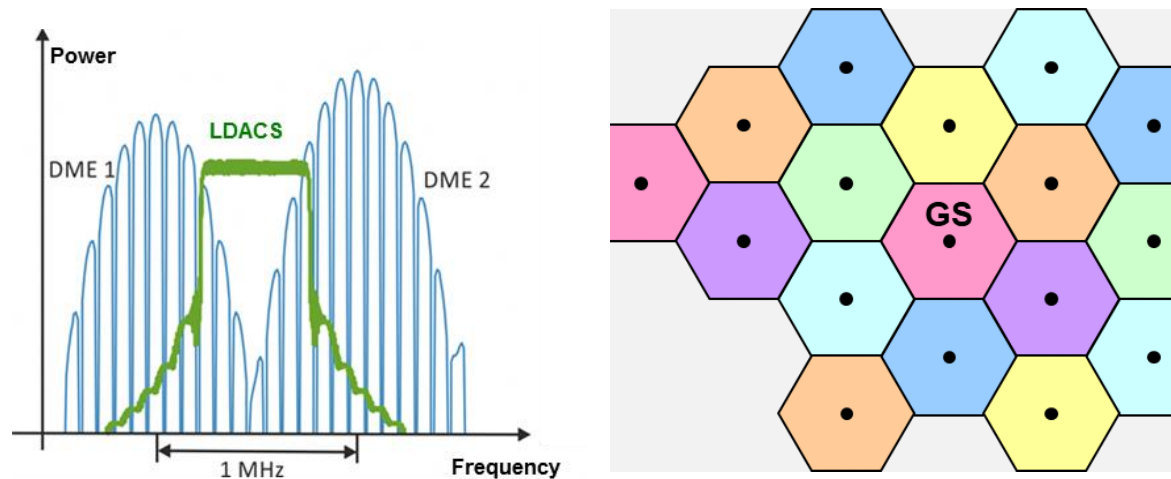
- LDACS stands for L-band Digital Aeronautical Communications System
- The upcoming broadband and secure terrestrial communications system for aviation
- Originally developed under the EUROCONTROL contract and being refined within SESAR 2020
- Exclusively designed for aviation use in a protected aeronautical L-band with AM(R)S allocation
- Well-positioned in SESAR's ATM Master Plan and an essential part of the FCI
- Reflected in ICAO's Global Air Navigation Plan
- Under ICAO standardization (Communications Panel)

LDACS is a **mature technology for aviation!**
Flight trials have taken place in March/April 2019

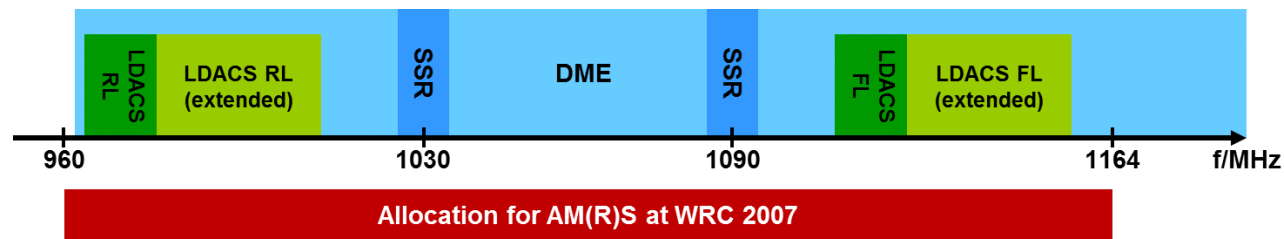


LDACS System Characteristics

Principle of operation



- **LDACS inlay approach:** Deployment in L-band among DME channels
 - Ensuring the right frequency separation and geographic distance
 - Suppression of out-of-band radiation towards other L-band systems
 - Mitigation of L-band interference from other L-band systems



- **Cellular** communications concept
- Apply **FDD** due to the limited bandwidth available with the inlay approach
 - Forward Link: 1110 – 1156 MHz
 - Reverse Link: 964 – 1010 MHz



What does LDACS offer?

A variety of useful features and capabilities

- Broadband Connectivity to enable modern ATM concepts
 - LDACS is based on technology as applied for LTE/4G mobile radio systems
 - High-rate data communications with 550 kbps – 2.6 Mbps per channel (55 – 260 times VDL2)
- Improved communications performance to overcome current deficiencies
 - LDACS provides both data link connectivity and digital voice
 - Low-latency transmission through coordinated channel access
 - Service priorities ensure low-latency and high continuity of service for safety-critical ATS and AOC
 - No co-channel interference problems as experienced during VDL2 data link deployment



What does LDACS offer?

A variety of useful features and capabilities

- Secure transmissions through built-in cybersecurity means
 - Ensuring mutual entity authentication
 - Protecting the confidentiality, integrity and authenticity of messages
 - Ensuring availability and continuity of service

What does LDACS offer?

A variety of useful features and capabilities

- Simultaneous transmission of **ATS and AOC** services
 - Each service transmits according to its **priority**, suitable for the service requirements
 - Transmission of **high-volume AOC data** while ensuring **immediate access for safety-critical services**
 - LDACS covers ATN/B1 and ATS/B2 as well as emerging ATS/B3 and additional future services, including full 4D TBO, flight-centric ATM, secure connectivity to the flight deck, and secure GBAS
- **Integrated CNS**
 - **C**ommunications for ATS and AOC services – **main task**
 - **N**avigation/positioning through ranging to ground stations providing enhanced APNT capabilities
 - **S**urveillance through detection of airborne LDACS transmissions at ground stations
- Potential **extensions** under current consideration
 - Extension towards **direct air-air communications** (LDACS A2A)
 - Extension towards **Command & Control link** for single-piloted aircraft or RPAS

What does LDACS offer?

Special benefits for airlines

- LDACS enables improved and secure aircraft connectivity
 - High-volume, secure AOC and ATS communications for **improved operational efficiency**
 - Secure, private communications for aircraft operators including AOC VoIP connections to aircraft
- LDACS enables modern ATM procedures → increased airspace capacity, reduced delays and costs
 - Full 4D trajectory-based operations and flight-centric ATM for **increased airspace capacity and safety**
 - Air-traffic becomes more predictable and is handled more efficiently, improving **punctuality and costs**
 - Less detours and waiting times/patterns **reduce fuel burn**
- LDACS assists transformation towards greener aviation
 - Modern ATM procedures result in **reduced fuel burn**
 - Noise optimized routes over populated areas **reduce noise foot prints** and increase public acceptance



How will LDACS be deployed?

With a valid business case for airlines/airframers

- **Main guideline:** Re-use existing infrastructure on board and on ground as far as possible to reduce costs
- **Re-use avionics installation**
 - ✓ Bring LDACS on board without an additional antenna or avionics box
 - ✓ Develop a combined VDL/LDACS radio in a single avionics box
 - ✓ Exchange the VHF antenna with a combined VHF-/L-band antenna having the same footprint

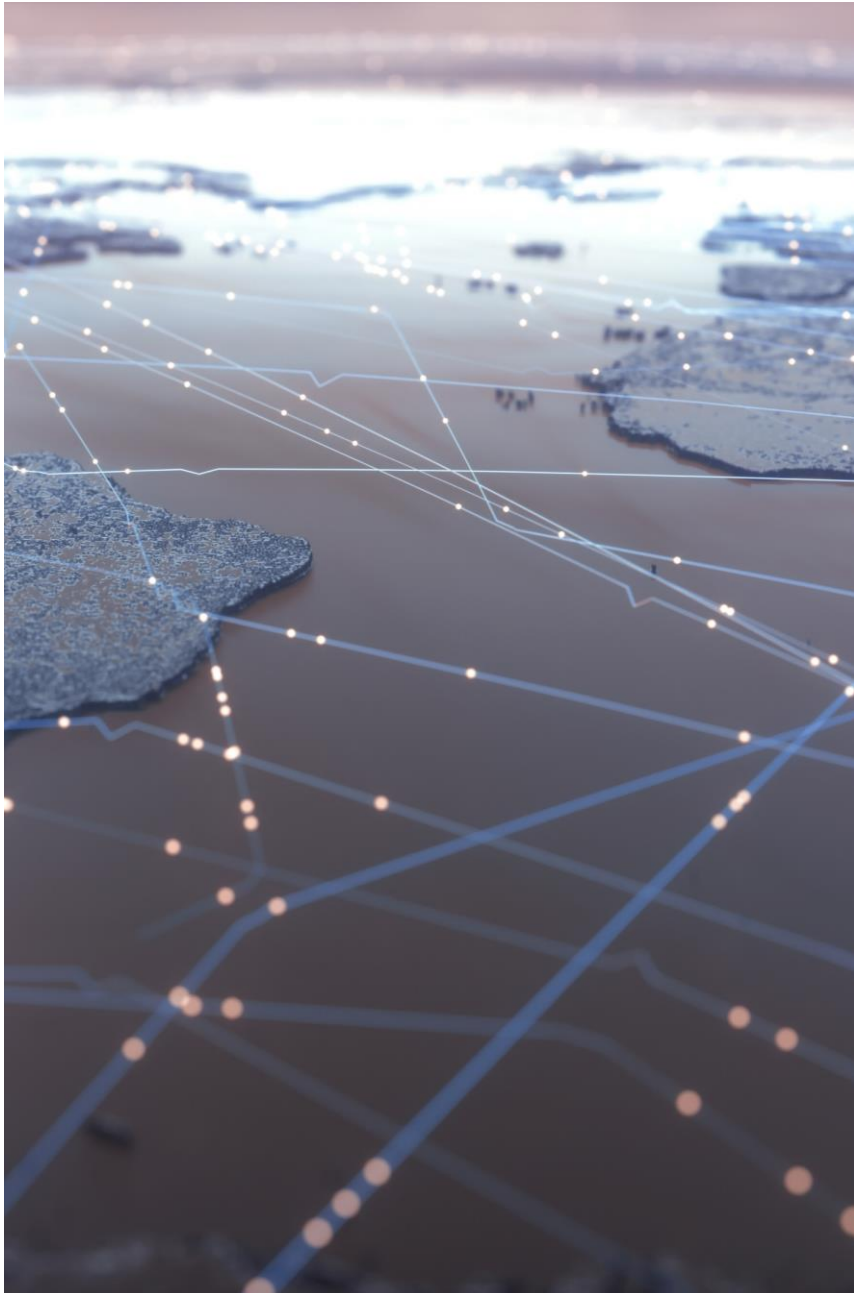


How will LDACS be deployed?

With a valid business case for airlines/airframers

Advantages

- Almost one-to-one exchange of VDL with a combined VDL/LDACS radio
- Reduced aircraft downtimes and reduced installation costs
- Gradual introduction of LDACS is possible, starting where broadband connectivity is needed most
- Aircraft can use LDACS wherever deployed on the ground; otherwise, VDL is used
- Use and return of investment start with the first LDACS ground installation





How will LDACS be deployed?

With a valid business case for CSPs/ANSPs

- **Main guideline:** Re-use existing infrastructure on board and on ground as far as possible to reduce costs
- **Re-use existing ground infrastructure**
 - ✓ The coverage area of a single LDACS ground station is comparable to VDL coverage
- **Advantages**
 - ✓ Ground station installations can be reused
 - ✓ Network infrastructure can be reused



How will LDACS be deployed?

With a valid business case for CSPs/ANSPs

- **Re-use existing service infrastructure**
 - ✓ CSPs can offer a broadband service where available as a complement to the VDL service
- **Advantages**
 - ✓ CSPs can use their infrastructure and client base
 - ✓ Seamless introduction of a broadband service to airlines (AOC) and ANSPs (ATS)

What is the current status of LDACS?

LDACS is well established and under ICAO standardization

- LDACS design is completed, and technical specifications are **available and published**
- Demonstrator equipment has been produced by **Frequentis, Rohde & Schwarz, and Leonardo**
- **First flight trials** using industrial demonstrator equipment have been performed in **March/April 2019**
 - Four LDACS ground stations and one LDACS airborne installation
 - LDACS PHY and MAC layers have been assessed and validated in a realistic environment
 - LDACS functionalities and capabilities have been demonstrated in-flight, including
 - Secure CPDLC and ADS-C-like communications, as well as secure GBAS
 - APNT capability through ranging to ground stations
- **SESAR flight trials** using industrial demonstrator equipment in **July 2022**
 - Two LDACS ground stations and one LDACS airborne installation
 - Validation of ICAO SARPs requirements in flight trials
 - Evaluation of upper protocol layers, including IPS networking and seamless handover
 - Connection to real end-user CPDLC and ADS-C applications

What is the current status of LDACS?

LDACS is well established and under ICAO standardization

- LDACS is well established in
 - ✓ ICAO's Global Air Navigation Plan (GANP)
 - ✓ SESAR's ATM Master Plan
 - ✓ Eurocontrol's future communications infrastructure (FCI)
- ICAO standardization was initiated in October 2016 with the establishment of the ICAO Project Team Terrestrial Data Link (PT-T) under the ICAO Communications Panel (CP).
- The LDACS Provisions for Adoption (PfA) were previously conditionally endorsed by the DCIWG in 2018
- Work on SARPs Validation and LDACS Manual stated in 2019
- The aim was to have an applicable standard from 2024 onwards



What is the current status of LDACS?

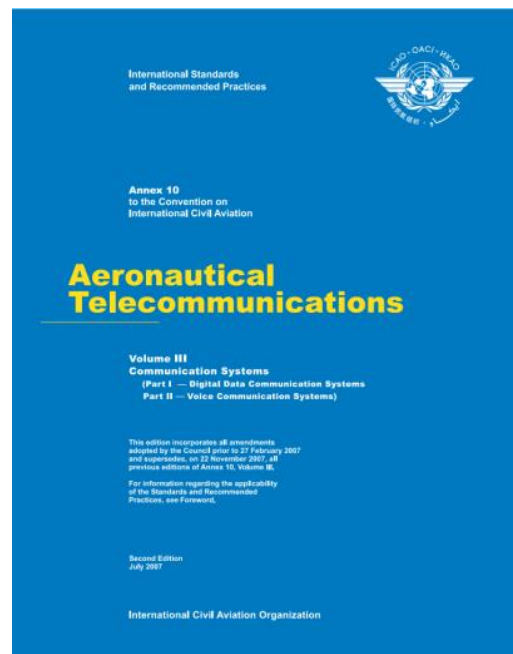
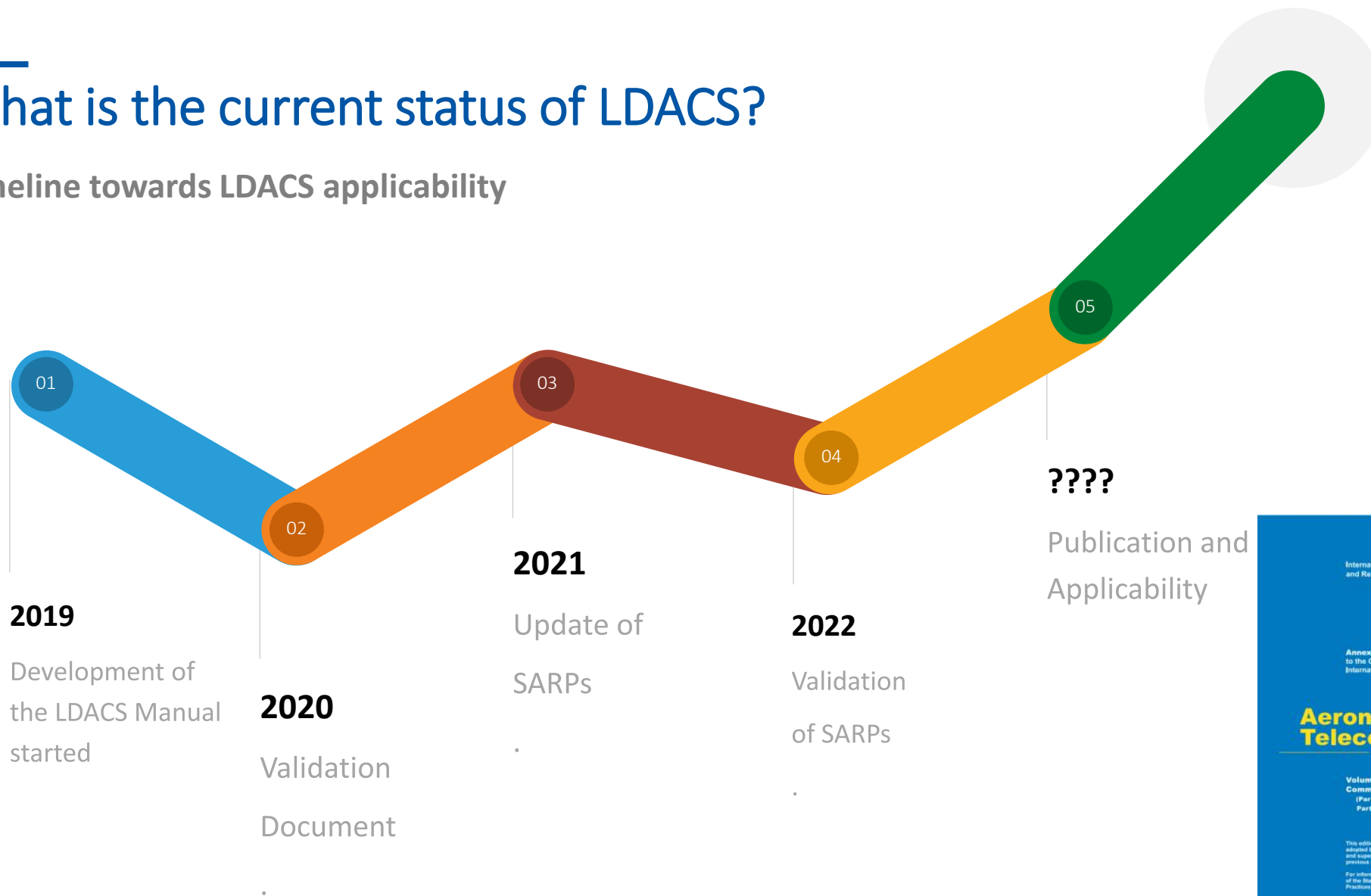
LDACS is well established and under ICAO standardization

- **Current status of ICAO standardization**
 - ✓ Conditions were not met at the time
 - ✓ The package did not progress to the Air Navigation Commission (ANC)
 - ✓ Formation of the LDACS Inter-Panel Task Force (IPTF) to resolve the outstanding technical concerns
 - ✓ ICAO inter-panel review of LDACS SARPs finalized
 - ✓ Update of LDACS SARPs based on comments from other ICAO Panels
 - ✓ Finalization of LDACS SARPs validation



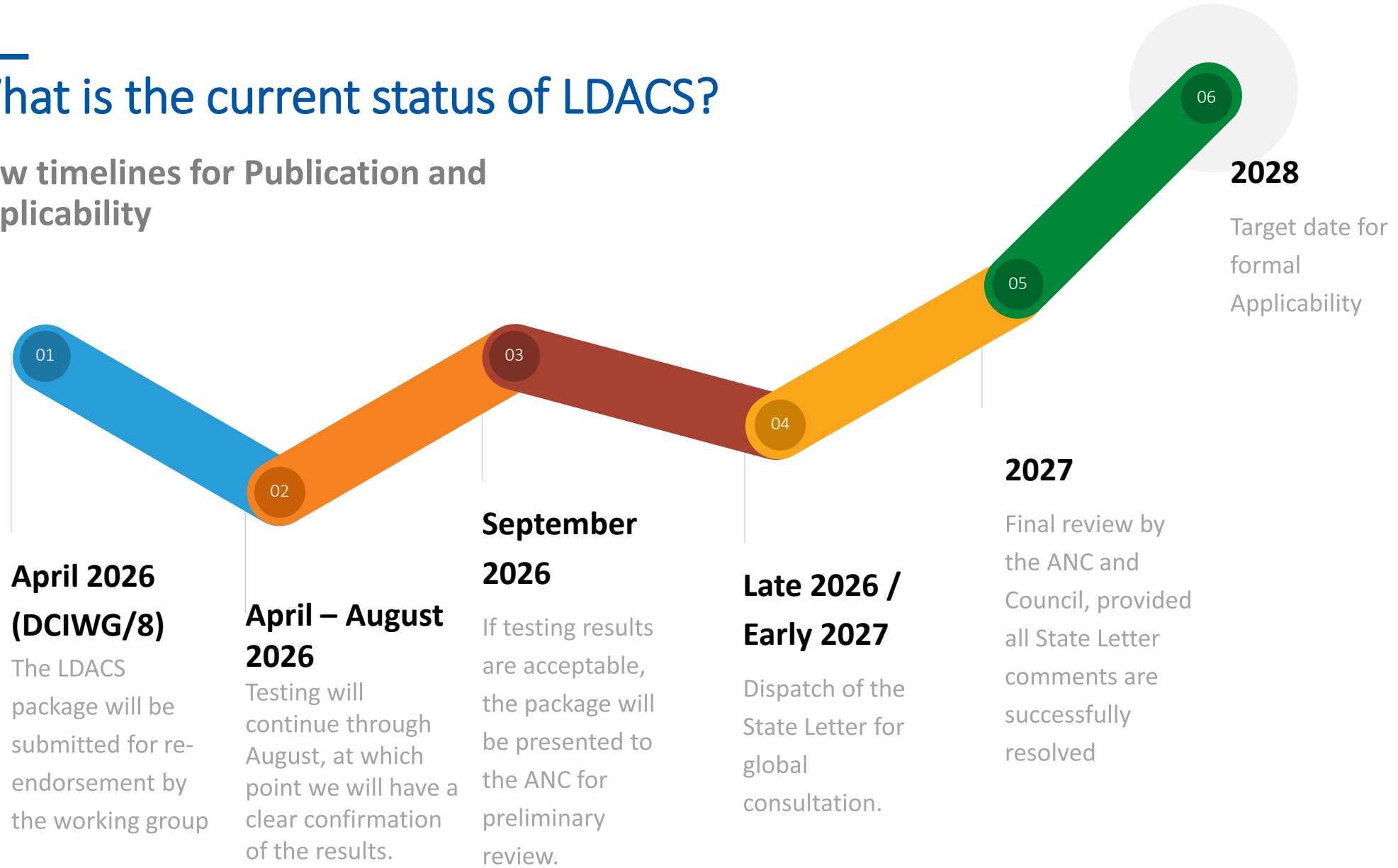
What is the current status of LDACS?

Timeline towards LDACS applicability



What is the current status of LDACS?

New timelines for Publication and Applicability



Conclusion

LDACS- A journey towards future system



Objectives

The central goal is improving overall operational efficiency.



Principles

- The digital transformation of air traffic management (ATM).
- Removing the air-ground connectivity bottleneck



Plan

- Future air-ground connectivity architecture- a multilink approach.
- Overcome datalink coverage and capacity limitations in specific areas
- Additional bandwidth and also deliver high operational performance



Why LDACS?

- High-throughput terrestrial datalink operating in the L-band
- Developed and validated over several years
- Distributed and fully open technology
- Provides global interoperability and ensures sovereignty of ground infrastructure for increased control of airspace



LDACS represents an essential pillar supporting the digital transition of aeronautical communications and is ready to play a main role in the FCI multilink infrastructure in continental airspaces, which is essential to cope with the predicted traffic growth and to achieve of carbon-neutrality targets.

Who are the Partners and Supporters?

“Founding Members” and Development Partners



Who are the Partners and Supporters?

Additional ICAO PT-T Supporters

You are invited to join!



Thank You

