Outline

• Background
  • SESAR2020 Programme
  • SESAR2020 PJ.14-02-01 "FCI Terrestrial Data Link"

• Project Status
  • LDACS Standardization Activities
  • LDACS Development Activities
    • LDACS High-Level Architecture
    • LDACS Prototypes
  • LDACS Technical Validation Activities

• Future work
Background – SESAR2020

SESAR (Single European Sky ATM Research) is going to modernise European ATM by defining, developing and delivering new or improved technologies and procedures (so-called SESAR Solutions).

SESAR Solutions PJ.14-02-01 "FCI Terrestrial Data Link" is part of the SESAR2020 Project PJ14 "Essential and Efficient Communication Navigation and Surveillance integrated system - EECNS"

The solutions developed and delivered by SESAR are divided into four key areas of ATM (key features), reflecting these stakeholders and their business interests.

**Enabling aviation infrastructure**

The enhancements described in the first three key features will be underpinned by an advanced, integrated and rationalised aviation infrastructure, providing the required technical capabilities in a resource-efficient manner.

Communications, navigation and surveillance (CNS) systems (like for instance LDACS) are considered in a coordinated way for application across the ATM system in a globally interoperable and harmonised manner.
SESAR2020 – Solutions

L-BAND DIGITAL AERONAUTICAL COMMUNICATIONS SYSTEM (LDACS) ACTIVITIES IN SESAR2020 – ICNS 2018
## Key Facts – Project Partners

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<th>Frequentis (FSP) – Solution Lead</th>
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<td>Leonardo</td>
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<td>DLR (AT-One), incl. sub-contractor R&amp;S</td>
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<td>EUROCONTROL</td>
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SESAR2020 PJ.14-02-01 "FCI Terrestrial Data Link "
Key Facts – Project structure

PJ14-02-01 FCI Terrestrial Data Link
FREQUENTIS

T01 LDACS Technical Requirements
DLR (AT-One)

T02 LDACS Architectural System Design Specification
LEONARDO

T03 Integration of a ranging functionality into LDACS
DLR (AT-One)

T04 LDACS System Prototype Specification and Development
FREQUENTIS

T05 LDACS System Prototype Verification Activities
LEONARDO

T06 Support to standardisation
EUROCONTROL
SESAR2020 PJ.14-02-01 "FCI Terrestrial Data Link "
Key Facts – GANTT (major tasks)

Legend:
TVALP: Technical Validation Plan
LDACS – At a glance

Multi-application cellular broadband system
- Supports Air Traffic Services (ATS) and Aeronautical Operational Control (AOC) communications services
- Optimized for data link communications, but also supports air-ground digital voice communications
- Supports communication in all airspaces (airport, TMA, and en-route), and on airport surface
- LDACS cell coverage is de-coupled from the operational coverage for a particular service
  - Services requiring wide-area coverage are installed at several adjacent LDACS cells
  - Handover between the involved LDACS cells is seamless, automatic, and transparent to the user
- Star topology
- Airborne stations (AS)
  - Ground station (GS)
    - AS must register at the controlling GS
    - GS controls its ASs
    - GS manages all resource requests
- Broadcast and addressed A/A data link (optional)
SESAR2020 PJ.14-02-01 "FCI Terrestrial Data Link "

Scope

Develop and progress standardization of the candidate future terrestrial data link system, called LDACS.

• Prepare a specification for the LDACS A/G link (including also support for ranging)
• Specify the LDACS high-level architecture (including security and digital voice concepts)
• Develop and technically validate these specifications and concepts with fully functional LDACS prototypes
• Analyse potential concepts for the seamless transition from existing data link technologies to LDACS
• Support international bodies in the standardization of the LDACS technology
• Define requirements for A/A
LDACS Standardization Activities

Currently, there are no standards and regulations for LDACS available.

- These standards need to cover the frequency aspects (signal in space and interference), performance avionics, etc.

LDACS standards are expected to be delivered from ICAO, EUROCAE/RTCA, AEEC.

- If in the future there will be a regulation associated with an LDACS deployment in Europe, regulatory standards (i.e., Implementing Rules) may also be required to be developed by the European Commission.
LDACS Standardization Activities - Status

ICAO:
• Project Team „Terrestrial Data Link” (PT-T) of the ICAO Communications Panel (CP) plans to develop:
  • Initial standards by the end of 2018,
  • Initial technical guidance material (Manual) by 2020,
  • Final LDACS SARPS in 2026.

EUROCAE:
• LDACS standardization activity in EUROCAE has been discussed and a EUROCAE group to support this activity has already been identified (Working Group 82).
• Activities in EUROCAE will be launched as soon as substantial progress with the standardization work in ICAO has been achieved (projected kick-off of LDACS standardization activities at the end of 2018).

AEEC:
• There have been briefings about LDACS to AEEC and LDACS is identified as a future development activity.
• Currently, it is considered too early to initiate an activity in AEEC.
The LDACS ground network reference model comprises several entities:

- ground-stations (GS),
- ground-station controller (GSC), AAA server,
- access router (AC-R) and
- A/G router (A/G-R).

Reference Point R1 consists of the protocols and procedures between an aircraft and a GS as part of the LDACS air interface (physical layer and medium access layer).
LDACS Development Activities – Status

LDACS Prototypes

Project PJ.14-02-01 will develop and verify fully functional LDACS prototypes.

Three project partners will contribute to the development of the validation platform:

• Frequentis (LDACS radios, routers)
• LEONARDO (LDACS radios, routers)
• AIRTEL (onboard and ground ATN B1/B2 applications)

Main aim of the subsequent validation exercises is:

• to validate the air interface requirements and
• to support the validation of ATN IPS infrastructure.
Validation Infrastructure

The LDACS Validation Platform consists of the following components:

• **Onboard Application and End System** denotes transport and application functions (above layer 3) that provide technical communications services for aircraft systems.

• **Airborne Router** describes layer 3 functions that perform link selection and inter-technology handovers for aircraft systems (Note: an airborne router is probably not available for the validations in this solution).

• **LDACS Airborne Station**: physical airborne radios that provide radio communication (conform to the LDACS A/G specification) and a layer 3 interface to the Airborne Router.

• **LDACS Ground Station(s)**: physical ground radios that provide radio communication (conform to the LDACS A/G specification) and a layer 3 interface to a Router.

• **Air/Ground Router** is a boundary router within the access provider infrastructure that facilitates air-ground data transmission.

• **Ground Application and End System** denotes transport and application functions (above layer 3) that provide technical communications services for ground end systems.
PJ-14.02.01 Planned Technical Validation Exercises
(4 Exercises)

• LDACS Conformance Testing:
  • (1) EXE 1: Validation of the RF front-end and physical layer conformance (transmitter & receiver) with regard to the LDACS A/G specification and the LDACS ranging concept.
  • (2) EXE 2: Validation of the conformance to the LDACS specification, in terms of:
    • Radio and physical layer conformance (transmitter & receiver performance, channel coding, OFDM structure);
    • TX-RX tests between airborne and ground station.

• (3) EXE 3: LDACS Interoperability Testing:
  • Technical validation of the interoperability of different LDACS prototypes, manufactured by different vendors, over the air interface

• (4) EXE 4: LDACS E2E Testing:
  • Technical validation of the interoperability of LDACS airborne and ground prototypes with the ATN/IPS ground network (including the verification of airborne and ground IP interfaces).
  • Technical validation of the LDACS mobility support, i.e., exchange of ‘LDACS – A/G mobility management information’ during LDACS airborne handoff.
Outlook

2018
• Finalization of development of prototypes
• Definition of initial Technical Validation Plan (TVALP)

2019
• Validation of prototypes
• Production of Technical Validation Report (TVALR)
• Preparing an updated Technical Validation Plan (for the next phase)
• Refining the LDACS A/G Specification serving as baseline for ongoing LDACS standardization

The SESAR2020 framework foresees that current activities (wave 1) will be completed in 2019 and new activities (wave 2) will be defined to continue the required work (2020 and beyond).
Thank you very much for your attention!