# Civil Aviation Datalinks

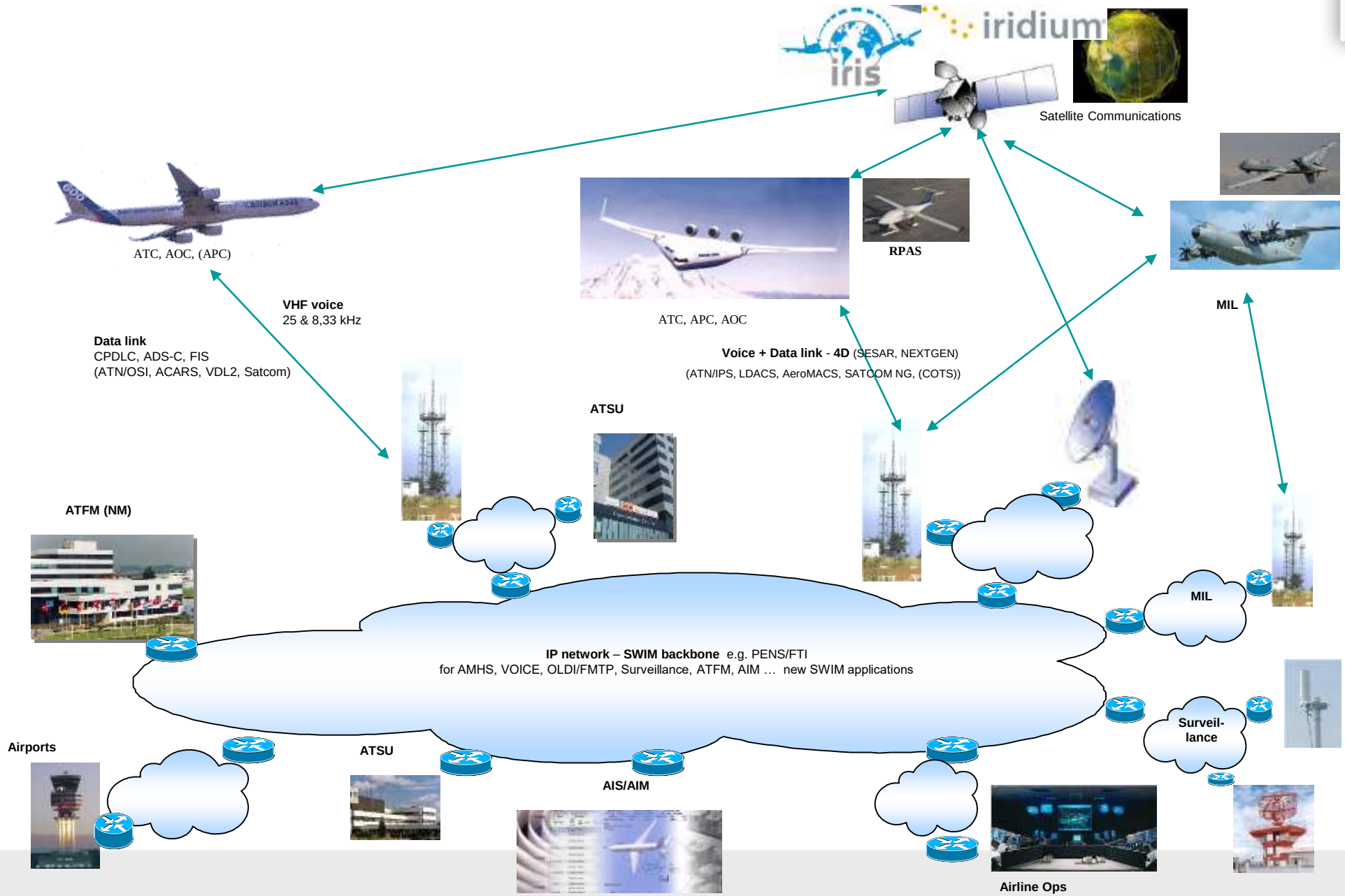
## Future Communication Infrastructure / LDACS
**Presentation to TCF 2022**

Bart VAN DEN EINDEN
Civil-Military CNS Unit
EUROCONTROL CMC

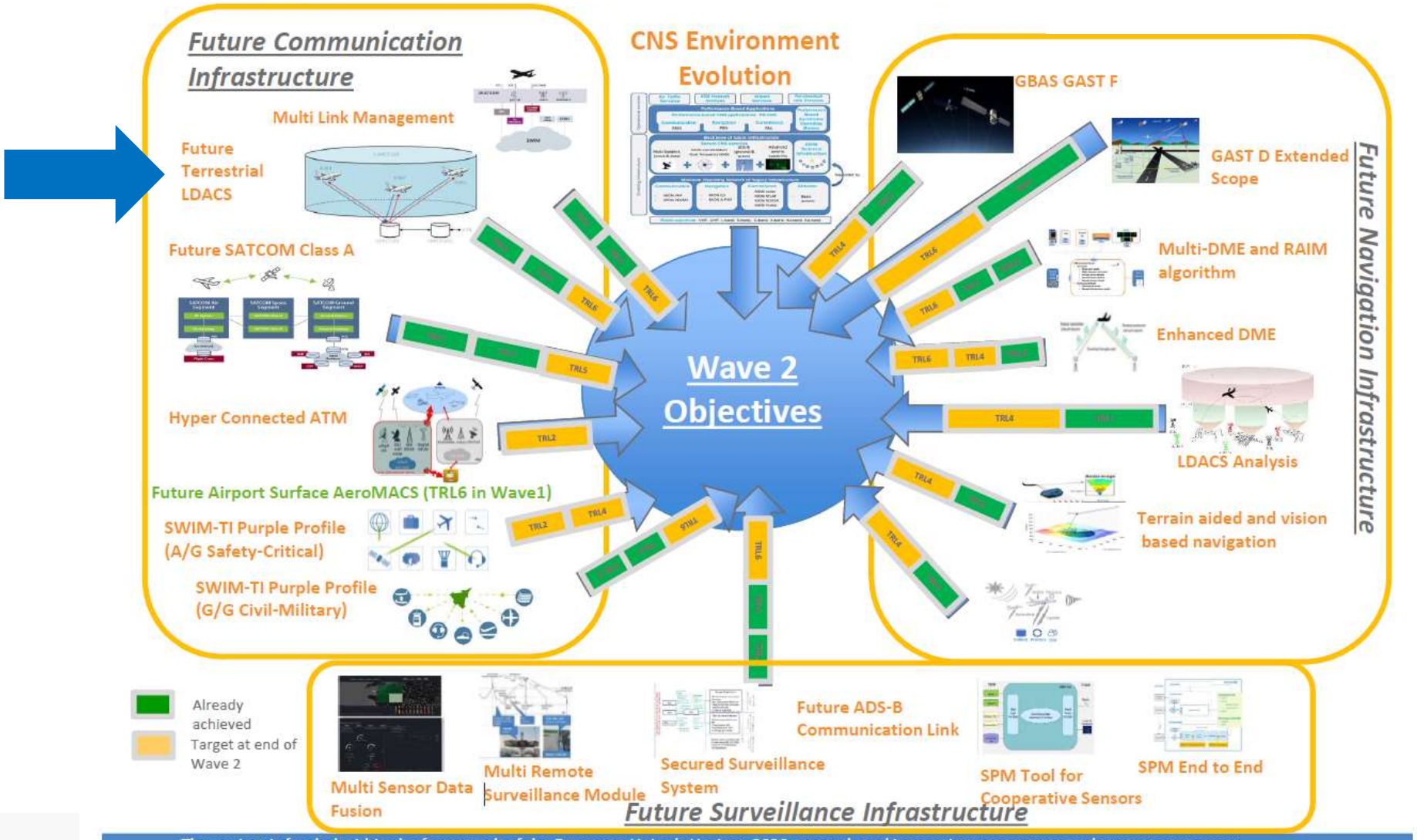
# Outline:

- Future COM infrastructure
- R&D Integrated CNS
- LDACS
  - Compatibility Measurements
    - DME/TACAN
    - JTIDS/MIDS

# Future Communications Infrastructure



# R&D Integrated CNS / SESAR2020 Wave 2 Project 14

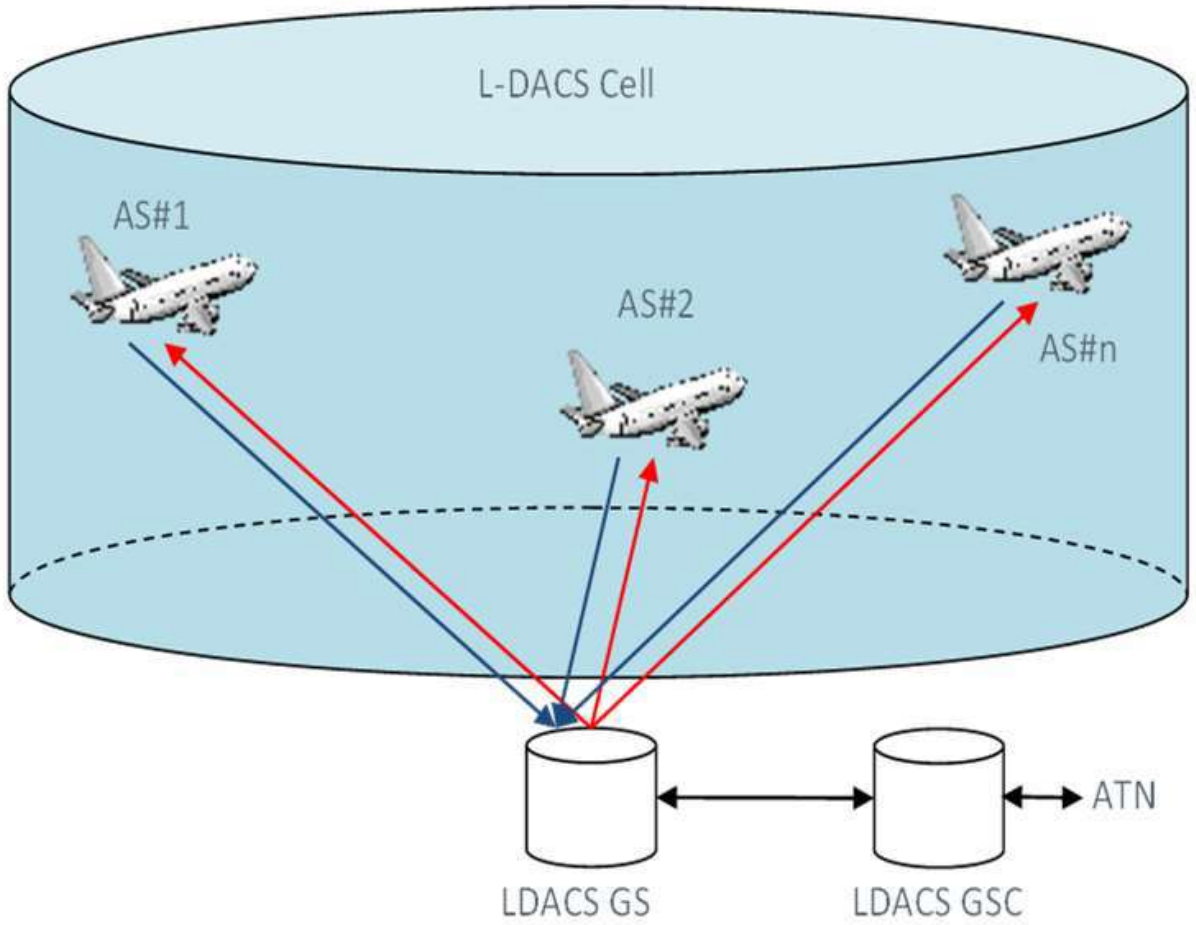



The project is funded within the framework of the European Union's Horizon 2020 research and innovation programme under grant agreement No 874478

# LDACS / L-BAND DIGITAL AERONAUTICAL COMMUNICATIONS SYSTEM

- Broadband & secure terrestrial communications system
- Originally developed under EUROCONTROL contract and being refined within SESAR 2020
- Exclusively designed for aviation use in protected aeronautical L-band with AM(R)S allocation
- SESAR's ATM Master Plan
- ICAO's Global Air Navigation Plan
- ICAO standardization (Communications Panel)

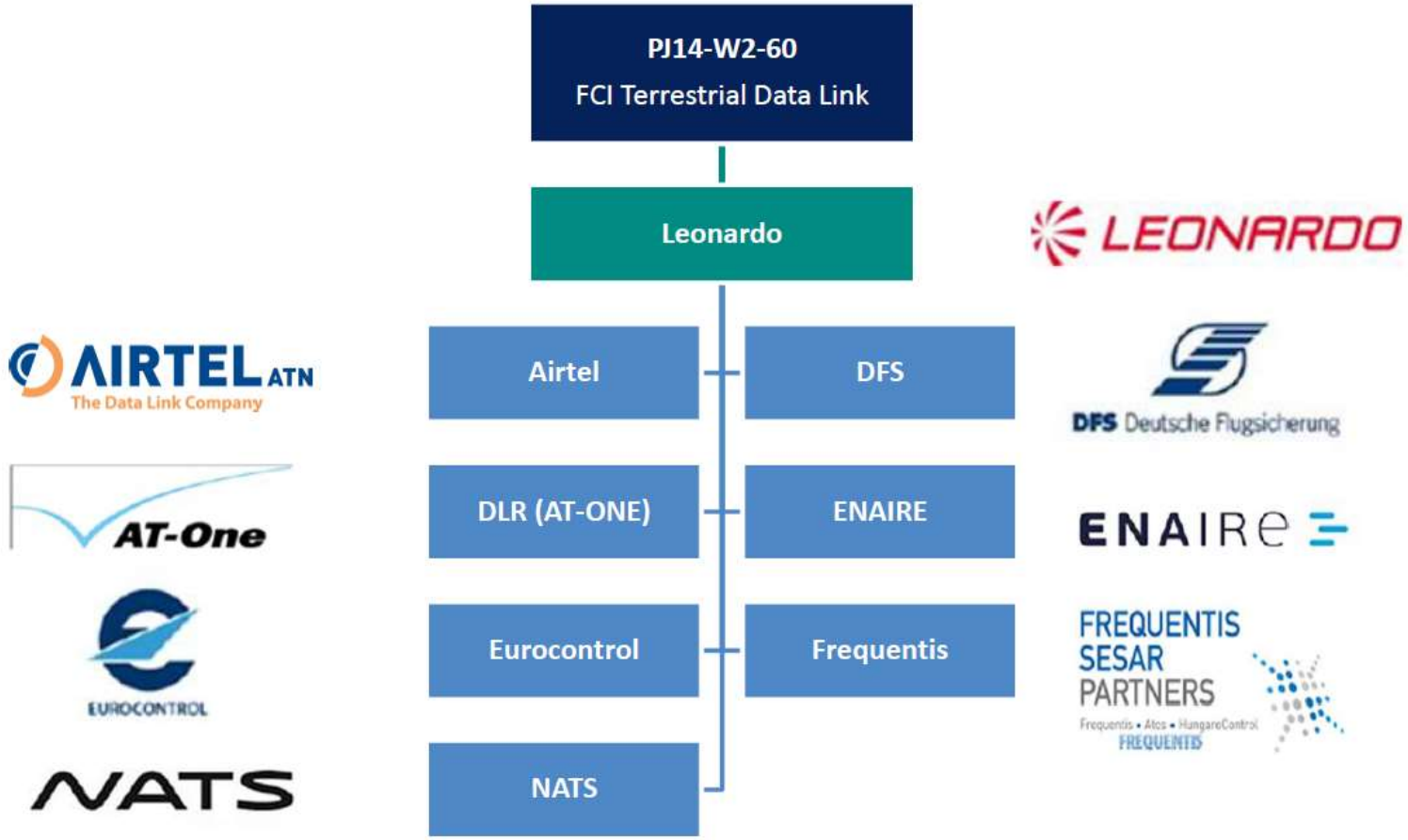




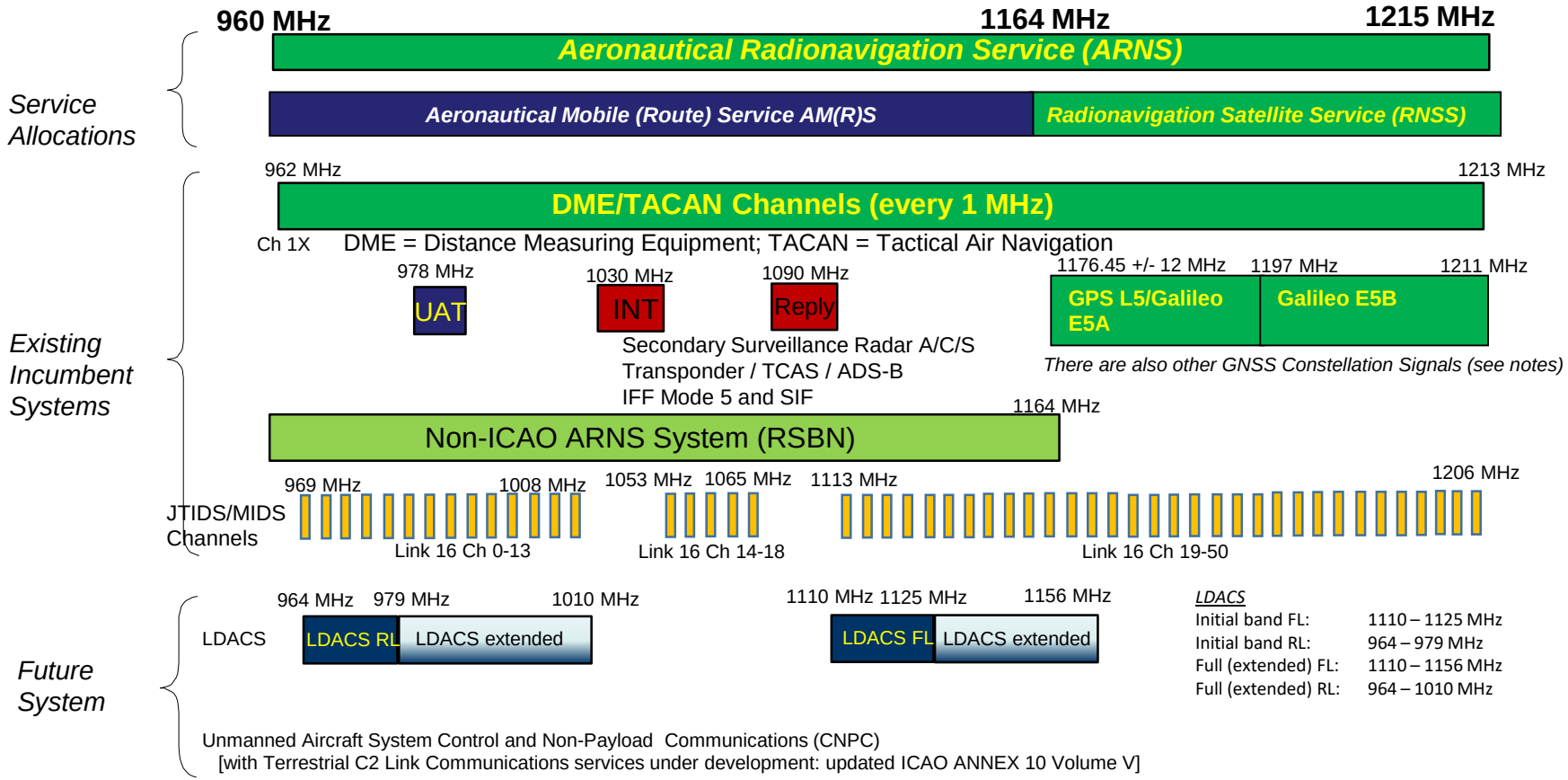
# FCI Terrestrial Data Link (Solution 60) LDACS

**Partners**:

- **Leonardo,** Airtel, DFS, DLR, ENAIRE, EUROCONTROL, Frequentis, NATS



# L-Band, the aeronautical hot-spot




*Incumbent Systems:*

- ***TACAN /*** *DME Interrogators and Beacons*
- ***M/M TACAN: Maritime Mobile TACAN***
- ***A/A TACAN: Air to Air TACAN***
- *SSR / Mode S /* ***IFF Interrogators and Transponders***
- *TCAS*
- *1090 Extended Squitter ADS-B OUT*
- *Universal Access Transceiver*
- ***Link 16 JTIDS/MIDS***

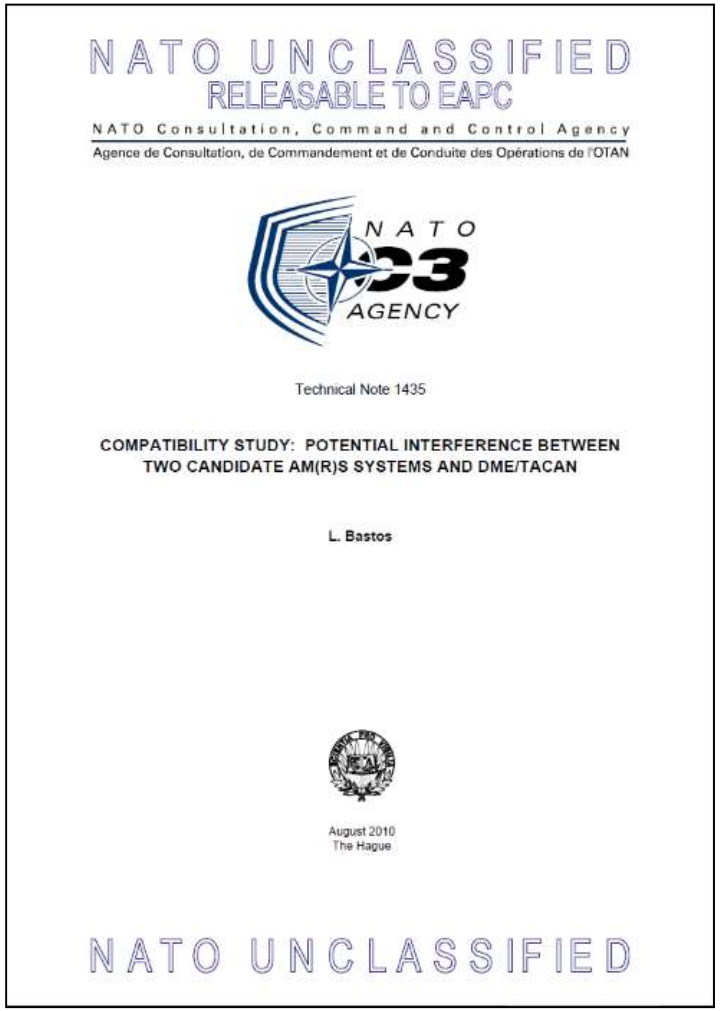
***Proposed*** *New AM(R)S Systems:*

- ***L-Band Digital Aeronautical Communication System (LDACS)***
- *Unmanned Aircraft System Control and Non-Payload Communications (CNPC)*

***Adjacent Band***

- *GSM/UMTS*
- *GPS L2*
- *Primary Radar*

# LDACS – DME/TACAN Compatibility Assessment/Testing



NATO UNCLASSIFIED
RELEASABLE TO EAPC

NATO Consultation, Command and Control Agency
Agence de Consultation, de Commandement et de Conduite des Opérations de l'OTAN

NATO C3 AGENCY

Technical Note 1435

COMPATIBILITY STUDY: POTENTIAL INTERFERENCE BETWEEN TWO CANDIDATE AM(R)S SYSTEMS AND DME/TACAN

L. Bastos

August 2010
The Hague

NATO UNCLASSIFIED

SESAR JOINT UNDERTAKING

Test Report for Assessing LDACS1 Transmitter Impact upon DME/TACAN Receivers

| Document information | |
|---|---|
| Project Title | Future Mobile Data Link System Definition |
| Project Number | 15.02.04 |
| Project Manager | Eurocontrol |
| Deliverable Name | Test Report for Assessing LDACS1 Transmitter Impact upon DME/TACAN Receivers |
| Deliverable ID | WA4 D22 |
| Edition | 00.01.02 |
| Template Version | 03.00.00 |
| Task contributors | |
| Frequentis | |
| DFS Deutsche Flugsicherung GmbH | |
| Eurocontrol | |
| NORACON | |

*Abstract*

This document is the deliverable D22 out of the SJU P15.2.4 activity WA4.2.1. It is the report of the measurement campaign and is based on the test plan (Deliverable D21) that was produced in the P15.2.4 project.

International Civil Aviation Organization

NSP/5-WP/38
02 Nov. 2018

WORKING PAPER

NAVIGATION SYSTEMS PANEL (NSP)

FIFTH MEETING

Montréal, 6 – 15 November 2018

Agenda Item 6 b) Signal and compatibility issues in the band 960 to 1215 MHz

LDACS (L-band Digital Aeronautical Communications System) versus DME/TACAN Compatibility Testing Plan

Presented by: SWG rapporteur, Felix Butsch

Prepared by: ICAO CP IWG PT-T with support by some ICAO NSP experts

*Defines the testing approach & testing plan to be used for the testing of the electromagnetic compatibility of LDACS with DME and TACAN*

*Findings serve as a means to discuss and agree on the acceptable impact of LDACS on the Parameter Under Test (interference criterion, aka pass-fail criterion) with ICAO NSP.*

# LDACS – DME/TACAN Compatibility Assessment/Testing (2)

DFS Aviation Services

Project EU-2019-004, Deliverable D4

**Final Test Report**

**Compatibility testing of LDACS with DME/TACAN in the SESAR2020 solution PJ.14-02-01**

**Customer: EUROCONTROL**

| | |
|---|---|
| Prepared by: | DFS Aviation Services GmbH |
| Version: | 1.0 |
| Status: | Final Version |
| Date: | 2020-03-16 |

Compatibility test campaign was based on Test-Plan agreed by ICAO NSP and ICAO PT-T November 2018

Test-plan* covered compatibility testing LDACS vs DME/TACAN

Study concluded, the results of this compatibility test campaign were not conclusive:

- non-performing DME equipment EUT
- overly conservative DME/TACAN EPE
- “overload” JTIDS/MIDS TSDF

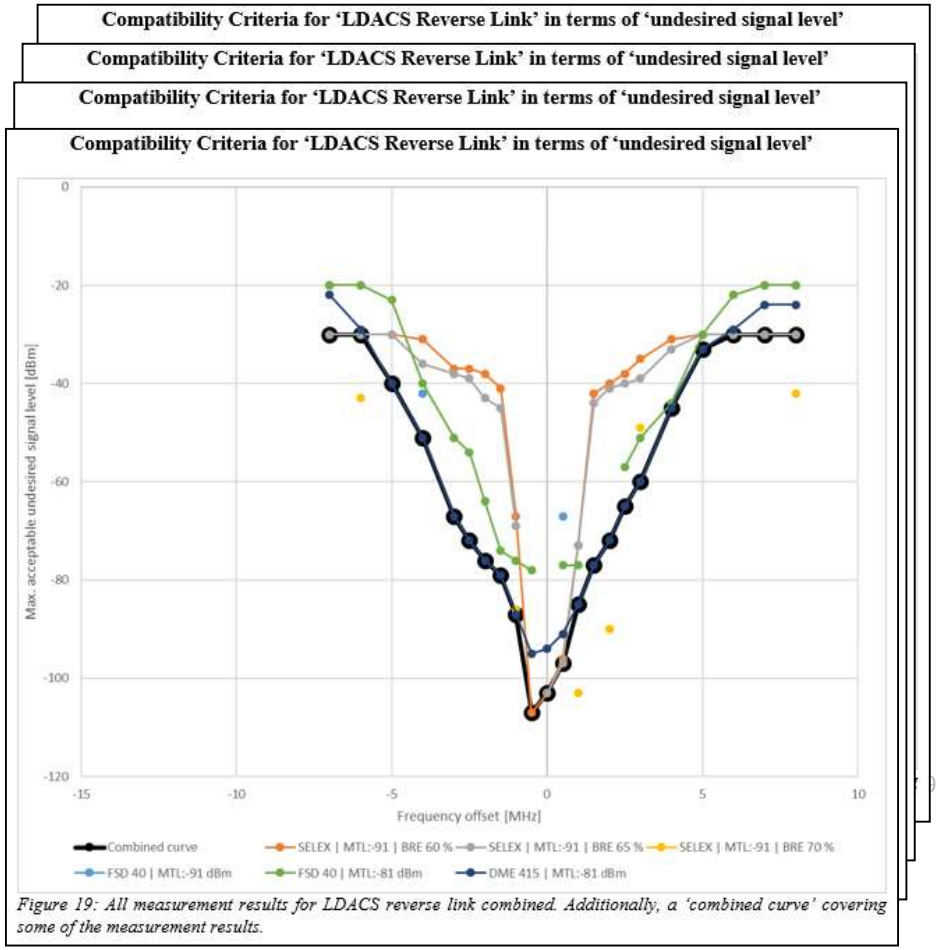


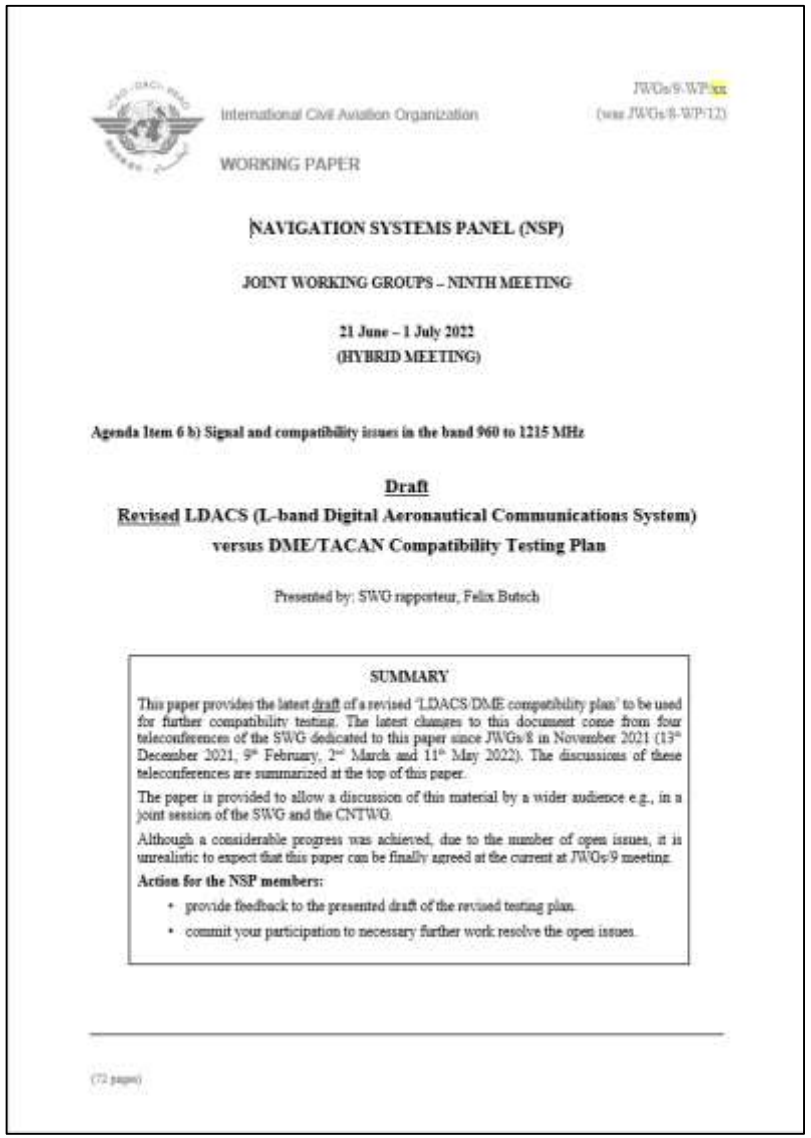

*Figure 19: All measurement results for LDACS reverse link combined. Additionally, a ‘combined curve’ covering some of the measurement results.*

“family of curves” (i.e. measurements results with various DME equipment types and various parameters e.g. LDACS Duty cycles, DME squitter rates etc.

-> Into a common “Compatibility mask” to be applied for the derivation of frequency separation rules.

* = Twelve Scenarios identified with DME/TACAN as both Interferer and Victim

# LDACS – DME/TACAN Compatibility Assessment/Testing (3)



International Civil Aviation Organization

WORKING PAPER

JWGs/9-WP/xx
(was JWGs/8-WP/12)

**NAVIGATION SYSTEMS PANEL (NSP)**

**JOINT WORKING GROUPS – NINTH MEETING**

**21 June – 1 July 2022**
**(HYBRID MEETING)**

**Agenda Item 6 b) Signal and compatibility issues in the band 960 to 1215 MHz**

**Draft**
**Revised LDACS (L-band Digital Aeronautical Communications System)**
**versus DME/TACAN Compatibility Testing Plan**

Presented by: SWG rapporteur, Felix Butsch

**SUMMARY**

This paper provides the latest draft of a revised 'LDACS/DME compatibility plan' to be used for further compatibility testing. The latest changes to this document come from four teleconferences of the SWG dedicated to this paper since JWGs/8 in November 2021 (13th December 2021, 9th February, 2nd March and 11th May 2022). The discussions of these teleconferences are summarized at the top of this paper.

The paper is provided to allow a discussion of this material by a wider audience e.g., in a joint session of the SWG and the CNTWG.

Although a considerable progress was achieved, due to the number of open issues, it is unrealistic to expect that this paper can be finally agreed at the current at JWGs/9 meeting.

**Action for the NSP members:**

- provide feedback to the presented draft of the revised testing plan.
- commit your participation to necessary further work resolve the open issues.

(72 pages)

ICAO PT-T and NSP agreed to update the Test Plan with focus on developing more reasonable, less conservative test procedures. Especially the background interference shall be refined accordingly.

Revision of the Test Plan started mid-2020 and is still ongoing.
>15 coordination meetings between ICAO PT-T and NSP Spectrum Working Group have been held to progress the test plan.

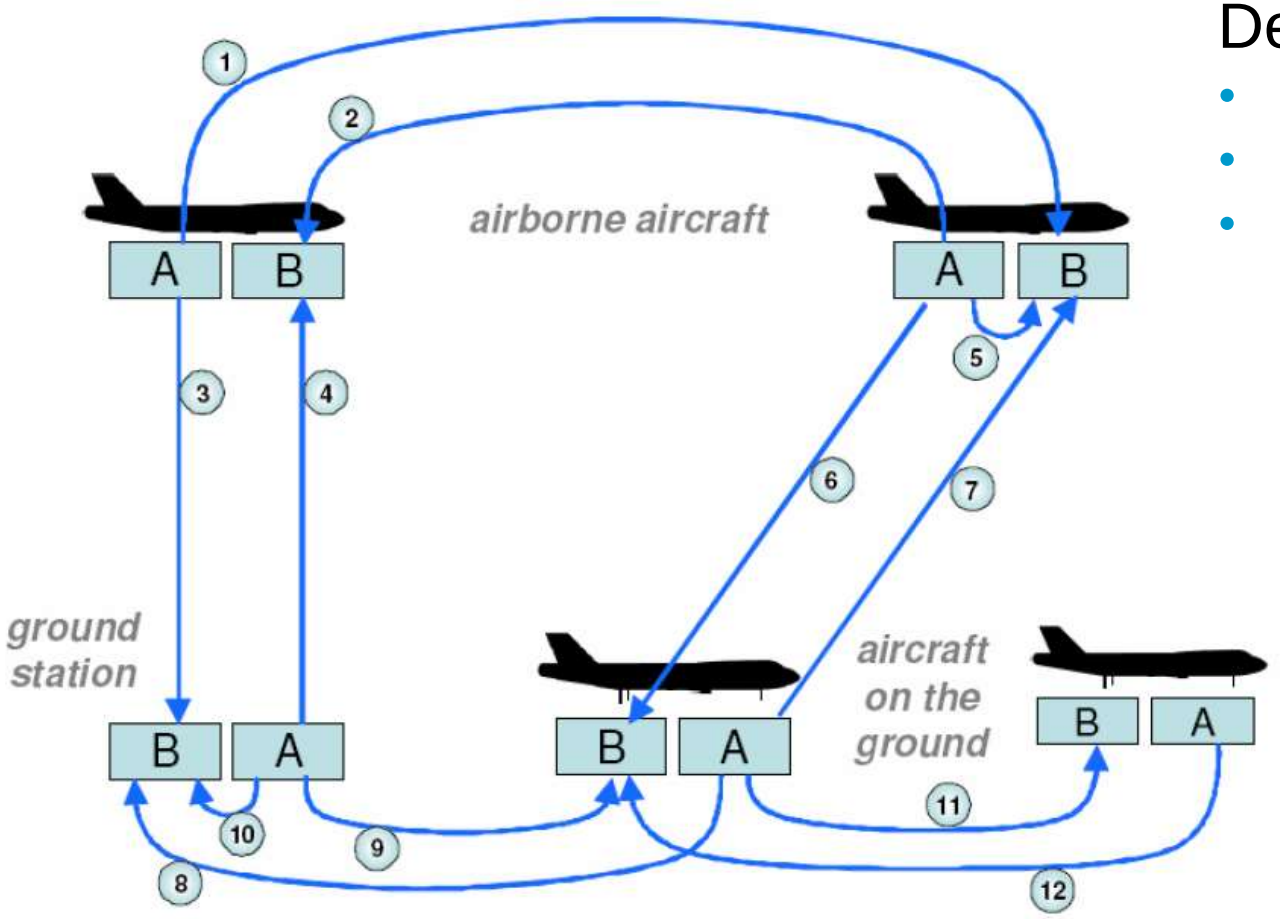
Besides relaxation of the background interference, the whole test plan is re-discussed.

**EUROCONTROL took Action Item to define an EUR DME/TACAN EPE,** rationale as used for deriving the Italian DME/TACAN EPE. Information collection with our stakeholders.

# LDACS – JTIDS/MIDS Spectrum Supportability

- Testing will take place as 2 discrete activities:
  - Activity 1 – LDACS Tx to JTIDS/MIDS Compatibility Testing
  - Activity 2 – JTIDS/MIDS to LDACS Rx Compatibility Testing
- A 3-stage approach will be used for both Activities:
  - Stage 1 is to establish the baseline performance of the system under test without any extraneous signals present
  - Stage 2 is to characterise its performance in the presence of signals from the interfering system (be that LDACS or JTIDS/MIDS)
  - Stage 3 will see the addition of a representative background load (Extraneous Pulse Environment)
- The purpose of this approach is to understand how well the system actually performs on its own, determine the impact / compatibility of the interfering system, and then make sure the results still hold true in a representative real-world test.

# LDACS – JTIDS/MIDS Spectrum Supportability (2)




## Defined Scenarios

- 12 Scenarios defined
- 11 considered
- 1 not addressed (co-located systems)

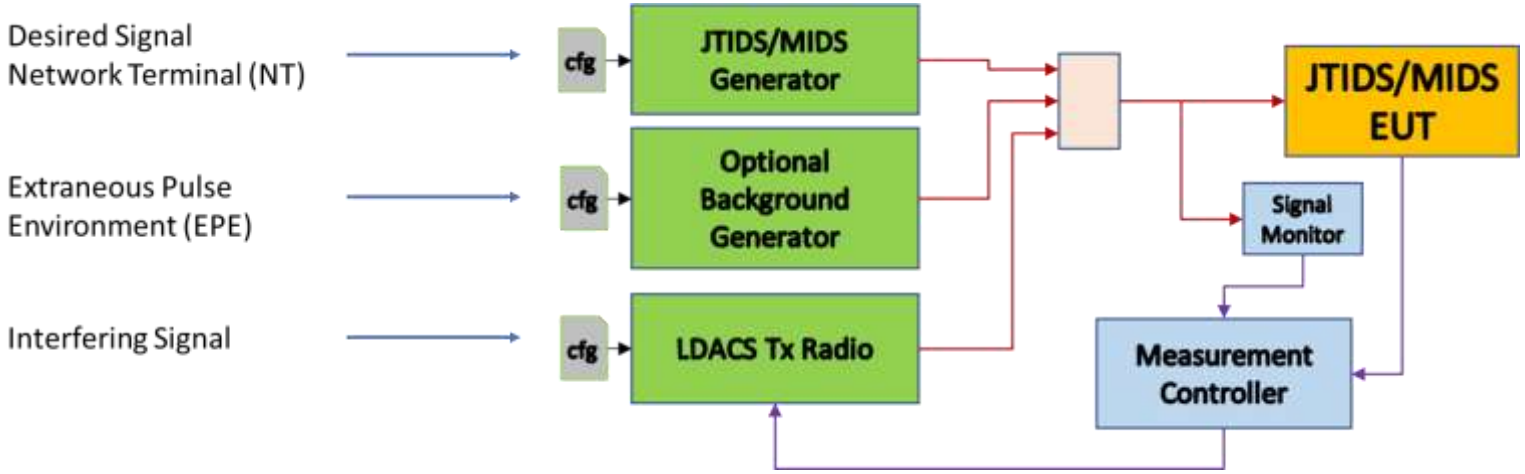
  *Scenario 5 - based on rationale that MIL Transport Type State aircraft will not be mandated to equip to mirror the current EC implementing rule on Datalink Services.*

A = Interferer

B = Victim

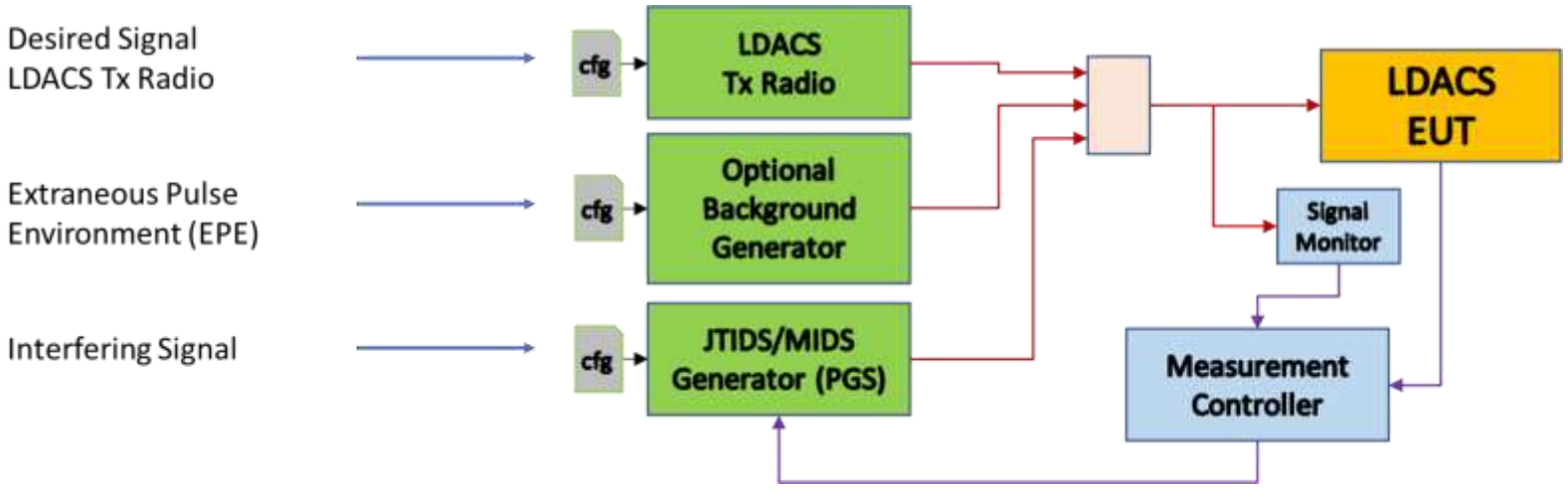
# LDACS – JTIDS/MIDS Spectrum Supportability (3)
# Activity 1 – LDACS Tx to JTIDS/MIDS Compatibility Testing

- It was found that in real world conditions, taking representative antenna gains into account, a FL LDACS ground transmitter with 100% duty cycle would have to be within 150m of a JTIDS/MIDS receiver before there is any effect on the EMR.
- On the RL, at all 4 duty cycles, and it was found that considerably more power is required to cause an effect.
- In order for a RL LDACS airborne transmitter to have an effect on JTIDS/MIDS it would need to be within 25m
- For both FL and RL there was no significant change in the EMR as the frequency was changed.
- The application of an EPE had no impact on the performance of the EUT, with or without the presence of LDACS signals



# LDACS – JTIDS/MIDS Spectrum Supportability (4)
# Activity 2 – JTIDS/MIDS to LDACS Rx Compatibility Testing

- Activity 2 will establish the effect of JTIDS/MIDS interference signals on LDACS performance.
- Three independent parameters of the JTIDS/MIDS interference shall be varied to characterise the response of an LDACS receiver, these are:
  - The power level of JTIDS/MIDS pulses
  - The frequency offset of JTIDS/MIDS pulses
  - The JTIDS/MIDS pulse rate
- The JTIDS/MIDS signals will be produced by a Pulse Generation System
- The LDACS Receiver to be used will be capable of demodulating and decoding LDACS signals that will be produced by a LDACS Transmitter (compliant with the ICAO draft SARPS)



# Q&A

**Take Aways:**

- LDACS as candidate technology
- LDACS compatibility assessments ongoing
- LDACS standardization ongoing

(replay) past webinars on LDACS:

1) A general introduction to LDACS (https://www.sesarju.eu/node/3809) (https://youtu.be/NlyTkL6yZls)
2) Technical details and capabilities of LDACS for Communications & integrated CNS (https://www.sesarju.eu/node/3832) (https://youtu.be/95gT7nn0QmM)
3) Deployment options and transition scenarios (https://www.sesarju.eu/node/3852) (https://youtu.be/Jyy_9lJH1es)


*bart.van-den-einden@eurocontrol.int*
*www.eurocontrol.int/mil*