UAS in European Civil Airspace: USICO and SINUE Results

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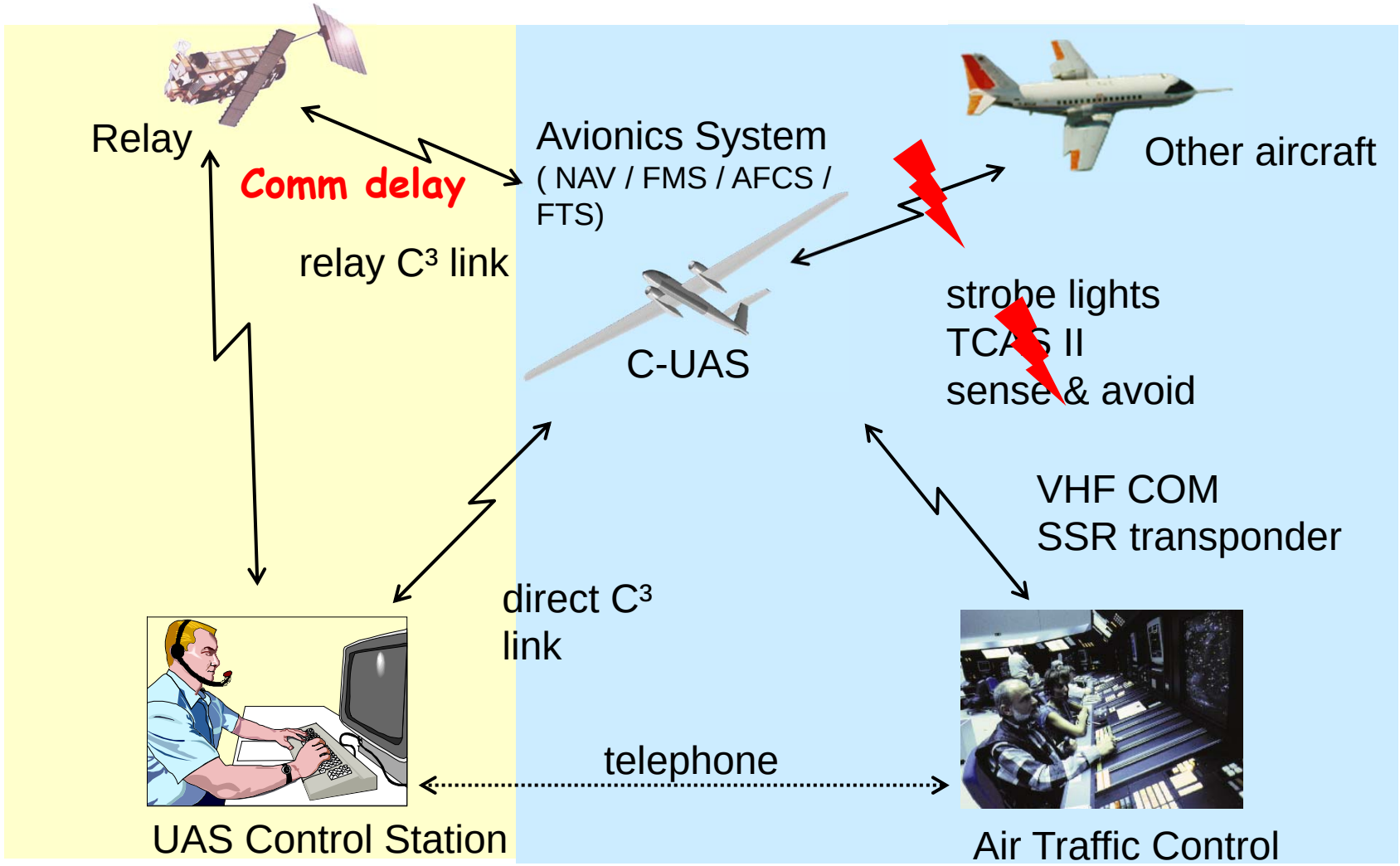
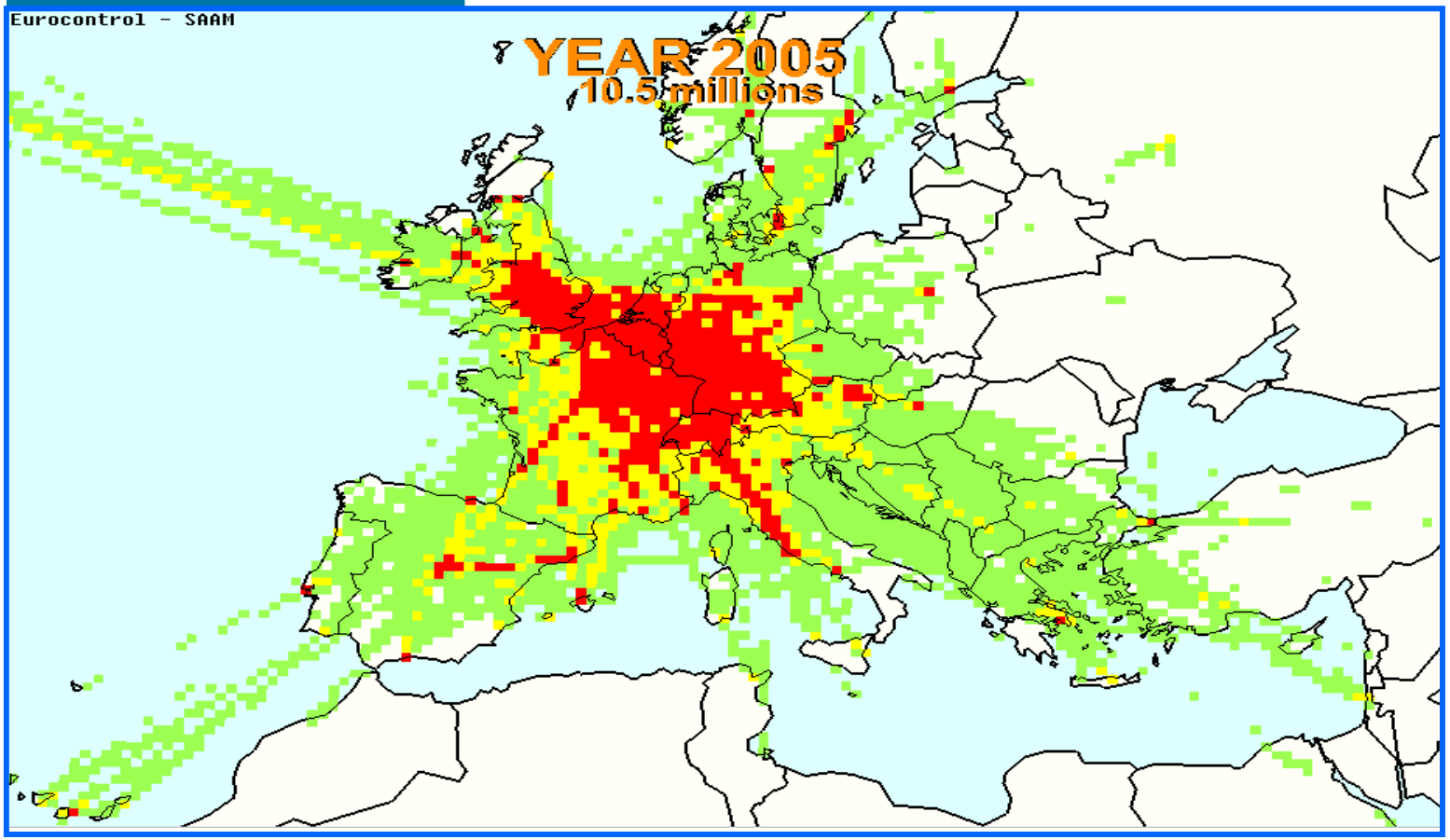
UAS Integration in Civil Airspace



SESAR D1 Results

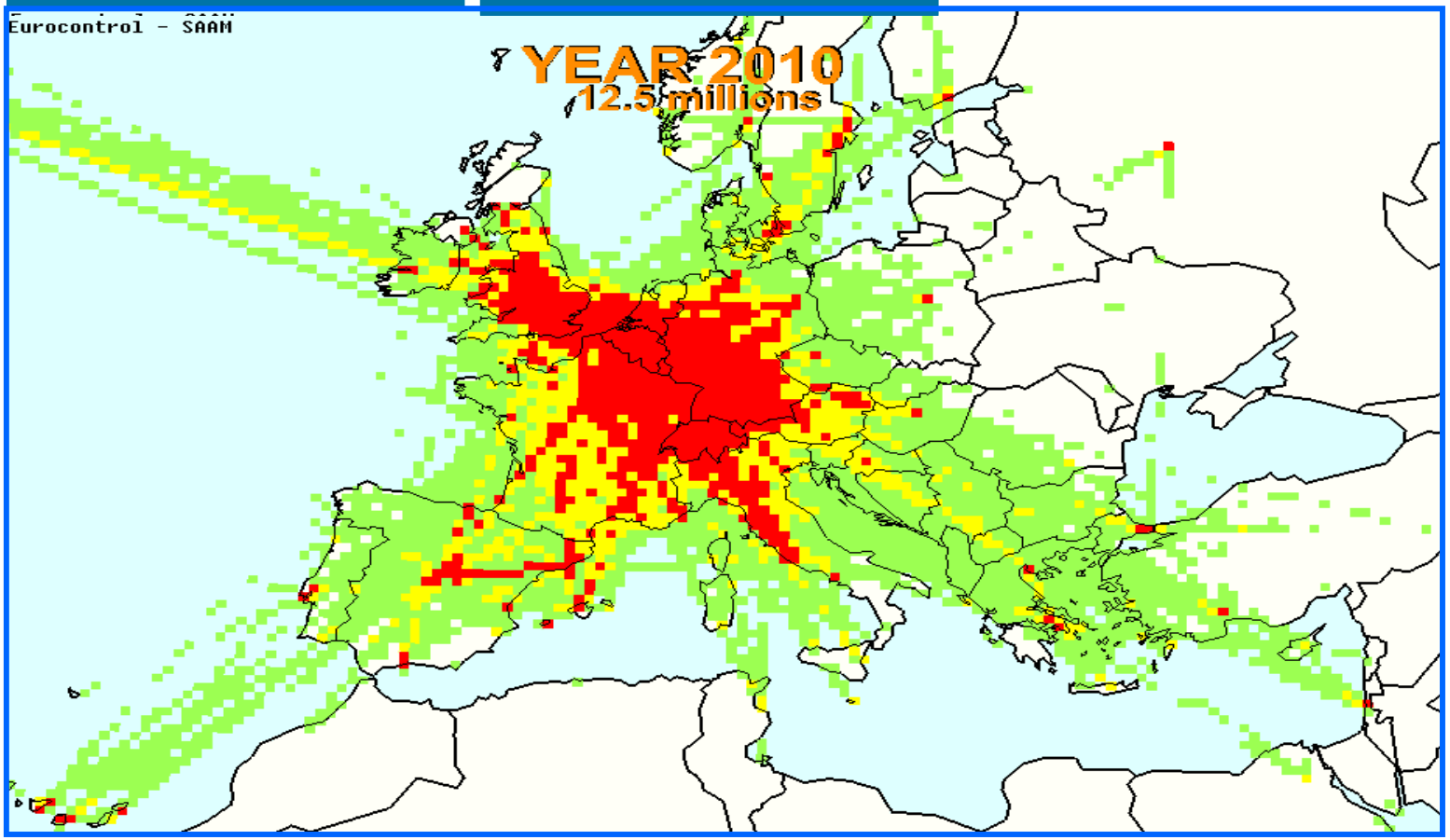
2005: 10.5 millions



SESAR D1 Results

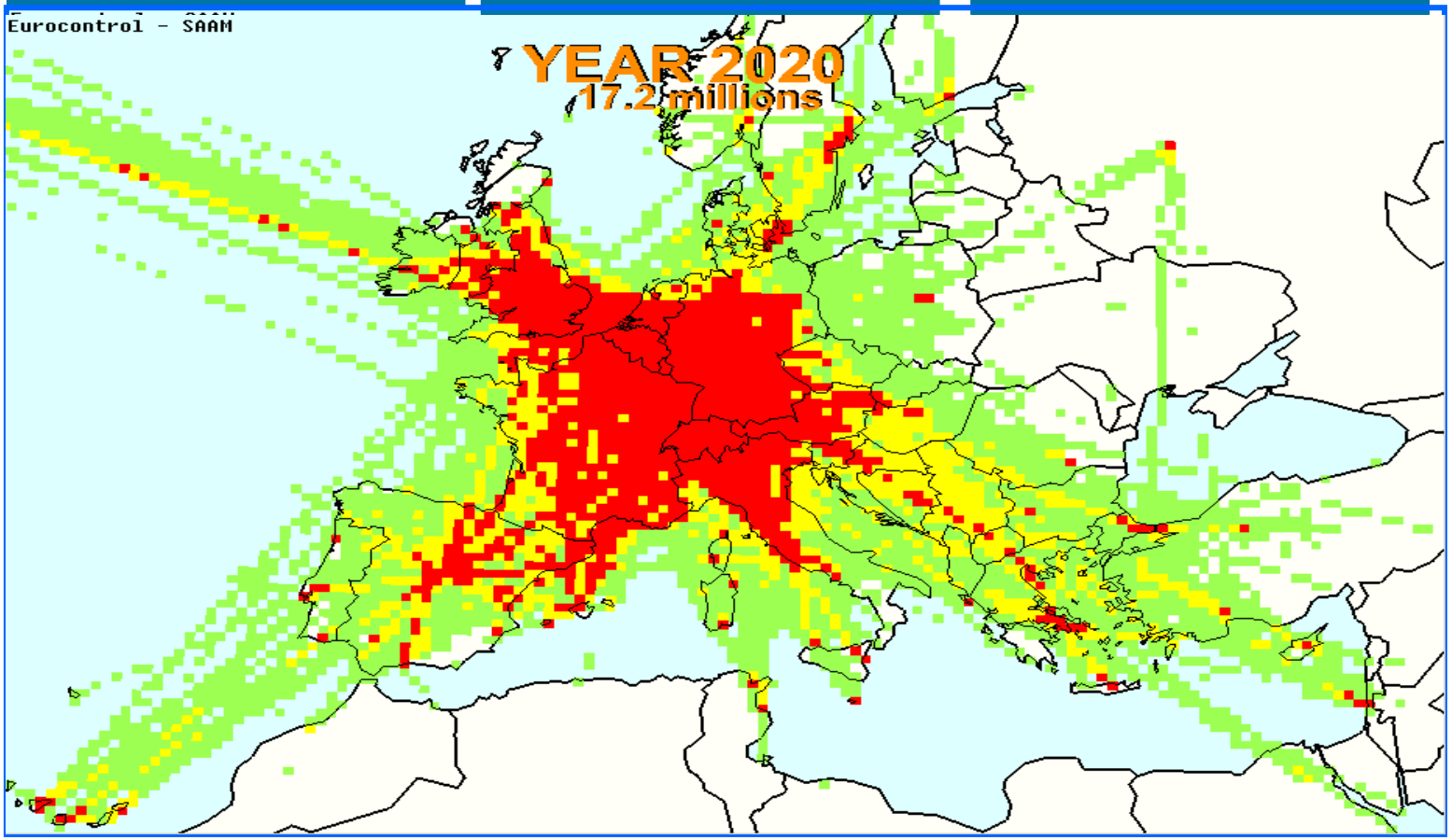
2005: 10.5 millions

2010: 12.5 millions

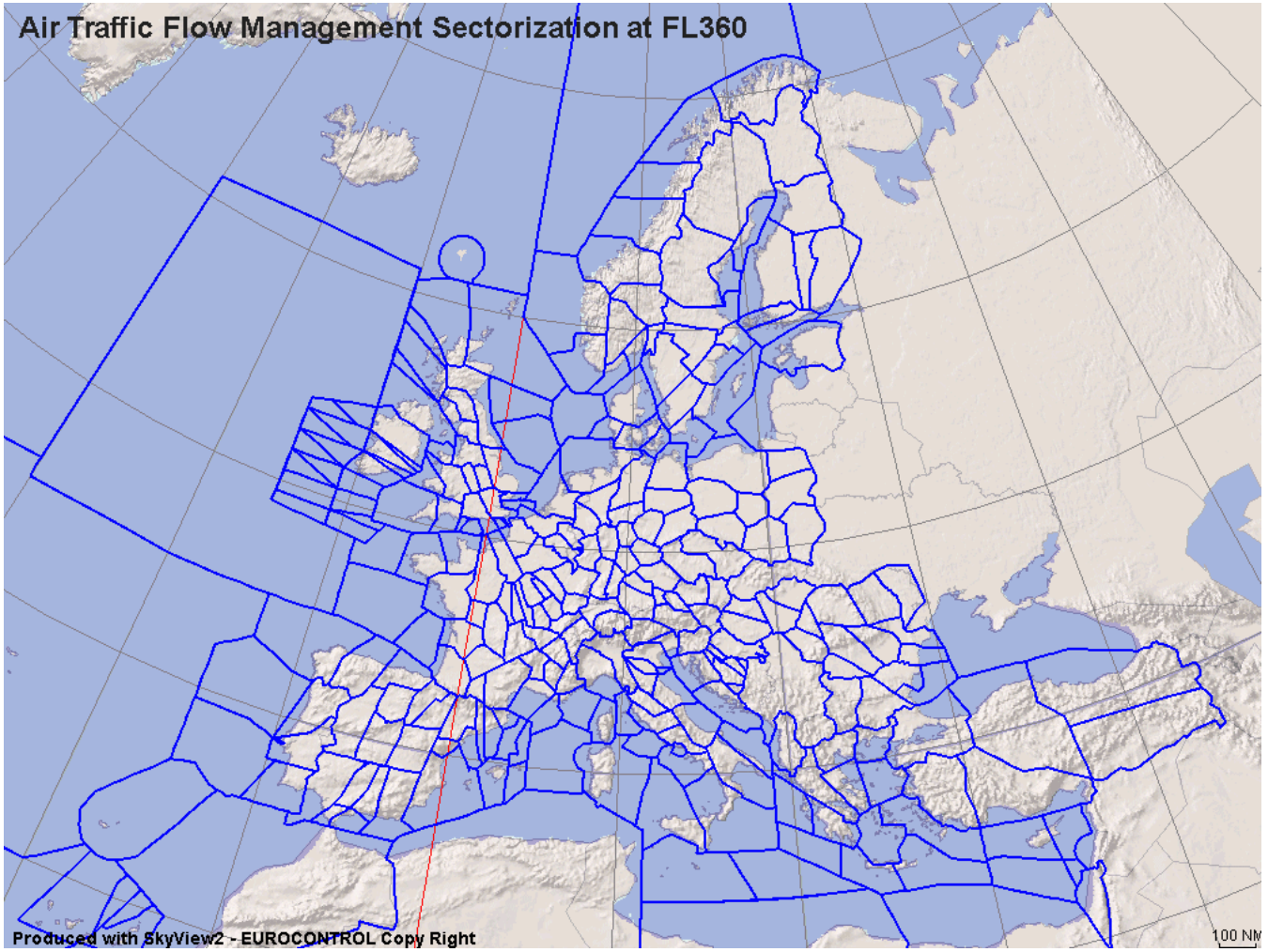


SESAR D1 Results

2005: 10.5 millions | 2010: 12.5 millions | 2020: 17.2 millions



Current Situation above FL 360 in Europe



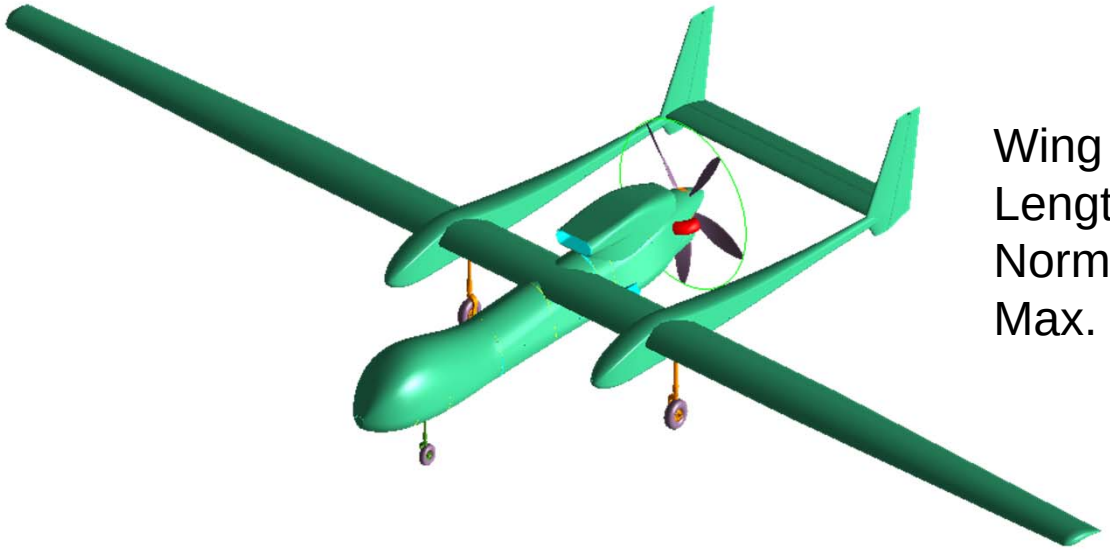
European Scale Research necessary

- **USICO**
  UAV Safety Issues for Civil Operations,
  European Commission 2002 – 2004

- **SINUE**
  Satellites enabling the Integration in Non-segregated airspace of UAS in Europe
  European Space Agency 2009 -2010

USICO Setup

Simulated MALE UAS
(*M*edium *A*ltitude *L*ong *E*ndurance
*U*nmanned *A*erial *V*ehicle)



Wing span (m)	22.6
Length (m)	10.68
Normal cruise (kcas)	110
Max. ceiling (ft)	45000

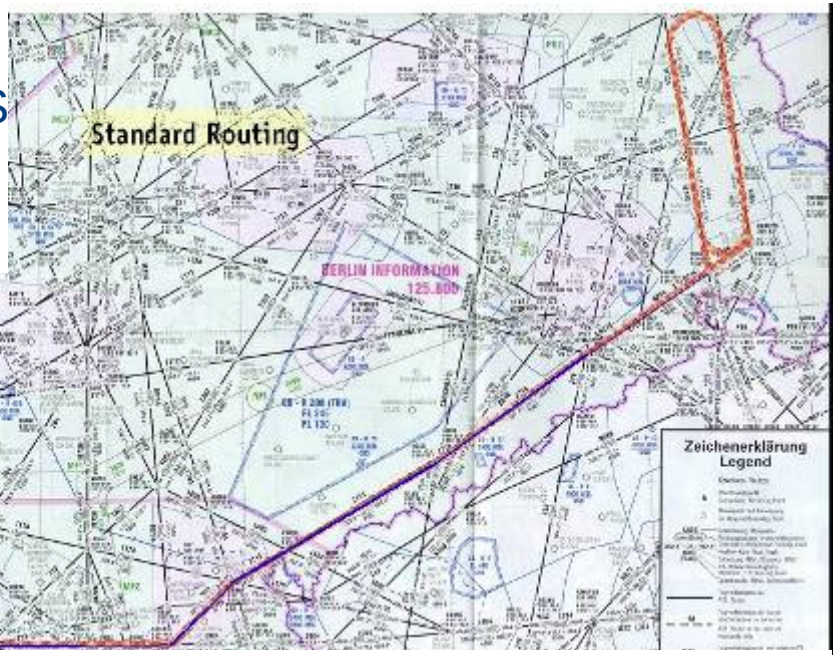
Objectives of ATC/ATM Real Time Simulations

- Evaluation of the UAS integration concept:
  - Normal operations
    - Avoidance of severe weather
  - Emergency Operations:
    - Standard emergency procedures:
      - Comm Loss squawk 7600
      - Thrust Loss squawk 7700
    - UAS specific emergency procedures
      - (additional emergency codes)
  - Loss of separation

- Investigation of UAS specifics:
  - Communication delay for voice and data

Real Time Simulations

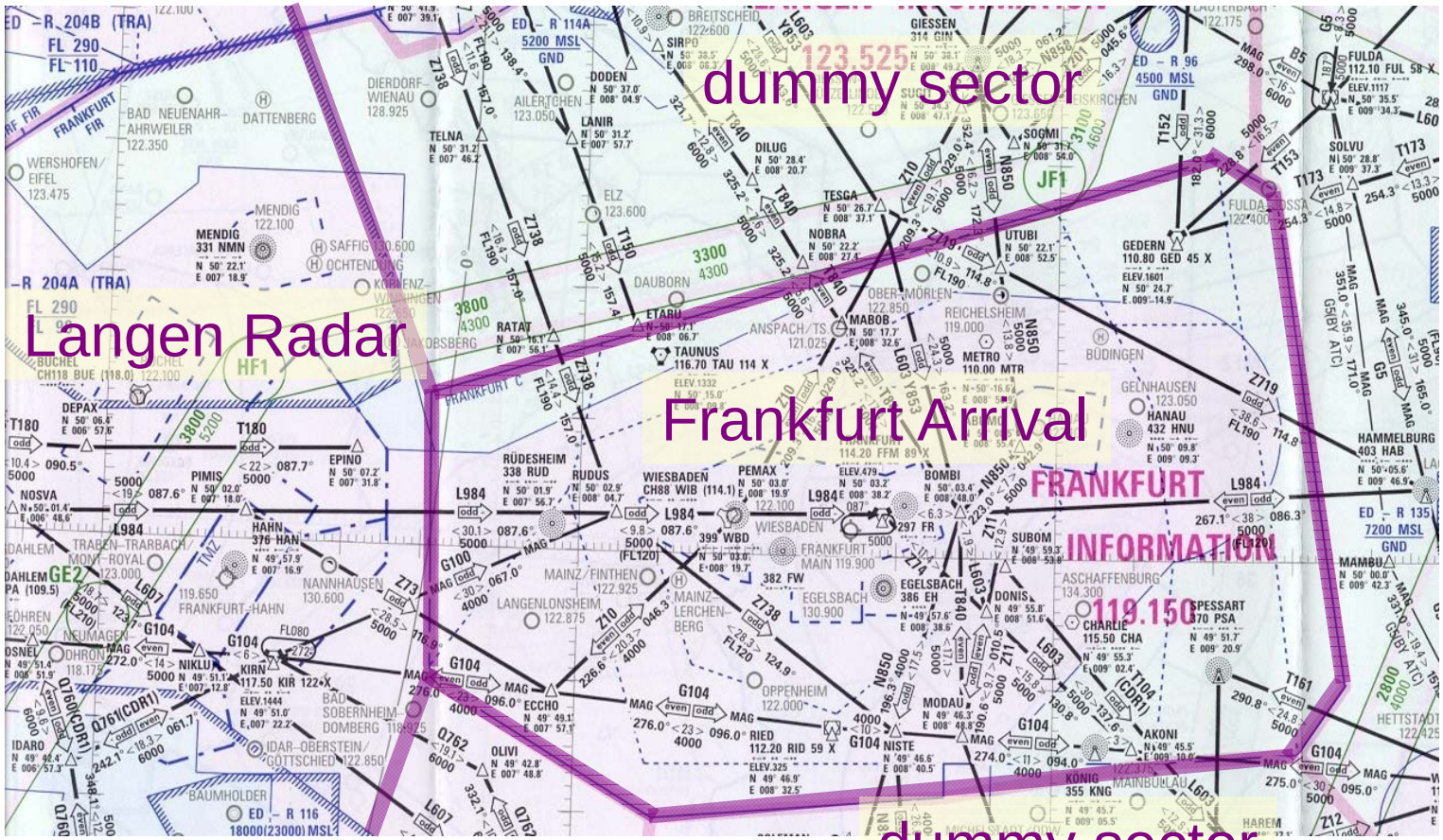
Mission Scenario:
- Surveillance Mission of a MALE UAS
- from regional airport Frankfurt-Hahn
- to mission area north of Bautzen



Scenario of Real Time Simulation:
- UAS crossing TMA Frankfurt on its outbound and inbound flight
- UAS emergencies within the TMA

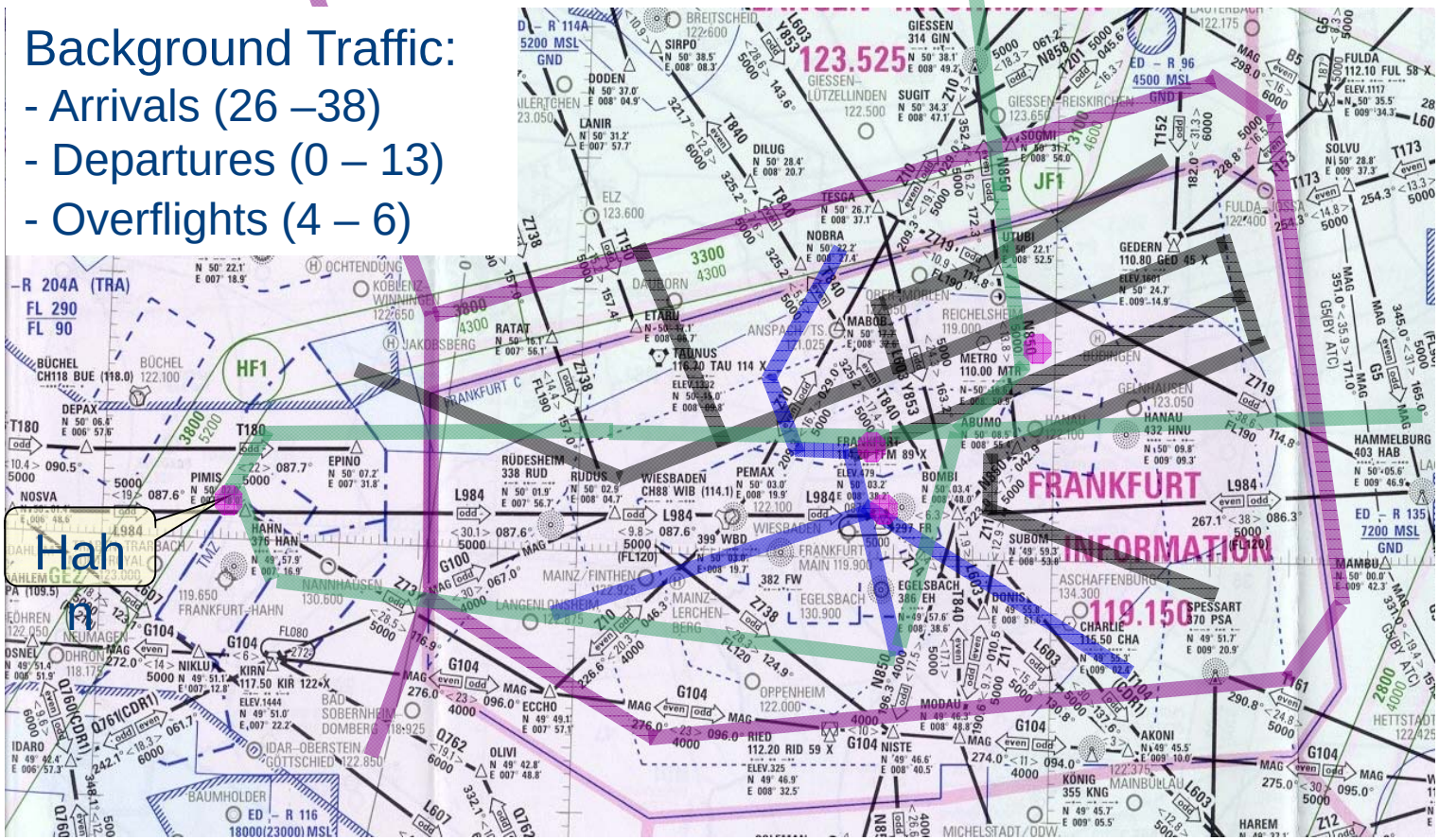
Simulated Airspace

FIR Frankfurt: TMA Frankfurt & Sector West (modified)



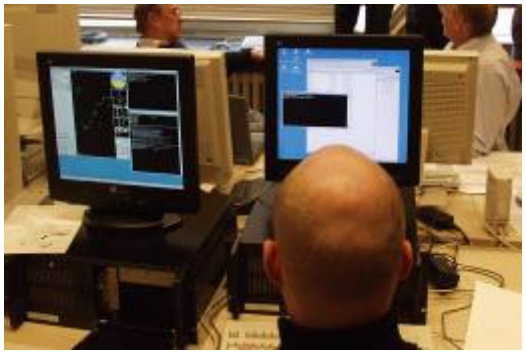
Simulated Airspace

Background Traffic:
- Arrivals (26 –38)
- Departures (0 – 13)
- Overflights (4 – 6)



Simulation Setup

Pseudo Pilots



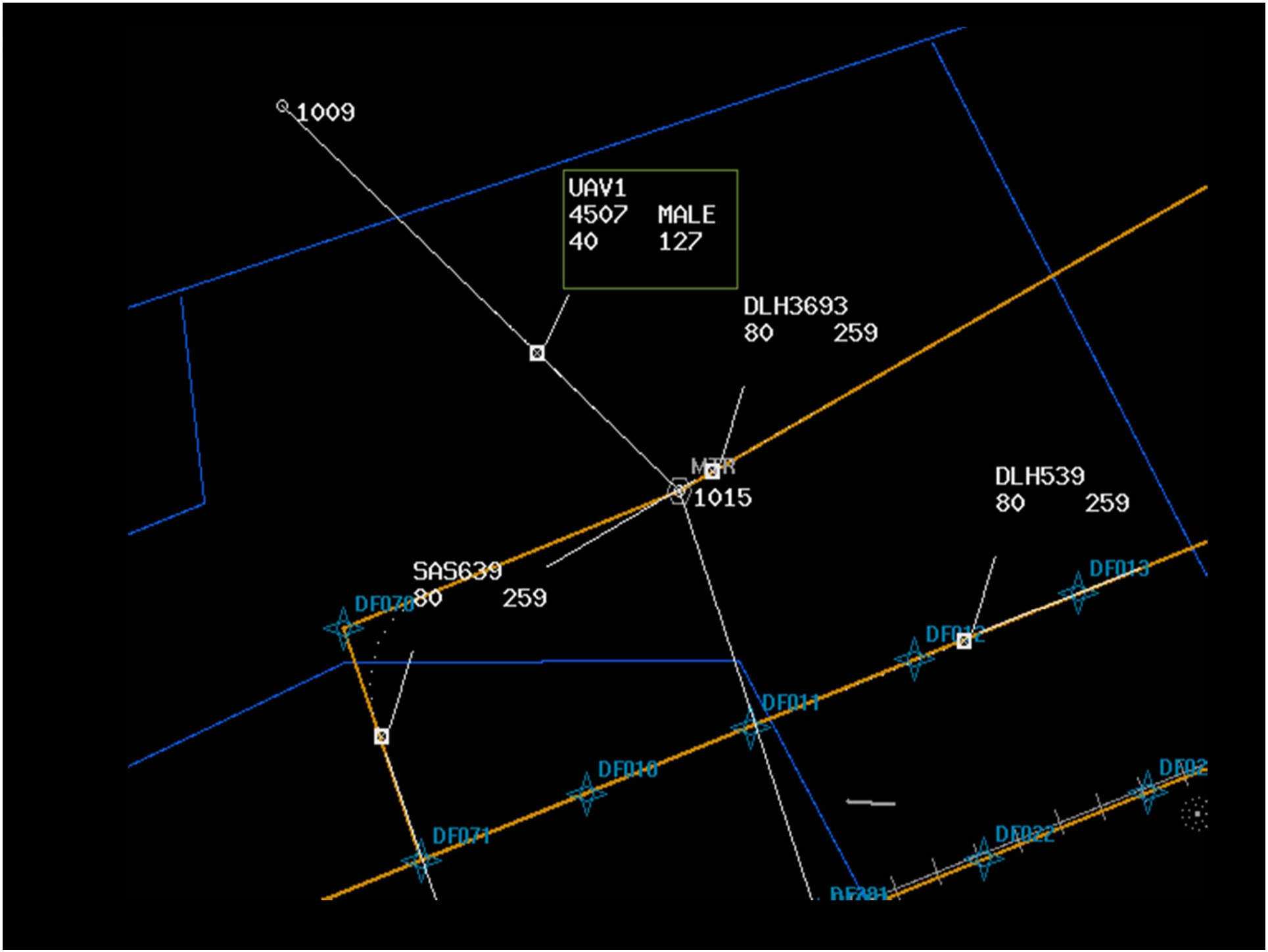
UAS Pilot

Air Traffic Management and Operations Simulator ATMOS

Simulation Setup

- *Communication*
  - Telephone communication between sector controller and arrival controller
  - Telephone communication between controller and UAS pilot if requested

- *Simulated Radio Telephony*
  - Radio telephony for the controller / pseudo pilot voice communication
    specially designed intercommunication device
    operation over wire link
  - Communication delay for satellite link is implemented:
    - 1.5 s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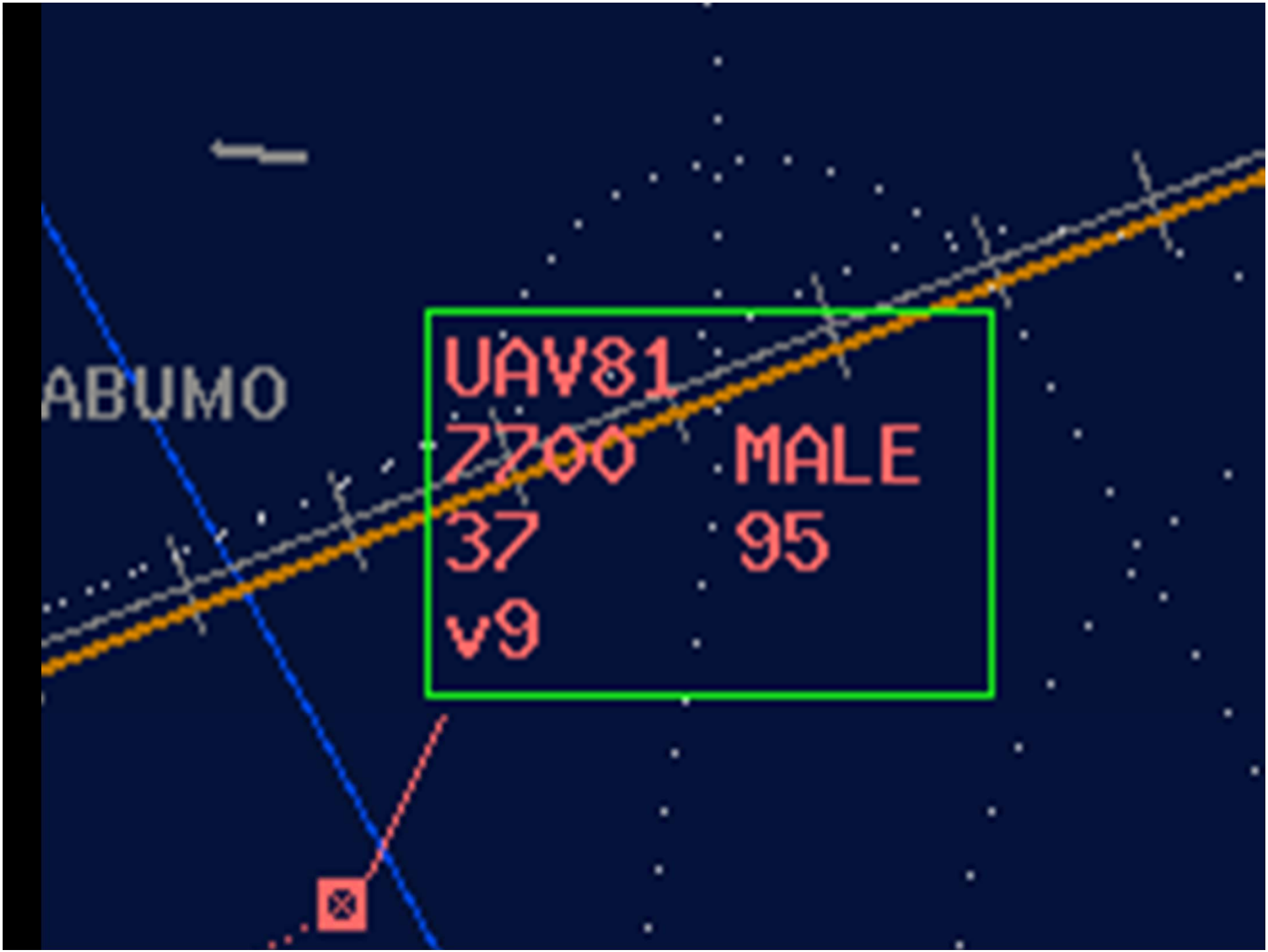
DF071
DF032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MALE
37
95
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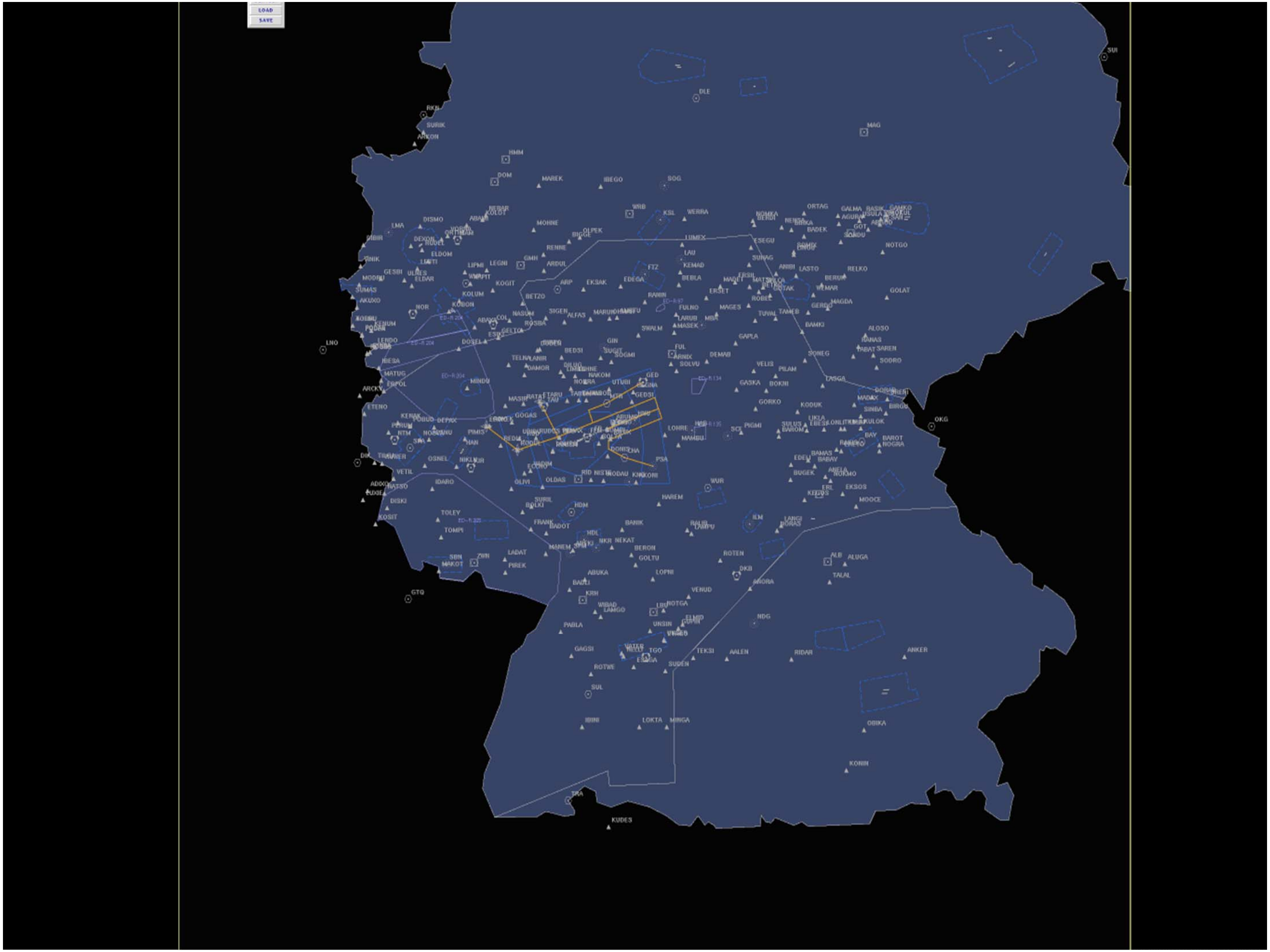

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DKB
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ALUGA
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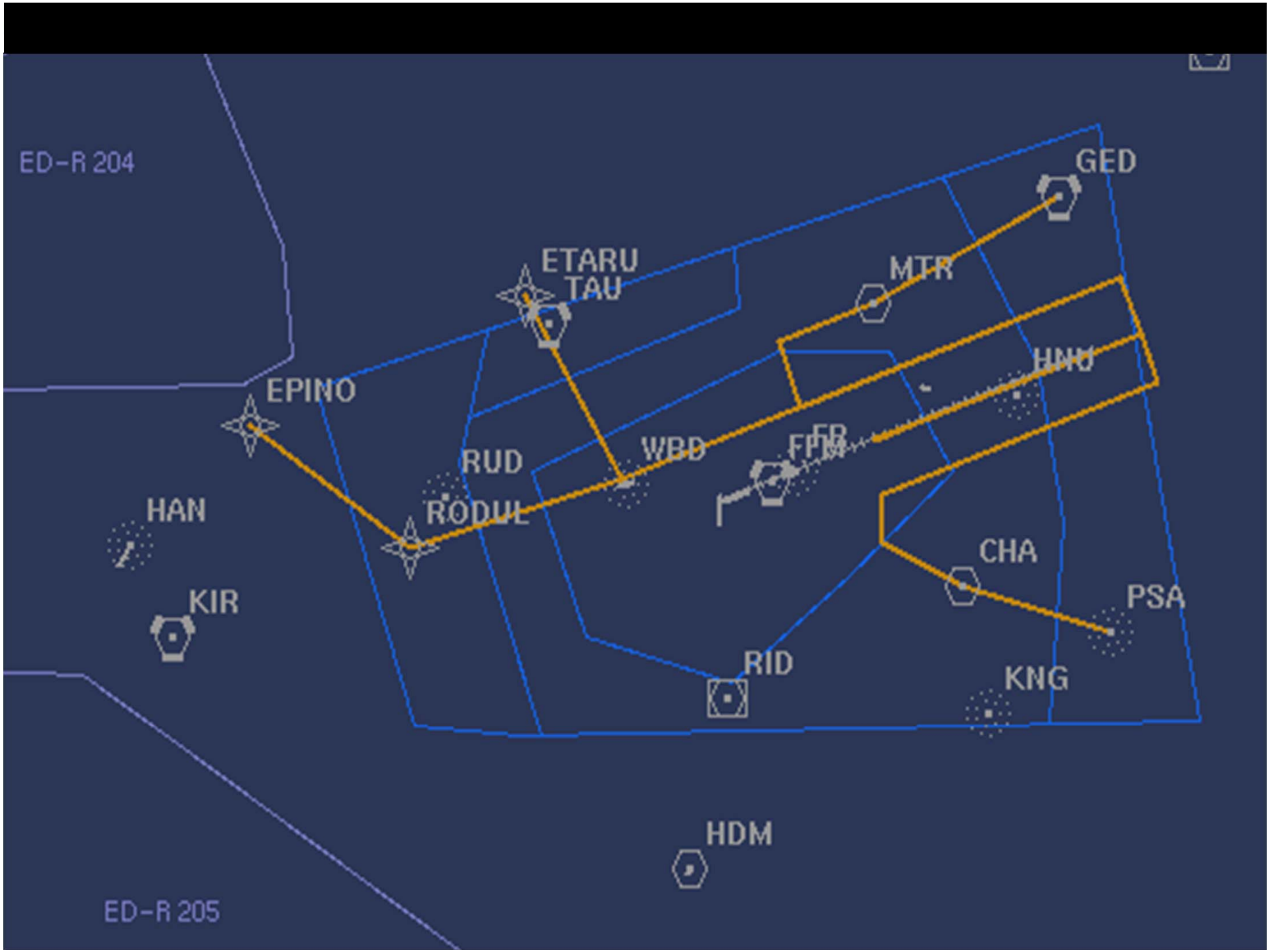
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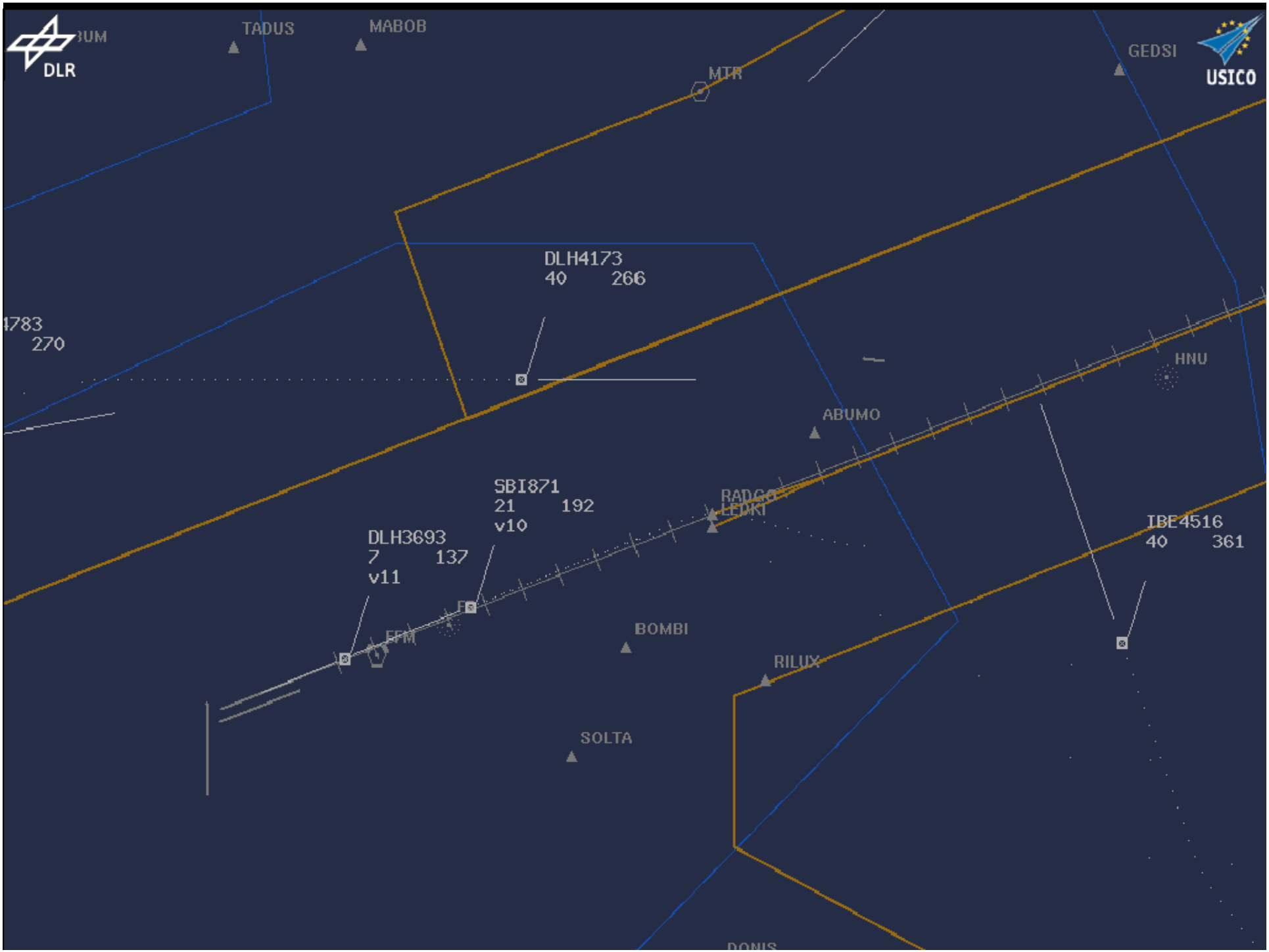
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HNU
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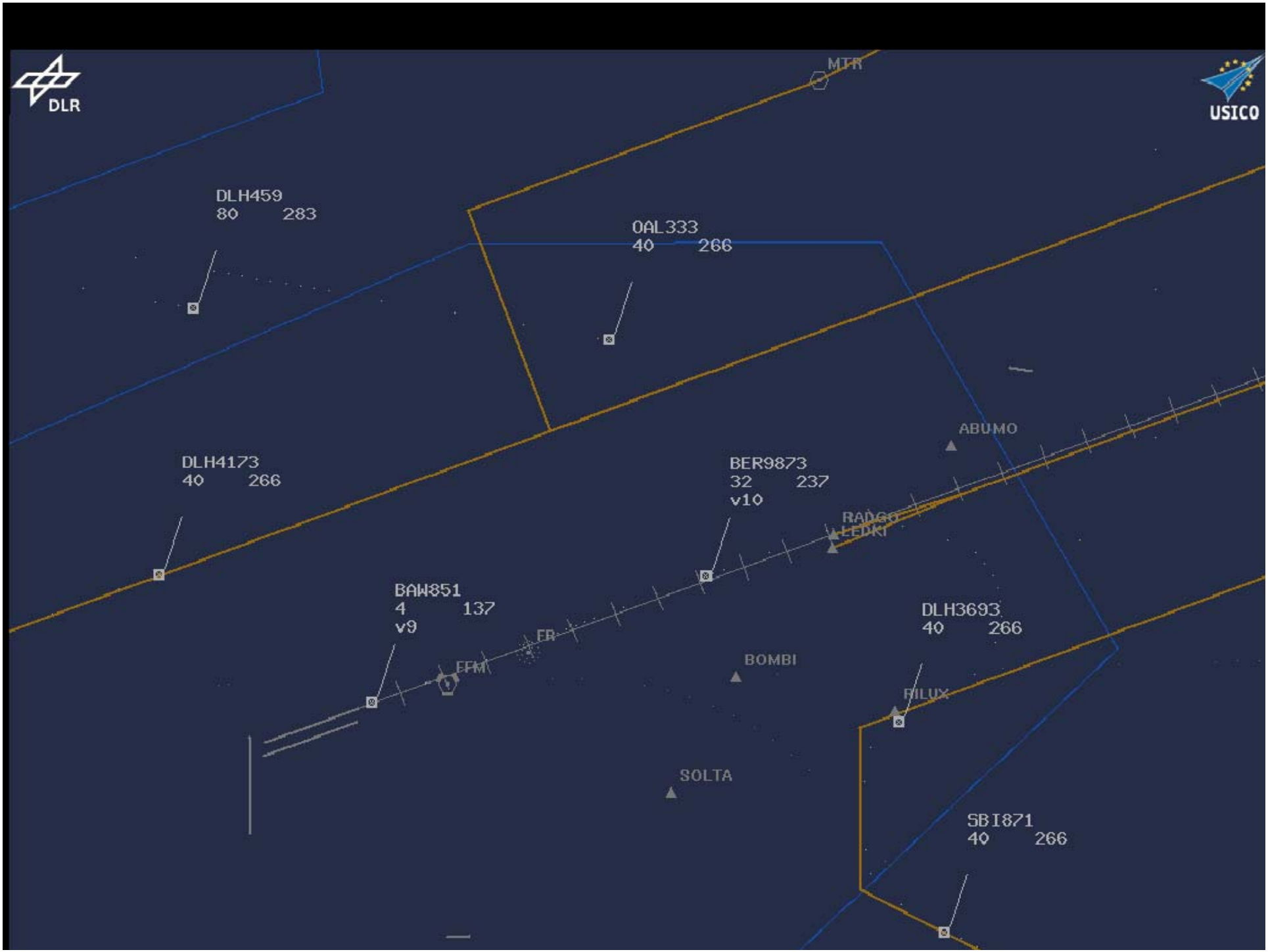
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SBI871
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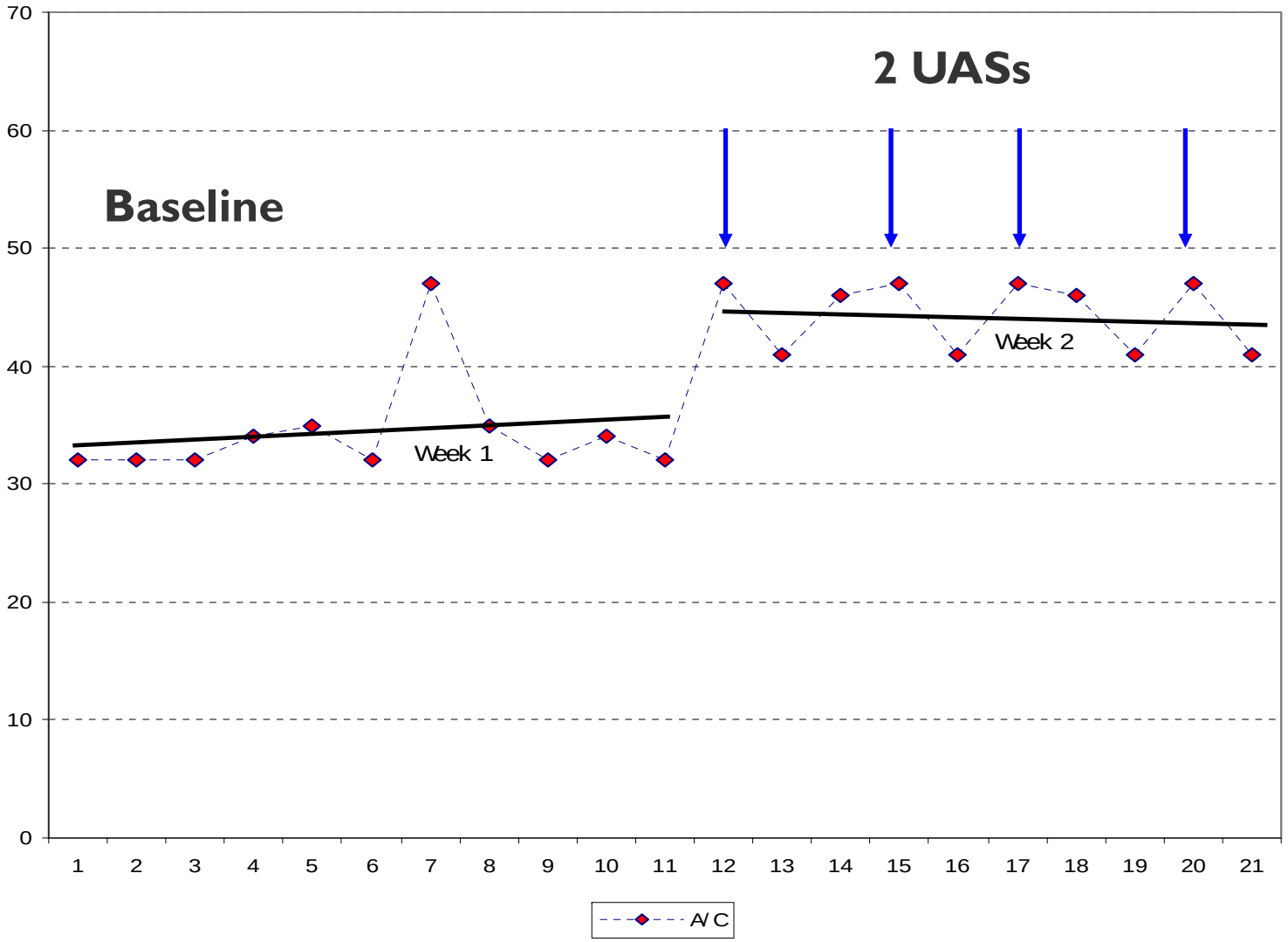
Workload of controllers

- UAS-pilot to ATCO interactions
- Instantaneous Self Assessment questionnaires
- NASA Task Load Index methodology
- Introduction of 1 UAS into airspace
- Introduction of 2 UAS into airspace

Workload of controllers



Workload of controllers

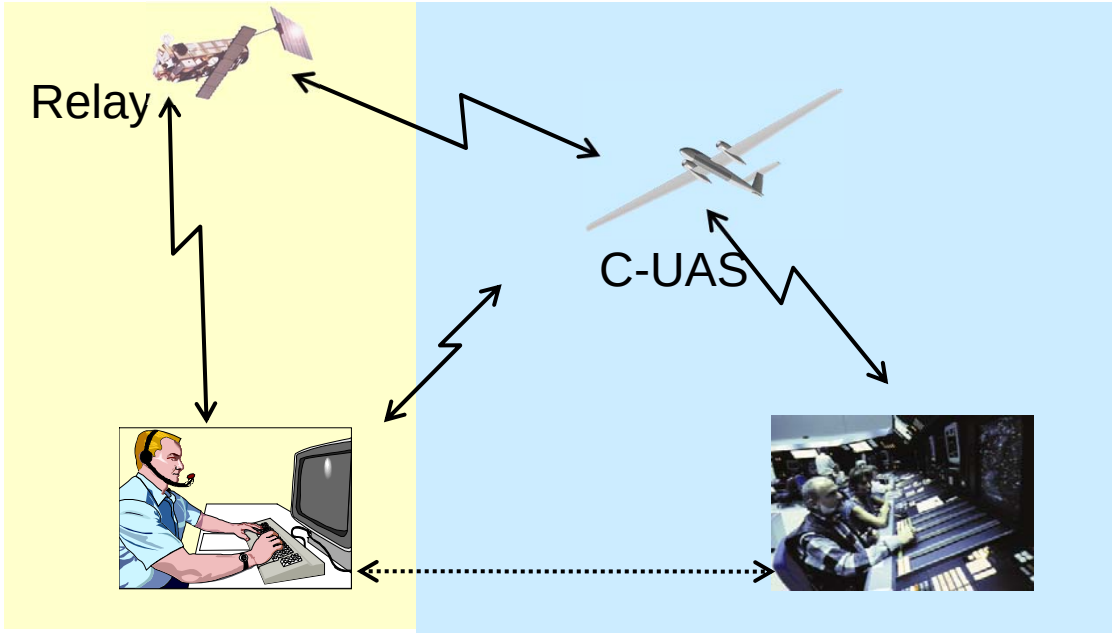
- Workload increased slightly
- Due to unkown behaviour
- Later on workload got to normal

USICO Results (1)

- **General**

  No special problems with UAS in airspace

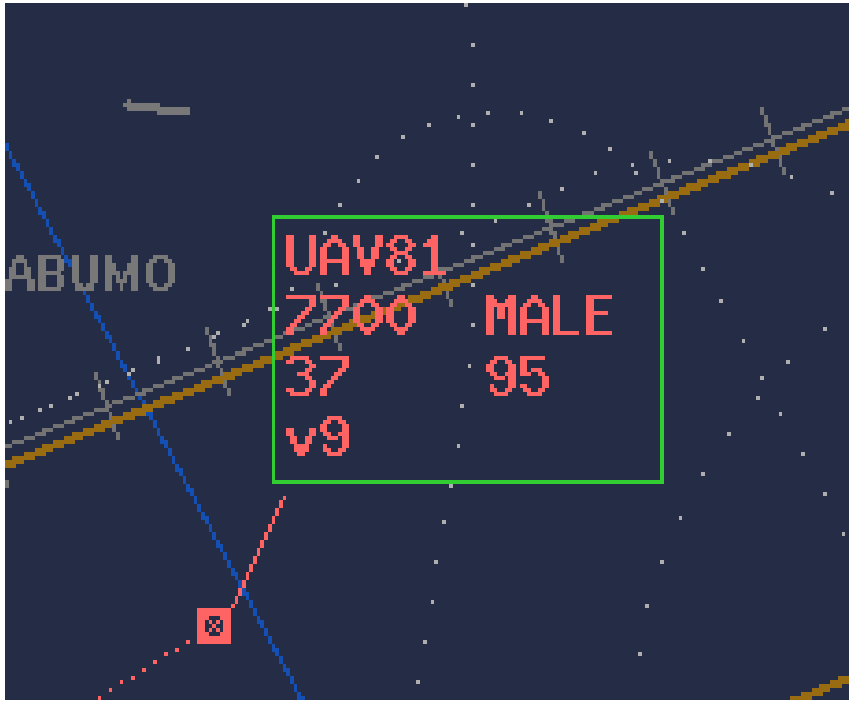
  Integration concept allows treatment of UAS like normal aircraft



USICO Results (2)

- **Emergency Codes**

7600 for data link loss and comm loss appropriate
7700 for unpredictable emergency behaviour only
No other codes recommended



USICO Results (3)

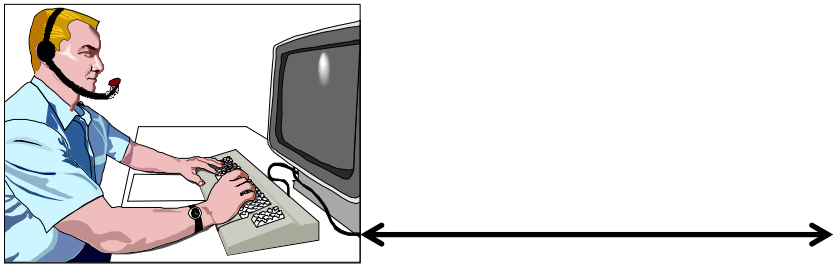
- **Work Load of Controllers**

Workload increased slightly
Due to unkown behaviour
Later on workload got to normal

USICO Results (4)

- **Communication**

Telephone comm between controller and UAS pilot is a benefit compared to manned aircraft



UAS Control Station

Air Traffic Control

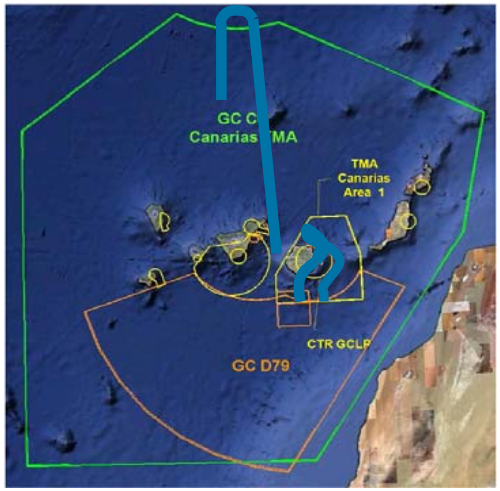
USICO Results (5)

- **Sense & Avoid**

Sense/See & Avoid is still an issue to be solved with highest priority

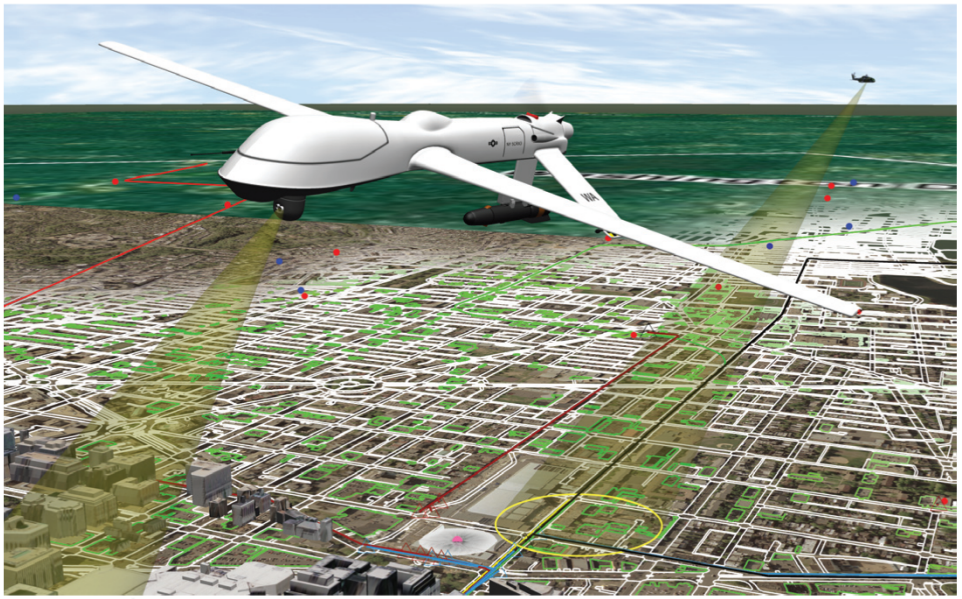
SINUE Setup

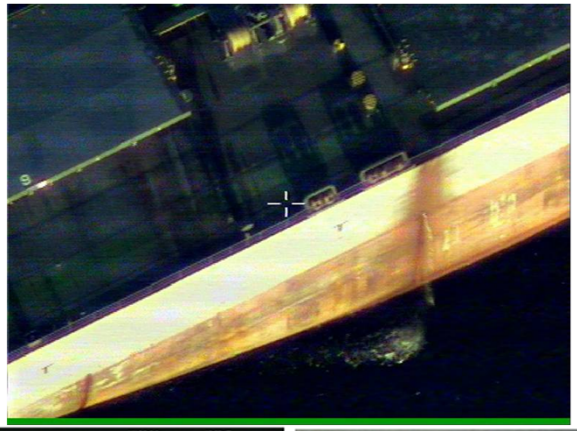
Satellites enabling the Integration in Non-segregated airspace of UAS in Europe



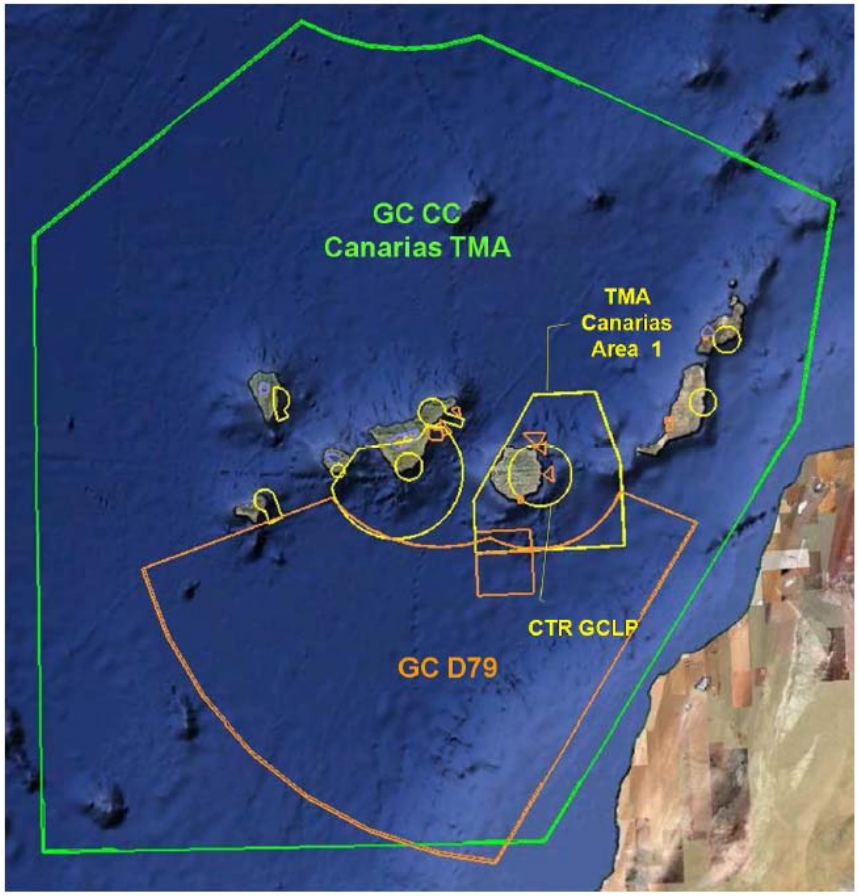
State of the art UAS usage

Unmanned Aerial Systems (UAS)
in non-segregated airspace
through real-time simulation of
Beyond Line of Sight (BLOS) scenarios.





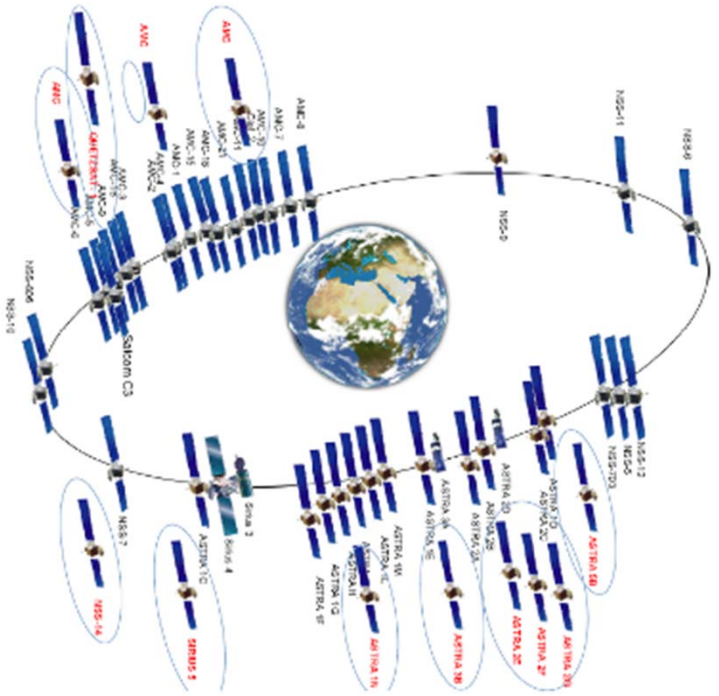
Airspace usage concept validation



The project SINUE investigates satellite aspects (BLOS operations)

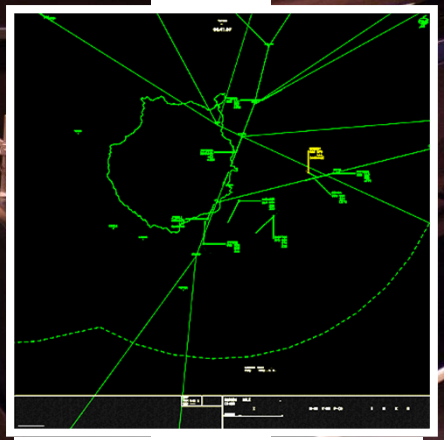
Satellite Communicaton BLOS

- Within the simulation architecture, a satellite model is included
- In the underlying scenarios, several satellite issues will be covered:
  - temporary comm failure because of satellite constellation
  - total comm failure
  - C2 failure
  - time delay
  - bandwidth for real-time surveillance mission
  - cost benefit study

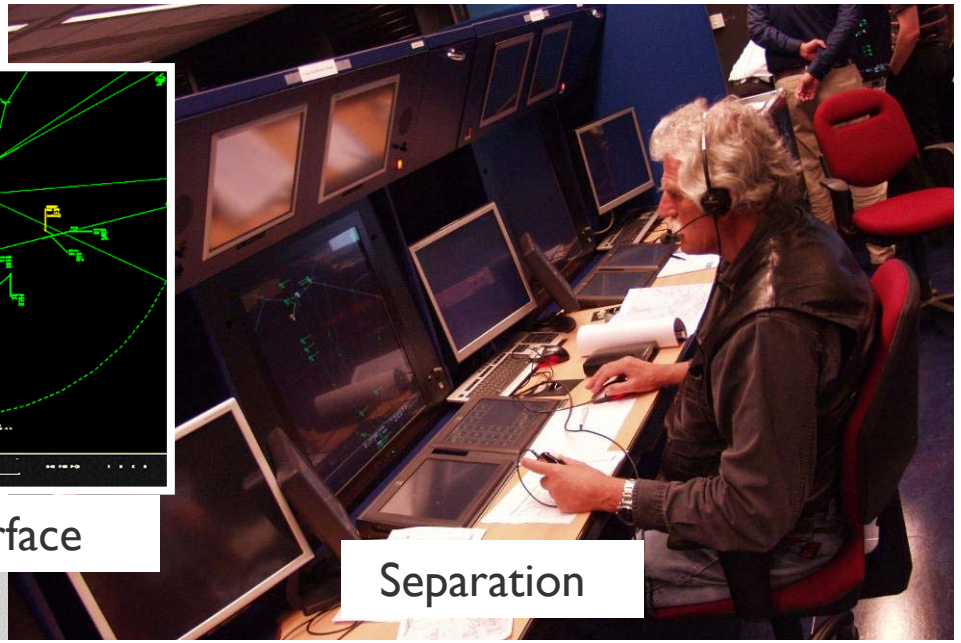


Simulation facilities NARSIM, MUST, GCS

Emergency procedures



ATC Interface



Separation

Architecture of communication

Pseudo Pilots

R/T
C2

Satellite

R/T

R/T
Radar

UAS

R/T C2

NARSIM

Back up telephone

Ground Control Station

SINUE communication overview

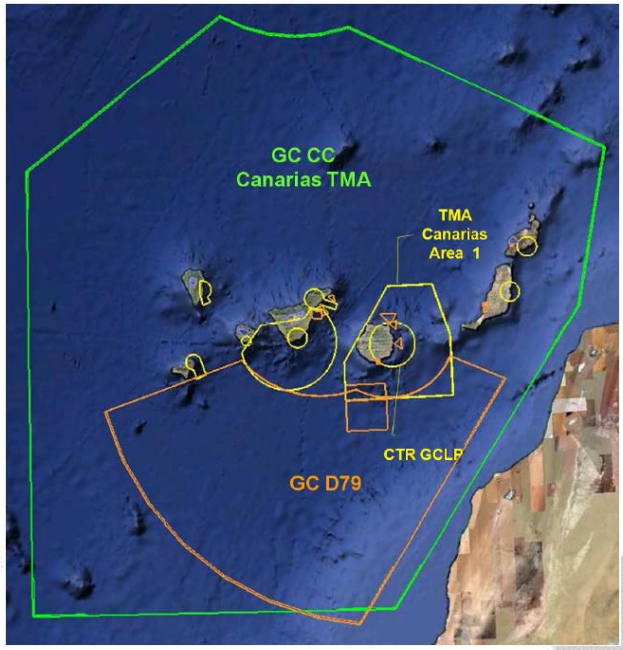
Communication

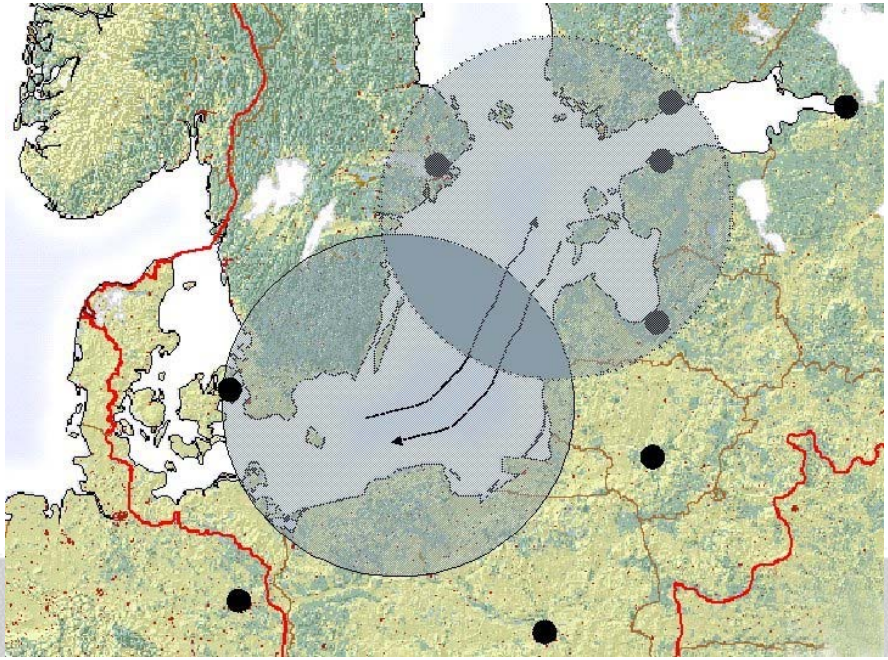
- *Communication*
  - Telephone communication between controller and UAS pilot if requested
- *Simulated Radio Telephony*
  - Radio telephony for the controller / pseudo pilot voice communication
  - Specially designed intercommunication device operation over wire link
  - Satellite Model integrated
  - Communication delay for satellite link is implemented:

SINUE Results

- General
  - No special problems with UAS in airspace
  - Integration concept allows treatment of UAS like normal aircraft

- Demonstration mission planned a the Canary Islands or Baltic Sea 2011-2012





Conclusions

- Validation prior to real life operation.
- Simulation results are very realistic
- See/Sense & Avoid:
  further investigations ongoing