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# ADAPT – Advanced Dynamic ATC Planning Tool



- ***ADAPT** is **COOPANS** concept to integrate FMP and Extended ATC Planning activities into a single working environment supported by AI and Machine Learning, and share the ATFM situational awareness on both DCB and ATC sides.*
- *Technical partner – **Thales with ECOsystem tool***
- **ADAPT is based on 2 gamechangers :**
  - 1) *AI Scalable Dynamic Planning up to 2h prior sector entry*
  - 2) *4d trajectory predictability in ATC systems and in Airborne systems*



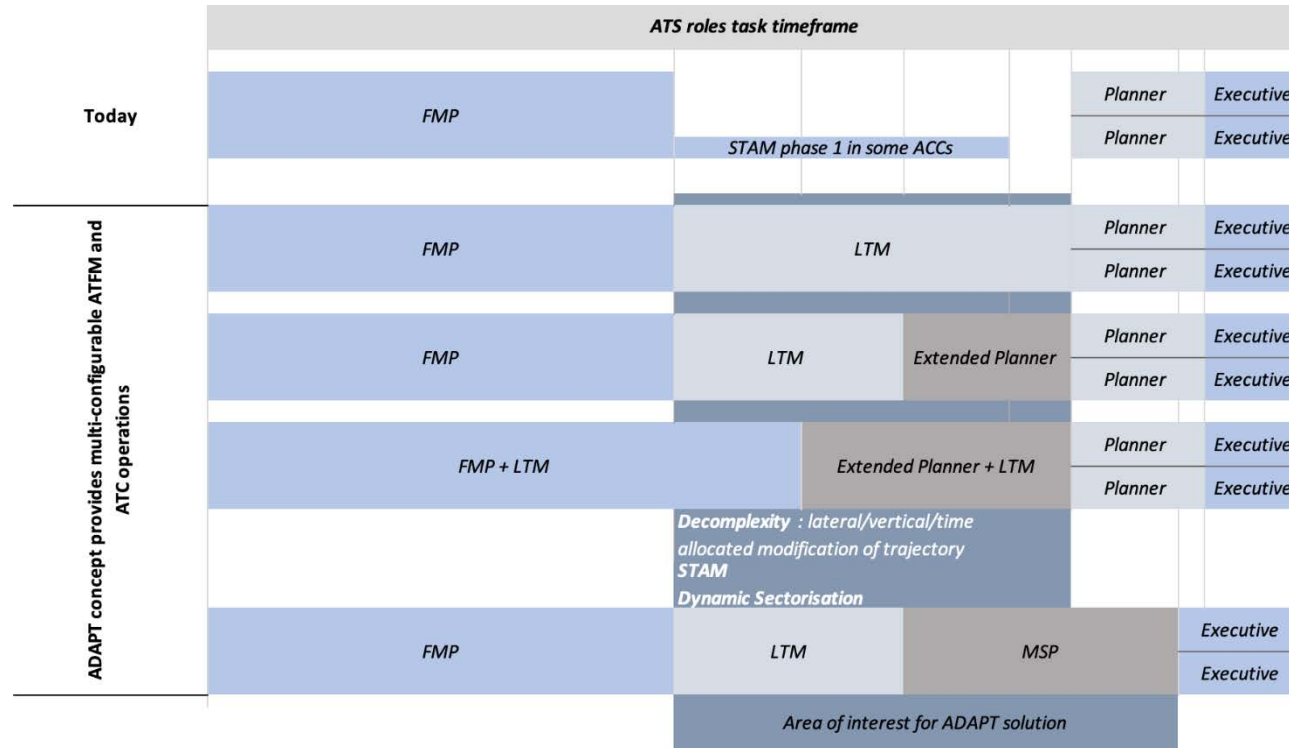
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# ADAPT – main pillars

- **Main ATC capacity amplifier is dynamic reduction of traffic complexity up to 2h prior sector entry which results in predictability in ground and airborne systems**
- Reduction of FMP staff and planning ATCOs mental workload by AI/Machine Learning
- Increase of ATC capacities by **AI decomplexified traffic and AI dynamic sectorisations** (or even flightcentric ATC)
- Aircraft 4D trajectory modification for decomplexity purposes is based on:
  - **Big data/historical data,**
  - **Most efficient trajectory (less fuel, less CO<sub>2</sub> emission...),**
  - **Airliners preferable trajectory,**
  - **Adverse Weather avoidance**and provided to the crew in advance (FMS can compute new efficient trajectory)
- Integration of FMP and ATC tools in one environment, to provide dynamic sectorisation of ATS roles and tool modules (**flexible and dynamic FMP/ATC staff planning**)

# Multi-configurable roles in ATCC



# ADAPT Concept of Operations

- **ATC capacities will be upgraded by traffic decomplexity chain:**
  1. **LTM** (Local Traffic Manager) role will provide initial decomplexity (flow orientated) to dynamic planning role (**EAP/MSP**)
  2. Dynamic planning role (**EAP/MSP**) will provide more dynamic decomplexity (flight orientated) for **Executive ATCOs**
  3. Executive ATCOs will have less potential conflicts which will increase sector capacity
- **Predictability instead of adhoc solutions:**
  - Predicted 4D trajectory shall be flown as much as possible, as it is most efficient trajectory calculated by AI

# Decomplexity Methods:

- Dynamic sector gates instead of coordination points (especially in FRA)
- Management of traffic flows (gate to gate flows) to disperse traffic along new sectorisation
- Time Travel Mode to display future traffic situation on radar display (including „what if” situations)
- Resectorisation/new sectors according to traffic complexity and staff availability
- Vertical and lateral trajectory modification in advance (up to 2h)
- Time to gain/time to lose for sector gate crossing
- 4D trajectory profile modification uploads in advance as „expected clearance”
- „Vertical Movement Green Light” as a supporting tool for executive ATCO to instruct pilot according to „expected clearances”
- ATC workload calculations based on each aircraft complexity scale including dynamic auto SKIP
- Adverse weather solutions (No Fly Zone Evolution and Resolution tool)

# COOPANS

REAL COOPERATION, REAL RESULTS



This project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 699238



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A CANSO partnership with ATCA

# SINAPS

A set of innovative ATFCM services  
to support Dynamic Airspace Configuration  
for FMPs and Supervisors

BEDOUET Judicaël (ONERA)  
DUBOT Thomas (ONERA)  
LUXEMBOURG Isabelle (DSNA)



# A VERY MODULAR AIRSPACE

A HUGE RANGE  
OF COMBINATIONS!



Many possible sector  
configurations to fulfil  
performance objectives

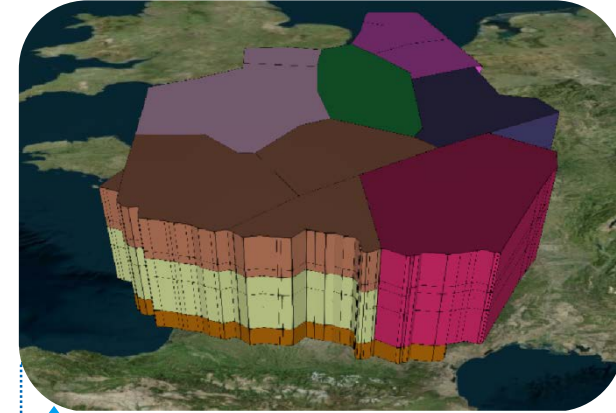
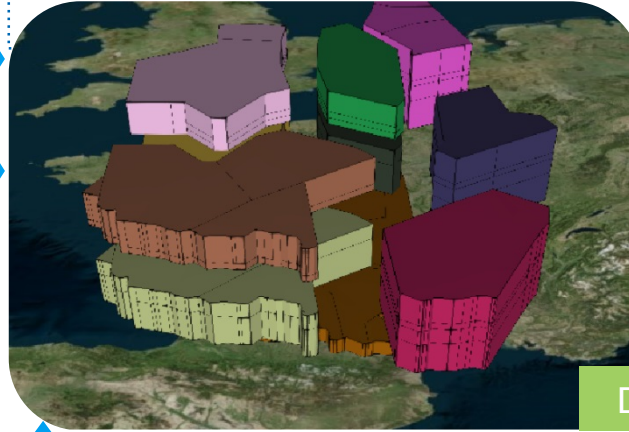


# OPTIMISING CAPACITY AND RESOURCES TO MEET TRAFFIC FLOWS

Traffic

Resources  
Environment

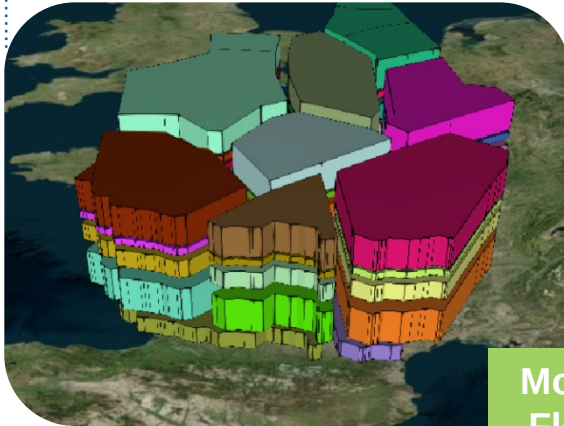
Organisation for airspace optimisation



Optimised configuration  
of en-route sectors

Dynamicity

Airspace in elementary blocks

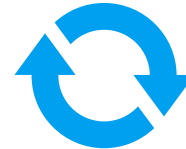


Modularity  
Flexibility

H-5 H-4 H-3 H-2 H-1 H-30' H ...



A continuous process



# SINAPS

*SWIM Integrated Network management and extended  
ATC Planning Services*

Support dynamic configuration of en-  
route sectors thanks to digitalisation  
and artificial intelligence:

- ⊙ Human Factors in design
- ⊙ Data Mining and Machine learning
- ⊙ Real time multi-objectives optimization
- ⊙ Exploratory mode
- ⊙ Web services architecture

Human  
Factors  
in design



- ⊙ Observations in ACC and workshops with Users
- ⊙ Iterative process to elaborate working methods, functionalities and interactions

Artificial  
Intelligence



- ⊙ Learning from the past days, weeks, months, years and feed automation
- ⊙ Correlations between sectors configurations / transition / workload
- ⊙ Learning to create new collapsed sectors and to calculate thresholds

Machine  
Learning



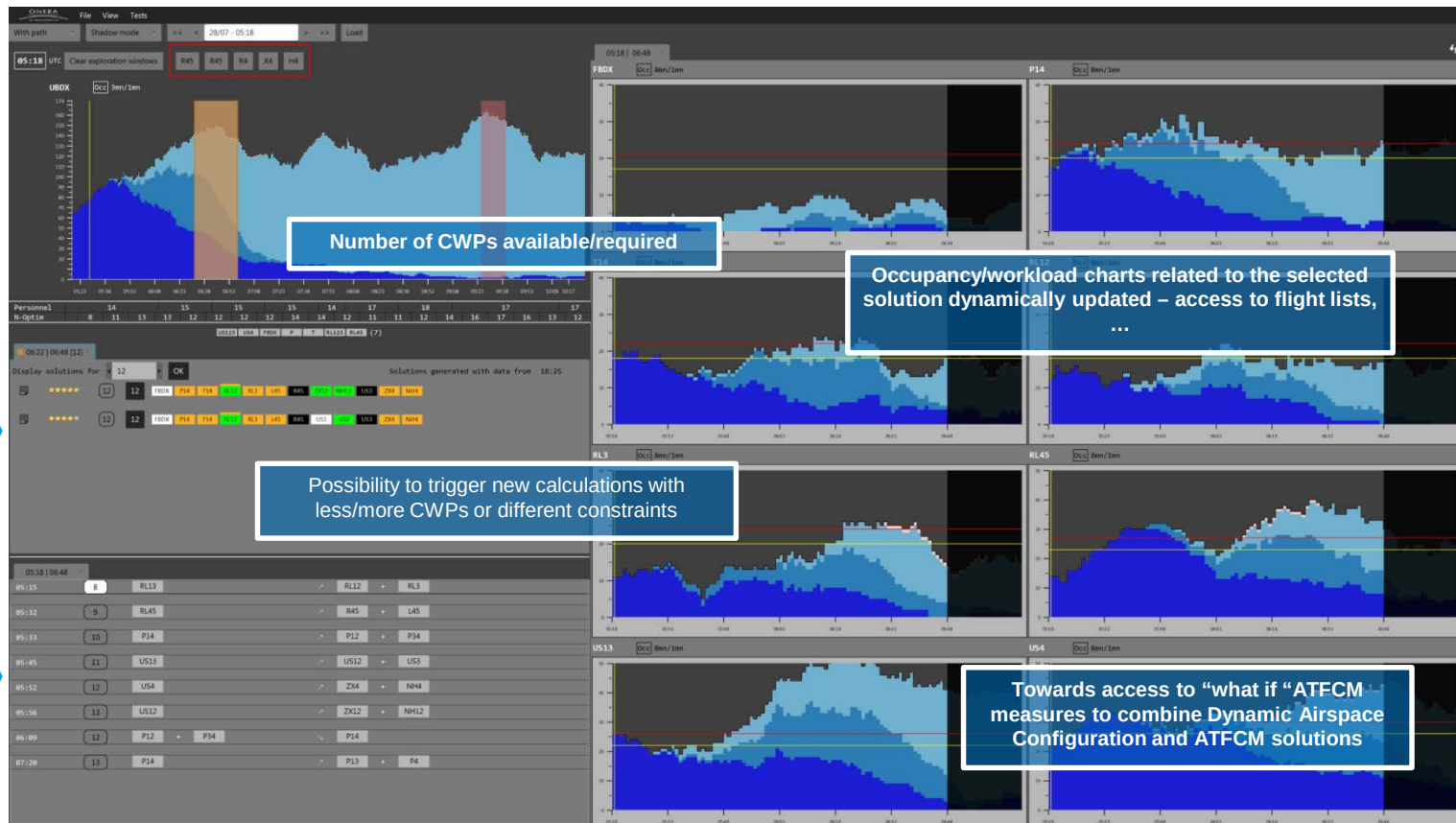
Web  
Services



# SINAPS HMI: FROM ALGORITHMS TO USER DECISION MAKING

Solutions provided instantly by a real-time multi-objective Optimizer

With a feasible transition path from the current ACC configuration



# SINAPS IS USED IN 2 MODES

SINAPS - Tactical mode

SINAPS - Exploratory mode

H-3h

H-30min

D+1

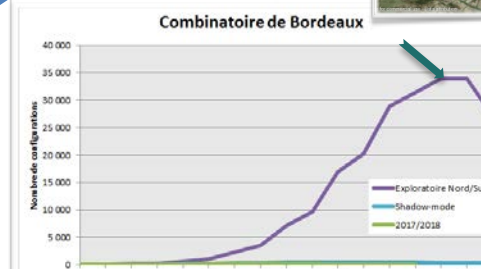
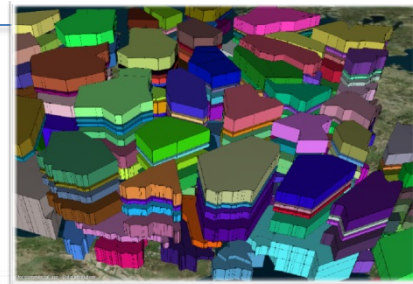
Network Planning

Execution

Post Operations



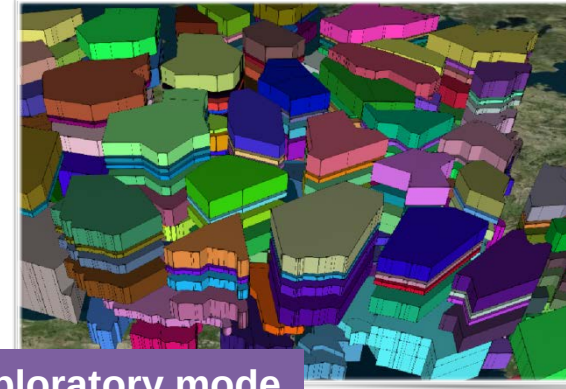
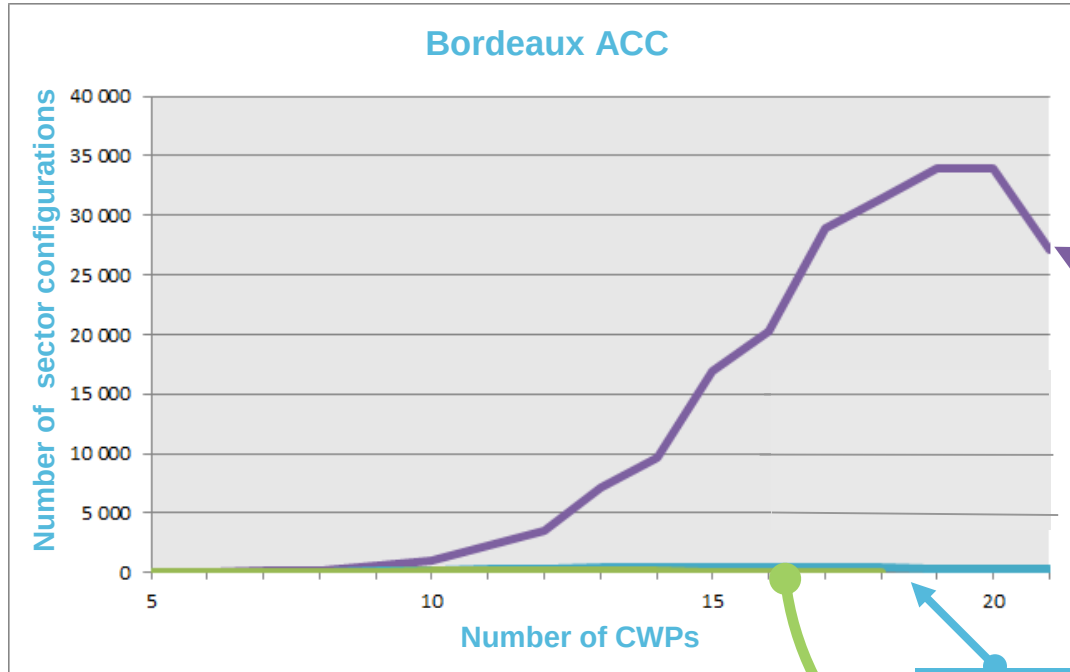
This mode is deliberately « restrained »:  
only ATC options are validated



Full range of geographical possibilities

**IN BOTH MODES: OPTIMISATION**

# HUGE RANGE OF COMBINATIONS



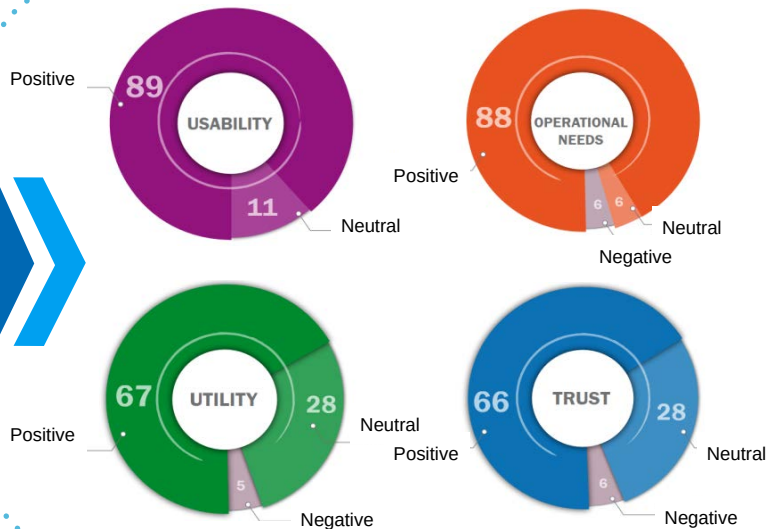
Tactical



# SINAPS IN EVALUATION AT BORDEAUX ACC



Very good results



Advanced Airspace Management



## Main outcomes in a nutshell:

- ⦿ Time saving in detection, resolution and decision making
- ⦿ Efficient innovative solutions provided by the tool
- ⦿ Valuable real time optimisation
- ⦿ Improved situational awareness shared by Supervisors and FMPs





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# MATIAS Functional upgrade

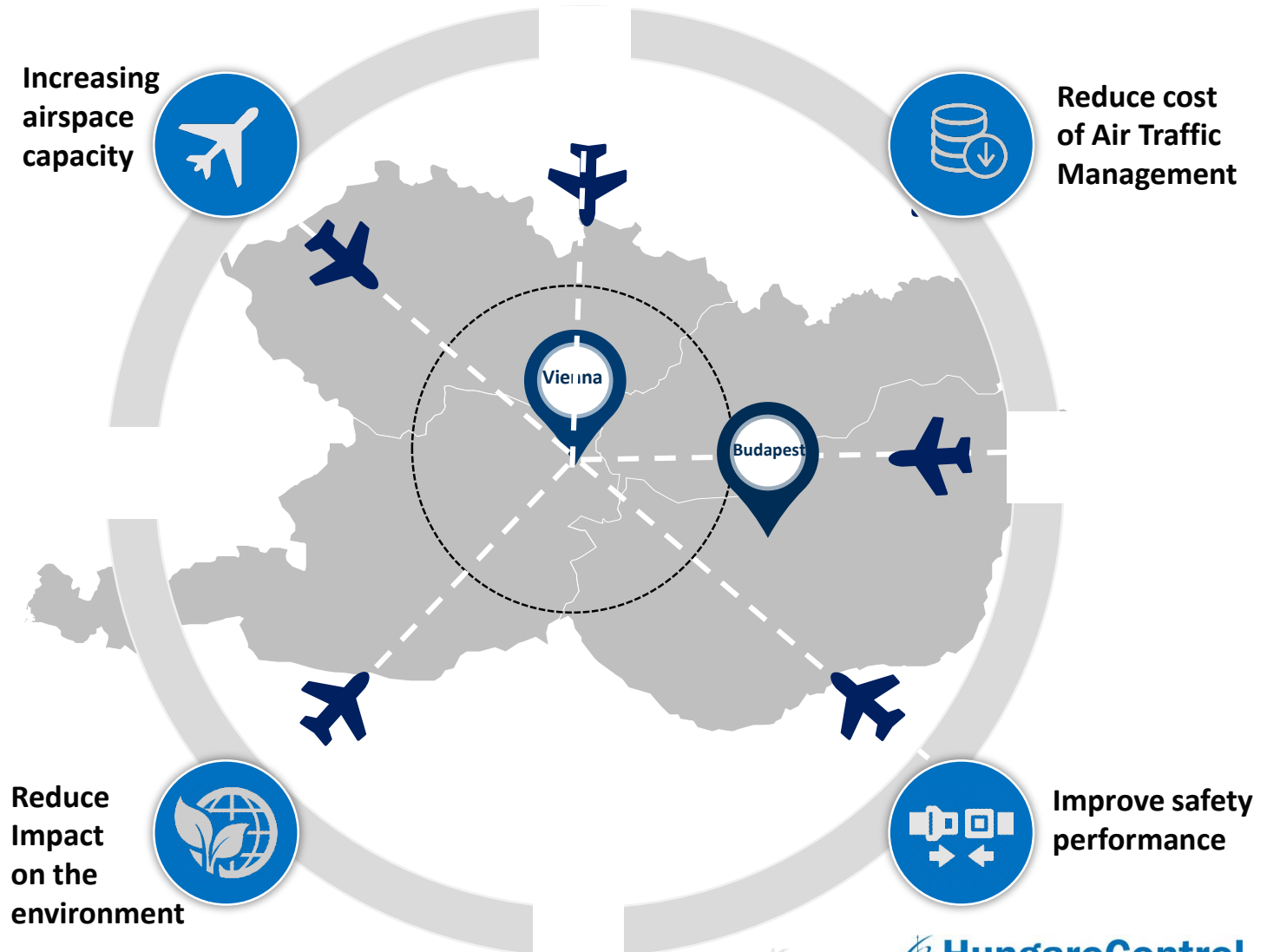
Increasing capacity through new ATC concepts  
Implementation of the Pilot Common Project

**Gábor Szabó**

Head of ATM System Development  
Department

### Basic Arrival Management AMAN – Operational benefits

- improve **sequencing and metering** of arrival aircraft in Vienna TMA and airport
- continuously calculate arrival sequences and times for flights, taking into account the locally defined landing rate, the required spacing for flights arriving to the runway and other criteria
- provide **automated decision support** for sequencing and metering of traffic arriving to an airport.
- One of the first Multi center AMAN implementation



# MATIAS Build 11

## #2015\_234\_AF1\_B AMAN LOWW initial

AMA

RJA127 LOVV E190/M  
360 NATEX N446 LOWW  
360 140 ASP ARC  
NATEX TXT

AMA

RJA127 LOVV E190/M  
360 NATEX N446 LOWW  
360 140 ASP ARC  
NATEX TXT  
N0326F120 MOUAB1S MOUAB DCT TALMI P52 BGN/0455  
F340 P52 GITLA UW13A VELOX UR18 ALSUS UL620 VESAR  
UL619 KFK UA16 FENER UT264 TUDBU Q26 ETUBA T226  
SODGE NATEX NATEX1W  
O  
L02 PESAT 1231

### Aim of the project – technology solution:

- Modification of FDP coordination function to include AMAN related messages exchange between Austro Control's and HungaroControl's ATM systems.
- Improvement of FDP to process AMA messages and present information - TTG (Time to Gain) and TTL (Time to Lose) and the TOM (Time over metering fix) - to controllers managing in the Hungarian airspace traffic landing in Vienna.

## #2015\_034\_AF3 MATIAS ATM System upgrade for cross-border Free Route

Increasing  
airspace  
capacity



Reduce cost  
of Air Traffic  
Management



Reduce  
Impact  
on the  
environment



Improve safety  
performance



### HC contribution to FREE ROUTE IMPLEMENTATION

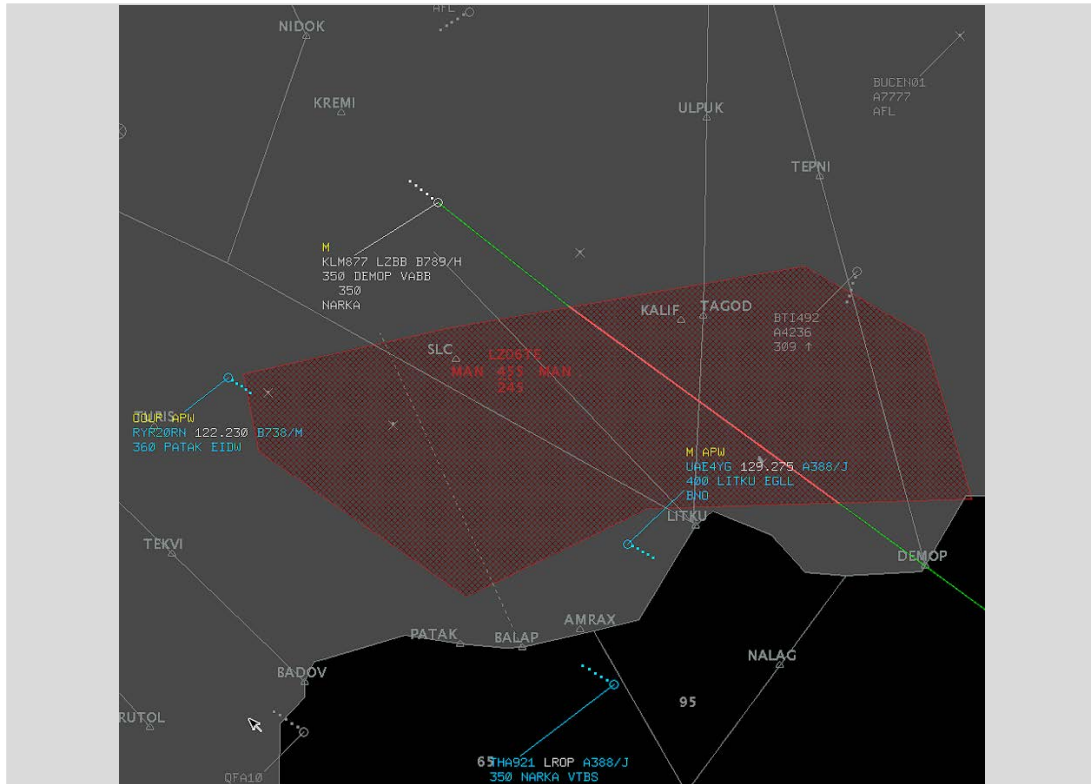
- February 2015  
HUFRA  
H24, ATS route network eliminated
- August 2015  
NFRAB (HU-RO x-Border FRA)  
During Night hours, FL 105-FL660-full free route
- December 2015  
LONG Distance DCT (GB-MUAC-DE-AT-HU)  
47 DCT routes from the UK airspace to the HU-RO Border
- 2017 Q1  
SEEN (HU-RO-BG x\_Border FRA)  
during night hours free route
- December 2018  
SEEN FRA extension toward Slovakia
- November 2019  
SEEN FRA turns into SEE FRA H24

**GOAL: Single European Sky**

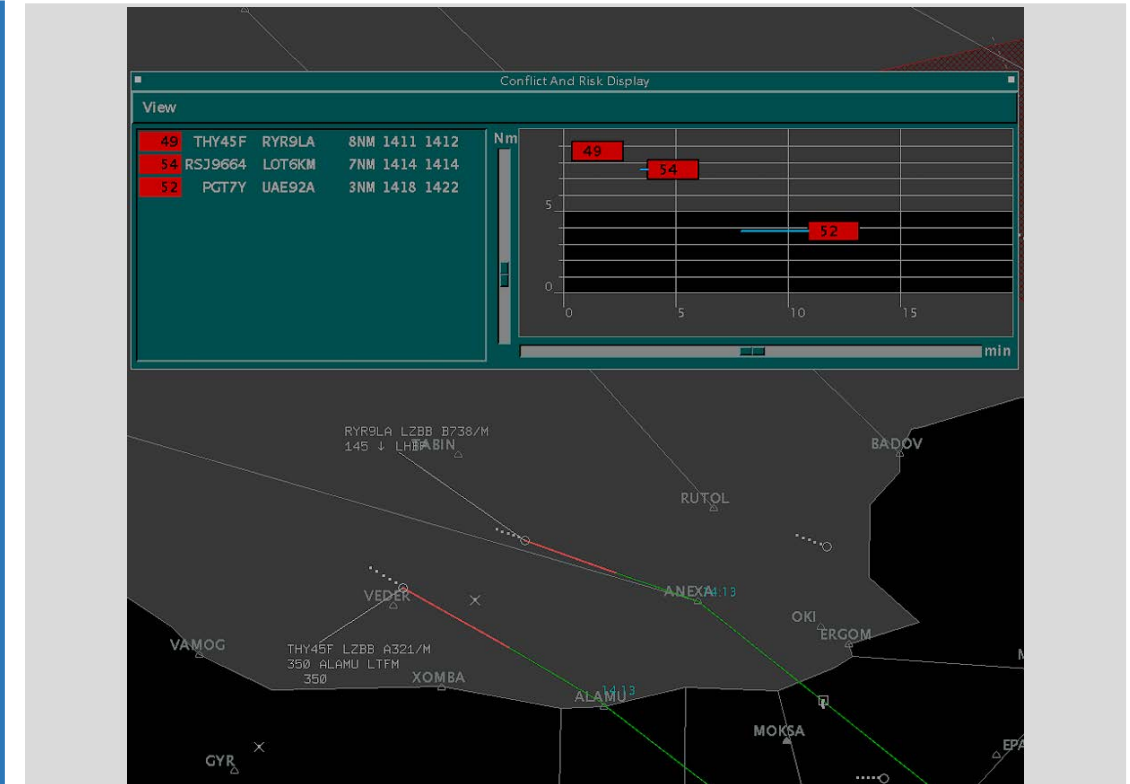
## #2015\_034\_AF3 MATIAS ATM System upgrade for cross-border Free Route

### TECHNOLOGY SOLUTION

Enhance FDP for TSA/Alternate routes definition outside AoR



Extend capacities for AoR cross-border operations



### TECHNOLOGY SOLUTION

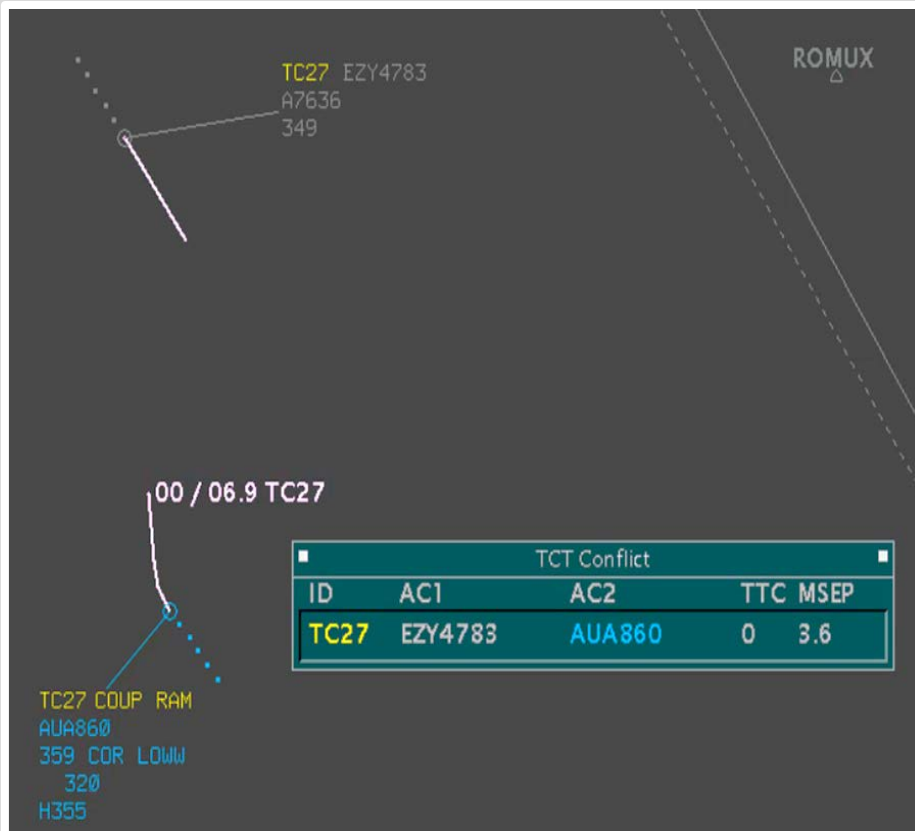
#### Extend capacities for AoR cross-border operations

- Extension of the system area beyond the FIR borders.
- System capacity increase
- OLDI message improvements



# OTHER PIONEER FUNCTIONALITIES WITHIN MATIAS BUILD 11

## TACTICAL CONTROLLER TOOL (TCT)



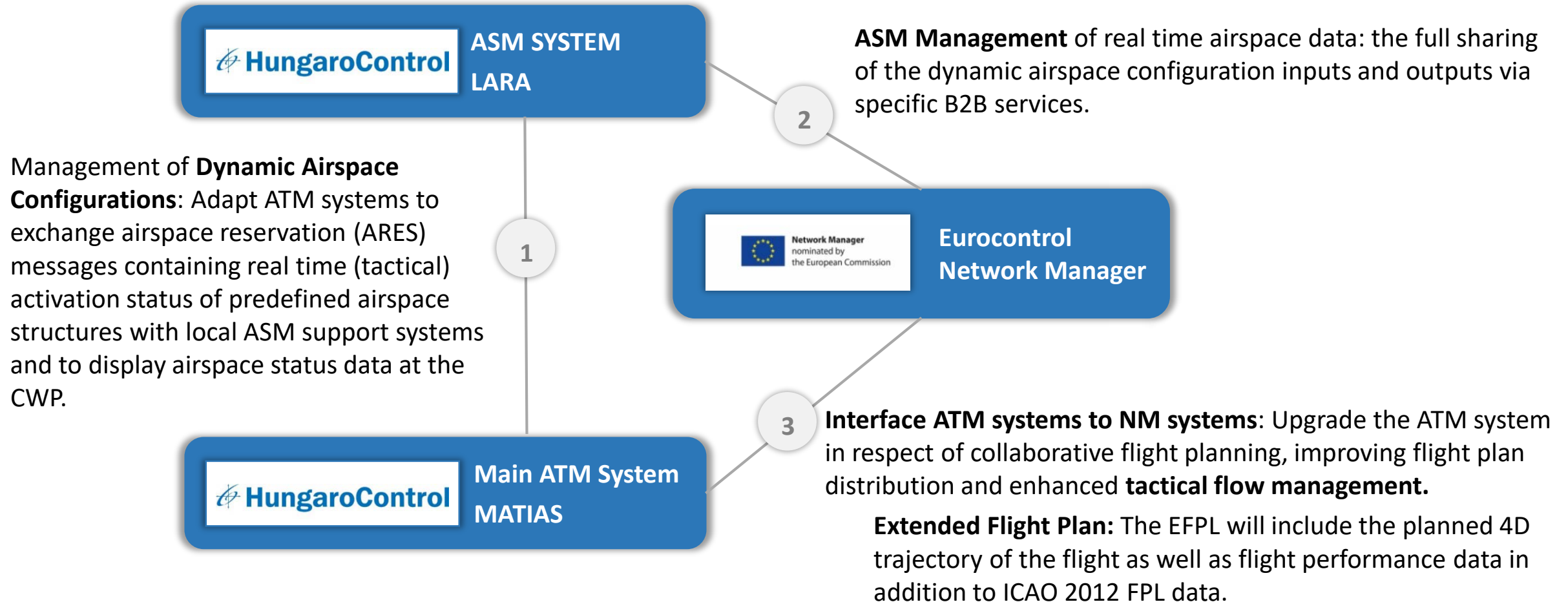
The function is developed by Thales, HungaroControl is the first ANSP that use it in operation.

- 4 dimensional conflict detection
- Multihypothesis principle
- Uses DAPS DSFL (Selected Flight Level) download from the aircraft.

Operationally implemented on 27.02.2019.

## #2017\_074\_AF3 Hungarian ATM system upgrade for AF3-AF4

This proposed Implementation Project aims to upgrade HungaroControl ATM system, to:



KÖSZÖNÖM A FIGYELMET!

**MORE  
THAN  
AN  
ANSP**



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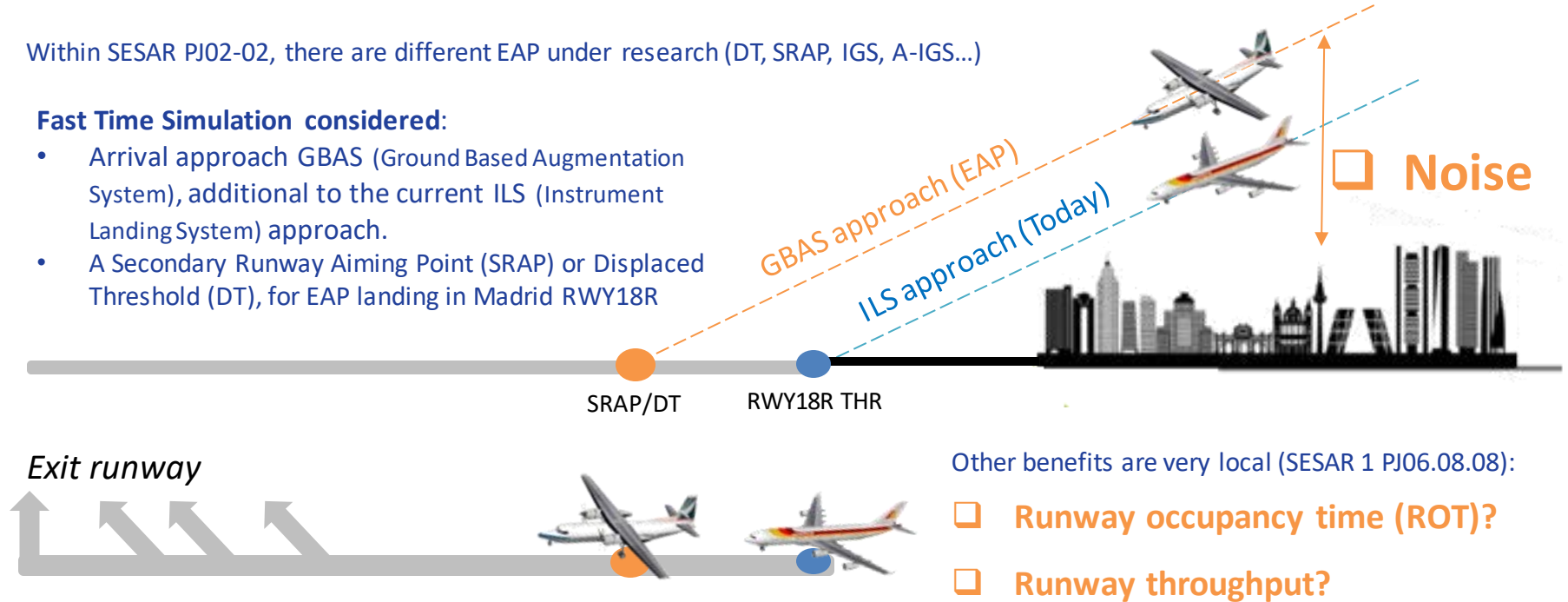


# Enhanced Arrival Procedures (EAP)

Within SESAR PJ02-02, there are different EAP under research (DT, SRAP, IGS, A-IGS...)

## Fast Time Simulation considered:

- Arrival approach GBAS (Ground Based Augmentation System), additional to the current ILS (Instrument Landing System) approach.
- A Secondary Runway Aiming Point (SRAP) or Displaced Threshold (DT), for EAP landing in Madrid RWY18R



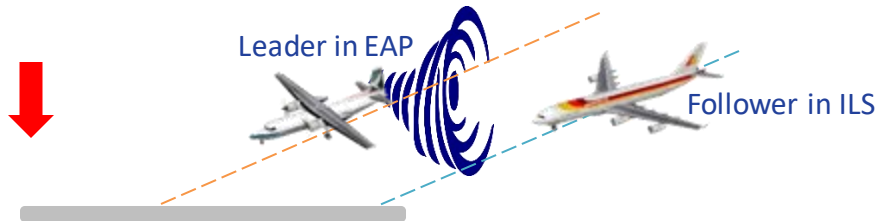
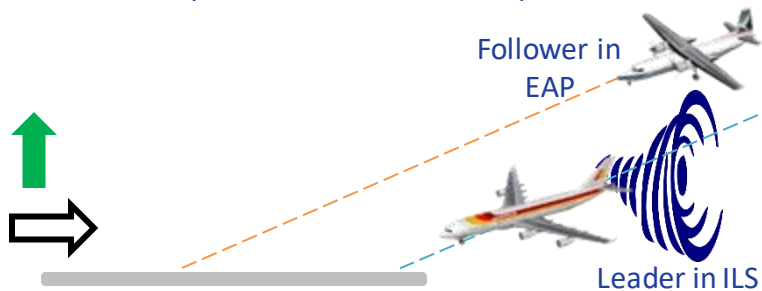
Other benefits are very local (SESAR 1 PJ06.08.08):

- Runway occupancy time (ROT)?
- Runway throughput?

# Enhanced Arrival Procedures (EAP)

## ❑ Separations (wake turbulence)

- Can any distance be used for displacement?



## ❑ CBA aspects

- Is it possible to enlarge the runway?
- Is it needed to modify runway exits?

## ❑ Aircraft capabilities

- % of aircraft able to use EAP (GBAS equipped)?

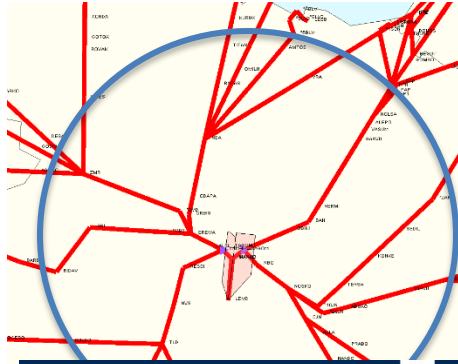
## ❑ Standards & Regulations

- Lightings and markings on the runway?

# Enhanced Arrival Procedures (EAP)

FAST TIME SIMULATION IN MADRID ADOLFO SUÁREZ BARAJAS AIRPORT (DT/SRAP)

## ECTRL NEST



SRAP 300m Approach Separation Minima (in NM) with ICAO WT categories - with 4 NM minimum separation as in LEMD

Baseline DBS (ICAO)

Note: "LST" -> lower glide, "SRAP" -> upper glide

| Lead S.S. | S | H | M | L | Lead S.S. | S | H | M | L |
|-----------|---|---|---|---|-----------|---|---|---|---|
| S         | 4 | 5 | 7 | 8 | S         | 4 | 5 | 7 | 8 |
| H         | 4 | 4 | 5 | 6 | H         | 4 | 4 | 5 | 6 |
| M         | 4 | 4 | 4 | 5 | M         | 4 | 4 | 4 | 5 |
| L         | 4 | 4 | 4 | 4 | L         | 4 | 4 | 4 | 4 |

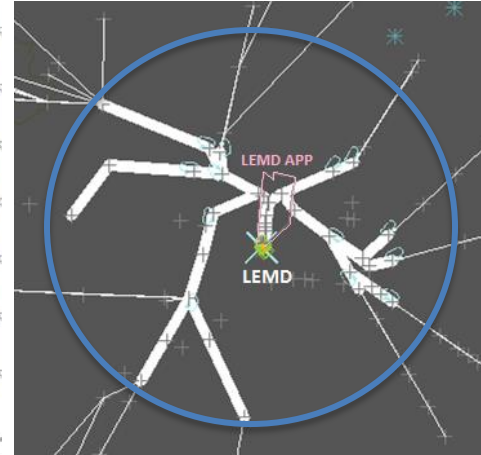
  

| Lead S.S. | S | H | M | L | Lead S.S. | S | H | M | L |
|-----------|---|---|---|---|-----------|---|---|---|---|
| S         | 4 | 5 | 7 | 8 | S         | 4 | 5 | 7 | 8 |
| H         | 4 | 4 | 5 | 6 | H         | 4 | 4 | 5 | 6 |
| M         | 4 | 4 | 4 | 5 | M         | 4 | 4 | 4 | 5 |
| L         | 4 | 4 | 4 | 4 | L         | 4 | 4 | 4 | 4 |

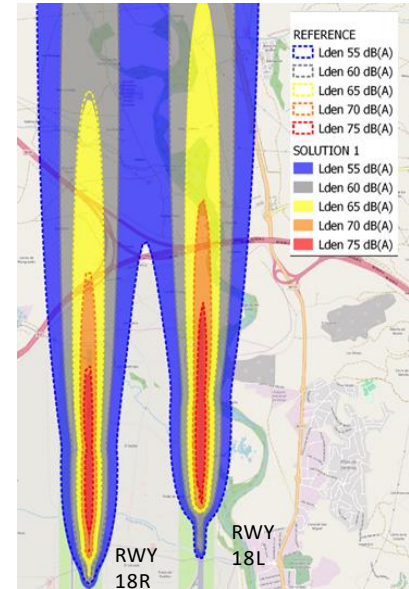
CARTA PARA SIMULACIÓN



## RAMSPlus



## ECTRL IMPACT



- Dependent (DT) and Independent (SRAP) use for arrivals
- 300 m displacement in RWY18R
- Heavy (19%), Medium (79%), Light (2%)



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# Enhanced Arrival Procedures (EAP)

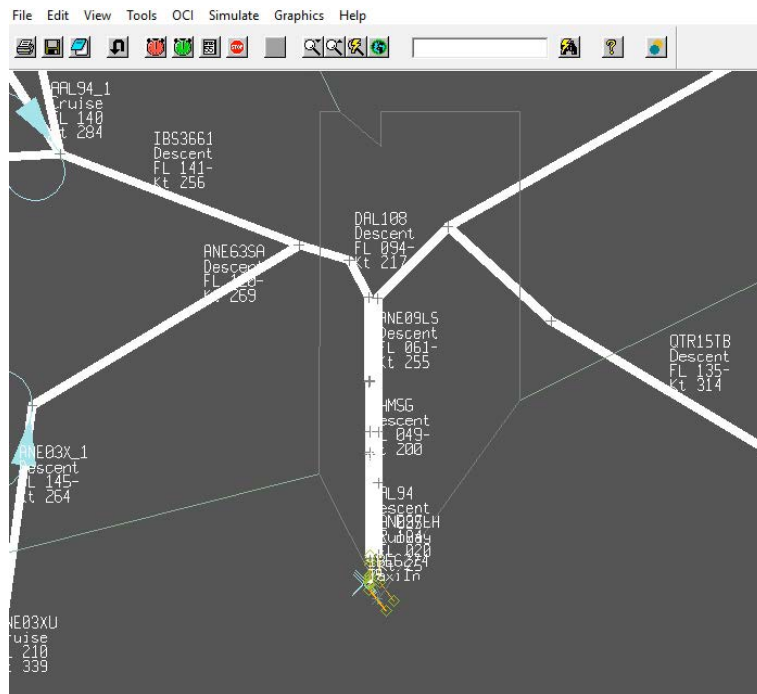
- **EAP Local assessment** identifies:
  - Opportunities in the daily hours for having benefits in runway throughput (e.g. 4-6% depending on runway use)
  - 2% benefit in total day CO2 emissions
  - 4% benefit in number of people exposed to noise levels during daytime

- **These benefits need of:**

- Tool to support APP/TMA ATC for identifying opportunities in daytime, while maintaining safety in separation provision (e.g. LORD & AMAN integration)
- Research on runway markings and lightings below 1000m displacement

Assessed benefits could be increased if runway could be enlarged (i.e. bigger displacement) and/or runway exits modified (i.e. costs incremented)





This project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 731781

# THANK YOU!

