

# Capacity sharing within Virtual Centre

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## Outline

- Background
  - Objective
- Model
  - Formulation
  - Example
- Results
- Conclusions

**FIR/UIR in the Upper Airspace (EUROCONTROL Member States)**

The map displays the Flight Information Regions (FIR) and Upper Information Regions (UIR) across Europe, North Africa, and parts of Asia. The legend indicates:

- FIR/UIR Upper Airspace
- EUROCONTROL Member States

**Source:** EAD  
**Effective:** 28 January 2021

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## Background (2/2)



Single European  
Airspace System

Network  
airspace operations

Air traffic services

Data and application  
services

Infrastructure



Source: AAS

11<sup>th</sup> SESAR Innovation Days



## Objective

- To understand the magnitude of possible benefits
  - Air traffic flow management (ATFM) delay reduction
  - With current ATC resources
- The contribution is a **mathematical model** designed to **assess delay reduction** that could be achieved by different Virtual Centre set-ups with **current resources**
- Requires a fair number of assumptions

## Virtual Centre concept explored

- Virtual Centre - a collaboration of a group of area control centers (ACCs), enabled by virtualisation, in provision of **location-independent ATC services**
  - No physical consolidation of facilities
  - Full technical and operational interoperability
  - Assume the use of ATM data services from data provider/s
  - Sector-independent ATCO licensing
  - Exploring ATC-C and ATC-S regulations
  - MACRO analysis

## Model assumptions and formulation (1/4)

- Assumptions:
  - Capacity issues when ATC-C and ATC-S regulations generated
  - Staff at ACC-A open a sector in ACC-B when the operational resources are lacking at the ACC-B
  - ACC-A can open an additional sector at ACC-B when it does not generate ATFM delay, and the number of currently open sectors is lower than those in planned Opening Schemes (pOS)
    - Three saturation levels – 0, 20 and 40% utilisation of open sectors

## Model assumptions and formulation (2/4)

- Additional sector(s) at ACC-A can be controlled by ACC-B if the number of open sectors at ACC-A does not equal the maximum number of sectors
- Individual sector capacity is expressed as average sector capacity per ACC

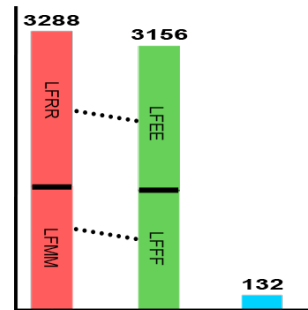
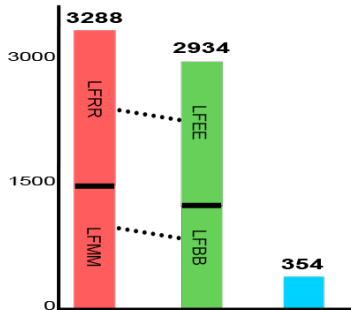
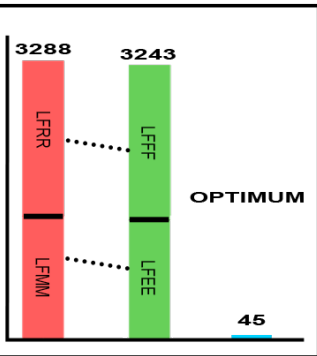
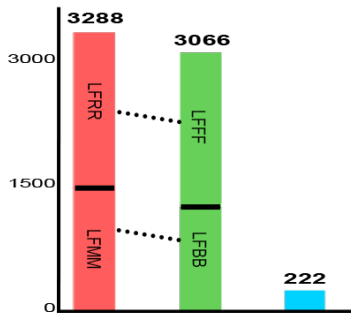
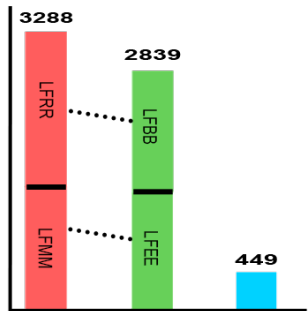
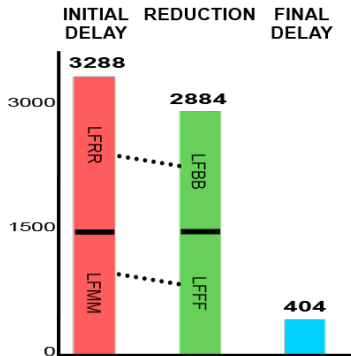
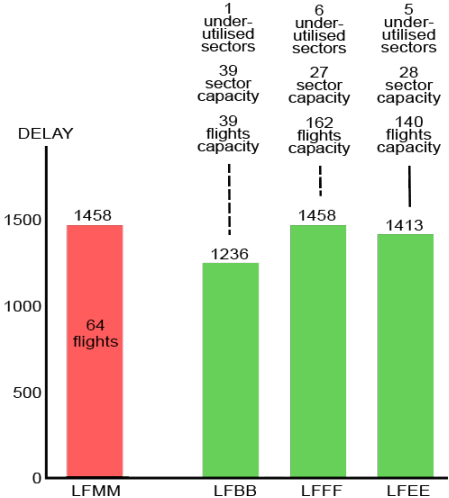
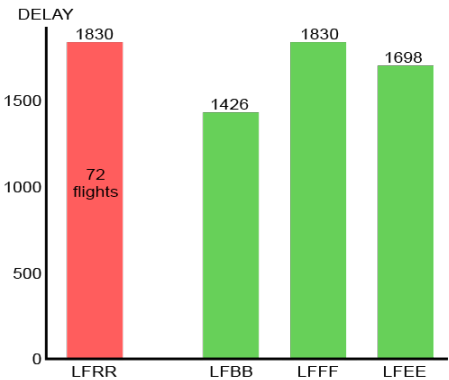
## Model assumptions and formulation (3/4)

- Sets:
  - the set of ACCs
  - the set of all time intervals (set to one hour)
  - $D_{it}$  the delay of  $ACC_i$  at interval  $t$
  - $D_{jt(i)}$   $ACC_i$ 's total delay that  $ACC_j$  can absorb at interval  $t$  if collaborating with  $ACC_i$
- Variables:
  - $x_{ijt}$  equals 1 if  $ACC_i$  and  $ACC_j$  collaborate in time  $t$
  - $d_{ijt}$  the minutes of delay of  $ACC_i$  absorbed by  $ACC_j$  at time  $t$

## Model assumptions and formulation (4/4)

- Objective is to find **the collaboration configuration** at each time interval  $t$  that **minimises the total delay**
- Subject to:
  1. At each time  $t$  an ACC can collaborate with only one ACC and cannot collaborate with itself
  2. If at time  $t$  an ACC is requesting a collaboration with another ACC, it cannot provide any delay transfer to other ACCs
  3. A delay is transferred from one ACC to another only if the two are collaborating
  4. The delay absorbed by an ACC is limited - by the created delay, or the delay the matched ACC is capable to absorb

# Example



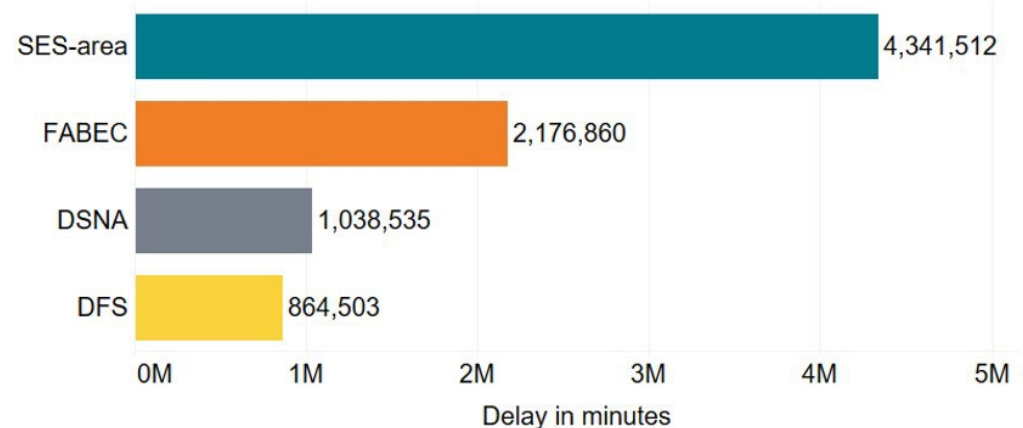
## Data and scenarios

### Data

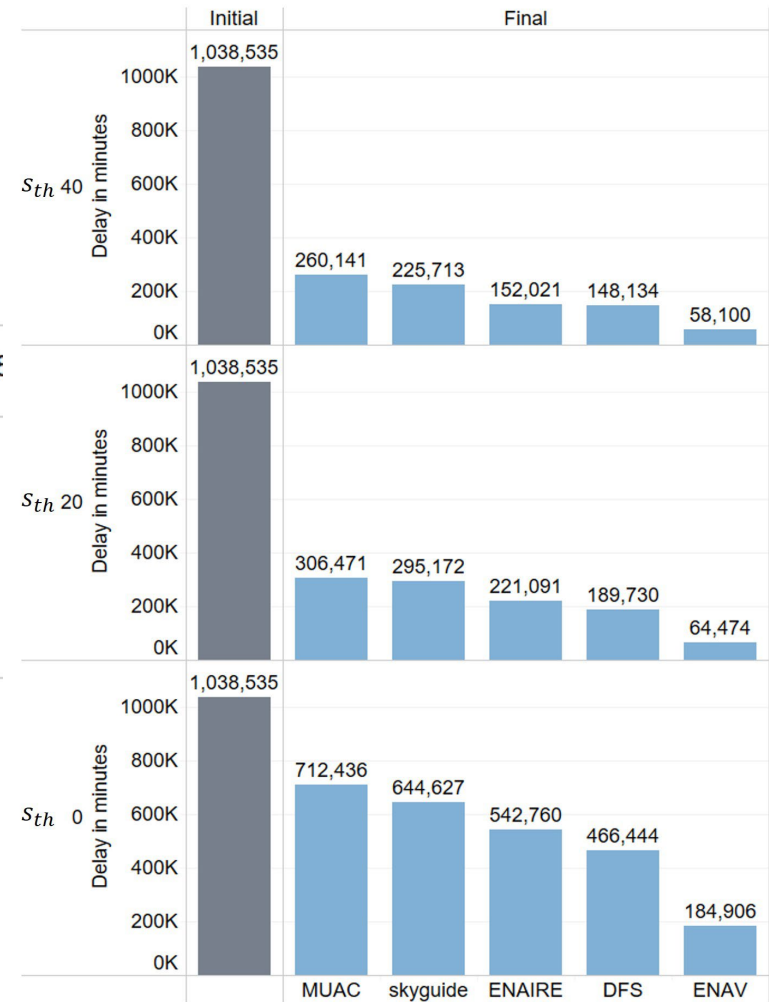
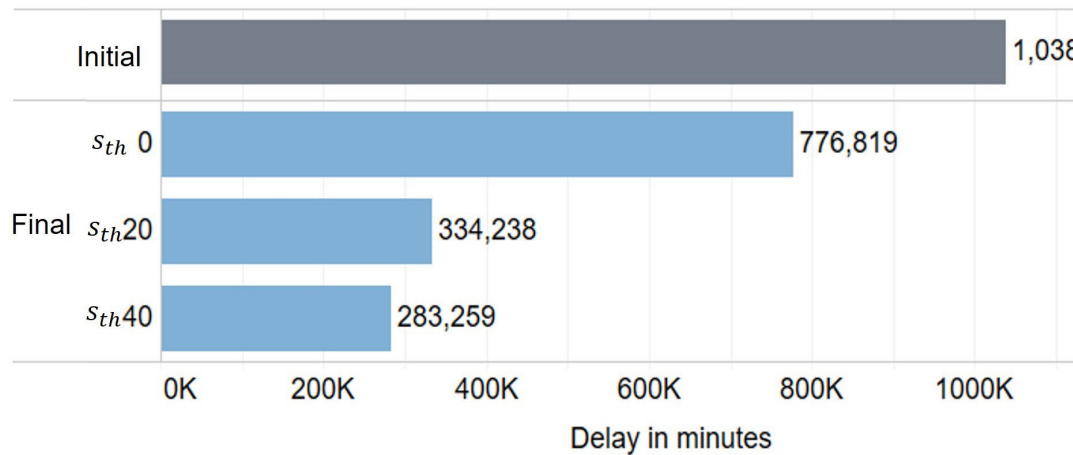
- 2 AIRACs from EUROCONTROL's DDR2 data
  - Sectors and saturations
  - Delayed flights
  - ATFM regulations
  - Configurations
  - Opening schemes
  - Sector capacity
- Planned opening schemes

### Scenarios

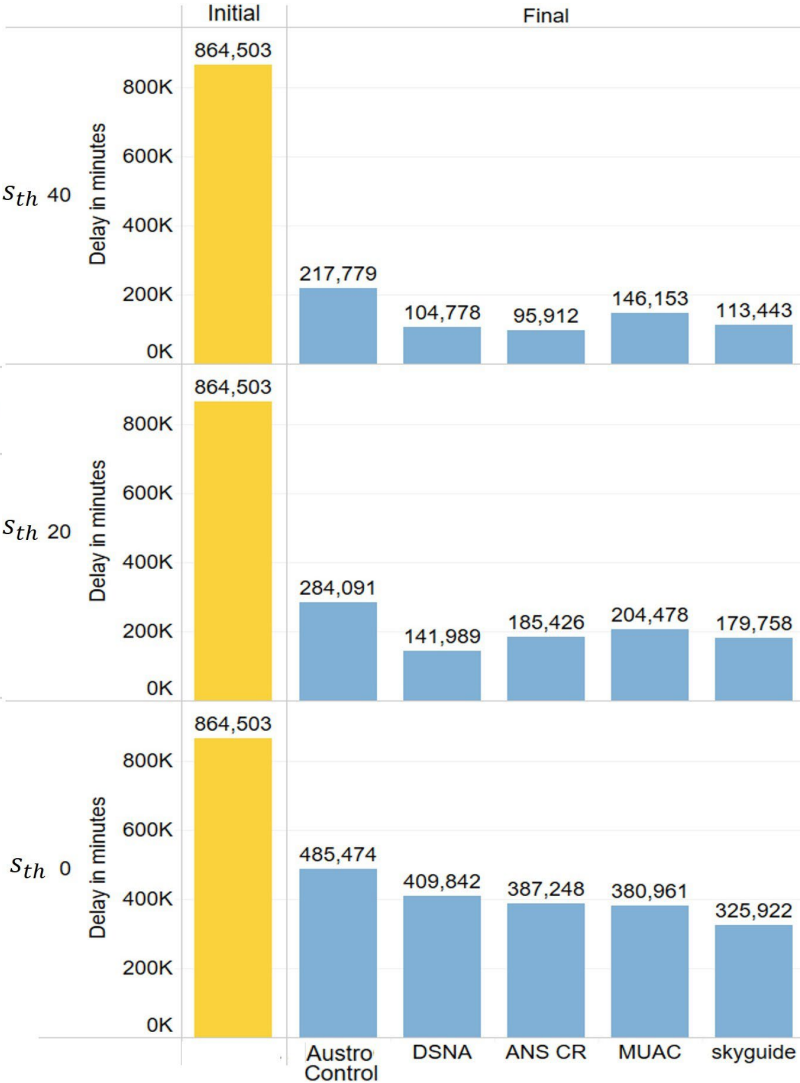
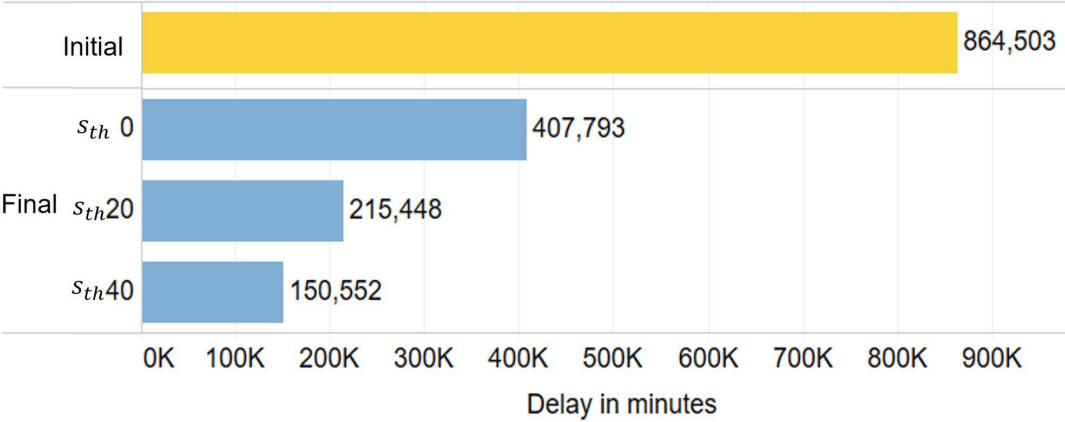
- Scenarios
  - Single ANSP
  - Single ANSP with a neighbour
  - Functional airspace block (FAB) - FABEC
  - Single European Sky (SES)



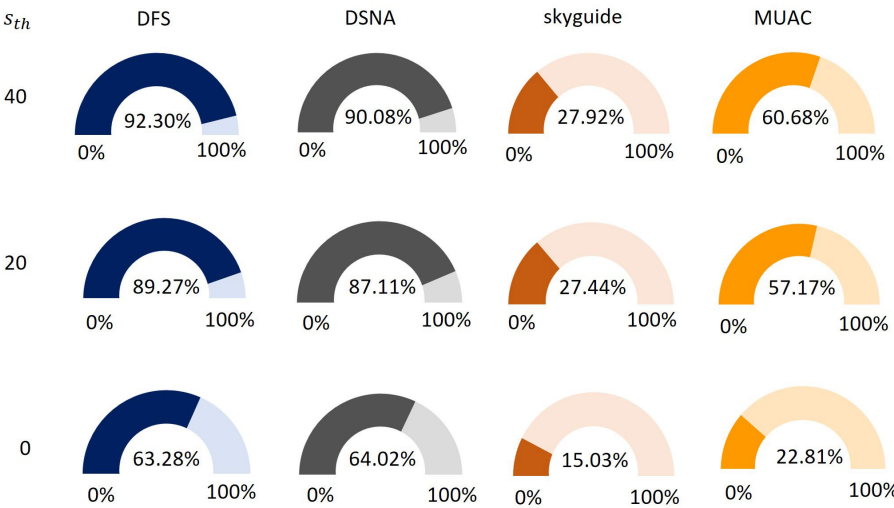
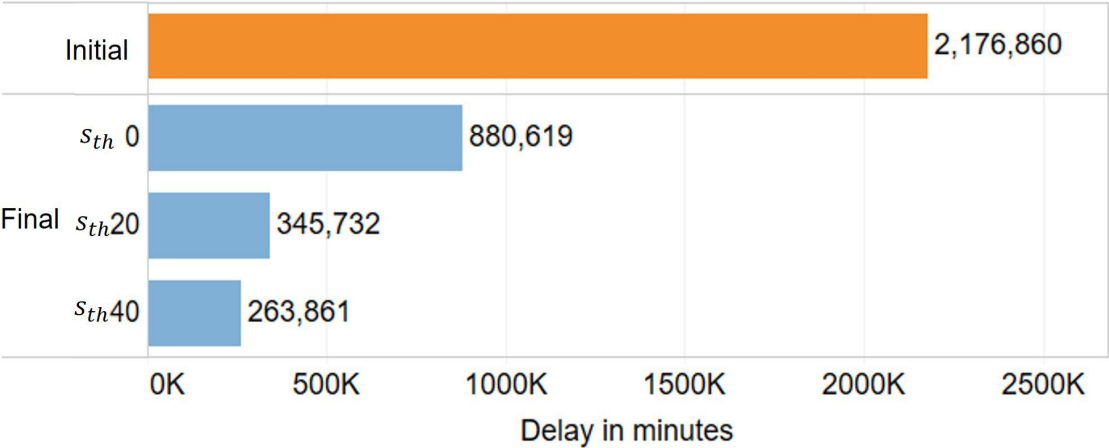
# Single ANSP and neighbours DSNA



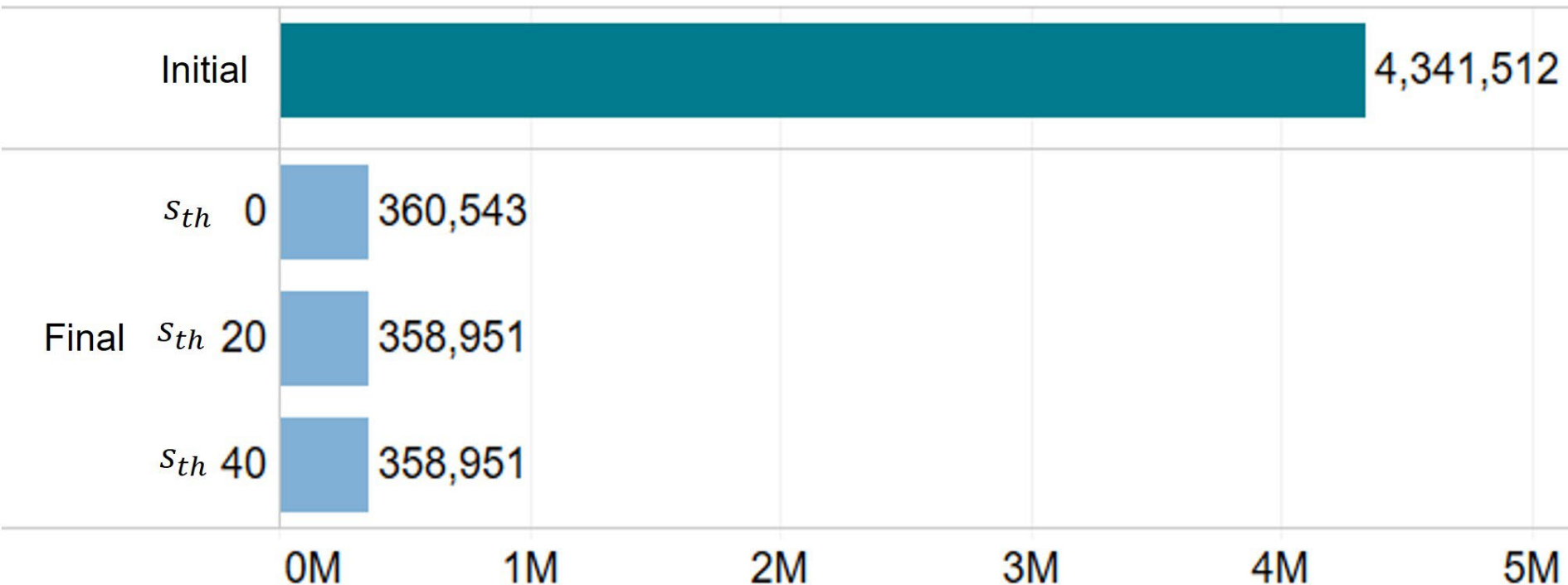
# Single ANSP and neighbours DFS



FABEC



## SES



## Conclusions

- Virtualisation could provide significant reduction of ATFM delay
  - Magnitude varies on geographical scope
- Virtualisation could significantly reduce capacity issues
  - It could not, on its own, eliminate delays completely
- Many assumptions needed here, but could be a good first approximation
- Future work
  - Introduce ATM solutions planned
  - Cost of Virtual Centre setup

# Thank you for attention!

## Questions?

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