

# Reducing Impact of Delays using Airspace User-Driven Flight Prioritisation



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

## User Driven Prioritisation Process Validation Simulation and Results

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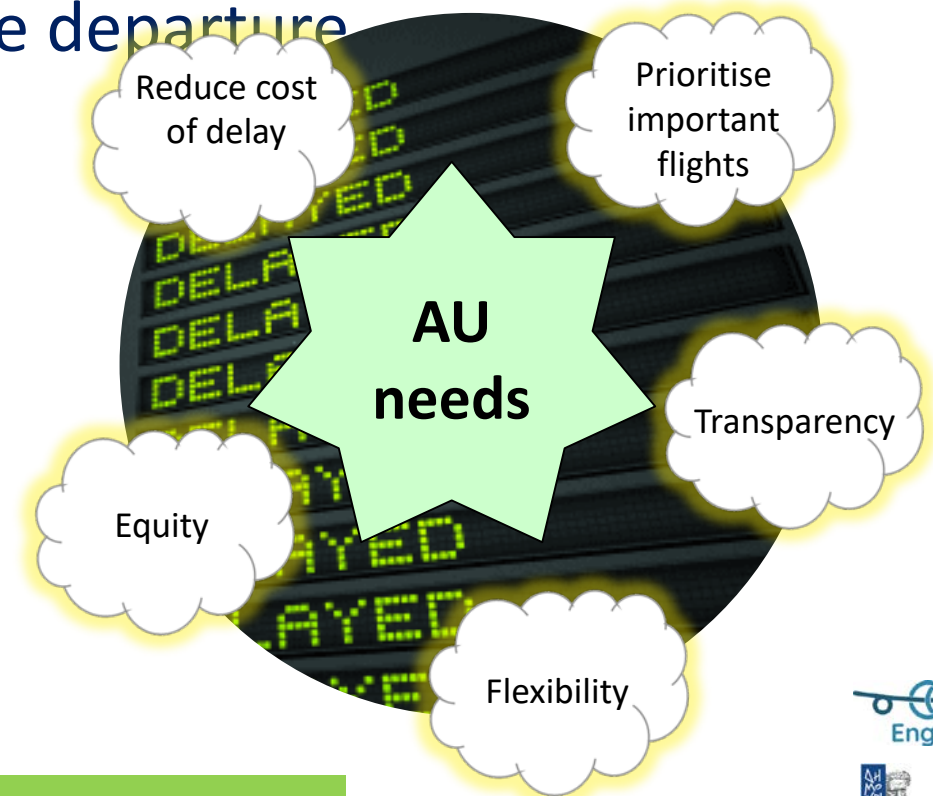


# Problem Statement

In order to maintain safety, the **European Network ATFM** Function at Airports or En-Route impose delays or other measures on certain flights before departure

→ Large impact on AUs operations

- For ATFM, all flights are equal
- For AUs, every flight is unique:
  - Passenger experience
  - Airport/Crew/Aircraft Limitations and constraints
  - Schedule Integrity
  - ...



**How to help AU reduce the impact of delay ?**

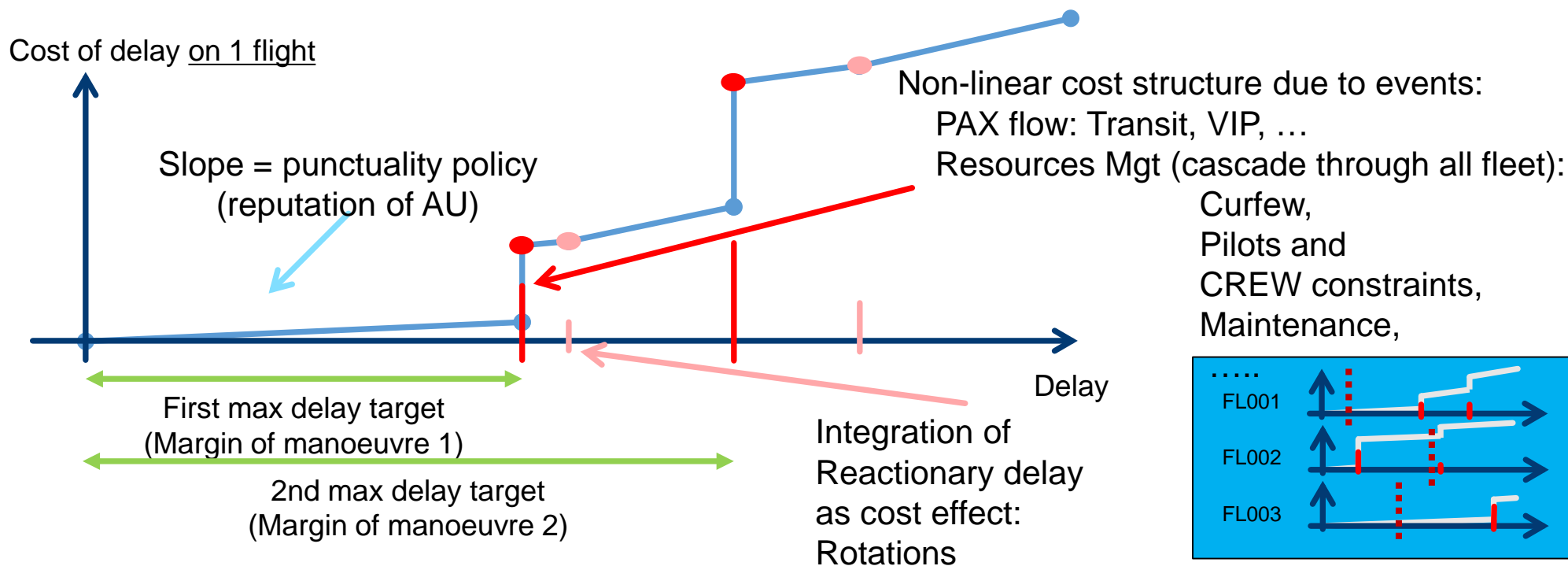


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# Operational Cost of delay for Airspace Users



Each flight has its own particular complex cost structure, including fleet rotation impacts, only known by the AU

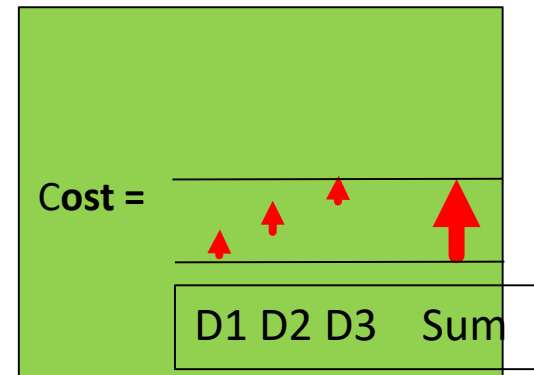
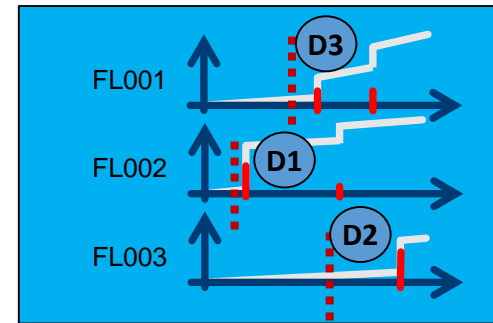
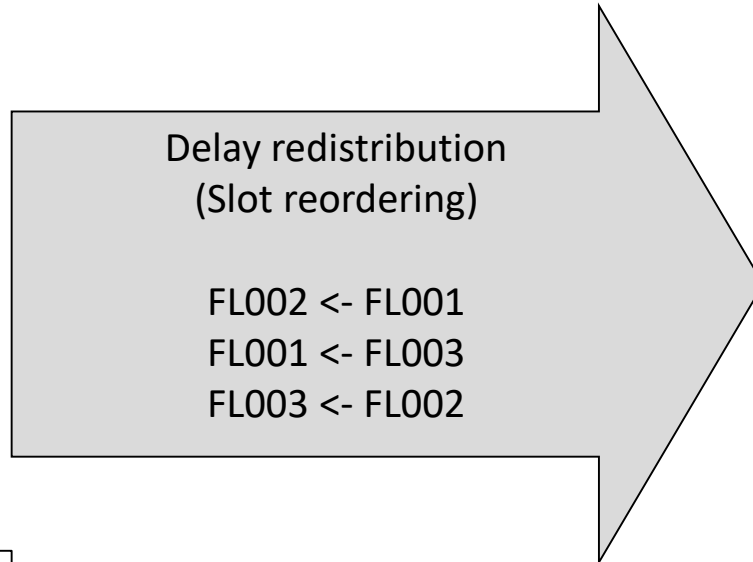
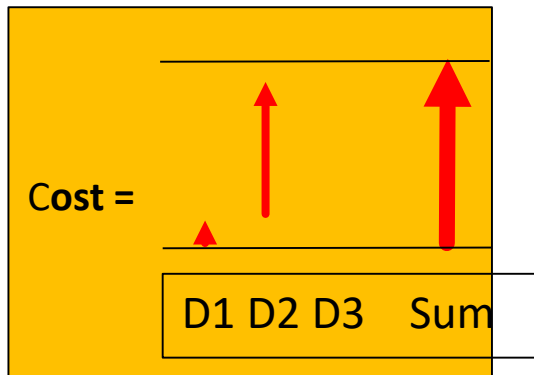
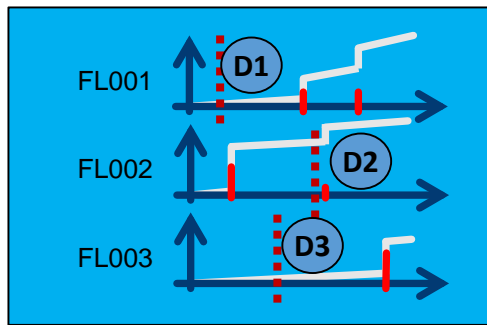


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# AUs can't act on ATFM delay, but on Operational Cost of delay



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# UDPP progressive design

current

- *Level 0 : ATFM Slot Swapping (NM since 1996)*
- **Level 1 : current Enhanced Slot Swapping (NM+SESAR1)**

- AUs swap flight 1 by 1 in ATFM Regulations coordinated with NM, not coordinated with STAM

IR

- **Level 2 : UDPP (SESAR2020)**

- AUs reorder several flights in a constraint, taking in account the Network impact and Airport constraints (What-If + API) – no impact on other AUs

ER

- **Level 3 : Flexible Credits for LVUC (Exploratory Research)**

- Taking into account Network impact and Airport constraints, AUs could accept impact from others to gain more flexibility for all AUs incl. Low Volume Users in a Constraint (LVUC) –which they are most of their time-.



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# UDPP features: FDR, SFP, Margins

## Original Schedule

BLUE AIRLINE slots:

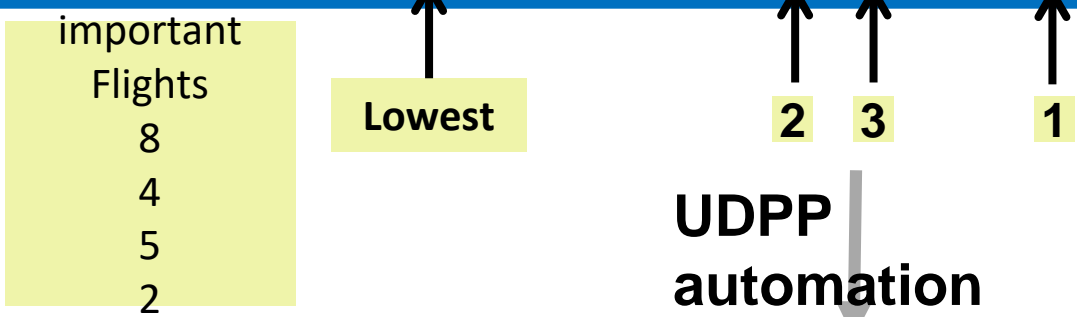


Hotspot => delays

BLUE AIRLINE new slots:



BLUE AIRLINE PRIO:



UDPP automation

BLUE AIRLINE Reordered flights slots



Equity : Neutral impact for other AUs' flights



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# UDPP features: FDR, SFP, Margins

Original Schedule

BLUE AIRLINE slots:



Hotspot => delays

BLUE AIRLINE new slots:



BLUE AIRLINE PRIO:

important Flight = 8



UDPP automation

Protect

1 – Swap 8 with 2

BLUE AIRLINE Reordered flights in slots



2 – put 8 at the first slot at schedule



Improvement for 3 and 4, 8 on-time

Equity :- Neutral impact for other AUs' flights after Schedule 8 and before Baseline 2  
- Positive impact for flights between Baseline 2 and Schedule 8



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# UDPP features: FDR, SFP, Margins

- **SFP: Selective Flight Protection**
  - Protect Flights
- **FDR: Fleet Delay Reordering**
  - value (from 1 to xxx) to reorder AU's flights
  - B (to keep the Baseline delay)
  - S (to UDPP-Suspend a flight = put it last in the Constraint)
- **MARGIN : Margins of Manoeuvre**
  - **Time Margins** reflect AU operational constraints :
    - time\_not\_before / time\_not\_after
  - **Priority on Margin reflect Margin's impact**
  - The system automatically optimises the flights reordering



Can be combined :

1. SFP
2. Margins
3. FDR

All based on Equity rules



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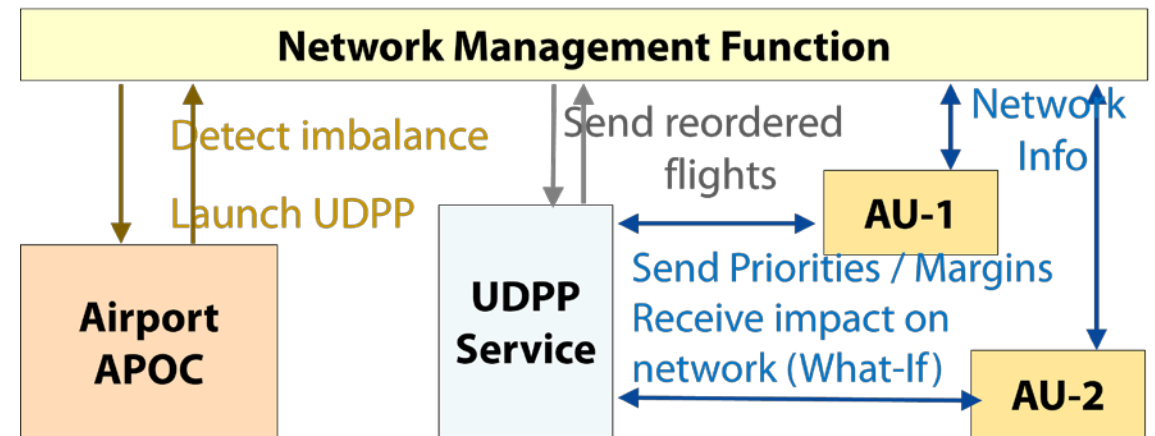


# UDPP in the ATM Collaborative Framework

New role of AUs in SESAR for better performance:

With UDPP, AUs become active in resolving certain DCB situations

- In front of a delay situation (ATFM or Airport regulation), each AU propose its solution that reduces impact of delay on AU's operational constraints on their fleet (costs) : flexibility
- No AU's prioritisation can negatively affect other AUs's flights : equity
- AU will prioritise their flights when they can significantly reduce their operational constraints on their fleet : cost efficiency



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Assuming DCB Full Delegation mode,

## UDPP VALIDATION AND RESULTS



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# Validate UDPP on Arrivals at a constrained airport

3 one-week simulations with 6 Airlines, and Airports participants from Schiphol, Heathrow, Munich

- in coordination with the Airport Operations Centre (APOC) at arrival airport (launching UDPP in “full delegation” mode);
- in planning i.e. from Day-1 to up to 30 mn (actually 4 hrs) before departure-;
- in case of Fog, Thunderstorm, Loss of Runway and Snow, in morning, midday or afternoon

AUs typology :

- **HUB** = airline at base airport and passengers’ connections matter
- **Medium** = LCC : many flights but no passenger connections to manage
- **Low Volume (LVUC)** = up to 6 flights in a constraint



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# Objective to validate

- **feasibility** of integrating UDPP with APOC processes using NM services,
- impact of UDPP on **airport** performance, focusing on Stand allocation planning
- **performance** of UDPP for AUs :
  - Flexibility
  - Equity: Total ATM delay per airspace user (participating or non-participating) is not negatively impacted compared to the reference scenario
  - AU Cost efficiency, in terms of **cost** and missed **passenger** connections:
    - Overall direct operating costs for airspace users reduces
    - Number of missed passengers connections is reduced for UDPP users
      - based on a cost-delay model developed for research with AU expert taking into account:
        - Duty of care
        - Curfew Restrictions (arrival and departures)
        - Transferring PAX
        - Overhead cost per minute per passenger
      - using a passenger-flow model setting typical proportions of connection per airline type



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# AU Cost efficiency : passengers' connections

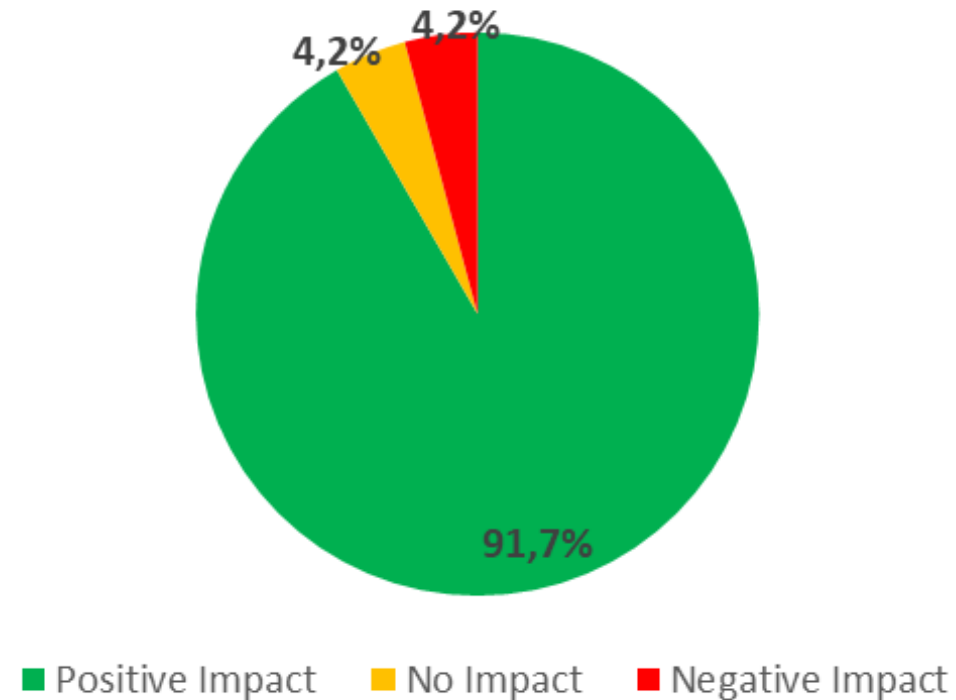
## Passengers for Hub User :

- connections improved by average **2.1%** (approx. **97** more pax)
- successfully reaching final destination on the day improved by **1.7%** (approx. **80** more pax).

In total, approx. **4% more** passengers reached destination

(Not counting avoided overnight passengers by saving the **curfew**)

Comparison of the Impact on Missed Passenger Connections per Run for the Hub Airline



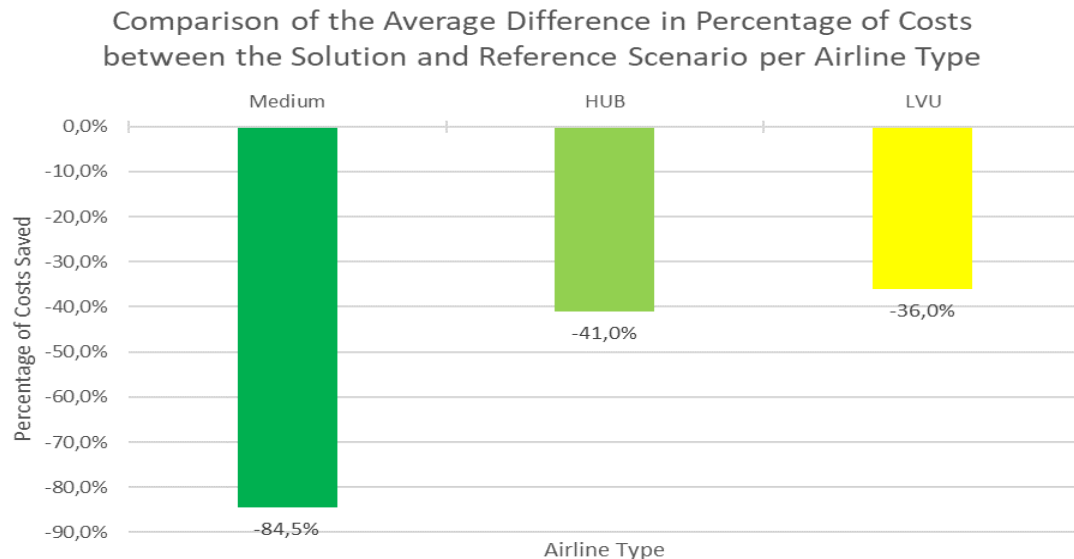
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# Airspace User Cost Efficiency results

During all scenario events, by all AUs and all UDPP Features, AUs could **reduce the cost of additional delay caused by ATFM**.



Note: Using Margins during Heavy fog, the Medium User could even reduce the costs a bit further than standard cost.

- additional costs caused by the imposed ATFCM delays are reduced on average during one CCS at one airport by 58%:
  - Hub users reduce additional cost by 74K€, 41%
  - Medium/Low-Cost Users reduce additional costs by 61K€, 85%
  - Low Volume Users reduced additional costs by 9K€, 36%

Average for all airlines : 50K€ (40%) for one UDPP Measure. \*

- Extrapolation ECAC-wide 2035 : 90 M€ (15 Apt, 120 times/yr/apt, 1 user/apt, network impacts not addressed)



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# Flexibility results

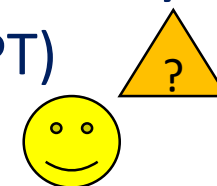
Measured by the SESAR definition: “Average delay for scheduled civil/military flights with change request\* and non-scheduled / late flight plan request.”

\* “change request” = any flight that changes slot (reordering) due to UDPP within the UDPP Measure.

- Neutral results = stability in the network.

Beyond the SESAR definition, Flexibility is also perceived by AUs as :

- Nb of times where UDPP will be triggered (by DCB/APT)
- Nb of opportunities to use UDPP when it is triggered
- Nb of change requests actually implemented



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# Airport APOC results

Results from qualitative and quantitative assessments, although non-conclusive, indicate that:

- UDPP improves the **pro-active participation of AUs** in CDM at airport.
- **Delay is slightly reduced** generally (when not, it is to improve departure punctuality)
- Expert judgement suggests that airports and NM may receive **less requests** from airlines and last minute changes, creating a **more stable plan**.
- **Better client service** is provided to AUs and passengers : this is good for the airport



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# UDPP, AN AU INPUT TO ATM COLLABORATIVE PROCESSES - NEW KPIS NEEDED IN SESAR

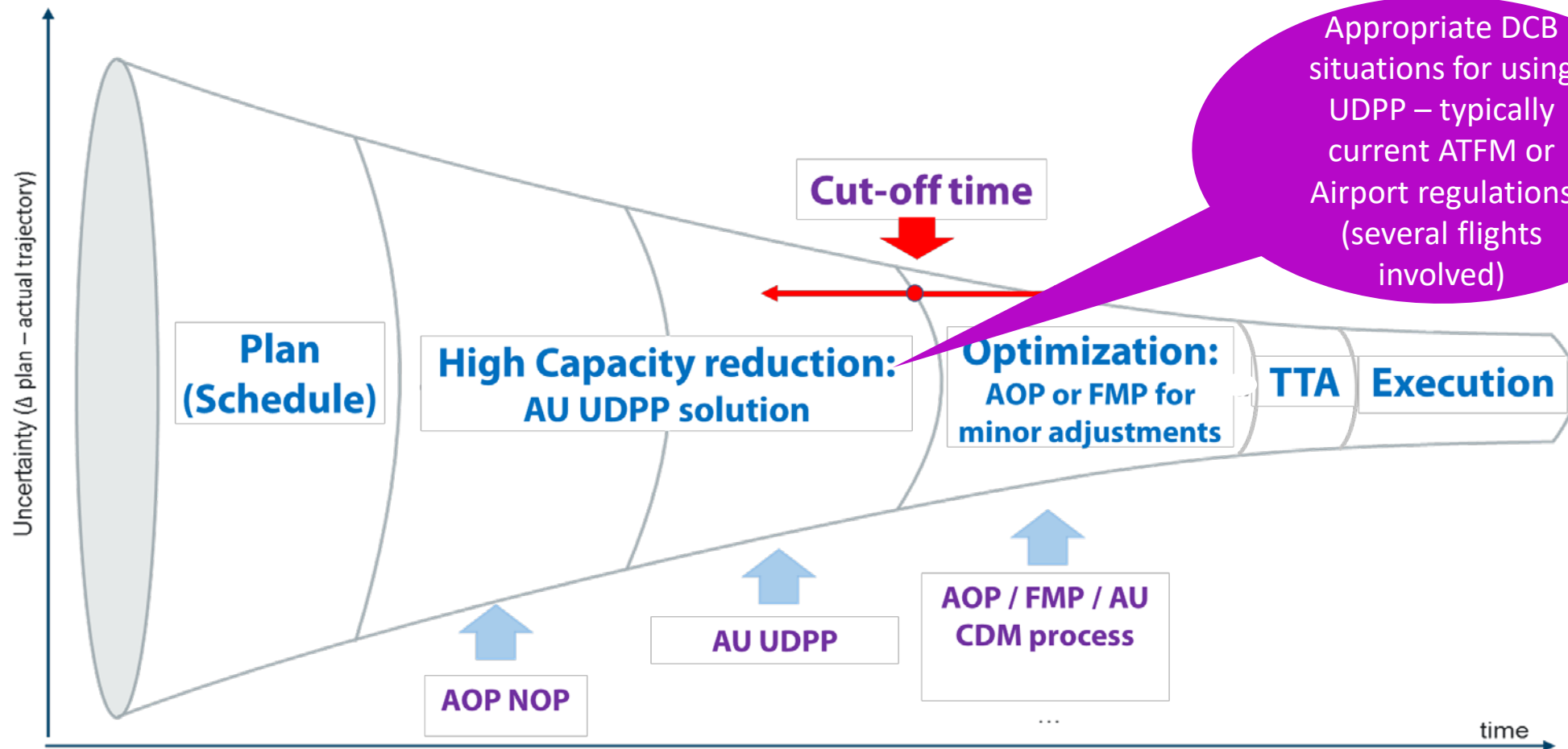


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# When to launch UDPP ? A collaborative DCB decision ?

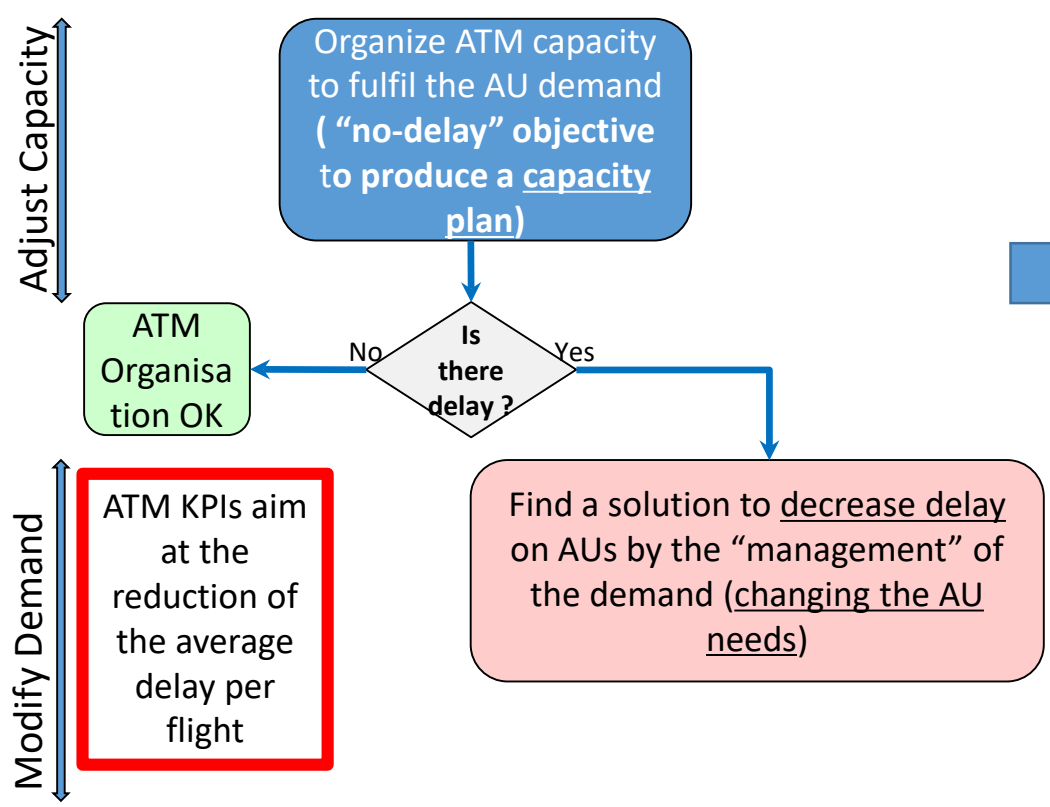


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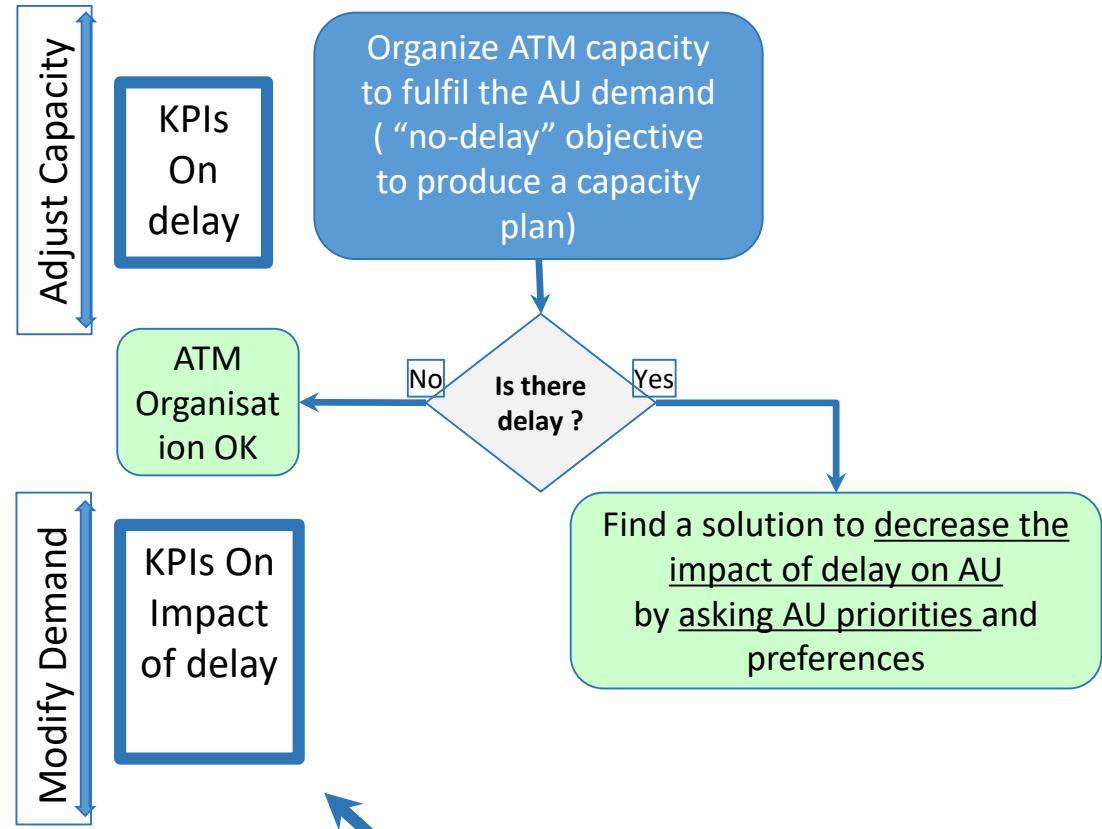




# ATM paradigm from “No-Delay” to “Impact of delay”, incl. AUs



This organisation is no more valid with STAM measures and when solutions are imposed on AUs.



Future KPIs should integrate AUs inputs, aiming to mitigate the impact of delay (a new objective for ATM)



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# SESAR Performance Framework – new KPIs

- Equity / fairness
- Flexibility (nb opportunities when UDPP is launched)
- **Passenger Experience**
- Stability



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# Conclusions & next steps

- Feasibility of UDPP features validated through 3 simulations with Airlines (IATA, Swiss, Air France, HOP, Air Baltic, ElAl, Transavia) and Airports participants (Schiphol, LHR, Munich)
- Reduction of cost of delay by 58% on average as well as an improvement in the number of passenger connections
- Shadow mode trial support to Swiss and Skyguide with a rapid integration in a realistic environment
- Aim for **integration in DCB Collaborative Framework** at few airports by end 2022

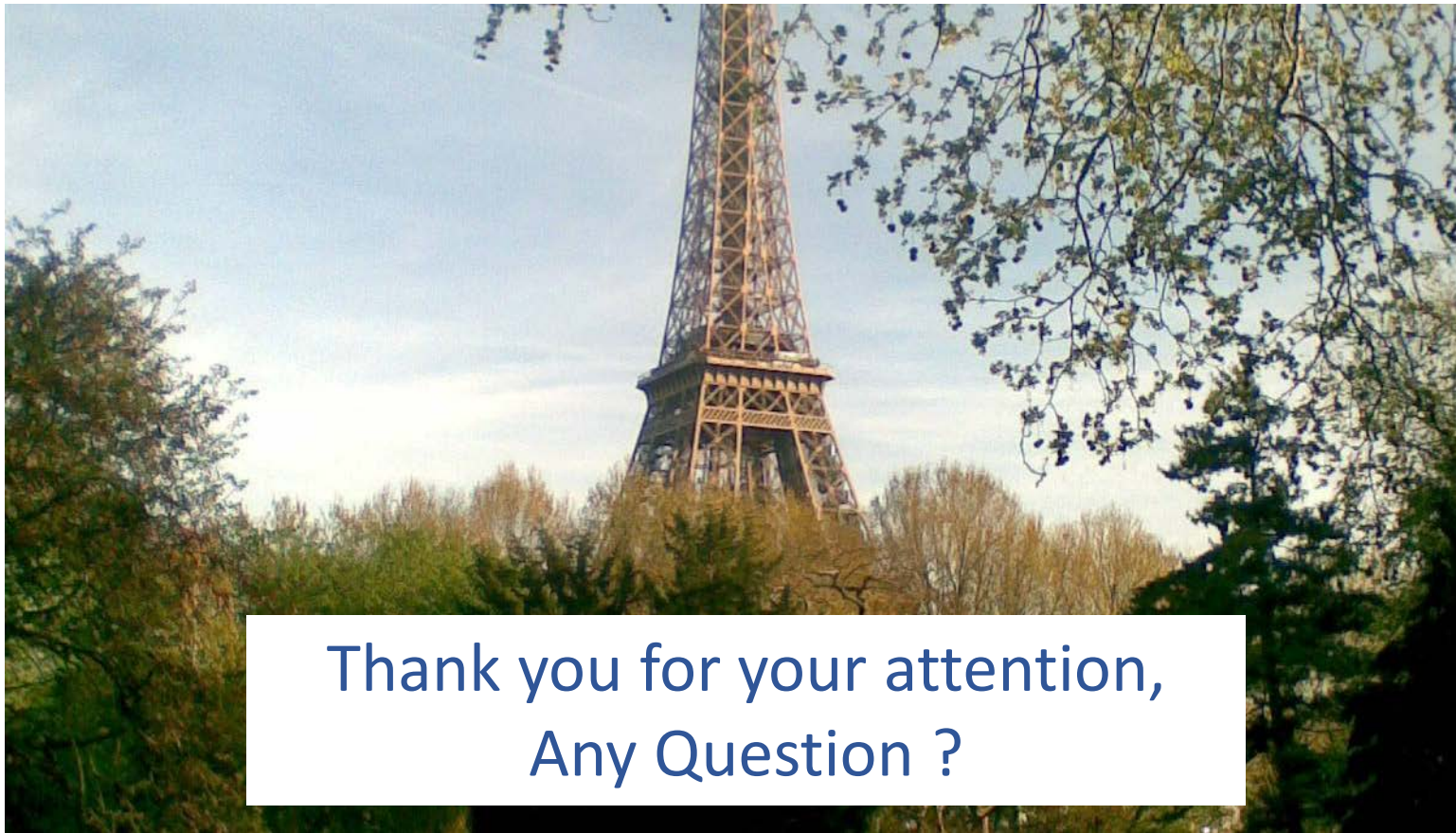
*Note: UDPP could be an NM service activated when:*

- *An FMP decides (only certain DCB situations can be solved with UDPP)*
  - *An FMP delegates the solution to an Airport that may trigger UDPP*
  - *An Airport decides to trigger UDPP for solving a constraint*
  - *Additional Proposal from AUs : « as soon as there is delay », until an FMP takes over*
- Impact of UDPP on Network stability needs to be assessed
  - New KPIs needed to support the integration of AU needs in ATM



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Thank you for your attention,  
Any Question ?



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