Webinar - ATM Use Cases

NAV Portugal; TU Delft

3rd April 2024

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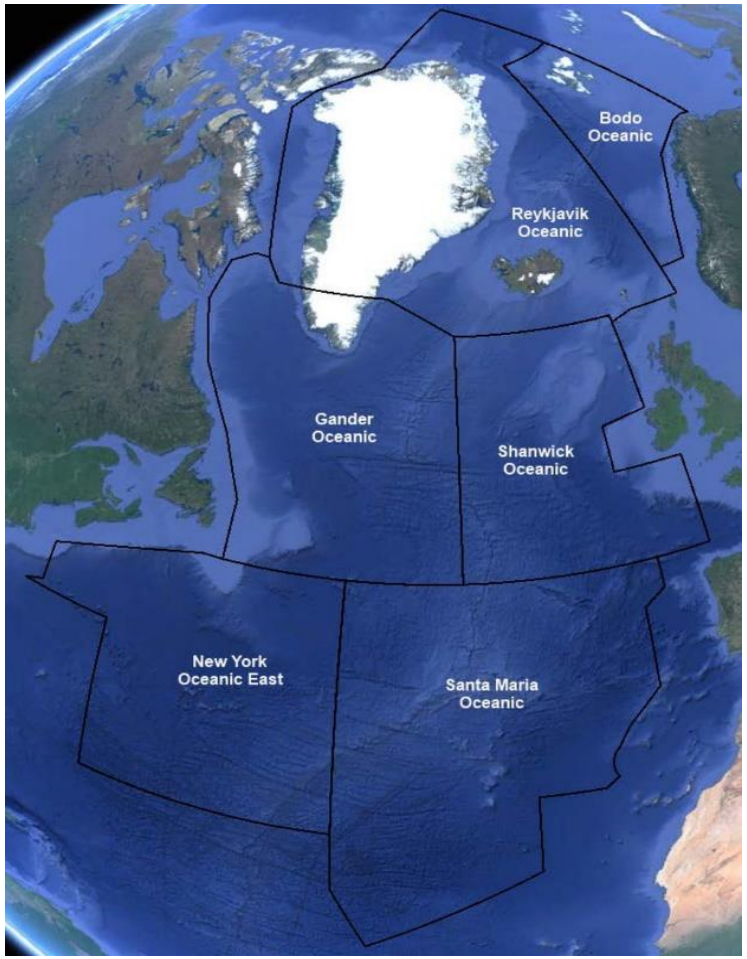
Use cases – Air Traffic Management

ATM Use case 5:
Sectorisation Assistant

ATM UC5 Description

Santa Maria Flight Information Region



Area: 5.180.000 Km^2
1 OACC
1 TMA
4 Towers
2023 movements: 180 703 ✈
*Annual evolution 2024/2023 = **+12,8%***

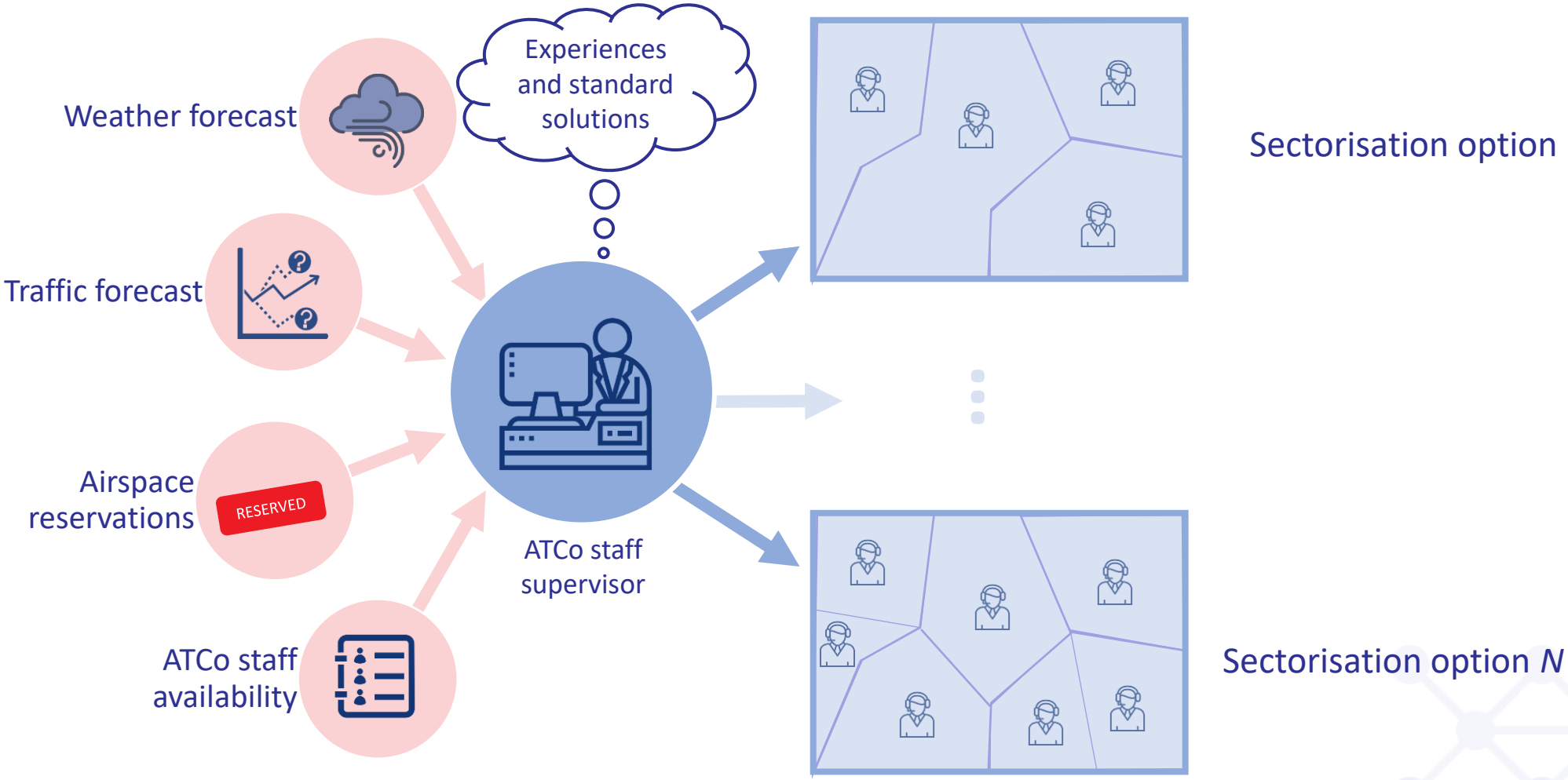
Sectorization

- ✓ ATC supervisor decides when/how to sectorize
- ✓ Pre-defined sectorization plans:
  - low traffic and/or complex situations
  - high terminal traffic and/or complex situations

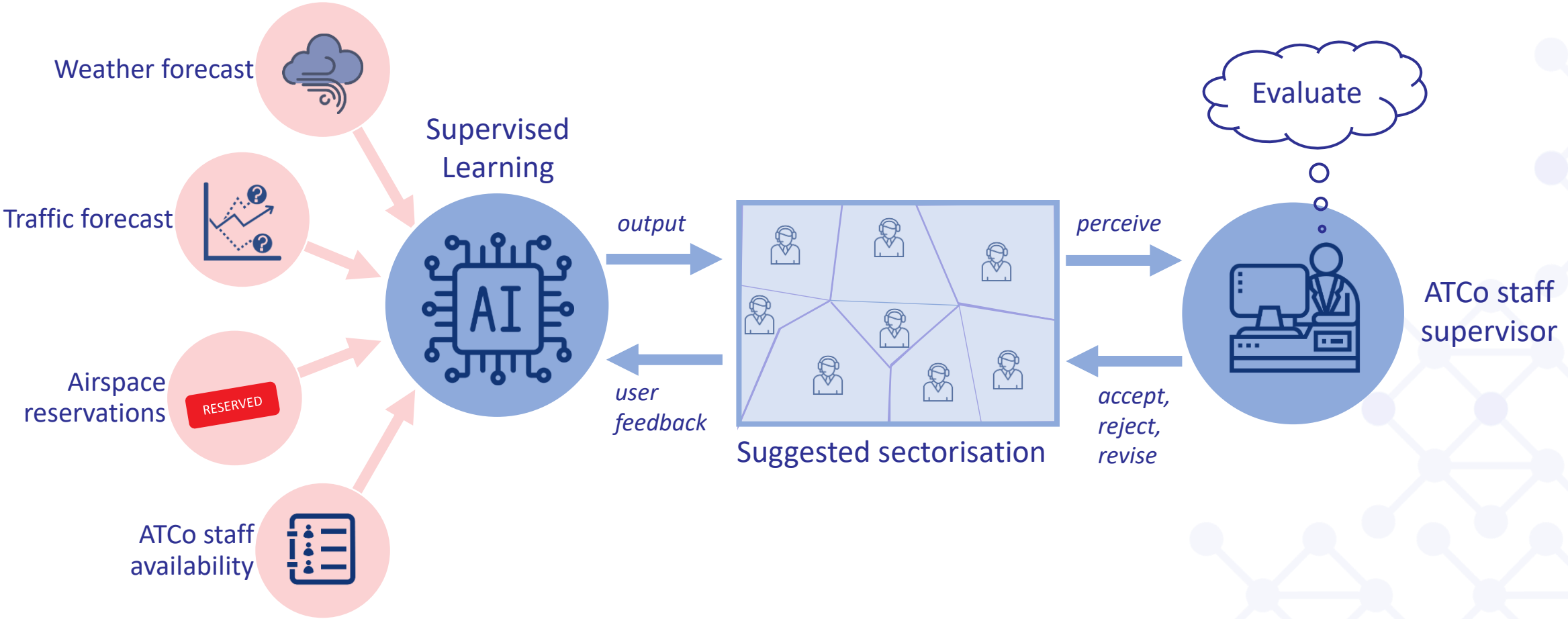
Split sectors
Vertically
Horizontally

- ✓ Information retrieved from different platforms
  - Weather, a/g coordination messages, airspace reservations,…

Today’s process



Tomorrow's process



Operational scenarios

Number	Scenario	Description	Results
1	**Nominal operational conditions**	The AI sectorisation system responds to predicted traffic fluctuations under nominal operational conditions. Variations in traffic loads over a typical day (24-hours) will be used as inputs	System proposes and/or executes acceptable sectorisation results and present them on an auxiliary interface for the human supervisor to evaluate.
2	**Environment perturbations**	This scenario deals with sudden changes in airspace availability due to adverse weather conditions of different magnitudes/scales, impacting sectorisation results.	System proposes and/or executes off-standard sectorisation results and present them on an auxiliary interface for the human supervisor to evaluate.
3	**ATCO staff shortage**	In off-nominal ATCO staffing capacities (e.g., due to sickness) will require off-standard, yet acceptable sectorisations. Other events e.g., weather perturbations may occour simultaneously simulating edge-case situations.	System proposes and/or executes off-standard sectorisation results and present them on an auxiliary interface for the human supervisor to evaluate.

ATM UC5 KPIs [1/2]

KPI	Description	Objective
Acceptance score	A staff manager can either accept, revise of reject the AI-generated sectorisation. A good system would foster 100% acceptance.	Reflects the acceptance choice in the AI's system decision.
Agreement score	How much the supervisor agrees with the AI-generated sectorisation.. Note: agreement and acceptance are not the same. One can accept a solution but not necessarily agree with it. A good system fosters a high-level agreement.	Reflects the agreement degree of the AI system.
Trust in AI solutions score	How much of the operator's confidence in the AI-generated solution, with and without the need for additional explanations.	Reflects the trust in the AI's system decision.
Decision support satisfaction	System effectiveness in supporting the efficient decision making by airspace managers.	Reflects the satisfaction with the effectiveness of AI system.
Efficiency score	How many times an AI-generated solution was revised. A good system would minimise the number of human interventions.	Reflects the efficiency of the combined human-AI team performance.

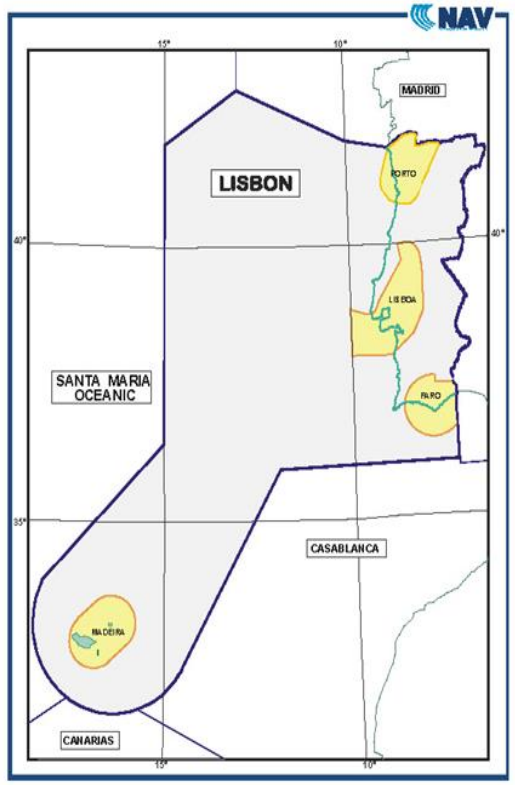
ATM UC5 KPIs [2/2]

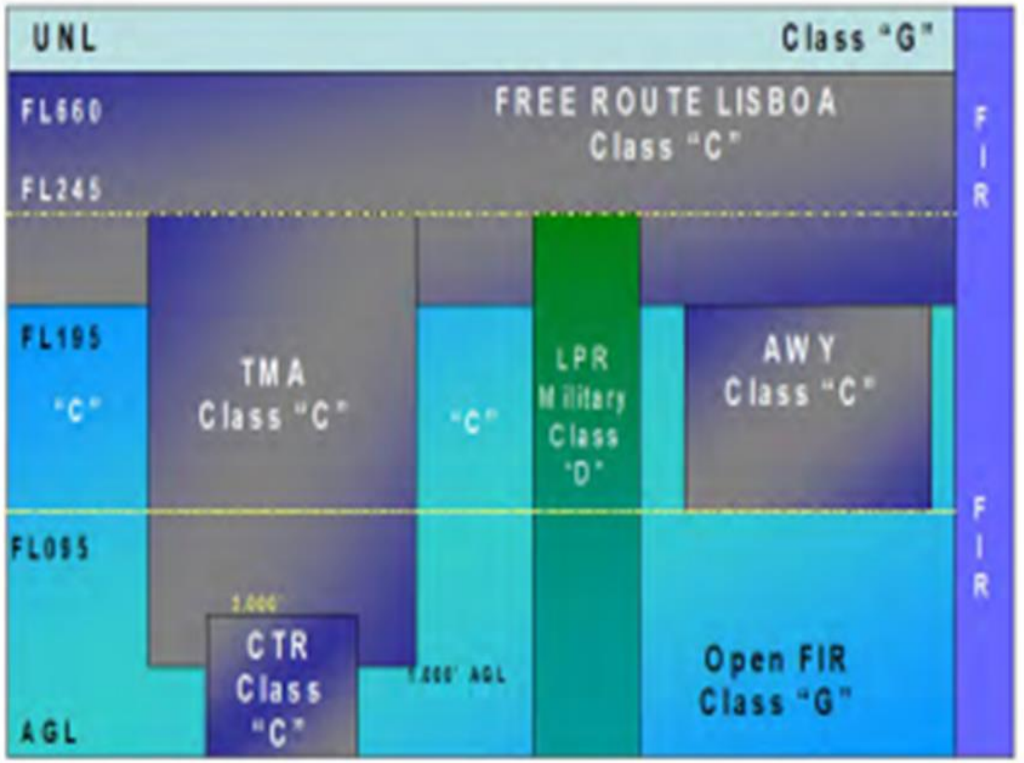
Significance of human revisions	The extent of human revisions compared to the AI decision. Here, small, localized revisions (e.g., merging two small adjacent sectors in the northeast corner of the FIR) would be rated differently from larger or multiple revisions across various areas in the FIR.	Reflects the AI system performance.
System reliability	System trustworthiness - operation as expected under several conditions without major failures.	Reflects the AI system performance.
AI prediction robustness	How accurately and robustly does the AI system predict a certain sectorisation over a certain time horizon.	Reflects the AI system performance.
Task load index	Assess how many times the ATCO prompts additional explanations from the AI generated solutions.	Reflects the efficiency of the combined human-AI team performance
AI co-learning capability	How much the system operator feels, by the end of trial runs, that AI has learn his/her preferences.	Reflects the efficiency of the combined human-AI team performance
Human response time	How much time is needed by the human supervisor to evaluate an AI decision, with and without the need for consulting additional explanations.	Reflects the efficiency of the combined human-AI team performance.

ATM Use case 6:
Flow Assistant

ATM UC6 Description

Lisbon Flight Information Region





FRAL since 2009

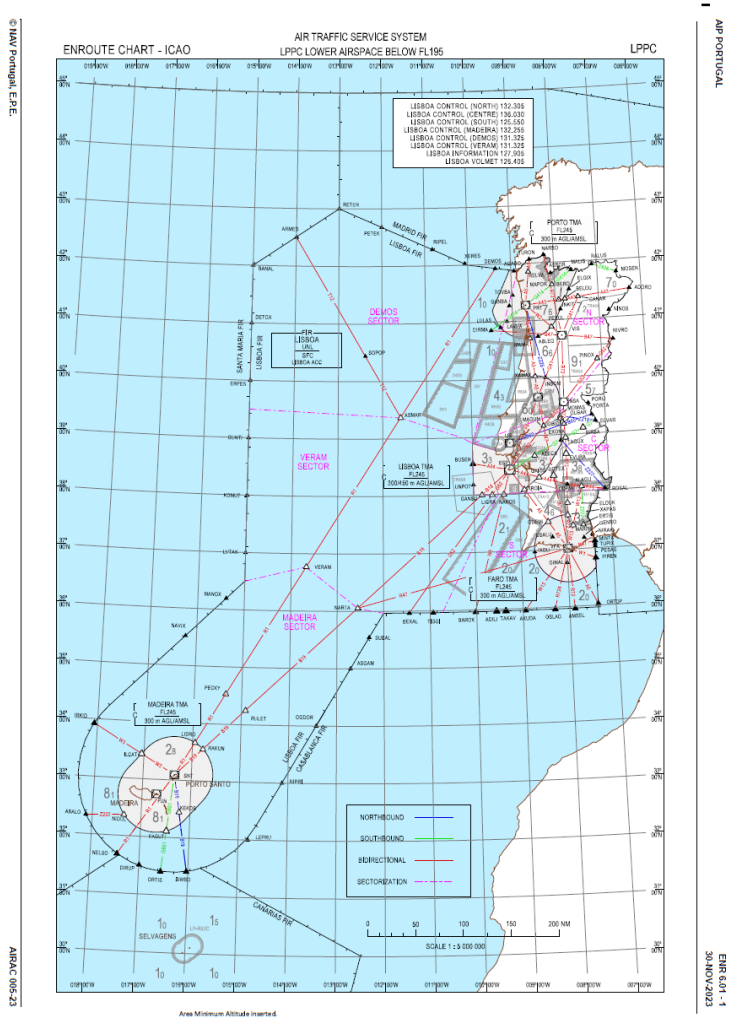
Military areas activation

pre-tactical phase

Horizontal En-route Flight Efficiency KPI:

***KEA** - Key performance Environment indicator based on Actual trajectory*

ATM UC6 Description



Objective: Airspace structuring (routing + sectorisation)

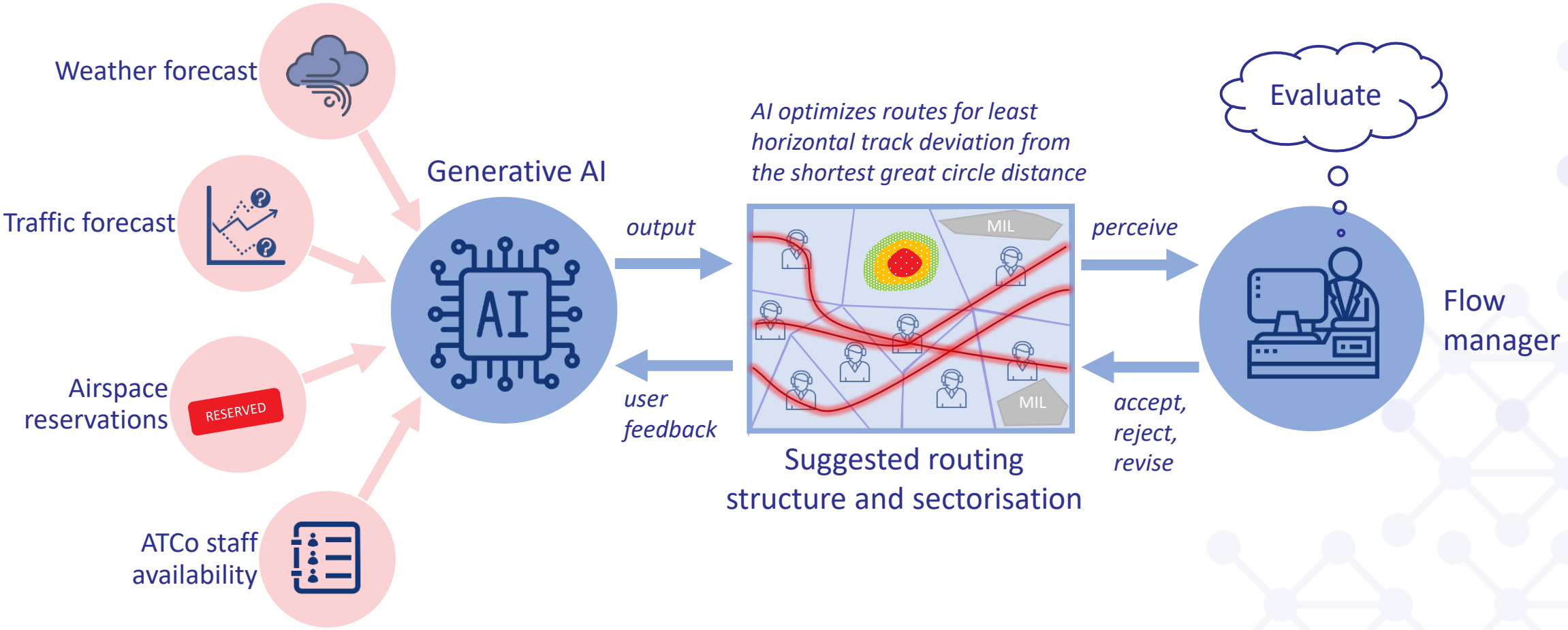
- Identify & collect critical system parameters
  - ✓ Predicted traffic
  - ✓ Airspace military activations
  - ✓ Environmental conditions
  - ✓ Staffing constraints

- Airspace Structuring implementation
- Trigger airspace Structuring revisions
- Implement tactical deviations

Goal:

Balance *flexibility* against *predictability* in airspace structuring and routing

Process


Weather forecast
Traffic forecast
Airspace reservations
RESERVED
ATCo staff availability
Generative AI
AI
output
user feedback
AI optimizes routes for least horizontal track deviation from the shortest great circle distance
MIL
MIL
Suggested routing structure and sectorisation
perceive
accept, reject, revise
Evaluate
Flow manager

ATM UC6 Scenarios

Number	Scenario	Description	Results
1	**Nominal operational conditions**	Baseline condition, allowing the comparison of minimum KEA routings devised by the AI system under nominal operational conditions with routings devised in restricted airspace availability conditions. Traffic loads over a typical day (24-hours) will be used as inputs.	System proposes and/or executes efficient flight routes and sectorisation and presents results on an auxiliary interface for the human supervisor to evaluate. This results are then used as baseline for comparison with scenarios with restricted airspace availability.
2	**Small perturbation**	Scenario with decreased airspace availability due to the activation of **one** or **two** military areas. Traffic should be routed around the military restricted airspace minimising the KEA, while adhering to sector capacity limits, which may require off-standard sectorisations.	System proposes and/or executes efficient flight routes and off-standard sectorisation and presents results on an auxiliary interface for the human supervisor to evaluate.

ATM UC6 Scenarios

Number	Scenario	Description	Results
3	**Medium perturbation**	This scenario deals with highly decreased airspace availability due to the activation of **more than two** military areas, in conjunction with challenging **weather conditions**, further reducing on a short time horizon the availability of the airspace, to evaluate robustness of the solutions.	System proposes and/or executes efficient flight routes and off-standard sectorisation and presents results on an auxiliary interface for the human supervisor to evaluate.
4	**Large perturbation**	This scenario deals with the future **increase in traffic** feed, in combination with highly decreased airspace availability due to the activation of **more than two** military areas, in conjunction with challenging **weather conditions**, further reducing on a short time horizon the availability of the airspace. This case simulates an edge-case situation.	System proposes and/or executes efficient flight routes and off-standard sectorisation and presents results on an auxiliary interface for the human supervisor to evaluate.

ATM UC6 KPIs [1/3]

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ATM UC6 KPIs [3/3]

Reduction in delays	Percentual reduction of flight delays due to AI implementation in airspace and air traffic management.	Reflects the AI impact on system performance results.
Workload perception	Assess ATCO PERCEPTION on the system impact on ATCO workload (either positive or negative).	Reflects the perception of the AI impact on human performance.

Thank you for your participation!

Conclusion

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