ADVANCED AUTOMATION IN ATC AT EUROCONTROL MAASTRICHT UAC

ARGOS - ATC Real Ground-Breaking Operational System

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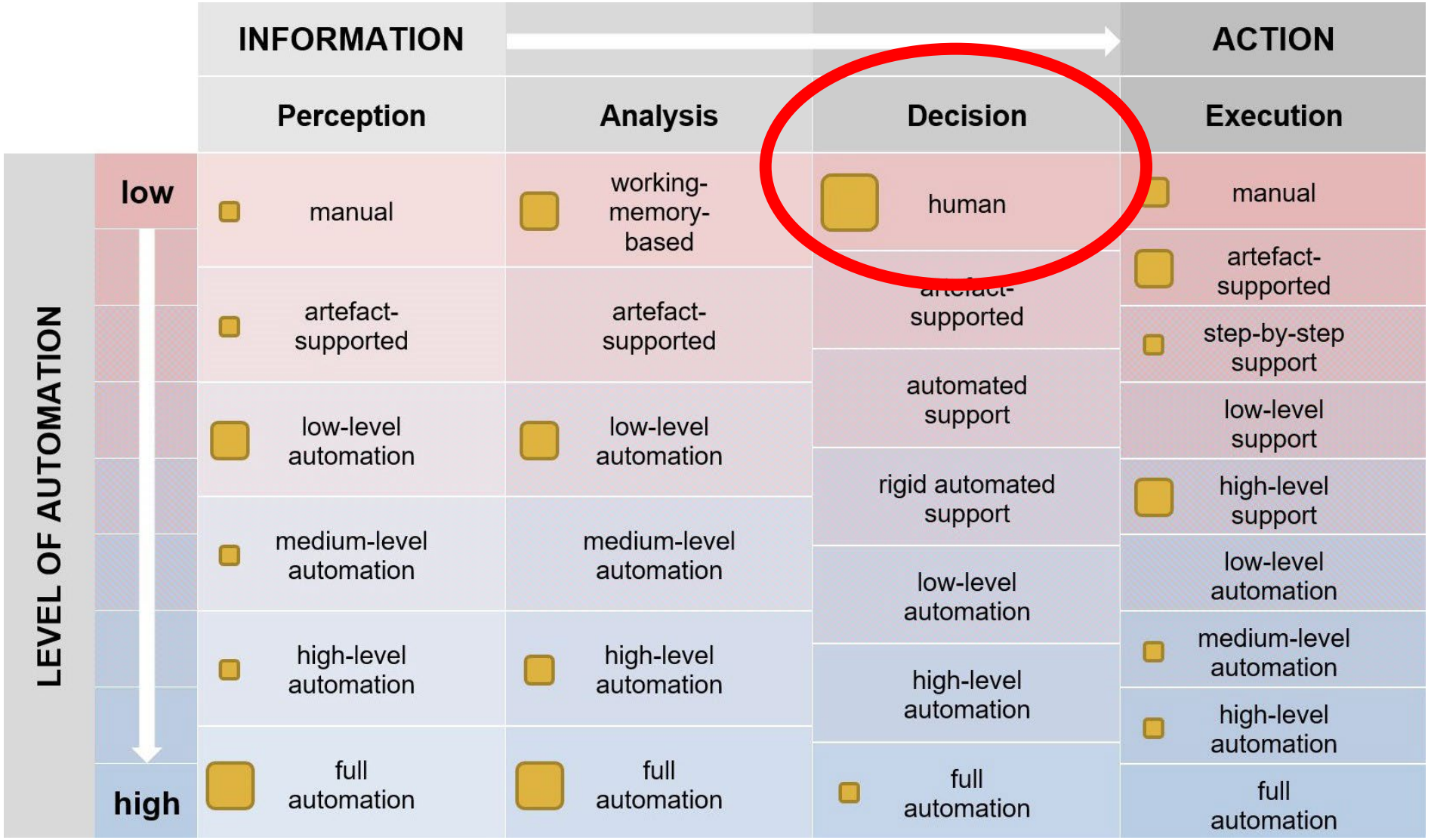
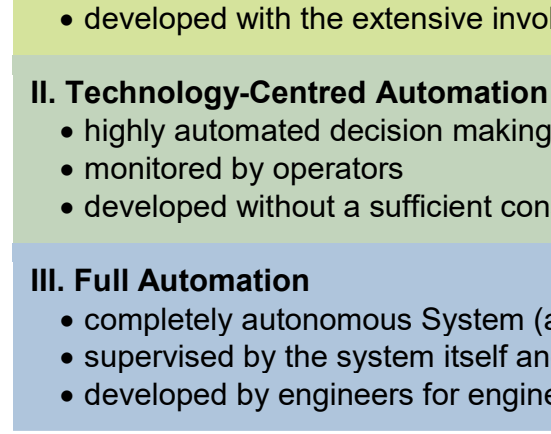
Level of Automation at MUAC (2018)



: current tasks

Paths to(wards) Full Automation – Autonomous Cars

Stage	Path A	Path B
I. Human-Centred Automation • human decision making accelerated by automated tools • moderately automated, cooperative System • developed with the extensive involvement of end users		
II. Technology-Centred Automation • highly automated decision making • monitored by operators • developed without a sufficient consideration of operator needs		
III. Full Automation • completely autonomous System (automated decision making) • supervised by the system itself and a few system engineers • developed by engineers for engineers		



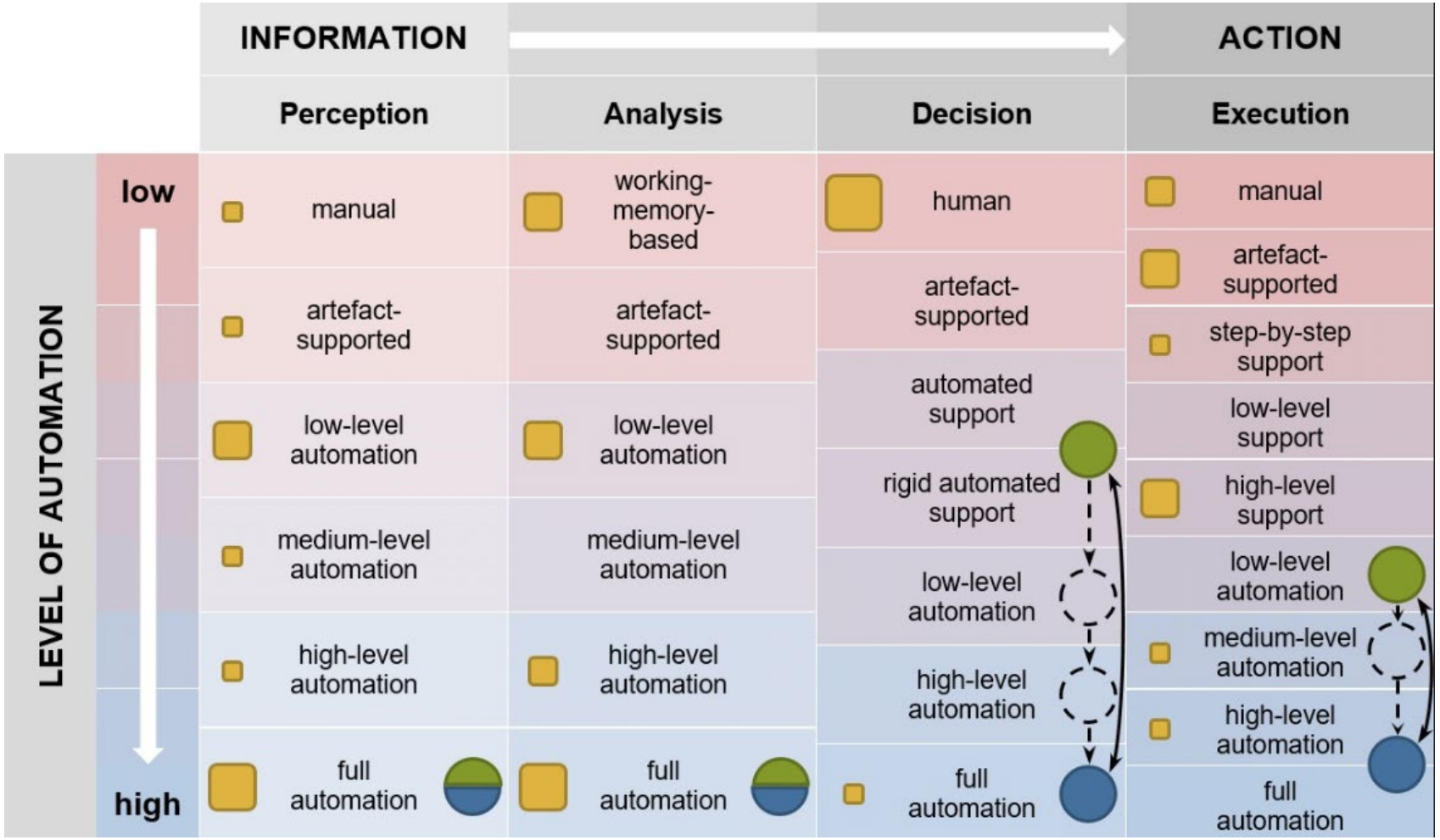
TESLA

Path A:
A gradual allocation of more and more functions to automation in all environments;
which renders Stage II inevitable.

Path B:
An early implementation of full automation in a constrained environment,
which is then gradually expanded;
so that Stage II is circumvented.

WAYMO

MUAC LoAT & Automation Ambitions



: current tasks

: complex scenarios

: basic scenarios

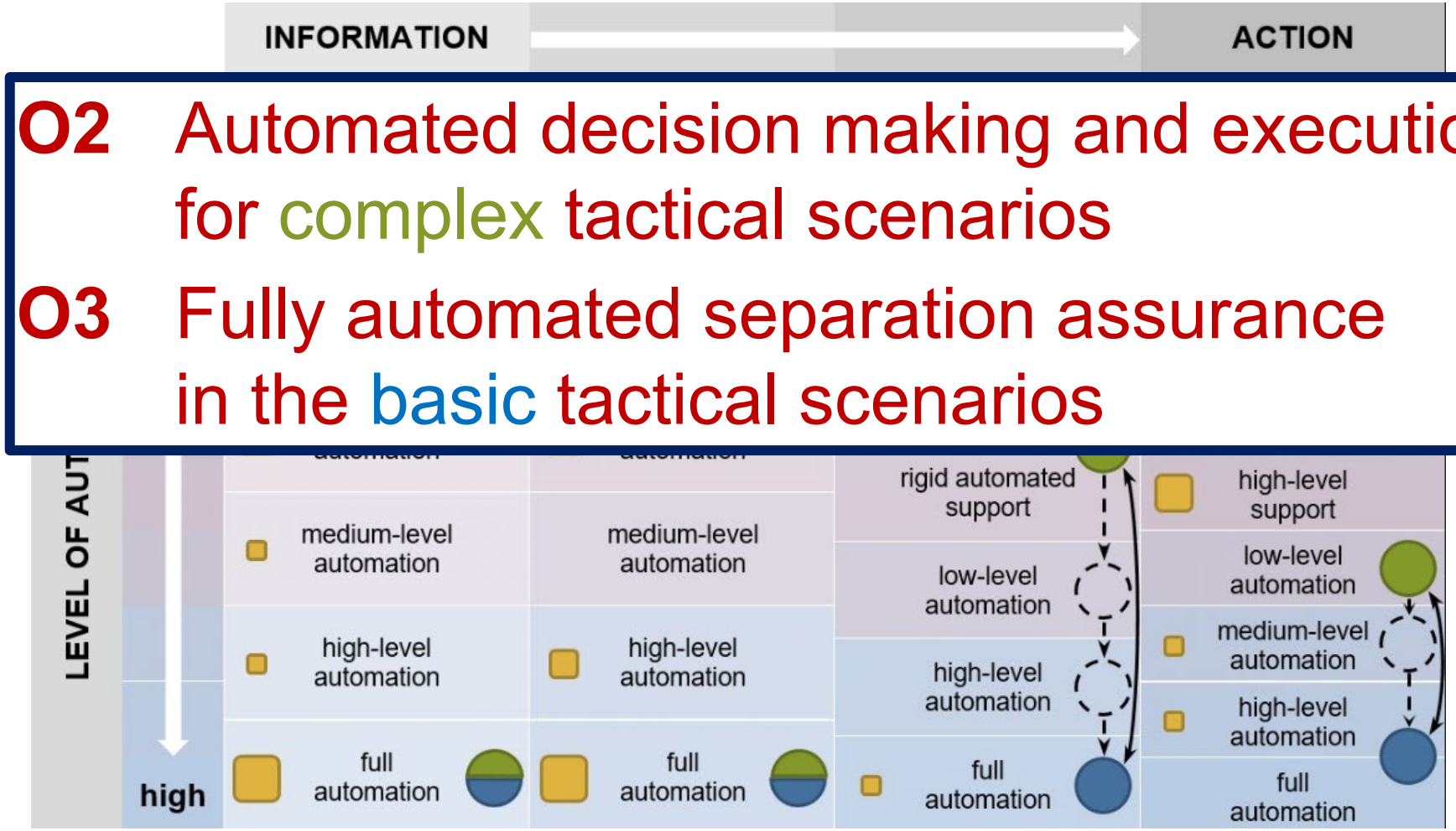
– – : Path A

—— : Path B (chosen)

MUAC LoAT & Automation Ambitions

O2 Automated decision making and execution support for complex tactical scenarios

O3 Fully automated separation assurance in the basic tactical scenarios



: current tasks

: complex scenarios

: basic scenarios

: Path A

: Path B (chosen)

Our Approach – Our Slogan

'Let ATCOs focus on the real, challenging work, to do what they are the best at, and leave the routine work to the machine.'

ARGOS Requirements

Initial requirements:

- Traffic MUST BE conflict-free (0 min = 5 NM, 1 min = 6 NM, 8 min = 8 NM)
- Try DCT to Exit Point
- Try to climb to TFL ASAP – descend to TFL ALAP
- Sequence at exit
- Stay in sector/AoR
- Stable solutions

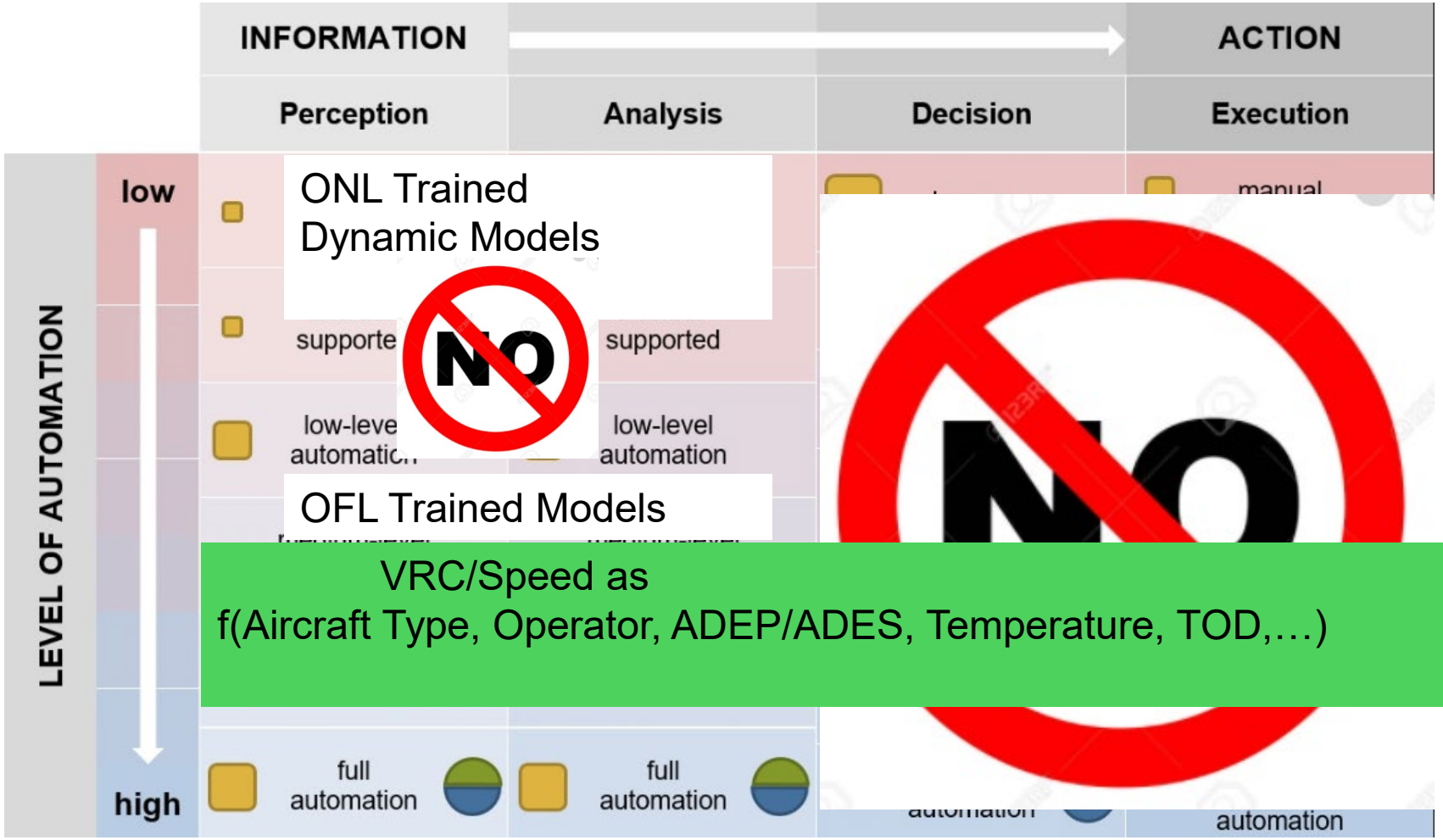
Advanced requirements:

- Avoid active TSAs (Contrail Areas)
- Multi interaction solution
- Support Training
- Scoring Safety/Efficiency
- Descend “When Ready”
- Categorize (non-)basic
- DIGI-talisation LoAs
- Calculate Environmental KPIs
- Maximise Safety/Efficiency
- ML Model for VRC & Speeds

ARGOS Level of Automation

ARGOS LoA	Description	LoA Decision	LoA Execution
L0	ARGOS does nothing.	C0	D0
L1	Upon ATCO request for individual flight(s), ARGOS suggests actions to the ATCO. The ATCO executes his/her own plan.		
L2	For all flights, ARGOS suggests actions to the ATCO. The ATCO executes his/her own plan.		
L3	For all flights, ARGOS displays the best plan (a set of multiple timed actions). The ATCO can approve the plan, impose a constraint to let ARGOS revise the plan, or come up with his/her own plan. For CPDLC flights, ARGOS executes the plan. For non-CPDLC flights, the ATCO is reminded and the plan is the default selection in the menus.	C2/3	D2/4/5
L4	ARGOS suggests a plan for each flight (set of multiple timed actions). The ATCO decides to let ARGOS handle individual flight(s) and controls the other flights.		
L5	ARGOS manages certain flights (for each flight, a plan is presented and executed). The ATCO supervises ARGOS and can take flights away from it. The ATCO controls all non-ARGOS flights.	C2/3 C6	D2/4/5 D7
L6	ARGOS manages all flights (for each flight, a plan is presented and executed). The ATCO monitors ARGOS and can switch it OFF. The ATCO controls flights when ARGOS is OFF.		
L7	ARGOS manages all flights (for each flight, a plan is presented and executed). The ATCO monitors ARGOS and can take flights away from it. The ATCO controls non-ARGOS flights.		
L8	ARGOS manages all flights (for each flight, a plan is presented and executed). The ATCO is alerted by ARGOS when supervision is required: ARGOS still manages the situation but outside its normal comfort zone (i.e. conflict-free look-ahead time is reduced). The ATCO either only supervises ARGOS as requested (i.e. stays in L8) or takes flights away from ARGOS (i.e. reverts to L5).	C6	D7
L9	ARGOS manages all flights without supervision.	C6	D8

AI in ATC – Safety Related Systems



VRC/Speed as
f(Aircraft Type, Operator, ADEP/ADES, Temperature, TOD,…)

: current tasks

: complex scenarios

- - : Path A

— : Path B (chosen)

Liability / Certification

ARGOS Legal Case (Liability Case):

- SESAR Legal Case Methodology
- DeepBlue external support
  - **Shift in target: from operators to organisations and producers**
  - **Shift in grounds: from negligence to defectiveness**

Certification:

- Proceed using current Certification Process

Closing the loop – Ground-Air-Ground

Vertical Clearances Uplinked via CPDLC:

- Check on ground using the received EHS-FSSA

Horizontal Clearances Uplinked via CPDLC:

- Check on ground using the received ADS-C EPP

SSR Code Change Uplinked via CPDLC:

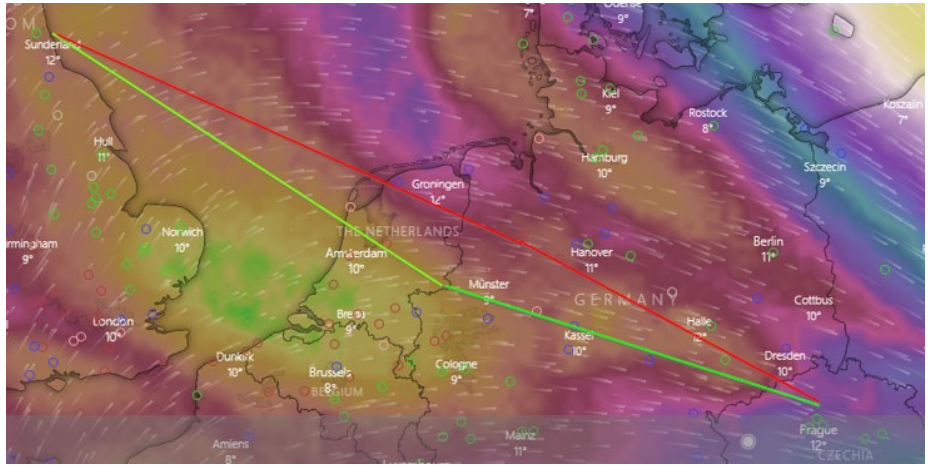
- Check on ground using the received Mode-A

Frequency Changes Uplinked via CPDLC:

- Check on ground using ATS Baseline 2 RevB (ADS-C)

But why?

- Offload ATCO work to the computer:
  - Less boring/routine work
  - Less stress but more traffic
  - Allows to focus on complex things
- Maybe more performant in some aspects
  - Environmental KPIs
- More time in the SIM to train (SO)
- Support in training

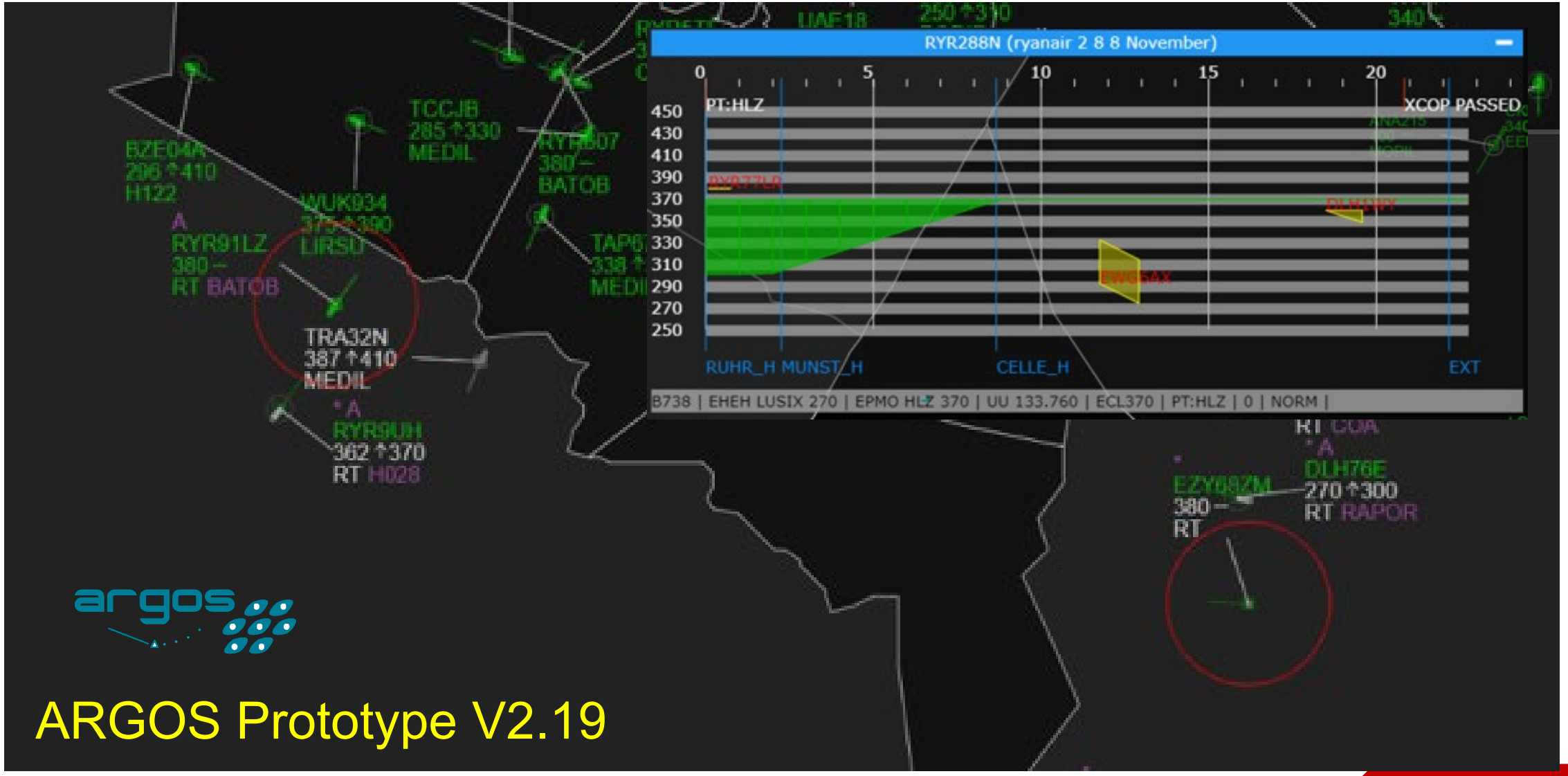


MUAC ATCO perception/position vis-à-vis Automation

- ATCOs involved from the on-set (SMART Team)
- Automation Subject can be discussed
  - Happening everywhere
  - Not a threat

‘Let ATCOs focus on the real, challenging work,
to do what they are the best at,
and leave the routine work to the machine.’

- COVID…
  - Boring to work on position
  - High Intensity Training (HIT) for competency



ARGOS Prototype V2.19

Performance
through
innovation

EUROCONTROL

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THANK YOU FOR YOUR ATTENTION
QUESTIONS?

argos

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