AT-One
the ATM Research Alliance

CEAS 2009 EUROPEAN CONFERENCE AIR AND SPACE

NLR DLR

Environmental Issues and application of corresponding Models in the context of Total Airport Management

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October, 29th 2009
CEAS 2009 – Manchester, UK

AT-One combines the strength of NLR and DLR in ATM Research

Structure

- What is TAM?
- Areas of Influence
- Environmental Models
- Open Issues

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- Environmental Models
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Why do we need Total Airport Management?

- It has been identified that currently existing approaches and implementations are not addressing all existing and future problems at the airport.

- There is no real dynamic coordination between airport stakeholders (competition, “don’t care”, hierarchical/ contractual “ignorance”, …).

- The impact of adverse weather conditions is most often **not known** – “it will impact us, but we have no clue to what extend” (most often true even in good weather situations).

➔ The Introduction of Airport-CDM (A-CDM) was believed to address these issues, but…

…Inherent problems despite A-CDM

Planning	CDM is currently largely limited to the tactical phase. There is a lack of (pro-active) pre-tactical and strategic planning between airport partners.
Data Sharing	Despite being a pillar of the EUROCONTROL CDM Implementation Guidelines, real-time data sharing is still limited and therefore pro-activity limited, too.
Flexibility	Limited flexibility in response to real-time events.
Shared vision	Still considerable “marketing” required to convince all airport partners of the benefits. Currently, almost no common performance indicators exist.

What can be done, where do we take Airport-CDM from here?

Motivation for Total Airport Management

SESAR (R&D Requirement 1 of D2.2.2): There is a need for

- more **dynamic** and **responsive** ways to incorporate the **customer's priorities** (i.e. UDPP),
- **pro-active** instead of re-active planning in **predicted** bottleneck situations,
- **fair** and **transparent** means of **handling competing interests** at an airport,
- improved **predictability** of the system „airport" at and within the network,
- **performance measurement** with a **common** set of (key) **performance indicators** to drive a harmonization process between the different airports' performances,
- …

Expectations from Total Airport Management

Expected benefits include:

- more **efficient** airport operations,
- less operational costs,
- **environmental benefits**,
- enabling of the system to cope with the future traffic demand.
- …

How can that be achieved?

How does that work out?

From A-CDM to TAM – Expected *Benefits*

Agreed Performance Measures

Agreed Airport Configuration

Agreed Performance Targets

Improved Predictability

AOP: Joint Plan

Based on commonly agreed performance indicators, TAM will allow for an assessment and visualization of future airport performance.

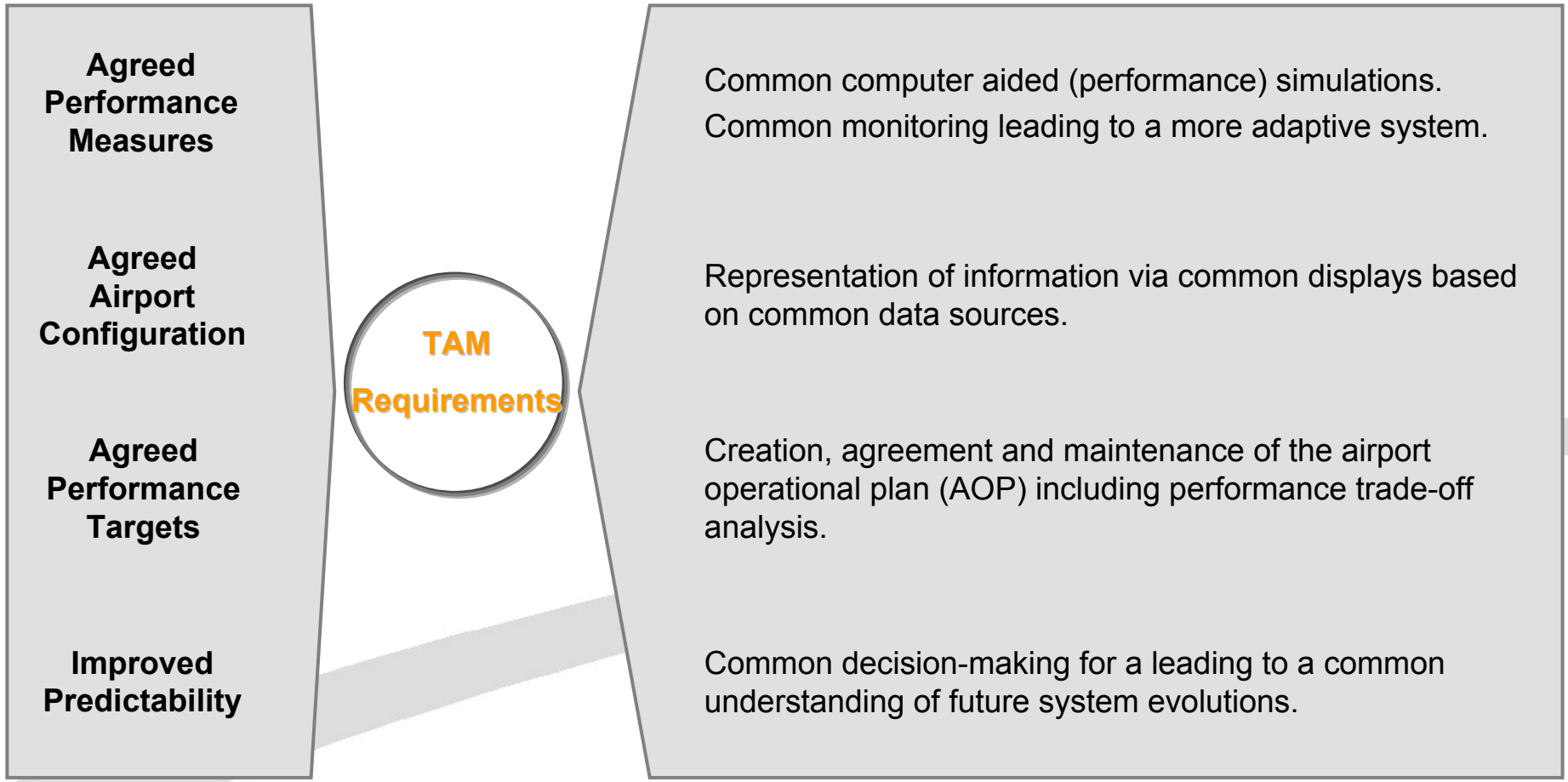
Introduction of common databases and systems.

This will allow operators to configure the airport according to agreed “scenarios” most applicable at the time of decision.

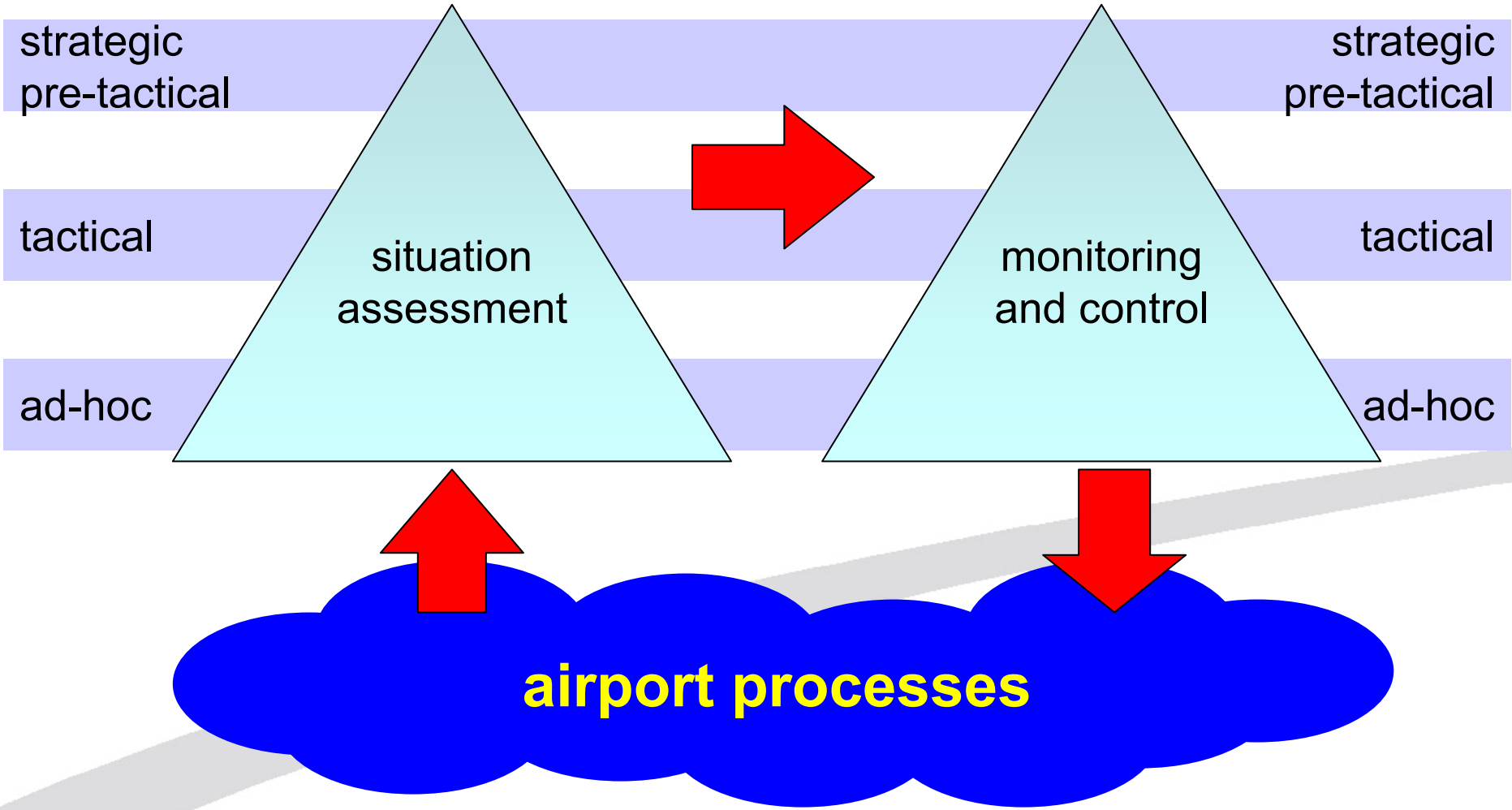
Demand and capacity management are organized to meet agreed performance targets for different time horizons. Also able to change the performance objective.

Based on an environment which is designed around the philosophy of information sharing. Past performance used to identify future requirements.

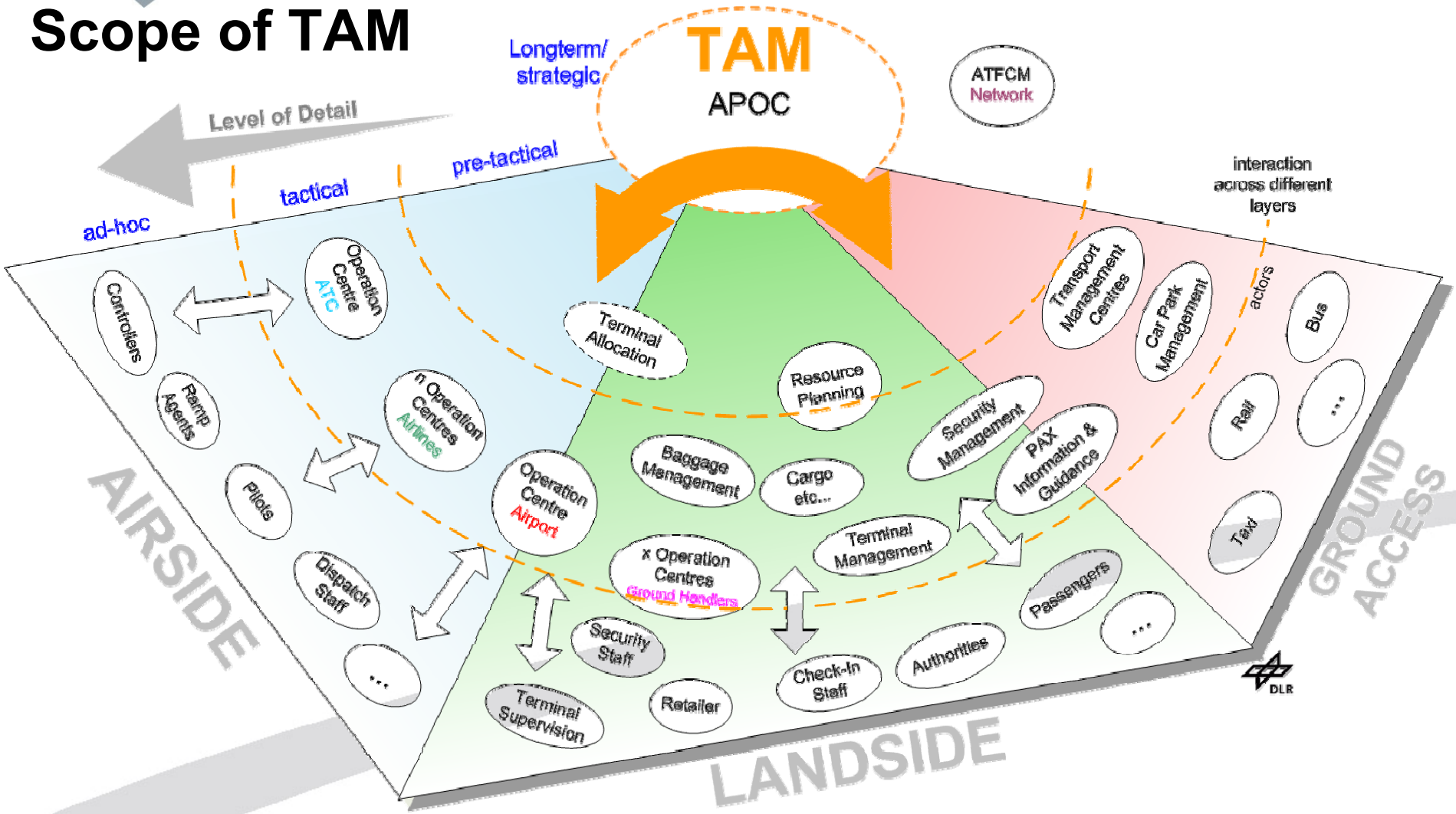
From A-CDM to TAM – Generic *Requirements*



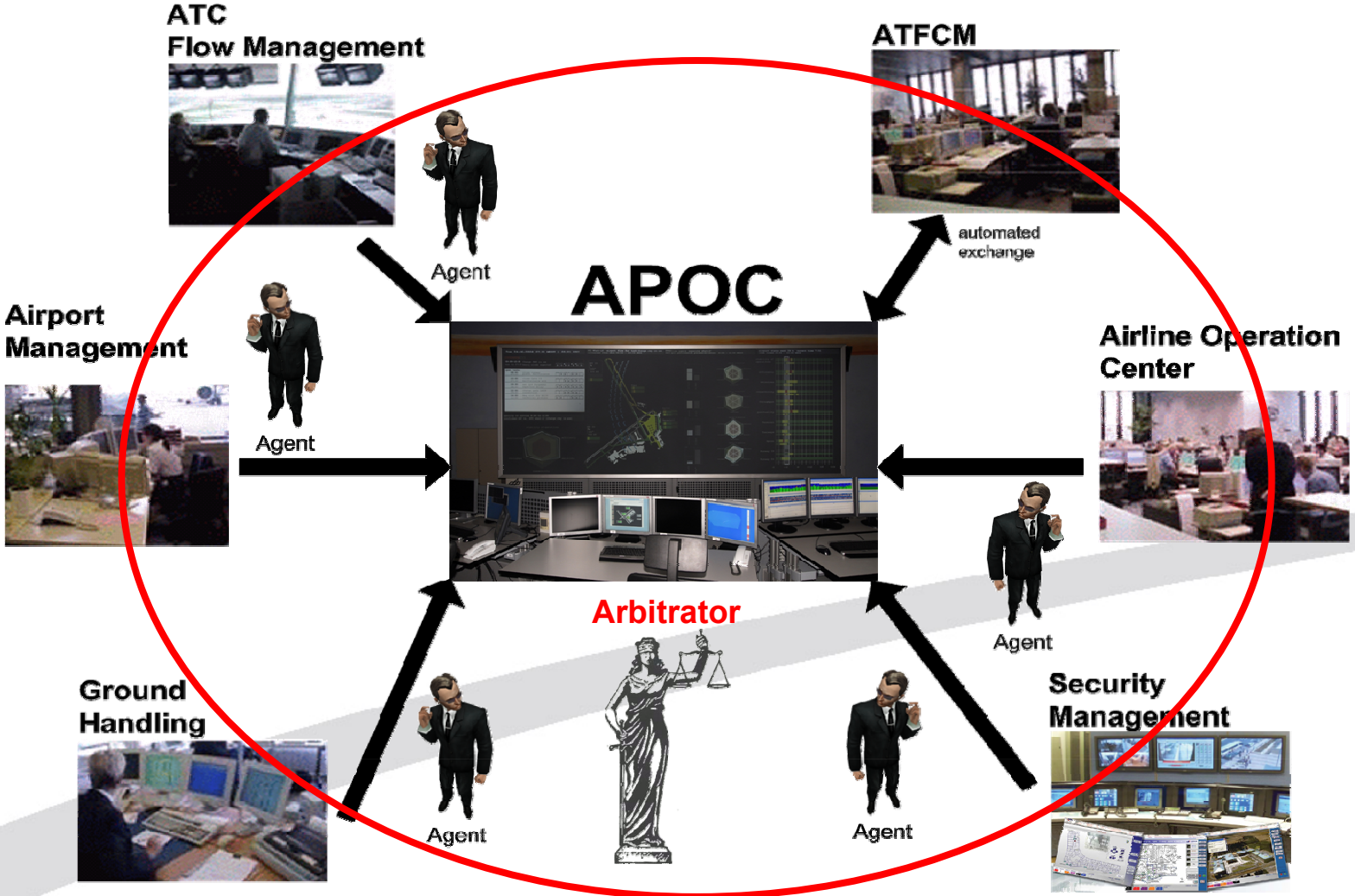
TAM Principles / Levels of decision making



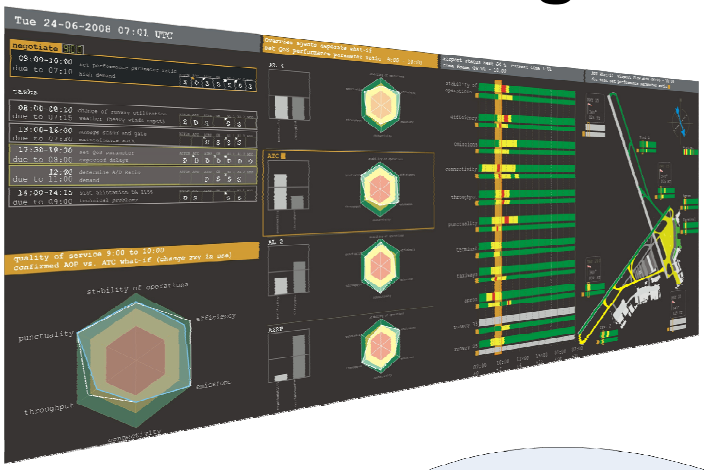
Scope of TAM

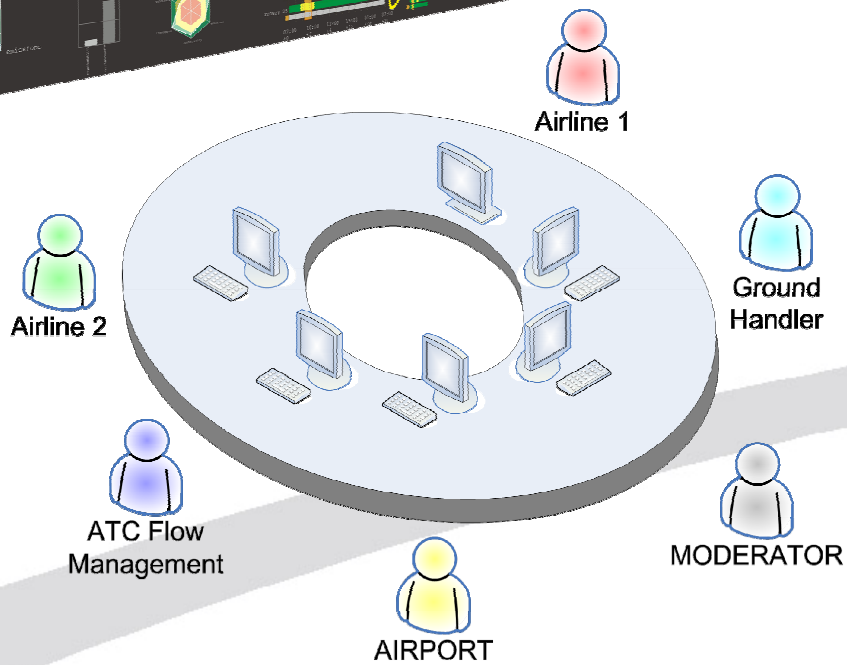

Longterm/ strategic
TAM
APOC
ATFCM Network
Level of Detail
ad-hoc
tactical
pre-tactical
interaction across different layers
actors
Controllers
Operation Centre ATC
Ramp Agents
n Operation Centres Airlines
Pilots
Dispatch Staff
...
Terminal Allocation
Resource Planning
Baggage Management
Cargo etc...
Operation Centre Airport
x Operation Centres Ground Handlers
Security Staff
Terminal Supervision
Retailer
Check-In Staff
Authorities
Terminal Management
Security Management
PAX Information & Guidance
Transport Management Centres
Car Park Management
Bus
Rail
...
Taxi
Passengers
...
AIRSIDE
LANDSIDE
GROUND ACCESS
DLR

TAM APOC: how does it look like?



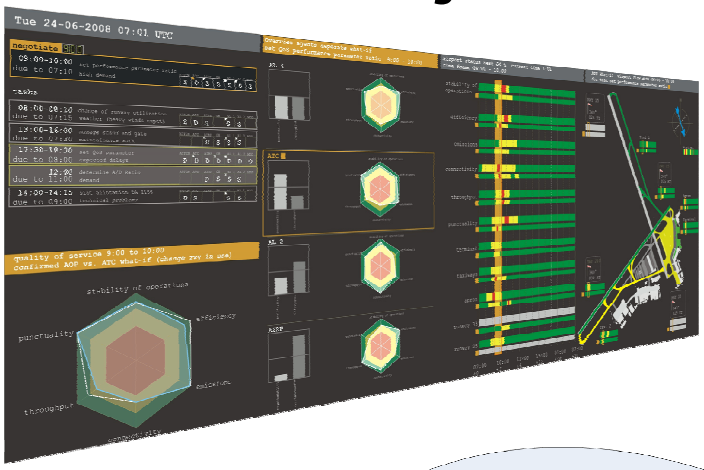
TAM APOC: Negotiation / Coordination workflow

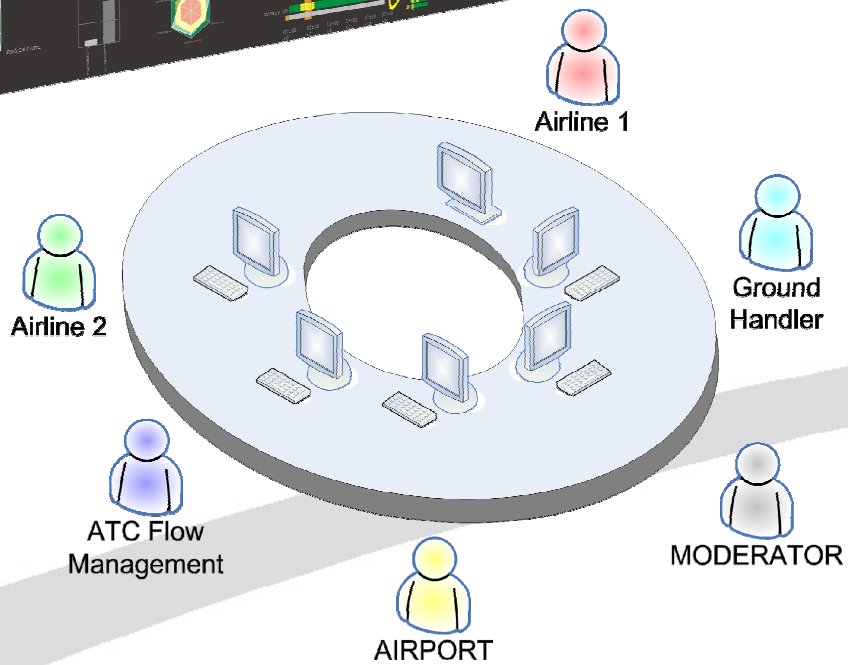




- Use cases for recurring situations that require coordinated decision making between stakeholders
- Protocols and rules guarantee transparency and fairness
- Support systems (i.e. central powerwall display showing key performance parameters and airport information) to create common situational awareness to all stakeholders
- Automated planning support tools constantly monitor and analyze situational data
- What-If support to analyze and pre-plan future traffic scenarios

TAM APOC: joint Airport mode of operation

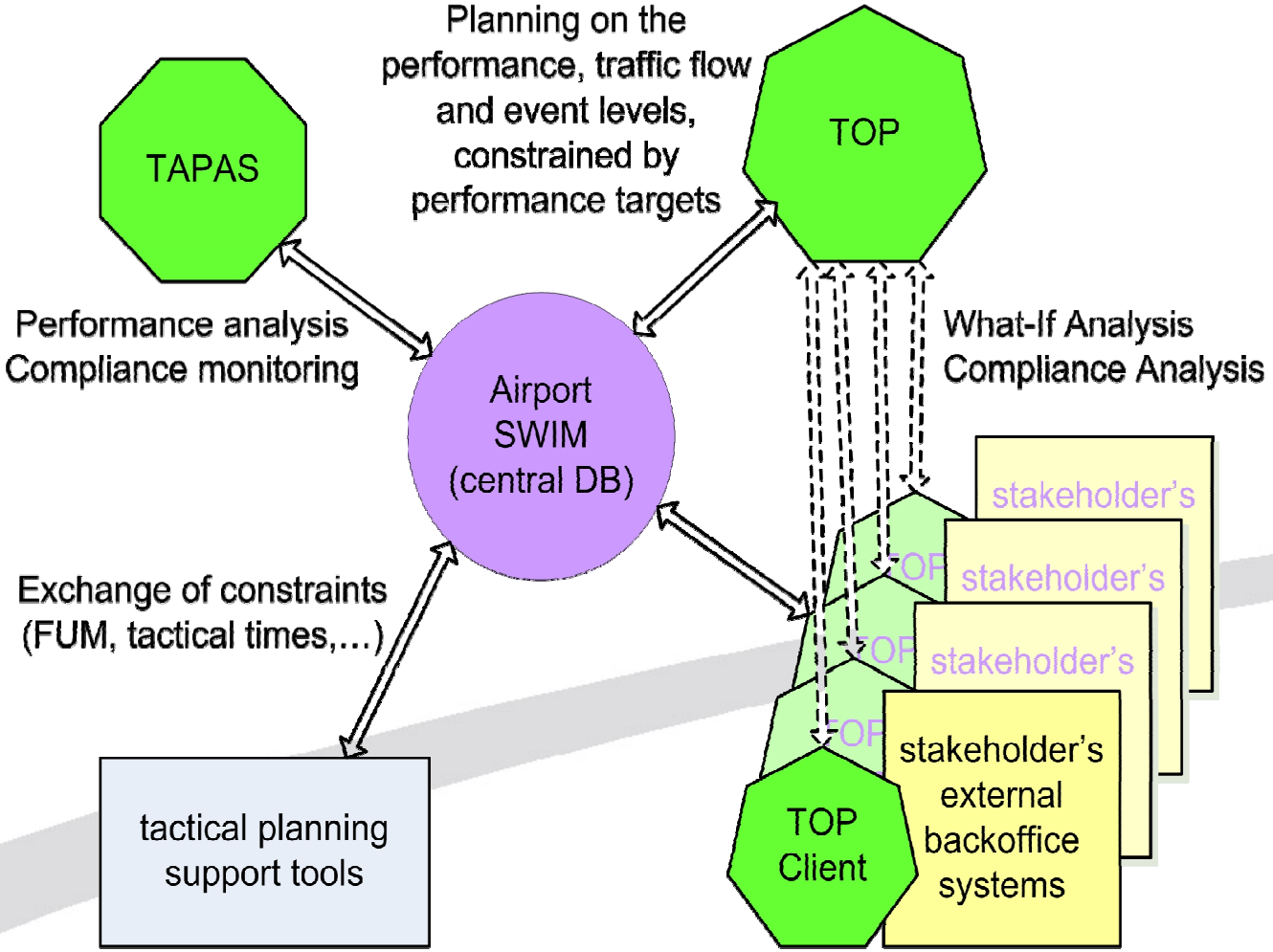




Agents decide how the airport shall be operated, i.e.

- punctuality above all else
- more departure than arrival traffic
- throughput over punctuality
- more green operations above all others
- …

TAM APOC system architecture



TAM APOC Situational Awareness

Situational Awareness created in the APOC between stakeholders includes

- Airport Performance based on i.e. traffic flows and capacity
  - Arrival and Departure rates/throughput
- Punctuality and Delay Situation
- Adherence to Network Performance promises
- Queue Lengths on Taxiways, PAX in Terminal, …
- Stability and Flexibility of Operations

Environmental awareness? What aspects? What exactly?

Structure

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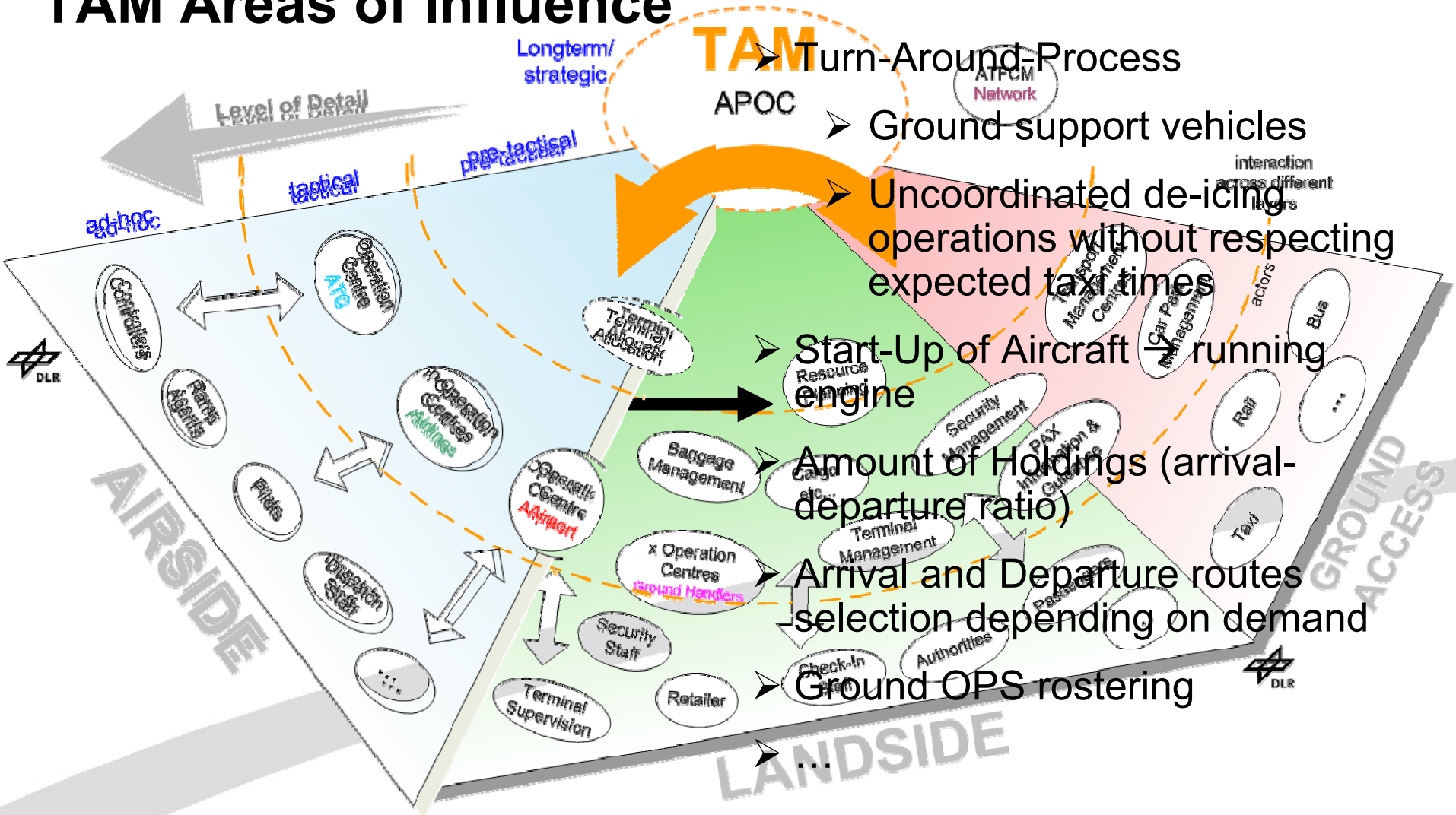
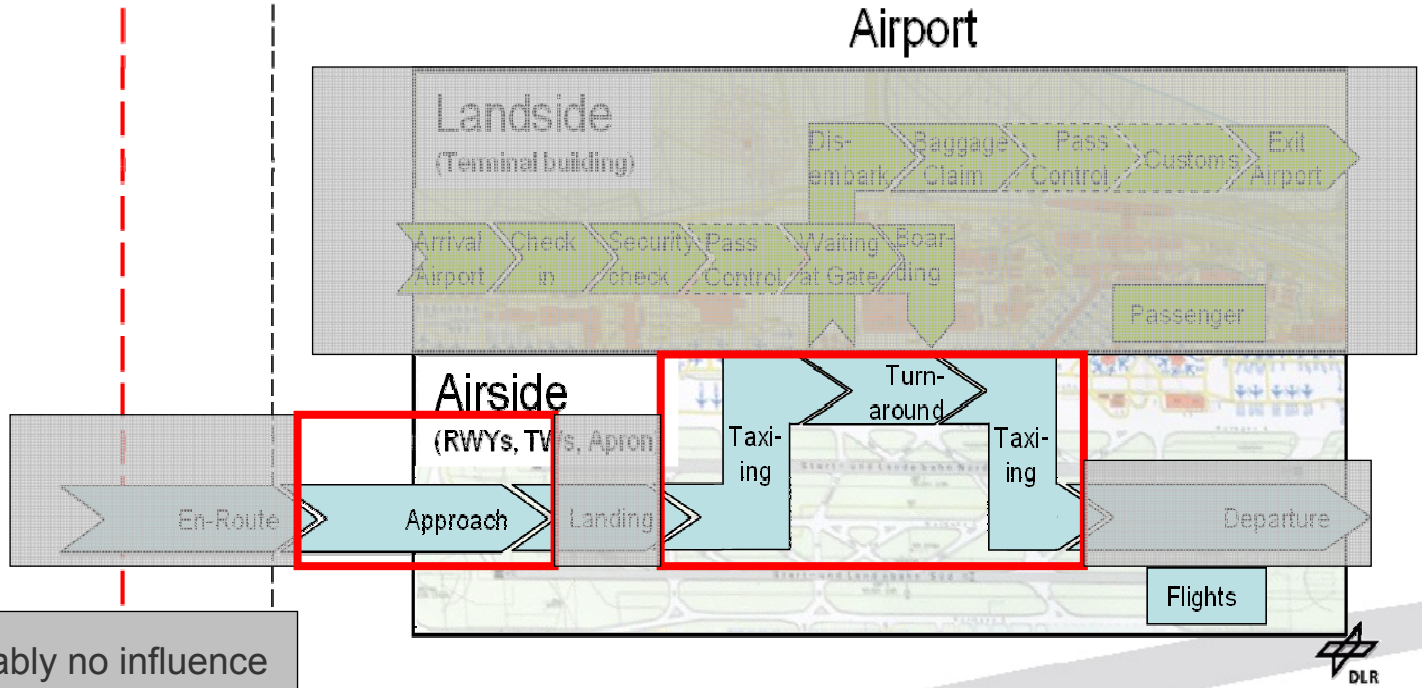
- Areas of Influence
- Environmental Models
- Open Issues

TAM Areas of Influence



- Turn-Around-Process
- Ground support vehicles
- Uncoordinated de-icing operations without respecting expected taxi times
- Start-Up of Aircraft → running engine
- Amount of Holdings (arrival-departure ratio)
- Arrival and Departure routes -selection depending on demand
- Ground OPS rostering
- …

TAM Areas of Influence - LTO



most probably no influence exerted by TAM APOC

influence feasible

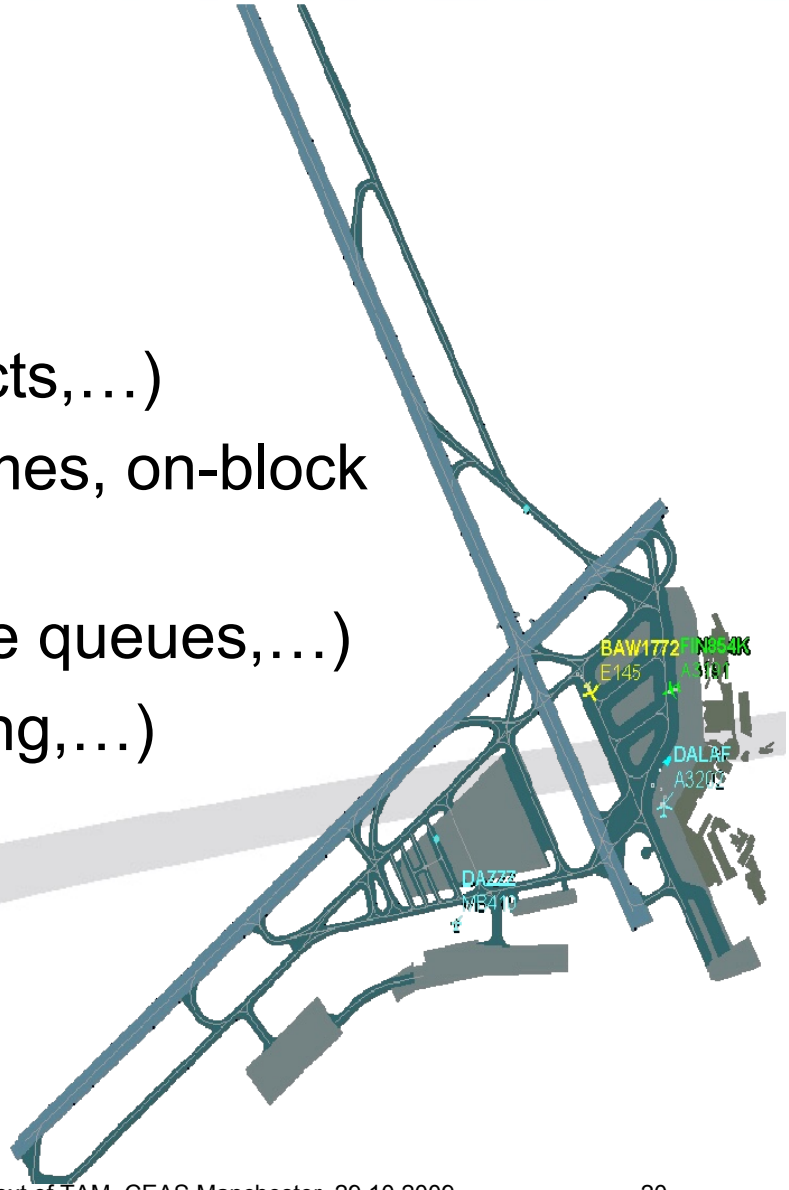
TMA/adjacent sectors

Surrounding departure airport

TAM Areas of Influence - LTO

Flights

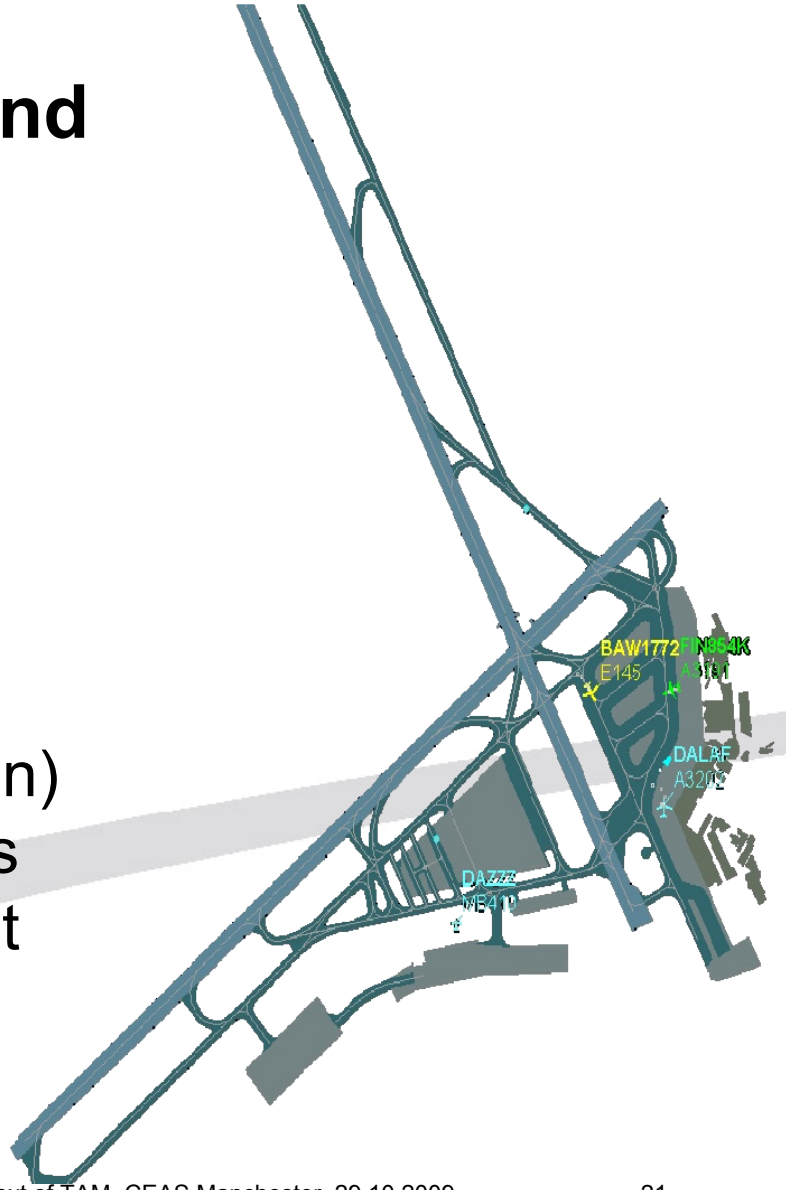
- Approach (patterns, holdings, directs,…)
- taxi-in (route, # of stops, waiting times, on-block queues,…)
- taxi-out (pushback delay, departure queues,…)
- Departure (indirect routes, re-routing,…)



TAM Areas of Influence - Ground

Ground Support Vehicles

- Route/Mission optimization
  - PAX bus
  - Baggage trucks
  - Catering
  - other support vehicles…
- Efficiency optimization (coordination)
  - i.e. reducing idle waiting times when waiting for delayed flight
  - …



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Environmental models

Intention:

- Utilize results from environmental model computation to indicate agents quality of planning with respect to environment (emissions, not noise)
- Modify existing planning algorithms to additionally optimize environmental impacts

Applicable Models (selected from EATRADA inventory)

- Since basically most applicable models are based on LTO, we'll use LTO directly.

Ground Based support traffic

- No European model yet existing, US models states unclear to us

Environmental models – Data requirements

LTO

- ICAO Aircraft type
- Type of reference engine for each ICAO AC type
- Emission indices
- Times for
  - Take-Off, Climb-Out, Approach, Taxi-in, Taxi-out (from LTO cycle)
- Information source can be
  - ICAO Engine Exhaust Emissions Data Bank
  - LTO Cycle ICAO Annex 16 Volume 2
  - Aircraft Engine configuration from AC manufacturers

For APOC pre-tactical planning this information is available for the day of operations!

A modified version of the LTO model will be used for airport and vicinity. Above 3k ft a different model exists, but currently not of interest to us.

Environmental models – Data requirements

Ground Based Support Vehicles

- Type of vehicle
- Average work effort of individual types of vehicles
- Fuel consumption for reference vehicles
- Emission indices for reference vehicles

Information sources can be

- Manufacturer
- A-SMGCS & other surveillance data for work effort / routes / distances
- Fleet Manager/Ground Handler

For APOC pre-tactical planning this information is available for the day of operations!

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Conclusion

- Utilization of (modified) LTO model with intend of bringing environmental information into APOC seems feasible
  - Stakeholder decision making variation due to availability of environmental planning data may be assessed
- Supplemental of APU utilization information is believed to be necessary
  - Important for remote stands where no local power supply nor GPU is available
- Creation of a ground support vehicle environmental model is necessary
  - Model needs to be adjusted to each airports' ground fleet composition

Open Issues with Environmental KPIs

- Currently there is no incentive for stakeholders to adjust their plans in order to optimize the overall environmental impacts (primarily emissions,…)
- Impact of emission trading mandated by EU not yet assessable
- …


Questions?

TAM – Further Sources of Information / Contacts

World Wide Web

http://www.tam.aero/

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