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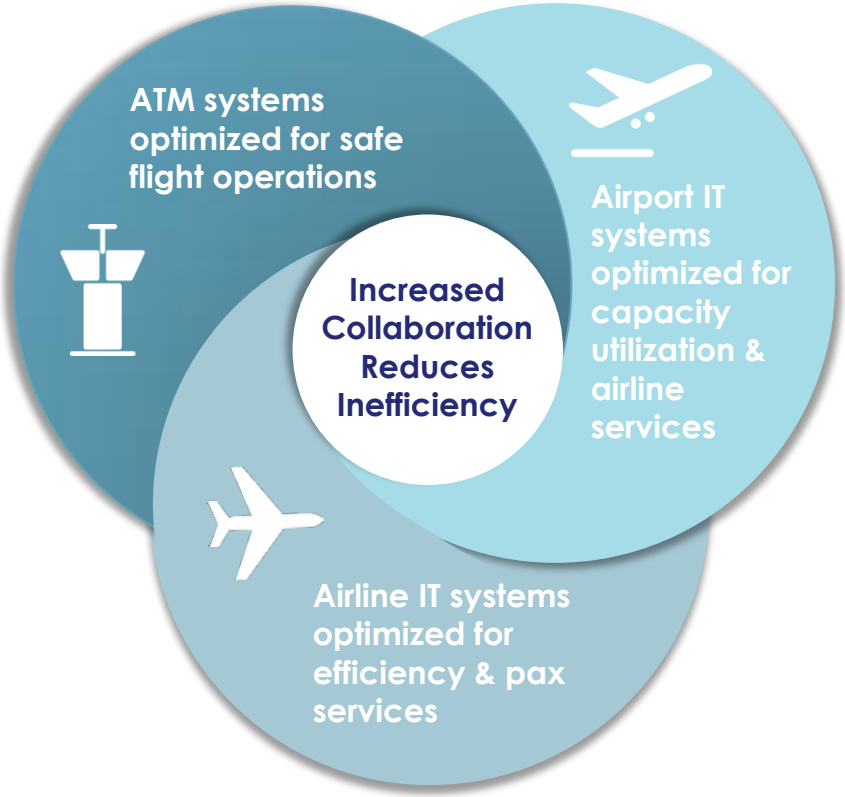
Advanced Traffic Flow Management (ATFM) & Collaborative Decision Making (CDM)

Share, Communicate, Anticipate for a better use of Airspace & Airport capacity

ECOSYSTEM

Why do we need collaborative systems?



Stakeholders have different drivers

Global standards are missing

Most valuable data is captive within each stakeholder's systems

Low incentive to share data – limited optimisation between stakeholders

$9B+ inefficiency per annum

Small gains in aviation operations efficiency = large value / benefits

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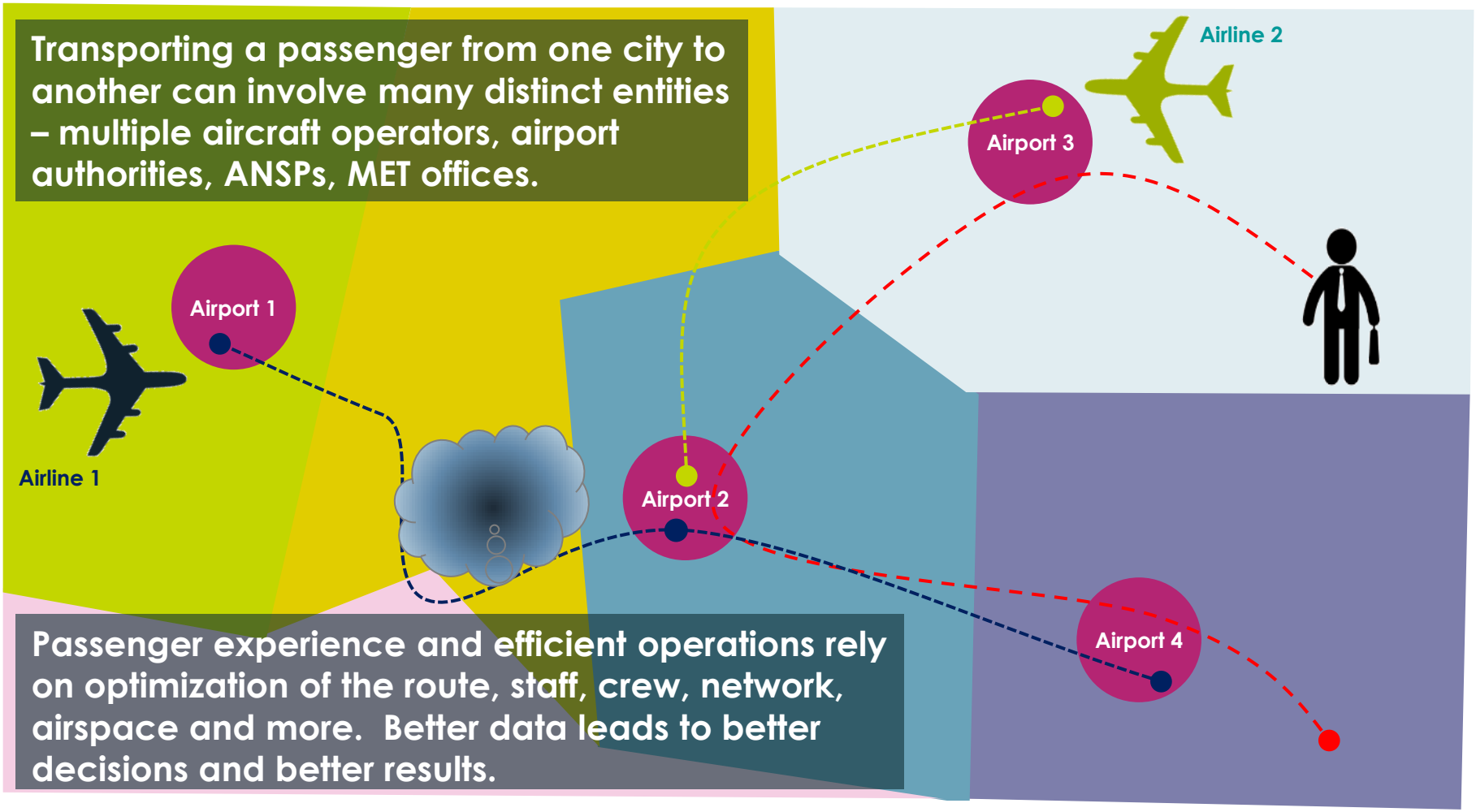
Digital collaboration is the key to optimizing aviation flight operations



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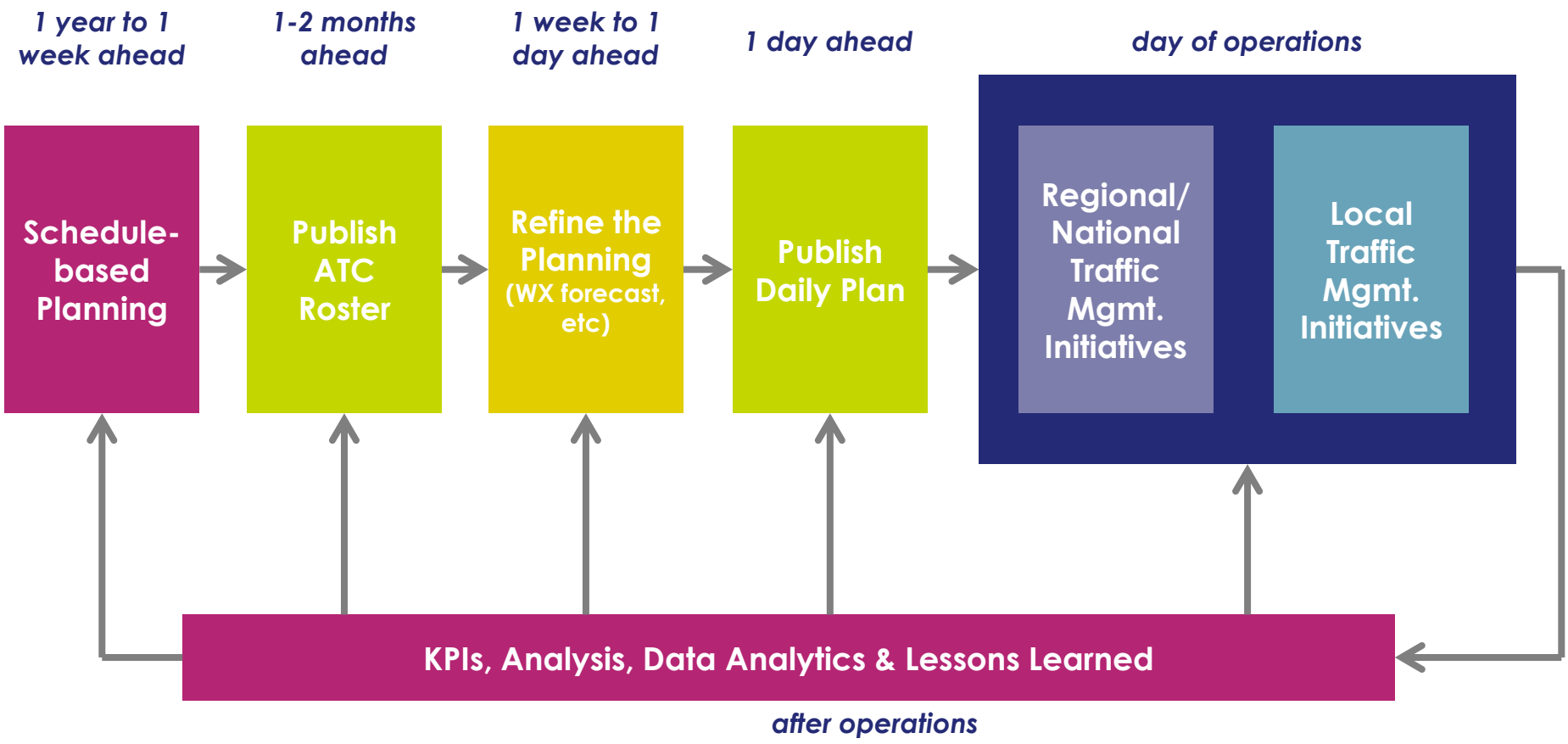
ATFM/CDM
Key Concepts

Demand/Capacity Balancing Continuum (ATC perspective)



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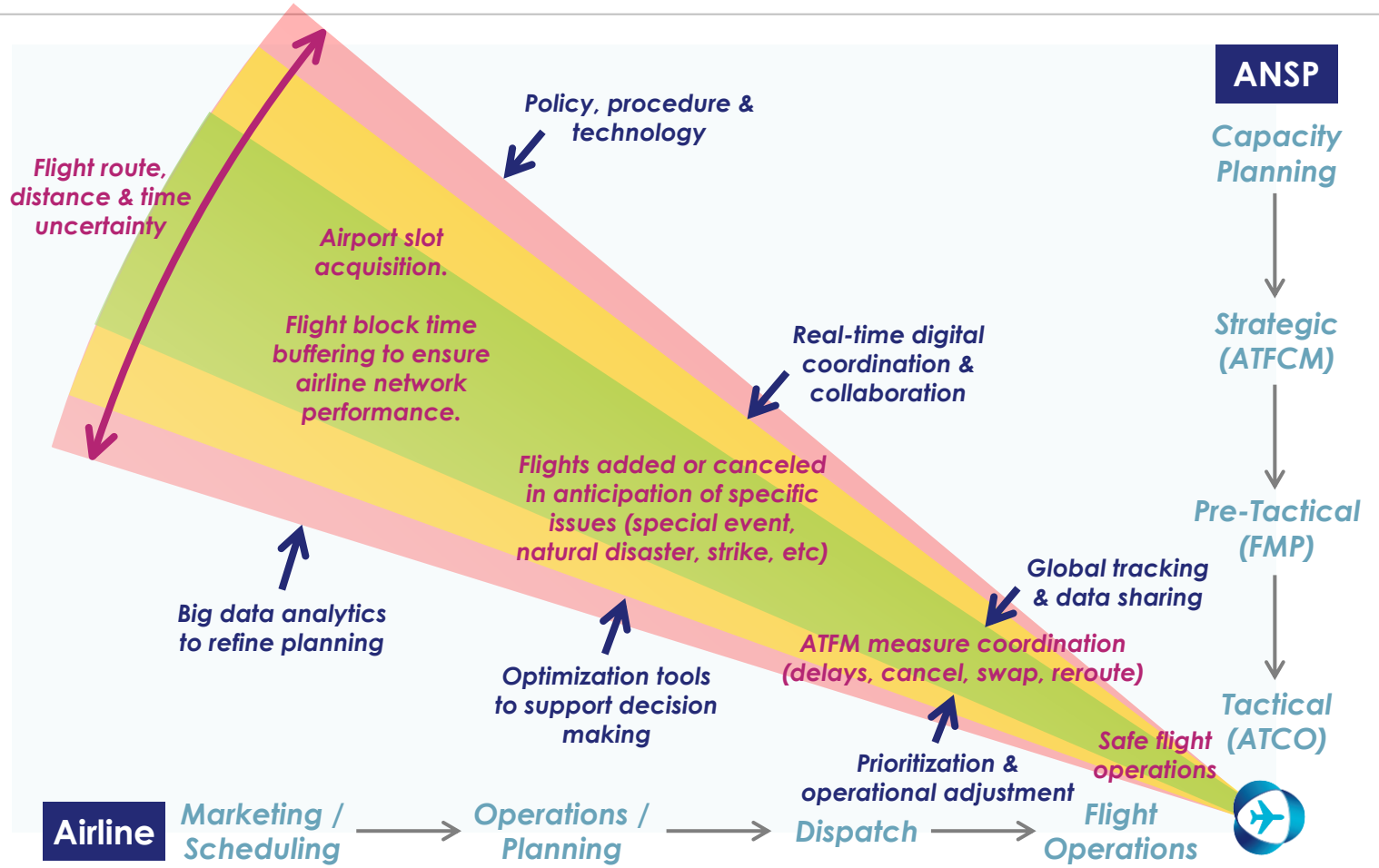
Operations improve through collaboration & data sharing



Reduction in uncertainty improves performance for all stakeholders

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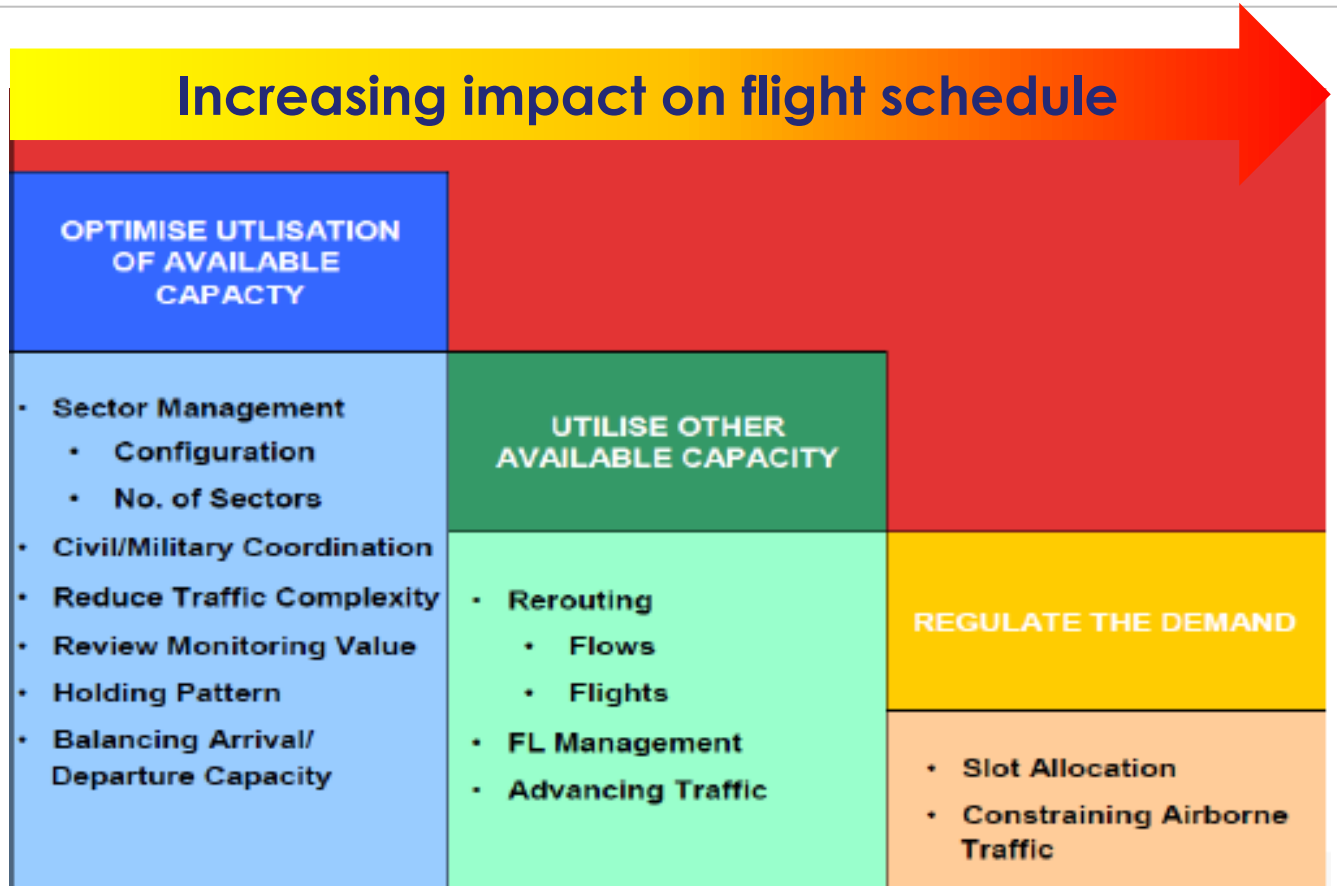
ATFM is much more than Slot Management



EUROCONTROL

ATFM automation required to apply the right action to the right flight at the right time to get the best outcome

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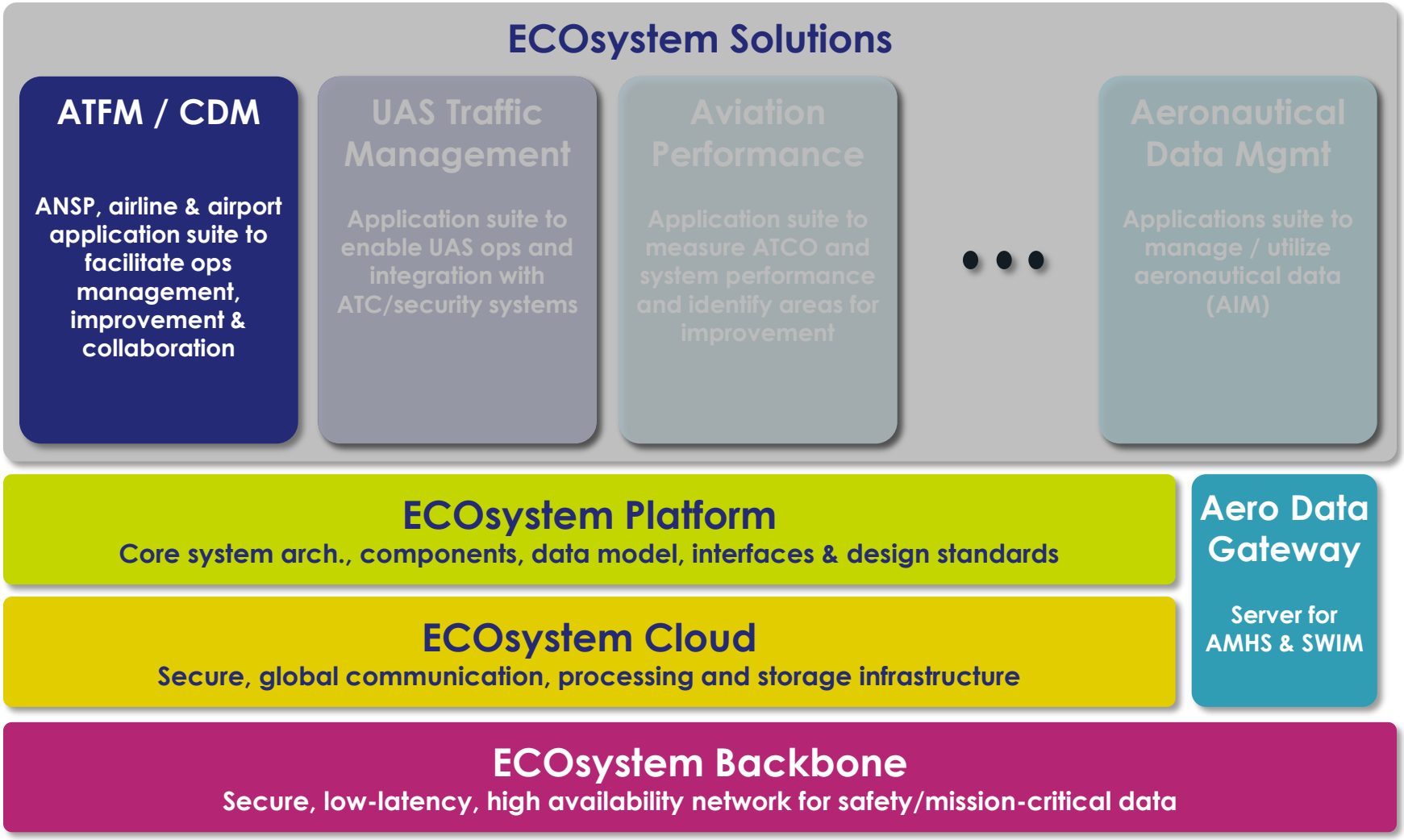
Thales Solution for ATFM/CDM

www.thalesgroup.com

OPEN

The ECOsystem Cloud-Hosted Platform and Application Suite



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Thales ATFM Philosophy – blending best practices from around the world

- Don't regulate traffic unless a problem is anticipated
- Use the correct tool (measure) for the problem faced
- Target equitable sharing of any operational impacts
- Provide airspace users the ability to share & select preferences
- Do not over-constrain flights
- Create incentives to encourage participation and compliance
- Combine policy and procedures with technology
- Use the analytics to improve forecasts and decisions

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Prioritized approach for managing demand/capacity imbalance

Address airport issues where demand approaches or exceeds capacity

- Ration by schedule allocation of flights to available airport capacity (metering)
- Load balance runways to accommodate demand
- Calculate take-off times and metering point times (upstream metering)
- Utilize sequencing (AMAN) to maximize utilization of available capacity
- Balance departure flows (DMAN) with arrival flows to ensure smooth operations

Address airspace issues once airport flows are planned

- Identify hot spots (capacity / complexity overload) which require management
- Evaluate available measures (route, speed, level, rate, time, sectorization, etc)
- Implement changes to flights or flows (including coordination with stakeholders)
- Monitor impact and continue to adjust as needed

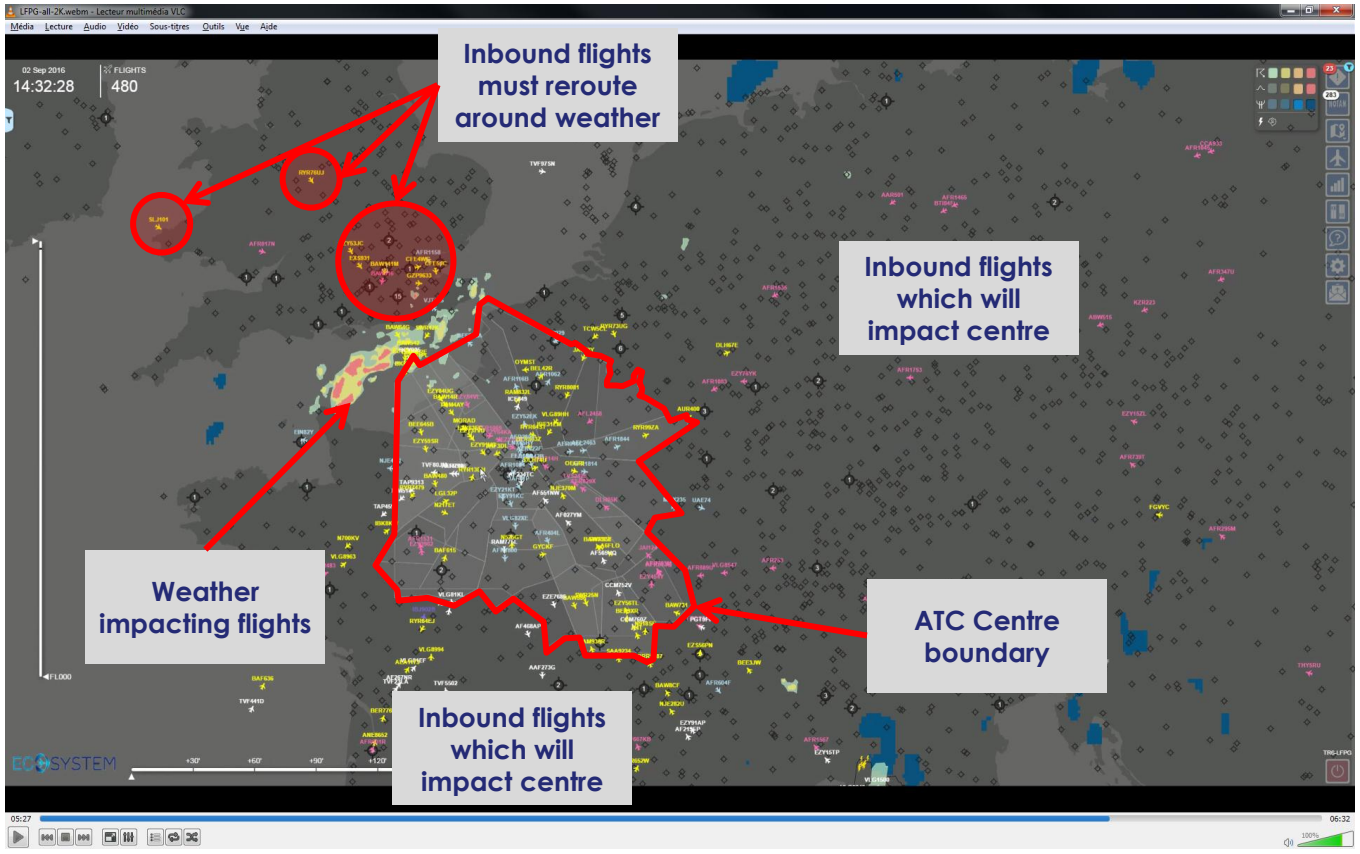
ATC Forewarning Beyond "Local" Situation Enable Better Planning

ATC Centres do not have access to location & status of flights outside their airspace

Weather / winds impact flight paths

Airline / airport operations & airspace congestion between origination & destination impact flight time

High degree of uncertainty as to when and where a flight will arrive for ATC



Advanced warning enables more proactive and effective solutions

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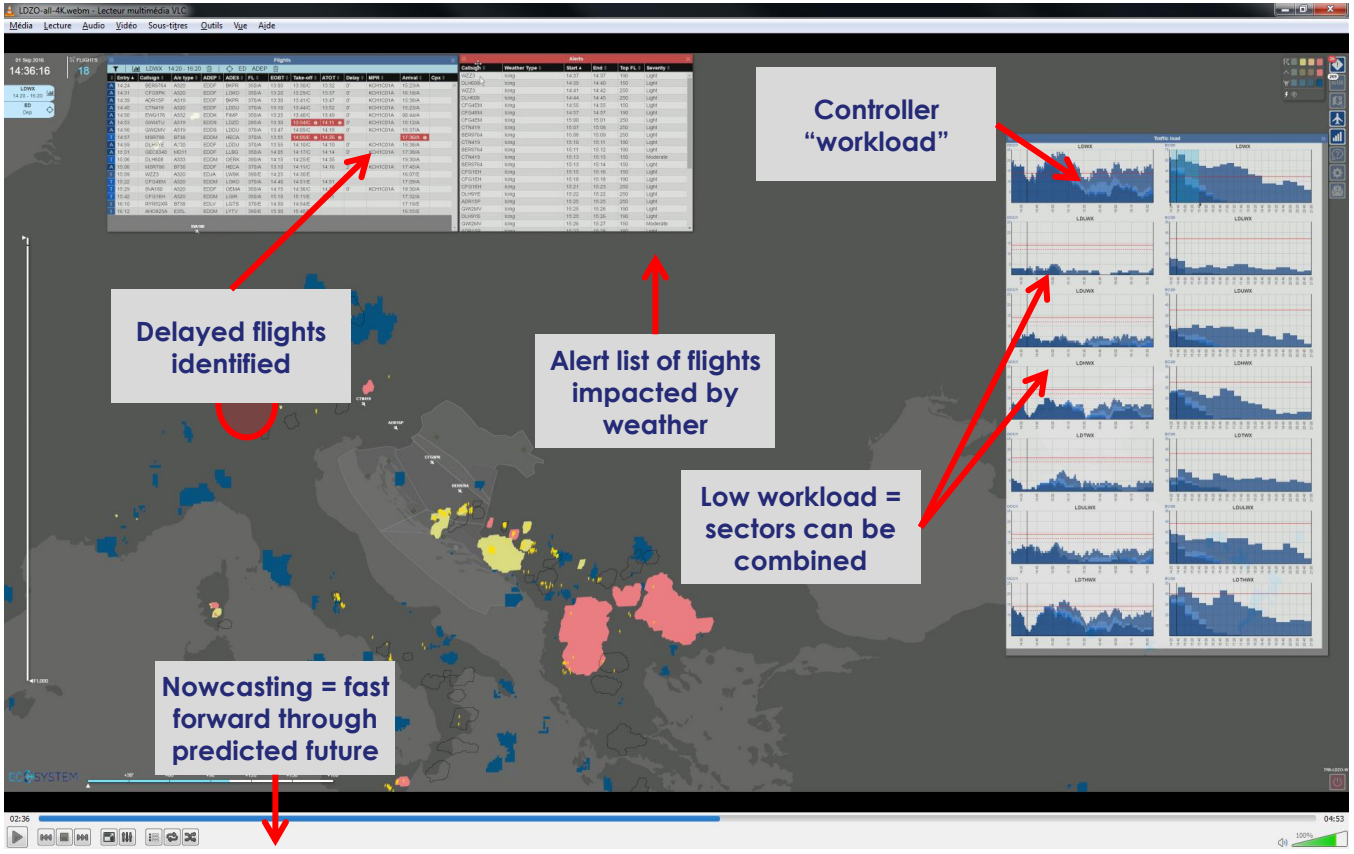
Sector Planning & Flight Re-Routing Enables ATC service optimization

Flight and weather predicted using models and historical behavior (machine learning).

Automated alerting of interaction between weather and flights.

Rerouting to address alerts and maintain safe flight operations.

Updated traffic / workload forecast allows sector combination / splitting to adjust staffing and costs.



Pre-tactical tools smooth controller workload & organize traffic

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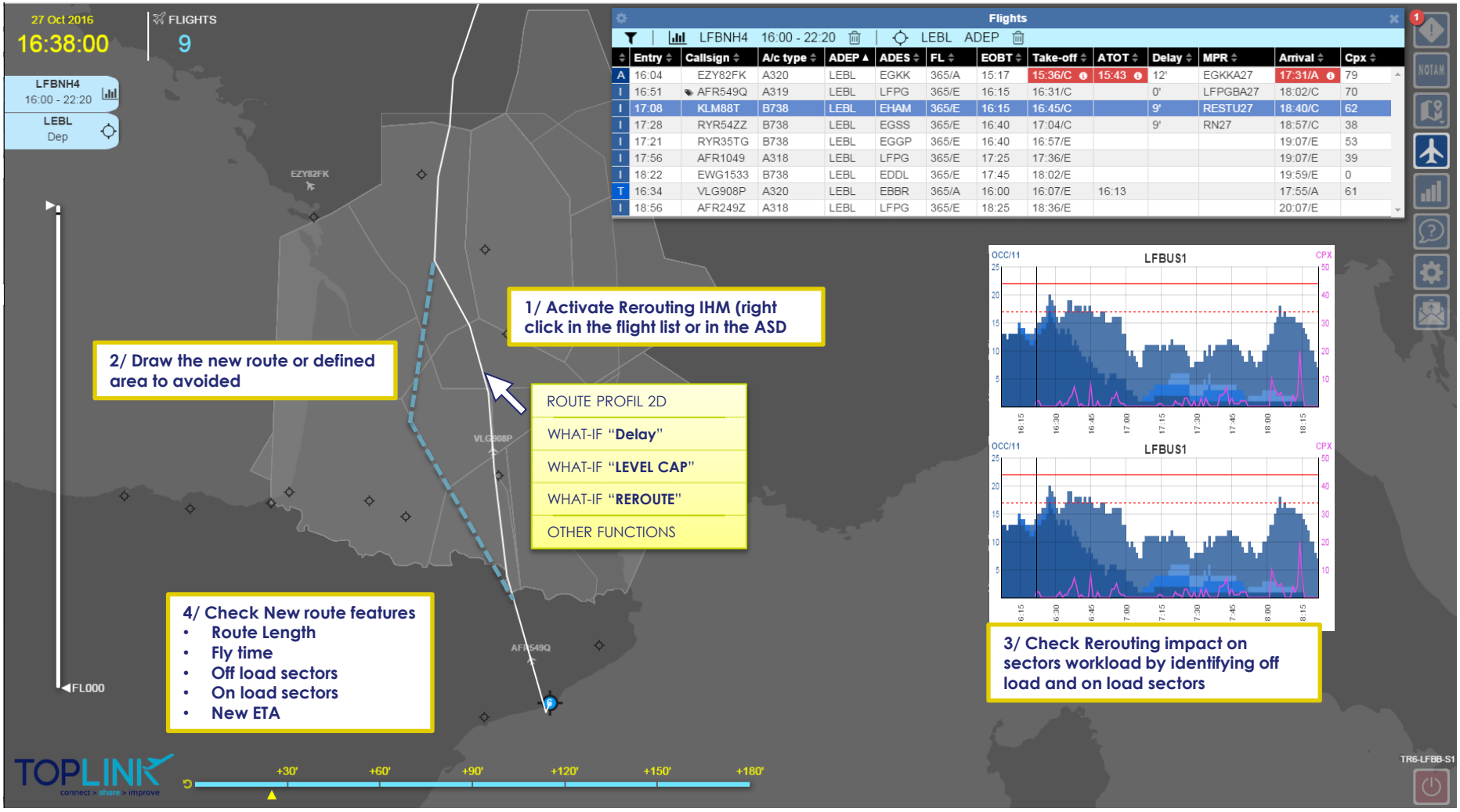
Rerouting to avoid severe weather or capacity/complexity issue



Flights

LFBNH4 16:00 - 22:20 | LEBL ADEP

	Entry	Callsign	A/c type	ADEP	ADES	FL	EOBT	Take-off	ATOT	Delay	MPR	Arrival	Cpx
A	16:04	EZY82FK	A320	LEBL	EGKK	365/A	15:17	15:36/C	15:43	12'	EGKKA27	17:31/A	79
I	16:51	AFR549Q	A319	LEBL	LFPG	365/E	16:15	16:31/C		0'	LFPGBA27	18:02/C	70
I	17:08	KLM88T	B738	LEBL	EHAM	365/E	16:15	16:45/C		9'	RESTU27	18:40/C	62
I	17:28	RYR54ZZ	B738	LEBL	EGSS	365/E	16:40	17:04/C		9'	RN27	18:57/C	38
I	17:21	RYR35TG	B738	LEBL	EGGP	365/E	16:40	16:57/E				19:07/E	53
I	17:56	AFR1049	A318	LEBL	LFPG	365/E	17:25	17:36/E				19:07/E	39
I	18:22	EWG1533	B738	LEBL	EDDL	365/E	17:45	18:02/E				19:59/E	0
T	16:34	VLG908P	A320	LEBL	EBBR	365/A	16:00	16:07/E	16:13			17:55/A	61
I	18:56	AFR249Z	A318	LEBL	LFPG	365/E	18:25	18:36/E				20:07/E	

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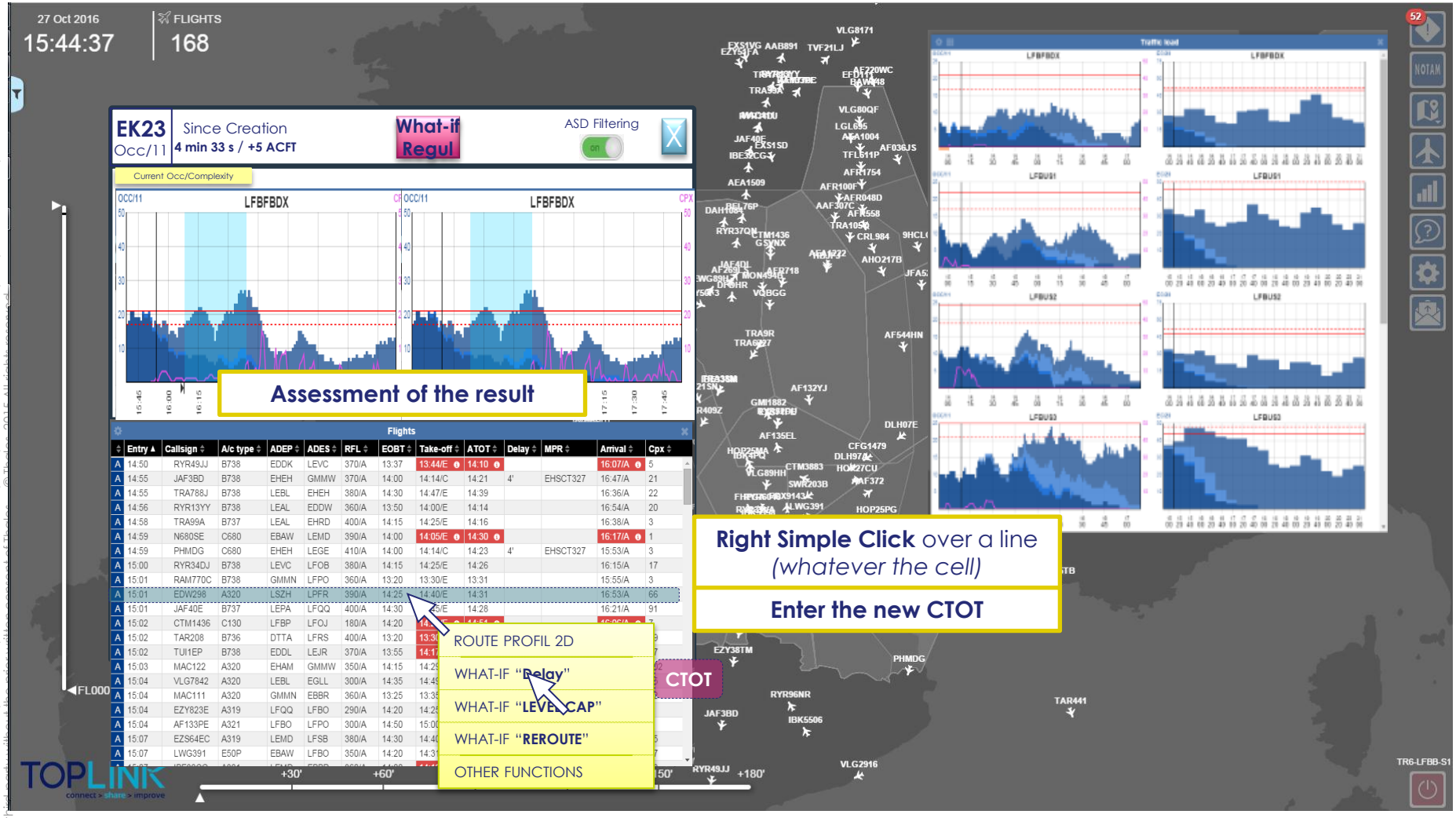
Select Individual Flights to Delay/Adjust to Address Capacity Issues



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ATFM Benefits

SESAR TOPLINK Trials Performance Results

Improved Ground Regulation

20+ M€ p.a.

- **Small gains on many flights**
- Better forecast of MET hazards enable a better use of regulations in space and time avoiding unnecessary penalization of flights
- Used by ANSPs for direct benefit on Airlines KPIs
- Quantitative assessment reached with a good confidence level – validating prior TOPMET results

Other Use Cases

- Airspace & airport **capacity**
- **Safety and passenger comfort**
- Benefits are clearly reported by end-users, but can be only ***qualitatively*** assessed at the current stage

Support to Flight Rerouting

-70% Delay

- **Large gains on few flights**
- Better forecast of flight impact enabling early and better rerouting decisions to avoid disruptions
- Used directly by airline taking into consideration expected ATC situation
- Based on a case-by-case (flight by flight) analysis

"Monitoring SN9938 BHX-BRU ferry flight. Technical issue: Gear not locked when retracting. A/C has to return gear down to BRU for repair on condition there are no icing conditions en route. Max altitude permitted 'gear down' procedure FL190. Return would never have been possible without the Toplink tool." – Brussels Airline

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“Improved regulations” Use Case: experimental results

Airspace	Current		Benefit TOPLINK	
	Delays (mn) (1)	Cost (k€) (2)	Delay reduction (mn) (3)	Cost reduction (k€)
	All Airlines			
LOVV (En Route)	18742	880	2623	126
LDZO (En Route)	12747	570	1936	91
LFBB (En Route)	45951	2159	11258	529
Total EU (En Route)	Brussels Airlines			
	3651	171,6	1800	85
	HOP!			
	1704	79,8	255	12
	All Airlines			
LFPG (CDG Approach)	39026	1834	6650	312

(1): Sources: Eurocontrol

(2): Estimation based on average cost of ground delays, source Univ Westminster

(3): Estimation based on a joint analysis of actual regulations and TOPLINK Tool capabilities

Reference period:
June-Aug 2016
(3 months)

Extrapolation:
12 months
EU En Route Airspace
All airlines

20 to 50 M€
cumulated gain p.a.

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TopLink “Flight Rerouting” Use Case 1: improved horizontal diversion

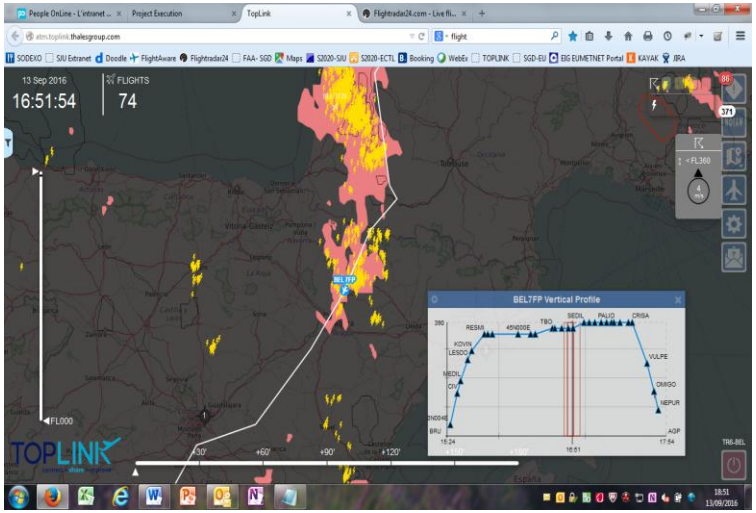
Planned route

Actual route

Alternative route

Actual scenario:
« last minute deviation »
based on Weather Radar info, to avoid severe convection over the Pyrenees

TOPLINK expected benefit:
Early rerouting decision 45 mn in advance (western avoidance route)



BEL7FP 13/09/2016 BRU-AGP	Planned	Actual	TOPLINK benefit vs actual (est.)
Take-off	15:28	15:24	
Arrival	17:57	18:08	
Track miles	983 NM	1039 NM	
	Impact of weather		
Arrival delay	0	+11 mn	- 7 mn
Extra flight duration	0	+15 mn	- 7 mn
Extra track miles	0	57 NM	- 40 NM
Extra cost (est.)	0	+ 599 €	- 420 €

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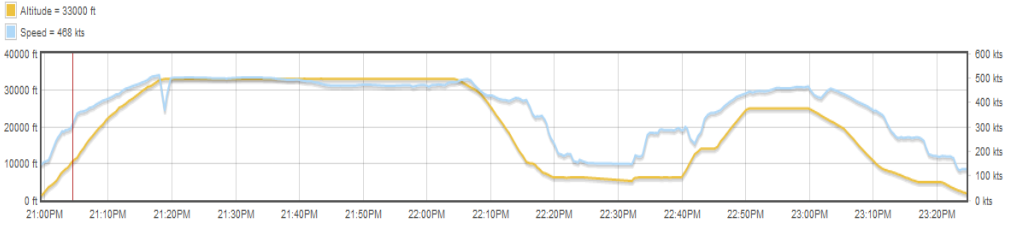
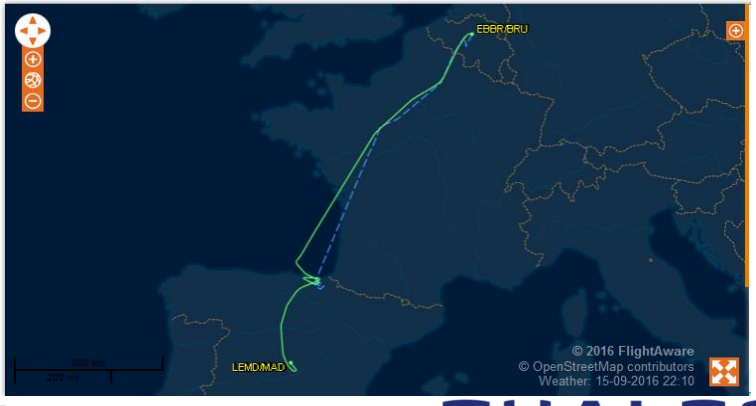
TopLink "Flight Rerouting" Use Case 2: Avoid diversion

Actual scenario:
20 mn holding over BIO
due to severe thunderstorm,
then diversion to MAD
Then PAX back to BIO by bus (395 km)
Aircraft back to BIO through ferry flight

TOPLINK expected benefit:
Ground delay at departure in BRU 60 mn then flight as planned

BEL14Z 15/09/2016 BRU-BIO	Planned	Actual	TOPLINK benefit vs actual (est.)
Take-off	20:45	20:45	
Arrival	22:28	23:24 (MAD) 05:00 (BIO) by bus	
	Impact of weather		
Arrival delay	0	+390 mn	- 330 mn
Extra travel duration	0	+390 mn	- 330 mn
Extra cost (est.)	0	+ 10 133 €	- 8 093 €





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TOPLINK: Project participants

Industry

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AIRBUS

MET Service Providers

METEO FRANCE

DWD

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

ANSPs

dgac DSNA

HRVATSKA KONTROLA ZRAČNE PLOVIDBE

austro CONTROL

Airlines

brussels airlines

AIRFRANCE

HOP!

AIR CORSICA
Les ailes de la Méditerranée

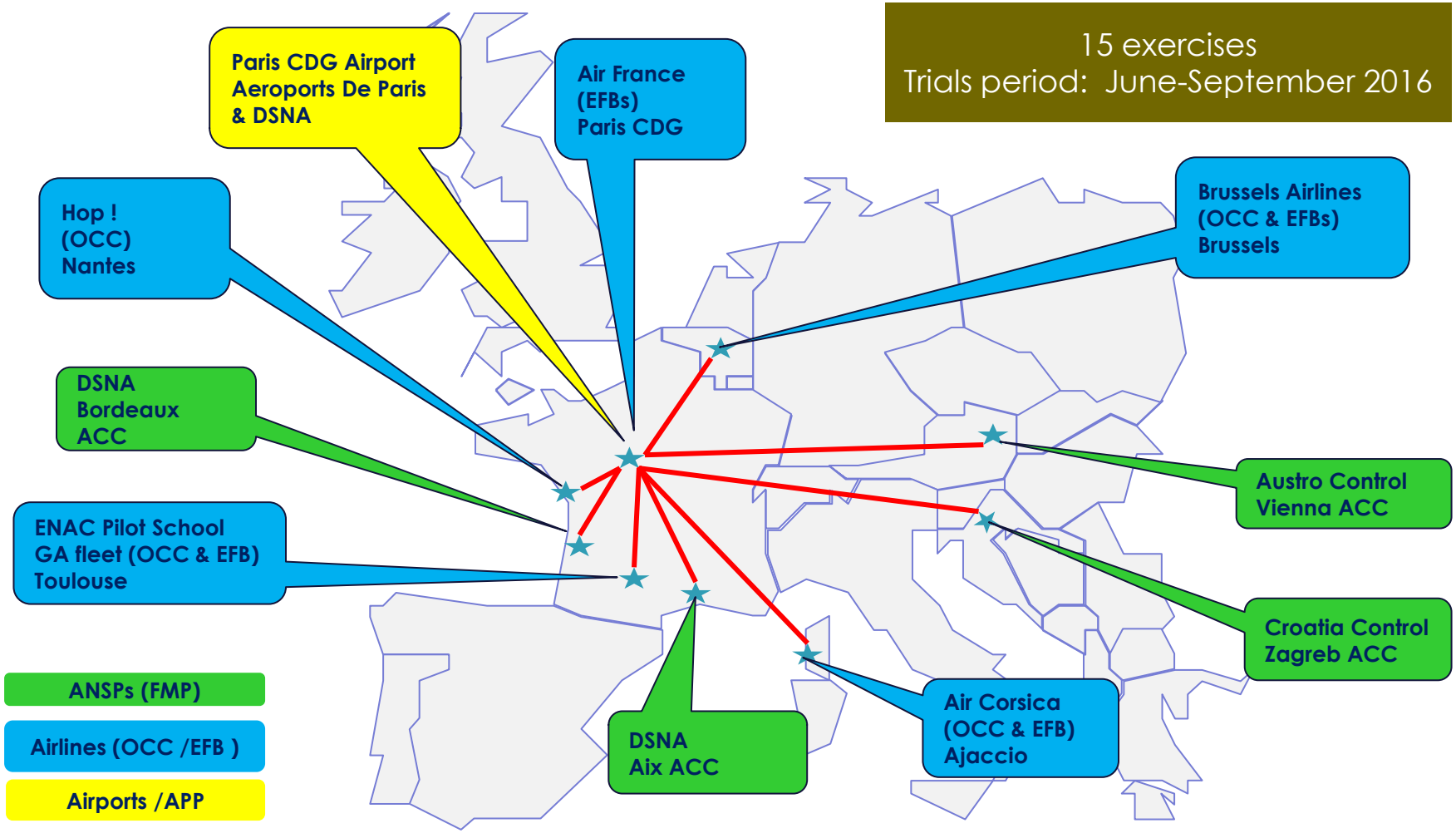
Airports

AÉROPORTS DE PARIS

GA Operator

ENAC
La référence aéronautique

TOPLINK : SESAR « Large Scale Demonstration » project



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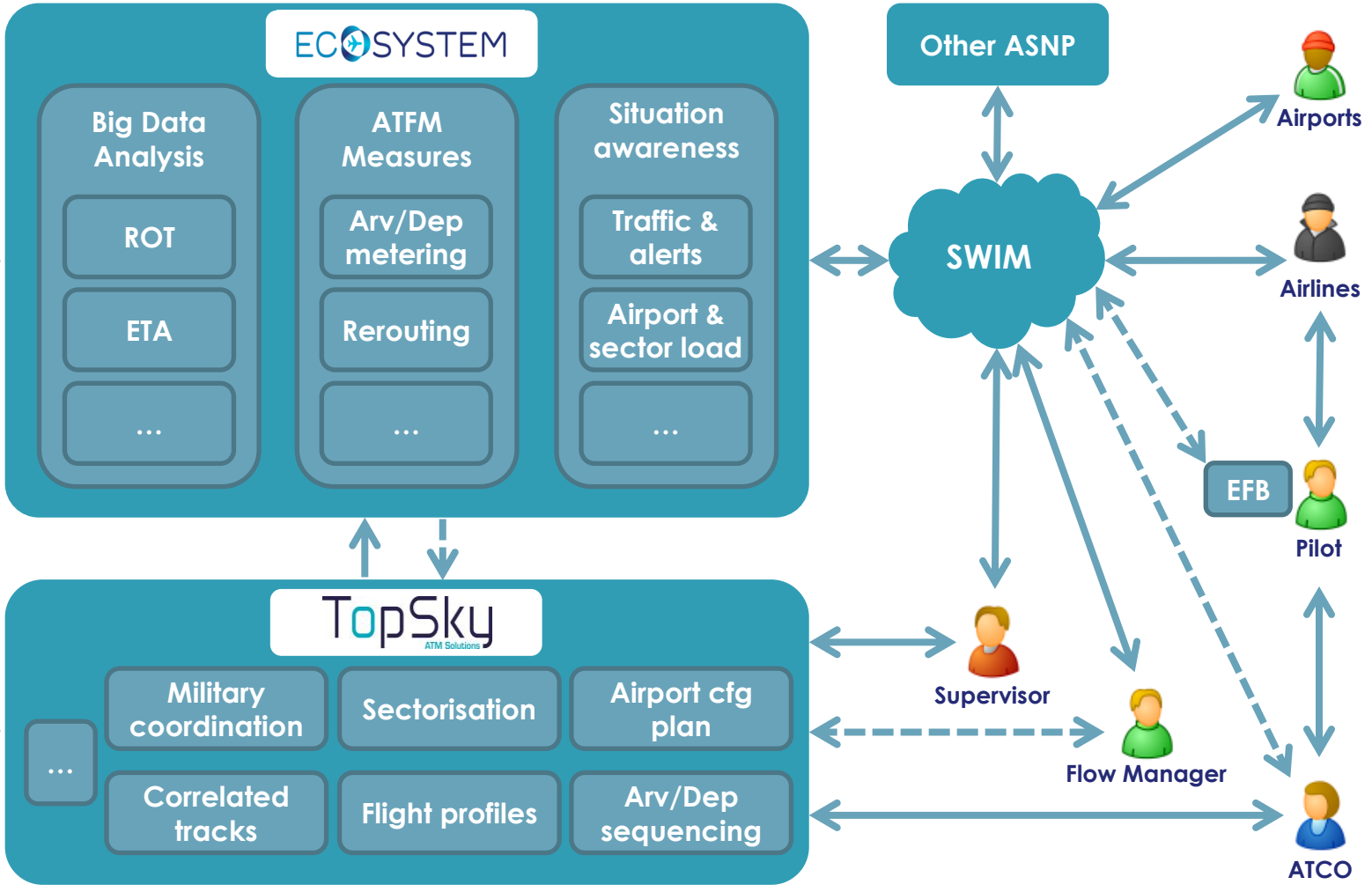
TopSky-ATC and ECOsystem supporting strategic through tactical ops

Global data sources:
- Surveillance
- Flight Plans
- Aero data
- WX/Meteo
- Flight Schedules
- Remote ATFM measures
- Remote airport status

Local data sources:
- Surveillance
- Flight Plans
- Aero data
- WX/Meteo
- System status



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a data-driven solution, providing

decision support for improved aviation operations

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