

## 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**

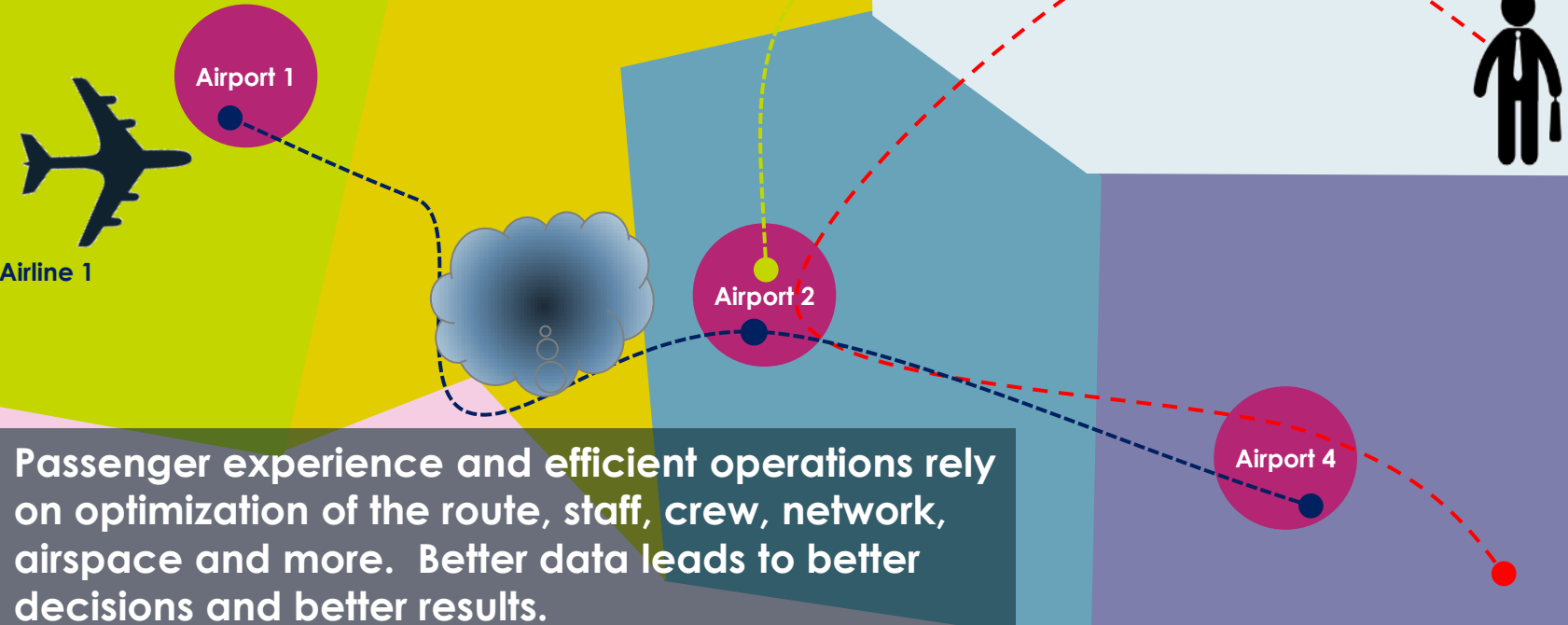
**Low incentive to share data – limited optimisation between stakeholders**

**\$9B+ inefficiency per annum**

**Small gains in aviation operations efficiency = large value / benefits**

# Digital collaboration is the key to optimizing aviation flight operations

Transporting a passenger from one city to another can involve many distinct entities – multiple aircraft operators, airport authorities, ANSPs, MET offices.



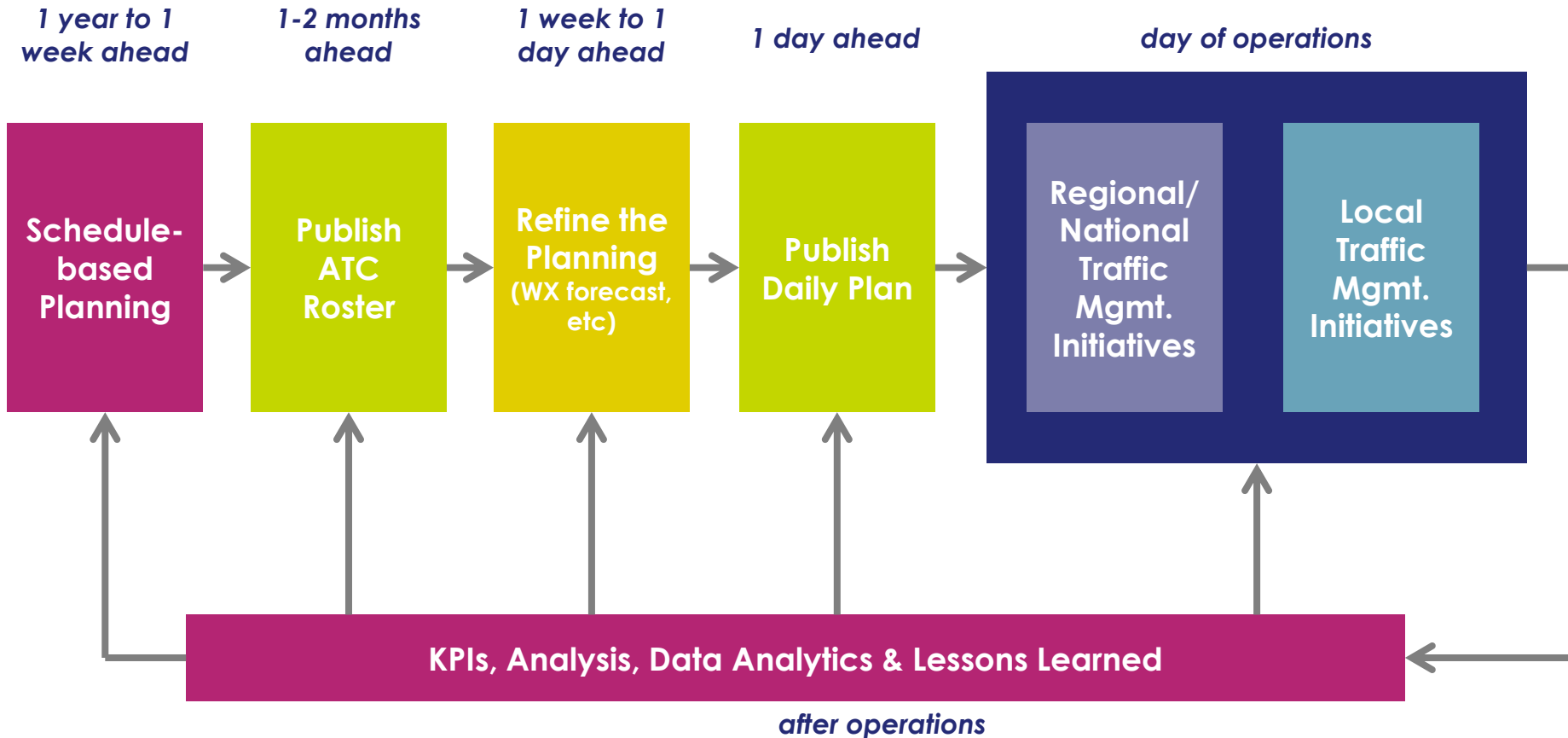
# THALES



## ATFM/CDM Key Concepts



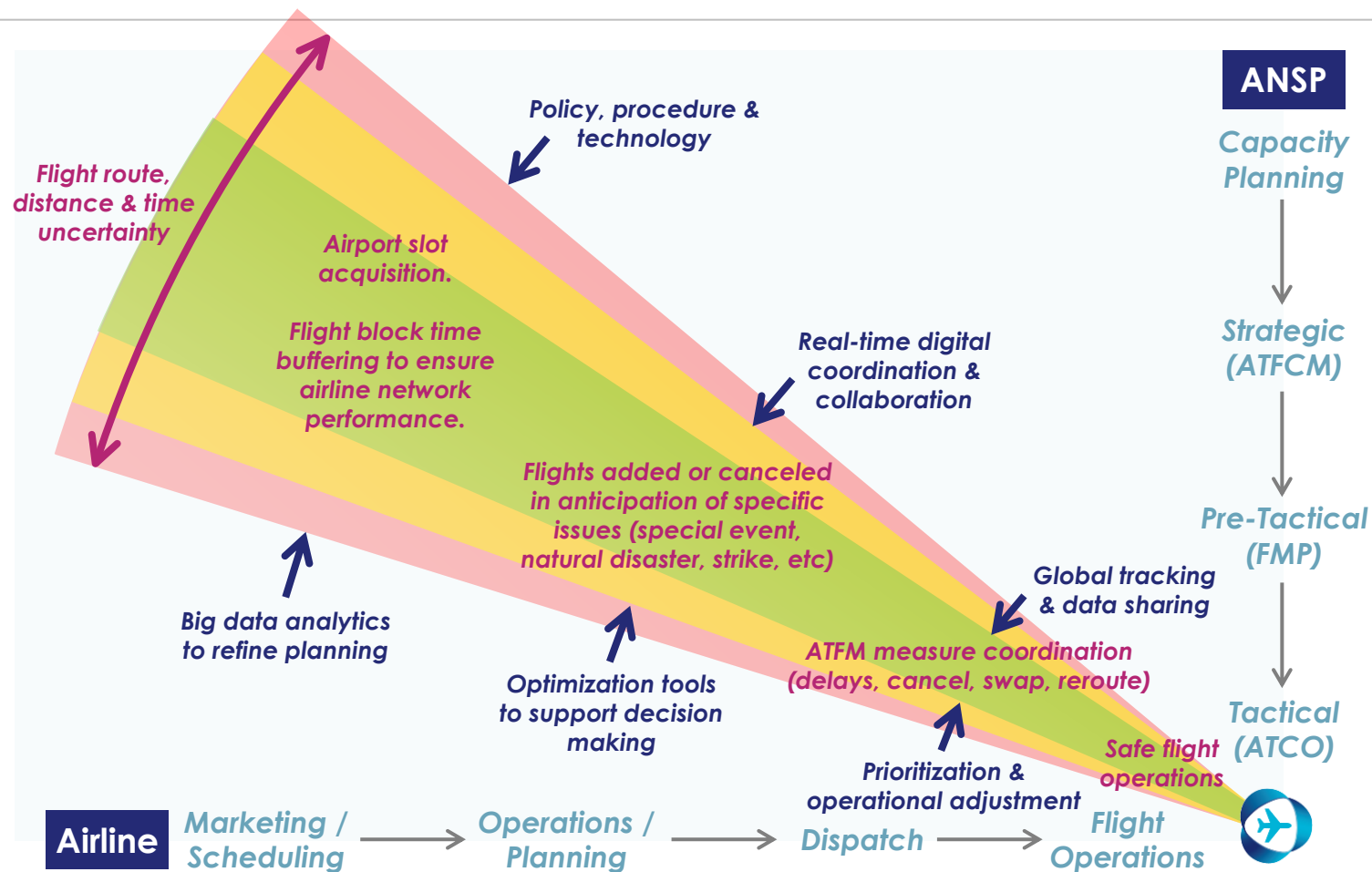
# Demand/Capacity Balancing Continuum (ATC perspective)



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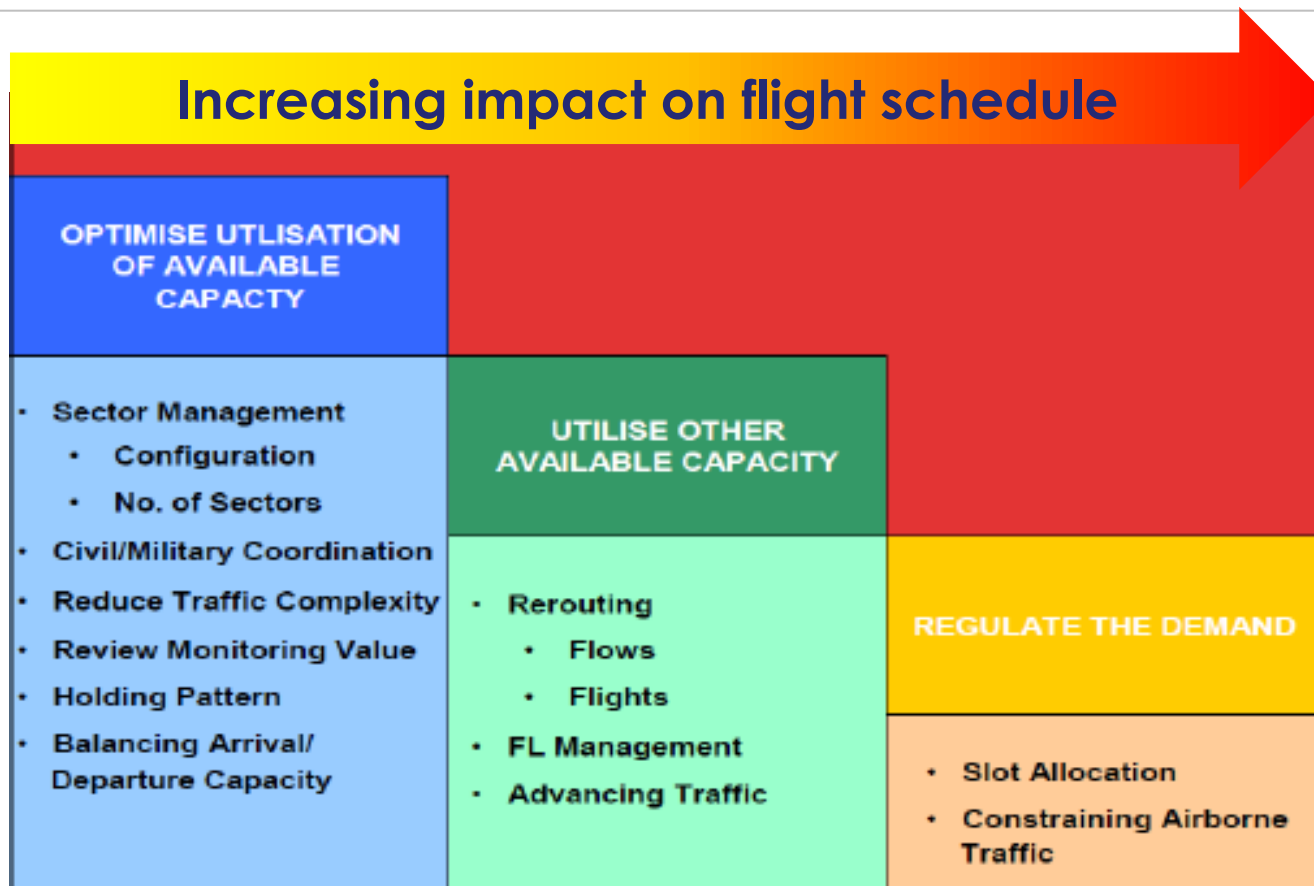
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# Operations improve through collaboration & data sharing



Reduction in uncertainty improves performance for all stakeholders

# ATFM is much more than Slot Management



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



# THALES



## Thales Solution for ATFM/CDM

[www.thalesgroup.com](http://www.thalesgroup.com)

OPEN





# The ECOsystem Cloud-Hosted Platform and Application Suite

## ECOsystem Solutions

### ATFM / CDM

ANSP, airline & airport application suite to facilitate ops management, improvement & collaboration

### UAS Traffic Management

Application suite to enable UAS ops and integration with ATC/security systems

### Aviation Performance

Application suite to measure ATCO and system performance and identify areas for improvement



### Aeronautical Data Mgmt

Applications suite to manage / utilize aeronautical data (AIM)

## ECOsystem Platform

Core system arch., components, data model, interfaces & design standards

## ECOsystem Cloud

Secure, global communication, processing and storage infrastructure

## ECOsystem Backbone

Secure, low-latency, high availability network for safety/mission-critical data

## Aero Data Gateway

Server for AMHS & SWIM

# 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

# 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

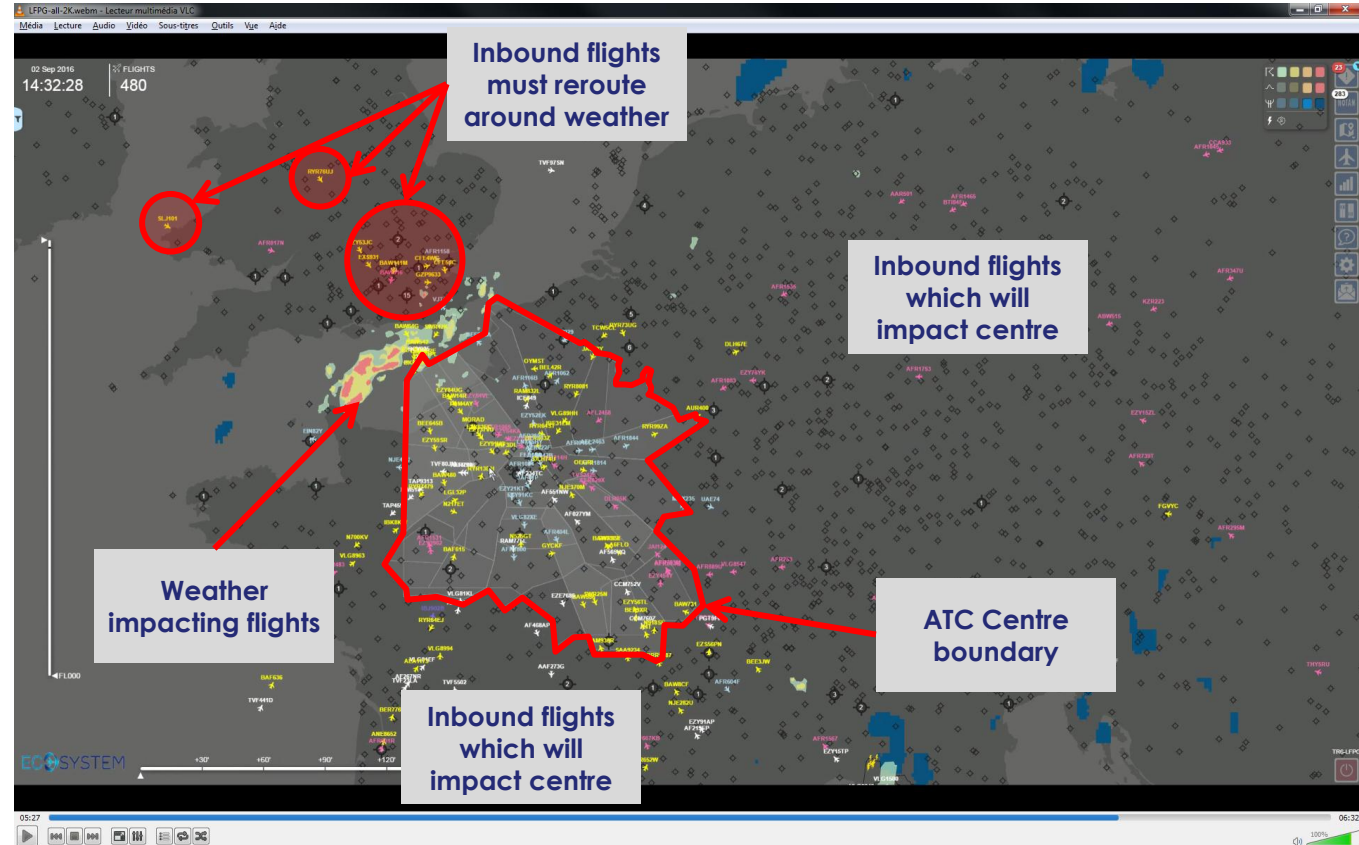
# ATC Forewarning Beyond “Local” Situation Enable Better Planning

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

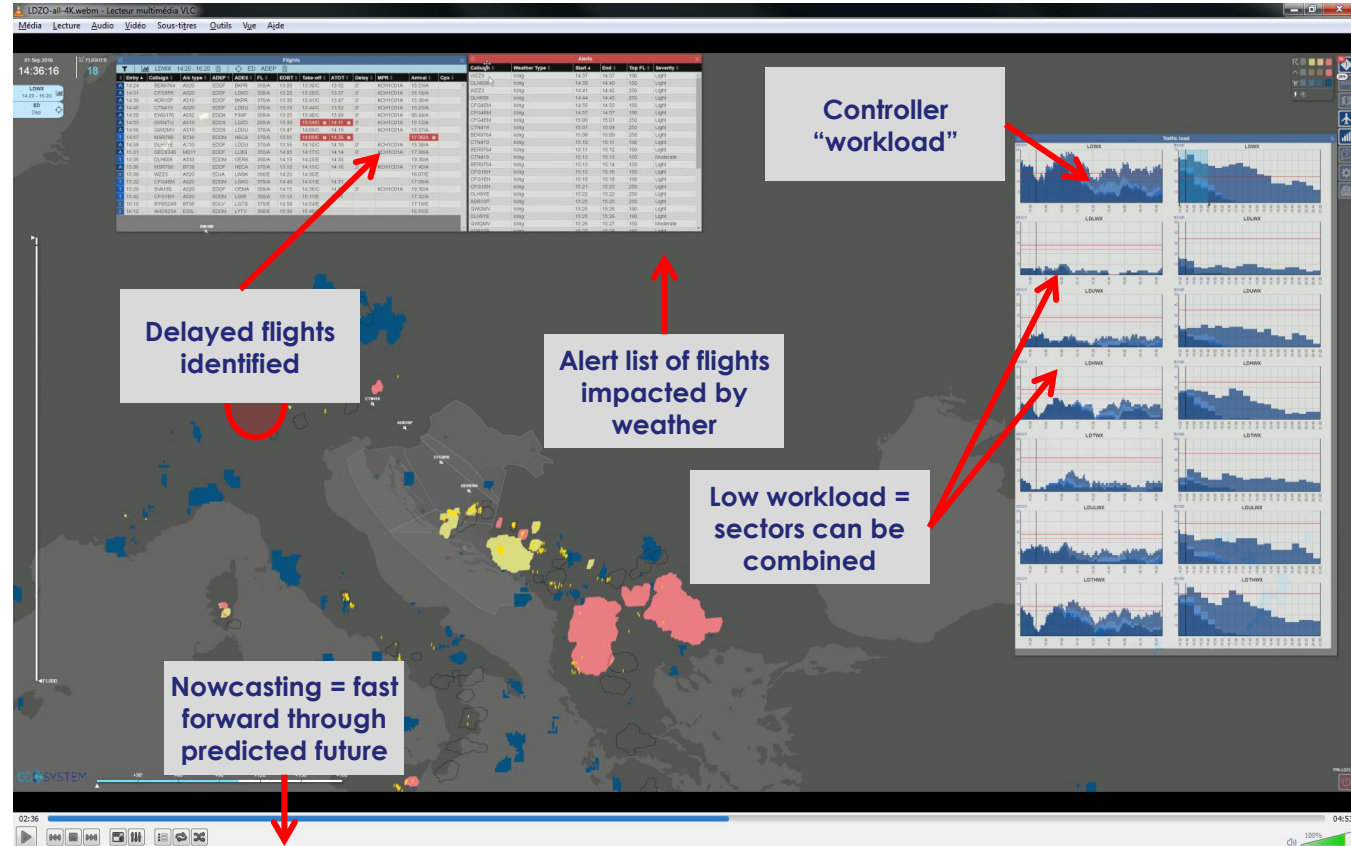
# Sector Planning & Flight Re-Routing Enables ATC service optimization

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

# Rerouting to avoid severe weather or capacity/complexity issue

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27 Oct 2016 16:38:00

FLIGHTS 9

LFBNH4 16:00 - 22:20

LEBL Dep

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	

1/ Activate Rerouting IHM (right click in the flight list or in the ASD)

2/ Draw the new route or defined area to avoided

ROUTE PROFIL 2D

WHAT-IF "Delay"

WHAT-IF "LEVEL CAP"

WHAT-IF "REROUTE"

OTHER FUNCTIONS

4/ Check New route features

- Route Length
- Fly time
- Off load sectors
- On load sectors
- New ETA

3/ Check Rerouting impact on sectors workload by identifying off load and on load sectors

TOPLINK connect > share > improve

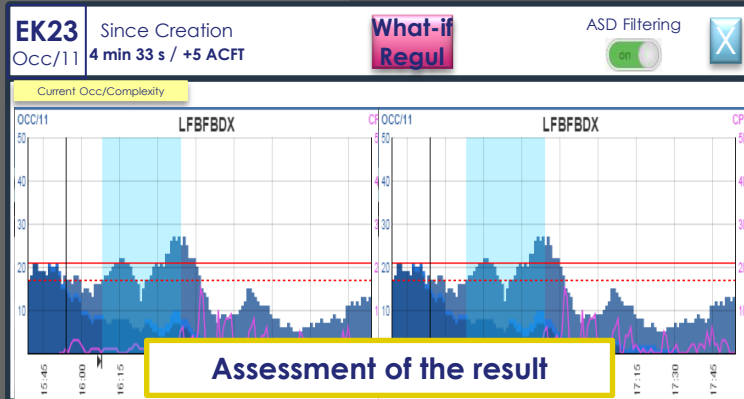
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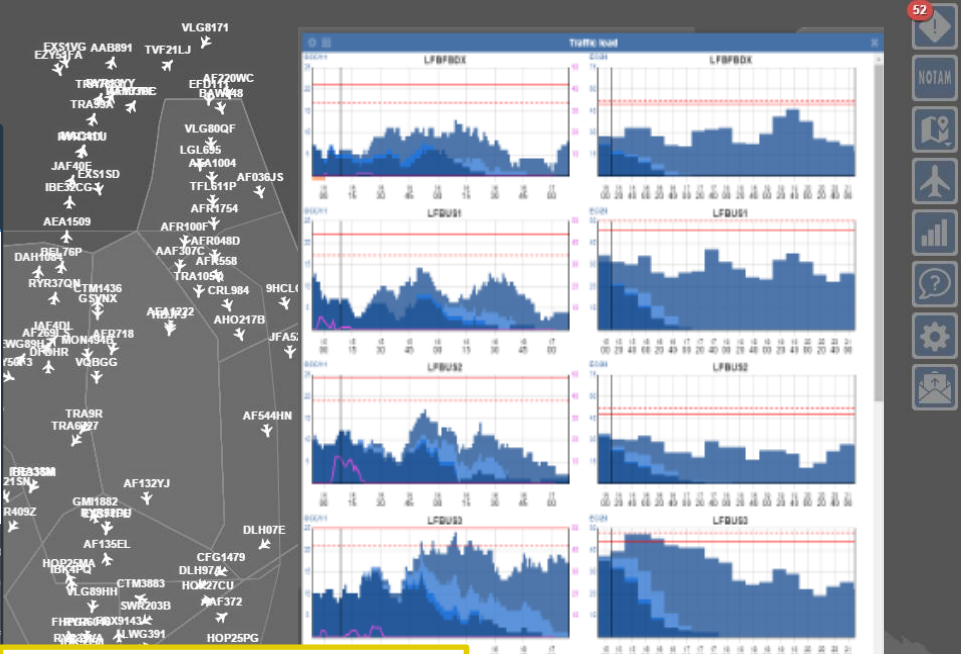


# Select Individual Flights to Delay/Adjust to Address Capacity Issues

27 Oct 2016  
15:44:37  
FLIGHTS  
168



Entry	Callsign	A/c type	ADEP	ADES	RFL	EOBT	Take-off	ATOT	Delay	MPR	Arrival	Cpx
A	14.50 RYR49JJ	B738	EDDK	LEVC	370/A	13:37	13:44/E	14:10			16:07/A	5
A	14.55 JAF38D	B738	EHEH	GMMW	370/A	14:00	14:14/C	14:21	4'	EHSCT327	16:47/A	21
A	14.55 TRA788J	B738	LEBL	EHEH	380/A	14:30	14:47/E	14:39			16:36/A	22
A	14.56 RYR13YY	B738	LEAL	EDDW	360/A	13:50	14:00/E	14:14			16:54/A	20
A	14.58 TRA99A	B737	LEAL	EHRD	400/A	14:15	14:25/E	14:16			16:38/A	3
A	14.59 N680SE	C680	EBAW	LEMD	390/A	14:00	14:05/E	14:30			16:17/A	1
A	14.59 PHMDG	C680	EHEH	LEGE	410/A	14:00	14:14/C	14:23	4'	EHSCT327	15:53/A	3
A	15.00 RYR34DJ	B738	LEVC	LFOB	380/A	14:15	14:25/E	14:26			16:15/A	17
A	15.01 RAM770C	B738	GMMN	LFPO	360/A	13:20	13:30/E	13:31			15:55/A	3
A	15.01 EDW298	A320	LSZH	LPFR	390/A	14:25	14:40/E	14:31			16:53/A	66
A	15.01 JAF40E	B737	LEPA	LFQO	400/A	14:30	14:35/E	14:28			16:21/A	91
A	15.02 CTM1436	C130	LFBP	LFQJ	180/A	14:20	14:25/E	14:54			16:08/A	1
A	15.02 TAR208	B736	DTTA	LFRS	400/A	13:20	13:30/E	13:31			15:55/A	3
A	15.02 TUI1EP	B738	EDDL	LEJR	370/A	13:55	14:11/E	14:12			16:07/A	5
A	15.03 MAC122	A320	EHAM	GMMW	350/A	14:15	14:25/E	14:26			16:15/A	17
A	15.04 VLG7842	A320	LEBL	EGLL	300/A	14:35	14:45/E	14:46			16:54/A	20
A	15.04 MAC111	A320	GMMN	EBBR	360/A	13:25	13:35/E	13:36			15:56/A	3
A	15.04 EYZ823E	A319	LFQO	LFBO	290/A	14:20	14:25/E	14:26			16:07/A	5
A	15.04 AF133PE	A321	LFBO	LFPO	300/A	14:50	15:00/E	15:01			16:54/A	20
A	15.07 EZS64EC	A319	LEMD	LFSS	380/A	14:30	14:40/E	14:41			16:38/A	3
A	15.07 LWG391	E50P	EBAW	LFBO	350/A	14:20	14:30/E	14:31			16:07/A	5



- ROUTE PROFIL 2D
- WHAT-IF "Delay"
- WHAT-IF "LEVEL CAP"
- WHAT-IF "REROUTE"
- OTHER FUNCTIONS



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## ATFM Benefits

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# SESAR TOPLINK Trials Performance Results

## Improved Ground Regulation

- **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

**20+**  
M€ p.a.

## Support to Flight Rerouting

- **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

**-70%**  
Delay

## 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

*“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*

# “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			
LOW (En Route)	18742	880	2623	126
LDZO (En Route)	12747	570	1936	91
LFBB (En Route)	45951	2159	11258	529
	Brussels Airlines			
Total EU (En Route)	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.

# TopLink "Flight Rerouting" Use Case 1: improved horizontal diversion



- Planned route
- Actual route
- - - Alternative route

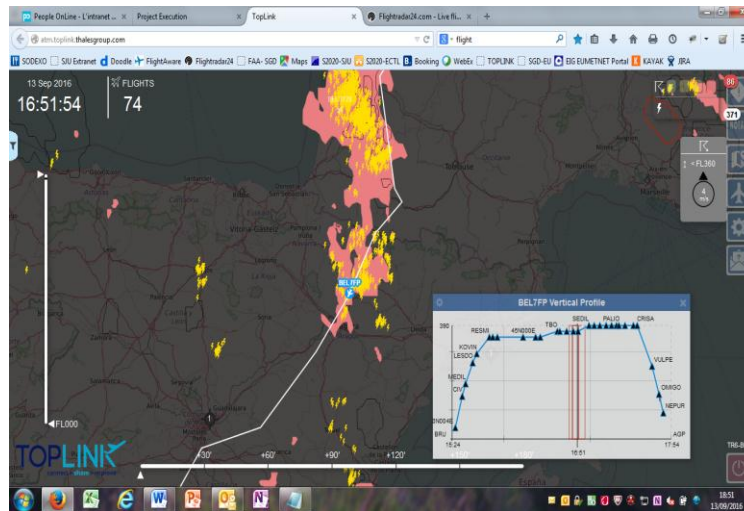
## Actual scenario:

« 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	
<b>Impact of weather</b>			
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 €



# TopLink “Flight Rerouting” Use Case 2: Avoid diversion

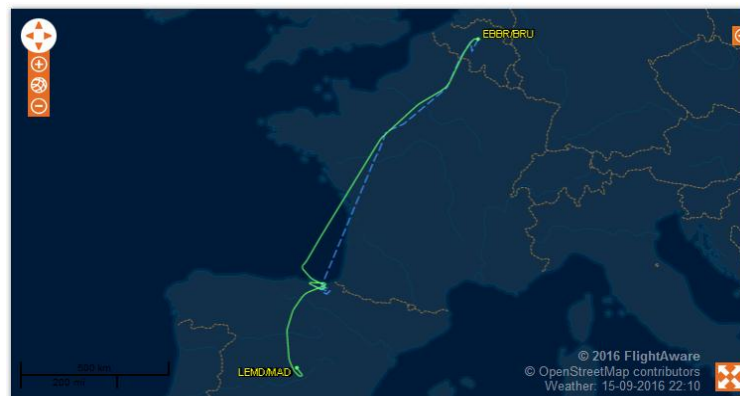
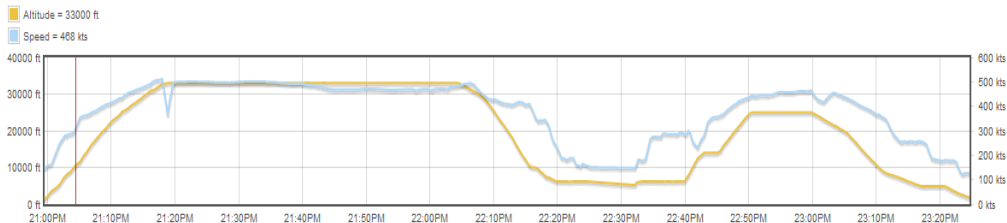
## Actual scenario:

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

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





# TOPLINK: Project participants

## Industry

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## MET Service Providers



## ANSPs



## Airlines



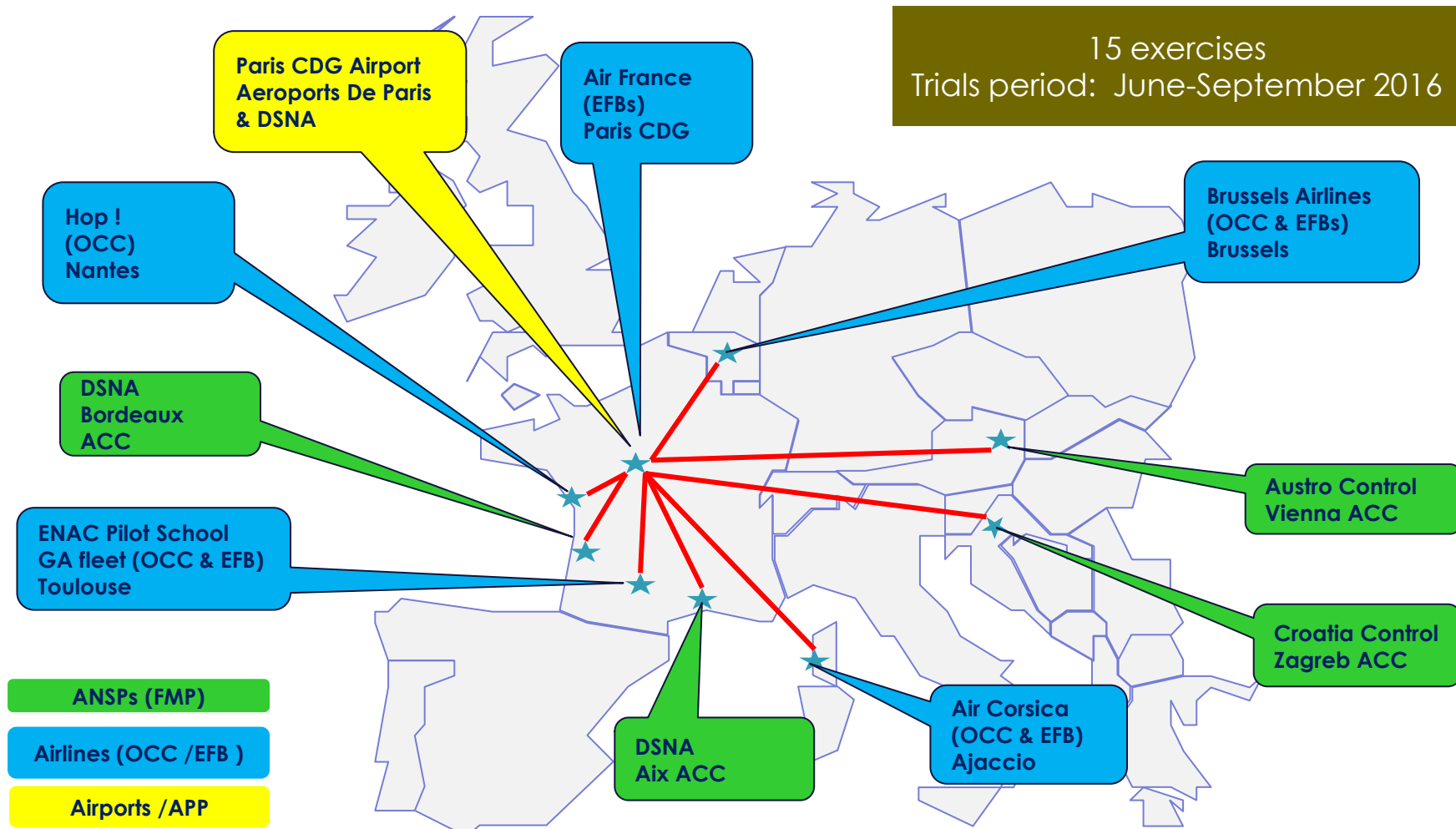
## Airports



## GA Operator



# TOPLINK : SESAR « Large Scale Demonstration » project



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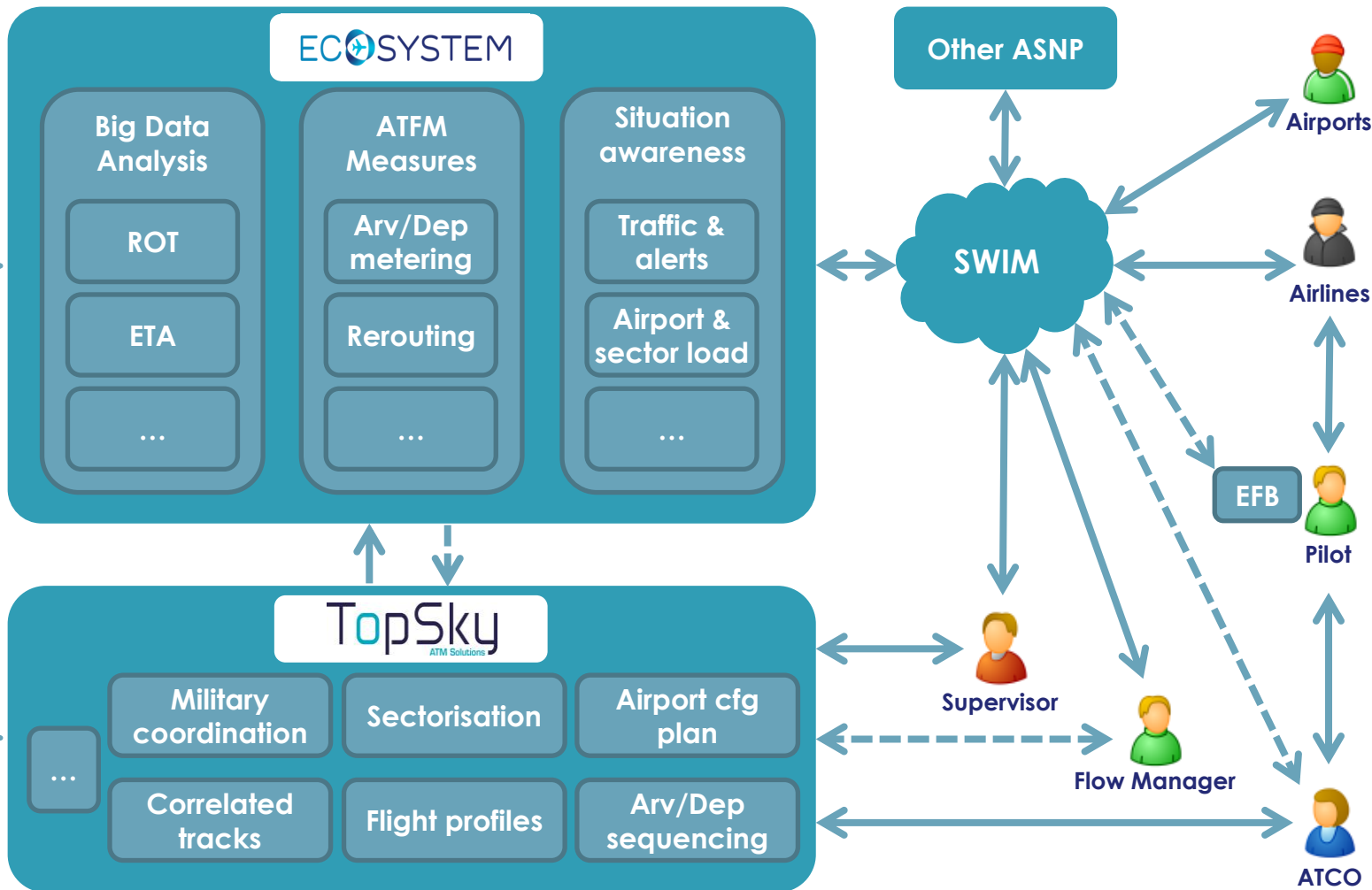
# TopSky-ATC and ECOSYSTEM supporting strategic through tactical ops

## 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





*a data-driven solution, providing*

**decision support for improved aviation operations**