MET-ATM integration in the SESAR program

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- Overview of the SESAR program
- SESAR1 MET information exchange solution
- One good example of integration of MET information in ATM systems : the Large Scale Demonstration Project TOPLINK
- MET-ATM integration in SESAR2020

Overview of the SESAR program

- ‘Single European Sky ATM Research’
- Set up in 2004
- To modernize and harmonize ATM systems through the definition, development and deployment of innovative technological and operational solutions
- With the aim of implementing the Single European Sky regulation package from a technological point of view

- European ATM system performance improvement targets :
  - *** Enabling handling 3 times traffic**
  - *** Improving safety by a factor of 10**
  - *** Reducing by 10 % the environmental impact per flight**
  - *** Cutting ATM costs by 50 %**

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Overview of the SESAR program

- 3 phases :
  - 2008-2016 ‘SESAR1’ research and development phase
  - 2014-202x SESAR Deployment phase aiming at implementing technological solutions validated in SESAR1
  - ~2016+ SESAR2020 2nd research and development phase

SESAR1 MET information exchange solution

Work Package 11.02 ‘Meteorological Information Services’ :

Definition and Developement of New enhanced MET Information or Services to be integrated in operational concept components and associated systems

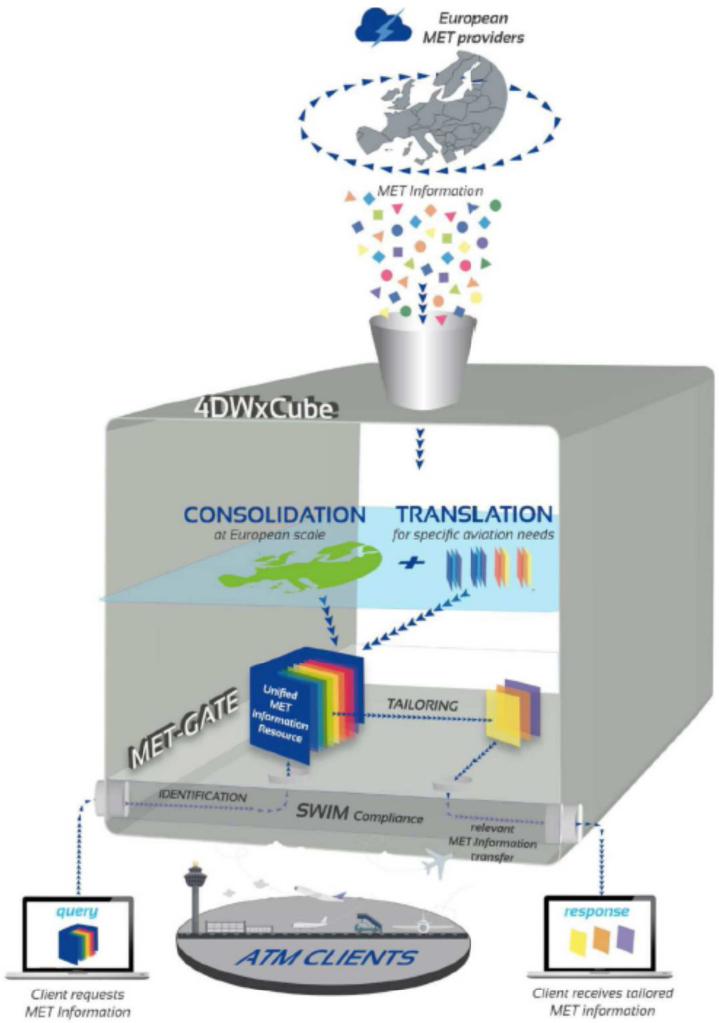
=> effective use of MET information

=> more automation

=> access to more accurate and higher-resolution MET information

→ Development of a platform called **4DWxCube** : a repository of shared, consistent and translated meteorological information, produced by multiple meteorological service providers (METSPs) and made available to stakeholders via its system-wide information management (SWIM) compliant exchange system.

SESAR1 MET information exchange solution



Consistent MET Information and Single Access Point to the Met Services :

MET Services are collections of MET products that shall be consistent in time and across the different Operational User Environments hence shall be **Consolidated** and **Translated in the 4DWxCube** before the **MET-GATE** constitutes the Services

http://www.sesarju.eu/sesar-solutions/enabling-aviation-infrastructure/met-information-exchange
https://www.sesarju.eu/newsroom/brochures-publications/sesar-solutions-catalogue

SESAR1 MET information exchange solution

ATM OUE Prototype			Associated MET Infrastructure Capability
Local	Sub-Regional	Network	
√	√	√	Radar composite of 3D convection
√	√	√	Nowcasting of convection
√	√	√	Super-ensemble mesoscale forecast of convection
√	√	√	Icing forecast
	√	√	Clear-air turbulence forecast
√		√	Winter weather conditions forecast at airports
		√	MET support to Network capacity reductions due to weather across Europe
	√	√	MET support to 4D Trajectory calculation
√	√	√	- Wind and temperature observations derived from Mode-S shared aircraft data
√	√	√	- AMDAR observation of humidity

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SESAR1 MET information exchange solution

Contribution to several validation exercices of other WPs

=> Allows assessing the maturity level of the 4DWxCube solution

Validation exercise	Name of EXE	Existing MET products (i.e. TAF, METAR, SIGWX etc.)	Enhanced 11.02 MET capabilities	Delivery via MET-GATE
VP513	De-icing Step 1 - V3	No	X1.6 Winter Weather	No
VP700	Advanced Short Term ATFCM including Network Supervision and interface with Local Tools	No	X1. 4 Icing Forecast X1.5 CAT Forecast	Yes
VP669	Close out Airport Integration through SWIM	No	Ensemble MET forecast X2.1 Mode-S New Sensors	No
VP757	APOC Performance Monitoring and Management	METAR, TAF	-	No
VP791	Use of Global ensemble wind forecasts (GEWF) within the flight planning process	Yes	Ensemble MET forecast, xGEWF	Yes
VP811	Assess the operational need and principles of cockpit integration for AIS/MET cockpit functions	No	X1.1 3D convection X1.2 Nowcast Convection X1.4 Icing Forecast X1.5 CAT Forecast	Yes (early prototype)

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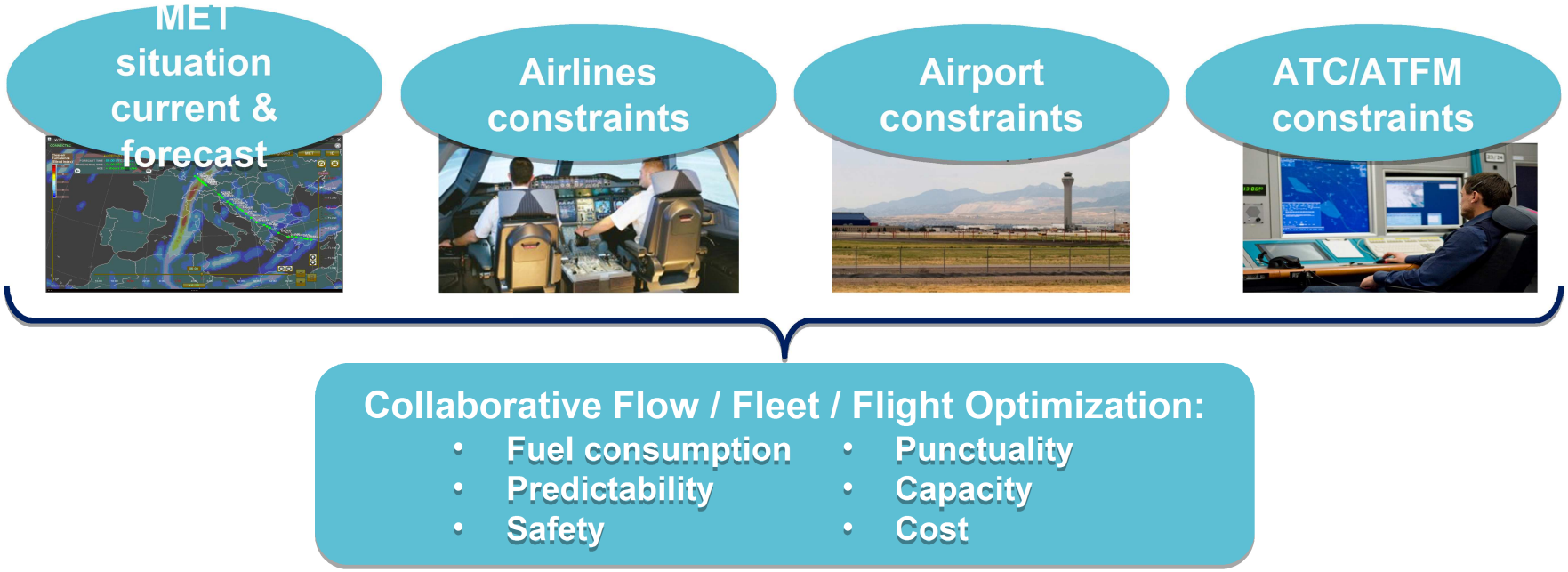
Large Scale Demonstration Project TOPLINK

Source THALES

Aim:

- Benefits for ATM stakeholders of the deployment of MET and AIM Services
- Improvements of operational performance

TOPMET /TOPLINK: the concept



Improving global efficiency & safety through collaborative System Wide Information Management

Large Scale Demonstration Project TOPLINK

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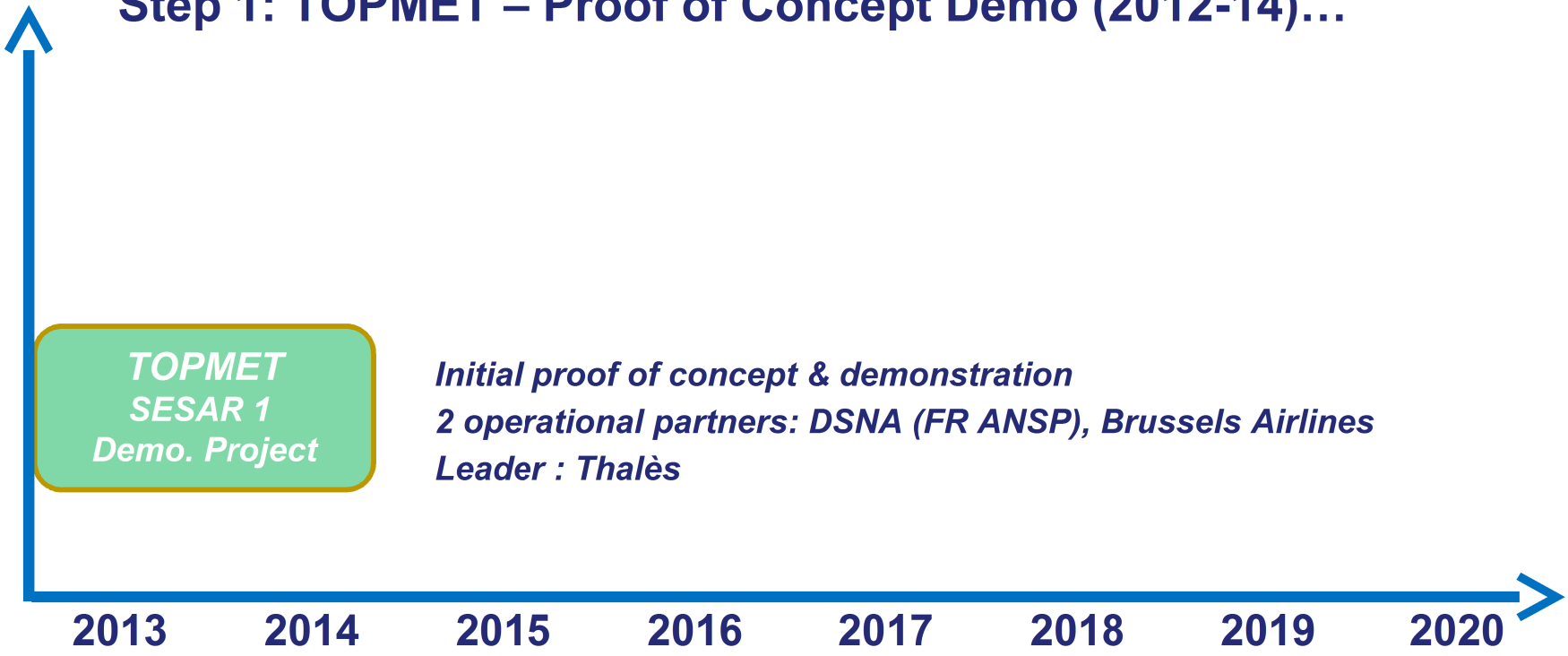
Step 1: TOPMET – Proof of Concept Demo (2012-14)…



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Source THALES

TOPMET (2014): Quantitative Results reported by participants

KPA	KPI	Scenario	Expected Benefit	TOPMET Results
EFFICIENCY (FUEL)	Extra fuel consumption due to MET	Airline rerouting	Reduce by 20%	26% reduction (4 flights)
		Airline diversion	Reduce by 20%	79% reduction (1 flight)
EFFICIENCY (COST)	Extra flight cost due to MET	Airline rerouting	Reduce by 10%	19% reduction (4 flights)
		Airline diversion	Reduce by 10%	73% reduction (1 flight)
		ANSP improved TFM	Reduce by 10%	18 % reduction (848 flights)
PREDICTABILITY	Extra flight delay due to MET	Airline rerouting	Reduce by 20%	33% reduction (4 flights)
		ANSP improved TFM	Reduce by 20%	18 % reduction (848 flights)

Promising quantitative results from limited operational trials resulted in a follow-on Large Scale Demonstration – TOPLINK

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Large Scale Demonstration Project TOPLINK

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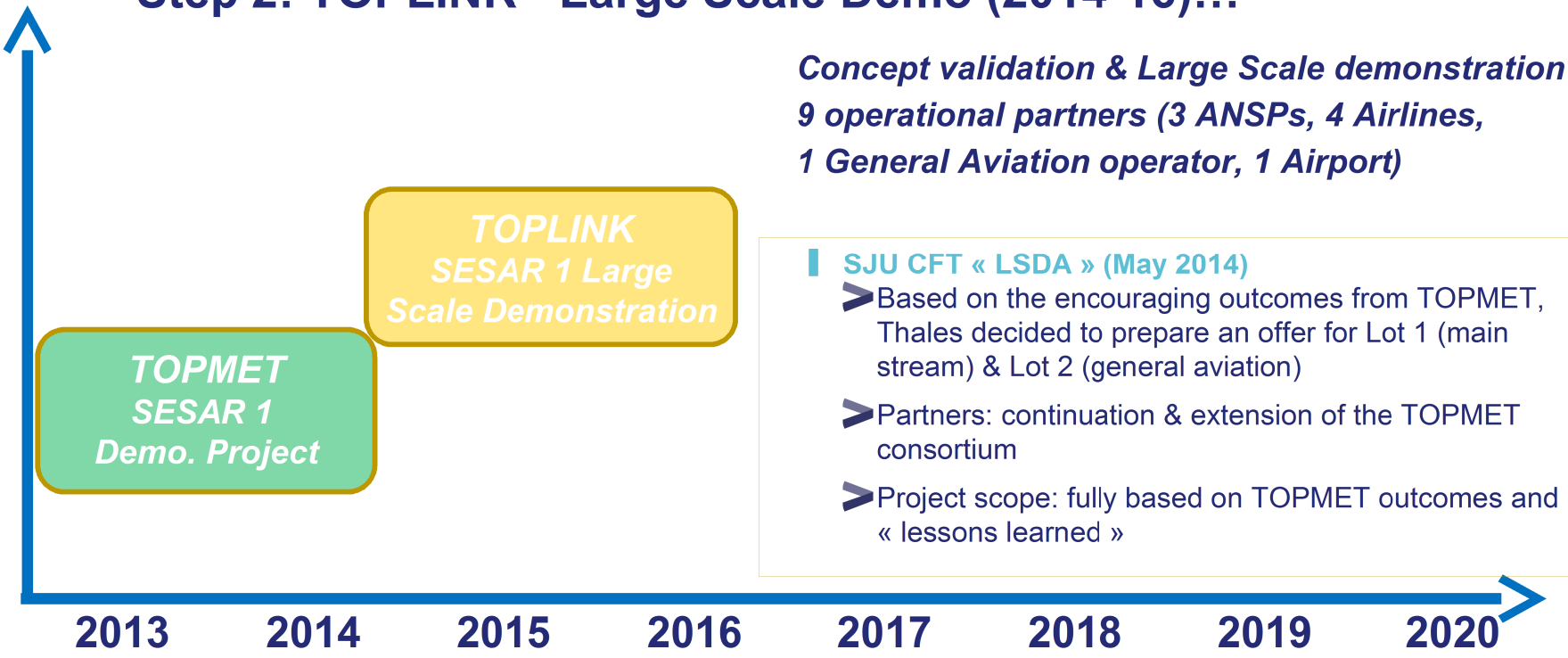
Step 2: TOPLINK - Large Scale Demo (2014-16)…

Concept validation & Large Scale demonstration
9 operational partners (3 ANSPs, 4 Airlines,
1 General Aviation operator, 1 Airport)



SJU CFT « LSDA » (May 2014)

- Based on the encouraging outcomes from TOPMET, Thales decided to prepare an offer for Lot 1 (main stream) & Lot 2 (general aviation)
- Partners: continuation & extension of the TOPMET consortium
- Project scope: fully based on TOPMET outcomes and « lessons learned »

TOPLINK
connect > share > improve

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Large Scale Demonstration Project TOPLINK

Source THALES

TOPLINK: Project Overview

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Project main purpose :

- The TOPLINK Lot 1 and Lot 2 projects aim at demonstrating the benefits for ATM stakeholders (ANSPs, Airlines, General Aviation, Airport operators) of the deployment of new **System Wide Information Services**, including Meteorological Services, Aeronautical Information Services, cooperative Network services, and Flight Information services (for their non-safety-critical aspects).

Project objectives :

- The TOPLINK Lot 1 & Lot 2 project have demonstrated, based on an end-to-end supporting infrastructure, how Air Traffic Flow Management Controllers, Airport operators, and Airspace Users staff (ground Flight Dispatchers, as well as Pilots, from Commercial Airlines and General Aviation) could improve their operational performance (especially in terms of safety, efficiency, and capacity) by the use of those new Information Services.

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Large Scale Demonstration Project TOPLINK

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TOPLINK: Project participants

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Industry

THALES

AIRBUS

MET Service Providers

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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

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Large Scale Demonstration Project TOPLINK

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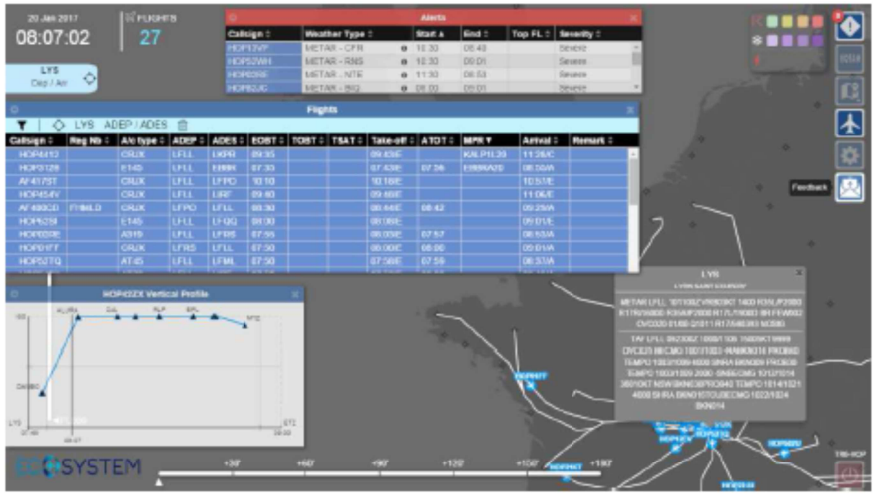
TOPLINK: « Airline OCC » position



- **Shared awareness**
  - Common situational picture (weather, traffic, airspace,…)
- **Assessment & alerts**
  - Assessment of MET impacts on user's operations, through customized KPIs and metrics
  - Customized alerts
- **Mitigation**
  - "What-if" scenarios (horizontal rerouting, FL change, …)
  - Collaborative Decision Support

Large Scale Demonstration Project TOPLINK

Source THALES

TOPLINK: « ATFM » position

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- **Shared awareness**
  - Common situational picture (weather, traffic, airspace,…)
- **Assessment & alerts**
  - Assessment of impacts on user's operations, through customized KPIs and metrics
  - Customized alerts
- **Mitigation**
  - "What-if" scenarios (regulations, …)
  - Collaborative Decision Support

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Large Scale Demonstration Project TOPLINK

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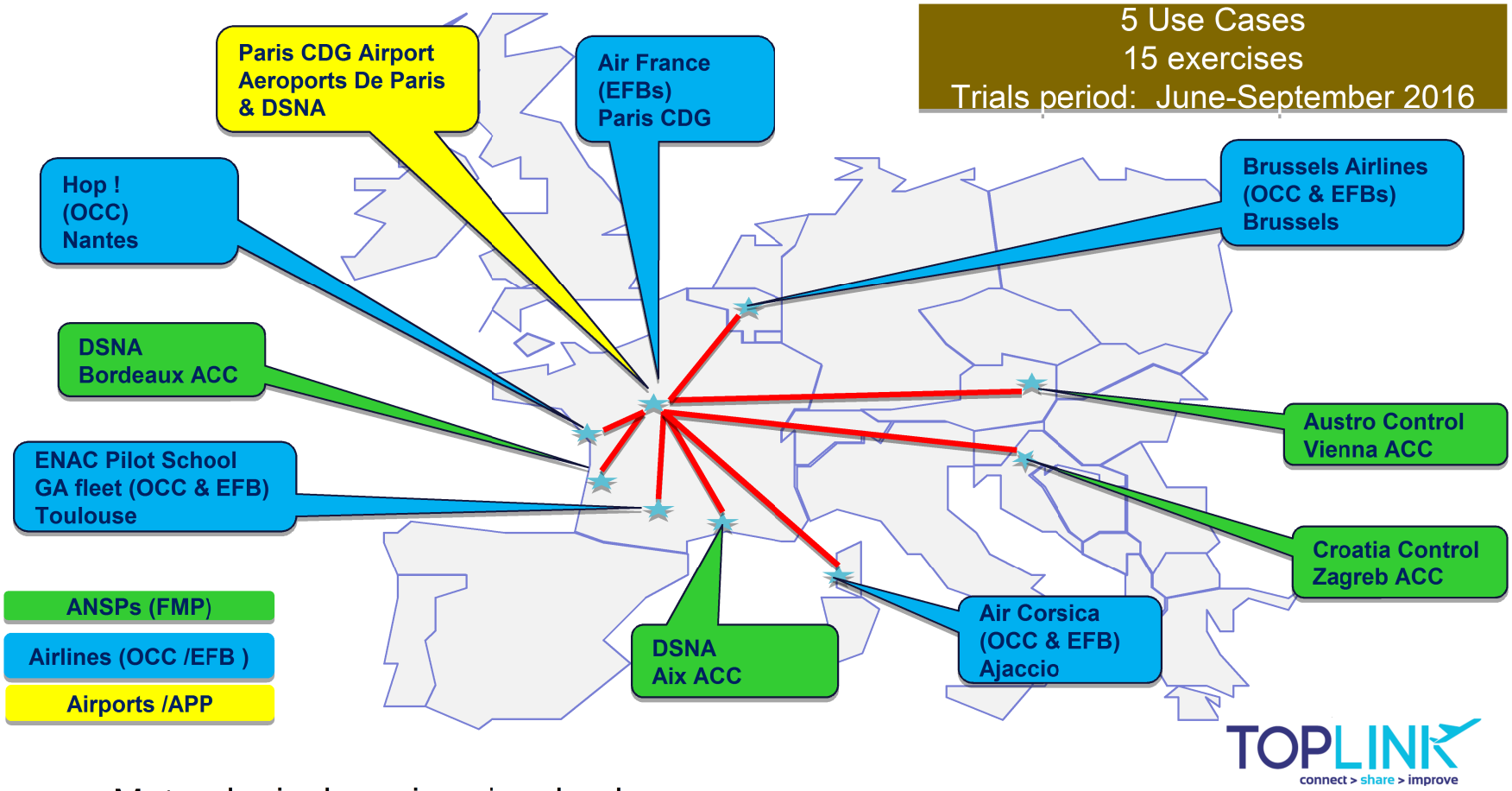

Meteorlogical services involved were :
METAR, TAF, SIGMET services
MET Hazard EnRoute services (convection, icing, turbulence)
Airport MET Services (local data, winter conditions)

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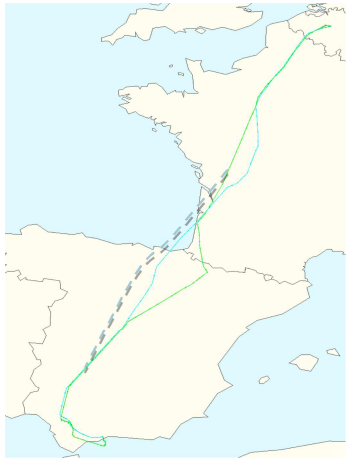
Large Scale Demonstration Project TOPLINK

Source THALES

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



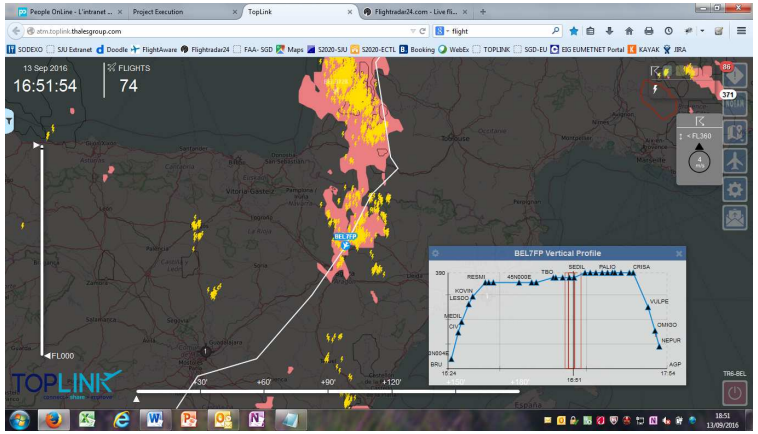
Planned route

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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Large Scale Demonstration Project TOPLINK

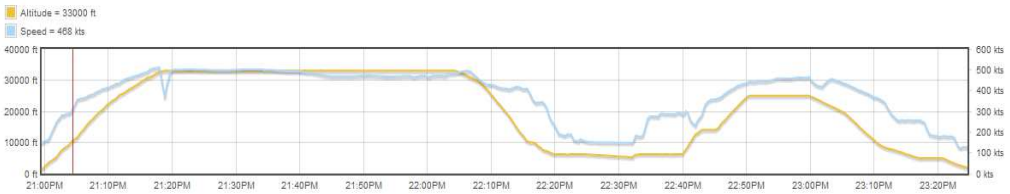
Source THALES

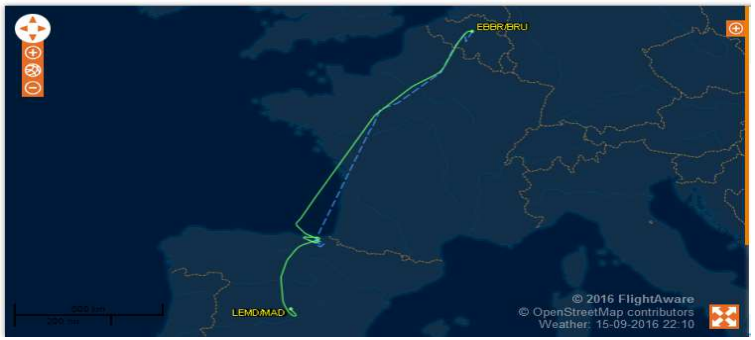
TopLink “Flight Rerouting” Use Case 2: Avoid diversion

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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Source THALES

TopLink “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

(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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Source THALES

TOPLINK performance results: overview

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Improved Ground Regulation

- **Small gains on many flights**
- **Better forecast of MET hazards enable a better « tailoring » 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.

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

- **Large gains on few flights**
- **Better forecast of weather impact on flights, 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

Up to -70% Delay*

*[*reduction through ECOsystem of the delay induced by weather effect on the initial FPL]*

"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 Airlines

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Source THALES

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Conclusions :

- TOPLINK project has demonstrated, based on an end-to-end supporting infrastructure, how Air Traffic Flow Management controllers, airport operators, commercial airlines staff (ground flight dispatchers, as well as pilots), and General Aviation (ground fleet managers, as well as pilots) could improve their operational performance, especially in terms of safety, efficiency and capacity by the use of those Information Services.

- Benefits of tight interaction between ground personnel and flight crews in pre-tactical, pro-active decision-making were also demonstrated.

- Finally the project clearly demonstrated the high added value of combining weather information (MET), aeronautical information (AIM) and flight information to support strategic & pre-tactical decisions.

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MET-ATM integration in SESAR2020

SESAR2020 is the next phase of SESAR from 2016 to 2021+

1. Exploratory research
2. Industrial research & validation
3. Very large scale demonstrations

A new programme membership was established:

Founding partners:
European Union
EUROCONTROL

Existing partners:
Airbus, DFS, DSNA, Enaire, ENAV, Finmeccanica, Frequentis, Honeywell, Indra, NATMIG, NATS, SEAC and two divisions of Thales

New Partners:
COOPANS (Naviair, Croatia Control, Irish Aviation Authority (IAA), Luftfartsverket (LFV) and Austro Control)
AT-One (DLR & NLR)
B4 (ATC's of Poland, Lithuania, the Czech Republic and Slovakia).
Dassault Aviation SA.
Skyguide

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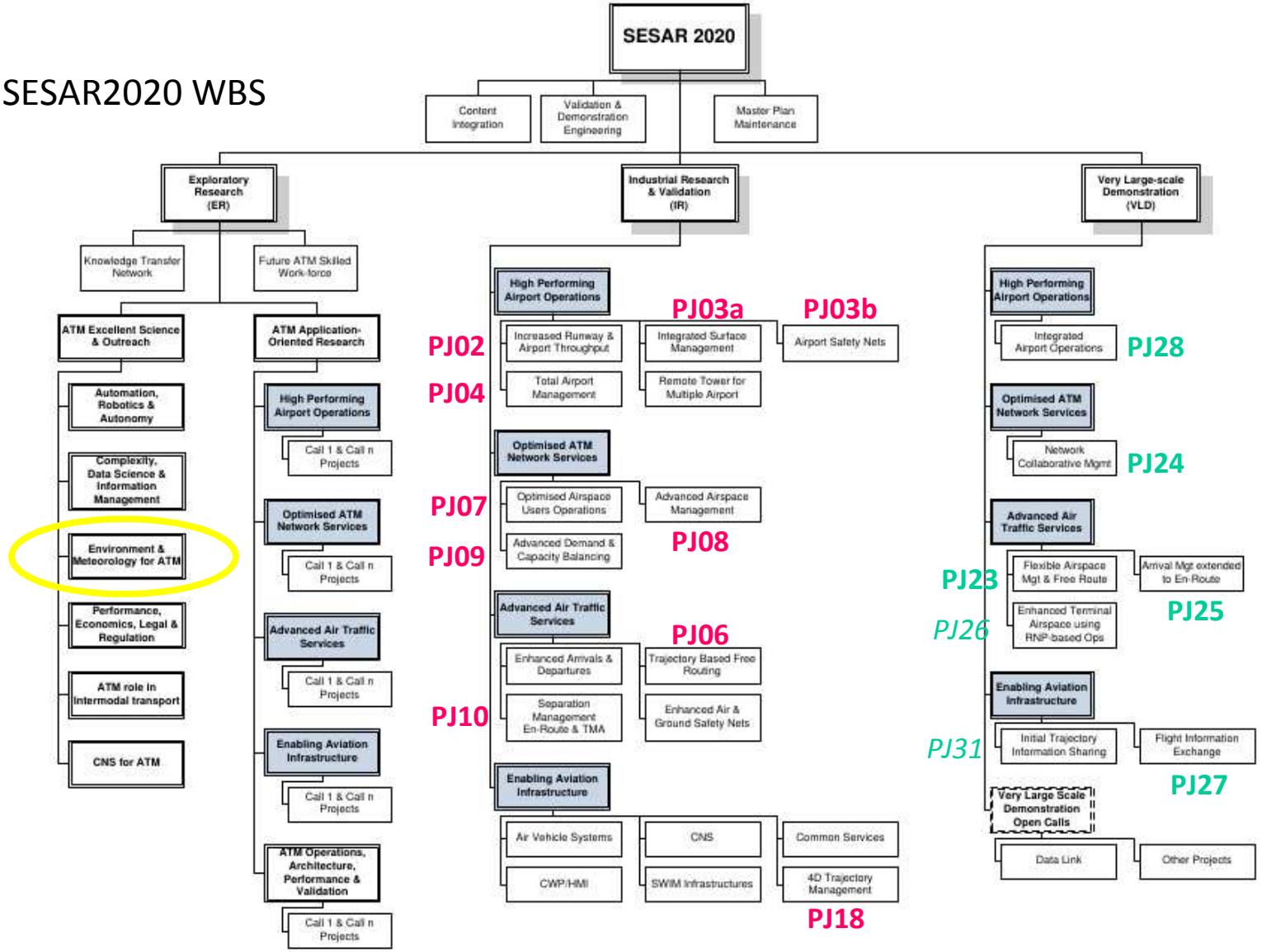
MET-ATM integration in SESAR2020

SESAR2020 WBS



MET-ATM integration in SESAR2020

(IR&V) WP18.04 : for the MET information/services/prototypes development

Various NMS's have 'linked 3rd party' arrangements with their local ANSP or with the industry for 'advisory' roles in individual projects/solutions.

Through this partnership, the MET community would attempt to ensure that meteorology is taken into account at an early stage of the projects for the design of the prototypes/solutions that use MET information, for the definition of MET requirements and in the validation exercises, for a better integration of MET information into ATM decision-support or aid systems.

Examples :

- PJ08.02 Advanced Airspace Management : use of probabilistic forecast of convection, integration into airspace management system
- PJ04.02 Total Airport Management : use of probabilistic forecast of crosswind or tailwind over operational thresholds, integration into airport management system
- PJ09.02 Advanced Demand and Capacity Balancing : use of nowcasting and forecast of convection, integration into ATC system

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MET-ATM integration in SESAR program

Further information on the WMO AeM website :
http://www.wmo.int/aemp/implementation_areas

Thank you !

Merci !