SESAR P12.2.2 progress & CDG campaign presentation

WakeNet EU 13/05/2014
Ph. Juge

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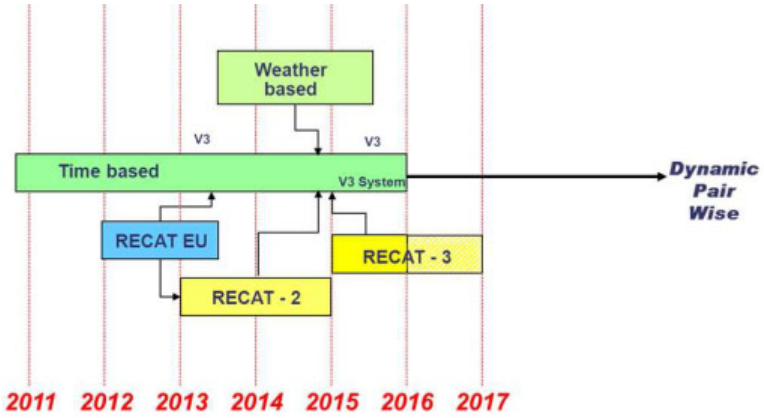
SESAR P12.02.02 Validation

- **Development and Validation in close cooperation with P06.08.01 (operational project)**
- **Validation in platform**
  - System performances assessment
  - Validation on specific scenario
  - Human factors
- **2 validation exercises planned**
  - Time Based Separation + RECAT-EU+ initial RECAT2: Oct 2014
  - Weather Dependant Separation + RECAT2 : Oct 2015
- **Large scale on field validation**
  - Need to get enough data to build a statistic assessment
  - Preparation of SPR
  - Preparation of CBA
- **One year trials campaign in CDG: mid 2014 – mid 2015**



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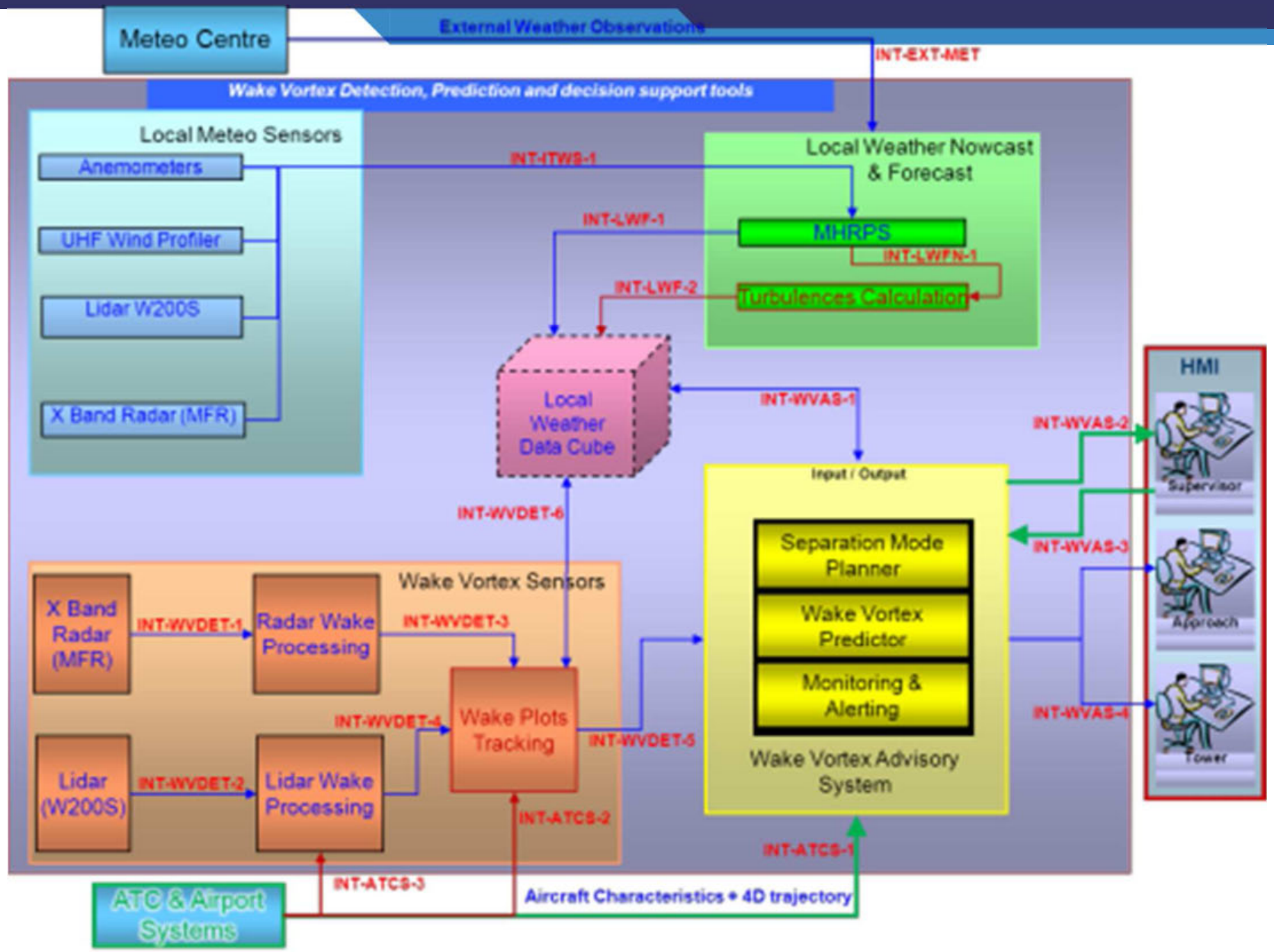
Wake Vortex Decision Support System (WVDSS) Architecture



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Validation Exercises Configuration

Simulated sensor alerts

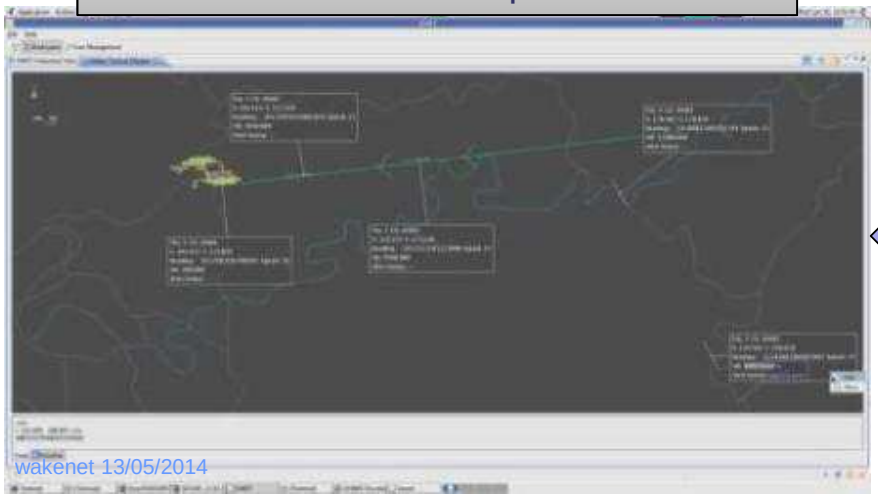
Weather scenario (Wind, EDR)

Traffic scenario

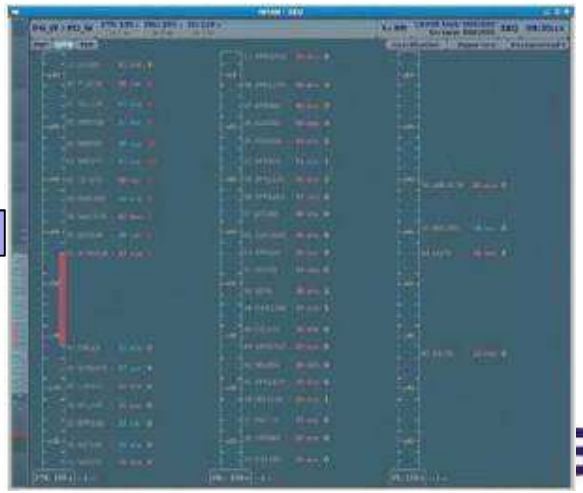
WV separation (RECAT)

WVDSS
Wake-Vortex Separation

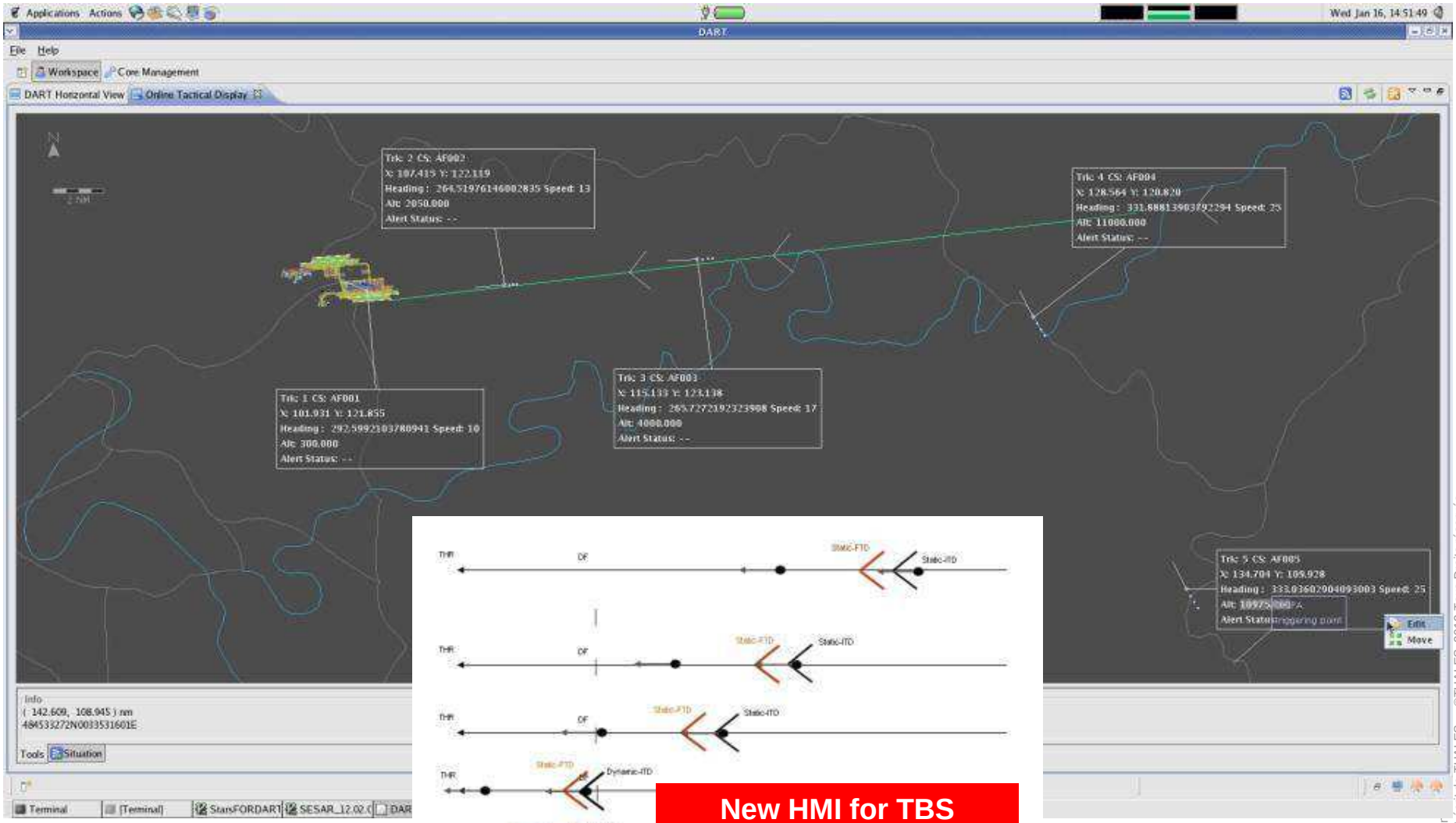
AMAN (MAESTRO)



Sequence



WVDSS with ORD concept



New HMI for TBS (Time Base Separation) ORD concept

< FTD, Targeted Separation

< ITD, Current Separation

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Enhance the scope

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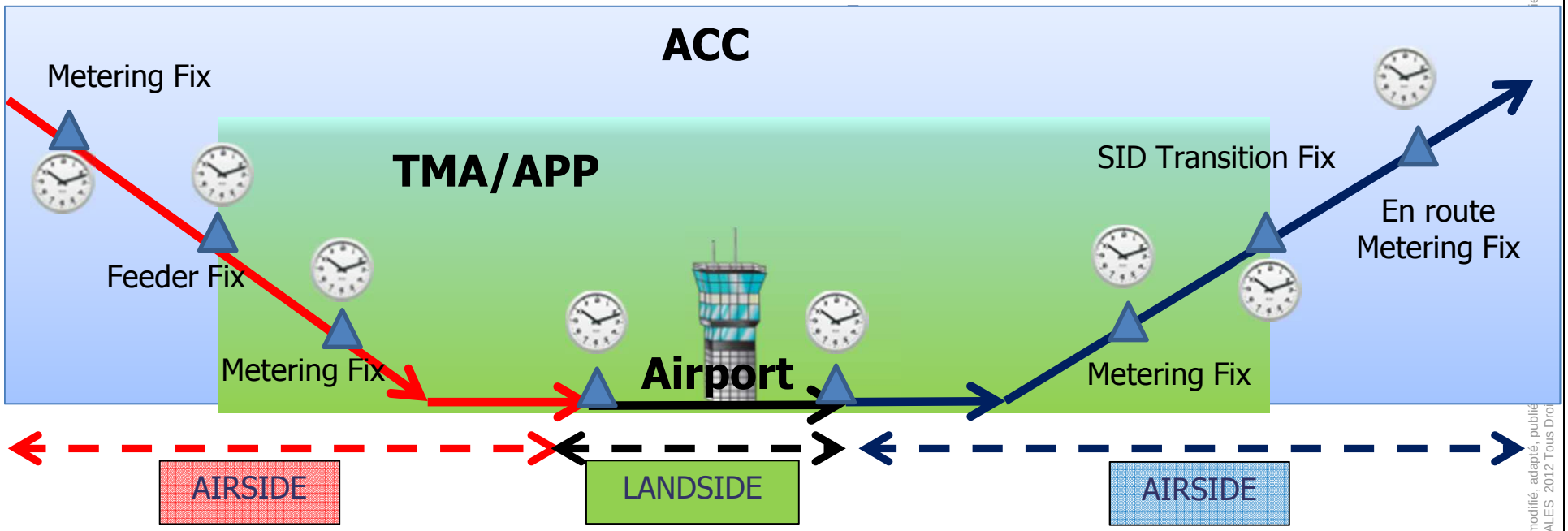
The global picture: Wake-Vortex & Runway Throughput

Solution to optimize traffic flow and capacity with same level of safety with automations



WVAMAN

Arrival Scheduling: Optimal RECAT Sequencing coupled with P-Merge Procedure

WVDSS

Arrival Separation: RECAT 1/2/3 Wake-Vortex Separation in the glide

WVSafetyNet

Alerts & Go-Around: Wake-Vortex Monitoring (alt. < 100 m) and Wind/EDR Monitoring (alt. < 500 m)

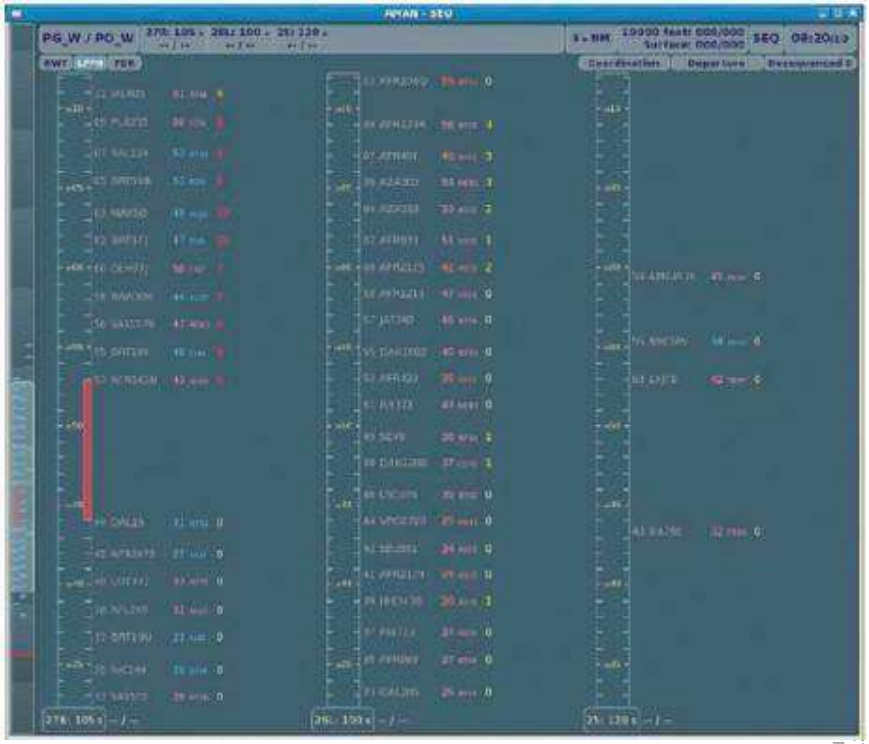
WVDMAN

Departure Scheduling Optimal Take off RECAT Sequencing at the runway coupled with Weather-Dependent Procedures

WVAMAN: AMAN with Optimal Sequencing Algorithm

AMAN with Wake-Vortex contraints

- AMAN should take into account Wake-Vortex separations constraints (RECAT 1 / 2 & 3) to optimize Airport throughput
- THALES is developing advanced algorithm to optimize sequencing for airport capacity improvment
- This algorithm could be tested for different airport traffic mix and runways layout



AMAN & Optimal Sequencing

- Non coordinated A380 Arrivals could grealty trouble Airport Capacity
  - *Bad Sequence :* A380 – (7 NM) - A320 – (3 NM) - A380 – (7 NM) - A320 = 17 NM
  - *Good Sequence :* A380 – (3 NM) - A380 – (7 NM) - A320 – (3 NM) - A320 = 13 NM

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AMAN Optimization Algorithm Illustration

Initial arrival sequence

Callsign	WTC	Class	STA	Sep. min	ETA min	ETA max	Delay
UPM100	M	D	10:10:00		10:09:00	10:16:00	1'00
LIG001	L	F	10:12:00	120	10:10:00	10:15:00	2'00
SUH002	A380	A	10:13:30	60	10:11:00	10:18:00	2'30
LIG003	L	F	10:16:42	192	10:12:00	10:20:00	4'42
UPH004	H	B	10:18:12	60	10:13:00	10:20:00	5'12
LIG005	L	F	10:21:00	168	10:15:00	10:22:00	6'00
LOM006	M	E	10:22:30	60	10:20:00	10:28:00	2'30
		Length	12'30			TOTAL	20'24

Optimized arrival sequence

Callsign	WTC	Class	STA	Sep. min	ETA min	ETA max	Delay
UPM100	M	D	10:10:00		10:09:00	10:16:00	1'00
LIG001	L	F	10:12:00	120	10:10:00	10:15:00	2'00
LIG003	L	F	10:13:30	72	10:12:00	10:20:00	1'30
LIG005	L	F	10:15:00	72	10:15:00	10:22:00	0'00
SUH002	A380	A	10:16:30	60	10:11:00	10:18:00	5'30
UPH004	H	B	10:18:06	96	10:13:00	10:20:00	5'06
LOM006	M	E	10:20:06	120	10:20:00	10:28:00	0'06
		Length	10'06			TOTAL	14'06

Shorten the sequence without increasing the overall delay

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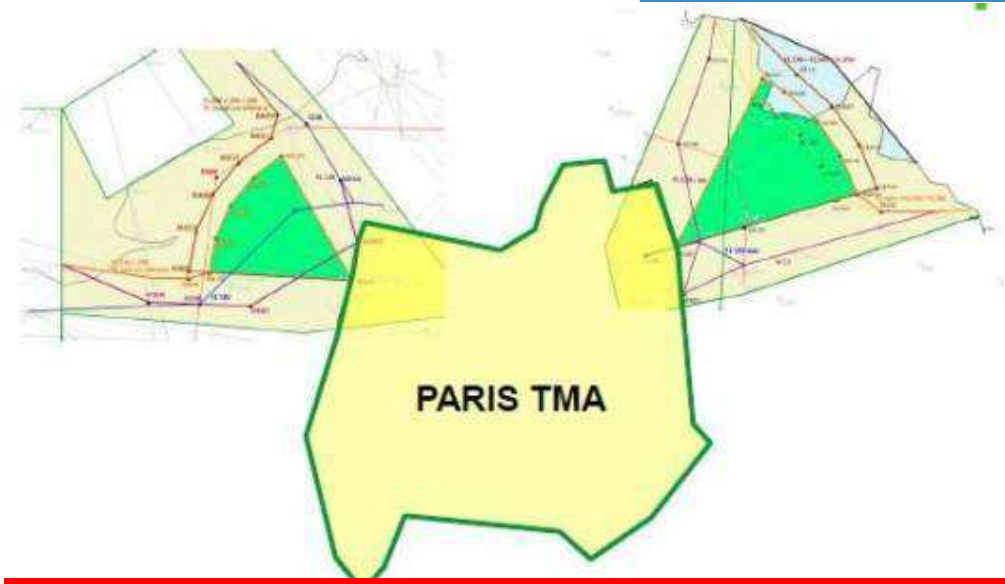
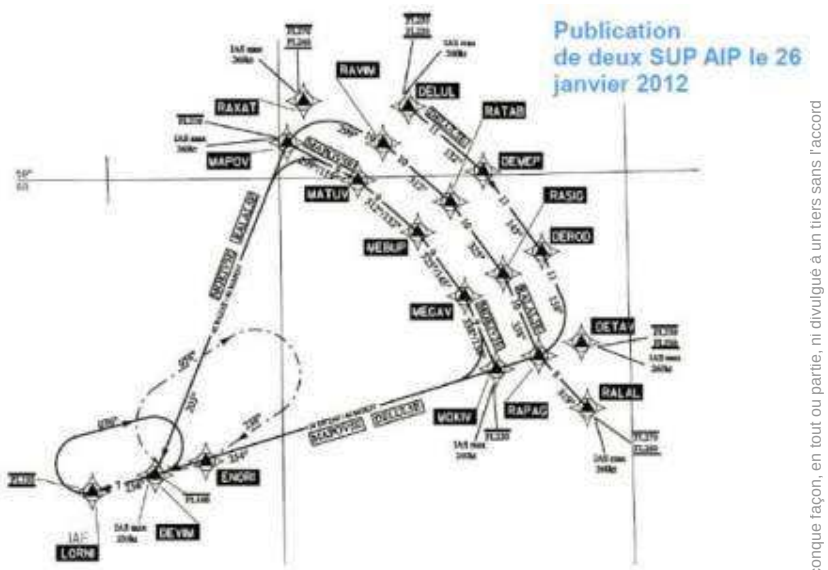
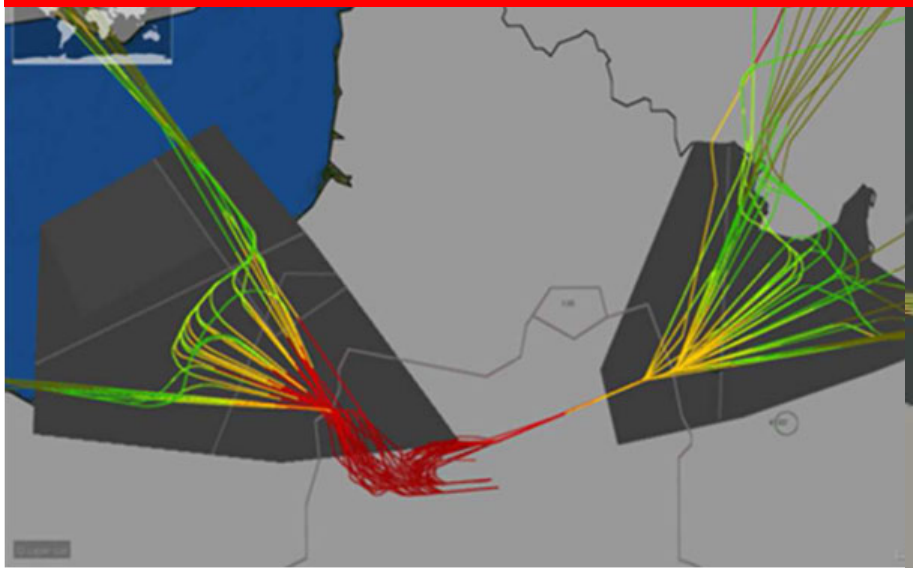
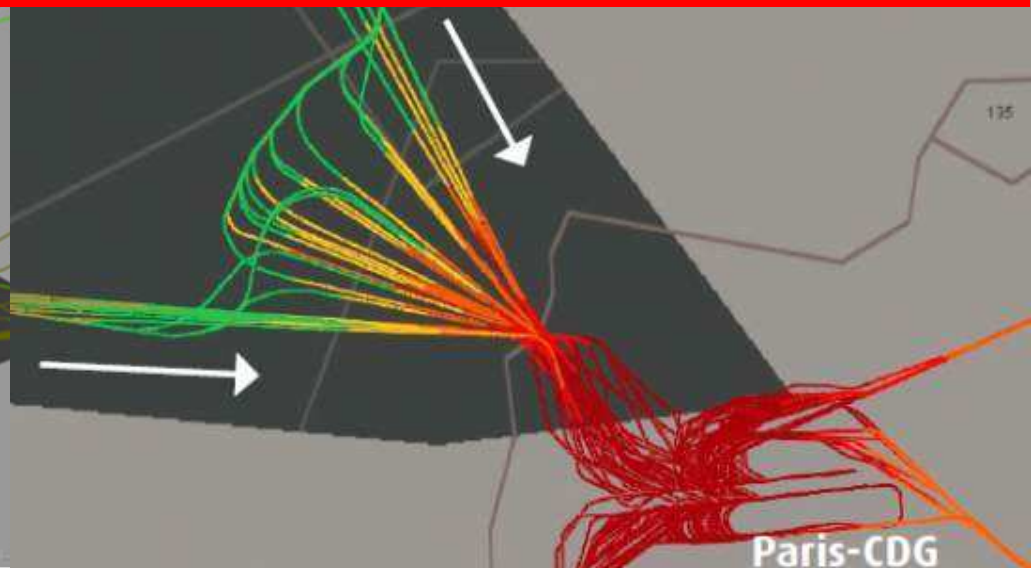
e.g.: “Point Merge Procedure” deployment at Paris CDG





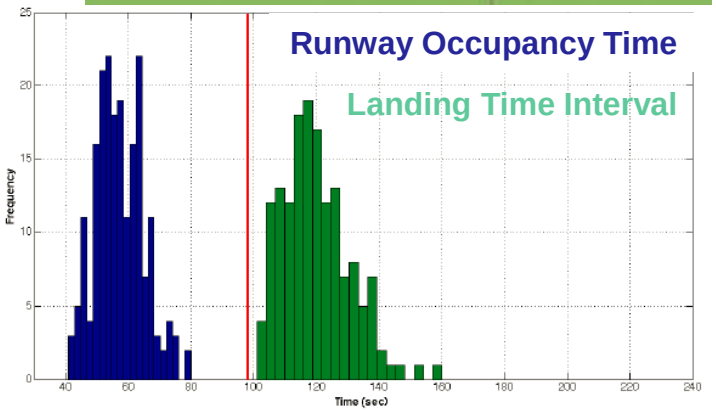
Paris ACC has implemented a high altitude approach procedure which is more efficient for handling North-West flights of the Paris region to Paris-Charles de Gaulle airport.
This is a first in the Core Area which deals with the most dense and complex traffic at the heart of Europe.

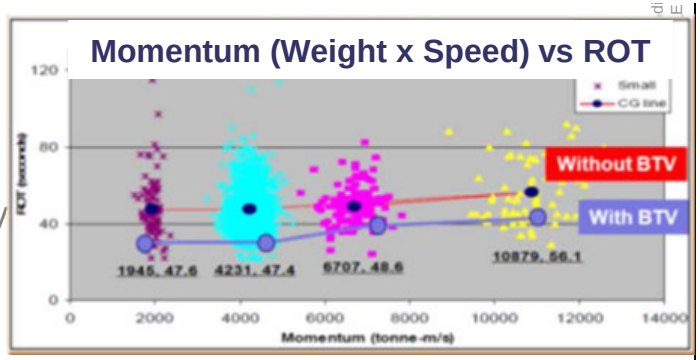




Runway Occupancy Time : Rationale

- **Runway Excursion (Primary cause of accident):**
  - An aircraft veering off the side of the runway (cross wind)
  - Overrun at the very end of the runway
- **Aicraft Braking Performance depend on:**
  - Runway Contaminant
  - Runway friction
  - Final Landing speed (dependent of Head/Tailwind)
  - Aircraft Weight and Braking strategy
- **and will impact:**
  - ***SAFETY (Accident /Incident or Go-Around)***
    - Runway Excursion
    - Aircraft collision (Runway Occupancy Time < Landing Time Interval)
  - ***CAPACITY (movment per hour)***
    - Runway Throughput limited by Runway Occupancy Time
    - Braking distance not adapted to Exit Taxiway (selected by Controller/Pilot 30 m before landing)
    - **Separation=Max(ROT, Wake-Vortex Separation)**





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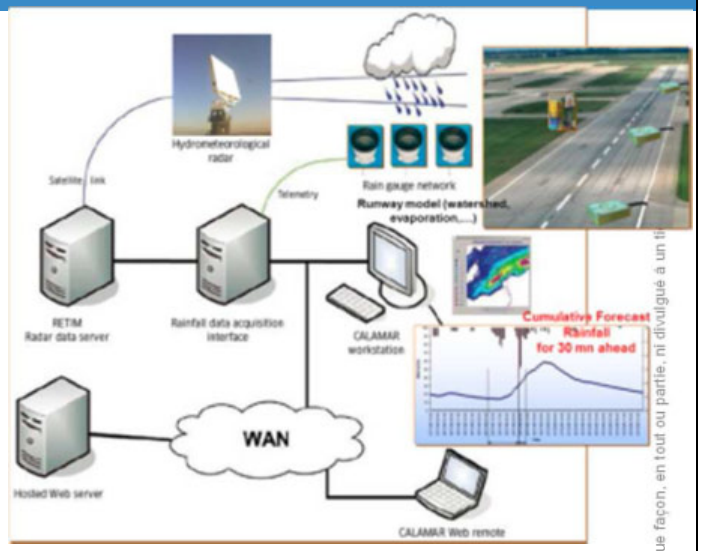
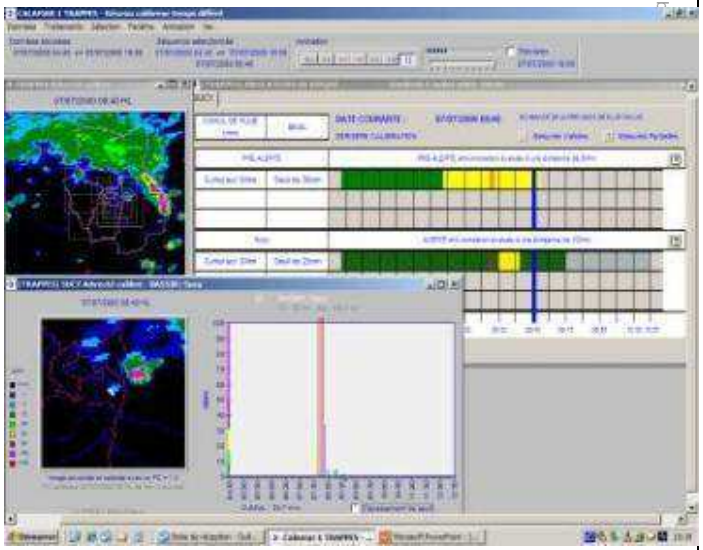
ROT: Runway Contaminant Prediction & Wind along Runway

Cumulative Rain 30 min prior before landing

- **Rain Rate Retrieval around the airport**
  - THALES High Resolution (5 m) / High Speed (45 s) X-band Radar
  - BOSCHUNG Water Level IT-Sens® probes installed on runways
  - Rain gauges data deployed around the airport
- **Cumulated Rain Forecasting by RHEA CALAMAR**
  - Cumulative Forecast Rainfall based on data in 1 min increments for periods up to 30 mn /1 hour ahead
  - Forecast reliability by the supply of data from rain gauges/ Water level probes (calibration)
- **Runway Contaminant Forecasting by DGAC/STAC Water Run-off model**
  - 3D map of Runway defined by Laser scanning instrument
  - Run-off model based on cumulate rain and runway slope
  - Recommandations for ICAO Friction Task Force
- **Coordination with Airborne ROPS (Thales Av.)**



Probes/Sensors ingested in A-CALAMAR



Cumulative Rainfall Forecast for 30 mn Ahead

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1 SCANSIM WVS SIMULATION TOOL FOR AIRPORT CAPACITY STUDY

- **THALES has developed a global "Wake-Vortex System (WVS)" simulator to assess airport capacity gain.**
- **This simulator integrates models of main factors and components impacting the runway throughput.**
- **This simulator includes:**
  - **Time of aircrafts on runways: Runway Occupancy Time (ROT) that is modeled statistically indexed by weather conditions (runway contaminant, head wind) and aircraft momentum (Maximum Landing Weight x Final Speed Approach)**
  - **Wake-Vortex Separation of aircrafts in the glide slope: WVDSS (Wake-Vortex Decision Support System) that monitor safe separation between aircraft in final approach phase taking into account new fixed procedures (ICAO, RECAT 1 and RECAT 2) or dynamical one (Weather dependent & Dynamic Pairwise RECAT 3)**
  - **Aircrafts sequence in the TMA: Wake-Vortex Constrained AMAN (Arrival MANager) that generates optimal time-efficient sequence of aircrafts in TMA taking into account wake-vortex pairwise separations constraints.**
- **The simulation is developed with SCANSIM that is a comprehensive and cost-effective ATC simulator suite for ATC training**
- **We could study Point-Merge procedure coupled with AMAN**

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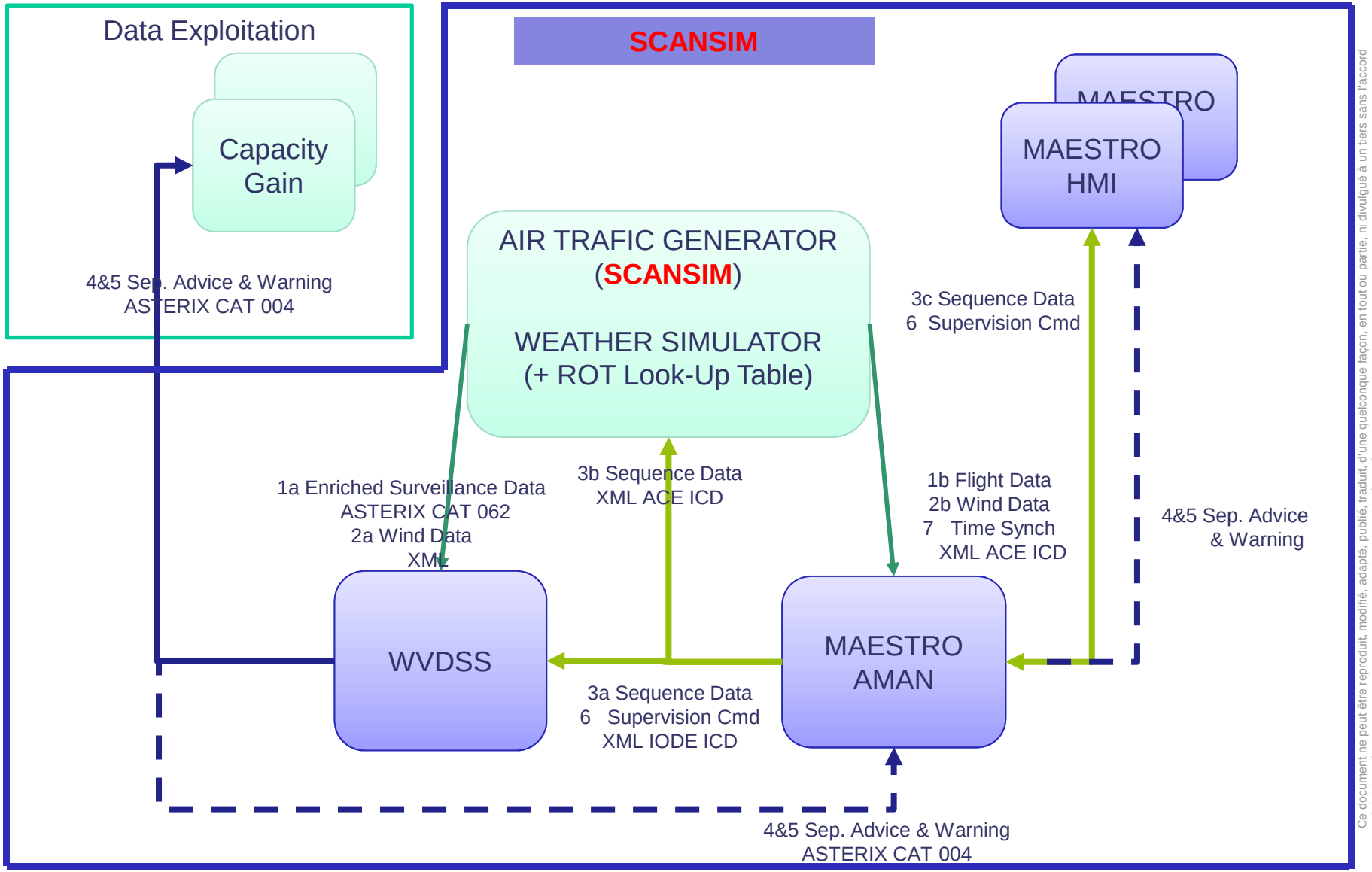
Wake-Vortex System Simulator Architecture with SCANSIM



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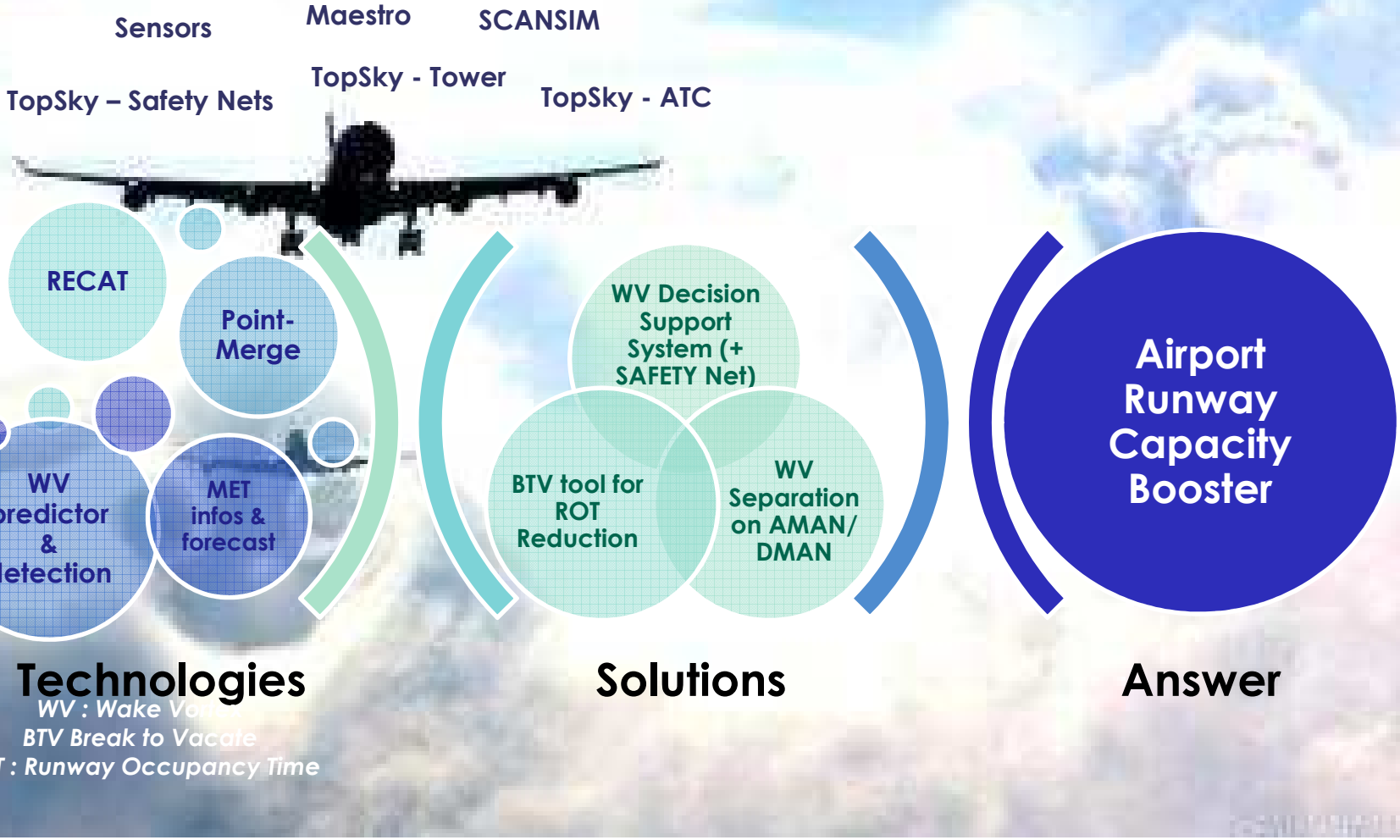
How to boost airport capacity?

Today's offer

Tomorrow's offer



Presentation of trials campaign in CDG Airport

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RADAR/LIDAR SENSORS TRIALS ON CDG AIRPORT

- In coordination with P6.8.1 deployment of X-Band radar and Lidar to perform wake vortex measurements.
- Objectives:
  - Gather data to feed the safety case and cost benefit assessment
  - Benchmark wake vortices tracking position and strength
  - Build a A380 WV measurement database
  - Increase Heavy WV database for RECAT2
  - Monitor RECAT-EU implementation
  - Work on WV severity by crossing WV measurements vs FDR data
- **Schedule**
  - Sensors deployment : from July 2014
  - Start of operational campaign : 1st September 2014
  - Duration : 1 year

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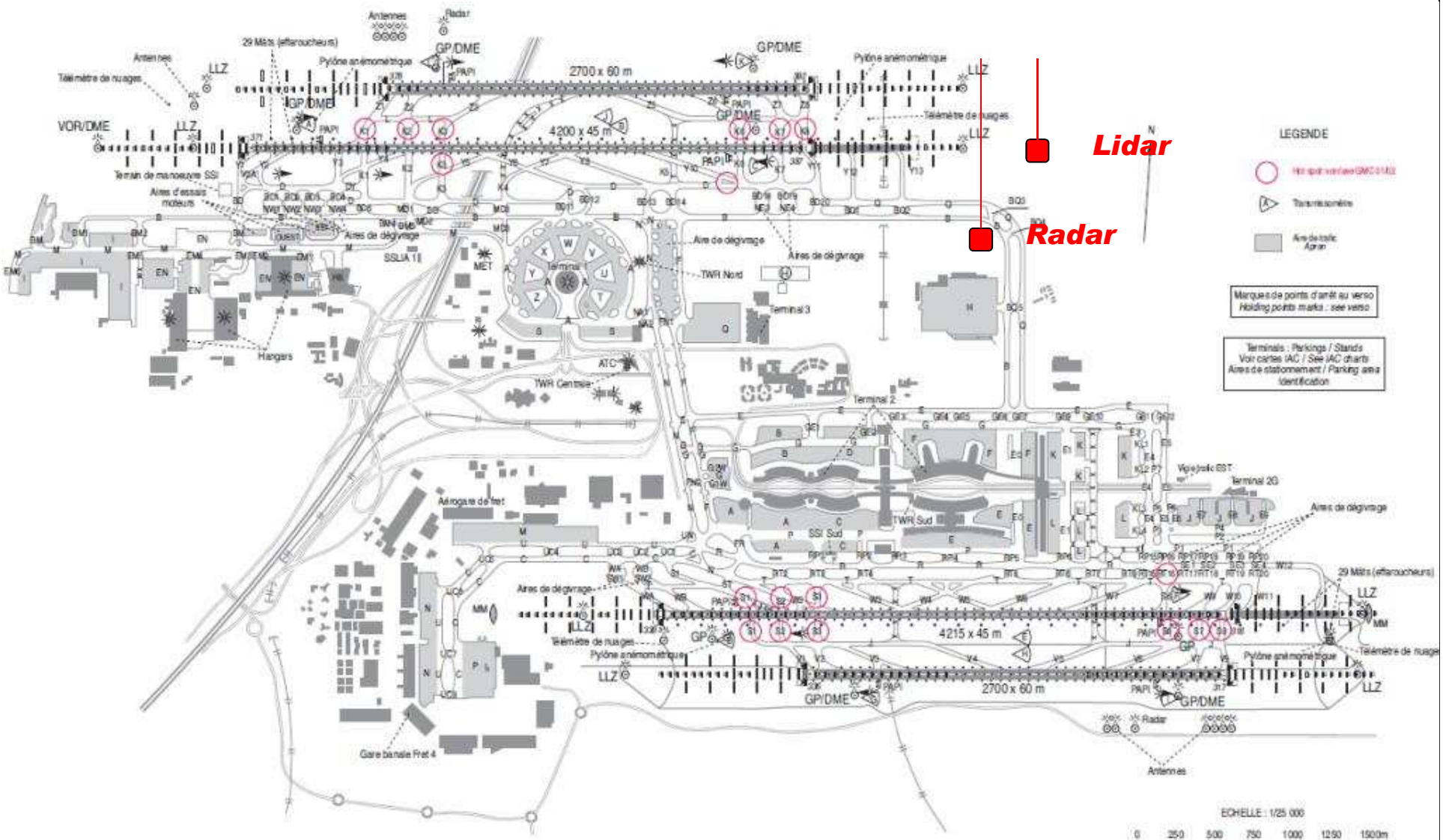
CDG AIRPORT



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WAKE-VORTEX RADAR SITE DEPLOYMENT ON CDG AIRPORT

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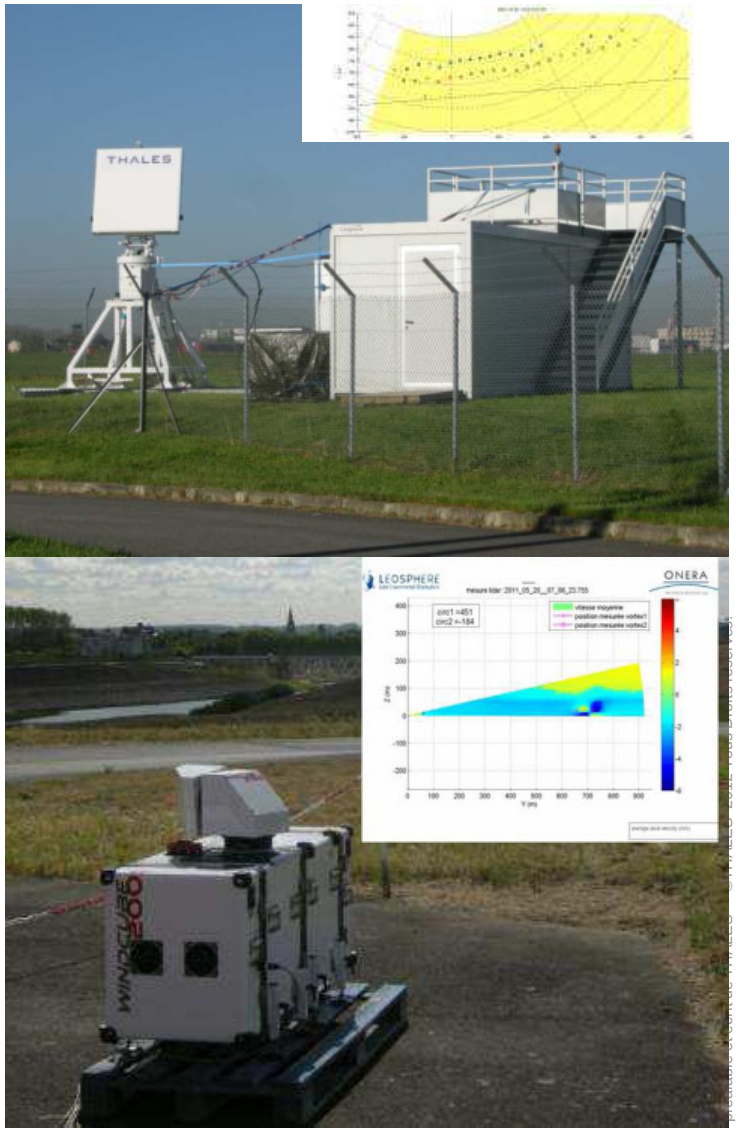
CDG campaign : THALES Radar/Lidar sensors suite

- **Radar/Lidar Combination**
  - X-band Radar in Wet /Foggy conditions
  - 1.5 micron Lidar in Dry Conditions
- **3D scanner capabilities**
  - Multi-function sensors (modes interleaving)
    - Detection of wake-vortex (positions scanned every 7.5 s)
    - Wake-Vortex Strength Retrieval (Circulation in m^2/s)
    - Wind that induces Wake-Vortex Transport
    - Air turbulence by EDR (Eddy Dissipation Rate) that induces Wake-Vortex Decay
    - Rain Rate (Radar) for ground segment of ROT
- **Additional functions**
  - Wind-Shear
  - Wind Burst / Microburst



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CDG campaign : THALES Radar/Lidar sensors suite

- **Collaborative Resources management**
  - Collaborative modes between Radar and Lidar according to weather conditions
- **THALES Radar/Lidar Sensors have been calibrated based on:**
  - Radar/Lidar Sensors simulators mixing EM/EO models and Fluid Mech. Models
  - Collaboration with AIRBUS on flight trials at Toulouse Airport
- **These sensors are operational to:**
  - **Develop a Wake-Vortex Database**
  - Feed Safety Cases for RECAT deployment
  - Support Airport Capacity study

The database structure could (should?) be discussed within the wake vortex community

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Questions

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