Performance Based Surveillance
&
New Sensors technology

Advance Surveillance Systems, evolution and implementation experience

Frederic Cuq

SEPTEMBER 2015, PANAMA

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Agenda

- Performance Based Surveillance and Standards
- Global Surveillance
- New Technology
- Implementation Experience

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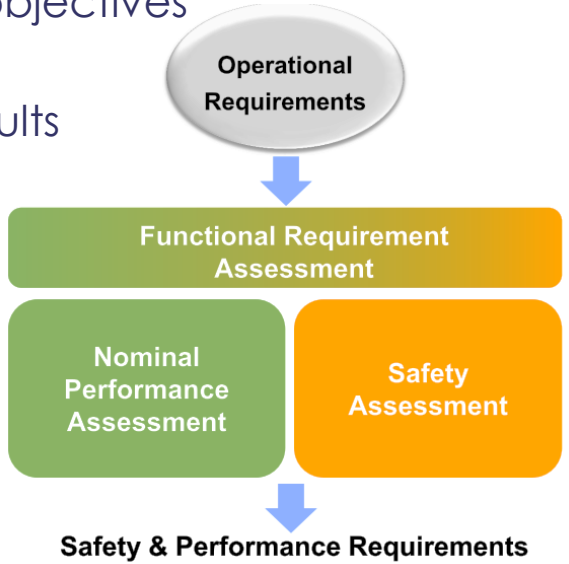
Fundamental Idea of Performance-based Operation

Based on industry practices evolved for many years outside of aviation

- Focus on desired/required results through performance objectives
- Systematic approach to safety aspects
- Informed decision making driven by desired/required results
- Reliance on facts and data
- Periodical performance measurement/data collection



Don't ask for a specific implementation – rather ask for its performance

Technology-agnostic but interoperable

Flexibility of architecture – adapted to specific needs

Optimization of performance and cost (addressing total cost of ownership)

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Performance-based CNS

Communication, Navigation, Surveillance (CNS) – the pillars of Air Traffic Management (ATM)

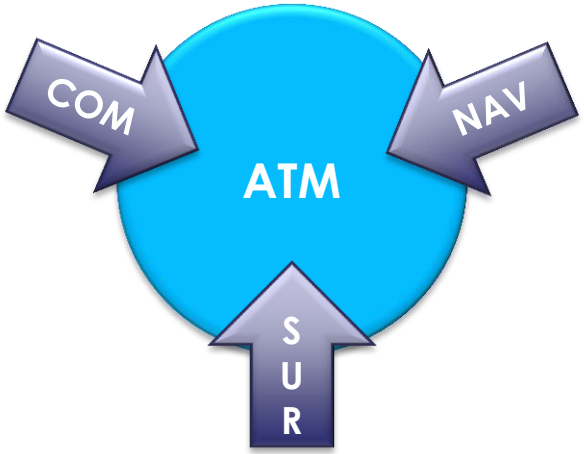
- Performance Based-CNS concept is closely linked to Required Performances (RCP/RNP/RSP) as defined in ICAO

Should help optimizing the airspace system in terms of

- Cost
- Efficiency
- Change management

Aims at achieving Strategic Objectives within an Airspace Concept

- Safety
- Capacity
- Efficiency
- Environment



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Performance-based CNS Solutions

In terms of continuity, availability, integrity, accuracy, safety and functionality

Performance-based Navigation: PBN

- Area navigation based on performance requirements for aircraft (RNAV specification, RNP specification) as defined in ICAO PBN Manual Doc 9613

Very Mature Concept

Performance-based Surveillance: PBS

- Performance requirements for air traffic service provision, allocated to surveillance system components as addressed in e.g. new Eurocontrol GEN SUR SPR standard

Often addressed together as PBCS

Performance-based Communication: PBC

- Communication performance requirements are allocated to all system components in terms of communication transaction time as defined in ICAO Global Operational Data Link Document GOLD

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Performance-Based Communication and Surveillance (PBCS)

A Way to Optimize your Communication & Surveillance Infrastructure to meet Future Aviation Needs

GENeric SURveillance Safety Performance Requirement – a European way towards PBS

Blue Book in 1997 (Eurocontrol Radar Spec)

- Defines Requirements for Surveillance Infrastructure based upon system capabilities of the time (Radar)
- Addresses Continuity and Reliability rather than Safety

ESASSP in 2012

- Defines System Performance, mainly in a bottom up manner but technology and environment independent
- Accommodates emerged/emerging surveillance techniques like Mode S, ADS-B, WAM, and mixtures
- Focus on performance & success case (safety not covered)

ESASSP V2.0 (GEN SUR SPR) 2015+

- Eurocontrol top-down methodology to define PBS
- From Separation requirements derive Generic SUR Reqs
- Allocate and apportion Generic SUR Reqs to Component Specs
- Derive Evaluation methods and implement Assessment Tools
- Define SUR standards introduce into ICAO documents

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ESASSP QUICK DESCRIPTION

WHAT

- EUROCONTROL Specification for ATM Surveillance System Performance SPEC-0147 30/03/2012
- Define mandatory and recommended performance requirements for 3/5 NM horizontal separation using cooperative or non-cooperative surveillance systems
  - Cover different levels of quality of service characteristics: availability, continuity, integrity, time, coherence

WHY

- Conformity/suitability to:
  - Commission Implementing Regulation (EU) N° 1207/2011 of 22 November 2011 laying down requirements for the performance and the interoperability of surveillance for the single European Sky
  - Requirements on horizontal separation minima

HOW

- Conformity assessment methodology
  - Mathematics and measurement methods are described and implementable
  - Define the different testing approaches (design analysis, live data testing)
  - Define procedure (volume, dataset, periodicity, measurement points) for customizing to the sensor and airspace environment

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Conformity assessment : from Sensor to Tracker output

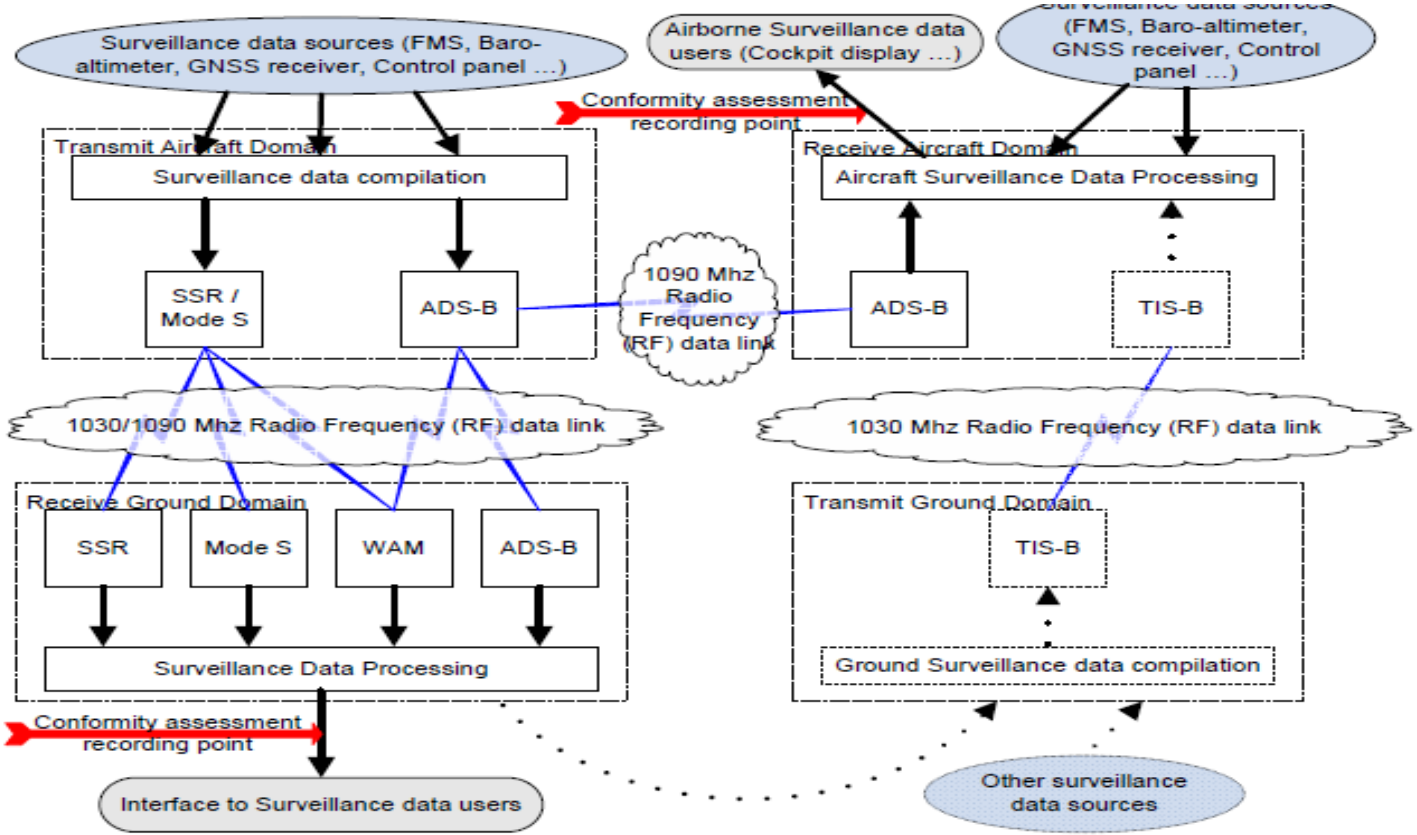

Figure 14: Future Air-Ground, Ground-Air and Air-Air Surveillance system implementation based on 1030/1090 MHz data link

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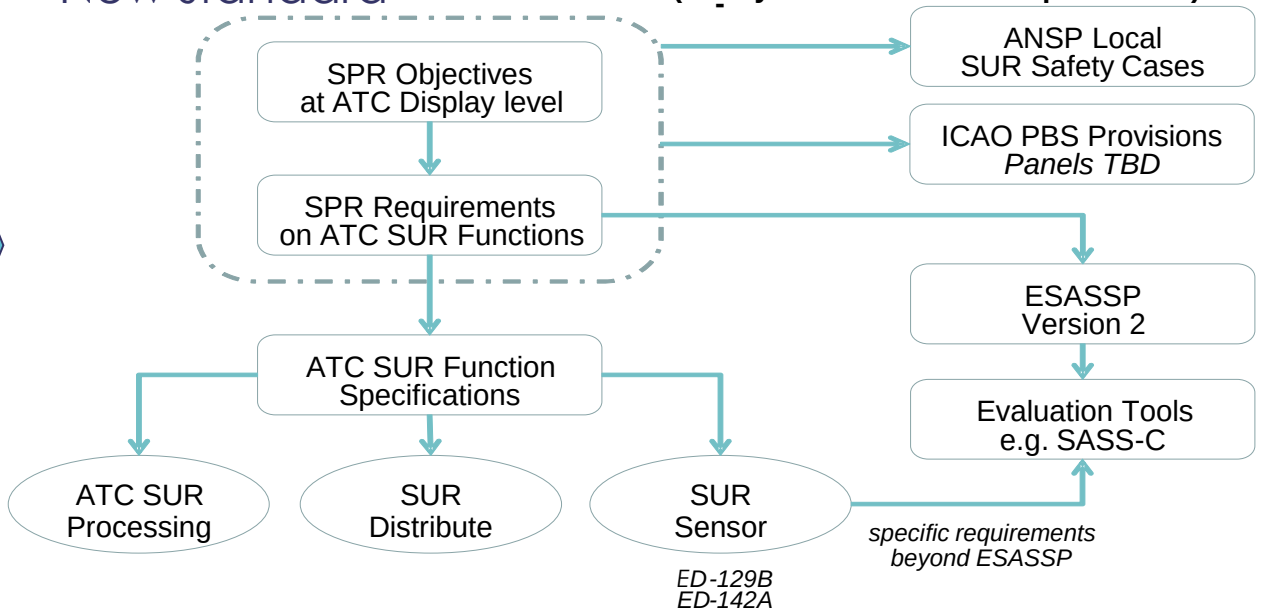
GENeric SURveillance SPR

Current standards

Standard Document for Radar Surveillance (Blue Book)

ESASSP Version 1

New standard = GEN SUR SPR (Safety & Performance Requirements)



GEN-SUR SPR aims at addressing/encompassing the safety aspect, required by EC regulations and not part from the two main relevant Surveillance document (Standard Document for Radar Surveillance and ESASSP).

The GEN-SUR SPR should also imply revision/update ESASSPS, ADS-B (ED-129B) and WAM (ED-142A) Eurocae standards as well as surveillance performance monitoring tools.

Other goals of this document is to establish the baseline of the PBS (Performance Based Surveillance) requirements in a similar way to PBN (Performance Based Navigation).

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Implementing Performance-Based Infrastructure

How do we get there?

PBCNS Implementation

Increased safety, efficiency and environmental benefits

- Time &fuel saving, airspace capacity increase thanks to reduced route spacing & separation minima, more efficient routing in an obstacle-rich or noise-sensitive environment

PBCNS implementation is coordinated at regional/global level

- Discussions at ICAO level (e.g. PBN Task Force, Navigation System Panel (NSP), OPLINK Panel, Air Surveillance Panel ASP)
- Discussion at regional level

The framework is being established – lets use it!

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What has to be done to achieve this? – Plan for it

Intended application has to be converted into a specification

- Required Performance for an intended application stated as RCP, RNP, RSP
- Assess current infrastructure against required performances
- Perform simulations to identify the most appropriate infrastructure elements together with cost-benefit analyses justifying the implementation of PBCNS
  - Allows optimum choice of systems on the ground, as well as airborne capability
  - Plan gradual transition and mitigation for the evolving ground infrastructure

Thales can help assessing existing infrastructure and then designing required architecture in response to RNP, RCP, RSP

Convert the Need into a Plan

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What has to be done to achieve this? – Implement it

Implement PBCNS

- Specify required performances according to operational needs
- Assess current performance against required performance
- Plan for adaptation – largely agnostic of specific technology
- Implement / modify required ground systems / procedures as planned

Post-implementation performance assessment

- Monitor actual post-implementation performance and re-assess periodically

Thales can help deploy solutions to implement the required service levels and assess system performance

Let us know when and where we can support you!

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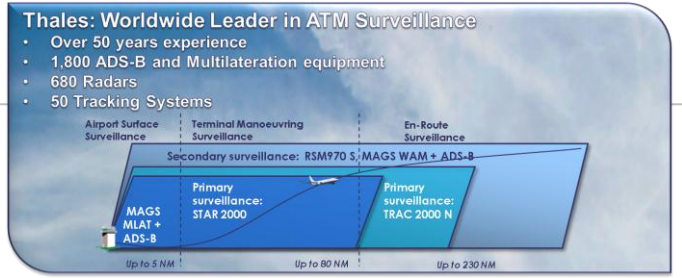
Global Surveillance



Thales supplies all surveillance technologies

- Use of tools and methods to plan their deployment, predict and assess their performance
- Led to definition of a performance-based global surveillance concept

Thales global surveillance concept reflects industry's response to PBS

Includes the capability to design a performance-based architecture for an air traffic surveillance environment

- Finding the right balance between system performance and lifecycle cost
- Supporting flexible airspace design
- Implementing GEN SUR SPR


PSR


SSR


ADS-B


ADS-C


Multilateration


Tracking Systems

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Why Global Surveillance?

Constraints

Surveillance technologies

Conventional Surveillance Technologies: PSR, SSR	New Surveillance Technologies: MLAT, ADS-B
Highly mature	Maturing solutions
Continuously improving	More and more proven references
Widely deployed technologies	Increasing operational deployement
Cornerstone of CNS infrastructures	

Surveillance Evolution : A dilemma for some ANSPs…

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Environment

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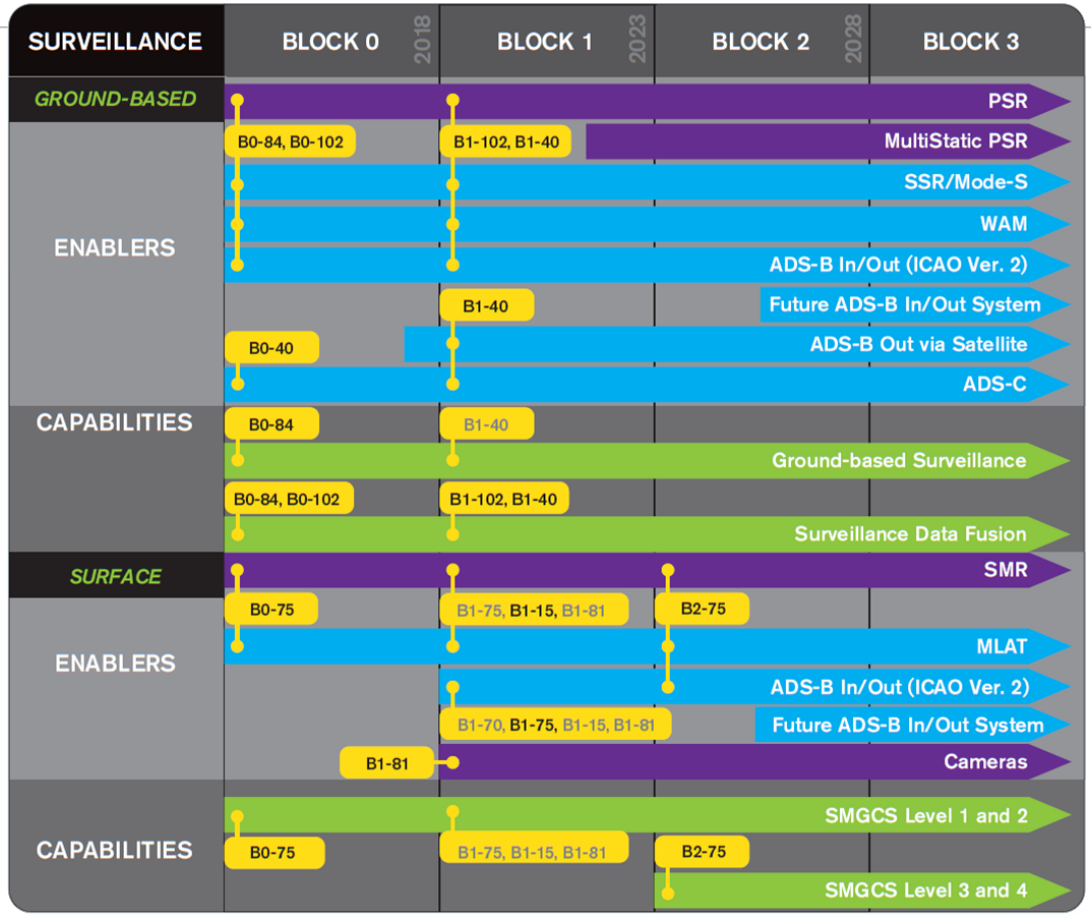
Technologies and ICAO implementation roadmap

- ICAO Document 9750 offer a structured approach to planning ATM modernisation
- Technology roadmaps for surveillance exist for surface, ground-based and air to air surveillance
- The ICAO ASBUs and roadmaps establish a common framework for harmonisation and interoperability



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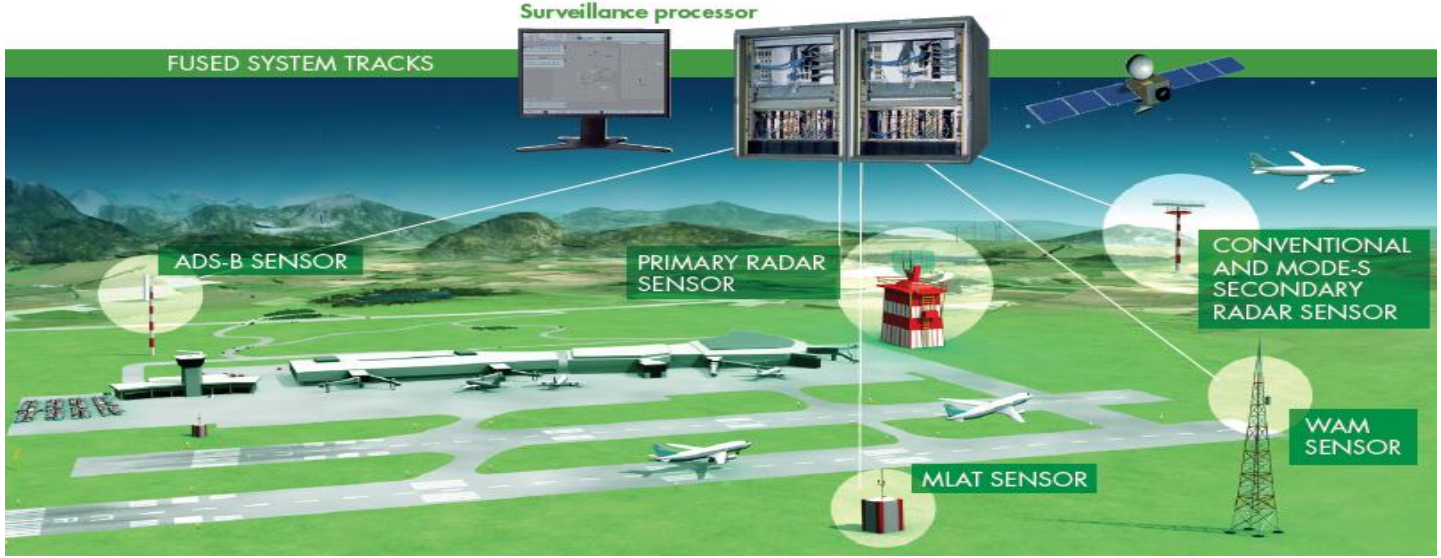
Tracking System

TopSky- Tracking is designed to provide an up-to-date, accurate and unique track based on the **fusion of multi-sensor (radar, ADS-B, WAM, MLAT, SMR, …)** reports by utilising the benefits of each sensor whilst eliminating their drawbacks



TopSky - Tracking, the key component for Global Surveillance

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A New Generation Primary Radar : STAR NG

Complex ENVIRONMENTS

- **Windfarm** mitigation: New radars, Upgrade of legacy radars, No more Gap-Fillers
- **4G** remediation
- Interference Map: **Spectrum management**

DUAL USE Features

- **Altimetry**
- **Anti Jamming** : Frequency Agility, Jam Strobes, Least Jammed Frequency
- **Slow / Fast moving** targets detection: Helicopters, Fighters
- **Small** targets detection
- Solutions for **Information Systems Security**

COMPETITIVE Edge

- **Most efficient** detection range: power, range resolution, clutter
- Scalable configurations **adapted to operational needs**
- **Simultaneous** Weather, Windfarm and Altimetry **capabilities**
- Incorporating **up-to-date radar technologies**
- **Already a commercial success**: Marshall project for UK MOD

Easy MAINTENANCE

- **Industrial Remote access**
- Optimized Design for **Reduced Life Cycle Costs**

SITE Oriented

- **Compact solution**: reduced constraints on civil works infrastructure
- **Low energy consumption (up to 20% reduction)**
- **Easy adaptation** to site environment

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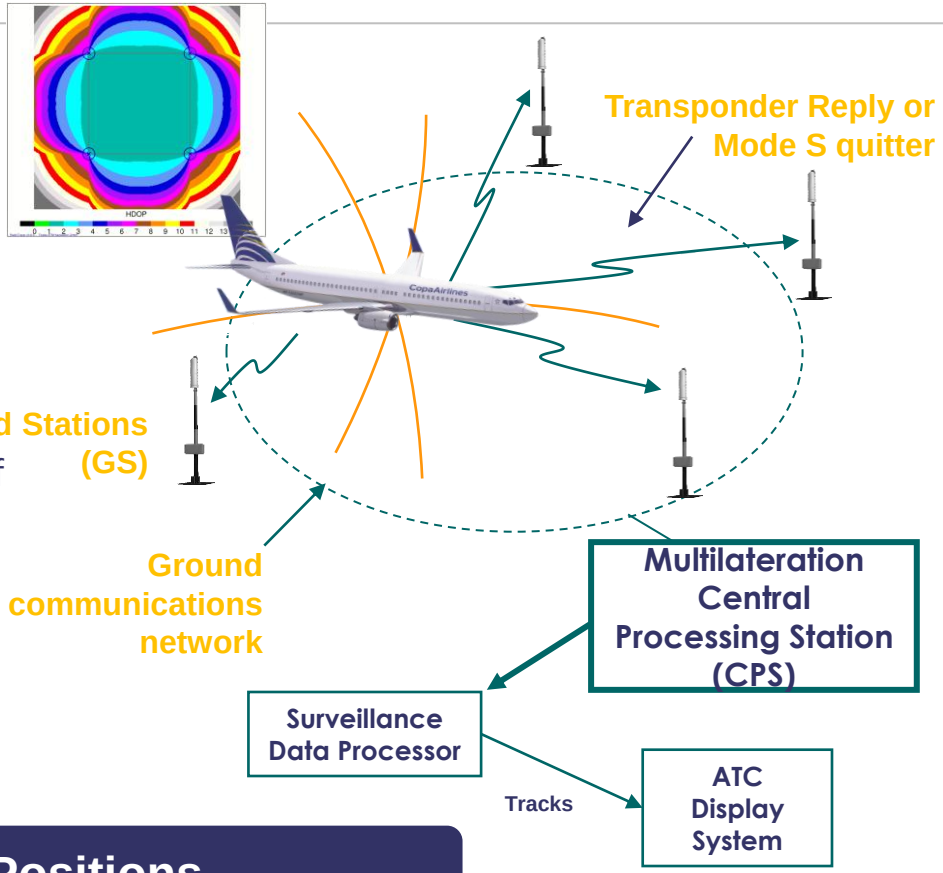
Airport/Wide Multilateration LAM/WAM

Key Features

- Signal transmitted by aircraft transponder is received by several ground stations (minimum of 3 for 2D position) in the vicinity.
- Ground stations determine the precise Time Of Arrival (TOA) of received signals.
- Central station calculates TOA difference of each pair of ground stations.
- Knowing the speed of wave propagation a hyperbolic line of position results.
- Intersection of several hyperbolas is the target position



Multilateration measures Positions

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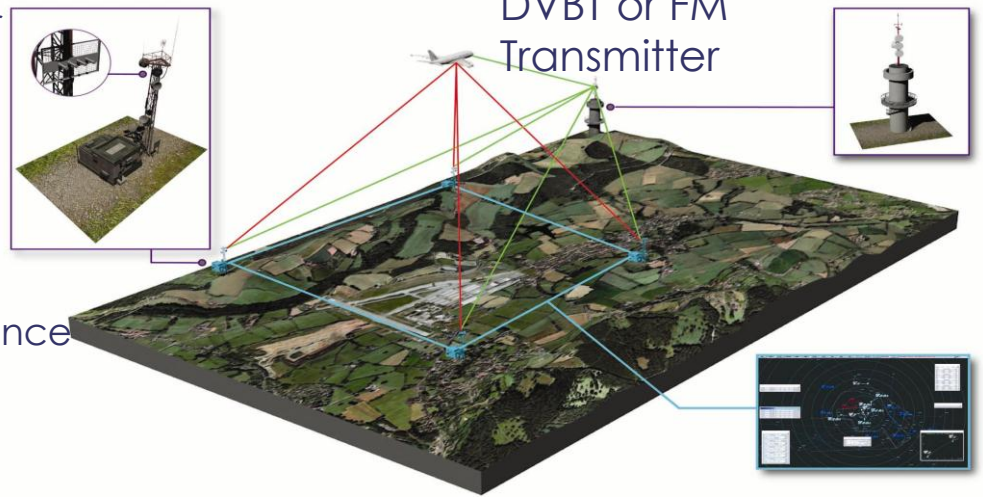
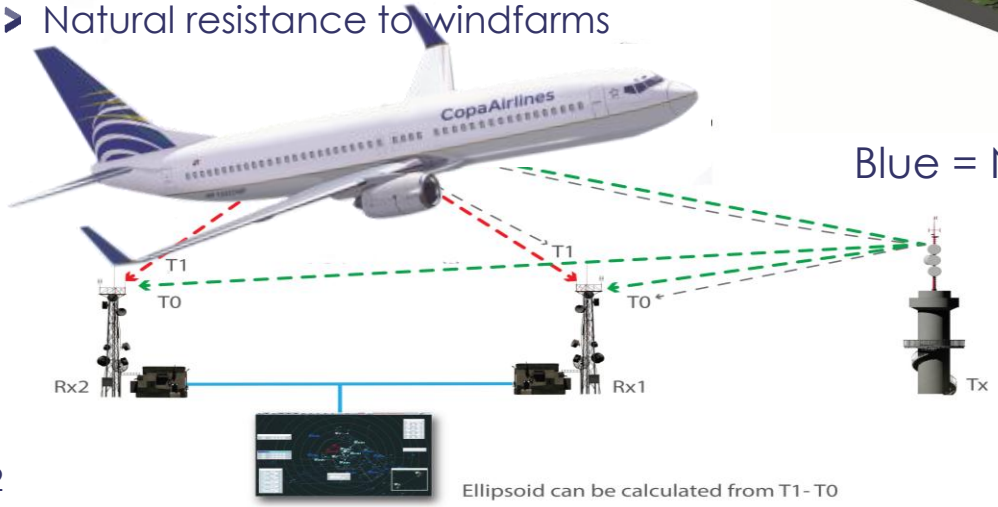
Multi Static Primary Surveillance Radar (MSPSR)

Key Features

- Third party and or dedicated Low power
- Scalable and adaptable
- Fast renewal rate
- no rotating parts
- 3D localisation, instantaneous velocity vector measurement
- Graceful degradation, flexible maintenance
- Natural resistance to windfarms



Blue = Network of ground receiving stations



Ellipsoid can be calculated from T1 - T0

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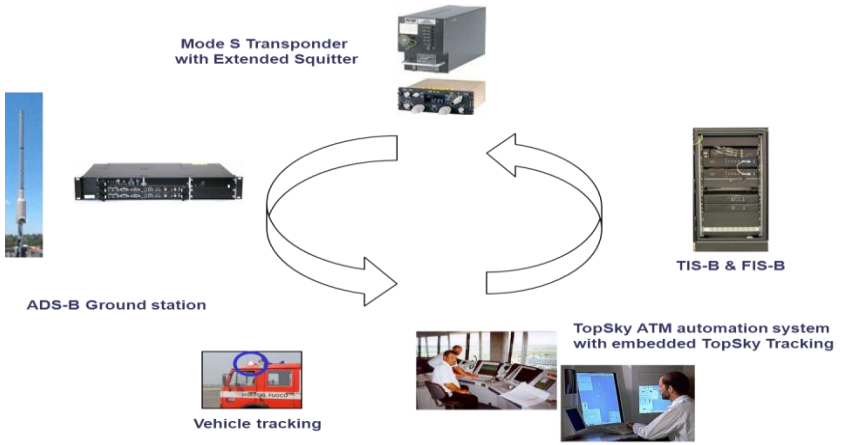
World leader in ADS-B

All main operational ADS-B programs are using Thales ADS-B



Full range of ADS-B solutions

1,800 ADS-B and Multilateration equipment sets around the world

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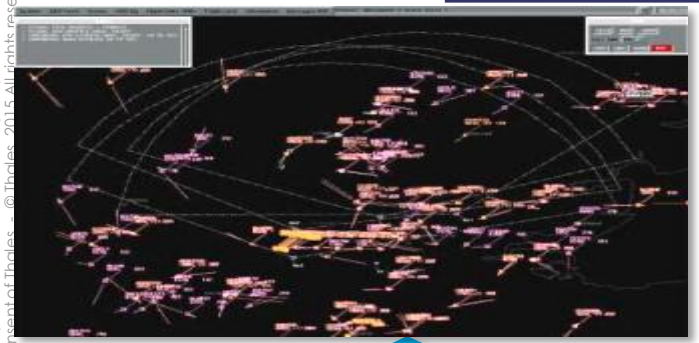
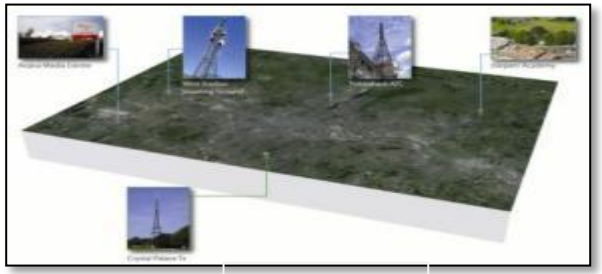
Thales New Surveillance Technologies and TopSky - ATC

UK - October 2013....

TopSky ATC

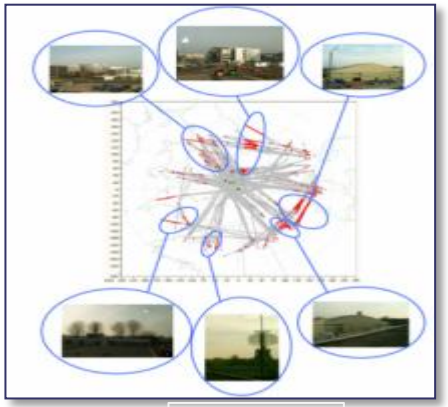
... A WORLD FIRST !





MSPSR

ADS-B Station



WAM

First interfaces between a TopSky – ATC and new surveillance technologies

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Application case : WAM & PRM (Precision Runway Monitoring)

THALES WAM SYSTEM OPERATIONAL AT FRANKFURT FOR PRM

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KEY BENEFITS FOR DFS CONTROLLERS

Target position update rate (nominal 1 second) and therefore:

- Early detection of planned and unplanned manoeuvres of aircraft
- Optimum capacity utilisation through improved utilisation of existing separation minima (e.g. in IMC conditions)

Unicity of plots in the whole TMA

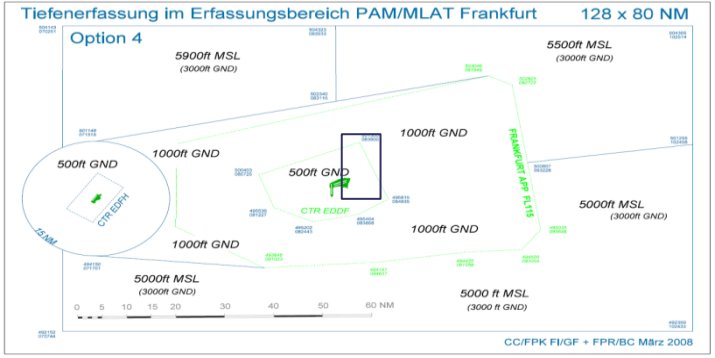
Improvements in the detection at low altitudes in the arrival / departure area of the other airports in the TMA

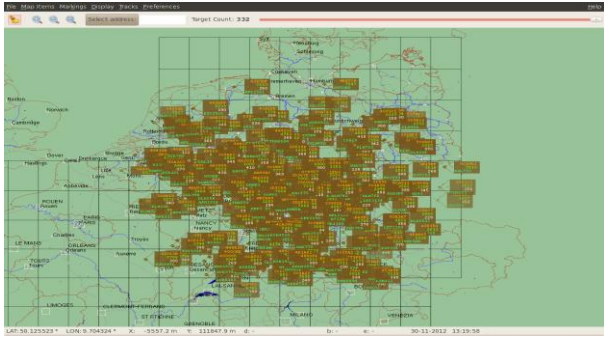
No "Cone of Silence"

High position accuracy ≤ 50 m RMS without tracking

Improvement of resilience in the Frankfurt TMA by a N-1 redundant MLAT

Flexible expandability of the PAM system with regard to future developments of the airport





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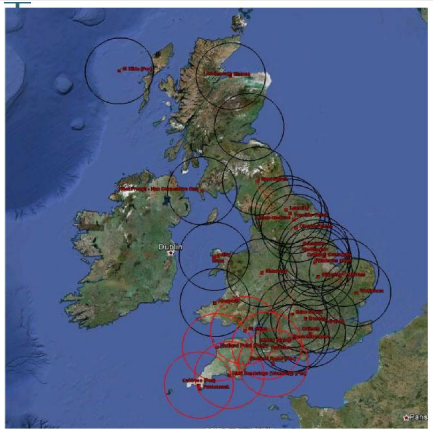
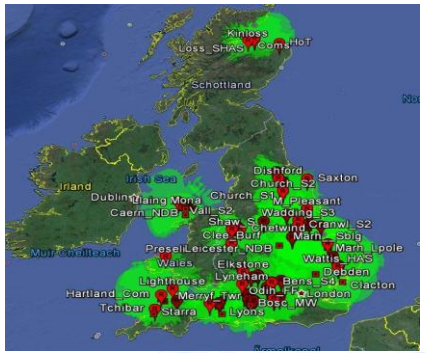
Application case : Surveillance (Fixed sites) Systems in Marshall

- MARSHALL will provide military terminal Air Traffic Management (ATM) capability for the MoD (RAF, Army and RN) for 22 years.
- Surveillance Objectives : To ensure Non cooperative and cooperative surveillance of the airspaces of more than 40 air bases and test ranges through a combination of sensors & external Feeds
- Non-Cooperative Surveillance: 20 PSR – STAR
- Cooperative Surveillance
  - 9 MSSR , including 6 co-mounted
  - 9 WAM (total of 112 ground stations)
- Feeds from NATS radars
- Surveillance Data Processing (SDP)



Areas to be covered and example of low altitude coverage



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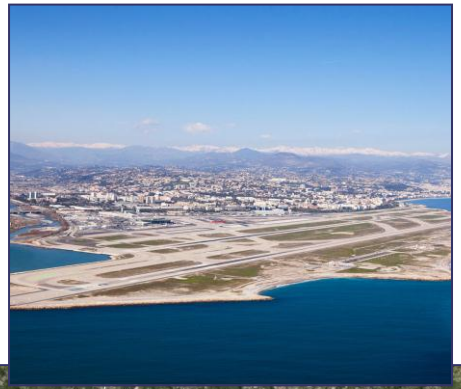
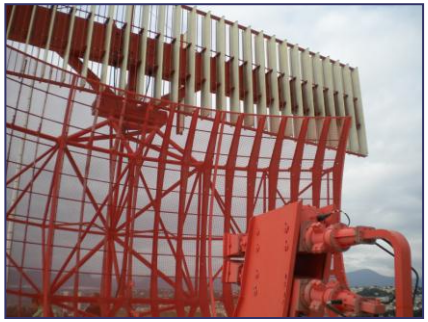
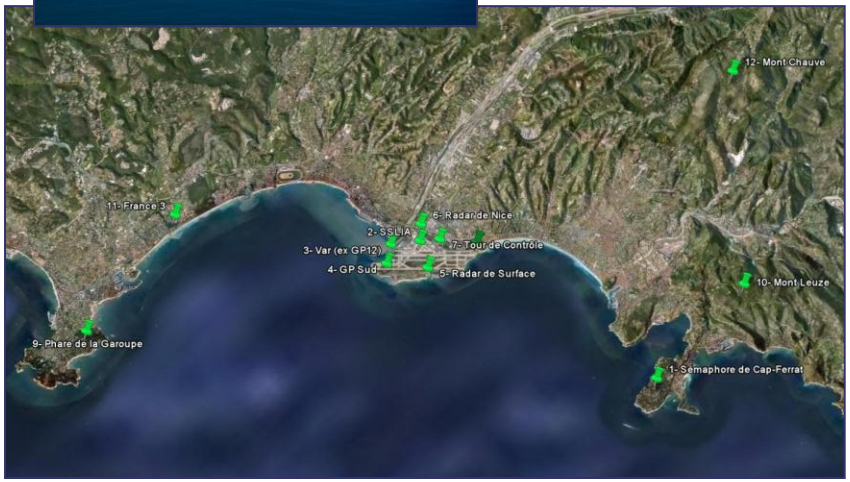
Application case : Nice (France)







- France's 3rd largest airport
- Approx. 11million passengers/year
- Thales WAM/MLAT to satisfy airport surface, as well as TMA to ensure (in combination with radars) surveillance requirements

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Conclusions

- Performance Based Surveillance will shape the scope of future procurements from ''Individual Sensors'' towards ''Surveillance Solutions ''
- It will allow to offer optimized performance/cost over a given volume whatever the sensors / technologies
- Thales has develop an evolutionary global surveillance solution based upon technologies, tools and methods to support any ANSP to optimise its surveillanc infrastructure

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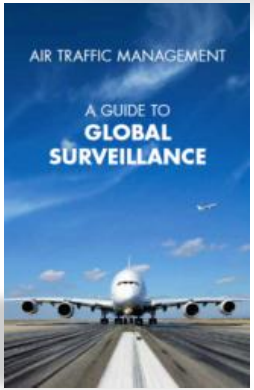

MUCHAS GRACIAS

Global Surveillance Booklet on ICAO website

http://www.icao.int/NACC/Documents/Meetings/2014/ADSBIMP/ADSBIMPP12.pdf

Thales Air Traffic Management - Global Surveillance Movie on YouTube

https://www.youtube.com/watch?v=O3b3VZurdNg

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