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ICAO EMERGING SURVEILLANCE TECHNOLOGIES SYMPOSIUM

Emerging Technologies for Non Radar Surveillance

Massimiliano Ferla, Product Line Manager for Nav aids and Non Radar Surveillance

Agenda

Secured ADS-B, RF Security, Hybrid WAM

ADS-B datalink a
good example

02

What we can do?

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Advanced ADS-B & WAM Surveillance existing solutions

INTRODUCTION

01

SECURE ADS-B
SOLUTIONS

- Automatic
Dependent
Surveillance
Broadcast

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HYBRID WAM

- Wide Area
Multilateration

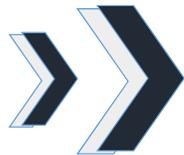
03

Aviation and safety, as of today

Aviation is built on trust and interoperability, open protocols, open standards
Growing attack surface

Threats to Surveillance Systems Operation

- Technical Failure
- Environmental Effects
- Unwanted Side Effects
- Accidental
- Malicious Intent



Security classically addressed based on

- *Physical security* through access control, shelters, locks, etc.
- *Networks and software security* through Cybersecurity rules

**Subject to Safety Assessment mostly taken care of
by specifications and system design already**

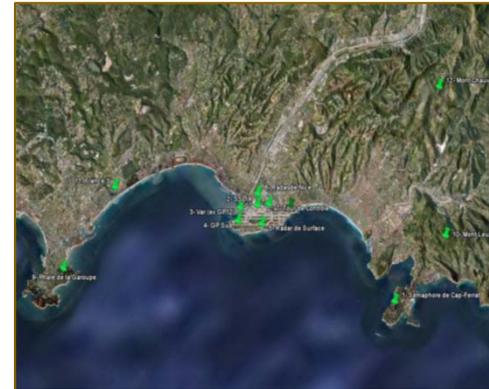
What can go wrong?

Cooperative Surveillance Systems in ATM

- SSR
- WAM/Airport MLAT
- ADS-B

Generally, we count on good faith!

- Willingness to cooperate between all parties
- Truthfulness of reported data
- Availability of required Data
- Compliance to applicable international and local standards



Why RF Security is impactful?

RF signal transfer in the ATC world can be impacted due to

- Transponder ground sensor transactions use a fixed frequency (1030/1090MHz)
- Signal formats and content of interrogations and replies are unencrypted
- Protocols are fully described in public standards
- ATC type antennas are not designed to reject jammers

ADS-B is particularly affected

- *Dependent Surveillance* security is the main entrance barrier

ATC market has no means against threads comparable to military Electronic Counter-Counter Measures (ECCM)



Not doing anything is not an option!

Basic RF Security threat types

Jamming

- Impairing ground station reception with different types of strong signals: CW, pulses, message lookalikes (preambles, telegrams) – denial of service attack

Spoofing

- Inserting false targets into RF processing using an artificial message set (complete or partial), or, replay of recorded single or multiple real targets

Data Modification

- Overwriting received signals in order to change e.g. identity or emergency status, also known as “Meaconing*”, related to classical “Man-in-the-Middle” Attack

Suppression of targets

- Inhibiting position decoding – target reports cannot be generated anymore

Compromise Support System

- GNSS, affects e.g. Synchronisation

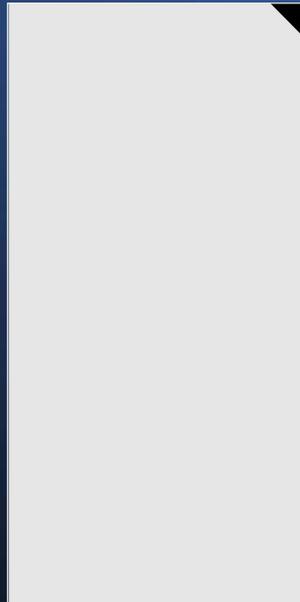


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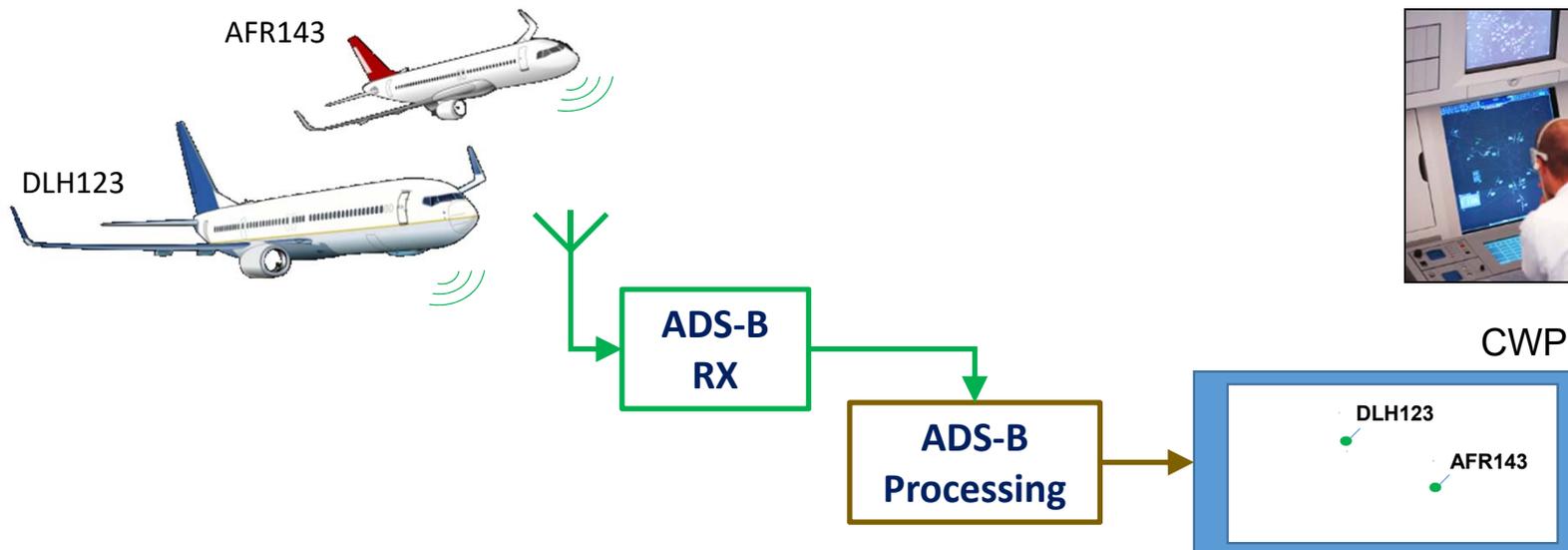
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HYBRID WAM

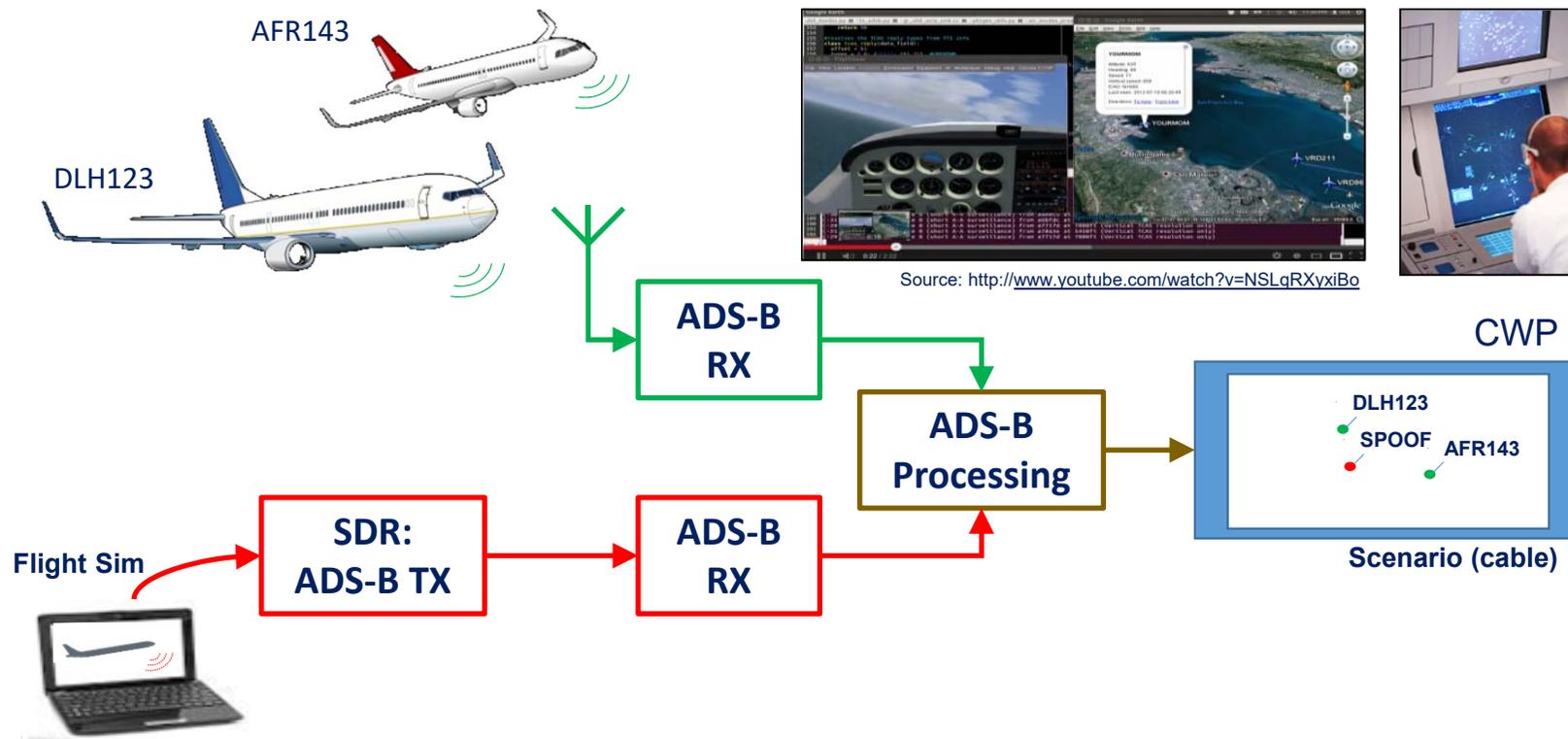
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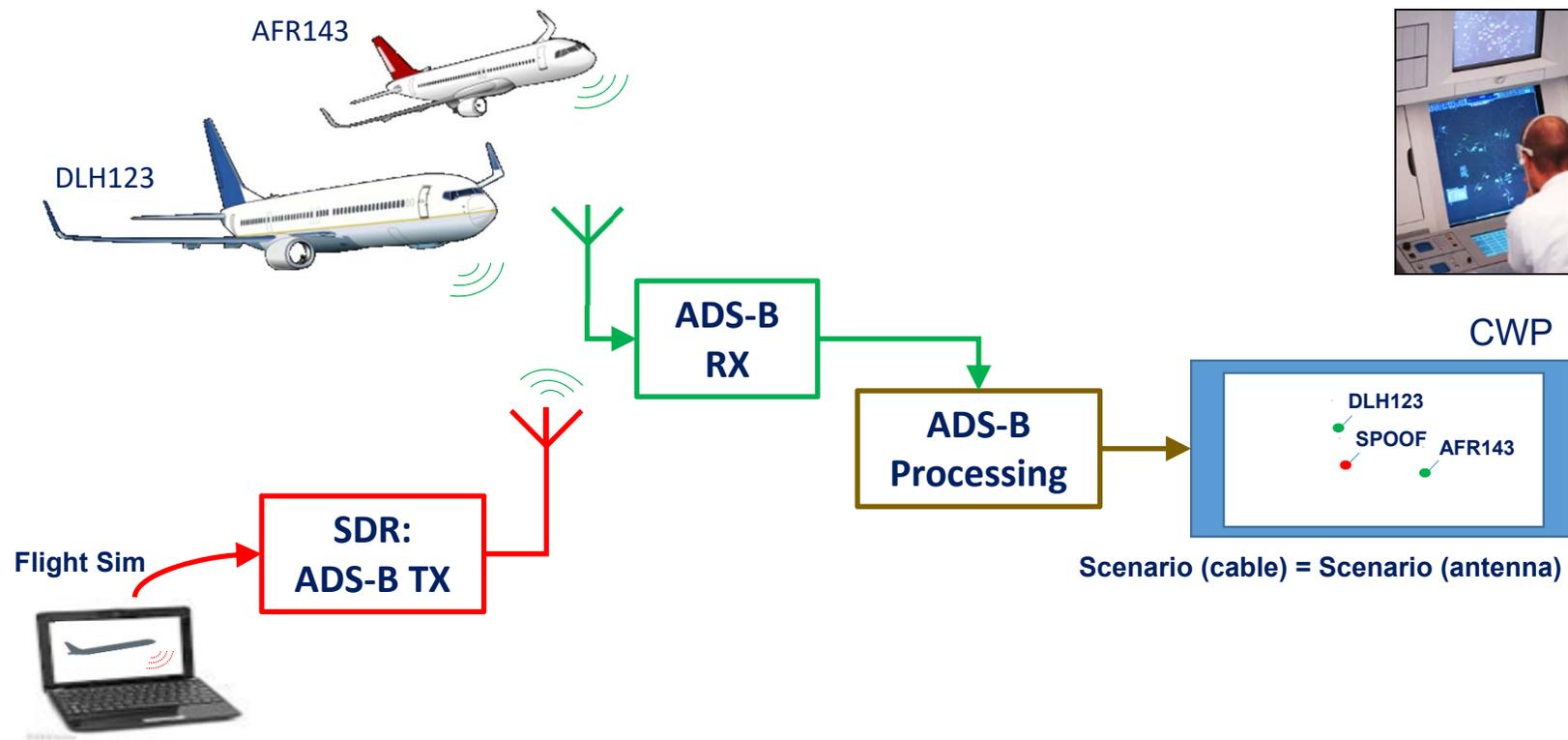
Regular ADS-B



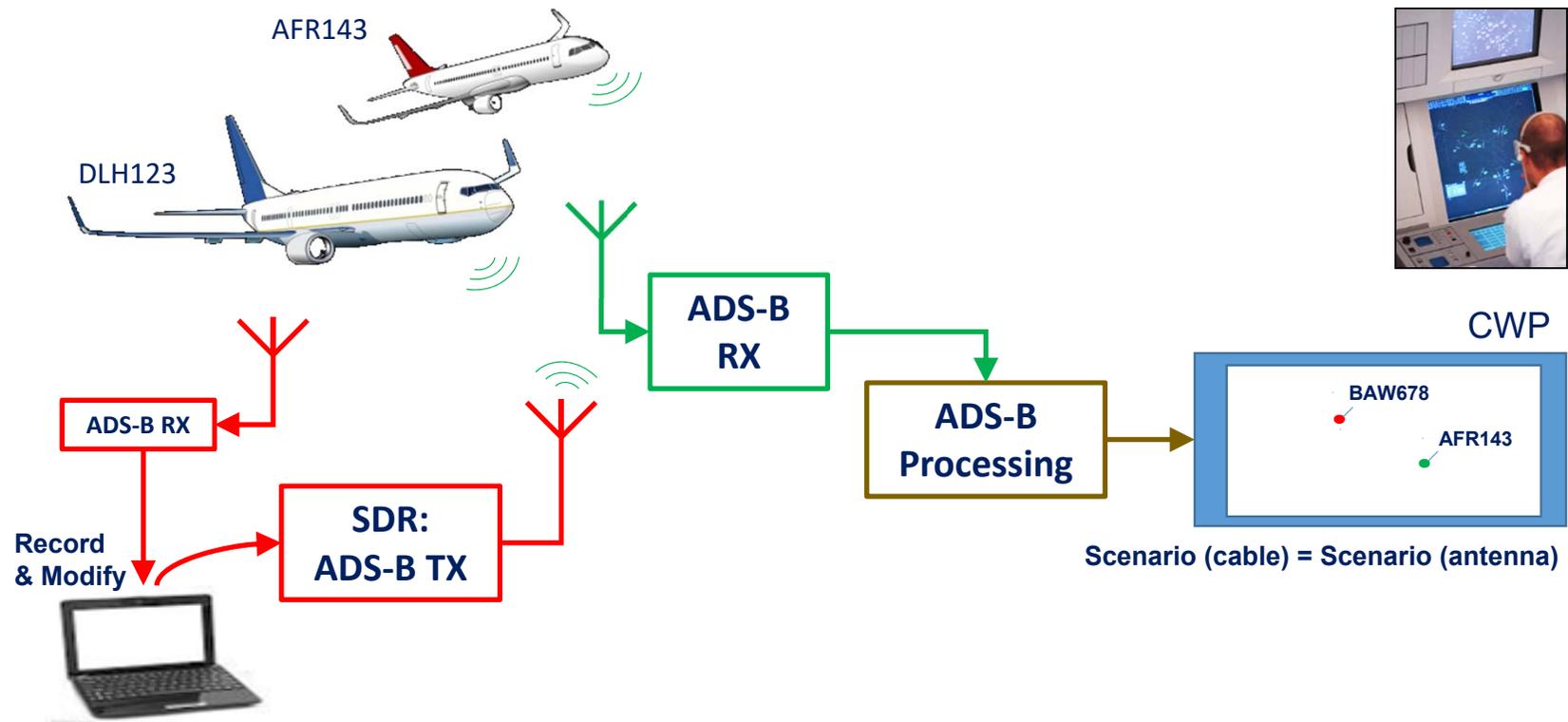
ADS-B Spoofing Demonstration



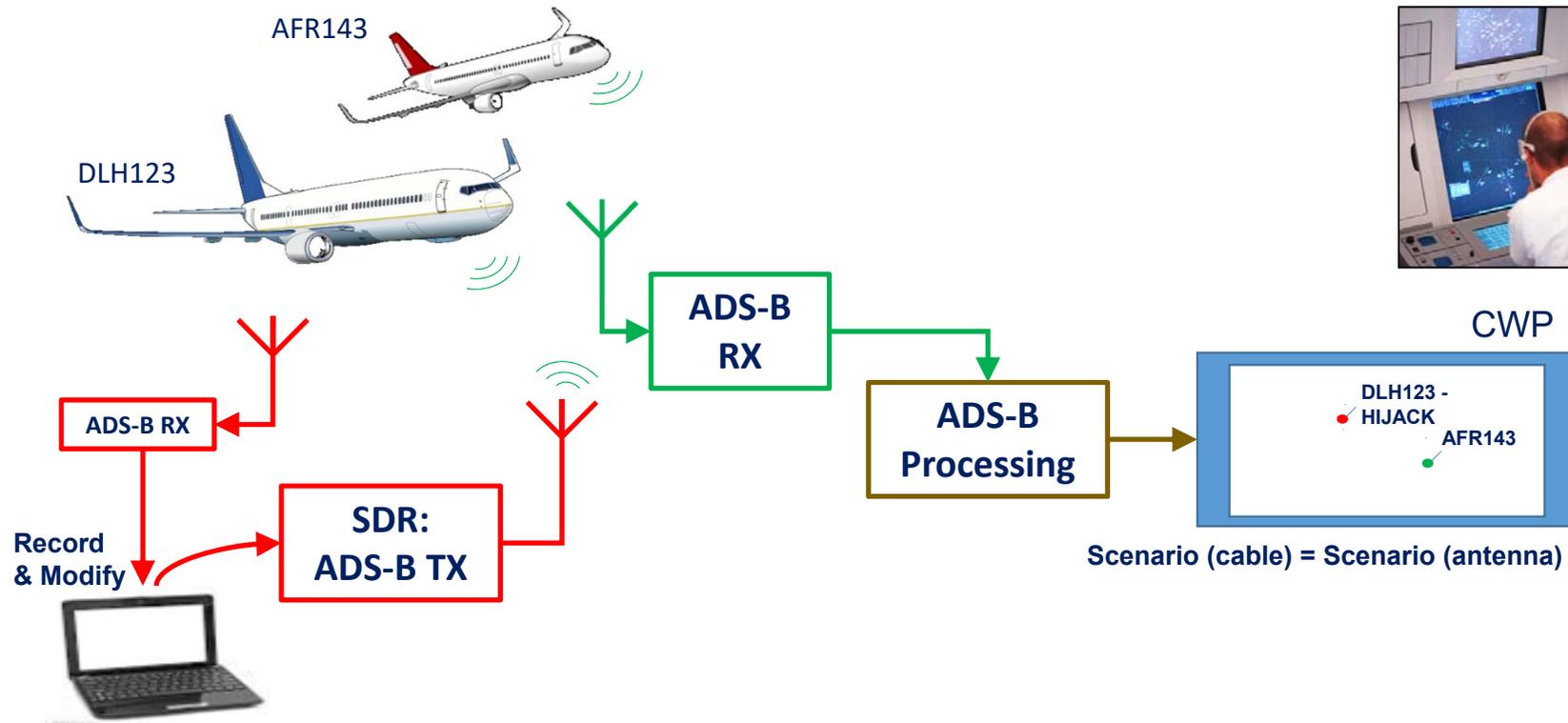
ADS-B Spoofing in Reality



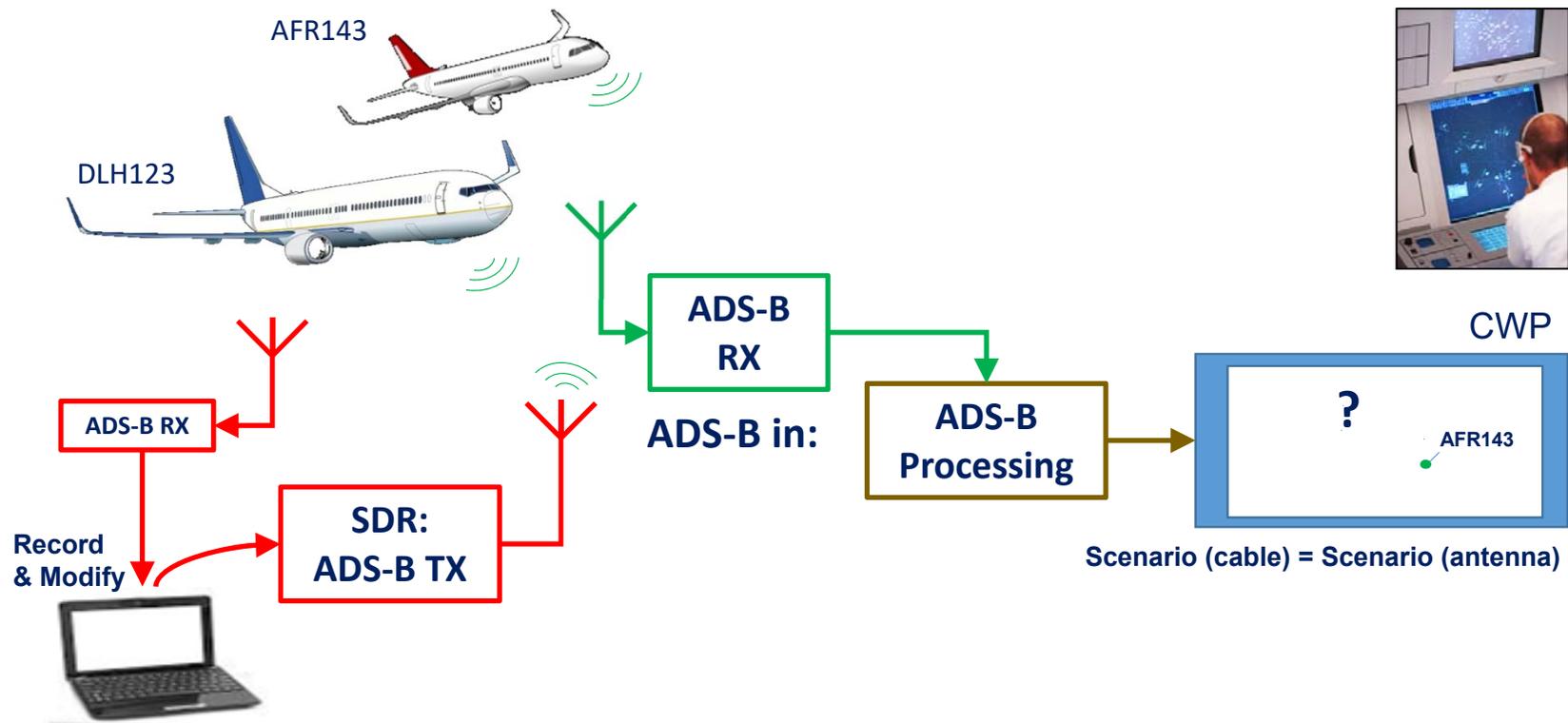
ADS-B Meaconing – Change of Identity



ADS-B Meaconing – Change of Status



ADS-B Target Suppression



What is the impact on Operations?

ADS-B in	Radar/WAM Airspace	Non-Radar Airspace
Effect	<ul style="list-style-type: none"> • False plots/tracks (spoofing) • False codes/ACID or emergency indicators (modification) • Complete failure of ADS-B (jamming) 	<ul style="list-style-type: none"> • False plots/tracks (spoofing) • False codes/ACID or emergency indicators (modification) • Complete failure of ADS-B (jamming)
Risk of not detecting	Low risk, due to other sensors and background data	Increased risk, background data only (flightplans, history)
Operational Impact	Slightly increased workload, safety not likely affected	Increased workload, no other surveillance data source
Mitigation	If detected use other sensors and disable ADS-B	Radio contact to actual pilots, fall back to procedural control

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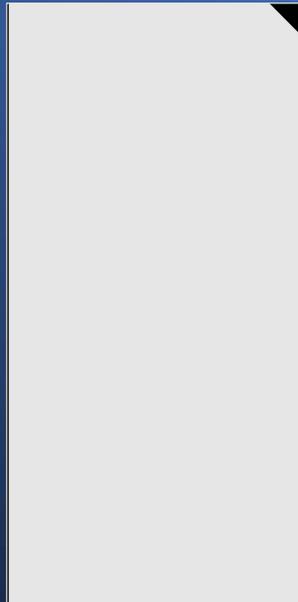
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Multiple Levels of Defense and countermeasures

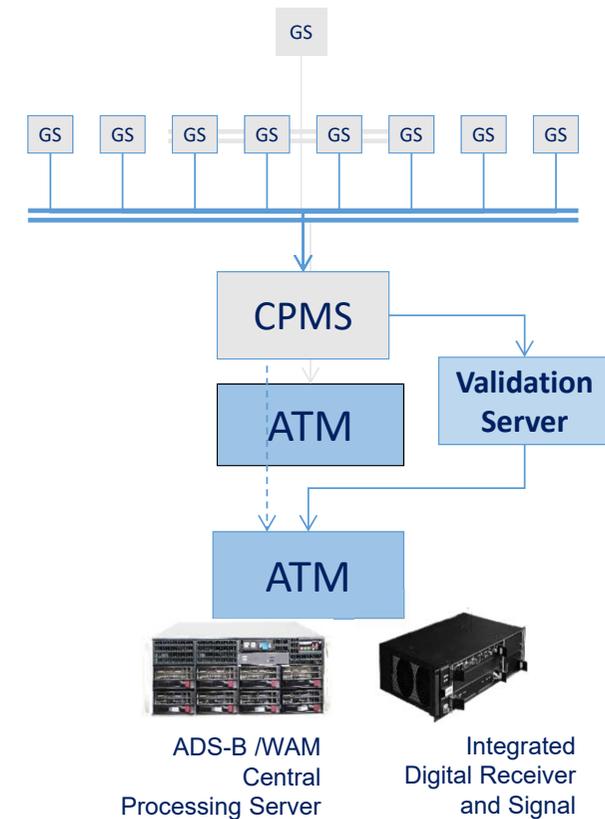
Multi-Level Threat Detection Approach

1. Single Ground Sensor Level (Frontend)
2. Central Processing Level
Multiple Ground Sensors of same Type
3. On ANSP Level Central Validation Server Level
Sensors of different Type (SSR, ADS-B, WAM, Flight plans)

Implementation verified and validated within SESAR

NEXT STEPS are Essential

- Define interoperable Surveillance Data Validation Message
- Define required Performance
- Standardize and certify



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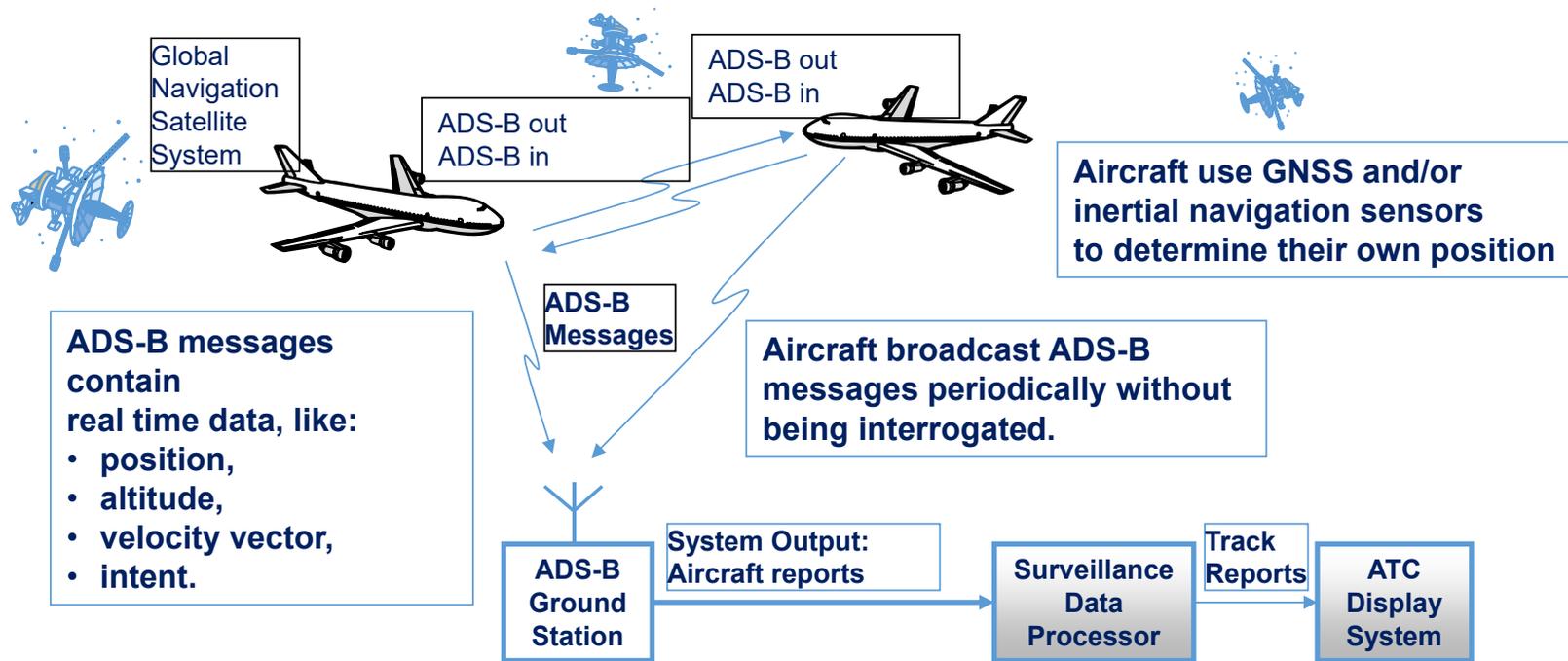
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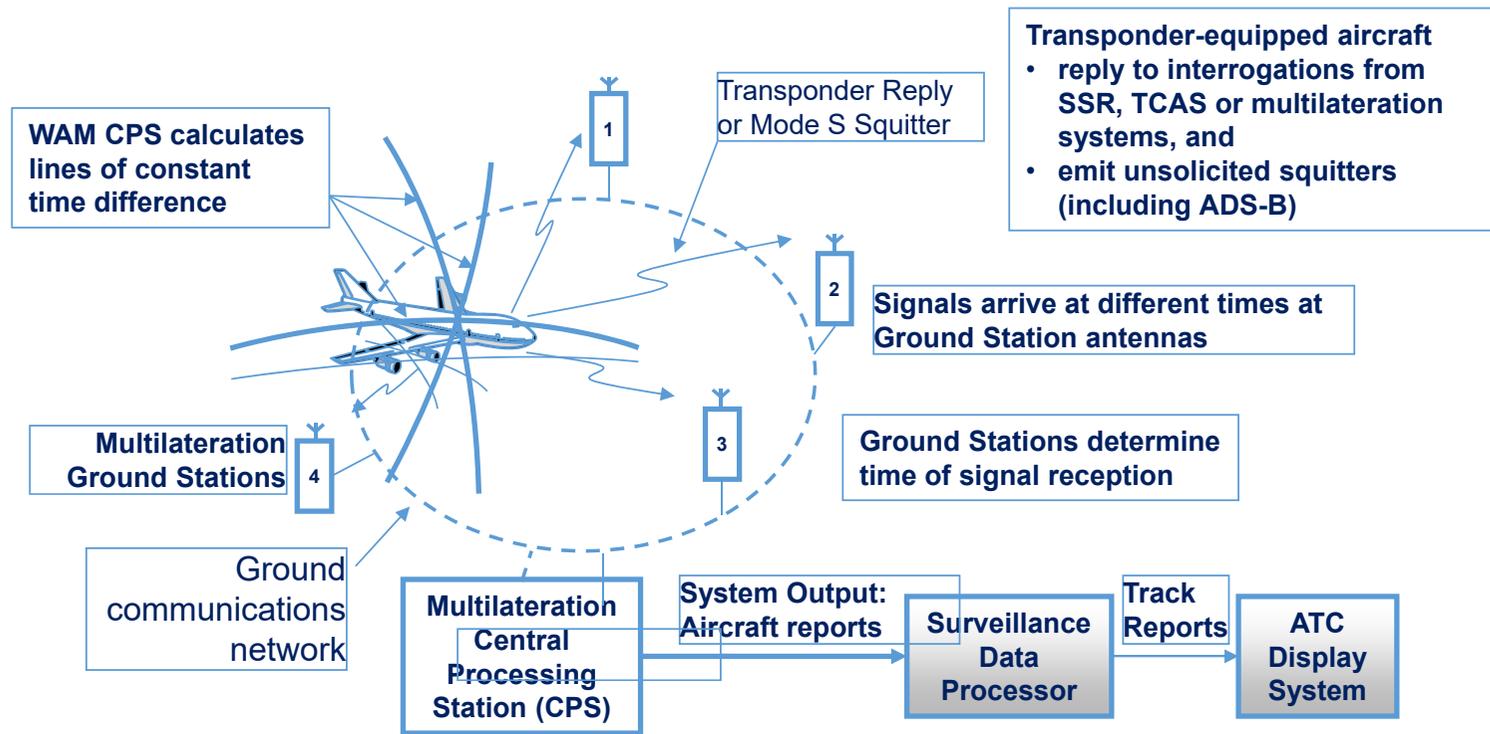
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ADS-B: Automatic Dependent Surveillance Broadcast



ADS-B receives Positions via Datalink

WAM: Wide Area Multilateration



WAM measures Positions

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ADS-B Cyber Security Protection



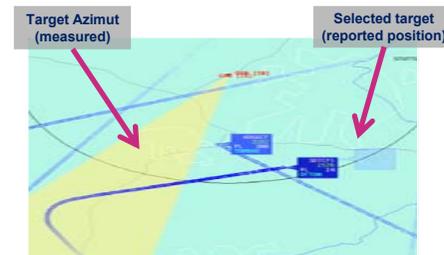
Cyber Security is a major focus in Thales Solutions



Thales extends Cyber Security
to security on radio interfaces



Special algorithms are implemented to manage
jamming and spoofing threats on all RF Interfaces



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ISSUES OF SPACE-BASED ADS-

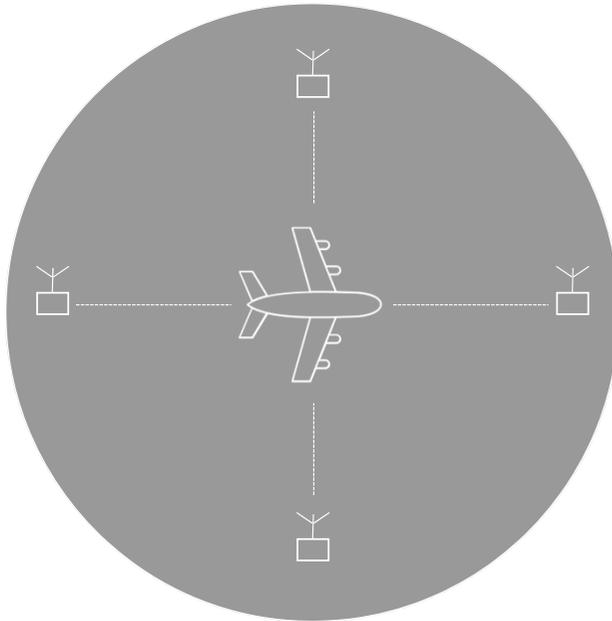
- Requires 100% aircraft ADS-B equipage for 100% surveillance coverage
 - special Mode S transponder with ADS-B transmission capability needed, connected to an onboard navigation data source)
- Limited position validation, no altitude validation of ADS-B targets

ISSUES OF WAM

- Vertical position accuracy cannot be used due to bad geometry
- Limited coverage range, particularly beyond borders and shorelines

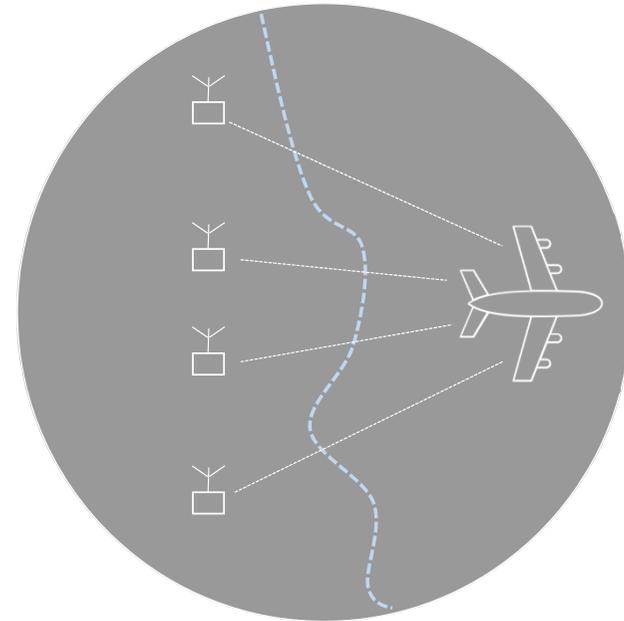
WAM Constellation Constraints

SUITABLE constellation
for horizontal position detection



TOP
VIEW

UNSUITABLE constellation
for horizontal position detection



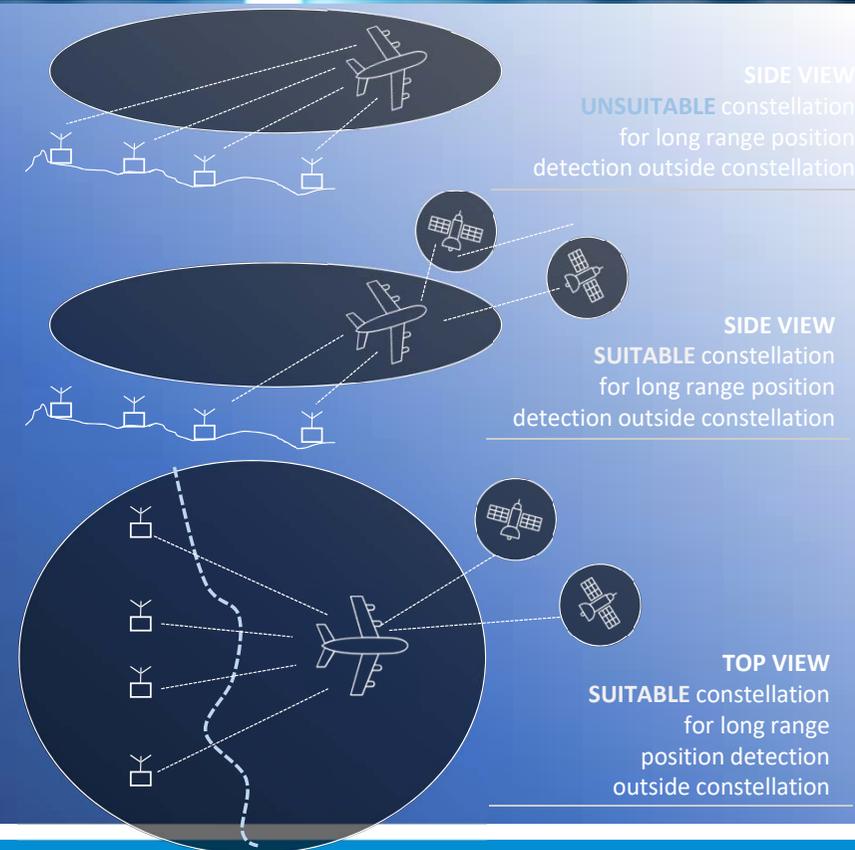
Possible Solution: Hybrid WAM

Satellites as “flying ground stations”

- Satellites as additional WAM ground stations
- All cooperative targets detected
- All ADS-B targets positively validated

Combine with terrestrial ground stations

- Combine space-based reception of transponder signals (beyond ADS-B) with terrestrial reception of a WAM system
- Extend coverage range of WAM beyond limits, borders, or shorelines
- Verify ADS-B targets using WAM technology and/or active interrogation by the WAM system.



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THANK YOU

