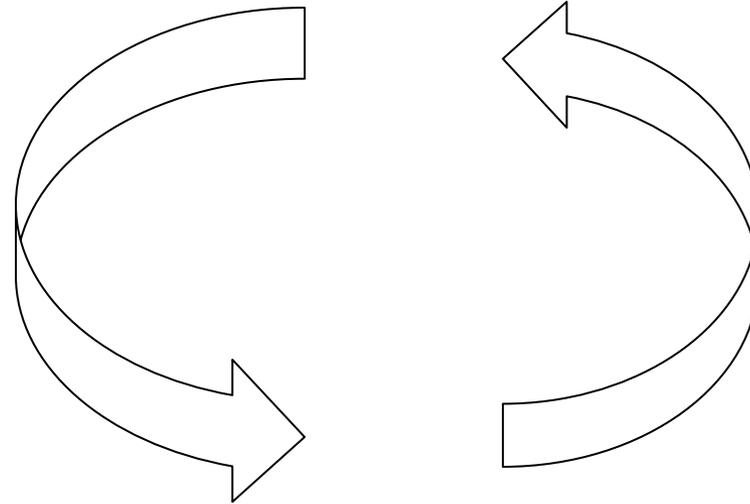# ASECNA ADS-B workshop

Dakar- 22-23th July 2014

Thales ADS-B Solutions
an update

THALES

> 1646

THALES

Mode S Transponder with Extended Squitter

TIS-B & FIS-B

ADS-B Ground station

TopSky ATM automation system with embedded TopSky Tracking

Vehicle tracking

HALES

AX680 series

◆ **Robust 19" equipment**

◆ **Hot-swap elements, maintenance free**

◆ **Redundant monitored fans, dual power supply**

◆ **Dual Ethernet Asterix interface, SNMP controlled**

◆ **Integrated GPS and Site Monitor**

◆ **Applications**

    ⊙ ADS-B

    ⊙ ACAS and Spectrum Monitoring

    ⊙ Surveillance Broadcast Services

    ⊙ Airport Multilateration

    ⊙ Wide Area Multilateration

Top cover

Air Inlet, Fan, dust filter

HW inside:
Integrated Receiver/Signal Processing Board
Digital, software-defined radio
Sensitivity -91 dBm
Mode A/C/S, 1090 ES ADS-B Decoding

THALES

Based on AX680 ADS-B Ground Stations

- **Without central compontent – „ADS-B Standalone"**
  - Airservices Australia – Upper Airspace Program
  - DGAC Indonesia – Nationwide ADS-B Deployment Program
  - FAA – Surveillance Broadcast Services Program

- **With central component (ADS-B server) – „ADS-B Centralised"**
  - Hong Kong Civil Aviation Department – ADS-B Program
  - DFS Germany – PAM FRA, WAM and ADS-B Program
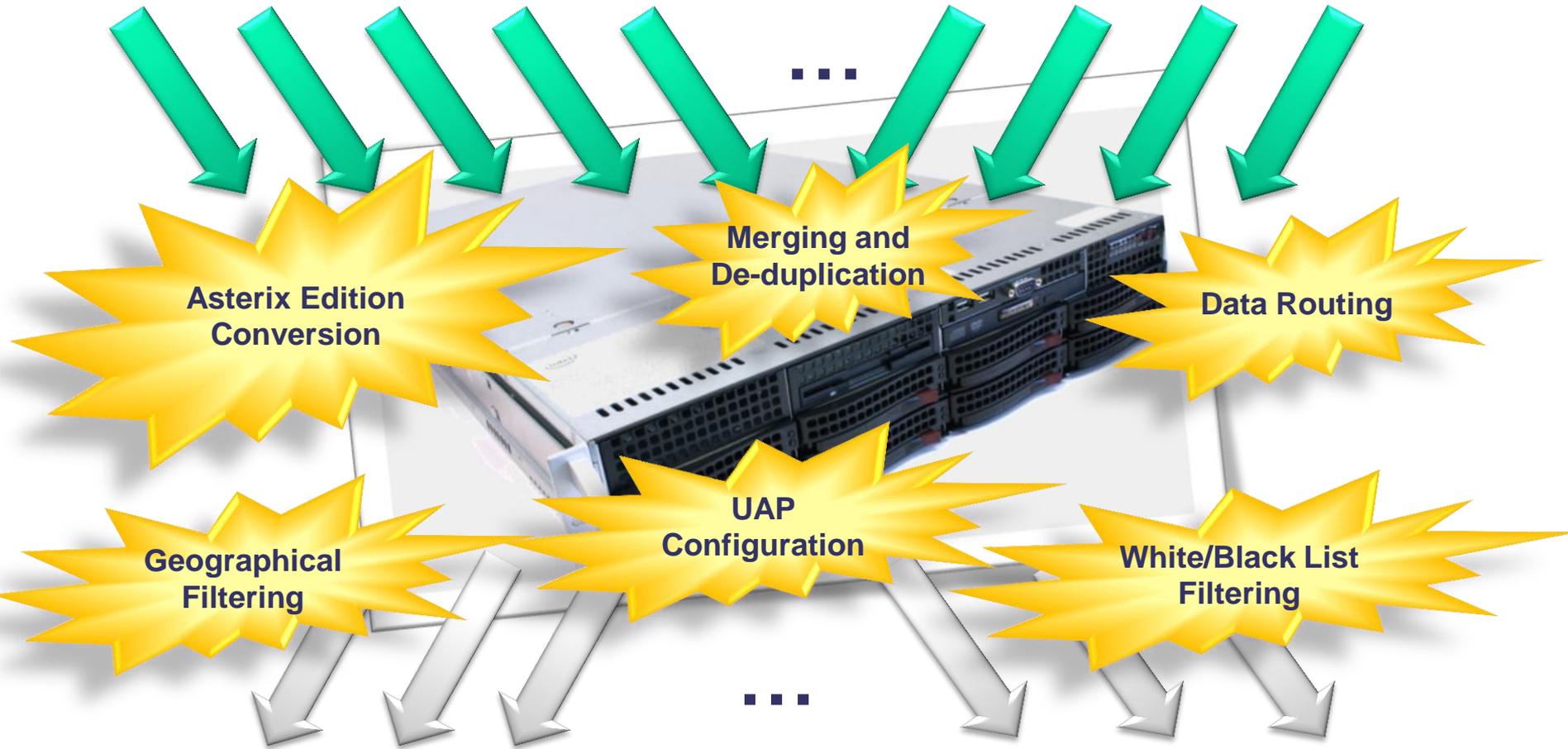 - DTI France – Lyon and Nice Airports, Multilateration and ADS-B Program

Compliant to international standards, including

- **ED129 (ADS-B) and ED129A (published 2014) and ED129B (planned 2015)**
- **ED102A/DO260B (ADS-B MOPS)**
- **ED126, ED161, ED163 ADS-B SPR for NRA, RAD, APT**
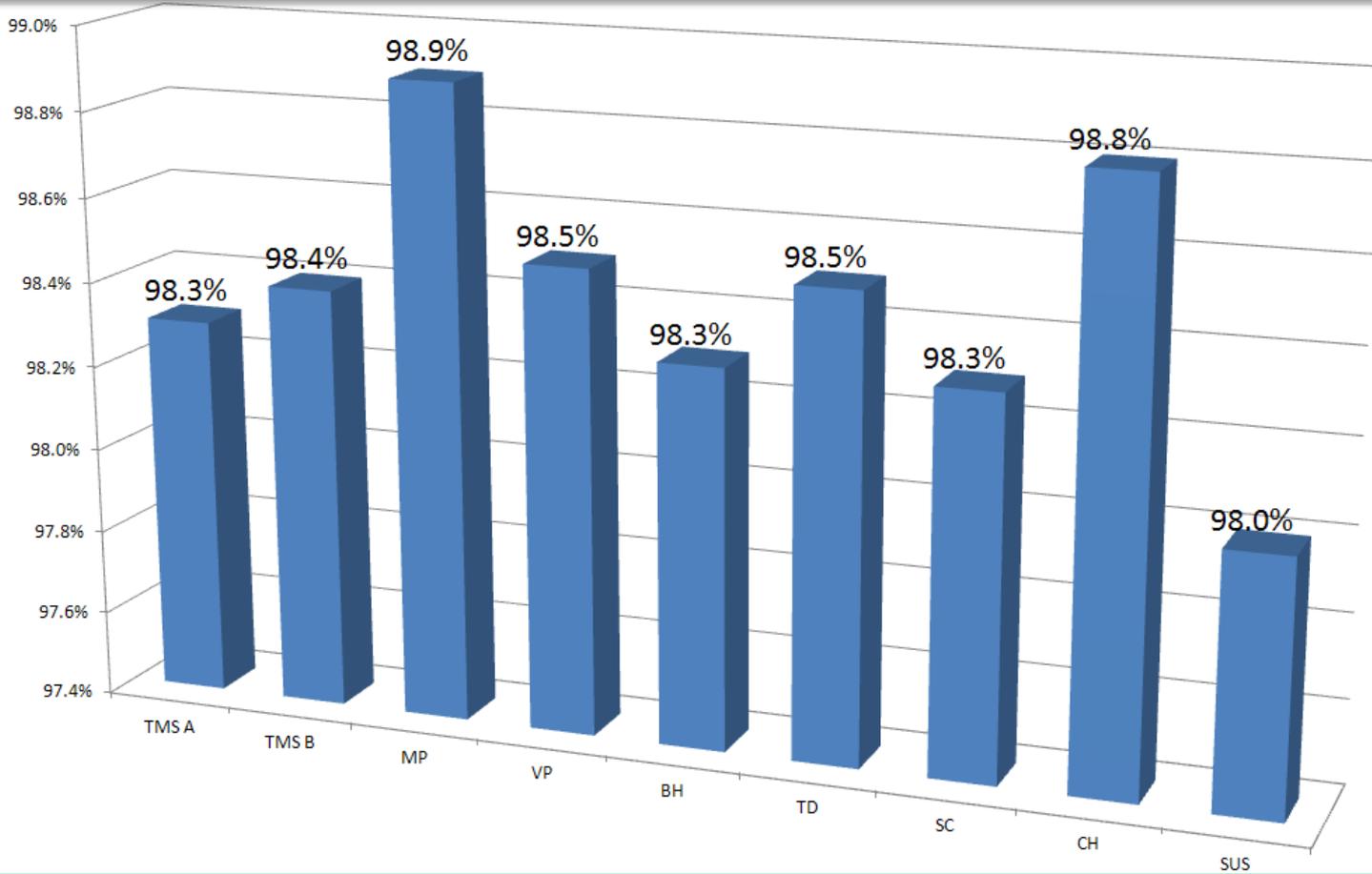- **ED109A / DO278B AL4 (Software Design Process)**

THALES

ASTERIX CAT21 Ed.0.23, 0.26 and 2.1   (from any vendor)

...

Asterix Edition Conversion

Merging and De-duplication

Data Routing

Geographical Filtering

UAP Configuration

White/Black List Filtering

...

ASTERIX CAT21 Ed. 0.23, 0.26 and 2.1   (to any client system)

THALES

Probability of detection of individual sites….

… combined by ADS-B Server to PD 99.5%

THALES

Standards exist, are being refined

- **Signal in space: RTCA DO260B / Eurcoae ED 102A**
- **Ground Station Specifications: ED129A to be released 2014**
- **Extended to full System Specification ED 129B ongoing, planned for 2015**

Interfaces are clearly defined

- **Asterix Cat 21 edition 0.23 (de facto standard)**
- **Asterix Cat 21 edition 2.1 (latest stable version)**

Ground and airborne equipment is available

- **Type approved**
- **Operational performance, in service**

Operational introduction – however – is globally slow

So what is missing?

THALES

International Regulations

Europe:

- **Surveillance Performance & Interoperability Implementing Rules (SPI IR 1207/2011)**
  - ADS-B mandate for aircraft MTOW > 5.7t or TAS > 250kts
  - Baseline ED102A / DO260B
  - Forward Fit/Retrofit: 2015/2017
  - Proposed Amendment:
    - Extend ADS- mandate to all aircraft mandated to carry a transponder
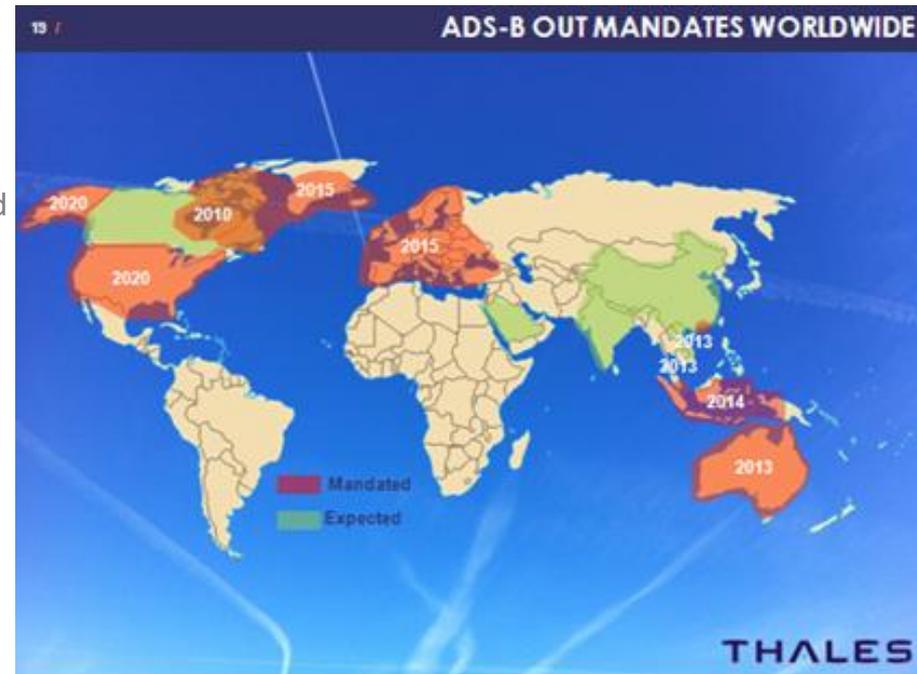
Other Countries

- **China: HK SAR Dec 2013**
  - Mandate for HKFIR (>FL290)

- **Australia Dec 2013**
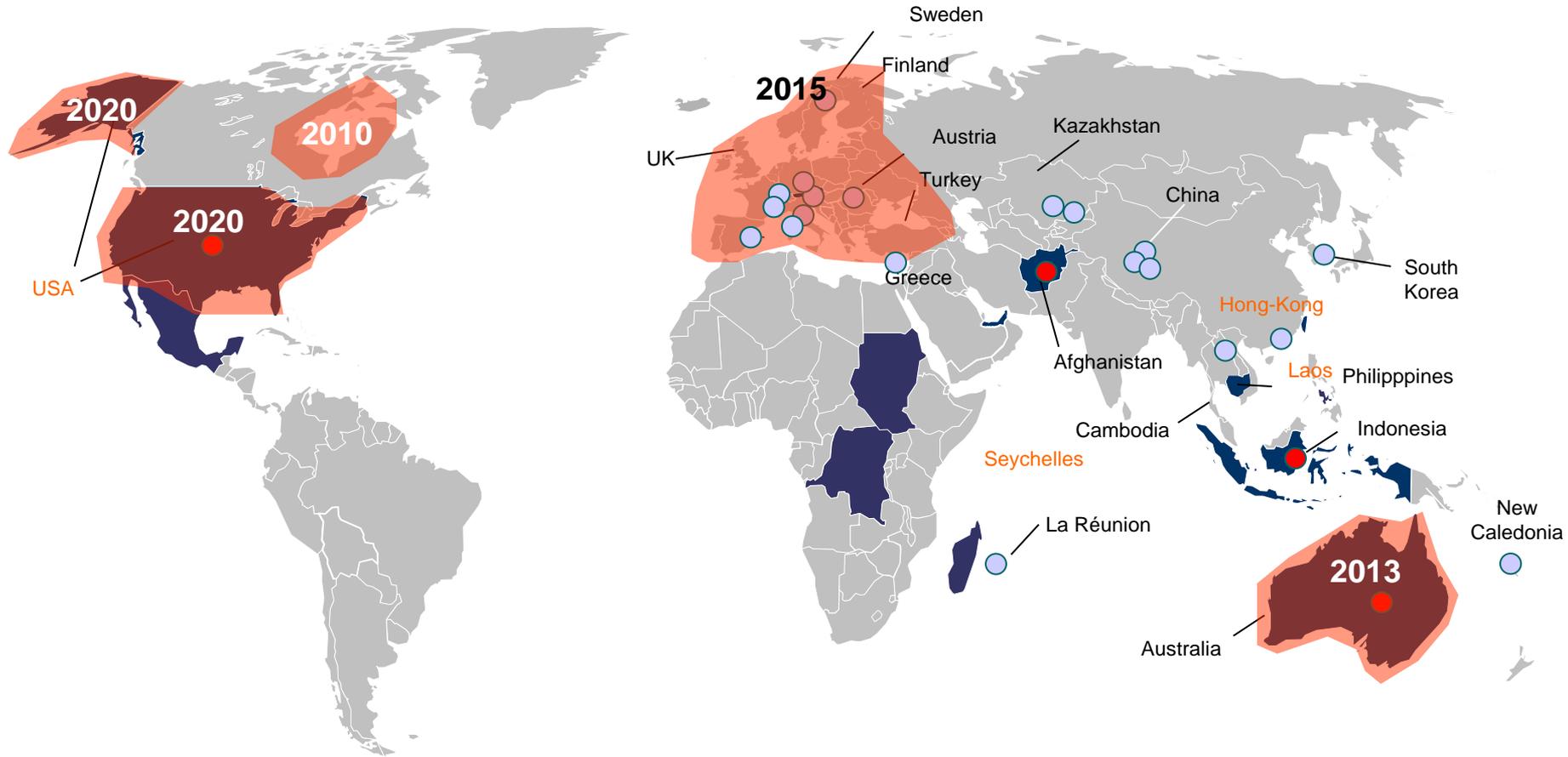 - Mandate for Upper Airspace (> FL290)
  - Baseline DO260A

- **USA 2020**
  - ADS-B Mandate for class A,B,C airspace (+class E > 10kft)
  - Baseline DO260B

Not explicitly mentioned here:
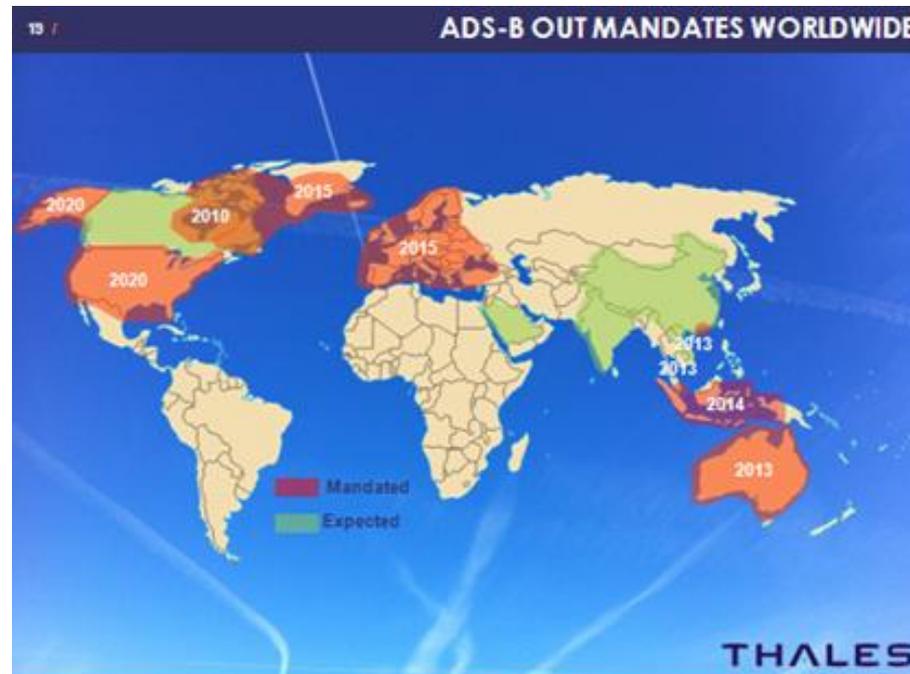Canada, Iceland, India, Indonesia, Singapore, Vietnam, Fiji

THALES

ADS-B Out capable aircraft and Thales based ADS-B infrastructure

Aircraft equipage mandates

1. ADS-B Aircraft Equipage levels

2. ADS-B Integrity and Security

3. ADS-B increased bandwidth

THALES

Barrier can be removed by:

◆ **providing unique benefits to equipped aircraft and separating ADS-B from non-ADS-B traffic, or**

◆ **issuing mandates, as in e.g. AUS, EU, US**

Plus many others, not mentioned here: e.g. Canada, India, Indonesia, Hong Kong, Singapore, Vietnam, Fiji…

Barrier is removed by:

◆ **adding integrity and security layers to ground system**

  ○ ADS-B Integrity: SESAR WP15.4.5

  ○ ADS-B Security: SESAR WP15.4.6

  ○ CyberSecurity: Thales Initiative

Implementing means

- **on ground station level (decentralized), and**

- **in a centralized ADS-B Validation Server**

- **from simple data consistency checks to additional measurements,**

- **fraud detection, and,**

- **jamming detection**

Prevent
- Threat Assessment
- Design Requirements
- Software, Hardware Standards
- Intelligence/ Interdiction

Respond
- SW / HW Updates
- Operational Updates
- Incident Response
- Event/ Threat Sharing

Detect
- Event Assessment
- Event Analysis
- Event Intelligence

- **Defined new Asterix cat 21 to include validation results (edition 2.1)**

- **Implementation validated by Eurocontrol**

Further Roadmap

- **Integrity Overlay based on 1090 MHz Phase Overlay (long term)**

CyberSecure Air Traffic Management

CyberSecure ADS-B

THALES
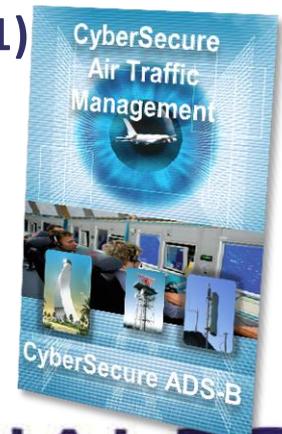
Overlay Concept

◆ **ATC Overlay uses Phase Data within the PPM signals**

◆ **8PSK Max Transmit/Receive Range Matches PPM Max Range Capability (Currently being worked by ICAO ASP TSG)**
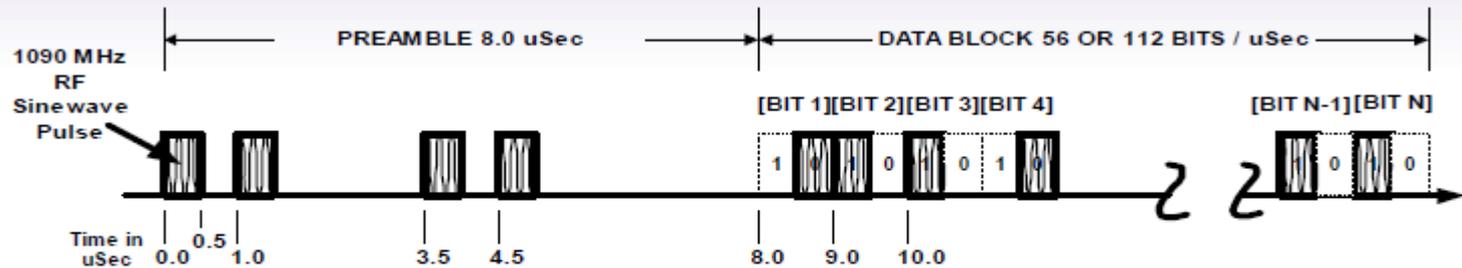
The first 8 pulses are used as reference. The phases of data bits are compared against the reference phases. More phases create more data bits.

◆ **Provides More Data Bits With Each Standard ATC PPM Message (up to 3 times : from 695 b/s up to 2 Kb/s for ES)**

◆ **Backward Compatible : Phase Modulation Not "Seen" By Existing TCAS / Radar Equipment**

THALES

Overlay Concept

- ◆ **Provides More Data Bits With Each Standard ATC PPM Message (up to 3 times : from 695 b/s up to 2 Kb/s for ES)**

- ◆ **Backward Compatible : Phase Modulation Not "Seen" By Existing TCAS / Radar Equipment**

Overlay Datalink Potential Uses

- ◆ **More ADS-B Data Bits For New Applications Such as: Met. Data, ATC ground control, Trajectory Change Points, Wake Vortex information/alerts**

- ◆ **DO-260 Appendix Of Possible Future ADS-B Uses Still Growing**

- ◆ **Use For Directed Overlay Messages To A Particular AircraftFor Parallel Approach/Path Crosslink Data or M&S Crosslink Data**

- ◆ **Increase (or replacement) Of Mode S DAPS Type Messages**

- ◆ **Mode S Reply Increased Data Rate DF22**

- ◆ **Bit Error Correction of Standard PPM Data Bits Improves Standard ADS-B Or Mode S Reply Interference Immunity**

THALES

Overlay Datalink Potential Uses

◆ **More ADS-B Data Bits For New Applications Such as: Met. Data, ATC ground control, Trajectory Change Points, Wake Vortex information/alerts**

◆ **DO-260 Appendix Of Possible Future ADS-B Uses Still Growing**

◆ **Use For Directed Overlay Messages To A Particular AircraftFor Parallel Approach/Path Crosslink Data or M&S Crosslink Data**

◆ **Increase (or replacement) Of Mode S DAPS Type Messages**

◆ **Mode S Reply Increased Data Rate DF22**

◆ **Bit Error Correction of Standard PPM Data Bits Improves Standard ADS-B Or Mode S Reply Interference Immunity**

THALES

Thales ADS-B Solution

◆ **Easy to implement**

◆ **Extremely reliable and robust solution - maintenance free**

◆ **Extremely low lifecycle cost**

◆ **Type approved and certified by German Regulator**

◆ **High performance system**

    ○ Long range

    ○ High processing capacity

◆ **Safe and secure implentation**

    ○ on ADS-B level

    ○ on network level – Thales CyberSecurity

◆ **Centralized or standalone architecture – tailored to customer needs**

◆ **Growth potential towards full WAM, Airport MLAT, and SBS System**

THALES

THANK YOU

THALES

ADS-B-NRA	Non Radar ADS-B
ADS-B-RAD	Radar Area ADS-B
APV	Approach with Vertical Guidance
ATSA	Airport Traffic Situational Awareness
DSL	Digital Subscriber Line - Ethernet protocol (ADSL
EUROCAE	European Organisation for Civil Aviation
FIS	Flight Information Service
FO	Optical Fiber
GNSS	Global Navigation Satellite System
HFOM	Horizontal Figure Of Merit
HPL	Horizontal Performance Level
IR	Implementing Rule
Mode S EHS	Enhanced Mode S
Mode S ELS	Elementary Mode S
MOPS	Minimum Operational Performance Standard
MSTS	Multi Sensor Tracking System
NACp	Navigation Accuracy Category for position
NIC	Navigation Integrity Category
NUC	Navigation Uncertainty Criteria
RNP	Required Navigation Performances
RTCA	Radio Technical Commission for Aeronautics
SA ON	Selective Availability On
SBAS	Satellite Base Augmentation System
SIL	Surveillance Integrity Level
SPI	Surveillance Performance and Interoperability
TIS	Traffic Information System
UAT	Universal Access Transponder (?)

THALES