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Thales' expertise in ADS-B WAM/MLAT Technologies

10TH FEBRUARY 2021

**Better
Skies
Together**

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Thales and ICAO “ADS-B WAM/MLAT Technologies” Webinar



How Thales ADS-B / WAM/MLAT technologies help ANSPs to face the global surveillance challenge in LATAM & Caribbean regions?



Como las tecnologías ADS-B / WAM/MLAT de Thales ayudarán a los ANSPs para enfrentar el desafío de la vigilancia global en las regiones de LATAM y el Caribe?

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Agenda - Topics



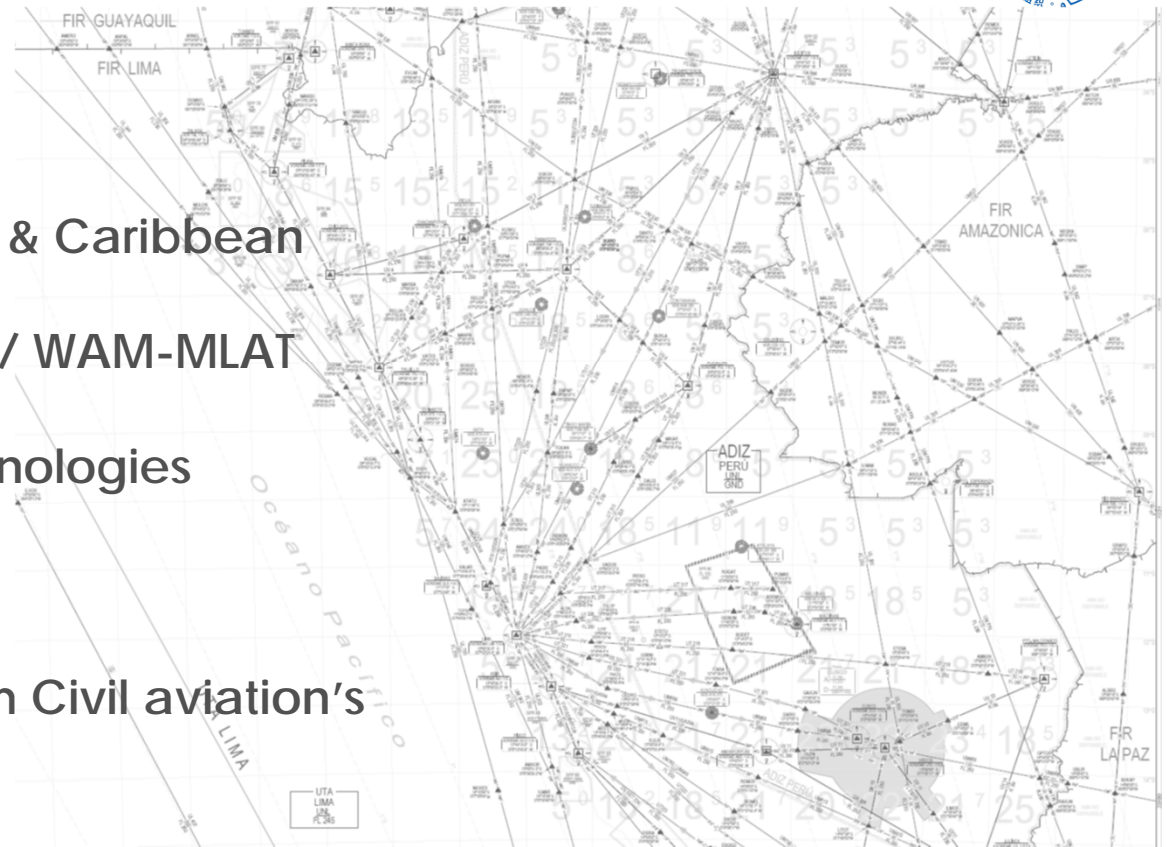
Panama time (GMT-5)

From	Until	Topic	Person	Role
10:00	10:05	ICAO introduction	Mayda AVILA	Regional Officer, Communications, Navigation and Surveillance
10:05	10:20	Thales' missions in LATAM & Caribbean	Pablo FERNANDEZ IZQUIERDO	Business Development Manager for LATAM & Caribbean
10:20	10:35	Thales' Expertise in ADS-B / WAM-MLAT	Todd DONOVAN	VP Business Development Manager for Thales Americas
10:35	11:20	ADS-B & WAM/MLAT technologies	Eva PAPANIKITA	Business Development and Bid Manager
11:20	11:30	<i>SENEAM surveillance capabilities</i>	Salvador LOZANO	Aeronautical Surveillance Systems Specialist Technician
11:30	11:50	Questions & Answers	All	-
11:50	12:00	Workshops proposals from Civil aviation's	Pablo FERNANDEZ IZQUIERDO	Business Development Manager for LATAM & Caribbean

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Agenda

- ICAO Introduction
- Thales' missions in LATAM & Caribbean
- Thales Expertise in ADS-B / WAM-MLAT
- ADS-B & WAM/MLAT technologies
- Questions & Answers
- Workshops proposals from Civil aviation's



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Todd DONOVAN



Vice President, Airspace Mobility Solutions – Americas



Todd Donovan has extensive global air traffic management experience, with more than 25 years of technical and leadership roles in the aviation industry. Currently, Donovan leads the Airspace Mobility Solutions business for the Americas region for **Thales** – responsible for supporting aviation stakeholders in leveraging technology to deliver safe, secure and reliable airspace operations including incorporation of new entrants, such as UAS, in to the airspace. Donovan serves on the CANSO Strategy and Integration Standing Committee and CANSO UTM Task Force.

Donovan received a BA from Dartmouth College, a BE from Thayer School of Engineering at Dartmouth College and an MBA from Emory University.



Todd Donovan tiene una amplia experiencia en la gestión del tráfico aéreo mundial, con más de 25 años de funciones técnicas y de liderazgo en la industria de la aviación. En la actualidad, Donovan dirige el negocio de Soluciones de Movilidad del Espacio Aéreo para la región de las Américas de Thales, responsable de apoyar a las partes interesadas de la aviación en el aprovechamiento de la tecnología para ofrecer operaciones de espacio aéreo seguras y fiables, incluyendo la incorporación de nuevos participantes, como los UAS, en el espacio aéreo.

Donovan forma parte del Comité Permanente de Estrategia e Integración de CANSO y del Grupo de Trabajo UTM de CANSO.

Donovan se licenció en el Dartmouth College, se licenció en la Thayer School of Engineering del Dartmouth College y obtuvo un MBA en la Emory University.



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Pablo FERNANDEZ IZQUIERDO

Business Development Manager for LATAM & Caribbean



27 years of experience in different companies and sectors, dedicating the last 20 years to the aeronautical business in different roles. Actually Currently **Business Development Manager** for **Thales** - responsible to promote the Thales systems and services around LATAM & Caribbean.

Computer Engineer from Universidad Pontificia de Comillas (ICAI) and Executive MBA from ISNIB.



27 años de experiencia en diferentes empresas y sectores, dedicando los últimos 20 años al negocio aeronáutico en diferentes roles. Actualmente es **Business Development Manager** de **Thales** - responsable de promover los sistemas y servicios de Thales en LATAM y Caribe.

Ingeniero Informático por la Universidad Pontificia de Comillas (ICAI) y Executive MBA por el ISNIB.



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PANAMÁ City, REP DE PANAMÁ

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pablo.fernandez@thalesgroup.com

Thales

Eva PAPANIKITA

Business Development support and Bid Manager



Extensive experience in systems at Thales and in aeronautical environments. Degree in physics, she has worked for Thales Germany for 8 years in non-radar surveillance systems.

She currently works as a **Business Development Support and Bid Manager** for non-radar surveillance systems opportunities at **Thales**.



Cuenta con una gran experiencia en sistemas en Thales y en entornos aeronauticos. Licenciada en físicas, trabaja para Thales Germany desde hace 8 años en los sistemas de vigilancia no radar.

Actualmente trabaja como **Soporte de Desarrollo Comercial y Gerente de Ofertas** para oportunidades de sistemas de vigilancia no radar en **Thales**.



Office

Thales Deutschland

Eva Papanikita

Bid Manager and Business Development
Manager NRS

Thalesplatz 1 - 71254 Ditzingen – Germany

Contact

Eva.Papanikita@thalesgroup.com

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- ICAO Introduction
- **Thales' missions in LATAM & Caribbean**
- Thales' expertise in ADS-B / WAM-MLAT
- ADS-B & WAM/MLAT technologies
- Questions & Answers
- Workshops proposals from Civil aviation's



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Thales Group global overview



Over **83,000**
employees

68
Countries
Global presence

1 bn €
Self-funded R&D*

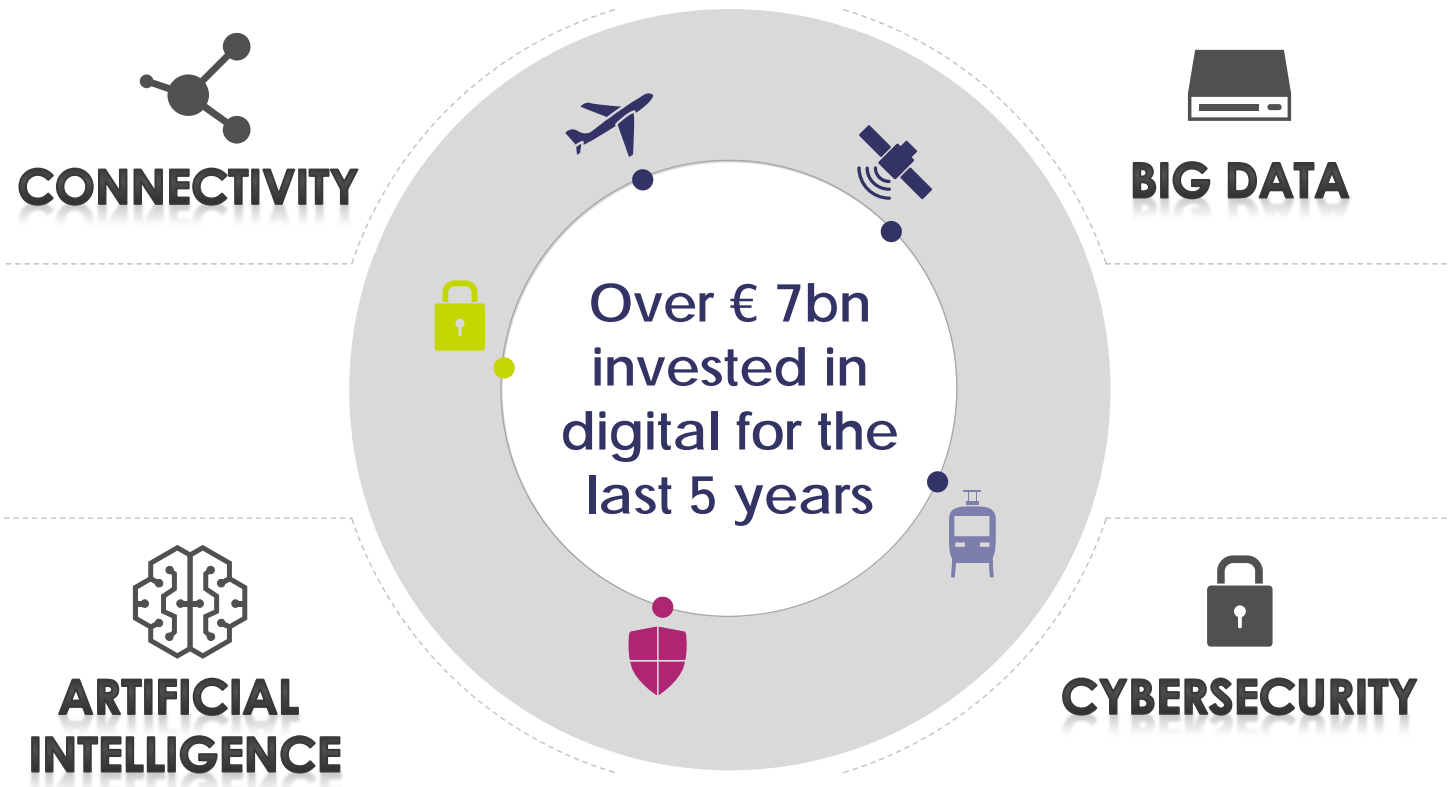
* Does not include externally financed R&D.

Sales in 2019
19 bn €

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Thales Group, Key Digital Technologies

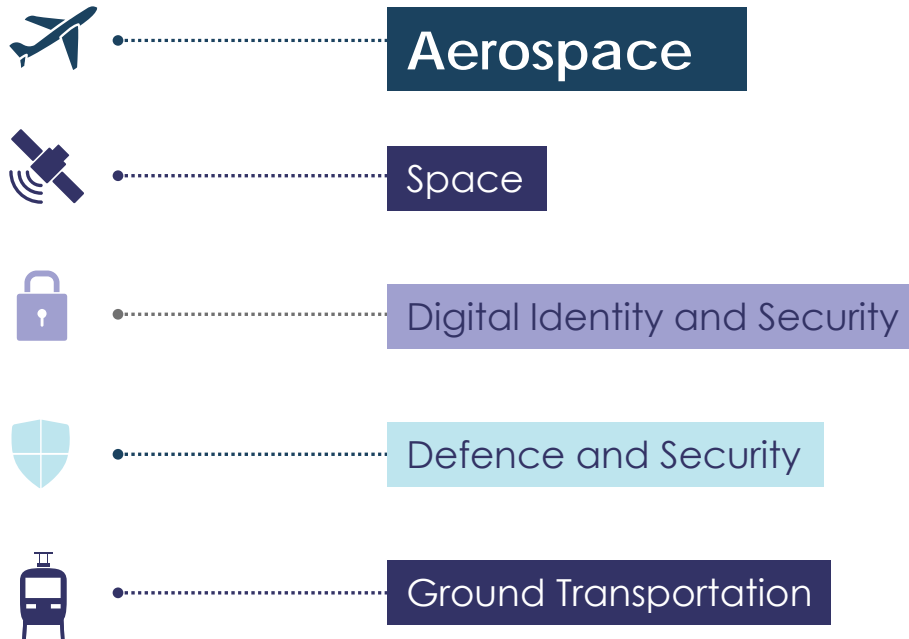


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Thales Group missions



Sensing & data gathering



Data transmission & storage



Data processing & decision making

We help customers master decisive moments by providing the right information at the right moment

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Aerospace: Make flying safer, easier and more efficient



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- Air traffic management (AMS)
- Training and simulation
- Nose-to-tail aircraft connectivity
- In-flight services

1bn passengers use Thales in-flight entertainment systems every day.

Over **160** Air Traffic Management control centres around the world are equipped by Thales.

Between them, they cover more than **40%** of global airspace.

60% of air traffic in China, is managed by Thales solutions.

2 out of 3 aircraft in the world take off and land using Thales equipment.

Training & simulation for civil and military helicopters and aircraft.



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THALES

AMS - Worldwide operations



1600
employees



500M
sales

Main Customers



Air Navigation
Services Authorities



Civil Security



Airports



Military Airbases

GLOBAL REACH



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AMS - Trusted by 180 countries



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AMS - Solutions respond to all air traffic management needs



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AUTOMATION



Air Traffic Control Centers and towers

Air Traffic Flow and traffic sequencing

Integration of UAS

AIM

AMHS

NAVIGATION AIDS



Landing systems

- **ILS** - Instrument Landing System
- **DME** - Distance Measuring Equipment

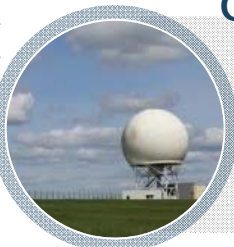
En route and approach systems

- **CVOR** - Conventional VOR
- **DVOR** - Doppler VOR
- **DME**
- **TACAN**

Mobile Nav aids

- **ILS**
- **TACAN**
- **DME**
- **CVOR**

GLOBAL SURVEILLANCE



- Radars L-Band
- Radars S-Band
- Radars Mode S

- **ADS-B / Automatic Dependent Surveillance Broadcast systems**

- **Airport Multilateration systems**
- **WAM Wide Area Multilateration systems**
- **Multi-Sensor Tracking**
- **Simulators**



Services

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THALES Video



Thales offices and factories in LATAM & Caribbean

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8 Sub-Regions



Mexico



Central America & Caribbean



Colombia



Peru & Ecuador



Brazil



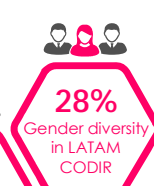
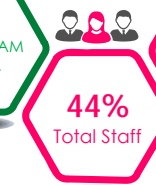
Bolivia



Chile



Argentina, Paraguay & Uruguay



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AMS – Presence in LATAM & Caribbean

- 

Mexico
ATC, AIM, AMHS, Simulation, **ADS-B**, Radar, Tower, Nav aids
- 

COCESNA
Nav aids, AMHS, AIM, **ADS-B**
- 

Panama
ATC, AIM, AMHS, Nav aids
- 

Colombia
ATC, Radar, Nav aids
- 


Ecuador
AMHS, AIM, Radar, Nav aids
- 

Haiti
AMHS
- 

Peru
Nav aids
- 

Chile
ATC, AIM, AMHS, Radar, Nav aids
- 

Bolivia
ATC, Radar, AMHS, Nav aids

- 

Sint Maarten
ATC, Radar



- 

Argentina
Radar, Nav aids
- 

Paraguay
Nav aids

- 

Bahamas
Nav aids
- 

Dominican Rep.
ATC, Radar, Nav aids
- 

Curacao
Nav aids
- 

Antigua & Barbados
Nav aids
- 

Saint Barthelemy
ATC, **ADS-B**
- 

Aruba
ATC, Nav aids, AMHS, AIS, **WAM**, **ADS-B**
- 

Jamaica
ATC, Radar, Simu, AMHS, AIM
- 

Venezuela
Nav aids
- 

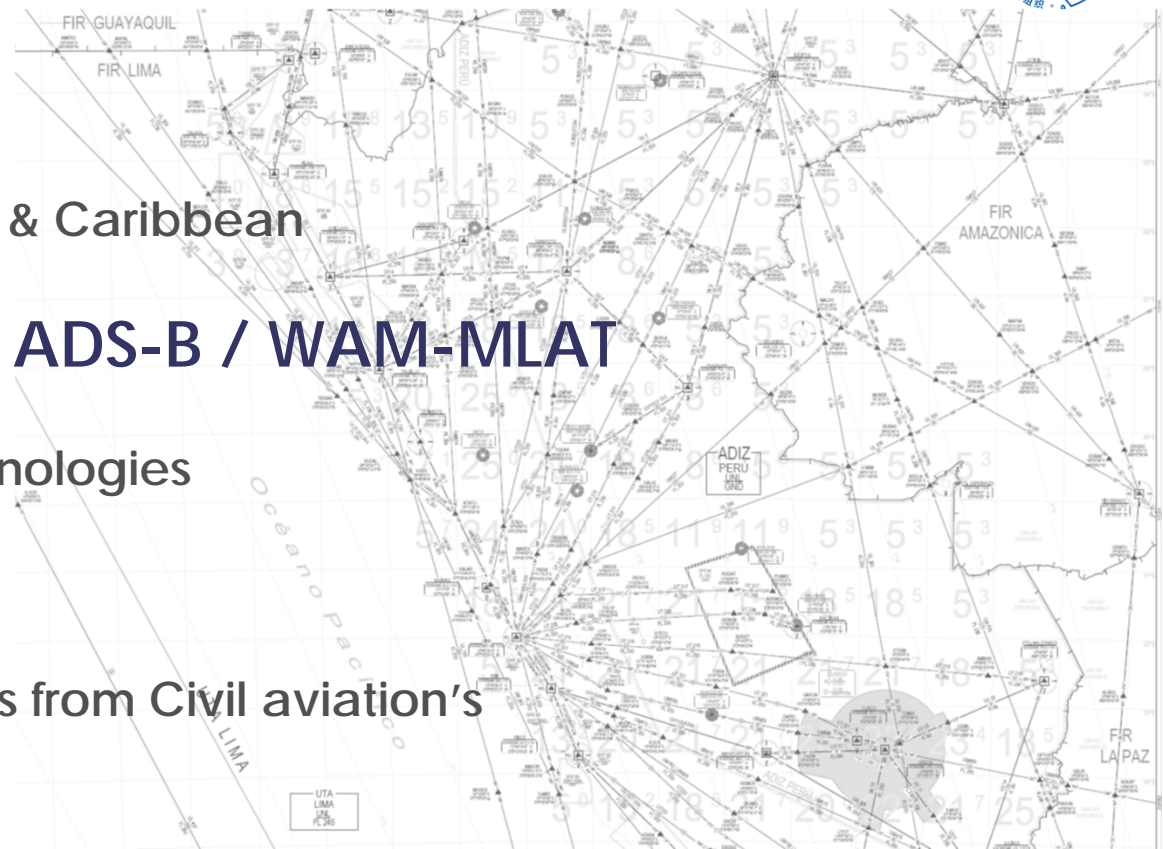
Brazil
Radar, Nav aids
- 

Uruguay
Radar, Nav aids

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- ADS-B & WAM/MLAT technologies
- Questions & Answers
- New Workshops proposals from Civil aviation's



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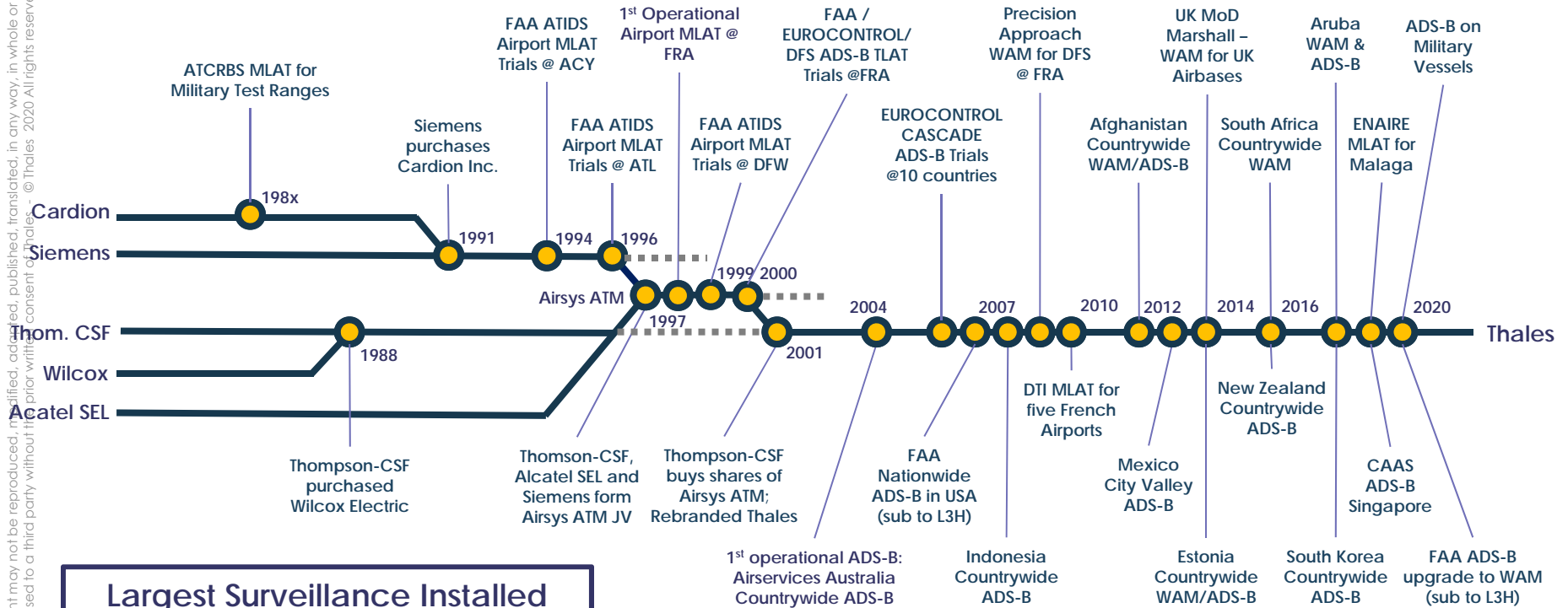
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Thales Is a World Leader in Non-Radar Surveillance

30+ Years of ADS-B, Multilateration & WAM Innovation and Deployments



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Largest Surveillance Installed Base in the World: 2,000+ Radios Deployed Globally

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Thales ADS-B Technologies At the Heart of FAA ADS-B Network

Trusted Partner to FAA/L3Harris for US National ADS-B Service



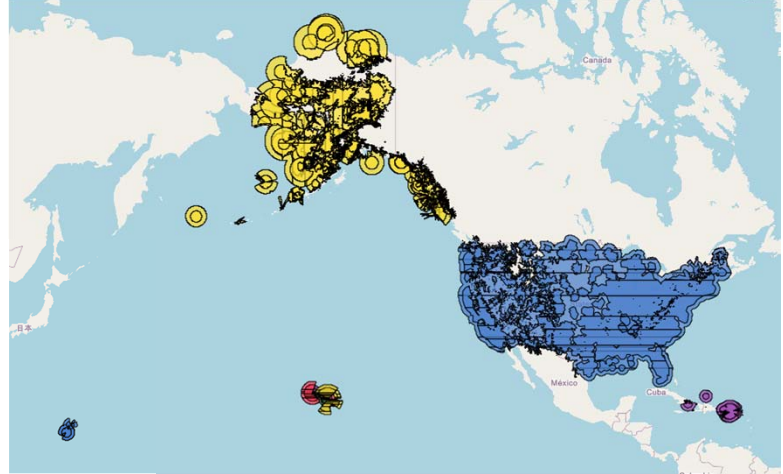
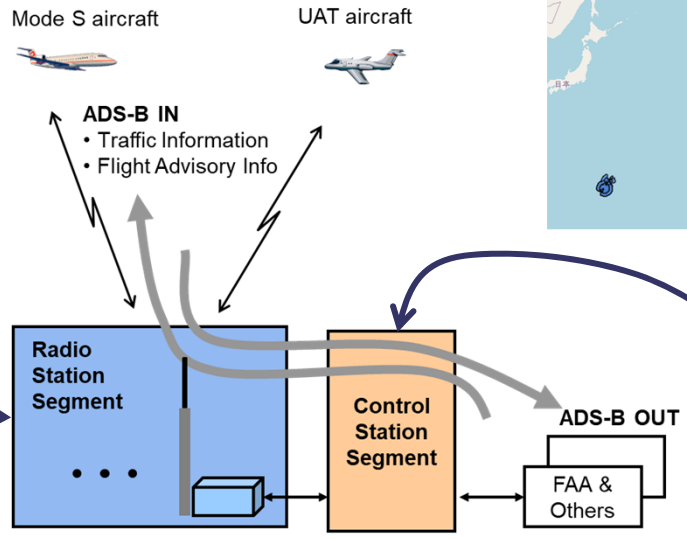
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1000+ Radios Deployed as part of L3Harris Managed Service for FAA

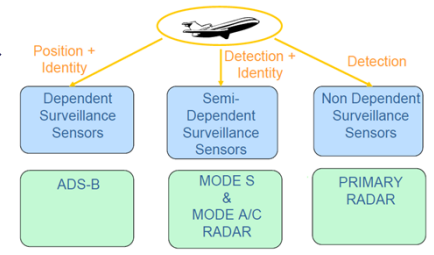


- Advanced Dual Link Radios**
- Mode S & UAT Data Links
 - ADS-B, ADS-R, TIS-B & FIS-B
 - Redundant Configurations
 - > 50M Hours of Operation

Simplified US ADS-B Architecture



Thales Multi-Sensor Tracker Fuses All Radar & ADS-B Data Across US



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Worldwide Non-Radar Surveillance References

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Thales has delivered more than 2,000 ADS-B and Multilateration Ground Stations around the World

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Thales Multilateration and Ground Surveillance Product

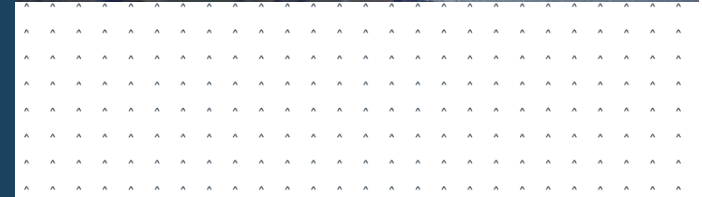


- Surveillance sensors based on Aircraft Transponder

- ❖ ADS-B – Automatic Dependent Surveillance Broadcast systems
- ❖ MLAT – Airport Multilateration systems
- ❖ WAM – Wide Area Multilateration systems
- ❖ Multi-Sensor Tracking Systems
- ❖ TopSky automation center

- Systems implementing last regulation requirements

- Latest technologies to offer cost effective architecture

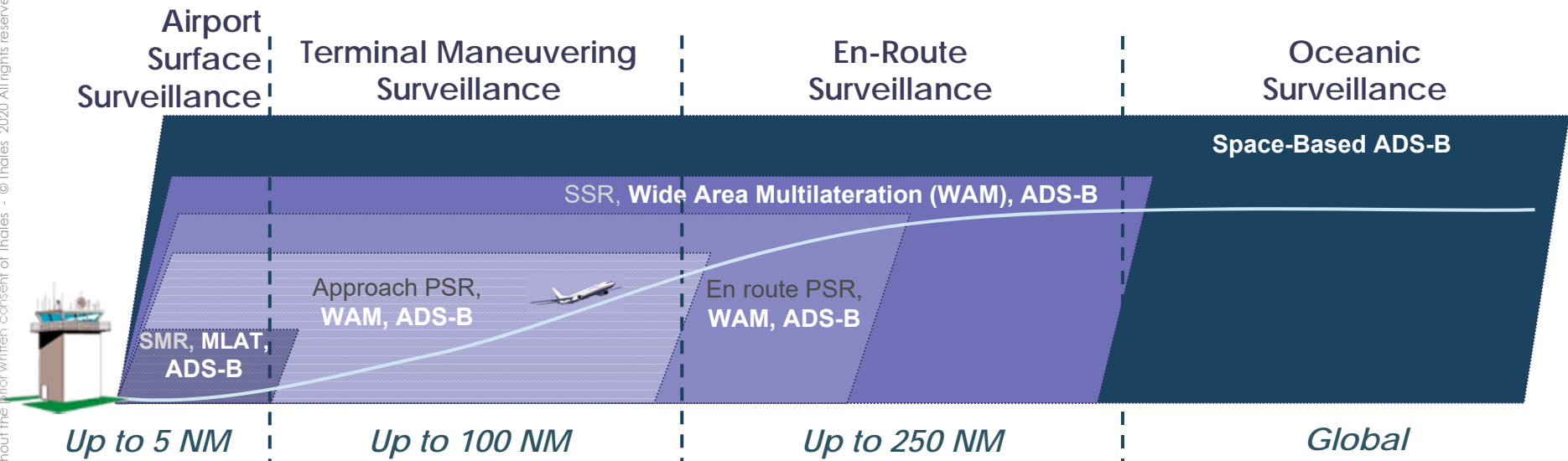


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Where to use our Non Radar Surveillance solutions?

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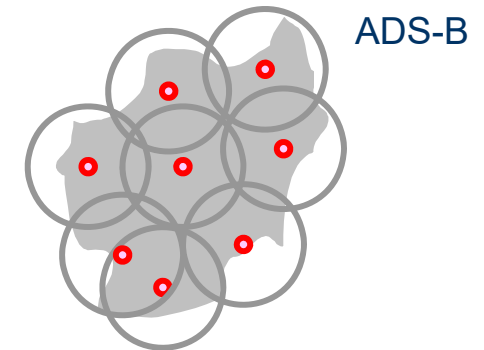
Thales Multilateration and ADS-B Ground Surveillance applications depends on

- Area to be covered (Airport Surface, Approach, CTR, TMA, FIR)
- Altitude to be covered, Flight Level

Comparison ADS-B vs Multilateration



CRITERION	ADS-B	MULTILATERATION
Ground Equipment	Single Ground Station for coverage	Multiple Ground Stations for coverage
Position Source	Dependent Surveillance: Onboard Navigation Position via Datalink, usually based on GPS	Independent Surveillance: Own Measurement of Position
Operational Principle	Passive	Passive/Active (e.g. interrogating for baro altitude)
Equipage	Needs ADS-B – capable Mode S transponder	Needs Mode S or Mode A/C transponder, also supports ADS-B
Coverage	As defined by ground station antenna and terrain	Tailored by ground station deployment
Ground Communication Network is needed to each Ground Station		



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Fully compliant with applicable International Standards



Automatic Dependent Surveillance Broadcast (ADS-B)

- Standalone ADS-B
- Centralized ADS-B

ED129B

Multilateration Systems

- Airport Multilateration Systems (MLAT)
- Wide Area Multilateration (WAM)

ED117(A)

ED142

Compliant to ADS-B MOPS

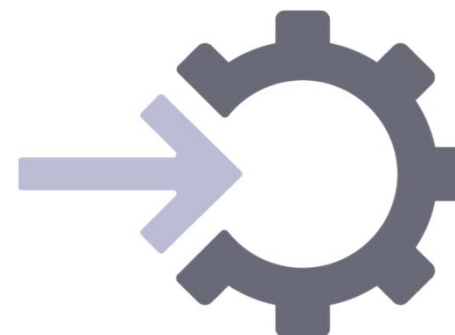
- DO260 / ED102, DO260A, DO260B / ED102A, (soon DO260C/ ED102B)

Compliant to DO278A (ED109A) : AL4

ED109A

Safety Performance Requirements

- DO303 / ED126 (ADS-B NRA)
- DO318 / ED161 (ADS-B RAD)
- DO321 / ED163 (ADS-B APT)





ASTERIX categories and editions

ASTERIX CATEGORY		APPLICATION
Cat. 10	Ed. 1.1	Multilateration on Airports
Cat. 19	Ed. 1.1; 1.3	WAM service and status reports
Cat. 20	Ed. 1.1; 1.5; 1.8 + REF*	WAM target reports
Cat. 21	Ed. 0.23; 0.26; 1.8; 2.1; 2.4 + REF*	ADS-B target reports (see NOTE)
Cat. 23	Ed. 0.11; 1.2 + REF*	ADS-B service and status reports
Cat. 25	Ed. 1.1	Generic CNS/ATM Ground System status reports
Cat. 34	Ed. 1.27	Pseudo Radar service and status reports
Cat. 48	Ed. 1.15	Pseudo Radar target reports
Cat. 247	Ed. 1.2	Version Number Exchange

*) REF (EUROCONTROL) = Reserved Expansion Field

Thales supports all ASTERIX editions

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Key benefits and expertise of our solutions

- Innovation to strengthen your performance
- High flexibility and scalability to tailor performances to your needs
- Easily configurable to satisfy the required safety and performance levels
- High accuracy, high refresh rate, dual synchronisation
- Successful implementation in multiple operational environments – From standard to complex system
- Able to provide ADS-B Surveillance simultaneous to Multilateration !
- Fulfils safety case requirements and Security features
- Early detection of planned and unplanned maneuvers of aircrafts
- Robust and proven equipment, Maintenance free



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Considerations for successful ADS-B/MLAT implementation

Existing surveillance infrastructure

- Easy colocation with Radar systems
- Easy Integration to ATC Systems

Location of sites

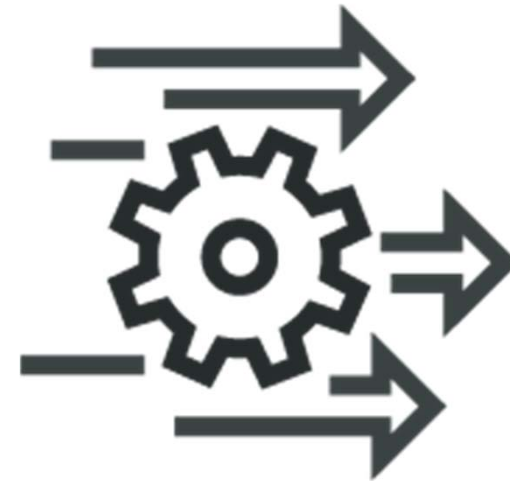
- Altitude (high altitude enables better coverage)
- Local constraints (mountains, buildings...oceanic)
- Accessibility

Available Infrastructure

- Communication network (low bandwidth required)
- Power supply (main power supply, UPS, Solar panels...)
- Indoor or outdoor installation

Required redundancy

- Partial or full redundancy
- Local or geographical redundancy



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Building Blocks combined into solutions

AX680 (Receiver)

NSTX (Transmitter)



Rack Indoor



Indoor Configuration

(same components inside)

Outdoor Configuration

BX680 RXB (Receiver)

BX680 TXB (Transmitter)

BX680 BTB (Uninterruptible Power Supply)

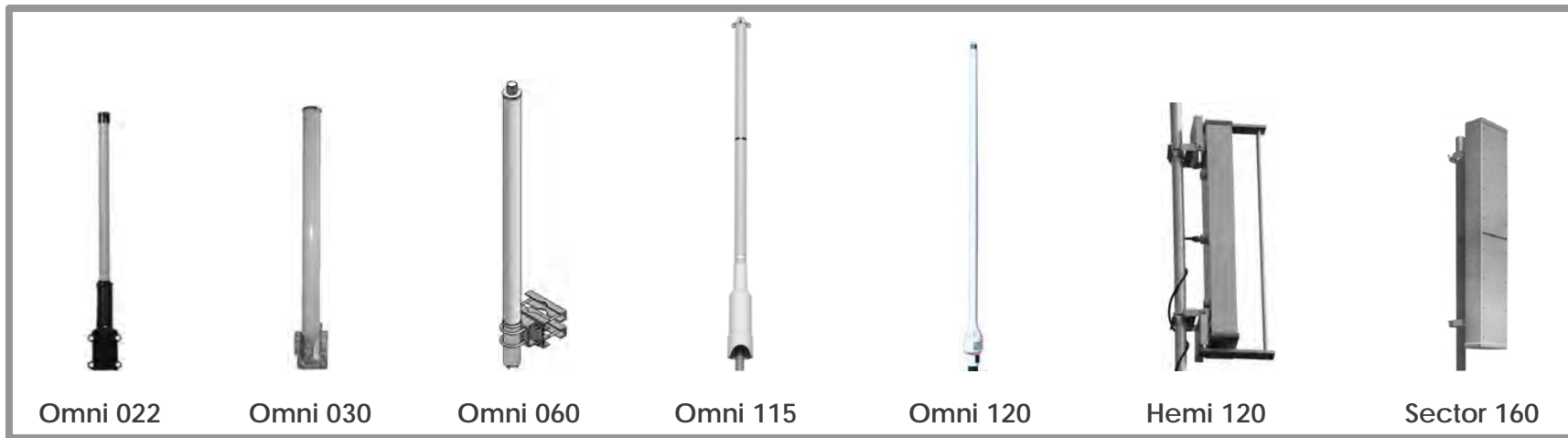


→ Cost



Wide Antennas portfolio to satisfy global coverage needs

- A complete range of antenna models mountable on buildings, towers, masts or similar structures
- Same RF antenna used for Receiver and Transmitter



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Smart ADS-B configuration



Pre-configured ADS-B Ground Station and LCMS consisting

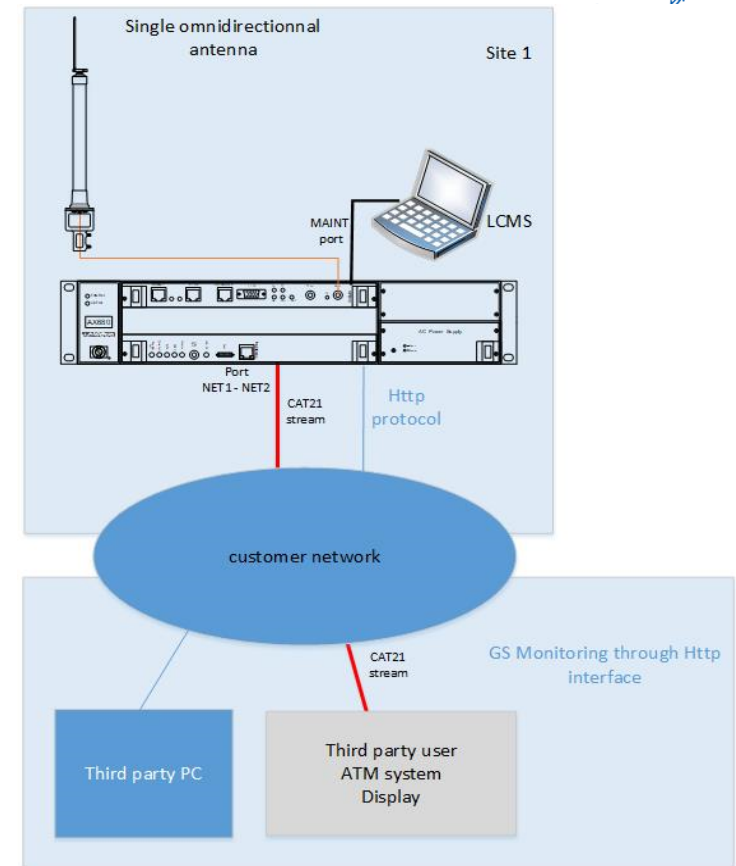
- ADS-B Receiver
- 1 omni or 2 sector antennas
- 1 GPS antenna
- Cabling between antennas and receiver
- LCMS
- Full SW package

Rapid delivery within 2-3 months

Full documentation package included

Easy installation and commissioning performed by Customer

Remote support from Thales



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Standalone ADS-B architecture

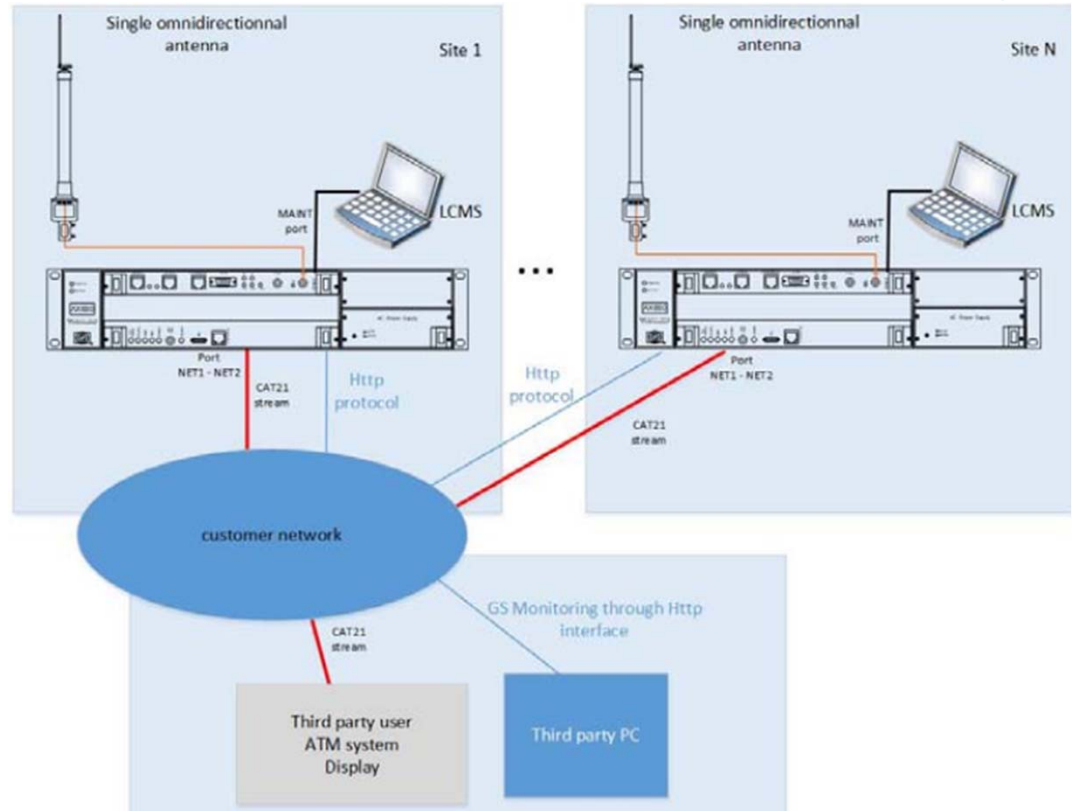


Values

- ✓ Easy integration to ATM via Standard interface ASTERIX CAT21
- ✓ Simple installation,
- ✓ Low cost solution

Components

- 1 to N Ground Stations Receivers
- Local Control and Monitoring System



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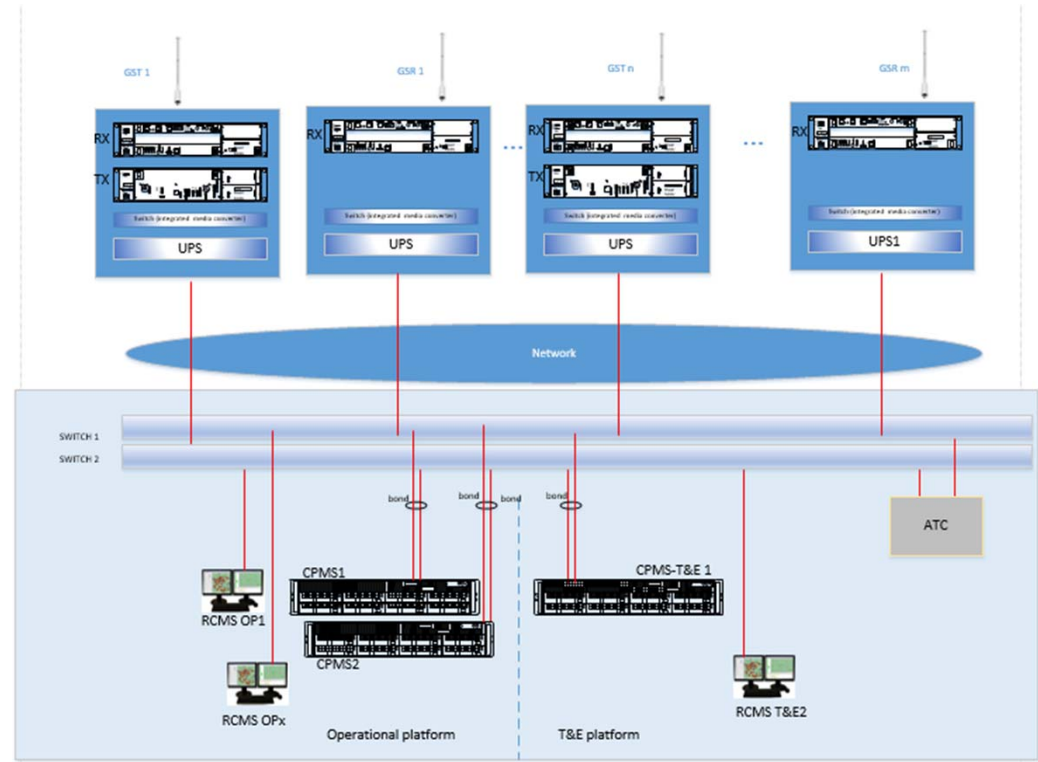
Centralized ADS-B/WAM/MLAT flexible architecture

Values

- ✓ Easy integration to ATM via Standard ASTERIX Interface
- ✓ Flexible, customized solution
- ✓ Enables data sharing with other ANSPs

Components

- 1 to N Ground Stations (Receivers, Receiver/Transmitters) designed in N-1 redundancy
- Data processing on Centralized Processing and Monitoring System (CPMS) in full redundant configuration
- Standard ASTERIX Interfaces
- 1 to N Remote Control and Monitoring Systems (RCMS)
- Optional Test and Evaluation platform



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Cybersecurity Issues for ADS-B

- **Simple protocol and signal structure, vulnerability discussed openly**
 - Presentations at DEFCON
 - BlackHat and others featured available online
- **Software-Defined Radio (SDR) Technology available at low cost**
 - Receiver and Transmitter available
 - Online Software and Documentation
- **RF hacking is not anymore a challenge for experts and specialists**



ADS-B can be used securely with appropriate protection

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Cyber threats & impact on Surveillance operations



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	Radar/WAM Airspace	Non-Radar Airspace
	False plots/tracks appear (spoofing) False codes/ACID or emergency indicators (modification) Complete failure of ADS-B sensor input (jamming)	
Risk of not detecting if no Cyber security	Low, due to other sensors and background data	Increased, only background data (flight plans, history)
Operational Impact of Cyber security	Slightly increased workload, safety not likely affected	Increased workload, no other surveillance data source
Mitigation risks	If detected use other sensors and disable ADS-B	Radio contact to actual pilots, fall back to procedural control

To make the ATM Cyber space safe and highly available

Thales has the breadth and depth to be your trusted partner for ATM Cybersecurity

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Thales advanced features to enhance ADS-B security

Detection at receiver Front-end

- Any Target specific behavior
- Anyone not behaving like a regular aircraft
- Verify consistency between measured and transferred data

Spectrum characterization – not target specific

- Any unusual traffic
- Number of targets, messages, message types...



Spoofing Detection
Lab Demonstration at DFS

Cybersecurity for safety and efficiency

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Successful cooperation with DFS & Eurocontrol on ADS-B security



■ ADS-B security features validated in SESAR (European NEXTGEN) program

■ ADS-B Ground Station proven to detect various threats

- Spoofing
- Modification
- Jamming
- Detects also anomalies – great for conformance monitoring!

■ Additional security features on Central Processing System

- Data from Ground Stations are validated against ADS-B threats
- WAM configuration rejects threats



Results of research programs further developed in the product
and proven in field implementations

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Our expertise in Cybersecurity



OPERATION AND CYBERSECURITY OF CRITICAL INFORMATION SYSTEMS FOR OVER **130** CUSTOMERS

HIGH-GRADE SECURITY PRODUCTS AND SOLUTIONS (CONFIDENTIAL OR TOP SECRET) FOR **50** COUNTRIES

INCL. NATO COUNTRIES

PROTECTION OF THE WORLD'S BANKING TRANSACTIONS **80%**

SECURITY FOR **19** OF THE **20** LARGEST BANKS

CYBERSECURITY FOR **9** OF THE TOP **10** INTERNET GIANTS

2,000 CYBERSECURITY SPECIALISTS

5 CYBERSECURITY OPERATIONS CENTRES



5 DATA CENTRES



amadeus



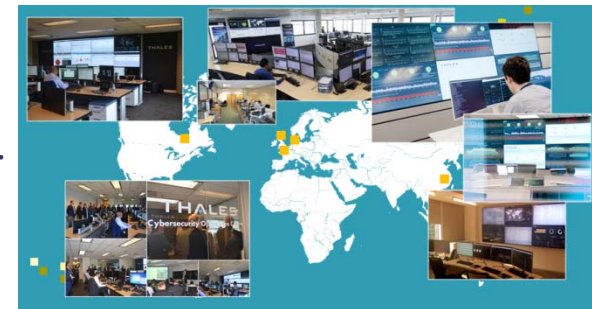
AIRFRANCE KLM



AIR CANADA



AIRCARAÏBES



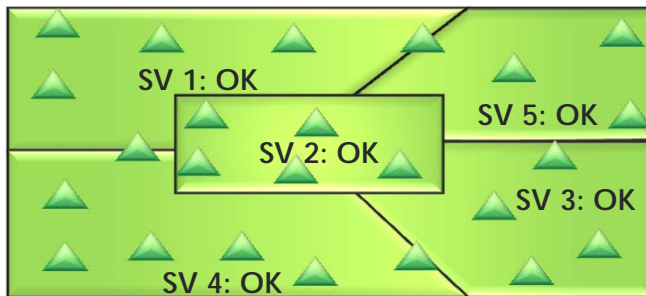
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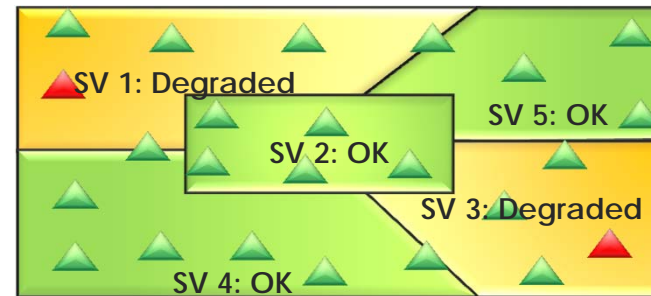


Innovation in Multilateration System availability

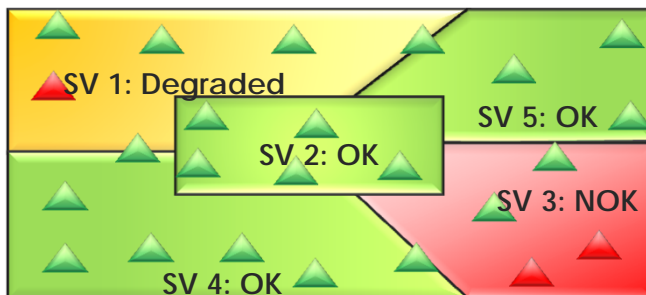
Virtual WAM/MLAT, the solution to improve the Availability & Resilience of your system



System State: **Normal**



System State: **Degraded**



System State: **Degraded**



System State: **Degraded**

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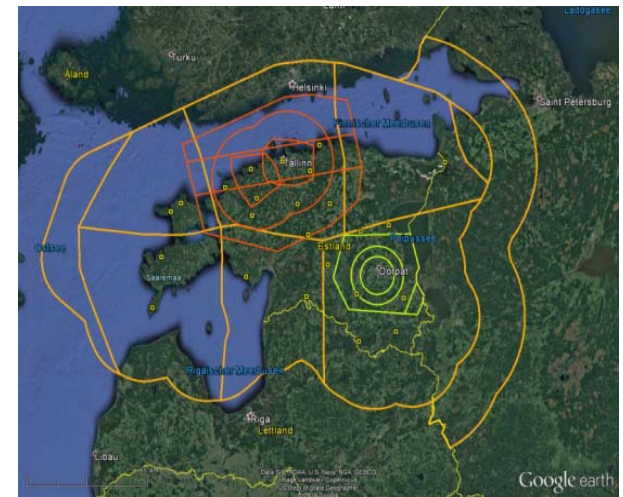
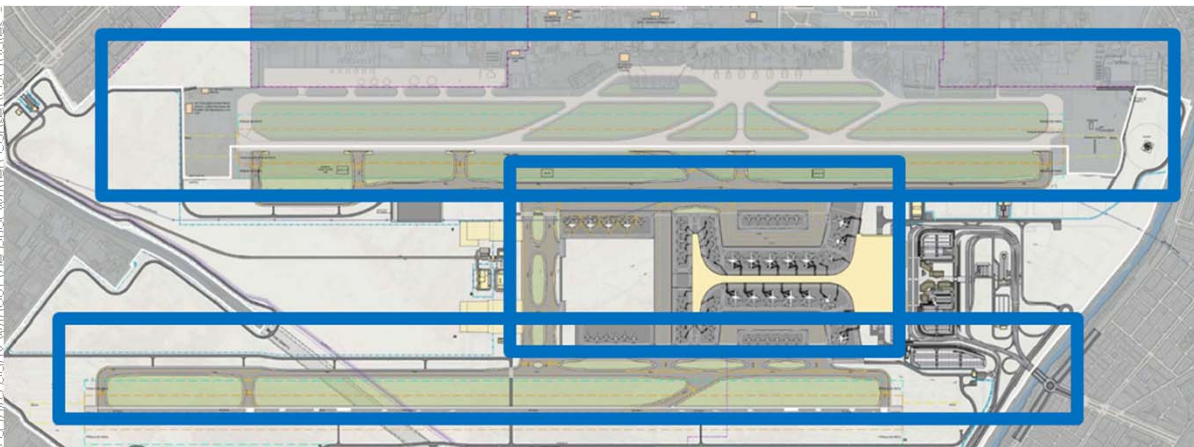
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Key value of Virtual WAM/MLAT at countrywide and Airports



Separate Areas are identified for Each Service Volume depending on the application

- Airport MLAT Runways, Terminal, Aprons/Approach areas
- WAM Airspace sectors, TMA, Altitude bands



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ADS-B/WAM/MLAT Product evolution



Thales develops its products in accordance with standardization evolution. Major evolutions include:

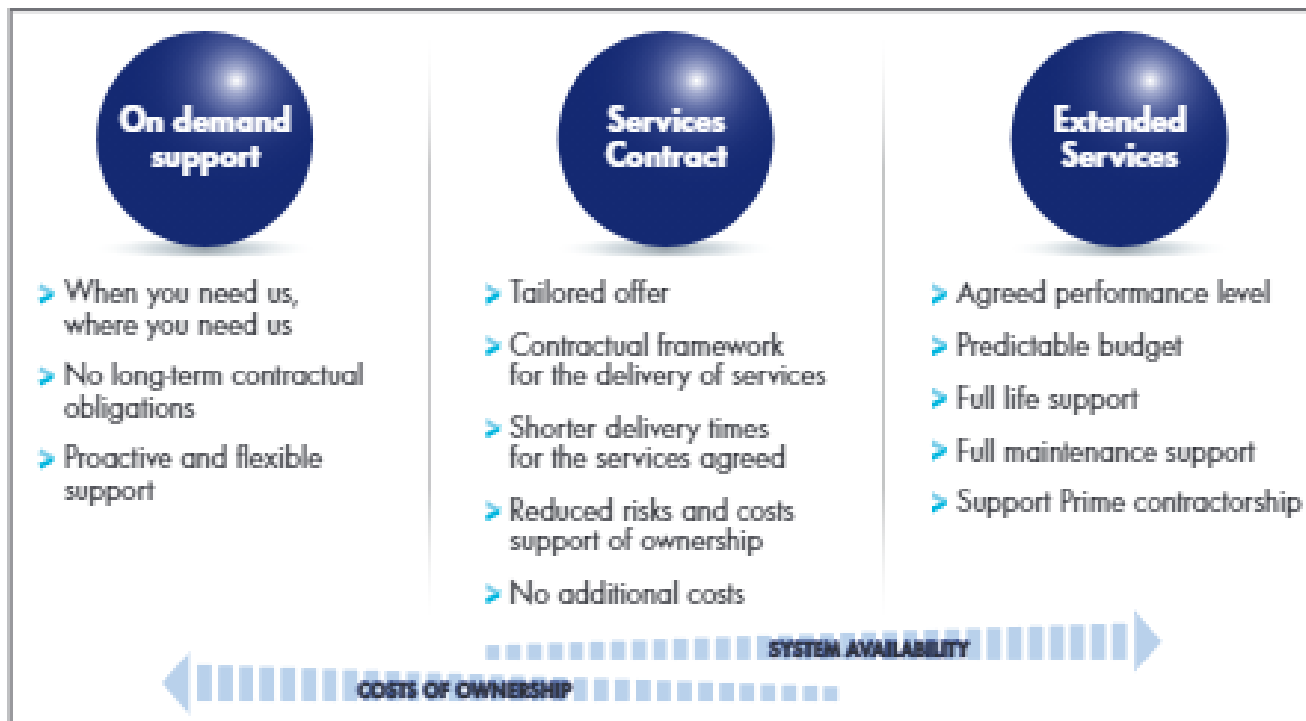
- Compliancy to ED129C
- Compliancy to ED142A
- Compliancy to DO260C
- Enhanced Cyber Security
- Spectrum Monitoring (1030/1090MHz)





Choose your service level

3 customizable levels, from traditional approach to comprehensive managed Services



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ADS-B / MLAT / WAM references World Wide



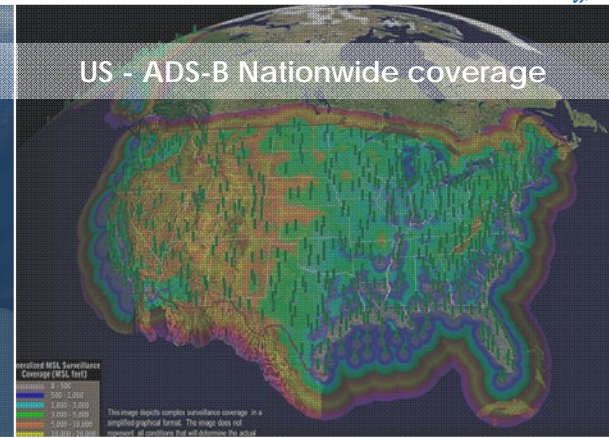
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DFS Germany - WAM PAMFRA



NEW ZEALAND - ADS-B technology



US - ADS-B Nationwide coverage



AUSTRALIA - ADS-B large coverage



FRANCE - MLAT Lyon airport



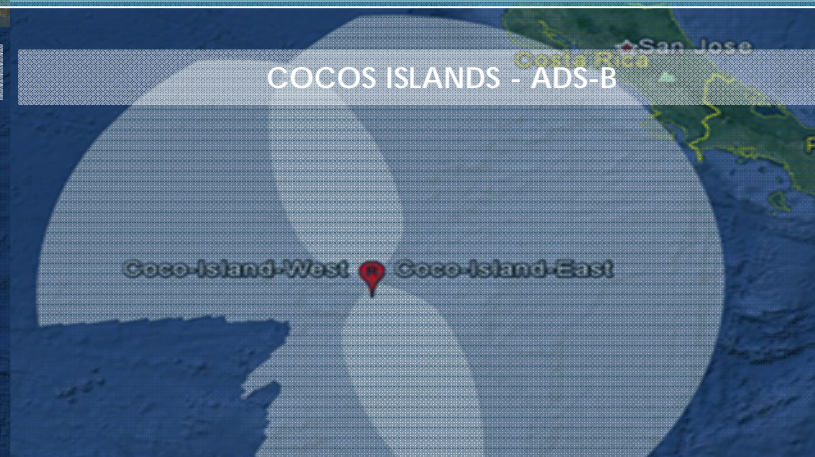
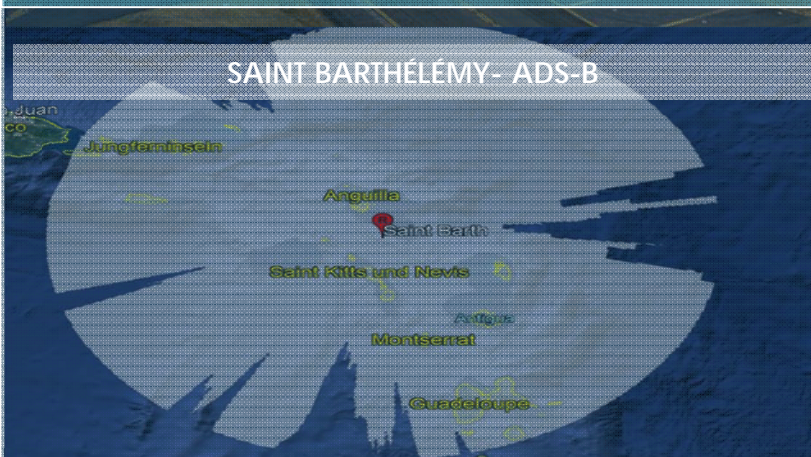
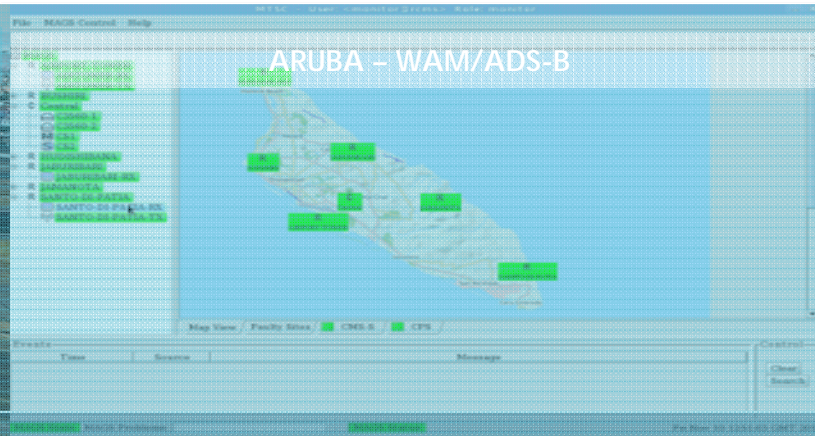
FRANCE - WAM Nice airport

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Main LATAM and Carribean ADS-B / MLAT / WAM references



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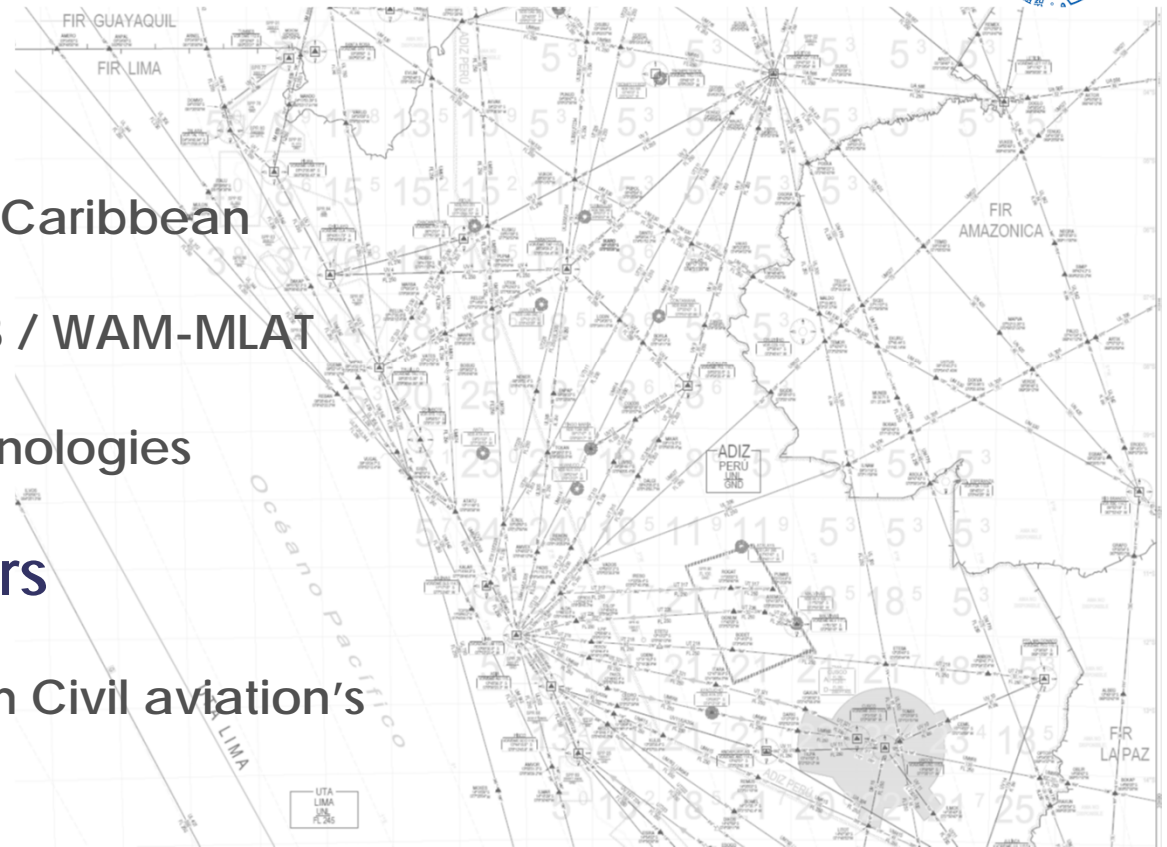
Thales in cooperation with Mexico – SENEAM



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Agenda

- ICAO Introduction
- Thales' missions LATAM & Caribbean
- Thales' expertise in ADS-B / WAM-MLAT
- ADS-B & WAM/MLAT technologies
- **Questions & Answers**
- Workshops proposals from Civil aviation's



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Questions & Answers

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