Surveillance Strategy

ENRI International Workshop on ATM/CNS

March 2009
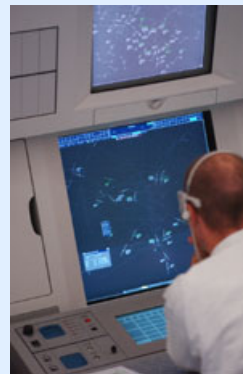
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Pillars of ATM Ground Based Surveillance

Non-Cooperative Independent Surveillance:

Determines the (2D) position without reliance on aircraft avionics

- Primary Surveillance Radar (PSR)

Cooperative Independent Surveillance:

Provides the calculated aircraft position and processes other aircraft avionic data (Mode A/C/S, DAPs or ADD)

- (Monopulse) Secondary Surveillance Radar (SSR), SSR Mode S, Airport Multilateration (MLAT) and Wide Area Multilateration (WAM)

Cooperative Dependent Surveillance:

Provides the aircraft derived position (GPS or INS) and other aircraft avionic data to broadcast "air-ground" and "air-air"

- ADS-B (Out and In)

Surveillance Strategy

3 pillars of mutually interoperable and compatible technologies

Primary Radar

MSSR	ADS-B (Out)	MLAT
SSR Mode S		WAM

Surveillance Data Processing Systems

Choice for Ground Based Surveillance

The Surveillance Strategy for ECAC does not mandate the implementation of any of these surveillance technologies or techniques, but leaves the choice for ground based surveillance systems to the (ANSP) surveillance provider, depending on:

- Operational requirements

- Safety assessment

- The business case (geography, cost, topology, preference, integration risk, redundancy, integrity, etc).

- This relies on the availability of a suitable transponder.

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SPI IR

- The draft **Surveillance Performance and Interoperability Implementing Rule** (SPI IR) will specify the performance and interoperability requirements for Surveillance, for 3/5nm separations.

- The transponder must therefore support all forms of ground based surveillance as well as enabling the air-to-air surveillance applications.

- All aircraft flying IFR/GAT will require SSR Mode S Elementary Surveillance (ELS) capability, and

- Aircraft >5,700Kgs or >250Kts airspeed will require SSR Enhanced Surveillance (EHS) capability, including Extended Squitter for ADS-B.
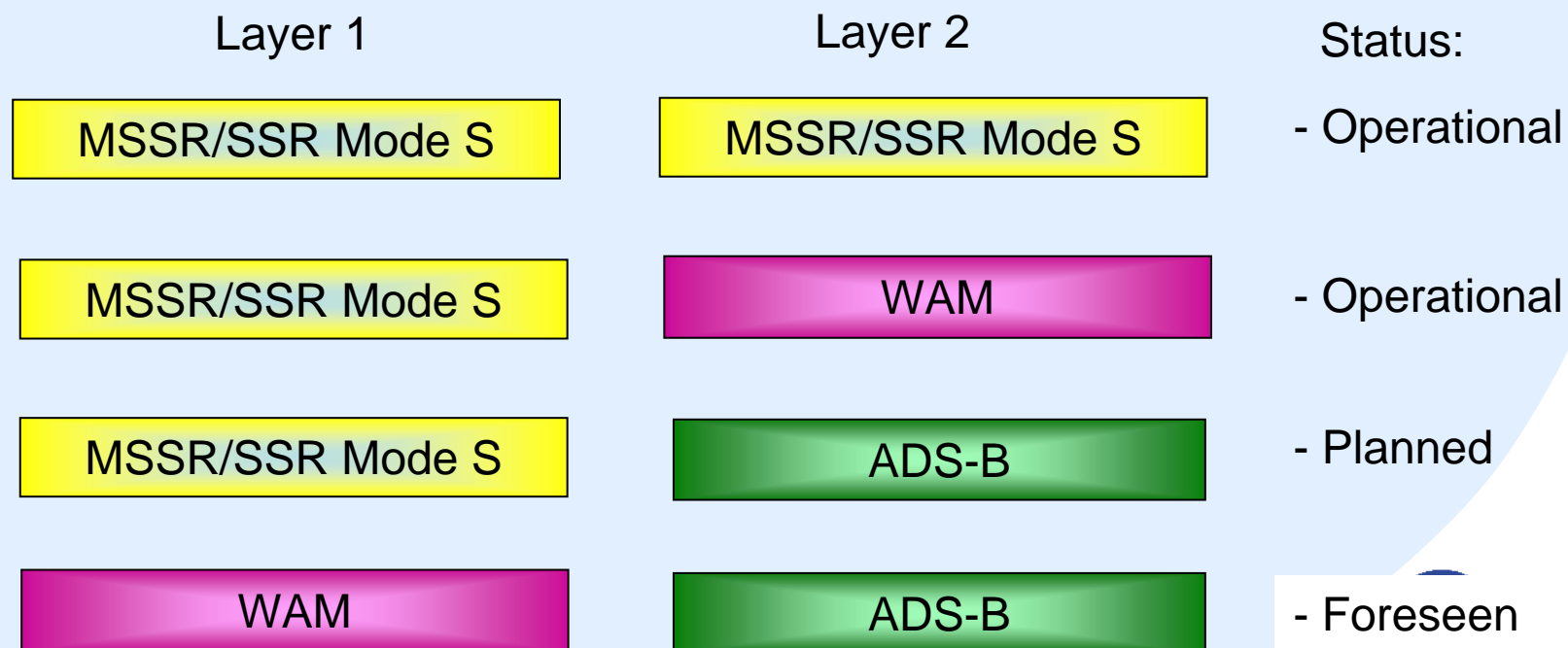
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Redundancy

- The current EUROCONTROL Surveillance Standards specify two independent layers of co-operative surveillance. (e.g. 2 separate SSRs)

- The SPI IR will require each ANSP to generate a safety case to demonstrate the required level of redundancy, depending on density of airspace, separation and service requirements.

- Similarly, the current standard requires PSR in major TMAs as a safety fallback. In future the specific safety case will determine whether or not a "non-co-operative independent surveillance" requirement exists.

- This will give ANSPs greater flexibility in providing safe, cost effective surveillance solutions.

Typical TMA / En-Route Surveillance

For safety or security reasons, Non-Cooperative Independent Surveillance is implemented, if required:

PSR	- Available

Until 2020+, at least one layer of ATM ground surveillance should be an co-operative independent surveillance to meet safety requirements:

Layer 1	Layer 2	Status:
MSSR/SSR Mode S	MSSR/SSR Mode S	- Operational
MSSR/SSR Mode S	WAM	- Operational
MSSR/SSR Mode S	ADS-B	- Planned
WAM	ADS-B	- Foreseen

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Ground Based Surveillance at Airports

For safety reasons, Non-cooperative Independent Surveillance is implemented, if required:

| SMR | - Available at most airports |

To provide an Airport Situation Picture, including identification of aircraft and vehicles, a cooperative independent surveillance is required, that also supports the implementation of higher A-SMGCS levels.

Airport Surveillance   Status:
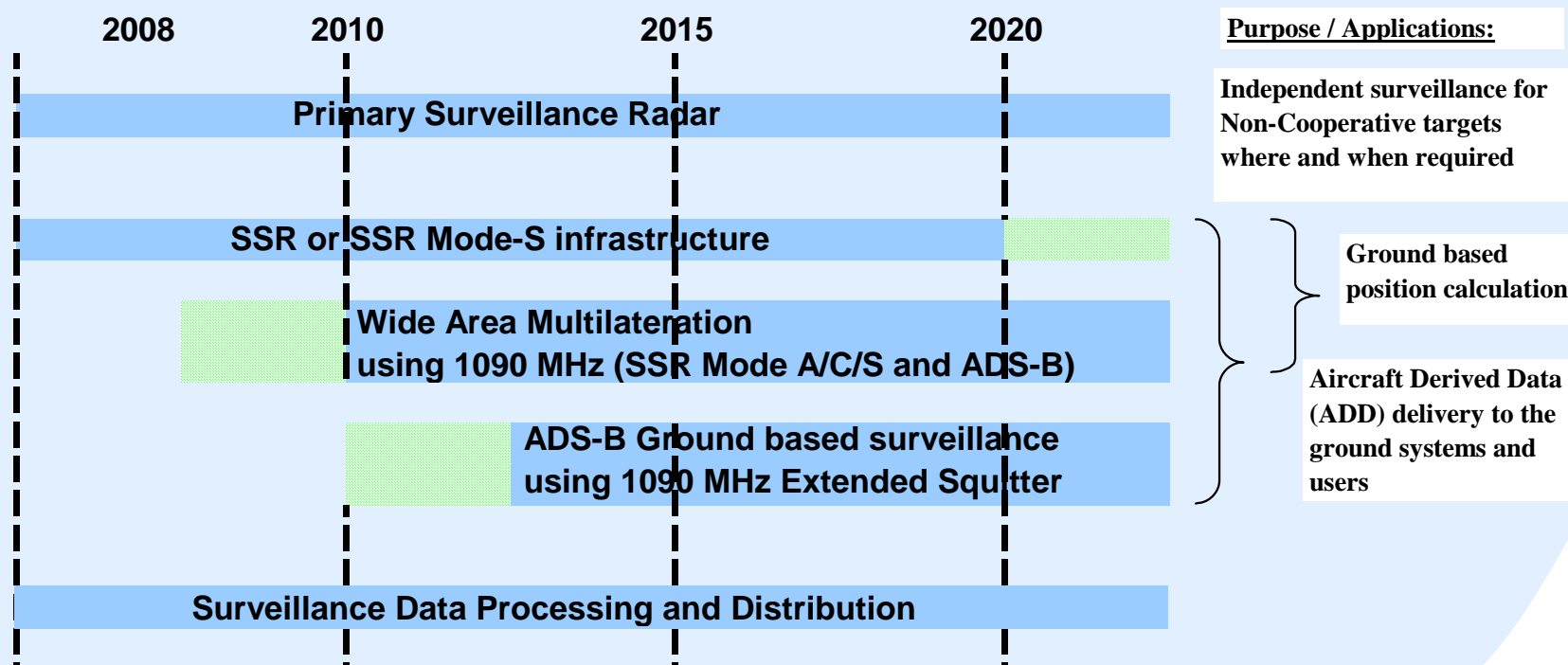
| Multilateration (MLAT) | - Operational at many major European airport |

| ADS-B | - Planned at secondary airports |

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Surveillance Strategy for ECAC

The evolution for the <u>ground based surveillance</u> infrastructure for **En-Route and TMA** applications is shown below:
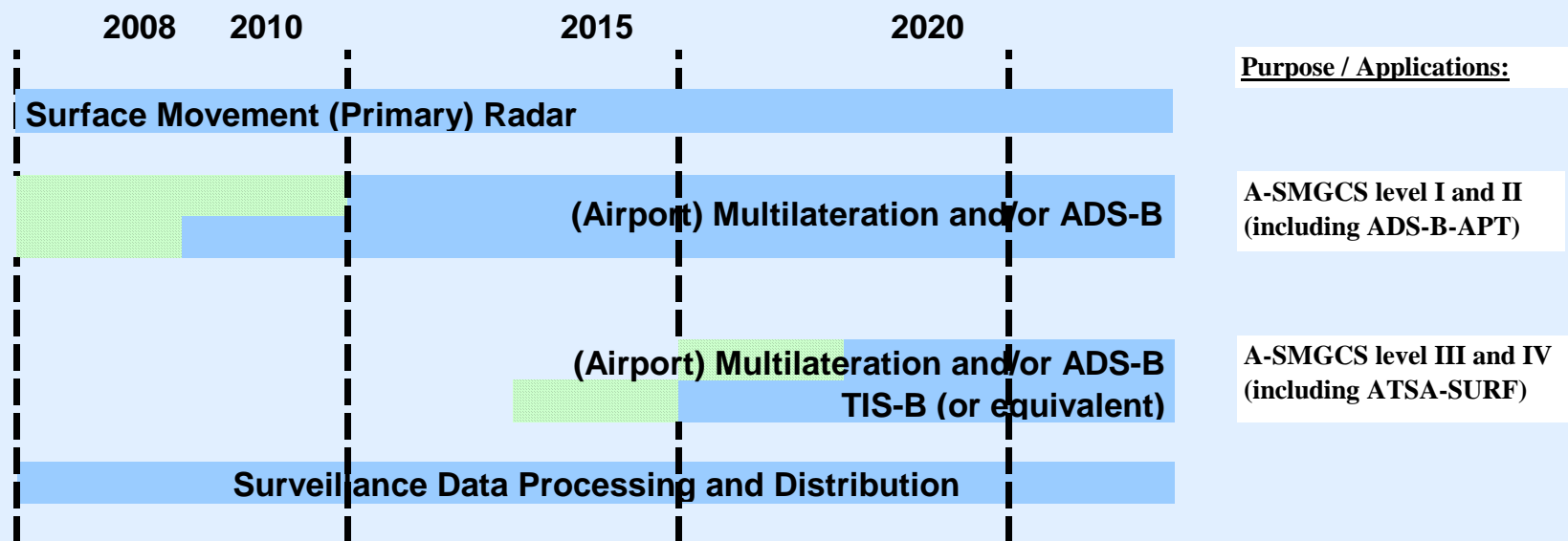
	2008	2010	2015	2020	

Purpose / Applications:

Primary Surveillance Radar

Independent surveillance for Non-Cooperative targets where and when required

SSR or SSR Mode-S infrastructure

Wide Area Multilateration using 1090 MHz (SSR Mode A/C/S and ADS-B)

Ground based position calculation

ADS-B Ground based surveillance using 1090 MHz Extended Squitter

Aircraft Derived Data (ADD) delivery to the ground systems and users

Surveillance Data Processing and Distribution

Ground based surveillance infrastructure for En-Route and TMA

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Surveillance Strategy for ECAC

The evolution of the **Airport surveillance infrastructure** is shown below:

	2008	2010	2015	2020	Purpose / Applications:
Surface Movement (Primary) Radar					
(Airport) Multilateration and/or ADS-B					A-SMGCS level I and II (including ADS-B-APT)
(Airport) Multilateration and/or ADS-B **TIS-B (or equivalent)**					A-SMGCS level III and IV (including ATSA-SURF)
Surveillance Data Processing and Distribution					

Surveillance Strategy at the Aerodrome

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Transponder Monitoring

The Airborne Monitoring Programme is also used to track the airborne transponder equipage: Mode-S and ADS-B

	January 2009	Trend
Elementary surveillance Statistics – ELS		
Percentage of the flights with SI code capability *(bds1,0)*	**98.73 %**	⇧
Percentage of the flights with aircraft ID capability *(bds1,0)*	**99.11 %**	⇧
Enhanced surveillance Statistics – EHS *(bds1,0 bit25=1)*		
Percentage of the flights with enhanced surveillance capability	**94.20 %**	⇧
ADS-B: Extended Squitter capability – ES *(bds 1,0)*		
Percentage of flights with Extended Squitter capability	**79.28 %**	⇧
Flights with aircraft ID confirmed correct	**93.15 %**	⇧

In the European Core area   January 2009 data

SSR Mode S and WAM

- Mode S Programme – coming to completion end 2009, successful operational introduction of Mode S transponders and ground stations ELS and EHS. Transponder anomolies being chased.

- Some WAM systems already in operational use, however Standards not yet generally available.

- EUROCAE WG 70 "WAM MOPS" due 2009.

- Certification was based on comparison with the SSR Standards; shows performance equal to or better than SSR.

- Generic WAM Safety Statement, available.

- Guidelines for Approval and Introduction into service, available.

ADS-B Out & In

- **Ground Surveillance Applications (ADS-B Out)**

  - In a non-radar environment
  - In a radar environment
  - On the airport surface
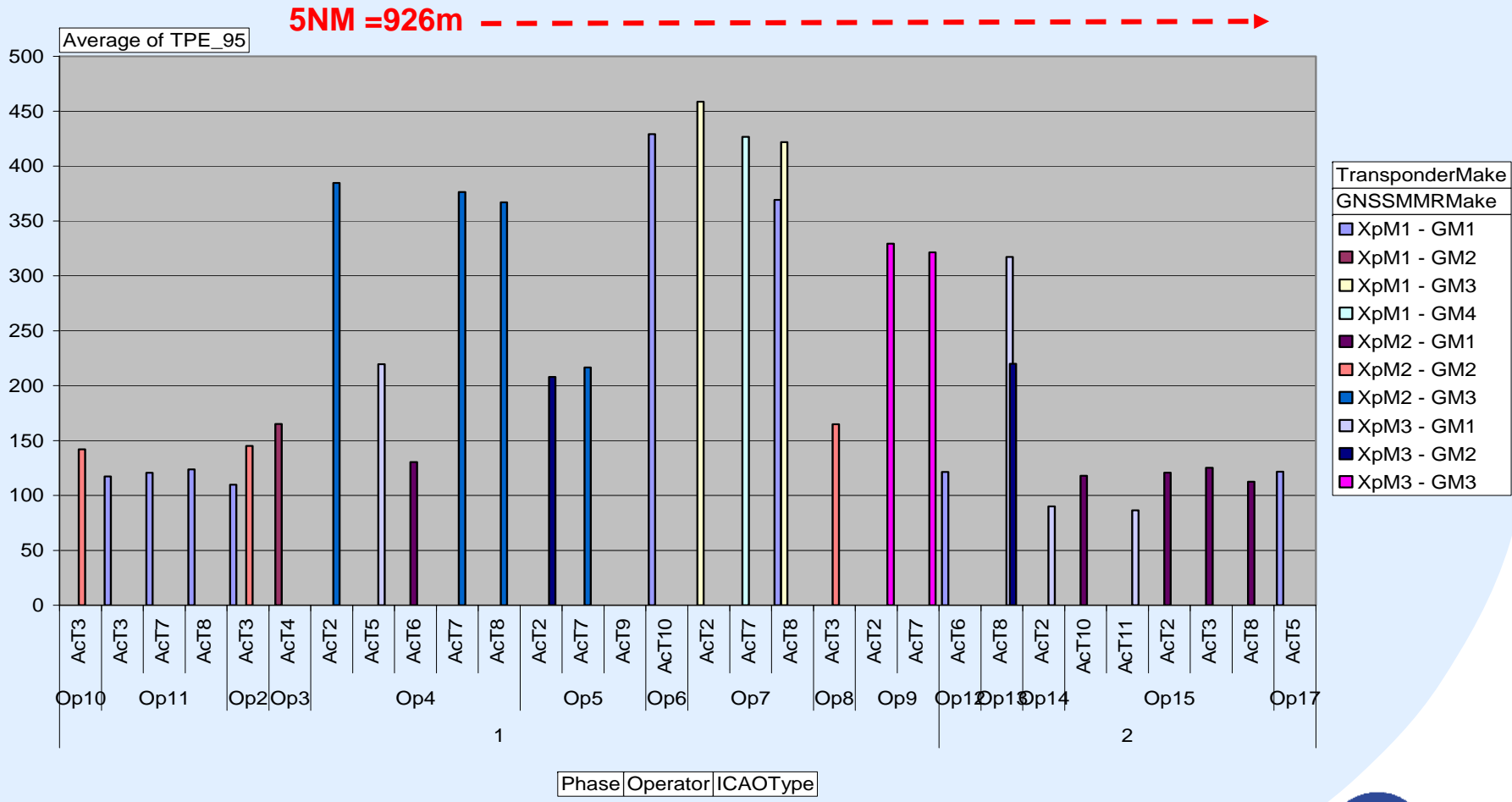
  2008

  ADS-B Receiver
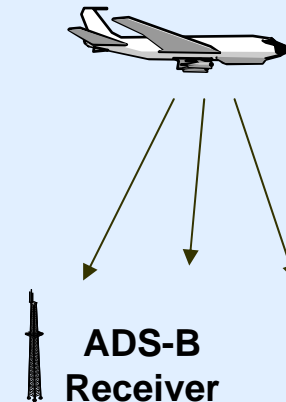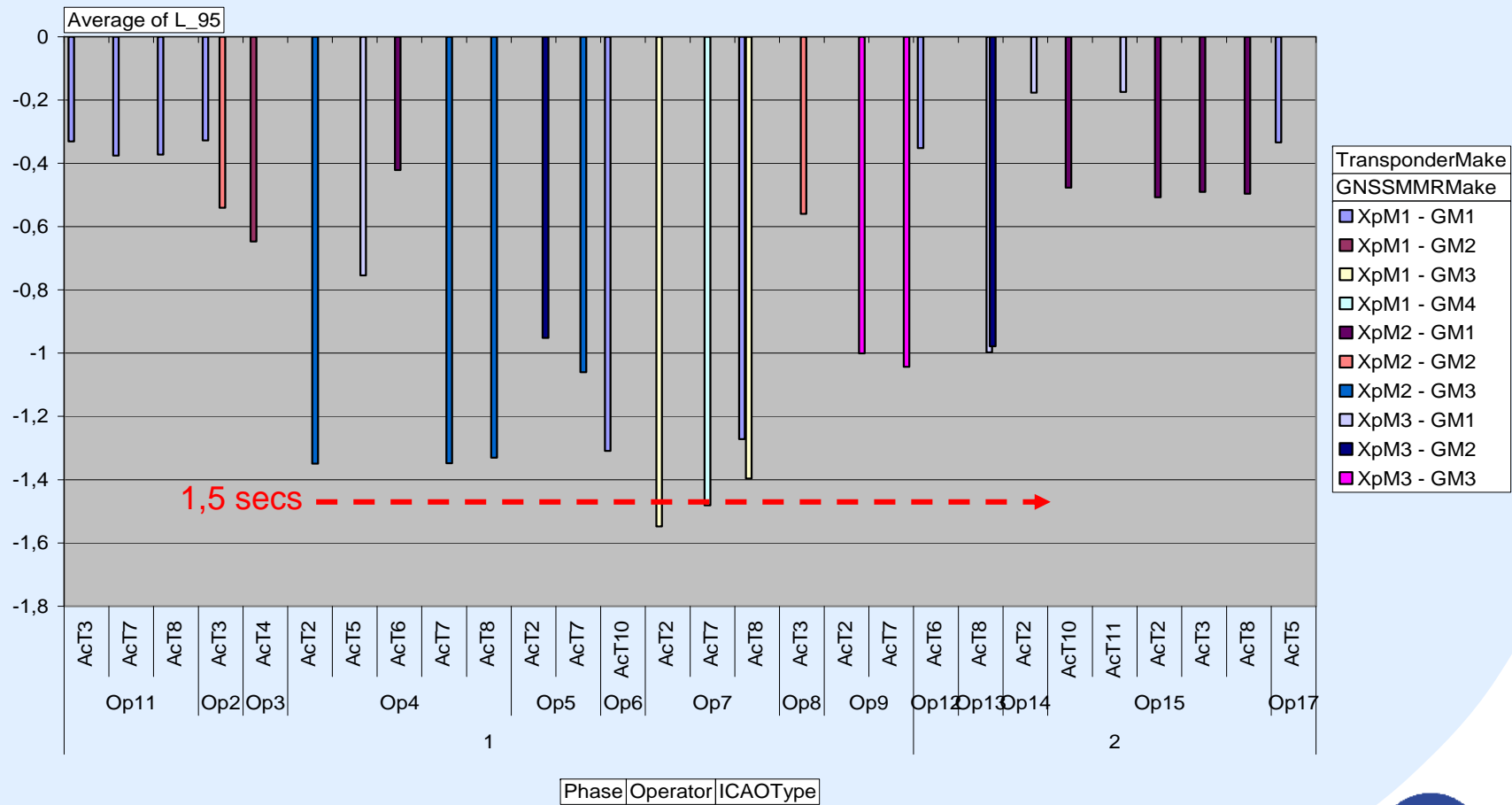
- **Airborne Surveillance Applications (ADS-B In)**
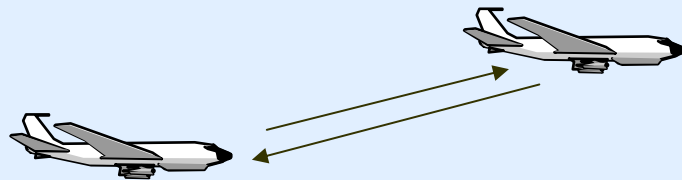
  - Airborne situational awareness
  - Visual separation on approach
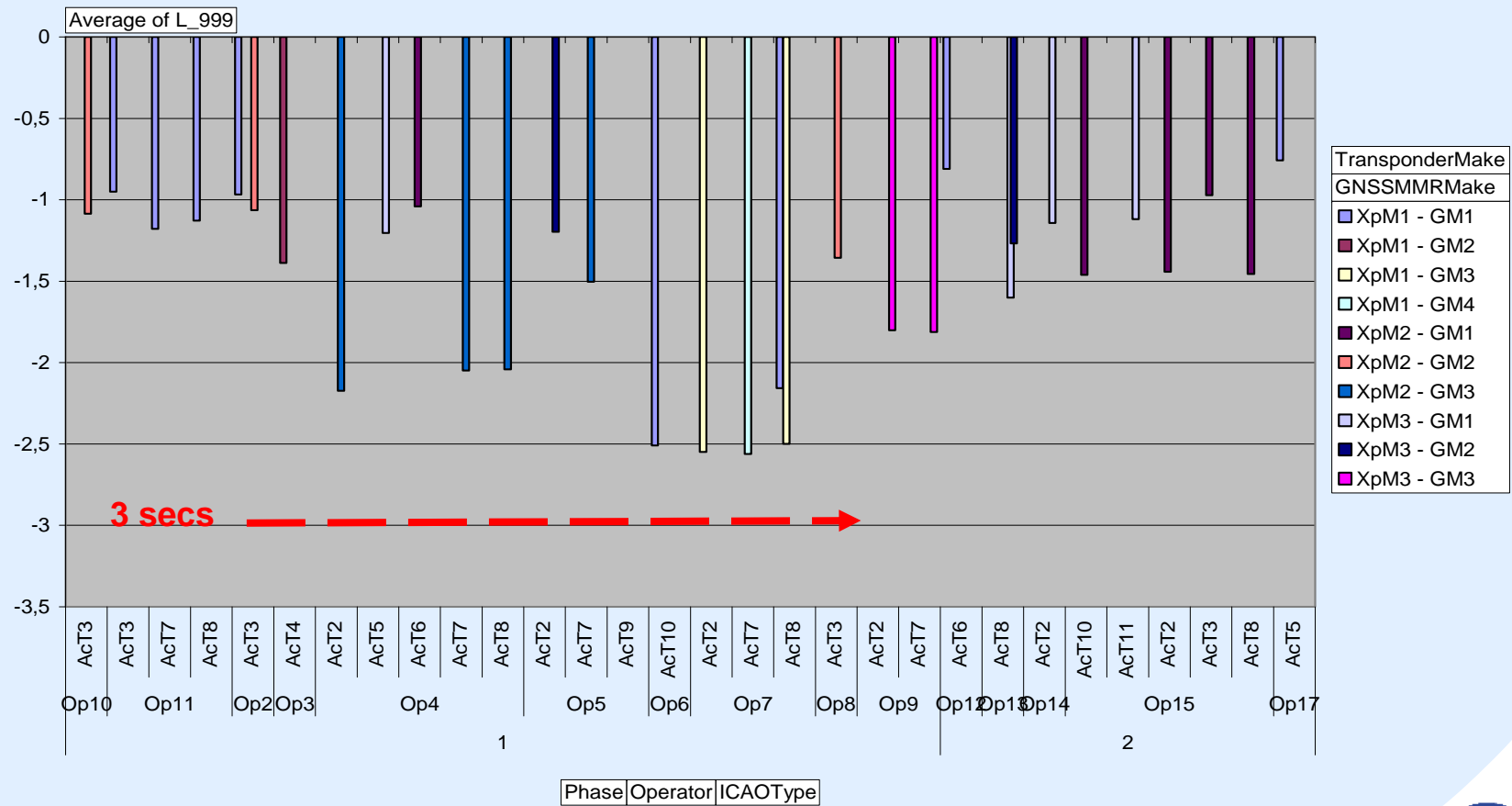 - In Trail Procedure
  - Situational awareness on the surface

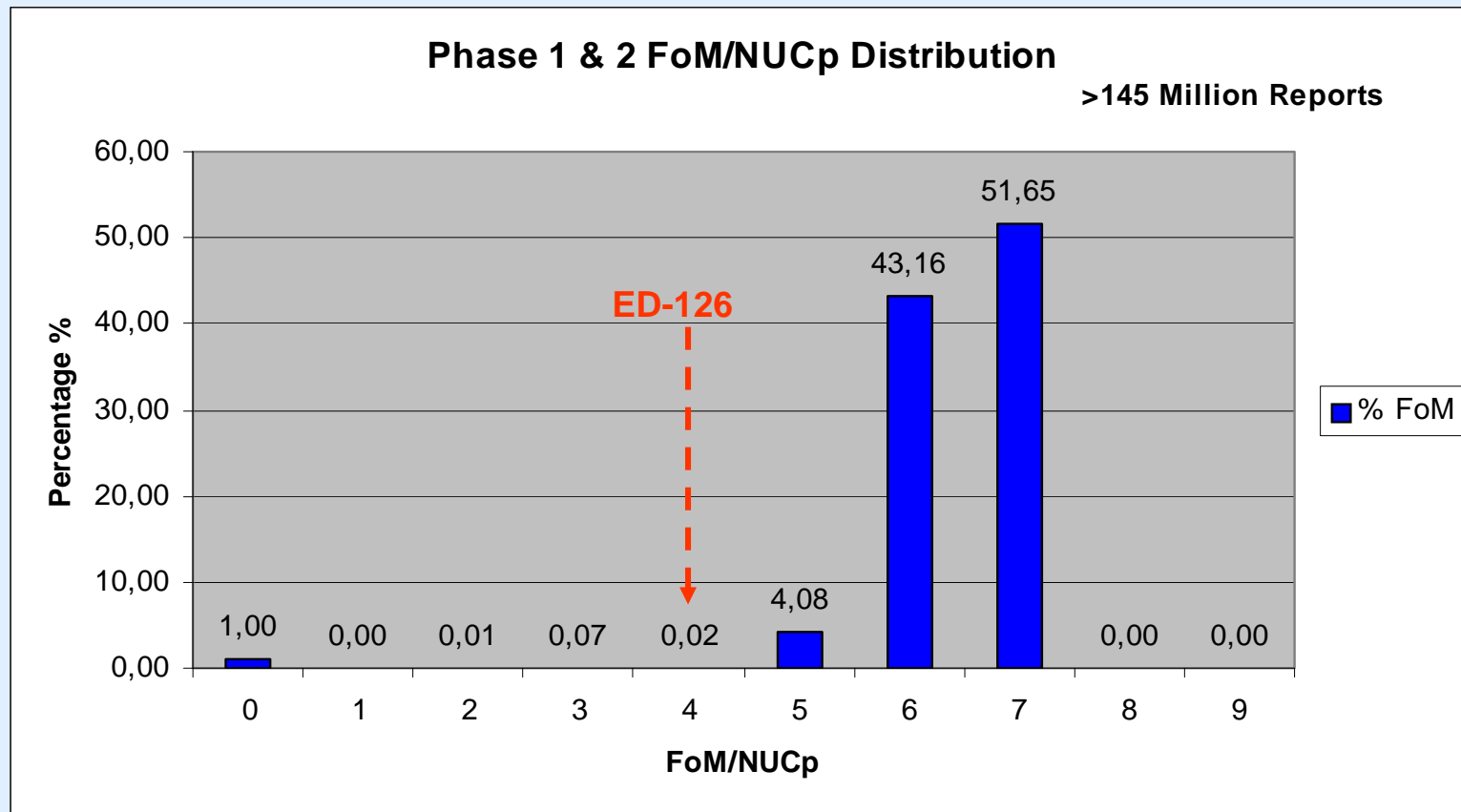 **2011**

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Pioneer Aircraft
Absolute Position Error

Pioneer Aircraft Latency (95 % Bound)

Phase 1 & 2 FoM/NUCp Distribution

>145 Million Reports

- Compared to ED-126 (NRA requirements)

  - 100 % of the aircraft meet the absolute position accuracy requirement (<926 m) (95%).

  - 98.7 % of the aircraft meet the
    latency requirement (<1.5 seconds) (95%) .

  - 100% of the aircraft meet the latency requirement (<3 seconds) (99.9%).

  - 98,92 % of the reports meet the integrity requirement FOM >=4 .

  - Some anomalies detected, currently under investigation

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