FROM INNOVATION TO SOLUTION

EASA WORKSHOP
PBN OPERATIONS
14-15, JANUARY, COLOGNE

Mara Dame

SESAR JU

Regulatory Affairs expert

SESAR
JOINT UNDERTAKING

founding members

EUROPEAN UNION   EUROCONTROL

- **Pilot Common Project approach**

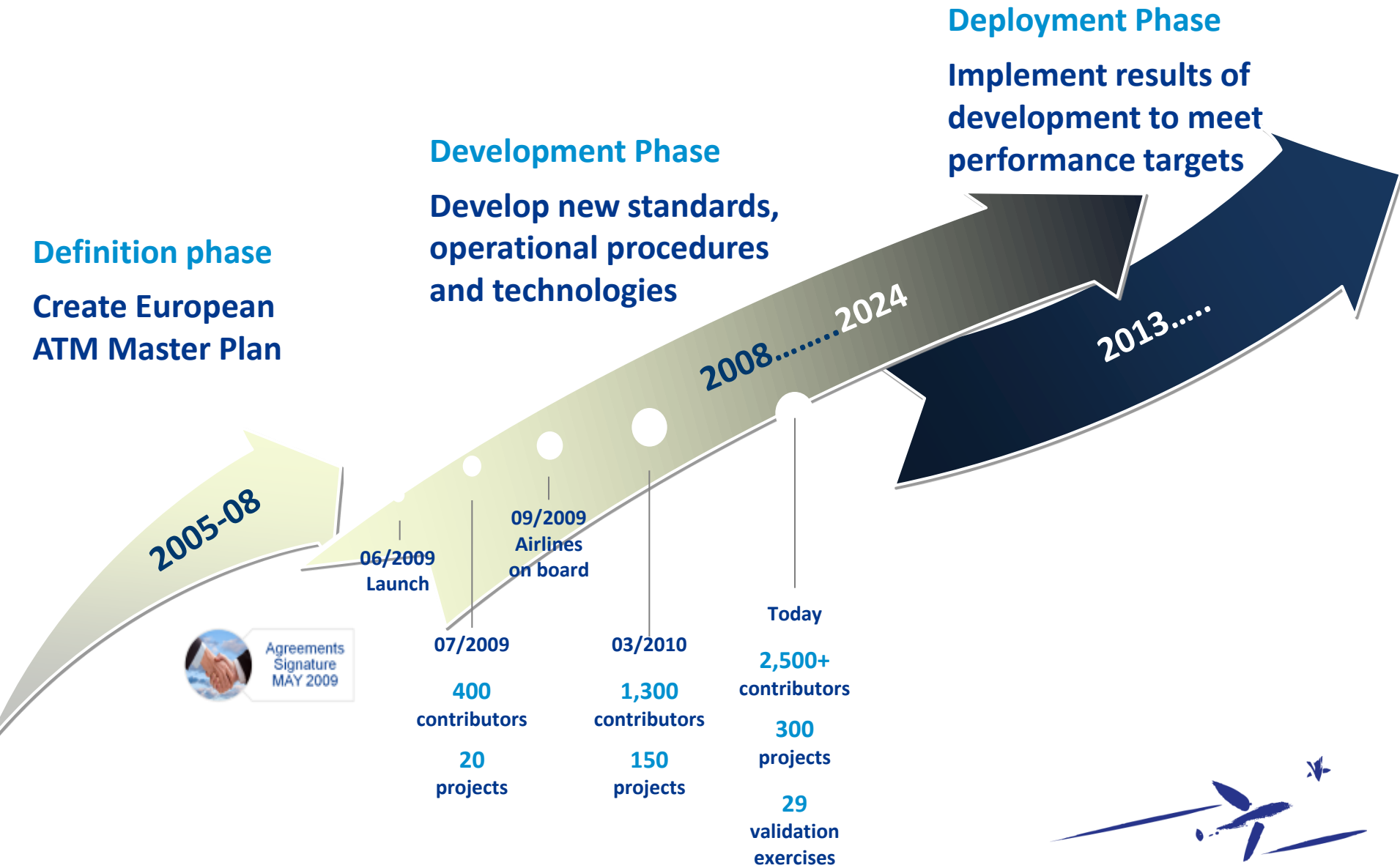- **PBN maturity- demonstrations**

- **Regulatory implications**

FROM INNOVATION TO SOLUTION

BUILDING SESAR...

Deployment Phase

Implement results of development to meet performance targets

Development Phase

Develop new standards, operational procedures and technologies

Definition phase

Create European ATM Master Plan

2005-08

2008.......2024

2013.....

06/2009
Launch

09/2009
Airlines
on board

Agreements
Signature
MAY 2009

07/2009

400
contributors

20
projects

03/2010

1,300
contributors

150
projects

Today

2,500+
contributors

300
projects

29
validation
exercises

FROM INNOVATION TO SOLUTION

METHODOLOGY

- Performance
- Deployable Capabilities

- PPP – 16 Members
- + 330 projects
- 2500 contributors

Objectives

Organisation

NEED FOR AN INDUSTRIAL DEVELOPMENT APPROACH TO MANAGE COMPLEXITY

Technology

Operations

- Information Management
- Automation
- Communication
- **Predictability**

- Air & Ground integration
- 4D Trajectory

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PBN Timeline

- ## Short term
  - – Pilot Common project

- ## Long- term
  - – ATM Master Plan

Moving from Development to Deployment

- **The SJU was mandated by the European Commission to prepare the Pilot Common Project**

- **6 packages identified**

Key functional improvements addressing critical network performance deficiencies

1. **Extended AMAN and PBN in high density TMAs**

2. **Airport Integration and Throughput Functionalities**

3. **Flexible Airspace Management and Free Route**

4. **Network Collaborative Management**

Building the infrastructure of the future

5. **iSWIM: ground-ground integration and aeronautical data management & sharing**

6. **Initial Trajectory Information Sharing: air-ground integration towards i4D**

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PCP Integration in the Programme

- PCP Content definition was based on Programme results and Release plans;

- Resulting changes to Operational Improvements (OI) and Enablers (EN) were fedback into the Programme;

- All PCP content shall be validated in Release 5 by the latest;

- Close monitoring set up with regular report to SJU Governance.

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PCP- AF 1

- Extended Arrival Management and Performance Based Navigation in the High Density Terminal Maneuvering Areas

- PBN in high density TMAs covers the development and implementation of fuel efficient and/or environmental friendly procedures for arrival and departure (Required Navigation Performance 1 Standard Instrument Departures (RNP 1 SIDs), Standard Arrival Routes (STARs)) and approach (Required Navigation Performance Approach (RNP APCH)).

- This functionality is composed of three sub-functionalities:
  - Arrival Management extended to en-route Airspace
  - Arrival Management into Multiple Airports
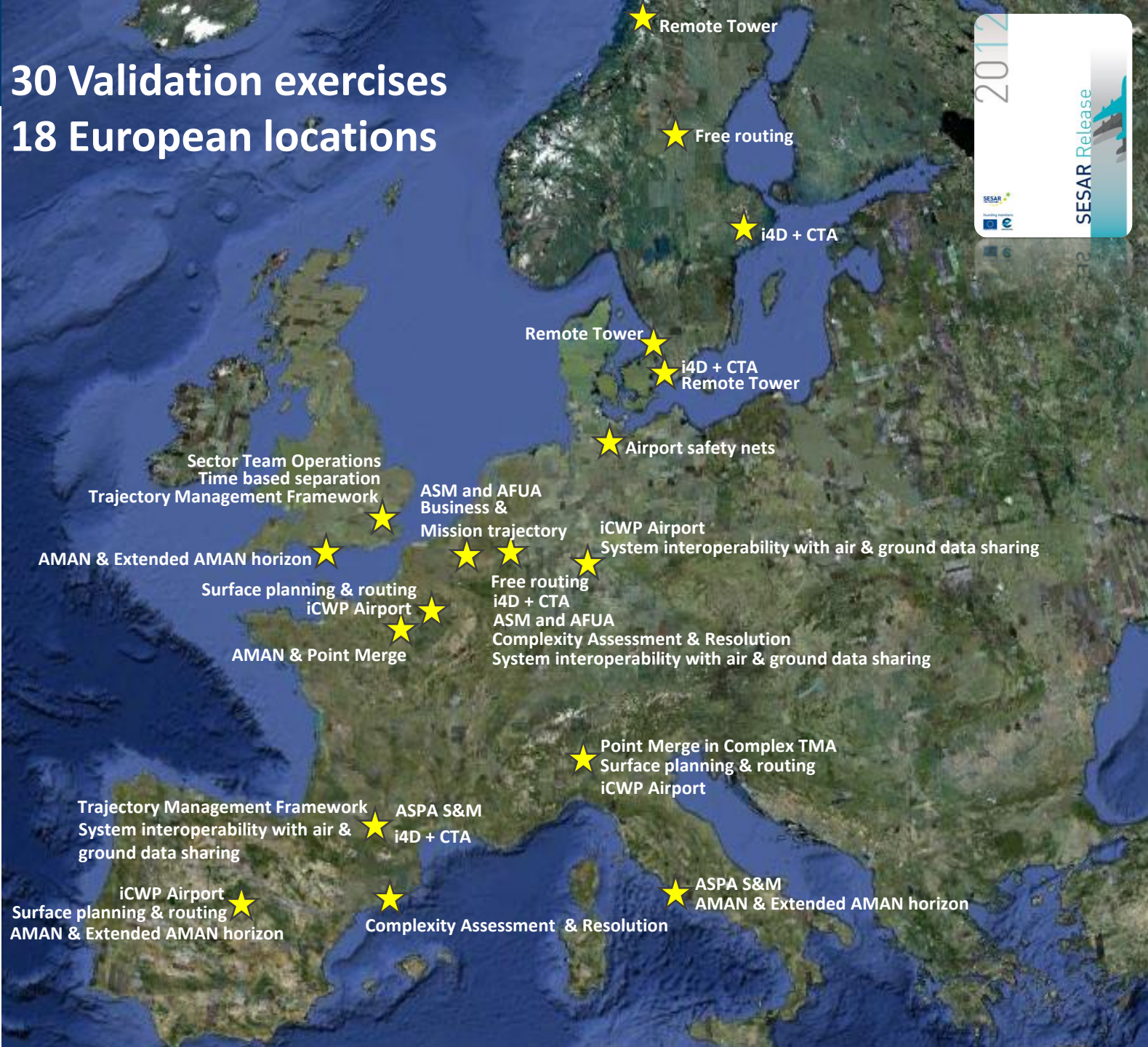 - Enhanced Terminal Airspace using RNP-Based Operations

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PCP Content Validation

AF#1 Extended AMAN and PBN in high density TMA			Key Deliverables available today	
Enhanced Terminal Airspace for RNP-based operations	R1		100%	✔
Arrival Management Extended to En Route Airspace – single TMA	R4		50%	
Enhanced Terminal ops with automatic RNP transition to XLS/LPV	R4		50%	
Arrival Management into Multiple Airports	R5		50%	

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30 Validation exercises
18 European locations

Remote Tower

Free routing

i4D + CTA

Remote Tower

i4D + CTA
Remote Tower

Airport safety nets

Sector Team Operations
Time based separation
Trajectory Management Framework

ASM and AFUA
Business &
Mission trajectory

iCWP Airport
System interoperability with air & ground data sharing

AMAN & Extended AMAN horizon

Surface planning & routing
iCWP Airport

Free routing
i4D + CTA
ASM and AFUA
Complexity Assessment & Resolution
System interoperability with air & ground data sharing

AMAN & Point Merge

Point Merge in Complex TMA
Surface planning & routing
iCWP Airport

Trajectory Management Framework
System interoperability with air &
ground data sharing

ASPA S&M
i4D + CTA

ASPA S&M
AMAN & Extended AMAN horizon

iCWP Airport
Surface planning & routing
AMAN & Extended AMAN horizon

Complexity Assessment & Resolution

SESAR Release 2012

SOLUTION

PBN maturity

- Demonstration activities
  - Amber
    - Design and perform RNP AR procedures for Riga international Airport.
  - Canarias
    - Improving the TMA of the Canary Islands by the development of RNAV STARs and RNP AR procedures with the implementation in parallel of Continuous descent Operations.
  - FRAMEC
    - The purpose of the project to establish a Free Route Airspace for Maastricht and Karlsruhe through live flight trials and live trial implementations.

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PBN maturity

AMBER Objectives

– Optimize arrival routes Riga RW18 using PBN

– Demonstrate turboprop aircraft capability to fly RNP AR

– Reduce CO_2 emissions, with track mile savings and Continuous Descent Arrivals (CDA)

– Reduce noise impact

AMBER Results

33 arrivals completed

– AMBER RNP trial underway

– Operationally successful (10% fuel savings)

– Distance and time savings demonstrated

– Arrivals are flown as CDA

– Noise impact still to be assessed

– Integration traditional with PBN arrivals still open

– Positive buy-in from all stakeholders achieved

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FRAMAK Objective

In a complex and high traffic density environment comprising MUAC and KUAC airspace FRAMaK will demonstrate the feasibility of

- Cross-Border Directs
- User Preferred trajectories

The project activities are addressing gains in the Key Performance Areas

- Efficiency
- Environmental Sustainability
- the effects on Capacity have to be carefully evaluated.

FRAMAK Results

- Based on SAAM (shortest route option) FRAMaK provided potential for 3873 flights per week (MAR 2013) and 5209 flights per week (JUN 2013).
- On average, route length could have been reduced by 2,46 NM (MAR) and 3,02 NM (JUN) per flight.
- Within one week AOs could have saved up to approx. 94t fuel in total.

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PBN maturity

- ## CANARIAS objectives
  - Reduce CO_2 emissions (Track mile savings)
  - Optimize the Canarias Flight Terminal Area using PBN
  - Improve access to La Palma and Lanzarote airports by using RNP AR procedures
  - Reduce the noise impact, where possible, over populated areas using optimized vertical profiles

- ## CANARIAS results (demonstration started 2013 Dec-April,2014)
  - La Palma and Lanzarote procedures tested and validated in A320 FFS (Toulouse) and B737NG FFS (Oslo).
  - Coding tables, charts and technical reports delivered.
  - Lanzarote FOSA completed, and La Palma FOSA under construction.
  - Visual Surface Segment report completed and delivered
  - ATC Training (Under ICAO Doc 9613) completed.
  - Operators confirmed coding of procedures in their database

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Legal implications

- EASA responsible for developing PBN legal framework
  - SEASAR input into Regulatory approach
- PCP Standartisation and regulatory roadmap(appendix II)

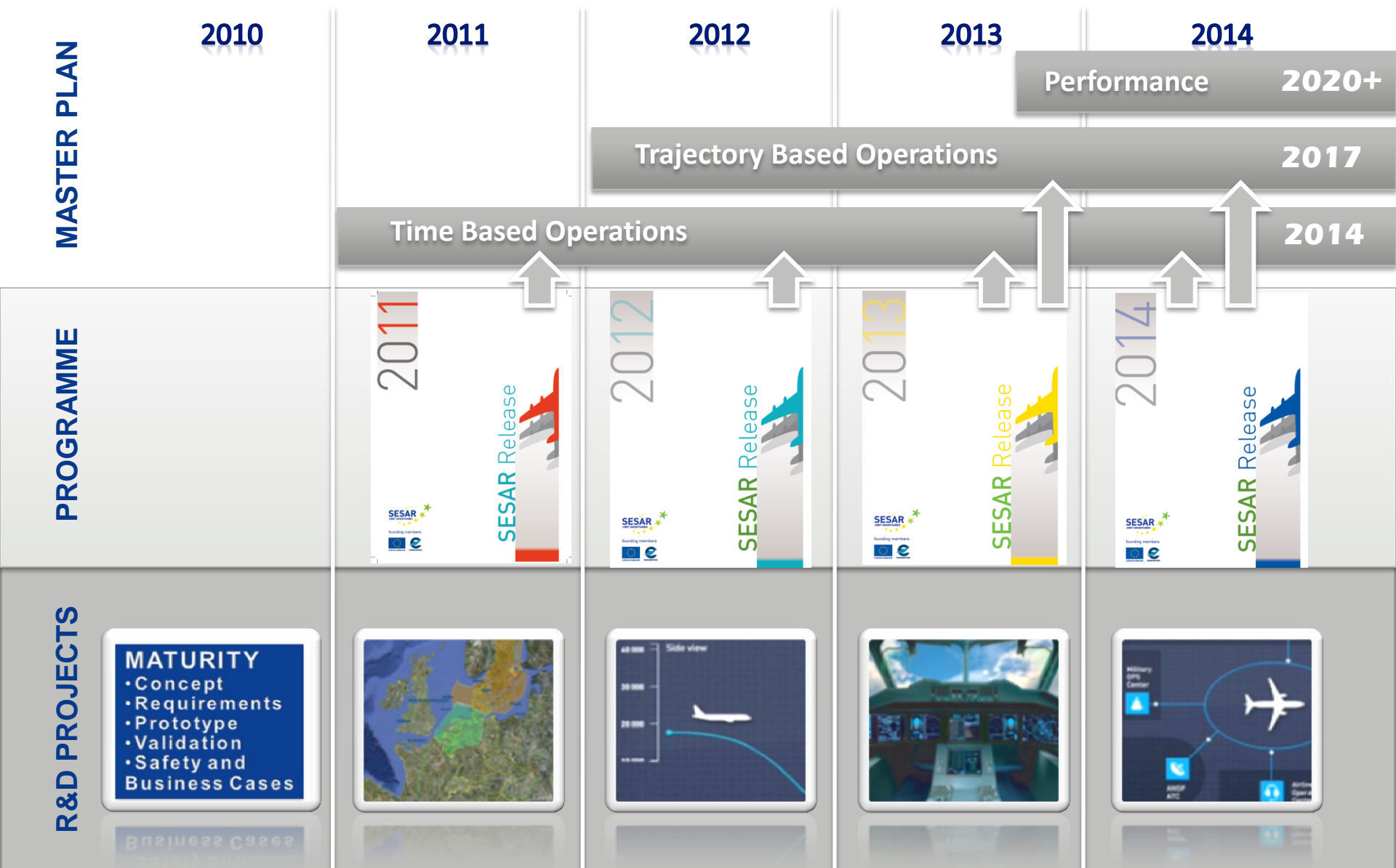| ATM functionality	Standardizati on activities	Regulatory activity	Regulato ry organiza tion	Regulato ry delivery	Start of investm ent	Industria lization on completi on	Start of deploy ment	End of deploy ment
PBN into high density TMAs	No specific need identified	EASA regulatory material on 1)PBN incorporati ng doc 9613 2)PBN Implementi ng rule	1)EASA 2)EK	1)2016 2)2016	2015	2016	2018	2023

Thanks for your attention

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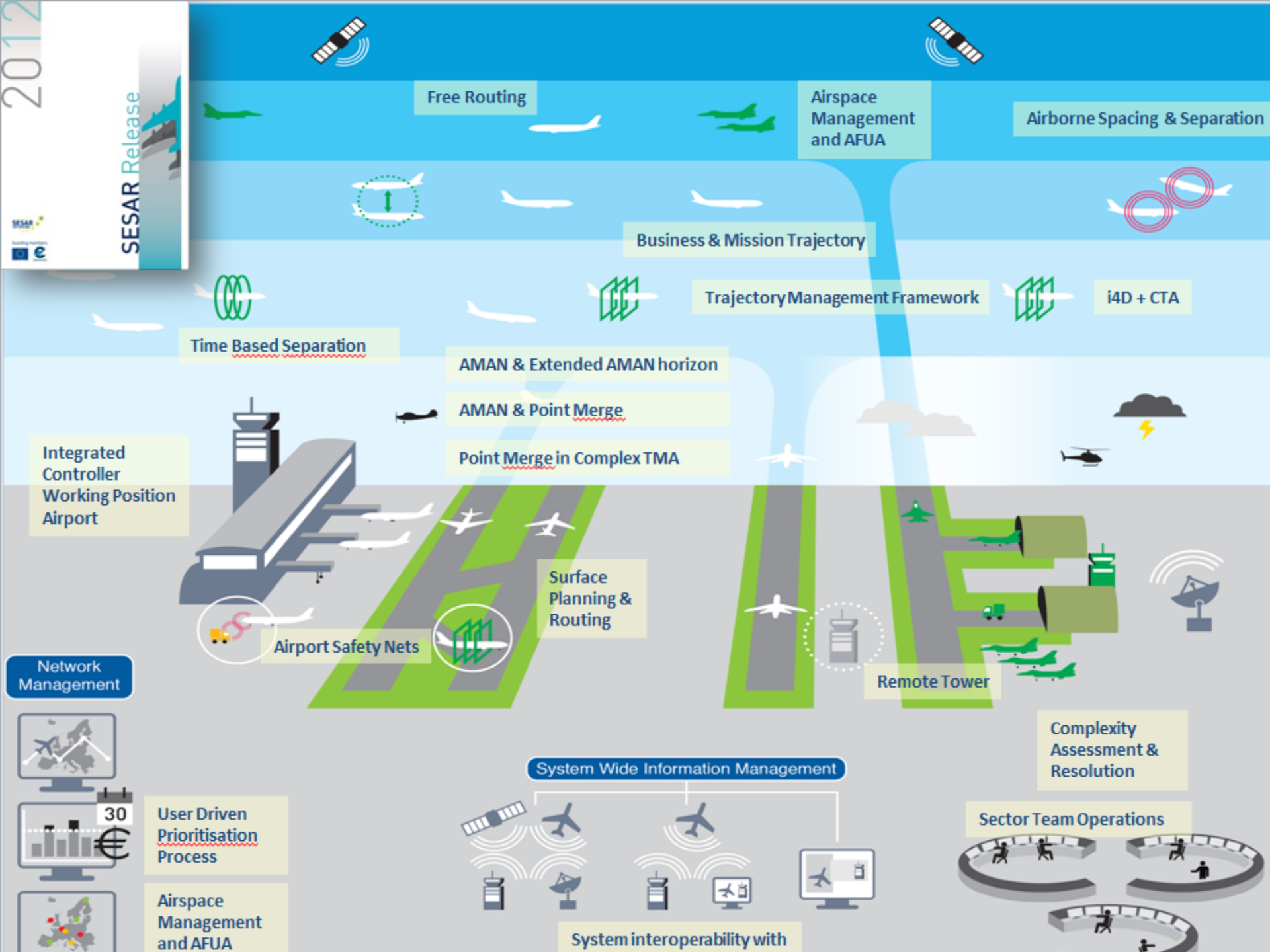| ATM functionality	Standardization activities	Regulatory activity	Regulatory organization	Regulatory delivery	Start of investment	Industrialization completion	Start of deployment	End of deployment
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FROM INNOVATION TO SOLUTION

- **Large Scale Demonstration Activities and AIRE** (>2012)

  - 18 contracts awarded all demonstrating strong complementarity with the SESAR Programme

  - 20 airlines, general aviation, 18 ANSPs, 6 airports and over 20 additional partners from the supply industry

  - Number of commercial flights expected: + 5000

  - Full results expected mid 2014

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DELIVER SESAR SOLUTIONS (Release)

MASTER PLAN

2010	2011	2012	2013	2014

Performance **2020+**

Trajectory Based Operations **2017**

Time Based Operations **2014**

PROGRAMME

R&D PROJECTS

MATURITY
• Concept
• Requirements
• Prototype
• Validation
• Safety and Business Cases

2012

SESAR Release

Free Routing

Airspace Management and AFUA

Airborne Spacing & Separation

Business & Mission Trajectory

Trajectory Management Framework

i4D + CTA

Time Based Separation

AMAN & Extended AMAN horizon

AMAN & Point Merge

Point Merge in Complex TMA

Integrated Controller Working Position Airport

Surface Planning & Routing

Airport Safety Nets

Remote Tower

Network Management

Complexity Assessment & Resolution

Sector Team Operations

User Driven Prioritisation Process

System Wide Information Management

Airspace Management and AFUA

System interoperability with

AMBER – Arrival Modernisation for Better Efficiency in Riga

OBJECTIVES: demonstrate regional turboprop aircraft capability of flying tailored Continuous Descent Approach into Riga International Airport and to reduce the noise impact, where possible, over populated areas.

PARTNERS: Latvian CAA.

VALIDATION APPROACH: 100 flight trials with commercial aircraft.

PCP Content Validation (3/3)

| AF#5 iSWIM Functionality & MET		Key Deliverables available today
SWIM for Step 1 (covered by AF#1 to AF#4 Deliverables)	R5	80%
Enhanced ops planning decisions through MET information integration (covered by AF#1 to AF#4 Deliverables)	R5	50%
SWIM deliverables – iterations (e.g. Information Models, security requirements)		80%
MET deliverables (e.g. Ops requirements & tech specifications)		50%

AF#6 Initial Trajectory Information Sharing (i4D - EPP)		Key Deliverables available today
i4D +CTA	R4	70%
ATM ground system upgrade with Extended Projected Profile (EPP)	R5	60%

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PCP R&D COMPLETION
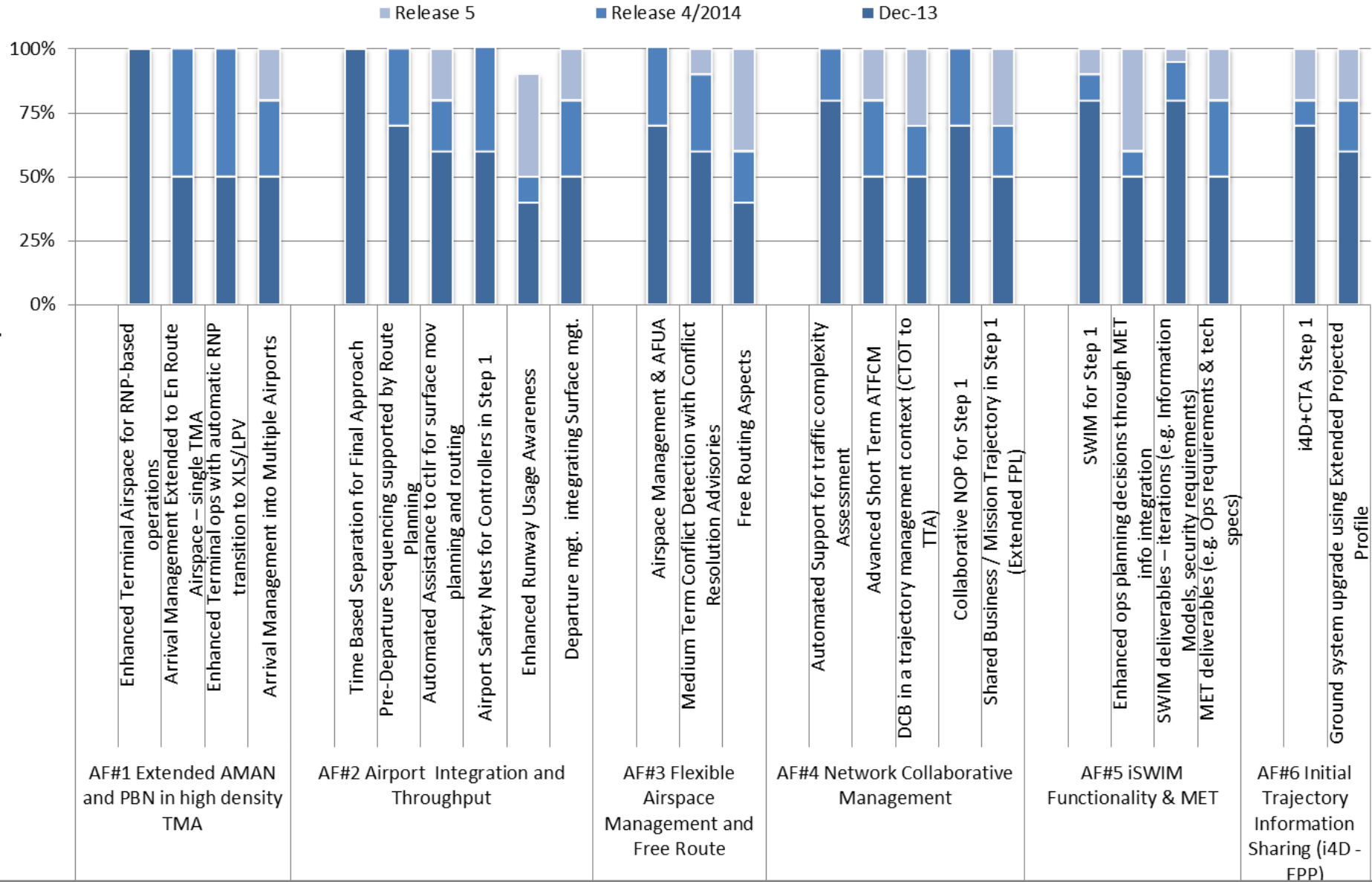
KEY WORDS

❖ SESAR delivers SESAR Solutions through **Releases;**

❖ First Solutions are available;

❖ The **Demo** activities complement the Programme;

❖ **PCP** content is fully integrated in the Programme.

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PCP AF 1

Enhanced Terminal Airspace using RNP-Based Operations includes:

- RNP 1 SIDs, STARs and transitions (with the use of the Radius to Fix (RF) attachment)
- RNP APCH (with Lateral Navigation (LNAV), Lateral Navigation/Vertical Navigation (LNAV/VNAV) and Localiser Performance with Vertical guidance (LPV) minima)

System Requirements

- ATC systems and ATC Safety Nets shall enable the Terminal Area and Approach PBN operations.
- RNP 1 operations require aircraft conformance to a track-keeping accuracy of +/- 1NM for at least 95% of flight time and on-board performance monitoring, alerting capability and high integrity navigation databases.
- For RNP APCH, the Lateral and Longitudinal Total System Error (TSE) of the airborne navigation systems shall comply with the EASA AMC 20-27.
- RNP 1 as well as RNP APCH capability requires inputs from GNSS.
- Vertical Navigation in support of APV

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PCP AF 1

- Enhanced Terminal Airspace using RNP-Based Operations consists of the implementation of environmental friendly procedures for arrival/departure and approach using PBN in high-density TMAs, as specified in the following navigation specifications:

  - SIDs and STARs using the RNP 1 specification with the use of the Radius to Fix (RF) path terminator

  - Required Navigation Performance Approach with Approach Procedure with Vertical guidance (RNP APCH with APV)

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