European ATM Master Plan
Update proposal 2019

ARISE+ - Support ASEAN ATM Master Plan – V2
Singapore, 4 July 2019

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Founding Members

A Master Plan: What for?

The Master Plan is the starting point for the SESAR Project – and the SESAR JU

EU
Council's
endorsement

Resolution and
Decision
30 March 2009

The European ATM Master Plan is the roadmap for SESAR development and deployment

An evolving document significantly updated every 3 years

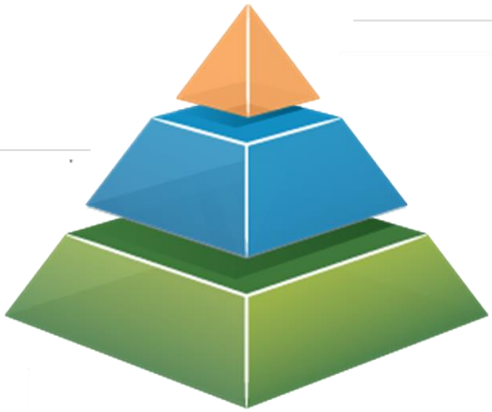
- A Master Plan contains:
  - ✓ Performance objectives (The **Why**)
  - ✓ Description and prioritisation of technical and operational solutions (The **What**)
  - ✓ Deployment scenarios per stakeholders (The **Where** and **When**)
  - ✓ Investment needs and performance gains over time (The **How Much**)
  - ✓ Standardisation and regulatory views, Risk Management Plan (The **How**)

Updates allow alignment with policy & market conditions changes

The 2019 Master Plan: Digitalising Europe's aviation infrastructure

- Provides a clear and future-proof vision for the finalisation of the SESAR project as a whole, towards a **"digital European sky"** (2040)
- **Addresses integration of all air vehicles**, manned and unmanned, civil and military, **in all airspaces, controlled or not (first reference to U-space)**
- Integrates results and recommendations of the **Airspace Architecture Study (AAS)** addressing the "capacity crunch" and is aligned with key Wise Persons Group's findings and recommendations
- Combines improvements linked to **airspace** optimisation and reconfiguration and **technological** solutions (AAS)
- Synchronised with EASA's **European Plan for Aviation Safety** (EPAS)

The 3 levels of the Master Plan: a tool for States and stakeholders



Level 1 | Executive

View (update every 3 years)

Vision
Performance
Priorities
Roll-out
Impact assessment
Risk Management

Level 2 | Development

View (yearly update)

Contains plan & architecture for SESAR Development activities

Level 3 | Deployment

View (yearly update)

Plan and report on implementation of SESAR activities

Also drives ATM changes in relation to EASA Rulemaking plan, Network Strategy Plan, Deployment Programme, standards (EUROCAE Work Programme)

The MP is the basis for annual planning and progress monitoring, it should be used by Member States when developing their performance plans

Linking to ICAO, feeding a global agenda

- ✓ The MP is linked to, and aligned with, the GANP and helps align and shape the global aviation agenda by ensuring that all EU/ECAC states **speak with one voice**
- ✓ At last year's ANC, papers on Committee A on Air Navigation and ATM were **directly or indirectly related to the Master Plan**
- ✓ The MP is also a high interest cooperation area in all **bilateral arrangements** with FAA, China, Japan, Singapore, Qatar …

Annex B of draft MP shows alignment with the GANP as it is expected to be adopted in September 2019. Any change will be reflected in MP before its formal approval by SJU Board

The MP is the voice and "ambassador" of European ATM on the global scene

Maintaining high EU safety standards

- Requires a shifting to a risk and performance-based mindset for the determination of future SESAR and EASA priorities for ATM
- The link between the MP and the EPAS is already strong and visible as from the current draft
- By doing that Europe will also help drive similar trends currently on-going at global level (ICAO)

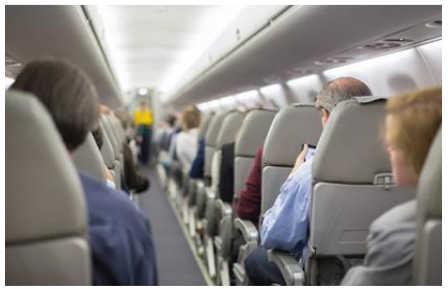
To be effective, link has to be maintained both ways (MP>EPAS, EPAS>MP)

Why this update now?

The aviation value chain

- **High performing connected aircraft or vehicles**
  - ✓ Industry is continually developing and improving its products in response to competition
  - ✓ New entrants in a global market are driving innovation
  - ✓ Technology lifecycles are accelerating

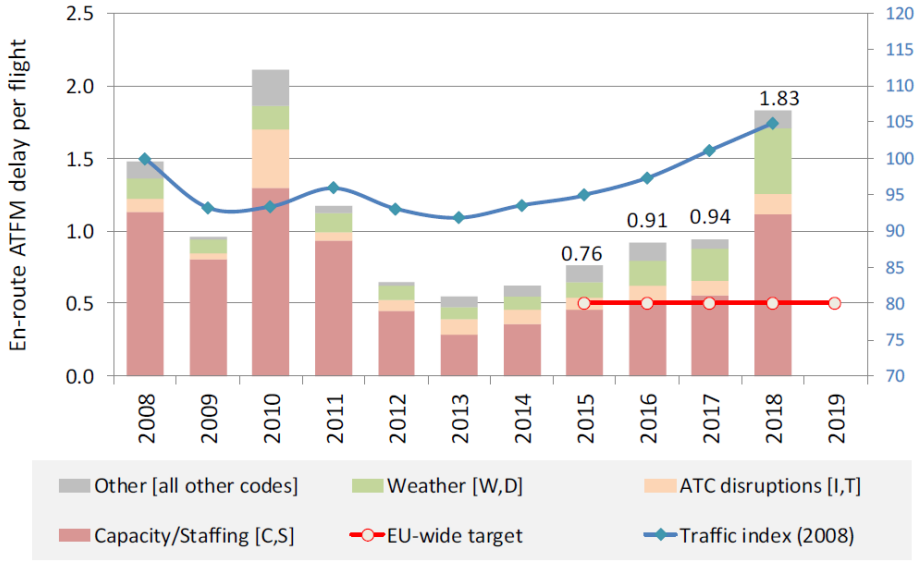
- **Optimised airline operations & new air services**
  - ✓ Significant pressure is being placed on trajectory optimisation and reduction of environmental footprint
  - ✓ Future “airspace revenues” are increasingly generated from new services



- **An ecosystem that will have to adapt**
  - ✓ Technology, regulation and policy are key drivers
  - ✓ Management of information is at the core of the system

Unprecedented increase in conventional traffic

- The SES delay target (0.5 min/flight) has not been met since 2015
- Capacity constraints are a key challenge, expected to further deteriorate in the coming years, if changes are not introduced to the current airspace architecture, airport capacity and ATM operations



Source: Eurocontrol, Performance Review Unit

- **The Airspace Architecture Study uses the Master Plan** and the Programme's R&D to address the capacity challenge through, for the first time, a coupling of airspace, operations and technical evolution, accompanied by proposed evolution of service provision
- Technological Solutions proposed span from mature Solutions providing **short-term** mitigation measures to prioritized R&D addressing **medium and longer term challenges requiring structural evolutions**

New entrants in the system

Today, thousands of aircraft in the sky

Traditional piloted aircraft & rotorcraft with limited connectivity

Today's capacity crisis is already showing the limits of the current system

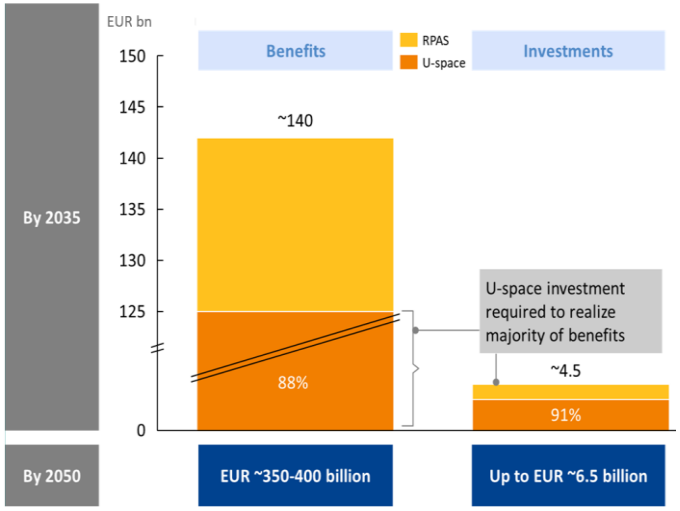
Tomorrow, hundred of thousands of connected flying devices in the sky

Connected & more autonomous aircraft

Future traffic and growing environmental concerns call for more radical transformation of ATM

Master Plan addresses issue of new entrants in the airspace

- Incorporates Drones roadmap adopted in March 2018, with its U-space dimension
- Initial R&D on U-space is integrated in operational view Chapter
- U-space services to be used as a “laboratory” that may support the gradual implementation of faster lifecycles in the manned aviation environment
- Incorporates Drones Business case highlighting major business opportunities
- Military drones (in particular MALE) fully considered with a priority need for early, seamless and safe integration into airspace (Target 2025 for airspace classes A-C)
- Placeholders for **very high altitude opera**tions and **urban air mobility** future developments



Overview of investment and benefit levels associated to integration of drones

Growing environmental concerns: Need to step up efforts to address environmental sustainability of aviation – and of ATM

- Commissioner Bulc's speech at IATA 2019 Annual General Meeting (2 June 2019):
  - ✓ *"aviation emissions are rising rapidly – today's CO_2 emissions from air transport are almost twice as high as they were in the 1990s.*
  - ✓ *environmental costs, such as climate change, air pollution and noise, represent almost 100% of all costs for aviation, with these costs amounting to €33 billion for 33 EU airports.*
  - ✓ *The price paid by those travelling by plane covers roughly the infrastructure costs, but not the environmental costs*."

- As far as ATM is concerned **trajectory based operations is required more than ever before** to reduce environmental footprint
  - ✓ Solutions for airports and TMAs (CCO/CDO), curved, steep and/or segmented approaches, noise preferential routes, flight/flow centric operations are addressed in the Master Plan
  - ✓ Evaluation tools are available for assessing SESAR Solutions and their impact on noise and/or emissions (European Aviation Environmental Report, EASA, Eurocontrol and EEA, January 2019)

The SESAR Vision

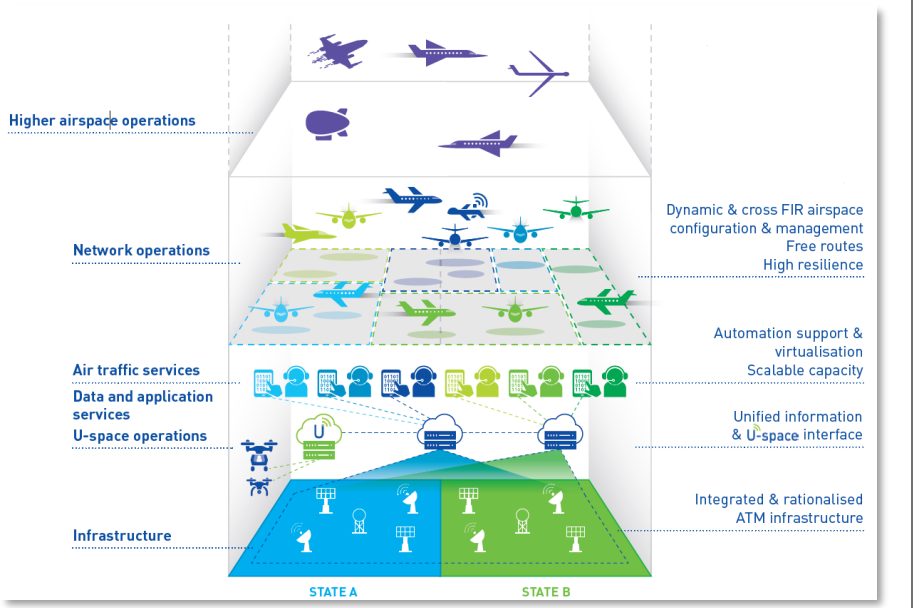
Vision – towards the delivery of a digital European sky

Fully scalable ATC system with strong **air-ground integration**

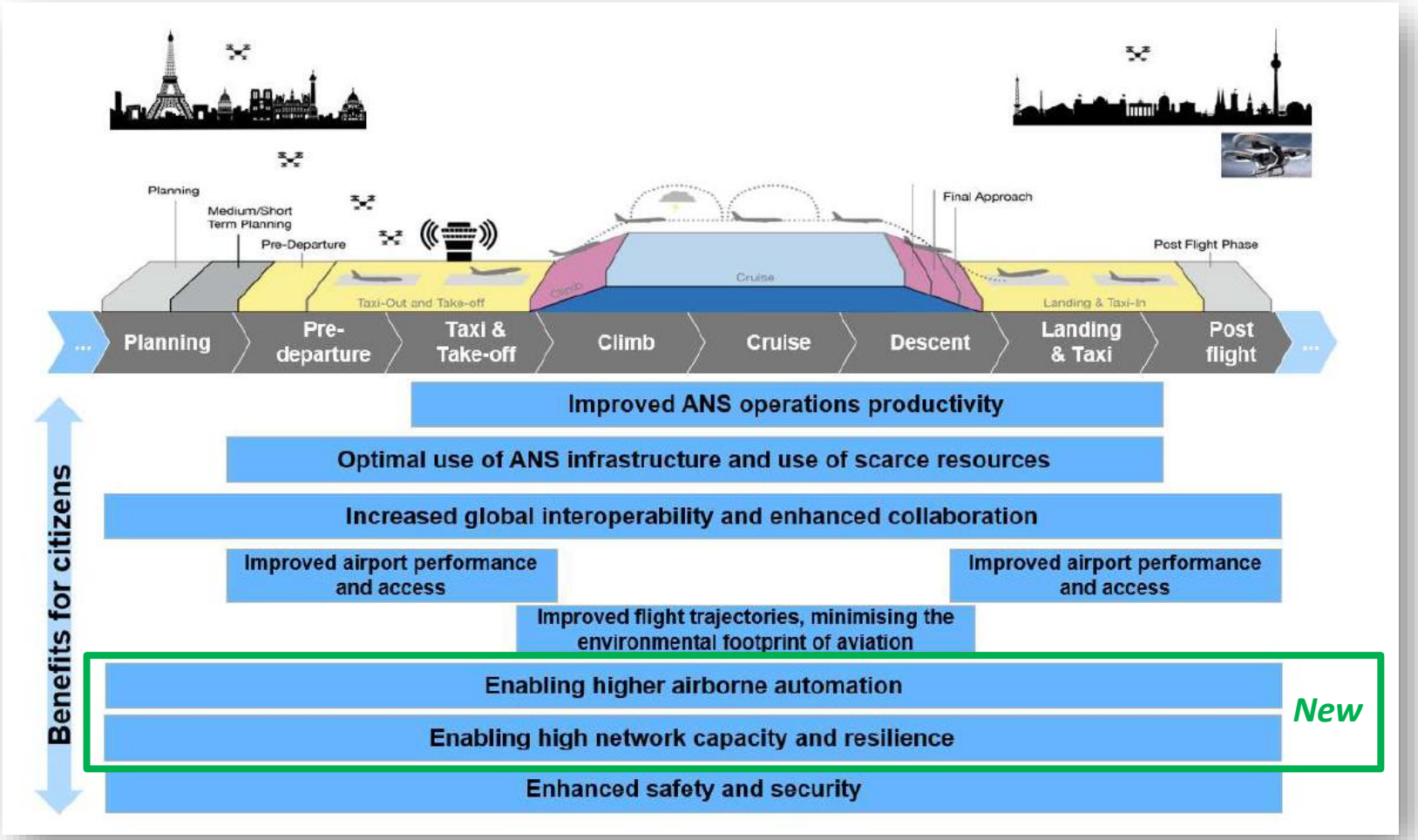
Relying on a **digital ecosystem**

Elimination of environmental inefficiencies caused by the aviation infrastructure

Ensuring that it offers solutions **that will fully exploit the potential offered by the next generation aircraft** for cleaner and quieter flight



Offering improvements across ATM



Embracing the digital transformation of aviation

Digital Transformation is about taking full advantage of digital technologies to generate new services, optimise current ones while delivering a better experience and benefits to all stakeholders.

Automation & AI

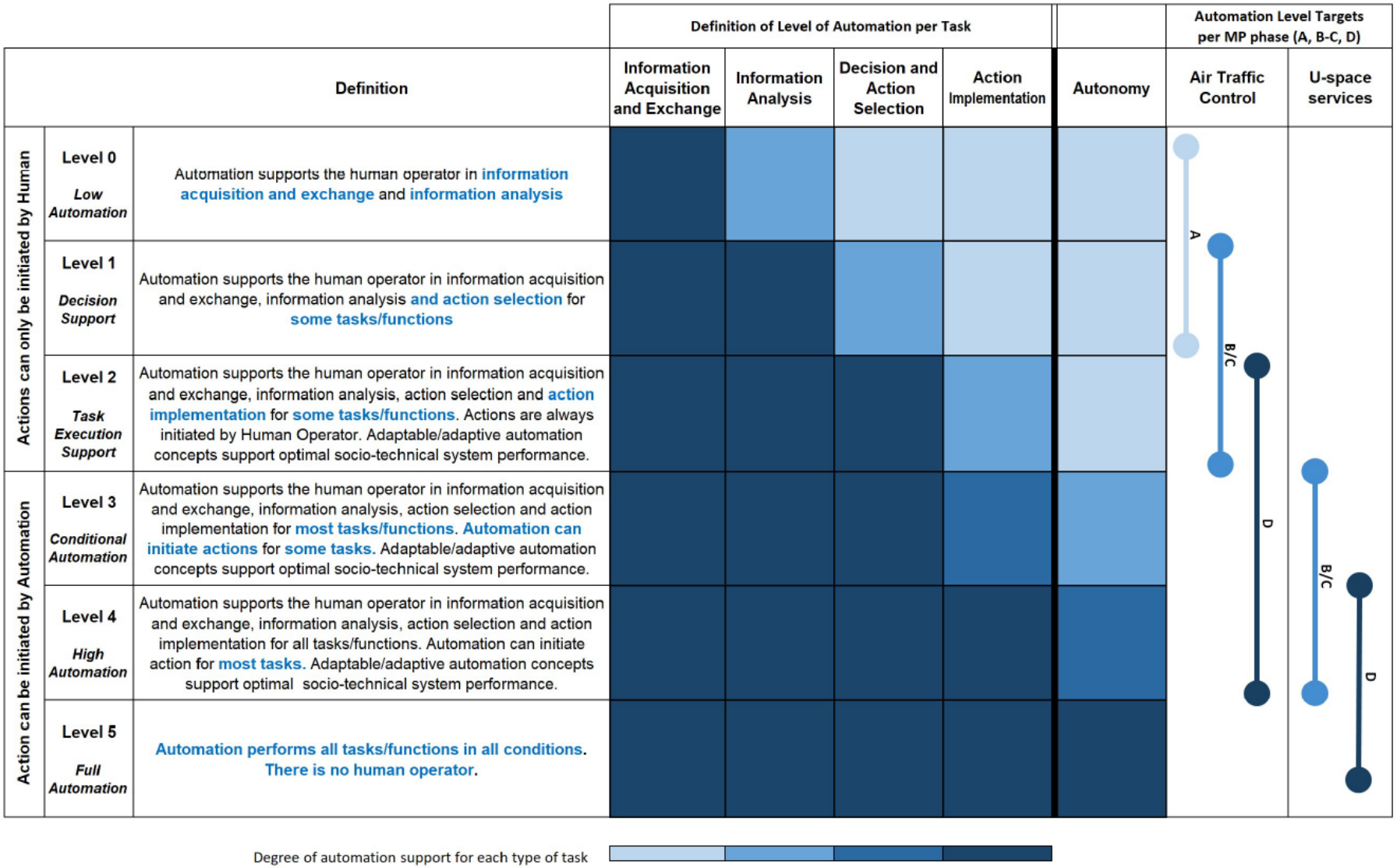
Connectivity

Data sharing & data services

Virtualisation

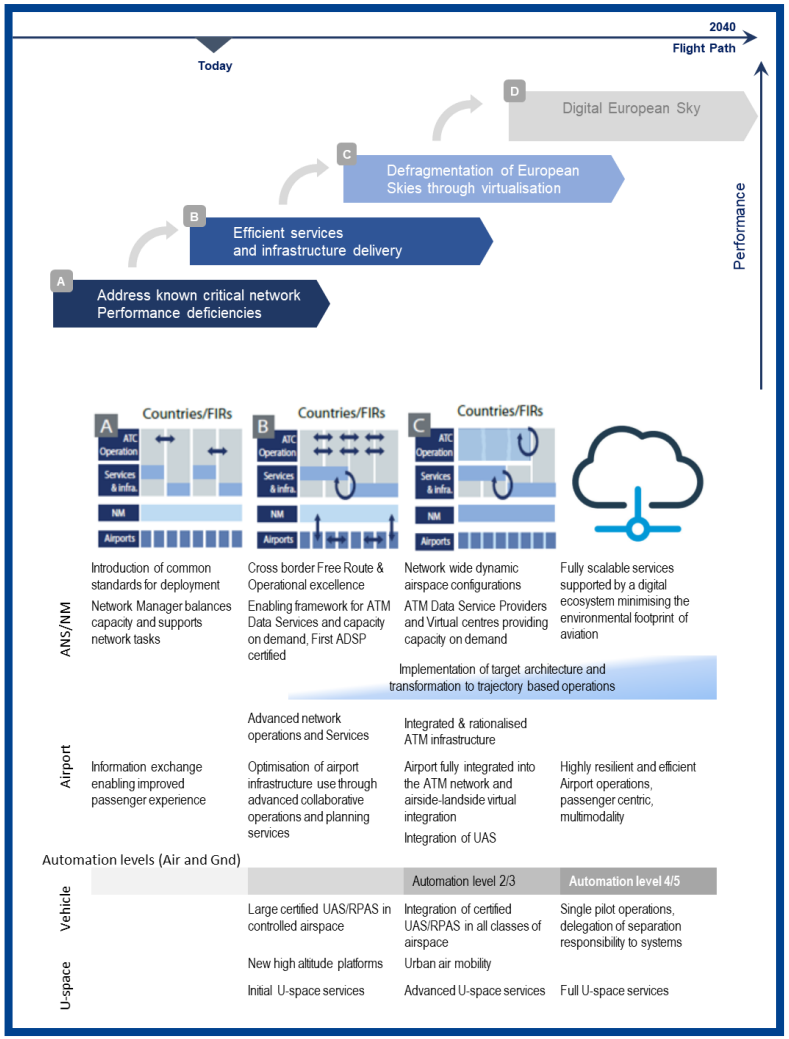
Cybersecurity & safety

Embracing the digital transformation of aviation



Vision – a phased approach

- ✓ Not a moving target: SESAR 2020 will deliver R&D required up to phase C
- ✓ Gradual increase in the level of automation support
- ✓ Fully consistent with outcome of the AAS
- ✓ Combining airspace design and technological solutions

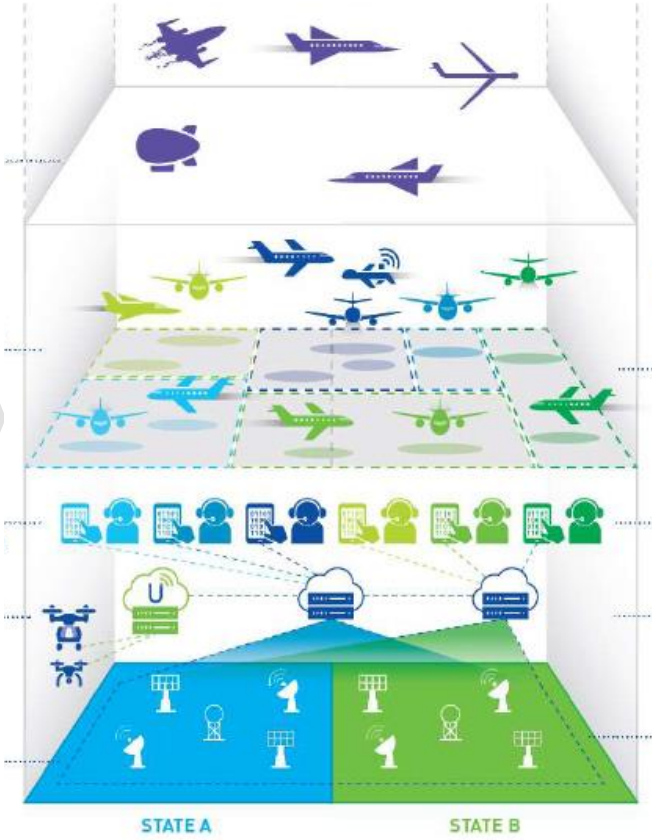


Clear priorities for elements that are in the pipeline towards deployment

9

Essential Operational Changes

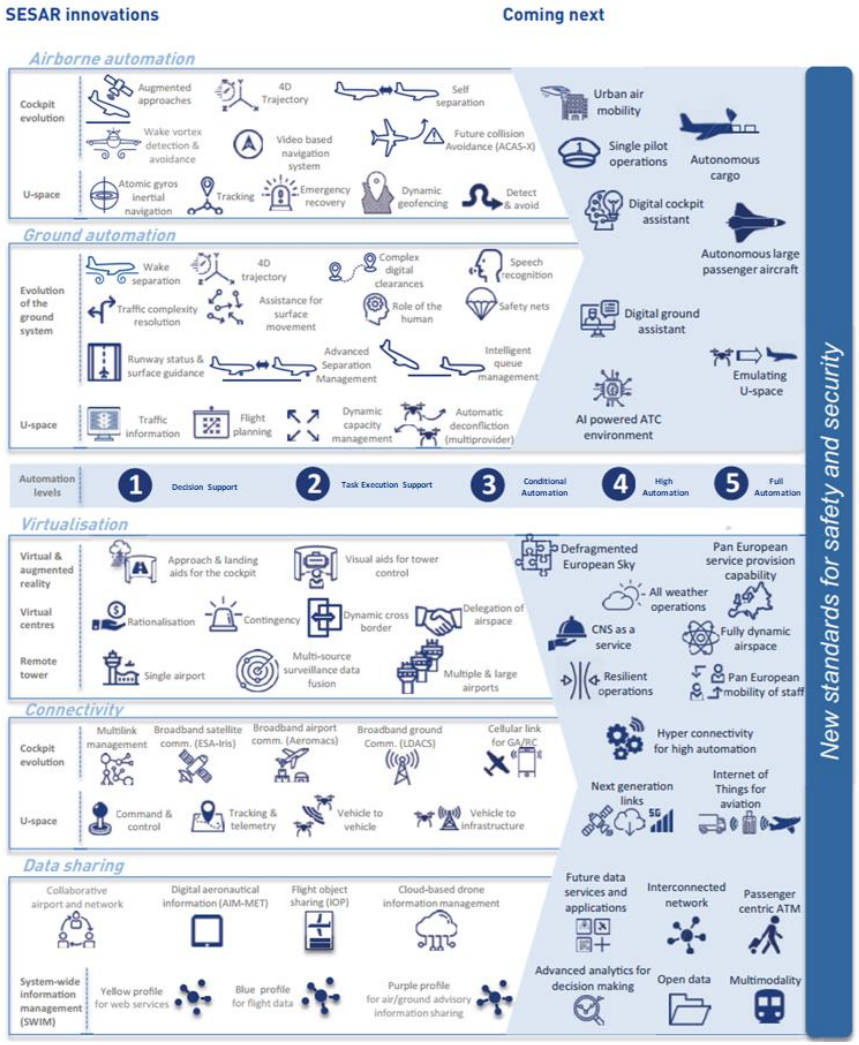
- CNS infrastructure and services
- ATM interconnected network
- Digital AIM and MET services
- U-space services
- Virtualisation of service provision
- Airport and TMA performance
- Fully dynamic and optimised airspace
- Trajectory based operations
- Multimodal mobility and integration of all airspace users



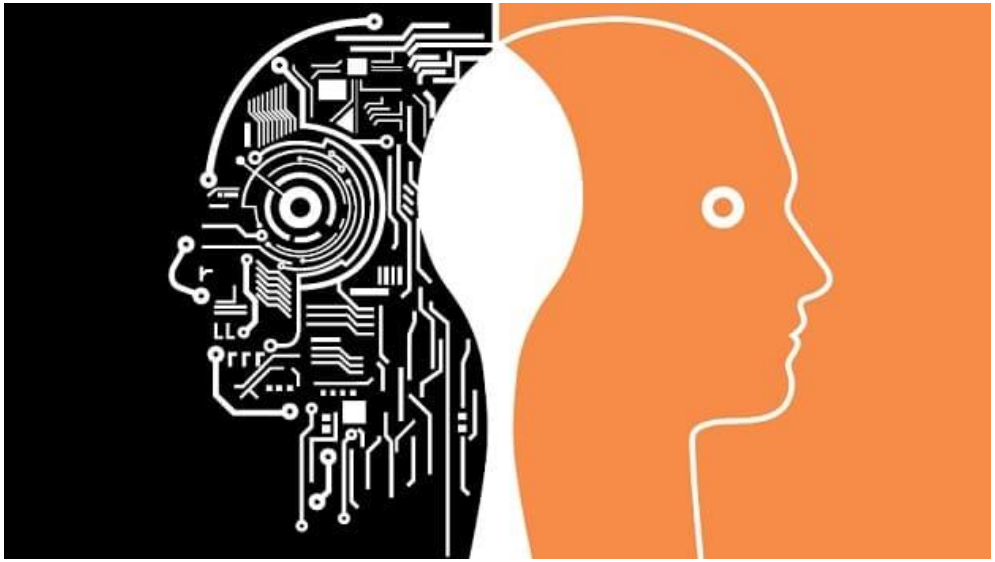
Towards the target architecture

Further R&D and changes in the way of working in SESAR is needed from 2020+ to deliver the digital sky

- ✓ **Further R&D to deliver digital European sky is identified** (more agile with involvement of new actors)
- ✓ Need for change in the way of working in SESAR **to shorten the innovation life cycle of ATM**
- ✓ Delivery to be more focused on de-risking **delivery of next generation standards and the path to certification**
- ✓ While **keeping a focus on the short term** …



A well recognised human dimension

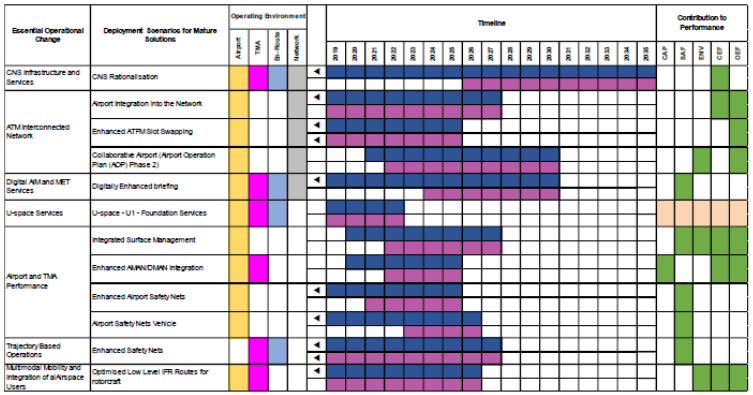


Evolving roles	Change management	Training
Social	Gender equality	Staff involvement

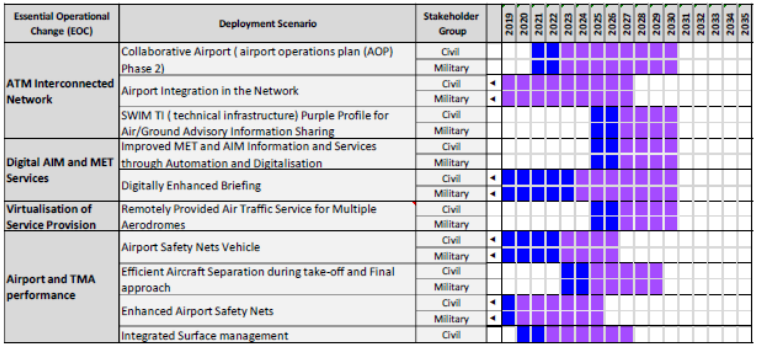
How close are we from realising this vision?

Deployment views

Deployment scenarios



Stakeholder roadmaps



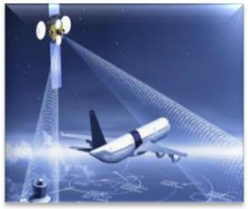
More detailed views on the elements that are in the pipeline towards deployment

Deployment scenarios and stakeholder roadmaps focusing on EOCs

Further refined in Level 3

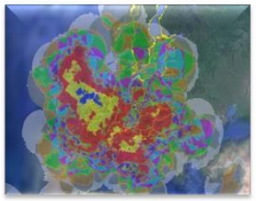
Infrastructure evolution (Drivers)

Increased **Digitalisation, Connectivity** and Higher **Automation** Levels



Combined Satellite-based, Airborne and Ground-based **CNS**

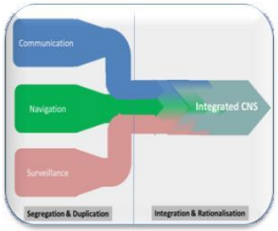
Safe, Secure and **Resilient** Infrastructure



Rationalised Infrastructure

Moving focus **from physical** assets **to** delivery of **services**

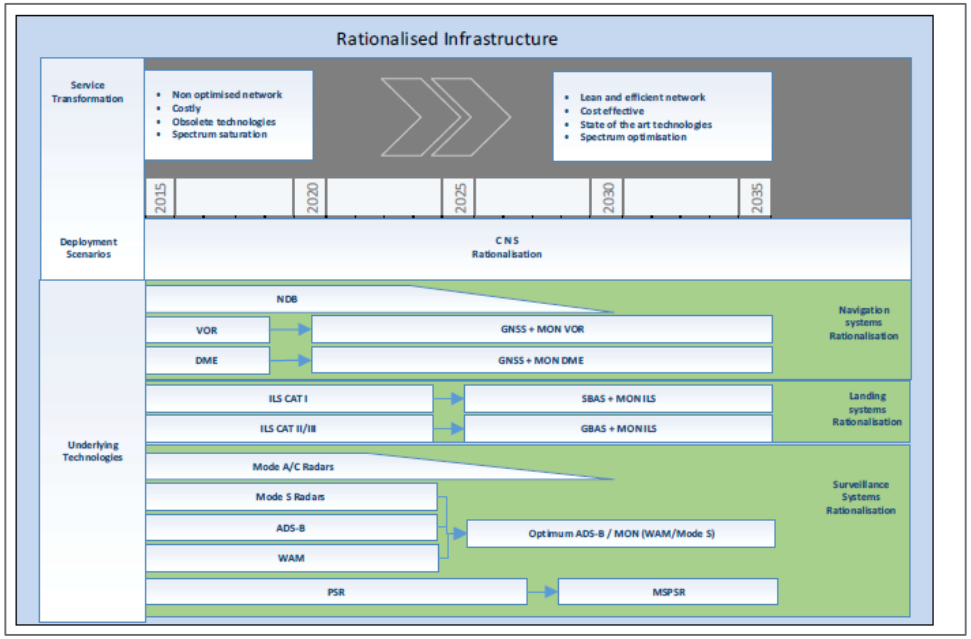
Increased **Civil-Military** Synergies and Dual Use



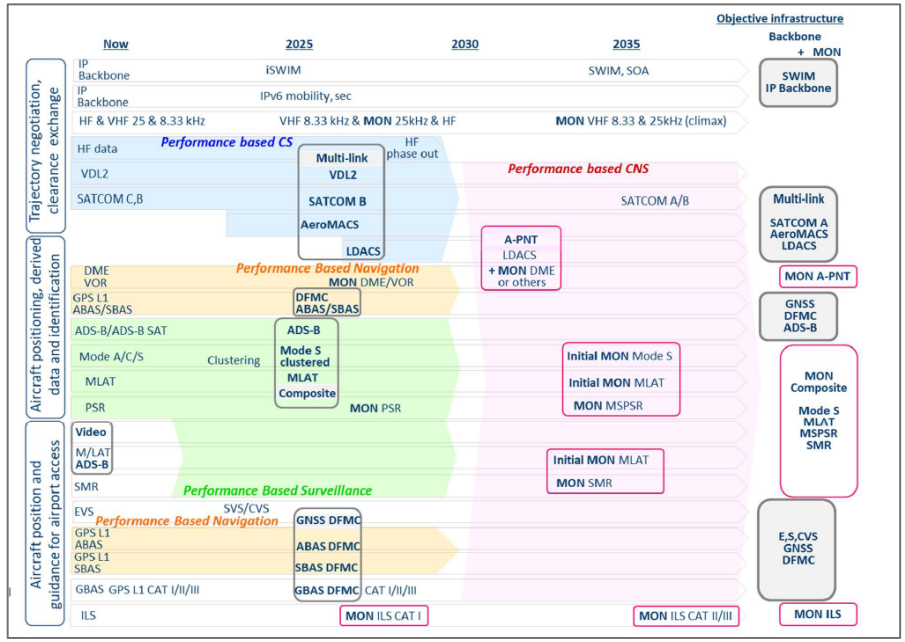
Performance Based and **Integrated** CNS

Efficient use and long-term **availability** of suitable radio **spectrum**

Infrastructure evolution (roadmaps)



Rationalisation



Integrated CNS roadmap

Standardisation and regulatory needs

Deployment Scenario	Code	Solution Title	STD	REG		
7. Fully dynamic and optimised airspace						
High Productivity Controller Team Organisation	**PJ.10-01a**	**High Productivity Controller Team Organisation**	●	◨		
Dynamic Airspace Configurations	PJ.08-01	Dynamic Airspace configurations (DAC)	○	■		
Flight-centric ATC and Improved Distribution of Separation Responsibility in ATC	PJ.10-01b	Flight Centred ATC	●	◨	EPAS	
	PJ.10-01c	Collaborative Control	●			
	PJ.10-06	Generic' (non-geographical) Controller Validations	●	◨		
Mission trajectories management with integrated Dynamic Mobile Areas Type 1 and Type 2	PJ.07-03	Mission Trajectory Driven Processes	◑	◨		
8. Trajectory based operations						
Enhanced Safety Nets	**#60**	**Enhanced Short Term Conflict Alert (STCA) for Terminal Manoeuvring Areas (TMAs)**	●	◨		
	#69	**Enhanced STCA with down-linked parameters**	●	◨		
eFPL Supporting SBT Transition to RBT	**PJ.18-02c**	**eFPL supporting SBT transition to RBT**	●	■		
Enhanced integration of AU trajectory definition and network management processes	PJ.07-01	AU Processes for Trajectory Definition	●	■		
Improved ground trajectory predictions enabling future automation tools	PJ.10-02a	Improved Performance in the Provision of Separation	●	■		
	PJ.10-02b	Advanced Separation Management	◑	■		
RBT revision supported by datalink and increased automation	PJ.18-02a	Trajectory based operations	◑	■		
	PJ.10-02b	Advanced Separation Management	◑	■		
Improved vertical profiles through enhanced vertical clearances	#56-W2	Improved vertical profiles through enhanced vertical clearances				
9. Multimodal mobility and integration of all airspace users						
Optimised Low-Level Instrument Flight Rules (IFR) routes for Rotorcraft	**#113**	**Optimised Low-Level Instrument Flight Rules (IFR) routes for Rotorcraft**	●	■		
Independent Rotorcraft operations at the Airport	**PJ.02-05**	**Independent Rotorcraft operations at the Airport**	◑	◨	EPAS	
Enhanced Rotorcraft and GA operations in the TMA	**PJ.01-06**	**Enhanced Rotorcraft and GA operations in the TMA**	◑	■	EPAS	
IFR RPAS accommodation in Airspace Class A to C	PJ.10-05	IFR RPAS Integration	◑	◨	EPAS	EUSCG
IFR RPAS Integration in Airspace Class A to C	PJ.10-05	IFR RPAS Integration	◑	◨	EPAS	EUSCG
Collision avoidance for IFR RPAS	PJ.11-A2	Airborne Collision Avoidance for Remotely Piloted Aircraft Systems – ACAS Xu	◑	◨	EPAS	EUSCG

●	No additional standardisation needs identified in R&D
○	Standardisation need identified in R&D
◑	Standardisation work planned or ongoing
■	No additional regulatory needs identified in R&D
◨	Regulatory work planned or ongoing
<blank>	Analysis in R&D pending
EPAS	covered in EPAS
EASCG	covered in EASCG Rolling Development Plan
EUSCG	covered in EUSCG Rolling Development Plan

High-level view of identified needs that support the deployment of the Essential Operational Changes.

Fully aligned with EPAS, EASCG and EUSCG work

Detailed view is maintained on a yearly basis at level 2 of the Master Plan

What are the expected benefits and investment needs ?

Confirming the performance ambitions for 2035

Key Performance Area	SES high-level goals vs. 2005	Key Performance Indicator	Baseline value (2012)	Ambition value (2035)	Performance ambition vs. baseline: Absolute improvement	Performance ambition vs. baseline: Relative improvement
Capacity	Enable 3-fold increase in ATM capacity	Departure delay[4], min/dep	9.5 min	6.5-8.5 min	1-3 min	10-30%
		IFR flights at congested airports[5]	4 million	4.2-4.4 million	0.2-0.4 million	5-10%
		Network throughput IFR flights[5]	9.7 million	~15.7 million	~6.0 million	~60%
		Network throughput IFR flight hours[5]	15.2 million	~26.7 million	~11.5 million	~75%
Cost efficiency	Reduce ATM services unit cost by 50% or more	Gate-to-gate direct ANS cost per flight[1], EUR(2012)	EUR 960	EUR 580-670	EUR 290-380	30-40%
Operational efficiency		Gate-to-gate fuel burn per flight, kg/flight	5280 kg	4780-5030 kg	250-500 kg	5-10%
		Additional gate-to-gate flight time per flight[2], min/flight	8.2 min	3.7-4.1 min	4.1-4.5 min	50-55%
		(Within the: Gate-to-gate flight time per flight[3], min/flight)	(111 min)	(116 min)		
Environment	Enable 10% reduction in the effects flights have on the environment	Gate-to-gate CO_2 emissions, tonnes/flight	16.6 tonnes	15-15.8 tonnes	0.8-1.6 tonnes	5-10%
Safety	Improve safety by factor 10	Accidents with direct ATM contribution[6], #/year Includes in-flight accidents as well as accidents during surface movement (during taxi and on the runway)	0.7 (long-term average)	no ATM related accidents	0.7	100%
Security	-	ATM related security incidents resulting in traffic disruptions	unknown	no significant disruption due to cyber-security vulnerabilities	unknown	-

1 Unit rate savings will be larger because the average number of Service Units per flight continues to increase.
2 "Additional" here means the average flight time extension caused by ATM inefficiencies
3 Average flight time increases because the number of long-distance flights is forecast to grow faster than the number of short-distance flights
4 All primary and secondary (reactionary) delay, including ATM and non-ATM causes
5 Includes all non-segregated unmanned traffic flying IFR, but not the drone traffic flying in airspace below 500 feet or the new entrants flying above FL 600
6 In accordance with the PRR definition: where at least one ATM event or item was judged to be DIRECTLY in the causal chain of events leading to the accident. Without that ATM event, it is considered that the accident would not have happened

Impact – significant value at stake

>600

EUR billion of value at stake by 2040

- ✓ Realising the benefits will largely depend on the ability of the sector to shorten the innovation life cycle for infrastructure modernisation
- ✓ **If these conditions are not created, the transformation is likely to be completed only by 2050 with negative implications for the environment, jobs and growth in Europe**

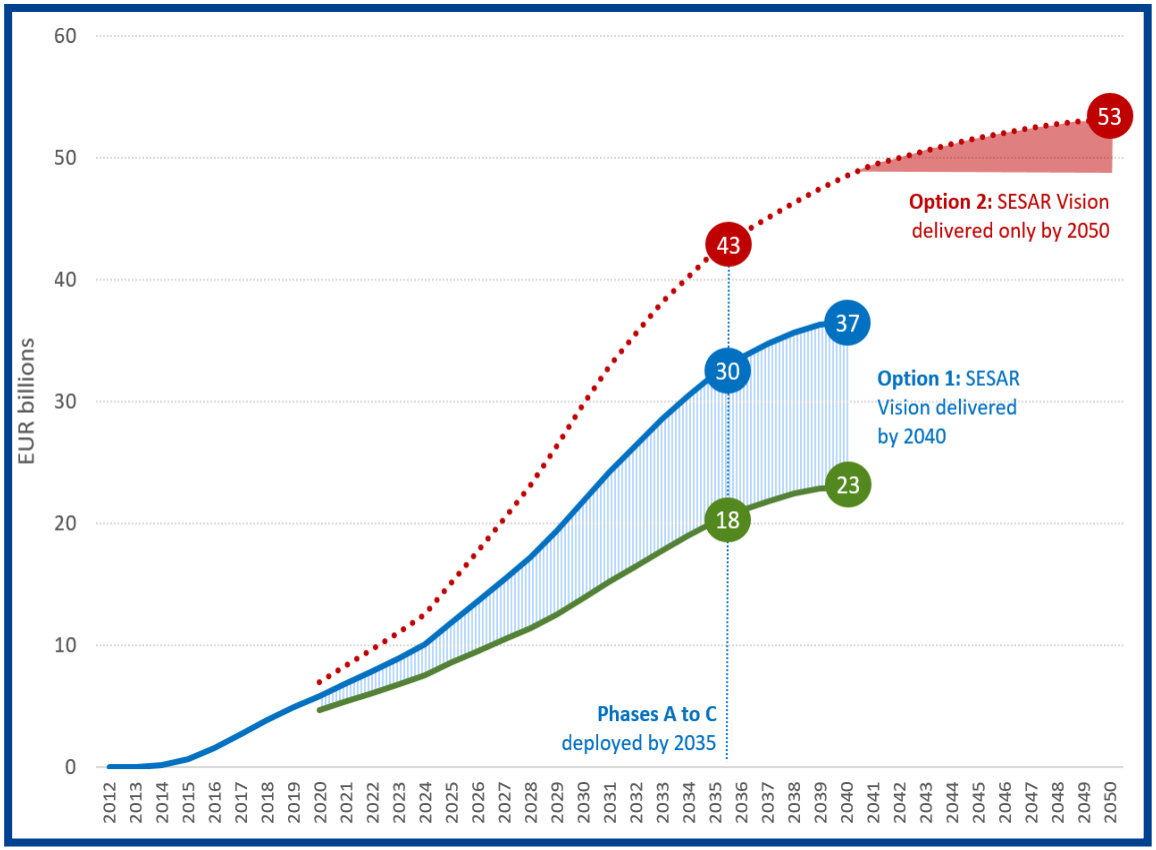
First major update of the macroeconomic impact of SESAR since 2011

Investments – representing less than 5% of value at stake

Total investment need in the range of EUR 23 to 37 billion

<5%

Share of investment needs in relation to value at stake



In a context where in the next 20 years, airspace users will be investing several EUR trillion to phase-in next generation aircraft

Main risks & mitigation measures

Risk management

- ✓ **The top 7 risks are linked to**
  - **The current implementation of SESAR and the capacity challenge***
  - **Potential delays in the implementation of SESAR pre requisites and common project functionalities***
  - Inability to successfully deploy the right solutions enabling the safe integration of drones
  - Potential cybersecurity vulnerabilities
  - **Inability to accelerate the pace of deployment of SESAR***
  - Human performance (incl. change management)
  - Need for coordination and harmonisation at global level
- ✓ **All risks are duly described and include a list of mitigation actions**

The Master Plan embeds risk management and mitigation measure and forms part of the SJU Risk Management policy

**deep dive on 3 risks in the following slides*

Conclusions

- The new MP will provide an **ambitious and future-proof response to the industry declaration "towards a digital European sky"**

- Further R&D and a change in the way of working inside SESAR to further **shorten the life-cycle of innovation** all the way to the delivery of standards and market uptake will be essential to realise the value at stake

- In doing that, it will also help steer SESAR in the right direction with the **fast tracking of Solutions related to building capacity, addressing environmental sustainability and drones**