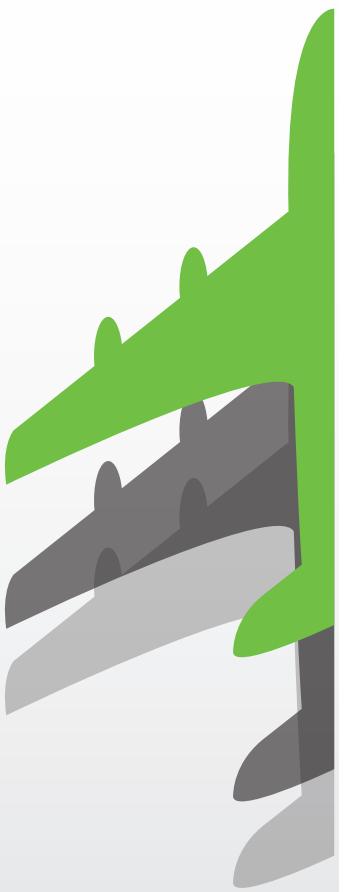


2017

# SESRAR Release



finding members



EUROPEAN UNION



EUROCONTROL



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# SESAR explained

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## The performance of Europe's Air Traffic Management system

is critically important for the sustainability of aviation and air transport, two sectors which drive European competitiveness, mobility and employment. Until SESAR, ATM research and development activities, initiatives and projects were performed in a fragmented way – small changes as and when technology advanced to fix areas of the current system, often in isolation from one another.

Guided by the European ATM Master Plan, the SESAR Programme brings together some 3,000 experts whose knowledge and expertise are ensuring that SESAR Solutions meet the needs of the ATM industry both for today and in the future, and are undergoing rigorous testing in preparation for deployment.

As the technological pillar of the Single European Sky, SESAR takes a European net-centric view of modernisation, delivering technological and operational solutions (SESAR Solutions) to improve the overall effectiveness, cost efficiency and environmental footprint of ATM, all the while maintaining the highest standards of safety.

SESAR Solutions address all parts of the ATM value chain, from airports, air traffic services to the network, as well as the underlying systems architectures and technological enablers, and are validated in real day-to-day operations. The SESAR Joint Undertaking is responsible for SESAR R&I and for delivering these solutions for wide-scale deployment.

Today, SESAR is proving to be a powerful catalyst in transforming Europe's ATM network into a modern, cohesive and performance-based operational system. Proof of the readiness of SESAR research is the decision by the EC to package a first set of SESAR solutions into a Pilot Common Project (PCP)<sup>1</sup>, that are considered mature enough for synchronised deployment across Europe (2015-2020). This will be managed by the recently established SESAR Deployment Manager, an alliance of European ATM actors collaborating under a framework partnership agreement with the EC, who will ensure that new technologies and solutions that have already been tested and validated through the SESAR JU are delivered into everyday operations across Europe, delivering significant benefits to airspace users and the environment. This means that Europe now has all the blocks necessary to build the ATM system that it needs to increase the performance and sustainability of its aviation sector.

(1) European Commission Implementing Regulation (EU) N° 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan Text with EEA relevance

# 02 The SESAR validation process

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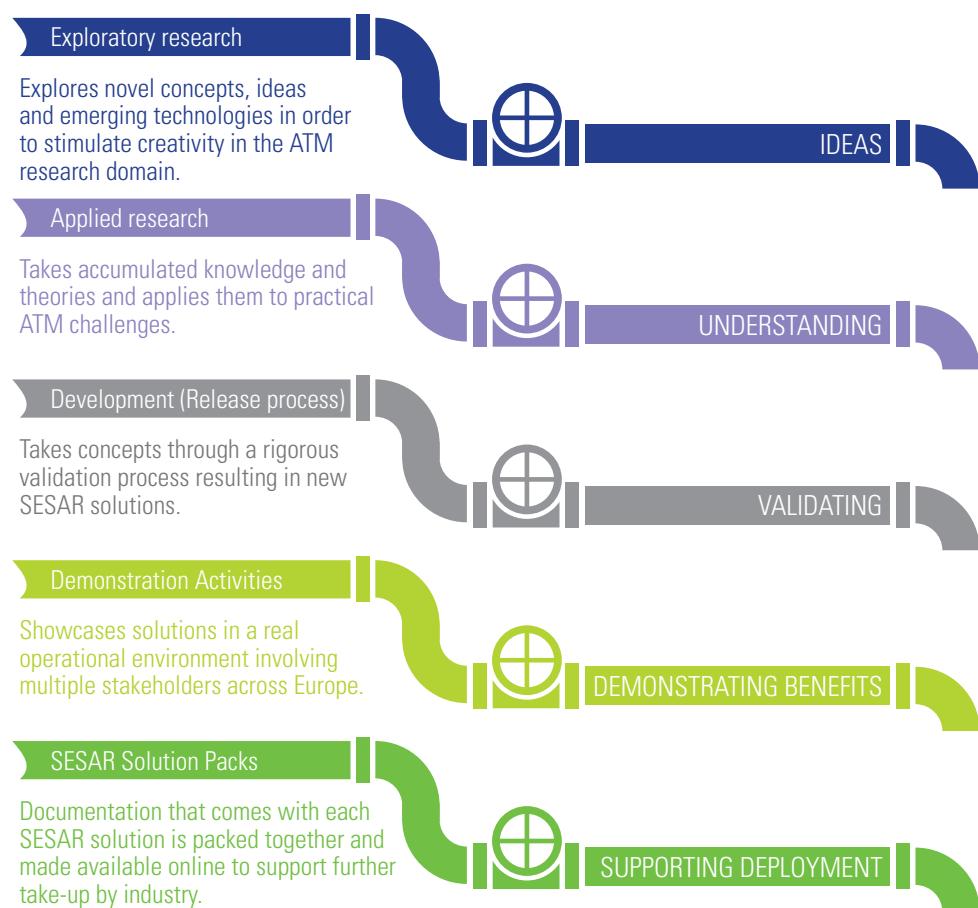
The SESAR Programme has developed an innovation pipeline towards deployment, which is stimulating new thinking in the ATM domain and then validating and demonstrating the viability and benefits of SESAR Solutions (see Figure 1).

The mechanism used to validate these solutions is known as the Release process. This process involves solutions undergoing thorough pre-industrial development and integration testing within a given timeframe in order to establish their readiness for industrialisation and subsequent deployment.

Since 2011, SESAR has been carrying out one release every year and has so far completed **82 exercises**, consisting of a range of flight trials and simulations.

This brochure gives an **overview of Release 5**, which addresses **33 potential SESAR Solutions** through **38 validation exercises** planned over the course of 2015 and 2016.

Figure 1: SESAR innovation pipeline





As previously mentioned, many of the solutions featured in this brochure are part of a first package of ATM functionalities for synchronised deployment in the short-to-medium term across Europe (2015-2020), as part of the PCP. Solutions which are part of the PCP and Release 5 are highlighted in this document using the PCP stamp.

Thanks to this incremental approach to developing, validating and deploying SESAR Solutions, the aviation community is benefiting from early improvements made to ATM operations:

- **Air Navigation Service Providers (ANSPs)** can deliver a better quality of service at a lower unit cost for airspace users, and can seamlessly interoperate with service providers across the network and beyond.
- **Air traffic controllers, pilots and engineers** have tools and systems that are built to their needs and support their ability to operate in an increasingly complex environment.

- **Airport operators** have access to more integrated systems into which they share valuable data to enable greater predictability and more efficient operations.
- **Airspace users (civilian and military)** can operate closer to their business or mission needs, while reducing fuel costs, service charges and reducing impact on the environment.
- **Regulator and administrators** can build their activities based on validated solutions agreed across the European ATM stakeholder community.
- **Suppliers** can gain access to the market, allowing them to develop their products in an innovative and competitive environment, confident that the user requirements are commonly agreed.
- **Scientific experts** have the opportunity to make an important contribution to the future of ATM in Europe.
- **Air passengers and European citizens** can benefit from shorter and more reliable journeys, lower costs and enhanced safety.

# Meeting ATM business needs

The SESAR Programme develops its solutions according to a set of Essential Operational Changes for the ATM industry, as outlined in the European ATM Master Plan (Key Features). These Six Key features have been defined to capture the

operational improvements and technical enablers required to deliver SESAR's contribution to the goal of a Single European Sky. In each Release, solutions are clustered in line with these areas, which are as follows:

- 1. Traffic synchronisation;**
- 2. Airport integration and throughput;**
- 3. Moving from airspace to 4D trajectory management;**
- 4. Network collaborative management and demand and capacity balancing;**
- 5. Conflict management and automation;**
- 6. System Wide Information Management.**



## 1. Traffic Synchronisation

"Traffic Synchronisation" covers all aspects related to improving arrival/departure management. It aims to achieve an optimum traffic sequence resulting in significantly less need for Air Traffic Control (ATC) tactical intervention, and the optimisation of climbing and descending traffic profiles.



## 2. Airport Integration and Throughput

"Airport Integration and Throughput" allows for the full integration of airports into the ATM network, ensuring a seamless process through Collaborative Decision Making. Airports will contribute to achieve SESAR performance goals through the increase of runway throughput and improved surface movement management, where air traffic controllers are supported by enhanced tools.



## 3. Moving from Airspace to 4D Trajectory Management

"Moving from Airspace to 4D Trajectory Management" entails the systematic sharing of aircraft trajectories between various participants in the ATM process to ensure that all partners have a common view of a flight and have access to the most up to date data available to perform their tasks. This creates an environment where air and ground stakeholders share a common view of the aircraft's trajectory, so that the flight can be managed as closely as possible to the airspace user's ideal profile, while optimising the flow of air traffic. The aim is to reduce formal airspace and route definitions and move towards an environment defined by the changing needs of the airspace users.



#### **4. Network Collaborative Management and Dynamic/Capacity Balancing**

"Collaborative Management of the ATM Network" relies on successive phases of operation planning from long to medium and short term. In this context, all involved ATM stakeholders progressively share more and more precise data to build a common traffic and operational environment picture called the Network Operations Plan (NOP). This NOP is updated in real time to reflect any changes in ATM operations. The NOP also covers military activity, taking full account of the needs of mission trajectories and military airspace demands. Throughout the lifecycle of the flights, the traffic demand/available capacity is monitored by the different ATM actors. When an imbalance occurs, capacity shortfall scenarios are collaboratively agreed and implemented. When required, the Aircraft Operators submit the revised user-preferred trajectories, integrating the ATM constraints.



#### **5. Conflict Management and Automation**

"Conflict Management and Automation" aims to substantially reduce controller task load per flight through a significant enhancement of integrated automation support, whilst simultaneously meeting the safety and environmental goals of SESAR. Human operators will remain at the core of the system (overall system managers) using automated systems with the required degree of integrity and redundancy. In addition, this strategic Key Feature covers the evolution of Ground and Airborne Safety Nets (and their mutual compatibility) through the use of new surveillance means and system wide information sharing. They will be fully adapted to SESAR future trajectory management systems and new separation modes, thus ensuring their continuing effectiveness as a last safety layer against the risk of collision (and other hazards).



#### **6. System Wide Information Management**

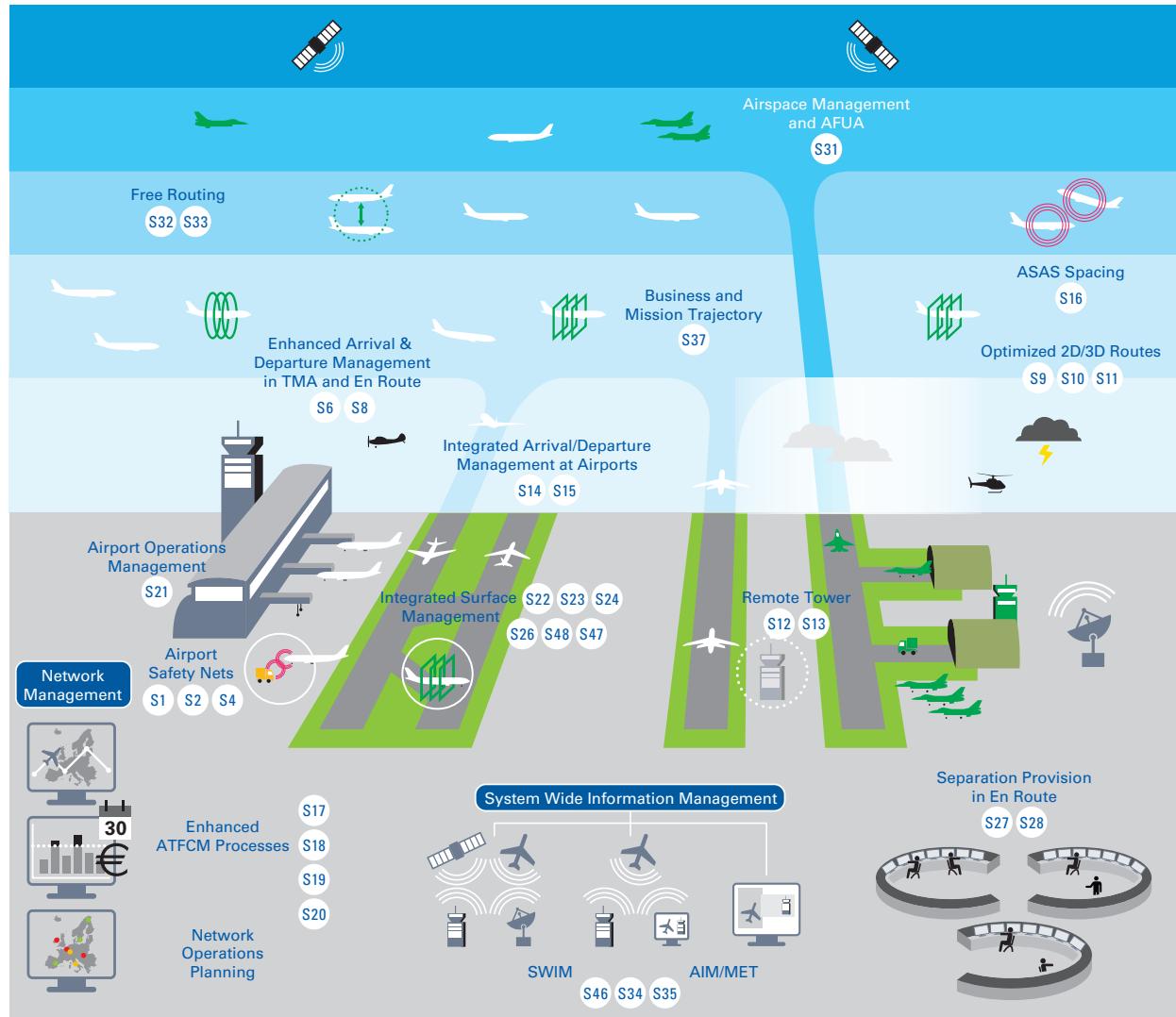
The concept of "System Wide Information Management" - SWIM - covers a complete change in paradigm of how information is managed along its full lifecycle, involving stakeholders from across the whole European ATM network. SWIM is an advanced concept designed to facilitate greater sharing of ATM system information, such as aeronautical, flight trajectory, aerodrome operational and meteorological (MET) information. It consists of standards, infrastructure and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services.

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# Release 5: A detailed look

Release 5 addresses **33 potential SESAR Solutions** through **38 exercises**, covering **6 Key Features** and is grouped by **13 essential operational changes**, also called **Operational Focus Areas**:

Figure 2: SESAR solutions addressed in Release 5



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## Releases 1-4 in a nutshell

- Release 1 included 25 operational validation exercises throughout Europe. The exercises centred on the development of efficient and green terminal airspace operations, the initial 4D trajectory, end-to-end traffic synchronisation and integrated and collaborative network management.
- Release 2 built on the experience gained during Release 1, widening the scope of the work and comprised 28 exercises, focussing on time-based separation minima, ATC sectorisation, new direct routing and increasing ATC efficiency.
- Release 3 expanded the scope with 13 exercises covering all 6 Key Features. The exercises focused on traffic synchronisation in complex environments, arrival management solutions, time-based operations, enhanced flight data exchange.
- Release 4 included 16 exercises, covering 4 Key Features and focusing on areas such as ASAS, i4D trajectory management, CTA, AMAN, DMAN, A-SMGCS, GBAS, CDM, STAM, ACAS.



## Traffic Synchronisation

- S6** Controlled Time of Arrival (CTA) in medium density and complexity environments
- S8** Arrival Management into Multiple Airports
- S9** Enhanced terminal operations with automatic Required Navigation Performance (RNP) transition to Instrument Landing System/GBAS Landing System
- S10** Optimised Route Networks using Advanced RNP
- S11** Continuous Descent Operations (CDO) and Continuous Climb Operations (CCO)
- S14** Departure Management integrating Surface Management constraints
- S15** Integrated and throughput-optimised sequence of arrivals and departures
- S16** ASAS spacing applications "Remain behind" and "Merge behind"

## Airport Integration & Throughput

- S1** Runway Status Light
- S2** Airport Safety Nets for controllers: conformance monitoring alerts and detection of conflicting ATC clearances
- S4** Enhanced Traffic Situational Awareness and Airport Safety Nets for vehicle drivers
- S12** Single Remote Tower operations for airports with medium traffic volumes
- S13** Remotely-Provided Air Traffic Service for Contingency Situations at Airports
- S21** Airport Operations Plan (AOP) and Seamless Integration with Network Operations Plan (NOP)
- S22** Automated Assistance to Controller for Surface Movement Planning and Routing
- S23** D-TAXI service for Controller-Pilot Data-Link Communications (CPDLC) application
- S24** Improved vehicle guidance via data link
- S26** Manual taxi routing function
- S47** Guidance Assistance through Airfield Ground Lighting
- S48** Virtual Block Control in Low Visibility Procedure

## Moving from airspace to 4D trajectory management

- S32** Free Route through the use of Direct Routing
- S33** Free Route through Free Routing flights both in cruise and vertically evolving
- S37** Extended Flight Plan

## Network Collaborative Management and Dynamic Capacity Balancing

- S17** Advanced Short ATFCM Measures (STAM)
- S18** Calculated Take-Off Time (CTOT) and Target Time of Arrival (TTA)
- S19** Automated support for Traffic Complexity Detection and Resolution
- S20** Collaborative NOP for Step 1
- S31** Variable profile military reserved areas and enhanced (further automated) civil-military collaboration

## Conflict Management and Automation

- S27** Medium Term Conflict Detection (MTCD) and conformance monitor tools
- S28** Automated Assistance to Controller for Seamless Coordination, Transfer and Dialogue through improved trajectory data sharing

## System Wide Information Management (SWIM)

- S34** Digital Integrated Briefing
- S35** MET Information Exchange
- S46** Initial SWIM

Figure 3:  
Map of Release 5 validation sites

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The following section gives an **overview of the solutions**, as well as a **brief description of the exercises**. Solutions have been grouped together when validation exercises address the same solution.



## TRAFFIC SYNCHRONISATION

### S6 – Controlled Time of Arrival (CTA) in medium density and complexity environments

The Controlled Time of Arrival (CTA) is an imposed time constraint at a defined point associated with an arrival runway, using airborne capabilities to improve arrival management. When a time constraint is needed for a flight, the ground system can calculate a CTA as part of the arrival management process, proposing it then to a flight which uses its on-board avionics to achieve the required accuracy. Airborne information may be used by the ground system in determining the CTA (e.g. ETA min/max) and in monitoring the implementation of the CTA.

#### Validation exercises

A series of exercises in Malmö and Toulouse will assess the maturity of the CTA solution and the impact on performance when applying CTA in the Extended Terminal Manoeuvring Area/En-route environments. The exercises will also assess the operational acceptance of CTA by controllers and flight crew.

Additionally, a combination of flight trials and real-time simulations taking place in Rome and Toulouse respectively will aim to demonstrate compatibility between Airborne Spacing - Interval Management, Sequencing and Merging (ASPA-IM-S&M) and initial four dimension trajectory (i4D)/CTA operations. The exercises will also validate that ASPA-IM-S&M can realistically be integrated into an Extended Arrival Manager (E-AMAN) horizon and brings added value compared to conventional procedures. An important aspect of these exercises will be to assess the acceptability of ground-ground interoperability with regards ASAS and i4D/CTA, in terms of information exchange and coordination, as well as

the impact on pilots' organisation. *These exercises also address the ASAS spacing applications "Remain behind" and "Merge behind" (S16) - See page 14 for more details.*

#### Expected benefits

- Enhanced predictability
- Improved fuel efficiency
- Increased capacity in TMA / En-Route phases
- Cost effectiveness
- Enhanced safety

### S8 – Arrival Management into Multiple Airports

Arrival Management into Multiple Airports is a system that combines planning for several arrival streams into different airports by calculating the sequence of aircraft flying towards an area where their routes intersect. By calculating adequate spacing of aircraft, the system can also calculate a Time To Lose (TTL) that the appropriate upstream E-TMA sector can aim to meet.

#### Validation exercises

A series of real-time simulations in Langen will aim to demonstrate the benefits produced by tactical planning for converging arrival streams in terms of predictability, environmental sustainability/fuel efficiency, airspace capacity, safety and cost-effectiveness. The exercises will assess the impact on air traffic controllers in handling converging arrival air traffic streams, and the technical systems, training, staffing and team organisation required.

#### Expected benefits

- Enhanced predictability
- Improved fuel efficiency
- Increased capacity in TMA / En-Route phases
- Cost effectiveness
- Enhanced safety

## **S9 – Enhanced terminal operations with automatic Required Navigation Performance (RNP) transition to Instrument Landing System/GBAS Landing System**

This solution refers to the use of advanced curved RNP procedures for final approach using ILS and GLS transitions. The solution is expected to improve airport access in terrain or airspace-constrained environments and to reduce environmental impact.



### **Validation exercises**

Flight trials taking place in Toulouse and Milan-Malpensa will validate a new arrival procedure based on the use of different glide path angles for two arriving aircraft aiming at different touchdown zones on the runway to reduce the risk of wake encounter. Specifically, the exercises will confirm the operational feasibility of the procedure, including its impact on the situational awareness of controllers and pilots.

### **Expected benefits**

- Increased predictability
- Improved fuel efficiency
- Enhanced capacity in Terminal Manoeuvring Areas
- Increased cost effectiveness
- Enhanced safety

## **S10 – Optimised Route Networks using Advanced RNP**

Advanced RNP allows for the design of optimised routes (E.g. spaced parallel routes) and is further enhanced by on-board performance monitoring and alerting.

### **Validation exercises**

A validation exercise will be undertaken to further assess the operational and technical maturity of Performance-Based Navigation (PBN) in the en-route phase of flight. The analysis will seek to identify outstanding issues for this functionality, as well as for the use of tactical parallel offset instructions rather than radar vectoring by air traffic

controllers - a functionality which is expected to reduce controller workload and enhance safety.

### **Expected benefits**

- Enhanced safety
- Reduced controller workload

## **S11 – Continuous Descent Operations (CDO) and Continuous Climb Operations (CCO)**

The solution sees the progressive implementation of procedures for Continuous Descent Operations (CDO) and Continuous Climb Operations (CCO) in higher density traffic, optimised for each airport arrival/departure procedure.

### **Validation exercises**

A combination of real-time simulations and live trials will be conducted to globally assess the benefits and limitations of CDO and Point Merge, particularly with regards to fuel efficiency. Specifically, the exercises will seek to further optimise vertical profiles and routes of aircraft and reduce step descents in case of arrivals on minority flow. These exercises will take place at Paris Charles de Gaulle and Paris Orly airports.

### **Expected benefits**

- Increased fuel efficiency
- Cost effectiveness
- Enhanced safety
- Improved capacity

## **S14 – Departure Management integrating Surface Management constraints**

The solution includes procedures and technical specifications supporting departure management that takes into account route planning and route monitoring information, in particular updates to taxi time.



## S15 – Integrated and throughput-optimised sequence of arrivals and departures

The solution refers to a fully integrated and throughput-optimised sequence of arrivals and departures, set up for the same runway (or for dependent runways) using an algorithm that takes into consideration separation minima. The sequence allows for a high level of planning stability and the involvement of controllers in establishing the plan. In addition to arrival metering and pre-departure sequencing, the solution allows for controllers to follow Target Take-Off Time (TTOT) and Target Landing Time (TLDT) as closely as possible.

### Validation exercises

A series of real-time simulations taking place in Madrid will assess the feasibility of integrating AMAN-DMAN and its impact to runway throughput, airport operations and controller workload.

This work will be complemented by exercises taking place in Lyon and Toulouse to assess the impact of integrating AMAN-DMAN on runway throughput, airport operations and controller workload. Exercises will specifically look at operational and human factor issues and possible showstoppers. An assessment will also be undertaken on the level of development reached so far regarding technical enablers, with a focus on the technical system architecture and specifications, performance requirements and interoperability requirements.

Meanwhile, in Milan, a series of real-time simulations will validate the refinement of departure sequences with the integration of surveillance data and the implementation of new and improved surface safety nets. The Milan exercises will also assess the usability of the controller's human-machine interface (HMI) and its ability to provide an integrated set of capabilities, such as departure management, route planning, 4D trajectory management, surface conflict alerts and flight data processing. *These exercises also address the solutions for Airport Safety Nets for controllers: conformance monitoring alerts and detection of conflicting ATC clearances (S2)*

*and Automated Assistance to Controller for Surface Movement Planning and Routing (S22) – See pages 15 and 18 for more details.*

### Expected benefits

- Increased predictability
- Enhanced safety
- Improved efficiency

## S16 – ASAS spacing applications

### “Remain behind” and “Merge behind”

ASAS Sequencing and Merging applications allow flight crew to achieve and maintain spacing for a designated aircraft. The applications are specified in new ATC instructions, instructing flight crew to achieve and maintain a given spacing for a designated aircraft, in time or in distance. Separation provision, however, remains the controller's responsibility and applicable separation minima remain unchanged.

### Validation exercises

A combination of flight trials and real-time simulations taking place in Rome and Toulouse respectively will aim to demonstrate the compatibility between Airborne Spacing - Interval Management, Sequencing and Merging (ASPA-IM-S&M) and initial four dimension trajectory (i4D)/Controlled of Time of Arrival (CTA) operations. *See page 12 (S6) for more details about this exercise.*

### Expected benefits

- Enhanced safety, thanks to a reduction in the controllers' workload



## AIRPORT INTEGRATION AND THROUGHPUT

### S1 – Runway Status Lights

This is a fully automated Runway Status Light system, based on Advanced Surface Movement Guidance & Control System (A-SMGCS surveillance) that can be

used at airports to increase safety by preventing runway incursions and associated operational procedures.

#### **Validation exercises**

A series of live trials in Paris CDG will seek to identify requirements for Runway Status Lights (Runway Entrance Lights and Take-off Hold Lights) and to validate operational procedures for tower controllers, supervisor, vehicle drivers and flight crews. The trials are expected to show how the lights can increase runway usage awareness and reduce the number of critical runway incursions, thereby enhancing safety.

#### **Expected benefits**

- Enhanced runway safety
- Increased situational awareness

#### **S2 – Airport Safety Nets for controllers: conformance monitoring alerts and detection of conflicting ATC clearances**

This solution refers to the identification of operational requirements and technical specifications for a system that detects conflicting ATC clearances and non-conformance to procedures for traffic on runways, taxiways and in the apron, stand and gate areas. The system will provide the appropriate indications and alerts to controllers.



#### **Validation exercises**

A set of exercises in Madrid and Langen will also assess the feasibility and benefits in terms of safety and performance of safety nets and advanced surface routing, conflict free planning and routing functionalities, as well as the provision of taxi route via data link, and their integration into the controller's working position. The exercises will include a combination of live trials and simulations and will validate the proposed performance improvements brought about by the exchange between flight crew and controller using data link for start-up, pushback, runway exit and taxiing. An enhanced SWIM

Runway-In-Use service with time information and planned runway configuration support will also be assessed. Further exercises will evaluate advanced surface routing, including dynamic taxi time prediction, automatic conflict-avoidance, use of runway exit information downlinked from Enhanced Breaking Systems (EBS), re-routing in case of runway reconfiguration.

A further set of exercises in Paris, will validate the relevance of alerts to tower controllers in case of conflicting ATC clearances during runway operations and of non-conformance to procedures or clearances for traffic on runways, taxiways and in the apron area. The exercises will also assess that generated routes are relevant for aircraft and vehicles, conforming to circulation rules and planning constraints, and the safety performance benefits offered by data link communications. Exercises conducted at Riga International Airport will validate the maturity of several airport safety net solutions.

*These exercises also address the solutions for Automated Assistance to Controller for Surface Movement Planning and Routing (S22) and D-TAXI service for CPDLC application (S23) – See page 18 for more details.*

Finally, real-time simulations will be used in Milan to validate the refinement of departure sequences – See page 14 (S15) for details of the Milan exercises.

#### **Expected benefits**

- Increased situational awareness
- Reduced taxi time variability
- Lower fuel emissions

#### **S4 – Enhanced Traffic Situational Awareness and Airport Safety Nets for vehicle drivers**

This solution provides operational requirements and technical specifications to detect a risk of collision between a vehicle with aircraft and the infringement of restricted or closed areas. The vehicle driver is provided

with the appropriate alert, either generated by the on-board system or uplinked from the controller airport safety net.

#### **Validation exercises**

Live trials in Paris will validate a set of operational requirements on alerts for vehicle drivers. Specifically, the trials will validate requirements for the display of information related to the surrounding traffic, including both aircraft and airport vehicles during taxi and runway operations in the vehicle driver's cockpit.

A separate series of trials will test the connectivity between the central system and the vehicle, as well as the use of the mobile device, including the moving map. Further assessment will be made on the provision of situational awareness and increased safety aspects.

#### **Expected benefits**

- Increased situational awareness
- Decreased taxi time variability
- Reduced fuel emissions

### **S12 – Single Remote Tower operations for airports with medium traffic volumes**

This solution enables the provision of ATS from a remote location of aerodrome control services or aerodrome flight information services to airports with medium traffic volumes.

#### **Validation exercises**

Shadow mode exercises in Saarbrücken will generate representative traffic scenarios for medium density traffic airports. Scenarios include traffic that is scattered in the visual field forcing the controller to monitor wider areas, and traffic that is close together requiring controllers to clearly distinguish aircraft. A basic set of functionalities will be assessed, updated and enhanced according to identified needs.

#### **Expected benefits**

- Maintained level of safety and workload
- Increased cost effectiveness
- Increased capacity

### **S13 – Remotely-Provided Air Traffic Service for Contingency Situations at Airports**

This solution enables the provision of air traffic control services (ATS) at a remote location or secondary facility at medium-sized airports in contingency situations where it is not possible to use the primary tower.

#### **Validation exercises**

Shadow mode exercises will take place in Girona to evaluate whether it is possible to provide a full range of ATS services as close to full-operating capacity as possible, compared to ATS provided from the primary tower which has direct sight of the airport. Specifically, the exercises will assess the start-up time, transition phase and shifting times linked to operations at the contingency remote tower, as well as the level of service that can be provided. Controllers must show that they gain sufficient information from the remote tower's controller working position to make decisions and provide ATS.

Further shadow mode exercises will take place in Gotheberg which will assess human performance, in terms of acceptability, workload capacity, situational awareness, when providing the ATS services remotely. The exercises will seek to gain an understanding of the value added by the system compared to a non-Remote Tower contingency baseline.

#### **Expected benefits**

- Maintained level of safety and workload
- Increased cost effectiveness
- Increased capacity

## **S21 – Airport Operations Plan (AOP) and Seamless Integration with Network Operations Plan (NOP)**

This solution offers services to steer, monitor, manage airport performance as well as perform post-operations analysis. The solution also provides processes and tools to ensure airport performance in normal, adverse and exceptional operating conditions. An increased scope and timescale of data is shared between AOP and NOP.

### **Validation exercises**

Real-time simulations in Braunschweig will validate the benefits resulting from the implementation of the SESAR Airport Operations Centre (AOPC). Specifically the exercises will validate interfaces (roles and responsibilities) between the AOPC and the operational units of individual stakeholders (airlines, airport operator, ground handler, ATC). Information requirements to support performance measurement, alerting and collaborative decision-making will also be assessed. Braunschweig will also carry out fast-time simulations to validate an AOPC Runway Manager tool (RMAN) and its ability to propose optimised runway configuration plans during capacity-constrained situations and to provide forecasted landing and take-off times.

Shadow mode exercises in Milan will complement this work by validating airport performance monitoring of airport processes, DCB management processes, the integration of a pre-existing operational A-CDM and the feasibility of ensuring common situational awareness among airport stakeholders. Building on previous CTOT/TTA validations, exercises in Palma Barcelona and Brussels airports will validate the systematic use of target time management in ATFCM, the initial integration of AMAN into DCB and an extended AOP/NOP integration.

Meanwhile, a series of shadow mode trials, also taking place in Palma, will demonstrate how AOP can improve the visibility of landside process information, leading to better use of airport resources. The exercise will evaluate stakeholder acceptance and the perceived usefulness of the alerts generated by the AOP. Improvements to

departure predictability and temporal efficiency through improved Target-Off Block Time (TOBT) accuracy will also be assessed. *These exercises also address the solution of CTOT to TTA (S18 – see page 21 for more details) and Collaborative NOP for Step 1 (S20 – see page 22 for more details).*

Finally, a series of live trials will validate the use of a De-icing Management Tool (DIMT) in an A-CDM environment and its ability to enable planning and co-ordination of de-icing operations among airport stakeholders.

### **Expected benefits**

- Increased efficiency
- Enhanced Predictability
- Improved airport capacity
- Enhanced safety

## **S22 – Automated Assistance to Controller for Surface Movement Planning and Routing**



This A-SMGCS-based route planning functionality allows controllers to graphically edit routes and compute estimated taxi times. Specifically, the functionality provides controllers with airport layout descriptions, flight plan information (e.g. aircraft type, destination stand), known operational constraints (e.g. closed taxiways) and Collaborative Decision Making (CDM) data (e.g. Target Start-Up Approval Time -TSAT), which allows them to create operationally realistic taxi routes for mobile vehicles under air traffic control (ATC).

## **S23 – D-TAXI service for Controller-Pilot Data-Link Communications (CPDLC) application**

This solution allows the use of data link communications between the tower controllers and the flight crew during surface movement, based on the D-TAXI service from the Controller-Pilot Data-Link Communications (CPDLC) application, already standardised by RTCA

and EUROCAE. The service is accessed by end users, through the controller working positions and through the aircraft's Datalink Control & Display Unit (DCDU).

### **Validation exercises**

A combination of live trials and simulations will validate both solutions (S22, S23). Real-time simulations in Paris will validate the relevance of alerts to tower controllers in case of conflicting ATC clearances, while a set of exercises in Madrid and Langen will assess the feasibility and benefits in terms of safety and performance of these solutions. A series of exercises at Riga International Airport will also assess the level of maturity for the integration of solutions addressing Airport Safety Nets and Integrated Surface Management. A further set of real-time simulations in Milan will be used to validate the refinement of departure sequences – See page 14 (S14) for details of the Milan exercises.

Meanwhile other exercises in Milan Malpensa will assess the level of maturity for the integration of solutions addressing Airport Safety Nets and Integrated Surface Management. An enhanced SWIM "Runway-In-Use" service with temporality and planned configuration support will also be assessed.

### **Expected benefits**

- Increased efficiency
- Improved predictability
- Enhanced safety

### **S24 – Improved vehicle guidance**

This solution allows the sending of ATC clearances and information to vehicles via data link, using the AeroMACS technology, and displaying the corresponding graphical path to the driver on an airport moving map. By reducing misunderstandings, reducing frequency congestion and improving the situation awareness of vehicle drivers, this solution is expected to improve safety.

### **S26 – Manual taxi routing function**

This solution corresponds to the graphical display of the taxi route received from ATC on the aircraft Airport Moving Map. If the taxi clearance is sent via data link, through the D-TAXI service, the corresponding message is interpreted and translated as a graphical path thanks to the onboard Airport Mapping Data Base. If the taxi clearance is sent via voice, the flight crew can enter it manually into the Airport Moving Map. This graphical display of the taxi route increases the flight crew's situation awareness, notably in low-visibility conditions or at an aerodrome with which they are not familiar.

### **S48 – Virtual Block Control in Low Visibility Procedure**

This solution supplements the set of stop bars on an aerodrome with virtual stop bars that are managed by tower systems and that displayed on the controller working position. Thanks to surveillance data, virtual stop bars can be de-activated once passed by an aircraft. For the purpose of alerting, the A-SMGCS control function considers virtual stop bars are physical ones, and warns the controller in case of violation. For aircraft equipped with data link, the location of virtual stop bars is uplinked to the cockpit and are displayed on the aircraft moving map.

### **Validation exercises**

A combination of live trials and simulations taking place in Toulouse and Milan will validate all three solutions (S24, S26, S48). Specifically the exercises will confirm the proposed safety performance improvements brought about by the exchange between flight crews and controllers using data link for start-up, pushback, runway exit and taxiing, and the display of cleared routes and dynamic traffic context information to vehicle drivers. The exercises will also assess generated alerts to vehicle drivers when potential or actual risks of collision are detected with aircraft and infringement of restricted or close areas. Alerts may be generated by the on-board system or uplinked from the controller safety net. These exercise also address the solution for the Guidance Assistance through Airfield Ground Lighting (S47) – See opposite for more details.

### Expected benefits

- Enhanced safety
- Improved predictability
- Increased runway capacity

### S47 – Guidance Assistance through Airfield Ground Lighting

This solution couples taxi route management with the airfield ground lighting, in order to provide flight crew and vehicle drivers with supplementary means of guidance. Taxiway centre line lights are automatically and progressively switched on in segments as the mobile progresses along its assigned route. Stop bars are automatically activated to mark clearance limit. The air traffic controller can issue simpler and shorter taxi clearances through a "Follow- the-Greens" type instruction.

### Validation exercises

Real-time simulations in Frankfurt will validate the Follow-the-Greens guidance procedures and system, including floating separation for low visibility procedures, Follow-the-Greens transition points (Ground Marker use) and the application of Follow-the-Greens for Remote Apron Control. Finally, exercises conducted at Riga International Airport will validate the maturity of several airport safety net solutions. A combination of live trials and simulations taking place in Toulouse and Milan will confirm the proposed safety performance improvements brought about by the exchange between flight crews and controllers using data link for start-up, pushback, runway exit and taxiing, and the display of cleared routes and dynamic traffic context information to vehicle drivers. *See page 19 (S48) for more details about the Milan-Toulouse exercises.*

### Expected benefits

- Improved predictability
- Enhanced safety
- Increased capacity



## MOVING FROM AIRSPACE TO 4D TRAJECTORY MANAGEMENT

### S32 – Free Route through the use of Direct Routing in cross border and complex environments

This solution offers additional flight planning route options on a large scale across flight information regions (FIRs), such that overall planned leg distances are reduced in comparison with the fixed route network and are therefore fully optimised. This solution is particularly relevant for cross border control centres located in high and very high complexity environments.



### S33 – Free Route through Free Routing flights both in cruise and vertically evolving

Free routing offers airspace users the possibility of planning a route according to user-defined segments (segment of great circle connecting any combination of two user defined or published waypoints.) Free Routing Airspace is an airspace defined laterally and vertically, allowing free route with a set of entry and exit features. Within this airspace, flights remain subject to air traffic control.



### Validation exercises

Real-time simulations in Toulouse and Rome will assess the operational acceptability of the free route environment, proposed services and roles (S32 and S33). Specifically, the exercises will compare the controller's workload when dealing with free routing and direct routing traffic and establish the maximum free routing traffic load which is acceptable for controllers. Other assessments will be made of benefits yielded when a mixture of free routing and direct routing is implemented, or when complexity measures and extending air traffic control planning are used. In addition, coordination across borders, as well as operational acceptability for a proposed workaround of military zones, will also be validated.



### Expected benefits

- Improved predictability
- Enhanced safety
- Increased airspace capacity
- Improved efficiency

### S37 – Extended Flight Plan

This solution sees the integration of 4D Flight Plan (FPL) data into the Network Manager Flight Planning acceptance and distribution system. The extended flight plan includes new information on the 4D trajectory (as calculated by the FOC flight planning system), which contains additional elements for each point of the trajectory such as speed and aircraft mass, as well as flight specific performance data, including predicted climb and descent profiles for a specific flight.



### Validation exercises

Shadow mode exercises in Brussels and Toulouse with real flights will validate the operational feasibility of the use of the Extended Flight Plan (EFPL) in the flight plan acceptance and distribution processes of the Network Manager. Specifically, the exercises will look at the use of the EFPL in processes related to Demand Capacity Balancing (DCB) and assess the required accuracy for trajectory information in EFPL. Associated performance gains will also be assessed.

### Expected benefits

- Enhanced safety
- Improved predictability

## NETWORK COLLABORATIVE MANAGEMENT AND DYNAMIC CAPACITY BALANCING

### S17 – Advanced Short Term ATFCM Measures (STAM)

Advanced Short Term ATFCM Measures (STAM) with automated tools enable air navigation service providers

(ANSPs) to improve predictability of operations and optimise traffic throughput. Advanced STAM includes a set of automated support tools for hotspot detection at network level, coordination and occupancy traffic monitoring values. These enhancements focus on improved predictability of operations, including for traffic supporting Initial Shared Business Trajectory/ initial Reference Business Trajectory (iSBT/ iRBT), complexity prediction, weather, airport operations (departure sequences, ground handling, gate management, runway usage), What-if function and network capabilities.



### Validation exercises

Shadow mode exercises in Brussels will assess the above described advanced STAM tools, as well as the operational use of global performance indicators to assist network performance monitoring. The exercises will also validate the integration of weather information into the network to support the elaboration of the network plan, the use of MET prediction and ASM solutions to improve fine-tuning of DCB measures, and the roles and responsibilities of the actors involved in these processes. The interaction of local and regional processes and tools will also be investigated.

### Expected benefits

- Increased airspace capacity in TMA and en-route phases
- Improved predictability
- Cost effectiveness

## S18 – Calculated Take-Off Time (CTOT) and Target Time of Arrival (TTA)

CTOT is a tactical slot allocation time calculated to determine the time at which a flight is required to become airborne. Target Time of Arrival (TTA) is a progressively refined planning time that is used to coordinate between arrival and departure



management, and to support DCB. This solution provides a complete set of DCB measures (including Dynamic Airspace Configurations) combined with 4D constraints that are needed to optimally adapt airspace capacity to the demand and minimize demand adjustments. Integrated airspace and 4D constraint solutions are obtained through an iterative optimisation and Collaborative Decision Making (CDM) processes involving local, sub-regional and regional levels.

#### **Validation exercises**

Live trials in Palma, Barcelona and Brussels will build on the CTOT/TTA concept, adding Target Time Over (TTO) for en-route constraints, and validating its feasibility with input from all actors involved (Flight crew, Airline Operational Center AOC, Network Manager). The trials cover the communication of both planned measures (e.g. TTO/TTA) and derived measures (e.g. CTOT) to relevant actors as targets, aiming to ensure that the flight is performed in line with the plan. The trials will also validate the feasibility and benefits of the AOP-NOP integration using SWIM. This integration involves the timely exchange of relevant airport and network information, resulting in a common situational awareness and improving both network and airport planning activities, as well as improving operational performance. In particular the exchange of arrival and departure planning information, airport capacities and event planning will be validated. *These exercises also address the solution of Collaborative NOP for Step 1 (S20 – see page 22 for more details) and Airport Operations Plan (AOP) and Seamless Integration with NOP (S21 – see page 17 for more details).*

#### **Expected benefits**

- Improve information sharing
- Enhanced predictability
- Increased cost effectiveness

#### **S19 – Automated support for Traffic Complexity Detection and Resolution**

This solution enables air traffic controllers to identify, assess and resolve local complexity situations, thereby reducing traffic peaks through early implementation of measures for workload balancing. The solution contains a traffic complexity assessment as well as individual traffic complexity-based solutions.



#### **Validation exercises**

Real-time simulations in Madrid will seek to identify complexity procedures that should be applied preferably by the planner controller, taking into account their impact on the AMAN sequence. The exercises will also assess the impact of the en-route controllers' procedures derived from the use of the E-AMAN on the measurement of en-route sectors' complexity. Open issues related to departures from airports within the E-AMAN time horizon may also be assessed. Finally, real-time simulations in Toulouse and Rome will assess benefits yielded by the complexity measures in a free route environment.

#### **Expected benefits**

- Increased airspace capacity
- Enhanced predictability
- Increased cost effectiveness

#### **S20 – Collaborative NOP for Step 1**

This solution is a collaborative NOP information structure, which provides updated data exchanges between the Network Manager and stakeholders systems to the required level of service, thus allowing shared operational decision-making (e.g. TTA, STAM) and their justifications in real-time. The structure includes an information model and classification by types of actions, influencers, performance objectives, relationships between actions, objectives, issues, among others.



## Validation exercises

Several validations will be undertaken which address the development of the collaborative NOP information structure. Live trials in Palma, Barcelona and Brussels will assess the feasibility and benefits of the AOP-NOP integration using SWIM – *More details about these exercises are available on page 21 (S18).*

In addition, live trials in Langen and Bretigny will demonstrate the feasibility of automatically updating the real airspace status into the Network Manager (NM) system, thereby delivering a collaborative decision-making process between air traffic control (ATC), airspace management (ASM) and NM systems. Specifically the exercises will validate the safety and technical feasibility of automatically updating the pre-notification, activation and modification of airspace reservations (ARES) on the controller working position. The exercises are expected to refine the interoperability requirements for the three systems to interface with one another. *These exercises also address the solution Variable profile military reserved areas and enhanced (further automated) civil-military collaboration (S31) – See opposite for more details.*

Meanwhile, a series of shadow mode exercises in Brussels are planned to assess advanced STAM tools and the operational use of global performance indicators to assist network performance monitoring. The exercises will also validate the integration of weather information into the network to support the elaboration of the network plan, the use of MET prediction and ASM solutions to improve fine-tuning of Demand and Capacity Balancing measures, and the roles and responsibilities of the actors involved in these processes. Finally, shadow mode exercises in Brussels and Toulouse with real flights will validate the operational feasibility of the use of the EFPL in the flight plan acceptance and distribution processes of the Network Manager.

## Expected benefits

- Improved predictability
- Enhanced airspace capacity
- Increased cost effectiveness

## S31 – Variable profile military reserved areas and enhanced (further automated) civil-military collaboration

This solution offers greater flexibility by allowing dynamic airspace management in all phases of ATM operations, from initial planning through to the execution phase, taking into account local traffic characteristics. The solution includes support tools, operational procedures and processes for real-time airspace status data exchange and for managing Variable Profile Area (VPA).



## Validation exercises

Live trials in Langen and Bretigny will demonstrate the feasibility of automatically updating the real airspace status into the Network Manager (NM) system, thereby delivering a collaborative decision-making process between air traffic control (ATC), airspace management (ASM) and NM systems.

Meanwhile, shadow mode trials will take place in Friedrichshafen and Brussels to validate that sharing and using aeronautical information for mission planning provides a suitable base to support State airspace user's mission planning. The trials should also confirm whether an improved Operational Air Traffic or EFPL are sufficient to allow State airspace user's intentions to fly. Validation will also be conducted with regard to the integration of the Wing Operations Centre WOC into the Network Management and ASM Management-related processes, and its ability to support mission monitoring for State airspace user's missions.



## CONFLICT MANAGEMENT AND AUTOMATION

### S27 – Medium Term Conflict Detection (MTCD) and conformance monitor tools

This solution addresses the development of tools to support tactical and planner controllers assisting them on their

monitoring tasks during busy periods. These tools are expected to contribute to safety enhancement through the reduction of controllers' workload.

### **Validation exercises**

Real time simulations in Southampton will validate how multi-sector planner and TMA concepts can support Planning Controller and Tactical Controller services. Specifically the exercises will assess "What if" and "What else" functions and integrated coordination functions for use in complex environments. A further series of real-time simulations in Langen will take place to validate the following: tactical and deviation trajectory, TCT, Medium Term Conflict Detection (MTCD) and MONitoring Aids (MONA) functionalities, and a "What else" probe for TCT, based on a refined tactical trajectory prediction for use in complex environments.

Real-time simulations in Toulouse and Rome will assess the operational acceptability of the free route environment, proposed services and roles. Within these exercises, assessments will be made on how flight trajectory data sharing (enabled through the use of the Flight Object) can improve the coordination of tasks and controller assistance services between ground control centres.

### **Expected benefits**

- Improve Safety
- Reduce controller's workload

### **S28 – Automated Assistance to Controller for Seamless Coordination, Transfer and Dialogue through improved trajectory data sharing**

This solution allows for better coordination, integration and identification of a controller's tasks thanks to improved trajectory data sharing (enabled by the Flight Object) in Predefined and User Preferred Route environments.



### **Validation exercises**

Real-time simulations in Toulouse and Rome will assess the operational acceptability of the free route environment, proposed services and roles. Within these exercises, assessments will be made of benefits of flight trajectory data sharing (enabled through the use of the Flight Object) for the coordination of tasks and controller assistance services between ground control centres.

A further set of real-time simulations in Rome, MUAC, Langen and Southampton will validate the system requirements and system architecture required for flight trajectory data sharing (enabled through the use of the Flight Object) and defined by the EUROCAE ED-133 document. Specifically the exercises will seek to demonstrate the suitability of the Flight Object to implement the SESAR Reference Business Trajectory within the en-route and TMA domains. A further goal will be to show that interoperability is feasible between different air traffic control centres based on one single representation of a flight (the iRBT within the Flight Object), which is synchronised during the course of the flight across these centres.

### **Expected benefits**

- Greater interoperability and information sharing between ATC systems

### **SYSTEM WIDE INFORMATION MANAGEMENT (SWIM)**

### **S34 – Digital Integrated Briefing**

This solution aims to improve information sharing between pilot, flight dispatchers and air traffic controllers for all phases of flight through the exchange of easier to understand, better filtered digital aeronautical data (including Digital NOTAM) and digital MET data.

### S35 – MET Information Exchange

This solution will lead to a better understanding of the impact on operations of actual and forecasted MET information, alerts and warnings of adverse weather conditions.



### S46 – Initial SWIM

This solution brings together several core elements for the initial implementation of System Wide Information Management, namely services for information exchange and governance; SWIM security; SWIM Technical Infrastructure Profiles, SWIM Foundation; ATM Information Reference Model (AIRM) and Information Service Reference Model (ISRM).



#### Validation exercises (S34, S35, S46)

Shadow mode exercises in Milan will validate a range of SWIM services in relation to airport performance monitoring, A-CDM integration and DCB management processes. Specifically these services address airport MET induced capacity reduction, calculated TSAT and TTOT provision, flight alert, inbound and outbound publications, and partner TOBT/TSAT/TTOT sets.

Meanwhile, real-time simulations in Vienna will assess enhancements in pilot briefing applications, based on Digital NOTAM, digital MET and Air Traffic Flow Management (ATFM) data, which aim to improve the situational awareness of pilots and reduce briefing times. SWIM Aeronautical Information Feature services and a new MET service will also be validated during these exercises.

In Langen, Runway in Use services with planned configuration support will be validated in relation to advanced surface planning and surface safety nets, as well as the provision of taxi route via data link, and their integration into the controller's working position. SWIM Met services will also be assessed within the framework of these exercises.

A SWIM EFPL Submission service will be used in shadow mode exercises in Brussels and Friedrichshafen to validate the operational feasibility of the use of the EFPL in the flight plans acceptance and distribution processes of the Network Manager. SWIM ARES services will underpin live trials in Langen and Bretigny to demonstrate the technical feasibility for automatically updating the pre-notification, activation and modification of airspace reservations (ARES) in the Network Manager (NM) system.

Exercises in Southampton, MUAC, Rome and Langen will use validate SWIM services for flight object sharing, while exercises in Palma and Barcelona will develop new SWIM B2B services to allow for effective target time management in ATFCM.

Finally, new SWIM services will be defined for validation in a series of shadow mode exercises in Brussels on advanced STAM tools.

#### Expected benefits

- Enhanced information sharing
- Improved service provision

# Conclusions and outlook

**Release 5** builds on the knowledge and experience gained in previous releases to produce a comprehensive validation plan and will be the largest and last under current SESAR Programme for R&I. This incremental approach to validating solutions allows SESAR to stay in tune with and responsive to the needs of the aviation industry, as they evolve. The 38 exercises are expected to demonstrate that the solutions included in Release 5 are sufficiently mature, allowing for a decision to be taken for their industrialisation and subsequent deployment.

At the same time, the Release work is guided by the European ATM Master Plan, which provides a

well-defined roadmap on how to make change happen in the ATM system in the long term. Release 5 will undoubtedly add to the solutions that have already been developed ready for deployment (beginning of 2015), thus delivering further concrete benefits to the entire ATM community, both today and in the future.

Release 5 involves a significant amount of coordination and planning between SESAR members and validation sites across Europe. It is therefore also proof of the strong partnership that underpins the SESAR Programme. Together, SESAR Members show that, by working together, real changes in the ATM domain are achievable.





# Glossary of terms and abbreviations

<b>ACAS</b>	Airborne Collision Avoidance System	<b>GLS</b>	GBAS Landing System
<b>AFUA</b>	Advanced Flexible use of Airspace	<b>HMI</b>	Human-Machine Interface
<b>AIRM</b>	ATM Information Reference Model	<b>ILS</b>	Instrument Landing System
<b>AMAN</b>	Arrival Manager	<b>IM</b>	Inteval Management
<b>ANSP</b>	Air Navigation Service Providers	<b>I4D</b>	Initial Four Dimensional Trajectory Management
<b>AOP</b>	Airport Operations Plan	<b>iRBT</b>	Initial Reference Business Trajectory
<b>APOC</b>	Airport Operations Centre	<b>ISRM</b>	Information Service Reference Model
<b>ARES</b>	Airspace RESevation	<b>MET</b>	Meteorological Information
<b>A-SMGCS</b>	Advanced Surface Movement Guidance and Control System	<b>MONA</b>	MONitoring Aids
<b>ATC</b>	Air Traffic Control	<b>MTC</b>	Medium Term Conflict Detection
<b>ATFM</b>	AirTraffic Flow Management	<b>NM</b>	Nautical Mile
<b>CDM</b>	Collaborative Decision Making	<b>NM</b>	Network Manager
<b>CCO</b>	Continuous Climb Operations	<b>NOP</b>	Network Operations Plan (Portal)
<b>CDO</b>	Continuous Descent Operations	<b>NOTAM</b>	Notice to Airmen
<b>CPDLC</b>	Controller-Pilot Data-Link Communications	<b>PBN</b>	Performance-Based Navigation
<b>CTA</b>	Controlled Time of Arrival	<b>PCP</b>	Pilot Common Project
<b>CTOT</b>	Calculated Take-Off Time	<b>RMAN</b>	Runway Manager
<b>DCB</b>	Demand Capacity Balancing	<b>RNP</b>	Required Navigation Performance
<b>DCDU</b>	Datalink Control & Display Unit	<b>RTCA</b>	Radio Technical Commission for Aeronautics
<b>DIMT</b>	De-Icing Management Tool	<b>S&amp;M</b>	Sequencing & Merging
<b>DMAN</b>	Departure Manager	<b>SESAR</b>	Single European Sky ATM Research
<b>DPI</b>	Departure Planning Information	<b>SMGCS</b>	Surface Movement Guidance and Control System
<b>DPI</b>	Dots per Inch	<b>STAM</b>	Short Term Air Traffic Flow Measures
<b>D-TAXI</b>	Datalink-Taxi	<b>SWIM</b>	System-Wide Information Management
<b>E-AMAN</b>	Extended-AMAN	<b>TLDT</b>	Target Landing Time
<b>EFPL</b>	Extended Flight Plan	<b>TOBT</b>	Target off block time
<b>EBS</b>	Enhanced Breaking Systems	<b>TSAT</b>	Target Start-Up Approval Time
<b>ETA</b>	Estimated Time of Arrival	<b>TTA</b>	Target Time of Arrival
<b>E-TMA</b>	Extended-TMA	<b>TTL</b>	Time To Lose
<b>EUROCAE</b>	European Organisation for Civil Aviation Equipment	<b>TTOT</b>	Target Take-Off Time
<b>FIR</b>	Flight Information Region	<b>UDPP</b>	User-Driven Prioritisation Process
<b>FPL</b>	Flight Plan message (ICAO format)	<b>WOC</b>	Wing Operations Centre
<b>GBAS</b>	Ground Based Augmentation System		





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