

2012



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SESAR Release 1 Results



2012

SESAR Rolls out R&D Results

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01 General Introduction

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The present report assesses the R&D results compiled in the Release 1 of the SESAR programme and constitutes a significant milestone, as it shows that the programme has now reached its cruising speed. The work performed to achieve this first raft of results has not only generated new operational solutions for the Air Traffic Management (ATM) community; it also allowed SESAR teams to stabilise their working processes and to produce intermediate results which will spill over into the next waves of development: Release 2&3.

SESAR's ability to deliver a solid stream of solutions for the modernisation of Europe's ATM system is now confirmed.

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Results explained: some highlights

The aim of SESAR's Release approach is to feed the aviation community with an incremental flow of new or improved ATM solutions at a pre-industrialisation stage, ready for deployment. Results delivered through the Release process will gradually allow the European ATM system to evolve into a new technological era, as by the end of decade the constraints which currently hamper the system's optimal performance will be lifted.

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Release 1 featured 25 operational validation exercises which took place throughout Europe in 2011 and in the first months of 2012. The exercises focused essentially on the development of efficient and green terminal air-space operations, the initial 4D trajectory, enhancing flight safety and collaborative network management.

Extended AMAN Horizon: reaching out for greener operations

Release 1 exercises demonstrated the clear environmental benefits of extending the geographical scope of Arrival Manager (AMAN) systems and tools, which are currently used by air navigation service providers to manage inbound traffic at airports.

AMAN systems were developed to relieve congestion and help airports cope with challenging situations, such as bad weather or runway closures. They are intended to calculate a smooth, optimal arrival flow capable of maximising runway throughput and conversely minimising arrival queuing time. Today, the scope of these systems is generally limited to TMA (Terminal Manoeuvring Area) airspace and to the final phase of the flight.

With an extended AMAN horizon, air traffic controllers can reach beyond the borders of the TMAs into the upstream airspace sectors. This enables them to pre-sequence incoming flights to further improve trajectory efficiency, thereby reducing fuel burn and emissions. Giving pilots the instruction to modify the aircraft speed before the Top of Descent (the transition from the cruise phase to the descent phase), Extended AMAN systems prevent stack holding upon arrival the destination airport and improve the organisation of traffic delivery to the TMAs.

A set of validation exercises constituted a shining example



of the successful implementation of a major new part of the SESAR concept: AMAN Extended horizon SESAR trials took place between October 2011 and February 2012 in different European geographical areas and operational environments. High density/complexity and Medium density/complexity scenarios were assessed.

In a High density/complexity scenario, representing London TMA, AMAN coverage was extended to 500 nautical miles (NM) – i.e. 926 kilometres, beyond the limits of the United Kingdom's airspace.

Aircraft fuel burnt to fly the last 500 nautical miles to destination was reduced by 942 kg on average per flight – which is a 9% decrease. As well, airborne waiting time (stack holding time) was reduced by between 78% and 87%, with proportional positive consequences on the flight's environmental impact.

The exercises in London also indicated that extended AMAN did not appear to affect the en route controllers' work load.

In a Medium density/complexity scenario, AMAN horizon was extended to 250 NM from Rome Fiumicino airport. The experience was evaluated in terms of environmental



“ A positive impact on the environment, allowing capacity increases ”

impact, for the most part related to fuel consumption and CO2 emissions. The results showed a drop in fuel consumption of up to 7.2 % for a short-haul Airbus A320 (flying from Paris to Rome), with CO2 emissions into the atmosphere reduced by about 325 Kg.

These reductions were mainly highlighted in TMA sectors where the aircraft trajectories were shorter and the holding manoeuvres reduced, thanks to a better management of arrivals.

Remote towers: real results for virtual reality

SESAR's remote and virtual tower projects conducted a three week long operational validation trial campaign in the autumn of 2011, which showed that the technology could be introduced in a wide European context.

Using virtual imagery, remote towers allow cost effective provision of Air Traffic Services at one airport with controllers that are not physically present on location. This technology could make a strong contribution to the economically sustainable operation of smaller regional and ultra-peripheral airports.

Twelve Swedish air traffic controllers took part in the SESAR validation at the remote tower facility in Malmö Sturup Airport, in shadow mode. They monitored all

day-to-day live air and ground traffic at Ängelholm airport, 100km away, testing the latest

updates to the remote tower concept and its technologies in daylight, dawn, darkness, CAVOK (Ceiling and Visibility are OK) and low visibility conditions.

Under nominal conditions, the controllers confirmed that a safe service could be provided remotely.

The National Supervisory Authority of the Netherlands participated in the exercise, and identified a number of areas of improvement including the need to mitigate large contrast differences – e.g. between ground and sky or when facing the sun. The trials also indicated that the use of infrared cameras would create increased opportunities for the use of Remote Towers and enable additional flexibility in the controllers' working methods.

P-RNAV: Precision in Complex environments

Through real-time validation activities in Madrid's Terminal Manoeuvring Area (TMA), SESAR trials showed that improved procedures and guidelines for implementing Precision Area Navigation (P-RNAV) in complex TMAs have a positive impact on the environment and alleviate the work load of air traffic controllers, while allowing substantial capacity increases.

The trials demonstrated the feasibility of environmentally-friendly Continuous Descent Approaches (CDAs) and Continuous Climb Departures (CCD) thanks to P-RNAV. These upgraded procedures also reduced airborne waiting time prior to descent in Madrid's TMA, lowering the flights' environmental impact and cutting delays subsequent to the airborne waiting time.

The exercise also showed an increase in capacity through the integration of P-RNAV into conventional routes in high traffic density TMAs. In Madrid, the technology enabled the possibility of using two parallel runways operating independently, which led to a doubling of aircraft movements. At the same time, the trials demonstrated that the upgraded P-RNAV procedures and guidelines allowed a reconfiguration of air traffic controller teams, which effectively decreased the controllers' work load by between 47% and 57%.

Point Merge: bringing order in high density traffic

Validation activities in London's Terminal Manoeuvring Area (TMA) demonstrated that point merge procedures increased the capacity of the area, prompting a higher





runway throughput, reducing the occurrence of airborne aircraft holding and consequently cutting fuel consumption as well as the environmental impact of flights.

Point Merge systems build on Precision Area Navigation (P-RNAV) technologies, allowing the convergence and the smooth sequencing of approaching and departing flights.

Improved Point Merge procedures in London's TMA, as tested in SESAR Release 1, showed that these new procedures could make a substantial contribution to the development of a new, fully effective air traffic management concept for TMA airspace. The validation exercises in London showed a reduction in fuel burn and related emissions of 2%. At the same time, runway throughput increased by 4% in the entire London TMA, while the work load of air traffic controllers dropped by 16%.

Release 1 exercises also showed that Point Merge procedures work most effectively when implemented in combination with high performance AMAN (Arrival Manager) systems and procedures.

Enhanced Conflict Avoidance: Silencing False Alarms

Two separate SESAR Release 1 exercises demonstrated the efficiency and safety benefits of enhanced conflict and collision avoidance systems, which are now ready for industrialisation.

A first validation exercise pertaining to enhanced Short Term Conflict Alert (STCA) systems looked at ways to support air traffic controllers in identifying possible conflicts for steady and manoeuvring aircraft in the Terminal Manoeuvring Area (TMA). The enhanced STCA technology allows a reduction in the number of false alarms while the occurrence of genuine alerts remains stable. This improved technology is beneficial for flight safety, as it helps controllers focus on issues which require their full attention – i.e. Resolution Advisory (RA) which designate situations that need solving.

During the SESAR trial, the new systems proved very efficient in avoiding undesired Resolution Advisory. The likelihood of air traffic controllers receiving an unnecessary RA during a level-off encounter between two trajectories was shown to be reduced by a factor of 30 – or even a factor of 70, with the introduction of additional functionalities.

A second validation exercise looked at warnings sent to pilots by the aircraft's ACAS (Airborne Collision Avoidance System); it demonstrated the operational and safety benefits of linking these RAs with the autopilot, to ensure an appropriate reaction automatically. Existing systems have proven their effectiveness in reducing the risk of mid-air collision. However, pilots very often do not respond to warnings exactly as expected, which reduces the system's safety benefits and makes air traffic control operations more complex. The solution assessed and validated by this exercise triggers a safe, automated response by the aircraft itself, instead of the current manual response performed by pilots.

“ A safe,
automated
response ”

STAM: Collaborate to Mitigate

A SESAR Release 1 exercise showed that Short Term Air traffic control flow and capacity management Measures (STAM) are an efficient tool to mitigate congestion and delays; their operational implementation is currently considered for 2013.

The trial was part of the overall dynamic Demand Capacity Balancing (dDCB) project, which seeks to develop ways of smoothing traffic and easing the congestion that causes capacity demand peaks and sudden increases in work load for air traffic controllers.



The results indicate that measures such as minor ground delays, flight level capping and re-routings initiated through a collaborative decision-making mechanism, reduce the complexity of traffic peaks and facilitate the overall flow of traffic.

The iterative dDCB process takes place between a few hours and a few minutes before an aircraft enters an airspace sector. The objective of the process is to foster collaboration between all air traffic management stakeholders – airports, airline flight planners, network managers, etc. – to identify measures that are capable of solving a capacity issue with a minimum impact on aircraft operations. The selected measures are subsequently coordinated with the actors directly concerned, and finally implemented.

“ Reducing the initial delay by a factor of 10 ”

Network Managers and Air traffic Flow Management Positions in London, Reims and Maastricht as well as 11 airlines participated in the exercise. On November 9, 2011, a hotspot was identified at

Reims Area Control Centre, requiring a regulation of the airspace sector due to high demand and flow complexity. Initial regulation measures, such as they would have been implemented with existing technologies and procedures, generated a potential total delay of 810 minutes. The application of nine STAM measures - in this case, flight level capping - reduced the initial delay by a factor of ten, to 99 minutes.

I4D + CTA : time is under control

Release 1 features a première, with SESAR's first four-dimensional trajectory management (I-4D) validation exercise, which took place on February 10, 2012 and marks the beginning of a paradigm shift.

The test was carried out with Airbus A320 aircraft of the most advanced generation, which flew from Toulouse to Copenhagen and Stockholm and back, operating to a time in the En-Route as well as in the Terminal Manoeuvring Area (TMA) airspace.

I-4D represents a key element in the transition from constrained flights in the current ATM system to optimised, safe, efficient and predictable flights in the future Single European Sky. I-4D tools & procedures establish far in advance a sequence for aircraft operations, which will



converge to a merging point in a congested area. After coordination between the ground systems and the aircraft, each aircraft is allocated a time slot for its arrival at the merging point and is allowed to fly its optimum flight profile up to that point, without receiving any further vectoring instructions from air traffic controllers.

Departing from Toulouse, the test aircraft flew through the Eurocontrol Maastricht Upper Area Control Centre (MUAC) airspace, where the airborne and ground systems automatically agreed on a first time constraint at a merging point close to Copenhagen airport. The flight then continued into Scandinavian airspace and demonstrated an optimised descent to Copenhagen. After reaching the first merging point, the aircraft climbed back to a cruise level, where it negotiated a second time constraint aiming at a merging point close to Stockholm Arlanda Airport. The flight then operated a fully optimised descent into Swedish airspace, reached the second merging point and landed at Arlanda.

The trial successfully verified the automated 4D data exchange between aircraft Flight Management System (FMS) and ground automation systems through data link. The level of precision reached automatically by the airborne FMS was more than satisfactory. In the original I4D concept, time constraints for flying through En-Route waypoints included a 30 second tolerance. For these SESAR trial flights, tolerance was lowered to 10 seconds and the test aircraft stayed well below that threshold at all times.

Last but not least, the full safety of the procedure was ascertained, as the trial was performed live over the MUAC airspace.

Exercise Factsheets

The Release 1 includes 25 Exercises, clustered in 15 Operational Focus Areas (OFA). Four additional exercises, initially planned in Release 1, were moved to Release 2.

The following fact sheets present research results for each OFA. The criteria applied for assessing the maturity of the concepts under review – and hence the success of the exercise – were the following:

- The Operational & System Requirements were developed and tested in a realistic environment and are properly documented;
- Validation evidence shows that the expected Performance is adequate to justify further investment for industrialisation;
- Evidence shows that, when implemented, the Concept Option will be safe under normal and abnormal operational conditions.
- The validation process has been conducted with a level of rigour and quality sufficient to justify confidence in the results.

“ 25 Exercises, clustered in 15 Operational Focus Areas (OFA). ”

The each exercise fact sheets integrate the following colour codes:

Conclusions



The exercises successfully demonstrated the maturity of the concept.



The exercises partially demonstrated the maturity of the concept.



The exercises did not demonstrate the maturity of the concept.

Preparation for industrialisation



The exercise results are conclusive and sufficient to support a decision for industrialisation.



Further work on the concept is planned prior to industrialisation.



No benefits are demonstrated for this concept element.



01 Optimized RNP structures

Main objectives

This exercise consisted in performing validation activities for the use of Precision Area Navigation (P-RNAV) technologies in Madrid Terminal Area (TMA). Enhanced precision allows improved predictability and hence safe capacity optimisation. P-RNAV is a substitute for today's radar vectoring activities by air traffic controllers; the aim of the technology is:

- to improve the design and organisation of the Terminal Manoeuvring Area (TMA) by implementing new procedures, such as curved and segmented P-RNAV approaches and Flexible Use of Airspace (FUA);
- to improve the route network organisation using RNP1 (Required Navigation Performance) a capability now available for latest generation commercial aircraft.

(SESAR reference: EXE-05.07.04-VP-142 PRNAV in Complex TMA)

Results

The exercise demonstrated the operational feasibility of P-RNAV, of Continuous Descent Approaches (CDA) and Continuous Climb Departures (CCD) in high traffic density scenarios.

With the implementation of this concept, a reduction of delays due to airborne holding was observed, resulting in better predictability and potential fuel savings. The exercise assessment also concluded that the concept will allow a capacity increase in terms of P-RNAV Arrivals, Transitions, Standard Instrument Departures (SID) & Standard Terminal Arrival Routes (STAR), compared with the usual mode of operations

For the LEMDREN sector above Madrid, which is representative of many situations encountered elsewhere in Europe, the calculated capacity was increased from 48 aircraft movements to 50 + 47 movements, as the concept enabled the independent operation of two parallel runways.

The Environmental assessment confirmed that P-RNAV procedures can deliver reductions in Fuel burn and Emissions, as :

- they limit airborne holding periods and associated delays;
- they allow smooth, low fuel consumption CCDs;
- they do not hinder smooth, low fuel consumption CDAs in most circumstances.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

The Release results are conclusive and sufficient to support a decision for industrialisation.

02

Point merge in complex TMA

Main objectives

On the basis of validation activities, this exercise aimed at validating the improvement of Point Merge Procedure in London's multi-airport Terminal Manoeuvring Area (TMA) which includes Stansted, Luton and London city airport. This new procedure design builds upon the P-RNAV concept for merging traffic into a single entry point, which allows efficient integration and sequencing of inbound traffic while solving safety, capacity, complexity, environment or efficiency limitations.

The exercise was centered on Point Merge Systems for arrivals but also integrated P-RNAV route structures for Departures, so that a fully operational concept could be developed for real-life airport environments.

(SESAR reference: EXE-05.07.04-VP-229)

Results

The exercise demonstrated the operational feasibility and the benefits of the concept.

The exercise's assessment revealed:

- a 16% reduction in air traffic controller work load;
- a 2% decrease in fuel burn; and
- a 4% increase in average runway throughput.

It also showed that Point Merge procedures do not adversely impact the TMA system. Furthermore, the exercise indicated that the Point Merge procedure works even more effectively and provide a further potential capacity increase, when used in combination with an effective Arrival Manager (AMAN).

Safety performance overall was maintained.

Approach controllers also reported an improved situational awareness and stressed that the new concept considerably reduced their use of voice communications.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

Further activities are planned as part of Release 2.



03

Approach procedures with vertical guidance (APV)

Exercise Factsheet

Main objectives

Measure the impact on air traffic control of the implementation of Localizer Performance with Vertical Guidance (LPV) procedures.
Assess air traffic controller training needs for the use of LPV procedures.

(SESAR Reference: EXE-05.06.03-VP-224)

Results

Validation activities at Glasgow airport demonstrated that LPV approaches can be safely integrated into the operational environment and implemented as a fallback solution in case of failure of the Instrument Landing System (ILS). LPV procedures also enable landing operations in bad weather conditions or in airports that are not equipped with ILS.

The exercise showed that the implementation of LPV procedures cause only a minor increase in controller's workload.

Airport landing rate is improved or maintained and costs associated with airport closure or flight diversions due to bad weather conditions can be avoided.

The exercise has provided valuable lessons learnt for the design of LPV procedures, such as the importance of defining and using standard phraseology.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

The Release results are conclusive and sufficient to support decision for industrialisation.

Trajectory management framework

Main objectives

Validation of initial 4 dimensional (i4D) trajectory through the issuing of Controlled Time of Arrival (CTA) to inbound aircraft. CTA is calculated thanks to ground-ground datalink coordination between air traffic control sectors and air-ground datalink coordination between aircraft and ATC.

CTA allows pre-sequencing of inbound traffic, which supports safe, smoother and more cost effective operations.

(SESAR Reference: EXE-05.05.01-VP-212 & EXE-04.05-VP-041)

Results

Validation activities in Rome showed that:

- CTA allocation does not impact safety;
- The concept allows improvements of vertical efficiency: flights were flown at higher, more fuel efficient altitudes and descended following a fuel efficient Continuous Descent Profile.
- The concept leads, however, to a deterioration of horizontal performance, which needs to be further investigated.

Conclusion

The exercises partially demonstrated the maturity of the concept; its applicability to other situations has not been validated yet.

Preparation for industrialisation

The results will contribute to further i4D+CTA exercises planned in Release 2 and Release 3.



05 Sector team operations

Exercise Factsheets

Main objectives

Validation of an electronic decision aid tool kit for En Route air traffic controllers including:

- medium term conflict detection (MTCD) monitoring aid; and
- a first step towards CORA (Conflict resolution assistant) technology.

These technologies were implemented in the ERATO (En-route Air Traffic Organiser) tool which enables air traffic control teams to:

- Upgrade team organization;
- Enhance cooperation between planner and executive controllers;
- Improve information & task sharing.

(SESAR reference: EXE-04.03-VP-032 & EXE-04.03-VP-237)

Results

On the basis of Shadow Mode and live trials, the general usability of ERATO was assessed and confirmed.

The exercises demonstrated the ability of air traffic controllers to increase their productivity and perform their controlling tasks effectively, using the ERATO support tools and working methods. No noticeable safety issue related to the ERATO concept was highlighted during the exercises.

Conclusion

The exercises successfully demonstrated the maturity of the En Route air traffic organiser tool.

Preparation for industrialisation

The Release results are conclusive and sufficient to support decision for industrialisation.

06 Enhanced STCA

Main objectives

Validation of enhanced algorithms for a Short Term Conflict Alert (STCA) prototype, enabled for earlier warning and lower false & nuisance alert rates related to steady and manoeuvring aircraft, through a comparative analysis with existing STCA technology as a comparison baseline.

(SESAR reference: EXE-04.08.01-VP-140)

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Results

Tests using real traffic data in Lyon (France) demonstrated the operational and system feasibility of the prototype for the identification of conflicts between flights, both En route and in Terminal Manoeuvring Areas (TMA).

Initial validation results did not demonstrate a clear advantage of the prototype when compared with baseline systems, particularly in terms of false alerts.

Subsequent tuning lifted the level of performance of the prototype, which eventually met the success criteria set for the exercise. For instance: the false alert rate of the prototype was 15% lower than the existing system at Lyon TMA, which operates the same state-of-the-art technology (i.e. a multi hypothesis algorithm).

Human factors and local circumstances have a significant influence on determining what constitutes an operationally relevant conflict which must be alerted by STCA and what is an effective minimum level of nuisance/false alarms. The STCA needs to be tuned and adapted to local operational environment.

In addition, it was confirmed that a number functionalities which have not yet been integrated by the prototype would drastically improve its performance.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

The exercise results are conclusive and sufficient to support a decision for industrialisation.



07 Enhanced ACAS

Exercise Factsheet

Main objectives

Assessment of the introduction of new altitude capture laws to reduce unnecessary ACAS (Airborne Collision Avoidance System) alarms. Validation of the operational and safety benefits brought by establishing a link between ACAS and the autopilot, prompting automatic reactions to ACAS alarms.

(SESAR Reference: EXE-04.08.02-VP-054 & EXE-04.08.02-VP-480)

Results

Validation exercises showed that the concept can bring significant operational and safety benefits.

ATC compatibility criteria have been positively assessed.

Safety levels are maintained while the compatibility of ACAS operations with Air Traffic Management is improved.

The occurrence of unnecessary alerts during a level-off encounter between two trajectories was reduced by a factor of 30 – or even a factor of 70, with the introduction of additional functionalities.

Pilots will be more likely to take the appropriate action as the number of false alerts decreases.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

The exercise results are conclusive and sufficient to support a decision for industrialisation.

08 Integrated AMAN DMAN

Main objectives

Validation of enhanced Departure Manager (DMAN) procedures to establish a pre-departure sequence at Paris CDG, to improve traffic predictability, airport capacity, cost & environmental effectiveness and safety.

(SESAR Reference: EXE-06.08.04-VP-470)

Results

On the basis of live trials, in Paris CDG and with inputs from Frankfurt and Zurich Airports, exercises involving a total of 48 air traffic controllers demonstrated that the new tool can:

- Decrease the average taxi time by 9%; and
- Cut delays: 93.8% of the flights observed in the trials were authorised to depart within 5 minutes after schedule (TOBT - Target Off-Block Time), which constitutes a 7.8% improvement.

The implementation of DMAN tools also enable an improved adherence to Central Flow Management Unit (CFMU) slots, with 81% of all departing flights managing to match the slot that was attributed to them.

The tests also demonstrated the reliability of the DMAN tool and showed that it facilitates the implementation of changes to runway capacity and configuration.

The technology has shown favourable results on fuel consumption, with an average reduction of 14.6 kg per flight, corresponding to 46.6 kg drop in CO2 emissions.

The system will be used as baseline for future AMAN and DMAN integration during Release 3.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

The exercise results are conclusive and sufficient to support a decision for industrialisation.



09

AMAN and Extended AMAN horizon

Exercise Factsheet

Main objectives

Validation of the impact of extending the Arrival Manager (AMAN) horizon and pre-sequence incoming flights to improve traffic smoothing, on the basis of validation activities at ENAV's Industry-Based Platform (IBP) in Rome; Schiphol-East; NATS London TC and NORACON Malmö.

(SESAR Reference: EXE-05.06.04-VP-187; EXE-05.06.04-VP-187bis; EXE-05.06.04-VP-188 & EXE-05.06.04-VP-189)

Results

SESAR validation exercises in London, Rome, Amsterdam and Malmö TMAs showed significant benefits, including substantial environmental gains.

More specifically, in the London exercise, aircraft fuel burnt in the 500 nautical miles extended AMAN Horizon was reduced by 9% or 942 kg on average per flight. Aircraft stack holding time (i.e. airborne waiting) was reduced by between 78% and 87%, with matching positive consequences on the flight's environmental impact.

The validation in Rome showed that extended AMAN could cut the fuel consumption of a short-haul Airbus A320 flight by 7.28% or 103 kg in the journey through three Italian air traffic control sectors between Rome and the country's northern border.

No safety concerns were identified in any of the four locations as a result of the exercises. Furthermore, the reported reduction in TMA air traffic controller workload seems to indicate a possible increase in safety – but quantified data is not available at this stage.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

The results will be fed into the follow-up activities planned in release 2.

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i4D + CTA

Main objectives

Validate the operational concept of flying to a time constraint in the En-Route as well as in the Terminal Maneuvering Area (TMA).

(SESAR reference: EXE-04.03-VP-323; EXE-05.06.01-VP-203 & EXE-05.06.01-VP-205)

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Results

The SESAR exercises included the first four-dimensional trajectory management (I-4D) validation trial flight in the world, which took place on February 10, 2012. An A320 test aircraft flew six legs, from Toulouse Blagnac Airport, through French airspace, then through Maastricht Upper Area Control Centre (MUAC) and Danish-Swedish airspace to land at Stockholm Arlanda Airport, and back. The trial aimed at verifying that the Flight Management System (FMS) and ground automation systems implement the I4D solution through data link interoperability.

The flight trial proved that useful data supporting the concept can be exchanged by air-ground systems. Such data can be used by the ground system and communicated to the controller in charge.

The level of precision reached automatically by the airborne FMS was more than satisfactory. In the original I4D concept, time constraints for flying through En-Route waypoints included a 30 second tolerance. In the trial, all time constraints as set for the En-Route waypoints in the MUAC airspace were met within a 10 second tolerance (North bound +6 seconds; Southbound +1 second).

In another exercise concentrating on Controlled Time of Arrival (CTA), a series of 90 flight trials were performed with revenue flights into Stockholm Arlanda airport, in low to medium traffic density. These trials focused on evaluating the experience of pilots and air traffic controllers working with CTA operations.

Of the 90 trials, 72 were successfully completed and 92% of these met their assigned CTA within a 30 second tolerance.

CTA was perceived as positive way to absorb delays and sequence arriving aircraft in certain situations. The trials also generated useful information outlining possible improvements for CTA operations.

Conclusion

The exercises partially demonstrated the maturity of the concept.

Preparation for industrialisation

The results will contribute to further i4D+CTA exercises planned in Release 2 and Release 3.



Complexity assessment and resolution

Main objectives

Validation of new complexity prediction indicators to be implemented as automated decision aid tools for en-route air traffic controllers.

(SESAR reference: EXE-04.07.01-VP-001)

Results

The SESAR exercise consisted of a series of shadow-mode trials carried out at Maastricht Upper Area Control Centre (MUAC) which indicated that the concept option was feasible.

The trials confirmed that complexity prediction and assessment tools are capable of optimising airspace capacity utilisation and air traffic controller workload. The tools could also lead to significant fuel savings as a consequence of more direct aircraft routing. No negative impact on safety was observed.

However, the system's maturity is not demonstrated at this stage, as non-nominal cases and applicability in other Area Control Centres (ACC) have yet to be considered.

Conclusion

The exercises did not demonstrate the maturity of the concept.

Preparation for industrialisation

Further activities are planned in Releases 2.

Enhanced ATFCM processes

Main objectives

Assessment of Short Term Air Traffic Flow Management Measures (STAM) aiming at fostering collaborative decision making to smooth traffic and air traffic controller workload.

(SESAR reference: EXE-07.06.05-VP-314)5

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Results

A live trial conducted in November 2011 clearly demonstrated that STAM measures can safely optimise the utilisation of the Air Traffic Management systems' capacity and improve the predictability of traffic. The trials involved the Central Flow Management Unit (CFMU) system, Network Managers, Air Traffic Control Centres (Reims, Maastricht & London) and Airspace Users.

The trial showed that STAM can provide an immediate and safe method of mitigating delays caused by excess demand and subsequent regulation of the network. Using the example of Reims, whilst traffic grew year on year by almost 2%, corresponding delay was reduced by almost 65%.

Benefits in terms of punctuality and predictability were clearly illustrated during the trial observing a hotspot containing 59 flights. Applying STAM measures, the initial total delay generated by network regulation was reduced by 799 minutes, reducing average delay of 13 minutes per flight to 2 minutes per flight.

In terms of safety, feedback from participants in the trial highlighted that confidence from improved traffic monitoring, interpretation and prediction is seen to enhance safety, as a result of better assessment and awareness of potential traffic demand.

Several operational issues were identified for further assessment in later exercises (e.g. non-nominal cases, higher traffic loads and applicability to other Area Control Centres).

Conclusion

The Release 1 success criteria are partially fulfilled.

Preparation for industrialisation

Further activities are planned in Release 3.



SESAR CWP Airport

Exercise Factsheets 3

Main objectives

Validation of the use of a simple Airport Departure Data Entry Panel (ADDEP) for smaller airports not equipped with advanced electronic flight strip capabilities improving the availability and accuracy of departure information shared between the Tower and the Approach and with the Network Manager.

(SESAR Reference: EXE-12.04.01-VP-391 & VP-404)

Results

The SESAR trial took place Southampton Airport in the south of the United Kingdom and ran in shadow-mode. The ADDEP gives regional airports a low-cost solution to compute and departure data with approach controllers and the CFMU.

In the trial, departure data received directly from the airport tower's ADDEP panel was compared with similar data received at the Central Flow Management Unit (CFMU) through normal operations.

The operational and system feasibility were demonstrated, with a significant improvement in traffic predictability and, more specifically: an improvement of Estimated Take-Off Time (ETOT) accuracy at small airports. Only 6% of flights were outside a 10-minute margin of error, compared with 43% without the new SESAR tool.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

The Release results are conclusive and sufficient to support decision for industrialisation.

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SESAR CWP En-Route and TMA

Main objectives

Validation of a new Human Machine Interface (HMI) for the Integrated Controller Working Position (SESAR CWP) in the Terminal manoeuvring Area with improved design, addressing human factors with a focus on the Aircraft Situation Display.

(SESAR Reference: EXE-05.09-VP-148 & VP-356)

Results

Overall, controllers voiced a good appreciation of the new SESAR CWP features and the sequence of actions they are required to perform.

Automation tools outputs, reminders and triggers provided by the HMI, and resulting support in building and retaining a short & medium/long term traffic picture are considered useful and trustworthy by air traffic controllers.

However, some operational requirements have not been addressed yet and the system documentation remains incomplete.

Conclusion

The exercises did not demonstrate the maturity of the concept.

Preparation for industrialisation

Further exercises for this concept will be conducted in Release 2.



Remote tower

Main objectives

The overall aim of this trial was to assess the technical and operational capability of an initial prototype for the provision of Air Traffic Services (ATS) to a single aerodrome from a remote control site located at a distance of approximately 100 kilometres in an operational environment.

(SESAR Reference: EXE-06.09.03-VP-056)

Results

The SESAR trial was considered successful in achieving its aims, with a basic initial prototype platform assessed against various objectives. The functional requirements were confirmed by operational staff in the context of assessing the platform in a representative environment.

The controllers felt they could trust the system, finding it understandable and robust. The controllers had no issues regarding the roles and responsibilities when providing remote ATS. The trial generated initial insight into safety issues for normal and degraded flight conditions. The controllers and the project team were able to identify what they would consider as risks (and therefore areas for further assessment) and what they considered to be less of an issue.

Overall the controllers stated that they would be able to accommodate IFR (Instrument Flight Rules) traffic through remote ATS with no negative impact on capacity.

Under nominal conditions, the controllers participating in the exercise confirmed that a safe service could be provided remotely.

The controller's opinion was that the remote representation of a daytime situation generally clearer and easier to interpret than night time displays.

The use of infrared cameras could enable increased opportunities and enhance the flexibility of controllers' working methods.

Conclusion

The exercises successfully demonstrated the maturity of the concept.

Preparation for industrialisation

Further activities are planned as part of Release 2 to provide more information on the security, safety and human performance.





Members



Associate Partners



Associate Partners to the SESAR Joint Undertaking



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