Airspace Architecture study

Second Workshop | 20-21 November 2018
AGENDA

17:30 – 17:35  Welcome
Florian Guillermet, Executive Director, SESAR JU

17:35 – 17:45  Background and expectations from the European Commision
Maurizio Castelletti, Directorate-General for Mobility and Transport, Head of Unit Single European Sky, European Commision

17:45 – 18:00  The pressing need of the capacity challenge
Joe Sultana, Director, European Network Manager

18:00 – 18:30  Initial recommendations
Alain Siebert, Chief Economics and Master Plan, SESAR JU

18:30 – 21:00  Networking drink
WELCOME

17:30 – 17:35  Florian Guillermet, Executive Director, SESAR JU
Background and expectations from the European Commission

Maurizio Castelletti
Directorate-General for Mobility and Transport, European Commission
Head of Unit Single European Sky

Brussels, 21 of November 2018
Airspace Architecture Workshop -
The Pressing Need

Joe Sultana
Director Network Management

Brussels, 20 of November 2018
Saturday 29th July 2018

301,000’

461 regulations
Friday 29th June 14,30 UTC

The European Air Traffic Management Network
Traffic situation on Friday 29 June 2018 at 14:33 UTC

staffing and Maastricht due to capacity. Last week report: en-route delay/flight 2.73 min/flight, ATC capacity and ATC staff.
NM 4+ ACCs

4ACC project improvement on Friday 7 September 2018

Clock: 00:00:00

Nb flights affected by 4ACC measures: 1
Constantly evolving traffic demand

A European ATM network responding to variation in traffic changes
Challenges of Growth 2018: Summary & 4 Annexes

www.eurocontrol.int/articles/challenges-growth
Four scenarios for 2040
Flight forecast for Europe to 2040

- +53%
- +84%

Global Growth
Regulation & Growth
Fragmenting World

Flights in Europe (Million)

Annual Growth
Actual
Forecast


-5% 0% 5%
2025-2030-2035 Updated Outlook
Assumptions

High traffic growth scenario
  ▪ Approximately 3% yearly traffic growth

Capacity increase
  ▪ 2% per year for congested ACCs
  ▪ 3% per year for less congested ACCs
  ▪ Based on 20 years average capacity growth

Capacity enhancement between 1999-2018
  ▪ B-RNAV
  ▪ RVSM
  ▪ 8.33 kHz
  ▪ A-FUA
  ▪ Major airspace re-sectorisation projects
  ▪ Enhanced ATFCM
2025-2030-2035 Updated Outlook
Significantly Congested ACCs and Delay Forecast

- 2018 already recorded some days with delay around 6-7 minutes/flight
Significantly Congested Areas
2024-2025
Traffic Above FL 285

3 areas mostly loaded
Traffic density in Europe
Instantaneous nb of A/C in the 3 High density areas every 60s
Peak: 144

Instantaneous nb of A/C in the 3 High density areas every 10s
Peak: 144
Structurally Addressing Causes of ATC Workload

- Eliminate airspace structure constraints – Seamless airspace design
- Harmonised ATM system support – Automate key ATCO tasks
  - Harmonised Operational Procedures
  - Stepped gradual coordinated operational implementation
- Supported by opportunities provided by seamless Free Route Airspace operations
  - Supported by the SESAR 2020 Vision Technology
Summary

- Traffic growth, density and complexity cannot be managed safely anymore with the current approach
  - Need a game changer

- Focus on delivery of 4D preferred trajectories
  - From planning into operations

- Addressing ATCO workload
  - Effective, impartial airspace design
  - Operational and technical harmonisation
  - Focused research delivering automation of ATC tasks

Efficient and interoperable CNS/ATM Infrastructure

Focused research, targeted deployment, effective regulation and oversight, efficient impartial network design, operations and systems
Initial recommendations

Alain Siebert
SESAR JU
Chief Economics and Master Plan

Brussels, 21 of November 2018
This is not a new problem and in the long run it cannot be solved with the same approach as in the past.

Factors limiting overall capacity:
- Non-optimal organisation of airspace
- Limited use of data communications
- Limited availability of VHF frequencies

Factors limiting scalability and resilience:
- Limited information sharing and interoperability
- Limited flexibility in the use of ATCO resources across ACCs
- Limited predictability
- Limited automation support for ATCOs
Layered approach for analysis

**FRAMEWORK LAYERS**

Services are *enabled* by *airspace* and *technology* and dependent on the infrastructure & data services

**TECHNICAL LAYERS**

Stronger coupling and measurement of the impact through simulations factoring in known deployments and roadmaps from the Master Plan
Proposed problem-solving approach

Two sides of the capacity challenge

**Capacity & airspace**
How to ensure that the new architecture is able to provide **sufficient capacity** to meet growing demand from all airspace users?

**Scalability & resilience**
How to ensure that the new architecture is **resilient** to capacity and demand changes and enable **more efficient and more collaborative models** of service delivery?

Proposed solutions coupling airspace & technology

**Focus area 1**
*Increasing net capacity of the network*
- Optimised airspace organisation
- Operational harmonisation
- Automation and productivity tools

**Focus area 2**
*Optimising alignment of capacity with demand*
- Dynamic airspace configuration
- Flight centric operations if proven feasible
- Virtualisation and ATM data services
- CNS enhancements
- Sector independent air traffic service operations
- Trajectory-based operations and increased sharing of information to address predictability
There are conditions to increase the chances of success and in particular to secure the implementation timeline

**CAPACITY-ON-DEMAND:** Increase the resilience of the ATM system through horizontal collaboration between ANSPs

**ATM DATA SERVICE PROVIDER – ADSP:** Promote a new Air traffic Data Service Provider model jointly servicing multiple ANSPs

**REWARD EARLY MOVERS:** Reward actors that are the first to implement recommended improvements or that shift towards innovative delivery models
A possible way forward with progressive transition every 5 years

- ECAC-wide implementation of cross-border Free Route, IOP and datalink
- Launch airspace re-configuration supported by Operational Excellence Programme
- Set up an enabling framework for ADSP, capacity-on-demand service and rewards for early movers, first ADSP is certified

- Implement virtual centres and dynamic airspace configuration at large scale
- Gradual transition towards higher levels of automation supported by SESAR Solutions
- Capacity-on-demand arrangements implemented across Europe
- New ATM Data service provision model is implemented across Europe
- Transformation to flight/flow centric operations
- Trajectory-based operations
- Service-oriented air traffic management
Preliminary impact assessment

**Capacity**

Meeting SES target and 438 million of delay minutes saved between 2019 and 2035

**Environment**

Between 77 and 143 kg of fuel saved per flight in 2035

**Cost efficiency**

Total ANS productivity benefits are estimated to amount to EUR 5-7 billion between 2019 and 2035 (EUR 57-73 per flight in 2035)

**Net benefits**

Potential of EUR 31-40 billion between 2019 and 2035

Sufficient to demonstrate that investing in a solution to the anticipated capacity issues is essential for the future of European aviation?
Preliminary recommendations

1. Launch **airspace re-configuration** and **Operational Excellence programmes** to achieve quick wins.

2. Realise **virtual de-fragmentation of European skies**.

3. Create **SES framework that rewards early movers**.
1. Launch an EU-wide airspace re-configuration programme in which the Member States, Network Manager, air navigation service providers, civil airspace users and military should work together to define and implement an optimal cross-FIR and flow-centric redesign of airspace sectors. This optimised airspace design should be consistent with already agreed upon design principles at European level.

ii. Launch an EU-wide Operational Excellence programme in which the Network Manager, air navigation service providers, civil airspace users and military should work together to achieve operational harmonisation aligning ACC capacity and ways of working to best practices through systematic operational excellence throughout the Network (also leading to geographically independent ATCO validations).
Realise virtual de-fragmentation of European skies

**The Commission should**

1. **Review policy options which, on their own or in addition to FABs, could effectively deliver a virtual defragmentation of European skies and potentially generate higher levels of resilience by encouraging industry-based alliances to deliver core interoperability through common service delivery.**

2. **Options could include the implementation of a certification and remuneration framework for ATM Data Services Providers (ADSPs) taking also into account possible restructuring of ANSP services as well as an EU framework for on-demand cross border use of services (Capacity on Demand).**

3. **Continue to support timely delivery of SESAR solutions contributing to the delivery of the target architecture.**
The Commission should

Review its **incentivisation policy** to reward actors who are the **first to implement** the high-level milestones identified in the proposed transition strategy.

*We will present and discuss an illustrative list of such potential incentives examples (not exhaustive) tomorrow.*
Airspace Architecture study – DAY II

Second Workshop | 20-21 November 2018
08:30 – 08:45 Michael Standar, Chief Strategy and External Affairs, SESAR JU
The plan for today

<table>
<thead>
<tr>
<th>Focus is on …</th>
<th>Therefore we will …</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answering your <strong>questions</strong> and bringing <strong>clarifications</strong></td>
<td><strong>Reserve enough time</strong> to answer your questions</td>
</tr>
<tr>
<td>Creating an <strong>open discussion</strong></td>
<td><strong>Foster discussion</strong> and <strong>exchanges</strong> through the panels</td>
</tr>
<tr>
<td>Capturing <strong>feedback</strong> from the entire ATM community</td>
<td><strong>Collect your questions</strong> to the following email: <a href="mailto:communications@sesarju.eu">communications@sesarju.eu</a></td>
</tr>
</tbody>
</table>
AGENDA FOR DAY II (1/2)

8:45 – 10:00  
Coupling airspace, technology and data solutions  
- Ruben Flohr, Acting Chief ATM, SESAR JU  
- Razvan Bucuroiu, EUROCONTROL, Network Manager Directorate, Head of Network Strategy and Development, Division / Acting Head of Operations Planning Unit

10:00 – 10:30  
Q&A with the audience

10:30 – 11:00  
COFFEE BREAK

11:00 – 12:30  
Panel discussion & Q&A with audience: how can airspace change and technology work together to help address the challenges ahead?  
- Achim Baumann, Policy Director, A4E (representing the European Airspace User Community)  
- Christophe Vivier, Head of Unit, Single European Sky / SESAR, EDA  
- Gauthier Sturtzer, Professional Staff Organisation representative, ETF  
- Iacopo Prissinotti, Head of the International Strategies Department, ENAV (representing the A6 Alliance and CANSO)  
- Luc Laveyne, Senior Adviser Single European Sky, ACI Europe  
- Vincent De Vroey, Director Civil Aviation at ASD

12:30 – 13:30  
LUNCH
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:30 – 14:00</td>
<td><strong>How to achieve a smooth transition?</strong></td>
</tr>
<tr>
<td></td>
<td>• Alain Siebert, Chief Economics and Master Plan, SESAR JU</td>
</tr>
<tr>
<td></td>
<td>• Razvan Bucuroiu, EUROCONTROL, Network Manager Directorate, Head of Network Strategy and Development, Division / Acting Head of Operations Planning Unit</td>
</tr>
<tr>
<td>14:00 – 14:30</td>
<td><strong>Q&amp;A with the audience</strong></td>
</tr>
<tr>
<td>14:30 – 15:40</td>
<td><strong>Panel discussion &amp; Q&amp;A with the audience: How fast will we be able to structurally solve the challenges identified?</strong></td>
</tr>
<tr>
<td></td>
<td>• Achim Baumann, Policy Director, A4E (representing the European Airspace User Community)</td>
</tr>
<tr>
<td></td>
<td>• Christophe Vivier, Head of Unit, Single European Sky / SESAR, EDA</td>
</tr>
<tr>
<td></td>
<td>• Gauthier Sturtzer, Professional Staff Organisation representative, ETF</td>
</tr>
<tr>
<td></td>
<td>• Iacopo Prissinotti, Head of the International Strategies Department, ENAV (representing the A6 Alliance and CANSO)</td>
</tr>
<tr>
<td></td>
<td>• Kari Siekkinen, Chief Advisor ATM and ADR at Finnish Transport Safety Agency, Trafi</td>
</tr>
<tr>
<td></td>
<td>• Nathalie Dejace, Head of ATM/ANS, EASA</td>
</tr>
<tr>
<td>15:40 – 16:00</td>
<td><strong>Coffee break</strong></td>
</tr>
<tr>
<td>16:00 – 16:15</td>
<td><strong>Wrap up and conclusions</strong></td>
</tr>
<tr>
<td></td>
<td>• Florian Guillermot, Executive Director, SESAR JU</td>
</tr>
<tr>
<td>16:15 – 16:30</td>
<td><strong>Closing words</strong></td>
</tr>
<tr>
<td></td>
<td>• Maurizio Castelletti, Directorate-General for Mobility and Transport, Head of Unit Single European Sky, European Commission</td>
</tr>
</tbody>
</table>
Coupling airspace, technology and data solutions – Section 4

Ruben FLOHR – SESAR JU – Acting Chief ATM

Razvan BUCUROIU – Network Manager – Head of Network Strategy and Development Division / Acting Head of Operations Planning Unit

Brussels, 21 of November 2018
Layered approach for problem solving

FRAMEWORK LAYERS

Services are enabled by airspace and technology and dependent on the infrastructure & data services

TECHNICAL LAYERS

Stronger coupling and measurement of the impact through simulations factoring in known deployments and roadmaps from the Master Plan
Two sides of the same capacity problem

**Capacity & Airspace**

Increasing net capacity of the network

**Scalability & Resilience**

Optimising the alignment of capacity with demand
Coupling the airspace design and technological enablers

Impact of coupling airspace and technology

Optimised Airspace Organisation + Automation support + Geographic Service Decoupling

Technological enablers

- Improve net capacity of the system
- Reduce controller workload
- Increase resilience and ability to better align capacity to demand
Two sides of the same capacity problem

**FOCUS AREA 1**

Capacity & airspace

1. Optimised Airspace organisation
2. Operational harmonisation
3. Automation and productivity tools

**FOCUS AREA 2**

Scalability & resilience

1. Trajectory based operations
2. Virtualisation and ATM data services
3. Dynamic airspace configuration
4. Flight centric operations if proven feasible
5. Sector independent Air Traffic Service
6. CNS Enhancements
Two sides of the same capacity problem

**FOCUS AREA 1**

Capacity & airspace

1. Optimised Airspace organisation
2. Operational harmonisation
3. Automation and productivity tools

**FOCUS AREA 2**

Scability & resilience

1. Trajectory based operations
2. Virtualisation and ATM data services
3. Dynamic airspace configuration
4. Flight centric operations if proven feasible
5. Sector independent Air Traffic Service
6. CNS Enhancements
Achievement of a **consistent FRA cross-border** implementation
- In process of being achieved and down to TMA level
- Further opportunities for cross-border implementation to be looked into

**Significant and natural enabler for network harmonisation**
- In process of being achieved

**Natural enabler for enhanced design** of the lower airspace

**Natural enabler for sectorisation based on traffic flows**

**Natural enabler for systems harmonisation**
A-FUA Implementation

- 5-10 amendments to the **civil/military coordination** procedures annually
- Annual system support evolutions
- Several **military exercises** daily
- 3000 civil/military airspace structures **dynamically updated** on a daily basis
- 5-10 major **military exercises** yearly
- Further improvements under discussion for the next 5 years, including SESAR evolutions on more **dynamic airspace management**
Objectives and Principles

Design of an European airspace structure based on agreed Airspace Design Principles

- Responding to civil and military airspace users requirements
- Responding to operational requirements
- Irrespective of national / FAB / FIR boundaries
- Not bound by division between lower / upper airspace
- Taking into account traffic forecasts
- Responding to performance requirements
- Vertical and horizontal inter-connectivity
- ATC sectors designed along traffic flows alignments and allowing adaptable sector configurations
- Agreements on service provision across national / FAB / FIR boundaries
Main criteria and assumptions

- **Capacity** and **Environment** / flight efficiency performance
- Achievement of a consistent **FRA cross-border** implementation
- Application of steps defined in the European Route Network Improvement Plan Part 1 – **Technical Specifications for Airspace Design**
- Building on already **implemented and on-going** projects

- Stepped implementation **over RP3 and RP4**
- Aimed as a **significant contributor** to meeting performance targets
- Aimed at **reducing ATCO workload** through enhanced airspace design solutions
Pan European Network

European Network Design

Current
- Current Route Network
- Current Traffic Flow

RP2
- FRA and Route Network
- RP2 Traffic Flow

RP3 – Optimised
- Cross Border FRA
- RP3 Traffic Flow

Trade off between flight efficiency and network capacity
Building the Airspace Structure Concept

- Raw traffic demand
- Traffic flow
- Traffic flow areas
- Traffic flow groups
- Traffic flow families

Dynamic management

Compatibility traffic flow and sectors

Sectors
Building the Airspace Structure Density Criteria
Optimised airspace organisation

Building the Airspace Structure Conflict Density Criteria
Building the Airspace Structure Complexity Criteria
Illustration of two key design principles for new airspace configuration

**Group high complexity area under same operational areas**

- Align sectors with flight flow

**Illustration**

- No optimal route due to national FRA exit restrictions
- Optimal route is allowed

- Sectors aligned to national borders
- Sectors aligned to main flows
Building the Airspace Structure: Main Entry Gates and ...

Optimised airspace organisation
Illustration of what new sectorisation could look like

Network optimisation sectors

Optimised airspace organisation
Optimised airspace organisation

Building the Airspace Structure Traffic Flow Families and Sectors

- Harmonised operational concept and system support
- Sector capacities assessed with fast time simulation tools based on real models
- Demand in all sectors checked
- Aimed to reduce workload through boundaries at areas of low interactions

- Several possibilities for combination of sectors
- Reducing unnecessary sector splits
- Possibility to open additional sectors in the longer term
Two sides of the same capacity problem

**FOCUS AREA 1**

Capacity & airspace

1. Optimised Airspace organisation
2. **Operational harmonisation**
3. Automation and productivity tools

**FOCUS AREA 2**

Scalability & resilience

1. Trajectory based operations
2. Virtualisation and ATM data services
3. Dynamic airspace configuration
4. Flight centric operations if proven feasible
5. Sector independent Air Traffic Service
6. CNS Enhancements
Operational harmonisation

NM input on best practices

Addressing Operational Harmonisation

Entry Rates (No. of flights per hour)

<table>
<thead>
<tr>
<th>ACC 1</th>
<th>ACC 2</th>
<th>ACC 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>57</td>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td>75</td>
<td>58</td>
<td>46</td>
</tr>
<tr>
<td>105</td>
<td>81</td>
<td>66</td>
</tr>
</tbody>
</table>
Two sides of the same capacity problem

**FOCUS AREA 1**

- Optimised Airspace organisation
- Operational harmonisation
- **Automation and productivity tools**

**FOCUS AREA 2**

- Trajectory based operations
- Virtualisation and ATM data services
- Dynamic airspace configuration
- Flight centric operations if proven feasible
- Sector independent Air Traffic Service
- CNS Enhancements

Capacity & airspace

Scalability & resilience
<table>
<thead>
<tr>
<th>Level</th>
<th>Definition</th>
<th>Execution</th>
<th>Environment monitoring</th>
<th>Fallback</th>
<th>System autonomy</th>
<th>Automation level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No automation</td>
<td>The full-time performance by the Human operator of all aspects of the control task</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Operator assistance</td>
<td>Anticipation and proposal of action by an assistance system using information about the environment and with the Human operator performing all remaining aspects of the control task</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Partial assistance</td>
<td>Anticipation and execution of some aspects of the control task by an assistance system in nominal conditions with the Human operator performing all remaining aspects of the control task, ready to take back control immediately if needed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Conditional automation</td>
<td>Anticipation and execution of most aspects of the control task in nominal conditions. The Human operator supervises the system, ready to intervene upon system request</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>High automation</td>
<td>The system performs all aspects of the control task in nominal conditions. The Human operator supervises the system. In most non-nominal conditions, the system is capable of defining and implementing solutions and in the absence of human interventions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Full automation</td>
<td>The system performs all aspects of the control task for all conditions that can be managed by the Human operator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Delivered in SESAR 1

In the pipeline with SESAR 2020

- 4D Trajectory Exchange
- Extended Arrival Management horizon
- Advanced short ATFCM measures, STAM
- CTOT and TTA
- Automated support for traffic complexity detection and resolution
- MTCD and conformance monitoring tools
- Extended flight plan
In the pipeline with SESAR 2020

- Extended arrival management across overlapping AMAN operations
- Mission trajectory driven processes
- Management of dynamic airspace configuration
- Collaborative network management
- **Advanced separation management**
  - ATC planned trajectory performance improvement
  - Improved performance in the provision of separation
- **High productivity controller team organisation**
- Trajectory based operations
- Network Prediction and Performance
- Trajectory based planning system
- RBT revision uplink supported by datalink increased automation
- Automation supporting flight-centric ATC and improve distribution of separation responsibility in ATC
- **Collaborative advanced planning**
- SWIM TI Purple profile for Air/Ground Safety-Critical Information Sharing
New SESAR controller tools increase controller productivity and safety, highly rated by controllers.

Much more than an improved HMI, revolutionary use of tactical trajectory for CD&R and MONA.

MONA deemed necessary in FRA (where each flight has its own user-defined route).

Highly precise in its 6/7 minutes look-ahead time.

Includes “what-if” function and suggested rates of climb/descent with colour coding.

Initially validated in lower airspace (especially challenging), adaptation and validation on additional environments (including high en-route sectors) is ongoing in SESAR 2020.
Advanced separation management

- Use of A/G synchronization (EPP) and CPDLC for advanced separation management concepts.
- Extension of the SESAR 1 concepts with more precise ground trajectory and improved algorithms ("what-if" and "what-else" functions).
- CPDLC prefilled messages with constraints presented for controller approval and uplink, with particular focus on vertical constraints.
- MONA is extended to monitor compliance with the new clearances.
For both en-route and TMA/E-TMA, en-route is the most challenging.

Holistic view beyond the Multi Sector Planner (MSP) solution and its various local implementations.

Linked to collaborative control with unplanned boundaries, for coordination-free transfer between executive controllers supported by the same planner.

Boundaries between sectors may be adjustable by the MSP for workload-balancing purposes.
Collaborative Advanced Planning extension

New concept developed by DSNA in 2015 for coordination of re-routing, at first only 3 ACCs and a handful of AUs.

Concept extended to other ANSPs, and now including synchronization with NM for increased predictability, could support re-routing.

Latest test in the MADRID-LATEK traffic flow showed potential for savings:
Regulations avoided in 12/15 days.
Total savings over 4,000 minutes
Two sides of the same capacity problem

### FOCUS AREA 1

**Capacity & airspace**

1. Optimised Airspace organisation
2. Operational harmonisation
3. Automation and productivity tools

### FOCUS AREA 2

**Scalability & resilience**

1. **Trajectory based operations**
2. Virtualisation and ATM data services
3. Dynamic airspace configuration
4. Flight centric operations if proven feasible
5. Sector independent Air Traffic Service
6. CNS Enhancements
1. Increased predictability through better connectivity & sharing of information
2. Improved multi-stakeholder collaborative decision making
3. Reducing Air Traffic Controller workload primarily through support of decision making
Extended flight plan

- Included in the PCP (AF#4).
- Extension of the ICAO 2012 FPL, with flight-specific additional information (4D trajectory).
- Benefits validated in SESAR 1 include increased FPL acceptance rate and improvements to DCB (due to better prediction of sector flight-list).
- Additional benefits by using the 4D trajectory in ATC TP are under validation in SESAR 2020: use of flight-specific data rather than BADA.
4D trajectory exchange EPP (EPP availability on ground)

- Estimates according to FMS horizontal speed schedule
- Altitudes / flight levels according to FMS vertical speed schedule

Source: De Lang, Adams, Lawton, and Gimenez (2014)
RBT revision uplink supported by datalink and increased automation

- Builds on SESAR 2020 CPDLC and the IOP threads.
- Objective is to leverage ATN B2 (4)
- Introduces advanced automation concepts (e.g., automatic descent clearances delivered by the system unless controller intervenes).
- Further increases in controller productivity and improved service to AUs (e.g., auto-loadable clearances, more timely descents...).
Two sides of the same capacity problem

**FOCUS AREA 1**

- **Capacity & airspace**
  - i. Optimised Airspace organisation
  - ii. Operational harmonisation
  - iii. Automation and productivity tools

**FOCUS AREA 2**

- **Scalability & resilience**
  - i. Trajectory based operations
  - ii. Virtualisation and ATM data services
  - iii. Dynamic airspace configuration
  - iv. Flight centric operations if proven feasible
  - v. Sector independent Air Traffic Service
  - vi. CNS Enhancements
Rationale for the target architecture

Resilience of the ATM system
Ability to adjust to expected and unexpected disturbances (staffing problems, weather disturbances, system failures, cyber-attacks, temporary surge in needed capacity) in order to sustain required operations and secure sufficient capacity.

Continuity of air traffic services
By temporarily decoupling the controller working position (CWP) from the airspace served.
Dynamic management of cross-FIR sectors

Traditional sectorisation along borders

Sectors designed across borders and operated by one centre or the other depending on the flow

Virtualisation and ATM data services
Virtualisation and service orientation could be associated with new service delivery models

Virtualisation and ATM data services

**D_x configuration**

**CWP-S8 failing in ACC1 – reconfigured to ACC2**

**ACC2 power failure – all cross-border sectors taken by ACC1**

**D_y configuration**

Data Service Provider
Current architecture

Airspace User Operations

Network Services

Physical location constrained

Aircraft

Air Navigation Services

Virtualisation and ATM data services

ATS

ATM Data

AIM

SUR

WX

AIM integration

SUR integration

WX integration

AIM generation

SUR sensor

WX sensor

NAV signal

COM mobile

Communications and security services

OLDI
Target architecture

Virtualisation and ATM data services

Airspace User Operations

Network Services

Aircraft

Physical location constrained

Air traffic services

ATCO

ATCO

Interoperability Need

ATM data services

AIM Integration services

SUR Integration services

Weather Integration services

AIM generation services

SUR sensor services

Weather sensor services

NAV Signal services

Mobile COM services

Physical location constrained

Security and SWIM common services

Communication services

Interoperability Need

Interoperability Need

Interoperability Need
## Virtualisation and ATM data services

### Geographically decoupled

<table>
<thead>
<tr>
<th>Network Management Services</th>
<th>Virtual Centre Services</th>
<th>Transversal services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network</strong></td>
<td><strong>Air Traffic Services</strong></td>
<td><strong>Communication Services</strong></td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td><strong>Flight Data Services</strong></td>
<td></td>
</tr>
<tr>
<td>Services</td>
<td><strong>Integration Services</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Geographically fixed services**

<table>
<thead>
<tr>
<th></th>
<th><strong>Geographically fixed services</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Air traffic Flow Management</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>ATM data services</strong></td>
</tr>
<tr>
<td></td>
<td><strong>WX brokering and integration</strong></td>
</tr>
<tr>
<td></td>
<td><strong>CNS Services</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Ground IP network provision</strong></td>
</tr>
<tr>
<td></td>
<td><strong>SWIM registry</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Network Functions</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Network crisis management</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Network crisis management</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Two sides of the same capacity problem

**FOCUS AREA 1**

Capacity & airspace

1. Optimised Airspace organisation
2. Operational harmonisation
3. Automation and productivity tools

**FOCUS AREA 2**

Scalability & resilience

1. Trajectory based operations
2. Virtualisation and ATM data services
3. Dynamic airspace configuration
4. Flight centric operations if proven feasible
5. Sector independent Air Traffic Service
6. CNS Enhancements
Takes dynamic sectorisation to the next level, both in fixed-route airspace and in FRA (more challenging!).

Stepwise approach: from smarter sector-bandboxing to dynamic definition of sectors based on increasingly smaller volumes.

Most advanced concept requires sector-independent controller validation.

Full integration with ASM by supporting both trajectory requests with embedded ARES and independent ARES requests.

CDM process
Two sides of the same capacity problem

**FOCUS AREA 1**

- Optimised Airspace organisation
- Operational harmonisation
- Automation and productivity tools

**FOCUS AREA 2**

- Trajectory based operations
- Virtualisation and ATM data services
- Dynamic airspace configuration
- **Flight centric operations if proven feasible**
- Sector independent Air Traffic Service
- CNS Enhancements
Evolution towards new working models

Overcomes the **limitations** of further sector splitting.

Different flights within the same piece of airspace are **assigned to different controllers**

Leading to **balanced** workload **adapting to demand**

**Distributed flight-centric team** allows pooling of controller resources between ANSPs.

Unambiguous responsibility for separation. **Research ongoing**
Two sides of the same capacity problem

<table>
<thead>
<tr>
<th>FOCUS AREA 1</th>
<th>FOCUS AREA 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity &amp; airspace</td>
<td>Scalability &amp; resilience</td>
</tr>
</tbody>
</table>

**FOCUS AREA 1**
- i Optimised Airspace organisation
- ii Operational harmonisation
- iii Automation and productivity tools

**FOCUS AREA 2**
- i Trajectory based operations
- ii Virtualisation and ATM data services
- iii Dynamic airspace configuration
- iv Flight centric operations if proven feasible
- v **Sector independent Air Traffic Service**
- vi CNS Enhancements
Evolution of the ATCO training and validation schemes is essential to enable virtualization.

Need for sector specific knowledge will be minimized through increased automation support so that ATCOs can safely be validated to work in more sectors than today.

A more flexible ATCO validation.
Two sides of the same capacity problem

**FOCUS AREA 1**

*Capacity & airspace*

1. Optimised Airspace organisation
2. Operational harmonisation
3. Automation and productivity tools

**FOCUS AREA 2**

*Scalability & resilience*

1. Trajectory based operations
2. Virtualisation and ATM data services
3. Dynamic airspace configuration
4. Flight centric operations if proven feasible
5. Sector independent Air Traffic Service
6. CNS Enhancements
CNS as a service, through European wide harmonized and performance based services

### Performance-Based and Service-Oriented CNS

<table>
<thead>
<tr>
<th>Communication PBCS</th>
<th>Navigation PBN</th>
<th>Surveillance PBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Data (ATN-B1/B2/B3)</td>
<td>- Conventional</td>
<td>- 3 NM Separation</td>
</tr>
<tr>
<td>- Voice</td>
<td>- RNAV</td>
<td>- 5 NM Separation</td>
</tr>
<tr>
<td>- AOC</td>
<td>- RNP</td>
<td>- ACAS</td>
</tr>
<tr>
<td>- ....</td>
<td>- ....</td>
<td>- ....</td>
</tr>
</tbody>
</table>

### CNS Robustness & Opportunities

- **Data (ATN-B1/B2/B3)**
- **Voice**
- **AOC**
- **....**

- **Conventional**
- **RNAV**
- **RNP**
- **....**

- **3 NM Separation**
- **5 NM Separation**
- **ACAS**
- **....**

### Applications

- **Infra-structure**
  - Communication PBCS
  - Navigation PBN
  - Surveillance PBS

- **Operations (OPS)**

### Infra-structure

- **Digital voice**
- **Ground Navaids (ILS, DME & VOR) & Inertial**
- **MSPSR**

### IP backbone

### Integrated CNS Roadmap and strategy

- **Civil/Military interoperability**

---

**Note:** The diagram and text are interconnected, providing a comprehensive overview of CNS applications, communication, navigation, and surveillance services.
Both advanced airspace concepts and service orientation have a strong link to automation, which in turn requires improved air-ground communications.
Summary

- Increased ATM capacity and scalability to handle all en-route airspace air traffic safely and efficiently.

- Allow all flights to operate along (or at least as close as possible to) user-preferred routing across the entire ECAC airspace.

- Promote an optimal use of ATM resources, reducing current inefficiencies and ATM costs for airspace users and society.

- Increase the overall resilience of the system to all types of incidents, in terms of safety, efficiency and capacity.

- Continue to facilitate the civil and military access to European airspace.
Panel discussion and Q&A with audience: How can airspace change and technology work together to help address the challenges ahead?

Send your questions to the following email: communications@sesarju.eu

Mohr Manfred, Assistant Director RSFO (Regional Safety and Flight Operations) / SESAR 2020 Technical Manager, IATA

Christophe Vivier, Head of Unit, Single European Sky/SESAR, EDA

Gauthier Sturtzer, Professional Staff Organisation representative, ETF

Iacopo Prissinotti, Head of the International Strategies Department, ENAV (representing the A6 Alliance and CANSO)

Luc Laveyne, Senior Adviser Single European Sky, ACI Europe

Vincent De Vroey, Director Civil Aviation, ASD

11h00 to 12h30
How to achieve a smooth transition?
– Sections 5, 6 & 7

Alain SIEBERT – SESAR JU – Chief Economics and Master Plan

Razvan BUCUROIU – Network Manager – Head of Network Strategy and Development Division / Acting Head of Operations Planning Unit

Brussels, 21 of November 2018
A possible way forward by bringing progressive transition every 5 years

- ECAC-wide implementation of cross-border Free Route, IOP and datalink
- Launch airspace re-configuration supported by Operational Excellence Programme
- Set up an enabling framework for ADSP, capacity on demand service and rewards for early movers, first ADSP is certified

- Implement Virtual Centre and dynamic airspace configuration at large scale
- Gradual transition towards higher levels of automation supported by SESAR Solutions
- Capacity on demand arrangements implemented across Europe
- New ATM Data service provision model is implemented across Europe

- Transformation to flight/flow centric operations
- Trajectory-based operations
- Service-oriented air traffic management
Where we propose to focus

- ECAC-wide implementation of cross-border Free Route, IOP and datalink
- Launch airspace re-configuration supported by Operational Excellence Programme
- Set up an enabling framework for ADSP, capacity on demand service and rewards for early movers, first ADSP is certified
- Implement Virtual Centre and dynamic airspace configuration at large scale
- Gradual transition towards higher levels of automation supported by SESAR Solutions
- Capacity on demand arrangements implemented across Europe
- New ATM Data service provision model is implemented across Europe
- Transformation to flight/ flow centric operations
- Trajectory-based operations
- Service-oriented air traffic management
ECAC-wide implementation of cross-border Free Route, IOP and datalink

- Free Route implementation is structuring for future airspace
- There should be no room for interpretation in the law, cross-border implementation is a must
- IOP is the foundation for seamless and interoperable ATM in Europe
- It needs to become a reality!
- Network Collaborative Management and Initial Trajectory Information Sharing are also important continuous exchange of up-to-date and consistent flight information between all actors
- Datalink paves the way for Initial Trajectory Information Sharing
- We are stressing the importance of necessary technological upgrades that will ensure a stable and reliable ATN/VDL Mode 2 service
Launch airspace reconfiguration and Operational Excellence Programme

Network-centric airspace reconfiguration programme

- **Analysis** at a network level of potential improvements in airspace organisation
- **Propose** and **validate** new airspace organisation where relevant
- **Deliver** and **implement** an optimised airspace organisation at European level

Operational Excellence Programme

- **Identify** best practices and quick-wins across all stakeholders (e.g., operational procedures, rostering, collaborative DCB processes) and set up of implementation roadmap
- **Implement** operational changes as planned
- **Monitor** benefits brought by the implemented changes and update operational excellence plan accordingly

A collaborative decision making process involving all stakeholders
Setting up an enabling framework for ADSP, capacity on demand service and rewards for early movers

**CAPACITY ON DEMAND SERVICE:** Increase the resilience of the ATM system through horizontal collaboration between ANSPs

**ATM DATA SERVICE PROVIDER – ADSP:** Promote a new Air traffic Data Service Provider model jointly servicing multiple ANSPs

**REWARD EARLY MOVERS:** Reward actors that are the first to implement recommended improvements or that shift towards innovative delivery models
Capacity on Demand would allow sharing of capacity across ANSPs, increasing resilience of the system

What are we trying to achieve?
- Resilience is the intrinsic ability of ATM to adjust its functioning to disturbance, so that it can sustain required operations and ensure capacity under both expected and unexpected conditions:
  - Staffing
  - Weather
  - System failures
  - Cyber-attacks
  - Other operational issues
  - Inefficiencies and high level of stress

What will Capacity on Demand deliver?
- The goal is to ensure the continuity of services and available capacity during periods of disturbance or high traffic demand by temporarily decoupling the controller working position (CWP) and the airspace served through the remote provision of air traffic services based on bilateral agreements
- In other words, the main question is how to enable horizontal one-on-one collaboration for ANSPs to let them develop their own model for resilient Air Traffic Service
In the new model, information data services could be provided by dedicated actors.

1. ANSPs who wish to keep the *current vertically integrated model* could continue to do so.

2. ANSPs *could* decide to acquire their air traffic data services from a *separate provider on a voluntary basis* (with potential incentives).

3. ADSPs should be required to be interoperable to exchange information based on European or ICAO standards.

Allowing ANSPs to freely chose its delivery model enabling the opportunity to:

- Defragment services, Foster collaboration between ANSPs and promote infrastructure rationalization
- Form alliances and/or specialised ADSP providers
- Let each ANSP decide on the delivery model best suited to their specificities
Several models could co-exist with the apparition of new delivery models for ATM data service providers.

Current model: Certain ANSPs would continue as vertically integrated provider of their own flight information services.

Alliance model: Certain ANSPs would form alliances by creating a dedicated jointly-owned entity responsible for producing and providing the needed air traffic data for their airspace (COOPANS/ITEC like model).

Separate integrated ADSPs: Certain ANSPs would transfer all their data infrastructure, systems and operations to an independent entity from which they would “buy” their air traffic data.

Specialised data service providers: Specialised data providers focus on certain parts of the “Data Service” value chain could be created through competitive entry or partial transfer of existing activities by ANSPs.

Realisation of an example of ATM data service provision model.
List of potential rewards for early movers

The goal is to reward actors who support and/or are the first to implement the change towards the new delivery models

- Incentives could be provided for airspace users to invest in SESAR related technologies by lowering en-route charges for those having installed it (for example through modulation of charges) ensuring that they pay only for services uses;

- Additionally, or alternatively, preferential ATM services could be accorded to airspace users that are equipped with SESAR technologies during a pre-determined transition phase (for example through the concept of Best Equipped Best Served).

- Promote SESAR related investments and service delivery during performance scheme implementation to support the transition;

- Allow a profit margin to be made for 1-on-1 agreement of provision of remote ATS capacity (resilient services);

- Reward the achievement of specific KPIs (e.g., cost-sharing for operational performance programme or certain investment subject to reaching certain operational or performance targets);

- Allow faster cost depreciation and decommissioning of legacy assets for actors installing new systems and services.

- European guarantees (equity or debt) could be provided for the first actors to enter the market or shift to a new delivery model (e.g., first ANSPs creating a joint ADSP);

- Direct financial support mechanisms (e.g., conditioned grants, faster depreciation of legacy assets) could be introduced to stimulate the launch of ADSPs meeting certain desired conditions (e.g., transfer of CNS infrastructure to a new ADSP entity, ADSP covering more than one State).
Preliminary impact assessment

**Assumptions from simulations**

**AS-IS**
- Traffic forecast: high-growth scenario
- All operational changes inserted in the NSP
- Deployment of PCP as scheduled
- Yearly increase of ACC capacity (+2% and +3%)

**Run 1**
- All previous features from AS-IS
- ECAC-wide cross-border FRA (2025 plus)
- Optimised airspace reorganisation
- Upward-alignment of ACC capacity to the level of current well-performing ACCs

**Run 2**
- All previous features from run 1
- Subset of SESAR 2020 solutions
- Datalink as primary mean for A/G comm (90% equipage rate)

**Results from simulations for 2035**

**AS-IS**
- Annual delay per flight of 8.5 min/flight and extension of trajectory of 7 NM
- 35 ACCs will have delays higher than 2 min/flight

**Run 1 & 2**
- Flight efficiency: potential gain of 18 NM per flight
- Average maximum theoretical sector throughput can increase from 45 flights/hour to 68 (run 1) and to 107 (run 2)

---

**AS-IS simulation in 2035**

8.5 Minutes average en-route delay per flight vs 0.9 minutes in 2017

**Full implementation of the transition plan in 2035**

0.5 Minutes average en-route delay per flight
Preliminary impact assessment

Preliminary overall results from combined analysis

<table>
<thead>
<tr>
<th>KPA</th>
<th>Impact (Order of magnitude)</th>
<th>Value € billion 2019-35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>▪ 438 million of delay minutes saved between 2019 and 2035</td>
<td>34</td>
</tr>
<tr>
<td>Environment</td>
<td>▪ 77 and 143 kg of fuel saved per flight in 2035</td>
<td>3-6</td>
</tr>
<tr>
<td>Cost efficiency</td>
<td>▪ ANS productivity gains equivalent to 57-73 € per flight in 2035</td>
<td>5-7</td>
</tr>
</tbody>
</table>

Preliminary results of the CBA analysis indicate a considerable net benefits potential of €31-40 billion (or €13-17 billion in NPV) over the 2019-2035 period.
Panel discussion & Q&A with audience: How fast will we be able to structurally solve the challenges identified?

Send your questions to the following email: communications@sesarju.eu

- Achim Baumann, Policy Director, A4E (representing the European Airspace User Community)
- Christophe Vivier, Head of Unit, Single European Sky/SESAR, EDA
- Gauthier Sturtzer, Professional Staff Organisation representative, ETF
- Iacopo Prissinotti, Head of the International Strategies Department, ENAV (representing the A6 Alliance and CANSO)
- Kari Siekkinen, NCP Chair FAB working group
- Nathalie Dejace, Head of ATM/ANS, EASA

14h30 to 15h40

1. Launch airspace re-configuration and Operational Excellence programmes to achieve quick wins
2. Realise virtual de-fragmentation of European skies
3. Create SES framework that rewards early movers
Airspace architecture study workshop
Wrap up

Florian Guillermet
*Executive Director, SESAR JU*
What’s on the table?

Proposed solutions **coupling airspace and technology** with **preliminary impact assessment**

Conditions for success and in particular to **secure the implementation timeline**

**Preliminary recommendations** to achieve quick wins, defragmentation of effort and speed up implementation
Key takeaways from today’s discussions

✔ This workshop has confirmed that we are going in the right direction

✔ In order to accelerate change, we need to start somewhere (i.e en-route airspace). Other initiatives are required resolving issues with TMA/airport capacity.

✔ The target architecture is not an alternative to the European ATM Master Plan, rather it is a wider framework that will increase the benefits of SESAR deployment.

✔ A successful transition requires cross-stakeholder commitment, strong political support and a project-management approach - This is not something that can be achieved by any one stakeholder alone.
Are preliminary recommendations confirmed?

1. Launch **airspace re-configuration** and **Operational Excellence programmes** to achieve quick wins.

2. Realise **virtual de-fragmentation of European skies**.

3. Create **SES framework that rewards early movers**.
What comes next?

Integrate workshop feedback from stakeholders → Finalise study findings → Deliver study to the European Commission

Simplified for clarity reasons
Closing words

Maurizio Castelletti

*Directorate-General for Mobility and Transport, Head of Unit Single European Sky, European Commission*