Interoperability Requirements (INTEROP)

Document information

<table>
<thead>
<tr>
<th>Document title</th>
<th>User Preferred Routing</th>
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<td>Project N°</td>
<td>07.05.03</td>
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<tr>
<td>Project Manager</td>
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<tr>
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Task contributors

NORACON, EUROCONTROL, DSNA, ENAV, THALES

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Document Status:
The 7.5.3 INTEROP is an initial draft according to the progress of operational concept definition for User Preferred Routing (OSED 7.5.3 V0.4)

For this intermediate draft, the principal objectives were: 1) translate use cases and operational scenario into a first level of Interoperability requirements 2) get a first impact of UPR on NIMS systems and sub systems 3) validate the assumptions.

Abstract
This document contains the INTEROP requirements definition for the project 7.5.3: user preferred routing. In reference of the OFA definition, this project is affected to 2 OFAS:

- OFA 03.01.01: Trajectory Framework
- OFA 03.01.03: Free route

The version is focused on planning phase interoperability requirements, the execution phase will be described in the Trajectory Framework OFA Interoperability requirements.
Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.
Table of Contents

EXECUTIVE SUMMARY ........................................................................................................................................4

1 INTRODUCTION .........................................................................................................................................5

1.1 PURPOSE OF THE DOCUMENT ...........................................................................................................5
1.2 INTENDED READERSHIP .......................................................................................................................5
1.3 INPUTS FROM OTHER PROJECTS .........................................................................................................5
1.4 ACRONYMS AND TERMINOLOGY .........................................................................................................5

2 SYSTEM DESCRIPTION ............................................................................................................................8

2.1 ASSUMPTION .........................................................................................................................................8
2.2 HIGH LEVEL DESCRIPTION AND RATIONALE OF THE SELECTED TECHNOLOGY ................................8
  2.2.1 Impact on Network Functional blocks .........................................................................................9
  2.2.2 B2B services ..................................................................................................................................12
  2.2.3 ADEXP Messages .......................................................................................................................13

3 INTEROPERABILITY REQUIREMENTS ......................................................................................................15

3.1 REQUIREMENTS FOR ATS CNS/ATM APPLICATIONS ......................................................................15
3.2 DYNAMIC FUNCTIONS / OPERATIONS ...............................................................................................15
3.3 UNIQUE CHARACTERISTICS ...............................................................................................................15

4 REFERENCES .............................................................................................................................................16

4.1 APPLICABLE DOCUMENTS ...............................................................................................................16
4.2 REFERENCE DOCUMENTS ....................................................................................................................16

APPENDIX A TRACEABILITY ....................................................................................................................17

A.1 INTEROP REQUIREMENTS TRACEABILITY .......................................................................................17
List of tables
Tableau 1 Flow exchanges ................................................................. 12
Table 2: INTEROP requirements traceability ........................................... 17

List of figures
Figure 1 FB Cooperative Airspace Management ...................................... 10
Figure 2 Data Exchanges ........................................................................ 11
Executive summary

Executive summary is informative and is an expanded version of the abstract (front page). In addition to information about the purpose, scope, and methods used, the executive summary includes the results, conclusions, and recommendations.

Executive summary should be less than one page, except for very long document (more than 100 pages) for which up to two pages can be accepted.

Executive summary must not contain abbreviations or any reference to subsequent sections in the document or to any external input documents.

Executive summary must briefly explain the method and approach used, and the results obtained.

All statements in the Executive summary should be supported by facts.

The template for SESAR INTEROP documents addresses the system level. The executive summary should clearly identify the operational service and concept elements to which Interoperability requirements apply.
1 Introduction

1.1 Purpose of the document
This is the INTEROP Step 1 document for P7.5.3 User Preferred Routing (UPR) and its purpose is to provide the interoperability requirements for the Operational Focus Area (OFA) OFA03.01.01 - Trajectory Management Framework & OFA OFA03.01.03 - Free Routing.

The concept of User Preferred Routing is part of the Network Operations concept developed by SWP7.2.

To support this services and OFA, the document covers the interoperability between an ASM tool and the different Air traffic management (ATM) systems. Because in Step 1 V3 the scope is limited to ground-ground communications, this document will define:

Interoperability requirements between an ASM tool and ATFCM systems for:
- Publication of Free Routing Airspace status
- General use of DCT in Route definition
- Flight route with DCT in Flight Planning systems

Interoperability requirements between an ASM tool and ATC systems for
- Publication of Free Routing Airspace status
- Flight route with DCT in Flight Planning systems

These requirements will be an input for system project P13.2.1.

1.2 Intended readership
The intended audience is:
- P7.5.3 Project members.
- P13.2.1 Project manager and Project members as an initial basis for the development of the tools that will support the development of prototypes to validate the User Preferred Routing operational concepts.
- SWP7.2 & SWP13.1 to assess the interoperability requirements in the most general network operation concept and in the NIMS architecture definition.
- WP7 Leader
- SJU / IS and OFA 03.01.03 leaders.

1.3 Inputs from other projects
ARN work in RNDSG. (some information in 71 on SJU extranet)

1.4 Acronyms and Terminology
To be completed if needed

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<thead>
<tr>
<th>Term</th>
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<tr>
<td>ADD</td>
<td>Architecture Definition Document</td>
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<tr>
<td>ADPEXP</td>
<td>ATS Data Exchange Presentation</td>
</tr>
<tr>
<td>ADR</td>
<td>Airspace Data Repository</td>
</tr>
<tr>
<td>AO</td>
<td>Aircraft Operator</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<td>----------------------------------------------------------------</td>
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<tr>
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<td>Airspace Management</td>
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<td>ATM</td>
<td>Air Traffic Management</td>
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<tr>
<td>B2B</td>
<td>Business To Business</td>
</tr>
<tr>
<td>CDM</td>
<td>Collaborative decision making</td>
</tr>
<tr>
<td>DCT</td>
<td>Direct</td>
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<td>DDR</td>
<td>Demand Data Repository</td>
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<td>DOD</td>
<td>Detailed Operational Description</td>
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<td>European Air Traffic Management System</td>
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<td>FDP</td>
<td>Flight Data Processing</td>
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<td>Free Route Airspace</td>
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<td>Interoperability Requirements</td>
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<td>Interface Requirements Specification</td>
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<td>OSED</td>
<td>Operational Service and Environment Definition</td>
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<tr>
<td>RAD</td>
<td>Route Availability Document</td>
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<td>RNDSG</td>
<td>Route Network Development Sub Group</td>
</tr>
<tr>
<td>SESAR</td>
<td>Single European Sky ATM Research Programme</td>
</tr>
<tr>
<td>SESAR Programme</td>
<td>The programme which defines the Research and Development activities and Projects for the SJU.</td>
</tr>
<tr>
<td>SJU</td>
<td>SESAR Joint Undertaking (Agency of the European Commission)</td>
</tr>
<tr>
<td>SJU Work Programme</td>
<td>The programme which addresses all activities of the SESAR Joint Undertaking Agency.</td>
</tr>
<tr>
<td>SPR</td>
<td>Safety and Performance Requirements</td>
</tr>
<tr>
<td>SWIM</td>
<td>System Wide Information Management</td>
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<tr>
<td>TAD</td>
<td>Technical Architecture Description</td>
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<tr>
<td>TS</td>
<td>Technical Specification</td>
</tr>
<tr>
<td>UPR</td>
<td>User Preferred Routing</td>
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</table>
2 System Description

This section provides a high level description of the selected technology for sharing information supporting the systems and applications that will be listed in the OSED.

The processes and services are not yet defined in the OSED. The INTEROP needs to be updated when this section of the OSED is mature enough.

In step 1 project 7.5.3 validation exercise will be based mainly on existing systems at network management level, or at local level Flight Data Processing (FDP) systems. No real change is foreseen in the general architecture or functional block at network level.

2.1 Assumption

To support the Interoperability between the different systems above mentioned the following assumptions have been made:

- SWIM is partially implemented and operational
- ADR is implemented
- Standards identified in this document fulfil the requirements

No interface ground / ground interface between ATC systems are defined in 7.5.3.

OSED of UPR provides operational scenario and uses cases. Based on this inputs, Ground / Ground interoperability is between:

- ASM / ATFCM systems: information about FRA, military activity inside a FRA
- ASM / ATC systems: information about FRA, military activity inside a FRA, authorized DCT, entry / exit point of the FRA
- ATFCM / AO systems: information about FRA, information about military activity, entry exit point of FRA, authorized DCT, route catalogue, preferred routing

2.2 High Level description and rationale of the selected technology

In the European ARN V-7 Concept of Operations and Catalogue of Projects (Reference document [8]) for free routing, the enablers are:

- Appropriate System Support - enhancement for the purposes of Flight Planning and ATFCM;
- Procedures – enhanced procedures where necessary for operations within Free Route airspace and at its interfaces;
- Adaptations to airspace structures;
- Adaptations to airspace management procedures.

No additional equipment requirements or flight planning procedures changes are foreseen for aircraft operators. Nevertheless, modifications to flight planning systems may be required to ensure that full benefit of the Free Route operations can be realised.

Recent evolution of NOP has provided the B2B services to external users and systems. In Step 1, at least, the B2B services used to support the data exchange between actors and systems are the current ones. It is not foreseen to develop more B2B services.

To keep a good level of interoperability, it is also necessary to keep the ADEXP messages between Network Manager and AO flight planning systems for flight plan information exchanges and for rerouting proposal information exchanges. The rationale is to allow a system update on AO side at their own rhythm at least to be able to deploy step 1 improvements.

FRA at network level has an impact on:
- ASM to indicate whether FRA is active or not and to link the FRA operation with the military activity.
- Flight Planning to retrieve and validate flight route and to manage trajectory revision in planning phase.
- Aeronautical information management to store and share the FRA and airspace availability.
- CDM process in re routing activity to adapt the route to the last known constraint at the network level.

At local level, FRA impacts FMP's tools during planning phases and ATC systems during execution phase. Execution phase is not in the scope of 7.5.3 project, nevertheless, ground – ground interoperability for free route is a crucial point in flight data exchange at system point of view and coordination at operational point of view, and some validation exercise may assess the concept during execution phase.

FMP tools for planning phase needs the airspace status information either to handle in the right way the free route, or to propose airlines changes in their flight plans according to the latest network status. Two possibilities exist for this purpose:

- Either the local tool is an extension of the regional network system (CHMI, NOP for instance),
- Either the local tool is a dedicated one, and needs a connection to the regional network ADR for airspace status and DDR for up to date flight information.

The local FMP's are strongly involved in the DCB process, and the interfaces defined for example for STAM must be compliant with the FRA concepts.

### 2.2.1 Impact on Network Functional blocks

FRA and UPR have an impact on Network Management. According to WP-13 functional block definition, the FBs impacted are:

- FB-2.01 Cooperative Capacity Planning
- FB-2.03 Cooperative Airspace Planning
- FB-2.05 Demand & Capacity Balancing
- FB-2.08 Traffic Demand Management

The FB 2-07 Network Operations Plan Management is also impacted. This FB is in charge of the NOP at regional level. The impact is limited for Step 1, as it is just to have information about FRA stored into the NOP in the AUP/UUP part, and accessible for other stakeholders.

The schema shows the data exchange inside NIMS between FB-2.03 Cooperative Airspace Management and the others FB.
Inside the Regional Network Management System, the FB "Traffic Demand Management" validates the flight plan according to the last aeronautical information available:

- RAD
- NOTAM
- CDR
- AUP / UUP

The FRA status must be known from Network Manager to perform a complete validation of the flight plan.

As the flight plan is distributed to ATC systems, the information about FRA status must be shared between all actors.
2.2.2 Data exchanges

The colours of the boxes represent the flight phases:

- Green is for a Planning phase
- Yellow is for a Both planning and execution phase
- Blue is for an Execution phase
- Red is for a post flight phase

The table hereafter details each flow of data.

<table>
<thead>
<tr>
<th>Name</th>
<th>Producer</th>
<th>Consumer</th>
<th>Phase</th>
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<td>1 Long term planning Airspace Definition – Including FRA definition &amp; RAD</td>
<td>Cooperative Airspace Management</td>
<td>DCB</td>
<td>Planning</td>
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<tr>
<td>2 Long term planning Airspace Definition – Including FRA definition &amp; RAD</td>
<td>Cooperative Airspace Management</td>
<td>NOP</td>
<td>Planning</td>
</tr>
<tr>
<td>2 AUP / UUP – including FRA status</td>
<td>Cooperative Airspace Management</td>
<td>NOP</td>
<td>Planning / Execution</td>
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### Table 1 Flow exchanges

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<td>AUP / UUP – including FRA status</td>
<td>Management</td>
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<tr>
<td>4</td>
<td>Long term planning Airspace Definition – Including FRA definition &amp; RAD</td>
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<td>5</td>
<td>Long term planning Airspace Definition – Including FRA definition &amp; RAD</td>
<td>NOP</td>
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<tr>
<td>6</td>
<td>Long term planning Airspace Definition – Including FRA definition &amp; RAD</td>
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</tr>
<tr>
<td>7</td>
<td>Flight Data Updates – radar plots, trajectory updates</td>
<td>ATC</td>
</tr>
<tr>
<td>8</td>
<td>Flight Plans Creation – Route validation by Network Operation according to latest AUP / UUP – DCT / Route Network</td>
<td>AO</td>
</tr>
<tr>
<td>9</td>
<td>CDM – Rerouting - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network</td>
<td>AO</td>
</tr>
<tr>
<td>10</td>
<td>CDM – Rerouting - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network</td>
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<td>11</td>
<td>CDM – Rerouting - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network</td>
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</tr>
<tr>
<td>12</td>
<td>CDM – Rerouting - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network</td>
<td>ATC</td>
</tr>
</tbody>
</table>

### 2.2.3 B2B services

The network B2B services in place at regional level are based on JAX-WS 2.0 specifications.

Some services are already in use, and the general principles have already been validated in operational context. Without any change in the current design and implementation of these B2B services, the idea of SESAR Step 1 is to define new services needed by the evolution of the operational concept. As the technology is already well known and well tested, adding new services should be compliant with these principles.

The major evolution is due to SWIM as major media of communication between configuration capabilities and between functional blocks.

Another advantage of using the current B2B infrastructure is to guarantee a good level of confidentiality and security.
2.2.3.1 Airspaces B2B services

The evolution of ADR will support FRA and DCT usage.

On the Network Manager web site, we read that ADR Phase I encompasses the following elements:

- electronic Airspace Management Information (e-AMI),
- the electronic Route Availability Document (e-RAD) publication,
- the Airspace Use Plan/Updated Airspace Use Plan (AUP/UUP),
- the publication of Flight Profile Restrictions (e-FPR),
- the publication of FRA/DCT and EU/EURO restrictions.

The ADR must be deployed at least in its phase 1 to allow a efficient UPR.

The B2B services allow a complete access to AUP and UUP to retrieve the latest airspace status. The AUP shall include the status of FRA and UUP shall contain the FRA status update.

2.2.3.2 Flight Services (Flight Preparation, Flight Plan Filling and Management)

Flight B2B services are used for different purpose:

- Flight Plan preparation and validation
- Flight plan management including change of route

One of the main constraints of the UPR concept is to allow direct route between entry point and exit point of the FRA.

The Entry / Exit point are published to help the transition between FRA and fixed route network airspace.

The re routing tools at regional or local level take into account status of FRA to propose to AO the most efficient route, or at least the route close as possible as to the UPR.

ARN V8 of May 2012 ([9]) details some important features of interoperability between systems to implement a real FRA concept.

The existing services associated to flight planning in step 1 are sufficient to manage publish DCT route inside a specific airspace. Nevertheless, flight planning systems and Network manager demand manager system might require further improvements to facilitate the management of complete free route airspace.

2.2.4 ADEXP Messages

The ADEXP messages are used for the communication between Network Manager, AO and ATC centre.

In UPR two aspects of ADEXP messages support the operational concept:

- Flight information exchanges
- Rerouting CDM process

For Step 1, the use of ADEXP messages is still recommended, but SESAR step 2 and SWIM achievements will allow the communication through new B2B services.

2.2.4.1 Flight Planning & Management

Flight plan messages already integrate the DCT keyword in the route description.

ADEXP already allow AO to file flight plan with direct route between published points. The example below taken from ADEXP specification ([10]) shows how to integrate DCT keyword into the ADEXP message for initial flight plan filling.

-TITLE IFPL
2.2.4.2 Rerouting CDM

During the planning phase, the re-routing CDM process relies on ADEXP format to exchange information between AO and Network.

The rerouting procedures are described in the document [11] chapter 6. All the conditions for rerouting proposal and exchanges between AO and Network manager are still valid for Free Routing or UPR.

The rerouting is activated if:

- FRA status changes because of local or regional decision
- FRA status changes because of military activity
- AO wants to avoid a congested area and wants to apply free routing to his flight

This change of trajectory during planning phase must be complaint with the general principles of trajectory management applicable to SBT management.
3 Interoperability Requirements

3.1 Requirements for ATS CNS/ATM Applications

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Requirement</th>
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<tr>
<td></td>
<td>The AUP shall include the status of FRA</td>
</tr>
<tr>
<td></td>
<td>The UUP shall include the status of FRAs</td>
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</tbody>
</table>

3.2 Dynamic functions / operations

TBC

3.3 Unique characteristics

TBC
4 References

4.1 Applicable Documents

This INTEROP complies with the requirements set out in the following documents:

1. SESAR SEMP v2.0
2. SESAR PMP 02.00.00
3. Template Toolbox 02.00.00
4. Requirements and V&V Guidelines 02.00.00
5. Toolbox User Manual 02.00.00

4.2 Reference Documents

The following documents were used to provide input/guidance/further information/other:

6. ED-78A Guidelines for Approval of the provision and use of Air Traffic Services supported by Data Communications
7. ICAO Document 9694
8. European ARN V-7 Concept of Operations and Catalogue of Projects
Appendix A Traceability

A.1 INTEROP Requirements Traceability

This section presents the traceability matrix, which identifies, for every INTEROP requirement:

- The key elements of the INTEROP requirement (reference and title);
- The functional block that the INTEROP requirement is allocated to;
- The higher level requirement that the INTEROP satisfies (reference and title).

This traceability matrix, provided by SESAR Industrial Support, enables to check the coverage.

<table>
<thead>
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</tr>
<tr>
<td></td>
<td>requirement title</td>
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</tbody>
</table>

Table 2: INTEROP requirements traceability

Note:

- The case where a "Functional block identifier" does not match an "INTEROP requirement " indicates an incomplete allocation;
- The case where a "Higher level requirement" does not match an "INTEROP requirement " indicates a possibly unjustified INTEROP requirement;
- It should also be checked that the INTEROP does indeed addresses all the higher level requirements, but by definition non covered higher level OSED and SPR requirements will not be found in the resulting INTEROP, so the analysis should be done at TAD level.