



Interoperability Requirements (INTEROP)

Document information

Project title	User Preferred Routing
Project N°	07.05.03
Project Manager	NORACON
Deliverable Name	Interoperability Requirements (INTEROP)
Deliverable ID	D03
Edition	00.00.02
Template Version	02.00.00

Task contributors

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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.

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Document History

Edition	Date	Status	Author	Justification
00.00.01	16/08/2011	Draft	██████████	Initial Draft
00.00.02	05/08/2013	Draft	██████████	Initial Draft updated with FB diagram from 13.1.1 TAD.

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This deliverable consists of SJU foreground.

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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

Term	Definition
ADD	Architecture Definition Document
ADPEXP	ATS Data Exchange Presentation
ADR	Airspace Data Repository
AO	Aircraft Operator

Term	Definition
ARN	ATS Route Network
ASM	Airspace Management
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
B2B	Business To Business
CDM	Collaborative decision making
DCT	Direct
DDR	Demand Data Repository
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
FDP	Flight Data Processing
FRA	Free Route Airspace
INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
OFA	Operational Focus Areas
OSED	Operational Service and Environment Definition
RAD	Route Availability Document
RNDSG	Route Network Development Sub Group
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements
SWIM	System Wide Information Management
TAD	Technical Architecture Description
TS	Technical Specification
UPR	User Preferred Routing

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 re routing 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 others stakeholders.

The schema shows the data exchange inside NIMS between FB-2.03 Cooperative Airspace Management and the others FB.

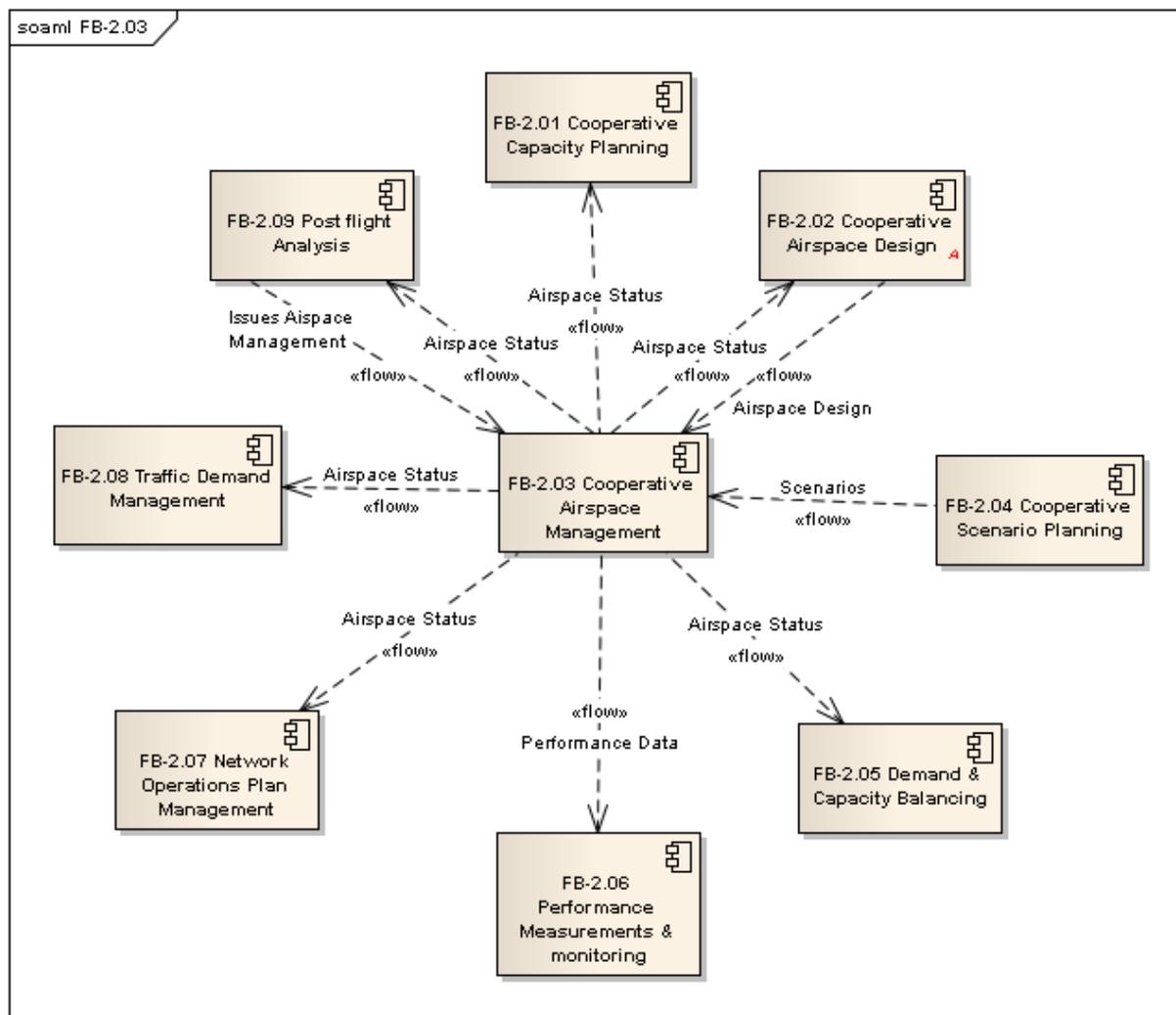


Figure 1 FB Cooperative Airspace Management

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

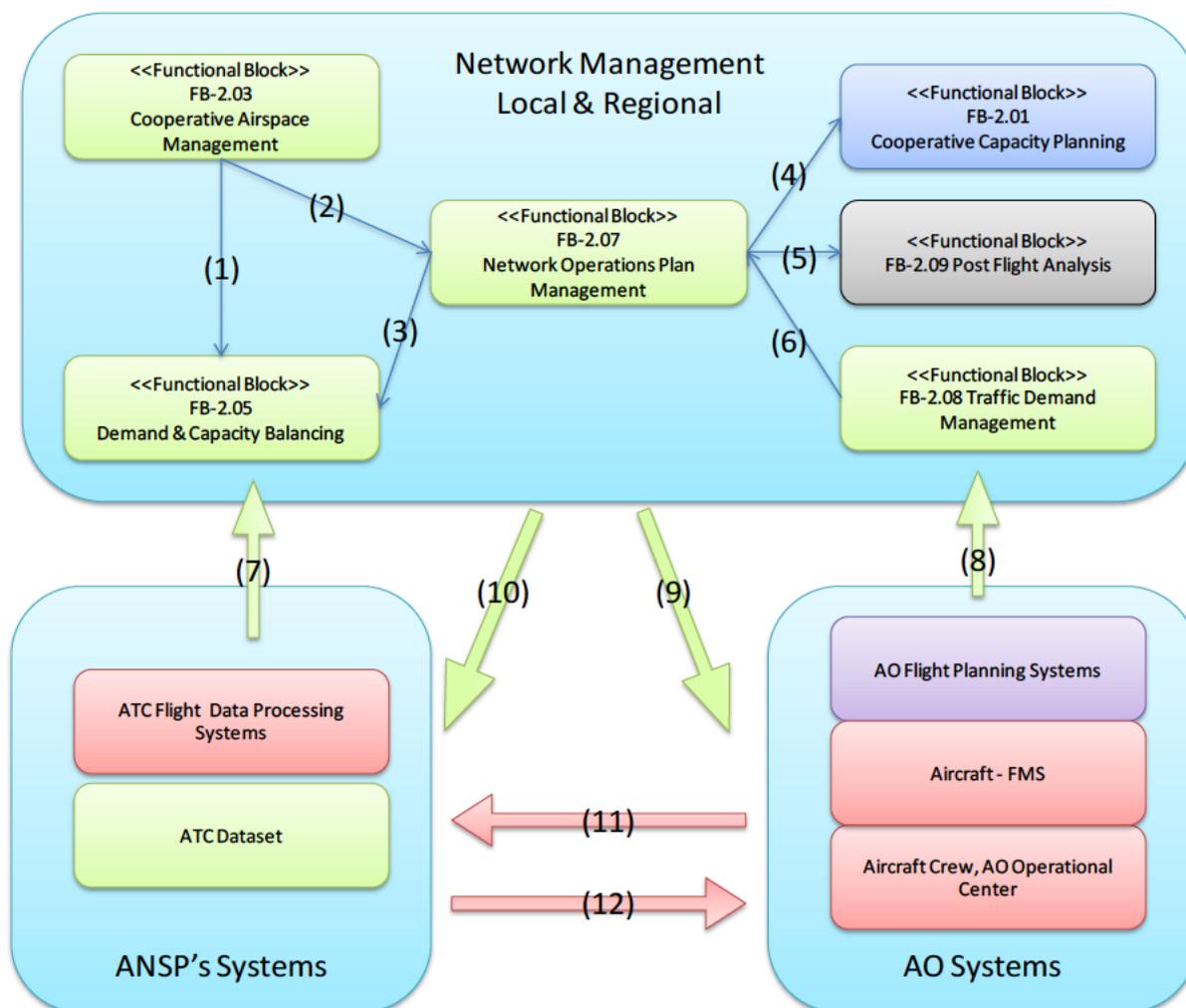
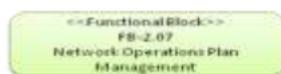


Figure 2 Data Exchanges

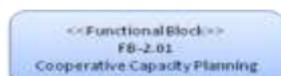
The colours of the boxes represent the flight phases:



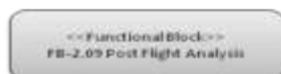
is for a Execution phase



is for a both planning and execution phase,



is for a planning phase



is for post flight phase

The table here after details each flow of data.

	Name	Producer	Consumer	Phase
1	Long term planning Airspace Definition – Including FRA definition & RAD	Cooperative Airspace Management	DCB	Planning
2	Long term planning Airspace Definition – Including FRA definition & RAD	Cooperative Airspace Management	NOP	Planning
2	AUP / UUP – including FRA status	Cooperative Airspace	NOP	Planning / Execution

		Management		
3	AUP / UUP – including FRA status	Cooperative Airspace Management	DCB	Planning Execution
4	Long term planning Airspace Definition – Including FRA definition & RAD	NOP	Cooperative Capacity Planning	Planning
4	AUP / UUP – including FRA status	NOP	Cooperative Capacity Planning	Planning
5	Long term planning Airspace Definition – Including FRA definition & RAD	NOP	Post Flight Analysis	Post Flight
5	AUP / UUP – including FRA status	NOP	Post Flight Analysis	Post Flight
6	Long term planning Airspace Definition – Including FRA definition & RAD	NOP	Traffic Demand Management	Planning
6	AUP / UUP – including FRA status	NOP	Traffic Demand Management	Planning Execution
9	AUP / UUP – including FRA status	NOP	AO	Planning Execution
9	Long term planning Airspace Definition – Including FRA definition & RAD	NOP	AO	Planning
10	Long term planning Airspace Definition – Including FRA definition & RAD	NOP	ATC	Planning
10	AUP / UUP – including FRA status	NOP	ATC	Planning Execution
7	Flight Data Updates – radar plots, trajectory updates	ATC	Network Management	Execution
11	ATC coordination – DCT	AO (pilot)	ATC	Execution
12	ATC coordination - DCT	ATC	AO (pilot)	Execution
8	Flight Plans Creation – Route validation by Network Operation according to latest AUP / UUP – DCT / Route Network	AO	Network Management	Planning
8	Flight Plan Management - Route validation by Network Operation according to latest AUP / UUP – DCT / Route Network	AO	Network Management	Planning
8	CDM – Rerouting - - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network	AO	Network Management	Planning Execution
9	CDM – Rerouting- - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network	Network Management	AO	Planning Execution
10	CDM – Rerouting- - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network	ATC	Network Management	Execution
11	CDM – Rerouting- - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network	AO	ATC	Execution
12	CDM – Rerouting- - Route proposal + validation by Network Operation according to latest AUP / UUP – DCT / Route Network	ATC	AO	Execution

Table 1 Flow exchanges

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

```
-ROUTE N0448F370 DCT LIFFY UL975 WAL UM16 DOLAS UL603 LAMSO DCT
-BEGIN RTEPTS
-PT -PTID EIDW
-PT -PTID LIFFY
-PT -PTID GINIS
-PT -PTID NATKO
-PT -PTID LYNAS
-PT -PTID ROLEX
-PT -PTID *1ROL
-PT -PTID MALUD
-PT -PTID WAL
-PT -PTID MCT
-PT -PTID DISAL
-PT -PTID NAPEX
-PT -PTID DOLAS
-PT -PTID ENITO
-PT -PTID DIBAL
-PT -PTID BUKUT
-PT -PTID LAMSO
-PT -PTID EHAM
-END RTEPTS
-DCT EIDW LIFFY
-ATSRT UL975 LIFFY WAL
-ATSRT UM16 WAL DOLAS
-ATSRT UL603 DOLAS LAMSO
-DCT LAMSO EHAM
```

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 re routing 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

Identifier	
Requirement	The AUP shall include the status of FRA

Identifier	
Requirement	The UUP shall include the status of FRAs

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
- [9] European Route Network Improvement Plan ARN Version-8 Catalogue of Airspace Projects Edition 1.1 – 21st May 2012.
- [10] EUROCONTROL Specification for ATS Data Exchange Presentation (ADEXP) – Eurocontrol – Edition 3.1 – October 2011
- [11] ATFCM Users manual – Eurocontrol – Edition 16.0 – Feb 2012

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.

INTEROP Requirement		Satisfied requirement		
Reference	Title	Functional block that the requirement is allocated to	Identifier	Title
INTEROP requirement reference	INTEROP requirement title	Functional block identifier	Satisfied OSED or SPR higher level requirement identifier	Satisfied OSED or SPR higher level requirement title

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.

- END OF DOCUMENT -