ENAV

QUALITY MANAGEMENT SYSTEM

SGQ-L-AT.I.2-03/D03 AMAN Technical Specifications

Area Tecnica

Procurement and Integration of a Support Tool for Arrival Sequencing on Major Airports (Arrival Manager)

Technical specification

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1 DATA CONFIDENTIALITY

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2 INTRODUCTION

2.1 PURPOSE AND CONTENTS OF THE DOCUMENT

The present document identifies "Technical Specification of Procurement and Integration of a Support Tool for Arrival Sequencing on Major Airports (Arrival Manager)" project that aims to put into operations AMAN Tool in the SATCAS environment.

2.2 CONTEXT OF THE PROGRAM

The Program is articulated in terms of the implementation phases of the functionality provided by the PCP, with particular reference to *ATM Functionality 1 (AF1 – Extended AMAN and PBN in high density TMAs)*. The main objective is to provide an incremental approach for the integration of AMAN in SATCAS through an external dedicated AMAN HMI, in ROMA and MILANO ACC's, with subsequent integration in CWP within the 4-Flight program.

2.3 APPLICABLE DOCUMENTS

[1] AMAN Technical/Operational Requirements ENAV 31/07/2014

[2] ICAO DOC 4444 PANS ATM parte messaggi ATS

[3] ISO 27001:2005

[4] Regulation (EC) N.482/2008

[5] Regulation (EC) N.1035/2011

[6] Regulation (EC) N.552/2004

[7] Regulation (EC) N.1033/2006

[8] Regulation (EC) N.1206/2011

[9] Regulation (EC) N.929/2010

[10] Regulation (EC) N.633/2007

[11] Regulation (EC) N.30/2009

[12] Regulation (EC) N.1032/2006

[1] Regulation (EC) N.29/2009

[13] Regulation (EC) N.1032/2006

[14] Regulation (EC) N.1079/2012

[15] Spec-0107 Edition 3.1 - EUROCONTROL Specification for ATS Data Exchange Presentation (ADEXP)

[16] Spec-0100 Edition 2.0 - EUROCONTROL Specification of Interoperability and performance requirements for the Flight Message Transfer Protocol (FMTP)

[17] Spec-0106 Edition 4.2 - EUROCONTROL Specification for On-Line Date Interchange (OLDI)

[18] Spec-0101 Edition 1.1 - EUROCONTROL Specification for the Initial Flight Plan

3 ACRONYMS LIST

Acronym	Definition
ABI	Advance Boundary Information
ACC	Area Control Center
ATA	Actual Time of Arrival
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
APP	Approach Control (Office)
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
BADA	Base of Aircraft Data
CAS	Calibrated Airspeed
CTA	Controlled Time of Arrival
DMAN	Departure Manager
ETA	Estimated Time of Arrival
ETFMS	Enhanced Tactical Flow Management System
ETO	Estimated Time Over
ETOT	Estimated Take-Off Time
EXIT	Estimated Taxi In Time
FCFS	First Come First Served
FDP	Flight Data Processing
FIR	Flight Information Region
FL	Flight Level
FLS	Flight Suspension
FMS	Flight Management System
FPL	Flight Plan
GND	Ground Control
IAF	Initial Approach Fix
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organization
HMI	Human Machine Interface

LAT	Look-Ahead Time
LoA	Letter of Agreement
LVP	Low Visibility Procedures
NM	Nautical Miles
OLDI/AIDC	On-Line Data Interchange / ATS Interfacility Data Communication
OTP	On-time Performance
PBN	Performance Based Navigation
PCP	Pilot Common Project
PMS	Point Merge System
RBT	Reference Business Trajectory
RNAV	Area Navigation
RTA	Required Time of Arrival
RWY	Runway
SESAR	Single European Sky ATM Research
SID	Standard Instrumental Departure Route
SSR	Secondary Surveillance Radar
STAR	Standard Arrival Route
TMA	Terminal Manoeuvring Area
TSAT	Target Start-Up Approval Time
TTG	Time To Gain
TTL	Time To Lose
TTA	Target Time of Arrival
TTO	Target Time Over
TTOT	Target Take-Off Time
TWR	(Aerodrome Control) Tower
UTC	Universal Time Coordinated
WTC	Wake Turbulence Category

Table 1: Acronyms list

4 GLOSSARY

Terms	Description
AMAN Runway	Landing runway proposed by AMAN
Correlated Flight	A flight which is linked to a radar track.
Flight in deviation	FDP shall consider a flight as in deviation when the difference between the current position of the aircraft and the predicted one is greater than an off-line configurable threshold (e.g. 10NM for lateral deviation, ±300ft (non RVSM) e ±200ft (RVSM) between C-Mode and CFL for vertical deviation).
Flight Plan Status	• PENDING: flight plan pre-activated by FDP without departure/entrance clearance; • ACTIVE : flight plan with departure/entrance clearance but not yet owned by any sector; • LIVE: flight plan that has been reported at least on one fix; • CONTROLLED: ACTIVE or LIVE flight plan that owned by a sector.
Geographical Volume	Airspace with defined dimension. A logical sector is defined with the aggregation of one or more geographical volumes.
Logical Position	It is the set of EXE and PLN operating on the same geographical volumes
Logical Sector	It is the combination of one or more geographical volumes controlled by the same logical position.
Multi Sector Planner	It is a Logical Position consisting of only 1 PLN and 2 different EXE where the geographical volumes controlled by PLN are the union of geographical volumes controlled by each EXE.

Table 2: Glossary

5 REQUIRED PROVISION

The project will be articulated with a preliminary phase of system design which shall establish and eventually refine the user requirements expressed in this document. After completion of this phase, validated by a critical design review, several steps will follow including implementation, integration and validation of the new system, up to the final phase of put into operation.

List of the main activities to be executed:

1. System design
2. Hardware procurement
3. System customization
4. FAT
5. Integration Plan
6. Integration in PSA rooms
7. Integration in Simulation rooms
8. Integration in OPS rooms
9. SAT
10. Support to operational validation and certification
11. Operational and technical training
12. Put into operation
13. Support to operational start
14. Updating of SW configuration management tool
15. Documentation provision
16. Spare Parts provision

In addition a tentative planning will be provided at the end of this section.

6 ACTIVITIES DESCRIPTION

6.1 SYSTEM DESIGN

System design activity shall be articulated in the following subtasks:

- Project definition
- Architectural definition (data and interface specification)
- Transition plan

A preliminary phase called "Project Definition" shall be foreseen to analyze and go deeper into the requirements expressed in the present document and, together with ENAV, get a common level of understanding.

An important activity of Project Definition will concern HMI definition. Such an activity is expected to be quite complex since it involves the introduction of new operational concepts and procedures. In this process, a key factor will be a strict collaboration between ENAV and industry to identify HMI without leaving open points or misunderstandings. In order to get precious and punctual requirements, it is expected by ENAV to proceed with an activity of HMI prototyping to define together with industry all the aspects concerning the interactions of controller with the system.

Technological prototyping tools to support this activity can be proposed by industry and then validated by customer.

The basic principle which shall drive the architectural design is the concentration of adaptations of AMAN in very few components to interface SATCAS environment (SA-ADPTER), whose interface specification will be provided by ENAV to Suppliers during Project Definition Phase. The goal is to make feasible and cost-effective the future integrations (4-FLIGHT platform) with new elements in case of substitution of one of the components.

In the following figures a high level architectural scheme is proposed to make the concept just mentioned more comprehensive.

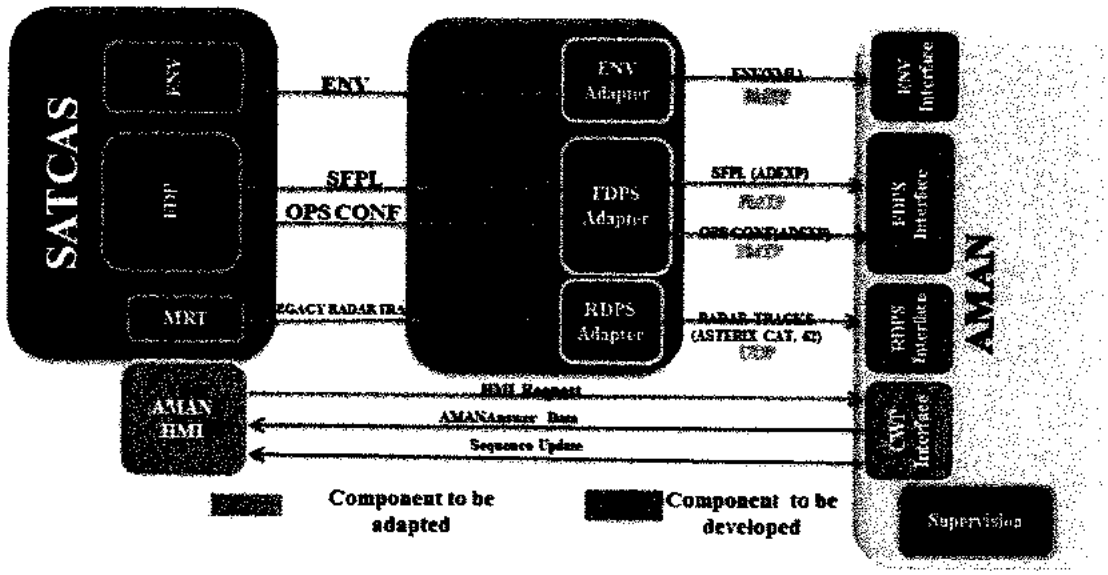

Figure 1: Architectural schema of AMAN integration in SATCAS

In the implementation of such activity, SATCAS system design shall be taken into account with all the actual interfaces with internal and external sub-systems.

In particular the definition of architecture shall consider the results produced by safety analysis: FHA (Functional Hazard Assessment) and PSSA (Preliminary System Safety Assessment)/SSA (System Safety Assessment) and also consider the applicable regulations about interoperability (rule 552/04) of EATMS components.

To ensure a robust fault-tolerant of the new HW/SW components which will be integrated in the existing ATM architecture, a redundant HW architecture is expected and also a proper software mechanism to deal with critical situations shall be foreseen.

Finally one of the tasks of this work-package will be the definition of transition plan which takes into account the following aspects:

- Foresee an initial period of training of the ATCOs with the new system in a simulation environment
- Foresee a period of shadow mode trials, to be performed in PSA , in which ATCOs can perform a meaningful training with real traffic data.
- Make easy and with very few risks the roll-back from AMAN disconnection.

As mentioned in the previous chapter, system design activity will be subject to a validation phase (Critical Design Review) that shall be passed to continue the following steps of the program.

Input

- Technical Specification document
- SA-ADAPTER Interface Control Document
- Risk Assessment Report (RAR)

Output

- SSS, IRS and SSDD documents
- HMI detailed requirements document
- Architecture Plan

6.2 HARDWARE PROCUREMENT

Industrial suppliers shall proceed to hardware procurement taking into account the architecture plan elaborated in the system design phase.
Different types of HW configuration are distinguished:

- **AMAN full platform** which foresees an adequate number of computers in cluster and redundant configuration sized to manage real traffic data for OPS Rooms
- **AMAN light platform** which foresees a limited number of computers to manage functional test activities in PSA Rooms.
- **AMAN reduced platform** which foresees a limited number of computers to manage training activities in Simulation Rooms.

Equipment list to be procured shall cover the following configurations:

- **AMAN full platform** for ROMA ACC
- **AMAN full platform** for MILANO ACC
- **AMAN reduced platform** for each ACC's Simulation Room
- **AMAN light platform** for ROMA and MILANO PSA
- **AMAN reduced platform** for each ENAV ACADEMY Simulation Room
- **AMAN clients** for all 4 ENAV ACC's

The envisaged AMAN Clients positions, each configurable as full power or read only, are listed in the following table:

Site	OPS	PSA	SIMU
MILANO	21+1	2 +1	4+1
ROMA	24+1	2+1	8+1
PADOVA	Up to 13+1	-	4+1
BRINDISI	Up to 6+1	-	4+1
ENAV Academy	-	-	8+1

Table 3: Aman Positions

The added positions in the above table indicate the provision of at least one AMAN Technical Supervision position on each room.

This program doesn't include any equipment needed by suppliers to set up their own test bed platform to be used in factory premises during development and debugging phase.

According to the hardware equipment so defined, industry shall identify and procure also the necessary base software (e.g. database management, operating system, etc..) for the correct working of the system.

Input

- SSS, and SSDD documents
- Architecture Plan

Output

- HW and base SW provision
- HW e base SW technical documentation

6.3 SYSTEM CUSTOMIZATION

This activity follows the system design phase and shall take into account the results produced by that work-package.

All the new HW/SW components foreseen in the architecture shall be customized and documented according to the safety levels determined in PSSA/SSAS.

For all foreseen activities concerning new SW components, ENAV will apply the current policies regarding SW documentation (e.g. SRS, SDD, STD) and SW intellectual properties rights.

In details the expected sub-tasks for this activity are the following:

- Production of software requirements for all new CSCIs
- Production of software detailed design for all new CSCIs
- Production of software test procedures for all new CSCIs
- Production of software source code for all new CSCIs
- Software verification activities (Unit tests, CSCI's test and integration tests)
- Update of User Handbook

Industrial provider shall use an own HW/SW platform to perform software verification activities. Such platform may be composed by a minimal set of equipment to execute properly functional tests.

Any tool (simulation and stimulation) may be used in order to make easier, more efficient and rigorous such verification activities, especially in an early phase of testing, when some input data flow may be missing and whence it is necessary to proceed with simulated data properly generated.

As far as performance and capacity aspects concern, they shall be verified in the operational platforms installed on ACC sites.

Input

- SSS, IRS and SSDD documents
- Critical Design Review Report

Output

- SRS documents (only for CSCI owned by ENAV)
- STD and STR (for factory test)
- SW released (executable files, libraries, JAR, etc.)
- Deployment Plan Document

- User Handbooks
- Technical Handbooks

6.4 FAT

Factory Acceptance Test represents an initial formal process of new system verification. It shall occur in Supplier premises or in any other location negotiated during Project Definition Phase with ENAV.

FAT's shall run in a test bed with a reduced hardware platform that can ensure all the functional tests. All the procedures specified in STD shall be run successfully and the positive responses shall be reported in STR.

Input

- STD

Output

- STR

6.5 INTEGRATION PLAN

On site activities at ROMA and MILANO ACC's shall be scheduled according to the following time order:

1. Deploy of Pre-Operational testing Environment (PSA) of **Full Platform/Clients.**
2. Deploy in SIM environment of **Reduced Platform/Clients.**
3. Site Acceptance Tests (SAT) in Pre-Operational testing Environment(PSA) with life and simulated traffic including reliability tests **Full Platform/Clients**
4. Deploy in OPS environment of **Full Platform/Clients.**
5. Support for Transition Plan to OPS environment – "Ready for operation" with **Full Platform/Clients.**

On site activities at PADOVA and BRINDISI ACC's shall be scheduled according to the following time order:

1. Deployment in SIM environment of **Reduced Platform/Clients.**
2. Site Acceptance Tests (SAT) in SIM/PSA environment with life and simulated traffic including reliability tests of **Reduced Platform/Clients**

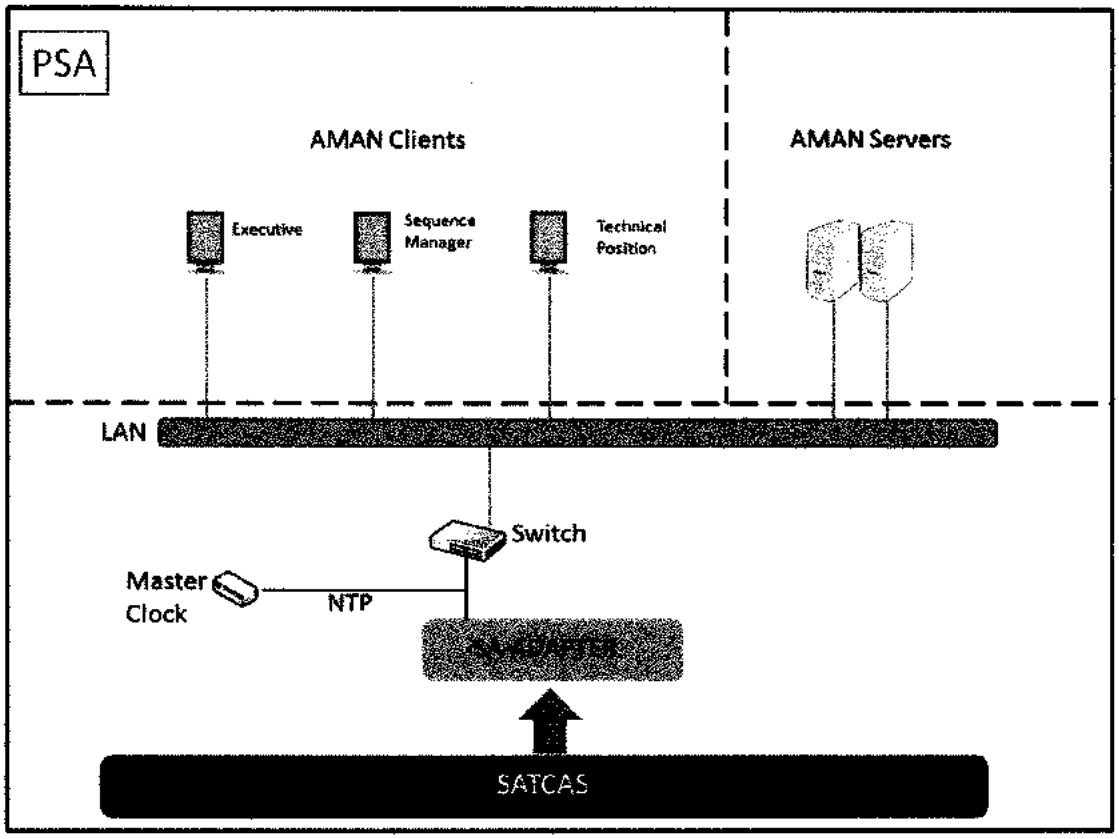

Figure 2: Platform schema in PSA

Input

- SW released (executable files, libraries, JAR, etc.)
- Deployment Plan Document

Output

- None

6.7 INTEGRATION IN SIMULATION ROOMS

The aim of this activity is the training of the ATCOs with the new operational procedures introduced by AMAN tool.

Suppliers shall install an HW/SW platform, ENAV ACADEMY included, in a reduced configuration which shall be fed with simulated traffic data.

AMAN shall be able to manage extended geography (2 ACC aggregated) and to be configured for different TMA's.

ATRES system (Techno Sky's simulation platform) shall be used as tool of ATM traffic generator to create operational scenarios with coherent and controlled data and with expected output results.

Suppliers shall provide Network and Power Supply needs in order to be connected on existing infrastructure.

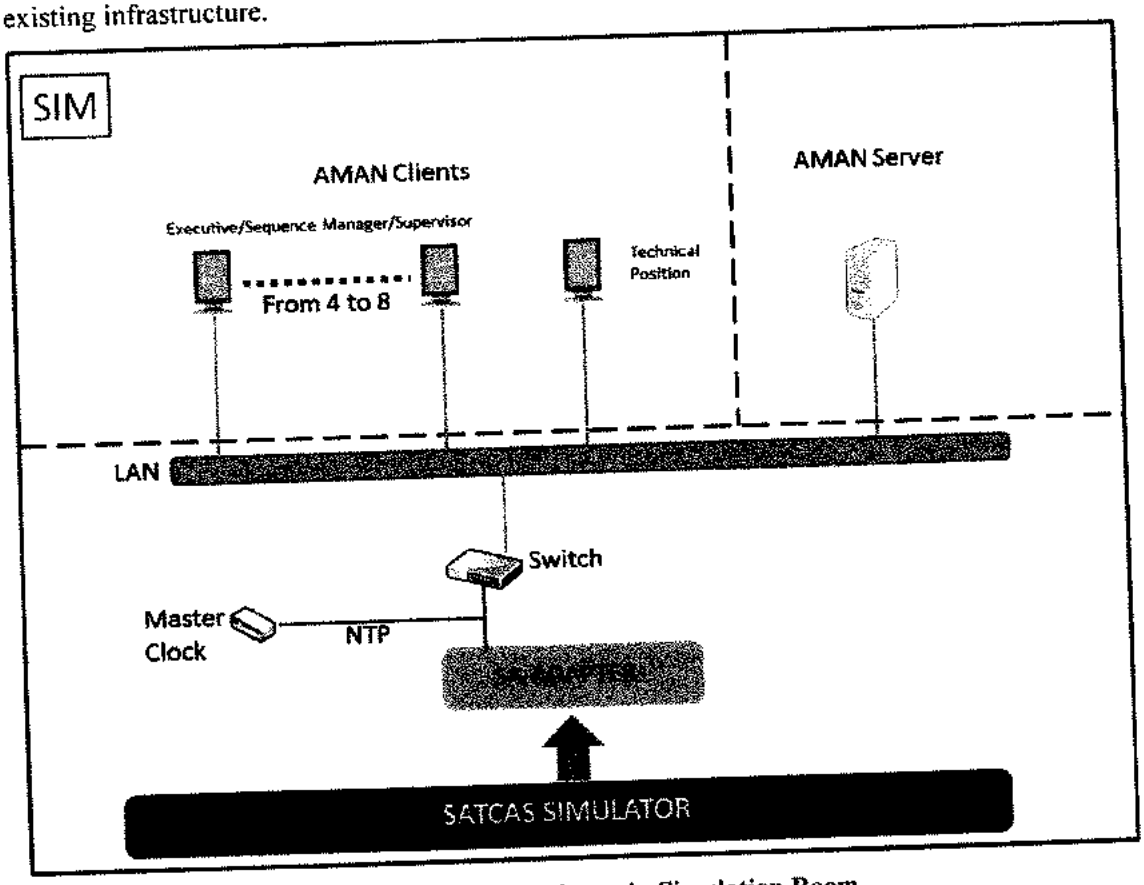

Figure 3: Platform schema in Simulation Room

Input

- SW released (executable files, libraries, JAR, etc.)
- Deployment Plan Document

Output

- None

6.8 INTEGRATION IN OPS ROOMS

The aim of this activity is the validation ad operational exploitation of all the implemented functionalities in the system inside an Operational Environment. Suppliers shall install an HW/SW platform in complete configuration (redundant cluster) which shall be fed with operational live traffic data. In addition Suppliers shall install client HW/SW in remote Operational Environments connected via E-Net (WAN).

Suppliers shall provide Network and Power Supply needs in order to be connected on existing infrastructure.

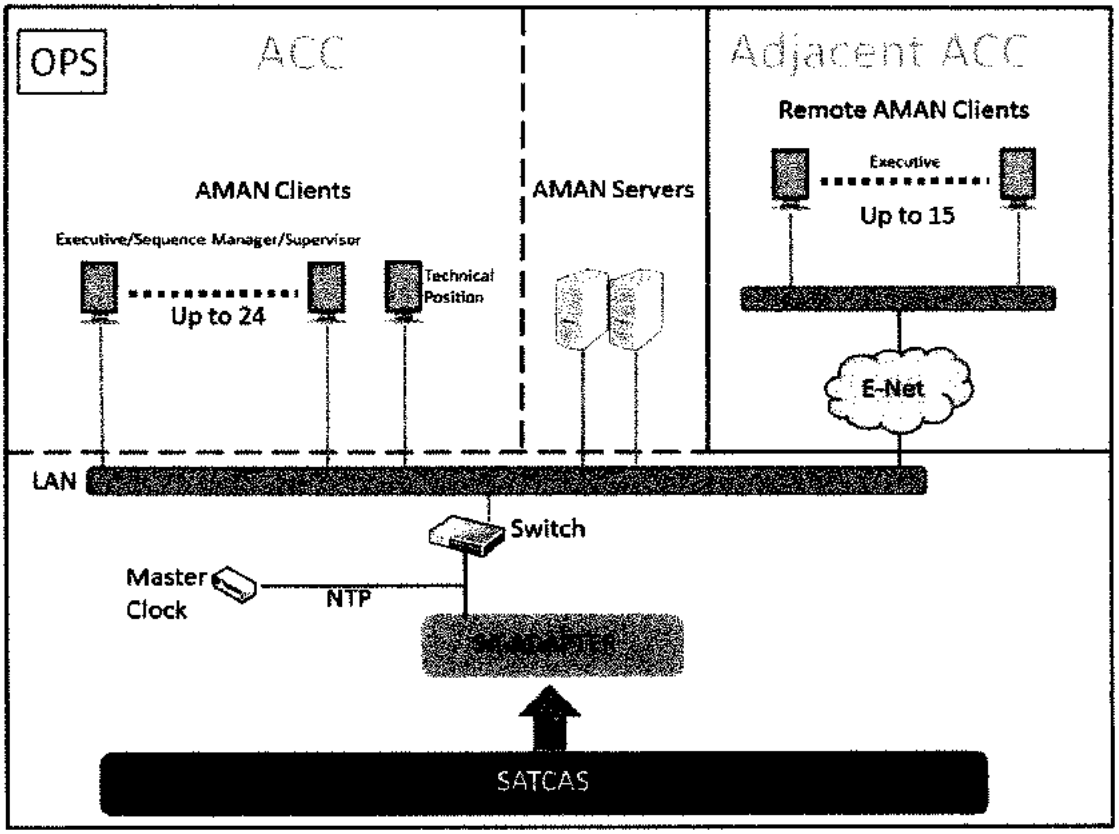

Figure 4: Platform schema in OPS Room

Input

- SW released (executable files, libraries, JAR, etc.)
- Deployment Plan Document

Output

- None

6.9 SAT

Site Acceptance Test represents the formal process of new system verification.

SAT shall occur in each PSA/SIMU of the 4 Italian ACC's and ENAV ACADEMY, and shall run on the operational hardware platform to ensure the proper verification of both functional tests and performance/capacity tests. All the procedures specified in ATP Document shall be run successfully and the positive responses shall be reported in ATPR document.

ENAV could run also additional free tests to verify some particular conditions that are not covered in the Acceptance test procedures.

Input

- ATP (Acceptance Test Procedures)

Output

- ATPR (Acceptance Test Procedures Report)

6.10 SUPPORT TO OPERATIONAL VALIDATION AND CERTIFICATION

This work-package will consist in the necessary support that industry shall provide to ENAV in the activities of operational validation and certification, just before "Ready for Operation".

By means of simulation platform, ENAV will run all the validation scenarios with proper sessions of real time simulation. It will be in charge of ENAV the definition of these scenarios and the preparation shall be performed with a proper industry support. A final phase of validation shall be foreseen in which new functionalities may be tested in shadow mode.

6.11 OPERATIONAL AND TECHNICAL TRAINING

Suppliers shall ensure the provision of training course for operating personnel according to the following guidelines:

- Headquarters: ROMA ACC, PADOVA ACC, MILANO ACC, BRINDISI ACC, ACADEMY;
- Addresses : Operational staff;
- Topics:
  - New methods and operating procedures for AMAN ;
  - AMAN Operational Configuration;

Suppliers shall indicate how these courses will be provided in terms of duration and number of sessions.

Suppliers shall ensure the provision of training course for technical personnel according to the following guidelines:

- Headquarters: ROMA ACC, PADOVA ACC, MILANO ACC, BRINDISI ACC, ACADEMY;
- Addresses: technical personnel;
- Topics: AMAN Operational Configuration ;
  - Installation and maintenance of AMAN system;
  - AMAN software configuration;
  - AMAN Tool Start-up and Stop;

Suppliers shall indicate how these courses will be provided in terms of duration and number of sessions.

6.12 PUT INTO OPERATION

According to the transition plan , Suppliers shall perform all the actions necessary to put new system into operations, in strict cooperation with ENAV personnel.

In case of system faults or any other unforeseen malfunction could affect the new system run, Suppliers will put in place all the measures already planned within the transition strategy in order to revert back to a normal operation scenario.

New system shall be put into operation in :

- ROMA ACC
- MILANO ACC

In addition AMAN SIM shall be put in operation in ENAV ACADEMY.

In addition AMAN clients positions shall be put into operation in BRINDISI and PADOVA ACC's to receive and display AMAN information provided by AMAN installed in ROMA ACC and/or MILANO ACC.

6.13 SUPPORT TO OPERATIONAL START

Suppliers shall ensure the provision of personnel necessary to guarantee an adequate hourly assistance, for a period of at least 10 days.

Suppliers shall estimate, in technical proposal, the man/days and the number of daily hours of staff presence on the required sites. Each proposal will be still subject to evaluation by ENAV.

6.14 UPDATE OF SW CONFIGURATION MANAGEMENT TOOL

Suppliers shall make available all the elements that allow the identification and classification of new or modified SW components in this program, to be properly handled in ENAV SW configuration management tool.

6.15 DOCUMENTATION

Suppliers shall produce all the documentation required by current legislation. Suppliers shall, in particular, produce the following documents:

- **Project Management**
  - **PMP** (Project Management Plan)
  - **V&VP** (Verification and Validation Plan)
- **Technical**
  - **SSS** (System Subsystem Specification) for acceptance;
  - **SSDD** (System Subsystem Design Document) for acceptance;
  - **SRS** (Software Requirement Specification);
  - **IRS** (Interface Requirement Specification)
  - **SDD** (Software Design Document);
  - **STD** (Software Test description) for acceptance;
  - **STR** (Software Test Report);
  - Deployment Plan Document
  - Graphic work (horizontal and vertical wiring, canalization, plan, layout positioning devices, wiring diagram etc.),

- As-Built ;
- User Manual and technical management manual;
- **ESA.**

In relation to modifications on SW already owned by ENAV, or new SW developments for which ENAV shall acquire intellectual property rights (IPR), all the documentation shall be provided, in particular:

- **Development environment** (Script, Libraries, etc);
- **Source Code.**

Otherwise Suppliers shall release to ENAV SW Licenses.

Suppliers shall respect and produce the documentation required by EC Regulation no. 482/2008 of the Commission of 30 May 2008 establishing a system of software safety assurance, mandatory for air navigation services providers and respecting the requirements from Eurocontrol 'ESARR 6' Software in ATM systems'.

Suppliers shall provide all project documentation necessary to implement Regulation EC 552/2004 on " Interoperability 'of the European Network of Air Traffic Network.

6.16 SPARE PARTS

The Technical Proposal shall contain a specific logistics study for the spare parts optional supply. This study shall be elaborated on the basis of the following parameters / elements:

- Population of the modules to be delivered;
- MTBF (Mean Time Between Failure);
- System redundancies;
- Any item of "single point of failure";
- Probability of sufficiency equal to 95%;
- Logistics Horizon equal to 24 months.

In particular, the logistics study shall consider that ENAV has a management service for spare parts on national scale, so Suppliers, shall consider, for the constituent parts of "single point of failure", a probability of sufficiency equals to 95% per single system, while for the redundant parts, the probability of sufficiency shall be considered in terms of the overall population of the modules.

According to the above instructions, Suppliers shall include in the technical proposal, the list of spare parts deemed necessary in support of the systems to be delivered.
The list shall contain, for each proposed article, the following data:

- Part Number;
- Description item;
- MTBF;
- Unit price;
- Proposed quantity;
- Applicability;
- Time of delivery.

ENAV, on the basis of the proposed study, will develop the final sizing of spare parts to be acquired, also according to the inventory already in place at its stores and its logistics and, if necessary, it will activate the option.

6.17 PLANNING

The program is foreseen to finish in the time frame October 2016 – March 2017 and in order to fit this specific constraint a tentative planning is shown below:

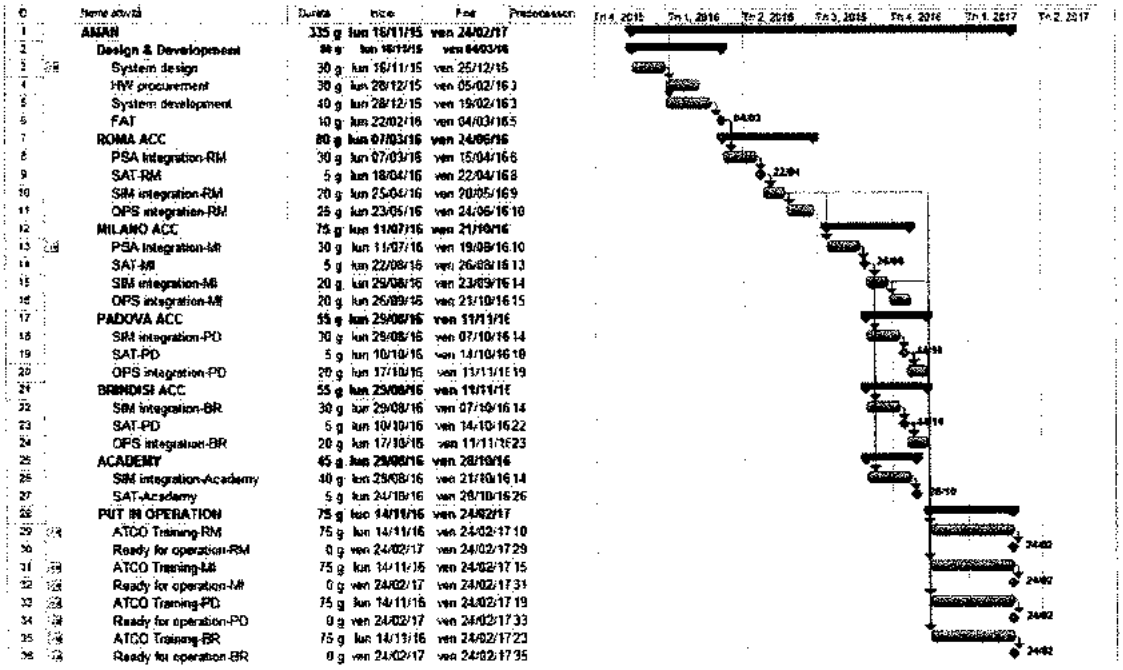

Figure 5: Tentative GANTT

7 SYSTEM REQUIREMENTS

The functionalities required in this Technical Specification must be implemented in compliance with the requirements listed below, as well as represented, even though implicitly, in other sections of this document.

In general, all the requirements expressed here shall not be understood as a limitation with respect to the best achievable functional and technological solution. Suppliers are free to propose alternative solutions providing what is requested with respect to maximum safety of ATC service and proposed system reliability.

Suppliers shall ensure that non-regression , relatively to FDPS and RDPS interface, shall be satisfied with respect to the baseline of legacy system, at the moment of the SW release developed in the context of the program.

7.1 GENERAL

R-GEN-0010 All activities that will take place at the affected sites shall be approved and coordinated with the ENAV site responsible.

R-GEN-0020 The suppliers shall release all the project documentation as requested by this Technical Specification Document.

R-GEN-0030 The technical documentation shall be provided in three paper copies and one copy on CD ROM support.

R-GEN-0040 The released documentation shall allow the requirements traceability through a proper table which shall be compiled during the project collecting all the functional, not functional and operational requirements.

R-GEN-0050 Safety analysis shall be carried out concerning required interventions; the impact of such interventions shall be evaluated by applying SAM methodology

currently used in ENAV, which is in line with the directives and international regulations (ESARR 4).

R-GEN-0060 The suppliers shall produce and release all the required project documentation to transpose the EC Regulation 552/2004 on the Interoperability of European Air Traffic Management Network.

R-GEN-0070 The suppliers shall produce and release all the required project documentation to transpose the EC Regulation 482/2008 entered into force at 30th of May 2008 (EUROCONTROL ESARR6).

R-GEN-0080 The project shall be realized according to the quality standards current applied in ENAV – SGQ (Sistema di Gestione della Qualità conforme alla Normativa ISO 9001:2008) also as regards reporting and documentation.

R-GEN-0090 Suppliers shall have a Quality Management System conformal to ISO 9001:2008 rules.

R-GEN-0100 The project shall be represented and described, in its different phases, by a detailed development plan with WBS and GANTT schemas.

R-GEN-0110 The project shall be furnished with an exhaustive test and functional validation plan.

R-GEN-0120 Installation, integration, experimentation and system validation shall be coordinated with the site manager to avoid interferences with the operational activities.

R-GEN-0130 A proper technical documentation set shall be produced specifying the hardware equipment set-up, SW installation and activation procedures, and user manuals.

R-GEN-0140 All the needs expressed informally in the context of this document shall be considered as user requirements.

R-GEN-0150 Any misunderstandings about needs expressed by ENAV in this document shall be overcome through a strict collaboration with ENAV during the initial phase of the project before the SSDD consolidation.

R-GEN-0160 A Project Definition Phase will take place at Customer's premises, at the beginning of the Project, between Customer and Suppliers representatives in order to fully clarify and define the user requirements which may be considered not completely clear.

R-GEN-0170 In order to accomplish HMI requirements, during an initial Project Definition Phase, a HMI prototype will be developed in cooperation between the Customer and the Supplier. HMI customization will be based on the results of the agreed prototypes.

7.2 ARCHITECTURAL REQUIREMENTS

R-ARC-0010 Suppliers shall interface SATCAS environment through specific components that translate SATCAS and ATRES output to specific AMAN input.
Both interface specifications will be provided by ENAV to Suppliers during Project Definition Phase.

R-ARC-0020 Suppliers shall develop the following components:

- ENV Interface, FDPS Interface, RDPS Interface.

R-ARC-0030 Suppliers shall adapt a specific CWP Interface in order to supply the subsequent integration in CWP of the AMAN tool within the 4-Flight program, providing interface specifications.

R-ARC-0040 AMAN full platform shall be installed on HW/SW platform in complete configuration (redundant cluster) which shall be fed with operational traffic data (recorded, simulated or repeated from operational environment).

7.3 CONFIGURATION

7.3.1 OFF-LINE MODIFICATION

R-CFG-0010 AMAN shall perform its computations on the data received from FDPS, RDPS and on the static ENV data (e.g. operational configuration, type and performance of the aircrafts, ATS geography and volumes).

R-CFG-0020 AMAN shall update all sequence information according to the following events:

- On reception of new SFPL;
- On reception of SFPL updating;

- On reception of Radar data update;
- On execution of an AMAN Order.

R-CFG-0030 AMAN shall be able to manage multi-runway configuration and multi airport environment.

R-CFG-0040 AMAN shall be able to manage the MILANO TMA with three airports (Linate, Malpensa, Orio al Serio) and the ROMA TMA with two airports (Fiumicino, Ciampino).

R-CFG-0050 AMAN shall allow off-line definition of Managed Airports List.

R-CFG-0060 AMAN shall allow off-line definition of Inner Airports List containing a selection of all airports inside the related ATSU.

R-CFG-0070 AMAN shall allow off-line definition of the following Reference Points for each defined airport :

- Runways (with the associated airport);
- Metering Fixes (e.g. COP, IAF, FAF, Sector Entry/Exit Fix).

R-CFG-0080 AMAN shall allow off-line definition of the following Reference Routes:

- Route Network;
- STARs;
- SIDs.
- Arrival Transition Routes;
- Holding Patterns;

R-CFG-0090 AMAN shall allow off-line definition of Runway Allocation Strategies for each defined airport.

R-CFG-0100 On each Runway Allocation Strategy. AMAN shall allow the definition of the following Runway Allocation Rules:

- Single runway operation;
- Multiple runway operation (non-exclusive):
  - Dependent;
  - Independent;
- Minimum Taxi;
- No Crossing (e.g. East-East, West-West);
- Airline;
- Aircraft Type.
- WTC
- Flight Type

R-CFG-0110 AMAN shall allow off-line definition of Arrival Rate (flights per hour) for each configured runway.

R-CFG-0120 AMAN shall allow off-line definition of Arrival Spacing (NM) for each configured runway.

R-CFG-0130 AMAN shall allow off-line definition of LVP rate (flights per hour) for each configured runway.

R-CFG-0140 AMAN shall allow off-line definition of LVP spacing (NM) for each configured runway.

R-CFG-0150 AMAN shall allow off-line definition of the following AMAN Horizon for each configured airport:

- Operational Horizon;
- Active Advisory Horizon;
- Frozen Horizon;
- Common Path Horizon.

Each AMAN Horizon shall be configurable asymmetrical.

R-CFG-0160 AMAN shall allow off-line definition of Stability Interval Set associated to different configurable geographical areas in order to support sequence stability.

R-CFG-0170 AMAN shall allow off-line definition of Routes Weight Table, enabling the Delay Management Strategy distributing the flight total delay among different flight path for each configured airport.

R-CFG-0180 AMAN shall allow off-line definition of Flight Path Weight Table, enabling the Delay Sharing Distribution among different flight path for each configured airport.

R-CFG-0190 On Flight Path Weight Table, AMAN shall allow the definition of the following information:

- Flight Path
- For Each Flight Path :
  - Delay Weight (Total Delay %)
  - Maximum Delay allowed
  - Gain Weight (Total Gain %)
  - Maximum Gain allowed

R-CFG-0200 AMAN shall allow off-line definition of Maximum Delay absorbed by the ATSU.

R-CFG-0210 AMAN shall allow off-line definition of Shared Delay that can be distributed to any adjacent ATSU.

R-CFG-0220 AMAN shall allow off-line definition of WTC Minimum Separations Table based on ICAO Document 4444 standards [2].

R-CFG-0230 AMAN shall allow off-line definition of Runway Separation Matrix including the following values :

- Minimum separation in NM (distance that successor must have when the predecessor arrives at same runway);
- Minimum diagonal separation in NM ("diagonal" separation, considering the runway geometry to specify separations between flights on parallel, dependent runways).
- WTC Minimum Separations Table based on ICAO Document 4444 standards [2].

R-CFG-0240 AMAN shall allow off-line definition of Sectors Distribution List Mapping (Geographical Volume /Metering Fix), associating each geographical volumes with the relevant metering fix to manage timelines and lists visualization.

R-CFG-0250 AMAN shall allow off-line definition of Maximum Time to Gain Limit.

7.3.2 ON-LINE MODIFICATION

R-CFG-0260 For each defined airport, AMAN shall allow modification of Runway Allocation Strategy.

R-CFG-0270 For each defined airport, AMAN shall allow modification of Flight Path Weight Table.

R-CFG-0280 For each ACC, AMAN shall allow modification of Maximum Delay.

R-CFG-0290 For each ACC, AMAN shall allow modification of Shared Delay that can be distributed to adjacent ACC.

R-CFG-0300 For each configured runway, AMAN shall allow modification of Arrival Spacing.

R-CFG-0310 For each configured runway, AMAN shall allow modification of Arrival spacing for an individual flight.

R-CFG-0320 For each configured runway, AMAN shall allow modification of Arrival Rate.

R-CFG-0330 For each configured runway, AMAN shall allow modification of LVP rates.

R-CFG-0340 For each configured runway, AMAN shall allow modification of LVP spacing.

R-CFG-0350 For each configured runway, AMAN shall allow modification of Maximum Time to Gain Limit.

7.3.2.1 Sectorization

R-CFG-0360 AMAN shall distribute to all positions, according to Sectors Distribution List Mapping, the following information:

- Runway timelines (one for each Runway);
- Airport timelines (one for each Metering Fix);
- COP lists (one for each COP) to the Adjacent ACC (ROMA, MILANO,BRINDISI or PADOVA).

R-CFG-0370 Upon Sectors band-boxing/splitting, AMAN shall re-distribute sequence information according to Sectors Distribution List Mapping.

7.4 FUNCTIONAL

7.4.1 PREDICTION AND PLANNING

AMAN receives from SA-ADAPTER the Estimated Time of Arrival (ETA) for each inbound flight in the configured airports as results of trajectory prediction based on radar and flight plan data.

Flight plan creation and updates are provided by SA-ADAPTER as basis for AMAN trajectory prediction considering ENAV aircraft performance table to calculate the flight profile.

Furthermore, SATCAS FDPS trajectory prediction, in case of lateral deviation from the nominal route, will determine the next fix on a route for a flight, starting at its current radar position.

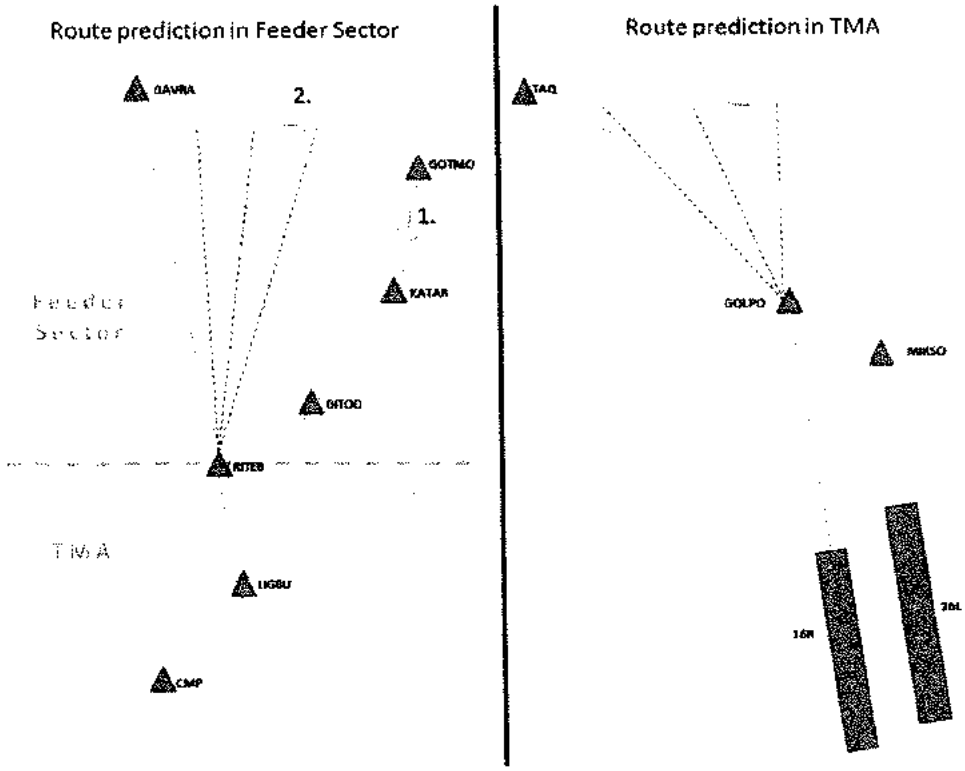

Figure 6: Examples of Route Prediction on lateral deviation.

R-FUN-0010 AMAN shall be able to receive SFPL creation and updates, provided by SA-ADAPTER.

R-FUN-0020 AMAN shall be able to receive Radar Tracks updates provided by SA-ADAPTER.

R-FUN-0030 AMAN shall be able to receive ENV data updates provided by SA-ADAPTER.

R-FUN-0040 AMAN shall extract ETA for each inbound flight in the configured airports as results of received trajectory prediction.

R-FUN-0050 AMAN shall extract, for each inbound flight, the ETO's at Reference Points included in the related received trajectory.

R-FUN-0060 AMAN shall consider a flight, departing outside AoR, as eligible for elaboration if all the following conditions are satisfied:

- The flight enter the operational horizon configured with a look-ahead time (e.g. 60 or 120 minutes);
- The flight plan is Active (e.g ABI message received for adiajent ACCs)

R-FUN-0070 AMAN shall consider a flight, departing inside the AoR, as eligible for elaboration at Take-Off.

7.4.2 RUNWAY ALLOCATION

R-FUN-0080 AMAN shall enable to select from different pre-defined Runway Allocation Strategies

R-FUN-0090 AMAN shall allow to set Runway Allocation Strategy at a given time in the future or after a given flight in the sequence.

R-FUN-0100 Upon selection of Runway Allocation Strategy, AMAN shall allocate an AMAN Runway for each inbound flight, following the pre-configured Runway Allocation Rules.

R-FUN-0110 If planned runway of an inbound flight differ from the AMAN Runway, AMAN shall suggest a new Runway.

R-FUN-0120 AMAN shall assign, for each inbound flight, the corresponding Standard Arrival Route (STAR) extracted by received SFPL.

R-FUN-0130 AMAN shall take into account any change of planned runway provided by received SFPL updates, re-allocating the flight on the related sequence.

R-FUN-0140 AMAN shall be able to manage independent runway operation based on arrival spacing and WTC separation, as pre-defined in the Runway Separation Matrix.

R-FUN-0150 AMAN shall be able to manage dependent runway operation based on the minimum staggered separation between two subsequent flights on two different runways, as pre-defined in the Runway Separation Matrix.

(Note : A staggered separation of 0 NM means the two runways are operated independently from each other, moreover a value greater than 0 NM means that subsequent arrivals on the two runways should maintain a diagonal minimum separation of the specified value)

7.4.3 ARRIVAL SEQUENCING

R-FUN-0160 AMAN shall optimize arrival sequences in accordance of the following criteria:

- ETA comparison following the first come, first served principle
- Routes Weight Table
- Defined Runway Allocation Strategy

R-FUN-0170 AMAN shall calculate and provide Target Time of Arrival (TTA) for each inbound flight based on the optimized arrival sequence on each configured landing runway.

R-FUN-0180 AMAN shall calculate TTA with the following constraint:

- Equal to ETA, if no delay absorption is required;
- Later then ETA, if delay absorption is required;
- Earlier then ETA, taking into account the Maximum Time to Gain Limit, if gain is required.

R-FUN-0190 AMAN shall provide total delay at the runway advice, for each inbound flight, as difference between TTA and ETA.

R-FUN-0200 AMAN shall provide Target Time Over (TTO) on any pre-defined Reference Point and for each inbound flight.

R-FUN-0210 AMAN shall distribute the total delay at the runway and provide Time To Lose/Time To Gain (TTL/TTG) advice, on any pre-defined Reference Point and for each inbound flight, according the Flight Path Weight Table. (See Section 7.4.6)

R-FUN-0220 AMAN shall provide three kind of sequence:

- Runway Arrival Sequence (containing all the flights landing at a specified runway);
- Airport Arrival Sequence (containing all flights landing at a specified airport, with one or more runways, whom trajectories match a set of pre-defined Reference Points);
- COP list (containing all inbound flights whom trajectories match a set of pre-defined Reference Points) to adjacent ACC (ROMA, MILANO,PADOVA or BRINDISI);
- Removed Flight List (containing all flight temporary removed from the arrival sequence, e.g missed approach, late appearing flight).

R-FUN-0230 AMAN shall be able to manage following flight priorities :

- Priority: the concerned flight is re-sequenced with the constraint that its TTA is as close as possible to its ETA (TTG remains applicable);
- Emergency: the concerned flight is the only landing at the allocated runway;

7.4.4 RE-PLANNING & SEQUENCE STABILIZATION

R-FUN-0240 AMAN shall updates flight related data, sequence and metering advices upon reception of the following data updates :

- radar data updates;
- flight plan updates;
- manual user input.

R-FUN-0250 AMAN shall enable to modify the sequence by the following manual inputs:

- Change flight position in the sequence;
- Set TTA for a flight;
- Remove a flight from the sequence;
- Re-Insert a removed flight;
- Insert Reservation Slot;
- Change flight priority;
- Change Arrival Spacing for a runway;
- Change Arrival Spacing for a flight;
- Change Arrival Rate for a runway;
- Change Runway for a flight;
- Change runway direction;
- Freeze one or more flight in the sequence;
- Unfreeze one or more frozen flight in the sequence;
- Runway Closure.

R-FUN-0260 AMAN shall divide the arrival sequence into three sections according the pre-defined AMAN Horizons:

- Free Section of the sequence:
- Frozen Section of the sequence;
- Common Path Section of the sequence.

R-FUN-0270 AMAN shall insert flights that enter the operational horizon into the Free Section of the sequence based on the optimization criteria, the initial delays of the sequenced flights, and the actual delay distribution.

R-FUN-0280 AMAN shall freeze the position of flights entering the Frozen Section of the sequence and allow only automatic TTO shifts to adjust the target times, with the exception of priority flights.

R-FUN-0290 AMAN shall adapt the sequence according to the actual passing times of inbound flights on a pre-defined Reference Point at the beginning of the Common Path Section, (e.g. 6 NM out), for a given runway, without exception or further optimization of the flights to ensure that the actual landing order is always reflected.

R-FUN-0300 AMAN shall change the sequence position of a flight only if the difference between the calculated ETA and TTA is outside the pre-defined Stability Interval in the associated geographical area.

7.4.5 SHORT ROUTE FLIGHT HANDLING

R-FUN-0310 AMAN shall sequence all flights departing form the pre-defined Inner Airports List (short route flights) at take-off.

R-FUN-0320 AMAN shall sequence a flight departing inside the pre-defined Frozen Horizon as the last flight in the frozen section of the sequence.

R-FUN-0330 AMAN shall manage a short-route flight as normal inbound flight.

7.4.6 DELAY SHARING

R-FUN-0340 AMAN shall support delay sharing between en-route and TMA sectors based on a weighted distribution of delay inside the pre-defined maximum delay that each sector can absorb.

R-FUN-0350 AMAN shall distribute, starting from the total delay at the runway (TTA-EYA), the TTL among the crossed sectors, following the pre-defined Flight Path Weight Table that associates a weight and a maximum absorbed delay for each sector and/or flight path.

R-FUN-0360 If the total delay exceed Maximum Delay allowed of the current ATSU, AMAN shall distribute the Shared Delay portion to the upstream ATSU, if any.

R-FUN-0370 If the total delay exceed a pre-defined amount (Maximum Delay allowed of current ATSU + Shared Delay of adjacent upstream ATSU), AMAN shall re-distribute remaining delay to the TMA.

Delay sharing rational is explained by the following example :

1. A flight has the following flight plan : GAVRA-RITEB-LIGBU-CMP-MIKSO-16L
2. The estimated times over the reference points are :
   - GAVRA(Entry COP) 10:45
   - RITEB 11:07
   - 16L 11:27
3. The maximum absorbed delay and the weight for each crossed sectors are, in this example:
   - NE : 5 minutes ; 50%
   - TN : 6 minutes ; 50%
4. Maximum Delay that can be distributed to Padova ACC (SD) is 2 minutes
5. The delay will increase from 0 to 20 minutes and shall be distributed as shown in the following table that presents on each column what shall be presented respectively to the Sequence Manager, TN Controller, NE Controller, Padova Controller:

TTA/Total Delay	16L/TTL	RITEB/TTL	GAVRA/TTL
11:27	11:27	11:07	10:45
11:29 / +2	11:29 / +1	11:08 / +1	10:45/ 0
11:31 / +4	11:31 / +2	11:09 / +2	10:45/ 0
11:33/ +6	11:33/ +3	11:10 / +3	10:45/ 0
11:37 / +10	11:37 / +5	11:30/ +5	10:45/ 0
11:40 / +13	11:37 / +6	11:30/ +5	10:45/+2
11:42 / +15	11:42 / +8 (6+2)	11:32 / +5	10:47/ +2
11:47 / +20	11:47 / +13 (6+7)	11:34 / +5	10:47/ +2

Table 4: Example of Sharing Delays between Sectors

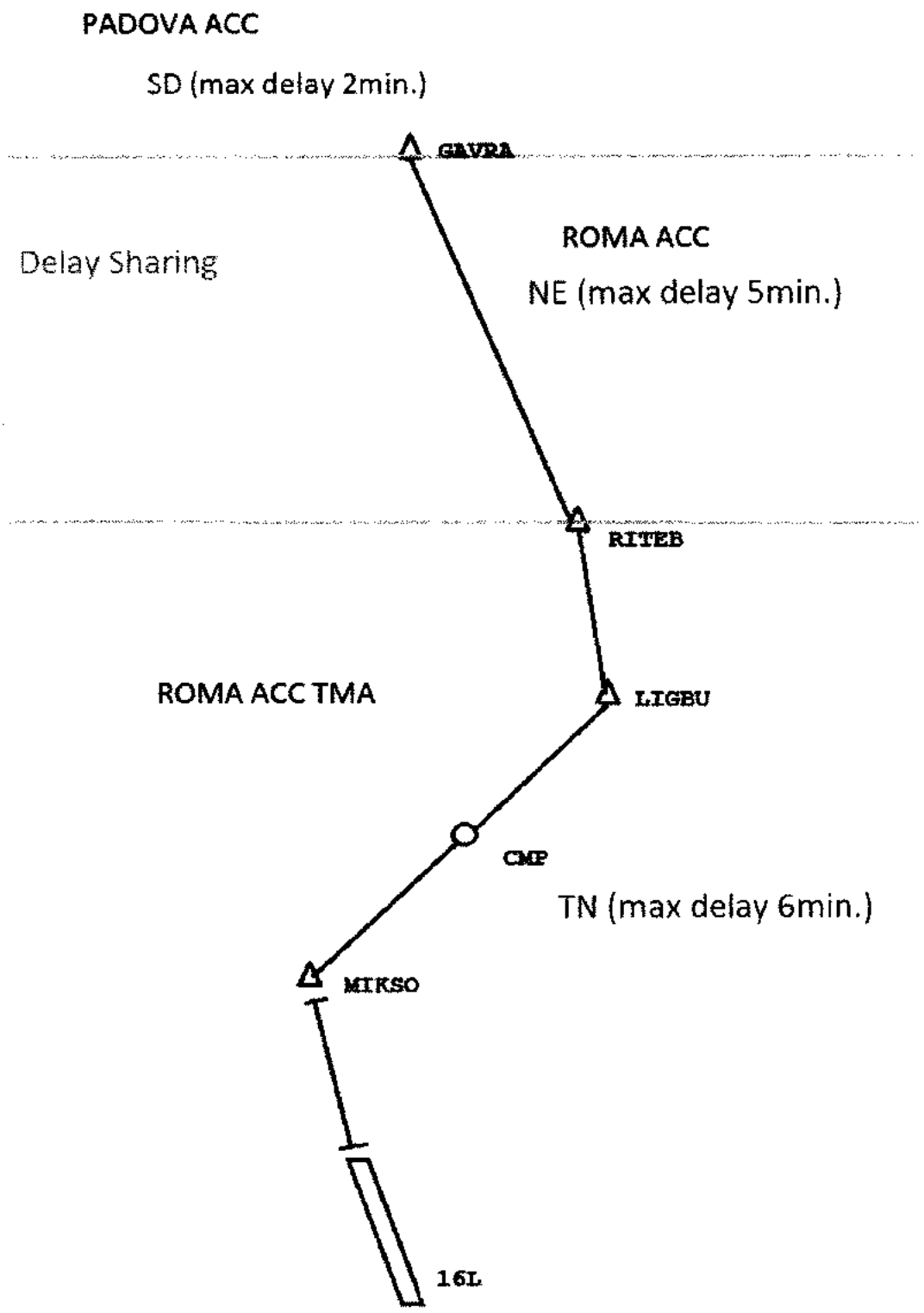

Figure 7: Delay Sharing Example

7.5 HMI

The following HMI requirements could be consolidate during the HMI prototyping activities.

7.5.1 GENERAL PRINCIPLES

R-HMI-0010 AMAN HMI shall be deployed on a dedicated Working Position (narrow vertical monitor with the following dimensions: 40x60 cm).

R-HMI-0020 AMAN HMI shall be deployed on:

- 25 working positions in ROMA ACC OPS;
- 22 working positions in MILANO ACC OPS;
- Up to 14 working positions in PADOVA ACC OPS;
- Up to 7 working positions in BRINDISI ACC OPS;
- 9 working positions in ROMA ACC Simulation Environment;
- 5 working positions in MILANO ACC Simulation Environment;
- 5 working positions in PADOVA ACC Simulation Environment;
- 5 working positions in BRINDISI ACC Simulation Environment;
- 9 working positions in ENAV Academy;
- 2 working positions in ROMA PSA;
- 2 working positions in MILANO PSA.

The precise number will be provided by ENAV during Definition Phases.

R-HMI-0030 On each working position, AMAN HMI shall be configured according to one of the foreseen AMAN roles.

R-HMI-0040 It shall be possible to on-line modify the role assigned to an AMAN HMI working position.

R-HMI-0050 AMAN HMI shall be configured in order to follow (on the CALLSIGN field) the following colour coding currently implemented in SATCAS CWP:

- LIGHT GREEN → Flights assumed under the sector control (CONCERNED Flights);

- YELLOW →Flights in Pending Status;
- RED → Flights for which an STCA Alarm is detected;
- MAGENTA → Flights under Transfer of Control (TOC), i.e. Tentative Flights;
- DARK GREEN →Concerned AIS Flights;
- LIGHT GREEN (CALLSIGN) & WHITE → Exit Handover Flights;
- WHITE →Nearby Flights.

7.5.2 AMAN HMI WINDOWS

R-HMI-0060 AMAN HMI shall display the following windows:

- Timeline Window;
- Flight Information Window;
- Removed Flight List Window;
- Configuration Window.

R-HMI-0070 AMAN HMI shall display the Timeline Window as the main interface element.

R-HMI-0080 AMAN HMI shall display (when active) Removed Flight List Windows and Configuration windows in an off-line configured position of the Timeline Window.

R-HMI-0090 It shall be possible to on-line select the window to be displayed by clicking on a dedicated button.

R-HMI-0100 It shall be possible to interact with the AMAN HMI windows by means of a three-button mouse with a mouse wheel defined as follows:

- AB= Action Button;
- IB= Information Button;
- WB= Window Button.

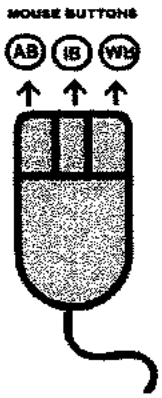

Figure 8: Mouse Description

R-HMI-0110 Each button of the mouse shall be associated to the following functions:

- CLICK LEFT BUTTON (AB): allows to interact with objects (e.g. selection of objects, pressing buttons, selecting among multiple options, designating points in time on a timeline);
- DRAG&DROP: allows to relocate objects to a different point in time or to a different timeline;
- DRAG: allows to move windows within the Timeline Window;
- MOUSE WHEEL: allows to scroll the visible part of the window or list or allows to alter the value of a selected input field;
- RIGHT BUTTON (WB): allows to open the context window of an object.

7.5.2.1 Timeline Window

R-HMI-0120 AMAN HMI shall display, in the Timeline Window, the following information:

- Configured Timelines (Airport/Runway);
- COP Lists;
- Button Bar;
- Current Parameters;
- Status Bar;
- Range Scale;
- Default scale settings.

R-HMI-0130 AMAN HMI shall display the Timeline Window with a dark grey background.

7.5.2.2 Timelines

R-HMI-0140 AMAN HMI shall display, in the Timeline Window, the following off-line configurable Timelines:

- Runway Timelines (one for each selected Runway), representing the Runway Arrival Sequence containing all flights landing at a specific runway;
- Airport Timelines (one for each selected Airport), representing the Airport Arrival Sequence containing all flights, whose trajectory matches a set of predefined reference points, landing at a specified airport ;
- COP Lists (one for each selected COP), representing all inbound flights whose trajectory matches a set of predefined COPs.

R-HMI-0150 AMAN HMI shall allow to on-line select the Timelines to be displayed on each working position by selecting the corresponding Runway/Airport.

R-HMI-0160 AMAN HMI shall allow to on-line select the COP Lists to be displayed on each working position by selecting the corresponding COP.

R-HMI-0170 AMAN HMI shall display each Timeline in the Timeline Windows as vertical scale marked at regular off-line defined time intervals.

R-HMI-0180 AMAN HMI shall display on each Timeline in the Timeline Window the Current Time Marker according to off-line customization.

R-HMI-0190 AMAN HMI shall display in the Timeline Window the Current Time Marker on a fixed point of the vertical scale.

R-HMI-0200 AMAN HMI shall display on each Timeline in the Timeline Window the UTC Time next to the Current Time Marker.

R-HMI-0210 AMAN HMI shall display the planning situation in the Timeline Window on both sides of the Timeline, according to off-line configuration. West-bound flights shall be displayed on the left part of the Timeline and East-bound flights shall be displayed on the right.

R-HMI-0220 AMAN HMI shall display in the Timelines future events above or below the Current Time Marker, according to off-line configuration.

R-HMI-0230 AMAN HMI shall allow to on-line change the orientation of the Timelines according to the orientation of the corresponding runways.

R-HMI-0240 AMAN HMI shall allow to simultaneously scroll (up and down) all Timelines displayed in the Timeline Window, by means of the mouse wheel. The name of the corresponding Airport/Runway shall always remain visible.

R-HMI-0250 AMAN HMI shall allow, at any time, to return to the current time position by clicking on a dedicated button.

R-HMI-0260 AMAN HMI shall display, for each Timeline, the name of the reference Airport/runway at the top/bottom of the Timeline, according to off-line configuration.

Hereafter an example of Timeline Window:

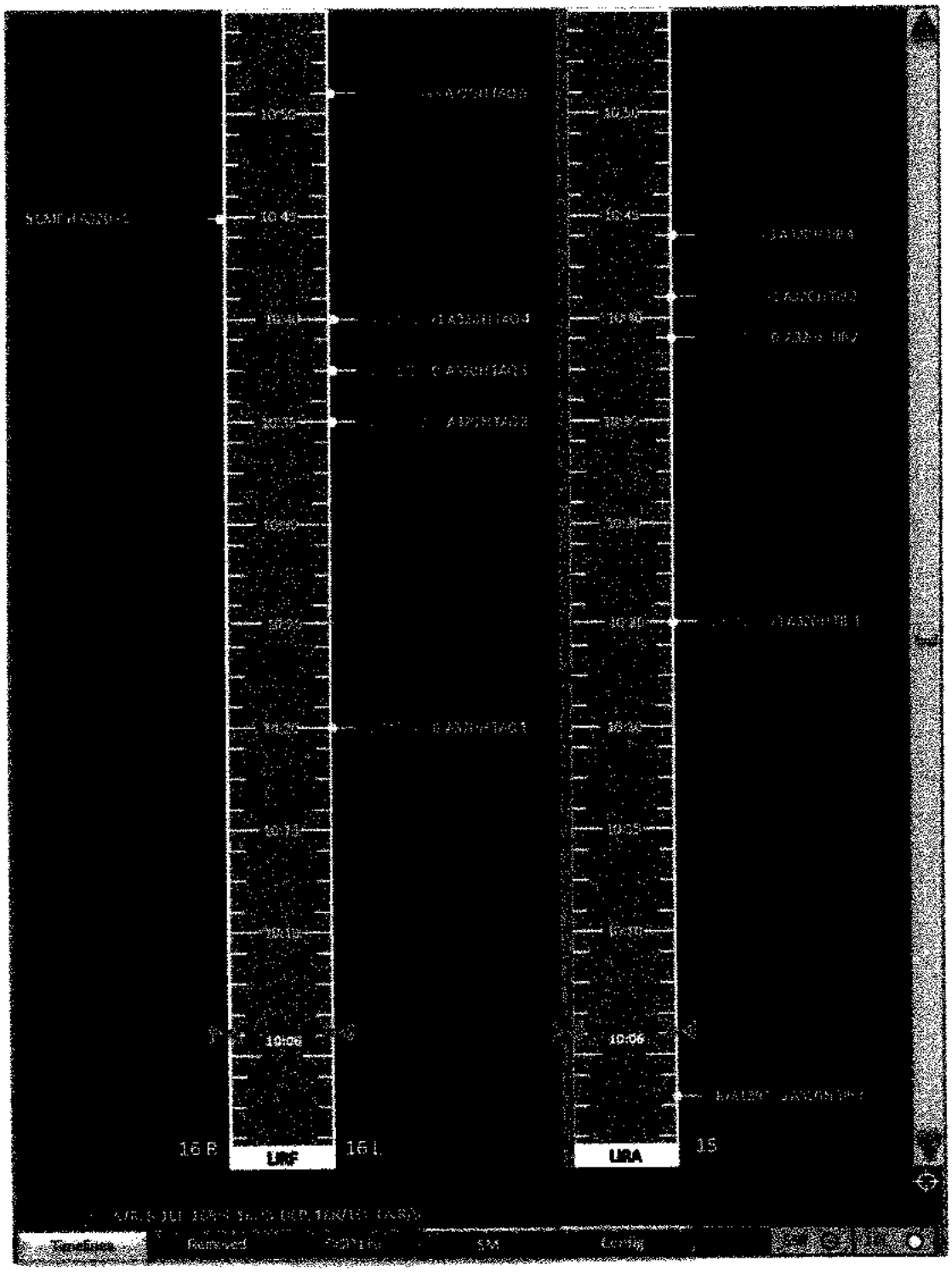

Figure 9: SM Timeline Window (Example)

7.5.2.3 Flight Labels

R-HMI-0270 AMAN HMI shall display sequenced flights, in the Timeline Window, as Flight Labels.

R-HMI-0280 AMAN HMI shall display Flight Strips connected to the Timeline at the point corresponding to the TTO (Target Time Over) of the configured metering FIX or the TTA (Target Time of Arrival) at the runway, by means of an off-line defined Connector Line.

R-HMI-0290 AMAN HMI shall display the AMAN Flight State by means of the following off-line defined colours associated to the Connector Line:

- WHITE: for flights in the Active Horizon;
- GRAY: for flights in the Frozen Horizon;
- DASHED GRAY: For flights in the Common Path.

R-HMI-0300 For each flight in the Timeline Window, AMAN HMI shall display the following textual flight information in the corresponding Flight Label:

- CALLSIGN (up to 8 characters);
- CURRENT DELAY (minutes): up to 3 characters;
  - "0" – if there is no delay;
  - "+XX" – if there is a TTL (in minutes);
  - "–XX" – if there is a TTG (in minutes);
  - "--" (two dashes) - in case the delay calculation is not possible.
- ICAO AIRCRAFT TYPE CODE (up to 6 characters) or TTO on the Metering FIX (5 characters) e.g. Holding Exit (Configurable);
- WTC (up to 1 character);
- METERING FIX (up to 3 characters);
- SEQUENCE NUMBER (only for Runway Timelines), up to 2 characters;

- FURTHER INDICATION (if any): 1 character with coloured background.

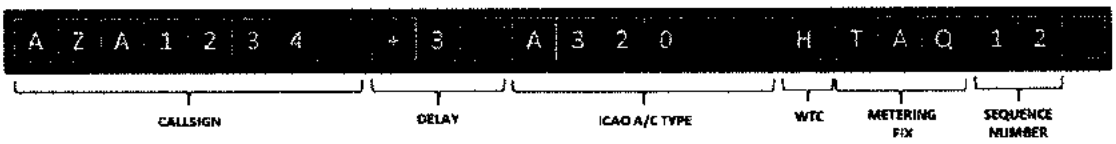

Figure 10: Flight Label

R-HMI-0310 AMAN HMI shall display the fields of each Flight Label with the following colour coding:

- CALLSIGN: Flight Status;
- TTL: Yellow or Orange (if TTL>Maximum delay);
- TTG: Cyan;
- NO DELAY: white;
- All other fields: white.

R-HMI-0320 AMAN HMI shall display, according to the off-line configured Metering fixes, on the Airport Timeline both flights under control and flights not under control, belonging to neighbouring sectors and which are sequenced on the same airport. The flight labels shall follow the Flight status colour coding.

Hereafter an example of Flight Label fields colour coding:

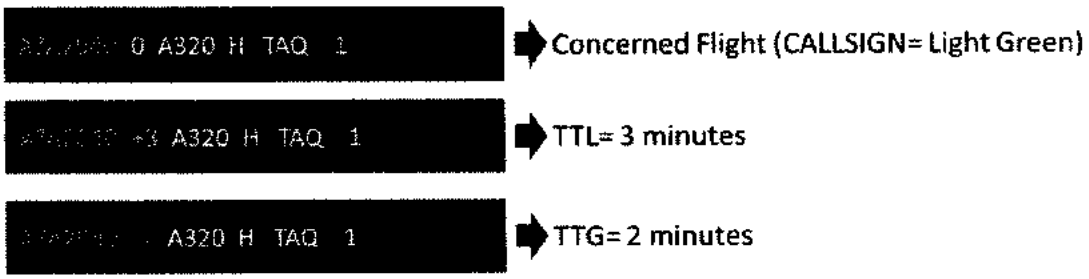

Figure 11: Flight Label (examples)

R-HMI-0330 On selecting a flight Label, its background colour shall change according to off-line configuration.

R-HMI-0340 AMAN HMI shall highlight the Flight Label when hovering over it with the mouse. If the same flight is displayed on other Timelines , their Flight Labels are also highlighted.

R-HMI-0350 AMAN HMI shall indicate manually sequenced flights in the last field of the Flight Label.

R-HMI-0360 AMAN HMI shall highlight flights with Priority or Emergency Status in the Flight Label callsign field as follows:

- ORANGE Callsign: Priority Flights;
- RED Callsign: Emergency Flights.

R-HMI-0370 When the current TTL assigned to a flight is greater than an off-line configured threshold, the corresponding TTL/TTG field in the Flight Label shall change colour.

R-HMI-0380 AMAN HMI shall allow to acknowledge an highlighted TTL field.

7.5.2.4 Slots

R-HMI-0390 AMAN HMI shall display SLOTS on the Timelines representing a time interval in which special events occur.

R-HMI-0400 AMAN HMI shall display SLOTS positioned on the corresponding Timeline and according to its start time and duration.

R-HMI-0410 AMAN HMI shall display SLOTS as a coloured line as follows:

- RUNWAY CLOSURE SLOT (Time Interval during which the runway will not be used by AMAN): Red Line;

- SPACING SLOT (Manually assigned separation (NM) after a selected flight): White Line;
- RESERVATION SLOT (Placeholder for a specific flight): Yellow Line.

R-HMI-0420 AMAN HMI shall display a dedicated label for each SLOT on the Timeline indicating the type and duration of the SLOT.

7.5.2.5 Indicators

R-HMI-0430 AMAN HMI shall display Indicators indicating a change of global sequencing and spacing AMAN parameters.

R-HMI-0440 AMAN HMI shall highlight Indicators on the Timeline with an off-line configured label indicating the type and value of the change at the point of time at which the change becomes effective.

R-HMI-0450 AMAN HMI shall display the following INDICATORS:

- RUNWAY STRATEGY INDICATOR representing a change of the runway strategy usage;
- RUNWAY SPACING INDICATOR representing a change in the minimum separation between two subsequent flights on the runway;
- RUNWAY RATE INDICATOR representing a change in the arrival rate on the runway;
- SPACING SLOT INDICATOR representing a change in the minimum separation between the selected flight and its predecessor;
- RUNWAY DIRECTION INDICATOR representing a change in the runway direction;
- RESERVATION SLOT representing a label that identifies the type and value of a reservation time slot;

- RUNWAY CLOSURE SLOT INDICATOR representing the closure of a runway.

7.5.2.6 Button Bar

R-HMI-0460 AMAN HMI shall display, at the bottom of the Timeline Window, a button bar with the following selectable buttons:

- CONFIGURATION button: to open a window which allows to configure the displayed timelines;
- REMOVED FLIGHTS button: to open the window containing the non-sequenced flights;
- COP LIST button: to open the window containing the estimated times over the FIR or Sector Exit FIX;
- SM button: to enable/disable the sequence manager authority for the AMAN HMI.

R-HMI-0470 AMAN HMI shall allow, by clicking with the left mouse button on the buttons of the button bar, to display the corresponding content information window.

R-HMI-0480 On selecting one of the buttons of the button bar, a specific dedicated window shall open in an off-line defined position displaying the related information content.

7.5.2.7 Configuration Window

R-HMI-0490 By clicking with the left mouse button on the CONFIGURATION button in the Button Bar, AMAN HMI shall display a dedicated AMAN configuration window which allows to change the following HMI settings related to the displayed Timelines:

- NUMBER OF DISPLAYED TIMELINES;
- RUNWAYS/METERING FIXES displayed on the Timelines;

- Displayed TIME HORIZON;
- Orientation of Flight Labels on the Timeline.

7.5.2.8 Non-Sequenced Flights Window

R-HMI-0500 By clicking with the left mouse button on the REMOVED FLIGHTS button in the Button Bar, AMAN HMI shall display non-sequenced flights in a dedicated Removed Flights List Window.

R-HMI-0510 Each flight in the Removed Flights List Window shall be represented by its Flight Label.

R-HMI-0520 Non-sequenced flights in the Removed Flights List Window shall be ordered according to their de-sequencing time and shall contain the CALLSIGN and reason for de-sequencing.

R-HMI-0530 AMAN HMI shall display in the Removed Flights List Window the following possible de-sequencing reasons:

- Manual removal from the sequence;
- Flights with invalid or unknown route;
- Automatically de-sequenced flights.

R-HMI-0540 AMAN HMI shall display the Removed Flights button in the Button Bar with the following colours:

- GRAY: when the Removed flights list is empty;
- ORANGE: when the Removed Flights List Window contains at least one flight.

R-HMI-0550 For each flight in the non-sequenced flight list, AMAN HMI shall display the following information in the flight label:

- CALLSIGN;
- ICAO Aircraft Type code;

- WTC;
- Metering FIX;
- Reason for de-sequencing;
- ADEP;
- ADES;
- ETA (if available);
- TTO (EAT 4 CHARS).

7.5.2.9 Current Parameters

R-HMI-0560 AMAN HMI shall display, in a dedicated area at the bottom of the Timeline Window, the parameters currently in use for AMAN.

R-HMI-0570 AMAN HMI shall display the following parameters:

- RUNWAY STRATEGY;
- ARRIVAL RATE;
- ARRIVAL SPACING;
- RUNWAY CLOSURE;
- TOTAL DELAY;
- AVERAGE DELAY (optional) over one or more Metering Fixes;
- NUMBER OF SEQUENCED FLIGHTS.

R-HMI-0580 Each time a parameter changes value, the corresponding information is highlighted in the Timeline Window.

7.5.2.10 Status Bar

R-HMI-0590 AMAN HMI shall display a Status Bar which allows to visualize the availability of network connection between AMAN and other systems (input data) at the bottom right side of the Timeline Window.

R-HMI-0600 AMAN HMI shall display the following connection information in the Status Bar:

- Reception of Track Data (SSR);
- Reception of Flight Plan Data (FPL);

R-HMI-0610 AMAN HMI shall display the fields in the Status Bar as follows:

- GRAY: all data is available;
- ORANGE: data reception is interrupted;
- RED: no connection is established/no data is available.

7.5.2.11 Range Scale

R-HMI-0620 AMAN HMI shall display in the lower right side of the Timeline Window the RANGE SCALE buttons which allow to increase/decrease the currently displayed scale on the Timelines.

R-HMI-0630 AMAN HMI shall display a DEFAULT SCALE button which allows to return to the off-line defined range scale of the Timelines.

7.5.2.12 Role Management

R-HMI-0640 AMAN HMI shall foresee the following different user rights related to different roles:

- SEQUENCE MANAGER;
- SUPERVISOR;
- EXECUTIVE;
- TECHNICAL.

R-HMI-0650 AMAN HMI configured as SEQUENCE MANAGER shall have full authorization to modify the runway sequence and an off-line defined set of global sequencing parameters.

R-HMI-0660 AMAN HMI configured as SEQUENCE MANAGER shall display runway timelines, Airport Timelines and COP Lists.

R-HMI-0670 For each ACC one or more positions can be in SEQUENCE MANAGER role at the same time.

R-HMI-0680 AMAN HMI configured as SUPERVISOR shall display runway timelines, Airport Timelines and COP Lists.

R-HMI-0690 AMAN HMI configured as SUPERVISOR shall have full authorization to modify a set of off-line defined global sequencing parameters.

R-HMI-0700 It shall be possible to switch to SEQUENCE MANAGER the AMAN HMI configured as SUPERVISOR by using a message box confirmation.

R-HMI-0710 AMAN HMI configured as EXECUTIVE shall be read-only.

R-HMI-0720 AMAN HMI configured as EXECUTIVE shall display Runway Timelines, Airport Timelines and COP Lists.

R-HMI-0730 AMAN HMI configured as TECHNICAL shall be dedicated to maintenance.

R-HMI-0740 AMAN HMI configured as TECHNICAL shall allow to perform:

- AMAN System Monitoring;
- AMAN System Control;
- AMAN System Failover.

R-HMI-0750 AMAN HMI configured as TECHNICAL shall display the Timeline as displayed on the SEQUENCE MANAGER and SUPERVISOR positions (read-only).

R-HMI-0760 AMAN HMI configured as TECHNICAL shall not be authorized to modify the AMAN sequence or sequencing parameters.

R-HMI-0770 There shall be only one AMAN HMI fixed position configured as TECHNICAL.

7.5.3 ON-LINE ORDERS

7.5.3.1 Manual Spacing and Sequencing of Individual Flights

R-HMI-0780 AMAN HMI shall allow to change the position of a flight on the current runway as follows:

1. AB press & hold on the CALLSIGN field of the Flight Label;
2. AB release on desired position (before or after a flight).

R-HMI-0790 AMAN HMI shall allow to change the TTA for a flight on the current runway as follows:

1. AB press & hold on connector line;
2. Current TTA is highlighted;
3. Timeline displays 1 minute step timing;
4. On mouse move the Time is highlighted related to the position;
5. AB release on desired TTA.

R-HMI-0800 AMAN HMI shall allow to change the runway for a flight as follows:

1. AB press & hold on CALLSIGN field;
2. On mouse move on the other runway:
   - Timeline displays 1 minute step timing;
   - Time is highlighted related to the position.
3. AB release:
   - A window is displayed with three choices:
     - Change runway: AMAN shall automatically re-sequence the flight on the new runway;

- Change runway at specified position: AMAN shall insert the flight in the released position (after or before a flight);
- Change runway at specified TTA : AMAN shall insert the flight at the highlighted TTA.

R-HMI-0810 On WB click on CALLSIGN field of the Flight Label, AMAN HMI shall display a window with the following choices:

- Remove: the selected flight is removed from the sequence and inserted in the non-sequence flight window;
- Freeze: the flight position is locked;
- Unfreeze: the flight position is unlocked;
- Spacing:
  1. A window is displayed that allows the definition of a flight-dependent separation in NM after the selected flight;
  2. A spacing indicator is displayed on the Timeline;
  3. AB click on Spacing Indicator :
     - A window is displayed that allows to change or remove the flight-dependent separation;
- Priority: the flight is re-sequenced in such a way that its TTA is as close as possible to its ETA (TTG remains applicable);
- Emergency: the concerned flight is the only landing a the allocated runway;

R-HMI-0820 On IB click on the CALLSIGN field of the Flight Label, the latter shall be extended with additional flight information.

R-HMI-0830 AMAN HMI shall allow to Re-Insert a non-sequenced flight, except for flights with invalid or unknown route by the following interaction with the Removed Flights List:

1. AB press & hold on CALLSIGN field:
2. On mouse move on a runway Timeline:

- Timeline displays 1 minute step timing;
- Time is highlighted related to the position.

3. AB release:
   - A window is displayed with three choices:
     - Change runway: AMAN shall automatically re-sequence the flight on the new runway;
     - Change runway at specified position: AMAN shall insert the flight in the released position (after or before a flight);
     - Change runway at specified TTA : AMAN shall insert the flight at the highlighted TTA.

R-HMI-0840 Manual changes to individual flights shall always have priority on automatic sequencing advices.

7.5.3.2 Global Sequencing and Spacing Parameters orders

R-HMI-0850 AMAN HMI shall allow authorized users to manually modify the ARRIVAL RATE (flights per hour). by selecting Start Time, Runway and Rate. The arrival rate change shall be displayed as Runway Rate Indicator in the Timeline Window and shall also be displayed at the bottom of the Timeline Window in the parameter Section.

R-HMI-0860 AMAN HMI shall allow authorized users to manually modify the ARRIVAL SPACING by setting the minimum separation (NM) between two subsequent flights on the same runway, selecting Start Time, Runway and Distance. The arrival spacing change shall be displayed as Runway Spacing Indicator in the Timeline Window and shall also be displayed at the bottom of the Timeline Window in the parameter Section.

R-HMI-0870 AMAN HMI shall allow authorized users to manually modify the RUNWAY DIRECTION by setting the direction of runway, selecting Start Time and

Runway. The runway direction change shall be displayed as Runway Direction Indicator in the Timeline Window.

R-HMI-0880 AMAN HMI shall allow authorized users to manually modify the RUNWAY STRATEGY by defining which runway is currently assigned to accommodate incoming flights. It shall be possible to select among different off-line defined strategies and the corresponding starting time. A runway strategy change shall be displayed in the Timeline Window as Runway Strategy Indicator and shall also be displayed at the bottom of the Timeline Window in the parameter Section. It shall also be possible to attach a runway strategy change to a flight. affecting all the subsequent flights. Runway strategies can be modified and terminated.

R-HMI-0890 AMAN HMI shall allow authorized users to manually modify the DELAY SHARING by setting the delay sharing distribution among sectors. It shall be possible to modify the default flight path weight table.

R-HMI-0900 AMAN HMI shall allow authorized users to manually modify the LVP RATE by setting runway arrival rate (flight per hour), selecting from a pre-defined set of LVP rates. The runway rate change shall be displayed as Runway Rate Indicator in the Timeline Window and shall also be displayed at the bottom of the Timeline Window in the parameter Section.

R-HMI-0910 AMAN HMI shall allow authorized users to manually modify the LVP SPACING by setting the minimum separation (NM) between two subsequent flights on the same runway, selecting from a pre-defined set of LVP spacing. The arrival spacing change shall be displayed as Runway Spacing Indicator in the Timeline Window and shall also be displayed at the bottom of the Timeline Window in the parameter Section.

R-HMI-0920 AMAN HMI shall allow authorized users to manually assign/modify the RESERVATION SLOT used to occupy a slot in the sequence for a flight that

did not show up yet (e.g. planned departure from a nearby airport or incoming flight). For each reservation slot it shall be possible to insert the start time, the runway and the WTC. When the flight shows up it shall be possible to replace the reservation slot with the flight. The reservation slot insertion shall be displayed as a Reservation Slot Indicator in the Timeline Window and shall also be displayed at the bottom of the Timeline Window in the parameter Section.

R-HMI-0930 AMAN HMI shall allow authorized users to manually assign/modify the RUNWAY CLOSURE by specifying the start time and the time interval when a runway shall not be used by AMAN. The runway closure shall be displayed as Runway Closure Slot Indicator in the Timeline Window and shall also be displayed at the bottom of the Timeline Window in the parameter Section. It shall be possible to re-locate runway closure slots on the same timeline by "drag & drop", to update the runway closure slot and remove it.

7.5.4 HMI OFF-LINE CONFIGURATION

R-HMI-0940 It shall be possible to off-line define the number of simultaneously displayed Timelines.

R-HMI-0950 It shall be possible to off-line define the reference points (runways and/or metering FIX) for which the flights are displayed.

R-HMI-0960 It shall be possible to off-line define the time horizon to be displayed in the Timeline Window.

R-HMI-0970 It shall be possible to off-line define the information content to be displayed in the Flight Strips among the following:

- CALLSIGN
- Delay (TTL/TTG)

- ICAO aircraft type code
- WTC (Wake Turbulence Category)
- Metering FIX
- Sequence Number
- ...

R-HMI-1010 It shall be possible to off-line define the colours associated to the Flight Strip state (Flight strip columns and connector line).

R-HMI-1020 It shall be possible to off-line define the label associated to an Indicator.

R-HMI-1030 It shall be possible to off-line configure the data to be displayed in the extended Flight Information.

R-HMI-1040 It shall be possible to off-line configure the default runway separation values for each runway.

R-HMI-1050 It shall be possible to off-line configure the following access rights and related layout:

- SEQUENCE MANAGER;
- SUPERVISOR;
- EXECUTIVE;
- TECHNICAL.

R-HMI-1060 It shall be possible to off-line define the configuration for each sector and sector combination. The configuration shall include:

- Timelines to be displayed
- Timescale

R-HMI-1070 It shall be possible to off-line define the default sector associated with a specific EXECUTIVE role.

R-HMI-1080 It shall be possible to off-line define the color coding according to the flight plan state as follows:

- Concerned Flight = Light Green;
- Pending Flight = Yellow;
- Flight with STCA Alarm = Red;
- Light under Transfer of Control (TOC) = Magenta;
- AIS = Dark Green;
- Nearby Flight = White.

7.6 INTERFACE

7.6.1 AMAN INTERFACE

7.6.1.1 CWP Interface

R-IRQ-0010 AMAN shall include in any Sequence Update message the following information :

- Reference Point name;
- Reference Point spacing;
- Reference Point type.

For each flight in the Arrival Sequence:

- Arrival Sequence Number;
- CALLSIGN;
- Planned Runway (runway extracted from the SFPL);
- Type of Aircraft;
- WTC;
- ETA/ETO if Reference Point type is respectively Runway / Metering Fix;
- Flight Priority (Emergency, Priority, No priority);
- Flight Status (Active, Frozen, Common Path);
- Suggested Runway, if any;

- TTA/TTO if Reference Point type is respectively Runway / Metering Fix;
- Total delay;
- TTL (Time to lose) / TTG (Time to gain).

7.6.1.2 ENV Interface

R-IRQ-0020 The ENV Interface shall be able to receive the following environmental data:

- Fixes;
- Aerodromes;
- Sectors;
- Geographical Volumes;

R-IRQ-0030 The ENV Interface shall exchange data via EUROCONTROL FMTP ("Flight Message Transfer Protocol") as defined in the community specification N.0100 Edition 2.0[].

R-IRQ-0040 The ENV Interface shall be able to receive data using the XML format following the specification provided by ENAV during Project Definition Phase.

7.6.1.3 FDPS Interface

R-IRQ-0050 The FDPS Interface shall be able to receive the following data:

- Flight plan data;
- Operational sectors configuration data;

R-IRQ-0060 The FDPS Interface shall exchange data via EUROCONTROL FMTP ("Flight Message Transfer Protocol").

R-IRQ-0070 The FDPS Interface shall exchange data using ADEXP format as defined in the community specification N.0107 Edition 3.1, following the specification provided by ENAV during Project Definition Phase.

R-IRQ-0080 The FDPS Interface shall be able to receive at least the following flight plan data :

- Flight Plan Status (new, update, terminated);
- SSR Code;
- ICAO Code (aircraft type);
- Wake Turbulence Category;
- ADEP
- ADES
- 4D Trajectory (4D trajectory of FDP used to extract the route of the flight: waypoints defined by name, latitude and longitude, including speed and level constraints at the waypoints, route up to TMA Feeder Fix at least);
- RFL;
- CFL;
- ICAO flight rule (I, V, Y, Z);
- ICAO Flight type (G, M, N, S, X);
- Aircraft equipment (field 10 of ICAO flight plan);
- ATA (Actual Time of Arrival);
- ATD (Actual Time of Departure);
- Sector (Controlling the flight);
- Flight Track Status (Assumed, AIS, Tentative, Hand Over, Nearby, Pending, STCA Alarm);

7.6.1.4 RDPS Interface

R-IRQ-0090 The RDPS Interface shall be able to receive radar tracks data.

R-IRQ-0100 The RDPS Interface shall exchange data via UDP.

R-IRQ-0110 The RDPS Interface shall be able to receive data using ASTERIX CAT62 format.

R-IRQ-0120 The RDPS Interface shall be able to receive at least the following radar tracks data items:

- I062/010 (Data Source Identifier);
- I062/015 (Service Identification);
- I062/040 (Track Number);
- I062/060 (Track Mode 3/A Code);
- I062/070 (Time Of Track Information);
- I062/080 (Track Status);
- I062/100 (Calculated Track Position);
- I062/120 (Track Mode 2 Code);
- I062/135 (Calculated Track Barometric Altitude);
- I062/136 (Measured Flight Level);
- I062/185 (Calculated Track Velocity);
- I062/200 (Mode Of Movement);
- I062/220 (Calculated Rate Of Climb/Descent);
- I062/340 (Measured Information);
- I062/380 (Ground Speed);
- I062/390 (Flight Plan Related Data);
- SP (Special Purpose field).

Further details about data format and contents will be provided by ENAV with ICD, during Project Definition Phase.

7.7 SUPERVISION

R-SPV-0010 The AMAN supervision shall be able to monitor and provide the status of AMAN, automatically detecting failures and solving it.

R-SPV-0020 The Supervision shall monitor the actual status of the following components:

- AMAN hardware (Client, Server, LAN);
- AMAN software;
- AMAN interface with SATCAS (FDPS, RDPS, ENV).

specifying when any of it has a failure.

R-SPV-0030 The AMAN supervision shall allow the Operational/Technical Supervisor to enable/disable AMAN services on all operational room configuration.

R-SPV-0040 The AMAN supervision shall allow the Technical Supervisor to switch on/off the AMAN tool.

R-SPV-0050 The AMAN supervision shall notify to the ATCO and the Technical Supervisor the AMAN status (e.g. enable/disable, on/off) on all the related HMI.

R-SPV-0060 The failure of AMAN Supervision system shall not affect the normal operation of the monitored AMAN system.

R-SPV-0070 The AMAN Supervision system shall allow the Technical Supervisor to perform the following class of actions towards managed objects:

- stop, start, restart, enable, disable :
  - RDPS acquisition;
  - FDPS acquisition;
  - HMI communication;
- start, stop, restart one or more logical sector;
- stop, (re)start :
  - AMAN HW
  - AMAN SW;
  - Any server;
  - Any AMAN process
- restart NTP synchronization on a server;

R-SPV-0080 The AMAN Supervision system shall provide a Supervision HMI to display all configured information of interest exchanged with managed objects.

R-SPV-0090 The AMAN Supervision HMI, shall display the following data to be managed by the Supervisor:

- Alarms;
- Relevant Events;
- Commands/Actions;
- Technical and Functional data;
- Instant indicators;
- Status of managed objects.

R-SPV-0100 The AMAN supervision shall store commands and components status for later analysis.

R-SPV-0110 The AMAN supervision HMI shall be provided for 3 positions on each ACC (OPS + SIM + PSA).

7.8 RECORDING & PLAYBACK

R-RBP-0010 Video recording & playback system shall encompass all the data produced and managed by AMAN and displayed on dedicated AMAN HMI.

R-RBP-0020 Video recording & playback system shall allow the replay of all AMAN operations for each Logical Position.

R-RBP-0030 AMAN shall store diagnostic and application data.

R-RBP-0040 AMAN shall make available recorded and stored data for a period of 30 days.

7.9 MODELLING & POST-ANALYSIS

R-DAF-0010 AMAN shall collect statistical data for the following sources:

- FDPS (flight plan data including actual landing time);
- RDPS (ModeS and path monitoring data);
- AMAN (Sequence and advisory data) .

R-DAF-0020 AMAN shall record, for each inbound flight, at least the following data :

- CALLSIGN;
- SSR CODE;
- Aircraft ModeS;
- Aircraft Type;
- Departure Aerodrome;
- Entry Fix;
- Time/date and level at Entry fix;
- Initial Estimated Time of Landing;
- Initial Track Miles inside a pre-defined area;
- Initial Delay;
- Initial Runway in use;
- Initial flight route;
- Landing rate;
- Actual time/date of landing;
- Actual landing Runway;
- Actual flown radar tracks;
- Actual Track Miles inside a pre-defined area.

R-DAF-0030 AMAN shall record statistical data into daily log files.

7.10 NON-FUNCTIONAL

7.10.1 FAILURE FLOWS

R-NOF-0010 The System shall notify that AMAN server has a failure, removing all the obsolete information if the failure holds for more than 10 seconds.

R-NOF-0020 The System shall notify that SA adapter has a failure, removing all the obsolete information if the failure holds for more than 10 seconds.

7.10.2 CAPACITY

R-NOF-0030 The System shall be able to manage up to 128 geographical volumes aggregated into a maximum of 50 logical sectors.

R-NOF-0040 The System shall be able to manage up to 900 active flights (up to 120 flights for each logical sector);

R-NOF-0050 The System shall be able to manage up to 1024 radar track;

R-NOF-0060 The System shall be able to manage up to 100 dedicated AMAN HMIs;

R-NOF-0070 The System shall be able to manage up to 50 geographical points for each trajectory.

7.10.3 PERFORMANCE

R-NOF-0080 The System shall, at initialization, compute the whole situation and to distribute it to dedicated AMAN HMIs in less than 2,5 minutes.

R-NOF-0090 The System shall, upon any connection lost, re-compute the whole situation and to re-distribute it to dedicated AMAN HMIs in less than 30 seconds without any resource locking.

R-NOF-0100 The System shall, upon AMAN server failure, re-compute the whole situation and to re-distribute it to dedicated AMAN HMIs in less than 30 seconds without any resource locking.

R-NOF-0110 The System shall, upon FDPS failure, re-compute the whole situation and to re-distribute it to dedicated AMAN HMIs in less than 2,5 minutes without any resource locking.

R-NOF-0120 The System shall manage a change of Sector configuration in less than 15 seconds.

R-NOF-0130 The System shall be able to accept up to 11 dedicated AMAN HMIs requests per minute.

R-NOF-0140 The System shall compute a dedicated AMAN HMIs request in less than 1000 milliseconds (of which 700 milliseconds spent for AMAN server elaboration).

R-NOF-0150 The System shall update, upon new flight plan insertion or flight plan modification, the presented information in less than 2,5 seconds.

R-NOF-0160 The System shall elaborate a sector absorption/splitting in less than 15 seconds.

7.10.4 AVAILABILITY

R-NOF-0170 The Availability of AMAN system shall be greater than 0.9999.
Note: 0.9999 is more or less 5 minutes per month.

7.11 TECHNICAL

7.11.1 TIME

R-TEC-0010 AMAN server shall be able to synchronize its clock with other SATCAS components via NTP protocol.

7.11.2 HARDWARE

R-TEC-0020 Each HW component of the system (both servers and clients) shall maintain a CPU occupancy less than 50%.

R-TEC-0030 AMAN platform (both full and reduced) shall run on an hardware platform based on Intel x86 processor with operating system LINUX.

R-TEC-0040 AMAN full platform shall be based on a hardware solution that ensures full fault tolerance capabilities and a very fast recovery operations (see performance requirements)

7.11.3 NETWORKING

R-TEC-0050 All envisaged hardware shall be connected via dedicated ATC Tools LAN.

R-TEC-0060 AMAN servers shall be connected with two ETHERNET network switches set in redundant mode, utilizing an interconnection among each other and using "Rapid Spanning Tree" protocol.

R-TEC-0070 The network switches provide redundancy by utilizing an interconnection among each other and using "Rapid Spanning Tree" protocol (RSTP). It is still to be decided whether FDPS LAN or ATC Tools LAN shall be used.

R-TEC-0080 AMAN Clients from any ACC to any other ACC shall be connected via WAN (E-NET).

R-TEC-0090 The WAN (E-NET) require a continuously available bandwidth of at least 2Mbit/s.

R-TEC-0100 The suppliers must draw up a list of all host/server belonging to the new supply contract and produce a proper connectivity matrix, with details of all local and geographical communication needs within E-NET network.

R-TEC-0110 All Site system IP addresses must be connected to the ENAV national numbering plan, available in CGE-NET and ICT Security department.

R-TEC-0120 While using local sub-networks, Provider must avoid any overlapping with sub-networks already deployed at national level.

R-TEC-0130 In order to properly convey traffic flows onto E-NET geographical network, Provider must respect VPN logical partition and VPN/IP numbering plan/service association.

R-TEC-0140 All the servers and front-end systems belonging to a site and dedicated to geographical communication for a service must be shown toward geographical network on the unique assigned LAN as default gateway network. Network range and addresses will be chosen by CGE-NET and ICT Security department following ENAV national network planning rules.

R-TEC-0150 LAN network redundancies shall be managed by duplicating network devices and fault tolerance protocols. Moreover, server and front-end systems must interconnect following active/stand-by bonding criteria, in order to guarantee the expected high reliability constraints.

R-TEC-0160 Provider must provide the LAN infrastructure equipment (it should be a network resource upgrade or a new HW resource supply) to interconnect server and front-end systems, in total agreement with current technology

R-TEC-0170 Systems interfacing methods with LAN access infrastructure must respect E-NET program (ENAV geographical network) defined criteria.

R-TEC-0180 Systems Interconnection criteria (port assignment) and necessary configuration (IP addressing, interfacing rules, etc.) must be shared with E-NET & ICT Security management centre.

R-TEC-0190 Port configuration must be set by forcing ETH specific negotiation (i.e. ETH 100 full-duplex) in order to minimize possible interfacing problems.

R-TEC-0200 End-to-end communication between systems/services within geographical environment must be enabled exclusively on ports/protocols necessary to a correct service operation.

R-TEC-0210 All application exchanges between different LANs must be implemented and managed at level 3 ISO/OSI. Application equipment with two or more different ports connected to different Operation LANs must not be allowed to exchange traffic.

R-TEC-0220 Within system implementation scope, any kind of interconnection (application or network level) between Operational LAN and third parties LAN (Companies Intranet, internet, etc.) can only be realized passing through E-NET Security modules.

R-TEC-0230 In respect of guarantee a correct correlation between events, server and front-end systems must be synchronized with NTP server.

R-TEC-0240 All server and front-end systems must be compatible with standard LDAP authentication protocol. Moreover, a local authentication method must be provided in order to protect from unauthorized access to the systems. Configuration details and integration with authentication server must be shared with CGE-NET & ICT Security department.

R-TEC-0250 Each provided switch must be SNMPv3 embedded in order to be remotely monitored via RTDM from ENAV. Concerning this, each switch must be provided with a Management VLAN and cabling must be prepared for interconnection towards E-NET network security modules (MS E-NET). Systems configuration and integration details must be shared with CGE-NET & ICT Security department.

R-TEC-0260 Server and front-end Windows systems must be prepared for antivirus configuration by ENAV SOC. Systems configuration and integration details must be detailed in SDD document.

R-TEC-0270 System Design and implementation stages must be scheduled respecting ISO 27001 Standard, for information security management system.

7.11.4 PLANT DESIGN

R-TEC-0280 Hardware and LAN equipment shall be redundant in their power supply components.

R-TEC-0290 Each rack hosting the active equipment shall be powered by two multiple sockets connected to different slots on electric box.

7.12 SOFTWARE

R-SFW-0010 Suppliers shall use all necessary means to ensure the configuration control of installed software and verify non-regression of the modified CSCIs. The choice of tools to perform these activities shall be approved by ENAV during Project Definition.

R-SFW-0020 Suppliers shall provide the Software Maintenance Policy and Evolution Roadmap.

R-SFW-0030 All software changes provided for this project shall at least ensure the maintenance of functional and performance characteristics of the system already in operation (no functional regression).

R-SFW-0040 ENAV will acquire, equally to the supplier, the intellectual property rights (IPR) of the Software. project documentation and source code related to changes in Software already owned and of new Software developed from scratch (SA-ADAPTER). The entire development environment necessary for the production of executable code developed on behalf of ENAV or, being already owned earlier, only modified, shall be included in the supply.

R-SFW-0050 The Software shall be respected what is indicated in ESARR 6 and adopted by European Regulation (EC) 482/2008 relating to the Software in ATM systems.

R-SFW-0060 The Software developed in this program shall be developed with a technology that ensures an high degree of portability and uses COTS hardware.

7.13 HAZARD & SAFETY

The safety requirements shall be provided in respect of results raised during safety analysis conducted by the Risk Assessment Team (RAT). The results of the RAT shall be considered as part of this document.

The Safety Requirements reported below are traced to the System Requirements as follow :

Safety Requirements	System Requirements
SR-07	R-RBP-0010, R-RBP-0020, R-RBP-0030, R-RBP-0040
SR-08	R-HMI-0590, R-HMI-0600, R-HMI-0610 R-SPV-0010, R-SPV-0020, R-SPV-0050
SR-09	R-CFG-0070, R-CFG-0360, R-HMI-0160
SR-10	R-FUN-0030, R-IRQ-0020, R-IRQ-0030, R-IRQ-0040
SR-11	R-FUN-0220, R-HMI-0120, R-HMI-0140, R-HMI-0160, R-HMI-0460
SR-12	R-CFG-0150

Table 5 : Safety Tracebility Matrix

7.14 TERM OF USE AND RELIABILITY

The Suppliers shall indicate the following parameters for each HW equipment:

7.14.1 RELIABILITY

R-TUR-0010 The Suppliers shall specify the following parameters of reliability:

- Average number of faults per year, excluding the anomalies of a transitory nature:
- Minimum value of MTBF, with a confidence level of 90%. This limit shall be provided in cases of:
  - Fault not compromising operational service;
  - Total loss of service;
  - Fault related to management subsystem, diagnostics and maintenance.

7.14.2 MAINTAINABILITY

R-TUR-0020 The Suppliers shall specify the following parameters of maintainability:

- MTTR
- Periodic maintenance Plan.

7.14.3 USEFUL LIFE

R-TUR-0030 The Suppliers shall specify the useful life of the systems to allow for planning and management of equipment on time scale.

7.14.4 AVAILABILITY

R-TUR-0040 The Suppliers shall indicate the availability of supplied systems in accordance with the minimum requirements set by ENAV at a value of 99.995% thereby producing evidence of such availability.

8 COMPLIANCE WITH LAW 552/2004

In accordance with requirements of current legislation respect to the concept of interoperability between ATM systems, in this section all the key elements in terms of Constituents, ER (Essential Requirements), IR (Implementing Rules), MoC (Means of Compliance) will be identified and whatever else is necessary to provide a basis for the compilation of a traceability matrix between IOP requirements applicable to this project and relevant verification tests.

In this section a preliminary analysis is started, essentially in terms of quality, and afterwards it will be further depth and completed during an early stage of final design. This phase, known as Project Definition, will originate, through direct involvement of Supplier, the design documentation, which will give evidence of the logical path that connects the interoperability requirements (ER), previously identified by law 552, and any Implementing Rules (IR) with the user requirements, system requirements collected in SSS document and relevant verification test. Through this traceability it will be possible to measure the achievement of IOP requirements at SAT (Site Acceptance Test) time in relation to the different Constituents involved in the project.

Here below will be identified the list of IOP topics, necessary to start with analysis described earlier:

- Constituents
- Applicable ERs
- Applicable IRs
- Traceability Matrix
- IOP Requirements to fulfill 552 regulations.

8.1 CONSTITUENTS

The table below include all new constituents identified in the project:

System	Sub-System	Constituent
ATM ACC	AMAN	AMAN Server
ATM ACC	AMAN	AMAN HMI

Table 6: New constituents

8.2 APPLICABLE ERs

Constituent	ER 1 Seamless Operation	ER 2 New Concept of Operation	ER 3 Safety	ER4 Civil-military coordination	ER5 Environmental constraints	ER6 Principles governing the logical architecture of systems	ER7 Principles governing the construction of systems
AMAN Server	X	X	X				X
AMAN HMI	X	X	X				X

Table 7: Applicable ERs

The above identified ERs are liable to further integration by Suppliers if new updates to the regulations had occurred.

8.3 APPLICABLE IRs

Not Applicable.

8.4 APPLICABLE CRs

Not Applicable.

8.5 REGULATORY BASELINE

Regulatory baseline inherent to this program is composed by following documentation:

- EC Regulation 552/2004 on the Interoperability of European Air Traffic Management Network.

8.6 IOP

R-IOP-0010 The System shall comply with all applicable legislation and in particular shall satisfy the constraints imposed by the "Regulatory Baseline" identified in section 8.5.

R-IOP-0020 All constituents of new or modified constituents shall comply with the applicable regulations (IR, CS, MoC) and Suppliers shall produce the relevant certification (DSU / DOC).

R-IOP-0030 Suppliers shall design, built, maintain and operate new constituents ensuring the seamless operation of the System at all times and for all phases of flight.

R-IOP-0040 The system shall comply to seamless operation in terms of information sharing, including the relevant operational status information, common understanding of information, comparable processing performances.

R-IOP-0050 The associated procedures enabling common operational performances shall be agreed for the whole or parts of the System.

R-IOP-0060 AMAN server shall be interoperable in terms of the timely sharing of correct and consistent information , and a common operational understanding of that information, in order to ensure a coherent and consistent planning process and resource-efficient tactical coordination throughout the System during all phases of flight.

R-IOP-0070 AMAN server shall process flight data performances in order to be equivalent and appropriate for TMA and en-route environment, with known traffic

characteristics and exploited under an agreed and validated operational concept, in particular in terms of accuracy and error tolerance of processing results.

R-IOP-0080 AMAN HMI shall be designed, built, maintained and operated using the appropriate and validated procedures, in such a way as to offer to all control staff a progressively harmonized working environment, including functions and ergonomics, meeting the required performance in TMA and en-route environment, with known traffic characteristics.

R-IOP-0090 New constituents shall support, on a coordinated basis, new agreed and validated concepts of operation that improve the quality and effectiveness of air navigation services, in particular in terms of safety and capacity.

R-IOP-0100 Suppliers shall guarantee a safe implementation of technological developments related to collaborative decision-making, increasing automation and alternative methods of delegation of separation responsibility, supporting their operational validation.

R-IOP-0110 AMAN server shall be designed, built, maintained and operated, using appropriate and validated procedures, in such a way as to be interoperable in terms of timely sharing of correct and consistent and a common understanding of the current and predicted operational situation.

R-IOP-0120 AMAN HMI shall accommodate the progressive introduction of new, agreed and validated concepts of operation and increased automation, in such a way as to ensure that the tasks assigned to the control staff remain compatible with human capabilities, in both the normal and degraded modes of operation.

8.7 TRACEABILITY MATRIX OF REQUIREMENTS

In the next page, the structure of traceability matrix is reported.

Of course, the table shall be filled with all ERs indicated in the previous paragraphs and relevant IRs, IOP requirements specified in this document and the functional requirements individuated in the project definition.

Area Tecnica

TRACEABILITY COMPLIANT TO INTEROPERABILITY REGULATION (Reg. CE 552/04)

Program: AMAN

(*) = if it is expected

				IOP compliance verifications :							
		NSE requirements	Technical/Operational requirements	System Design		Development and pre-operational validation	Operational integration		IOP verification of maintainability instructions	Constituent	
Essential Requirements (ER)	*IR*	*(Comm. Spec., ICAO, Eurocae, ENAV regulation)*	*Technical specification*	*Technical proposal (indicate ref.)*	*System design (indicate ref.)*	*FAT (*) (indicate test id.)*	*SAT (indicate test id.)*	*Operational validation (*)*		*Constituent identifier*	*DoC/DSU (prot. doc.)*
ER1 Seamless Operation (new constituents)			R-IOP-0030								
			R-IOP-0040								
			R-IOP-0050								
			R-IOP-0060								
			R-IOP-0070								
			R-IOP-0080								

				IOP compliance verifications :							
		Reg. requirements	Technical/Operational requirements	System Design		Development and environmental validation	Operational integration		IOP verification of maintenance interventions	Constituent	
Essential Requirements (ER)	*IR*	*(Comm. Spec., ICAO, Eurocae, ENAV regulation)*	*Technical specification*	*Technical proposal (indicate ref.)*	*System design (indicate ref.)*	*FAT (*) (indicate test id.)*	*SAT (indicate test id.)*	*Operational validation (*)*		*Constituent Identifier*	*DoC/DSU (prot. doc.)*
ER2 New Cocept of Operation (new constituents)			R-IOP-0090								
			R-IOP-0100								
			R-IOP-0110								
			R-IOP-0120								
ER3 Safety											
ER7 Principles governing the construction of systems			R-ARC-0040								
			R-NOF-XXXX								

Table 8: Traceability to interoperability regulation

9 SUPPLY

9.1 EQUIPMENT AND ACTIVITY OF SUPPLY

In this program the supply is composed by the following items:

- Definition of the system requirements
- Definition of system architecture
- Supply of all the necessary equipment
- SW development of new components
- Necessary adaptations to the operational systems (if it could be necessary)
- Support to the validation activities of new SW versions
- Safety assessment of new system
- Production of all technical documentation.