Update of 5.6.4 SPR-INTEROP - Step 1 - Edition 2

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Abstract

This document presents Safety, Performance and Interoperability Requirements for SESAR Solution #05 (E-AMAN) plus Long Range AMAN on operational level that have been developed in P05.06.04 (QM-4 – Tactical TMA and En-route Queue Management) and P05.06.07 (QM-7 – Integrated Sequence Building/Optimisation of Queues) as part of OFA04.01.02 and within SESAR Step 1. Since E-AMAN and CTA are closely related, relevant CTA requirements are provided in addition not belonging to the solution #05 as such. The document addressed Operational Improvement TS-0305-A at the E-OCVM V3 phase. It is based on safety assessment conducted by the project and reported in D34-001 Safety Assessment Report. It further draws from outcomes of a series of validation exercises executed in projects 05.06.04 and 05.06.07. A further synthesis

should take place at the OFA level where the findings in this report would be considered in conjunction with those of the closely related OI, e.g. TS-0103 and TS-0303.
Furtherly, Appendix C "INTEROP" is included in the document. It provides interoperability requirements for the Extended Arrival Management within OFA04.01.02 Enhanced Arrival and Departure Management in TMA and En-Route. The operational scope is comprising Extended AMAN operations covered by operational improvement step TS-0305-A.

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Executive summary

This document presents Safety, Performance and Interoperability Requirements for SESAR Solution #05 (E-AMAN) plus Long Range AMAN on operational level that have been developed in P05.06.04 (QM-4 – Tactical TMA and En-route Queue Management) and P05.06.07 (QM-7 – Integrated Sequence Building/Optimisation of Queues) as part of OFA04.01.02 and within SESAR Step 1. The assessment addressed Operational Improvement Step TS-0305-A at the E-OCVM V3 phase. It is based on results of a safety assessment activity conducted previously and draws from outcomes of a series of validation exercises executed in projects 05.06.04 and 05.06.07. Due to this reason and as solution E-AMAN does not include CTA, although they are closely related, relevant CTA requirements are provided in addition not belonging to the solution # 05 as such.

Safety Requirements were defined in D34-001 Safety Assessment Report, having applied SESAR Safety Reference Methodology under guidance from P16.06.01 safety experts. Performance requirements were defined part in Operational Performance Assessment conducted by the project and in part provided from Human Performance assessments conducted by respective WP16 projects, all on the basis of validation evidence resulting from a range of validation activities executed primarily in P05.06.04 and P05.06.07. Interoperability requirements, provided in an embedded document, were produced by P05.06.07 in cooperation with P05.06.04 and are based on prior work by P10.01.07 on technical architecture, the P05.06.04 Safety Assessment of the concept and the outcomes of a series of validation exercises executed in projects P05.06.01, P05.06.04 and P05.06.07.

Other WP16 projects were consulted and findings concerning their respective assessments of the OI were included in this document.

In OFA level coordination it was agreed that this SPR-INTEROP activity should restrict itself to a purely operational view; as per the SESAR framework the work is to be continued by technical projects.

A further synthesis should take place at the OFA level where requirements defined in this document would be considered in conjunction with those of the closely related OI, e.g. TS-0103 and TS-0303.

1 Introduction

1.1 Purpose of the document

This Safety and Performance Requirements (SPR) document provides the safety and performance requirements for services related to the operational processes defined by P05.06.07 D15 (Update of 5.6.4 OSED - Step 1 [27]) that have been developed in P05.06.04 (QM-4 – Tactical TMA and En-route Queue Management) and P05.06.07 (QM-7 – Integrated Sequence Building/Optimisation of Queues) as part of OFA04.01.02 and within SESAR Step 1 in order to meet SESAR Solution #05 (E-AMAN) plus Long Range AMAN. The SPR also provides their allocation to Functional Blocks. They shall identify the requirements needed to fulfil each KPA and include, or reference, the sources justifying those requirements.

1.2 Scope

This document supports the operational services and concept elements identified in the Operational Service and Environment Definition (OSED) [27]. These services are expected to be operational (IOC) in the 2020-2024 time frame according to DS14 and are representing SESAR Solution #05 (E-AMAN) on operational level and belong to Operational Improvement Step TS-0305-A (Arrival Management Extended to En Route Airspace - single TMA). Since solution E-AMAN and CTA are closely related, relevant CTA requirements are provided in addition not belonging to the solution #05 as such.

The narrower scope of the SPR is inherited from the SAR which provides the basis of this document. Namely, the OSED scope applies except partly Satellite Airports and CTA (only basic CTA addressed here) context, as there were felt to fall within the purview of other operational projects in WP5 and 6.

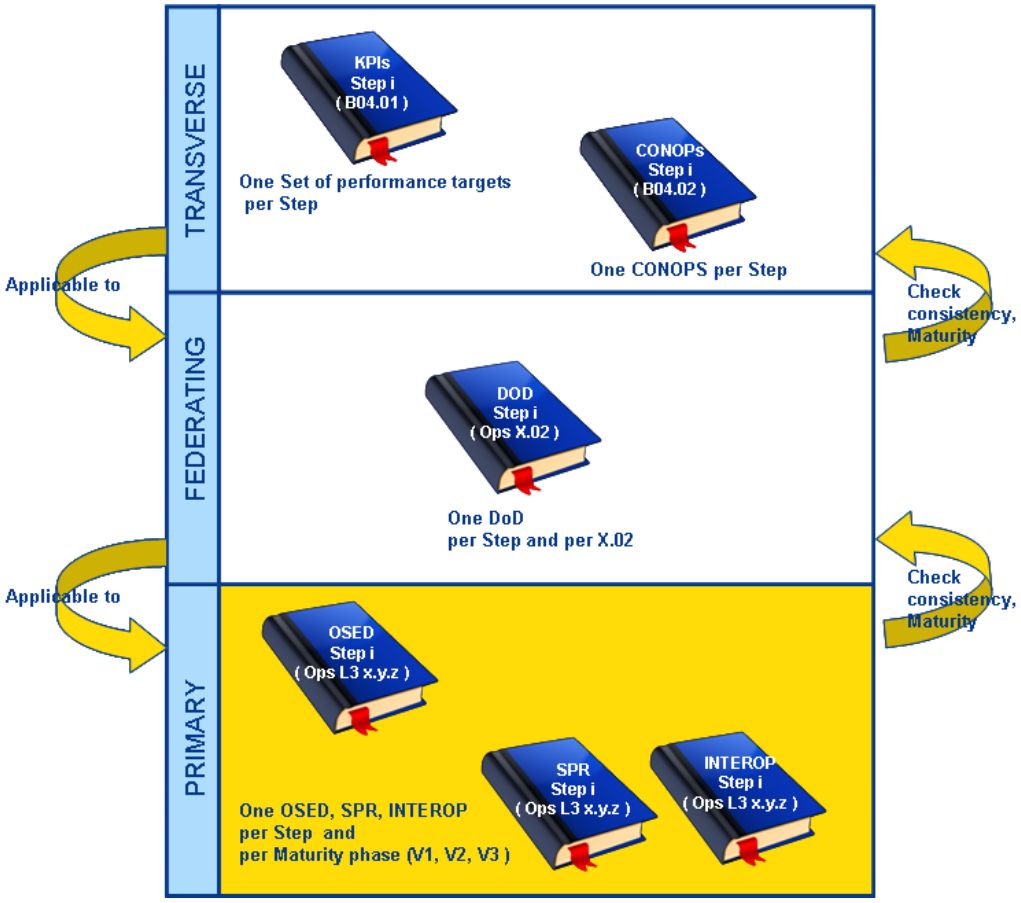

Figure 1: SPR document with regards to other SESAR deliverables

In Figure 1~~Figure 1~~, the Steps are driven by the OI Steps addressed by the project in the Integrated Roadmap document [9].

1.3 Intended readership

Projects of the OFA 04.01.02 Enhanced Arrival & Departure Management in TMA and En Route in addition to P5.6.4:

- 05.03 Integrated and Pre-operational Validation & Cross Validation
- 05.06 Queue Management in TMA and En-Route
- 05.06.07 Integrated Sequence Building/Optimisation of Queues
- 10.09.01 Integration of Queue Management
- 10.09.02 Multiple airport arrival/departure management
- 12.04.04 Integration of Departure Management and Surface Management

Federating Projects:

- P04.02 Consolidation of Operational Concept Definition and Validation
- P05.02 Consolidation of Operational Concept Definition and Validation
- P10.01.07 ATC System Specification

Other Primary Projects whose work is relevant to OFA04.01.02:

- WP4:
  - P04.07.01 Complexity Management
- WP5:
  - P05.04.02 TMA-2 Co-Operative Planning Requirements and Validation
  - P05.05.01 Trajectory Management Framework in TMA
  - P05.06.01 QM1 – Ground and Airborne Capabilities to Implement Sequence
  - P05.09 Usability Requirements and Human Factors Aspects for the Controller Working Position
- WP6:
  - P06.08.04 (Coupled AMAN-DMAN)
- WP8:
  - P08.01.03: AIRM Deliverable
  - P08.03.10: Information Service Modelling deliverables
- WP9:
  - P09.01 Airborne Initial 4D Trajectory Management
- WP10:
  - 10.01.07 ATC System Specification
- WP16 :
  - 16.05.04 Selection and training requirements to work with automated decision and support tools
  - 16.06.01 Safety support and coordination function
  - 16.06.02 Security support and coordination function
  - 16.06.03 Environment support and coordination function

- 16.06.05 Human Performance support and coordination function
- 16.06.06 Business Case Maintenance support and coordination function

- WP B:
  - B.05 Performance Analysis of ATM Target Concept

1.4 Structure of the document

This document follows the structure of the SPR template. Chapter 2 provides references to detailed concept, service and environment definitions. Chapter 3 provides the full set of safety and performance requirements. Chapter 4 provides a list of referenced literature. Source documents, activities and arguments are provided separately in Appendices.

1.5 Background

The following activities served as the basis for this document, in the chronological order as required by the system engineering process.

P05.06.04 OSED [5] provided the definition of the operational concept, services and environment, as well as a draft security assessment.

P05.06.04 Safety Assessment Report [7] provided the complete set of operational requirements, developed as per SESAR SRM.

P10.01.07 Functional Decomposition [6] provided the breakdown of the system architecture required for allocation of requirements.

Validation projects addressing TS-0305-A (EXE-244, EXE-485, EXE-695) provided validation results and human performance assessments taken into account in the production of performance requirements.

According to the template, performance requirements should be addressed using Performance Indicators defined by OSED and supported by Benefit Impact Mechanisms by B04.01. As the 05.06.04 OSED [5] does not publish any such Indicators, the SPR task group investigated the issue of performance first in the broader context of SESAR and tried to distinguish between the different organisational levels and the according document types which helps to define a more accurate scope of different documents like SPR and INTEROP (See Figure 2~~Figure 2~~).

It was necessary to differentiate between a business performance level, an operational performance level and a service performance level. Business performance is re-stated in requirements of the DoD documents and reflecting KPAs like Safety, Capacity or Environment/Fuel Efficiency.

SPR level is identifying the operational performance needs, either identified within the Safety part or related to other KPAs. Beyond specific KPAs, general operability, feasibility and acceptance should be covered in the human performance part, sourced from validation activities targeting TS-0305-A. The task group also coordinated with 16.06.03 and 16.06.06 with the intent to identify assessments in the fields of Environmental Sustainability and Cost Benefit Analyses that have been conducted in support of TS-0305-A.

In KPA Security, a preliminary assessment was conducted as part of the OSED; the KPA summarizes its output in A.1.2, although no requirements have been defined due to low maturity of the assessment.

In case it needs to be regarded for ‘service design’, i.e. Information Exchange Requirements (IERs) have been defined; there is more information to be given which is covered by the INTEROP document. The task group termed this as service performance and delegated the area to the INTEROP document, which serves to identify and characterize the information exchange done within a service, i.e. quality of service/IER performance. INTEROP collects the minimum high level service needs before a technical solution could be identified.

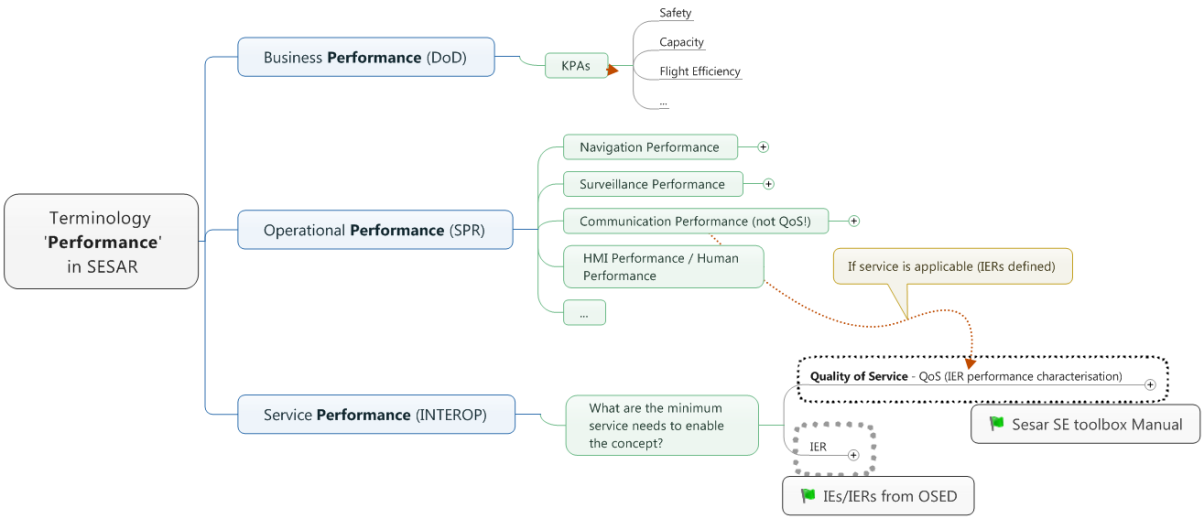

Figure 2: Terminology 'Performance' in SESAR

1.6 Glossary of terms

Term	Definition
Actor	An implementation independent unit of responsibility that performs an action to achieve an effect that contributes to a desired end state. [ATM Lexicon]
Airspace	A defined three dimensional region of space relevant to air traffic. [ATM Lexicon]
AMAN	A planning system to improve arrival flows at one or more airports by calculating the optimised approach / landing sequence and Target Landing Times (TLDT) and, where needed, times for specific fixes for each flight, taking multiple constraints and preferences into account. [ATM Lexicon]
CTA	Controlled Time of Arrival – An ATM imposed time constraint on a defined merging point associated to an arrival runway [SESAR lexicon].
CTO	Controlled Time Over – An ATM imposed time constraint over a point [SESAR Lexicon]
DMAN	A planning system to improve departure flows at one or more airports by calculating the Target Take Off Time (TTOT) and Target Start Up Approval Time (TSAT) for each flight, taking multiple constraints and preferences into account. [SESAR Lexicon]
ETA min/max	ETA min/max is a reliable earliest/latest ETA at a waypoint; wind/temp error is also taken into account in order to guarantee that any CTA defined within associated ETA min/max interval will be satisfied with high probability (95%). [source P5.6.4]
Implementation horizon	The period of time reserved for active sequence implementation, from AAH to MP
Inter-aircraft spacing	The desired inter aircraft spacing at MP as configured in AMAN
Open Loop Clearance	An ATC clearance that does not include a specified or implied point where the restriction on the trajectory ends.

Term	Definition
Potential conflict	A potential conflict is given when future position of 2 or more aircraft might fall below specified minima (not necessary the separation minima), given the uncertainty in the prediction.
Queue Management	The tactical establishment and maintenance of a safe, orderly and efficient flow of traffic.
RTA	Required Time of Arrival - A function of the airborne FMS that allows the flight to comply with a CTA/CTO. [SESAR Lexicon]
Traffic Sequencing	Traffic sequencing is the process of organising aircraft into a specific order.

1.7 Acronyms and Terminology

Term	Definition
AAH	Active Advisory Horizon
A/C	Aircraft
AEM	Advanced Emission Model
AMAN	Arrival Manager (Equipment)
ANSP	Air Navigation Service Provider
APP	Approach (control sector/position)
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATSU	Air Traffic Service Unit
ATSU DEST	ATSU Destination
BADA	Base of Aircraft Data
COTR	Coordination and Transfer (equipment)
CTA	Controlled Time of Arrival
CWP	Controller Working Position
DOD	Detailed Operational Description
E-AMAN	Extended AMAN
EH	Eligibility Horizon
ENR	En-route

Term	Definition
EOBT	Estimated Off-Block Time
E-OCVM	European Operational Concept Validation Methodology
ETA	Estimated Time of Arrival
EXE	Executive controller
EXE-nnn	SESAR Validation Exercise VP-nnn
FDPS	Flight Data Processing System
FH	Flight Hour *also styled as flt hr*
FIR	Flight Information Region
FL	Flight level
FMS	Flight Management System
FPL	Flight plan
HF	Human Factor(s)
HMI	Human Machine Interface
HP	Human Performance
ICAO	International Civil Aviation Organisation
INTEROP	Interoperability Requirements
LTUP	Landing Time Update Point
MCDU	Multipurpose Control and Display Unit
MET	Meteorological information (data source)
MP	Metering Point
NM	Nautical Mile
OFA	Operational Focus Area
OI	Operational Improvement (Step)
OLDI	On-Line data Interchange
OSED	Operational Services and Environment Description
PLN	Planning controller

Term	Definition
RT	Radio Telephony *also styled as R/T*
RTA	Required Time of Arrival
RWY	runway
SAR	Safety Assessment Report
SDPS	Surveillance Data Processing System
SEQ_MAN	Sequence Manager (role)
SESAR	Single European Sky ATM Research Programme
SFPL	System Flight Plan
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SOH	Sector Operating Hour
SPR	Safety and Performance Requirements
SR	Safety Requirement
SRM	SESAR Safety Reference Material
STAR	Standard Arrival Route
SWIM	System-Wide Information Management
TMA	Terminal (Manoeuvring) Area
TOBT	Target Off Block Time
ToD	Top of Descent
TP	Trajectory Predictor (or Prediction)
TTG	Time to Gain
TTL	Time to Lose
TTOT	Target Take-Off Time
TWR	Tower (ATS Unit/role)
VALS	Validation Strategy
WVE	Wake Vortex Encounter
WX	weather

2 Summary of Operational Concept (from OSED)

2.1 Description of the Concept Element

The concept element at hand is OI TS-0305-A « Arrival Management Extended to En Route Airspace – single TMA ». Its SESAR Operating Method features arrival management horizon extended well into en-route airspace to approximately 40 minutes flight time remaining, and furnishes the method with additional services, processes, interoperability and support. For thorough description see OSED [5], section 3, and SAR [7], section 1.1.

2.2 Description of Operational Services

OSED [27] defines the following structure of Processes and Services in support of the Operating Method:

- Traffic Synchronization
  - Pre-sequence and sequence arrival aircraft
    - Pre-sequence long-range arrivals (included in the updated SAR [7])
    - Execute ground delay process
    - Sequence and Meter Arrivals with CTA and TTL/TTG (SAR scope narrowed by omitting the i4D context, i4D part is covered by project 05.06.01 and SESAR solution #06)

The processes are further developed and updated within EATMA. The SAR that provided the basis for the requirements detailed herein considered EATMA v4 as its principal reference concerning Processes and Services. For various reasons, the SAR excluded certain services from its scope; requirements concerning those services are hence not captured within this SPR. SAR is focussed on SESAR Solution #05 (E-AMAN) including Long Range AMAN but excluding i4D. Although basic CTA does not belong to the scope of solution #05 it is regarded in the SAR analysis for completeness and the strong link and interaction between operational improvement steps TS-0305-A and TS-0103.

2.3 Description of Operational Environment

The environment is defined as single airport TMA, Medium/Medium and High/High Density-Complexity classification as per P05.02 VALS [10]. See OSED [5] section 4 or SAR [7] section 2.2 for a detailed definition.

3 Requirements

This section shall describe the safety and performance requirements. The SPR requirements show traceability to the operational requirements (applicable to Processes and Services (P&S)) as described in the OSED. Consequently it is structured per Operational Service (P&S), and subdivided into Safety and Performance Requirements.

The following numbering of Requirement ID's is applied in this document.

Base string: REQ-05.06.04-SPR-0034.XXXX

Block ranges for XXXX:

0001 through 0099 & 0301 through 0308[1]	Safety requirements derived in SAR success approach
0100	Reserved
0101 through 0199 & 0309[2]	Safety requirements derived in SAR failure approach
0200	Reserved
0201 through 0299	Performance requirements
0300	Reserved
0310 through 0399[3]	New Requirements

The only procedural enabler linked to TS-0305-A is PRO-245 that specifies the ATC Procedures developed for the use of extended Arrival management, involving cooperation between different ANSPs and protocol for coordinating through several areas of responsibility, including across borders. The following requirements are covering PRO-245:

- REQ-05.06.04-SPR-0034.0039
- REQ-05.06.04-SPR-0034.0059

3.1 Operational Service OFA04.01.02 SVC005 Arrival Sequence Information

3.1.1 Safety Requirements

Identifier	REQ-05.06.04-SPR-0034.0001
Requirement	E-AMAN shall build arrival sequence

Identifier	REQ-05.06.04-SPR-0034.0002
Requirement	AMAN ATSU shall provide E-AMAN with flight information regarding all flights inbound to the destination airport.

Identifier	REQ-05.06.04-SPR-0034.0003
Requirement	AMAN ATSU shall provide E-AMAN with flight information regarding an arriving flight when the flight reaches the defined Eligibility Horizon.

Identifier	REQ-05.06.04-SPR-0034.0004

[1] 0301 through 0308 safety requirements are covering long range AMAN based on E-AMAN and are derived from the updated SAR [7].
[2] 0309 safety requirement is covering long range AMAN based on E-AMAN and is derived from the updated SAR [7].
[3] Except 0347 safety requirement that is included in the group of safety requirements derived in SAR success approach.

Requirement	Flight data distribution shall ensure that flight information provided to E-AMAN is correct and accurate to the standard as required for the provision of the ATC separation service.

Identifier	REQ-05.06.04-SPR-0034.0005
Requirement	Sequence Manager shall supervise and control E-AMAN.

Identifier	REQ-05.06.04-SPR-0034.0006
Requirement	E-AMAN shall insert a representation of an inbound flight reaching the Eligibility Horizon in the sequence in accordance with applicable rules and strategies.

Identifier	REQ-05.06.04-SPR-0034.0007
Requirement	Sequence manager shall adjust control parameters of E-AMAN to reflect actual and planned operational conditions. In all cases this refers to downstream constraints such as desired landing runway throughput or holding stack entry rate/delay. In specific cases, other constraints may be considered as required by local implementation.

Identifier	REQ-05.06.04-SPR-0034.0008
Requirement	Sequence manager shall have the authority to select and engage ATC strategies.

Identifier	REQ-05.06.04-SPR-0034.0009
Requirement	Satellite airport shall provide to E-AMAN planned departure information regarding an inbound flight about to depart a satellite airport, prior to the flight's EOBT.

Identifier	REQ-05.06.04-SPR-0034.0010
Requirement	E-AMAN shall insert a representation of an inbound flight about to depart a satellite airport in the sequence in accordance with applicable rules and strategies.

Identifier	REQ-05.06.04-SPR-0034.0011
Requirement	E-AMAN shall update the sequence to account for new and relevant information.

Identifier	REQ-05.06.04-SPR-0034.0012
Requirement	Sequence manager shall introduce changes and adjustments to the sequence as deemed necessary for safe and expedient flow of inbound traffic.

Identifier	REQ-05.06.04-SPR-0034.0013
Requirement	Sequence manager shall use COTR to coordinate with other controllers regarding sequence build as required.

Identifier	REQ-05.06.04-SPR-0034.0014
Requirement	For each inserted flight E-AMAN shall plan the flight so as to comply with the required traffic flow parameters and subsequently determine whether there exists a need to delay or expedite the flight.

Identifier	REQ-05.06.04-SPR-0034.0015
Requirement	For each inserted flight where a need for delay or expedition was identified, E-AMAN shall determine the appropriate form of advisory and subsequently issue the advisory to associated controllers.

Identifier	REQ-05.06.04-SPR-0034.0016

Requirement	EXE/PLN En-Route sector controllers shall implement the sequence and delay/expedition of flights under their control before flights reach coordination point with Approach sectors.

Identifier	REQ-05.06.04-SPR-0034.0017
Requirement	E-AMAN shall assess a prospective delay need to an inbound flight departing a satellite airport, as delay (TTL) only.

Identifier	REQ-05.06.04-SPR-0034.0018
Requirement	For each flight assessed with a need for delay or expedition, AMAN shall consider the equipment and capability of the flight in determining the appropriate form of advisory or proposal.

Identifier	REQ-05.06.04-SPR-0034.0019
Requirement	For each flight assessed with a need for delay or expedition and CTA as applicable means of implementation, E-AMAN shall assess whether the delay or expedition need, expressed as a CTA proposal, can be reasonably expected to be met once implemented.

Identifier	REQ-05.06.04-SPR-0034.0020
Requirement	E-AMAN shall not issue a CTA proposal if the proposal cannot be reasonably expected to be met by the flight, once implemented.

Identifier	REQ-05.06.04-SPR-0034.0021
Requirement	On receiving a CTA proposal in their CWP HMI, controllers shall assess if the proposal can be safely implemented in the current air traffic picture.

Identifier	REQ-05.06.04-SPR-0034.0022
Requirement	Controllers shall issue, by means of voice or datalink as determined locally, an appropriate instruction commensurate with the value in the CTA proposal (CTA instruction) to the flight crew if, in the controllers' judgment, the proposal can be safely implemented in the current air traffic picture.

Identifier	REQ-05.06.04-SPR-0034.0024
Requirement	Controllers shall implement AMAN advisories to flights in lieu of CTA in any of the following cases : • The proposed CTA was not instructed by the controller • The proposed CTA was rejected by crew prior to implementation • The implemented CTA was cancelled by controller

Identifier	REQ-05.06.04-SPR-0034.0025
Requirement	E-AMAN shall indicate clearly to the controller a change in state of an implemented CTA.

Identifier	REQ-05.06.04-SPR-0034.0026
Requirement	E-AMAN shall display to the controller an actual and updated advisory value pertaining to the flight if the CTA is cancelled or rejected.

Identifier	REQ-05.06.04-SPR-0034.0027
Requirement	Flight crew shall receive CTA instruction via RT Voice or datalink.

Identifier	REQ-05.06.04-SPR-0034.0028
Requirement	Flight crew shall assess whether it is feasible to comply with the received CTA instruction.

Identifier	REQ-05.06.04-SPR-0034.0029

Requirement	Flight crew shall use RT Voice or datalink to inform the controller regarding their assessment of feasibility of the CTA instruction.

Identifier	REQ-05.06.04-SPR-0034.0030
Requirement	On positive acknowledgement of the CTA instruction to the controller, flight crew shall engage the RTA function with the appropriate constraint value inserted.

Identifier	REQ-05.06.04-SPR-0034.0031
Requirement	Controllers shall continuously monitor traffic in their sectors and ensure that the AMAN advisories are complied with.

Identifier	REQ-05.06.04-SPR-0034.0032
Requirement	Satellite TWR shall receive arrival management information from E-AMAN.

Identifier	REQ-05.06.04-SPR-0034.0033
Requirement	Satellite TWR shall determine a TTOT for a departing flight inbound to the destination ATSU, compliant with the assigned ground delay[4].

Identifier	REQ-05.06.04-SPR-0034.0034
Requirement	When Satellite TWR determines that the calculated TTOT cannot be met by the departing flight inbound to the destination ATSU, Satellite TWR shall inform E-AMAN accordingly.

Identifier	REQ-05.06.04-SPR-0034.0035
Requirement	On receiving a request for new arrival management information from a Satellite TWR, E-AMAN shall reschedule the respective satellite departure in the sequence and communicate new arrival management information to the Satellite TWR.

Identifier	REQ-05.06.04-SPR-0034.0036
Requirement	Quality of trajectory prediction used by E-AMAN to build the sequence shall be sufficient to support concept operation.

Identifier	REQ-05.06.04-SPR-0034.0037
Requirement	E-AMAN shall continuously monitor and diagnose its operation and alert Sequence manager if its operational status has exceeded applicable operational parameters. *Note: Operational service parameters will result from SPR-INTEROP, technical design and local implementation*s.

Identifier	REQ-05.06.04-SPR-0034.0038
Requirement	E-AMAN shall continuously monitor the quality of its input data and alert Sequence manager if input data quality is suspect.

Identifier	REQ-05.06.04-SPR-0034.0039
Requirement	Upstream ATSU ATM system shall receive, process and display arrival management information.

Identifier	REQ-05.06.04-SPR-0034.0040
Requirement	E-AMAN configuration shall provide functionality to define rules to govern potential overtake situations, as functions of route, aircraft type and its associated performance characteristics, distance-to-go, downlinked aircraft

[4] A process and procedure was defined and tested in EXE-485. A detailed realisation of tower and airport processes is out of scope. 5.6.X identified the arrival management needs only.

	parameters if available, strategic prioritization, other data sources and other operational parameters as available.

Identifier	REQ-05.06.04-SPR-0034.0041
Requirement	Sequence manager shall be able to arbitrarily assign a runway to a flight

Identifier	REQ-05.06.04-SPR-0034.0042
Requirement	Sequence manager shall be able to prompt E-AMAN to recalculate an arbitrary portion of a stabilized sequence.

Identifier	REQ-05.06.04-SPR-0034.0043
Requirement	E-AMAN shall make consistent use of best source of information for the following service data: - weather/MET - operational parameters - flight information - trajectory prediction

Identifier	REQ-05.06.04-SPR-0034.0044
Requirement	E-AMAN shall provide to Sequence manager at the minimum the following arrival management information: - value of advisory/CTA status - sequence number - time ordered sequence - sequence filterable by runway/metering or feeder fix - *Note: distance to go is an optional information item as per local implementation.*

Identifier	REQ-05.06.04-SPR-0034.0045
Requirement	Configuration of E-AMAN shall be validated and verified prior to operational deployment.

Identifier	REQ-05.06.04-SPR-0034.0046
Requirement	E-AMAN shall consider any change introduced in the sequence by Sequence manager as permanent unless prompted to recalculate by Sequence manager

Identifier	REQ-05.06.04-SPR-0034.0347
Requirement	E-AMAN shall, either through a parameter setting or through internal logic, define a horizon with respect to the landing time. In the time range defined by the point where flight information is received, and the horizon, E-AMAN shall freely change ordering of flights in the sequence unless prohibited from doing so by input from Sequence manager. The horizon is referred to as Stable Sequence Horizon (SSH) in this SPR and its related OSED.

Identifier	REQ-05.06.04-SPR-0034.0048

Requirement	E-AMAN shall not automatically change order in the sequence of traffic that has passed SSH. *Note: Satellite departures shall have their sequence slot reserved in advance.*

Identifier	REQ-05.06.04-SPR-0034.0049
Requirement	E-AMAN shall not constrain a flight by an advisory or CTA proposal when it is determined that there is no need for delay.

Identifier	REQ-05.06.04-SPR-0034.0050
Requirement	E-AMAN shall be configurable to indicate explicitly to Sequence manager and ATCO an intentionally unconstrained flight.

Identifier	REQ-05.06.04-SPR-0034.0051
Requirement	E-AMAN shall determine and assign runway to a flight in accordance with a predefined runway utilization strategy.

Identifier	REQ-05.06.04-SPR-0034.0052
Requirement	Controllers in any involved ATSU (Upstream and Destination) shall coordinate with Sequence manager with respect to desired changes in sequence as required.

Identifier	REQ-05.06.04-SPR-0034.0053
Requirement	Controller in ATSU Upstream shall receive information sufficient to make an assessment of CTA capability of a sequenced flight in their sector.

Identifier	REQ-05.06.04-SPR-0034.0054
Requirement	Sequence manager shall be able to insert a tactical reservation of arbitrary length in the sequence to account for abnormal cases such as low performance aircraft or short term runway closure.

Identifier	REQ-05.06.04-SPR-0034.0055
Requirement	Sequence manager shall be able to designate a flight for special treatment where deemed necessary

Identifier	REQ-05.06.04-SPR-0034.0056
Requirement	E-AMAN shall exclude from sequencing a flight designated by Sequence manager for special treatment.

Identifier	REQ-05.06.04-SPR-0034.0057
Requirement	Sequence manager shall be able to manually define and insert a flight in the sequence.

Identifier	REQ-05.06.04-SPR-0034.0058
Requirement	Sequence manager shall be able to manually remove a flight from the sequence.

Identifier	REQ-05.06.04-SPR-0034.0059
Requirement	E-AMAN shall monitor communication of Arrival Management information in Upstream ATSU and alert Sequence Manager if reception of said information cannot be verified.

Identifier	REQ-05.06.04-SPR-0034.0301
Requirement	E-AMAN shall build arrival pre-sequence.

Identifier	REQ-05.06.04-SPR-0034.0302
Requirement	AMAN ATSU shall provide E-AMAN with flight information regarding an arriving flight when the flight reaches the defined Long Range Eligibility Horizon.

Identifier	REQ-05.06.04-SPR-0034.0303
Requirement	E-AMAN shall insert a representation of an inbound flight reaching the Long Range Eligibility Horizon in the sequence in accordance with applicable rules and strategies.

Identifier	REQ-05.06.04-SPR-0034.0304
Requirement	For coordination purposes an ATC strategy including delay sharing strategy and letter of agreements regarding sequence build as required shall be in place.

Identifier	REQ-05.06.04-SPR-0034.0305
Requirement	EXE/PLN En-Route sector controllers shall implement the pre-sequence and delay/expedition of flights before flights reach coordination point with downstream en-route sectors.

Identifier	REQ-05.06.04-SPR-0034.0306
Requirement	E-AMAN shall propose speed advisories according to the delay strategy.

Identifier	REQ-05.06.04-SPR-0034.0307
Requirement	For situation awareness and in order to detect speed variations, speed (Mach number) and speed changes shall be displayed and highlighted if necessary to the responsible controller. Alternatively a speed reporting by the aircrews shall be made mandatory where required.

Identifier	REQ-05.06.04-SPR-0034.0308
Requirement	E-AMAN shall select the value from an acceptable speed range (AU acceptance mainly) in case of a proposed speed instruction. E-AMAN shall consider resulting speed range of aircraft in case of TT@IMP.

Note: Following requirements contain likelihood figures that may require further consolidation during implementation. Validation results do not refine the expressed needs further. Figures have been achieved by expert assessment.

Identifier	REQ-05.06.04-SPR-0034.0101
Requirement	The likelihood of E-AMAN being not available or unserviceable shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0102
Requirement	The likelihood of E-AMAN operating on an incorrect time reference shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0103
Requirement	The likelihood of E-AMAN failing to accept and correctly process human input shall be no more than 1e-3 SOH, approximately once every 6 weeks.

Identifier	REQ-05.06.04-SPR-0034.0104
Requirement	The likelihood of E-AMAN incorrectly assessing need for delay or expedition shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0105
Requirement	The likelihood of E-AMAN incorrectly determining the appropriate form of advisory or proposal shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0106
Requirement	The likelihood of E-AMAN failing to classify a satellite departure accordingly shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0108
Requirement	The likelihood of E-AMAN failing to correctly determine feasibility of a CTA shall be no more than 3e-3 SOH, approximately once every two weeks.

Identifier	REQ-05.06.04-SPR-0034.0109
Requirement	The likelihood of E-AMAN failing to provide applicable CTA status to the controller shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0110
Requirement	The likelihood of E-AMAN failing to provide the actual value of AMAN advisory following a cancellation of a CTA shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0111
Requirement	The likelihood of E-AMAN failing to re-sequence a satellite departure with a reported “TTOT unachievable” shall be no more than 6e-3 SOH, approximately once weekly.

Identifier	REQ-05.06.04-SPR-0034.0112
Requirement	Sequence manager shall be trained in control, supervision, operation and HMI input/output functions of E-AMAN.

Identifier	REQ-05.06.04-SPR-0034.0114
Requirement	E-AMAN shall implement a “what-if” function as defined in the OSED. Such a function allows the SEQ_MAN to assess the impact of a prospective action before the action is committed and implemented in the sequence.

Identifier	REQ-05.06.04-SPR-0034.0115

Requirement	Controllers shall be trained with respect to the following actions : • Coordination of tasks related to sequence implementation • Implementation of advisories • Assessment of CTA capability of flights (local implementation) • Assessment of CTA feasibility in relation to overall safety and expediency of traffic flow in own sector, with special emphasis on potential sudden changes in workload in case of multiple simultaneous cancellation of CTA's. • Handling of CTA proposals • Continuous monitoring and assessment of flights operating on an assigned CTA • Phraseology for CTA instructions • Continuous monitoring and assessment of compliance with clearances related to implementation of AMAN advisories

Identifier	REQ-05.06.04-SPR-0034.0116
Requirement	E-AMAN shall be designed to facilitate coordination of sequence build and implementation related information between Sequence manager and EXE/PLN controllers active in or contributing to the implementation of the sequence.

Identifier	REQ-05.06.04-SPR-0034.0122
Requirement	The controller should have the possibility to solicit a CTA proposal concerning a CTA-capable aircraft under their control.

Identifier	REQ-05.06.04-SPR-0034.0123
Requirement	For Arrival Management planning, Ground system shall use a trajectory updated with the ATC-determined expected STAR and runway combination prior to provision of Arrival Management Service.

Identifier	REQ-05.06.04-SPR-0034.0124
Requirement	For Arrival Management planning, Aircraft system shall use a trajectory updated with the ATC-determined expected STAR and runway combination prior to provision of Arrival Management Service.

Identifier	REQ-05.06.04-SPR-0034.0128
Requirement	The likelihood that incorrect flight information is provided by flight data processing system shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0129
Requirement	The likelihood that incorrect CTA capability is provided in flight information shall be no more than 3e-3 SOH, approximately once every two weeks.

Identifier	REQ-05.06.04-SPR-0034.0130

Requirement	The likelihood that incorrect flight information is provided by flight data processing system for CTA feasibility assessment shall be no more than 3e-3 SOH, approximately once every two weeks.

Identifier	REQ-05.06.04-SPR-0034.0131
Requirement	The likelihood that ATSU Destination provides incorrect STAR/RWY information to Sequence Manager/E-AMAN shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0132
Requirement	The likelihood that [destination] provides to Sequence Manager /E-AMAN landing rate information that is incompatible with required operating parameters of the destination airport shall be no more than 2.5e-4 SOH, approximately once every 5.5 months. *Note: Under [destination] consider the constituent function that supplies the respective runway usage parameters to E-AMAN or Sequence Manager, as per local implementation.*

Identifier	REQ-05.06.04-SPR-0034.0133
Requirement	The likelihood that ATSU fails to define a correct ATC strategy shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0134
Requirement	The likelihood that ATSU fails to implement agreed delay sharing strategy in AMAN configuration shall be no more than 2e-3 SOH, approximately once every three weeks.

Identifier	REQ-05.06.04-SPR-0034.0135
Requirement	[Local implementation] The likelihood that coordination and transfer equipment is inoperative in support of arrival management shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0136
Requirement	The likelihood that CWP HMI fails to present AMAN advisories to the controller shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0137
Requirement	The likelihood that CWP HMI presents incorrect AMAN advisories to the controller shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0138
Requirement	The likelihood that CWP HMI fails to present CTA proposal to the controller shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0139

Requirement	The likelihood that CWP HMI fails to indicate applicable CTA state to the controller shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0140
Requirement	The likelihood that CWP HMI fails to present the appropriate advisory following a CTA cancellation shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0141
Requirement	The likelihood that CWP HMI fails to acknowledge input from the controller regarding a CTA proposal shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0142
Requirement	[Local implementation] The likelihood that datalink service fails to communicate a CTA instruction in time and thereby causes the CTA to become unachievable shall be no more than 1e-3 SOH, approximately once every six weeks.

Identifier	REQ-05.06.04-SPR-0034.0143
Requirement	Flight crews shall be trained with respect to the following actions : • Assessment of feasibility of an instructed CTA • Compliance with instructed CTA • Operation of the RTA function

Identifier	REQ-05.06.04-SPR-0034.0146
Requirement	The likelihood that the Flight Management System fails to correctly assess feasibility of an inserted CTA shall be no more than 2e-3 SOH, approximately once every three weeks.

Identifier	REQ-05.06.04-SPR-0034.0147
Requirement	The likelihood that the Flight Management System fails to acknowledge crew input in the RTA function shall be no more than 1e-3 SOH, approximately once every six weeks.

Identifier	REQ-05.06.04-SPR-0034.0148
Requirement	The likelihood that the Flight Management System fails to alert crew when engaged CTA has become unachievable shall be no more than 1e-3 SOH, approximately once every six weeks.

Identifier	REQ-05.06.04-SPR-0034.0149
Requirement	The likelihood that Satellite TWR provides incorrect departure info to ATSU DEST shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Identifier	REQ-05.06.04-SPR-0034.0150

Requirement	Satellite TWR controllers shall be trained to request new departure planning information from E-AMAN after it was determined that the original TTOT cannot be met.

Identifier	REQ-05.06.04-SPR-0034.0151
Requirement	The likelihood that inaccurate Trajectory Prediction information is provided to E-AMAN shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0152
Requirement	The likelihood that Trajectory Prediction information is unavailable to E-AMAN shall be no more than 2.5e-4 SOH, approximately once every 5.5 months.

Identifier	REQ-05.06.04-SPR-0034.0153
Requirement	The likelihood that inaccurate Trajectory Prediction information is provided to E-AMAN for CTA feasibility assessment shall be no more than 3e-3 SOH, approximately once every two weeks.

Identifier	REQ-05.06.04-SPR-0034.0309
Requirement	The likelihood that CWP HMI fails to indicate undesired speed changes of an aircraft being pre-sequenced (executing any delay method) to the controller shall be no more than 5e-4 SOH, approximately once every 12 weeks.

Note: For the following group of requirements a tolerable level of risk cannot be prescribed nor demonstrated in the form of failure rates or conditions per unit of time or operation as would be the case in functional elements of mechanical or electrical character. Instead, the tolerable level of risk must be designed into the software by ensuring that proper design validation, verification and assurance procedures are followed. A Software Assurance Level (SWAL) implicitly recognizes that in software design, defined in ESARR 6 (See [26]). The level is indicated in each relevant requirement.

Identifier	REQ-05.06.04-SPR-0034.0154
Requirement	Software functions associated with Trajectory prediction and its provision to the arrival management process shall comply with SWAL4 or other design assurance criteria as applicable to effect severity class 4, “serious incident”.

Identifier	REQ-05.06.04-SPR-0034.0155
Requirement	Software functions associated with E-AMAN or otherwise the arrival management process shall comply with SWAL4 or other design assurance criteria as applicable to effect severity class 4, “serious incident”.

Identifier	REQ-05.06.04-SPR-0034.0156
Requirement	Software functions associated with Flight data production and distribution for the purposes of the arrival management process shall comply with SWAL4 or other design assurance criteria as applicable to effect severity class 4, “serious incident”.

3.1.2 Performance Requirements

Identifier	REQ-05.06.04-SPR-0034.0201
Requirement	Manual intervention on specific aircraft, including swap in a pair, within SSH shall not impact aircraft other than those directly targeted

Identifier	REQ-05.06.04-SPR-0034.0202
Requirement	Trajectory prediction as used by E-AMAN should be of such quality to guarantee a maximum prediction drift of +/-30 seconds over the span of 30 minutes, or one second of drift per minute in the entirety of the implementation horizon, N % of the time. *Note: N will be determined by local safety assessment depending on the resiliency of the concept in its operating environment, which is influenced by factors such as daily and annual traffic density distribution, recourses available to the ATCO, quality of support etc. Validations conducted on TS-0305-A have proposed but not validated a value of 95.*

Identifier	REQ-05.06.04-SPR-0034.0203
Requirement	Trajectory prediction shall be consistent in performance in the entire Area of Interest encompassing the Extended Horizon

Identifier	REQ-05.06.04-SPR-0034.0204
Requirement	E-AMAN shall continuously monitor quality of the trajectory prediction used in sequence build and maintenance.

Identifier	REQ-05.06.04-SPR-0034.0205
Requirement	E-AMAN shall alert Sequence Manager if Trajectory Prediction quality drops below a defined alert level.

Identifier	REQ-05.06.04-SPR-0034.0206
Requirement	E-AMAN shall suppress advisories based on suspected defective prediction.

Identifier	REQ-05.06.04-SPR-0034.0207
Requirement	Once a CTA proposal was withdrawn as lapsed, or cancelled by operator, E-AMAN shall not automatically propose a new CTA.

Identifier	REQ-05.06.04-SPR-0034.0208
Requirement	Controller should be able to manually requisition a CTA for a CTA-capable flight

Identifier	REQ-05.06.04-SPR-0034.0209
Requirement	Ground system shall calculate, update and monitor probability of success for each CTA proposal using all available data

Identifier	REQ-05.06.04-SPR-0034.0210
Requirement	A CTA shall be considered success if CTA-ATA of a flight at the MP is within a defined tolerance *Note: values to be determined by validation and implementation*

Identifier	REQ-05.06.04-SPR-0034.0211
Requirement	E-AMAN shall only issue CTA proposals with probability success above a minimum pre-configurable threshold. *Note: values to be determined by validation and implementation*

Identifier	REQ-05.06.04-SPR-0034.0213
Requirement	E-AMAN shall replace a withdrawn “invalid proposal” with an updated AMAN advisory immediately after the withdrawal.

Identifier	REQ-05.06.04-SPR-0034.0214
Requirement	Controller shall accept or reject a CTA proposal by means of a CWP HMI function

Identifier	REQ-05.06.04-SPR-0034.0215
Requirement	Where CWP HMI cannot provide an instantaneous execution of controller initiated action on a CTA proposal such as accept or cancel, the CWP HMI should inform the controller that the desired action has been taken into account.

Identifier	REQ-05.06.04-SPR-0034.0216
Requirement	Actual CTA implementation status shall be propagated to all relevant actors each time the status has changed.

Identifier	REQ-05.06.04-SPR-0034.0217
Requirement	Arrival Management Information (shared IE) shall be consistently and simultaneously distributed to all concerned actors.

Identifier	REQ-05.06.04-SPR-0034.0218
Requirement	Speed and level constraints required by Arrival Management shall be reflected in TP.

Identifier	REQ-05.06.04-SPR-0034.0219
Requirement	Satellite flights shall be clearly identified as such in the AMAN HMI, indicating the status of the flight (on ground/departed)

Identifier	REQ-05.06.04-SPR-0034.0220
Requirement	Satellite flights on ground should provide a function to display TTOT in the AMAN HMI.

Identifier	REQ-05.06.04-SPR-0034.0223
Requirement	AMAN shall maintain actual TTL/G value for implemented CTAs and make it available to ATCO on request.

Identifier	REQ-05.06.04-SPR-0034.0224
Requirement	A Satellite departure should not be automatically re-sequenced upon take-off.

Identifier	REQ-05.06.04-SPR-0034.0225
Requirement	To aid the monitoring task, the controller shall be provided with available Mode-S information as enabled by the underlying surveillance capabilities of the ATM system.

Identifier	REQ-05.06.04-SPR-0034.0226
Requirement	To aid controller decision support, constraints imposed on a flight by the transferring sector with respect to sequence implementation should be provided to the receiving controller.

3.2 Information Exchange Requirements (IER)

This section describes the safety and performance requirements on the information exchanges. It collects the Information Exchange Requirements (IER) defined in the OSED and completes them with the required safety and performance aspects.

Service attributes to the following Information Exchange Requirements were produced by operational and technical experts involved with EXE-485 and EXE-695 as well as the Safety Assessment.

Coordination has been done with WP08 to fill out the IER table.

[IER]

Identifier	Name	Content Type	Frequency	Safety Criticality	Confidentiality	Maximum Time of Delivery[5]	Interaction Type	Free
IER-5.6.4-IERS-0032-0010	Arrival Management Information (upstream airborne)	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 1 s (approach center, airport) < 10 s (enroute center)	<One-way>	N/A
IER-5.6.4-IERS-0032-0020	AMAN Plan Implementation	<Voice> <Data>	<Ad-hoc>	<Minor>	<Public>	< 10s This value applies to voice only, refer to DL related projects (e.g. 5.6.1) in case of data.	<Two-way dialogue>	N/A
IER-5.6.4-IERS-0032-0040	Runway Usage Constraints	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
IER-5.6.4-IERS-0032-0050	Arrival Management Information (Upstream Ground)	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
IER-5.6.4-IERS-0032-0060	Departure Planning Information	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
IER-5.6.4-IERS-0032-120	CTA status	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A

Table 1: IER layout

Note: The list of the identifier and name of the IER has been extracted from the OSED [5].

[5] It must take into account that the maximum time of delivery is not the time of transaction.

3.3 Deleted or contested requirements

This chapter records for the requirements that were removed or are in the process of being removed in the Revised Draft stage of the document. This is necessary to maintain continuity with other documents of reference, primarily OSED [5], SAR [7], and other validation evidence discussed in the appendices of this SPR-INTEROP.

3.3.1 Safety and Performance (SPR)

Identifier	REQ-05.06.04-SPR-0034.0023
Requirement	On receiving a positive result from flight crew, controller shall issue an appropriate instruction to the flight, commensurate with the value of the agreed CTA.

Identifier	REQ-05.06.04-SPR-0034.0107
Requirement	The likelihood of E-AMAN failing to determine CTA capability of a flight shall be no more than 3e-3 SOH, approximately once every two weeks.

Identifier	REQ-05.06.04-SPR-0034.0121
Requirement	E-AMAN should implement a mechanism to determine the validity of a pending CTA proposal. If for operational reasons the controller elects to not act on a CTA proposal instantaneously, the decreasing time window to the metering fix may cause the proposal to fall outside the performance envelope of the aircraft, thus invalidating the proposal. In such cases, E-AMAN should withdraw the proposal and inform the controller accordingly.

Identifier	REQ-05.06.04-SPR-0034.0212
Requirement	E-AMAN shall automatically cancel a pending CTA proposal in which the success probability has dropped below a pre-configured level (“invalid proposal”) *Note: values to be determined by validation and implementation*

Note: The rationale for deletion of requirements 0121 and 0212 goes by the logic that the authority over assessing a CTA as achievable or not resides within the aircraft system. Additionally, Ground System should not be allowed to interfere with a proposal once issued to avoid causing undue distraction to the controller who may have been acting on the proposal in the meantime.

Identifier	REQ-05.06.04-SPR-0034.0047
Requirement	E-AMAN shall continuously update estimated landing times for sequenced traffic

4 References and Applicable Documents

4.1 Applicable Documents

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

[1] Template Toolbox 03.00.00
https://extranet.sesarju.eu/Programme%20Library/SESAR%20Template%20Toolbox.dot

[2] Requirements and V&V Guidelines 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Requirements%20and%20VV%20Guidelines.doc

[3] Templates and Toolbox User Manual 03.00.00

https://extranet.sesarju.eu/Programme%20Library/Templates%20and%20Toolbox%20User%20Manual.doc

[4] EUROCONTROL ATM Lexicon
https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR

4.2 Reference Documents

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

[5] SESAR P05.06.04 D35 Consolidated OSED, Ed 03.00.00 19/12/2014

[6] SESAR P10.01.07 D107 Functional Decomposition Cycle 2013, Ed 01.00.00, 14/03/2014

[7] SESAR P05.06.04 D34-001 Safety Assessment Report, Ed 00.01.06, 16/12/2015 – provided as embedded document in Appendix A

[8] SESAR P05.06.04 D31 VP-244 Validation Report, Ed 04.00.00, 09/04/2014

[9] SESAR WPB.01 Integrated Roadmap DS14

[10] SESAR P05.02 D50 WP5 Validation Strategy for Concept Step 1, Ed 00.00.05, 10/12/2012

[11] SESAR P05.06.07 D17 VP-485 Validation Report, Ed 00.02.00, 05/12/2014

[12] SESAR P05.06.07 D49 VP-695 Validation Report, Ed 00.01.01, 25/06/2015

[13] SESAR P16.06.01 D06 Human Performance Reference Material, Ed 00.01.00, 15/12/2010

[14] SESAR P16.06.01, Task T16.06.01-006, SESAR Safety Reference Material, Edition 00.02.02, 10th February 2012

[15] SESAR P16.06.01, Task T16.06.01-006, D-26 Guidance to Apply the SESAR Safety Reference Material, Edition 00.02.00, 12th December 2014

[16] SESAR P05.06.04, D34 Final SPR/INTEROP, Ed 00.00.01, 13/03/2015

[17] SESAR P05.06.07, D06 Technical Note to 5.6.4 OSED/SPR/INTEROP - Step 1, Ed 00.01.01, 10/04/2014

[18] SESAR P05.06.01 M197 Step 1 INTEROP – Iteration 3, Ed 00.01.01, 20/12/2013

[19] SESAR P05.06.01 D74 Step 1 OSED - Iteration 3, Ed 01.00.00, 11/09/2013

[20] SESAR Safety Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[21] SESAR Security Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[22] SESAR Environment Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[23] SESAR Human Performance Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[24] SESAR Business Case Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[25] SESAR B5 Performance Assessment Report (PAR) for OFA 04.01.02 Enhanced Arrival & Departure Management in TMA and En-route, Edition: 00.00.01 (and following editions), 23/06/2015

[26] ESARR 6 Software in ATM Functional Systems, 06 May 2010, ed. 02.00. https://www.eurocontrol.int/sites/default/files/article/content/documents/single-sky/src/esarr6/esarr6-e2.0.pdf

[27] SESAR P05.06.07 D15 Update of 5.6.4 OSED - Step 1, Ed 00.01.01 28/10/2015

Appendix A Assessment / Justifications

A.1 Safety and Performance Assessments

A.1.1 Safety assessment

Safety Assessment was conducted under the supervision from 16.06.01 and applying the SRM. Its outcome is detailed in the embedded document.

05.06.04-D34-001-S
AR for Tactical TMA a

A.1.2 Security risk assessment

Initially a security assessment draft by 16.06.02, embedded in OSED [5], was reviewed. The draft was not considered mature enough at the time of the writing of SPR D34 for valid conclusions and requirements to be drawn.

In the meantime a new Security Risk Assessment has been performed under the lead of 16.06.02 embedded here:

OFA 4 1 2 Security
Risk Assessment 00 0

The security risk assessment of OFA 4.1.2 has highlighted a number of key risks to the following Supporting Assets: AMAN Processor, ADS-C datalink(s) and ADS-C processor. Whilst there are several other key systems involved in supporting OFA 4.2.1 Primary Assets, these have been excluded from the scope of the assessment as they are either in current operation or the security requirements will be driven by a higher order capability than Extended AMAN. A small set of controls has therefore been recommended.

As it has been assumed that the SESAR Minimum Set of Security Controls (MSSCs) will be applied, these should also be taken forward (with the recommended controls) into the next stage of system development. A question that arose is on whether live trials will be the best validation method for all controls. This will depend on whether the next stage of system development is still pre-operational. If this is the case then a mix of live-trial and other means may be needed. Therefore, there are two requirements MSSC and non-MSSC as below:

Identifier	REQ-05.06.07-SEC-0010.0020
Requirement	Extended AMAN shall implement the following security controls to complement the MSSCs: AMAN and ADS-C processor · Firewall Separation · Hardware & Software Installation Process · Standby / Alternate Facilities · System Accreditation (in this case specifically requiring penetration testing, potentially in the context of the wider base of ATM systems within an ATSU). · Technical Control (bespoke control design to address the specific threat of cyber intrusion, alongside firewall and system accreditation). ADS-C datalinks · Data Input Credibility Checking AND Authentication · Encoding Data

	· Technical Control (bespoke control design to address the specific threats of jamming, spoofing and denial of service).
	Additional Security Controls to MSSCs

Identifier	REQ-05.06.07-SEC-0010.0010
Requirement	Extended AMAN shall implement the applicable minimum set of security controls, with particular focus on: • Data Input Credibility Checking AND Authentication (MSSC C42) • Viruses & Malware Installation and Patches (MSSC C24)
	SESAR Minimum Set of Security Controls (MSSCs)

Security as pertinent to SWIM and associated Services is covered in a dedicated project 14.02.02 SWIM Security Solutions.

Additionally and independently of the above mentioned assessment, security attributes in the form of performance attribute “Confidentiality” to Information Exchange Requirements was determined through expert judgment in 3.2.

A.1.3 Environment impact assessment

Coordination with 16.06.03 revealed that while the project supported a host of exercises partially or fully targeting TS-0305-A, and that many of the activities performed assessments from the perspective of fuel burn and CO2 emissions, no requirements were identified for inclusion in the SPR. As a number of Release exercises are still planned or ongoing, it is recommended in the consolidation of SPRs at OFA level to revisit this KPA.

Exercises that targeted TS-0305-A:

- EXE-05.06.04-VP-191;
- EXE-05.06.04-VP-187; R1
- EXE-05.06.04-VP-189; R1
- EXE-05.06.04-VP-187bis;R1
- EXE-05.09-VP-356;R1
- EXE-05.06.04-VP-188;R1
- EXE-05.06.04-VP-186;R2;
- EXE-05.03-VP-034;R2
- EXE-05.06.04-VP-183;R2
- EXE-05.06.04-VP-185;R2
- EXE-05.06.04-VP-244;R2
- EXE-05.06.04-VP-184;R3
- EXE-05.06.01-VP-326;R3
- EXE-05.06.07-VP-485;R3;
- EXE-05.06.07-VP-695;R4; confirmed 16.06.03 support
- EXE-05.03-VP-708;R4; confirmed 16.06.03 support

A detailed review of results has been produced by B5 in the Performance Assessment Report (PAR) for OFA 04.01.02 (See [25]).

Ongoing or planned exercises in R5, receiving 16.06.03 support, will focus on i4D/CTA supported by the E-AMAN solution and will further investigate the performance in combination.

Note: In the course of preparations of validation exercise EXE-05.06.01-VP-477 targeting TS-0103 but with relevance to TS-0305-A, a discrepancy was identified by 16.06.03 in the proposed method of evaluation of Environmental Impact[6], and an alternative method was developed to remedy the issue. Incidentally, the contested method was used consistently in several of the past exercises targeting TS-0305-A. As a result, the VP-477 validation team recommends awaiting final results of the exercise before definite conclusions concerning environmental impact of TS-0103, and by extension TS-0305-A, are drawn.

A.1.4 OPA

The following Performance Assessments were conducted and taken into account in this SPR.

- Operational Performance Assessment in 05.06.07-VP-EXE-485, assessing primarily qualitative performance issues on part of the concept.
- Human performance assessment in 05.06.07-VP-EXE-485, providing a set of recommendations.
- Human performance assessment in 05.06.07-VP-EXE-695, providing a set of recommendations.
- Human Performance Assessment 05.06.04-VP-244, providing a set of recommendations.

A.1.4.1 Operational Performance Assessment in VP-485

ID	Performance Issue	relevant functional block	OSED	SAR	SPR
485.01	Manual intervention on specific aircraft, including swap in a pair, within SSH shall not impact aircraft other than those directly targeted	E-AMAN	---	---	0034.0201
485.02	Automatic sequence updates shall be inhibited within SSH unless	E-AMAN	0028.0170	E-AMAN-N06	0034.0048

[6] *In the current version of IMPACT, fuel burn is calculated by AEM, exactly in the same way as in the standalone version of AEM. The modelling principle of AEM relies on the use of tabulated default (standard) Fuel Flow values derived from BADA, provided for different aircraft attitudes (climb, cruise, descent) and altitude layers. These tabulated data correspond to nominal/standard speed conditions (obtained from BADA). The speed information provided in the user-defined input data is only used by AEM to calculate the duration of each flight segment, which is further multiplied by the above-mentioned tabulated fuel flow values to determine the fuel burn on each segment. In particular, AEM does not adjust the tabulated default/standard fuel flow values to account for the actual speed of the aircraft on each flight segment, whereas fuel flow is directly influenced by this factor, among other flight parameters. This constitutes a major modelling limitation when assessing fuel burn/CO2 for concepts involving speed changes, with a risk to introduce potentially large errors in fuel burn results when speeds associated to particular concepts significantly differ from the nominal BADA speed conditions implicitly assumed in the AEM Fuel Burn calculation method.*

	specifically permitted by an ATC strategy.				
485.03	CTA missed without warning	aircraft	0028.0710	SR-148	0034.0148
485.04	TP quality: TP performance should be sufficient to allow for drift of no more than 30 seconds in flight time between TOD and runway, assuming no intervention in flight execution from ATC.	TP	0028.0520	SR-44 SR-151	0034.0036 0034.0151 0034.0202
485.05	TP monitoring: AMAN shall continuously monitor quality of TP and alert the controller if TP performance is suspect AND suppress advisories based on a suspect defective prediction	E-AMAN	---	SR-46	0034.0204 0034.0205 0034.0206
485.06	TP uniformity: TP quality shall be consistent in the entire AOI encompassing the EH.	TP	OSED-0028.0530		0034.0203
485.07	No multiple automatic CTA proposals	E-AMAN	---	---	0034.0207
485.08	Controller should be able to manually requisition a CTA for a compatible flight	E-AMAN	---	---	0034.0208
485.09	AMAN shall calculate and maintain	E-AMAN	OSED-0028.0600	---	0034.0209

	probability of success for each CTA proposal using all available data		(partly addressed)		
485.10	A CTA shall be considered success if RTA-ATA of a flight at the MP is within a defined tolerance Note: values to be determined by validation and implementation	E-AMAN	---	---	0034.0210
485.11	AMAN shall only issue CTA proposals with probability success above a minimum pre-configurable threshold. Note: values to be determined by validation and implementation	E-AMAN	OSED-0028.0620 (within ETA Min/Max)	---	0034.0211
485.12	Proposal timeout: AMAN shall automatically cancel a pending CTA proposal in which the success probability has dropped below a pre-configured level (“invalid proposal”) Note: values to be determined by validation and implementation	E-AMAN	---	SR-121	0034.0212
485.13	AMAN shall replace a withdrawn “invalid proposal” with an updated AMAN advisory immediately after the withdrawal.	E-AMAN	---	Related to SR-33	0034.0026 0034.0213

485.14	Controller shall have the ability to accept or reject a CTA proposal	CHMI	Basic HMI funtionality (not found in OSED)	SR-27 SR-31	0034.0023 0034.0024 0034.0214
485.15	CTA accept and cancel dialogues shall include a confirmation that the desired command has been taken into account.	CHMI	OSED-0028.0690	SR-141	0034.0141 0034.0215
485.16	Actual CTA implementation status shall be propagated to all relevant actors each time the status has changed.	CTA	OSED-0710 OSED-0720	SR-32 E-AMAN-N02 SR-109 SR-139	0034.0025 0034.0044 0034.0109 0034.0139 0034.0216
485.17	Arrival Management Information (shared IE) shall be consistently and simultaneously interpreted to all concerned actors.	AMAN	---	SR-11 E-AMAN-N05	0034.0011 0034.0047 0034.0217
485.18	Speed and level constraints required by Arrival Management shall be reflected in TP.	TP	OSED-0520	---	0034.0218
485.19	Satellite flights shall be clearly identified as such in the AMAN HMI, indicating the status of the flight (on ground/departed)	CHMI	REQ-05.06.04-OSED-0028.0260 (Arrival Management Advisories, as a minimum – not directly described)	Related to SR-106	0034.0219
485.20	Satellite flights on ground may display TTOT in the AMAN HMI.	CHMI	REQ-05.06.04-OSED-0028.0900 (Rq to send	Related to SR-106	0034.0220

			TTOT to AMAN)		
485.21	Changes to sequence shall be confirmed by the controller before they are committed.	CHMI	REQ-05.06.04-OSED-0028.0450 (What-if capability for Sequence Manager)	SR-114	0034.0114
485.22	what-if function	CHMI	REQ-05.06.04-OSED-0028.0450	SR-114	0034.0114
485.23	AMAN shall maintain actual TTL/G value for implemented CTAs and make it available to ATCO on request.	AMAN	REQ-05.06.04-OSED-0028.0690	related to SR-33 and SR-110	0034.0223
485.24	A Satellite departure should not be automatically re-sequenced upon takeoff.	AMAN	---	---	0034.0224

Table 2: Results of OPA in VP-485

A.1.4.2 Human Performance Assessment 05.06.07-VP-485

An assessment of human performance in support of safety performance was conducted by P16.06.05 as part of VP-485 [11]. The assessment focused on resilience, human performance areas and long term development and predominant focus was afforded to i4D/CTA (TS-0103), which was jointly subject to validation with TS-0305-A in said exercise. The assessment provided the following recommendations:

- Increase overall trust in system support.
- Develop locally definable ATC strategies in system support.
- Improve support for monitoring task.
- Engage airspace users in dialogue on the trade-offs of i4D and effect of variations in aircraft cost function.
- Adhere to chosen behaviour and style principles for the design of Human-Machine Interface and Human-Computer Interaction.

In the context of this SPR, the recommendations were assessed and incorporated as follows:

ID	Recommendation VP-485	OSED/SAR	SPR

485.R1	Increase overall trust in system support.	D34-001-SAR-[training related SR]	0034.0112 0034.0115 0034.0143
485.R2	Develop locally definable ATC strategies in system support.	D34-001-SAR-SR-08 D34-001-SAR-SR-49 D34-001-SAR-SR-133	0034.0008 0034.0040 0034.0133
485.R3	Improve support for monitoring task.	REQ-05.06.04-OSED-0028.0280	0034.0223 0034.0225
485.R4	Engage airspace users in dialogue on the tradeoffs of i4D and effect of variations in aircraft cost function.	P05.06.01	N/A
485.R5	Adhere to chosen behaviour and style principles for the design of Human-Machine Interface and Human-Computer Interaction.	System projects executing physical design	N/A

Table 3: Results of HPA in VP-485

A.1.4.3 Human Performance Assessment 05.06.07-VP-695

An assessment of human performance in support of safety performance was conducted in accordance with P16.06.05 guidelines as part of Release 4 VP-695 [12] which were assessed and incorporated as follows:

Issue ID	HP Issue VP-695 Benefit & Impact	Issue Status Recommendations Requirements	OSED/SAR	SPR
695.01	The delay sharing procedure might not be appropriate.	Closed	REQ-05.06.04-OSED-0028.0240 REQ-05.06.04-OSED-0028.0250 REQ-05.06.04-OSED-0028.0295	0034.0134

			REQ-05.06.04-OSED-0028.0340 REQ-05.06.04-OSED-0028.0610 D34-001-SAR-SR-134	
695.02	The provision of a target time over a waypoint to pilots may generate potential separation issue due to unpredictable changes in speed.	It is recommended to explain to the ATCO that catch-ups should be coordinated as soon as longitudinal separation is less than 10 minutes. It is recommended to explain to the aircrews that reporting of instructed Mach should be mandatory. Enhanced Mode S(CAT62) should be available.	REQ-05.06.01-Step 1SPR IT3-SAF1.0035 and elsewhere in 05.06.01 SPR as identified in D34-001 SAR. Note: This issue is specifically related to the LREH adaptation of Extended Arrival Management, but in a generalized form it applies to the standard Extended AMAN as well.	N/A Assumed covered by training, 0034.0115 0034.0143 and monitoring task support, 0034.0223 and 0034.0225.
695.03	The En-Route controllers might have to take into account the evolution of the Coordination Point (COP) delay or the time at COP during the crossing of the En-Route sectors.	Closed	N/A. Related to delay sharing, which is covered by SAR to the extent of its scope.	0034.0134
695.04	Pop-up flights may create variations of the target time at COP.	Open	N/A	N/A Assumed related to TP Note: Pop-up flights for LREH are out of scope.
695.05	It is not yet demonstrated that the delay absorption in the En-Route sectors is feasible.	Closed	N/A	Local implementation defines absorbable delay.
695.06	The En-Route controllers' added workload related to the arrival management	Closed	N/A	Not supported by validation

	constraints may not be acceptable.			results of TS-0305-A.
695.07	The arrival management constraints in the EnRoute sectors might adversely affect the overall traffic management (unacceptable increase traffic complexity).	Closed	See D34-001-SAR, Assumptions A-002, A-003.	N/A
695.08	When controllers need to solve a separation issue, their choices might be limited if one of the aircraft has been instructed in order to achieve an arrival management constraint as observed in a previous exercise (VP 188).	Closed	See D34-001-SAR, Assumption A-006.	N/A
695.09	The delivery task of the traffic to the receiving partner might be more complex to achieve when one aircraft within the stream of traffic has been instructed in order to achieve an arrival management constraint.	Closed	N/A	Not supported by validation results of TS-0305-A.
695.10	It is likely that the En-Route controllers will have to mitigate potential bunching at the Coordination Point (COP) generated by the AMAN sequence calculation.	In addition to delay absorption, it is recommended that the XMAN improves traffic presentation at the COP by optimising longitudinal/vertical separation at the COP.	D34-001-SAR Assumption A-006 and A-007, further A-002 and A-003. Note: Handovers of traffic between sectors should be done according to rules stipulated in LoA. Unless explicitly stated, COP is only relevant as far as coordination of flight information for the purpose of the handover between the participating ATSUs' flight data processing systems. Controllers resolve bunching as part of the separation	N/A

			assurance provision task.	
695.11	For traffic presentation purposes the En-Route controllers may have to speed up aircraft that were previously slow down to meet an arrival management constraint.	Closed N/A	N/A	Assumed related to LREH.
695.12	The arrival management constraint in the En- Route sectors might adversely affect the EnRoute flight vertical profile.	Closed	N/A	N/A
695.13	The arrival management constraints might not be feasible for the pilots.	Closed	D34-001-SAR-SR-35 D34-001-SAR - SR-143 D34-001-SAR - SR-146	0034.0028 0034.0143 0034.0146
695.14	The En-Route controllers might not be able to maintain current capacity.	EXE 696 will assess the impact of XMAN constraints management coming from several TMA.	N/A	N/A Out of scope – related to overlapping horizons. For E-AMAN, it is assumed that DCB-NM ensures capacity will not be exceeded.
695.15	The AMAN delay information provided to the En-Route controllers might not be usable.	It is recommended to improve the readability, accessibility and stability of information of the XMAN HMI. The ATCO shall be able to read the information presented on the XMAN HMI at screen distance. The ATCO shall be able to directly input in the XMAN HMI	Stability is contingent on TP quality and consistency. REQ-5.6.4-OSED-0028-0520 Readability and accessibility is joint responsibility of 5.9 and technical projects at OFA level. HMI HCI principles should be followed.	0034.0202 0034.0203 0034.0204 0034.0205 0034.0206

		the most frequent instructions given without having to open menus. It is recommended to ensure consistency between the ETFMS and radar calculated delays in order to facilitate the identification by the ATCO of the instruction to be given.		
695.16	The En-Route controller may not know which aircraft have been given a constraint for arrival management purpose.	Closed	N/A	0034.0226
695.17	There is a potential increase of workload due to possible wider range of flight speeds.	It is recommended that the ATCO are provided with enhanced Mode S(CAT62) to be able to monitor speed evolution.	REQ-05.06.04-OSED-0028.1200 + other Stream E reqs.	0034.0225
695.18	The new display presenting AMAN information may not be well integrated in the controller working position.	It is recommended to further investigate on which controllers' working positions the XMAN HMI should be integrated.	Implementation dependent. 5.9 + technical projects.	N/A
695.19	There is a potential increase of workload for both the Executive and Planning Controllers due to the decision making process on the applicability of the constraint.	It is recommended to improve the XMAN HMI so that it better supports the ATCO with silent coordination (e.g. improve the visibility of the flights having speed instruction and of the information selected by the previous sectors)	OSED 0028.12xx (Stream E)	0034.0116 (inbuilt coordination support) 0034.0223 (actual TTL/G value of a/c on CTA) 0034.0225 (Mode S Downlink CAP) 0034.0226 (preceding sector constraints)

				Recommendation to develop additional controller decision making support tools.
695.20	The use of the Long Range Extended AMAN Horizon might have an impact on the number of coordination between Reims UAC and London ACC.	Closed	N/A	N/A
695.21	There is a risk on ATCO acceptability and job satisfaction if the workload level and situation awareness are not satisfactory.	It is recommended to improve the XMAN HMI usability so that the increase of the ATCO workload remains acceptable.	N/A Out of scope	N/A
695.22	Training needs are not yet identified regarding procedure to apply on the En-Route sectors.	Closed	D34-001-SAR-[training related SR]	0034.0115 0034.0143

Table 4: Results of HPA in VP-695

A.1.4.4 Human Performance Assessment 05.06.04-VP-244

An assessment of human performance in support of safety performance was conducted in accordance with P16.06.05 guidelines as part of Release 2 VP-244 [8] which were assessed and incorporated as follows:

ID	Recommendation VP-244	OSED/SAR	SPR
244.01	Plan further studies to investigate the integration in E-AMAN sequence of aircraft taking off from multiple local airports in a realistic traffic environment in order to obtain quantitative data to better assess the impact of planned departures within the AMAN horizon both in terms of sequence stability and operator mental workload. [PROCEDURES ROLES AND RESPONSIBILITIES]	VP-485 was conducted to address this recommendation, resulting in D05 Technical Note and a subsequent update of the OSED [5] Subsequently handled by the D34-001-SAR-SR-09 D34-001-SAR-SR-10 D34-001-SAR-SR-19	0034.0009 0034.0010 0034.0017 0034.0033 0034.0034 0034.0035

		D34-001-SAR-SR-40 thru 43.	
244.02	ATCOs suggest to customize the implementation criteria for the DS technique taking into account also the sector peculiarities (e.g. cruise sector or approach area) [PROCEDURES ROLES AND RESPONSIBILITIES]	REQ-05.06.04-OSED-0028.0240 REQ-05.06.04-OSED-0028.0250 REQ-05.06.04-OSED-0028.0295 REQ-05.06.04-OSED-0028.0340 REQ-05.06.04-OSED-0028.0610 D34-001-SAR-SR-49 D34-001-SAR-SR-133	0034.0040 0034.0133
244.03	Implementing AMAN with an extended horizon will require that several criteria essential for an effective sequence building are considered. These criteria are strictly related to the specific environment in which the tool is expected to work and to the procedures in force. An initial list is provided in section 6.1.4.2 of the VALR. [HUMAN AND SYSTEM]	N/A	Implementation dependent details are out of scope of this SPR.
244.04	ATCOs suggest to customize the implementation criteria for the DS technique taking into account also the sector peculiarities (e.g. cruise sector or approach area) [HUMAN AND SYSTEM]	REQ-05.06.04-OSED-0028.0240 REQ-05.06.04-OSED-0028.0250 REQ-05.06.04-OSED-0028.0295 REQ-05.06.04-OSED-0028.0340 REQ-05.06.04-OSED-0028.0610 D34-001-SAR-SR-49 D34-001-SAR-SR-133 D34-001-SAR-SR-134	0034.0040 0034.0133 0034.0134
244.05	Initial training will be required to: (i) learn the principles of the tool as well as the DS technique and its behaviour, (ii) be able to start using them effectively. No particular	D34-001-SAR-[training related SR]	0034.0112 0034.0115 0034.0143

	recurrent training is foreseen. [TRANSITION FACTORS]		

Table 5: Results of HPA in VP-244

Appendix B Derivation of Performance Requirements on Quality of Trajectory Prediction

Related OSED operational requirements: REQ-05.06.04-OSED-0028.0520, REQ-05.06.04-OSED-0028.0530

Related SAR safety requirements: SR-04, SR-44, SR-151, SR-152, SR-153

In the context of Extended Arrival Management, the quality of trajectory prediction, expressed primarily as accuracy, plays a central role as the planned sequence and timing determined by AMAN relies upon it. The operational need for sufficient quality of trajectory prediction information is expressed in the OSED, without guidance on how the quality aspect should be captured, nor are any related Performance Indicators provided. The SPR task group elected to apply its operational expertise and propose a definition in this appendix to the SPR.

In assessing success or failure of predictive processes, attention must be paid in the choice of metric and particularly its applicability. In the case of trajectory prediction as applied in arrival management, the process runs at a given look-ahead horizon and attempts to predict the four-or five dimensional state of a target at the end of that horizon. The output of the process is continuous and provides its result to be readily used by the constituent functions such as sequencing, metering, ATC control and monitoring. Since the result of the success/failure assessment cannot be known before the end of the horizon, the quality of the continuously provided result likewise cannot be assessed at the time when the result is being provided to user functions or elements. The quality should instead be continuously measured and monitored over time.

To define what constitutes a sufficiently accurate trajectory prediction, let us consider the following initial definitions:

- *Potential conflict: A potential conflict is given when future position of 2 or more aircraft might fall below specified minima (not necessary the separation minima), given the uncertainty in the prediction.*
- *Implementation horizon: The period of time reserved for active sequence implementation, from AAH to MP*
- *Inter-aircraft spacing: the desired inter aircraft spacing at MP as configured in AMAN*

With these definitions in mind, let us formulate the underlying hypothesis:

An accurate trajectory prediction is a trajectory which when used in the context of arrival management extended to en-route, does not cause a potential conflict by its uncertainty in the entire extent of the implementation horizon, all other factors being considered equal.

In an expanded meaning, the predicted trajectory must be sufficiently accurate as well as consistent throughout the sequence implementation phase, from AAH to MP, so that the controller does not consider it necessary to introduce an additional corrective measure with the intent to prevent an impending separation loss, a measure that would not have been needed in the absence of the arrival management process.

Key terms are underscored in the expanded definition:

- Controller consideration; the controller remains the ultimate judge of air safety of a given traffic picture in a given sector. This introduces a stochastic element in the decision logic as different controllers will assess situations differently, taking into account external parameters, most of which would be impossible to capture in a workable definition.
- The presence of the corrective measure is required.
- In the absence of the arrival management process, controllers plan traffic picture ahead within self-determined safety margins added on top of any applicable objective minima (such as radar separation); these self-defined margins in turn depend on a range of external factors. Controllers may also utilize system generated trajectory prediction, or they may depend on own mental calculation supported by training and experience. It will occur that aircraft actual behaviour will deviate from what the controller assessed as the predicted state, and the magnitude and frequency

of the deviations is assumed to follow normal distribution. Through the application of operator defined safety margins, the controller allows for a degree of tolerance to absorb the majority of such deviations, however the remainder subset of deviations will be large enough to warrant the additional corrective action. Let us call this subset the *residual rate of potential conflicts*, and to comply with the definition, the trajectory prediction used by AMAN must be accurate and consistent enough to generate approximately the same *residual rate of potential conflicts* as would be governed by the controllers self-determined applied safety margins, all other factors being considered equal.

Expressing the hypothesis in measurable and testable values requires empirical research and validation. A research of validation reports from activities targeting TS-0305-A (VP-189, VP-244, VP-485) will result in the following assumptions:

Ref	Assumption	Validation
A-01	Extent of the sequence implementation horizon is 30 min. Justification: EH to MP ~ 40 min AAH to MP ~ 35 min, allow 5 minutes for higher priority workload associated with separation assurance task and overall traffic picture planning. Remaining time for implementation of the sequence: 30 min.	Expert judgment
A-02	Inter-aircraft spacing at MP is 90-100s. Justification: In a single runway operation, inbound volume into TMA must be no higher than throughput at the runway, which with the M/M traffic mix tested in VP-485 corresponds to approximately 36 movements per hour in segregated runway mode. *Note: in a worst case scenario, this leaves 45-50s either side before a potential conflict or unplanned swap occurs at the MP.*	Expert judgment
A-03	Maximum prediction deviation between AAH and MP to minimise potential conflict is +/- 30s. Justification: Corresponds with the ETA min/max interval as defined for non-i4D but CTA capable traffic, see 05.06.04 OSED. *Note: Subtract this value from the 45-50 s buffer assumed in A-02 to receive an approximate value of controller imposed safety margin as estimated by subject matter experts in the applicable scenario and environment.*	Expert judgment

Table 6: Assumptions regarding definition of quality of trajectory prediction

Using these assumptions, it is possible to formulate measurable and demonstrable requirements on accuracy of trajectory prediction:

REQ-05.06.04-SPR-0034.0202

Trajectory prediction as applied in the context of arrival management should be of such quality to guarantee a maximum prediction drift of +/-30 seconds over the span of 30 minutes, or one second of drift per minute in the entirety of the implementation horizon, n % of the time.

Note: n value is proposed as 95%, commensurate with the reliability bounds of the ETA min/max interval as per definition. To be validated.

REQ-05.06.04-SPR-0034.0203

Trajectory prediction shall be consistent in performance in the entire Area of Interest encompassing the Extended Horizon.

For completeness, see the underlying argument illustrated in figure below, featuring two examples of evolving trajectory predictions: a compliant green, and a non-compliant red.

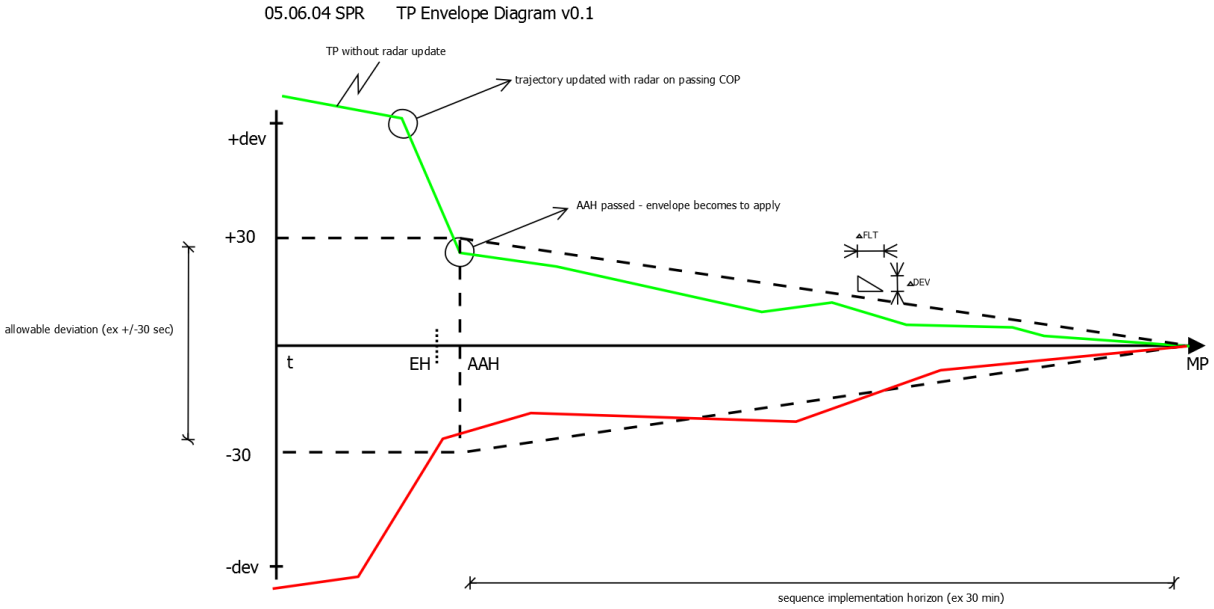

Figure 3: Accuracy of trajectory prediction

Appendix C INTEROP

C.1 Executive summary

This document presents Interoperability requirements for concept “QM-4 – Tactical TMA and En-route Queue Management” in OFA04.01.02 in Step 1 operations. The assessment addressed Operational Improvement TS-0305A at the E-OCVM V3 phase. It is based on prior work by 10.01.07 on technical architecture, 05.06.04 Safety Assessment of the concept and the outcomes of a series of validation exercises executed in projects 05.06.01, 05.06.04 and 05.06.07.

In OFA level coordination it was agreed that the assessment and the ensuing SPR and INTEROP activities should restrict themselves to a purely operational view; as per the SESAR framework the work is to be continued by technical projects.

A further synthesis should take place at the OFA level where the Interoperability requirements should be considered in conjunction with those of the closely related OI, e.g. TS-0103.

The report is presented as input document to the production of the D34 05.06.04 Updated SPR. As a project internal deliverable, this report does not anticipate submission approvals.

C.2 Introduction

C.2.1 Scope of the INTEROP

The purpose of this INTEROP annex is to provide interoperability requirements for the Extended Arrival Management within OFA04.01.02 Enhanced Arrival and Departure Management in TMA and En-Route. The operational scope is comprising Extended AMAN operations covered by operational improvement step TS-0305-A.

The INTEROP is conceived as a mainly technology independent definition of interoperability requirements commensurate with maturity at V3 and with predominant focus on operational needs imposed by the context on information exchange. This INTEROP relies on and derives from the Operational Requirements captured in OSED (D35/D15) and the associated SPR (D34).

The INTEROP guidance material (template & FAQ) states that:

“The INTEROP is used to define the minimum technical and functional requirements that provide the basis for ensuring compatibility among identified elements of the CNS/ATM system using a specific technology imposed as a design constraint (therefore captured as a requirement).”

In cases where interoperability can be achieved through SWIM according SWIM Service Design guidance provided in “F.A.Q. How to develop and validate an Operational Improvement step enabled by SWIM” expects the following:

“This activity aims to specify a service enabled by SWIM. The Results of the design are modelled in the ISRM and are incorporated in the documents called Service Description Documents (SDD) and in the Operational Interoperability documents (INTEROP). The output of the “Service Design” must be independent of the technology.”

Consequently the given INTEROP defines requirements as technology independent in SWIM context, and constrained to a specific technology otherwise.

Since OSED already identifies that some of the pre-existing technology (e.g. OLDI) is insufficient to fully support the concept, Interoperability requirements to fully support the concept are defined for OLDI in C.4.4 as Unique Characteristics.

The scope of this INTEROP is defined as follows:

Principal inputs:

- Information Exchange Model, developed by 05.06.04 OSED (Technical Note D06-05.06.07) and reviewed with WP8 and B04.03.

- IE-IER from OSED and SPR
- Safety requirements associated with Information Exchange, from SAR.

Intermediate task:

- Definition of Quality of Service associated to IERs:
  a. Issuer
  b. Addressee
  c. Content Type (data/voice)
  d. Frequency (ad-hoc/periodic/with update rate)
  e. Safety Criticality (SR)
  f. Confidentiality (public/restricted)
  g. Maximum Time of delivery (s)
  h. Interaction type (simplex/duplex)

Principal output:

- Definition of interoperability requirements for CNS services associated with each IER
- Allocation of interoperability requirements to functional blocks as provided by 10.1.7 D107 Functional Decomposition – Cycle 2013

Following an inter-project coordination with 05.06.X and 10.1.7, it is expected for 10.1.7 to carry out the physical design including decomposition of functional blocks and for 10.9.1/2 to produce the related TS/IRS. In SWIM context, Service Identification and Service Design should be carried out within WP8.

C.2.2 Intended readership

Projects of the OFA 04.01.02 Enhanced Arrival & Departure Management in TMA and En Route in addition to P5.6.4:

- P05.03 Integrated and Pre-operational Validation & Cross Validation
- P05.06.07 Integrated Sequence Building/Optimisation of Queues
- P10.09.01 Integration of Queue Management
- P10.09.02 Multiple airport arrival/departure management

Federating Projects:

- SWP05.06 Queue Management in TMA and En-Route
- P04.02 Consolidation of Operational Concept Definition and Validation
- P05.02 Consolidation of Operational Concept Definition and Validation
- P10.01.07 ATC System Specification

Other Primary Projects whose work is relevant to this INTEROP

- WP4:
  - P04.07.01 Complexity Management
- WP5:
  - P05.04.02 TMA-2 Co-Operative Planning Requirements and Validation
  - P05.05.01 Trajectory Management Framework in TMA
  - P05.06.01 QM1 – Ground and Airborne Capabilities to Implement Sequence

  - P05.09 Usability Requirements and Human Factors Aspects for the Controller Working Position
- WP6:
  - P06.08.04 (Coupled AMAN-DMAN)
- WP7:
  - P07.06.05 (Dynamic DCB in Execution Phase)
- WP8:
  - P08.01.03: AIRM Deliverable
  - P08.03.10: Information Service Modelling deliverables
- WP9:
  - P09.01 Airborne Initial 4D Trajectory Management
- WP12:
  - 12.04.04 Integration of Departure Management and Surface Management
- WP16:
  - 16.05.04 Selection and training requirements to work with automated decision and support tools

Principal input for this activity was drawn from the following projects and deliverables:

- P05.06.04 D35 Final OSED, D34-001 SAR and SPR
- P10.01.07 D107 Functional Decomposition – Cycle 2013

C.2.3 Acronyms and Terminology

Term	Definition
ADD	Architecture Definition Document
ADS-C	Automatic Dependent Surveillance - Contract
AM	Arrival Management (information)
AMAN	Arrival Manager
AOP	Airport Operations Plan
ATM	Air Traffic Management
ATSU	Air Traffic Service Unit
CPDLC	Controller-Pilot Data Link Communications
CTA	Controlled Time of Arrival
CWP	Controller Working Position
DMAN	Departure Manager

Term	Definition
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
ELDT	Estimated Landing Time
ETA	Estimated Time of Arrival
FAF	Final Approach Fix
FDPS	Flight Data Processing System
HMI	Human Machine Interface
i4D	Initial 4D
IE	Information Element
IAF	Initial Approach Fix
IER	Information Exchange Requirements
IMP	Initial Metering Point
INTEROP	Interoperability Requirements
IRS	Interface Requirements Specification
LAM	Logical Acknowledgement Message
LREH	Long Range Extended Horizon
NOP	Network Operations Plan
OFA	Operational Focus Areas
OLDI	On-Line Data Interchange
OSED	Operational Service and Environment Definition
QoS	Quality of Service
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements

Term	Definition
SWIM	System Wide Information Management
TAD	Technical Architecture Description
TLDT	Target Landing Time
TP	Trajectory Prediction
TS	Technical Specification
TTL/G	Time to Lose/Gain

C.3 System Description

In accordance with document purpose and scope, **Error! Reference source not found.**~~C.2.1~~, this document will consider the functional block 'Arrival Management' (support tool AMAN), described by 10.01.07, as a technology independent black box. Its decomposition, application of specific technologies and system architecture are outside the scope of this document.

Instead, information exchange model from D06-05.06.07 Technical Note [17] is used to gain the required high level overview of operational interaction between systems of the solution.

In absence of a determined technical implementation, it may be difficult to disentangle the human and system roles contributing to the Use Cases, as the partitioning (as well as the actual role involved) may depend on local implementation choices. Therefore in the representation of the IERs the "Issuer" and "Addressee" column are filled using "mixed entities" defined in the following table:

Issuer / Addressee	Constituent CONOPS[7]/DOD[8]/OSED[9] Roles	Constituent Systems
Arrival Management	Sequence Manager[10]	AMAN Tool
Stakeholder ATSU	Executive Controller in TMA or En-route Planning Controller in TMA or En-route Flow Management Position (i.e. any approach and upstream En-route sector, within the same ATSU or in other ATSU)	ATSU FDPS / Controller HMI (CWP-HMI)
Satellite Airport (i.e. Departure Airport within AMAN Horizon)	Tower Clearance Delivery Controller Tower Runway Controller	Tower FDPS and HMI
Destination Airport	Tower Runway Controller	Tower FDPS and HMI Airport CDM System DMAN
Aircraft	Flight Crew	a/c COM, NAV systems

Table 7: Entity Table

Figure 4~~Figure 4~~ provides an overview of the information exchanges described in 5.6.4 D35 Updated OSED [5]. It covers all requirements discussed in this document, in particular also those of the current "baseline" AMAN operations (refer to chapter 6), and is provided to facilitate the understanding of information exchanges in the context of arrival management.

[7] See document B4.2 - SESAR Concept of Operations Step 1 – Appendix D
[8] 5.2 DOD refers to B4.2 Conops as well
[9] See P05.06.04 - Updated OSED, D35 [5]
[10] See ~~96~~

Note: Numbers refer to the identifiers used in the tabular description of the requirements.

It should be remarked that operational flows in the full context are given by operational BPMN flow models of EATMA. These models will not be regarded in this INTEROP.

Points of note:

- The interactions with the Network Manager are out of scope of the Step 1 OSED. They will be considered in Step 2.
- The additional information exchanges required for CTA operations are outlined below for completeness of the diagram from an OFA perspective. They are not in scope of the present OSED except 120. Related IERs quoted below have been introduced by 05.06.04.
- There is also an interaction between the "Satellite" Airport and the a/c to pass the departure time (which takes into account the arrival management information). This is airport specific and hence out of the scope of the SPR-INTEROP.
- Departure information may be provided from a variety of source systems, such as DMAN or an integration of AMAN and DMAN, both outside the scope of this SPR-INTEROP.

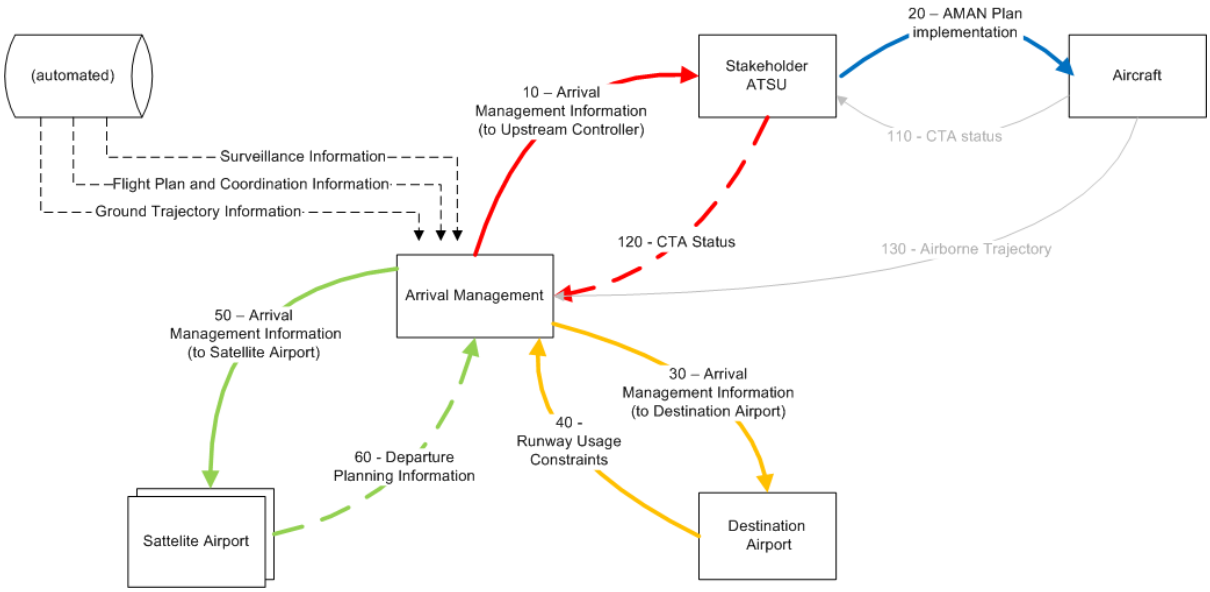

Figure 4: Overview of Information Exchanges [based on D06-05.06.07]

There are five interaction exchange groups

- "**red** / **blue**" – Baseline AMAN & Extended Horizon: The AMAN outputs are provided to air traffic controllers, who implement the sequence. The extension of the AMAN horizons delivers information to upstream controllers further than in case of baseline AMAN. A potential use of CTA techniques is implied here.
- "**yellow**" – Baseline AMAN & Extended Horizon: AMAN provides sequence to the airport, and the airport provides runway constraints.
- "**green**" – Extended Horizon (including a dedicated method of handling of traffic originating from satellite airports): Feedback loop with satellite airport includes flights from it in the arrival management process.
- "**grey**" – i4D/CTA flows from a/c to ground (see also 05.06.01 OSED [19] or INTEROP, when available) are not considered further here but displayed for completeness.
- "**black**" – Reference data are required by the AMAN tool in the ATC System of the AMAN ATSU (e.g. FDPS).

Note: The reference data is not subject to the information exchange discussion as it was agreed to set it out of scope for interoperability consideration in this project and within the scope of Extended AMAN itself. Nevertheless operational performance needs are identified within the SPR document.

C.4 Interoperability Requirements

REQ

Identifier	
Requirement	
Title	
Status	
Rationale	
Category	
Validation Method	
Verification Method	

REQ Trace

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	OSED or SPR Requirement Identifier	<Full>
<APPLIES_TO>	<Operational Focus Area>	Operational Focus Area Identifier	N/A
<ALLOCATED_TO>	<Functional block>	Functional block Identifier	N/A
<CHANGED_BECAUSE_OF>	<Change Order>	Change reference	N/A

Table 8: Requirements Layout

Following the given approach described in the introduction there is a list of information that needs to be collected before:

- Information elements (IE) that need to be exchanged, see D35 OSED [5] and D06 Technical Note [17]
- Information element requirements (IER) that state who needs the information and who is the source. See D35 OSED [5] and D06 Technical Note [17]
- Quality of service (QoS) of IERs, that is represented by the IER performance characterized by a set of attributes as per Guidance by Toolbox Manual. For source see D35 OSED [5], D34 SPR [16] and D06 Technical Note [17]
- Functional blocks that have been defined by 10.01.07, [6].

Note: Any considerations about quality of data (operational communication needs regarding information content) in contrast to QoS can be found within the performance part of SPR.

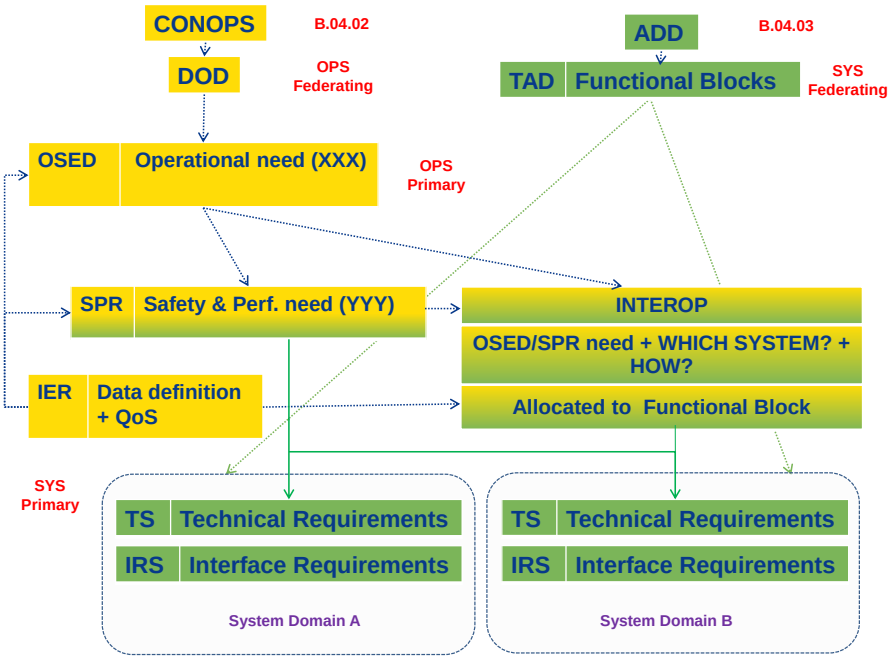

Figure 5: FAQ - INTEROP vs. IRS and IER - Relationship of INTEROP with other SESAR deliverables

According to the FAQ guideline this input information (see list before) will be transposed into a set of interoperability requirements that express the operational needs for communication via a (/n information) service.

C.4.1 Requirements for ATS CNS/ATM Applications

C.4.1.1 Information Elements

The following Information Elements from OSED D35-05.06.04 are taken into consideration for interoperability:

- IE-5.6.4-0032-0032 – Arrival Management Information
- IE-5.6.4-0032-0033 – Runway Usage Constraints

C.4.1.2 Information Element Requirements

The following Information Exchange Requirements from OSED D35-05.06.04 are taken into consideration for interoperability:

- IER-5.6.4-IERS-0032-0010 – Arrival Management Information (to Upstream Controller)
- IER-5.6.4-IERS-0032-0020 – AMAN Plan Implementation
- IER-5.6.4-IERS-0032-0040 – Runway Usage Constraints
- IER-5.6.4-IERS-0032-0050 – Arrival Management Information (to Satellite Airport)
- IER-5.6.4-IERS-0032-0060 – Departure Planning Information
- IER-5.6.4-IERS-0032-120 – CTA Status (Ground - Ground)

The following IERs will not be regarded as they are out of scope:

- IER-5.6.4-IERS-0032-0030 – Arrival Management Information (to Destination Airport)
- IER-5.6.4-IERS-0032-110 – CTA Status (Air- Ground)

- IER-5.6.4-IERS-0032-121 – Airborne Trajectory (Air - Ground)

Outside the 05.06.04/07 scope, IER 030 is covered by 06.05.04 in its OFA level INTEROP (06.05.04-D12-OFA 05.01.01 INTEROP V2):

- REQ-06.05.04-INTEROP-FLTP.0106 – exchange of Actual time at IAF with NOP
- REQ-06.05.04-INTEROP-FLTP.0109 – exchange of Actual time at FAF with NOP
- REQ-06.05.04-INTEROP-FLTP.0201 – exchange of ELDT with NOP
- REQ-06.05.04-INTEROP-FLTP.0202 – exchange of TLDT with NOP
- REQ-06.05.04-INTEROP-FLTP.0106 and .0107 are related to the LREH variant of Extended Arrival Management

IER 110 and 130 are relevant to air-ground exchange and hence fall within the purview of project 05.06.01.

Furthermore AMAN requires automated system input for sequence calculation that needs to consider:

- Ground Trajectory Information (Trajectory Prediction, TP, internal to AMAN or provided, as determined by implementation)
- Flight Plan and Coordination Information
- Surveillance Information (radar data, implementation dependent)

Note: Operational performance aspects are addressed in the SPR part. There are no service needs related to these points expressed in this document or these projects (5.6.4/7).

C.4.1.3 Quality of Service (IER Performance characterisation)

Service attributes defined in the quality of service have been identified by operational and technical experts mainly taking into account the preparation, execution and assessment of the following validation exercises:

- EXE-5.6.7-VP-695
- Theoretical foundation provided by EXE-5.6.7-VP-485 and earlier 05.06.04 validation exercises.

The following table (initially created in Technical Note D06-05.06.07) characterizes the information service by a set of attributes defined in the Toolbox Template Manual (See [3]):

Identifier	Name	Issuer	Intended Addressees	Content Type	Frequency	Safety Criticality	Confidentiality	Maximum Time of Delivery	Interaction Type	Free
IER-5.6.4-IERS-0032-0010	Arrival Management Information (upstream airborne)	Arrival Management	Stakeholder ATSU	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 1 s (approach center, airport) < 10 s (enroute center)	<One-way>	N/A
IER-5.6.4-IERS-0032-0020	AMAN Plan Implementation	Stakeholder ATSU	Flight Crew	<Voice> or <data>	<Ad-hoc>	<Minor>	<Public>	< 10s This value applies to voice	<Two-way dialogue>	N/A

								only, refer to DL related projects (e.g. 5.6.1) in case of data.		
IER-5.6.4-IERS-0032-0040	Runway Usage Constraints	Destination Airport	Arrival Management	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
IER-5.6.4-IERS-0032-0050	Arrival Management Information (Upstream Ground)	Arrival Management	Satellite Airport	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
IER-5.6.4-IERS-0032-0060	Departure Planning Information	Satellite Airport	Arrival Management	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
IER-5.6.4-IERS-0032-120	CTA status	Stakeholder ATSU	Arrival Management	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
For info only!	Ground Trajectory Information	(automated)	Arrival Management	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 1s	<One-way>	N/A
For info only!	Flight Plan and Coordination Information	(automated)	Arrival Management	<Data>	<Ad-hoc>	<Minor>	<Restricted>	< 10s	<One-way>	N/A
For info only!	Surveillance Information	(automated)	Arrival Management	<Data>	<Periodical>	<Minor>	<Restricted>	< 1s	<One-way>	~ 5s (radar update)

Table 9: IER Performance characterisation for TS-0305-A (AMAN extended horizon)

C.4.2 Functional Blocks

The Arrival Management functional block is responsible for determining an optimal arrival sequence at designated aerodromes and providing associated advisories such as time to lose/gain and Controlled Time of Arrival based on downlinked ETA min/max at the metering point. Sequence and advisories are distributed to the Controller Working Positions and to external clients. The AMAN also allows the controller to manually alter the arrival sequence, also provides a subset of the arrival sequences restricted to the part of the approach where TBS (Time Based Separation) procedures are in operation. The required time separation between successive aircraft is calculated and converted to an effective distance for display and monitoring. [source: ATM Masterplan/Architecture]

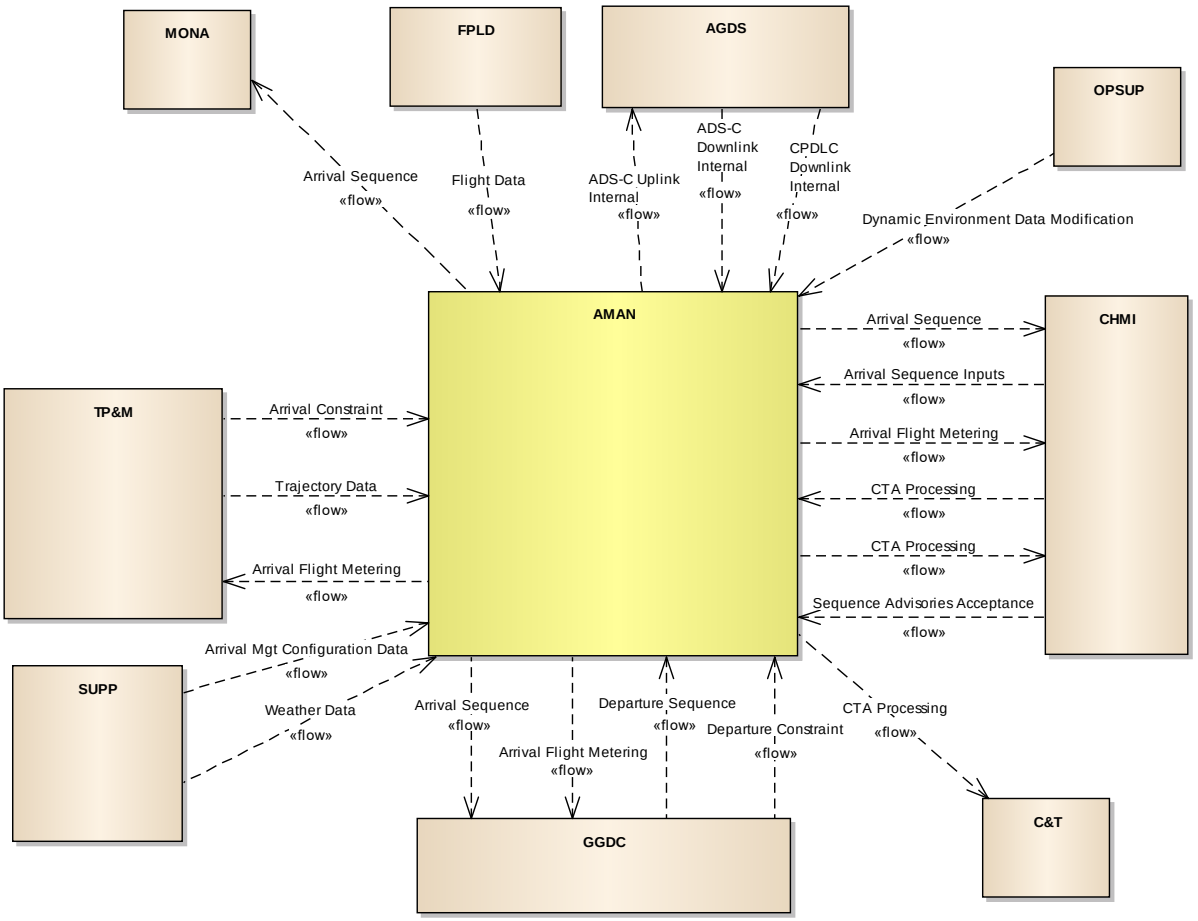

Figure 6: FAQ - Arrival Management. Source: 10.01.07 Functional Decomposition

Data Flow In	Origin	Destination
ADS-C Downlink Internal	AGDS	AMAN
Arrival Constraint	TP&M	AMAN
Arrival Mgt Configuration Data	SUPP	AMAN
Arrival Sequence Inputs	CHMI	AMAN
CPDLC Downlink Internal	AGDS	AMAN
CTA Processing	CHMI	AMAN
Departure Constraint	GGDC	AMAN
Departure Sequence	GGDC	AMAN
Dynamic Environment Data Modification	OPSUP	AMAN
Flight Data	FPLD	AMAN
Sequence Advisories Acceptance	CHMI	AMAN
Trajectory Data	TP&M	AMAN
Weather Data	SUPP	AMAN

Data Flow Out	Origin	Destination
ADS-C Uplink Internal	AMAN	AGDS
Arrival Flight Metering	AMAN	CHMI
Arrival Flight Metering	AMAN	GGDC
Arrival Flight Metering	AMAN	TP&M
Arrival Sequence	AMAN	CHMI

Arrival Sequence	AMAN	GGDC
Arrival Sequence	AMAN	MONA
CTA Processing	AMAN	C&T
CTA Processing	AMAN	CHMI

Source 10.01.07 Functional Decomposition [6][6]

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C.4.2.1 Requirements

Note: The given INTEROP requirements are irrespective of an AMAN horizon definition. Therefore, they include long range AMAN operations as well.

The interoperability requirements presented here focus on the following:

- Data Content
  - Issuer, Addressee and Information Element or data content
  - Interaction Type
- Quality of Service
  - Frequency
  - Maximum time of Delivery
  - Update Rate (if not covered by SPR Performance)

Safety criticality or Confidentiality are subject to SPR (Safety and Security).

Naming convention for the requirements is REQ-05.06.07-INTEROP-xxxx.yyyy, where:

- xxxx refers to the IER number
- yyyy is an IER-specific iterator

Each IER is in most of the cases broken in two requirements covering the IER including the information exchange (Data Content) and the Quality of Service.

The requirements can be grouped in several groups.

Group 1: Arrival Management Information:

- REQ-05.06.07-INTEROP-0010.0010
- REQ-05.06.07-INTEROP-0010.0020
- REQ-05.06.07-INTEROP-0050.0010
- REQ-05.06.07-INTEROP-0050.0020

Group 2: Airport Interaction (Local and Satellite Airport):

- REQ-05.06.07-INTEROP-0040.0010
- REQ-05.06.07-INTEROP-0040.0020
- REQ-05.06.07-INTEROP-0060.0010
- REQ-05.06.07-INTEROP-0060.0020

(IER 0030 is not specified as it is out of scope. Service needs must be expressed by WP6 as mentioned before.)

Group 3: Aircraft Interaction (here only ground interaction with ATSU having A/C under their control)

- REQ-05.06.07-INTEROP-0120.0010
- REQ-05.06.07-INTEROP-0120.0020

The following requirement is not split into two, since the service is specified by other projects if it is not done via voice (e.g. 5.6.1 for the datalink part of i4D):

- REQ-05.06.07-INTEROP-0020.0010

Quality of Service regarding voice cannot be specified here as it is a human interaction. QoS for datalink is out of scope for 5.6.4/7 and should be covered by 5.6.1 on the operational level.

The only procedural enabler linked to TS-0305-A is PRO-245 that specifies the ATC Procedures developed for the use of extended Arrival management, involving cooperation between different ANSPs and protocol for coordinating through several areas of responsibility, including across borders. The following requirements are covering PRO-245:

- REQ-05.06.07-INTEROP-0020.0010
- REQ-05.06.07-INTEROP-0010.0010
- REQ-05.06.07-INTEROP-0120.0010

The following requirements are listed according to their IER number (0010-0120) as presented in figure (Figure 4~~Figure 4~~):

Identifier	REQ-05.06.07-INTEROP-0010.0010
Requirement	Arrival Management Information, consisting of required and optional elements, shall be provided to Upstream ATSU. (IE-5.6.4-0032-0032).

Identifier	REQ-05.06.07-INTEROP-0010.0020
Requirement	Arrival Management Information shall not exceed a time of delivery of 1s for approach and destination airport or 10s for upstream ATSU. Update cycle shall not exceed 5 seconds (radar update).

Identifier	REQ-05.06.07-INTEROP-0020.0010
Requirement	AMAN Plan shall be implemented via voice or via datalink from ground to aircraft in the responsible ATSU. The options of information content are the following: • ATC Instruction (to comply with TTL/TTG or Speed advisory) • Target Time Over (at IMP) • CTA (i4D or non-i4D) The AMAN information/plan/sequence is presented to the controller. This information contains AMAN advisories, to enable the plan. The advisories are translated, as/when appropriate, by the controller into specific actions for the flight crew to follow. The flight crew respond to the instructions as they would to any ATC instruction.

Identifier	REQ-05.06.07-INTEROP-0040.0010
Requirement	AMAN unit shall receive Runway Usage Constraints (IE-5.6.4-0032-0033) from the destination airport (destination of arriving aircraft sequence).The information can be processed either automatically or via manual input in the AMAN tool by the controller.

Identifier	REQ-05.06.07-INTEROP-0040.0020
Requirement	Runway Usage Constraints shall not exceed a time of delivery of 10s for AMAN unit. Information shall be updated before sending as soon as new information is available.

Identifier	REQ-05.06.07-INTEROP-0050.0010
Requirement	AMAN Sequence shall be provided to Satellite Airport by sending Arrival Management Information (IE-5.6.4-0032-0032) as required. Arrival Management Information shall be filtered to the specific needs of the Satellite Airport. Information includes Time to Lose for specific aircraft on ground.

Identifier	REQ-05.06.07-INTEROP-0050.0020
Requirement	Arrival Management Information shall not exceed a time of delivery of 10s for a Satellite Airport. Update cycle shall not exceed 5 seconds (radar update).

Identifier	REQ-05.06.07-INTEROP-0060.0010
Requirement	Satellite Airport shall send Departure Planning Information data (REQ-5.6.4-REQS-0028-0810 or REQ-5.6.4-REQS-0028-0820) to the AMAN.

Identifier	REQ-05.06.07-INTEROP-0060.0020
Requirement	Departure Planning Information shall not exceed a time of delivery of 10s from a Satellite Airport. Update cycle shall not exceed 60 seconds (derived from Tower or CDM information).

Identifier	REQ-05.06.07-INTEROP-0120.0010
Requirement	CTA Status data shall be provided to Downstream ATSU and AMAN unit by sending CTA Status Information (IE-5.6.4-0032-0104) on CTA event from upstream if applicable.

Identifier	REQ-05.06.07-INTEROP-0120.0020
Requirement	CTA Status Information shall not exceed a time of delivery of 10s to AMAN unit.

C.4.3 Dynamic functions / operations

The SPR-INTEROP activity identified dynamic functions requiring attention only in the CTA context, which is comprehensively handled in P05.06.01 INTEROP; see [18].

C.4.4 Unique characteristics

As stated in the introduction, this INTEROP document is conceived as technology agnostic; nonetheless, for completeness the following requirements are provided for interoperability with legacy Ground-Ground technology represented by the OLDI standard.

The only procedural enabler linked to TS-0305-A is PRO-245 that specifies the ATC Procedures developed for the use of extended Arrival management, involving cooperation between different ANSPs and protocol for coordinating through several areas of responsibility, including across borders. The following requirements are covering PRO-245:

- REQ-05.06.07-INTEROP-OLDI.0010
- REQ-05.06.07-INTEROP-OLDI.0020

Identifier	REQ-05.06.07-INTEROP-OLDI.0010
Requirement	On reception of Arrival Management information by means of an OLDI AMA message, the receiving system shall generate and provide to the sending system a message indicating any of the following states: • AM accepted • AM rejected

Note: For non-OLDI operations a logical acknowledgement message (LAM) that is explicitly described above is not existing and is covered by SPR requirements that are ensuring the correct operating mode und functionality in the upstream component.

Identifier	REQ-05.06.07-INTEROP-OLDI.0020
Requirement	Arrival Management Information items referring to a time constraint established for the purposes of Arrival Management shall be specified with precision of one second.

C.5 References

See main references in this document (section 4)!

-END OF DOCUMENT-