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SESAR Solution PJ.02-01-04 SPR-INTEROP/OSED Final Version for V3 - Part I

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Copyright Statement

PJ.02-W2-AART

AIRPORT, AIRSIDE AND RUNWAY THROUGHPUT

This OSED is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874477 under European Union's Horizon 2020 research and innovation programme.

Abstract

This SPR-INTEROP/OSED presents the PJ.02-01 concepts that contribute to WTS for Arrivals:

- AO-0328: Optimised Runway Delivery on Final Approach (ORD) (PJ.02-01-01);
- AO-0306: Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics (PWS-A) (PJ.02-01-04);
- AO-0310: Weather Dependent reductions of Wake Turbulence Separations for final approach (WDS-A) (PJ.02-01-03).

The PJ.02-01-04 Solution is an extension of the PJ.02-01 arrivals solutions that were developed in SESAR Wave 1 to V3 maturity. PJ.02-01 aimed to optimise wake turbulence separation minima for arrivals to enhance airport runway throughput. It focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions;
- Separation delivery support tools for ATCOs.

The purpose of this PJ.02-01-04 OSED as a separate Wave 2 document is to describe the further development of the static pairwise wake separation minima based on an expanded aircraft type matrix. These updates are principally represented through the introductions of:

- The revised S-PWS distance-based aircraft type matrix to section 3.2.4.2.1;
- The methodology and results description for the Wave 2 developments as Annex A. This document presents the results of the study to update the RECAT pairwise wake turbulence separation matrix for arrivals and departures (RECAT-PWS).

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1 Executive Summary

This SPR-INTEROP/OSED presents the PJ.02-01 concepts that contribute to WTS for Arrivals :

- **AO-0328: Optimised Runway Delivery on Final Approach (ORD)**

  ORD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between arrival pairs on final approach to the runway landing threshold through providing Target Distance Indicators (TDIs) to the controllers;

- **AO-0306: Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics (PWS-A)**

  PWS-A is the efficient aircraft type pairwise wake separation rules for final approach, consisting of both the aircraft type based pairwise wake separation minima and the twenty wake category (20-CAT) based wake separation minima for arrival pairs involving other aircraft types;

- **AO-0310: Weather Dependent reductions of Wake Turbulence Separations for final approach (WDS-A)**

  WDS-A is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions, so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

Revising the wake separation minima aims to increase arrival runway capacity, efficiency, predictability and resilience while maintaining or increasing safety.

The PJ.02-01-04 Solution is an extension of the PJ.02-01 arrivals solutions that were developed in SESAR Wave 1 to V3 maturity. PJ.02-01 aimed to optimise wake turbulence separation minima for arrivals to enhance airport runway throughput. It focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions;
- Separation delivery support tools for ATCOs.

ORD, PWS-A and WDS-A are all V3 mature. WDS-A ended in Wave 1. For PWS-A, this PJ.02-01-04 OSED represents a further refinement of the 96x96 aircraft type matrix for inclusion of seven additional types to create a 103x103 matrix. For ORD refinements/new functionalities will be encompassed in a new OI AO-0334 in Wave 2.

2 Introduction

2.1 Purpose of the document

This document[1] provides the requirements specification, covering functional, non-functional and interface requirements related to SESAR Wave 1 arrival solutions in PJ.02-01 focusing on PJ.02-01-04. This document builds on the Wave 1 PJ.02-01 arrival solutions and focusses on providing updates to the S-PWS-A solution.

The purpose of this PJ.02-01-04 OSED as a separate Wave 2 document is to describe the further development of the static pairwise wake separation minima based on an expanded aircraft type matrix. These updates are principally represented through the introductions of:

- The revised S-PWS distance-based aircraft type matrix to section 3.2.4.2.1;
- The methodology and results description for the Wave 2 developments as Annex A. This document presents the results of the study to update the RECAT pairwise wake turbulence separation matrix for arrivals and departures (RECAT-PWS).

The SESAR Solution Development Life Cycle aims to structure and perform the work at project level and progressively increase SESAR Solution maturity, with the final objective of delivering a SESAR Solution data-pack for industrialisation and deployment. The Part I of the SPR-INTEROP/OSED represents one of the key parts of this SESAR Solution data-pack.

2.2 Scope

This is the Part I of the SPR-INTEROP/OSED for PJ.02-01 SESAR arrival solutions focusing on PJ.02-01-04 for the V3 pre-industrial development & integration maturity phase.

This SPR/INTEROP/OSED covers safety, performance, operational aspects as well as the interoperability aspects related to a specific technology to support the SESAR Solution PJ.02-01-04 WTS (for Arrivals) based on Static Aircraft Characteristics for the following concepts solutions:

- AO-0328: Optimised Runway Delivery on Final Approach (ORD);
- AO-0306: Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics (PWS-A);
- AO-0310: Weather Dependent reductions of Wake Turbulence Separations for final approach (WDS-A).

[1] The opinions expressed herein reflect the authors view only. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

2.3 Intended readership

The intended readership is the SESAR Solution PJ.02-01-04 project members, the other solutions in SESAR Project PJ.02 Airport, Airside and Runway Throughput, the related solutions in SESAR Project PJ.0.1 Enhanced Arrivals and Departures, the related solutions in SESAR Project PJ.04 Total Airport Management, the related solutions in SESAR Project PJ.09 Advanced Demand & Capacity Balancing, the related transversal SESAR Projects PJ.19 and PJ.22, and all impacted and interested stakeholders.

2.4 Background

For the arrivals concept and the development of ATC support tool prototypes previous work from SESAR 1 Project P06.08.01 and SESAR 1 OFA 01.03.01 is relevant. SESAR 1 Project P06.08.01 Flexible and Dynamic Use of Wake Turbulence Separations focused on separation delivery of arriving aircraft, which led to the operational deployment of a Time Based Separation(s) (TBS) tool at Heathrow.

Other relevant research is RECAT-EU and RECAT-EU-PWS. RECAT-EU and RECAT-EU-PWS are optimisations of ICAO wake turbulence categories scheme, developed by EUROCONTROL in consultation with European stakeholders. RECAT-EU for arrivals is currently deployed at five European airports (Paris CDG, Le Bourget, Leipzig Halle (partial application to some aircraft pairs), London Heathrow and Toulouse Blagnac airports).

As part of SESAR 2020 Wave 2, the PJ.02-01-04 solution has been created to support the planned refinements to the 96x96 matrix proposed in Wave 1. This has since been expanded to a 103x103 matrix to include seven new aircraft types. For completeness, this OSED still contains all three of the Wave 1 PJ.02-01 arrivals solutions (ORD, PWS-A and WDS-A).

2.5 Structure of the document

The SPR-INTEROP/OSED consists of five parts:

- Part I, this part, providing the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP) related to SESAR Solution PJ.02-01-04 WTS (for Arrivals) based on Static Aircraft Characteristics, that have been developed and validated during the validation activities of SESAR 2020 Solution PJ.02-01-04 to a V3 maturity level. They are presented in the context of the Operational Service and Environment Definition (OSED) which describes the environment, assumptions and other issues that are applicable to the SPR and INTEROP requirements;
- Part II: The Safety Assessment Report which describes the results of the safety assessment work for the SESAR Solution PJ.02-01-04 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I;
- Part III: The Environmental Assessment Report which describes the results of the environmental assessment work for the SESAR Solution PJ.02-01-04 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I;
- Part IV: The Human Performance Assessment Report which describes the results of the Human Performance Assessment Report which describes the results of the Human Performance assessment work for the SESAR Solution PJ.02-01-04 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I;

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- Part V: The Performance Assessment Report (PAR) that consolidates the performance results obtained across the different validation activities at the SESAR Solution PJ.02-01-04 concepts solutions level.

This part of the SESAR Solution PJ.02-01-04 SPR-INTEROP/OSED (Part I) consists of five main sections, an appendix and an annex. Each section, and the appendix, addresses each of the Wave 1 SESAR arrivals solutions based on Static Aircraft Characteristics concepts solutions; while the Annex focuses on Wave 2 S-PWS-A research:

- Section 1: Executive Summary of the brief description of the concepts solutions and the associated research needs gaps and issues.
- Section 2: Introduction covering the purpose of the document, the scope, the intended readership, the background to the V2 feasibility maturity level of the concepts at the end of SESAR 1, the glossary of terms and the list of acronyms.
- Section 3: The Operational Service and Environment Definition detailing the concepts solutions and the improvements, expected benefits, allocated validation targets, key features and capabilities, any dependencies on other SESAR 2020 solutions, operational characteristics, roles and responsibilities, technical characteristics, applicable standards and regulations, previous operating method, new operating method, use cases, and differences between the new and previous operating methods.
- Section 4: The Safety, Performance and Interoperability Requirements (SPR-INTEROP) established in the V3 maturity validation activities of SESAR 2020 Solution PJ.02-01-04.
- Section 5: References and Applicable Documents
- Appendix A: Costs and Benefits Mechanisms including stakeholders identification and expectations, benefits mechanisms and costs mechanisms;
- Annex A: PWS-A/D Methodology, detailing the process used to produce the proposed 103 x 103 DB-PWS-A matrix.

2.6 Glossary of terms

Term	Definition	Source of the definition
DBS	Refers to applying wake separations on final approach which are based on distances. This is how wake separations are applied in the majority of current operations.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [42]
In-trail aircraft pair	Refers to consecutive aircraft pairs that are landing on the same runway.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [42]
Not-in-trail aircraft pair	Refers to consecutive aircraft pairs that are landing on different parallel runways.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [42]
ORD	Refers to the Optimised Runway Delivery concept which intends to provide additional tool support to show the	OFA 01.03.01 Enhanced Runway Throughput

	Controller the required spacing on the approach to take into account the effect of compression primarily caused by aircraft decelerating to land.	Consolidated Final Step 1 OSED [42]
S-PWS	A wake separation concept where wake separations are optimised by defining them between aircraft type pairs rather than between wake categories.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [42]
TBS	Refers to the generic TBS concept that was developed in SESAR 1 Project P06.08.01 which included tool support to show the Controller the required separation.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [42]
WDS (arrivals)	There are two versions: WDS (total wind) and WDS (crosswind). WDS (total wind) aims to allow reduced Wake Turbulence (WT) separations based on the argument that WT is more rapidly decayed as the wind magnitude increases. WDS (crosswind) aims to allow the reduction of WT separations based on the argument that WT is transported out of the path of follower aircraft.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [42]

Table 1: Glossary of terms

2.7 List of Acronyms

Acronym	Definition
ACC	Area Control Centre
AFTN	Aeronautical Fixed Telecommunication Network
AMAN	Arrival Manager (System)
ANSP	Air Navigation Service Provider
APP	Approach
APT	Airport
AROT	Arrival Runway Occupancy Time
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Service
CAP	Capacity

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CAT	Category (for aircraft classification for wake)
CBA	Cost Benefit Assessment
CONOPS	Concept of Operations
CSPR	Closely Spaced Parallel Runway
CWP	Controller Working Position
DBS	Distance Based Separation
DF	Deceleration Fix (for landing stabilisation)
DMAN	Departure Manager (System)
DME	Distance Measuring Equipment
EATMA	European ATM Architecture
EFPS	Electronic Flight Progress Strip
FAF	Final Approach Fix
FAP	Final Approach Point
FDP	Flight Data Processor
FMS	Flight Management System
FTD	Final Target Distance
FTS	Fast Time Simulation
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GWCS	Glideslope Wind Conditions Service
HLOR	High Level Operational Requirement
HMI	Human Machine Interface
IAF	Initial Approach Fix
IAS	Indicated Air Speed
ILS	Instrument Landing System
INTEROP	Interoperability Requirements
IPW	In-Plane Wind
ITD	Initial Target Distance
KIAS	Knots Indicated Air Speed
LIDAR	Light Detection and Ranging
LORD	Landing with Optimised Runway Delivery
MET	Meteorological
MLS	Microwave Landing System

MRS	Minimum Radar Separation
MTOW	Maximum Take Off Weight
NDB	Non-Directional Beacon
NOV	Node View
OFA	Operational Focus Area
OI	Operational Improvement
ORD	Optimised Runway Delivery (arrivals)
OSED	Operational Service and Environment Definition
PAR	Performance Assessment Report
PCP	Pilot Common Project
PFS	Paper Flight Strip
PSR	Primary Surveillance Radar
PWS	Pairwise Wake Separations
REQ	Requirement
RNAV	Area Navigation
ROT	Runway Occupancy Time
RSVA	Reduced Separation in the Vicinity of the Aerodrome
RTS	Real-Time Simulation
RWY	Runway
SAR	Safety Assessment Report
SESAR	Single European Sky ATM Research Programme
SPR	Safety and Performance Requirements
SSR	Secondary Surveillance Radar
STAR	Standard Terminal Arrival Route
TAS	True Air Speed
TBS	Time Based Separation
TDI	Target Distance Indicator
TMA	Terminal Manoeuvring Area
TWR	Tower
VALR	Validation Report
VCR	Visual Control Room
VOR	VHF Omnidirectional Range
WDS	Weather Dependent Separation

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WTC	Wake Turbulence Category
WTE	Wake Turbulence Encounter
WTS	Wake Turbulence Separation

Table 2: List of acronyms

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3 Operational Service and Environment Definition

3.1 SESAR Solution PJ.02-01-04 WTS (for Arrivals) based on Static Aircraft Characteristics: a summary

3.1.1 Introduction

SESAR Solution PJ.02-01-04 has aimed to optimise wake turbulence separation minima for arrivals to enhance airport runway throughput. SESAR Solution PJ.02-01-04 encompasses the following concepts solutions:

- AO-0328: Optimised Runway Delivery on Final Approach (ORD)
- AO-0306: Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics (PWS-A)
- AO-0310: Weather Dependent reductions of Wake Turbulence Separations for final approach (WDS-A)

SESAR Solution PJ.02-01-04 has focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions;
- Separation delivery support tools for ATCOs.

SESAR Solution PJ.02-01-04 is part of the High Performing Airport Operations Project PJ.02.

As airports remain one of the most significant bottlenecks in the ATM, the WTS (for Arrivals) based on Static Aircraft Characteristics solutions represent great potential for system-wide improvements.

3.1.2 Summary of Arrivals Solutions

ORD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between arrival pairs on final approach to the runway landing threshold through providing Target Distance Indicators (TDIs) to the controllers.

PWS-A is the efficient aircraft type pairwise wake separation rules for final approach consisting of both the aircraft type based pairwise wake separation minima and the twenty wake category (20-CAT) based wake separation minima for arrival pairs involving other aircraft types.

WDS-A is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions, so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

The wake separation minima on final approach are defined as both distance-based minima and time-based minima, and so may be applied as either distance-based minima or time-based minima.

ORD, PWS-A and WDS-A increase arrival runway capacity, and improve the efficiency, predictability and resilience of arrival operations, while maintaining or increasing safety:

- **Runway Capacity:** The reduction of wake separation minima through the application of the more efficient PWS-A, and the application of the conditional reduction or suspension of WDS-A, facilitated by the ORD ATC support tool, has a direct impact on runway throughput and therefore capacity.
- **Efficiency:** The ORD ATC support tool enhances operational efficiency by reducing over conservative spacing delivery, allowing the ATCOs to more accurately deliver to the PWS-A and WDS-A wake separation minima.
- **Predictability:** The ORD ATC support tool, by facilitating delivery to the optimised arrival wake separation minima (PWS-A, WDS-A), especially when time-based, helps to maintain runway throughput in adverse final approach headwind conditions. Additionally, where the reduction of separation (PWS-A) is not translated 100% into an increase in the declared capacity, the additional spare capacity allows for the more efficient delivery of any peak over-demand, thus reducing delay.
- **Flexibility:** PWS-A can be used to refine delivered separations to either increase capacity or to provide additional resilience in the runway throughput schedule. WDS-A as a conditional separation reduction, can be used tactically when conditions allow, to provide additional resilience to the arrival throughput.
- **Resilience:** The ORD ATC support tool and the use of PWS-A and WDS-A under different modes of operation (segregated, mixed mode) supports ATC to be able to more flexibly manage the runway mode of operation, and so provide added resilience to disruption events such as a temporary unserviceable runway.
- **Environment/Fuel Efficiency:** Through reducing delay and disruption there is a positive impact on fuel efficiency and the associated emissions impact on the environment.
- **Human Performance:** The ORD ATC support tool helps to manage the complexity of employing the efficient PWS-A and WDS-A wake separation minima, facilitating efficient and consistent delivery to the wake separation minima, and mitigating the associated impact on ATC workload.
- **Safety:** Efficient and consistent separation delivery to the PWS-A and WDS-A rules facilitated by the ORD ATC support tool enables the simultaneous reduction in the overall wake separation that is required to be delivered and also improves conformance to the required wake separation minima. This means that the rate of under spacing delivery is significantly reduced, which improves safety related to wake separation delivery conformance, but also improves spacing related delivery consistency with respect to runway occupancy time related spacing.
- **Cost Efficiency:** For airports deploying TBS (PCP), runway throughput increases made available through PWS-A and WDS-A will be at relatively low cost because the ORD ATC support tool support can be implemented as an enhancement to the already deployed TBS ATC support tool. For other airports, the expected increase of capacity will largely compensate for the associated cost of deploying the ORD ATC support tool to enable the employment of the efficient PWS-A and WDS-A wake separation minima.

More details on the benefits results from the validation exercises are detailed in the VALR and PAR documents.

For the arrivals concepts solutions there are no major dependencies to other SESAR Solutions.

3.1.3 Validation Targets Allocated to SESAR Solution PJ.02-01-04

From the PJ.19 Validation Targets (2022) [44] the following validation targets were allocated to SESAR Solution PJ.02-01-04:

- Airport Capacity

SOL CODE	Solution Validation Target	APT CAP Target per Sub-OE		
		APT Very Large	APT Large	APT Medium
Solution PJ.02-01-04	2,160%	2,160%	2,160%	2,160%

- Predictability

SOL CODE	Solution Validation Target	PRD1 Target per Sub-OE			
		TMA Very High Complexity	TMA High Complexity	TMA Medium Complexity	TMA Low Complexity
Solution PJ.02-01-04	0,800%	0,494%	0,104%	0,098%	0,104%

- Environment/Fuel Efficiency (saving kg/flight)

SOL CODE	Solution Validation Target	FEFF Target per Sub-OE					
		TMA Very High Complexity	TMA High Complexity	TMA Medium Complexity	APT Very Large	APT Large	APT Medium
Solution PJ.02-01-04	20,643	7,035	1,481	1,389	4,443	3,703	2,592

- Safety

SOL CODE	Solution Validation Target	Safety		
		APT Very Large	APT Large	APT Medium
Solution PJ.02-01-04	-0.86%	-3.68%	-3.68%	-3.68%

3.1.4 Scope and Related OI Steps and Link to CONOPS

SESAR Solution ID	SESAR Solution Title	OI Steps ID	OI Steps Title	Enabler ID	Enabler Title	OI Step/Enabler Coverage
PJ.02-01-01	Optimised Runway Delivery on Final Approach	AO-0328	Optimised Runway Delivery on Final Approach	APP ATC 99	ATC System to use Real-Time Meteo Information Received From Met Systems	Fully Covered
				APP ATC 120	Approach ATC System to support Optimised Runway Delivery on Final Approach	Fully Covered
				APP ATC 156	ATC System to Support Time-Based Separation in Final Approach	Fully Covered
				APP ATC 169	Approach ATC System to support Optimised Runway Delivery on Approach based on Aircraft ROT Characterisation	Fully Covered
				AERODROME-ATC-17	Airport ATC tool to Support Time-Based Separation in Final Approach	Fully Covered
				AERODROME-ATC-55	Aerodrome ATC System to support Optimised Runway	Fully Covered

					Delivery on Final Approach based on Aircraft ROT Characterisation	
				AERODROME-ATC-68	Aerodrome ATC System to support Optimised Runway Delivery on Final Approach	Fully Covered
				A/C-47	On-board management of meteorological data from on-board sensors for sharing and integration by ATM and ATM-MET systems	Fully Covered
				SWIM-APS-07a	Stakeholder systems consumption of G/G Meteorological Information services	Fully Covered
PJ.02-01-04	WTS (for Arrivals) based on Static Aircraft Characteristics	AO-0306	Wake Turbulence Separations (for Arrivals) based on Static Aircraft Characteristics	APP ATC 118	ATC System to support static pair-wise wake separation (S-PWS) on approach	Fully Covered
				AERODROME-ATC-42a	Airport ATC tool to support static pair-wise wake separation (S-PWS) in final approach	Fully Covered

				REG-0523	Regulatory provisions (AMC) for static pair-wise wake separation minima (S-PWS)	Fully Covered
PJ.02-01-05	Weather-Dependent Reductions of Wake Turbulence Separations for Final Approach	AO-0310	Weather-Dependent Reductions of Wake Turbulence Separations for Final Approach	APP ATC 74	ATC System Support for Reduced, Weather-Dependent Separation Standards in Final Approach	Fully Covered
				APP ATC 99	ATC System to use Real-Time Meteo Information Received From Met Systems	Fully Covered
				AERODROME-ATC-60	Airport ATC system to monitor wake turbulence risk using ground-based LIDAR/Radar	Fully Covered
				A/C-47	On-board management of meteorological data from on-board sensors for sharing and integration by ATM and ATM-MET systems	Fully Covered
				SWIM-APS-07a	Stakeholder systems consumption of G/G Meteorological Information services	Fully Covered

				REG-0522	Regulatory provisions for weather-dependent separation minima (WDS)	Fully Covered

Table 3: SESAR Solution PJ.02-01-04 Scope and related OI steps/enablers

The High Level Requirements applicable to PJ.02.01 are provided in Table 4.

High Level Concept of Operations Requirement ID	High Level Concept of Operations Requirement	Reference to relevant Concept of Operations Sections e.g. Operational Scenario applicable to the SESAR Solution
S02-01-HLOR-01	The Optimisation of Wake Turbulence Separation shall: • increase runway throughput • ensure more refined and efficient wake separation than current ICAO rules • ensure consistent and efficient management of spacing compression on final approach and the initial departure phase of flight by automatically managing the complexity of applying the required wake separation between each aircraft pair through: • the implementation of S-PWS and WDS • the use of the associated ATC support tools while: supporting passive wake vortex decay devices	Airport Operational Scenario Execution Phase: Arrival (Scope: Approach, Final Approach, and Landing) Airport Operational Scenario Execution Phase: Departure (Scope: Take-Off) Airport Operational Scenario Post Execution phase: Arrival (Scope: Approach, Final Approach, and Landing) Airport Operational Scenario Post Execution phase: Departure (Scope: Take-Off)

Table 4: Link to Concept of Operations

3.1.5 Deviations with respect to the SESAR Solution(s) definition

No deviations.

3.2 Detailed Operational Environment

3.2.1 Operational Characteristics PJ.02-01-04 WTS (for Arrivals) based on Static Aircraft Characteristics

SESAR Solution PJ.02-01-04 aims to optimise wake turbulence separation minima for arrivals in Very Large Airports, Large Airports and Medium Airports, and Terminal Very High Complexity, Terminal High Complexity and Terminal Medium Complexity sub operational environments. These operational environments are defined in PJ.19 Validation Targets (2022) [44] and extracted into Table 5 below.

OEs	Sub Operating Environments	Definition
Terminal	Terminal Very High Complexity	Very High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of equal or more than 10
	Terminal High Complexity	High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a
	Terminal Medium Complexity	High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a
	Terminal Low Complexity	Low complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a
En-route	En-route Very High Complexity	Very High complexity ACCs have a complexity score of equal to or greater than 10
	En-route High Complexity	High complexity ACCs have a complexity score of between 6 and 10
	En-route Medium Complexity	Medium complexity ACCs have a complexity score of between 2 and 6
	En-route Low Complexity	Low complexity ACCs have a complexity score of less than 2
Airport	Very Large Airport	Airports with more than 250k movements per year
	Large Airport	Airports with more or equal than 150k and less or equal than 250k
	Medium Airport	Airports with more or equal than 40k and less than 150k
	Small Airport	Airports with more or equal than 15k and less than 40k
	Other	Airports with less than 15k movements per year

Table 5: Overview of Operating Environments (OEs) and Sub-OEs

The runway configurations and modes of operations employed at Very Large Airport, Large Airports and Medium Airports include:

- Single runway operating in mixed mode operations
- Independent parallel runways operating in segregated mode operations
- Dependent parallel runways operating in segregated mode operations with the option of some arrival aircraft landing on the designated departure runway
- Closely spaced parallel runways operating in segregated mode operations
- Closely spaced parallel runways operating in mixed mode operations

Final approach segment is described in ICAO Doc 8168 [36]. For precision approach, the final approach segment begins at the Final Approach Point (FAP). This is a point in space on the final approach track where the intermediate approach altitude / height intercepts the Instrument Landing System (ILS) / Microwave Landing System (MLS) glide path elevation angle.

Typically, the intermediate approach altitude / height generally intercepts the ILS / MLS glide elevation angle at heights from 300m (1,000ft) to over 1,200m (4,000ft) above runway elevation. In this case, for a 3° ILS / MLS glide path angle, interception occurs between 6km (3 NM) and 37km (20 NM) from the runway landing threshold.

In TMA controlled airspace, runway glideslope interception by arrivals can occur up to over 4,000ft and up to 20 NM from runway threshold.

Figure 1 provides an illustration of a typical final approach segment with different possible altitudes of glide path interception and approach speeds.

A variety of local procedural airspeed profiles are employed on final approach as illustrated for the specimen final approach segment below. These are typically between 220 KIAS and 160 KIAS on joining the final approach localiser, reducing to between 180 KIAS and 160 KIAS to the start of landing speed stabilisation, with landing speed stabilisation starting from between 6 NM and 4 NM from the runway landing threshold.

Figure 1: Example Final Approach

The landing stabilisation speed profiles, starting from around 6 NM to 4 NM from the runway landing threshold until touchdown, vary considerably depending on aircraft type, landing weight, stabilisation altitude, stabilisation mode, and the associated airline operator cockpit procedures. The range of stabilisation airspeeds varies from under 100 KIAS for some Light wake category aircraft types to over 160 KIAS for some Heavy wake category aircraft types.

During the final approach phase all distance separations tend to reduce due to the global reduction of the arrival aircraft airspeed from the interception of the glideslope until crossing the runway landing threshold to touchdown.

In a first phase covering interception of the glideslope until commencing the landing stabilisation procedures starting at the Deceleration Fix (DF) usually at 4 NM from the runway landing threshold, the airspeed variations are coherent for all aircraft and dictated by the procedural airspeed profiles. In this phase the compression is relatively predictable. The final approach controller anticipates the compression to reach the initial spacing at the DF. During this phase, there is no or very limited time separation variation.

In a second phase, the separation distances continue globally to reduce but in different proportions as a function of the leader and follower final approach airspeed profiles. The time separations may vary significantly in this phase. The follower is gaining or loosing time compared to the leader aircraft. At the first order, the time lost or gained is driven by the final approach airspeeds of the leader and follower and therefore by the pair of aircraft types. However, if one observes the time variation for a given pair for a large range of headwind profiles along the glide, it appears that the wind has a second order effect that cannot be neglected.

As well as considering the applicable separation (WT or MRS) and the effect of compression, the final approach controller may also need to allow for addition spacing due to the ROT (for example A380-A380 pairs will be constrained by ROT).

3.2.2 Roles and Responsibilities

The EATMA Node and Node Instances impacted by the arrivals concepts solutions are:

- En-Route/Approach ATS
  - Approach Supervisor
  - Final Approach Control
  - Intermediate Approach Control
- Aerodrome ATS
  - Tower Runway Supervisor
  - Tower Runway Control
- Flight Deck
  - Flight Deck

The applicable roles and responsibilities for the arrivals concepts solutions include:

- Tower ATC Roles
  - Tower ATC Supervisor
  - Tower Runway Controller
- Approach ATC Roles
  - Approach Supervisor
  - Final Approach Controller
  - Intermediate Approach Controller
- Flight Crew Roles
  - Flight Crew
- System Roles
  - Operation Technicians / System Engineers

These roles and the specific/additional role responsibilities are detailed below.

Role	Current Responsibility	Specific/additional role
Tower ATC Supervisor	Has overall responsibility for the planning of the tower operation. Monitors operations. Decides on arrival rates. Decides on staffing and manning of CWPs in accordance with expected traffic demand. Proposes runway configuration. Gives permission for maintenance, etc.	Is aware of the wind conditions, and for determining and deciding on the application (if required) of the arrivals concept (TBS-A, PWS-A, WDS-A) in consultation with the Approach Supervisor. Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the arrival Separation Delivery tool support for Tower ATC. Responsible for ensuring runway conditions, and planned and forecast changes to the runway conditions, are reflected in the separation policy information.
Tower Runway Controller	The Tower Runway Controller is responsible for the provision of air traffic services to aircraft within the	Uses the Separation Delivery tool to monitor that separation / spacing remain consistent as aircraft descend on final approach, so as to enable timely intervention action to be taken when there is separation infringement.

	control zone, or otherwise operating in the vicinity of controlled aerodromes (unless transferred to Approach Control/ACC, or to the Tower Ground Controller), by issuing clearances, instructions and permission to aircraft, vehicles and persons as required for the safe and efficient flow of traffic.	Monitors runway occupancy, and runway conditions, and ensures separation policy is consistently maintained to support the runway conditions, and changes to the runway conditions. Receives, from different sources, and disseminates to the flight deck, critical WT and weather information, when needed.
Approach Supervisor	Plans and monitors operation in the TMA.	Is aware of the wind conditions, and for deciding and agreeing to the application (if required) of the applicable arrivals concept (TBS-A, PWS-A, WDS-A), in consultation with the Tower Supervisor. Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the arrival Separation Delivery tool support for Approach ATC. Responsible for ensuring that flight crew are informed of the application of the applicable arrivals concept (TBS-A, PWS-A, WDS-A), for example, through D-ATIS.
Final / Intermediate Approach Controller	Are in charge of safe and efficient processing of arrivals to the runway.	Responsible for ensuring that the arrival aircraft information used by the Separation Delivery tool to calculate the TDIs is correct. This includes the arrival sequence order intent, and the flight specific aircraft information such as the aircraft type, the landing speed intent, and in the case of parallel active duty runways-in-use, the landing runway intent of each aircraft. Uses the Separation Delivery tool to ensure final approach separations are set up consistently and efficiently. Uses the Separation Delivery tool to monitor that separations remain consistent as aircraft descend on final approach, so as to enable timely intervention action to be taken when there is separation infringement.
Flight Crew	The Flight Crew remains ultimately responsible for the safe and orderly operation of the flight.	Is aware of the applicable arrivals concept (TBS-A, PWS-A, WDS-A) in operation and the impact on the distance separation set up on final approach.

		Is informed of when the applicable arrivals concept (TBS-A, PWS-A, WDS-A) is being employed on final approach, for example, through D-ATIS. Reports critical weather and WT information to ATC.
Operation Technicians / System Engineers	Monitors the health of the systems used to provide air traffic control services and restore them in case of failure.	Monitors the health and when necessary, restores the Separation Delivery Tool support, and the associated support tools and system services, such as the glideslope wind conditions service.

Table 6: Applicable Roles and Responsibilities for the Arrivals Concepts Solutions

3.2.3 Technical Characteristics

This section describes the technical characteristics and constraints that define the context in which the technical requirements are applicable, for the Arrival phase.

3.2.3.1 Approach Arrival Sequence Service

The Separation Delivery tool requires a reliable Approach Arrival Sequence Service that is updated upon any change in the sequence in order to allow the tool to correctly display TDIs. The service must use the sequence as planned / implemented by the Approach controllers. Options for such a service include an AMAN, AMAN plus an HMI solution to enable controllers to modify the sequence tactically, an auto sequence detection solution (EFPS).

3.2.3.2 Departures Sequence Service Support for Mixed-Mode

The Separation Delivery tool might require inputs from the Departure Sequence Service. In case of a mixed-mode runway assessment, the Arrival Separation Delivery tool might need to be aware of the planned departing aircrafts in the sequence.

3.2.3.3 Wind Forecasting and Monitoring

The TBS, ORD, S-PWS and WDS concepts rely on wind forecasting and monitoring at the surface and along the final approach path. The reliability, accuracy and stability of the wind forecasting solutions available to a local implementation determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For TB S-PWS with ORD for arrivals, both for calculating the TB S-PWS distance and for calculating the ORD anticipated distance spacing compression, a glideslope wind conditions profile is required with a forecast horizon of the flying time from the follower aircraft turning on from downwind to base until the follower aircraft crosses the runway landing threshold. This is typically between 15 NM and 25 NM flying distance to the runway landing threshold which equates to around 7 to 10 minutes flying time. If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 10 minutes forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For WDS for arrivals, both for the total wind concept and the crosswind concept there is a need to establish the wind forecasting and monitoring requirements which may include both landing runway 10m anemometer wind speed measurements and a full final approach glideslope wind profile. One aspect to consider is sufficient forecast notification of when the wind conditions will drop below the minimum criteria.

There is a need to stop the wake separation reduction in good time before the wind conditions change below the minimum criteria. This should be at least the flying time of the follower aircraft from downwind until crossing the runway landing threshold so as to provide assurance that the minimum criteria will be prevalent until the follower aircraft crosses the runway landing threshold.

If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 10 minutes forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required. There may be a need for a longer forecast horizon to support avoiding switching in and out of employing WDS for arrivals in variable or unstable wind conditions and also to support the arrival flow management decisions with respect to committing to a higher arrival flow rate into the TMA and on to approach.

3.2.3.4 Arrivals Solution OIs

Individually for each Arrivals Concepts Solutions OI the following technical characteristics have been identified.

AO-0328 - Optimised Runway Delivery on Final Approach (ORD)

The ORD concept is intended to assist Controllers in coping with the effect of compression by providing additional tool support to show them what spacing needs to be delivered at the Deceleration Fix (DF) in order to achieve the required separation / spacing. This spacing can be built into the same Separation Delivery tool that is used for the wake separation concepts S-PWS and WDS.

In SESAR 2020 work the concept evolved by:

- providing functionalities from SESAR Solution PJ.02.02 (Enhanced Approach Procedures)
- providing refined pairwise constraints from SESAR Solution PJ.02.08 (Runway Occupancy Time)
- working for different set of runway operations, procedures and constraints

AO-0306 – Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics (PWS-A)

The S-PWS concept is intended to optimise wake separations between arrivals on final approach by moving from schemes defined by wake categories to a scheme defined between aircraft type pairs. It uses:

- ATCO delivery tool support

AO-0310 – Weather-dependent reductions of Wake Turbulence separations for final approach (WDS-A)

The WDS-A concept allows conditional reduction or suspension of separation minima for most aircraft pairs by using total or cross wind:

- If it is based on a total wind then as the magnitude of the wind increases, the decay rate of wake turbulence increases allowing a reduction of wake turbulence separations. This would be a reduction in time separations as the total wind increases when the total wind is above a certain threshold. These time separations can then be used as input into the Separation Delivery tool.
- If it is based on a cross wind, then when the cross wind exceeds a certain value the WT can be shown to have been transported out of the path of arrivals allowing for the reduction of WT separations. This would be a reduction in time separations as the cross wind increases when the cross wind is above a certain threshold. These time separations can then be used as input into the Separation Delivery tool.

The concept needs:

- ATCO delivery tool support for arrivals
- Local environment weather information and wind forecasting capabilities
- Coordination between Approach and Tower Supervisor for using the wind information to activate/deactivate the WDS. If the wind were to drop below the required threshold unexpectedly then the Supervisors and Controllers shall need to be alerted to allow for a transition to a different separation mode.

3.2.4 Applicable standards and regulations

3.2.4.1 Reference Scenario WTC Schemes for the Arrivals Concepts Solutions

Today, radar and wake turbulence distance-based separation minima (hereafter referred to as DBS) are applicable by ATS to arrivals concepts solutions based on surveillance capabilities, to separate traffic in order to mitigate respectively collision risk and wake-turbulence-induced accidents.

Such WT separation schemes (including ICAO, RECAT-EU 6 category and UK 6 category) are based on Wake Turbulence Categories (WTC) and are applied independent of the wind conditions.

Additionally in SESAR 1 TBS for Arrivals (AO-0303) was developed and validated to V3 maturity and is now operationally deployed at London Heathrow based on the DB RECAT-EU 6 category scheme applied to the runway landing threshold.

3.2.4.1.1 ICAO-4 DB Scheme for Arrivals

The ICAO-4 radar separation standards for arrivals include MRS which prevents aircraft collision and WT separation which is intended to protect aircraft from adverse WTEs. Historically WT separations have been based on aircraft grouped into categories based on their MTOW and have a resolution of 1 NM. This has been needed in the past to ensure Controllers can memorise the wake separations and apply them without tool support. Additional separation has been prescribed whenever a less heavy category is following behind an aircraft from a heavier category.

This implies that when the traffic at a certain airport contains aircraft from mainly one of the categories, a low penalising effect of WT separations will appear. On the other hand, whenever the aircraft categories are mixed, there will be efficiency and capacity losses due to the extra separation that has to be applied.

ICAO Doc 4444 [37] defines the following WT separation categorisation and separation minima for application on the approach and departure phase of flight. ICAO-4 WT separation minima are based on a grouping of aircraft types into three categories according to the maximum certificated take-off mass as follows:

- **HEAVY ("H")**: all aircraft types of 136,000 kg or more;
- **MEDIUM ("M")**: aircraft types less than 136,000 kg but more than 7,000 kg;
- **LIGHT ("L")**: aircraft types of 7,000 kg or less.

Typical aircraft types in the Heavy WT category are: B747 family, B767 family, B777 family, A330/A340 family, A300/A310 family, MD11. Typical aircraft types in the Medium WT category are: B757 family, B737 family, A320 family, CRJs family (CRJ100/200/700/900/1000), E-Jets family (E135/140/145/170/175/190/195) and ATRs. A list of more than 9000 aircraft types is categorised on that basis in ICAO Doc 8643 [38].

The Airbus A380-800 (A388), with a MTOW in the order of 560,000 kg, is the largest passenger aircraft ever entered into revenue service. The aircraft is in the Heavy WTC, which has no upper limit defined. However, for the A380-800, an ICAO State guidance released in 2008 [39] recommends an increase in relation to the WT separation minima published in the PANS-ATM.

Currently the ICAO-4 scheme for distance-based wake turbulence longitudinal separation minima applies on approach in the majority of airports. Additional separation has then been prescribed behind Heavy category lead aircraft and for Light category follower behind Medium category leader. For arrivals the WT separations are defined in distance to be applied on approach.

Approach Distance Based Wake Turbulence Separation Minima		Follower Aircraft ICAO-4 Wake Category or Aircraft Type			
		A388	Heavy	Medium	Light
Lead Aircraft ICAO-4 Wake Category or Aircraft Type	A388	(*)	6 NM	7 NM	8 NM
	Heavy	(*)	4 NM	5 NM	6 NM
	Medium	(*)	(*)	(*)	5 NM
	Light	(*)	(*)	(*)	(*)

Table 7: ICAO-4 Wake Category Based Distance Based Separations for Arrivals

(*) When a wake turbulence restriction is not required, then separation reverts to radar separation minimum set for collision risk mitigation. This is typically 3 NM although can be 2.5 NM under certain conditions prescribed in ICAO Doc 4444 [37] or as prescribed by the appropriate ATS authority. This is when local radar capabilities permit and with respect to the conditions prescribed in ICAO Doc 4444, between succeeding aircraft which are established on the same final approach track within 10 NM of the runway landing threshold.

WT separation minima are to be applied in the following scenarios:

- an aircraft is operating directly behind another aircraft at the same altitude or less than 300m (1,000ft) below, or;
- both aircraft are using the same runway, or parallel runways separated by less than 760m (2,500ft); or;
- an aircraft is crossing behind another aircraft, at the same altitude or less than 300m (1,000ft) below.

3.2.4.1.2 RECAT-EU DB Scheme for Arrivals

The RECAT-EU 6 category scheme aims to provide a more efficient WT scheme by re-grouping aircraft based upon MTOW and wing span and is the result of an optimisation of the ICAO wake turbulence separation classes.

The criteria used for categorisation of existing and new aircraft types are respectively provided in Figure 2.

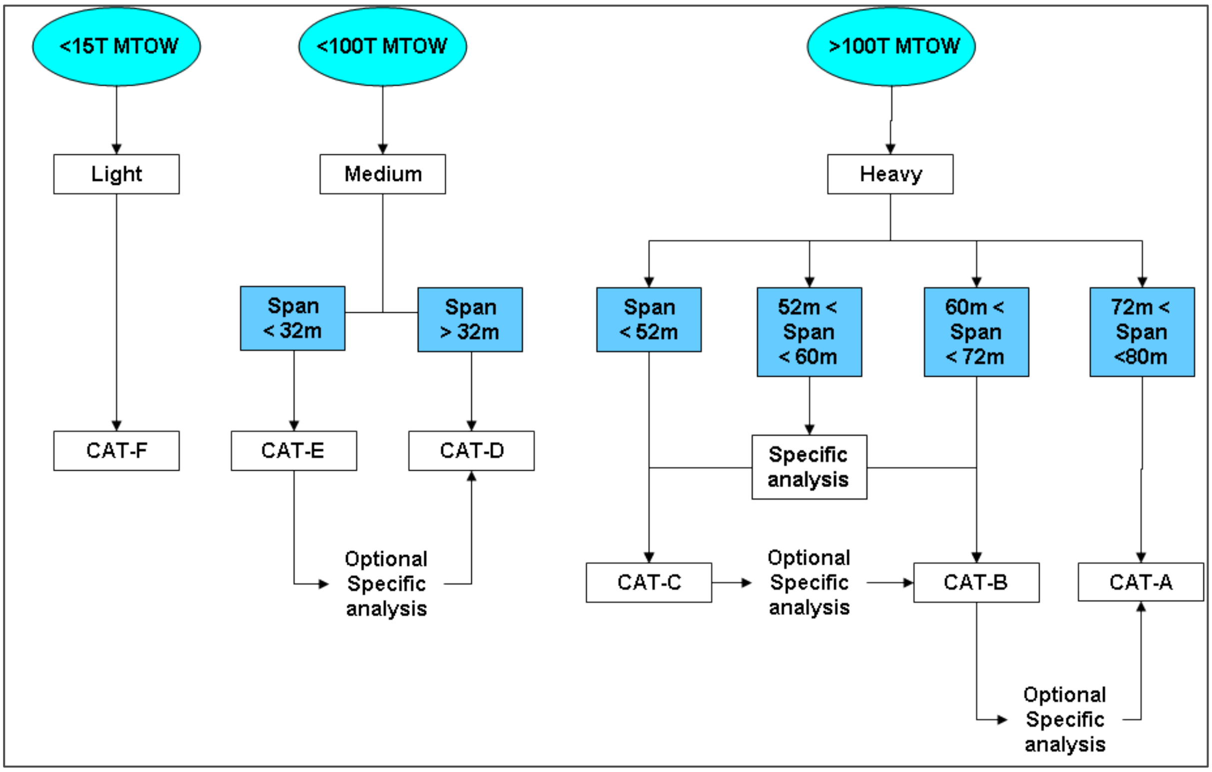

Figure 2: Categorisation process and criteria for assigning an existing aircraft type into RECAT-EU scheme

The assignment to a wake turbulence category as proposed in RECAT-EU scheme is made per aircraft type, regardless of possible variable (reduced) MTOW schemes used by the airlines for a particular aircraft type, by considering the upper range of the MTOW as defined in Manufacturers' Aircraft Characteristics Manuals for Airport Planning.

The resulting mapping of the ICAO wake category and aircraft type A380 scheme to RECAT-EU wake category scheme is as follows:

- The A380 is mapped into Super Heavy (CAT-A)
- The ICAO Heavy Wake Category is split into Upper Heavy (CAT-B) and Lower Heavy (CAT-C)
- The ICAO Medium Wake Category is split into Upper Medium (CAT-D) and Lower Medium (CAT-E) with ICAO Medium aircraft types with a MTOW greater than 100T (e.g. B752, B753) being mapped to Lower Heavy (CAT-C)
- The ICAO Light Wake Category is mapped into Light (CAT-F)

Some examples of the aircraft type assignment to the RECAT-EU wake category scheme for the most common types at European airports are provided in Table 8.

'Super Heavy'	**'Upper Heavy'**	**'Lower Heavy'**	**'Upper Medium"**	**"Lower Medium"**	**"Light"**
'CAT-A'	**'CAT-B'**	**'CAT-C'**	**'CAT-D'**	**'CAT-E'**	**'CAT-F'**
A388	A332	A306	A318	AN32	BE40
A124	A333	A30B	A319	AT43	BE45
(…)	A342	A310	A320	AT45	C152
	A343	B703	A321	AT72	C180
	A345	B752	AN12	B462	C525
	A346	B753	B736	B712	C650
	A359	B762	B737	B732	D328
	AN22	B763	B738	B733	E120
	B744	B764	B739	B734	FA10
	B748	B783	C130	B735	FA20
	B772	C135	IL18	CL30	H25B
	B773	DC10	MD81	CL60	JS32
	B77L	DC85	MD82	CRJ1	JS41
	B77W	IL76	MD83	CRJ2	LJ35
	B788	L101	MD87	CRJ7	LJ60
	IL96	MD11	MD88	CRJ9	P180
	(…)	TU22	MD90	DC93	SF34
		TU95	T204	DH8D	(…)
		(…)	TU16	E135	
			(…)	E145	
				E170	
				E175	
				E190	
				E195	
				F70	
				F100	

'Super Heavy'	'Upper Heavy'	'Lower Heavy'	'Upper Medium"	"Lower Medium"	"Light"
'CAT-A'	'CAT-B'	'CAT-C'	'CAT-D'	'CAT-E'	'CAT-F'
				GLF2 GLF4 RJ85 RJ1H (...)	

Table 8: Example List of Aircraft Types Assigned to RECAT-EU Wake Categories

For arrivals the RECAT-EU WT separations are defined in distance to be applied on approach as per Table 9.

Approach Distance Based Wake Turbulence Separation Minima		Follower Aircraft RECAT EU Wake Category					
		"Super Heavy" 'CAT-A'	"Upper Heavy" 'CAT-B'	"Lower Heavy" 'CAT-C'	"Upper Medium" 'CAT-D'	"Lower Medium" 'CAT-E'	"Light" 'CAT-F'
Lead Aircraft RECAT EU Wake Category	"Super Heavy" 'CAT-A'	3 NM	4 NM	5 NM	5 NM	6 NM	8 NM
	"Upper Heavy" 'CAT-B'		3 NM	4 NM	4 NM	5 NM	7 NM
	"Lower Heavy" 'CAT-C'		(*)	3 NM	3 NM	4 NM	6 NM
	"Upper Medium" 'CAT-D'						5 NM
	"Lower Medium" 'CAT-E'						4 NM
	"Light" 'CAT-F'						3 NM

Table 9: RECAT-EU 6 Category Wake Category Based Separations for Arrivals

(*) means minimum radar separation (MRS), set at 2.5 NM, is applicable as per ICAO Doc 4444 [37] provisions.

For aircraft category pairs with no defined WT separation then the MRS is to be applied. This is typically 3 NM although can be 2.5 NM under certain conditions prescribed in ICAO Doc 4444 [37] or as prescribed by the appropriate ATS authority.

For the deployment it remains optional to locally deploy only part of the RECAT-EU scheme, or apply larger separation minima than proposed ones, or opt for a progressive application.

It should be noted that after specific analysis there are five aircraft types that require special treatment with a recommendation to treat these aircraft as CAT-B as leader and CAT-C as follower. These aircraft types are as per Table 10.

Manufacturer	Model	ICAO Type Designator
NORTHROP GRUMMAN	B-2 Spirit	B2
BOEING	B-52 Superfortress	B52
DOUGLAS	C-133 Cargomaster	C1233
TUPOLEV	TU-160	T160
MYASISHCHEV	Atlant	VMT

Table 10: Aircraft Types Requiring Special Treatment

3.2.4.1.3 ICAO TB Scheme for Arrivals

AO-0303 TBS for Arrivals was developed to V3 maturity in SESAR 1 in Project P06.08.01 [35]. To apply an ICAO TB Scheme for Arrivals reference time separations need to be established for each wake category pair for reference low headwind conditions over the DB ICAO wake separation to the runway landing threshold, for a reference airspeed profile over the DB ICAO wake separation. The reference time-based separations and reference airspeed profile are then applied in the prevailing wind conditions on final approach to calculate the TBS distance to be applied as the wake separation minima.

3.2.4.1.4 RECAT-EU TB Scheme for Arrivals

At London Heathrow TBS for Arrivals based on the DB RECAT-EU 6 category scheme is in operation. Reference time-based separations have been established for each wake category pair for reference low headwind conditions over the DB RECAT-EU wake separation to the runway landing threshold for a reference airspeed profile over the DB RECAT-EU wake separation. The reference time-based separations and reference airspeed profile are then applied in the prevailing wind conditions on final approach to calculate the TBS distance to be applied as the wake separation minima.

3.2.4.2 Solution Scenarios WT Separation Schemes for the Arrivals Concepts Solutions

The Solution Scenario WT Separation Schemes are RECAT-PWS-EU (PWS-A) Scheme and the Weather Dependent Separation Scheme (WDS-A).

3.2.4.2.1 RECAT-PWS-EU DB Scheme for Arrivals (DB-PWS-A) (AO-0306)

The S-PWS concept is intended to optimise wake separations between arrivals on final approach by moving from schemes defined by wake categories to a scheme defined between aircraft type pairs. In current operations aircraft are grouped into wake categories depending on their MTOW. Example wake category schemes include ICAO 3+1 category, RECAT-EU 6 category or UK 6 category. However, the majority of wake separations defined in a wake category scheme are overly conservative because they are designed to protect the most wake susceptible follower aircraft type in a category from the potential wake turbulence of the strongest wake generating leader aircraft type in a category.

All other combinations of aircraft type pairs have larger wake separations than they require. This results in different wake risk between different aircraft type pairs. Through optimising the wake separations between aircraft type pairs the S-PWS concept results in an improved distribution of wake risk between aircraft type pairs. An example of an S-PWS wake scheme is RECAT-PWS-EU [34] that has been developed by EUROCONTROL.

The RECAT-PWS-EU wake scheme covers the aircraft types which are common at major European airports which have been used to specify a matrix of distance based separations. In Wave 2, seven additional aircraft types have been added to the aircraft type matrix assessed in Wave 1.

The separations have been calculated using a wake severity metric method which is based on characterisation of the leader aircraft type (generated wake decay profile) and characterisation of the follower aircraft type (approach speed profile and wing geometry characteristics to determine wake resistance). This matrix may evolve further over time as new aircraft types are added based on specific analysis using the wake severity metric.

These S-PWS distance based separations apply on approach, and are defined by the updated aircraft type matrix, which is embedded below:

AppendixC_PWS-A_
methodology_and_r

Additionally, a 14 category scheme has been defined which covers > 90% of ICAO aircraft types and has been defined in terms of MTOW, wing span and resistance factor. These categories have been defined based on similarities in aircraft design and on similarities and grouping of the PWS minima.

For all aircraft types the minima are specified by the RECAT 20 category scheme which is a combination of the RECAT-EU 6 category scheme and the RECAT 14 category scheme. For all aircraft types that have MTOW, wing span and resistance factor that fall into the one of the 14 categories then the minima are specified by the 14 category scheme. For all of the remaining aircraft types, the minima are specified by the RECAT-EU 6 category scheme.

New aircraft types can be assigned to one of the 20 categories, to one of the 14 categories and / or on a pairwise basis.

Table 11 is the 20-CAT Table extracted from [34].

	A1	A	B1	B2	B	C1	C2	C3	C4	C	D1	D	E1	E2	E3	E	F1	F2	F3	F
A	3.0	3.0	4.0	4.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	8.0	8.0	8.0	8.0
A1	2.0	3.0	3.5	3.5	3.5	3.5	4.0	4.5	4.5	4.5	4.5	5.0	6.0	6.0	6.0	6.0	6.5	6.5	8.0	8.0
B	2.0	2.5	3.0	3.0	3.0	3.5	4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	5.0	5.0	6.5	6.5	7.0	7.0
B1	2.0	2.5	2.5	3.0	3.0	3.0	3.5	3.5	3.5	4.0	4.0	4.0	4.5	5.0	5.0	5.0	6.0	6.0	7.0	7.0
B2	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.5	3.5	3.5	3.5	4.0	4.5	5.0	5.0	5.0	5.5	6.5	7.0	7.0
C	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	5.5	6.0	6.0	6.0
C1	2.0	2.0	2.0	2.0	2.0	2.0	2.5	3.0	3.0	3.0	3.0	3.0	3.5	4.0	4.0	4.0	4.5	5.0	6.0	6.0
C3	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	3.0	3.5	4.0	4.0	4.0	4.5	5.0	6.0	6.0
C2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	3.0	3.5	3.5	4.0	4.0	4.0	4.5	6.0	6.0
C4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	3.0	3.5	3.5	3.0	4.0	6.0	6.0
D																	3.0	4.0	5.0	5.0
D1																	3.0	3.5	5.0	5.0
E																	3.0	3.5	4.0	4.0
E1																			4.0	4.0
E2																			4.0	4.0
E3																			4.0	4.0
F																			3.0	3.0
F1																			3.0	3.0
F2																			3.0	3.0
F3																				

Table 11: RECAT 20-CATegories Separation Minima for all 9000+ Aircraft Types

Application of the RECAT-PWS-EU wake scheme in an operational environment will require a Separation Delivery tool as Controllers will be unable to memorise the required separation. However, there is also the option of using the knowledge developed through the separation design of an S-PWS wake scheme to develop modified wake category schemes that are optimised for the local aircraft type traffic mix at an airport. Such a customised scheme may or may not need a Separation Delivery tool to support the Controllers depending on the number of categories and the complexity of the combinations of separations to be applied.

If a Separation Delivery tool is required, then the distance based separations defined in the S-PWS wake turbulence scheme will be used as input as a separation constraint to be considered.

3.2.4.2.2 RECAT-PWS-EU TB Scheme for Arrivals (TB-PWS-A) (AO-0306 with AO-0303)

The RECAT-PWS-EU DB wake separation scheme can be applied in combination with the TBS concept. Such a combined concept would be Time Based S-PWS or TB-PWS-A. The time separations are derived using the methods listed in SESAR 1 research [35].

3.2.4.2.3 Weather Dependent Scheme for Arrivals (WDS-A) (AO-0310)

The Weather Dependant Separations for arrivals (WDS-A) is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

Weather Dependant Separations for arrivals (DB-WDS-A) consists in defining acceptable distance or time separation reductions in favourable wind conditions (total and/or cross component). Two concepts are envisaged: a concept based on total wind effect (A-WDS-Tw) on wake vortex decay allowing for reduced separations in strong total wind conditions, and a concept based on crosswind effect (A-WDS-Xw) on vortex lateral transport allowing for reduced separations in strong crosswind conditions.

The distance separation reductions are to be applied directly to the runway landing threshold with the support of Optimised Runway Delivery on Final Approach (AO-0328)

The time separation reductions are to be applied in conjunction with TBS on final approach (AO-0303) and the support of Optimised Runway Delivery on Final Approach (AO-0328).

The time separation reduction for the crosswind concept has been defined and is detailed below. The time separation reduction for the total wind concept has not yet been defined.

The distance separation reductions for the crosswind concept and the total wind concept have not been defined as they are not considered interesting in terms of benefits because by providing wind information (which is a requisite to apply WDS-A) to the separation delivery tool it is more efficient to use time-based separations rather than distance-based separations.

3.2.4.2.4 Weather Dependent TB Scheme for Arrivals (TB-WDS-A) (AO-0310 with AO-0303)

Weather Dependent Crosswind-Based TB Scheme for Arrivals (A-TB-WDS-Xw)

Based on the work initiated in the framework of SESAR P6.8.1 and continued in S2020 Solution PJ.02.01, the WDS-Xw time-based minima have been established. They rely on the analysis of a LiDAR database providing lateral transport of wake vortex for various aircraft types evolving in various crosswind conditions.

The first step in the WDS-Xw concept definition consists in the definition of the crosswind measurement. The crosswind measurement that are available in the database are the crosswind component of the anemometer data measured at 10m height and the In-Plane Wind (IPW) provided by the LiDAR as the averaged crosswind component measured in the LiDAR scanning plane of measurement just before and just after the wake measurement. As it provides a better estimate of the wind as experienced by the vortices (because measured at several altitudes), the IPW is here used in the analysis. Indeed, the wind vertical evolution might vary from one airport to another. Hence, providing results relying only on 10m measurements might be more difficult to generalise to other places.

For WDS separation design, we here consider that the upwind vortex must have travelled a distance such that it is located at one half vortex spacing from the follower' closest wing tip. In order to establish WDS-Xw time-based minima, the time required for 99% of the vortices to travel the considered distances are determined as a function of the measured IPW and for each aircraft pair category. Note that for all ICAO Medium and Lights (RECAT-EU D, E and F categories), A321 results are conservatively used as sole data available in the LiDAR dataset. Example of results for a IPW threshold of 9 knots are provided in Table 12 for wind for each RECAT-EU category pair.

9 kts	Cat-A	Cat-B	Cat-C	Cat-D	Cat-E	Cat-F
Cat-A	77	74	74	71	69	66
Cat-B	77	73	68	63	63	58
Cat-C	65	59	55	51	51	48
Cat-D	58	53	50	46	46	39
Cat-E	57	53	49	46	39	34
Cat-F	50	49	46	34	33	33

Table 12: Minimum A-TB-WDS-Xw time separation [s] for an IPW of 9 knots depending on the leader and follower RECAT-EU category

More details on the A-WDS-Xw concept are provided in Appendix B.

The A-TB-WDS-Xw minima defined above depend on the aircraft pair and crosswind conditions along the straight-in approach path to the runway landing threshold. The application hence requires an accurate forecast of the crosswind. The information on the separation allowed for a specific aircraft pair, provided to the ATCO typically 10 minutes before the leader aircraft has landed, is based on the wind information available at that time.

However, when the leader aircraft reaches the separation delivery point, the wind might have dropped or changed in orientation, and the A-TB-WDS-Xw reduction might no longer be allowed. Tactical and strategic models have hence to be developed to cope with those uncertainties on the wind.

The operational definition of the activation threshold conditions should be the result of an optimisation maximising the reduction in the wake separation of the WDS-Xw application while limiting as much as possible the “failure rate” after WDS-Xw deactivation. Indeed, at the moment of WDS-Xw deactivation, some pairs were already spaced following the WDS-Xw reduced wake separation and a crosswind above the threshold might hence no longer be observed at the threshold for those pairs. A failure rate is hence defined as the number of occurrences of wind conditions below the WDS-Xw crosswind criteria in the next few minutes after deactivation.

As an example, we here provide a methodology to define the WDS-Xw activation and deactivation criteria that minimised the failure rate after WDS-Xw deactivation while maximising the use of reduced WDS-Xw wake separation (and hence maximising capacity benefits). WDS-Xw will be activated following three criteria, all required at the same time:

- The in-plane wind IPW is above or equal to IPWact,
- The minimum crosswind Xw is above or equal to XWact
- The 2 above criteria have been observed for the past Tact minutes

WDS-Xw will be deactivated if at least one of the following criteria is met:

- The in-plane wind IPW is below IPWdeact
- The minimum crosswind Xw is below XWdeact
- The forecast IPW in the next Tforecast minutes is below IPWthr
- The forecast XW in the next Tforecast minutes is below IPWthr

Where:

- IPWthr is the crosswind threshold value as defined in the A-TB-WDS-Xw matrix
- IPWact≥ IPWthr
- XWact≥ IPWthr
- IPWact≥IPWdeact≥ IPWthr

The IPW and Xw forecasts are based on a linear extrapolation of the two last measurements to the considered time forecast horizon. The use of such forecasts should allow for prediction of fast wind drops.

The deactivation criteria depend on the safety conditions required for A-TB-WDS-Xw operation. They hence correspond to the values obtained in the A-TB-WDS-Xw definition and safety assessment. The wind criteria used for A-TB-WDS-Xw activation should be above or equal to the deactivation criteria. For the activation of A-TB-WDS-Xw, a margin compared to the deactivation threshold should indeed be considered in order for the system to remain on for a certain range of time. All those criteria have to be designed locally and using a maximum “acceptable” failure rate to be determined also on a local basis.

3.3 Detailed Operating Method

3.3.1 Previous Operating Method

The operating method covers from the arrival aircraft crossing the Initial Approach Fix (IAF) until the aircraft vacates the runway.

The Air Traffic Control (ATC) procedures for an aircraft approaching an aerodrome will be specific to each airport. This section summarises the standard procedures used to transition an arriving aircraft through the TMA and approach to landing and vacating the runway.

3.3.1.1 Transition from TMA to Approach

Aircraft approaching one or more aerodrome(s) from surrounding sectors typically follow a number of Standard Arrival Routes (STARs) – each aircraft follows one STAR - providing the transition from the En-route structure, and are progressively merged into a single flow for each active landing runway.

The separation of arrivals and departures is facilitated by strategic segregation of flows through airspace structures. The separation of arrivals from other arrivals is often closely related to the building and maintenance of the sequence. These tasks are performed through the use of open loop vectoring, issuing a large number of headings, speeds and level instructions.

Holding patterns may be used for arrivals, subject to local practices, either when the TMA capacity is exceeded at peak times, or more systematically to maintain the pressure at the runway.

Area Navigation (RNAV) Procedures have been defined to replace open-loop vectors. In such procedures ideally the principle is to keep aircraft on their routes; the procedures are designed so that the trajectory can be stretched or shortened through pre-defined/fixed route modifications if this is needed for the merging of arrival flows; these procedures are generally fully applied only under low to medium traffic loads.

An "efficient landing sequence" refers both to an optimised sequence order (e.g. according to wake turbulence constraints), and to the achievement of appropriate spacing between flights, both aspects contributing to maintain the throughput as close as possible to the available runway capacity. This involves:

- Planning the sequence (i.e. allocate landing runway if needed, and define sequence order);
- Building the sequence (including order and appropriate spacing);
- Maintaining the sequence (including optimisation of inter-aircraft spacing).

The Controller is the authority for assuring safe operations in the TMA / Approach and issues information and instructions to aircraft under control in order to assist pilots to navigate safely and timely in the TMA / Approach.

Voice communication is the primary Air / Ground communication in the TMA / Approach.

The Ground / Ground connection is ensured through an overall network approach using common protocols such as Aeronautical Fixed Telecommunication Network (AFTN). It covers exchanges of surveillance, trajectory data and other flight planning information.

Navigation services using conventional terrestrial navigation aids (such as VOR/DME/NDB and ILS for the final approach phase) are the primary form of ground based navigation aid, however there is an increased usage of developing technologies such as GPS and GNSS. A large range of airborne navigation capability exists, usually based on multi-sensor navigation systems.

Surveillance Coverage is provided by the use of SSR (Secondary Surveillance Radar) in combination with PSR (Primary Surveillance Radar).

3.3.1.2 Separation Standards

Radar separation standards for arrivals include MRS which prevents aircraft collision and WT separation which is intended to protect aircraft from adverse WTEs. In current day operations WT separations are defined between categories of aircraft which are grouped based on their MTOW. Examples of WT category schemes include ICAO, RECAT-EU 6 category and UK 6 category. When no WT separation is applicable then MRS is applied. This is typically 3 NM although can be 2.5 NM under certain conditions. Radar separations in current operations are defined in distance for arrival aircraft.

If Tower ATC can apply visual separation procedures from the VCR, the separation mode changes, and reduced separation in the vicinity of the aerodrome (RSVA) may be applied for pairs where no WT separation is applicable.

If the Flight Crew perform a visual approach, the separation mode changes, and the responsibility lies with the Flight Crew to determine the spacing.

Radar separation is applied by observing the headings, distances, and speeds, between consecutive aircraft. The Final Approach Controller knows the locally applied wake turbulence radar separation table (i.e. ICAO). From the respective aircraft wake turbulence categories from the flight strips, or from the target labels, the Controller establishes the wake turbulence radar separation required between the respective aircraft.

The separation distance limits are determined by the Controller by the use of scales on the radar map and through the observation of catch-up from the separation distance progression observed between the follower aircraft and the lead aircraft. In case of possible infringement, the Controller will first use speed instructions, and then use vectoring, or order a go-around. Inside of 4 NM from the runway threshold no speed instructions are advised.

3.3.1.3 Runway Layout Configuration

Runway direction is chosen, based on many criteria, but the main one is the wind direction. Headwind conditions at the runway surface are the preferred wind for arrivals and departures, compared to crosswind conditions or tailwind conditions.

3.3.1.4 Runway Modes of Operation

In a large airport, you can distinguish between two main runway operations. One is the segregated mode, where one duty runway-in-use is used for arrivals, and another duty runway-in-use is used for the departures. The other configuration is mixed mode, where the arrival and departure streams are interlaced on to a duty runway-in-use.

If operating in mixed mode, the penalty of having to apply distance based separation is less, since Controllers are typically able to reduce the ‘Gap’ size required to depart one aircraft between two arrivals, as the headwind increases, without becoming constrained by the wake turbulence separation minimum.

The two modes can also be combined, so that a few arrivals will land on the departure runway, or vice versa.

3.3.1.5 Arrival Management

In current operations, an Arrival Manager (AMAN) is often used for the TMA approach sector. The AMAN organises the arriving traffic, so that it can be merged and sequenced to one or more runways, as efficiently as possible. The AMAN can integrate wake turbulence categories (and distance needed) for each aircraft pair, and allocate them accordingly into the sequence. Aircraft speeds are taken into account, as well as wind speeds.

The arrival Controllers will, as far as is feasible, accommodate the AMAN proposed sequence order. Normally, the sequence order in AMAN is not updated after aircraft have passed the IAF. This means that the sequence order intent can be changed by the Approach Controllers without any update input into the associated system support. Through procedural coordination the Approach Controllers know the changed sequence order, which can also be deduced by looking at the relative display positions of the aircraft lined up on intermediate and final approach. As a consequence, there is currently no need for the Approach Controllers to update the associated system support.

For the Tower Runway Controller, the same logic applies, since there will in most cases be a slave radar display in the Tower. For other actors, it is not as clear what the real sequence actually is, or will be.

Different airports have developed different solutions, in order to provide the airport with correct landing estimates, and the correct landing runway for each aircraft.

When aircraft approach final approach, the Final Approach Controller will separate, sequence and merge all arrivals to a specific runway. This task is very precise, and requires skills in determining the correct headings and speeds to be applied, in order to be both efficient and remain safely separated.

3.3.1.6 Planning

In current operations at an airport, one important aspect of the short term planning, and reiterative planning done during the execution phase, is to select the most appropriate runway combination and configuration. This takes into account many criteria, such as weather forecast, infrastructure status, traffic demand and traffic mix.

For arrivals, the planning horizon is at least 20-30 minutes, in order to smoothly change the runway for landing, when in high traffic demand. Even so, a runway change will often lead to disruptions and delays.

3.3.1.7 Runway Arrival Control

In current operations, the Tower Runway Controller is responsible for providing landing clearance to arriving aircraft. In order to do this, the arrival traffic is transferred to the Tower Runway Controller a few nautical miles from the threshold, and the Tower Runway Controller monitors that the runway occupancy of preceding aircraft is progressing as expected.

The Tower Runway Controller monitors the speed and position of the next approaching arrival, in order to determine when to give a landing clearance, or to order a go-around, if the previous aircraft runway occupancy exceeds the applied separation. Both visual out of the window, and surveillance equipment, is used.

If in mixed mode, the Tower Runway Controller also has to deliver line-up and take-off clearances to departing aircraft, and time this so that the gap between the two associated arrivals can be used.

The accuracy of planning and execution of runway and surface movements is constrained by the degree of uncertainty of aircraft behaviour in the landing, roll-out and taxi phases. Tower Runway Controllers apply additional margins to take account of aircraft behaviour during these phases, in terms of predictability of performance. Margins to absorb the uncertainty over the AROT are factored into the final approach spacing applied.

Observations at congested airports indicate that depending on runway and taxiway layout and airline operating procedures, an excess of time can be spent on the runway by individual aircraft as the current aircraft auto-brake systems apply predetermined braking to the aircraft. If braking is left to the auto-brake system, the aircraft will stop on the runway. However, in practise, the Flight Crew disconnect the auto-brake on the roll out and use pedal braking to arrive at the runway exit at the correct speed.

Existing auto-brake systems reduce pilot workload by providing deceleration at a set rate. The auto-brake setting will guarantee that the aircraft stops at or before the pre-selected distance (adjacent to the selected exit).

With a limited number of auto-brake settings available the deceleration is not necessarily customised to the specific runway exit. In theory this can lead to the AROT being extended.

As there are many factors that influence AROT it is not possible to predict an accurate AROT or guarantee the runway exit.

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The situation is worsened in low visibility conditions when CAT II/III operations are in force and after landing, the auto-brake decelerates the aircraft according to the predetermined setting until the Flight Crew disconnect the auto-brake system. Flight Crew have to cope with reduced visibility and must locate the runway exit in constrained visibility conditions and this may take considerably longer than would be the case in better visibility conditions (CAT I or better).

As a result, this is one reason why reductions in runway capacity are declared during CAT II/III operations which can lead to significant delays.

3.3.2 New SESAR Operating Method

This section presents the S-PWS, WDS, ORD concepts which are applicable on the final approach for arrivals.

The S-PWS and WDS concepts define various forms of wake turbulence separation rules. Although there are some exceptions, the application of these separation rules requires a Separation Delivery tool to visualise the required minimum separation on the CWP.

The ORD concept provides additional support to assist Controllers in delivering the required minimum separation to the separation delivery point (e.g. runway threshold) by considering the effect of compression. This is achieved through an additional visualisation in the Separation Delivery tool to show Controllers the required spacing to deliver at the DF (typically 4-6 NM from the runway landing threshold) in order to deliver the required minimum separation at the delivery point.

3.3.2.1 Optimised Runway Delivery on Final Approach (AO-0328)

This section describes the ORD concept and in particular the Separation Delivery tool that supports and is used by the Controllers in delivering the required separation or spacing on approach to the runway landing threshold. The Separation Delivery tool calculates and displays Target Distance Indicators (TDIs) on the Approach and Tower CWPs. The TDIs include an FTD indicator which displays the required separation / spacing to be delivered to the required delivery point and an Initial Target Distance (ITD) indicator which displays the required spacing to deliver at the DF to support the Controller in delivering the required separation / spacing.

The key steps regarding the calculation and display of these TDIs are as follows:

- Determine the Approach Arrival Sequence;
- Identify all applicable separations / spacing’s per arrival pair (includes in-trail and not-in-trail pairs);
- Compute the equivalent distance for any time separations or spacing’s;
- Select the maximum applicable separation or spacing which is known as the FTD;
- Compute the ITD by taking into account the effect of compression;
- Determine if the TDI should be displayed;
- Display the TDI on all applicable CWPs.

The sections below describe these key elements in further detail showing the different options that have been developed in SESAR 1 Project P06.08.01 and further refined in the current SESAR 2020 Solution PJ.02.01. This is followed by information on turn on support which is needed to help the Controllers judge when to turn towards the localiser, information about normal / degraded modes as well as additional monitoring and alerting features that have been developed.

3.3.2.1.1 Approach Arrivals Sequence Input

The first step is to identify leader and follower pairs based on a sequence which is supplied by an Approach Arrival Sequencing Service. This could be sourced from one of the following proposed methods:

- Electronic Flight Progress Strip (EFPS);
- Sequencing tool allowing Controllers to modify the sequence;
- Automatic sequence detection tool.

In addition, the runway intent of each arrival aircraft is required to enable the Separation Delivery tool to identify in-trail and not-in-trail aircraft pairs.

The key requirement from an operational perspective is that the tool must use a very reliable sequence and the tool shall use the sequence as planned / implemented by the Intermediate and Final Approach Controllers.

High reliability is needed as the TDIs need to remain stable otherwise the Controller's workload and situational awareness could be impacted if they regularly jump around (due to sequence modifications). Also the Approach Controllers do not want the sequence dictated to them. They wish to remain in control of the sequence meaning the Separation Delivery tool needs to remain updated with any tactical sequence or runway intent changes.

One method to obtain the sequence order is to use an existing EFPS system where the Controllers are maintaining the sequence by ordering their strips. This order is stored in the system hence the Separation Delivery tool can interface with it to obtain the information. This meets the requirement of using the Controller planned / implemented sequence. If a tactical change is made, then the Controller expects to see a change to the TDIs as they are the one who initiated the change.

However, many European airports use a paper environment where sequence information is recorded on Paper Flight Strips (PFS) through writing sequence numbers down and / or ordering the strips in the sequence order. This means other viable methods should be considered so that the concept does not have to rely on EFPS as an enabler.

Many European airports are equipped with an AMAN. However, these can have issues when their sequence information is used by a Separation Delivery Tool. Controllers do not always follow the AMAN sequence if they can see a better way to handle the traffic. Also if a Controller makes a tactical change to the sequence, the Separation Delivery tool shall rely on the Controller (or another actor) to manually update the AMAN with that change.

An automatic sequence detection tool is ideal as it does not rely on any human input into the system along with the associated workload. However, such solutions may be limited in their sequence prediction horizon which in turn determines how soon TDIs can be displayed.

Finally, a custom built sequencing tool can be developed which enables the Controllers to edit the sequence via their CWP HMI. It could receive an initial sequence via an AMAN but then allow Controllers to input tactical sequence changes to ensure the Separation Delivery tool has the latest information. However, the added Controller workload to interact with the tool needs to be taken into consideration.

The Approach Arrival Sequence should be displayed on the Final Approach and Intermediate Approach CWPs showing the order of aircraft, wake category and separation / spacing constraints. However, if it can be demonstrated that the Approach Arrival Sequence has sufficient integrity then this may not be required.

3.3.2.1.2 Separation and Spacing

This section describes the separation and spacing constraints that need to be considered between each arrival pair in the Approach Arrival Sequence. This is where the different WT concepts are described which all make use of the Separation Delivery tool.

Wake Turbulence Separation

The separation delivery tool can use different Wake Turbulence scheme to maintain the separations between aircraft pair. The schemes can be the standard reference used nowadays at European airport like ICAO or RECAT-EU (see 3.2.4.1) or more advanced schemes. Two of these new advanced schemes are part of the PJ.02.01 work: Static Pairwise Separation and Weather Dependent Separations for Arrivals (see section 3.2.4.2)

Managing Compression on Final Approach

On final approach there are two main sections in terms of aircraft speed. Firstly, the procedural section when the Final Approach Controller is giving speed instructions and secondly the landing stabilisation section which occurs in the last 4 NM to 6 NM before the runway landing threshold when aircraft are decelerating for landing. In the landing stabilisation section, speed profiles vary considerably depending on aircraft type, landing weight, stabilisation altitude, stabilisation mode, and the associated airline operator cockpit procedures. The range of stabilisation airspeeds varies from under 100 KIAS for some Light wake category aircraft types to over 160 KIAS for some Heavy wake category aircraft types.

The variation in speed profile can result in compression (in terms of distance and time) between leader and follower aircraft pairs. In current operations Controllers have to handle the compression themselves based on their experience of aircraft performance by adding additional spacing.

The ORD concept is intended to assist Controllers in coping with the effect of compression by providing additional tool support to show them what spacing needs to be delivered at the DF in order to achieve the required separation / spacing. This spacing is shown on the CWP as the ITD indicator. Further details regarding the calculation of the ITD are provided in Section 3.3.2.1.6.

Minimum Radar Separation

A Separation Delivery tool needs to respect the MRS. In current operations this is typically 3 NM although can be 2.5 NM under certain conditions prescribed in ICAO Doc 4444 [37] or as prescribed by the appropriate ATS authority.

However, the MRS used in current operations provides a limit on the benefits that can be gained from the above wake concepts (S-PWS and WDS). An option is to reduce the MRS constraint to 2 NM to increase the possible benefit from the wake concepts. This is being developed and validated in SESAR Solution PJ.02-03.

The Separation Delivery tool needs to be aware of the MRS constraint for in-trail aircraft pairs using the same runway and if applicable for not-in-trail aircraft pairs for dependent parallel runway operations.

Runway Occupancy Time Support

Reducing wake separations using the above concepts means the Runway Occupancy Time (ROT) is a more important consideration. The reduced wake separations mean more aircraft pairs become ROT constrained and also reducing MRS to 2 NM means certain MRS pairs become ROT constrained.

The Separation Delivery tool can factor in the spacing that is required to enable the lead aircraft to vacate the runway by the time the follower aircraft requires a landing clearance. It can be defined per aircraft type / airline operator combination to ensure airline specific behaviour in terms of commonly used runway exits is taken into account. Other variables can be considered to refine the ROT model depending on the local environment.

The time when an aircraft needs to be given clearance to land depends on the local operation but this should be considered when defining the ROT spacing constraint which the Separation Delivery tool uses.

Additional Separation / Spacing Constraints

As well as the separation and spacing constraints described above, there are several additional constraints that may be needed by the Separation Delivery tool. Both the current and planned changes of these constraints are required. Regarding in-trail aircraft pairs these include (but are not limited to) the following:

- Spacing minimum – this may be different from the MRS;
- Specific spacing behind a certain wake category – for example there may be a specific spacing behind A380s;
- Scenario specific spacing – this is defined behind a certain lead aircraft (i.e. to provide a spacing for a runway inspection);
- Interlaced departure spacing – this may be defined as a standard gap spacing for one departure or two departures between an arrival pair;
- Specific airborne spacing constraint – for example to handle a specific arrival procedure.

Regarding not-in-trail aircraft pairs these include the following:

- Spacing minimum – this may be different from the not-in-trail MRS;
- Specific airborne spacing constraint – for example to handle a specific arrival procedure.

3.3.2.1.3 Wind Input

There are two main wind inputs needed by the Separation Delivery tool. The Glideslope Wind Conditions Service (GWCS) and a Runway Surface Wind Service.

The GWCS is required to measure or forecast the wind on the final approach path along the section applicable for calculating the FTD and ITD. This can be supplied by a wind profiler, downlinked Mode S data (allowing wind to be calculated from the IAS and groundspeed), a wind forecast algorithm or a combination of solutions. This information is required for the FTD and ITD calculation in order to convert time separation or spacing into an equivalent distance.

The Runway Surface Wind Service may be used to complement the FTD and ITD calculation if the GWCS is unable to provide wind measurements near the runway threshold. Also if applying a conditional version of a concept (e.g. WDS) then both forecast and actual runway surface wind is required. The forecast runway surface wind is required by the Approach and Tower Supervisor to plan when the applicable concept (e.g. WDS) can be applied. The actual runway surface wind is needed so the Supervisors can monitor the wind in case there is a need to revert back to DBS mode if the wind drops below the required threshold.

3.3.2.1.4 Additional Tool Inputs

The following additional inputs are needed as a minimum by the Separation Delivery tool:

- Callsign, aircraft type and wake category[2][3] of all arrival aircraft including any updates to this information;
- Aircraft position and altitude updates of all arrival aircraft.

3.3.2.1.5 Final Target Distance

The FTD is the separation or spacing that the Controller needs to deliver on final approach. This is the largest separation or spacing constraint. In order to compare all constraints, the time separation or spacing constraints need to be converted into an equivalent distance. There are two methods that can be used for this conversion as follows:

- Offline data mining aircraft type ground speed profiles across a range of wind conditions to compute the time-to-fly per segment of the final approach per wind band. This information can then be used alongside the reference time separation / spacing and wind conditions that are forecast at the time the follower is expected to fly the separation to compute the equivalent distance. In addition, the offline data mining can allow the uncertainty in the time-to-fly profile to be quantified which can be used to compute additional buffer on the FTD if this safety mitigation is required [41];
- Alternatively, an assumed airspeed profile can be applied over the separation / spacing distance in the wind conditions that are forecast at the time the follower is expected to fly the separation to compute an assumed groundspeed profile. This assumed groundspeed profile can then be applied over the reference time separation or spacing to compute the equivalent distance. The assumed airspeed profiles can either be defined as a single reference speed profile or speed profiles per aircraft type [40] [41].

After all time separation / spacing constraints (both in-trail and if applicable not-in-trail) have been converted into equivalent distances then all constraints can be compared and the largest constraint is selected as the FTD.

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[2] If implementing S-PWS this wake category refers to the S-PWS 20 category scheme which is needed if the aircraft does not exist in the aircraft type pairwise scheme.

[3] The wake category can either be derived in the Separation Delivery tool from aircraft type or provided to the Separation Delivery as an input. This decision is dependent on whether the applicable wake category is used elsewhere in the system architecture.

3.3.2.1.6 Initial Target Distance

The ITD is the spacing to be applied at the DF to assist the Controller in delivering the required separation or spacing (the FTD) at the delivery point. This is the FTD plus the predicted compression distance plus any additional buffer (if needed, as safety mitigation to uncertainty in the aircraft speed or wind forecast). The compression distance is the difference between the distance the leader travels from the DF to the point of delivery and the distance the follower travels in the same period of time. This can be calculated using one of the following methods:

- The same offline data source as described in Section 3.3.2.1.5 which provides the time-to-fly per aircraft type per segment of the final approach per wind band. Then the uncertainty in the time-to-fly profile can be used to compute additional buffer on the ITD if this safety mitigation is required;
- Alternatively, the same calculation can be carried out using assumed airspeed profiles for the leader and follower and using the input headwind profile. Additional adjustments can be made to these profiles for example to take into account the runway surface wind impact on landing stabilisation speed.

In challenging wind conditions (e.g. wind profile inversion at low altitude), if possible, the ITD computation should take into account the different wind conditions between the deceleration and the stabilisation phase on the straight-in approach path, as the ITD only calculates and incorporates into the ITD Indicator the distance compression/catch-up that will occur from the lead aircraft crossing the DF and the lead aircraft crossing the runway landing threshold.

Challenging wind conditions were tested in RTS3b, when working with the ORD, controllers had to take into consideration any compression prior to the lead aircraft crossing the deceleration fix. For doing so they were instructed to add extra buffer behind the ITD as the follower aircraft was merged on to the straight-in approach path to account for the anticipated compression until the lead aircraft crossed the deceleration fix. How this issue should be addressed will depend on local implementation considerations.

It is worth to consider providing additional support to the separation delivery tool for managing the compression effects between the deceleration and stabilisation phase on the straight in approach path in SESAR 2020 Wave 2. For example, this could be done either by:

- Updating the position of the ITD moving it up further in the glide path before the aircraft intercepts the ITD.
- Add additional buffer in the ITD computation.

3.3.2.1.7 Indicator Support and Turn-On Support

The FTD and ITD are displayed on the extended runway centreline of the Intermediate Approach, Final Approach and Tower Runway Controller CWPs. The display criteria for initial display of TDIs depends on the operational needs of a local implementation. A key point that needs to be considered for the Approach Controllers is regarding support to turn aircraft onto base leg and intercept. This can be achieved through the early display of TDIs as that shows the Controller the required spacing on final approach however this relies on a sufficiently reliable Approach Arrival Sequence before aircraft have started the turn. If the extent of the sequence horizon is not sufficient for this, then alternative system support is required. Options include displaying the expected spacing in a table that the Controllers can refer to or displaying the expected spacing in the aircraft label. Such options still require sequence information but this may not need such a high level of integrity.

TDIs are to be displayed on the extended runway centreline for all leader aircraft that are established on the localiser. If the leader is not established and the perpendicular projected position on the localiser is behind its own ITD (or FTD if ORD is not implemented) then the TDI is to be displayed behind the perpendicular projected position on the localiser. If the leader is not established and the perpendicular projected position on the localiser is ahead its own ITD (or FTD if ORD is not implemented) then the TDI is to be displayed behind the ITD (or FTD if ORD is not implemented) ahead.

The Controller shall have the ability to display TDIs on demand. Also automatic TDI display criteria should be configured to avoid a Controller inadvertently crossing a hidden FTD.

Rules to suppress the display of a TDI until its associated aircraft is within a defined distance of the TDI can be used but this is a local implementation decision.

Information about the distance value of the FTD or ITD (which TDI depends on what is most useful for the Controller) and the distance ahead or behind the TDI can be displayed on the HMI.

TDI distance step resolution shall be at least 0.1 NM and TDIs shall update at the same rate as the radar update.

The FTD and ITD must not change after the point that Controllers require a stable indicator. Before this point it may be possible to update TDIs as the wind profile changes however this is a local implementation decision.

During dependent parallel runway operations there may be the need to display not-in-trail TDIs if a not-in-trail constraint is the largest applicable constraint for that aircraft.

The HMI design of the TDIs shall harmoniously integrate into the applicable CWPs. There may be a need to configure the HMI of the TDIs depending on the type of constraint it represents if there is an operational need to distinguish between them.

Figure 3 below shows an example of implementation design for the TDIs: in this example, shapes are constraints specific and colours are CWP specific.

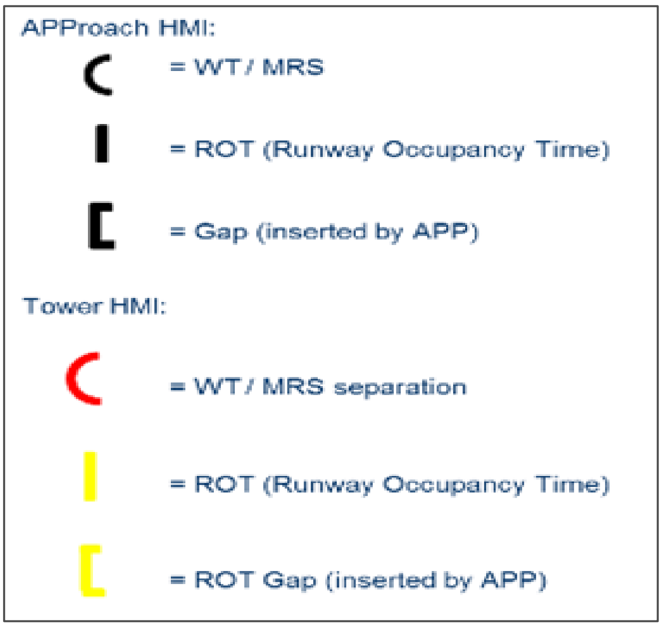

Figure 3: Example of HMI Design for TDIs

There shall be a method to allow Controllers to see the link between an aircraft and its associated TDI.

The TDI display on the extended runway centreline shall be robust to the variety of ways that aircraft merge onto final approach, typical path stretching manoeuvres and acceptable deviation from the final approach path while accommodating late runway change scenarios.

TDI removal normally occurs when the lead aircraft lands or enters a radar blanking area although there may be local requirements to display TDIs for longer such as for large spacing gaps.

For any change in aircraft sequence, separation / spacing constraints or runway intent, the TDIs for all affected arrivals pairs shall be re-calculated. This includes missed approaches which can be considered as the temporary removal of an aircraft from the sequence.

There may be a need to allow the selective removal of TDIs (for example when follower aircraft is applying visual separation from leader aircraft). This need has to be assessed on a local basis.

If a TDI cannot be calculated (for example due to insufficient information) then it shall not be displayed and the Controller shall be alerted. In this scenario the Controller is to apply a DBS wake (category based) separation.

Recommendation from Real Time Simulations

The ORD FTD for MRS and WT constraints should be distinguishable (i.e. displayed differently) as the tower runway controllers could work different depending on whether a separation is due to MRS or WT and depending on other local procedures they might use to maintain separations. For example if a separation is due to MRS, then, if the arriving aircraft is in sight and the lead aircraft has departed the runway, the runway tower controller would allow the arriving aircraft to infringe slightly the FTD. However, they would not allow the FTD to be infringed at all if the separation minimum was due to WT (see VALR[43]).

A buffer is included in the ORD to account for variability in aircraft performance and potential errors in the accuracy of wind measures. In order not to be too high, it is recommended that an additional analysis is conducted prior to implementation to determine what buffer should be applied to further optimise separation/spacing delivery at the runway threshold in the airport environment whilst maintaining safety. Buffer parameters should be first refined based on analysis of a large operational dataset from the airport approach and airport environment and eventually fine-tuned in live trials to provide more realistic and accurate values (see VALR[43]).

3.3.2.1.8 Modes of Operation

The normal modes of operation for S-PWS and WDS are listed below. The ORD concept may or may not be implemented with these concepts. The list below assumes ORD is implemented. Note there could be other combinations of modes:

- DBS Category mode (with ORD);
- Distance Based S-PWS mode (with ORD);
- Time Based S-PWS mode (with ORD)
- Time Based WDS (total wind) mode (with ORD);
- Time Based WDS (cross wind) mode (with ORD);

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Note that several separation computation modes could be implemented at the same time. Then ORD can be put in the most favourable mode in terms of runway throughput, e.g. TBS, WDS or DBS, depending on the MET conditions.

Table 13 provides the Modes of Operation the associated Separation Computation considered in the PJ.02.01 RTS prototyping activities.

Modes of Operation	Associated Separation Computation
Arrival Nominal mode.	TBS with standard separation scheme (standard separation could be for instance ICAO, RECAT EU etc.). TBS with Static pair wise concept (S-PWS).
Arrival with WDS conditional mode on	For Arrival with WDS conditional mode, TBS with WDS cross wind (WDS-XW) as a separation computation mode is considered in the remaining part of the document.
Mixed mode	TBS with standard separation scheme (standard separation could be for instance ICAO, RECAT EU etc.). TBS with Static pair wise concept (PWS).
Degraded mode	

Table 13: Modes of Operation and Associated Separation Computation

The reasons for switching to degraded modes are listed below. The main scenarios leading to a degraded mode include loss of GWCS, loss of the Runway Surface Wind service (if implemented) and complete loss of the Separation Delivery tool:

- Loss of the GWCS – reversion to DBS Category mode (plus ORD if using a conservative assumption for the wind profile);
- Loss of the Runway Surface Wind Service (if this complements the FTD and ITD calculations) – remains in current mode but with added conservatism due to loss of a wind data source; another possible option is the reversion to DBS Category mode;
- No system support if there is a complete loss of the Separation Delivery tool, loss of the Approach Arrival Sequence Service, loss of the flight data input or loss of the radar data input. If all TDIs are lost suddenly then Controllers are to apply DBS wake category separations for those aircraft not yet established while maintaining current separations for those already established if considered safe to do so;

The current operating mode (normal or degraded) shall be displayed on the CWPs of the Supervisors and Controllers.

3.3.2.1.9 Monitoring and Alerting

The following monitoring and alerting options may be considered as possible safety mitigations but the exact needs depend upon the local implementation:

- Catch-up alert – this alert informs the Controller if the aircraft is predicted to cross the ITD within a set period of time if the speed remains unchanged;
- Speed conformance alert – this alert informs the Controller if the actual aircraft speed deviates beyond a configured range from the expected speed profile;

- Sequencing alert – this alert cross check the actual aircraft order against the order in the Approach Arrival Sequence Service and alert the Controller if there are any differences;
- Wind monitor / alert – this alert informs the Controller if there is a large difference between the wind used to calculate the FTD and the actual wind experienced by the Controller;
- Aircraft turned onto wrong TDI alert – this alert informs the Controllers if an aircraft is intercepting towards the incorrect TDI;
- Aircraft turned onto wrong localiser – this alert informs the Controllers if an aircraft establishes on a different localiser than that defined by the runway intent of the aircraft;
- Separation Delivery tool / support tool failure – this alert informs the Controllers and Supervisors if the Separation Delivery tool or any supporting tool fails;
- Time spacing monitor – It is proposed as a function to check actual time spacing delivered against the intended time spacing.
- Automatic FTD popup - If there is no catch-up alert, the ORD tool shows only one FTD and one ITD as described in sections 3.3.2.1.5 and 3.3.2.1.6. If ITD related to a given constraint is infringed, the Approach controller sees the FTD associated to the same infringed constraint. If the ITD associated to the second largest constraint is infringed, the FTD associated to this second largest constraint is also displayed to the approach controller; and so on. Note that even if there are not displayed, all constraints –i.e. MRS; wake separation; ROT and GAP-associated ITD and FTD are computed.

Figure 4 shows an example prototype implementation of the Catch-up alert, where the catch-up alert is triggered when the ground speed difference between follower and ITD is greater than 12 knots, and if in the next 60 seconds the ITD will be infringed. The alert is the yellow "CATCHUP" in the follower line zero of the target label together with the yellow highlight of the lead and follower IAS field in the target label.

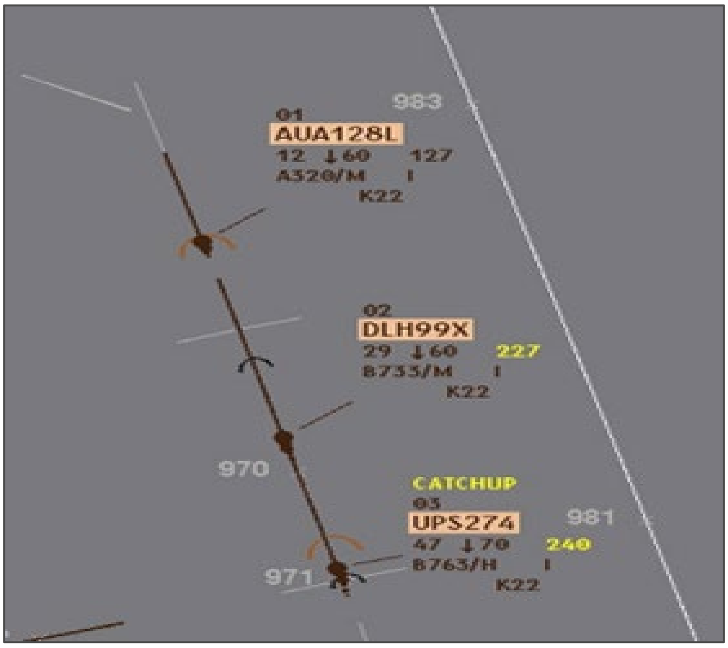

Figure 4: Example Prototype Implementation of the Catch-up Alert

Figure 5 shows an example prototype implementation of the Speed conformance alert, where the speed conformance alert is triggered when there is 20 KIAS difference between the aircraft speed and the 160 KIAS reference speed used by the LORD tool within the last 10 NM from the threshold.

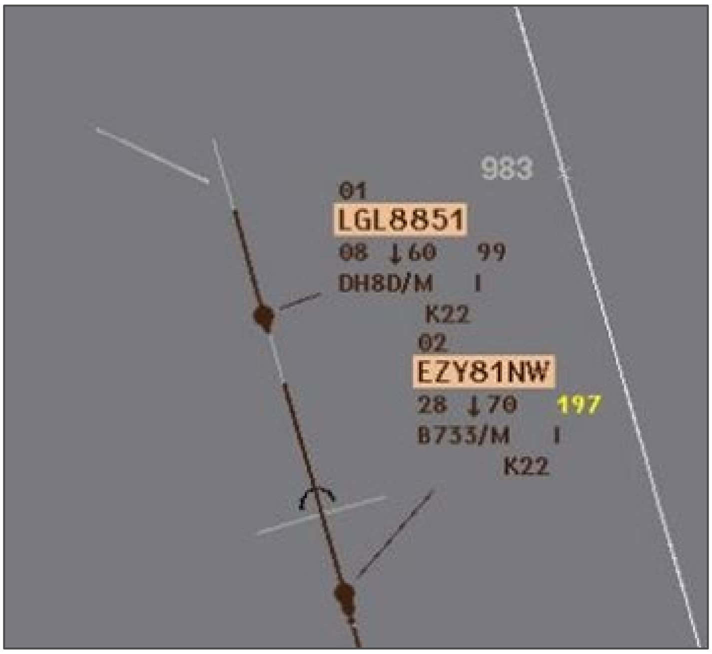

Figure 5: Example Prototype Implementation of the Speed Conformance Alert

Figure 6 shows an example prototype implementation of the Sequencing alert, where the alert appears when the actual aircraft sequence (calculated by system based on distance from a specific point on glide) is different from the a/c sequence displayed in the sequence list and a/c label.

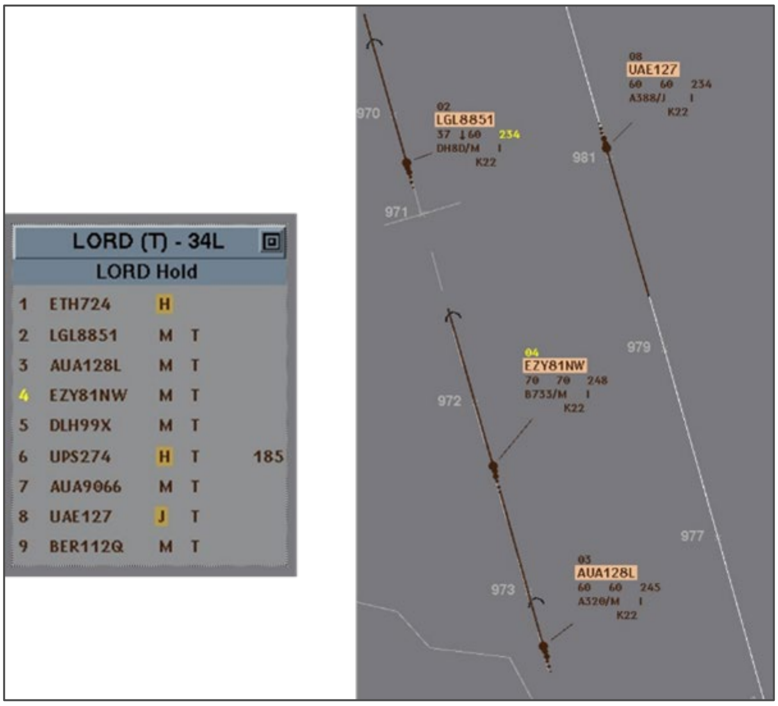

Figure 6: Example Prototype Implementation of the Sequencing Alert

Figure 7 shows an example of an Automatic FTD popup, where when the ITD is infringed, the FTD associated with the same constraint is automatically displayed.

Figure 7: Example Prototype Implementation of the Automatic FTD Pop-Up

As recommended in RTS03 (see VALR[43]), for safety reasons, the minimum separation (WT or MRS) should be displayed if an aircraft infringes the Gap ITD / FTD to give the controllers an awareness of the safety minima (the same also applied to the ROT target distance indicators).

In addition to the FTD, when the ITD infringed is associated to MRS or WT separation constraint, the tower controller gets information about the distance between FTD and aircraft position, this information is displayed next to the FTD as shown by Figure 8.

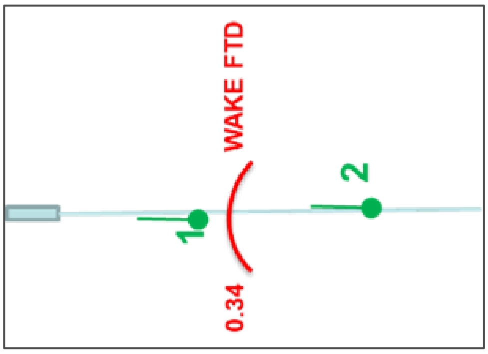

Figure 8: Example Prototype Implementation of the infringement Alert Display for the Tower Runway Controller

3.3.2.1.10 Controller Procedures for Optimised Runway Delivery (ORD)

Controllers shall remain responsible for monitoring for separation infringements and for timely intervention actions to resolve them. If using the FTD indicator only (if ORD is not implemented), then the Final Approach Controller shall allow for additional spacing due to the effect of compression. If using the ITD the procedure for merging onto final approach and catching up the ITD shall depend on the local implementation of the ITD algorithm.

For example, sufficient conservatism in the ITD calculation may mean the Controllers can catch up the ITD without providing additional margin. The procedure regarding what to do if you cross the ITD will also depend on the local implementation of the ITD algorithm.

The Final Approach Controller shall take into account any non-standard procedures or abnormal approach speeds as reported by the Flight Crew when setting up the spacing on final approach.

The Tower Supervisor in coordination with the Approach Supervisor shall ensure the separation and spacing constraints remain up to date including planned changes.

Procedures regarding the transition of wake separations before merging onto final approach to reduced wake separations (or potentially removed wake separations if using the WDS cross wind concept) on final approach need to be considered to get most benefit from these concepts. If applying a conditional version of a concept (e.g. WDS Cross Wind concept) then the Approach and Tower Supervisors shall coordinate using available wind measurement / forecast information regarding when the transition in and out of using the applicable concept.

Separation transition procedures also need to be considered regarding go-arounds as the aircraft leaves the final approach path. Also the reduced separations on final approach mean there will be more aircraft on final approach which means a scenario causing multiple go-arounds can lead to more go-arounds than experienced in current operations.

A local implementation needs to assess if the Intermediate Approach Controllers are able to feed sufficient aircraft to the final approach to meet the optimised separations. If this is an issue, then perhaps solutions should be considered to allow the wider approach environment to meet these needs.

Procedures regarding how Controllers are able to use the available spacing information on the HMI to report the distance to touchdown for aircraft applying a Continuous Descent Approach should be considered.

Training aspects are part of implementation of the ORD tool that needs to be considered by ANSPs, depending on the specific environment, procedures, and the desired local implementation of the tool. The HP Assessment Report (Part IV of the OSED) contains considerations on the training aspect.

3.3.2.1.11 Airspace User Procedures for Optimised Runway Delivery (ORD)

Flight Crews shall be briefed on the applicable concept (e.g. S-PWS or WDS) to ensure sufficient understanding. Also they shall be aware of the current mode of operation at the airport which can be achieved through the Digital Automatic Terminal Information Service (D-ATIS).

Flight Crew shall notify the Approach Controller of an inability to fly the standard procedure or of any non-conformant final approach speeds.

The aircraft type is an important input into the Separation Delivery tool due to the possible implications of an error. The Flight Crew could be required to confirm aircraft type on first call to allow the Controllers to cross check it. If this is not feasible then an alternative method to reduce the chance of aircraft type errors needs to be found (i.e. via Datalink).

The cautionary wake vortex advisory phraseology may require to be modified for the applicable concept.

Additional spacing can be requested by Flight Crew but it is expected to be rare as Flight Crew will be briefed on the applicable concept.

3.3.2.1.12 Coordination between Tower ATC and Approach ATC for Transition between Mode of Operations

Coordination between the Tower ATC Supervisor and the Approach Supervisor is needed to switch between the modes of operation listed below:

- Arrival nominal mode: in this OSED it is assumed that one of the following mode of separation computation is used in nominal mode:
    - DBS Category mode (with ORD);
    - Or Distance Based S-PWS mode (with ORD);
    - Or Time Based S-PWS mode (with ORD)
- Arrival with conditional WDS mode (with ORD)
- Mixed mode (with ORD)
- Degraded mode

As illustrated by Figure 9, transition could be applied from whatever mode to any mode listed above.

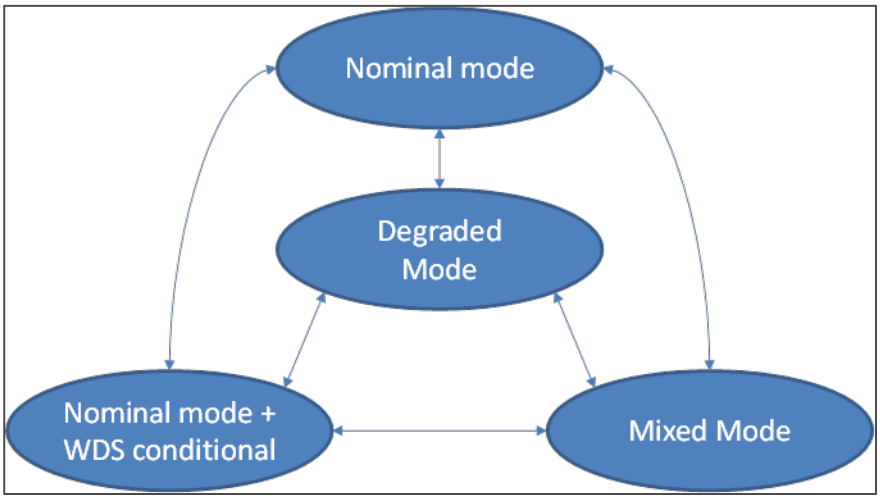

Figure 9: Transition between Modes of Operation

General principle for a transition from one mode to another (except to the degraded mode)

Depending on the weather (wind nowcast and forecast) and operational conditions (traffic demand, runway conditions, ORD tool status etc.), ORD tool should be put in the most favourable mode in terms of runway throughput. Consequently, upon a change of weather conditions (nowcast or forecast), a loss of function, a strategic planning decision (e.g. application of mixed mode) or more generally upon operational change (traffic, runway status etc.), a mode transition is initiated by either the tower or approach supervisor. Both supervisors could also initiate a transition following approach/tower controller's feedback.

Coordination between approach and tower supervisors is needed to share the next mode to be applied as well as when to apply it. In practice, this means deciding the first leader aircraft in the arrival sequence list from which the new mode will be applied. For the approach controller to manage the potentially increased separation, the aircraft as from which the transition is applied should be on base leg at the latest.

Then, once the new mode is activated, the ORD tool computes and display alerts and Target Distance Indicators accordingly.

The only exception is when a transition to the degraded mode is decided. Then, after degraded mode activation, there is instantly no Target Distance Indicator nor alerts computed and display for any aircraft in the TSI area.

Note that the separation computation mode (TBS standard, TBD pair wise, WDS mode) is displayed to the ATCOs at all times as ATCOs need awareness of current mode of operation in case of failure.

See sections 3.3.2.1.14 and 3.3.2.3 for details on mixed mode operation and conditional WDS mode respectively.

3.3.2.1.13 Activation and de-activation of WDS-A

The activation/ de-activation of WDS-A can be fully automated or manually selectable by ATCOs and/or supervisor(s) depending on the local implementation.

WDS activation:

The "GO" option should be available only on the Supervisor’s side. This is a recommendation from RTS1, the ATCOs suggest to avoid having an activation button for WDS-A available on the ATCOs’ HMI in order to avoid confusions. Even if automated or initiated by the Supervisor, given the applicable wind conditions, the Supervisor shall confirm the activation by verbally communicating the transition to the ATCOs (with the mention of the first a/c from which the new mode of operations applies).

WDS de-activation

a) EITHER automatically changed by the tool- with a clear indication on the screen of both the Supervisor and the ATCO of the new mode of operation and additionally with an indication of the a/c from which the reversal to the conventional mode of operation applies (e.g. highlighting the a/c).

OR

An alert on both ATCO`s and Supervisor`s HMI, indicating the immediate required transition (to be manually changed by the Supervisor and/or ATCO).

The above mentioned options are mostly applicable for spontaneous changes that were not foreseen (e.g. degraded mode or loss of wind conditions).

b) Spontaneous change made by the ATCO- given consecutive WTE reported by pilots that confirm inadequate wind conditions OR the refusal of reduced separations by one pilot (in which case the reversal to conventional separations can be made for one a/c pair only and the ATCO must record this pair as such). For a change for one aircraft pair only, the ATCO is responsible to record the chance either of flight strips or with a "bear and range" indication on the screen so that they recall the reason for enhanced separations for an aircraft pair only, given the fact that the mode of operation would be

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still displaying reduced separations overall. The ATCO may use the (optional) function of the tool to remove TDIs for a single aircraft.

c) Planned by the Supervisor whom, based on the MET info and traffic situation, is able to anticipate wind changes and verbally communicate to the ATCO the first aircraft from which the reversal to the conventional mode of operation applies.

Transition to degraded mode

In degraded modes, the default procedures should be to switch back to RECAT or ICAO (i.e. existing WV separation scheme) procedures – with or without TDIs depending on the type of failure. (Note TDI (ITD and FTD) failure was tested in THALIN 2 P-RTS – from this the default procedures recommended when such a failure occurs were existing default procedures applied i.e. ICAO or RECAT-EU or ICAO).

If all the Target Distance Indicators disappeared due to a system failure, the supervisors in the tower and approach would co-ordinate, open a stack then revert to RECAT-EU or ICAO separations. Every degraded mode should be assessed by the safety assessment depending on what causes it and which training should be given to all controllers on such degraded modes to ensure they felt capable when dealing with such situations.

3.3.2.1.14 ORD in Mixed Mode Operation

In mixed mode operations with significant arrival and/or departure traffic demand, controllers need spacing target monitoring function and decision making support to be able to insert one or several aircraft(s) for take-off in between two consecutive arrival flights,

A gap is defined as a time lapse that covers the time needed for one or several aircraft(s) to align and take off in between two consecutive arrival flights. The gap is inserted as a spacing constraint the ORD tool considers along with the other constraints, i.e. wake, MRS and ROT (see section 3.3.2.1.5 & 3.3.2.1.6).

The ORD tool provides both decision making and spacing monitoring functions via the TDIs associated to gap constraint.

Insertion of Gap

Following recommendation of RTS 03a described in VALR [43], the gap required to insert departures within two consecutive arrivals could be defined in two ways: first according to the departure demand by Tower controller on case by case basis; or according to a predefined sequence of arrivals and departures for a predefined period of time (e.g. 2 arrivals followed by 1 departure) as part of the airport strategic plan. Tower and approach supervisor coordination is put in place for applying mixed mode operation. This is decided at the coordination step as described in the Use Cases section.

The approach controller inputs a gap of a given time at a given place in the arrival sequence, such that is possible for the final controller to intercept the GAP ITD on the final leg. Figure 10 and Figure 11 provide examples of how the gap spacing can be inserted within the ORD tool:

- Figure 10 illustrates the process of the approach controller selecting a flight in the arrival sequence, and selecting the Gap to be inserted behind it. The time spacing for the gap has standard values in the menu (e.g. 120s, 180s, 250s), or the approach controller can enter via the keypad the specific tailored time spacing required.

- Figure 11 illustrates the ORD tool computing the new spacing constraint for the arrival pair and displaying the gap spacing when it is the largest constraint compared to the MRS, the wake separation and the ROT spacing. A GAP specific TDI symbol is displayed to tower and approach controllers to aid the controllers' situation awareness. Monitoring and alerting associated to gap follows the behaviour described in Monitoring and Alerting section.

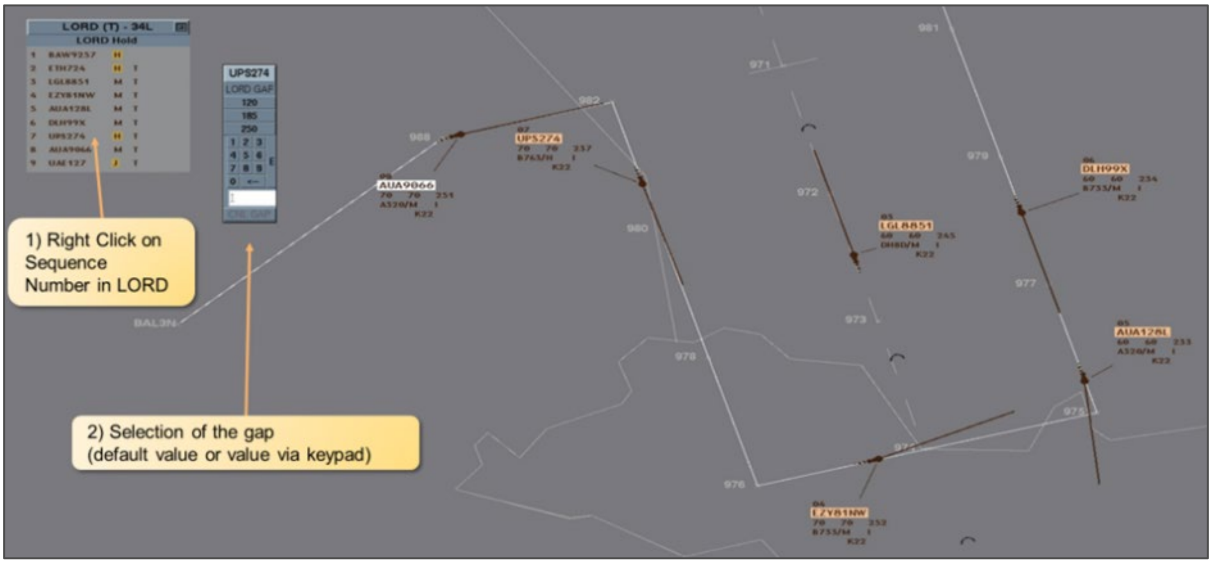

Figure 10: Example Prototype Implementation of Gap Insertion with the ORD Tool

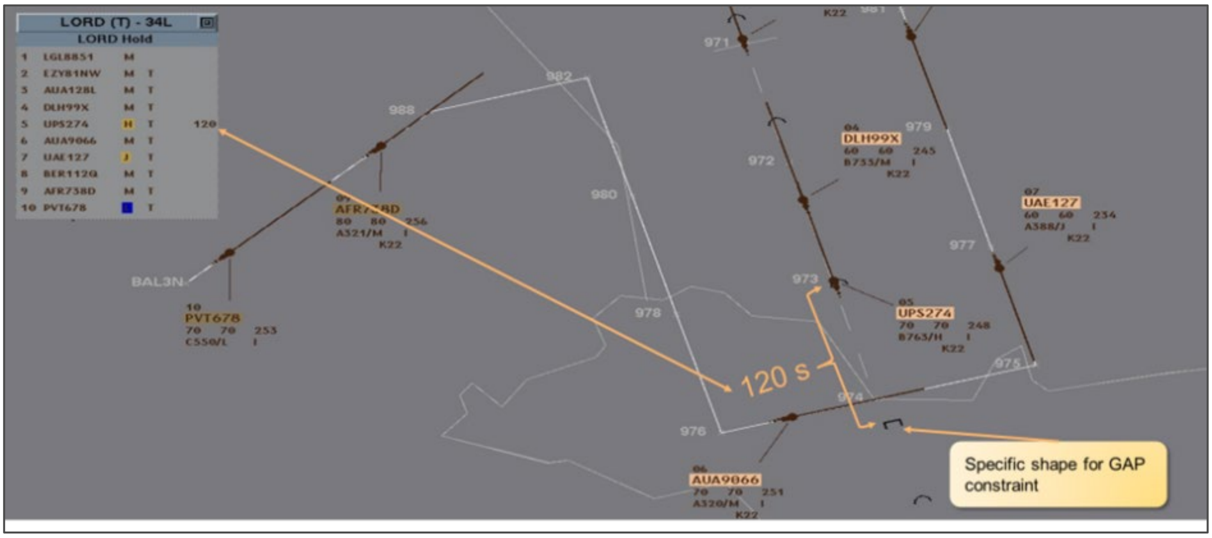

Figure 11: Example Prototype Implementation of an Inserted Gap in the ORD Tool

The flight on which gap is inserted shall be on the base leg, before aircraft intercepts the localiser at the latest, so that approach controller can adapt the heading and speed to target the gap TDI updated with increased spacing.

Following recommendation of RTS 03a described in VALR[43], if gap cannot be inserted due to the fact that the requested gap was not adequate e.g. due to the aircraft type of the lead aircraft or if there is a problem with the gap management tool then controllers need to be notified. The reason why the gap cannot be inserted should also be indicated to the controllers in the notification.

Once the gap is inserted, the tower controller has to verify whether the allocated gap size is compatible with the planned departures in the sequence. An evolution of the situation on the ground (e.g. departing aircraft not ready for line-up) or on the air (e.g. wrong/late interception of the glide) might lead to the modification of the Gap ITD for optimising the spacing on the final leg.

For example when a gap is created for two departures but the second departure will not be capable of lining-up on the runway in time it could be worth to reduce the Gap ITD size to accommodate 1 departure only and let the incoming arrival aircraft fly higher speed and land earlier. For optimising the tactical spacing described above the ATCO might use some support information described in Appendix C.

On the tower the ATCO monitors the landing and vacate of the runway of the arrival aircraft to which the GAP FTD was associated. He asses the gaps size by looking at the position of the next arrival aircraft when the first aircraft touches down. If the spacing is sufficient he gives clearance to line up and take-off to the departure. If the Tower ATCO cannot guarantee the respect of the separation between the two aircraft (departure and arrival), he holds the departing aircraft, gives clearance to land to the arrival and assess the position of the next gap where he can fit it in the planned departure for line-up and take-off.

3.3.2.1.15 ORD in CSPR

CSPR – Closely Spaced Parallel Runway operations are applied when two parallel runways centre line are separated by less than 2500ft. The separation delivery tool in CSPR must take into account all variables and calculates the required separation minima between two aircraft to display ITD and FTD correctly. The separations to be applied between two planes are governed by the same three constraints as for an approach on a single track:

- Wake Turbulence Separation, where 3 different cases shall be considered:
    - leader and follower aircraft on the same glide;
    - leader on glide 1 and follower on glide 2;
    - leader on glide 2 and follower on glide 1.
- MRS, where at least two values shall be considered:
    - if Leader and follower aircraft are on the same glide (e.g. 2.5 NM)
    - if leader and follower are on different glides (e.g. 2.0 NM)
- ROT:
    - The runway occupancy time (ROT) constraint shall only be checked for the next flight that lands on the leader's glide.

If two successive flights follow different glides, the reference distance is the diagonal distance between the two flights whereas if the two flights follow the same glide, the distance is measured along the axis of the same glide. See the figure below as example for two separations where leader and follower aircraft are on different glide.

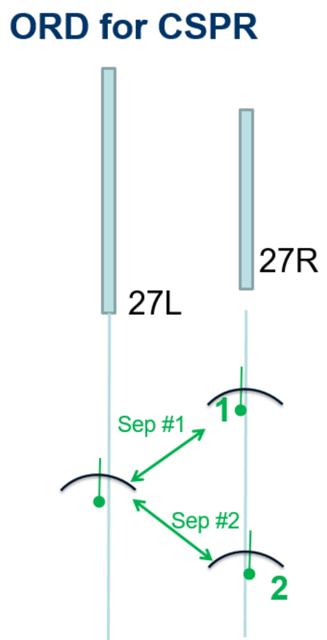

Figure 12: Example of TDI separations in CSPR

In CSPR mode, flights from both approaches are combined in one sequence, thus there is a need to differentiate on the ATCO HMI screen which aircraft are assigned to one runway and which to the others. These can be achieved by using different colours in the sequence list and on the radar label. The figures below show how CSPR has been used for the RTS4b with CDG airport environment.

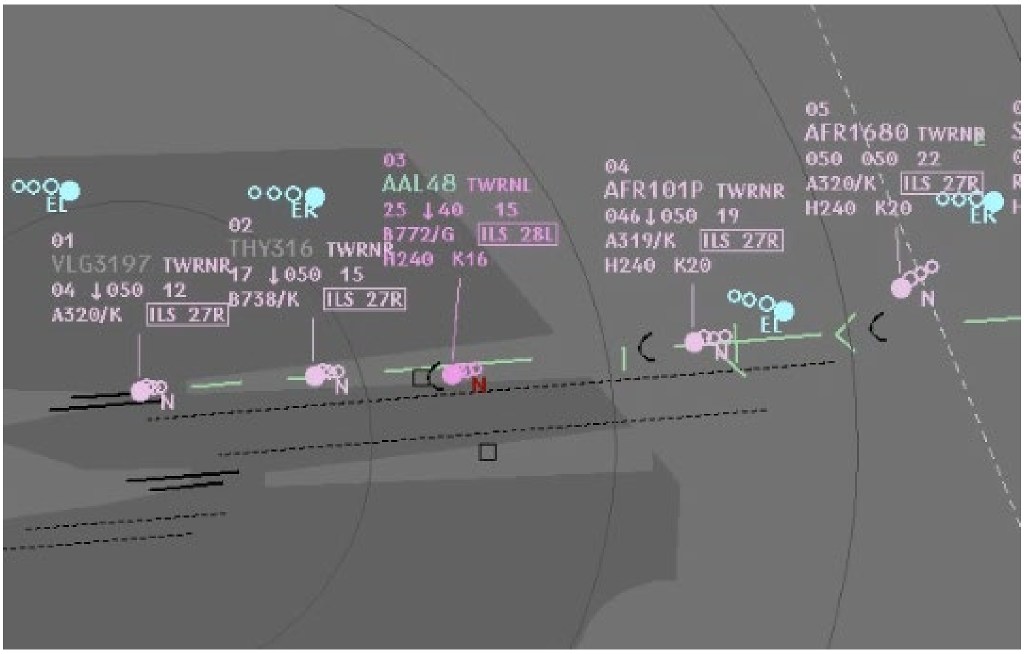

Figure 13: Example of CSPR ITD for aircraft number 3 assigned to RWY27L

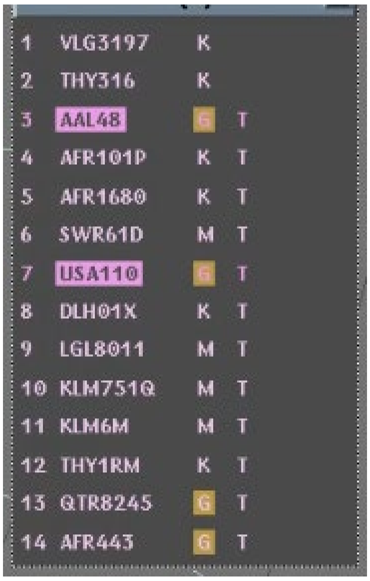

Figure 14: Example of Sequence list (based on situation above)

In Figure 13 and Figure 14 we see that aircraft assigned to the inner runway are highlighted.

3.3.2.2 Wake Turbulence Separations (for Arrivals) Based on Static Aircraft Characteristics (AO-0306)

The RECAT-PWS-EU DB Scheme for Arrivals (DB-PWS-A) is specified in Section 3.2.4.2. To apply this WT Separation Scheme the Controllers require the support of Optimised Runway Delivery on Final Approach (AO-0328) as described in Section 3.3.2.1.

The RECAT-PWS-EU TB Scheme for Arrivals (TB-PWS-A) is specified in Section 3.2.4.2 and is the based on the RECAT-PWS-EU DB Scheme for Arrivals (DB-PWS-A) in conjunction with AO-0303 TBS for Arrivals. To apply this WT Separation Scheme the Controllers require support of the Optimised Runway Delivery on Final Approach (AO-0328) as described in Section 3.3.2.1.

3.3.2.3 Weather Dependent Reductions of Wake Turbulence Separations for Final Approach (AO-0310)

The Weather Dependant Separations for arrivals (WDS-A) is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

Weather Dependant Separations for arrivals (WDS-A) consists in defining acceptable distance or time separation reductions in favourable wind conditions (total and/or cross component). Two concepts are envisaged: a concept based on total wind effect (A-WDS-Tw) on wake vortex decay allowing for reduced separations in strong total wind conditions, and a concept based on crosswind effect (A-WDS-Xw) on vortex lateral transport allowing for reduced separations in strong crosswind conditions.

The time separation reductions are to be applied in conjunction with TBS on final approach (AO-0303) and the support of Optimised Runway Delivery on Final Approach (AO-0328).

The time separation reduction for the crosswind concept (A-TB-WDS-Xw) has been defined and is detailed in Section 3.2.4.2 and Appendix B. The time separation reduction for the total wind concept has not yet been defined.

ORD Support for A-WDS-Xw Concepts

As described in Section 3.2.4.2 and Appendix B the WDS-Xw conditional mode is activated upon certain wind conditions, that ensure with an adequate level of certainty that the wake vortex are moved away from the centreline so that the minimum wake separation could be reduced.

Wake vortex displacement is characterised around the centreline, per aircraft pair and in certain wind conditions. Therefore, WDS wake separation scheme can be applied, only when all applicable conditions are met, i.e. when both aircrafts are on the centreline and in the applicable wind conditions.

Outside of the centreline, wind direction, wake vortices transportation uncertainty and great variability of an aircraft pair relative positions (in terms of relative heading and altitude) leads to not being able to apply the reduced separation and so the TMA separation minima apply instead.

To mitigate the risk for an aircraft to encounter wake vortices on the base leg due to the uncertainty of leader wake vortices relative position, a solution is for the controller to first target the minima of the standard separation scheme (ICAO, RECAT EU, S-PWS, etc.) for the aircraft pair and then only apply the WDS-Xw separation scheme once both leader and follower are aligned on the centreline.

With respect to the ORD tool support this implies the following:

- The TDIs first reflect the minima of the standard separation scheme in the TMA until both leader and follower are aligned on the centreline.
- Once both leader and follower are aligned, the TDI reflects the WDS-Xw separation scheme, resulting in a jump of the TDI that is to be recovered with airspeed management.
- Depending on the aircraft pair, on the interception position and the difference in ground speed of leader and follower aircraft, not all the margin could be recovered with airspeed management. The overall gain in throughput with this method is assessed in the FTS exercise and reported in the VALR[43].

Figure 15 and Figure 16 illustrate the jump of the ITD. In Figure 15 the TDIs for the pair B772-A319 are computed according to the ICAO wake separation scheme. Once the follower A319 aircraft is aligned on the centreline in Figure 16, the ITD jumps and the TDIs follow the WDS wake separation scheme. The controller has to provide adequate airspeed clearances to recover the distance from the leader aircraft and optimise the separation as allowed by A-WDS-Xw separation scheme.

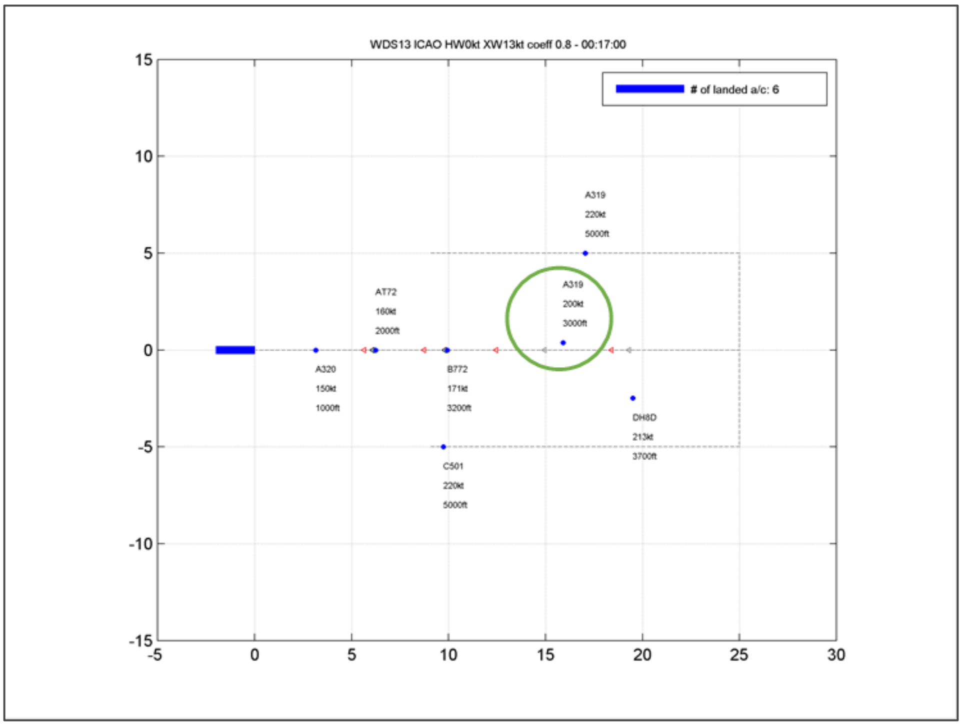

Figure 15: Illustration of TDIs following ICAO Wake scheme out of centreline

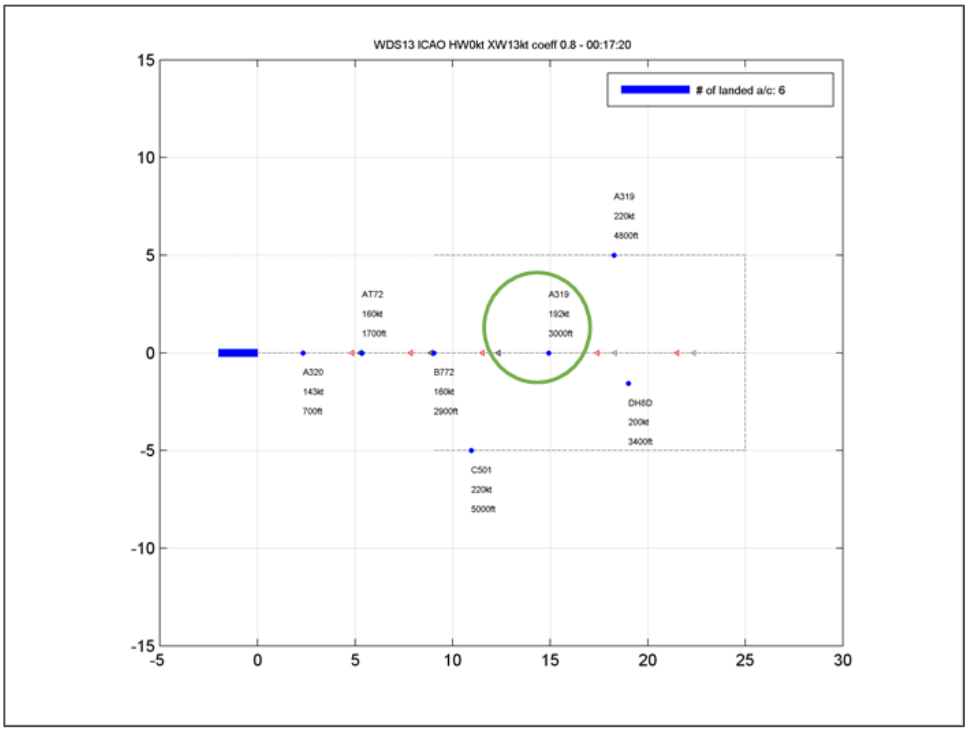

Figure 16: Illustration of TDIs following WDS wake scheme once both leader and follower are on the centreline

Strategic decision to apply or remove the WDS as a conditional mode

The present section follows validation recommendation from the VALR[43].

Strategic decisions on activation of WDS conditional mode is mainly based on weather nowcast and forecast expertise. Weather local model based on historical wind data, data mining and analysis considering the global uncertainty on wind evolution (and hence on the average buffer to be added on the separations in such wind conditions) supports the strategic decision to apply or not the WDS conditional mode.

Due to the workload levels of the ATCOs in the TMA, the point in the arrival sequence at which the transition is to be applied, should be planned and triggered by the supervisor. The Supervisor needs access to the weather expertise described above, aircraft sequence list, information on the traffic forecast and the approach radar situation in order to make this decision.

The Final Approach and Intermediate/Initial Approach controllers should be able to suggest and agree with the supervisor an alternative timing and aircraft from which the mode transition should take place if they think the aircraft selected for the transition is not feasible for some reason.

Transition from nominal mode to WDS conditional mode

The aircraft from which the mode change occurs must be able to reach the RWY threshold / separation delivery point without the wind reducing below the threshold value for WDS operations.

Transition from WDS conditional mode to nominal mode

This is the worst-case scenario, as it leads to increase the separation between aircraft pair, as from one aircraft in the sequence list. Therefore, Approach and tower controller need to be notified in advance about the change in wind conditions and the imminent need to transition from one separation scheme.

ATCOs in the approach sectors directly impacted by the mode change need to know the last aircraft in sequence that will be under the previous separation. The first aircraft in sequence under the new separation scheme should be on the base leg, before aircraft intercepts the localiser at the latest, so that the controller can adapt the heading and speed to target the TDI updated with increased separation.

It is advised to instigate a mode transition (WDS to RECAT-EU /ICAO) between two Medium aircraft where MRS is applied or where the change in separations pair with the new scheme is zero or very limited, to minimise the impact on the ATCOs work.

ATCOs in the TMA should be able to adapt the throughput capacity when there is a mode transition so when the transition goes from WDS to RECAT-EU or ICAO separation scheme, they can regulate the flow of traffic using holdings or via co-ordination with the adjacent upstream sectors.

An advanced warning of the mode transition is required in order to temporarily limit or regulate the flow of inbound traffic (e.g. through metering) during the switch of separation scheme in order to manage the change and controllers' workload

Also, it is advised to apply WDS cross wind operations when there is enough wind strength and stability for remaining during the entire duration of the traffic peak period; so that mode transition to nominal is avoided in peak traffic period.

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Transition to Degraded mode while WDS is applied

As assessed in RTS1, (see VALR[43]), controllers would have to receive training on contingency procedures in case of degraded modes for them to handle a sudden loss of the ORD separation. For example a degraded mode could be transitioning from WDS with the ORD tool to RECAT EU without indicators. As controllers are not systematically checking the aircraft type and WV categories of all aircraft with the ORD tool, controllers may not have the adequate level of situation awareness in degraded mode to adapt and recover quickly and safely if not properly trained.

3.3.2.4 Use Cases

3.3.2.4.1 [NOV-2] Operational Node View for WTS (for Arrivals) based on Static Aircraft Characteristics for Arrivals Concepts Solutions

The Operational Node View in Figure 17 summarises the information exchanges for PJ.02-01-04 concepts for arrivals described in the following Use Cases:

Use case	[NOV-5][ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)
Use case	[NOV-5][ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)
Use case	[NOV-5][MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)
Use case	[NOV-5][MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

There are additional information exchanges from Aerodrome ATS to the Flight Crew informing of the runways in use and associated operating modes, the prevailing operating conditions, and other important operational information through the automatic terminal information service (D-ATIS). Additionally, on first contact, Aerodrome ATC inform the Flight Crew of the prevailing runway surface wind conditions.

There are additional information exchanges between Approach ATC and the Flight Crew, for example with respect to informing of the landing runway and the final approach procedure to be flow.

These additional information exchanges from Aerodrome ATS to the Flight Crew between Approach ATC and the Flight Crew are not modelled in the Operational Node View in Figure 17 for simplification, and also because the Arrivals Concepts Solutions of PJ.02.01 do not impact these additional information exchanges.

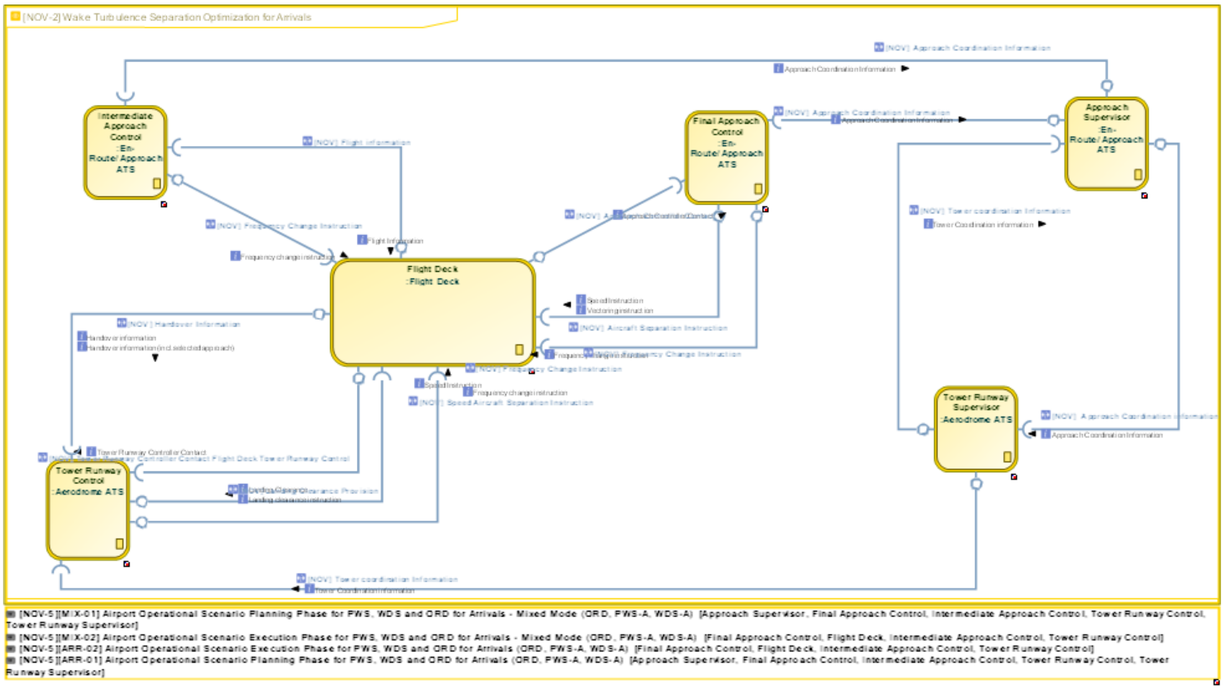

Figure 17: [NOV-2] Operational Node View for WTS (for Arrivals) based on Static Aircraft Characteristics for Arrivals

The [NOV-2] Operational Node View provided in Figure 17 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the operational node view is also provided below.

NOV-2-ARR.pdf

3.3.2.4.2 [NOV-5][ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

This Use Case takes place in the planning or tactical execution phase. It describes the coordination workflow and exchanges between ATC Supervisors (Tower and Approach) and Controllers when a scenario change is detected.

The following scenarios changes are identified:

- Conditional usage of WDS, based on nowcast and forecast weather conditions.
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Other specific non-nominal/alternative flows in addition to the cases mentioned above (e.g. planned or unplanned change of runway in-use) are detailed in the SESAR 1 OFA 01.03.01 Enhanced Runway Throughput OSED [42].

The use case starts when the Tower or Approach Supervisor identifies the need for a change in the scenario. The nominal flow ends when the new scenario is implemented.

General Conditions (Scope and Summary)

Approach and Tower controllers make use of ORD and related SESAR 1 and SESAR2020 concepts (e.g. TBS-A, PWS-A. WDS-A) as described in [NOV-5] [ARR-02].

Approach and Tower Supervisors put in place a coordination process that can lead to the following scenarios change:

- Conditional usage of WDS, based on nowcast and forecast weather conditions.
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Pre Conditions

The Separation Delivery tool and all applicable alerting / monitoring tools are operational.

The GWCS is operational.

The Approach Arrival Sequence Service is operational.

Post Conditions

Post conditions are depending on the change scenario implemented:

- **WDS**: The Approach and Tower Supervisors have coordinated the activation/deactivation of the WDS-A concept considering the current wind conditions (and coordinated with the MET service if needed).
- **Degraded Mode**: The Approach and Tower Supervisors have coordinated the reversion to DBS with or without TDI. The Separation Delivery tool and/or all applicable alerting / monitoring tools and/or GWCS and/or Approach Arrival Sequence Service are no longer operational.

For all the scenarios changes an updated flow of arrival aircraft for the aerodrome into the TMA is established. The new flow matches the runway capacity in the prevailing operating conditions.

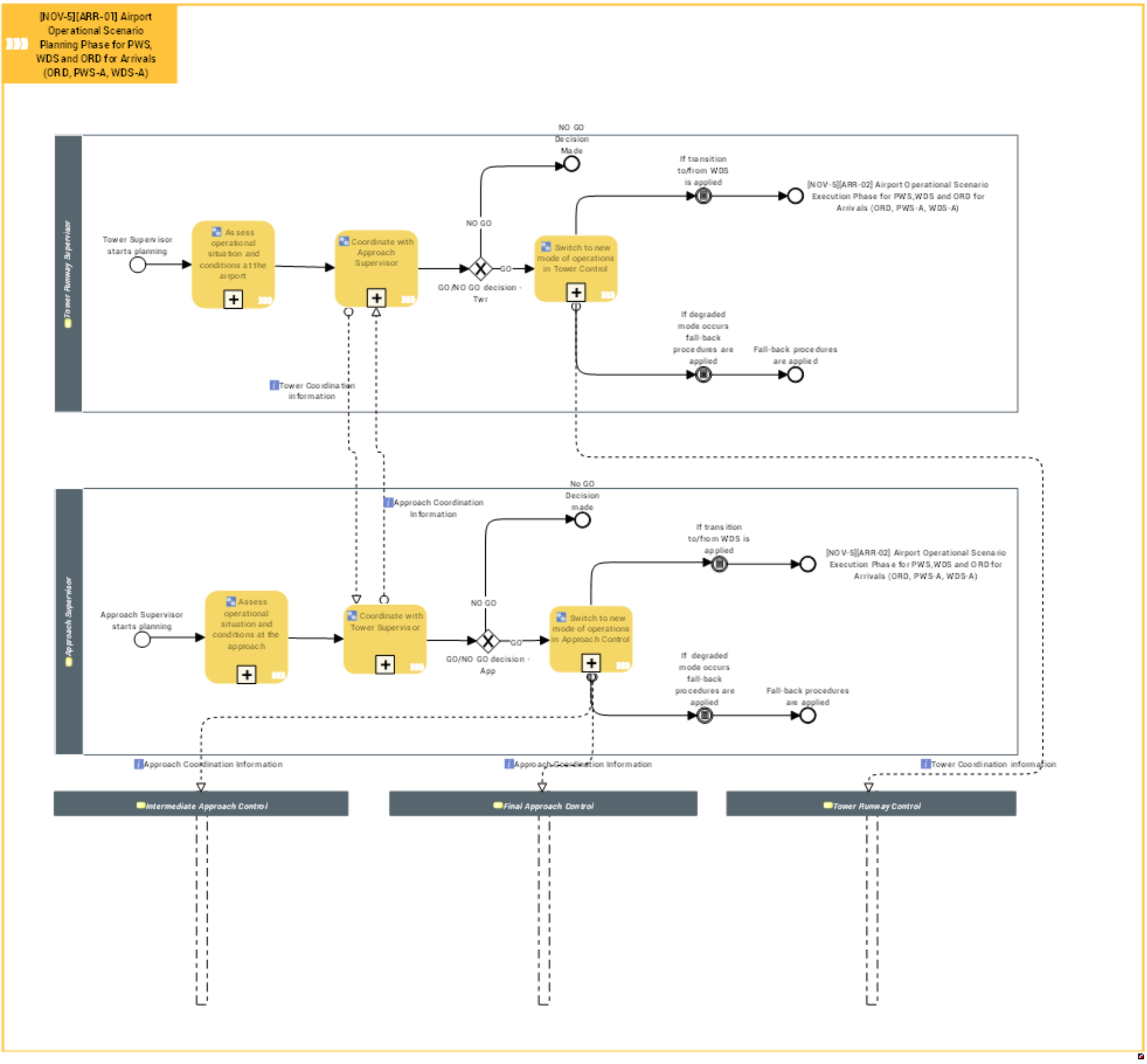

Figure 18: [NOV-5] [ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

The [NOV-5] Process Diagram provided in Figure 18 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-ARR-01.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 14 and Table 15 respectively.

Activity	Description
Assess operational situation and conditions at the airport	The Tower Supervisor is continuously monitoring and assessing the operational situation and conditions at the airport. For this purpose, the Tower Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • wind conditions • runway status This is in order to determine if a change in the mode of operations is needed. The Tower Supervisor also provides and receives feedback about the current status from the Tower Runway Controller.
Assess operational situation and conditions at the approach	The Approach Supervisor is continuously monitoring and assessing the operational situation and conditions at the approach control area of an airport. For this purpose, the Approach Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • wind conditions • runway status This is in order to determine if a change in the mode of operations is needed. The Approach Supervisor also provides and receives feedback about the current status from the Approach Controller(s).
Coordinate with Approach Supervisor	The Tower Supervisor might decide to • optimise the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate weather dependant separations due to the forecast information) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool) The Tower Supervisor contacts the Approach Supervisor to discuss the options and agree on timing and mode of operations to be applied.
Coordinate with Tower Supervisor	The Approach Supervisor might decide to • optimise the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate weather dependant separations due to the forecast information) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool) The Approach Supervisor contacts the Tower Supervisor to discuss the options and agree on timing and mode of operations to be applied.

Activity	Description
Switch to new mode of operations in Approach Control	After coordination with the Tower Supervisor on the terms and details of the transition to a different mode of operations, the Approach Supervisor informs the Approach Controller(s) of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool. **WDS** In the case of transition from one mode of operation to WDS (and vice-versa) the Tower or Approach Supervisor selects on the Separation Delivery Tool Sequence List the first aircraft from which the new mode will be applied. The Approach Supervisor will also ensure the applied change is properly reflected in Approach CWP (e.g. TDIs have been adapted to the WDS, sequence list indicates the new mode of operations). [NOV-5] [ARR-02] is applied. **DEGRADED MODE** In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) the Approach Supervisor informs the Approach Controller of the switch to degraded mode operations applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).
Switch to new mode of operations in Tower Control	After coordination with the Approach Supervisor on the terms and details on the transition to a different mode of operations, the Tower Supervisor informs the Tower Runway Controller of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool. **WDS** In the case of transition from one mode of operation to WDS (and vice-versa) the Tower or Approach Supervisor selects on the Separation Delivery Tool Sequence List the first aircraft from which the new mode will be applied. The Tower Supervisor will also ensure the applied change is properly reflected in Tower CWP (e.g. TDIs have been adapted to the WDS, sequence list indicates the new mode of operations). [NOV-5] [ARR-02] is applied. **DEGRADED MODE** In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) The Tower Supervisor informs the Tower Runway Controller of the switch to degraded mode operations applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).

Table 14: Activity Descriptions for [NOV-5] [ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Tower Runway Supervisor	Switch to new mode of operations in Tower Control o--> Tower Runway Control	Tower Runway Control	Tower Coordination information	CoordinationMessage
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Intermediate Approach Control	Intermediate Approach Control	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Final Approach Control	Final Approach Control	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Coordinate with Tower Supervisor o--> Coordinate with Approach Supervisor	Tower Runway Supervisor	Tower Coordination information	CoordinationMessage
Tower Runway Supervisor	Coordinate with Approach Supervisor o--> Coordinate with Tower Supervisor	Approach Supervisor	Tower Coordination information	CoordinationMessage

Table 15: Information Exchange Descriptions for [NOV-5] [ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

3.3.2.4.3 [NOV-5][ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

This use case takes place in the execution phase. It describes the operational flow involved in sequencing and delivering arrival aircraft on the approach phase with an Optimised Runway Delivery (ORD) Separation tool, which is available for Approach and Tower Control use. This ORD tool computes two indicators on the HMI (Initial and Final Target Distance Indicators -ITD, FTD-). Indicators are computed according to the different SESAR1 and SESAR2020 concepts which are applied (e.g. ORD, TBS, PWS-A and/or WDS-A).

This use case starts when the flight enters the TDI Area (taking into account that the Flight Deck has prepared and briefed the approach at the end of cruise). The nominal flow ends when the aircraft has landed.

General Conditions (Scope and Summary)

This Use Case describes the steps involved in sequencing and delivering arrival aircraft using the applicable SESAR1 and SESAR2020 concept (e.g. TBS, PWS-A, ORD and/or WDS-A) on final approach with the aid of TDIs displayed on the extended runway centreline of the Final Approach Controller radar display and Tower Runway Controller air traffic monitor display.

This Use Case takes place from the arrival aircraft entering the TDI area until the arrival aircraft lands and vacates the runway.

The Approach Operations in this Use Case are equipped with (some are optional subject to a local safety case):

- Separation Delivery tool;
- Approach Arrival Sequence Service;
- Approach Arrival Sequence Display;
- Wrong aircraft turned on TDI alert;
- Aircraft turned onto wrong localiser alert;
- Speed conformance alert;
- ITD catch-up alert;
- Separation Delivery tool monitor;
- GWCS monitor;
- Approach Arrival Sequence monitor;
- GWCS and distance display;
- Wind monitor / alert;

The Tower Operations in this Use Case are equipped with (some are optional subject to a local safety case):

- Separation Delivery tool;
- Approach Arrival Sequence Display;
- Speed conformance alert;
- ITD catch-up alert;
- Separation Delivery tool monitor;
- GWCS monitor;
- Approach Arrival Sequence monitor.

Pre Conditions

Airport Medium / Short Term Planning and Demand and Capacity Balancing have established a flow of arrival aircraft for the aerodrome into the TMA that matches the runway capacity in the prevailing operating conditions.

The approach arrival sequence into the IAFs is optimised as far as reasonable and if applicable is reflected in the AMAN.

The Separation Delivery tool and all applicable alerting / monitoring tools are operational.

The GWCS is operational.

The Approach Arrival Sequence Service is operational.

If applicable, the Approach and Tower Supervisors have coordinated the activation of the concept (TBS-A or WDS-A) considering the current wind conditions (and coordinated with the MET service if needed).

The Flight Crew are aware that an alternative WT scheme (TBS-A, PWS-A or WDS-A) is being employed on final approach through notification via the Aeronautical Information Publication (AIP), the pre-departure briefing, the top of descent briefing, and from the D-ATIS notification as the aircraft enters the TMA.

The Flight Crew establish the landing stabilisation speed required for the landing weight, cockpit stabilisation procedures including approach flap setting, and D-ATIS reported runway surface wind conditions soon after the aircraft enters the TMA.

The Flight Crew are aware of the runway in use and the approach type.

Post Conditions

The arrival aircraft has landed and vacated the runway.

Actors

Approach Supervisor, Tower Supervisor, TMA Sector Controllers, Intermediate Approach Controller, Final Approach Controller, Tower Runway Controller, Flight Crew.

Trigger

Coordination of an arrival aircraft into the assigned IAF is initiated between the TMA Sector Controller and the Intermediate Approach Controller.

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A) in Figure 19.

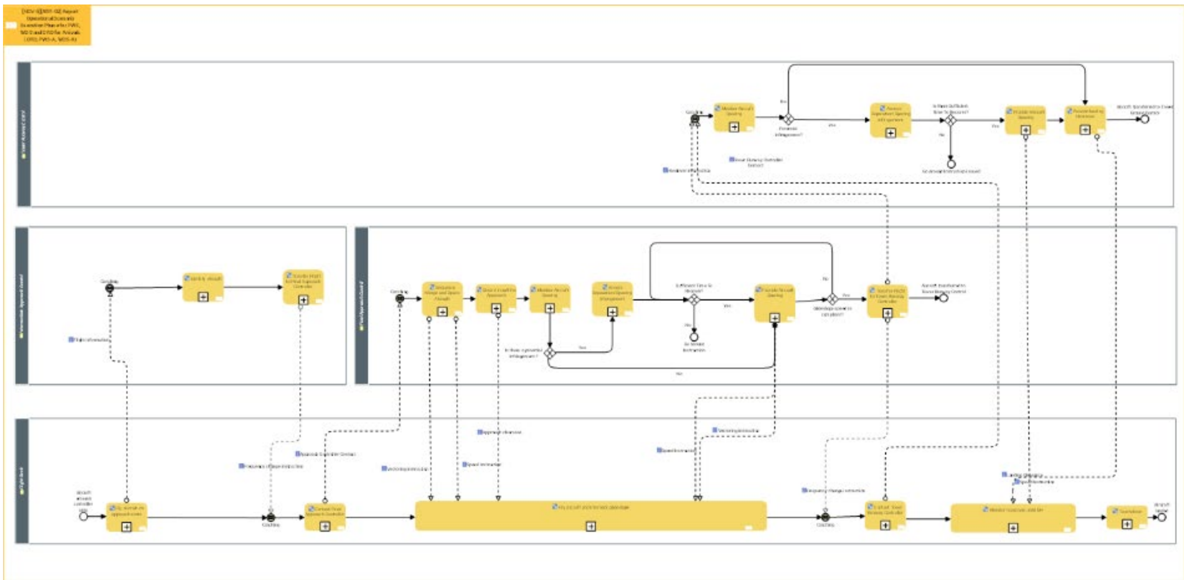

Figure 19: [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

The Process Diagram for [ARR-02] in Figure 19 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-ARR-02.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 16 and Table 17 respectively.

Activity	Description
Assess Separation/Spacing Infringement (Final Approach Control)	If an ITD infringement occurs, the Final Approach Controller assesses the feasibility and time to recover the flight. According to the result of the assessment: • Nominal: If it is positive, the Final Approach Controller will provide spacing through speed and/or vectoring instructions. • Non-Nominal: If it is negative, the Final Approach Controller will instruct the Flight Deck to go-around
Assess Separation/Spacing Infringement (Tower Runway Control)	If an FTD infringement occurs, the Tower Runway Controller assesses the feasibility and time to recover the flight. According to the result of the assessment: • Nominal: If it is positive, the Tower Runway Controller will provide spacing through speed and/or vectoring instructions. • Non-Nominal: If it is negative, the Tower Runway Controller will instruct the Flight Deck to go-around
Clear Aircraft for Approach	Nominal The Approach Controller authorises the aircraft to follow the approach procedure towards the runway. Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Contact Final Approach Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Final Approach Controller
Contact Tower Runway Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Tower Runway Controller
Fly aircraft and intercept glideslope	Nominal The Flight Deck flies the aircraft following previous ATC instructions towards intercepting the localiser and glideslope of the runway
Fly aircraft on approach route	Nominal Once the a/c enters the initial approach area (from IAF to FAF), the Flight Deck flies the aircraft following ATC speed and vectoring (vertical and horizontal) instructions
Identify Aircraft	Nominal Once the aircraft enters the TDI area, the corresponding ITD (Initial Target Distance) indicator and FTD (Final Target Distance) indicator are computed and displayed in the HMI for Intermediate Approach Controller's use. At that moment, the ATCO matches the entering aircraft with its corresponding ITD

Activity	Description
	to follow the evolution of the trajectory until the transfer to the Final Approach Controller.
Monitor Aircraft Spacing (Final Approach Control)	Nominal The Final Approach Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the ITD Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Monitor Aircraft Spacing (Tower Runway Control)	Nominal The Tower Runway Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the FTD Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Monitor trajectory until DH	Nominal Until the landing clearance is received, the Flight Deck monitors the approach, adjusting the trajectory until reaching the DA/H. If distance/altitude are provided on the chart, "Distance to Go" (to threshold) information can be used to perform distance/altitude checks. The purpose is to check whether the a/c flies the correct vertical approach path.
Provide Aircraft Spacing	Nominal The controller confirms that there is sufficient time to recover the aircraft back onto the safe spacing position, the controller will provide aircraft spacing via speed and vectoring (horizontal and vertical) instructions aiming to situate the aircraft on/behind the ITD/FTD.
Provide landing clearance	Nominal The Tower Runway Controller authorises the Flight Deck to land the aircraft.
Sequence, Merge and Space Aircraft	Nominal The Final Approach Controller sequence, merge and space the aircraft behind the ITD. On a best case scenario the Final Approach Controller aims to vector the a/c on the ITD indicator, which represents the separation to be applied at the Deceleration Fix point to assist the Final Approach Controller in delivering the required separation or spacing (represented by the FTD) at the Delivery point. Furthermore, the Final Approach Controller also monitors the spacing during the final approach, especially the spacing with the leader a/c, providing speed instructions if the traffic situation requires.

Activity	Description
	Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Touchdown	Nominal The Flight Deck safely executes landing until touchdown on the runway
Transfer Flight to Final Approach Controller	Nominal At appropriate time and operational conditions (around Final Approach Fix), the Intermediate Approach Controller • hands over and transfers the control of the flight to the Final Approach Controller • instructs the Flight Deck to contact Final Approach Control
Transfer Flight to Tower Runway Controller	Nominal At appropriate time and operational conditions (around Decision Point), the Final Approach Controller • hands over and transfers the control of the flight to the Tower Runway Controller • instructs the Flight Deck to contact Tower Runway Control

Table 16: Activity Descriptions for the [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Final Approach Control	Clear Aircraft for Approach o--> Fly aircraft and intercept glideslope	Flight Deck	Approach clearance	ApproachClearance
Approach Executive Control	Transfer Flight to Tower Runway Controller o--> Catching	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Approach Executive Control	Transfer Flight to Tower Runway Controller o--> Catching	Tower Runway Control	Handover information	
Flight Deck	Contact Final Approach Controller o--> Catching	Final Approach Control	Approach Controller Contact	AIRM_OutOfScope
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	SpeedConstraint
Flight Deck	Contact Tower Runway Controller o--> Catching	Tower Runway Control	Tower Runway Controller Contact	ATCInstruction
Tower Runway Control	Provide landing clearance o--> Monitor trajectory until DH	Flight Deck	Landing Clearance	LandingClearance
Approach Executive Control	Transfer Flight to Final Approach Controller o--> Catching	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Flight Deck	Fly aircraft on approach route o--> Catching	Approach Executive Control	Flight Information	Flight

Table 17: Information Exchange Descriptions for [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

3.3.2.4.4 [NOV-5][MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

This Use Case takes place in the planning or tactical execution phase. It describes the coordination workflow and exchanges between ATC Supervisors (Tower and Approach) and Controllers when a scenario change is detected.

The following scenarios changes are identified:

- Mix Mode of operations, applying tactical or planned specific scenario spacing (GAP management)
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Other specific non-nominal/alternative flows in addition to the cases mentioned above (e.g. planned or unplanned change of runway in-use) are detailed in the SESAR1 OFA01.03.01 Enhanced Runway Throughput OSED.

The use case starts when the Tower or Approach Supervisor identifies the need for a change in the scenario. The nominal flow ends when the new scenario is implemented.

General Conditions (Scope and Summary)

Approach and Tower Controllers make use of ORD and related SESAR1 and SESAR2020 concepts (e.g. TBS-A, PWS-A) as described in [NOV-5] [ARR-02].

Approach and Tower Supervisors put in place a coordination process that can lead to the following scenarios change:

- Mix Mode of operations, applying tactical or planned specific scenario spacing (GAP management)
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Pre Conditions

The Separation Delivery tool and all applicable alerting / monitoring tools are operational.

The GWCS is operational.

The Approach Arrival Sequence Service is operational.

Post Conditions

Post conditions are depending on the change scenario implemented:

- Mix Mode
    - The Approach and Tower Supervisors have coordinated the application of specific scenario spacing.

- Degraded Mode
    - The Approach and Tower Supervisors have coordinated the reversion to DBS with or without TDI.
    - The Separation Delivery tool and/or all applicable alerting / monitoring tools and/or GWCS and/or Approach Arrival Sequence Service are no longer operational.

For all the scenarios changes an updated flow of arrival aircraft for the aerodrome into the TMA is established. The new flow matches the runway capacity in the prevailing operating conditions.

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] Process Diagram for [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (PWS-A, WDS-A, ORD) in Figure 20.

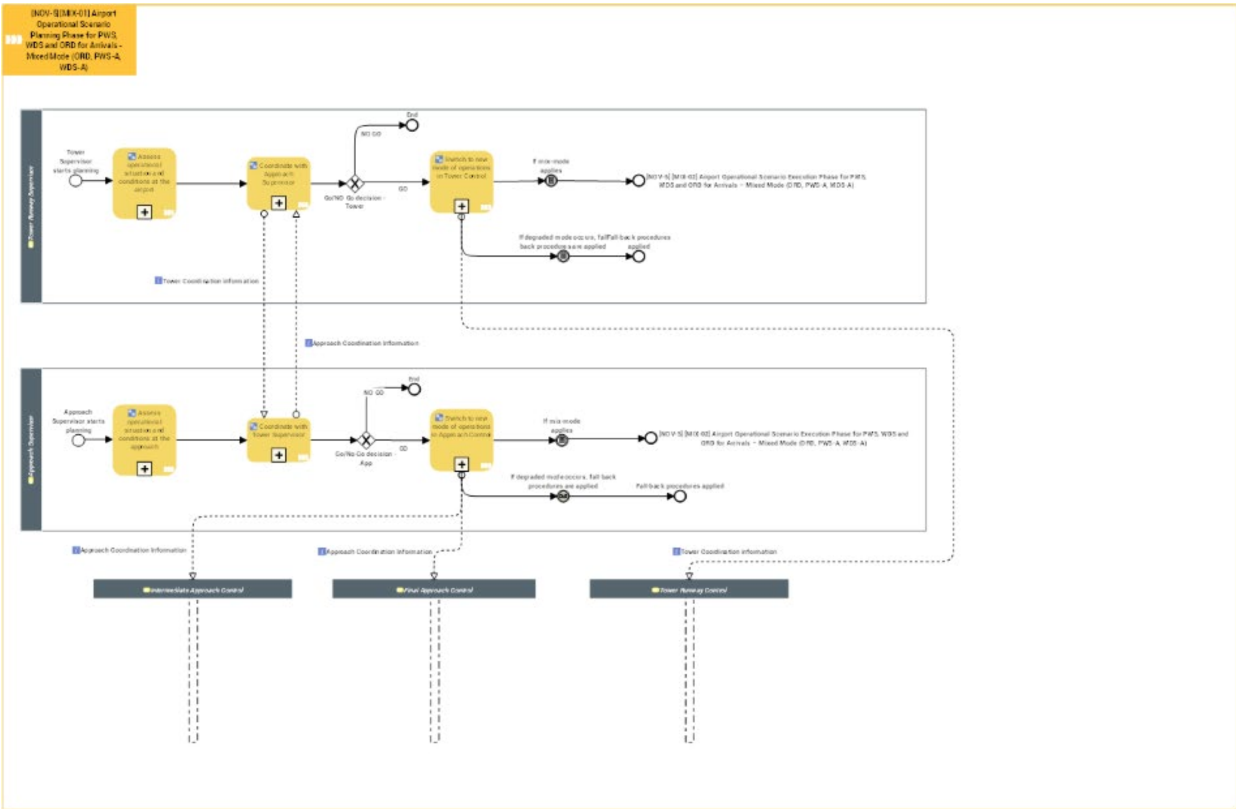

Figure 20: [NOV-5] [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (PRD, PWS-A, WDS-A)

The Process Diagram for [MIX-01] in Figure 20 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-MIX-01.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 18 and Table 19 respectively.

Activity	Description
Assess operational situation and conditions at the airport	The Tower Supervisor is continuously monitoring and assessing the operational situation and conditions at the airport. For this purpose, the Tower Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • runway status • arrivals vs departures need This is in order to determine if a change in the mode of operations is needed. The Tower Supervisor also provides and receives feedback about the current status from the Tower Runway Controller.
Assess operational situation and conditions at the approach	The Approach Supervisor is continuously monitoring and assessing the operational situation and conditions at the approach control area of an airport. For this purpose, the Approach Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • runway status • arrivals vs departures need This is in order to determine if a change in the mode of operations is needed. The Approach Supervisor also provides and receives feedback about the current status from the Approach Controller(s).
Coordinate with Approach Supervisor	The Tower Supervisor might decide to • optimise the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate mix mode operations to cope with airport capacity needs) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool) The Tower Supervisor contacts the Approach Supervisor to discuss the options and agree on timing and mode of operations to be applied.
Coordinate with Tower Supervisor	The Approach Supervisor might decide to: • optimise the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate mix mode operations to cope with airport capacity needs) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool)

Activity	Description
	The Approach Supervisor contacts the Tower Supervisor to discuss the options and agree on timing and mode of operations to be applied.
Switch to new mode of operations in Approach Control	After coordination with the Tower Supervisor on the terms and details of the transition to a different mode of operations, the Approach Supervisor informs the Approach Controller(s) of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool. Nominal (Gap spacing scenarios) In case specific spacing scenarios are implemented, the Approach Supervisor and/or the Approach ATCO insert spacing requests in the Separation Delivery Tool. The Approach Supervisor checks that the spacing requests are reflected in the Separation Delivery Tool. Use Case [NOV-5] [MIX-02] is applied for the aircraft pair where spacing requests are inserted. Non-Nominal (Degraded Mode) In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) the Approach Supervisor informs the Approach Controller of the switch to degraded mode of operations, applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).
Switch to new mode of operations in Tower Control	After coordination with the Approach Supervisor on the terms and details on the transition to a different mode of operations, the Tower Supervisor informs the Tower Runway Controller of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool. Nominal (Gap spacing scenarios) In case specific spacing scenarios are implemented, the Approach Supervisor and/or the Approach ATCO insert spacing requests in the Separation Delivery Tool. The Tower Supervisor checks that the spacing requests are reflected in the Separation Delivery Tool. Use Case [NOV-5] [MIX-02] is applied for the aircraft pair where spacing requests are inserted. Non-Nominal (Degraded Mode) In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) the Tower Supervisor informs the Tower Runway Controller of the switch to degraded mode of operations, applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).

Table 18: Activity Descriptions for [NOV-5] [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Tower Runway Supervisor	Switch to new mode of operations in Tower Control o--> Tower Runway Control	Tower Runway Control	Tower Coordination information	CoordinationMessage
Tower Runway Supervisor	Coordinate with Approach Supervisor o--> Coordinate with Tower Supervisor	Approach Supervisor	Tower Coordination information	CoordinationMessage
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Intermediate Approach Control	Intermediate Approach Control	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Coordinate with Tower Supervisor o--> Coordinate with Approach Supervisor	Tower Runway Supervisor	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Final Approach Control	Final Approach Control	Approach Coordination Information	CoordinationMessage

Table 19: Information Exchange Descriptions for [NOV-5] [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

3.3.2.4.5 [NOV-5][MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

This use case takes place in the execution phase. It describes the operational flow involved in sequencing and delivering arrival aircraft on the approach phase with an Optimised Runway Delivery (ORD) Separation tool and the applicable SESAR1 and SESAR2020 concepts (TBS, PWS-A, and /or WDS-A) including additional specific spacing requests previously coordinated by Approach and Tower Supervisors in the [NOV-5] [MIX-01] Use Case.

Spacing requests are called GAP in the Use Case.

The use case starts when the flight enters the TDI Area (taking into account that the Flight Deck has prepared and briefed the approach at the end of cruise). The nominal flow ends when the aircraft has landed.

General Conditions (Scope and Summary)

As per Use Case [NOV-5] [ARR-02]

Pre Conditions

As per Use Case [NOV-5] [ARR-02]

In addition the Approach and Tower Supervisors have coordinated on the provision of the scenario specific spacing (GAP) between two or more aircraft and they have agreed on the position in the sequence (see Use Case [NOV-5] [MIX-01]).

Post Conditions

The arrival aircraft after the spacing has landed and vacated the runway.

The aircraft(s) planned for departure within the arrival sequence has been cleared for take-off

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] Process Diagram for [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A) in Figure 21.

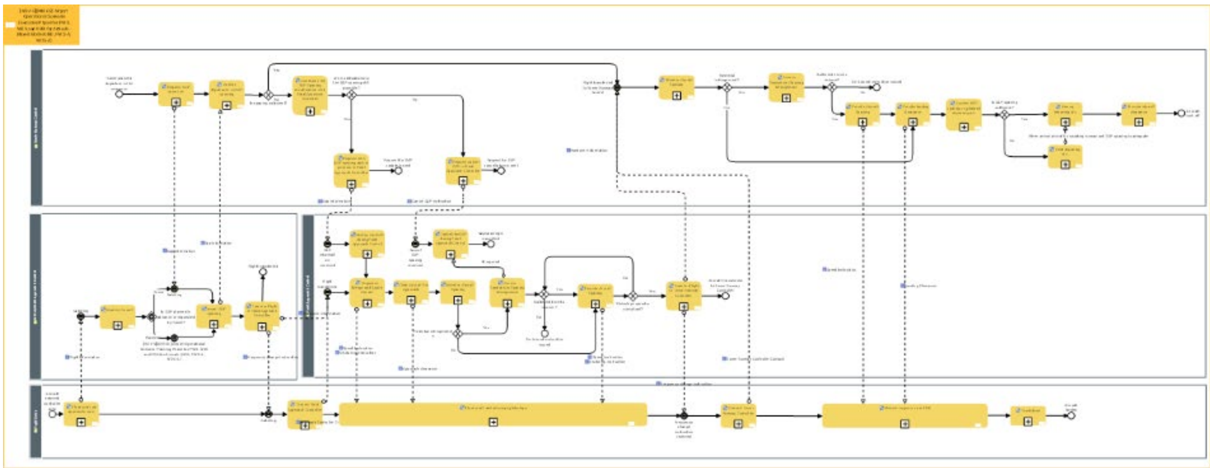

Figure 21: [NOV-5] [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

The Process Diagram for [MIX-02] in Figure 21 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-MIX-02.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 20 and Table 21 respectively.

Activity	Description
Assess departures vs GAP spacing	Nominal The Tower Runway Controller compares the departures aircraft position on the ground with the requested spacing between the next two arriving aircraft. If the spacing is not adequate he will coordinate a modification with the Final Approach Controller.
Assess GAP spacing vs planned departing a/c	Nominal While the leader arriving aircraft vacates the runway, the Tower Runway Controller monitors the position of the vacating aircraft, the position and readiness of the next departing aircraft as well as the spacing with the follower arriving aircraft. If the {GAP spacing} with the follower aircraft in the arrival sequence is still sufficient, the Tower Runway Controller will line-up on the runway the next planned departing aircraft. Alternate If the {GAP spacing} with the follower aircraft in the arrival sequence is not sufficient, the Tower Runway Controller will hold the next planned departing aircraft.
Assess Separation/Spacing Infringement (Final Approach Control)	If a GAP ITD infringement occurs, the Final Approach Controller assesses the feasibility and time to recover the spacing for the flight. According to the result of the assessment: • Nominal: If it is positive, the Final Approach Controller will provide spacing through speed and/or vectoring instructions • Non-Nominal: If it is negative, the Final Approach Controller will cancel the GAP spacing
Assess Separation/Spacing Infringement (Tower Runway Control)	If a GAP FTD infringement occurs, the Tower Runway Controller assesses the feasibility and time to recover the appropriate spacing for the flight. According to the result of the assessment: • Nominal: If it is positive, the Tower Runway Controller will provide spacing through speed and/or vectoring instructions • Non-Nominal: If it is negative, the Tower Runway Controller might issue a Go-Around if the arrival landing and/or departure take-off cannot be safely operated
Cancel the GAP during Final Approach Control	Non-Nominal The Final Approach Controller cancels the gap. This can happen upon request of the Tower Runway Controller or when the GAP ITD is infringed and is not possible to recover the spacing by the ATCO.
Clear Aircraft for Approach	Nominal The Approach Controller authorises the aircraft to follow the approach procedure towards the runway. Non-Nominal

Activity	Description
	A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Contact Final Approach Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Final Approach Controller
Contact Tower Runway Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Tower Runway Controller
Coordinate the GAP Spacing modification with Final Approach Controller	The spacing of GAP FTD has been deemed not large enough to accommodate the planned departures aircraft to be inserted between the two consecutive arrivals. Therefore, the Tower Runway Controller coordinates with either the Final Approach Controller or the Intermediate Approach Controller to assess whether: • Nominal: the modification of the gap spacing is still possible (e.g. for example gap spacing might be reduced from accommodating 2 departures to 1 departure) • Non-Nominal: the modification of the gap spacing is not possible. The Tower Runway Controller requests the GAP cancellation
Fly aircraft and intercept glideslope	Nominal The Flight Deck flies the aircraft following previous ATC instructions towards intercepting the towards intercepting the localiser and glideslope of the runway
Fly aircraft on approach route	Nominal Once the a/c enters the initial approach area (from IAF to FAF), the Flight Deck flies the aircraft following ATC speed and vectoring (vertical and horizontal) instructions
Hold departing a/c	Alternate The Tower Runway Controller gives a hold clearance to the next departing aircraft. Then the Tower Runway Controller has to execute again this use case to find another adequate gap spacing in the arrival sequence for the planned departure.
Identify Aircraft	Nominal Once the aircraft enters the TDI area, the corresponding ITD (Initial Target Distance) indicator and FTD (Final Target Distance) indicator are computed and displayed in the HMI for Intermediate Approach Controller's use. At that moment, the ATCO matches the entering aircraft with its corresponding ITD to follow the evolution of the trajectory until the transfer to the Final Approach Controller.
Insert GAP spacing	The request for GAP has been provided ad-hoc by the Tower Runway Controller or planned in advance by the Tower Supervisor. The Intermediate

Activity	Description
	Approach Controller inserts the requested GAP spacing in the correct position in the sequence list with the associated GAP information.
Line-up departing a/c	Nominal The Tower Runway Controller gives the line-up clearance to the next departing aircraft.
Modify the GAP during Final Approach Control	Nominal The Final Approach Controller modifies the gap according to the Tower Runway Controller's request to meet the departure demand and operational situation.
Monitor Aircraft Spacing (Final Approach Control)	Nominal The Final Approach Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the ITD.
Monitor Aircraft Spacing (Tower Runway Control)	Nominal The Tower Runway Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the FTD.
Monitor trajectory until DH	Nominal Until the landing clearance is received, the Flight Deck monitors the approach, adjusting the trajectory until reaching the DA/H. If distance/altitude are provided on the chart, "Distance to Go" (to threshold) information can be used to perform distance/altitude checks. The purpose is to check whether the a/c flies the correct vertical approach path.
Provide Aircraft Spacing (Tower Runway Control)	Nominal The Tower Runway Controller confirms that there is sufficient time to recover the aircraft back onto the safe spacing position, the controller will provide aircraft spacing via speed and vectoring (horizontal and vertical) instructions aiming to situate the aircraft on/behind the FTD.
Provide Aircraft Spacing (Final Approach Control)	Nominal The Final Approach Controller confirms that there is sufficient time to recover the aircraft back onto the safe spacing position, the controller will provide aircraft spacing via speed and vectoring (horizontal and vertical) instructions aiming to situate the aircraft on/behind the ITD.
Provide landing clearance	Nominal The Tower Runway Controller authorises the Flight Deck to land the aircraft.
Provide take-off clearance	Nominal Following line up clearance, the Tower Runway Controller issues the take-off clearance to the Flight Crew.

Activity	Description
Request cancel GAP to Final Approach Control	Non-Nominal Providing the modification of the GAP is not possible and not useful, the Tower Approach Controller requests the Final Approach Controller to cancel the gap.
Request GAP insertion	Nominal To accommodate the departure aircraft demand within the arrival sequence (according to case by case demand or strategic plan) the Tower Runway Controller request gap spacing (in distance or time) to be inserted in between consecutive arrival aircraft pairs.
Request new GAP spacing and/or position to Final Approach Control	Nominal Providing the modification of the GAP is still possible, the Tower Runway Controller requests a new gap spacing and/or new gap position to accommodate the requested departure(s) within the consecutive arrivals.
Sequence, Merge and Space Aircraft	Nominal The Final Approach Controller sequence, merge and space the aircraft behind the ITD. On a best case scenario the Final Approach Controller aims to vector the a/c on the ITD indicator, which represents the separation to be applied at the Deceleration Fix point to assist the Controller in delivering the required spacing (represented by the FTD) at the Delivery point. Furthermore, the Final Approach Controller also monitors the spacing during the final approach, especially the spacing with the leader a/c, providing speed instructions if the traffic situation requires. Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Touchdown	Nominal The Flight Deck safely executes landing until touchdown on the runway.
Transfer Flight to Final Approach Controller	Nominal At appropriate time and operational conditions (around Final Approach Fix), the Intermediate Approach Controller: • hands over and transfers the control of the flight to the Final Approach Controller • instructs the Flight Deck to contact Final Approach Control
Transfer Flight to Tower Runway Controller	Nominal At appropriate time and operational conditions (around Decision Point), the Final Approach Controller: • hands over and transfers the control of the flight to Tower Runway Control, mentioning the followed published approach chart, and • instructs the Flight Deck to contact Tower Runway Control

Table 20: Activity Descriptions for [NOV-5] [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

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Issuer	Info Exchange	Addressee	Info Element	Info Entity
Final Approach Control	Clear Aircraft for Approach o--> Fly aircraft and intercept glideslope	Flight Deck	Approach clearance	ApproachClearance
Flight Deck	Fly aircraft on approach route o--> Catching	Intermediate Approach Control	Flight Information	Flight
Flight Deck	Contact Final Approach Controller o--> Flight transferred	Final Approach Control	Approach Controller Contact	AIRM_OutOfScope
Tower Runway Control	Request cancel GAP to Final Approach Controller o--> Cancel GAP spacing received	Final Approach Control	Cancel GAP instruction	
Intermediate Approach Control	Transfer Flight to Final Approach Controller o--> Flight transferred	Final Approach Control	Handover information	
Tower Runway Control	Request new GAP spacing and/or position to Final Approach Controller o--> GAP information received	Final Approach Control	Gap information	
Intermediate Approach Control	Transfer Flight to Final Approach Controller o--> Catching	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	SpeedConstraint
Tower Runway Control	Provide landing clearance o--> Monitor trajectory until DH	Flight Deck	Landing Clearance	LandingClearance
Flight Deck	Contact Tower Runway Controller o--> Flight transferred to Tower Runway Control	Tower Runway Control	Tower Runway Controller Contact	ATCInstruction
Intermediate Approach Control	Insert GAP spacing o--> Assess departures vs GAP spacing	Tower Runway Control	Gap information	

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Tower Runway Control	Request GAP insertion o--> Catching	Intermediate Approach Control	Gap information	
Final Approach Control	Transfer Flight to Tower Runway Controller o--> Frequency change instruction received	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Final Approach Control	Transfer Flight to Tower Runway Controller o--> Flight transferred to Tower Runway Control	Tower Runway Control	Handover information	

Table 21: Information Exchange Descriptions for [NOV-5] [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

3.3.3 Differences between new and previous Operating Methods

Activities (in EATMA) that are impacted by the SESAR Solution	Current Operating Method	New Operating Method
Present separation to Arrival Controller (ORD)	ATCOs apply separation by observing the headings, distances, and speeds, between consecutive aircraft. The separation distance limits are determined by the Controller by the use of scales on the radar map and through the observation of catch-up from the separation distance progression observed between the follower aircraft and the lead aircraft.	ATCOs will apply separations by using a separation delivery tool and target distance indicators for giving headings and speeds between consecutive aircraft.
Apply PWS Separation (PWS-A)	Controllers use standard separations scheme where aircraft types are grouped on categories	Controllers will apply separations scheme where separations are based on each aircraft type pair
Adjust arrival WT separations according to WDS rules	Wake Turbulence separations are not reduced due to weather conditions.	Wake Turbulence separations are reduced/removed due to weather conditions.
Decide and agree to the application of WDS	WDS is never applied	Supervisor will monitor the weather conditions, decide whether to apply WDS and coordinate the activation.
Send landing data	Landing data (landing runway and landing conditions) are sent by Ground System to the Flight Crew on its request	No Change

Table 22: Differences between new and previous Operating Method

Table 23 is the table of differences exported from EATMA.

OI Step code – title (OI Step CR)		
AO-0306 - Wake Turbulence Separations (for Arrivals) based on Static Aircraft Characteristics (CR 03430 Update AO-0306 (PJ.02-01-04))		
Activity	**Impact**	**Change**
Assess operational situation and conditions at the airport	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Assess operational situation and conditions at the approach	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Assess Separation/Spacing Infringement	Update	The ATCO has a target indicator and supporting alerts on the CWP to assess the infringement of the ITD/FTD.
Coordinate with Approach Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Coordinate with Tower Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Identify Aircraft	Update	The ATCO matches the new incoming aircraft with its corresponding ITD on the CWP.
Monitor Aircraft Spacing	Update	The ATCO has a target indicator and supporting alerts on the CWP to monitor the potential infringement of the ITD/FTD.
Provide Aircraft Spacing	Update	The ATCO has a target indicator (ITD/FTD) and supporting alerts on the CWP when he gives instructions to follower aircraft for providing safe spacing and separation from the leader aircraft
Sequence, Merge, Space Aircraft	Update	The ATCO uses the ITD displayed on the CWP to sequence, merge and space the aircraft behind it
Switch to new mode of operations in Approach Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
Switch to new mode of operations in Tower Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
AO-0310 - Weather-Dependent Reductions of Wake Turbulence Separations for Final Approach (CR 03431 Update AO-0310 (PJ.02-01-04))		
Activity	**Impact**	**Change**
Assess operational situation and conditions at the airport	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)

Assess operational situation and conditions at the approach	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Assess Separation/Spacing Infringement	Update	The ATCO has a target indicator and supporting alerts on the CWP to assess the infringement of the ITD/FTD.
Coordinate with Approach Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Coordinate with Tower Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Identify Aircraft	Update	The ATCO matches the new incoming aircraft with its corresponding ITD on the CWP.
Monitor Aircraft Spacing	Update	The ATCO has a target indicator and supporting alerts on the CWP to monitor the potential infringement of the ITD/FTD.
Provide Aircraft Spacing	Update	The ATCO has a target indicator (ITD/FTD) and supporting alerts on the CWP when he gives instructions to follower aircraft for providing safe spacing and separation from the leader aircraft
Sequence, Merge, Space Aircraft	Update	The ATCO uses the ITD displayed on the CWP to sequence, merge and space the aircraft behind it
Switch to new mode of operations in Approach Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
Switch to new mode of operations in Tower Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
AO-0328 - Optimised Runway Delivery on Final Approach CR 03432 Update AO-0328 (PJ.02-01-04))		
Activity	**Impact**	**Change**
Assess departures vs GAP spacing	Update	The ATCO has a target indicator on the CWP and spacing information in the sequence list to assess whether the spacing between the next two arrival aircraft is sufficient or not for the planned departure(s).
Assess GAP spacing vs planned departing a/c	Update	The ATCO has a target indicator on the CWP and spacing information in the sequence list to assess whether the spacing between the next two arrival aircraft is sufficient or not for the planned departure(s).
Assess operational situation and conditions at the airport	Update	In addition to current method the assessment includes aspects related to separation delivery tool (gap spacing scenarios, system availability, ..)

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Assess operational situation and conditions at the approach	Update	In addition to current method the assessment includes aspects related to separation delivery tool (gap spacing scenarios, system availability, ..)
Assess Separation/Spacing Infringement	Update	The ATCO has a target indicator and supporting alerts on the CWP to assess the infringement of the ITD/FTD.
Cancel the GAP during Final Approach Control	Introduce	The ATCO cancel the requested GAP spacing in the separation delivery tool. A new computation of ITD/FTD is triggered and displayed on ATCO's CWP.
Coordinate with Approach Supervisor	Update	In addition to current method the coordination includes aspects related to separation delivery tool (gap spacing scenarios, system availability, ..)
Coordinate with Tower Supervisor	Update	In addition to current method the coordination includes aspects related to separation delivery tool (gap spacing scenarios, system availability, ..)
Identify Aircraft	Update	The ATCO matches the new incoming aircraft with its corresponding ITD on the CWP.
Insert GAP spacing	Update	The ATCO inserts the requested GAP spacing in the separation delivery tool. A new computation of ITD/FTD is triggered and displayed on ATCO's CWP
Modify the GAP during Final Approach Control	Update	The ATCO modifies the requested GAP spacing in the separation delivery tool. A new computation of ITD/FTD is triggered and displayed on ATCO's CWP.
Monitor Aircraft Spacing	Update	The ATCO has a target indicator and supporting alerts on the CWP to monitor the potential infringement of the ITD/FTD.
Provide Aircraft Spacing	Update	The ATCO has a target indicator (ITD/FTD) and supporting alerts on the CWP when he gives instructions to follower aircraft for providing safe spacing and separation from the leader aircraft
Sequence, Merge, Space Aircraft	Update	The ATCO uses the ITD displayed on the CWP to sequence, merge and space the aircraft behind it
Switch to new mode of operations in Approach Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
Switch to new mode of operations in Tower Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.

Table 23: Difference between new and previous Operating Method for Arrivals Concepts Solutions exported by EATMA

4 Safety, Performance and Interoperability Requirements (SPR-INTEROP)

This section provides the Safety, Performance and Interoperability Requirements applicable to arrival Concepts Solutions.

To facilitate the traceability between requirements and relevant concept the provided identifiers have the following structure:

- REQ-02.01-SPRINTEROP-XXXZ.YYYY where:
  - ARR for Arrivals Concepts Solutions
  - Z is:
    - 1 for Static Pair Wise Separation
    - 2 for Weather Dependent Separation
    - 3 for the OSD
    - 0 for wake monitoring concept, for wake decay concept, for arrival and departure concepts when it applies to more than 1 concept
  - YYYY is:
    - A progressive number.

4.1 Functional Requirements

The latest consolidated list of requirements for the Arrivals Concepts Solutions has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0010
Title	TBS concept
Requirement	The TBS concept shall apply time based wake turbulence separation rules on final approach.
Status	<validated>
Rationale	The time separation rules are defined as the time to fly the applicable DBS wake turbulence separation in reference wind conditions (i.e. low wind). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>

[REQ Trace]

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Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR1.0020
Title	S-PWS concept
Requirement	The S-PWS concept shall apply wake turbulence separation rules defined between aircraft type pairs or between S-PWS wake categories on final approach.
Status	<validated>
Rationale	The S-PWS rules are defined as the applicable DBS wake turbulence separation according to the RECAT PWS safety case submitted to EASA. This requirement has been validated in RTS2, RTS3a, RTS4a, RTS4b.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0030
Title	WDS concept
Requirement	The WDS concept shall apply weather dependent wake turbulence separation rules on final approach.
Status	<validated>
Rationale	The WDS separation rules are defined as function of the actual crosswind and its effect on the wake transportation, of the actual total wind and its effect on the wake decay and of the speed profiles of leader and follower aircraft. For example: In TB-modes where WDS is applied (WDS-Xw and WDS-Tw) the separation delivery tool shall be provided with time separation tables (for each cross-wind and respectively total wind value and each aircraft pair category) derived from: - the time required for a sufficient vortex decay - the time required for the vortex to be transported away from the path of the follower aircraft - the reference speed profile for the leader and follower aircraft This requirement has been validated in RTS1.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0040
Title	ORD concept
Requirement	The ORD concept shall support Controllers in delivering separation / spacing at the delivery point by considering the effects of compression caused by the leader and follower being at different stages of final approach speed management which results in different leader and follower speeds.
Status	<validated>
Rationale	ORD is needed to facilitate ATCOs in their work, to reduce the workload and improve the accuracy of separation/spacing delivery. ORD aim to simplify the complexity of Final Approach ATCOs as there is no need to calculate the compression between aircraft pair (historically identified as an ATCO need). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0050
Title	Separation Delivery Tool
Requirement	The Intermediate Approach, Final Approach and Tower Controllers shall be provided with a Separation Delivery Tool displaying Target Distance Indicators (TDI) to enable consistent and accurate application of TBS, PWS-A, DBS and/or WDS-A wake turbulence separation rules on final approach and landing.
Status	<validated>
Rationale	This is applicable for any wake turbulence separation rules that cannot feasibly be applied without tool support because the Controllers are unable to remember or calculate the required separation. This is a characteristic of a range of wake turbulence separation schemes including TBS, S-PWS and WDS. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0060
Title	TBS wake separation rules
Requirement	In TBS mode, the separation delivery tool shall be provided with time separation rules.
Status	<validated>
Rationale	Required as input into the FTD calculation. The time separation rules are defined as the time to fly the applicable DBS wake turbulence separation in reference wind conditions (i.e. low wind). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR1.0070
Title	S-PWS wake separation rules
Requirement	S-PWS wake separation rules shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	Required as input as these values will be the FTD if the S-PWS concept is being applied. This requirement has been validated in RTS2, RTS3a, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0080
Title	DBS wake separation rules
Requirement	In DB- modes the separation delivery tool shall be provided with a range of wake turbulence distance-based separation rules based on ICAO Aircraft Type (e.g. ICAO, RECAT-EU, RECAT-EU-PWS) depending upon the airport needs.
Status	<validated>
Rationale	Required input for the separation delivery tool. Could be used when is required a transition from a TBS to a DBS mode. This requirement has been validated in RTS1.
Category	<Safety>

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[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0100
Title	Separation Delivery Tool Modes
Requirement	The tool shall operate under Distance Based modes (DB- modes: DBS, S-PWS) and Time Based modes (TB- modes: TB S-PWS, TB-WDS-Tw, TB-WDS-Xw, TB-WD-PWS-TW, TB-WD-PWS-XW), with the possibility to switch between DB- modes and corresponding TB- modes.
Status	<validated>
Rationale	There is a need to change wake separation rules if applying a conditional version of the concept (e.g. WDS) or if there is insufficient information for the normal mode of operation (such as reversion to DBS if the GWCS fails). This requirement has been validated in RTS1.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0110
Title	FTD indicator
Requirement	The Separation Delivery tool shall provide to ATCOs a visualisation (FTD indicator) of the required minimum separation or spacing on final approach that needs to be delivered after considering all in-trail and if applicable not-in-trail constraints.
Status	<validated>
Rationale	The Controller will not know the required separation or spacing using either TBS, S-PWS or WDS in all different runway operation modes. Hence needs a visualisation of the required separation or spacing on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0120
Title	ITD indicator
Requirement	If the ORD concept is considered, the Separation Delivery tool shall provide to ATCOs a visualisation (ITD indicator) of the required spacing on final approach to be delivered at the deceleration fix in order to deliver the required minimum separation / spacing at the delivery point.
Status	<validated>
Rationale	The Controller will not know the predicted compression after the DF hence needs a visualisation of the required spacing to deliver at the DF on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0130
Title	FTD computation
Requirement	In TB mode, the FTD computed by the tool to indicate the wake separation applicable at the delivery point shall take into consideration: • The time separation from the wake turbulence separation table (for WDS the separation tables might be more than one depending on the total/cross wind values); • The aircraft pair (from the arrival sequence list); • The glideslope headwind profile; • The follower time-to-fly profile obtained either from modelled time-to-fly profile in the considered headwind conditions • The time separation buffer considering uncertainties of final approach speed profiles of the a/c pair and of the glide slope wind prediction
Status	<validated>
Rationale	Time separations or spacing need to be converted into equivalent distances so they can be displayed on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0131
Title	FTD computation II
Requirement	For the time based separation modes (TB-modes i.e. TBS, TB-PWS-A, TB-WDS-A or A-TB-WD-PWS), for which FTD (Final Target Distance standing for the separation indication) is computed based on a time separation, the risk of under-separation induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated.
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide accurate/safe FTD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0132
Title	FTD computation II
Requirement	For the Time based separation modes, the risk of under-separation induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated by one or a combination of the following means: • Adding a time separation buffer in the design of the FTD indicators displayed to Controllers. These buffers may vary depending on the considered applicable separation minima and wind conditions • The conditional application of any TB- mode (e.g. WDS shall be locally pre-determined and used as a wind-based criterion for the activation of that mode • For the TB- mode, taking a buffer in the design of TBS minima (e.g. higher headwind conditions when selecting reference baseline minima) • The selection of most appropriate mean(s) shall be based on the local operational conditions, local wind behaviour, wind profile and aircraft speed profile prediction system accuracy
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide safe FTD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0139

Title	TDI display
Requirement	TDIs shall be displayed on the extended runway centreline behind each lead aircraft established on final approach and shall be linked to the actual lead aircraft position along the runway axis.
Status	<validated>
Rationale	For being used by the ATCOs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0133
Title	TDI display II
Requirement	TDI position shall provide the accurate information about the required separation/spacing for each aircraft pair.
Status	<validated>
Rationale	For being used by the ATCOs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Assess Separation/Spacing Infringement Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0140
Title	FTD computation III
Requirement	Before the Leader reaches the separation delivery point, the FTD shall be “static” (i.e. the separation distance between the Leader position and the displayed FTD shall be static, the FTD shall hence move at the Leader speed). It shall be computed accounting for the expected time-to-fly of the Follower aircraft until the separation delivery point. After the Leader passes the separation delivery point and until the Follower reaches the separation delivery point, the FTD shall be disconnected from the Leader (e.g. move at the expected Follower speed to reach zero when the Follower is expected to reach the delivery point).
Status	<validated>
Rationale	To provide an FTD that is reliable and does not provide wrong separation or spacing information to the Tower Controller (e.g. infringement of FTD when the leader aircraft already landed). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0143
Title	Relation FTD/ITD with speed profile
Requirement	For all modes (where FTD and/or ITD are based on a pre-defined aircraft speed profile of the follower), the APP and TWR Controllers shall be made aware with respect to the impact on the TDIs correctness when actual aircraft speed profile is different from the pre-defined TAS profile used by the separation delivery tool.
Status	<validated>
Rationale	Speed profile is one of the main inputs of the tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0141
Title	FTD computation IV
Requirement	In WDS modes (total wind/cross wind) the Separation Delivery tool shall use the relevant separation table for the FTD computation based on the measured total/cross wind.
Status	<validated>
Rationale	The separation Delivery tool might have more than one WDS separation table (corresponding to e.g. 8kts, 10kts, 13kts, etc.). The separation table used for calculating the TDIs will depend on the measured total/cross wind at that moment. This requirement has been validated in RTS1.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0142
Title	Conservative wind for FTD computation
Requirement	If the required inputs to calculate a time based separation are temporarily not available (duration to be determined based on local wind forecast accuracy) a conservative wind input may instead be used to calculate the FTD.
Status	<validated>
Rationale	This may be possible if the Runway Surface Wind Service is used in conjunction with the Glideslope Wind Conditions Service. For example, if the Runway Surface Wind Service fails it may be possible to use a conservative runway surface wind value to allow time based FTDs to still be calculated. See Safety requirement SR1.301 as an example in the SAR. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0144
Title	Total wind monitoring function
Requirement	In WDS total wind modes (A-TB-WDS-Tw), the Approach and Tower Controllers and Supervisors shall be alerted by the total wind monitoring function about a significant difference between actual reference total wind and the reference total wind used for the TB computation, i.e. when the predicted allowed time separation (based on the total wind prediction used for Target Distance Indicator computation) compared to the actual allowed time separation (based on the actual total wind measurement) exceeds a threshold to be determined locally.
Status	<in progress>
Rationale	Wind has an impact on TDI displayed. The requirement was proposed in workshops in previous SAF work, but the final need of this requirement is still to be assessed in the local deployment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Assess operational situation and conditions at the approach Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0145
Title	Cross wind monitoring function
Requirement	In WDS cross wind modes (A-TB-WDS-Xw), the Approach and Tower Controllers and Supervisors shall be alerted by the cross wind monitoring function about a significant difference between actual reference cross wind and the reference cross wind used for the TB computation, i.e. when the predicted allowed time separation (based on the cross wind prediction used for Target Distance Indicator computation) compared to the actual allowed time- separation (based on the actual cross wind measurement) exceeds a threshold to be determined locally.
Status	<in progress>
Rationale	Wind has an impact on TDI displayed. The requirement was proposed in workshops in previous SAF work, but the final need of this requirement is still to be assessed in the local deployment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0146
Title	Headwind monitoring function

Requirement	In TBS and TB-PWS-A modes, in case there is a significant difference between actual glideslope headwind profile and the glideslope headwind profile used for the TDI computation, the Separation Delivery Tool shall re-compute the TDIs based on the correct headwind value and inform the ATCO about the re-computation.
Status	<in progress>
Rationale	Wind has an impact on TDI displayed. The requirement was proposed in workshops in previous SAF work, but the final need of this requirement is still to be assessed in the local deployment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0150
Title	ITD computation I
Requirement	The ITD computed by the tool for all separation and spacing constraints (wake separation in DB and TB modes, MRS, ROT and other spacing constraints) shall take in consideration: • The FTD for the considered aircraft pair • The glideslope headwind profile • The leader and follower time-to-fly profiles obtained either from modelled time-to-fly profile in the considered headwind conditions • The time separation buffer considering uncertainties of final approach speed profiles of the a/c pair and of the glide slope wind prediction
Status	<validated>

Rationale	The ITD needs to be calculated depending on the difference in groundspeed of the leader and follower aircraft types from the time the leader passes the DF until the leader reaches the delivery point. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0151
Title	ITD computation II
Requirement	For all separation modes, for which an ITD (Initial Target Distance standing for the compression indication) is used, the risk of under-separation after Deceleration Fix induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated.
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide safe ITD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0152
Title	ITD computation II
Requirement	For all separation modes, for which an ITD is used, the risk of under-separation after Deceleration Fix induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated by adding a time separation buffer in the design of the ITD indicators displayed to Controllers. These buffers may vary depending on the considered applicable separation minima and wind conditions.
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide safe ITD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0160
Title	ITD computation III
Requirement	Before the Leader reaches its Deceleration Fix (DF), the ITD shall be “static” (i.e. the separation distance between the Leader position and the displayed ITD shall be static, the ITD shall hence move at the leader speed). It shall be computed accounting for the compression/ pull-away effect for the aircraft pair expected from the leader DF until the separation delivery point. After the Leader passes the DF, the ITD shall move towards the FTD, accurately account for compression/pull-away effect for the aircraft pair expected from the actual leader position until the separation delivery point.
Status	<validated>
Rationale	The ITD shall be able to take in account the difference in compression after the leader passes the DF (e.g. difference in wind conditions). To not provide wrong spacing information to the Approach Controller (e.g. infringement of ITD by the follower aircraft when the leader aircraft already passed the DF). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0161
Title	Spacing constraint computation
Requirement	The spacing constraint computation shall take into consideration the same inputs as for the ITD and FTD plus: • The time separation value representing the spacing constraint (ROT, GAP, scenario specific spacing, etc.)
Status	<validated>
Rationale	Spacing constraints might represent bigger distances between aircraft than the separation spacing. To be computed they follow the same logic of the other constraints plus an addition time value that represents the extra spacing requested. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0162
Title	TDI greatest constraint
Requirement	The tool in any mode shall display TDIs representing the greatest constraint out of all applicable in-trail or not in-trail separation constraints. The constraints can be the high priority separation (e.g. Wake and MRS) and the low priority runway spacing (ROT) and other spacing constraints (e.g. departure GAP, runway inspections, etc.).
Status	<validated>
Rationale	The ATCOs need to comply with the biggest separation/spacing displayed by the separation delivery tool. With the display of the TDIs, the indication of the safety contract is considered mandatory, as ATCOs will exclusively rely on the TDIs, because they will no longer calculate the required separation, expecting the chevrons to correctly displayed the most constraining separation/spacing minima. The distance between the lead aircraft and the FTD associated to the preceding aircraft shall not be less than the applicable Minimum Radar Separation value (e.g. with TB-WDS the wake separation minima could go below 2.5nm, nonetheless the highest constraint applicable in this case would be the applicable MRS value). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0163
Title	ITD value not smaller than FTD
Requirement	If the ITD calculation is smaller than the FTD (e.g. pull away scenario) then it shall be changed to the same value as the FTD.
Status	<validated>
Rationale	There could be cases where very small follower aircraft have performances that lead to deceleration and stabilisation slower than leader aircraft. In these rare cases the ITD value cannot be smaller than FTD to avoid under-separation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0164
Title	FTD main TDI for Tower Controller
Requirement	The FTD indicator shall be the main TDI to be used by the Tower Controller.
Status	<validated>
Rationale	The Tower Controller is monitoring the delivered separation or spacing. This is represented by the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0165
Title	FTD main TDI for Tower Controller II
Requirement	The Tower Controller shall monitor and ensure that there is no infringement of the FTD.
Status	<validated>
Rationale	The Tower Controller is monitoring the delivered separation or spacing. This is represented by the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0166
Title	FTD infringement
Requirement	Clear guidelines with regard to the list of possible actions to be made in the case of an FTD infringement (in the APP and in the TWR) shall be described per position for the local implementation.
Status	<validated>
Rationale	Local implementation needs to define local procedures in case of FTD infringement. Based on the simulations, ATCOs were asked to give speed instructions prior to the deceleration fix - if they thought based on their knowledge and experience that this action will maintain the a/c behind the FTD. On the other hand if the ATCO thought that the FTD will be infringed based on the status of the FTD and the position of a/c in relation to FTD, as well as the speed of a/c (if a/c not flying as planned) then they were required to instruct a go-around. After the deceleration fix, the ATCOs were required to instruct a go-around. Similar guidelines shall be made available to the ATCOs covering various examples in nominal, abnormal ad degraded conditions. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0167
Title	ITD main TDI for APP Controller
Requirement	If both the FTD and ITD are available, the ITD indication ("compressions indicator") shall be the main indicator to be used by the final approach controller.
Status	<validated>
Rationale	The ITD represents the spacing to be delivered at the DF. The detail of the procedure to establish on the localiser and catch-up the ITD will depend on the local implementation of the ITD. APP ATCOs found working with ITD alone (with the FTD automatically appearing if and when the ITD was infringed), just as easy /usable as working with both the ITD and FTD displayed all the times but overall ATCOs preferred working with the ITD alone as there was less clutter on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0168
Title	Toggle on and off
Requirement	If the functionality to toggle on and off the ITDs/ FTDs is available there shall be an indication on the HMI that shows whether it has been toggled on or off on purpose by the Controller or Supervisor or if it is a system error.
Status	<validated>
Rationale	This option is required to ensure ATCOs have an appropriate level of situation awareness and this in turn would reduce the potential for human error, making it easier to identify potential system errors. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0169
Title	Buffers
Requirement	Training shall ensure Controllers understand the rationale behind the buffers inserted in the Separation Delivery Tool parameters, in order to avoid the risk of under separations.
Status	<validated>
Rationale	Knowing that the tool parameters contain a safety buffer (locally defined) some Controllers might be prone to "interpreting" the under separations (e.g. not give a go-around if slightly infringing the separations). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0170
Title	Respect of ITD spacing
Requirement	If the ORD concept is implemented, the Approach controller shall vector the follower aircraft so that it stays on or behind the corresponding ITD.
Status	<validated>
Rationale	ATCOs to manage the proper compression and avoid under-spacing shall space aircraft on or behind the ITD in all the situations: - For the turn on decision for merging on to final approach, - For vectoring the follower aircraft to intercept the final approach - For further spacing management during interception The ITD accounts for the separation compression on final approach due to the landing stabilisation speed characteristics of both the leader and follower aircraft and the glideslope headwind conditions. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0180
Title	Surveillance data inputs

Requirement	The Surveillance system shall provide the Separation Delivery Tool with aircraft position, speed and altitude for all arrival aircraft.
Status	<validated>
Rationale	Position and altitude data is required by the Separation Delivery tool to be able to correctly calculate and display TDIs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0190
Title	Surveillance data inputs II
Requirement	There shall be surveillance coverage down to the separation delivery point to allow the separation tool to display Target Distance Indicators on the runway extended centreline including the last part of the final approach.
Status	<validated>
Rationale	Position and altitude data is required by the Separation Delivery tool to be able to correctly calculate and display TDIs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Monitor Aircraft Spacing Provide Aircraft Spacing Provide landing clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0200
Title	Minimum runway spacing rule inputs
Requirement	All applicable runway configuration spacing rules shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The runway configuration spacing rules (both in-trail and if applicable not-in-trail) are needed in the TDI calculation to find the largest constraint. E.g. CSPR or dependant parallel runways. This requirement has been validated in RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0220
Title	Flight data inputs
Requirement	Aircraft identifier, ICAO aircraft type and wake category for all arrival aircraft, including subsequent updates to this information, shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	ICAO aircraft type and wake category are an important input into the Separation Delivery tool as they determine the required wake separation and spacing (e.g. ROT) between aircraft pairs. The aircraft identifier is needed to correlate flight data from different sources. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0230
Title	MRS constraint input
Requirement	All applicable Minimum Radar Separation (MRS) rules shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The MRS constraints (both in-trail and if applicable not-in-trail) must be respected by the Separation Delivery tool when calculating the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0240
Title	Other spacing rule inputs
Requirement	All applicable runway-related spacing rules other than those related to runway configuration shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	All applicable spacing rules (both in-trail and if applicable not-in-trail) to be considered by the Separation Delivery tool are needed in the TDI calculation to find the largest constraint. E.g. runway inspection, temporary closure of runway, dependent parallel runway operations or closely spaced parallel runway operations. If in a local implementation the tool is required to consider separation or spacing constraints dependant on the runway visibility conditions, and runway conditions, then the runway visibility conditions, and runway conditions, shall be provided to the Separation Delivery tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0250
Title	Scenario specific spacing inputs
Requirement	Scenario specific spacing gaps between aircraft pairs shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The separation delivery tool shall take in account scenarios that require extra spacing such as departure gaps or runway inspection in order to find the largest constraint applicable to aircraft pair. Scenarios can be applicable for a determined period of time/number of aircraft or created ad-hoc for single aircraft pair. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Insert GAP spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0251
Title	Capability to manage gap spacing between consecutive arrivals
Requirement	The separation delivery tool shall provide ATCOs the possibility to manage gap spacing between consecutive arrival flights.
Status	<validated>
Rationale	Gap spacing (e.g. a distinguishable TDI corresponding to gaps only) could be used to insert one or more departures between arrivals, for runway inspection, for aircraft with special separation to be applied and other situations where a specific spacing is required. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Coordinate the GAP Spacing modification with Final Approach Controller Request GAP insertion Assess departures vs GAP spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0253
Title	Feedback on gap spacing insertion
Requirement	The separation delivery tool shall provide confirmation to the ATCO that the gap spacing insertion is successful or not.
Status	<validated>
Rationale	If the gap spacing insertion is successful, the Controller shall see that the gap value was accepted in the tool and the corresponding TDI is updated. If the gap spacing insertion is not successful, the Controller shall receive a negative feedback (e.g. an alert on the CWP) from the tool. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Coordinate the GAP Spacing modification with Final Approach Controller Request GAP insertion

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0254
Title	Capability to insert automatic gap spacing
Requirement	The ATCOs shall be able to insert automatic gap spacing based on pre-defined scenarios in the sequence manager.
Status	<validated>
Rationale	Predefined scenarios of gap requests set forehand by the Supervisor/Approach controllers and are valid for the next X arrivals and/or Y minutes, depending on the mode of runway operation (mixed mode), the procedure and arrival management system information provided. This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Request GAP insertion

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0255
Title	Gap spacing update and cancelling
Requirement	The tool shall provide ATCOs the ability to update and cancel any gap spacing previously inserted.
Status	<validated>
Rationale	For ATCOs to be able to cover potential errors as well as cover coordination between Tower and Final approach ATCO leading to gap update or cancellation. This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Coordinate the GAP Spacing modification with Final Approach Controller Cancel the GAP during Final Approach Control Modify the GAP during Final Approach Control Request new GAP spacing and/or position to Final Approach Controller Request cancel GAP to Final Approach Controller

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0257
Title	TDI representation
Requirement	The separation delivery tool shall be able to represent each spacing constraint information (e.g. MRS/ROT/WAKE/Additional GAP) with a TDI shape.
Status	<validated>
Rationale	For the ATCO to be able to easily identify what is the highest constraint influencing the spacing, and thus maintain ATCOs situation awareness. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess departures vs GAP spacing Provide Aircraft Spacing Monitor Aircraft Spacing

		Sequence, Merge and Space Aircraft Assess GAP spacing vs planned departing a/c

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0270
Title	ROT spacing constraint
Requirement	The tool shall allow the runway occupancy time (ROT) constraints to be configurable for each aircraft based on multiple parameters.
Status	<validated>
Rationale	More efficient wake separations mean the ROT is a more common constraint. ROT spacing depends on many variables including (but not exhaustive) aircraft type, runway exit and airline operator. A suitable ROT spacing model needs to be defined to ensure the spacing constraint is reliable and efficient. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0280
Title	Glideslope wind conditions input
Requirement	The Separation Delivery tool shall be provided with the predicted headwind profile on the glideslope (ideally from ground to the published localiser interception altitude) to compute the ITD in all modes and the FTD in TB-modes. The used profiles shall ensure smooth temporal evolution of the ITD on the final approach.
Status	<validated>
Rationale	The glideslope wind conditions is required to convert time based separation in equivalented distance based separation This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0290
Title	Runway surface wind conditions
Requirement	If in a local implementation the tool is required to consider the actual runway surface wind conditions, then the runway surface wind conditions shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The actual runway surface wind conditions may be required as input into the ITD calculation. Also, if applying a conditional version of a concept (e.g. WDS) then the actual runway surface wind needs to be monitored to ensure the Separation Delivery tool is being used in the correct mode of operation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0300
Title	Approach arrival sequence service
Requirement	The approach arrival sequence information shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	Approach arrival sequence information is required by the Separation Delivery tool to allow aircraft pairs (both in-trail and not-in-trail) to be utilised in calculating the FTD and ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0310
Title	Speed or time-to-fly model for the FTD
Requirement	An expected aircraft speed or time-to-fly profile model on the final approach glideslope shall be provided to the Separation Delivery tool for the FTD calculation.
Status	<validated>
Rationale	An expected aircraft speed or time-to-fly profile is needed to convert distance based separation into equivalent time separation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR1.0320
Title	Speed or time-to-fly model for ITD
Requirement	An expected aircraft speed or time-to-fly profile model on the final approach glideslope shall be provided to the Separation Delivery tool for the ITD calculation.
Status	<validated>
Rationale	An expected aircraft speed or time-to-fly profile is needed for the ITD calculation to convert between time and distance. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0321
Title	Aircraft Time-to-fly profiles inputs
Requirement	Aircraft time-to-fly profiles used in the FTD and ITD calculations shall be based on a time-to-fly model representative of nominal aircraft speed behaviour on final approach, in the local environment.
Status	<validated>
Rationale	The separation delivery tool requires these model inputs for calculating the requested separations or spacing in the form of a TDI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0370
Title	Management of data inputs
Requirement	Local implementation shall ensure that roles and responsibilities are clearly defined regarding the management of data inputs into the Separation Delivery tool including runway policy, runway spacing constraints, visibility conditions and runway conditions.
Status	<in progress>
Rationale	The Separation Delivery tool relies on these data inputs for the calculation of separation and spacing hence it is important that clear roles and responsibilities are defined to ensure this information is maintained in a timely manner. Requirement in progress has it is to be locally defined.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0380
Title	Quality assurance of speed / time-to-fly and wake turbulence configuration data
Requirement	A quality assurance process shall be put in place to validate the time separation table configuration file (in TB- modes) or the distance separation table configuration file of the separation delivery tool.
Status	<validated>
Rationale	The wake turbulence configuration data are critical inputs into the TDI calculation hence the importance to ensure their reliability. This is to be done at implementation of the applicable concept and after changes are made. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0390
Title	Quality assurance of speed / time-to-fly and wake turbulence configuration data II
Requirement	Separation delivery tool verification shall be carried-out after modification of the time separation table configuration file (in TB- modes) or the distance separation table configuration file before the system returns in operational service.
Status	<validated>

Rationale	The wake turbulence configuration data are critical inputs into the TDI calculation hence the importance to ensure their reliability. This is to be done at implementation of the applicable concept and after changes are made (for example for accommodating a new aircraft type or updating the database with a fine tuning of the aircraft model used). This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0400
Title	Input data integrity
Requirement	It shall be demonstrated that the data inputs including flight data, approach arrival sequence information and glideslope wind conditions to the Separation Delivery are sufficiently robust.
Status	<in progress>
Rationale	The flight data, approach arrival sequence information and glideslope wind conditions impact the separation / spacing that is calculated by the Separation Delivery tool. Still in progress as this demonstration remains to be done at local level.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0410
Title	Software assurance level
Requirement	The software assurance level of the Separation Delivery tool and supporting tools shall be determined by the V4 Safety assessment.
Status	<in progress>
Rationale	The software assurance level (outside SESAR 2020 wave 1 scope) will depend on the ability of the Controllers to make checks of the TDIs. If Controllers are unable to make checks due to too many variables used in the calculation, then greater reliance is placed on the software. In the latter situation, the fact that ATCOs will manage to actively and correctly check the TDIs is considered a rather poor mitigation and shall not be one of their responsibility. They shall follow the tool in which they should confidently rely on, the reliance ultimately is placed on the software. Still in progress as the software assurance remains to be done in the V4 safety assessment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0420
Title	Separation delivery tool verification after modification of the time-to-fly/airspeed profile configuration file
Requirement	Separation delivery tool verification shall be carried-out after modification of the time-to-fly/airspeed profile configuration file (new A/C types or modification of existing A/C speed profiles) before the System returns in Operational service.
Status	<validated>
Rationale	The speed / time-to-fly profile and wake turbulence configuration data are critical inputs into the TDI calculation hence the importance to ensure their reliability. This is to be done at implementation of the applicable concept and after changes are made. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0430
Title	Flight data inputs error
Requirement	When a flight data input error (e.g. missing or wrong ICAO aircraft type or wake category) is detected, it shall be possible to update the corresponding information into the input for the separation delivery tool.
Status	<validated>
Rationale	ICAO aircraft type and wake category are major safety-related data input to the tool as they determine the required wake separation and spacing (e.g. ROT) between aircraft pairs. The aircraft identifier is needed to correlate flight data from different sources (e.g. CAT62 field). This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Identify Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0440
Title	Change of runway configuration
Requirement	In case of a change of runway configuration, the Approach and/or Tower supervisors shall be able to input to the separation tool the new arrival runway to be considered for Target Distance Indicators computation.
Status	<validated>
Rationale	The runway intent is one of the requested inputs for the TDI computation. A change in the runway intent results in the separation / spacing of each affected TDI being updated. This requirement has been validated in HP-SAF workshop.

Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0441
Title	Change of runway configuration II
Requirement	In case of a change of runway configuration, the Approach and/or Tower supervisors shall coordinate prior to inserting the new arrival runway into the tool.
Status	<validated>
Rationale	It has been concluded that the prior coordination will ensure an appropriate level of situation awareness is shared between the APP and TWR supervisors and ATCOs respectively. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0450
Title	Insufficient information to calculate a TDI
Requirement	If there is insufficient information to calculate a TDI then that TDI shall not be provided, together with a visual warning.
Status	<validated>
Rationale	If the Separation Delivery tool is unable to provide a TDI then the Controller needs a clear indication, so they know to use the procedure for no TDI available which is to apply a DBS separation ahead and behind the affected aircraft. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0460
Title	Insufficient information to calculate time based FTD
Requirement	If the required input to calculate a time based wake separation is not available and a conservative wind input is not used, then the distance based wake separation minima may instead be used to calculate the FTD provided that the change in computation is clearly displayed to the ATCO.
Status	<validated>
Rationale	Even without sufficient information to convert between time and distance the FTD can still be displayed using a DBS separation. the change in computation must be clearly displayed or communicated to the ATCO. An example could be Safety requirement SR1.301 in the Safety Assessment Report. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0470
Title	Turn on support
Requirement	The Separation Delivery tool and associated procedures shall support the Controller decision to turn onto final approach.
Status	<validated>
Rationale	When aircraft are approaching from downwind or baseleg, Controllers need information about the expected spacing to be applied on final approach path in order to support the decision to turn onto the final approach path. This can be achieved either through early display of TDIs (e.g. extended centreline or baseleg) or by another support tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0480
Title	Timely display of TDI
Requirement	The TDIs shall be displayed to the Intermediate and Final Approach Controllers sufficiently early in order to allow correct interception.
Status	<validated>
Rationale	The Final Approach Controller requires a stable TDI to be available for preparing the interception as the aircraft are merging towards the final approach. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.

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Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0490
Title	TDI position
Requirement	The follower TDI shall be linked to the actual aircraft position of the leader: - If the leader is aligned with the runway axis, then the follower TDIs are to be displayed behind the actual leader position; - If the leader is not yet aligned with the runway axis and the perpendicular projected position on the runway extended centreline is behind its own ITD then the follower TDIs are to be displayed behind the perpendicular projected position on the runway extended centreline; - If the leader is not yet aligned with the runway axis and the perpendicular projected position on the runway extended centreline is ahead its own ITD, then the follower TDIs are to be displayed behind the position of ITD ahead. In case several aircraft have not yet intercepted the glide, this leads to a train of ITDs, each one being attached to the previous one and all moving at the speed of the last aircraft on the extended runway centreline.
Status	<validated>
Rationale	TDI needs to be properly displayed on the extended runway centreline of the CWP and their position shall provide the good information about the required separation/spacing for each aircraft pair. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Provide landing clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0500
Title	ITD interception
Requirement	Once the follower aircraft has been positioned w.r.t ITD and before the leader reaches its deceleration point, the Controller shall apply speed instructions in accordance to the reference glide slope air speed used for ITD calculation.
Status	<validated>
Rationale	In order to keep consistent with the model assumptions used to compute in the separation delivery tool the ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0510
Title	Availability of wake category and aircraft type information
Requirement	Wake category and aircraft type information shall be always available in the aircraft labels so that this information remains visible for Controllers.
Status	<validated>
Rationale	This information will be required to support Controllers in delivering distance based separations without Target Distance Indicators if the Separation Delivery tool fails. With the separation delivery tool the ATCOs report that they do not need to know the a/c type and WV category when working under nominal conditions, however, in case of a degraded mode the controllers may need this information, e.g. they might need information with regard to the aircraft behaviour and this information must be easily retrievable thus it is required that the a/c type is displayed in the a/c label. The WTC might not be required for RECAT-PWS. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0520
Title	Separation Delivery tool failure alert
Requirement	Approach and Tower Supervisors shall be made aware if any tool / monitoring / alerting features are lost or inoperative.
Status	<validated>
Rationale	The Controllers and Supervisors need to remain aware of failures in the Separation Delivery tool or any supporting tools to ensure a controlled transition to a degraded mode if required. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0530
Title	Consistent operating mode across Controller Working Positions
Requirement	The System architecture shall ensure all applicable Controller Working Positions (e.g. per runway) operate in the same mode(s).
Status	<validated>
Rationale	To ensure that all Controllers are delivering the same separation or spacing. Note that two modes (e.g. WDS and RECAT-EU) could be applicable at the same runway in the case of transition. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.

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Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0920
Title	Approach arrival sequence display I
Requirement	The runway final approach sequence order shall be displayed on the HMI so that it is visible to the Approach, Tower and Supervisor positions.
Status	<validated>
Rationale	The sequence order is an input for the separation delivery tool. ATCOs might need to make sure that the sequence order is consistent in order to have correct TDI displayed on the CWP. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0930
Title	Approach arrival sequence display II
Requirement	The sequence order of each aircraft in the sequence may be displayed in the radar label.
Status	<validated>
Rationale	ATCO might use the sequence order information on the radar label to manually change the sequence or look at the sequence order. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0940
Title	Approach arrival sequence change I
Requirement	In case of a change of the arrival sequence order position of an aircraft, the Approach controller shall check that the arrival sequence order has been updated to reflect the change.
Status	<validated>
Rationale	Any change in the sequence order shall be correctly reflected in the sequence list, it is important to establish procedures for the ATCOs to make sure that the changes to the sequence order are put in place. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

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[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0941
Title	Approach arrival sequence change III
Requirement	The sequence manager shall ensure that for the change of the sequence order there is no overlap (or lack of awareness) between the actions taken by the Intermediate Approach Controller and the Final Approach Controller, by allowing only one change at a time.
Status	<validated>
Rationale	The system needs to ensure there that sequence changes are not input into the system simultaneously by more than one controller. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0960
Title	Go-around impact for sequence and TDI
Requirement	The Target Distance Indicators associated to a leader aircraft executing a go-around shall be removed from the sequence and new Target Distance Indicators shall be computed for the following a/c, considering the new arrival pairs created due to this go-around. The aircraft could be removed from the sequence manually by the ATCO or automatically.
Status	<validated>
Rationale	The landing sequence will change due to the go-around, so it is important that the sequence order input for the separation delivery tool represents the current traffic situation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0560
Title	TDI update after sequence change
Requirement	For every change in the arrival sequence (aircraft swapping positions, aircraft removed or missed approach, late change of the runway intent, etc.) the tool shall immediately re-compute all affected TDIs and reflect the change on the HMI accordingly.
Status	<validated>
Rationale	A change in the sequence means the currently displayed TDIs will no longer be correct meaning an update is required considering the new sequence of aircraft pairs. The separation delivery tool and associated sequence manager shall always show the most up to date image of the traffic, regardless of what changes in the arrival sequence have been made. The parameters behind the tool shall be re-computed as soon as changes of any sort (wind, go-arounds, insertion of new aircraft etc.) have been made. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0550
Title	Check TDIs after sequence update
Requirement	If there is a change to the sequence order or runway intent, the Approach Controller should check that each indicator for each affected aircraft pair have been updated.
Status	<validated>
Rationale	A change in the sequence or runway intent results in the separation / spacing of each affected TDI being updated. A procedure checking the TDIs update correctly helps maintain the high integrity sequence information. For example, a temporary visual confirmation message of the TDIs recalculation could be displayed on the CWP to support the ATCO. However, if the approach arrival sequence information is demonstrated to have sufficient integrity then this may not be required. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0910
Title	Input the arrival runway intent
Requirement	The separation delivery tool shall be given the arrival runway intent including eventual updates for each aircraft such that it is considered for the computation of the Target Distance Indicators.
Status	<validated>
Rationale	Displaying the approach arrival sequence information allows the Controllers to cross check the displayed information. Note this may not be required if the approach arrival sequence is demonstrated to have sufficient integrity. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0561
Title	TDI update after runway intent change
Requirement	For a late change of the runway intent, the tool shall immediately re-compute all affected TDIs and reflect the change on the HMI accordingly (i.e. the TDIs corresponding to the affected aircraft disappear from the extended runway centreline of the old runway and is displayed on the extended runway centreline of the new runway).
Status	<validated>
Rationale	A late change in the runway intent requires the adaptation of the arrival sequence for the affected runways. This requirement has been validated in RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0950
Title	Change of aircraft landing runway intent I
Requirement	When the aircraft is already inserted into the sequence with a runway intent and there is a change of aircraft landing runway intent, the Approach controller shall check that Target Distance Indicators reflect the change of aircraft landing runway intent.
Status	<validated>
Rationale	A change in the runway intent results in the separation / spacing of each affected TDI being updated. A procedure checking the TDIs update correctly helps maintain the high integrity sequence information. This requirement has been validated in RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0540
Title	Approach arrival sequence check
Requirement	Controllers shall be trained to check the aircraft landing runway intent and that the aircraft order is correct and coherent with the arrival sequence list. They shall check if and that the aircraft order is displayed in the arrival sequence list and/or if the aircraft sequence number is displayed in the radar label in accordance with their intended sequence.
Status	<validated>
Rationale	The Approach Arrival Sequence must have a high integrity level as technical errors could lead to under separations occurring without the Controller being aware of. A checking procedure will help maintain the high integrity. However, if the approach arrival sequence information is demonstrated to have sufficient integrity then this may not be required. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0570
Title	TDI update after separation or spacing constraint change
Requirement	If there is a change to the separation / spacing constraint (e.g. Gap) the TDI for the affected aircraft pair shall be re-computed.
Status	<validated>
Rationale	A change to the separation / spacing constraint may mean the currently displayed TDIs for the affected aircraft pairs are no longer correct hence the need to re-calculate TDIs for those pairs. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0580
Title	TDI display options
Requirement	The display option for the indicator shall be configurable depending on the type of separation / spacing.
Status	<validated>
Rationale	Controllers may need the ability to display certain types of TDI (e.g. ITD in the TWR) or to suppress the display of certain types of TDI to reduce clutter (e.g. ROT indication). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0590
Title	TDI display across applicable CWPs
Requirement	TDIs shall be displayed on all applicable ATCO and SUP CWPs (Tower Runway, Final Approach and Intermediate Approach), according to the local implementation rules.
Status	<validated>
Rationale	The Intermediate Approach and Final Approach Controller is required to set up and monitor the required separation or spacing. The Tower Runway Controller is required to monitor the required separation or spacing. As a result, local implementation rules shall specify the use of the TDIs (ITD and FTD) in both the Approach and Tower positions. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0620
Title	TDI update rate
Requirement	The indicators shall have the same update rate as the radar and be displayed with no discernible difference from the radar update time of the associated aircraft.
Status	<validated>
Rationale	This is to ensure the distance between the aircraft and the TDI always represents the intended separation or spacing. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0630
Title	TDI display timing criteria
Requirement	Criteria to determine the time for displaying indicators for each CWP shall be specified depending upon the local operation's needs.
Status	<validated>
Rationale	The usage and display of TDIs shall be locally defined, depending on whether or not both the ITD and the FTD are desired (APP and/or TWR), depending on whether the TDIs are used in both DBS and TBS conditions etc. The time to display TDIs depends upon each local implementation. TDIs can be displayed late (such as when the aircraft is on base leg) if another form of tool support is provided to support the initial turn from downwind. Example criteria for indicator display can include altitude, perpendicular distance from the extended runway centreline, distance to the runway threshold parallel to the runway centreline and heading. As an example, the TDI for the leader/follower aircraft pair shall be computed and displayed by the tool as soon as the two aircraft satisfy the following: • distance to the runway extended centreline is within a defined parameter; • altitude is below a defined parameter; and in addition, the leader has a difference between runway heading and aircraft track less than a defined parameter. These parameters shall be configurable within the tool based on the local environment. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0650
Title	FTD display on Approach CWP
Requirement	The Approach controller shall have the possibility to globally select the display of the FTD, however the FTD shall automatically be displayed when some alerts are active (e.g. risk of imminent FTD infringement).
Status	<validated>
Rationale	The Approach Controllers normally has only the ITD displayed. However, if the FTD is only a short distance ahead of it then crossing the ITD may result in the aircraft accidentally crossing the FTD as well. Without the FTD ATCOs might not be aware of the separation infringement. Functionality should be designed to prevent that scenario such as automatic display of the FTD if the aircraft crosses the ITD or is within a defined distance of the FTD. This should be considered for both in-trail and not-in-trail scenarios. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0651
Title	FTD display on Approach CWP II
Requirement	In case the ITD is the main display on the final approach, the ATCOs shall be able to display the FTD, depending upon the local operation's needs.
Status	<validated>
Rationale	As a result, the APP ATCO can have a look at the compression for each a/c pair quickly & easily. In the APP, in order to avoid clutter, ATCOs have mentioned their preference for the usage of the ITD as the main indicator. Example of local implementation: The FTD shall be automatically displayed with the highlighted ITD when: - the mouse is placed on the corresponding follower aircraft flight label - the mouse is placed on ITD indicator. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0660
Title	ITD display on Tower CWP
Requirement	The Tower controller shall have the possibility to globally select the display of the ITD (in addition to FTD which shall always be displayed).

Status	<validated>
Rationale	The Tower Controller is monitoring the delivered separation or spacing. This is represented by the FTD. However, it might decide to select also the ITD display to have a look at the spacing delivered by the Final Approach Controller. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0670
Title	TDI update due to changing glideslope wind conditions
Requirement	Local implementation shall define the latest time that a stable TDI is required by the Controller for spacing, so that the FTD and ITD indicators may be re-calculated due to changing glideslope wind conditions.
Status	<in progress>
Rationale	This can be used to accommodate variation in the glideslope wind conditions to ensure the latest possible measurement is used before the TDI needs to be fixed. In progress as local parameters need to be defined.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0680
Title	HMI integration in CWP
Requirement	The HMI layout (i.e. shape, colour, size and display priority) of the FTD and ITD indicator shall be adequately integrated into the air traffic surveillance display.
Status	<validated>
Rationale	To ensure clear display of required information to deliver consistent and accurate separation or spacing. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b. To be locally defined in deployment.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0681
Title	HMI integration in CWP II
Requirement	The design of the TDIs shall be made in order to ensure they are easy to read and interpret, being in line with the design philosophy (shape, colour etc.) of the other ATC tools used in the local environment.
Status	<validated>
Rationale	In order to ensure acceptability of the new tool and to avoid confusions in relation to the new display, it is important to consider HF design principles when locally implementing the new tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0690
Title	TDI display robustness/stability
Requirement	TDI display shall be robust to ensure they do not keep switching on and off as aircraft perform normal manoeuvres.
Status	<validated>
Rationale	Indicator display shall be robust to the variety of ways that aircraft merge onto final approach, typical path stretching manoeuvres and acceptable deviation from the final approach path while accommodating late runway change scenarios. However other scenarios when TDIs are expected to be removed or updated need to also be accommodated such as missed approach or runway change. Priority will be given to robust display resulting in slight delay for updates caused by genuine departures from the final approach path. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0691
Title	TDI HMI design I
Requirement	The Controllers shall be able to visually distinguish (via colour or symbol) if Target Distance Indicators are relative to WT, MRS or ROT (or other spacing constraint).
Status	<validated>

Rationale	The type of constraint will influence the Controllers' actions if they infringe it. Customising the HMI display of the TDIs (such as different colours or symbols) will allow them to know the type of separation or spacing constraint to aid in their decision making. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0700
Title	HMI consistency
Requirement	Approach and Tower shall have access to consistent information (on their CWP HMI) relating to separation delivery to be able to communicate effectively with each other.
Status	<validated>
Rationale	In order to communicate effectively the ATCOs cannot be misled by information that in the CWP is describing a different traffic situation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0710
Title	Automatic display of FTD
Requirement	The tool shall automatically display the FTD (if not already displayed) if the aircraft comes within a defined distance of the computed FTD. This distance shall be configurable within the tool.
Status	<validated>
Rationale	The Approach Controllers may only have the ITD displayed. However, if the FTD is only a short distance ahead of it then crossing the ITD may result in the aircraft accidentally crossing the FTD as well. Functionality should be designed to prevent that scenario such as automatic display of the FTD if the aircraft crosses the ITD or is within a defined distance of the FTD. This should be considered for both in-trail and not-in-trail scenarios. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0720
Title	Automatic display of FTD II
Requirement	The Approach controller shall be able to remove the FTD from the radar display, but not when the FTD has been automatically displayed by the System.
Status	<validated>
Rationale	Normally the Approach Controller can select to display or not the FTD, however there might be alerts that are displaying the FTD automatically (e.g. infringement of ITD), in these situations, as long as the alert is active, the FTD information shall be kept. The FTD automatic display, is alerting the APP ATCO that a separation infringement may occur, therefore it is important that this alert remains on the CWP HMI until the compression buffer has been restored and the aircraft is back behind the ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational> , <Safety> , <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0730
Title	TDI removal for MRS constraint
Requirement	The TDIs corresponding to the high priority MRS separation constraint shall remain visible on the radar display until the leader aircraft reaches the separation delivery point.

Status	<validated>
Rationale	The separation constraint shall be respected between leader and follower when leader is at touchdown. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0740
Title	TDI removal for Wake constraint
Requirement	The TDIs corresponding to the high priority Wake separation constraint shall remain visible on the radar display until the leader aircraft reaches the separation delivery point.
Status	<validated>
Rationale	The separation constraint shall be respected between leader and follower when leader is at touchdown. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0750
Title	TDI removal for ROT constraint
Requirement	The TDIs corresponding to the low priority Runway Occupancy Time constraint shall remain visible on the radar display until the leader aircraft reaches the separation delivery point.
Status	<validated>
Rationale	The spacing constraint shall be respected between leader and follower when the leader is at touchdown. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0760
Title	TDI removal for GAP constraint
Requirement	The TDIs corresponding to the low priority Gap spacing constraint shall remain visible on the radar display until the follower aircraft reaches the separation delivery point.
Status	<validated>
Rationale	For separation constraints is sufficient that the TDI disappears when the leader crosses the delivery point, however in the situation of spacing (e.g. GAP) these TDI might result in high distances between aircraft (e.g. 8/12 NM) so it is useful for the controller to keep a reference TDI displayed when the leader has already passed the delivery point. This requirement has been validated in RTS3a, RTS4a.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0770
Title	FTD and ITD consistent between CWPs
Requirement	The displayed indicator distance and shape shall be consistent between all applicable CWPs.
Status	<validated>
Rationale	To ensure consistent information when Controllers are communicating with each other. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0780
Title	TDI step resolution
Requirement	The Separation Delivery tool shall display indicators to at least a distance step resolution of 0.1NM.
Status	<validated>
Rationale	This is the smallest step distance that the Controllers can visualise and use. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0790
Title	TDI HMI design II
Requirement	If more than one type of indicator is displayed on the CWP HMI, then indicator HMI design shall be clearly distinguishable to avoid ambiguity.
Status	<validated>
Rationale	There needs to be clarity between FTD and ITD indicators on the HMI display. There also needs to be clarity between in-trail and not-in-trail TDIs. ATCOs require a timely and accurate display of the FTD that would allow them to adapt their instructions if needed, without having a negative impact on the traffic. For this reason, a clear distinction between the indicators (FTD or ITD) shall be made (e.g. colour, shape etc.). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

		Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0791
Title	TDI to be displayed in case of infringement
Requirement	When spacing ITD is infringed by the aircraft, the ATCOs shall be aware of the next most constraining separation factor ITD and FTD (e.g. Wake or MRS) on the APPROACH and TOWER positions.
Status	<validated>
Rationale	The ATCO needs this information to be able to assess if the actual separation meets separation criteria (e.g. MRS or WAKE) and if he can proceed safely with landing even when spacing TDI are infringed. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0792
Title	TDI to be displayed in case of infringement II
Requirement	For the Tower HMI, in case of high priority ITD infringement, the Tower Controller shall be able to assess if he can proceed safely with landing.
Status	<validated>
Rationale	To reduce the risk of an infringement of the FTD for the Tower Controller, keeping in mind that in some implementations the ITD is not displayed by default in the Tower HMI. Below an example for implementation for the TWR HMI: -If the first most constraining ITD corresponding to a high priority separation indicator (e.g. WAKE or MRS) is infringed, then its already displayed corresponding FTD shall be accompanied by the distance countdown to the FTD of the corresponding aircraft such that the TWR controller is aware that a high priority ITD has been infringed - if the second most constraining ITD corresponding to a high priority separation is infringed, the system shall display the corresponding FTD accompanied by the distance countdown to the FTD, in addition to the already displayed first most constraining FTD such that the TWR controller is aware that a high priority ITD has been infringed (FTD displayed according to the rules defined for the high priority separation indicators) Note this countdown to the FTD applies only to the high priority separation indicators (WAKE and MRS). The scope of this distance is to show the TWR ATCO when an ITD has been infringed keeping in mind that the ITD is not displayed by default for the TWR controller. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

<ALLOCATED_TO>	<Activity>	Provide landing clearance Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0793
Title	TDI to be displayed in case of infringement III
Requirement	For the Tower HMI, in case the high priority ITD is no longer infringed, the Tower Controller shall be informed that he can proceed safely with landing.
Status	<validated>
Rationale	Below an example for implementation: For the TWR HMI, if the high priority ITD is no longer infringed: - In case the FTD corresponding to this high priority ITD is the first most constraining FTD the corresponding countdown distance to the FTD shall be hidden by the system and - In case the FTD corresponding to this high priority ITD is the second most constraining FTD, the FTD shall be hidden together with the countdown to the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide landing clearance Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0795
Title	TDI to be displayed in case of infringement IV

Requirement	For the Approach HMI, in case of high/low priority ITD infringement, the Approach Controller shall be able to assess if he can proceed safely.
Status	<validated>
Rationale	The ATCO needs this information to be able to assess if the actual separation meets separation criteria (e.g. MRS or WAKE) and if he can proceed safely even with a high/low priority ITD infringement. Below an example for implementation for the APP HMI: - For the APP HMI, if the most constraining ITD corresponding to a high priority separation (e.g. WAKE, MRS) indicator is infringed or the aircraft comes within a defined distance of the computed FTD, then its corresponding FTD shall be displayed in a manner adequate to an alert (e.g. red colour) - If the most constraining ITD corresponding to a low priority spacing (ROT, gap, other spacing constraints) indicator is infringed or the aircraft comes within a defined distance of the computed FTD, then its corresponding FTD shall be displayed in a manner other than the one used for a high priority separation FTD (e.g. yellow colour) - if the second and/or third most constraining ITD corresponding to a low/high priority spacing/separation is infringed the system shall display the corresponding FTDs in addition to the already displayed first most constraining FTD (FTD displayed according to the rules defined for the high priority separation and low priority spacing indicators) This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Clear Aircraft for Approach Assess Separation/Spacing Infringement Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0796
Title	TDI to be displayed in case of infringement V
Requirement	For the Approach HMI, in case the high/low priority ITD is no longer infringed, the Approach Controller shall be informed that he can proceed safely.
Status	<validated>
Rationale	Below an example for implementation: - if the first/second and/or third most constraining ITD is no longer infringed, the corresponding FTDs shall be hidden by the system This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Clear Aircraft for Approach Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0800
Title	TDI pairing functionality
Requirement	The HMI design shall allow Controllers to identify the aircraft associated with each displayed indicator.
Status	<validated>

Rationale	Controllers need to be able to relate a TDI with its associated aircraft to maintain good situation awareness. For example, the Final Approach and Tower Controller shall be able to show which aircraft is linked with which TDI through a pairing functionality. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Identify Aircraft Identify Pairing between ITD/FTD and aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0810
Title	FTD or ITD value displayed
Requirement	The value of the FTD or ITD (which TDI depends on what is most useful for the Controller) may be displayed.
Status	<validated>
Rationale	To aid in the refinement and monitoring of the spacing set up on final approach. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>

[REQ Trace]

EUROPEAN PARTNERSHIP

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Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0820
Title	Relative distance to TDI displayed
Requirement	The distance the follower aircraft is ahead or behind the FTD or ITD (which TDI depends on what is most useful for the Controller) may be displayed.
Status	<validated>
Rationale	It has been concluded that this could aid in the refinement and monitoring of the spacing set up on final approach. For example, the distance from FTD could be activated in case of infringement of ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

EUROPEAN PARTNERSHIP

Co-funded by the European Union

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0830
Title	Relative distance to FTD displayed
Requirement	When the follower aircraft is within a certain distance from the FTD, the Separation Delivery Tool might display to the ATCO the FTD and the distance between the follower aircraft and the FTD.
Status	<validated>
Rationale	This functionality is implemented in the tool for the specific case when the FTD and ITD are very close to each other when calculated the first time (e.g. if the compression is just 0.3 NM) or when the ITD is infringed, then this distance to the FTD is displayed. It could also be an alternative to the catch-up alert. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0840
Title	Display of minimum separation and spacing information
Requirement	Spacing and separations minima information may be displayed on the Approach and Tower CWPs.
Status	<validated>
Rationale	To keep the Approach and Tower Controllers informed of the separations and spacing minima being used in the Separation Delivery tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

Co-funded by the European Union

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0850
Title	Selective suppression of TDIs
Requirement	The HMI design shall allow ATCO to hide/unhide indicators for a specific aircraft pair, and current and forthcoming alerts/warnings for that aircraft as a follower (e.g. infringement, catch-up, speed, …).
Status	<validated>
Rationale	It has been concluded that this functionality may be required for example in case of delegating responsibility for wake separation to flight deck. Depending on local implementation, the TDIs should be either removable, either change colour or display, in order to clearly indicate the situation for the ATCO. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0851
Title	Selective suppression of TDIs II
Requirement	Local procedures shall define the procedures related to the use of the TDIs and the specific instances in which they can be removed.
Status	<validated>
Rationale	For example, in case of delegating responsibility for wake separation to flight deck a procedure that dictates to suppress the related TDIs might be used. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0852
Title	Procedures assisting with tool reliability w.r.t certain behaviour of aircraft tracks
Requirement	If required in local implementation, training and procedures shall be developed to ensure that Controllers can manage correctly the Approach Arrival Sequence and display of Target Distance Indicators.
Status	<validated>
Rationale	Certain parts of the functionality including the display of Target Distance Indicators and the Approach Arrival Sequence service (if using an automatic sequence detection solution) rely on the aircraft tracks. Certain behaviour of aircraft tracks could reduce the reliability of these functions hence training and procedures could be developed to mitigate against this. For example, procedures could encourage the avoidance of non-standard vectoring where possible. An example could be safety requirement SR065 in the safety assessment report. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0860
Title	Measuring tool for inter a/c spacing
Requirement	ATCOs shall continue to have a 'click and drag' distance measuring tool so they can accurately measure inter a/c spacing when required (e.g. for building confidence in the tool or during degraded modes).
Status	<validated>
Rationale	The 'click and drag' distance measuring tool can support the ATCOs in providing the correct separation/spacing also when the Separation Delivery Tool is used, being as well a potential aid in detecting separation infringements. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0870
Title	Maintain surveillance separation on intercept
Requirement	The Approach controller shall maintain applicable surveillance separation minima at any point during approach. This includes the case of a leader aircraft established on the final approach axis and a follower not yet established.
Status	<validated>
Rationale	The Approach Controllers remain responsible for ensuring surveillance separation rules are maintained before the aircraft intercept the final approach. This is irrespective of the displayed TDI as there may be scenarios where an indicator is displaying a separation before that separation can be applied. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0880
Title	TDIs update for WDS
Requirement	When applying WDS the Separation Delivery tool may support updates of the TDIs when both leader and follower aircraft are established on the final approach.
Status	<validated>
Rationale	For safety reasons WDS separations are applicable only to the final leg. ATCOs might decide to use the separation delivery tool with the standard wake separation scheme and then update the TDIs or having WDS TDIs immediately available. It is a choice depending on local environment. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0890
Title	TDI update for wake separations II
Requirement	The separation delivery tool shall support ATCOs in the delivery of wake separations that are allowed only when leader and follower aircraft are aligned on the centreline.
Status	<validated>
Rationale	When applying WDS or any other dynamic wake separations scheme that is valid only when leader and follower aircraft are aligned on the glide, the separation delivery tool can compute TDIs based on the standard separation scheme before aircraft turns to intercept the glideslope. Then reflect with TDIs update new dynamic wake separations once both leader and follower aircraft are aligned on the centreline. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0900
Title	Separation/spacing computation update upon separation delegation to flight deck
Requirement	Following the ATCO action to suppress the TDIs for specific aircraft the tool shall • remove any information on the spacing/separation (ITD and FTD) • remove its ongoing or not display the forthcoming Separation Delivery Tool alerts (e.g. Catchup/Speed/Sequence Number/Infringement)
Status	<validated>
Rationale	As the separation responsibility is delegated to the flight deck, the spacing/separations indication (TDIs) and associated alerts becomes irrelevant. No displaying help maintain a good situation awareness. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0970
Title	Spacing procedure with FTD when ORD is not implemented
Requirement	If ORD is not implemented, the Final Approach Controller shall maintain the aircraft behind the FTD with sufficient buffer due to the effect of compression, caused by different leader and follower groundspeed profiles, and shall reduce aircraft's speed to the final approach procedural airspeed.
Status	<validated>
Rationale	Without an ITD indicator the Controllers will only be provided with the information regarding the separation or spacing to deliver. The effect of compression needs to be considered by the Controller when setting up the spacing. This requirement has been validated in SESAR1 P06.08.01 RTS.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0971
Title	Spacing procedure with FTD II
Requirement	The Tower Controller shall ensure that the actual spacing behind the leader aircraft is not infringing the FTD and in case of imminent infringement he shall apply adequate corrective action like delegating visual separation to Flight Crew or instructing go-around.
Status	<validated>
Rationale	In case of FTD infringement the Tower controller shall apply the adequate measure to mitigate the related safety risk. For example, an infringement of the wake separations is treated differently from an infringement of ROT (where the follower aircraft can still land safely if the preceding aircraft vacated the runway). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0980
Title	Separation and spacing constraint management
Requirement	The Tower Supervisor in coordination with the Approach Supervisor (and occasionally the Tower and Approach Controllers - in line with defined local procedures) shall determine the final approach separation mode and runway spacing constraints that are to be applied at any time by the separation delivery tool.
Status	<validated>
Rationale	To ensure consistency between Approach and Tower and the tool inputs, for example in case of conditional mode activation/deactivation or scenarios for specific gap spacing or additional spacing due to runway inspection. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0990
Title	Controller responsibility for separation infringement
Requirement	The Approach and Tower Runway Controllers shall remain responsible for monitoring for separation infringements and for timely intervention actions to resolve or prevent them.

Status	<validated>
Rationale	The FTD and ITD calculations make assumptions regarding the expected speed profile. The Controller is still needed to monitor for infringements due to variability in actual speed profiles. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.1000
Title	Spacing procedure with ITD
Requirement	If the ORD concept is implemented, the Final Approach Controller shall maintain the aircraft on or behind the ITD on the final approach and reduce to the final approach procedural airspeed until the transfer to the Tower controller.
Status	<validated>
Rationale	The ITD represents the spacing to be delivered at the DF. The detail of the procedure to establish on the localiser and catch-up the ITD will depend on the local implementation of the ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1010
Title	Procedures for missing TDIs
Requirement	Local Operational procedures shall be developed for handling traffic situations with missing Target Distance Indicators in different WT separation modes for both controllers and supervisors.
Status	<validated>
Rationale	If there is insufficient information to calculate a TDI then the Controllers will need to set up the required separation or spacing without a TDI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1020
Title	TDIs Training
Requirement	Controllers and Supervisors shall regularly receive training on reversal procedures (TB to DB modes) and contingency measures in case of abnormal and degraded modes of operation (e.g. loss of one TDI, loss of all TDIs, etc.).
Status	<validated>
Rationale	Controllers and Supervisors shall feel comfortable with the procedures linked to abnormal and degrade modes of operations. This requirement has been validated in RTS2.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Coordinate with Tower Supervisor Coordinate with Approach Supervisor Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1021
Title	Management of mode transitions/ Training
Requirement	The transition tasks (activation and deactivation of TB modes) shall be defined for all actors involved, for both a spontaneous transition (e.g. sudden change of wind conditions, etc.) as well as for a planned transition, where a collaborative approach for the ATCO and SUPs in APP and TWR shall apply.
Status	<validated>

Rationale	Clear procedures need to be defined regarding mode transitions to ensure Controllers can plan ahead. For example, see SR010 in the Safety Assessment Report and PJ.02.01 HPLOG. This requirement has been validated in RTS1.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1022
Title	Acceptability of procedures
Requirement	ATCOs, supervisors and pilots shall be involved in the local development of the definition of roles and responsibilities and associated procedures/ tasks with regard to the transition in conditional modes, in order to ensure their acceptability and feasibility.
Status	<validated>

Rationale	Particularly under WDS there will be a significant reduction of separation between a/c hence it is important that each actor understands their role and responsibility under WDS. The main changes with regard to the roles and responsibilities refer to the conditional application of the WDS, hence the transition modes, where especially the SUP and the ATCO have the responsibility of monitoring and applying the correct separations. Due to the lack of a reliable separation indication in the cockpit, the pilot`s responsibility in regard to transition modes remains to apply to separation as indicated by the ATCO. This requirement has been validated in RTS1.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Switch to new mode of operations in Approach Control Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1023
Title	Roles & responsibilities / tasks
Requirement	Local implementation shall define the distribution of tasks and responsibilities associated to the implementation of the separation delivery tool and the associated procedures (nominal, abnormal and degraded), taking into account the local environment (traffic load, number of APP ATCOs, etc.).
Status	<in progress>

Rationale	Given the different local environments, with different densities and hence a different number of ATCOs handling the traffic, it is important to locally define the responsibility of each of the actors involved. For example, during the validation activities carried out under the WDS-A umbrella, the simulations have been based on the CDG environment, where the final approach is divided into 2 positions: the Initial Final Approach ATCO (INI) and the Intermediate Final Approach ATCO (ITM) that eventually transfers the a/c to the TWR ATCO. The final approach positions were responsible for ensuring the a/c are on or just behind the ITD at 160knots before handing over the a/c to the TWR. The final approach ensured the a/c are flying the required speed at the specified point on the final approach (in RTS1 160knots at 10NM). In the same way, the exact procedures shall be defined at the local level. Furthermore, the TWR ATCO was responsible for monitoring the a/c in relation to the FTD and intervening if they considered the a/c would infringe the FTD by either using speed instructions (if the a/c was before the DF) or giving a go-around. In the same way for the TWR, the exact rules / procedures regarding speed instructions and go-arounds to be defined at the local level). With the ORD tool, the INI and the ITM had a common picture of the a/c sequence, that allowed the INI to hand over the traffic at a later stage than in current operations. By doing this, the INI took over part of the workload of the ITM, presenting a change in the working method. When working with WDS and the ORD tool with a high traffic pressure the distribution of tasks between the ITM and INI changed slightly, as the INI approach ATCO held on the a/c for longer than under RECAT-EU with no tool and setting up the aircraft to intercept the axis. Therefore, the INI approach ATCO takes on a more pro-active role to facilitate the ITM/final approach ATCO`s work. As a result. the ITM/final approach ATCO shares some of the workload with the INI ATCO, having more resources to focus on the final approach. No new responsibilities have been identified.
Category	<Human Performance>

[REQ Trace]

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Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing Assess Separation/Spacing Infringement Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1024
Title	Roles & responsibilities / tasks II
Requirement	A local description of procedures and roles and responsibilities with regard to the coordination on the final approach (in case more than one ATCO ensures final approach control) shall be available in case the Separation delivery tool is used.
Status	<validated>
Rationale	As in certain environments approach services are offered by the INI and the ITM ATCOs, the procedures should clearly define the roles and responsibilities and related communication between the 2 ATCOs with regard to the sequence change. It could imply a verbal communication or a highlight on the HMI of the change. In conformance with good HF practices. This requirement has been validated in RTS1, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Transfer Flight to Final Approach Controller Identify Aircraft Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1025
Title	Mixed mode I- gap
Requirement	The gap functionality procedures for mixed mode operations shall be clear and acceptable in order to enhance situation awareness for the Controllers, without increasing their workload.
Status	<validated>
Rationale	Controllers (APP and TWR) shall be at ease working with the gap functionality, knowing how to request a gap, how to collaborate in changing a gap spacing etc. This requirement has been validated in RTS3a, RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess departures vs GAP spacing Coordinate the GAP Spacing modification with Final Approach Controller Cancel the GAP during Final Approach Control Request cancel GAP to Final Approach Controller Insert GAP spacing

		Request new GAP spacing and/or position to Final Approach Controller Request GAP insertion Modify the GAP during Final Approach Control Assess GAP spacing vs planned departing a/c

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1026
Title	Mixed mode II- gap
Requirement	The Controllers shall be able to identify whether an inserted gap is no longer compatible with the planned sequence.
Status	<validated>
Rationale	The gap functionality shall be interoperable with all the other displays associated with the Separation delivery tool (e.g. an alert can pop-up in the sequence when the gap is not sufficient for the planned departures). This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess GAP spacing vs planned departing a/c Assess departures vs GAP spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1027
Title	Mixed mode III- gap
Requirement	The gap functionality/display shall ensure an enhanced team situation awareness between APP and TWR Controllers.
Status	<validated>
Rationale	The gap functionality shall ensure the APP and TWR Controllers share the same awareness with regard to mixed mode operations. The information needs to be presented in a distinguished way (as compared to other distance indicators) and in a timely manner. This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Cancel the GAP during Final Approach Control Modify the GAP during Final Approach Control Request new GAP spacing and/or position to Final Approach Controller Request cancel GAP to Final Approach Controller Coordinate the GAP Spacing modification with Final Approach Controller Request GAP insertion

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1030
Title	Safe mode transition
Requirement	The Approach or Tower Controller shall be able to safely perform their separation duties during transition between separation modes.
Status	<validated>
Rationale	Mode transitions must remain safe. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1031
Title	Safe mode transition II
Requirement	Mode transitions (planned) should take place outside peak hours.
Status	<validated>
Rationale	The transitions during peak hours should be considered a non-nominal event. The ATCOs consider the transitions shall be planned as such so that they are not affecting peak hours. Unless the wind conditions are considered to be stable enough, it is advised to avoid making transition during peak hours. This requirement has been validated in RTS1.

Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1032
Title	Transition procedure
Requirement	In order to minimise the impact on the ATCOs work, the supervisor or the co-ordinator shall try to initiate the transition from WDS to standard WT scheme starting with an aircraft pair involving no or limited change in applicable wake separation with the new scheme.
Status	<validated>
Rationale	Such a transition would minimise safety risks and an increase in the workload of the ATCOs. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1033
Title	Transition roles
Requirement	The ATCOs shall be able to start the transition with another a/c than the one proposed by the SUP or by the tool, by collaborating with the SUP.
Status	<validated>
Rationale	In certain cases, it could be that due to a wake encounter queue on the ground, low visibility etc., the ATCO has a different vision that the SUP or the support tool that could propose transitions. In this case, the ATCO shall be able to propose a different approach by discussing with the SUP. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1034
Title	Transition roles II
Requirement	Approach and Tower Controllers shall be informed in advance by their respective Supervisor prior to the planned activation or planned de activation of TB- modes.
Status	<validated>
Rationale	For an enhanced awareness and appropriate preparation for the mode transition. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1040
Title	Mode transition Training
Requirement	All licenced Approach and Tower controllers (and Supervisors) shall be fully trained to switch between the time based and distance based modes of operation.
Status	<validated>
Rationale	To maintain safe operations when transition between modes is put in place. This requirement has been validated in RTS1.

Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1041
Title	Working Methods
Requirement	A set of working methods / guidelines to cover the proposed TB or DB procedures and associated tools (i.e. Separation Delivery Tool) should be locally defined.
Status	<in progress>
Rationale	Working methods and procedures shall be tailored locally and tested before going in operations.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1050
Title	Activation of WDS mode
Requirement	The Separation Delivery tool implementation shall forbid the Approach and/or Tower Controller the possibility to activate the TB-WDS-A modes.
Status	<validated>
Rationale	Helps avoid confusion regarding roles and responsibilities for managing mode changes including the switching on / off of the Separation Delivery tool. This requirement has been validated in RTS1.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1060
Title	Conditional mode activation coordination
Requirement	For TB- modes the Approach and Tower Supervisors shall collaboratively decide when the conditional (TB) mode should be activated or de activated based on meteorological data information and predefined activation criteria and on prior coordination with Controllers.
Status	<validated>
Rationale	To ensure both Approach and Tower can prepare for a change in mode in good time. Parameters to be taken into account for the change shall be locally defined (MET indicators/ forecast, a/c type, time to inform ATCO before transition e.g. 2-3 min before the a/c will intercept the localiser). Note: Activation of a WT separation mode encompasses both starting operations at the beginning of the day and transition to a different WT separation mode during the day. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Coordinate with Approach Supervisor Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1070
Title	Large number of WTEs
Requirement	Supervisors must reconsider the mode of operation if Controllers report having received WTE reports from pilots over a short period of time.
Status	<validated>
Rationale	Several WTE reports in a short time interval may mean the incorrect mode of operation is activated hence Supervisors should reassess the decision. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1222
Title	Conditional mode deactivation coordination
Requirement	Timely reversion from conditional mode to standard mode of operations shall be triggered by the Supervisor or automatically by the System depending on the local implementation. The possibility for the ATCOs spontaneous reversal (e.g. in case of sudden loss of indicators) shall be locally defined.
Status	<validated>
Rationale	The timely reversion is required for safety reasons (e.g. in case of sudden wind drop). There could be different situations for reversal from conditional to standard modes of ops: a) EITHER automatically changed by the tool- with a clear indication on the screen of both the Supervisor and the ATCO of the new mode of operation and additionally with an indication of the a/c from which the reversal to the conventional mode of operation applies (e.g. highlighting the a/c in the sequence list). OR An alert on both ATCO`s and Supervisor`s HMI, indicating the immediate required transition (to be manually changed by the Supervisor and/or ATCO). -- the above mentioned options are mostly applicable for spontaneous changes that were not foreseen (e.g. degraded mode or loss of wind conditions). b) Spontaneous change made by the ATCO- given consecutive WTE reported by pilots that confirm inadequate wind conditions OR the refusal of reduced separations by one pilot (in which case the reversal to conventional separations can be made for one a/c pair only and the ATCO must record this pair as such). For a change for one aircraft pair only, the ATCO is responsible to record the chance either of flight strips or with a "bear and range" indication on the screen so that they recall the reason for enhanced separations for an aircraft pair only, given the fact that the mode of operation would be still displaying reduced separations overall. The ATCO may use the (optional) function of the tool to remove TDIs for a single aircraft. c) Planned by the Supervisor whom, based on the MET info and traffic situation, is able to anticipate wind changes and verbally

	communicate to the ATCO the first aircraft from which the reversal to the conventional mode of operation applies. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1080
Title	Minimal number of mode changes
Requirement	The frequency of separation mode switches shall be done in a way that would avoid controller confusion and unnecessary workload.
Status	<validated>
Rationale	The Controllers need consistency hence will require a minimal number of mode changes. Excessive fluctuations in mode transition will lead to ATCOs mistrusting the System and could also have a negative impact on their Performance in terms of situational awareness and workload. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1090
Title	Automatic transition Information
Requirement	In case the reversion from a TB mode is triggered automatically by the Separation Delivery Tool (e.g. due to the wind falling below the applicable minima), the Separation Delivery Tool shall indicate to the ATCO the aircraft to be separated according to the new separation mode. A notification shall indicate to the Controller and the Supervisor the change and preferably the reason behind it.
Status	<validated>
Rationale	ATCOs need to be aware of the current separation mode applied by the separation delivery tool. In case the reversal is done automatically, in order to ensure an appropriate level of situation awareness, the Controllers and the Supervisors shall be notified about the change and preferably the reason behind it (e.g. inadequate wind conditions). This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1100
Title	TDI display during mode transition I
Requirement	Upon reversion to (activation of) a new separation mode, the separation delivery tool shall display the adequate FTD (separation indication) and ITD (compression indications) to the Approach ATCO for all aircraft starting with the first aircraft in the arrival sequence to be separated according to the new mode.
Status	<validated>
Rationale	A transition might be applied for the entire aircraft sequence or only a part of it. In case the transition is applied only for a part of the traffic, it is important that TDIs are updated to reflect the new constraints starting from where the new mode is put in place. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control

		Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1110
Title	TDI display during mode transition II
Requirement	The Approach and Tower Runway ATCO shall continue to use the TDIs that are already displayed (as per the previous separation mode) for the aircraft in the arrival sequence preceding the first one to be separated according to the new mode.
Status	<validated>
Rationale	The TDIs that were calculated based on the previous mode of operations are still valid for the part of the sequence that still use the previous mode of operations. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1120
Title	Mode of operation HMI
Requirement	The mode of operation shall be clearly displayed to the controllers (Tower and Approach) and Supervisors (Tower and Approach) at all times.
Status	<validated>
Rationale	This is to allow the appropriate level of situation awareness ensuring the Controllers and Supervisors to know what procedures to apply. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Switch to new mode of operations in Approach Control Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1221
Title	New mode of operation activation coordination
Requirement	The Supervisor/ATCO coordinator shall be responsible for the activation of the conditional (TB) mode under all conditions.
Status	<validated>
Rationale	The results of the workshop addressing transition modes indicated that Supervisors and ATCOs agree that the transition from nominal to conditional mode should be initiated by the Supervisor, given the applicable wind conditions. Furthermore it was suggested that an activation button (e.g. for WDS-A) should not be available on the ATCO`s HMI, in order to avoid confusion with regard to whom should be responsible for the activation and also in order to avoid enhanced monitoring for wind conditions from the ATCO`s side. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1222
Title	New mode of operation activation
Requirement	The Approach and Tower Supervisors shall inform the respective Controller when the conditional (TB) mode will be activated or de activated by indicating the first aircraft in the arrival sequence to be separated according to the new mode (e.g. at least 2 min before interception- to be locally defined).

Status	<validated>
Rationale	Given the applicable wind conditions, the Supervisor shall confirm the activation by an input in the system as well as verbally communicating the transition to the ATCOs (with the mention of the first a/c from which the new mode of operations applies). ATCOs prefer the verbal instruction as well, which is seen as enhancing their situation awareness with regard to the transition. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1223
Title	Mode of operation HMI II
Requirement	The ATCOs and the Supervisors shall always have a clear indication in the CWP from which aircraft in the sequence the new mode of operations or the reversion to standard mode are applied.
Status	<validated>
Rationale	A clear indication on the screen of both the Supervisor and the ATCO of the new mode of operation and additionally with an indication of the a/c from which the reversal to the conventional mode of operation applies (e.g. highlighting the a/c) is necessary to maintain awareness for the separation delivery task. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Sequence, Merge and Space Aircraft Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1130
Title	WDS-TW activation
Requirement	The WDS-TW mode shall be activated only when the runway surface and glide-slope reference total wind (as used in the separation minima design) is equal or greater than the WDS-Tw threshold.
Status	<validated>
Rationale	The WDS Total Wind mode can be activated only when the criteria that justify the safe reduction of wake turbulence separations are respected. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Coordinate with Tower Supervisor Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport

		Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1140
Title	WDS-XW activation
Requirement	The WDS-Xw mode shall be activated only when the runway surface and glide-slope reference cross wind (as used in the separation minima design) is equal or greater than the WDS-Xw threshold.
Status	<validated>
Rationale	The WDS Cross Wind mode can be activated only when the criteria that justify the safe reduction of wake turbulence separations are respected. This requirement has been validated in RTS1.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Coordinate with Tower Supervisor Switch to new mode of operations in Approach Control Coordinate with Approach Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1150
Title	Wind thresholds for conditional application
Requirement	The WDS-Tw and WDS-Xw activation thresholds shall be determined to mitigate the risk of wake vortex encounter due to the uncertainties on the wind prediction data and on the lateral aircraft deviation from RWY extended centreline.
Status	<validated>
Rationale	The WDS Cross Wind and Total Wind modes can be activated only when the criteria that justify the safe reduction of wake turbulence separations are respected and there is sufficient margin on the wind measured. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1160
Title	Wind Forecast WDS-A
Requirement	In order to enable the modes activation/deactivation, the Tower Supervisor and the Approach supervisor shall be provided with a meteorological situation picture that includes the nowcast and forecast data regarding the wind speed and direction at different locations and altitudes covering the area encompassing the final approach phase of arrival flights. Such information shall in particular display the relevant wind component for the application of WDS-A concept reduced wake separations.
Status	<validated>
Rationale	Supervisors need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the supervisor making the decision about whether or not it is appropriate to apply the WDS-A X-Wind concept reduced wake separations and secondly to help ensure overall compliance with the procedure This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport Coordinate with Tower Supervisor Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1170
Title	Wind Forecast Service WDS-A (X-Wind or T-Wind)
Requirement	The Wind Forecast Service shall be provided to the users to plan or execute WDS-A (Xw or Tw) concept operations. The service shall include standard meteorological information and WDS-A (Xw or respectively Tw) concept specific information with respect to wind nowcast and forecast, wind speed, direction and trends, in particular the crosswind component (glide-slope and surface cross winds) or respectively the total wind (glide-slope and surface total winds) with respect to each runway direction.
Status	<validated>
Rationale	Controllers need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-A (Xw or Tw) concepts reduced wake separations and secondly to help ensure overall compliance with the procedure. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Switch to new mode of operations in Tower Control Assess operational situation and conditions at the airport Coordinate with Approach Supervisor Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1190
Title	Wind Forecast Service WDS-A Suspension and Separation Delivery Tool
Requirement	If the Wind Forecast service detects WDS-A concept suspension, the information shall be transmitted to the Separation Delivery tool and a corresponding alert shall be displayed to the CWPs of the Controllers and Supervisors.
Status	<validated>
Rationale	The two Systems shall be interfaced so that the display of the correct TDI based on safe conditions is applied. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1210
Title	WDS-A System Interface
Requirement	The TWR and APP supervisors shall access the Airport Weather Data Display System through a human-machine interface integrated into their working environment. The interface will be developed on purpose for WDS-A or will result from an upgrade of the current interfaces. The WDS-A System interface shall display information about: 1. Current and forecast headwind speed and direction 2. Current and forecast crosswind speed for each runway direction. 3. Applicability of WDS-A (Xw and Tw) concept reduced wake separation 4. Which concept(s) in use in the separation delivery tool for the arrival sequence These items will be displayed together or separately.
Status	<validated>
Rationale	To enable the use of WDS-A Xw and Tw concepts and facilitate the coordination process between the different actors. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1240
Title	Concept of operations training
Requirement	Supervisors and Controllers shall be trained on the TBS, S-PWS, WDS and / or ORD concept of operations.
Status	<validated>
Rationale	The Supervisors and Controllers need a good understanding of the concept of operations to be able to apply it in the operational environment. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1250
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes
Requirement	Approach and Tower Controllers shall be fully trained to apply the procedures for the new separation modes and to use of the Separation Delivery Tool and supporting Systems (e.g. alerts) with indicators prior to deployment.
Status	<validated>
Rationale	To ensure Controllers are sufficiently competent to apply the applicable concept. Controllers and Supervisors must feel at ease working with the Separation Delivery Tool and the associated procedures before deployment. They need to have high trust in the tool- which is associated with a high understanding of the procedures and the mechanisms of the tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1260
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes II
Requirement	All Approach and Tower controllers and Supervisors shall be fully trained in the operating procedures for the new WT separation modes prior to deployment.
Status	<validated>
Rationale	To ensure Controllers are sufficiently competent to apply the applicable concept. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1270
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes III
Requirement	ATCO training shall ensure that the operation in new WT separation modes will not lead to more un-stabilised approaches due to late/rush aircraft stabilisation as a result of tighter spacing and more frequent speed adjustments. However, a greater number of instructions might temporarily occur during the introduction of the new concept.
Status	<validated>
Rationale	To ensure Controllers are sufficiently competent to apply the applicable concept. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1280
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes IV
Requirement	In case of WDS cross wind, when the leader and follower are established on the glideslope, the Approach and Tower controllers shall be able to give heading instructions (e.g. break-off) to the follower only upwind and not downwind.
Status	<validated>

Rationale	To mitigate risk of wake encounter in cross wind. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1281
Title	Controller and Supervisor training on Separation Delivery tool, supporting Systems and new separation modes
Requirement	Controller and Supervisor training shall ensure they understand the logic behind the TDIs and related alerts.
Status	<validated>
Rationale	An appropriate understanding of the tools available on the CWP and the associated procedures is associated with better trust and acceptance from the ATCOs side. There is expected to be a change of paradigm for APP ATCOs, where instead of aiming for a distance behind a leading aircraft they would be aiming now for a target (vector for interception behind the ITD). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1282
Title	Training Separation Delivery Tool I
Requirement	Training shall ensure the Separation Delivery Tool indicators are not used as a mean to assess individual or team performance.
Status	<validated>
Rationale	The TDIs could potentially (and unintentionally) be used for assessing individual or team performance which might increase the risk of ATCOs trying to overperform, which could eventually bring a Safety risk. Through adequate training for both ATCOs and Supervisors these potential issues could be clarified and avoided. It is important that a "just" culture is fostered within the organisation as opposed to a competitive culture, so that ATCOs do not feel pressure from the TDIs to over-perform, or that they are used by supervisors to assess performance. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1283
Title	Training Separation Delivery Tool II
Requirement	Training shall ensure Controllers are taught a scanning pattern to maintain situation awareness when working with the separation delivery tool.
Status	<validated>
Rationale	The training of a scanning pattern in dual arrival environments (such as Roissy CDG with North and south arrivals) should include training to ensure controllers systematically scan and check the altitude of the a/c corresponding to the other ITM as they would when working currently with no separation delivery tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1284
Title	Training WDS
Requirement	Local training plans shall take into account that WDS specific issues might require additional training requirements, such as understanding problems with wind forecasting and the relationship between wind conditions and WT (to be defined locally).
Status	<validated>

Rationale	The WDS concept may bring another facet into the algorithm of the TDIs, such as different wind forecasting problems and the relationship between wind conditions and WT, which need to be well understood by the controllers, especially if there are problems. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1290
Title	Maintain aircraft performance knowledge
Requirement	Regular trainings shall ensure ATCOs maintain sufficient competency to safely revert to and manage air traffic in DBS operations without Target Distance Indicators (i.e. implementation of the separation tool shall not adversely affect the controller's air traffic- vectoring skills- using DBS WT Category without Target Distance Indicators).
Status	<validated>
Rationale	As Similar with all technical components- the Separation Delivery tool will might occasionally fail, it is mandatory that the Controllers need to maintain sufficient knowledge of aircraft characteristics and behaviours to be able to deliver separations without tool support. This requirement has been validated in RTS2.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1300
Title	Performance levels II
Requirement	Trainings shall ensure ATCOs reach a specified level of Performance before they can go Operational on TB operations with the separation delivery tool. The level of Performance needs to be locally defined.
Status	<in progress>
Rationale	To ensure all controllers are fully trained and competent working with the new procedures and associated tools a specified level of Performance shall be reached before ATCOs can work in live operations. To be locally defined.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1301
Title	New recruits
Requirement	New recruits shall be trained to work with conventional modes of operations without tool support as well as with the support of the separation delivery tool.
Status	<validated>
Rationale	All controllers must be able to work competently without the separation delivery tool in case of degraded modes where the fallback procedures will require the ATCOs to work without the separation delivery tool and to know separation schemes based on WV category applied in such conditions. In conformance with good HF practices. This requirement has been validated in RTS2.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1302
Title	Trust
Requirement	The training shall extensively cover the new working methods associated with introduction of the Separation delivery tool in order to ensure high trust in the tool and acceptability of the related procedures.
Status	<validated>

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Rationale	ATCOs must become confident that the ORD tool significant value to their work, admitting though the fact that they do not question the ORD features. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1310
Title	DBS look up tables
Requirement	Approach and Tower Controllers shall be provided with look-up tables for DBS minima to support DBS operations with no TDIs when necessary.
Status	<validated>
Rationale	There will be times when the Controllers need to revert to DBS with no TDIs hence may need a reminder of the DBS wake separations. This requirement has been validated in RTS2.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing

		Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1320
Title	TBS Distance Display
Requirement	A TBS Distance Display may be provided to the Approach and Tower Runway CWPs.
Status	<validated>
Rationale	This is to provide ensure Controllers with have an appropriate level of situation awareness of the separation reductions to expect when applying the TBS concept. This requirement has been validated in SESAR1 P06.08.01 RTS.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1330
Title	Wind information Display in TBS mode
Requirement	In TB modes, relevant wind information shall be displayed on Approach / Tower Controller working positions for awareness purposes (e.g. to enable significant discrepancy check with the displayed TDI).
Status	<validated>
Rationale	When applying TBS the stronger the headwind component the bigger are the wake reductions. By looking at the wind conditions and measuring the distance between aircraft and FTD for wake constrained pair the Controller can verify whether significant discrepancies is present between expected separations and what is computed by the Separation Delivery Tool. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1340
Title	Separation rule training and procedures
Requirement	The current Operational procedures for transitioning from intermediate separations (3NM) to final approach separations (e.g. 2.5NM MRS) shall continue to apply.
Status	<validated>
Rationale	Clarity is needed regarding the transition from both intermediate MRS to final approach MRS and from intermediate wake separations to final approach wake separations to avoid loss of separation during the transition. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1350
Title	Infringement procedures
Requirement	Procedures shall be defined regarding required actions if catching up or infringing the ITD or FTD.
Status	<validated>
Rationale	Controllers need clarity regarding the actions to be taken during catch up or infringement situations in order to correctly manage risk. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1351
Title	Infringement procedures III
Requirement	In a dual approach arrival environment, ATCOs shall have supporting alert, for identifying vertical and horizontal infringements for the crossing aircraft (e.g. North runways to South runways).
Status	<validated>
Rationale	By focusing on the target distance indicators, in a dual arrival environment (North and South arrivals) there could be a potential risk of the APP Controller overlooking the altitude of the a/c corresponding to the other APP sector, as they would in RECAT EU with no ORD tool, with potential for separation loss. This requirement has been validated in RTS1, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1360
Title	Procedure regarding non conformant speed or non-standard approach 1
Requirement	The Approach Controller shall take into account any notified inability to fly the standard approach procedure and any non-conformant final approach procedural airspeed issues when setting up the spacing on final approach.
Status	<validated>
Rationale	The TDI calculation assumes a certain speed or time-to-fly profile. Any significant deviations from this need to be taken into account by the Controller when setting up the spacing. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1370
Title	Procedure regarding non conformant speed or non-standard approach 2
Requirement	Pilots shall notify ATC of an inability to fly the standard approach procedure, and of any non-conformant final approach procedural airspeed issues, in a timely manner.
Status	<validated>
Rationale	The TDI calculation assumes a certain speed or time-to-fly profile. Any significant deviations from this need to be taken into account by the Controller when setting up the spacing. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope Fly aircraft on approach route

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1380
Title	Spacing request and runway change procedures
Requirement	Procedures shall be locally defined for the handling of scenario specific spacing requests and runway changes.
Status	<in progress>
Rationale	Scenario specific spacing can impact the TDI calculation and needs to be managed in a timely manner through clear procedures to ensure the TDI for the affected aircraft pair is calculated in sufficient time. Still in progress as these procedures need to be locally defined.

Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1390
Title	Impact on external systems and processes
Requirement	Consideration shall be given to the impact of mode changes on external Systems and processes such as AMAN and flow management.
Status	<validated>
Rationale	Different modes of operation can result in different runway throughput. For example, a degraded DBS mode in strong wind conditions would reduce the runway throughput compared with TBS mode. This can impact other systems or processes that rely on knowledge of the current and / or planned runway throughput. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

		Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1400
Title	Concept of operations published in AIP
Requirement	An overview of the key principles of the TBS, S-PWS, WDS and / or ORD concept of operations (ConOps) shall be published in AIP.
Status	<validated>
Rationale	To ensure airspace users have access to the information to understand the concept. Source: HP-SAF workshop. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Fly aircraft on approach route Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1410
Title	Airspace user briefing
Requirement	The Flight Crew shall be made aware of the locally applied separation mode and minima via appropriate means (e.g. from ATIS, AIP, NOTAM, information campaigns).
Status	<validated>
Rationale	Keeping Airspace Users informed of the concept and procedures / practises will increase the chances of a successful implementation. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Fly aircraft on approach route Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1420
Title	Airspace user briefing II
Requirement	For all modes (where FTD and/or ITD are based on a pre-defined aircraft speed profile of the follower), Flight Crew shall be briefed and reminded (e.g. via information campaigns) on the importance to respect on the Final Approach path the ATC speed instructions until the start of the deceleration and/or the published procedural airspeed on final approach and to notify Controller in a timely manner in case of inability to conform to one of those.
Status	<validated>
Rationale	As the separation delivery tool will manage the TDI separation/spacing basing on the expected aircraft speed, it is necessary for the Airspace Users to comply with ATC instructions. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope Fly aircraft on approach route

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1421
Title	Airspace user briefing III
Requirement	Information campaigns shall familiarise the flight crew/ airspace users with all novel concepts associated to the implementation of reduced separations.
Status	<validated>
Rationale	It is paramount for the flight crew to understand and feel comfortable with the novel concepts for reduced separations. It is important as well for the flight crew to understand the support tool available on the ATC side, in order to enhance their trust. In concordance with HF principles. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope Fly aircraft on approach route

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1430
Title	Airspace user briefing III
Requirement	With regards to WDS modes (total wind or cross wind) Flight Crew shall be briefed and reminded on the importance to respect the Final Approach path in terms of lateral deviation from the glide path and to notify Controller in a timely manner in case of inability to conform to it.
Status	<validated>
Rationale	As in WDS mode the TDI separation/spacing computation is based on the expected aircraft speed, it is necessary for the Airspace Users to comply with ATC instructions. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1440
Title	check the validity of Flight Plan information used by the Separation Delivery tool
Requirement	Approach control shall check the validity of Flight Plan information displayed on the CWP (ICAO aircraft type, wake category).
Status	<validated>
Rationale	Aircraft type is an important input into the Separation Delivery tool. An incorrect aircraft type can result in a large under separation without the Controllers being aware. It is important that mitigations are applied to ensure a highly reliable aircraft type input. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Identify Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1441
Title	Provide aircraft type for verification
Requirement	At the first contact with the Approach, the flight crew shall provide the Aircraft type or alternatively this information could be provided to the Approach Controller via data link and the Approach Controller shall cross check this information with the information displayed on the CWP.
Status	<validated>
Rationale	in order to check the validity of Flight Plan information used by the Separation Delivery tool. This requirement has been validated in RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Fly aircraft on approach route

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1450
Title	Pilot requesting extra space
Requirement	Pilots must still be able to request extra spacing behind an aircraft (as they do today).
Status	<validated>
Rationale	Occasionally pilots may have a need to request extra space behind an aircraft. Although this should be rare it should be accommodated in the procedures. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1500
Title	Speed conformance alert I
Requirement	The Approach and/or Tower controller shall be alerted by the speed conformance alert function when the actual aircraft speed differs by more than a locally defined threshold from the aircraft speed profile used for the TDIs computation.
Status	<validated>
Rationale	The speed conformance alert is a mandatory alert for safety reasons - if the a/c - is not flying at the required speed at a given point as defined in the ORD algorithm, the FTD displayed will not be correct and this has serious safety implications as a/c might be flying too close to be safe. The FTD and ITD calculation assumes a certain speed / time-to-fly profile. If the actual speed / time-to-fly profile deviates from this expected speed / time-to-fly profile, then the Controllers need to be alerted as there is increased risk of an infringement. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1510
Title	Speed conformance alert II
Requirement	The triggering value used for the speed conformance alert shall be determined on the basis of the used buffers in the TDI computation. The region on the glideslope where the alert is active shall be defined locally (e.g. 8 NM from RWY threshold).
Status	<validated>
Rationale	Depending on the buffer applied a certain difference between leader and follower speed profiles will be covered by the tool, thus might not be necessary to trigger alerts for those cases. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.1520
Title	Separation infringement alert ITD
Requirement	The Separation Delivery tool shall provide automatic monitoring and alerting of imminent separation infringement.
Status	<validated>
Rationale	To reduce the risk of an infringement of the FTD. See SRyy1 and SRyy3 as examples in the safety assessment report. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1530
Title	Wrong aircraft turned onto TDI alert (sequence error alert)
Requirement	The Approach Controllers shall be alerted in case the aircraft instructed to turn onto the Target Distance Indicator on the runway extended centreline is not the one planned in the Arrival Sequencing Tool list.
Status	<validated>
Rationale	An aircraft turning onto the wrong TDI could result in a large under separation without the Controller being aware. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1560
Title	Sequence error alert procedure
Requirement	In case of sequence error alert, the Approach Controllers shall perform corrective action to re-establish consistency between the actual sequence order and the Arrival Sequencing Tool list.
Status	<validated>
Rationale	The sequence order is an input for the separation delivery tool. ATCOs might need to take actions in order to have correct TDI displayed on the CWP. The system could also automatically update the sequence order. In case the update is done manually by the Controller, this system shall allow the sequence change in a simple and timely manner without having an adverse impact on workload. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.1540
Title	ITD catch-up warning
Requirement	The Separation Delivery tool may provide automatic monitoring and warning of catch up of the ITD.
Status	<validated>
Rationale	This is to support the ATCO in monitoring separations and reduce risk of an aircraft crossing the ITD which also reduces the risk of an infringement scenario occurring further along the final approach. An alert or a tool that would inform ATCOs that the ITD will be infringed imminently if they do not reduce a/c speed should be implemented to support the final approach controllers` work. The parameters of the tool will depend on whether this functionality is implemented as a tool or as an alert - this is to be decided and a local implementation level. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1570
Title	Aircraft missing input in sequence
Requirement	If an aircraft that needs to be inserted in the arrival sequence cannot be input into the Arrival Sequence Service, the Approach Controller shall inhibit the Target Distance Indicator corresponding to the follower aircraft whose position in the actual sequence is taken by the newly inserted aircraft and the Approach Controller shall observe DBS WT Category separation for the impacted pairs of aircraft.
Status	<validated>
Rationale	If the aircraft is not inserted in the sequence there is a set of TDI information wrong, the ATCO shall ignore those TDI by hiding them and apply DBS WT separation for the leader - follower (new aircraft) and for the leader (new aircraft) - follower pairs. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1581
Title	ITD display
Requirement	After start of the compression, the ITD shall be displayed in a coherent way along the glideslope, in order to avoid negatively impacting the Controllers` performance.
Status	<validated>
Rationale	At the start of the compression, the ITD starts merging with the FTD. The ITD displayed on the CWP shall not confuse/degrade ATCO's performance. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1640
Title	Separation Delivery tool failure III
Requirement	In case of Separation Tool Failure, the Supervisors and Controllers shall receive a message containing the source of the tool failure.
Status	<validated>
Rationale	The ATCOs need to be aware of the source of the problem. In conformance with good HF practices. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1670
Title	Total Wind Monitoring Alert
Requirement	In WDS total wind modes (A-TB-WDS-Tw), in case of total wind monitoring alert, the Approach and Tower Controllers shall revert to the correspondent distance based or time based (e.g. TB-PWS) separation mode using the FTD and ITD indicators and when needed take corrective actions during the transition phase like instructing go-around.
Status	<validated>
Rationale	If the WDS Total Wind can no longer be applied the controllers shall switch to the standard separation mode in use. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1680
Title	Cross Wind Monitoring Alert
Requirement	In WDS crosswind modes (WDS-Xw), in case of cross wind monitoring alert, the Approach and Tower Controllers shall revert to the correspondent distance based or time based (e.g. TB-PWS) separation mode, using the FTD and ITD indicators and when needed take corrective actions during the transition phase like instructing go-around.
Status	<validated>
Rationale	If the WDS Cross Wind can no longer be applied the controllers shall switch to the standard separation mode in use. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1690
Title	Trigger for Headwind, Total and Cross Wind Monitoring Alert
Requirement	The triggering values of the headwind, total wind and cross wind monitoring alerts shall be determined on the basis of the used buffers in the TDI computation.
Status	<validated>
Rationale	The wind safety buffer in the TDI computation is used to cover the differences between measured wind and actual situation. Depending on the buffer used, an additional buffer on the wind can be used when defining the triggering values for WDS activation (e.g. WDS Cross wind reductions could start to be applied with 7 knots crosswind but then 9 knots is decided to be used as activation value). This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1700
Title	Speed conformance alert III
Requirement	In TB-modes, in case of speed conformance alert before the stabilisation fix, the Final Approach or Tower Controllers shall check whether the actual spacing behind the leader aircraft is below the distance-based WTC separation minima and if positive shall apply adequate corrective actions: airspeed instructions, path stretching instructions (if allowed after localiser interception), delegation of visual separation to Flight Crew and, if necessary, missed approach instruction, and shall manage the impact on subsequent aircraft in the arrival sequence.
Status	<validated>
Rationale	If an aircraft lands faster than what predicted by the speed profile in the separation delivery tool the compression information represented by the ITD might not be correct, thus the controllers need to assess the situation and apply the relevant corrective action. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1710
Title	Speed conformance alert IV
Requirement	For all modes, in case of speed conformance alert the Final Approach and Tower Controllers shall be aware that ITD indicators are no longer accurate if the same speed is kept until the deceleration fix (ITD computation impacted by pre-defined glideslope airspeed profile of both follower and leader) thus shall manage compression without indicators as per today operations.
Status	<validated>
Rationale	The Separation Delivery tool assumes in the speed profile that the aircraft will be at a certain speed at the deceleration fix. If at the deceleration fix the aircraft is flying faster and the speed conformance alert is triggered the compression information represented by the ITD might not be correct. The controllers need then to assess the situation and apply the relevant corrective action. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1720
Title	Approach arrival sequence failure
Requirement	If the Approach Arrival Sequence Service fails, the Separation Delivery tool shall continue displaying TDIs for aircraft already established and shall stop displaying TDIs for all other aircraft.
Status	<validated>
Rationale	The loss of the Approach Arrival Sequence Service does not impact aircraft that are already established hence TDIs should continue to be displayed to reduce the impact on the Controllers. For aircraft not already established there will be no way to know if the sequence information remains reliable hence TDIs will not be displayed. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Monitor Aircraft Spacing Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1721
Title	Separation tool failure with loss of all TDIs (aircraft already established and aircraft going to intercept)
Requirement	In case of separation tool failure with loss of all TDIs (aircraft already established and aircraft going to intercept), the Controllers shall revert to DBS without indicators for all aircraft (one or several aircraft might be instructed to break-off).
Status	<validated>
Rationale	To mitigate Hz06b. This requirement has been validated in RTS2.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1730
Title	Separation tool failure with loss of TDI computation (TDIs preserved for aircraft already established)
Requirement	In case of separation tool failure with loss of TDI computation (TDIs preserved for aircraft already established) a specific separation tool failure alert shall be provided, and the Controllers shall revert to DBS without indicators for aircraft without TDIs. Only for aircraft already established, TDIs that continue to be displayed can be used up to the separation delivery point.
Status	<validated>
Rationale	A complete failure of the Separation Delivery tool means TDIs will turn off suddenly meaning Controllers have to revert to DBS without TDIs. This requirement has been validated in RTS2.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1600
Title	Separation Delivery tool glideslope headwind profile status information

Requirement	For all modes, in case of loss of glideslope headwind profile input to the separation tool, the alert for loss of glideslope headwind profile service shall be displayed to the Controllers and Supervisors.
Status	<validated>
Rationale	The Controllers and Supervisors need to remain aware of the health of the Separation Delivery tool or any supporting tools to ensure a controlled transition to a degraded mode if required. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1650
Title	Degraded mode when glideslope headwind profile is missing in TB mode
Requirement	In TB-modes, in the degraded situation where glideslope headwind profile input is missing: - The Controllers shall revert to the correspondent DB- mode (DBS or S-PWS) with use of FTDs only whilst ITDs shall no more be displayed (manual management of compression) or shall revert to an acceptably safe TB-mode with ITD and FTD computed using a conservative wind profile (until the glideslope headwind profile is available again); OR - The Separation Delivery Tool shall automatically revert to the correspondent DB-mode or to an acceptably safe TB-mode (FTD and ITD computed using a conservative wind profile). A notification of the automatic switch shall be provided to the ATCOs and Supervisors.
Status	<validated>

Rationale	Depending on the local implementation several options could be used to manage the unavailability of headwind glideslope profile. Both FTD and ITD could still be displayed to ATCOs (but in a conservative way) or only FTD. The transition could be manual or automatic by the system. This is applicable for the local implementation where reversal to DBS is done using the ORD tool. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1660
Title	Degraded mode when glideslope headwind profile is missing in DB mode
Requirement	In DB- modes, in the degraded situation where glideslope headwind profile input is missing, the Approach Controller shall use only the FTD for the turn-on decision for merging on to final approach (whilst ITDs shall no more be displayed), vectoring the follower aircraft to intercept the final approach and further spacing management during interception whilst adding extra buffer to the FTD to manually account for compression or shall revert to an acceptably safe DB-mode with ITD and FTD computed using a conservative wind profile (until the glideslope headwind profile is available again).
Status	<validated>

Rationale	Without the headwind profile information in DBS mode the ITD information might not be accurate. The controllers can work using only the FTD or keep displaying the ITD but computed with a conservative wind profile (e.g. low wind conditions) to not negatively impact the compression spacing task. This is applicable when the reversal to DBS is done using the ORD tool. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1760
Title	Runway surface wind alert
Requirement	In case of conditional application in TB-modes, the Supervisors (Tower and Approach) and Controllers (Tower and Approach) shall be alerted automatically in advance when the predefined activation criteria will not be met anymore hence the imminent need to transition from one separation mode to another, in order to temporarily limit or regulate the flow of inbound traffic (e.g. through metering) prior to the switch of separation mode in order to manage the change and controllers workload.
Status	<validated>

Rationale	A conditional application of a concept (e.g. WDS) relies on the total runway surface wind being above a defined threshold to ensure sufficient wake dissipation or transport to allow for the reduced separations while considering the uncertainty in the speed / wind profile. The Supervisors and Controllers will need to be aware if the wind drops below the required threshold so they can complete a controlled reversion (e.g. back to DBS) with TDIs. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1770
Title	Loss of wind monitoring functions
Requirement	Approach and Tower Supervisors shall be alerted when the wind monitoring function for the conditional application of the TB modes (glideslope headwind, total wind, cross wind) are lost or inoperative (encompassing loss of wind input).
Status	<validated>
Rationale	This information is required to assess whether transition shall be put in place. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1771
Title	Controller/ Supervisor Working Position
Requirement	The working positions shall ensure that with the introduction of the Separation Delivery tool related indicators and alerts the displays do not become unnecessarily cluttered.
Status	<validated>
Rationale	The amount of information available on the screens shall be minimised as much as possible. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1772
Title	Controller/ Supervisor Working Position II
Requirement	The input devices shall be designed in a way that allows ATCOs to set up the HMI according to personal preferences, when applicable.
Status	<validated>
Rationale	ATCOs should be able to set up the HMI according to personal preferences, allowing for an enhanced SA and confidence in working with the tools. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1773
Title	General alerts
Requirement	All proposed alerts shall be salient and easy to identify and interpret so that Controllers and Supervisors can react as necessary in a timely and accurate manner.
Status	<validated>
Rationale	Alerts shall be developed in line with human factors in design principles. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.

Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

4.2 Security Requirements

High level security requirements have been provided by the security experts for PJ.02-01-04.

These have been mapped to the PJ.02-01-04 Solutions through the following application of the requirements identifier fields:

- XXXZ is
    - ALL4 when the security requirement applies to all Concepts Solutions
    - SYS3 when the security requirement applies to the three system/software based Concepts Solutions only

The latest consolidated list of high level security requirements has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0001
Title	Security Policy (C2.1)
Requirement	The Responsible Organisation shall produce, approve, and adopt a security policy which complies with the Reference ATM Security Policy; this security policy shall be communicated to all relevant parties. Note: it is recommended that this be based upon the principles set out in ISO-270001:2013, or later.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0002
Title	Reviewing Security Policy (C2.2)
Requirement	The Responsible Organisation shall regularly review the security policy and ensure that it remains effective.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0003
Title	Resourcing & Assigning Security Policy Roles (C3.1)
Requirement	The Responsible Organisation shall provide the resources needed for information and ATM services security and assign roles and responsibilities for all security management functions.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0004
Title	Coordinating Security Controls (C3.2)
Requirement	The Responsible Organisation shall ensure that the implementation of information and ATM services security controls is co-ordinated across the organisation.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0005
Title	Information Storage and Exchange Means (C3.3)
Requirement	Information storage and exchange means shall be defined in accordance with the security value of such information.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

EUROPEAN PARTNERSHIP

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0006
Title	Background Security Verification Checks (C4.1)
Requirement	Background verification checks on all staff shall be carried out in accordance with relevant laws, regulation, and ethics. The checks shall be proportional to the roles and responsibilities, in particular in respect to the business requirements (e.g. safety-critical function, developments), the protective marking or classification of information to be accessed, and the perceived risks.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0007
Title	Staff Application of Security (C4.2)
Requirement	Staff shall apply security in accordance with the established policies and procedures.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0008
Title	Security Awareness Training (C4.3)
Requirement	Staff shall receive appropriate awareness training and regular updates in organisational policies and procedures, as relevant for their job function.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0009
Title	Staff Security Procedures (C4.4)
Requirement	Staff shall undergo a formal rotation, change, and leaving procedure.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0010
Title	Inventory of Assets (C5.1)
Requirement	All assets shall be clearly identified, and an inventory of all important assets drawn up and maintained.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0011
Title	Designated Responsibility (C5.2)
Requirement	All information and ATM services associated with information processing facilities shall be ‘owned’ by a designated responsible individual or role.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0012
Title	Acceptable Use of Asset Policy (C5.3)
Requirement	Rules for the acceptable use of assets shall be identified, documented, and implemented.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0013
Title	Security Classification (C5.4)
Requirement	All Information and ATM services shall be classified in terms of its value, legal requirements, sensitivity and criticality to ATM, ATM organisations and stakeholders.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0014
Title	Labelling and Handling Procedures (C5.5)
Requirement	An appropriate set of procedures for information and ATM services labelling and handling shall be developed and implemented in accordance with the protective marking or classification scheme adopted.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0001
Title	Removable Media Procedures (C5.6)
Requirement	There shall be procedures in place for the management of removable media.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0002
Title	Media Disposal Procedures (C5.7)
Requirement	Media shall be disposed of securely and safely when no longer required, using formal procedures.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0003
Title	Procedures for Handling and Storage of ATM Information (C5.8)
Requirement	Procedures for the handling and storage of ATM information shall be established to protect ATM services and information from unauthorised disclosure or misuse.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0015
Title	Protection of ATM System Documentation (C5.9)
Requirement	ATM system documentation shall be protected against unauthorised access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0016
Title	Access Control Policy (C6.1)
Requirement	An access control policy shall be established, documented, and reviewed based on business and security requirements for access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

EUROPEAN PARTNERSHIP

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0017
Title	Access Control Procedure (C6.2)
Requirement	There shall be an access control procedure in place for granting and revoking access to all information systems and services.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0018
Title	Allocation of Access Privileges (C6.3)
Requirement	The allocation of access privileges shall be restricted to users who have been specifically authorised to use ATM facilities, and such privileges should be controlled by a formal management process.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0004
Title	Access Control Policy for Shared ATM Networks (C6.4)
Requirement	For shared ATM networks, especially those extending across the Responsible Organisation's boundaries, the capability of users to connect to the network shall be restricted, in accordance with the access control policy and requirements of the operational applications.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0005
Title	Utility Programs Policy (C6.5)
Requirement	The use of utility programs that might be capable of overriding system and application controls shall be restricted and tightly controlled.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0006
Title	Sensitive Systems Policy (C6.6)
Requirement	Sensitive systems shall have a dedicated (protected) computing environment.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0007
Title	External Access Policy (C6.7)
Requirement	The Responsible Organisation shall review the security requirements and risks of every external access to information or ATM Services before granting access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0008
Title	User Security Practices (C6.8)
Requirement	User shall be required to follow good security practices in the protection of authentication information or devices.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0009
Title	Unattended Equipment Procedure (C6.9)
Requirement	Users shall ensure that unattended equipment has appropriate protection.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0010
Title	Papers, Media and Information Processing Facilities Policy (C6.10)
Requirement	A security policy for papers and removable storage media and information processing facilities shall be adopted.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

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[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0019
Title	Security Perimeter Policy (C7.1)
Requirement	Security perimeters shall be used to protect ATM sensitive areas and ATM processing facilities.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0020
Title	Entry Control Policy (C7.2)
Requirement	ATM secure areas shall be protected by appropriate entry controls which allow access only to authorised personnel and which detect unauthorised access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0011
Title	Auxiliary Means Policy (C7.3)
Requirement	ATM equipment shall be provided with auxiliary means to compensate for deliberate compromising of power supply, overheating and fire.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0012
Title	ATM Cabling Policy (C7.4)
Requirement	ATM cabling shall be protected from deliberate damage, eavesdropping or interference.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0021
Title	Maintenance and Servicing Policy (C7.5)
Requirement	ATM equipment shall be maintained and serviced to ensure their availability and integrity.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0022
Title	Operating ATM Procedures Policy (C8.1)
Requirement	Operating ATM procedures shall be documented, maintained, and made available to all users who need to know them.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0023
Title	Change Control Procedures Policy (C8.2)
Requirement	Changes to ATM information processing facilities, ATM services and systems shall be controlled.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0013
Title	ATM Software Controls Policy (C8.3)
Requirement	Detection, prevention, and recovery controls to protect ATM software against malicious code and appropriate user awareness procedures shall be implemented.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0014
Title	Back-up Policy (C8.4)
Requirement	Backup copies of ATM information and software shall be taken and tested regularly in accordance with an agreed backup policy.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0015
Title	Monitoring Procedures (C8.5)
Requirement	Procedures for monitoring the use of ATM services and information processing facilities shall be established and the results of the monitoring activities reviewed regularly.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0024
Title	ATM Logging Protection Procedures (C8.6)
Requirement	ATM logging facilities and log information shall be protected against tampering and unauthorised access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0025
Title	Fault Logging and Resolution Procedures (C8.7)
Requirement	Faults shall be logged, analysed, and appropriate action taken.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0016
Title	ATM Networks Policy (C9.1)
Requirement	ATM Networks shall be adequately managed and controlled, in order to be protected from threats, and to maintain security for the ATM systems and applications using the network, including information in transit.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0017
Title	Formal Exchange Policies (C9.2)
Requirement	Formal exchange policies, procedures, and controls shall be in place to protect the exchange of ATM services and information through the use of all types of communication facilities. Agreements shall be established for the exchange of ATM services and information and software between the Responsible Organisation and external parties.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0018
Title	Electronic Messaging Protection Policy (C9.3)
Requirement	Information conveyed by electronic messaging shall be appropriately protected.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0026
Title	Security Requirements Policy (C10.1)
Requirement	Every specification for new or updated facilities shall include security requirements.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0027
Title	Change Control Approval Policy (C10.2)
Requirement	An operational process and plan which controls how system changes are approved and implemented, and how security considerations are incorporated in the change process shall be enacted.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0028
Title	Security Testing Policy (C10.3)
Requirement	Security testing shall be performed whenever a system is updated.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0029
Title	Security Acceptance Criteria Policy (C10.4)
Requirement	Security acceptance criteria for new ATM information systems or services, upgrades, and new versions shall be established, and suitable security tests of the ATM system(s) carried out during development and prior to acceptance. This shall include individual development activities such as specification, design, development and qualification which may have corresponding acceptance criteria.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0030
Title	Reporting of Security Events Policy (C11.1)
Requirement	ATM service and Information security events shall be reported through appropriate management channels as quickly as possible.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0031
Title	Reporting of Suspected Security Weaknesses or Malfunctions Policy (C11.2)
Requirement	All employees, contractors and third party users of information systems and services shall be required to note and report any observed or suspected security weaknesses or malfunctions in ATM systems or services.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0032
Title	Responding to Security Incidents Policy (C11.3)
Requirement	Management responsibilities and procedures shall be established to ensure an effective and orderly response to ATM service and information security incidents.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0033
Title	Security Incident Evidence Management Policy (C11.4)
Requirement	Where a follow-up action against a person or organisation after an ATM service or information security incident involves legal action (either civil or criminal), pieces of evidence shall be collected, retained, and presented to the relevant jurisdiction(s).
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0034
Title	Security Incident External Authorities Involvement Policy (C11.5)
Requirement	The Responsible Organisation shall have procedures in place that specify when and by whom external authorities (e.g. law enforcement, fire department, supervisory authorities) shall be contacted in the event of a security incident.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0035
Title	ATM Business Continuity Security Requirements Policy (C12.1)
Requirement	A managed process shall be developed and maintained that addresses the ATM service and information security requirements needed for ATM business continuity.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0036
Title	Disruptive Events Identification and Risk Assessment Policy (C12.2)
Requirement	Events that can cause interruptions to ATM business processes shall be identified, along with the likelihood and impact of such interruptions and their consequences for ATM information security.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0037
Title	Planning Policy for Restoration from Disruptive Events (C12.3)
Requirement	Plans shall be developed and implemented to maintain or restore operations and to ensure the availability, integrity and confidentiality of information at the required level and in the required time scales following interruption to critical ATM business processes.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0038
Title	Policy for Testing and Updating Business Continuity Plans (C12.4)
Requirement	ATM business continuity plans shall be tested and updated regularly to ensure that they are up to date and effective.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0039
Title	Compliance Policy (C13.1)
Requirement	Compliance to statutory, regulatory and contractual requirements shall be checked, and the correct and authorised use of facilities and assets shall be defined.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0040
Title	Compliance to National and European Requirements (C13.2)
Requirement	Any personal or protectively classified information shall be protected in accordance with National and European requirements.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0019
Title	Malicious Software Policy (C8.3 PR1)
Requirement	The software development and production process shall detect and remove malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0020
Title	Malicious Software Removal on Detection Policy (C8.3 PR2)
Requirement	The software management process shall ensure that all detected malicious software is removed on detection.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0021
Title	Malicious Software User Policy (C8.3 PR3)
Requirement	Once detected users shall be immediately informed of the event and as soon as possible provided with detailed of any effects.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0022
Title	Software Installation Media Policy (C8.3 PR4)
Requirement	Software shall only be installed from verified media.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0023
Title	Software Validation and Verification Testing Policy (C8.3 PR5)
Requirement	Only software which has been the subject of documented validation and verification testing shall be installed.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0024
Title	Related Systems Malicious Software Policy (C8.3 PR6)
Requirement	The software management process shall ensure that related systems are informed of any infection or repulsed malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0025
Title	Malicious Software Staff Training Policy (C8.3 PR7)
Requirement	Software development, operations, maintenance and management staff shall be proved with periodic training on type of malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0026
Title	Malicious Software Operational System Fall-Back Policy (C8.3 PR8)
Requirement	The operational system shall retain the most recent (-1) version of software to provide an immediate fall-back if the detected malicious software requires cessation of operations.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0027
Title	Scanning Policy (C8.3 TR1)
Requirement	The detection and removal system shall scan all software before installation, all data items that are input to the system, all data and software on access and scan all system software in every 7 day period.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0028
Title	Operational Systems Malicious Software Protection Policy (C8.3 TR2)
Requirement	For operational systems, protection against detected malicious software shall be achieved within 10 minutes of detection. If cessation of operations is necessary, this shall be done as soon as operationally safe to do so.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0029
Title	New Form of Malicious Software Protection Policy (C8.3 TR3)
Requirement	In response to information about a new form of malicious software development and operation software shall be reviewed for presence. The detection software shall utilise signature databases from a reputable security source; systems connected to the Internet shall update their detection databases within 12 hours of the availability of new signatures, or within 72 hours if the system has no Internet connection.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0030
Title	Malicious Software User Notification Policy (C8.3 TR4)
Requirement	The system and its management processes must ensure that users are notified of the detection of malicious software or any other security event that may cause perceptible loss of performance or a safety risk; such notification shall be within 1 hour of the identification of the risk.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0031
Title	Malicious Software Alerting Policy (C8.3 TR5)
Requirement	The System shall alert the Security and Software Management processes within 5 minutes of detecting malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0032
Title	Verified Media Definition Policy (C8.3 TR6)
Requirement	Verified media shall be defined within the Software Management process.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0033
Title	Validation and Verification Processes Policy (C8.3 TR7)
Requirement	Validation and verification processes to be used shall be based on industry standards e.g. ISO or Def Standards and industry best practices.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0034
Title	Malicious Software Staff Training Policy (C8.3 TR8)
Requirement	Training to staff shall ensure that all users understand and practice processes for handling media, are aware of the risks resulting from malicious software and the mechanisms by which such software may be inadvertently introduced into the system, and understand general security requirements and good practice for the protection of security tokens such as passwords and access controls. Users shall demonstrate current knowledge of these issues at intervals of no less than 1 year.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0035
Title	Operational Software Access Restriction Policy (C8.3 TR9)
Requirement	The Security and Software management processes shall maintain an up to date listing of those who have been trained and shall restrict access to operational software to those who have been trained and are current.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0036
Title	Virus Protection Policy (C8.3 TR10)
Requirement	To achieve the highest protection against virus introduction White Listing (or an acceptable industry standard equivalent) shall be used.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01-04

EUROPEAN PARTNERSHIP

Co-funded by the European Union

5 References and Applicable Documents

5.1 Applicable Documents

Content Integration

[1] B.04.01 D138 EATMA Guidance Material
[2] EATMA Community pages
[3] SESAR ATM Lexicon

Content Development

[4] B4.2 D106 Transition Concept of Operations SESAR 2020

System and Service Development

[5] 08.01.01 D52: SWIM Foundation v2

[6] 08.01.01 D49: SWIM Compliance Criteria

[7] 08.01.03 D47: AIRM v4.1.0

[8] 08.03.10 D45: ISRM Foundation v00.08.00

[9] B.04.03 D102 SESAR Working Method on Services

[10]B.04.03 D128 ADD SESAR1

[11]B.04.05 Common Service Foundation Method

Performance Management

[12]B.04.01 D108 SESAR 2020 Transition Performance Framework

[13]B.04.01 D42 SESAR2020 Transition Validation

[14]B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition.

[15]16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model

[16]16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA

[17]Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)

[18]ATM Cost Breakdown Structure_ed02_2014

[19]Standard Inputs for EUROCONTROL Cost Benefit Analyses

[20]16.06.06_D26-08 ATM CBA Quality Checklist

[21]16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms

EUROPEAN PARTNERSHIP

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Validation

[22] 03.00 D16 WP3 Engineering methodology

[23]Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects

[24]European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

System Engineering

[25]SESAR 2020 Requirements and Validation Guidelines

Safety

[26] SESAR, Safety Reference Material, Edition 4.0, April 2016

[27]SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

[28]SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[29]SESAR, Resilience Engineering Guidance, May 2016

Human Performance

[30]SESAR Human Performance Assessment Process V1 to V3 - including VLD, Edition 03.01, January 2020

[31]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[32]SESAR, Environment Reference Material, alias, “Environmental impact assessment as part of the global SESAR validation”, Project 16.06.03, Deliverable D26, 2014.

[33]ICAO CAEP – “Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes” document, Doc 10031.

5.2 Reference Documents

[34]P06.08.01, Wake Turbulence Re-Categorisation and Pair-Wise Separation Minima on Approach and Departure (RECAT-PWS-EU) Safety Case, v1.2, D38, 4th February 2016.

[35]P06.08.01, OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED, D30, 00.00.01, 31st May 2016.

[36]ICAO Doc 8168, Aircraft Operations.

[37]ICAO Document 4444 - ICAO Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM), Doc 4444, Fifteenth Edition, 2007.

[38]ICAO DOC 8643 – ICAO, Aircraft Type Designators

[39]ICAO State Letter on update guidance for wake turbulence aspects of Airbus A380-800 aircraft, July 2008.

[40]P06.08.01, Operational Service and Environment Definition (OSED) for Time Based Separation for Arrivals (TBS), 00.01.02, D05, 3rd June 2013.

[41]P06.08.01, TBS, ORD, S-PWS and WDS for Arrivals OSED, 00.00.04, 16th October 2015.

[42]OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED, P06.08.01 D30, Edition 00.01.00, 31st May 2016

[43]D1.1.04 – PJ.02-01-04 VALR (Final) – 01.00.00

[44]PJ.19-W2: Validation Targets - SESAR2020 Wave 2 & Wave 3 - 00.00.04

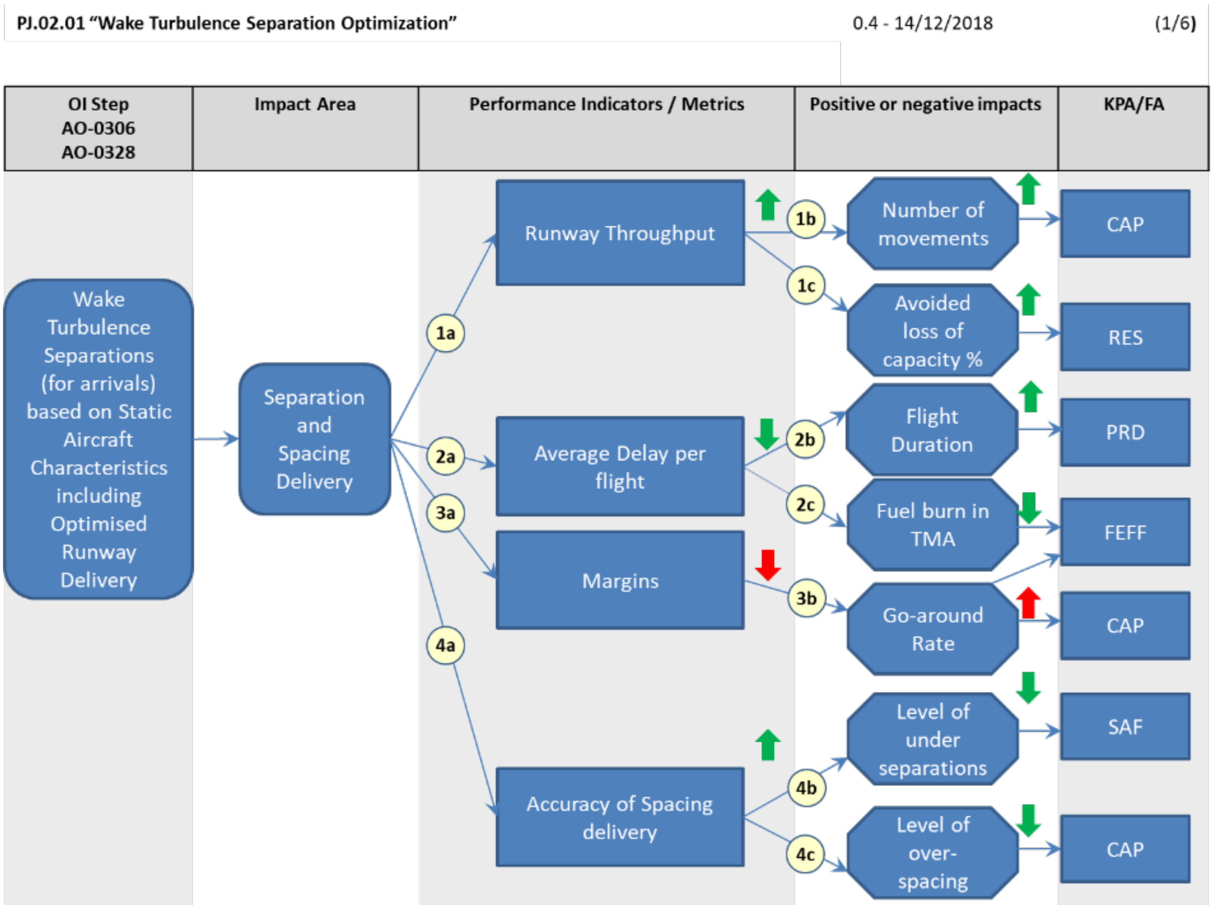
Appendix A Cost and Benefit Mechanisms

A.1 Stakeholders identification and Expectations

Stakeholder	Involvement	Why it matters to stakeholder
Flight Crew	Are subjected to new wake turbulence separation rules applied by ATC.	Flight crews need to be aware of updated wake separation rules. Flight crews need to trust the safety of the applied rules.
Flight Crew	Are aware of concepts deployment and impact on reduced separations	They are responsible for the safety of aircrew and passengers on-board. It is important that they respond to the ATCO instructions promptly.
Airport Operator	They cope with the arrivals traffic pressure	Arrivals concepts deployment can provide capacity, resilience and predictability benefits to the arrival flow
ANSP	They deploy the arrivals concepts	They manage the air traffic control operations
Regulator	They need to approve the use of the concepts	They regulate the standards for air traffic control
ATCO	They provide ATC services and apply separations based on the concepts	The use of the tool and arrivals concept shall not impact their workload altering safety of operations
Airline Operator	They schedule the flights	Improved capacity, predictability and resilience can reduce disruptions and provide financial benefits.

Table 24: Stakeholder's expectations

A.2 Benefits mechanisms



(1a) The use of PWS-A is expected to reduce wake separation between arrivals. The use of ORD impacts the separation and spacing delivery between arrivals. The resulting optimised separation and spacing delivery increases the runway throughput.

(1b) The higher the throughput, the higher the number of movements, leading to a positive impact on Capacity.

(1c) Reduction of separations and spacing will result in higher Resilience and avoid loss of capacity.

(2a) Reduction of separations and spacing will reduce the average delay per flight.

(2b) Reduction of average delay per flight will reduce the variance between the flight duration and its planned duration (without delays). This has a positive impact on Predictability.

(2c) As airborne delay uses more fuel (e.g. in case of holding), a reduction in this delay will result in reduced fuel burn in the TMA. This has a positive impact on Fuel Efficiency.

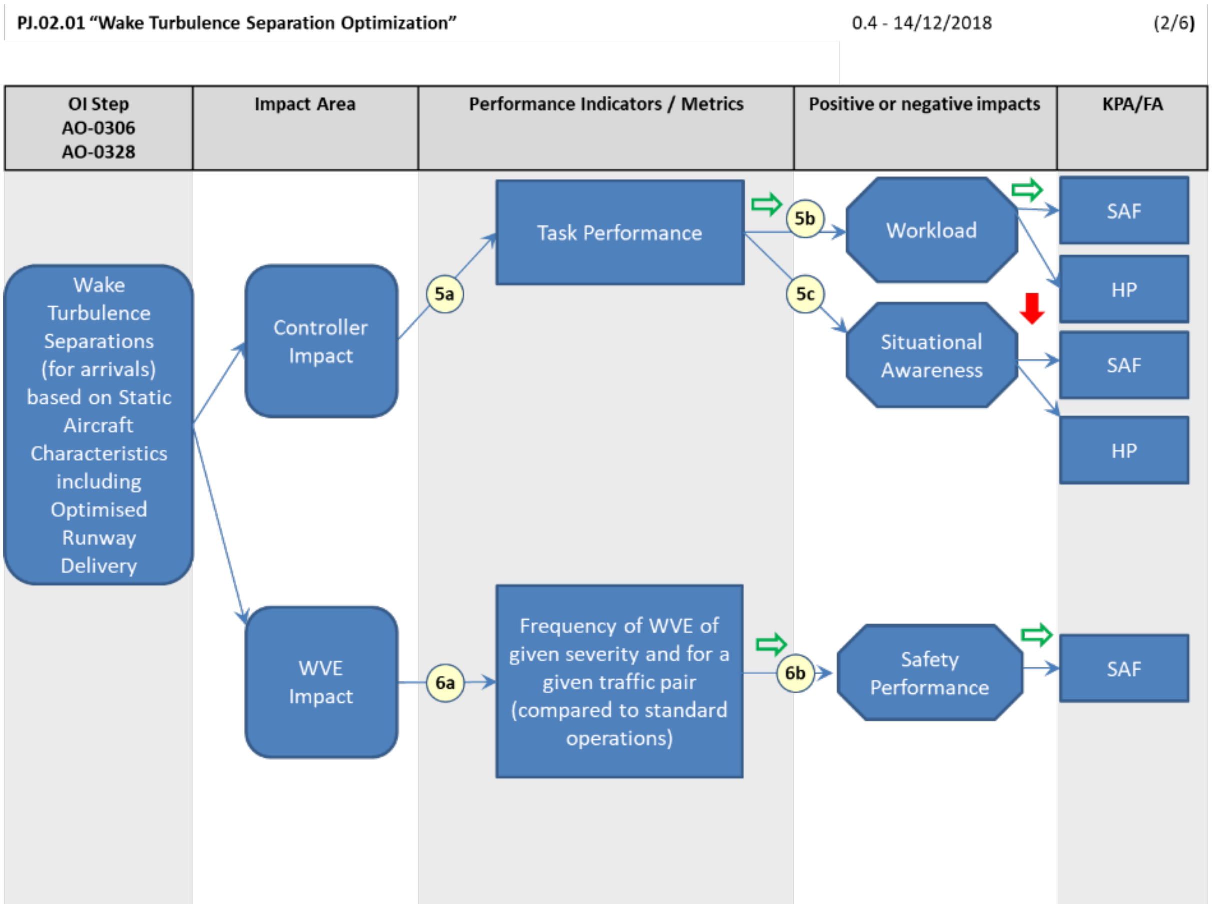
(3a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will reduce the margins delivered.

(3b) This may increase the go-around rate and will affect Capacity and Fuel Efficiency.

(4a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will allow controllers to deliver aircraft with greater accuracy than today.

(4b) Improving spacing accuracy will reduce the number of aircraft that are under-separated which links to Safety.

(4c) Improving spacing accuracy will enable more aircraft to be sequenced with reduced spacing which links to Capacity.



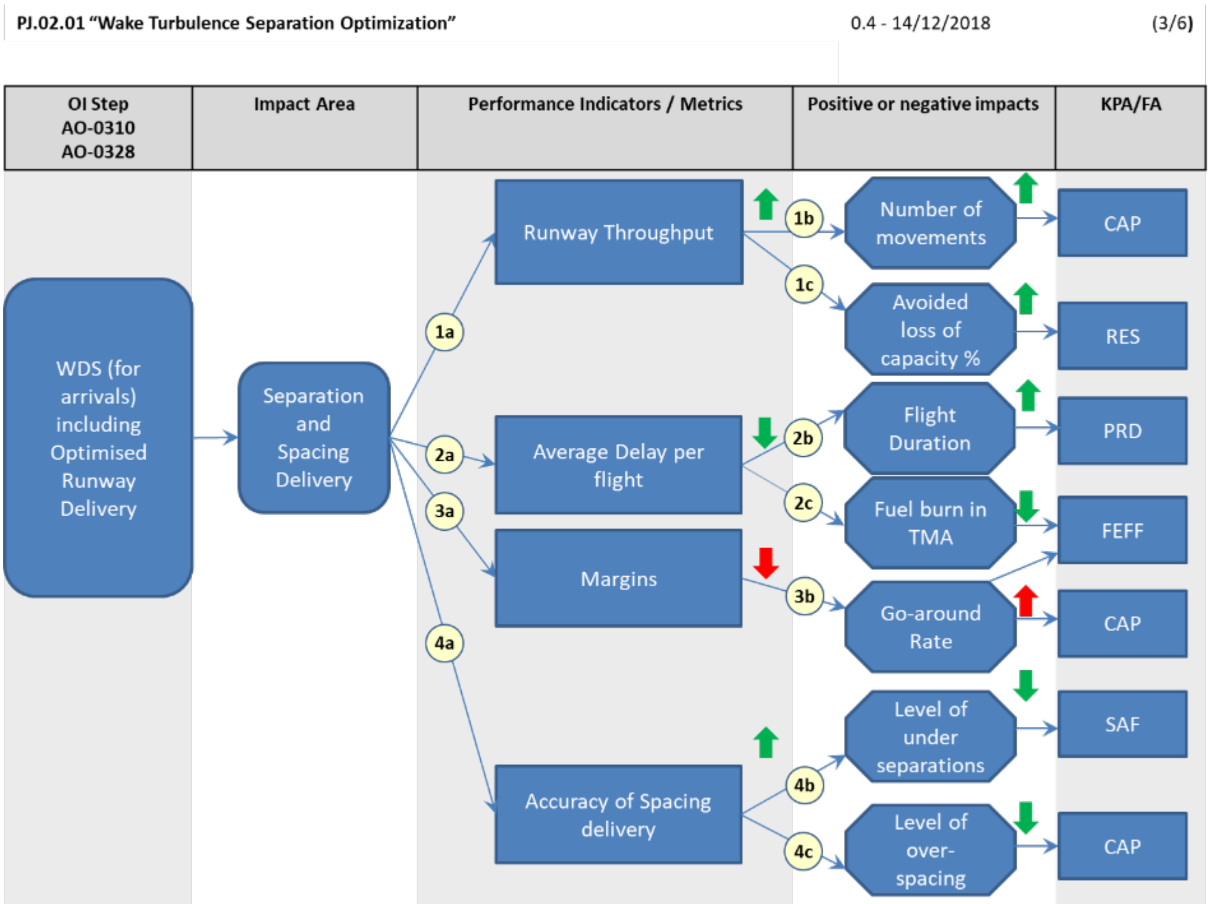
(5a) Controller reliance on target indicators may impact Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

(5b) Overall workload will not increase. It is expected that workload will increase for some tasks such as using the new Sequencing tool HMI. However the benefits of tool support (i.e. the target distance indicators) will reduce workload in other areas so no changes are expected to Safety and Human Performance.

(5c) Reduced Situational Awareness (less aware of aircraft type), if below acceptable levels, could result in a decreased Safety and Human Performance.

(6a) Using PWS-A will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(6b) No increase in potential WVEs, will not impact safety performance – links to Safety.



(1a) The use of WDS-A (e.g. for WDS based on crosswind when crosswind is above the activation threshold) is expected to reduce the separation between arrivals. The use of ORD impacts the separation and spacing delivered between arrivals. The resulting optimised separation and spacing delivery increases the runway throughput.

(1b) Increased average runway throughput will result in an increase Capacity.

(1c) Reduction of separations and spacing will result in higher Resilience and avoid loss of capacity.

(2a) Reduction of separations and spacing will reduce the average delay per flight.

(2b) Reduction of average delay per flight will reduce the variance between the flight duration and its planned duration (without delays). This has a positive impact on Predictability.

(2c) As airborne delay uses more fuel (e.g. in case of holding), a reduction in this delay will result in reduced fuel burn in the TMA. This has a positive impact on Fuel Efficiency.

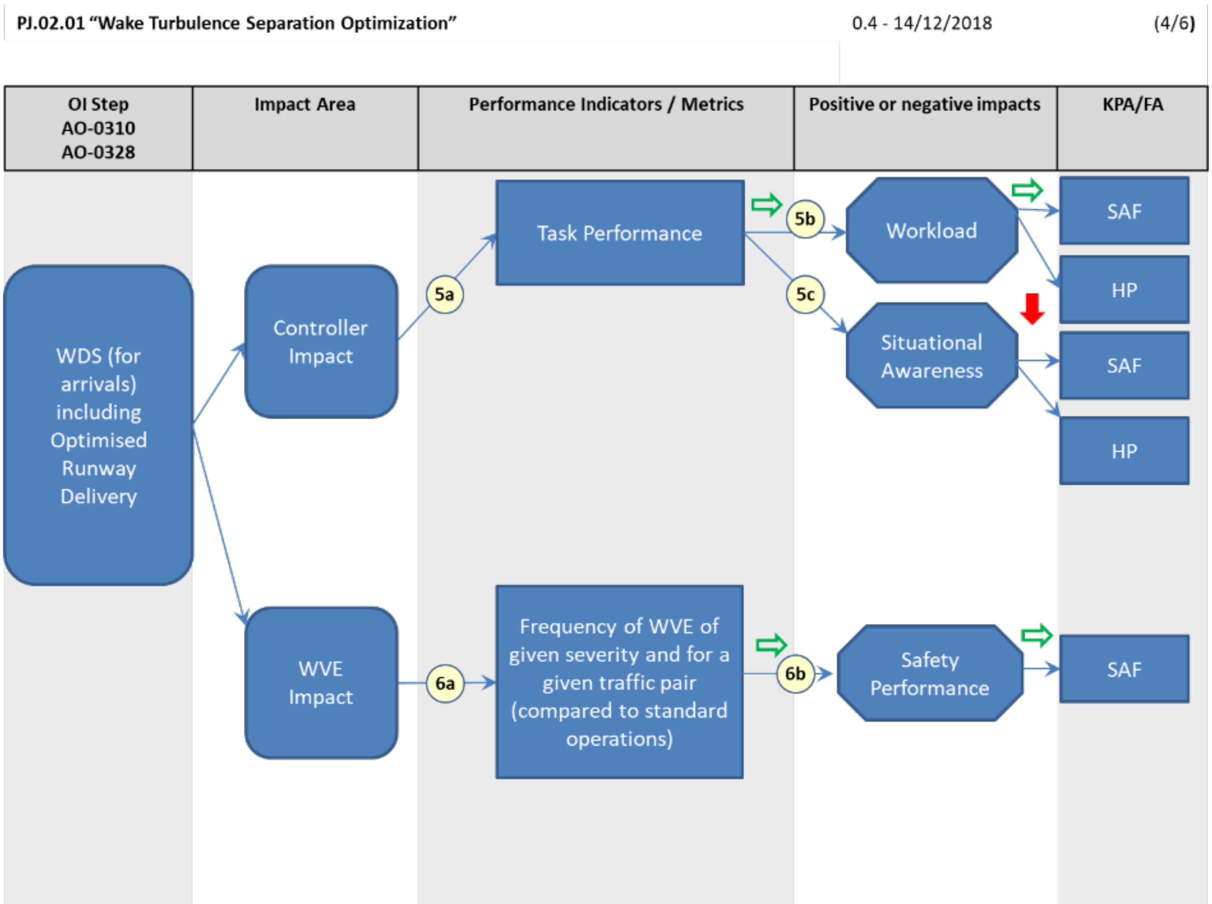
(3a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will reduce the margins delivered.

(3b) This may increase the go-around rate and will affect Capacity and Fuel Efficiency.

(4a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will allow controllers to deliver aircraft with greater accuracy than today.

(4b) Improving spacing accuracy will reduce the number of aircraft that are under-separated which links to Safety.

(4c) Improving spacing accuracy will enable more aircraft to be sequenced with reduced spacing which links to Capacity.



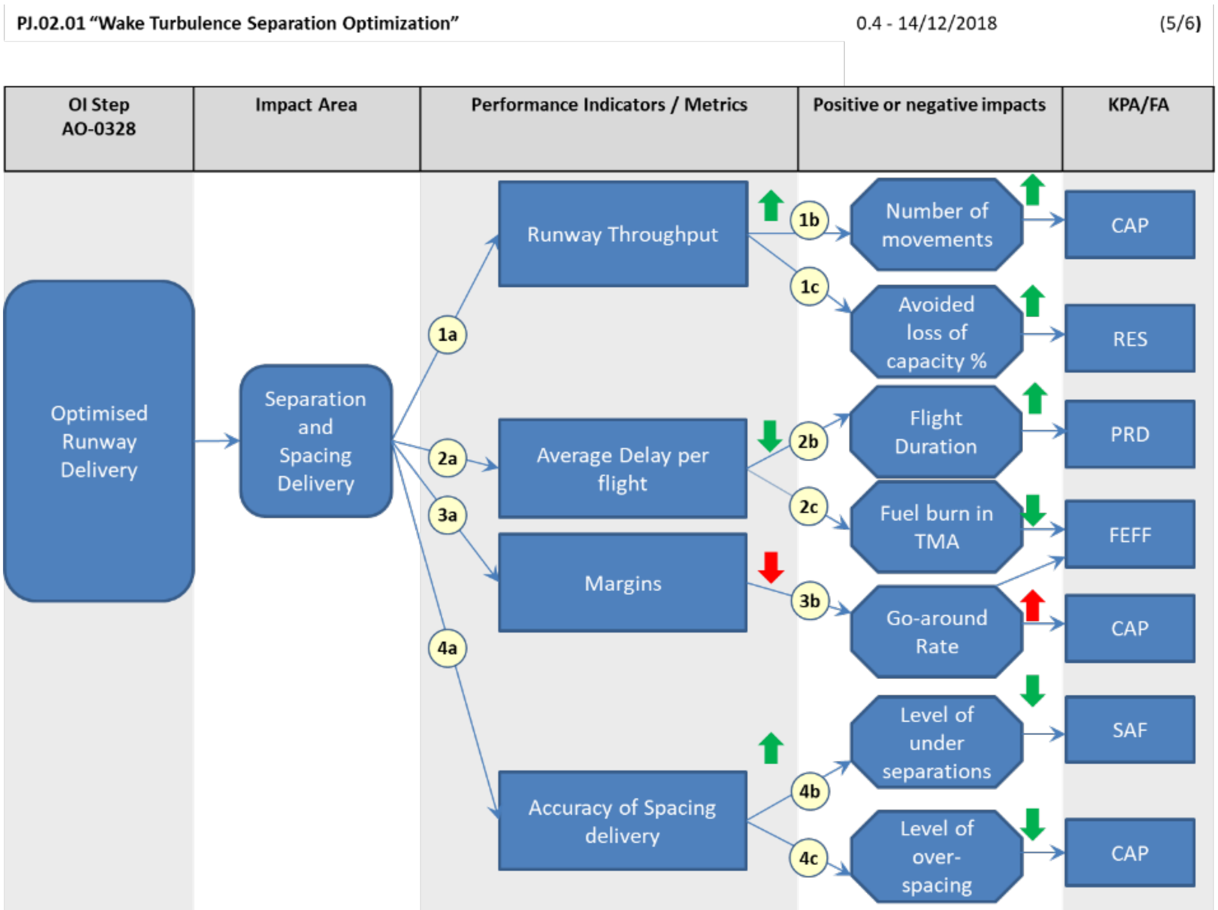
(5a) Controller reliance on target indicators may impact Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

(5b) Overall workload will not increase. It is expected that workload will increase for some tasks such as using the new Sequencing tool HMI. However the benefits of tool support (i.e. the target distance indicators) will reduce workload in other areas so no changes are expected to Safety and Human Performance.

(5c) Reduced Situational Awareness (less aware of aircraft type), if below acceptable levels, could result in a decreased Safety and Human Performance.

(6a) Using WDS-A will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(6b) No increase in potential WVEs, will not impact safety performance – links to Safety.



(1a) The use of ORD impacts the separation and spacing delivery between arrivals. The resulting optimised separation and spacing delivery increases the runway throughput.

(1b) The higher the throughput, the higher the number of movements, leading to a positive impact on Capacity.

(1c) Optimised separations and spacing delivery will result in higher Resilience and avoid loss of capacity.

(2a) Optimised separations and spacing delivery will reduce the average delay per flight.

(2b) Reduction of average delay per flight will reduce the variance between the flight duration and its planned duration (without delays). This has a positive impact on Predictability.

(2c) As airborne delay uses more fuel (e.g. in case of holding), a reduction in this delay will result in reduced fuel burn in the TMA. This has a positive impact on Fuel Efficiency.

(3a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will reduce the margins delivered.

(3b) This may increase the go-around rate and will affect Capacity and Fuel Efficiency.

(4a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will allow controllers to deliver aircraft with greater accuracy than today.

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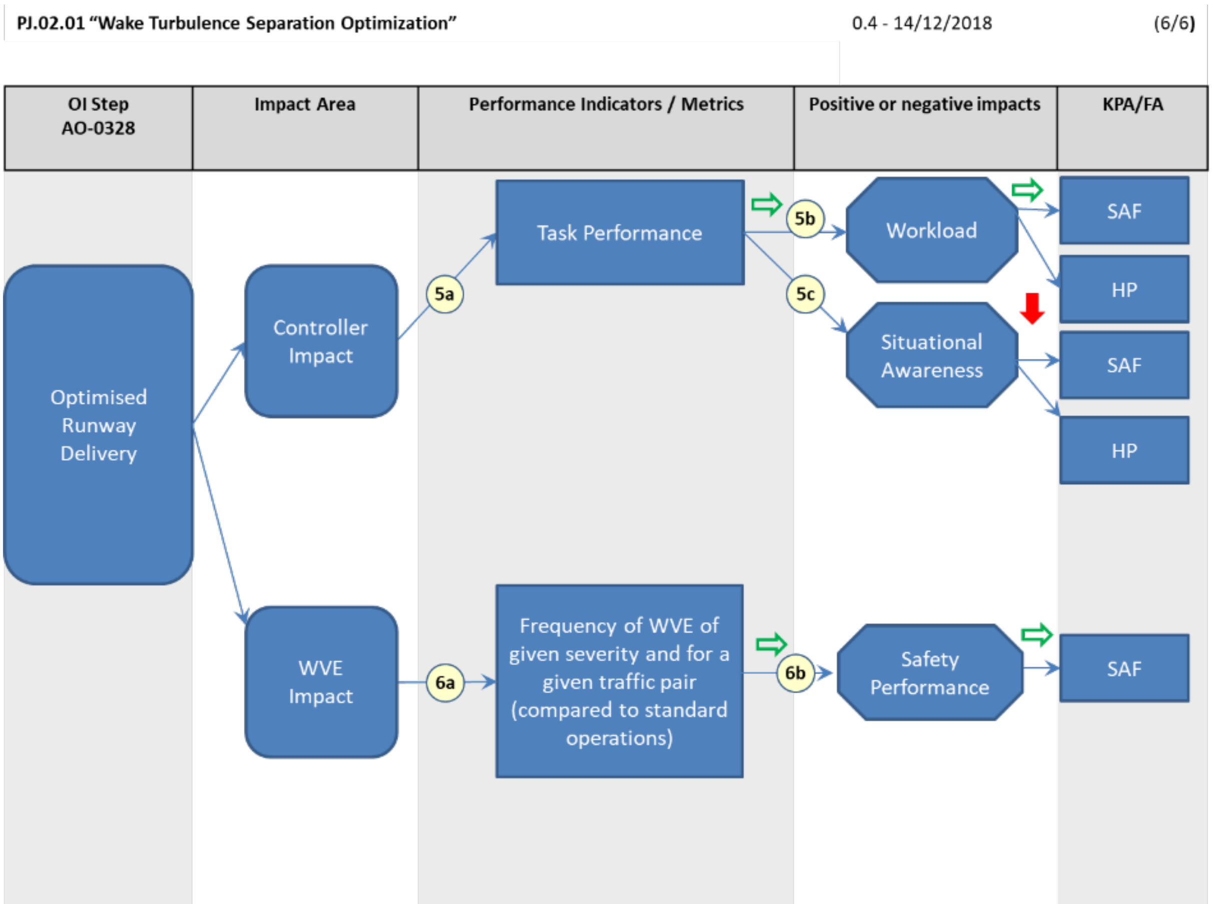

(5a) Controller reliance on target indicators may impact Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

(5b) Overall workload will not increase. It is expected that workload will increase for some tasks such as using the new Sequencing tool HMI. However the benefits of tool support (i.e. the target distance indicators) will reduce workload in other areas so no changes are expected to Safety and Human Performance.

(5c) Reduced Situational Awareness (less aware of aircraft type), if below acceptable levels, could result in a decreased Safety and Human Performance.

(6a) Using ORD will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions.

(6b) No increase in potential WVEs, will not impact safety performance – links to Safety.

A.3 Costs mechanisms

The main cost drivers for the Arrivals Concepts Solutions are:

- The development and validation of the local method of operations covering all local nominal, non-nominal and failure scenarios.
- The training of the ATCOs and Supervisors and the development and provision of the supporting real-time simulation training facilities and briefing materials.
- The briefing of the Airline Operators and Airspace Users and the development and provision of the supporting briefing materials.
- The data mining and analysis of the local aircraft behaviour on final approach required to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support.
- The data mining and analysis of the local final approach wind conditions aloft behaviour and runway surface wind conditions behaviour required to characterise the required performance of the final approach wind profile modelling in the ATC tool support.
- The data mining and analysis of the local aircraft behaviour on each arrival runway with respect to expeditious exit taxiway vacation and associated runway occupancy time profiles required to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support to provide for ROT Spacing support for clearance to land.
- The development and provision of the required local ATC tool support, the associated integration with the local ATC systems and services with respect to the provision of the required information and events, and the associated integration with the controller and supervisor workstation position facilities with respect to the provision of the required display and HMI interaction facilities support.
- The support of the required optimised wake turbulence separations by the local ATC tool support.
- The development and provision of the required local final approach wind conditions aloft service.
- The provision of the required local runway surface wind conditions service.
- The preparing of the local case with the associated evidence, and the activities for obtaining the local regulatory approval.
- The development of the system support for local post operational monitoring and the provision of the associated local resources for carrying out, reporting and acting on the monitoring findings and associated recommendations.
- The local ATC tool support maintenance costs with respect to accommodating new aircraft types and with respect to actioning required refinements to the characterisation of the aircraft type behaviour modelling and actioning required refinements to the final approach wind profile modelling.

The integration with local ATC systems includes consideration of:

- Surveillance tracking of the arrival aircraft on the intermediate and final approach path legs until entering the airport surface radar blanking area approaching the runway landing threshold.
- Provision of a high integrity final approach arrival sequence order out to the horizon that separation/spacing support is required to be provide to the approach controllers. This may be

through provision of the electronic flight progress strip order of the final approach controller, or through the population and controller amendment of the AMAN sequence order, or through the provision of an auto-sequence function or an automatic checking and correction function in the ATC tool support.

- Provision of the flight data for the arrival aircraft on intermediate and final approach. This may be from the AMAN System or from the Flight Data Processing (FDP) System.
- Provision of the other Separation and Spacing Minima that are required to be applied; both non-changing pre-configured criteria such as the MRS associated with the Surveillance Service being employed by the approach controllers and also the prevailing operating conditions dependent criteria such as the Spacing Minima required to be applied for the runway surface conditions and the visual conditions in order to ensure provision of the required spacing for the clearance to land procedures. The required Spacing Minima may be provided through the AMAN System.
- Provision of scenario specific spacing requirements such as gaps for accommodating crossing movements, gaps for accommodating departure aircraft in mixed mode operations, and gaps for other reasons such as for accommodating a runway inspection for foreign objects and debris.
- Provision of runway surface wind conditions from the local runway anemometer service.
- Provision of the final approach wind conditions aloft profile through a suitable MET Service which may include local derivation from the downlinked Enhanced Mode S airborne parameters in the secondary surveillance data of the local final approach surveillance service.

The above are reflected in the enablers for each of the Arrivals Concepts Solutions listed below.

AO-0328: Optimised Runway Delivery on Final Approach

- AERODROME-ATC-68: ATC system to support optimised runway delivery on final approach (Required)
- APP ATC 120: ATC system to support optimised runway delivery on final approach (Required)
- APP ATC 99: ATC System to use Real-Time Meteo Information Received from Met Systems (Required)
- STD-093: EUROCONTROL Guidelines for Optimised Runway Delivery (Required)

AO-0306: Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics

- AERODROME-ATC-42a: Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information (Required)
- APP ATC 118: ATC System to support static pair-wise wake separation (S-PWS) on approach (Required)
- REG-0523: Regulatory provisions (AMC) for static pair-wise wake separation minima (S-PWS) (Required)
- STD-HNA-13: Non-ICAO Standards for 'Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information' (Required)

AO-0310: Weather-dependent reductions of Wake Turbulence Separations for final approach

- APP ATC 74: ATC System Support for Reduced, Weather-Dependent Separation Standards in Final Approach (Required)
- APP ATC 99: ATC System to use Real-Time Meteo Information Received from Met Systems (Required)

 Co-funded by the European Union

Annex A SESAR PJ.02-01 PWS Arrivals and Departures Methodology & Results

The following document presents the results of the study to update the RECAT pairwise wake turbulence separation matrix for arrivals and departures (RECAT-PWS):

Annex A_SESAR W2 PJ02-01_PWS_metho