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D12.5.120 - PJ14-W2-84e-TRL6 Final TS/IRS– Surveillance Performance Monitoring Tool for Cooperative Sensors

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PJ.14 W2 I-CNSS

PJ.14-W2-84E SURVEILLANCE PERFORMANCE MONITORING TOOL FOR COOPERATIVE SENSORS

This Technical Specification is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874478 under European Union's Horizon 2020 research and innovation programme.

Abstract

The objective of this document is to produce the final technical requirements after validating the implementation of Surveillance Performance Monitoring (SPM) tools for the Cooperative (ADS-B, WAM, MLAT) sensors targeting TRL6.

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1 Executive summary

PJ.14-W2-84e Surveillance Performance Monitoring Tool for Cooperative Sensors aims at adapting the detailed assessment methods and tools from Wave 1 to take into account the evolution of the emerging standards that follow the performance-based approach. PJ.14-W2-84e will:

- complete the work performed in wave 1 by solution PJ14.04.01 on enablers (CTE-S07a for ER & TMA and CTE-S07b for Surface) and align to the relevant standards that were not completed and published during wave 1 (i.e., EUROCAE ED-142A for WAM and ED-129C for ADS-B).
- contribute to the harmonisation of surveillance performance assessment through detailed specification and close cooperation between tool prototype providers and ANSPs

The aim of this document is to produce the technical requirements for the implementation of Surveillance Performance Monitoring (SPM) tools for the performance analysis at sensor level of Cooperative (ADS-B, WAM, MLAT) sensors targeting TRL6.

The SPM TS/IRS is dependent on the input from the standards for Cooperative Surveillance.

At the time of the development of this TS/IRS, the level of maturity of the relevant standards defining the methods are heterogeneous:

- ADS-B standard ED129B is published,
- ADS-B standard ED129C is still under development
- WAM standard ED142A is still under development[1],
- MLAT standard ED117A is published in September 2016 but the concept is not fully harmonised with the above standards documents
- Generic Surveillance Standard ED-261 (GEN-SUR SPR) is under open consultation

One of the objectives of PJ.14-W2-84e is the harmonisation of the tools. Recognising there is a trend of the standards towards harmonisation, the choice in this TS/IRS has been made to harmonise the various metric assessment methods in line with this trend started by ED129B and continued with the on-going standards. During the elaboration of initial TS/IRS a number of open points were identified in the standards and used for exchanges with the related groups (EUROCAE), such as Maximum Update Delay assessment, reported covariance assessment.

[1] ED142 is dated September 2010 and is considered outdated

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2 Introduction

This project is part of the SESAR 2020 Multi Annual Program for the period 2019-2022. It is part of the Industrial Research & Validation phase, developed under the SJU Private Public Partnership. Solution PJ.14-W2-84e is a continuation of the work initiated by PJ14-04-01 which reached Maturity TRL4 at the end of wave 1. The solution targets now Maturity TRL6 at the end of wave 2.

Communications, Navigation and Surveillance (CNS) systems provide the invisible and often unappreciated infrastructure which is essential for Air Traffic Management. CNS enables efficient navigation and safe separation in all phases of flight.

In Surveillance, several SESAR solutions will be developed to enhance, harmonize and integrate cooperative and emerging non-cooperative sensors, advanced multi-sensors data fusion capabilities, security related functionality together with the methods and tools for Surveillance Performance Monitoring. This is in line with a Performance-based Surveillance (PBS) approach.

The objective of the solution PJ.14-W2-84e is to enable a harmonised performance monitoring of surveillance systems. Such monitoring will seek to identify degradation trends early, using both off-line and in continuous quasi real-time processes. In the PJ.14-W2-84e this will be applied at sensor level (the output of the entire surveillance chain is handled in solution PJ.14-W2-84f). It is expected that the SPM tool can be used for performance assessment of cooperative sensors (WAM, ADS-B, MLAT). It is to be noted that performance assessment methods for some of these sensor types are still developing and that the available classical methods and tools are considered to be inadequate. In this regard, recognising there is a trend of the standards towards harmonisation, already during wave 1 the choice has been made to harmonise the various metric assessment methods in line with this trend started by ED129B and continued with the on-going standards and is continued also in this TS/IRS. This approach is also expected to provide useful feedback to the standards under development and to future updates.

PJ.14-W2-84e will

- Identify the baseline material driving performance requirements and assessment methods for surveillance sensors.
- Implement and verify the “harmonized” tools (when possible)
- Validation of developed SPM tools
- Derive the related tools technical specifications

2.1 Purpose of the document

The main purpose of the Technical Specification document is to provide the requirements specification, covering functional, non-functional and interface requirements related to SESAR Solution PJ.14-W2-84e, for the Cooperative (ADS-B, WAM, MLAT) part of the Surveillance Performance Monitoring (sensor level).

2.2 Scope

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This document is the final TS/IRS for the Solution PJ.14-W2-84e Surveillance Performance Monitoring Tool for Cooperative Sensors for TRL6-phase. This final TS/IRS covers functional, non-functional and interface requirements related to SESAR Solution PJ.14-W2-84e for the Cooperative (ADS-B, WAM, MLAT) part of the Surveillance Performance Monitoring (sensor level).

2.3 Intended readership

This document can be of interest to Solution PJ.14-W2-84a Multi sensor Data Fusion and Solution PJ.14-W2-84f Surveillance Performance Monitoring at end-to-end for En-route & TMA due to the synergies between these solutions:

- PJ.14-W2-84a: to support initial verification of the surveillance data prior to it is input to the multi-sensor data fusion component of PJ.14-W2-84a.
- PJ.14-W2-84f: to share requirements/information/rationale that would be applicable to the end-to-end part.
- PJ.19.04 project: having an interest on matters related to safety or CBA

2.4 Background

Solution PJ.14-W2-84e is a continuation of the work initiated by PJ14-04-01 which reached Maturity TRL4 at the end of wave 1. The solution targets now Maturity TRL6 at the end of wave 2. Some requirements have been reviewed to take into account the latest versions of the standards, and new requirements have also been created in order to fully cover the targeted Maturity TRL6.

2.5 Structure of the document

The structure of the document is composed of the following sections:

- **Section 1:** Summary
- **Section 2:** This section introduces the document
- **Section 3:** Provides general context of the project,
- **Section 4:** Details Functional and non-Functional requirements
- **Section 5:** Provides some recommendation for implementation
- **Section 6:** Provides the assumptions considered in the Technical Specification
- **Section 7:** Lists the relevant references used within this document

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2.6 Glossary of terms

Term	Definition	Source of the definition
Aircraft Identity	Mode 3/A code and/or Aircraft Identification (Target Identification)	*ED142A*
Cell Grid	Division of the OSV into equal sized 2D/3D cells in a cartesian coordinate system	*ED129C, Section 6.6*
Entry/Birth	The event time for the first target report for an aircraft within the OSV or the cell grid, depending whether the aircraft entry through boundary or starting within OSV/cell.	*Eurocontrol SRS Products*
Exit/Death	The event time for the last target report for an aircraft within the OSV or the cell grid, depending whether the aircraft exits through boundary or ends within OSV/cell.	*Eurocontrol SRS Products*
False Target	A supernumerary or outlier target report corresponding to a true aircraft located in the OSV at the time of applicability of the target report	*ESASSP Ed 1.2, Section 4.1*
Ghost Target Report	A target report not corresponding to a true aircraft located in the OSV at the time of applicability of the target report	*ESASSP Ed 1.2, Section 4.1*
ka/kc	Parameter used in the WAM/ADS-B surveillance standards to derive the statistical probability grade.	ED142A, Appendix D.4
OSV	An *Operational Service Volume* is a sub volume in the *Operational Coverage Volume* wherein the system provides a specific surveillance service with a single set of performance requirements.	*ED129C, Appendix K*

Table 1: Glossary

2.7 Acronyms and Terminology

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Term	Definition
ADS-B	Automatic Dependent Surveillance - Broadcast
APT	AirPorT area
ASTERIX	All-purpose STructured Eurocontrol suRveillance Information eXchange
ATC	Air Traffic Control
ATM	Air Traffic Management
ATSEP	Air Traffic Safety Electronics Personnel
CBA	Cost Benefit Analysis
CC	Capability Configurations
CSV	Comma Separated Values File Format
CWP	Controller Working Position
DFGT	Density of False/Ghost Target
EATMA	European ATM Architecture
ER	En-Route
FL	Flight Level
GEN-SUR SPR	GENeric SURveillance Safety and Performance Requirements
GPX	GPS Exchange Format
HPA	Horizontal Position Accuracy
IP	Internet Protocol
IRS	Interface Requirements Specification
MLAT	MultiLATeration
MTBF	Mean Time Between Failures
MUD	Maximum Update Delay
NAF	NATO Architecture Framework
NAV	ATC Navigation
NCITR	Number of Correctly Identified Target Reports (Mode A, Mode S)
NM	Nautical Mile

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NMEA	National Marine Electronics Association (as GPS data exchange format)
NSOV	NAF Service Oriented View
NOV	NAF Operational View
NSV	NAF System View
OSED	Operational Service and Environment Definition
OSV	Operational Service Volume
PFID	Probability of False Identification
PFT	Probability of False Tracks
PFTR	Probability of False Target Report
PGT	Probability of Ghost Tracks
PID	Probability of Identification
PJ	ProJect
PLG	Probability of Long Gaps
PMP	Project Management Plan
PTR	Probability of Target Report
PU	Probability of Update
QRT	Quasi Real-Time
RMS	Root Mean Square
RPA	Reported Position Accuracy
SDD	Service Description Document
SDPDS	Surveillance Data Processing and Distribution System (including tracker, data fusion systems)
SE-DMF	System Engineering – Data Framework
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SPM	Surveillance Performance Monitoring
SPR	Safety and Performance Requirements

SUR	ATC Surveillance
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol / Internet Protocol
TES	Thales Electronic Systems
TMA	Terminal Manoeuvring Area
TRL	Technology Readiness Level
TTR	True Target Report
TS	Technical Specification
TS/IRS	Technical Specification / Interface Requirements Specification
TVALP	Technical VALidation Plan
TVALR	Technical VALidation Report
V&V	Validation and Verification
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VP	Validation Plan
VR	Validation Report
VS	Validation Strategy
WAM	Wide Area Multilateration

Table 2: Acronyms and terminology

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3 SESAR Solution Impacts on Architecture

3.1 Target Solution Architecture

3.1.1 SESAR Solution(s) Overview

The main purpose of this document is to provide the requirements specification covering functional, non-functional and interface requirements related to SESAR Solution PJ.14-W2-84e for the Cooperative part (ADS-B, WAM, MLAT) of the Surveillance Performance Monitoring at sensor level.

SESAR Solution ID and Title	Functional Blocks/Role impacted by the SESAR Solution (from EATMA)	Enabler ID (from EATMA)	Enabler Title (from EATMA)	Enabler coverage
PJ.14-W2-84e - Surveillance Performance Monitoring Tool for Cooperative Sensors	En-route/TMA Cooperative Sensor Surveillance	CTE-S07a	Coop sensor SPM Tool – ER & TMA	Fully
PJ.14-W2-84e - Surveillance Performance Monitoring Tool for Cooperative Sensors	Airport Surface Cooperative Sensor Surveillance	CTE-S07b	Coop sensor SPM Tool – Surface	Fully

Table 3: SESAR Solution PJ.14-W2-84e Scope and related Functional Blocks/roles & Enablers

OI Step	OI description	Open CR
POI-0061-SUR	Surveillance performance monitoring for cooperative sensors	Created by CR 05251. CR has been completed.

Table 4: SESAR Solution PJ.14-W2-84e Operational Improvement Steps

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

No deviations have been identified.

3.1.1.2 Relevant Use Cases

This solution is not intended to modify the operations, hence the description of operational use cases is not present.

The list of system processes applicable to the current task are given in the following table:

System Process	Description
Surveillance Performance Monitoring of Cooperative Sensors at Airport Surface	This use case describes the Surveillance Performance Monitoring Tool operation at Airport Surface for cooperative sensors
Surveillance Performance Monitoring of Cooperative Sensors at En-route/TMA	This use case describes the Surveillance Performance Monitoring Tool operation at En-route/TMA for cooperative sensors

Table 5: SESAR Solution PJ.14-W2-84e System Processes

3.1.1.3 Applicable standards and regulations

1. EUROCAE ED-142A Draft TECHNICAL SPECIFICATION FOR A WIDE AREA MULTILATERATION GROUND SYSTEM ([16])
2. EUROCAE ED-129C Draft TECHNICAL SPECIFICATION FOR A 1090 MHZ EXTENDED SQUITTER ADS-B GROUND SYSTEM ([18])
3. EUROCAE ED-117A MINIMUM OPERATIONAL PERFORMANCE SPECIFICATION FOR MODE S MULTILATERATION SYSTEMS FOR USE IN ADVANCED SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEMS (A-SMGCS) ([17])
4. EUROCAE ED-261 GEN-SUR SPR Draft ([19])

3.1.2 Capability Configurations required for the SESAR Solution

SESAR Solution ID and Title	Capability Configurations (CCs) (from EATMA)	Sub-Operating Environment(s) where the CCs operate	Capabilities (from EATMA)	Nodes (from EATMA)	Stakeholders (from EATMA)
Solution PJ.14-W2-84e - Surveillance Performance Monitoring Tool for Cooperative Sensors	Communication Infrastructure Surveillance Infrastructure Airport/TMA/En-route Surveillance Performance Monitoring	En-route TMA Airport	Separation Provision (Airspace) Surface Guidance Provision	En-route/Approach ATS; Aerodrome ATS	Civil CNS Service Provider; Military CNS Service Provider;

Table 6: List of Capability Configuration required for the SESAR Solution

3.2 Changes imposed by the SESAR Solution on the baseline Architecture

The changes related to this solution have already been introduced and integrated in Roadmap Dataset DS19.

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Enabler ID (from EATMA)	Enabler Title (from EATMA)	Changes
CTE-S07a	Coop sensor SPM Tool – ER & TMA	Technical system: Surveillance Performance Monitoring Tools Functional Blocks: En-route/TMA Cooperative Sensor Surveillance, Airport Surface Cooperative Sensor Surveillance Functions: En-route/TMA Cooperative Monitoring, En-route/TMA cooperative sensor data acquisition, En-route/TMA Surveillance Sensor Performance Assessment Report, Receive reference trajectory, Reference trajectory reconstruction, Surveillance data acquisition, Surveillance Performance assessment
CTE-S07b	Coop sensor SPM Tool – Surface	Technical system: Surveillance Performance Monitoring Tools Functional Blocks: Airport Surface Cooperative Sensor Surveillance Functions: Airport Surface Cooperative Monitoring, Airport Surface cooperative sensor data acquisition, Airport Surface Surveillance Sensor Performance Assessment Report, Process data from airport cooperative sensors, Receive reference trajectory, Reference trajectory reconstruction, Surveillance data acquisition, Surveillance Performance assessment

Table 7: List of changes due to the SESAR Solution

Solution PJ.14-W2-84e uses the architecture elements defined in Wave 1 by PJ.14-04-01 Task 1 and has been modified to separate sensor and end-to-end architectural elements into two separate solutions. And further sensor part has been limited to only cooperative sensors. No new Functional Blocks or Technical Systems are introduced. Therefore, no changes to the baseline architecture component are expected as part of the PJ.14-W2-84e.

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4 Technical Specifications

4.1 Functional architecture overview

This SESAR solution aims to develop Surveillance Performance Monitoring (SPM) tools as enabler of a harmonised performance monitoring of surveillance systems.

SPM tools seek to identify degradation trends early, using both off-line and in continuous quasi real-time processes. SPM aims to demonstrate correct functioning of the ATM surveillance function at the individual sensor level or at ATC end-to-end level. SPM and the mount point for SPM Tools within the ATM Surveillance is shown in Figure 1.

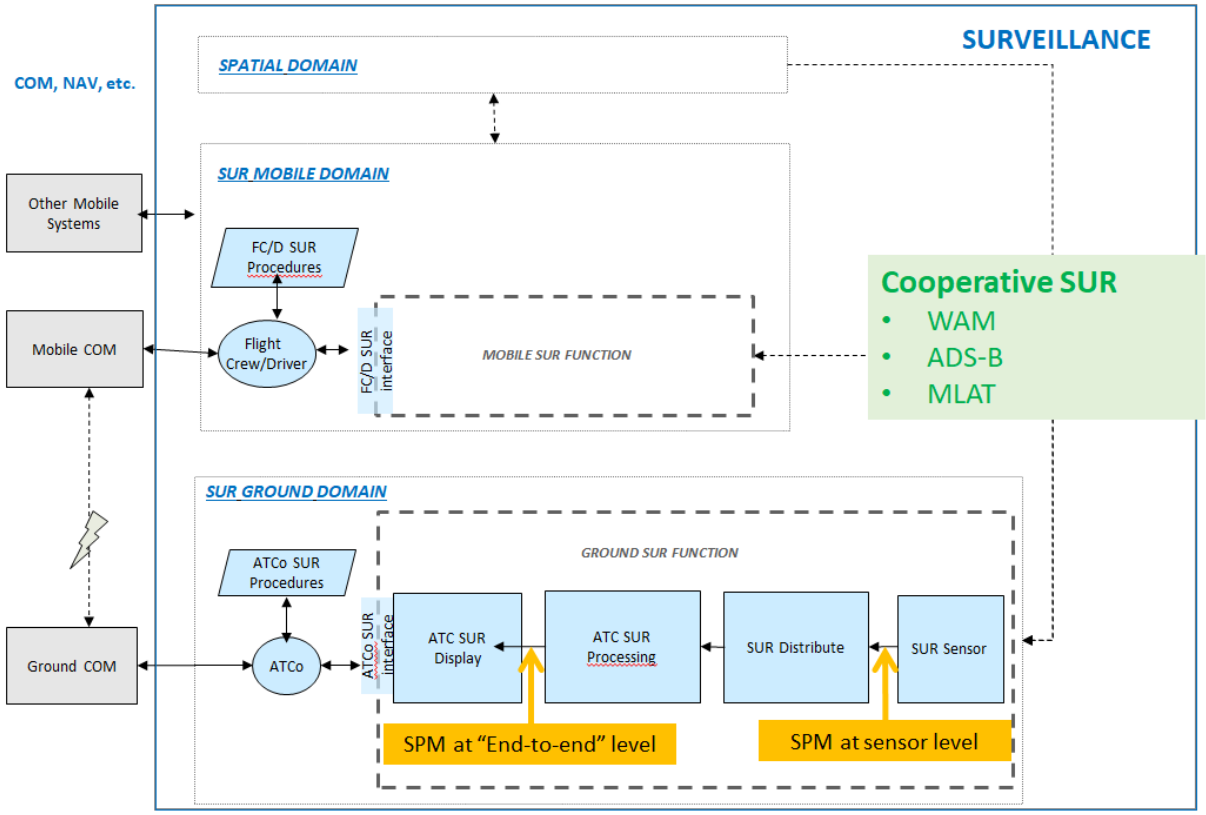

Figure 1: Surveillance Performance Monitoring Tool within Surveillance (84e for Sensor Level, 84f for End- to-End level).

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A functional architecture overview for a generic SPM tool is shown in Figure 2. The SPM tool has main input interfaces from surveillance sensors whose performance will be assessed and monitored. There is additional input from external references like on-board GPS recordings or other data sources that can be used as reference. On-board GPS recordings are generally captured during test flights for site acceptance tests or for detailed monitoring or testing. The aircraft position derived from the GPS can be used as reference position to assess the aircraft position provided by the sensor. There are also configuration data that defines the sensor characteristics, geographical and service characteristics of the service volume, type of analysis to be performed and related settings.

Output interfaces are performance analysis reports and graphical displays for inspection. Performance analysis reports give a list of performance metrics and whether the metrics are within allowed limits. Reports provide a standardised way to output the performance metrics in order to facilitate the comparison of results from the SPM tools that will be developed as part of the current specification. Graphical displays enable inspection of the results from intermediate processing stages and the detailed analysis results of the SPM tool. Graphical displays provide the mechanism to investigate the reasons for unexpected values for performance metrics and identify problematic input data that adversely affect the performance metrics. Such problematic input data, typically a faulty aircraft[2], can be filtered out by defining a filter as part of configuration data.

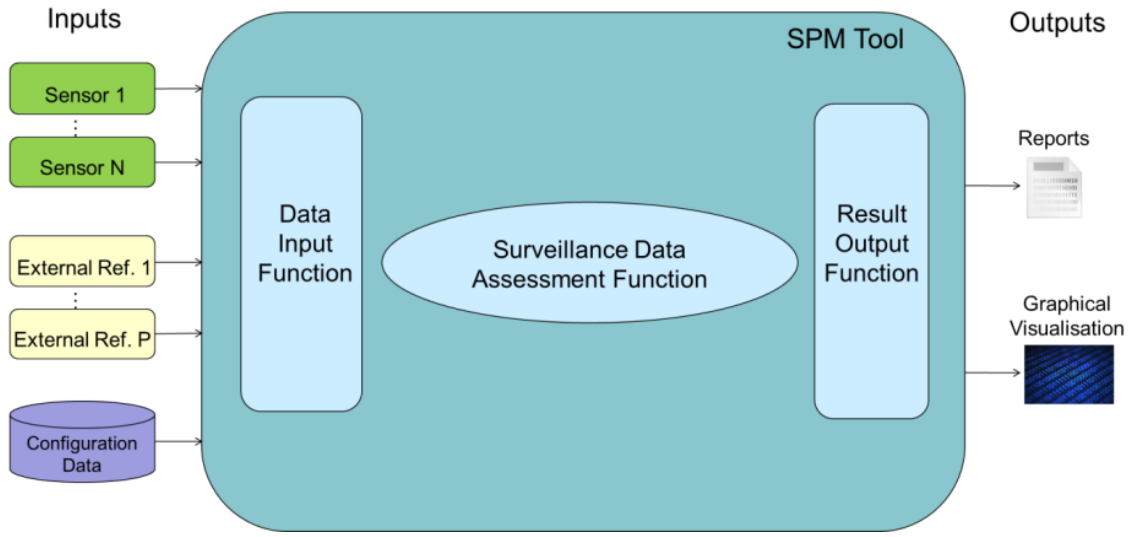

Figure 2: Functional architecture overview of a generic Surveillance Performance Monitoring Tool.

Main functions of the SPM tool can be summarised as:

[2] By a faulty aircraft it is meant that the aircraft transponder is not behaving as expected (not in line with its minimum specification). The judgment is thereby done on the reference trajectory, assumed to provide the true trajectory. Sometimes such faulty behaviour is "visible" as there is a sudden huge position jump in the trajectory maintaining an offsetted aircraft track thereafter or a too noisy track with large position offsets. For other cases, on the other hand, a "faulty aircraft" can only be declared as such for sure when considering also other additional information. Such additional information may be gained e.g. after consultation with the ANSP or other authorities. Therefore no automated approach can be established by the SPM tool for the identification of faulty aircraft.

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- Data Input Function (e.g. recording data from different media or decoding data),
- Surveillance Data Assessment Function (e.g. all processing activities related to the performance assessment)
    - Computation of performance metrics (compared to reference trajectory[3])
- Result Output Function (e.g. all graphical interfaces for input/output data to/from the tool)
    - Geographical displays
    - Other graphical representations
    - Report generation

System continuity, availability, reliability, MTBF aspects of the sensor are out of scope for the SPM tool and are not part of this specification as SPM is not safety critical.

The Surveillance Performance Monitoring Tools receive data from the surveillance sensors or the SDPD system from pre-recorded data files and optionally via the TCP/IP network through compatible data capture tool.

The Infrastructure connectivity model is reported in the following diagram:

[3] Note: the reference may be either reconstructed internally or imported from external source. The reconstruction of reference trajectories is out of scope of this solution.

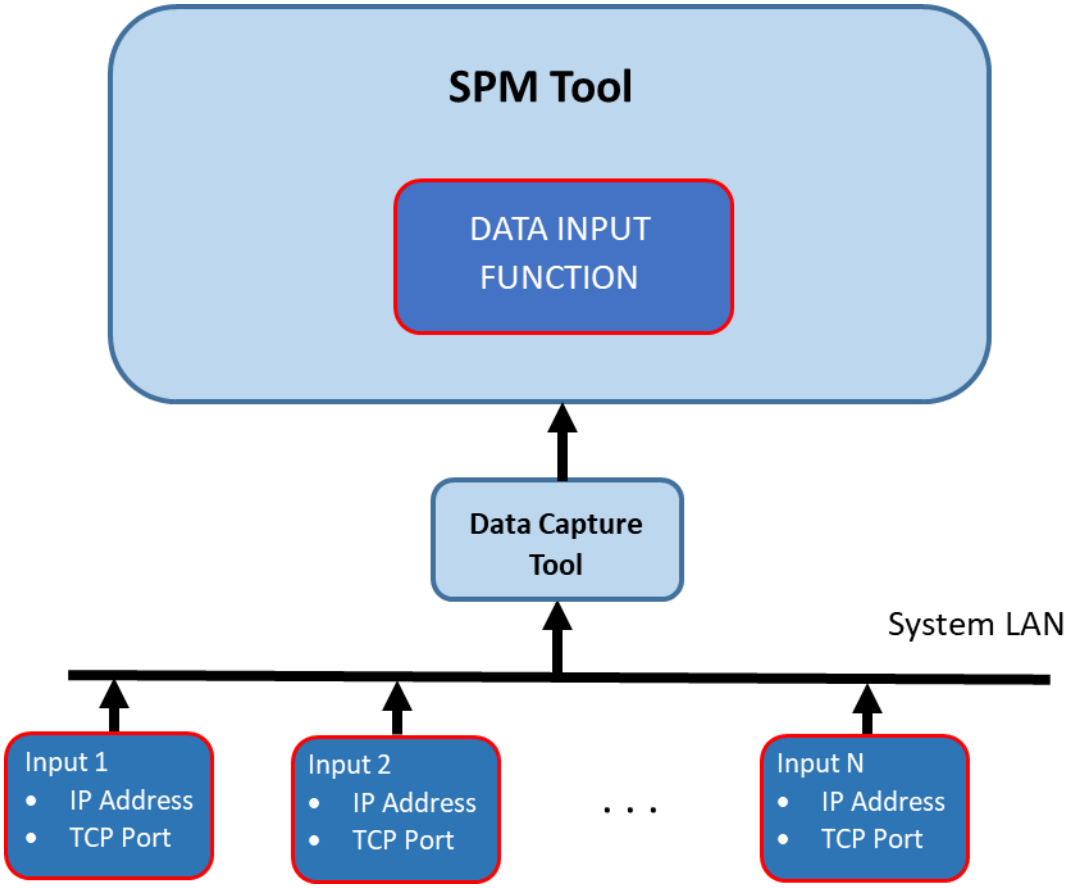

Figure 3: Infrastructure Connectivity Model of Surveillance Performance Monitoring Tool.

Surveillance data uses standard ASTERIX format. In particular:

- ASTERIX Cat 10 version 1.1, for MLAT target reports;
- ASTERIX Cat 20 version 1.9, for MLAT/WAM target reports;
- ASTERIX Cat 21 version 2.1 and 2.4, for ADS-B target reports.

Concerning the Quasi Real-time aspects, the monitoring of the temporal behaviour of a sensor in operation is of interest to different groups of stakeholders.

For a manufacturer of a system a monitoring aid helps in identifying the impact of a system change on the system performance. A continuous performance assessment involving long term recordings of traffic of opportunity provides a reasonable check before the system is put in operation. A regular performance update on a daily basis or at most an update every few hours is sufficient therefore.

On the other hand, for a system operator the continuous monitoring of the system performance and the detection of performance degradation trends could be used to provide warnings or alerts in case the system performance does not meet the expectations any longer.

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The process of evolution from an offline assessment tool to a monitoring system providing alerts is depicted in the next figure.

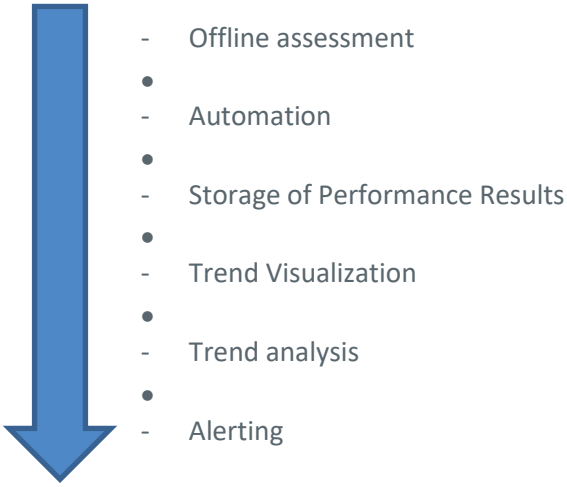

Figure 4: Evolution steps from offline assessment tool to monitoring system with alerts

The ***automation*** process consists of a mechanism that is able to run recurrent assessments while taking each time a different time portion of a continuous data set for assessment.

The ***storage of performance results*** comprises the stacking of the recurrent assessment results in a distinct manner, so that they are available and unambiguously traceable for further usage.

The ***trend visualization*** comprehends the collection of the results of the recurrent assessments and the generation of a graphical output that depicts the performance over time. The graphical output is updated each time a new performance result is obtained, in order to incorporate the latest result.

The ***trend analysis*** describes the process of investigating the performance trend with respect to performance thresholds ***and aims to guarantee that anomalies are detected.*** Therefore a logic is required that depicts the applicable performance threshold in the graphical trend visualization and that makes aware of performance values exceeding the threshold by highlighting them. The analysis might cover several performance thresholds that allow distinction i.e. between a warning and real out of tolerance.

The ***alerting*** step consists of a mechanism to indicate performance degradations falling below performance threshold expectation. Hereby different alerts (i.e. warning or real alert) could be issued depending on which performance threshold has been exceeded.

The offline assessment is linked to an interactive execution where after the processing phase the results and reports are produced. Performance results are obtained for the selected data set and are compared to the thresholds configured. The age of the data under analysis is thereby irrelevant. The user has the possibility to manually refine the setup and re-run the execution and/or to investigate specific cases via the interface.

While the scope of this solution (started as Task 01 in PJ14-04-01) in wave 1 was to proceed a step further from an offline tool towards a real-time monitoring approach by covering the steps of automation and the storage of performance results, the scope in wave 2 is to cover also the trend visualization. An automated execution of a data recording assessment is envisaged that produces results related to user configured time frames (e.g. between 20 min and 2 hours), which are

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distinctively saved in a database. The results related to the different time frames are visualized to demonstrate the trend over time. The trend is updated as each time there is a new result available.

This document focuses on the PJ.14-W2-84e solution and therefore focuses on the performance assessment of cooperative sensors.

A summary of the functional architecture in EATMA is given in the following table:

Role	Functional Block	Function
Surveillance Performance Monitoring of Cooperative Sensors at Airport Surface		
ATSEP	Airport Surface Cooperative Sensor Surveillance	Airport surface cooperative sensor data acquisition; Surveillance data acquisition; Airport Surface Surveillance Sensor Performance Assessment Report; Receive reference trajectory; Reference trajectory reconstruction; Surveillance Performance assessment;
Surveillance Performance Monitoring of Cooperative Sensors at En-route/TMA		
ATSEP	En-route/TMA Cooperative Sensor Surveillance	En-route/TMA cooperative sensor data acquisition; En-route/TMA Surveillance Sensor Performance Assessment Report; Receive reference trajectory; Reference trajectory reconstruction; Surveillance data acquisition; Surveillance Performance assessment;

Table 8: Surveillance Performance Monitoring of Cooperative Sensors architecture overview

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4.1.1 Resource Connectivity view for ER/TMA – cooperative sensors (NSV-1)

This view includes the use case Surveillance Performance Monitoring Tools operations at En-route/TMA for cooperative sensors.

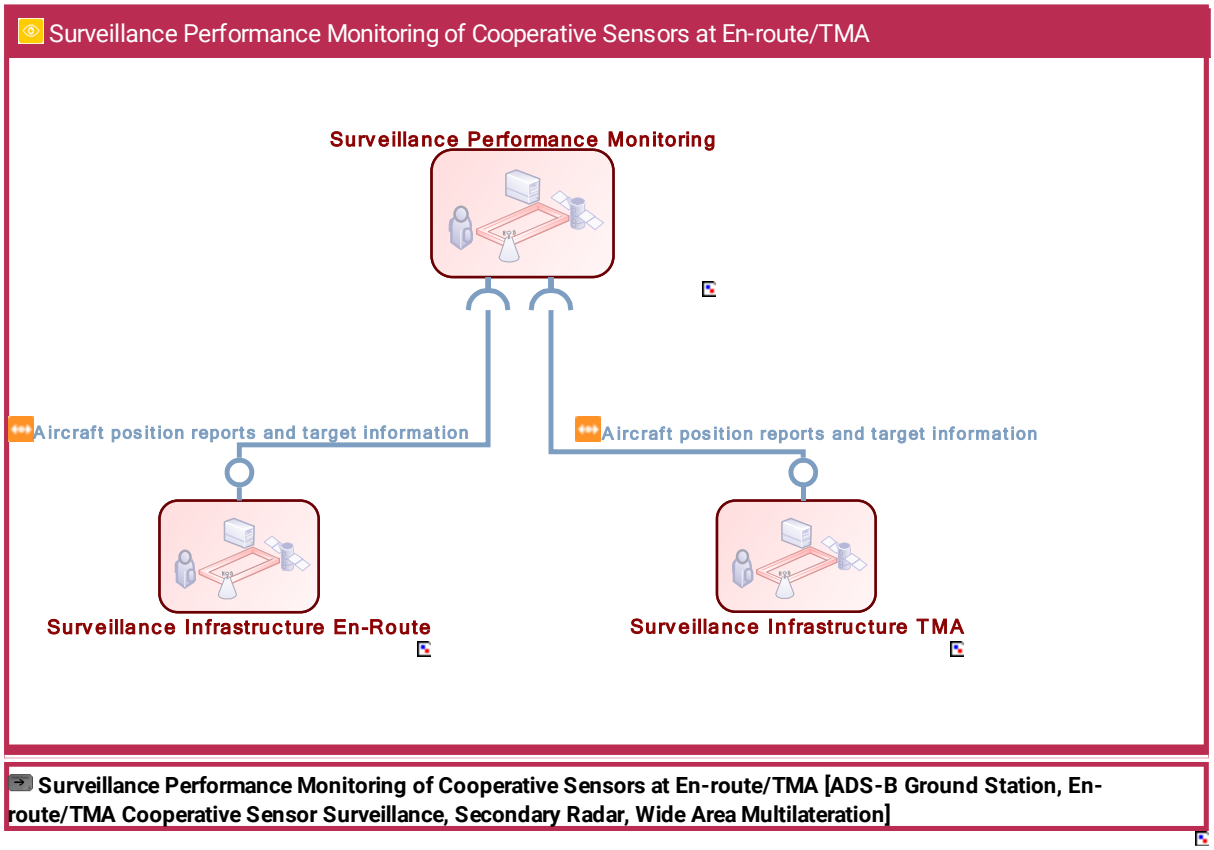

Figure 5: Resource connectivity for Surveillance Performance Monitoring Tools at En-route/TMA

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4.1.1.1 Resource Infrastructure view (NSV-2)

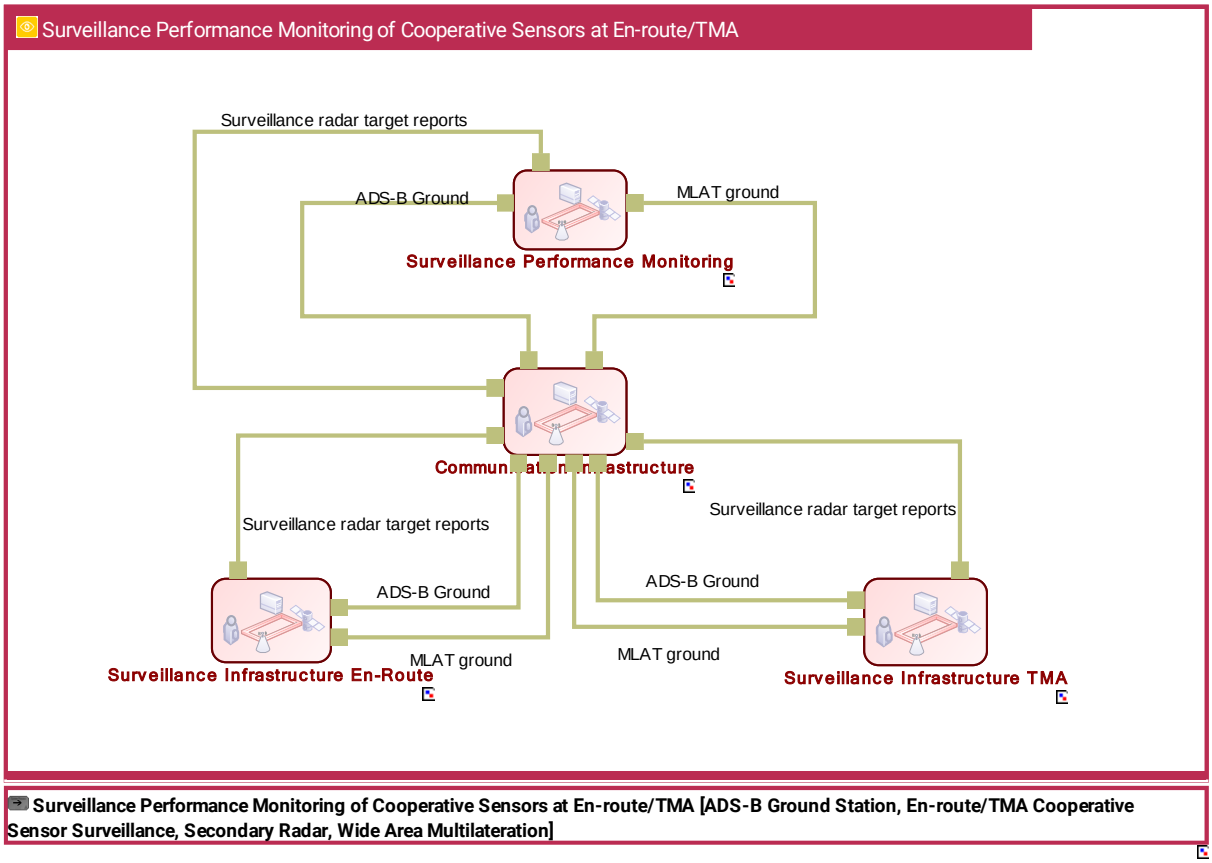

Figure 6: Infrastructure connectivity for Surveillance Performance Monitoring Tools at En-route/TMA

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4.1.1.2 Resource Orchestration view (all NSV-4s linked to the NSV-1)

This use case describes the Surveillance Performance Monitoring Tool operation at En-route/TMA for cooperative sensors:

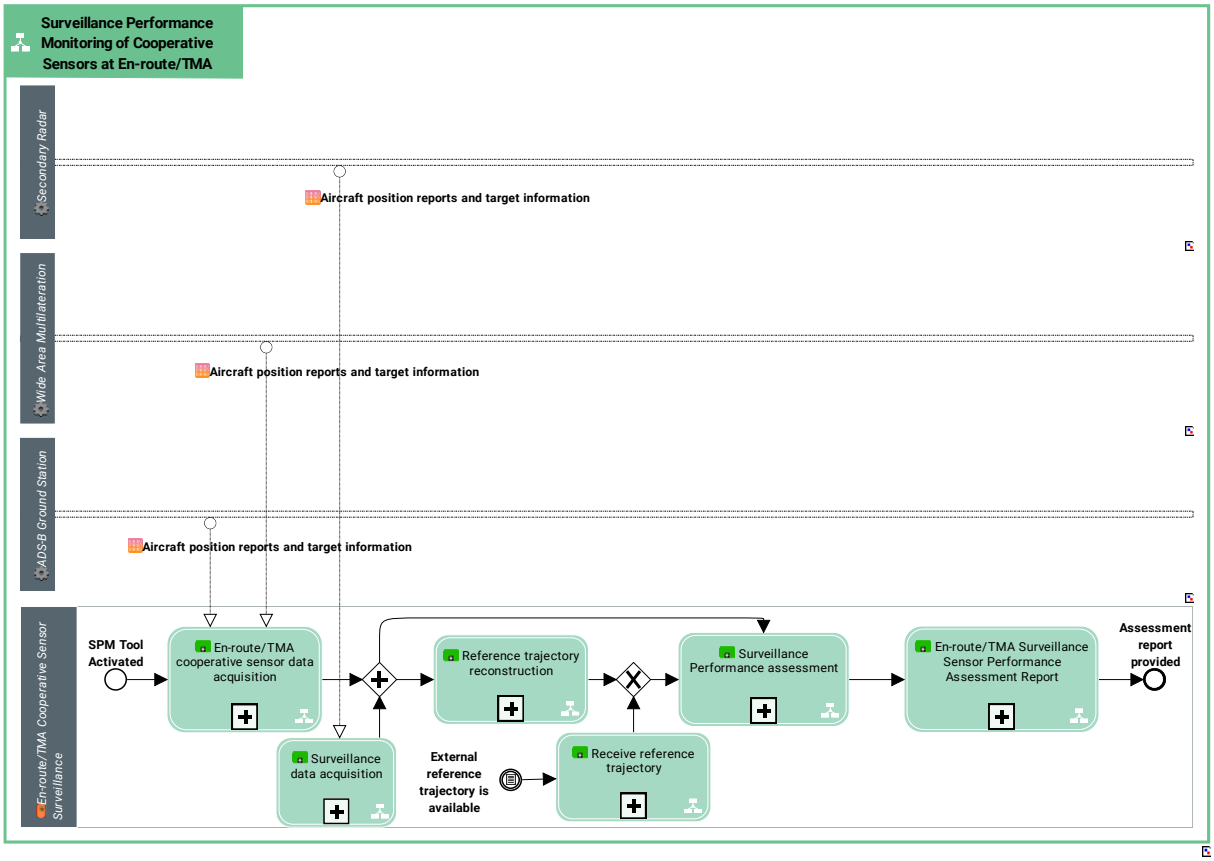

Figure 7: Interaction diagram for Surveillance Performance Monitoring Tools at En-route/TMA

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4.1.2 Resource Connectivity view for surface – cooperative sensors (NSV-1)

This view includes the use case Surveillance Performance Monitoring Tools operations at Airport Surface for cooperative sensors:

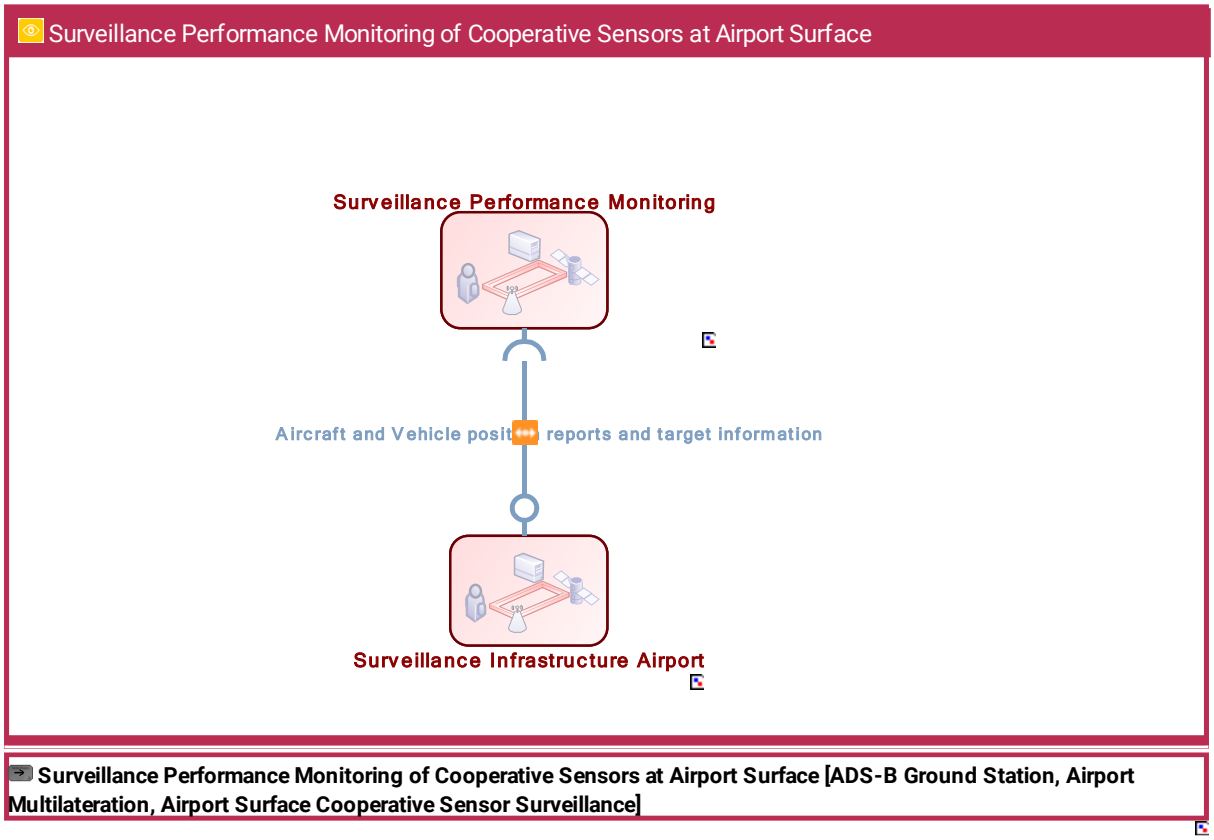

Figure 8: Resource connectivity for Surveillance Performance Monitoring Tools at Airport Surface

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4.1.2.1 Resource Infrastructure view (NSV-2)

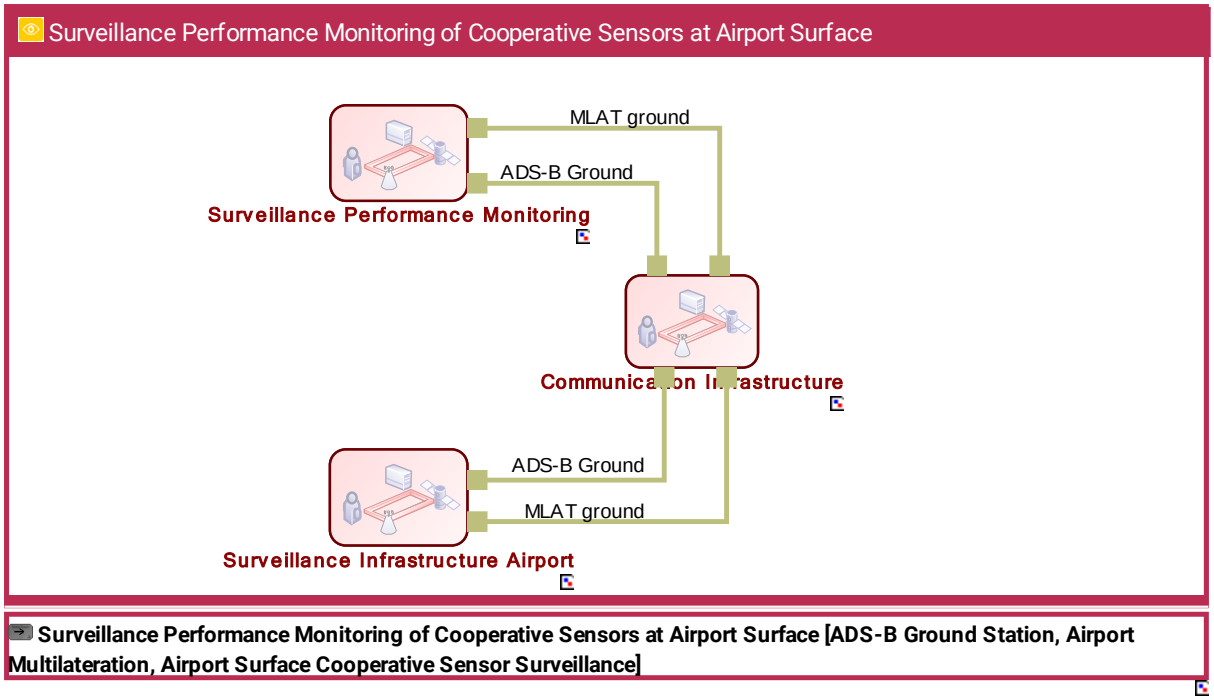

Figure 9: Infrastructure connectivity for Surveillance Performance Monitoring Tools at Airport Surface

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4.1.2.2 Resource Orchestration view (all NSV-4s linked to the NSV-1)

This use case describes the Surveillance Performance Monitoring Tool operation Airport Surface for cooperative sensors.

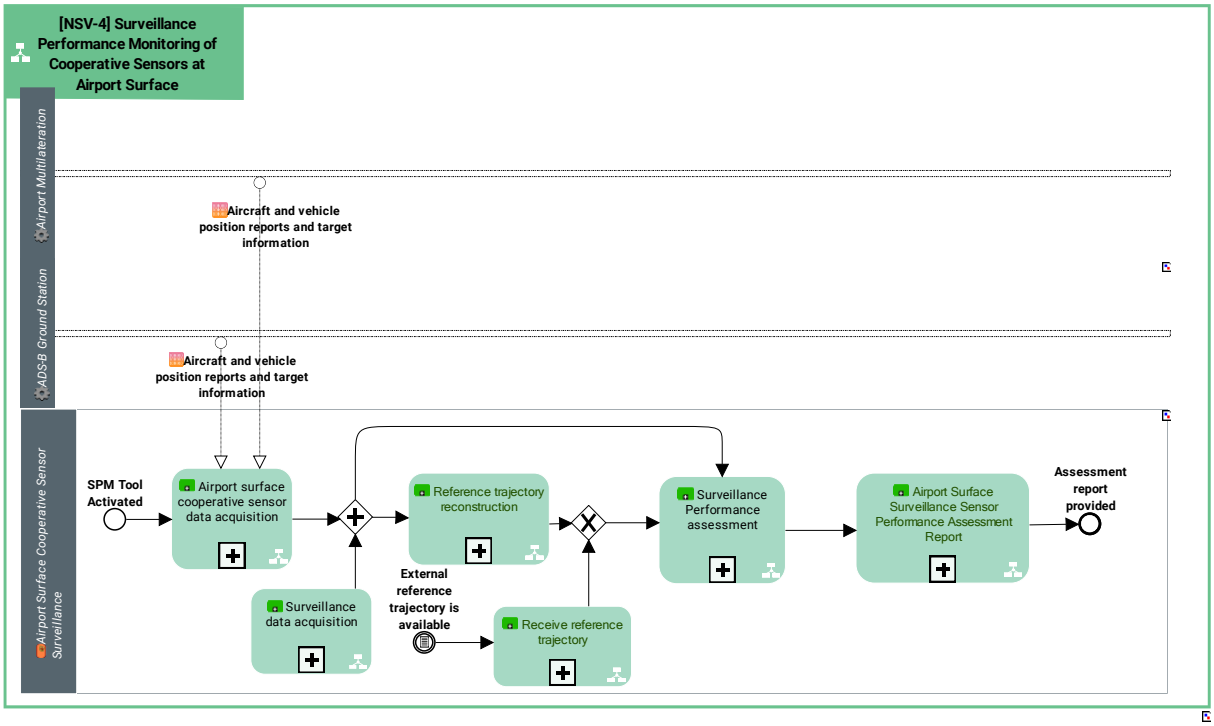

Figure 10: Interaction diagram for Surveillance Performance Monitoring Tools at Airport Surface

4.1.3 Resource Composition

The architectural elements defined in PJ14-04-01 Task 1 in Wave 1 are used and there are no new elements introduced.

4.1.4 Service view

Not applicable.

4.1.4.1 Service description

No services to external systems are provided by Surveillance Performance Monitoring.

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4.1.4.2 Service Provisioning

Interaction	Consumer CC	Consumer System	Provider CC	Provider System
Aircraft and Vehicle position reports and target information. Surveillance Infrastucture Airport_CC and Surveillance Performance Monitoring_CC	Surveillance Performance Monitoring (PJ.14-W2-84e)	Surveillance Performance Monitoring Tools;	Surveillance Infrastructure Airport	Airport Multilateration; ADS-B Ground Station;
Aircraft position reports and target information. Surveillance Infrastructure TMA_CC and Surveillance Performance Monitoring_CC	Surveillance Performance Monitoring (PJ.14-W2-84e)	Surveillance Performance Monitoring Tools;	Surveillance Infrastructure En-route/TMA	ADS-B Ground Station; Airport Multilateration; Secondary Radar; Wide Area Multilateration;
Aircraft position reports and target information.Surveillance Performance Monitoring_CC and Surveillance Infrastructure TMA_CC	Surveillance Performance Monitoring	Surveillance Performance Monitoring Tools;	Surveillance Infrastructure TMA	ADS-B Ground Station; Airport Multilateration; Multistatic Primary Radar; Primary Radar; Secondary Radar; Wide Area Multilateration;

4.1.4.3 Service Realization

Interaction Aircraft and Vehicle position reports and target information. Surveillance Infrastructure Airport_CC and Surveillance Performance Monitoring_CC

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

System Port: SUR_MLAT_GND at Surveillance Infrastructure - Airport_CC

Protocol Stack	Protocol
MLAT ground	
	Asterix Cat20
	UDP

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	IP

System Port: SUR_MLAT_GND at Surveillance Performance Monitoring_CC

Protocol Stack	Protocol
MLAT ground	
	Asterix Cat20
	UDP
	IP

System Port: SUR_WAM_GND at Surveillance Performance Monitoring_CC

Protocol Stack	Protocol
MLAT ground	
	Asterix Cat20
	UDP
	IP

System Port: SUR_ADSB_GND at Surveillance Performance Monitoring_CC

Protocol Stack	Protocol
ADS-B ground	
	Asterix Cat21
	UDP

System Port: IP_GND at Communication Infrastructure_CC

Protocol Stack	Protocol
IP	

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4.2 Functional and non-Functional Requirements

The requirement identifier is composed as follows:

<Object type>-<Solution code>-<Document code>-<Reference code>.<Reference number>

e.g. REQ-XXb.YY-TS-UU01.0123

- REQ is the <Object type> (i.e. requirement),
- 14.84e is the <Solution code> ,
- TS is the <Document code> (i.e. technical specification),
- the <Reference code> is COOP
- uuuu is the <Reference number>, sequence of 4 digits,

Each requirement has a unique identifier.

Note: The reference number of the requirements derived from wave 1 has been chosen to be the same as in previous wave. Requirement numbers 23, 34, 42, 43, 46, 47, 74, 75, 76, 79, 80, 101, 102, 103, 105 are not used in this version of the document.

4.2.1 Functional Requirements

The subsequent requirements developed in this section address the functional requirements of the Surveillance Performance Monitoring. These requirements are organised around the key functional blocks of the SPM after a first General Requirements section.

Requirements specified as “shall” present mandatory requirements, whereas those specified as “should” are optional requirements.

A mandatory requirement can be considered to be generally applicable – which, if relevant, can be understood as also applicable to all cooperative surveillance sensors (multilateration and ADS-B) and all operational environments (En-Route, TMA, surface) discussed herein - unless it is indicated otherwise by:

- Specific sub-chapter indicating the applicable sensor (e.g. MLAT specific requirements)
    - This approach is usually used when there are different methods applicable for different systems or when the requirement is only applicable to specific sensors
- An explanation in the rationale
    - This approach is usually used for requirements that are mandatory for one or more technologies and optional for others.

To provide better clarity a list with the traceability between each requirement and the applicability for each sensor/environment combination has been captured in the Excel file “D12.5.200 PJ.14-W2-84e TS-IRS Ed 00.01.00 Exercise Verification Objectives Traceability.xlsx”.

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4.2.1.1 General Requirements

This section addresses the requirements related to the use of external Reference data and configuration parameters as presented in Figure 2,

[REQ]

Identifier	REQ-14.84e-TS-COOP.0001
Title	Reference trajectory data
Requirement	The SPM Tool **shall** use reference data.
Status	<Validated>
Rationale	The reference trajectory can be ASTERIX coming from different sources than the one to be analysed, GPS data recorded e.g. during a flight test (with the limitation that not all types of analyses can be performed), reconstructed or simulated trajectory. The choice of the reference data is part of the configuration parameters. The reference is assumed to contain the true aircraft position and other aircraft data items. The sensor under analysis is assessed against the reference data.
Category	<Interoperability><Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

[REQ]

Identifier	REQ-14.84e-TS-COOP.0002
Title	Configuration Support
Requirement	The SPM Tool **shall** support the following configuration:

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	• Sensor characteristics (type, position, etc.),
	  ○ Type (ADS-B, WAM, MLAT)
	  ○ Position (latitude, longitude, altitude),
	• Measured position output type (Cartesian, geodetic)
	• Mode of operation: Manual (offline) or Quasi Real-Time assessment,
	• Target report classification method
	• Input data acquisition settings,
	• Geographical and service characteristics of the OSV (see Note 1) (operational environment as given in GENSUR Table 2 for airborne, and ED129C and in ED117A Table 3.1 (manoeuvring area, aprons/taxiways/taxilanes and stands as defined in ED117A Section 3.3.2) for surface, applicable standard, metrics selection, requirements and methods),
	• Filter parameters (e.g. data type, validity flag, quality indicator, aircraft address, etc.),
	• Reference to be used (another sensor, reconstruction, simulated, GPS recording), that is assumed to indicate the true aircraft position & other aircraft data items,
	• Graphical output background information (geographic maps, aeronautical information, etc.),
	
	Note 1: The OSV is defined as vertically extruded geodetic polygon where the vertex to vertex segment is a great arc circle and where the vertical extension is defined in the following space: flight level. As the focus of this solution is on the harmonisation of the core part of the assessment functionality such features as OSV has been kept to a minimum.

Status	<Validated>
Rationale	Requirements and methods are fully defined with the selection of operational environment and applicable standard, the individual metrics can be selected (full set or a subset).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0003
Title	Recommended Configuration Parameters
Requirement	The SPM Tool **should** manage the following configuration parameters: • Gap size as a number of Update intervals
Status	<Validated>
Rationale	Gap size is used as input parameter to Probability of Long Gaps analysis and it is user configurable to allow calculation with respect to various standards and environment supported. While gap sizes of N=2, 3 and 4 UIs present a mandatory probability of long gaps performance evaluation for ED142A, it is suggested to optionally evaluate also gaps larger than N>4 UI, with configurable N. According to ED117A different gap sizes (3, 15sec) need to be evaluated depending on the operational environment (apron, stands, etc.).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

4.2.1.2 Data Input Function Requirements

The following requirements are common to all SPM Tools.

[REQ]

Identifier	REQ-14.84e-TS-COOP.0004
Title	Data Format - Cat 10
Requirement	The SPM Tool **should** decode MLAT target reports in ASTERIX Cat 10 (MLT Surface Movement Data) with the version required in latest edition of EUROCAE Standards ([17], [16]).

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Status	<Validated>
Rationale	ASTERIX Cat 10 is limited to the surface MLAT data and it supports legacy implementations. ASTERIX Cat 20 is the recommended category for all MLAT/WAM target reports exchange. ASTERIX Cat 10 is not suitable for ADS-B, ASTERIX Cat 21 is used. ASTERIX Cat 247 messages, if transmitted by the sensor or SDPDS, can be used to deduce the version and contents of the Cat 10 messages.
Category	<Interoperability><Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0005
Title	Data Format - Cat 20
Requirement	The SPM Tool **shall** decode MLAT/WAM target reports in ASTERIX Cat 20 (MLAT/WAM Messages) with the version required in latest edition of EUROCAE Standards ([17], [16]).
Status	<Validated>
Rationale	The specific version of the ASTERIX category needs to be specified due to possible binary incompatibility between different versions. ASTERIX Cat 247 messages, if transmitted by the sensor or SDPDS, can be used to deduce the version and contents of the Cat 20 messages.
Category	<Interoperability><Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

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<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0006
Title	Data Format - Cat 21
Requirement	The SPM Tool **shall** read ADS-B target reports in ASTERIX Cat 21 (Automatic Dependent Surveillance-Broadcast (ADS-B) Messages) with the version required in latest edition of EUROCAE Standards ([17], [16], [18]).
Status	<Validated>
Rationale	The specific version of the ASTERIX category needs to be specified due to possible binary incompatibility between different versions.
Category	<Interoperability><Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0007
Title	Data Format – External Reference trajectory data in ASCII format.
Requirement	The SPM Tool **should** decode external reference data in CSV format, GPX or NMEA
Status	<Validated>
Rationale	The external GPS data comes from on-board GPS recordings either from the installed avionics or a separate GPS data recorder. Reference trajectory data ideally are provided in CSV format, with CSV representing the main format, equivalent formats are GPX, NMEA. Therefore the recordings needs to be converted to the following format: Optional: Date (YYYY-MM-DD) Mandatory: Time (HH:MM:SS.XXX) Mandatory: Latitude (in degrees ddd.dddddd) Mandatory: Longitude (in degrees ddd.dddddd), Mandatory if ASTERIX: Baro Altitude (ft), Mandatory if GPS Ref.: Geo Altitude (ft), (Optional: Groundspeed (in knots dddd.d or in m/s dddd.d).) (Optional: Track Angle (in degrees ddd.d), Warning: External data is expected to have sufficient accuracy and correctness. As an example, the expected accuracy should be as a minimum 1/10 of the performance requirement objective being measured.
Category	<Interoperability><Interface>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

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<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information

There are some known issues that might be present in the input surveillance data that requires the SPM Tool to take specific actions for processing the data and to notify the user of existence of such problems. These issues may not adversely affect the operational use of the surveillance system, but they may cause SPM Tool to calculate the performance metrics incorrectly. Currently identified issues are described in the following paragraphs.

Duplicate Reports:

It is possible that ADS-B and WAM sensors may output two or more target reports with the same content and with identical or very close time of detection. Such duplicate reports can be identified easily since they will have the all identical data content (ICAO 24 bit, position, etc.) except time and a time difference less than 200 ms. As an outcome from Wave 1 it has been agreed that during data import the SPM Tool should filter out the duplicate reports and should not use them for performance metrics calculations. The filtered out duplicate target report statistics can be given as part of the data import statistics.

[REQ]

Identifier	REQ-14.84e-TS-COOP.0133
Title	Removal of Duplicate Reports
Requirement	The SPM Tool **shall** filter out duplicate reports from performance metrics calculations and provide feedback on number of duplicate reports to the user.
Status	<Validated>
Rationale	Observation from Wave 1 was that duplicate reports may falsify the performance results and therefore should be removed from performance evaluations.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

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<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information

Back Jumps in WAM data (CAT 20 ASTERIX):

In ASTERIX CAT20 data imported into the SPM tool, in Wave 1 it has been observed that the ASTERIX TOD is not monotonically increasing as required by the ED-142A. The data shows back jumps of several seconds. In a tracker these data messages would be considered as irrelevant and are ignored as they do not contribute for refreshing the ATC display. According to the ED-142A standard those reports should not be part of the ASTERIX output at all and normally would not be dealt within the SPM tool. The following sequence of ASTERIX messages describe the problem:

ASX Message 1: TOD1

ASX Message 2: TOD2

ASX Message 3: TOD4

Possible real gap

ASX Message 4: TOD5

ASX Message 5: TOD3

Negative time difference

ASX Message 6: TOD6

Possible unreal gap

ASX Message 7: TOD7

ASX Message 8: TOD8

For PU & PLG, these cases could lead to unreal missed periods or gaps due to the consideration of the time difference between successive target reports (from back jump again to ordinary report).

For HPA, False/Ghost Report/Track assessment, they contribute to the statistics computation, although they will be discarded from tracker and do not really have an impact on the ATC.

Therefore, as an outcome from Wave 1 it has been agreed that the back jump reports shall be removed during data import and not considered for any analyses. The presence of such back jumps shall be reported to the user[4] as it violates the required standard system behaviour. The following depiction shows the target reports that will be used by the performance metrics assessment.

ASX Message 1: TOD1

ASX Message 2: TOD2

ASX Message 3: TOD4

Possible real gap

[4] The intended user of the SPM Tools is ATSEP responsible for the proper operation of surveillance sensors

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ASX Message 4: TOD5

~~ASX Message 5: TOD3~~

ASX Message 6: TOD6

ASX Message 7: TOD7

ASX Message 8: TOD8

[REQ]

Identifier	REQ-14.84e-TS-COOP.0134
Title	Removal of back jumps
Requirement	The SPM Tool shall filter out back jumps from performance metrics calculations and provide feedback on number of back jump reports to the ATSEP user.
Status	<Validated>
Rationale	According to the ED-142A standard back jumps reports (target reports arriving later than newer reports) should not be part of the ASTERIX output at all and normally should not be dealt within the SPM tool. Observation from Wave 1 was that back jumps may falsify the performance results and therefore should be removed from performance evaluation.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information

4.2.1.3 Surveillance Data Assessment Function Requirements

4.2.1.3.1 General

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0008
Title	Fundamental Performance Metrics to be assessed
Requirement	The SPM Tool **shall** assess the following performance metrics: • Probability of Update, • Probability of Long Gaps, • Position Accuracy, • Probability of False and Ghost Detection, • Probability of Identification, • Probability of False Identification • Probability of Incorrect Identification • Maximum Update Delay • Ground Processing & Communication Delay. The specific metrics will be defined separately for each standard in the subsequent requirements.
Status	<Validated>
Rationale	These metrics are the key performance indicators commonly or partly addressed by ED-129C, ED-117A and ED-142A. Note that not all performance metrics can be calculated for all sensor technologies. For example, “Ground Processing & Communication Delay” is not applicable for WAM and MLAT. Similarly, “Position Accuracy”, “Probability of False and Ghost Detection”, “Probability of Identification” and “Probability of False Identification” are optional for ADS-B.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0009
Title	Operational Service Volume
Requirement	The SPM Tool **shall** consider geometrical volumes that limit the evaluation to operational service volumes (OSV).
Status	<Validated>
Rationale	ED-129C (section 3.3) requires performance evaluation for operational service volumes. For description of OSV see Note 1 in Configuration Parameters Requirement.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0010
Title	Operational Environment
Requirement	The SPM Tool **shall** allow the allocation of an **Operational Environment** to the OSV. ED-129C defines the following sector types:

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	- Low-Density ER - Medium-Density ER - High-Density ER - Low-Density TMA - Medium-Density TMA - High-Density TMA - High-Density APP2.5 - High-Density APP2.0 - ADS-B APT ED-117A defines the following airport areas: - Stands - Runways - Taxi lanes
Status	<Validated>
Rationale	Each ATC Sector type is attached a parameter set (PU req., PLG req., update interval, minimum number of samples, etc.) which is to be used for the calculations. These parameters will be detailed in the corresponding sections for each assessment.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0011
Title	OSV-Based Evaluation – Data Selection
Requirement	The SPM Tool **shall**, for all but the Ghost Target Report assessment, consider reference trajectory associated target reports when this reference trajectory

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	is either 3D located in the defined OSV (when reference has a height) or 2D located in the defined OSV (when reference has no height).
Status	<Validated>
Rationale	Note: The details for the identification of target reports to be used for Ghost Target Report assessment will be provided in the Probability of False and Ghost Detection section.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0012
Title	Cell Based Evaluation – Data Selection
Requirement	The SPM Tool **shall**, for all but the Ghost Target Report assessment, consider reference trajectory associated target reports when this reference trajectory is either 3D located in the defined OSV and in the relevant cell (when reference has a height) or 2D located in the defined OSV and in the relevant cell (when reference has no height).
Status	<Validated>
Rationale	Note: The details for the identification of target reports to be used for Ghost Target Report assessment will be provided in the Probability of False and Ghost Detection section.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

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<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0013
Title	ADS-B capability determination
Requirement	The SPM Tool **shall** consider a reference trajectory as ADS-B capable as soon as ADS-B data has been associated to the reference trajectory at least once.
Status	<Validated>
Rationale	Identifying the capability of a reference trajectory is an essential prerequisite for the performance assessment / metrics computation.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0014
Title	MODE-S capability determination

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Requirement	The SPM Tool **shall** consider a reference trajectory as Mode S capable as soon as Mode S data has been associated to the reference trajectory at least once.
Status	<Validated>
Rationale	Identifying the capability of a reference trajectory is an essential prerequisite for the performance assessment / metrics computation.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0015
Title	Filtering reference trajectory
Requirement	The SPM Tool **shall** filter reference trajectories based on the selected “capability” (ADS-B capable, Mode S capable, ground bit).
Status	<Validated>
Rationale	Filtering (and classifying) the reference trajectories based on the capability is an essential prerequisite for the performance assessment / metrics computation.
Category	<Functional>

[REQ Trace]

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Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0016
Title	OSV Reference Trajectory Segment Identification
Requirement	The SPM Tool **shall** identify, for each reference trajectory, the segments of trajectory in the OSV and their respective time of entry/birth or exit/death.
Status	<Validated>
Rationale	Identifying these segments is an essential prerequisite for the performance assessment / metrics computation as it will contribute to the identification of false/ghost/true target reports and tracks.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0017
Title	Cell Reference Trajectory Segment Identification

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Requirement	The SPM Tool **shall** identify, for each reference trajectory segments identified in the OSV, the sub-segments of trajectory in the cell and their respective time of entry/birth or exit/death in the cell.
Status	<Validated>
Rationale	Identifying these sub-segments is an essential prerequisite for the cell-based performance assessment.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0018
Title	Trajectory-Based Evaluation
Requirement	The SPM Tool **shall** do the performance evaluation for each individual reference trajectory.
Status	<Validated>
Rationale	The trajectory-based approach is commonly addressed by ED-129C and ED-142A. Note: For all but the False Target Report assessment
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0019
Title	OSV Based Evaluation – Metric Calculation
Requirement	The SPM Tool **shall** do the performance evaluation overall for the OSV.
Status	<Validated>
Rationale	The OSV-based approach is commonly addressed by ED-129C, ED-117A and ED-142A.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0020
Title	Cell-based Evaluation – Metric Calculation
Requirement	The SPM Tool **shall** do the performance evaluation per 3D grid cell in the OSV considering all trajectory sub-segments identified in the cell.
Status	<Validated>
Rationale	EUROCAE ED-129C (Technical Specification for ADS-B Ground System (with provision for Space Based ADS-B)) has incorporated cell-based calculation for PU evaluations (ED-129C, 6.5.1.6.3).

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	The Cellular Basis is adopted as it provides a focussed means to assess the performance of a surveillance infrastructure on a regional basis rather than aggregating performance across the entire coverage volume. Performance is assessed in the airspace where coverage is required. Whilst this approach also improves the means to assess airspace where traffic densities are low its key strength lies in the means in which the data can be graphically portrayed and subsequently analysed in a 3D (horizontally and vertically) manner. The grid-based analysis mechanism is optional for assessing the Probability of Long Gap (PLG) (ED-129C section 6.5.2.6.3). Although the grid cell approach is currently only addressed for PU and PLG in the standard documents, it is expected that it will be extended to the other metrics in the new and updated standards as well. For the current development, grid-based performance metrics calculation and presentation is mandatory for PU, optional for PLG and not required for other performance metrics.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

Calculation – cell based

[REQ]

Identifier	REQ-14.84e-TS-COOP.0021
Title	Cell Grid – Horizontal Grid
Requirement	The SPM Tool **shall** consider as for the horizontal aspect of the gridding a Cartesian grid in the plan result of a projection (free for airport OSV, stereographical for others).
Status	<Validated>
Rationale	Requirement added for completeness of grid definition. Refer to rationale in requirement “Cell-based Evaluation – Metric Calculation” for further details.

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	In this phase the rotation with respect to the north is not included in this requirement as not required by any standard.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0022
Title	Cell Grid – projection
Requirement	The SPM Tool **shall** consider the projection as configured in the calculation configuration among standard guidelines values and totally custom values.
Status	<Validated>
Rationale	Requirement added for completeness of grid definition.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

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Identifier	REQ-14.84e-TS-COOP.0024
Title	Cell Grid – Vertical Grid
Requirement	The SPM Tool **shall** consider the vertical grid derived from the altitude bands defined in the calculation configuration.
Status	<Validated>
Rationale	Requirement added for completeness of grid definition. Refer to rationale in requirement “Cell-based Evaluation – Metric Calculation” for further details.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

Calculation – generalities

Input

[REQ]

Identifier	REQ-14.84e-TS-COOP.0025
Title	Cell Grid Projection Definitions
Requirement	The SPM Tool **shall**, if relevant (free for airport OSV, stereographical for others), be able to associate to the performance calculation configuration the definition of the projection parameters for the cell grid, as the latitude, longitude and MSL height of the projection result plan coinciding with the cell grid origin (cell center), considering that the geographically opposite location serves as projection center.
Status	<Validated>
Rationale	The calculation is performed on a projected Cartesian coordinate system, and stereographic projection is used in ATC CWP. Stereographic projection is to be used for En-route and TMA environments, which span larger areas. For Airport surface, direct or orthographic projection Cartesian coordinate

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	system can be used. This requirement will accommodate both Enroute/TMA and airport surface.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0026
Title	Cell Grid Rotation Definition
Requirement	The SPM Tool **should** be able to associate to the performance calculation configuration the definition of the rotation for spanning a cell grid.
Status	<Validated>
Rationale	The rotation is needed to accommodate a rectangular grid for runway in airport surface. The requirement is optional, because for En-route/TMA WAM and ADS-B it is not used and for surface it is not specified in the corresponding standards.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0027
Title	Cell Grid Horizontal Resolution Definition
Requirement	The SPM Tool **shall** be able to associate to the performance calculation configuration the definition of the grid horizontal resolution as among predefined values as defined in ED-261 ([19]) (and referenced in ED-129C ([18]) and ED-142A (draft) ([16]) Standards or user configurable values.
Status	<Validated>
Rationale	The recommended values for ADS-B and WAM are: The recommendation for MLAT is a user-configurable cell size ensuring more than 1000 samples (ED-117A, chapter 6.4.3).
Category	<Functional>

	Low density	*Medium Density*	*High Density*
EN-ROUTE	*20 NM*	*15 NM*	*10 NM*
TMA	*10 NM*	*7 NM*	*3 NM*
APP	*N/A*	*N/A*	*3 NM*
APT	*500 m*		

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0028
Title	Altitude Band Definition

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Requirement	The SPM Tool **shall** consider altitude bands specified in FL or in feet above MSL associated to a user configurable QNH (defaulted 1013.25HPa) to limit the data for evaluation.
Status	<Validated>
Rationale	ED-129C requires it for PU evaluations (ED-129C, 6.5.1.6.3). Optional for PLG (6.5.2.6.3). ED-129C only gives guidance about the grid cell sizing: - *"To demonstrate that the "at any place" requirement is met vertically, the volume should be split into two bands; i.e. from FLmin to FLmin+5000ft and from FLmin+5000ft to top of coverage".*
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0029
Title	Horizontal Position Error to Reference
Requirement	The SPM Tool **shall** calculate the horizontal position error from sensor data to reference data as the distance between target report position and associated reference position interpolated at one of the following target report times ASTERIX CAT 21 Item 71 for ADS-B (Time of Applicability for Position) or ASTERIX CAT 21 Item 73 for ADS-B (Time of Message Reception) Only one of the items is transmitted. ASTERIX CAT10 and 20 Item 140 for WAM and MLAT (Time of Day) This requirement is optional for ADS-B sensor. Note1: The reference position is assumed to reflect the true aircraft position. The target report position provided by sensor under analysis is assessed

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	against the reference data. Refer to REQ-14.84e-TS-COOP.0001 for options on reference data. Note2: It is recommended that the position errors are calculated in WGS84 coordinates frame when relevant to minimize distortions (e.g. for large area).
Status	<Validated>
Rationale	The position errors are required for the horizontal position accuracy calculations and for the false target identification. Further, the calculation of position errors is necessary for PU and PLG, in order to exclude false targets from evaluation. Note: Even though the exclusion of false targets for PU and PLG is not required by the ADS-B standard ED-129C or the airport MLAT ED-117A, it has been decided to follow the same approach for all technologies. There is however, the possibility to switch off the false position exclusion (see target report classification). The method is given in Ref [17](ED-117A, section 6.4.7) for MLAT using Cartesian coordinates. Draft ED-142A: reference to be completed once finalized (inputs from the SPM to WG51: “ensure that the standard is specific enough the accuracy assessment is done in a projected referential or in true distance referential” – so that the SPM can select the one or the other). Same applies to the grid and more generally as soon as a distance applies. Note: within this solution it has been agreed that the position errors are calculated in WGS84 coordinates frame when relevant to minimize distortions (e.g. for large area).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

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<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.3.1.1 Target Report Classification

Target report classification is necessary, in order to identify the target reports to be used as input in the different evaluations. The classification is done on the basis of whether a target report is associated to a reference and if associated, on its horizontal position accuracy. The following table describes the various classifications of target reports and gives an overview of their consideration in the different performance assessment types.

Target Report Classification and selection (Y) for the various metrics			
	Existence of a "Reference trajectory" within OSV (!)	No Existence of a "Reference trajectory" within OSV (!)	
	True Target Reports	False Target Reports	Ghost Target Reports
Horizontal Position Accuracy Computation	Y		
Probability of Update and Long Gap Computation	Y		
Maximum update Delay	Y		
Probability of correct and false identity and probability of incorrect Computation	Y		
Ground Processing & Communication Delay Computation	Y	Y	Y
False Report/Track Computation		Y	
Ghost Report/Track Computation			Y

Table 9: Target report classification and selection for various metrics

The target report classification is mainly required for WAM and MLAT as it is specified in the related sensor standards ([15][16][17]) to exclude the false target reports. For ADS-B no such classification is required in the related sensor standard ([14]), since the target position and its accuracy are attributed to the aircraft/vehicle, and all reports are used for the sensor PU/PLG performance assessment. For this reason, the position accuracy calculation is specified as optional for ADS-B target reports in Section 4.2.1.3.3. Nevertheless, surveillance data processing systems use the ADS-B target reports in the same manner as other sensors and ANSPs may find it useful to be able to apply target report classification to ADS-B in order to make the performance assessment similar to other sensors.

To be able to support both cases of PU/PLG performance assessment, that is including or excluding target reports exceeding a given false position error threshold, a user configuration option is defined to perform target report classification in two distinct ways:

- If position error is not calculated:
  - target reports with an associated reference in OSV will be considered as True,
  - target reports in OSV without an associated reference in OSV will be considered as Ghost,
  - no target reports will be classified as False

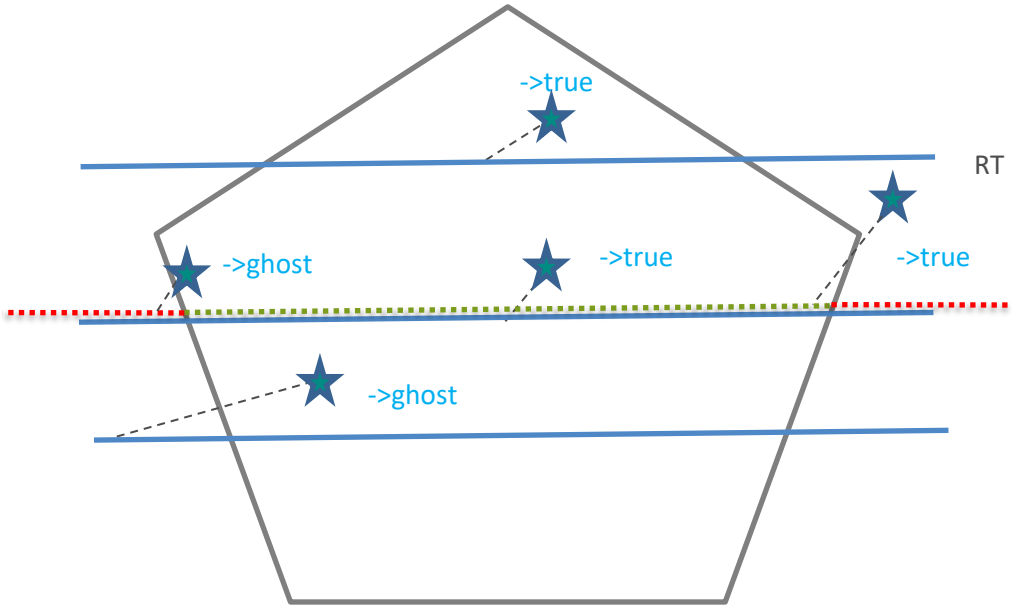

Figure 11: Target report classification if no position error is calculated

- If position error is calculated:
  - target reports with an associated reference in OSV with a position error less than a given false position threshold will be considered as True,
  - target reports with an associated reference in OSV with a position error greater than the given false position threshold will be considered as False,
  - target reports in OSV either without any associated reference at all or with an associated reference outside OSV but exceeding the false position threshold will be considered as Ghost

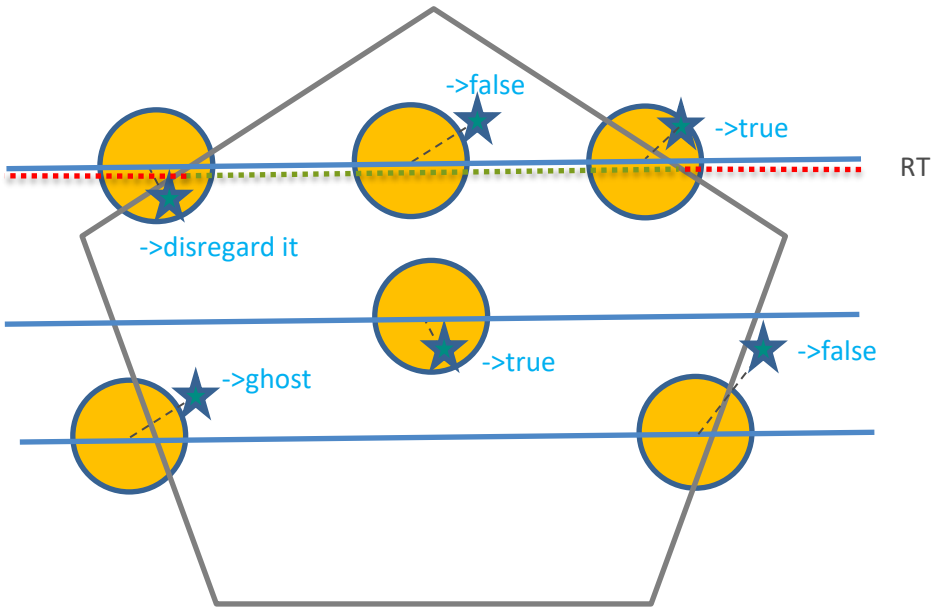

Figure 12: Target report classification if position error is calculated

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The following descriptions further give the details of target report classification with and without position error calculation:

Existence of a "Reference trajectory" within OSV (!)	Target Report that is associated/correlated (identity and/or location) to a reference trajectory within the OSV at the time of Target Report
No Existence of a "Reference trajectory" within OSV (!)	Target Report that is in the OSV but isn't associated/correlated (identity and/or location) to a reference trajectory within the OSV at the time of Target Report

True Target Reports	Target Report that is associated/correlated (identity and/or location) to a reference trajectory within the OSV at the time of Target Report and – *if position error is calculated* – that is found at a horizontal position error less than a false position threshold to the reference trajectory it has been associated to.
False Target Reports	*If position error is calculated* – Target Report that is associated/correlated (identity and/or location) to a reference trajectory within the OSV at the time of Target Report and that is found at a horizontal position error greater than a false position threshold to the reference trajectory it has been associated to.
Ghost Target Reports	Target Report that is in the OSV but isn't associated/correlated (identity and/or location) to a reference trajectory within the OSV at the time of Target Report Or – if position error is calculated – is associated to a reference trajectory outside the OSV but has a position error greater than the false position threshold.

[REQ]

Identifier	REQ-14.84e-TS-COOP.0030
Title	Target Report Classification Method
Requirement	The SPM tool **shall** perform target report classification (described in the table above) in one of the following ways using the value of the configuration option “target report classification method”: • either using target report position error to reference, • or without using target report position error to reference and assuming zero position error. This requirement is optional for ADS-B sensor.

Status	<Validated>
Rationale	Target report classification is used to selectively include target reports in performance assessment. In order to perform the performance assessment in a generic manner for WAM, MLAT and ADS-B, target report classification can be performed in two distinct ways. Both ADS-B standard ED-129C and the airport MLAT ED-117A consider all target reports (true and false target reports) for performance assessment, whereas WAM standard ED-142A considers only target reports that are “close” to the reference (true target reports).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0031
Title	True Target Reports- Identification
Requirement	The SPM tool **shall** identify true target reports as all target reports associated to reference trajectories when the latter is in OSV excluding the false target reports. This requirement is optional for ADS-B sensor.
Status	<Validated>

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Rationale	Identifying the true target reports is an essential prerequisite for the performance assessment / metrics computation. Note: Even though the classification approach and especially the exclusion of false targets is not required by the ADS-B standard ED-129C or the airport MLAT ED-117A, it has been decided to harmonize and follow the same approach for all technologies (see target report classification).
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0032
Title	False Target Reports- Identification

Requirement	The SPM tool **shall** identify false target reports as target reports with horizontal position error- to reference trajectory located in OSV - greater than or equal to the false position threshold applicable for the selected Operational Environment:
	
	• For airport MLAT: 5 times the RPA (Reported Position Accuracy) value, optionally no False Target Reports,
	• For ADS-B and WAM:
	  ○ Either the HP-ATU values specified below (default for WAM and optional for ADS-B),
	  ○ Or no false target (default for ADS-B and optional for WAM).

ATC Service Type	**'HP-ATL$_{Sensor}$' and 'HP-ATU$_{Sensor}$' [m] per Sensor Output Period**

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	<table><tr><th></th><th>1s</th><th>2s</th><th>4s</th><th>5s</th><th>8s</th></tr><tr><td>Low-Density</td><td>1485 / 2175</td><td>1415 / 2075</td><td>1285 / 1885</td><td>1225 / 1800</td><td>1065 / 1565</td></tr><tr><td>Medium-Density ER</td><td>1230 / 1805</td><td>1170 / 1715</td><td>1050 / 1540</td><td>1000 / 1465</td><td>865 / 1265</td></tr><tr><td>High-Density ER</td><td>1040 / 1525</td><td>980 / 1440</td><td>875 / 1280</td><td>825 / 1215</td><td>710 / 1040</td></tr><tr><td>Low-Density TMA</td><td>755 / 1110</td><td>695 / 1020</td><td>605 / 885</td><td>565 / 830</td><td></td></tr><tr><td>Medium-Density TMA</td><td>590 / 865</td><td>535 / 785</td><td>460 / 675</td><td>435 / 635</td><td></td></tr><tr><td>High-Density TMA</td><td>450 / 660</td><td>405 / 595</td><td>345 / 505</td><td>325 / 475</td><td></td></tr><tr><td>High-Density APP2.5</td><td>265 / 390</td><td>240 / 350</td><td>205 / 300</td><td>205 / 300</td><td></td></tr><tr><td>High-Density APP2.0</td><td>210 / 310</td><td>190 / 280</td><td>165 / 240</td><td>165 / 240</td><td></td></tr></table> <table><tr><th>ATC Sector Type</th><th>RPA [m]</th></tr><tr><td>Manoeuvring Area</td><td>12</td></tr><tr><td>Apron Taxiways and Taxi Lanes</td><td>20</td></tr><tr><td>Stands</td><td>25</td></tr></table> This requirement is optional for ADS-B sensor. Recommendation: The factors for the thresholds should be configurable by the user.
Status	<Validated>
Rationale	Identifying the false target reports is an essential prerequisite for the performance assessment / metrics computation. If horizontal position error is not used for classification, no target reports will be classified as False. Note: Even though the classification approach and especially the false target identification is not required by the ADS-B standard ED-129C or the airport MLAT ED-117A, it presents a pre-step for the true target identification, which is considered a mandatory requirement for all technologies within this TS/IRS and therefore the current requirement presents a mandatory requirement itself.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance

<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0033
Title	Ghost Target Reports- Identification
Requirement	The SPM tool **shall** identify ghost target reports as target reports being either 3D located in the defined OSV (when there is height information) or 2D located in the defined OSV (when there is no height information) but not associated to any reference trajectory within OSV and – if position error is calculated –associated to reference trajectory outside OSV but only when exceeding the false position threshold. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Identifying the ghost target reports is an essential prerequisite for the performance assessment / metrics computation. Note: Even though the classification approach and especially the ghost target identification is not required by the ADS-B standard ED-129C or the airport MLAT standard ED-117A, it presents a pre-step for the true target identification, which is considered a mandatory requirement for all technologies within this TS/IRS and therefore the current requirement presents a mandatory requirement itself.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance

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<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0035
Title	False/Ghost Tracks - Identification
Requirement	The SPM Tool **shall** identify false/ghost tracks as a sequence of correlated false/ghost target reports lasting more than 2 update intervals. An initial algorithm to identify correlated false/ghost target reports is as follows: 1. Step: consider only false target reports satisfying time diff<1UI 2. Step: then consider only those reports with position difference that would correspond to velocity <1500m/s 3. Step: then out of step 2 reports find consecutive intervals (3 or more subsequent reports) lasting more than 2UIs This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Identifying the false/ghost tracks is an essential prerequisite for the performance assessment / metrics computation. If horizontal position error is not used for classification, there will be no False tracks. Only WAM standard (ED-142A) is referring to false and ghost tracks. This requirement has nevertheless been extended to MLAT and optionally to ADS-B.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

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<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.3.2 Probability of Update and Long Gap

4.2.1.3.2.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0036
Title	Probability of Update Computation
Requirement	The SPM Tool **shall** compute the probability of update (PU) and the sample size (N_{UI}) considering the selected Operational Environment in the Configuration Data as follows $$PU = 1 - \left(\frac{Total\ miss\ period}{Total\ flight\ duration}\right)$$ $$\text{Total flight duration} = \sum_{t=1}^{N_t} \text{duration of trajectory}_t$$ $$\text{Total miss period} = \sum_{t=1}^{N_t} \sum_{k=1}^{N_{miss,t}} \text{Miss period}_{k,t}$$ $$\text{Miss period}_{i,t} = \begin{cases} G_{i,t} - UI, & if\ G_{i,t} > UI \\ 0, & if\ G_{i,t} \leq UI \end{cases}$$ $$G_{i,t} = T_{i+1,t} - T_{i,t}$$

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	$$N_{UI} = \frac{\text{Total flight duration}}{\text{UI}}$$ With N_t = the number of reference trajectories within applicable volume $N_{miss,t}$= the number of identified missed periods for t^{th} trajectory $T_{i,t}$= time stamp of i^{th} true target report in trajectory t i = index in the range [1 and N] with N being the number of true target reports in a trajectory UI = update interval applicable for operational environment Probability of Update should be calculated separately for position, altitude and code (Mode A, aircraft identification) for WAM/MLAT. For ADS-B, PU calculation for position only is sufficient, the other data items (Mode A, emergency, SPI) are indicated as being implicitly covered by the Position PU (see ED-129C Section 3.3.1.1 Note 4 and Appendix E). Note: In case the reference trajectory does not contain code (in full or partially), this might affect the PU performance results. It is proposed that information on missing code in the reference data is provided to the user to facilitate its investigation (e.g., faulty aircraft issue and degraded ground station performance). Therefore, it is recommended that feedback on the number of target reports of data under analysis is provided, where no code was available in the reference data.
Status	<Validated>
Rationale	ADS-B standard (ED-129C) describes how to calculate the PU in section 6.5.1.6.2. The method has been extended to WAM and MLAT.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

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<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0037
Title	Probability of Long Gaps Computation- n=2, n=3, n=4
Requirement	The SPM Tool **shall** compute the probability of long gaps (PLG) and the sample size (N_{UI}) considering the selected Operational Environment in the Configuration Data as $$PLG(n) = \frac{UI}{Total\ flight\ duration}\sum_{t=1}^{N_t}\sum_{k=1}^{N_{agi,t}} agi_{k,t}(n)$$ $$Total\ flight\ duration = \sum_{t=1}^{N_t} duration\ of\ trajectory_t$$ $$agi_{i,t}(n) = pgi_{i,t}(n) \times n$$ $$pgi_{i,t}(n) = \left(\frac{G_{i,t}}{UI} - n\right)\ for\ n \times UI \le G_{i,t} < (n+1) \times UI$$ $$+\left(n + 2 - \frac{G_{i,t}}{UI}\right) for\ (n+1) \times UI \le G_{i,t} < (n+2) \times UI$$ $$G_{i,t} = T_{i+1,t} - T_{i,t}$$ $$N_{UI} = \frac{Total\ flight\ duration}{UI}$$ With N_t = the number of reference trajectories within applicable volume $N_{agi,t}$= the number of $agi_{i,t}(n)$ for t^{th} trajectory $T_{i,t}$= time stamp of i^{th} true target report in trajectory t i = index in the range [1 and N] with N being the number of true target reports in a trajectory UI = update interval applicable for operational environment

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	While for ADS-B only the position long gaps are of interest, for the WAM system also the long gaps for pressure altitude are to be computed.
Status	<Validated>
Rationale	ED-129C describes how to calculate the PLG in section 6.5.2.6.2 and 6.5.2.6.3. The method has been extended to WAM. Note that PLG is only required for n=3 in current ED-129C draft, nevertheless it is assumed that ED-129C will be aligned to ED-261 [19] (similar to ED-142A draft), which requires PLG for n=2, 3 and 4.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0038
Title	Probability of Long Gaps Computation – N≥5
Requirement	The SPM Tool **should** compute the probability of long gaps (PLG) for gaps longer than 4 UIs and the sample size (N_{UI}) considering the selected Operational Environment and the configured gap size (NxUI) in the Configuration Data as follows: $$PLG(\geq N) = \frac{UI}{Total\ flight\ duration} \sum_{t=1}^{N_t} \sum_{i=1}^{N_G(n \geq N)} agi_{i,t}(\geq N)$$

	$$Total\ flight\ duration = \sum_{t=1}^{N_t} duration\ of\ trajectory_t$$ $$agi_{i,t}(\geq N) = N \times \left(\frac{G_{i,t}}{UI} - N\right)\ for\ N \times UI \leq G_{i,t} < (N+1) \times UI$$ $$+(\frac{G_{i,t}}{UI} - 1) for\ G_{i,t} \geq (N+1) \times UI$$ $$G_{i,t} = T_{i+1,t} - T_{i,t}$$ $$N_{UI} = \frac{Total\ flight\ duration}{UI}$$ With N_t = the number of reference trajectories within applicable volume $N_{agi,t}$= the number of $agi_{i,t}(n)$ for t^{th} trajectory $T_{i,t}$= time stamp of i^{th} true target report in trajectory t i = index in the range [1 and N] with N being the number of true target reports in a trajectory UI = update interval applicable for operational environment While for ADS-B only the position long gaps are of interest, for the WAM system also the long gaps for pressure altitude are to be computed.
Status	<Validated>
Rationale	ADS-B standard (ED-129B) describes how to calculate the PLG(n>=4) in section 6.5.2.6.2 and section 6.5.2.6.3. The method has been used instead for PLG(n>=5) due to assumed PLG requirement update for n=2,3 and 4 in ED-129C (to be aligned with ED-261[19] similar to ED-142A draft) and has been extended to WAM. ED-142A draft states *"…events that are longer than 'four' consecutive missed updates, should be treated as a 'fail"* and justifies the PLG(n>=5) requirement.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a

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<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

4.2.1.3.2.2 WAM and ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0039
Title	PU - Computation of ka factor
Requirement	The SPM Tool **shall** for the PU assessment compute a "ka" factor depending on the computed PU percentage, the samples size (N_{UI}) and the PU thresholds applicable for the selected Operational Environment as follows: $$ka_{PU} = \frac{N_{UI} \cdot (PU_{meas} - PU_{req})}{\sqrt{N_{UI} \cdot PU_{req} \cdot (1 - PU_{req}) + \frac{PU_{req}^2}{2}}}$$ With N_{UI} = the computed sample size (number of update intervals) PU_{meas}= the computed PU percentage PU_{req}= the required PU percentage for the applicable Operational Environment

ENVIRONMENT	Required 'PU_{req}' for Horizontal Position
ER_5NM Low Density	96.0%
ER_5NM Medium Density	97.5%
ER_5NM High Density	98.5%
TMA_3NM Low Density	96.5%
TMA_3NM Medium Density	97.5%
TMA_3NM High Density	98.5%
APP_2.5NM High Density	99.0%
APP_2.0NM High Density	99.0%
ADS-B APT(moving)	90%
ADS-B APT (stationary)	90%

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Status	<Validated>
Rationale	ADS-B standard (ED-129C) describes how to calculate the ka_pu factor in section 6.5.1.5. The method has been extended to WAM.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0040
Title	PLG - Computation of ka factor
Requirement	The SPM Tool **shall** for the PLG assessment compute a "ka" factor depending on the computed PLG percentage, the samples size (N_{UI}) and the PLG thresholds applicable for the selected Operational Environment as follows: $$ka_{PLG} = \frac{N_{UI} \cdot (PLG_{req} - PLG_{meas})}{\sqrt{N_{UI} \cdot PLG_{req} \cdot (1 - PLG_{req}) + \frac{(1 - PLG_{req})^2}{2}}}$$ With N_{UI} = the computed sample size (number of update intervals) PLG_{meas}= the computed PLG percentage with n=3 PLG_{req}= the required PLG percentage for the applicable Operational Environment

	<table><tr><th>ATC Sector Type</th><th>Update Interval (s)</th><th>n = 3</th></tr><tr><td>Low-Density ER</td><td>8</td><td>0.222%</td></tr><tr><td>Medium-Density ER</td><td>8</td><td>0.083%</td></tr><tr><td>High-Density ER</td><td>8</td><td>0.037%</td></tr><tr><td>Low-Density TMA</td><td>5</td><td>0.185%</td></tr><tr><td>Medium-Density TMA</td><td>5</td><td>0.074%</td></tr><tr><td>High-Density TMA</td><td>5</td><td>0.030%</td></tr><tr><td>High-Density APP2.5</td><td>5</td><td>0.015%</td></tr><tr><td>High-Density APP2.0</td><td>5</td><td>0.012%</td></tr><tr><td>ADS-B APT (moving)</td><td>1</td><td>N/A</td></tr><tr><td>ADS-B APT (stationary)</td><td>5</td><td>N/A</td></tr></table>
Status	<Validated>
Rationale	ADS-B standard (ED-129C) describes how to calculate the ka_plg factor in section 6.5.2.5. The method has been extended to WAM.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0041

Title	Gap Allocation to Cell
Requirement	For a gap contained in one cell or overlapping two or more cells, the SPM Tool **shall** allocate the calculated $agi_{i,t}$ (given in REQ-14.84e-TS-COOP.0037 and REQ-14.84e-TS-COOP.0038) to each affected grid cell proportional to the gap duration within that cell in a cell-based PLG performance evaluation. For a gap between two reports at time $T_{i,t}$ and $T_{i+1,t}$, the first cell is the cell where reference is at time T_i + UI (i.e., 1 UI after the last target report before the start of the gap) and the last cell is the cell where reference is at time $T_{i+1,t}$. The $agi_{i,t}$ to be allocated to first and following cells involved in the gap is given as follows: $$agi_{i,t,cell:1} = agi_{i,t}\frac{G_{i,t,cell:1} - UI}{G_{i,t} - UI}$$ $$agi_{i,t,cell:2} = agi_{i,t}\frac{G_{i,t,cell:2}}{G_{i,t} - UI}$$ … $$agi_{i,t,cell:n} = agi_{i,t}\frac{G_{i,t,cell:n}}{G_{i,t} - UI}$$ where $G_{i,t,cell:1}$ to $G_{i,t,cell:n}$ is the gap within each cell given as: $G_{i,t,cell:1} = T_{CB:1,2} - T_{i,t}$, $G_{i,t,cell:2} = T_{CB:2,3} – T_{CB:1,2}$, …. $G_{i,t,cell:n} = T_{i+1,t} – T_{CB:n-1,n}$, where $T_{CB:1,2}$ to $T_{CB:n-1,n}$ is the time of the reference at the cell boundary between consecutive cells. If the gap is contained within a single cell, then the gap in cell is simply given as: $G_{i,t,cell:1} = T_{i+1,t} - T_{i,t}$ and all $agi_{i,t}$ will be attributed to this cell. The PLG for each cell will be calculated as the sum of all $agi_{i,t,cell:n}$ over all trajectories and gaps in these trajectories as given in REQ-14.84e-TS-COOP.0037 and REQ-14.84e-TS-COOP.0038.
Status	<Validated>

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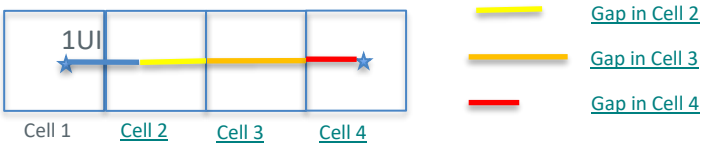
Rationale	ED-129C (section C.5) states to allocate it this way. PLG cell-based performance evaluation is though optional. If, however, cell-based approach used, this requirement is mandatory.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND



4.2.1.3.2.3 MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0044
Title	Probability of Long Gaps (MLAT) – Gaps Size
Requirement	The gaps **shall** be at least of 3 times the update period (configurable). Update period is - 1 (one) sec for Manoeuvring Area, Apron and Taxi lanes - 5 (five) sec for the Stands
Status	<Validated>
Rationale	This requirement is included to comply with calculation of PTR according to ED-117A.
Category	<Functional>

[REQ Trace]

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Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.3.3 Horizontal Position Accuracy

4.2.1.3.3.1 Common Requirements

It is recognized that ED-129C does not include ADS-B accuracy requirements, whereas those exist in ED-142A and ED-117A. It is proposed that GENSUR SPR16 that addresses the “core accuracy” and that SPR17 that address the “tail accuracy” at SUR sensor level are used (for SPR16 and SPR17 the same requirement table is part of ED-142A). Beside this, the accuracy of the Position Accuracy Covariance Matrix data required in ED-142A is considered as well.

The following horizontal accuracy performance assessments are used:

- Root Mean Square (RMS) horizontal position accuracy
- Percentage of values within a given position error (thresholds for core and tail accuracy as defined in ED-142A, threshold per area for surface applications)
- Horizontal position accuracy for a given percentile
- Accuracy of the Position Accuracy Covariance Matrix data

[REQ]

Identifier	REQ-14.84e-TS-COOP.0045
Title	RMS horizontal position accuracy assessment
Requirement	The SPM tool **shall** calculate the RMS Horizontal Position Accuracy for all true target reports as $$RMS = \sqrt{\frac{1}{\mathrm{N}}\sum_{i=1}^{N} Pos\ Error_i^2}$$ Where N = the number of target reports

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	Pos Error$_i$= the horizontal position error of the ith true target report to the reference. This requirement is optional for ADS-B sensor. Regarding ADS-B: ED-129C does not require any accuracy performance computation but from ANSP perspective it is needed to have performance values for accuracy (with respect to GEN SUR). The accuracy depends entirely on the aircraft on-board systems.
Status	<Validated>
Rationale	Even though the requirement is specified only in ED-142A for WAM applications, this requirement has been extended to multilateration systems in general and optionally to ADS-B.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0048
Title	Percentage within required HPA – method 1
Requirement	The SPM tool **shall** calculate the percentage of position errors within the required horizontal position accuracy of the selected operational environment as $P_{ACC} = N_{ACC}/N$

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	With N_{ACC}= being the number of true target reports with position error equal to or smaller than the required horizontal position accuracy applicable for the selected operational environment N = the total number of true target reports. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.3.3.1 Common Requirements. The requirement is specified in ED-117A for surface applications and in ED-142A for MLAT and WAM systems and has been extended optionally to ADS-B. ED-117A: requirement 63 and test chapter 6.4.7. ED-142A: requirements 76 (core accuracy) and 77 (tail accuracy) and test chapter 6.8.3.6.3. For each of the two requirements two thresholds are applicable: core accuracy: lower & upper bound, tail accuracy: lower and upper bound.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

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Identifier	REQ-14.84e-TS-COOP.0049
Title	HPA for a Percentile – method 2
Requirement	The SPM tool **shall** calculate the horizontal position accuracy for the percentile, P, applicable for the selected operational environment as $$HPA(P) = \begin{cases} \frac{1}{2}(Pos\ Error_{N\cdot P} + Pos\ Error_{N\cdot P+1}); & if\ N \cdot P \notin \mathbb{Z} \\ Pos\ Error_{N\cdot P}; & if\ N \cdot P \in \mathbb{Z} \end{cases}$$ With $Pos\ Error_i =$ being the i[th] element in a sorted list of ascending true target report horizontal position errors N = being the number of true target reports This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.3.3.1 Common Requirements ED-117A: requirement 63 and test chapter 6.4.7. Even though the requirement is specified only in ED-117A for surface applications, this requirement has been extended to multilateration systems in general and optionally to ADS-B.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

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<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0116
Title	HPA - Computation of kc factor
Requirement	The SPM Tool **shall** for the core and tail HPA assessment compute a "kc" factor depending on the computed HPA percentage P_{meas}, the sample size (NM) and the HPA percentage requirement P_{req} applicable for the intended HPA evaluation (core or tail accuracy) as follows: $$kc_{HPA} = \frac{\sqrt{NM} \cdot (P_{meas} - P_{req})}{\sqrt{P_{req} \cdot (1 - P_{req})}}$$ With NM = the computed sample size (number of target reports) P_{meas}= the computed percentage within required HPA threshold (according to REQ-14.84e-TS-COOP.0048) P_{req}= the required percentage for the applicable HPA requirement thresholds (lower (L) and upper bound (U)) depending on the core (ACL, ACU) or tail accuracy (ATL, ATU) evaluation **HPA requirement** / **Cumulative Error Preq** $HP\text{-}ACL_{sensor}$ — 63.2% $HP\text{-}ACU_{sensor}$ — 95% $HP\text{-}ATL_{sensor}$ — 99% $HP\text{-}ATU_{sensor}$ — 99.93% Table 10: Extracted from ED-142A Table 24 This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	The requirement is specified in ED-142A for WAM system only and has been extended optionally to multilateration systems in general (including surface applications) and to ADS-B. WAM standard (ED-142A) describes how to calculate the kc_HPA factor in section 6.8.3.5.

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Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

4.2.1.3.3.2 WAM and MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0117
Title	Accuracy of the Position Accuracy Covariance Matrix data Computation
Requirement	The SPM Tool **shall** compute the accuracy of the reported position accuracy covariance matrix data components as follows: $$\overline{SD_1Ratio} = \sqrt{\frac{\sum_{i=1}^{N} VAR_1Ratio_i}{N}}$$ $$\overline{SD_2Ratio} = \sqrt{\frac{\sum_{i=1}^{N} VAR_2Ratio_i}{N}}$$ $$\overline{COV_{1,2}Ratio} = sign\left(\sum_{i=1}^{N_{nz}} COV_{1,2}Ratio_i\right) \cdot \sqrt{\frac{\sum_{i=1}^{N_{nz}} COV_{1,2}Ratio_i}{N_{COV}}}$$ With $$VAR_1Ratio_i = Err_{1,i}^2 / VAR_{1,i}$$

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	$$VAR_2Ratio_i = Err_{2,i}^2/VAR_{2,i}$$ $$COV_{1,2}Ratio_i = Err_{1,i} \cdot Err_{2,i}/COV_{1,2,i}$$ Where: $VAR_{1,i}/VAR_{2,i}$= the variance components of the covariance matrix for the i[th] target report (square of reported SD in local X/Y coordinates or latitude/longitude coordinates). $COV_{1,2,i}$= the covariance component of the covariance matrix for the i[th] target report (square of reported covariance SD in local X/Y coordinates or latitude/longitude coordinates multiplied by its reported sign (±1). $Err_{1,i}/Err_{2,i}$ = the computed horizontal position error components along the same coordinate axes as the reported covariance matrix components N = the number of target reports with $VAR_{1,i}/VAR_{2,i}$ covariance components not equal to 0. N_{COV}= the number of target reports satisfying the following condition $\frac{COV_{1,2,i}}{VAR_{1,i}+VAR_{2,i}} \geq 0.01$.
Status	<Validated>
Rationale	The requirement is specified in ED-142A for WAM system only and has been extended to multilateration systems in general (including surface applications). WAM standard (ED-142A) describes how to calculate the accuracy of reported accuracy in section 6.8.4.7.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

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4.2.1.3.4 Probability of False/Ghost Tracks and Density of False/Ghost Spurious Target Reports

[REQ]

Identifier	REQ-14.84e-TS-COOP.0050
Title	Density of False/Ghost Target Reports
Requirement	The SPM Tool **shall** compute the density of False/Ghost target reports as DFGT=NF/N Where: NF: Number of identified false/ghost target reports N: Number of total Target reports (including True, False and Ghost target reports) This requirement is optional for ADS-B.
Status	<Validated>
Rationale	Only the ED-117A requires the assessment of the probability of false target reports. The requirement has nevertheless been extended to WAM and optionally to ADS-B, including also the ghost reports density for all technologies.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

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<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0051
Title	Probability of False Tracks Computation (PFT)
Requirement	The SPM Tool **shall** compute the probability of False Tracks as PFT=NFUI/NUI Where: NFUI: Number of Update Intervals containing correlated false Target Reports contributing to a false track NUI: Number of total Update Intervals of the reference trajectories (same as used in PU) This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Only WAM standard (ED-142A) is referring to false and ghost tracks. This requirement has nevertheless been extended to MLAT and optionally to ADS-B.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0052
Title	Probability of Ghost Tracks Computation (PGT)
Requirement	The SPM Tool **shall** compute the probability of Ghost Tracks as PGT=NFUI/NUI Where: NFUI: Number of Update Intervals containing correlated ghost Target Reports contributing to a ghost track NUI: Number of total Update Intervals of the reference trajectories (same as used in PU) This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Only WAM standard (ED-142A) is referring to false and ghost tracks. This requirement has nevertheless been extended MLAT and optionally to ADS-B.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.3.5 Probability of correct/false identification and incorrect

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The following metrics are currently defined related to the correct, false or incorrect identification

- Probability of correct identification – PID (as requested in ED-117A)
- Probability of false identification – PFID (as requested in ED-117A)
- Probability of Incorrect –PoI (as requested in ED-142A)
    - Pressure Altitude (PA-PoI)
    - Aircraft Identity (AI-PoI) (Mode A code and Target identification)

This PID metric calculation differs from the PU approach in the sense that it is independent on the notion of update interval as defined by ED-129C and ED-142A, but more dependent on the number of target reports.

The PFID metric calculation is also based on the number of target reports and analyses the falsely identified reports.

The Probability of Incorrect analyses the durations of incorrect reports.

4.2.1.3.5.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0053
Title	Target reports with Correct Data Item
Requirement	The SPM Tool **shall** identify true target reports with correct identification for the target identification parameters below as follows For Mode A: it is correct if present and equal to reference trajectory value For Target Identification: it is correct if present and equal to reference trajectory value For Pressure Altitude it is correct if present and equal to reference trajectory value with tolerance +/-200ft This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	This requirement is included to comply with calculation of PTR according to ED-117A (Mode A, Target Identification, Mode S). Mode S data item has been, however, not included in this requirement, since due to the nature of track building the Mode S address would always be correct if present. This requirement is modified to comply with calculation of PoI according to ED-142A (Mode A, target identification, Pressure Altitude).
Category	<Functional>

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[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.3.5.2 WAM and ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0125
Title	Probability of Incorrect Computation
Requirement	The SPM Tool **shall** calculate the probability of incorrect for all identification parameters below ▪ Pressure Altitude ▪ Mode A code ▪ Target Identification) by using the following formula: $$PoI = \frac{\sum DI_i}{D_F} \cdot 100\%$$ Where DI_i: i^{th} duration when incorrect PA/AI data-item is provided by the system i = index in the range [1 and N] with N being the number of target reports with incorrect PA/AI data-item D_F: total flight duration of considered tracks

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	This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	This requirement is included to comply with calculation of PoI according to ED-142A. The requirement has been optionally extended to ADS-B.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

4.2.1.3.5.3 MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0054
Title	Probability of Identification Computation
Requirement	The SPM Tool **shall** calculate the probability of identification for all identification parameters below ▪ Mode A Code ▪ or Target Identification, by using the following formula: PID=NCITR/NTR x 100% Where: NTR: Total Number of true Target Reports NCITR: Number of true Target Reports with correct Data Item
Status	<Validated>
Rationale	This requirement is included to comply with calculation of PID according to ED-117A. Mode S data item has been, however, not included in this

	requirement, since due to the nature of track building the Mode S address would always be correct if present.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0055
Title	Target Reports with Identification
Requirement	The SPM Tool **shall** identify the true target reports with identification. The requirement holds for each identification parameter below ▪ Mode A Code ▪ or Target Identification.
Status	<Validated>
Rationale	This requirement is included to comply with calculation of PFID according to ED-117A. Mode S data item has been, however, not included in this requirement, since due to the nature of track building the Mode S address would always be correct if present.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0056
Title	Probability of False Identification Computation
Requirement	The SPM tool **shall** calculate the probability of false identification of a Target Identification Parameter, which is ▪ Mode A Code ▪ or Target Identification, by using the following formula: PFID=NEITR/NITR Where: NEITR: Number of true Target Reports among the NITR, which have a different identity than the reference. NITR: Number of identified true Target Reports with identification (derived in REQ-14.84e-TS-COOP.0055).
Status	<Validated>
Rationale	This requirement is included to comply with calculation of PTR according to ED-117A. Mode S data item has been, however, not included in this requirement, since due to the nature of track building the Mode S address would always be correct if present.
Category	<Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

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4.2.1.3.6 Maximum Update Delay

4.2.1.3.6.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0129
Title	Update Delay Computation
Requirement	The SPM Tool **shall** compute the update delay UD for each of the following data items ■ Mode A ■ Target identification ■ Emergency & SPI as follows $$UD_{k,i}(C_{k,i,Ref}) = t_{k,Analysis}(C_{k,i,Ref}) - t_{k,Ref}(C_{k,i,Ref})$$ With $C_{k,i,Ref}$ = being the i^{th} occurring code in the k^{th} reference data track $t_{k,Ref}(C_{k,i,Ref})$ = timestamp of first occurrence of the code $C_{k,i,Ref}$ in k^{th} reference data track $t_{k,Analysis}(C_{k,i,Ref})$ $= \begin{cases} \text{timestamp of 1st occurrence of same code } C_{k,i,Ref} \text{ in } k^{\text{th}} \text{analysis track, if code } C_{k,i,Ref} \text{ found} \\ \text{time of exit of } k^{\text{th}} \text{track from OSV, if code } C_{k,i,Ref} \text{ not found or reference trajectory stops} \end{cases}$ Where: i = index in the range [1, N] with N being the number of all appearing codes in the k^{th} reference data track k = index in the range [1, NT] with NT being the number of considered reference data tracks This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	This requirement has been introduced for the Maximum Update Delay Computation required in the WAM standard (ED-142A). The method has been extended to MLAT and optionally to ADS-B.
Category	<Functional>

[REQ Trace]

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Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.3.7 Position Ground Processing & Communication Latency

4.2.1.3.7.1 ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0057
Title	Maximum Position Ground Processing & Communication Latency Computation
Requirement	The SPM Tool **shall** compute the Maximum Position Ground Processing & Communication Latency as the maximum time difference between time of message reception (Item I021/073) and the transmission (Item I021/077) of the corresponding ASTERIX report.
Status	<Validated>
Rationale	Draft ED-129C [18] specifies a maximum allowable for latency (in reference draft it is 1.5 s). For final version of the TS/IRS an ambiguity in the determination of the processing latency was removed.
Category	<Functional>

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[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

4.2.1.3.7.2 WAM Specific Requirements

For WAM system, ED-142A refers to “time of reception of the target signal to the WAM System” that is not available in ASTERIX category 020. Best available data is item 020/140 that is not guaranteed to be time of transponder signal reception. Therefore, there is not a clear way to calculate this metric for WAM.

4.2.1.3.7.3 MLAT Specific Requirements

For MLAT system, ED-117A refers to “time of reception of the target signal to the MLAT System” that is not available in ASTERIX category 010 or 020. Therefore, there is not a clear way to calculate this metric for MLAT.

4.2.1.4 Reporting Output Function Requirements

Reporting functionality requirements aim to specify the output of the performance metrics defined in the Section 4.2.1.2.

The provision and representation form of the result values are specified as mandatory requirements for each output of the performance metrics. However, the reporting template is only a guidance established by the solution and is therefore optional. The tool manufacturer may decide to provide a different template for the report that better suits his needs, as long as the mandatory reporting requirements (value and representation form) are met.

The report contains the performance metrics that are output in a well-defined layout with the corresponding pass/fail grades in order to demonstrate standards compliance. The pass/fail grades are generally the thresholds to be applied for the particular Operating Environment in combination with the sample size. The pass/fail grade of each metric is indicated with a colour coding as well as the mention of the Pass/Fail grade or with the mention of NC/NA (Not Computed/ Not Applicable).

The pass/fail grades and corresponding shades of colours are currently defined only for PU and PLG metrics in ED-129C and additionally for core & tail HPA metrics in ED-142A as detailed in Section 4.2.1.4.1.1.

For other performance assessment metrics, the following simple pass/fail grades will be used for the reporting:

- “Pass” text and dark green colour indicates the metric satisfies the standard,

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- "Fail" text and red colour indicates the metric fails the standard,
- "NC" text and light grey colour indicates the metric cannot be computed,
- "NA" text and dark grey colour indicates the metric is not applicable.

Not Computed (NC) condition can be reported in the case the pass/fail cannot be determined due to insufficient sample size or other reasons. Not Applicable (NA) condition is reported if the metric is not applicable for the currently evaluated sensor or operational environment. NA condition is necessary as the SPM tool supports analysis of ADS-B, WAM and MLAT sensors with corresponding standards in various operational environments.

The report outputs the performance metrics and associated information in a tabular format. As the metrics are calculated in three domains, there are three base tables corresponding to these three domains of metrics calculation:

- Overall OSV metrics,
- Per trajectory metrics,
- Per grid cell metrics.

Additional information is also provided for the sensor under evaluation, OSV, Operational Environment, applied filters and reference used for the analysis.

4.2.1.4.1 General

Depending on the performance evaluation type, the report will have several parts giving different aspects of the analysis performed:

- Background information,
- Performance evaluation type (e.g. PU/PLG, HPA, etc.)
    - OSV based metric results,
    - Trajectory based metric results,
    - Grid based metric results.

One or more performance evaluation types can be selected for reporting, as well as the calculation domain. For trajectory and grid based evaluation, each performance metric will be output in a separate table grouping similar information for all trajectories or grid cells; e.g. PU and PLG will be output in separate tables. Considering the large number of trajectories and grid cells, the output will be limited to user configurable metric value threshold; e.g. all trajectories with PU up to 98%.

The first part of the report gives the background information for the analysis performed including the following:

- Name or identifier of sensor under evaluation,
- Sensor Type,

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- Input data date time start-end,
- OSV definition,
- Operational Environment and applicable parameter set,
- Type of reference used for analysis,
- Grid definition,
- Applied filters if any,
- Date-time of evaluation,
- SPM Tool Identifier.

The background information is given in text format similar to the example below:

Sensor under evaluation: MUAC ADS-B Ground Station

Sensor Type: ADS-B

Input Data Date-Time start-end: 2017-09-01 08:00:00 – 2017-09-01 12:00:00

OSV Definition: Maastricht Upper Area Control, (50.0N, 7.0E; 52.0N, 7.0E; 52.0N, 9.0E; 50.0N, 9.0E; 50.0N, 7.0E)

Operational Environment: High-Density Enroute

Type of Reference used for analysis: Internal reconstruction from Radars X, Y, Z and MUAC ADS-B

Grid Definition:

Origin: (51.0N, 8.0E),

Rotation: 0 deg,

X Cell size and number: 10 NM, 12 cells

Y Cell size and number: 10 NM, 12 cells

Altitude Bands: (-1500 ft, 5000 ft), (5000 ft, 50000 ft)

Applied filters: None

Date-time of evaluation: 2017-09-18 10:00:00

SPM Tool Identifier: SASS-C VERIF v1.0.0

The OSV based metric results are output in a tabular format with the following columns:

- Metric value,
- Metric threshold,

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- Sample size,
- Pass/Fail grade or NA/NC condition,

Probability of Update

PU Metric Value	Metric Threshold	Sample Size	Pass/Fail Grade
98 %	≥ 95 %	100000	High Pass

Probability of Long Gap

PLG Metric Value	Metric Threshold	Sample Size	Pass/Fail Grade
0.1 %	≥ 95 %	100000	High Pass

The trajectory based metric results are output as sorted by their corresponding metric value in a tabular format with the following columns:

- Trajectory Id (ICAO 24 bit address, Mode A code(s) or internal trajectory identifier),
- Trajectory start/end within OSV,
- Metric value,
- Sample size,
- Pass/Fail/NA/NC condition,

The trajectories that are included in this table will be limited by a user configurable metric value threshold; e.g., all trajectories with PU up to 99% are to be output with ascending metric value. The metric threshold, as it is applicable to all trajectories, is given in the metric value column header.

Probability of Update

Trajectory Id	Trajectory start/end	PU Metric Value (≥ 95 %)	Sample Size	Pass/Fail Grade

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123456	10:00:00-10:30:00	98 %	400	High Pass
654321	10:00:00-10:20:00	99 %	600	Very High Pass
…				

The grid based metric results are output in a tabular format with the following columns:

- Grid cell indices,
- Metric value,
- Sample size,
- Pass/Fail/NA/NC condition,

The grid cells that are included in this table will be limited by a user configurable metric value threshold; e.g., all grid cells with PU up to 99% are to be output. The grid cell output can be sorted either with ascending metric value or grid cells. The metric threshold, as it is applicable to all grid cells, is given in the metric value column header. The grid cell indices indicate the cell x, y and z axis in the Cartesian co-ordinate system. The cell at the origin has index 0:0:0, but origin does not have to be at the center of the OSV. Negative cell indices for x and y can be given if the origin is around the center.

Probability of Update

Grid Cell Indices	**PU Metric Value (≥ 95 %)**	**Sample Size**	**Pass/Fail Grade**
-6:-6:0	98 %	200	High Pass
-6:-6:1	99 %	300	Very High Pass
…			

The grid cell based metric results are actually intended and can be better understood if presented as a coloured graphical chart. Such a graphical chart can be output for a user configurable altitude band for all x, y grid cells geographically. The output of such a “static” graphic chart as part of the report output is given as an optional requirement. The availability of a “dynamic” graphic chart within the graphical user interface by means of filtering functionality for various metrics for investigation purposes is given in Section 4.2.1.5.

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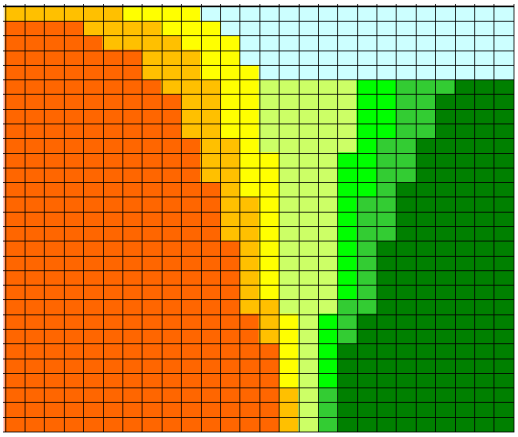

[REQ]

Identifier	REQ-14.84e-TS-COOP.0058
Title	Reporting Template
Requirement	The SPM Tool **should** output the background information and the OSV, Trajectory and Grid based performance metrics for the user selected performance evaluations in the Report Template given in this section.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0059
Title	OSV based Metrics Reporting

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Requirement	The SPM Tool **should** output the OSV-based performance metrics for one or more of following user selected performance evaluations: • Probability of Update (REQ-14.84e-TS-COOP.0036), • Probability of Long Gaps N=2, N=3, N=4 (REQ-14.84e-TS-COOP.0037), • Probability of Long Gaps N≥5 (REQ-14.84e-TS-COOP.0038), • RMS of HPA (REQ-14.84e-TS-COOP.0045), • Percentage within required HPA (REQ-14.84e-TS-COOP.0048), • HPA for Percentile (REQ-14.84e-TS-COOP.0049), • Accuracy of the Position Accuracy Covariance Matrix data (REQ-14.84e-TS-COOP.0117) • Density of False/Ghost Target Reports(REQ-14.84e-TS-COOP.0050), • Probability of False Tracks (REQ-14.84e-TS-COOP.0051), • Probability of Ghost Tracks (REQ-14.84e-TS-COOP.0052), • Probability of Identification for Mode A Code (REQ-14.84e-TS-COOP.0054), • Probability of Identification for Target Identification (REQ-14.84e-TS-COOP.0054), • Probability of False Identification for Mode A Code (REQ-14.84e-TS-COOP.0056), • Probability of False Identification for Target Identification (REQ-14.84e-TS-COOP.0056), • Maximum Update Delay for Target Identification (REQ-14.84e-TS-COOP.0129) • Maximum Update Delay for Mode A (REQ-14.84e-TS-COOP.0129) • Maximum Update Delay for Emergency & SPI (REQ-14.84e-TS-COOP.0129) • Probability of Incorrect for Mode A (REQ-14.84e-TS-COOP.0125) • Probability of Incorrect for Target Identification (REQ-14.84e-TS-COOP.0125) • Probability of Incorrect for Pressure Altitude (REQ-14.84e-TS-COOP.0125) • Position Ground Processing & Communication Latency (REQ-14.84e-TS-COOP.0057)
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0060
Title	Reporting Template Metrics for Trajectory
Requirement	The SPM Tool **should** output the trajectory-based performance metrics for one or more of following user-selected performance evaluations ordered from the worst to the best metric value for trajectories with metric values between user selected thresholds: • Probability of Update (REQ-14.84e-TS-COOP.0036), • Probability of Long Gaps N=2, N=3, N=4 (REQ-14.84e-TS-COOP.0037), • Probability of Long Gaps N≥5 (REQ-14.84e-TS-COOP.0038), • RMS of HPA (REQ-14.84e-TS-COOP.0045), • Percentage within required HPA (REQ-14.84e-TS-COOP.0048), • HPA for Percentile (REQ-14.84e-TS-COOP.0049), • Accuracy of the Position Accuracy Covariance Matrix data (REQ-14.84e-TS-COOP.0117) • Probability of Identification for Mode A Code (REQ-14.84e-TS-COOP.0054), • Probability of Identification for Target Identification (REQ-14.84e-TS-COOP.0054), • Probability of False Identification for Mode A Code (REQ-14.84e-TS-COOP.0056), • Probability of False Identification for Target Identification (REQ-14.84e-TS-COOP.0056), • Maximum Update Delay for Target Identification (REQ-14.84e-TS-COOP.0129) • Maximum Update Delay for Mode A (REQ-14.84e-TS-COOP.0129) • Maximum Update Delay for Emergency & SPI (REQ-14.84e-TS-COOP.0129) • Probability of Incorrect for Mode A (REQ-14.84e-TS-COOP.0125) • Probability of Incorrect for Target Identification (REQ-14.84e-TS-COOP.0125) • Probability of Incorrect for Pressure Altitude (REQ-14.84e-TS-COOP.0125) • Position Ground Processing & Communication Latency (REQ-14.84e-TS-COOP.0057)

Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0061
Title	Reporting Template Metrics for Grid
Requirement	The SPM Tool **should** output the grid-based performance metrics for one or more of following user-selected performance evaluations ordered from the worst to the best metric value for grid cells with metric values between user selected thresholds: • Probability of Update (REQ-14.84e-TS-COOP.0036), • Probability of Long Gaps N=2, N=3, N=4 (REQ-14.84e-TS-COOP.0037), • Probability of Long Gaps N≥5 (REQ-14.84e-TS-COOP.0038), • RMS of HPA (REQ-14.84e-TS-COOP.0045), • Percentage within required HPA (REQ-14.84e-TS-COOP.0048), • HPA for Percentile (REQ-14.84e-TS-COOP.0049), • Accuracy of the Position Accuracy Covariance Matrix data (REQ-14.84e-TS-COOP.0117) • Probability of Identification for Mode A Code (REQ-14.84e-TS-COOP.0054), • Probability of Identification for Target Identification (REQ-14.84e-TS-COOP.0054), • Probability of False Identification for Mode A Code (REQ-14.84e-TS-COOP.0056), • Probability of False Identification for Target Identification (REQ-14.84e-TS-COOP.0056),

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Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0062
Title	Metric Pass/Fail/NC/NA
Requirement	The metric output table row **should** be output with a certain colour and pass/fail condition column set whether or not the metric satisfies the criteria as following for evaluation types other than PU, PLG (N=2,3,4 and N>4) and core & tail HPA: • Dark Green and condition Pass if condition is satisfied, • Red and condition Fail if condition is not satisfied, • Light grey and condition NC if sample size is not sufficient, • Dark grey and condition NA if condition is not applicable.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

The colour shades and pass/fail grades for PU, PLG and core & tail HPA are described more in detail in Section 4.2.1.4.1.1. The thresholds and pass/fail criteria for other performance evaluation types are given in the following sections.

4.2.1.4.1.1 PU, PLG and core and tail HPA pass/fail grades colour shading

The pass/fail grades and corresponding colours are currently defined for PU, PLG metrics in ED-129C Table 37 & 38 and core and tail HPA ED-142A Table 20 & 21. The pass/fail grade is determined by the use of a ***ka*** value (PU& PLG) and kc (HPA) indicating the fidelity of the measurement. Depending on the sample size being greater or less than a minimum number of Update Intervals (PU&PLG)/number of target reports (HPA) different pass/fail grades and colours are used. REQ-14.84e-TS-COOP.0039 and REQ-14.84e-TS-COOP.0040 give how the **ka** factor is calculated for PU, PLG and **kc** factor in REQ-14.84e-TS-COOP.0116 for HPA respectively.

The following tables from ED-129C give the pass/fail grades and colouring, and the N_{UIMIN} for each operating environment. The same table applies to the kc factor used for HPA.

Grade Probability	Grade Colour	Grade 'ka' Value
> 97.5%	VERY HIGH PASS	> 1.96
90.0% .. 97.5%	HIGH PASS	1.28 .. 1.96
75.0% .. 90.0%	MEDIUM PASS	0.67 .. 1.28
25.0% .. 75.0%	NOMINAL PASS	-0.67 .. 0.67
10.0% .. 25.0%	MEDIUM FAIL	-1.28 .. -0.67
2.5% .. 10.0%	HIGH FAIL	-1.96 .. -1.28
< 2.5%	VERY HIGH FAIL	< -1.96

ED-129B Table 37, or ED-142A Table 20, giving Pass/Fail grade definitions for sample sizes ≥ N_{UIMIN}

Grade Probability	Grade Colour	Grade 'ka' Value
> 25.0%	POSSIBLE Pass	-0.67 .. 0.67
10.0% .. 25.0%	MEDIUM Fail	-1.28 .. -0.67
2.5% .. 10.0%	HIGH Fail	-1.96 .. -1.28
< 2.5%	VERY HIGH Fail	< -1.96

ED-129B Table 38, or ED-142A Table 21, giving Pass/Fail grade definitions for sample sizes < N_{UIMIN}

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ENVIRONMENT	Required 'PU_{req}' for Horizontal Position	Minimum Sample Size '$N_{UI,min}$'	Total Flight-Time 'T_{flt}' [s]
ER_5NM Low Density	96.0%	153	1224
ER_5NM Medium Density	97.5%	246	1968
ER_5NM High Density	98.5%	418	3344
TMA_3NM Low Density	96.5%	175	875
TMA_3NM Medium Density	97.5%	246	1230
TMA_3NM High Density	98.5%	418	2090
APP_2.5NM High Density	99.0%	630	3150
APP_2.0NM High Density	99.0%	630	3150
ADS-B APT(moving)	90%	57	57
ADS-B APT (stationary)	90%	57	570

ED-129B Table 36, or ED-142A Table 19, giving required PU, minimum PU sample size and related total flight time

ENVIRONMENT	Required 'PLG_{req}' for Horizontal Position	Minimum Sample Size '$N_{UI,min}$'	Total Flight-Time 'T_{flt}' [h]
ER_5NM Low Density	0.222%	2900	6.4
ER_5NM Medium Density	0.083%	7600	16.9
ER_5NM High Density	0.037%	17200	38.2
TMA_3NM Low Density	0.185%	3400	4.7
TMA_3NM Medium Density	0.074%	8500	11.8
TMA_3NM High Density	0.030%	21400	29.7
APP_2.5NM High Density	0.015%	41900	58.2
APP_2.0NM High Density	0.012%	52300	72.6
ADS-B APT (moving)	N/A	N/A	N/A
ADS-B APT (stationary)	N/A	N/A	N/A

ED-129B Table 40, or ED-142A Table 23, giving required PLG, minimum PU sample size and related total flight time

HPA requirement	Cumulative Error Preq	Minimum sample size NMmin
$HP\text{-}ACL_{sensor}$	63.2%	125
$HP\text{-}ACU_{sensor}$	95%	300
$HP\text{-}ATL_{sensor}$	99%	1100
$HP\text{-}ATU_{sensor}$	99.93%	8500

ED-142A Table 24 giving minimum sample size required for the different HPA test metrics defining lower (L) an upper (U) bound for core (ACL, ACU) and tail accuracy (ATL, ATU)

For the PU, PLG and core & tail HPA reporting, if sample size is larger than the minimum required:

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- “Very High Pass” text and dark green colour indicates the metric satisfies the standard with very high confidence,
- “High Pass” text and green1 colour indicates the metric satisfies the standard with high confidence,
- “Medium Pass” text and green2 colour indicates the metric satisfies the standard with medium confidence,
- “Nominal Pass” text and light green3 colour indicates the metric satisfies the standard with nominal confidence,
- “Medium Fail” text and yellow colour indicates the metric fails the standard with medium confidence,
- “High Fail” text and dark yellow colour indicates the metric fails the standard with high confidence,
- “Very High Fail” text and red colour indicates the metric fails the standard with very high confidence.

For the PU, PLG and core & tail HPA reporting, if sample size is less than the minimum required:

- “Possible Pass” text and light cyan colour indicates the metric may possibly satisfy the standard,
- “Medium Fail” text and yellow colour indicates the metric fails the standard with medium confidence,
- “High Fail” text and dark yellow colour indicates the metric fails the standard with high confidence,
- “Very High Fail” text and orange colour indicates the metric fails the standard with very high confidence.

[REQ]

Identifier	REQ-14.84e-TS-COOP.0066
Title	PU/PLG/core & tail HPA - Report Statistic – Pass/Fail Coloring
Requirement	The SPM tool **shall** use different pass/fail grades and corresponding color codes for the PU, PLG and core & tail HPA metrics depending on the calculated ka/kc factor and the sample size as follows

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TABLE 37: *PASS / FAIL GRADE DEFINITIONS FOR SAMPLE SIZES ≥ 'N$_{UIMIN}$'*

Grade Probability	Grade Colour	Grade 'ka' Value
> 97.5%	VERY HIGH PASS	> 1.96
90.0% .. 97.5%	HIGH PASS	1.28 .. 1.96
75.0% .. 90.0%	MEDIUM PASS	0.67 .. 1.28
25.0% .. 75.0%	NOMINAL PASS	-0.67 .. 0.67
10.0% .. 25.0%	MEDIUM FAIL	-1.28 .. -0.67
2.5% .. 10.0%	HIGH FAIL	-1.96 .. -1.28
< 2.5%	VERY HIGH FAIL	< -1.96

TABLE 38: *PASS / FAIL GRADE DEFINITIONS FOR SAMPLE SIZES < 'N$_{UIMIN}$'*

Grade Probability	Grade Colour	Grade 'ka' Value
> 25.0%	POSSIBLE Pass	-0.67 .. 0.67
10.0% .. 25.0%	MEDIUM Fail	-1.28 .. -0.67
2.5% .. 10.0%	HIGH Fail	-1.96 .. -1.28
< 2.5%	VERY HIGH Fail	< -1.96

With

N_{UIMIN} = the minimum required sample size

- (number of update intervals) for the applicable Operational Environment for PU&PLG
- (number of target reports) NMmin for HPA

HPA requirement	Cumulative Error Preq	Minimum sample size NMmin
HP-ACL$_{sensor}$	63.2%	125
HP-ACU$_{sensor}$	95%	300
HP-ATL$_{sensor}$	99%	1100
HP-ATU$_{sensor}$	99.93%	8500

Operational Environment	PU Requirement	PLG Requirement

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	<table><tr><th>ENVIRONMENT</th><th>Minimum Sample Size '$N_{UI,min}$'</th><th>Minimum Sample Size '$N_{UI,min}$'</th></tr><tr><td>ER_5NM Low Density</td><td>153</td><td>2900</td></tr><tr><td>ER_5NM Medium Density</td><td>246</td><td>7600</td></tr><tr><td>ER_5NM High Density</td><td>418</td><td>17200</td></tr><tr><td>TMA_3NM Low Density</td><td>175</td><td>3400</td></tr><tr><td>TMA_3NM Medium Density</td><td>246</td><td>8500</td></tr><tr><td>TMA_3NM High Density</td><td>418</td><td>21400</td></tr><tr><td>APP_2.5NM High Density</td><td>630</td><td>41900</td></tr><tr><td>APP_2.0NM High Density</td><td>630</td><td>52300</td></tr><tr><td>ADS-B APT(moving)</td><td>57</td><td>N/A</td></tr><tr><td>ADS-B APT (stationary)</td><td>57</td><td>N/A</td></tr></table>
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. ED-129C (Table37, 38) proposes to have several levels of pass/fail depending on the computed "ka" factor of the measurement probability density distribution. ED-142A proposes to additionally have the different pass/fail levels for HPA assessment depending on the "kc" factor.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

4.2.1.4.2 Probability of Update and Long Gap

4.2.1.4.2.1 Common Requirements

Identifier	REQ-14.84e-TS-COOP.0063

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Title	PU and PLG - Report Statistic- OSV global
Requirement	The SPM tool **shall** report the PU and PLG performance calculation results for the whole OSV.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0064
Title	PU and PLG - Report Statistic- per trajectory
Requirement	The SPM Tool **shall** report in textual format, per altitude band and per reference track, the PU and PLG performance calculation results, ordered respectively ascending and descending on PU and PLG performance value.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

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[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0065
Title	PU and PLG - Report Statistic – per cell
Requirement	The SPM tool **shall** report the PU and PLG performance calculation results per 3D cell distinctively for each selected altitude band.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

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<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.2.2 MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0067
Title	PU - Report Statistic – Pass/Fail Coloring-MLAT
Requirement	The SPM tool **shall** color the reported PU statistic in green if the threshold of the applicable operational environment ▪ ≥95% (1 sec update rate) for Manoeuvring Area ▪ ≥70% (1 sec update rate) for Apron Taxiways and Taxi Lanes ▪ ≥90% (5 sec update rate) for Stands is met, whereas in red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

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Identifier	REQ-14.84e-TS-COOP.0068
Title	PLG - Report Statistic – Pass/Fail Coloring-MLAT
Requirement	The SPM tool **shall** color the reported PLG statistic in green if the threshold of the applicable operational environment ▪ $\leq 10^{-3}$ (3 sec gaps) per target report for Manoeuvring Area ▪ $\leq 10^{-2}$ (3 sec gaps) per target report for Apron Taxiways and Taxi Lanes ▪ $\leq 10^{-3}$ (15 sec gaps) per target report for Stands is met, whereas in red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.3 Horizontal Position Accuracy

4.2.1.4.3.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0069
Title	Horizontal Position Accuracy – RMS report – OSV global
Requirement	The SPM tool **shall** report the RMS of horizontal position error for the whole OSV. This requirement is optional for ADS-B sensor.
Status	<Validated>

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Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Even though the RMS assessment is specified only in ED-142A for WAM applications, this requirement has been extended to multilateration systems in general and optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0070
Title	Horizontal Position Accuracy – RMS report – per trajectory
Requirement	The SPM tool **should** report the RMS of horizontal position error per trajectory. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Even though the RMS assessment is specified only in ED-142A for WAM applications, this requirement has been extended to multilateration systems in general and optionally to ADS-B.

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Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0071
Title	Horizontal Position Accuracy – RMS report – per cell
Requirement	The SPM tool **should** report the RMS of horizontal position error per 3D cell distinctively for each selected altitude band. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Even though the RMS assessment is specified only in ED-142A for WAM applications, this requirement has been extended to multilateration systems in general and optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier

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<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0072
Title	Horizontal Position Accuracy – Percentage within required HPA report – OSV
Requirement	The SPM tool **shall** report the percentage of horizontal position errors being within a required horizontal position accuracy for the whole OSV. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Even though the percentage-within-required-HPA assessment is specified only in ED-117A for MLAT applications and in ED-142A for core & tail position accuracy assessment, this requirement has been extended optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance

<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0121
Title	Horizontal Position Accuracy – Percentage within required HPA report – cell
Requirement	The SPM tool **shall** report the percentage of horizontal position errors being within a required horizontal position accuracy for each grid cell in a cell-based evaluation. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Even though the percentage-within-required-HPA assessment is specified only in ED-117A for MLAT applications and in ED-142A for core & tail position accuracy assessment, this requirement has been extended optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information

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<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0073
Title	Horizontal Position Accuracy – HPA for a Percentile report – OSV
Requirement	The SPM tool **shall** report the horizontal position accuracy for a given percentile for the whole OSV. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Even though the HPA-for-a-percentile assessment is specified only in ED-117A for MLAT applications, this requirement has been extended to multilateration systems in general and optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

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4.2.1.4.3.2 MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0077
Title	Horizontal Position Accuracy – Percentage within required HPA report – Pass/fail coloring
Requirement	The SPM tool **shall** color in green the percentage of horizontal position errors being within a required horizontal position if the threshold of the applicable operational environment given below ▪ ≥95% for Manoevring Area ▪ ≥95% for Apron Taxiways and Taxi Lanes ▪ ≥95% for Stands is met, whereas in red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0078
Title	Horizontal Position Accuracy – HPA for a Percentile report – Pass/fail coloring
Requirement	The SPM tool **shall** color in green the horizontal position accuracy for a given percentile if the threshold of the applicable operational environment given below ▪ ≤12m for Manoeuvring Area ▪ ≤20m for Apron Taxiways and Taxi Lanes

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	▪ ≤25m for Stands is met, whereas in red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.3.3 WAM and MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0122
Title	Accuracy of the Position Accuracy Covariance Matrix Data Report
Requirement	The SPM tool **shall** report the obtained accuracy components of the Position Accuracy Covariance Matrix data for the whole OSV, per trajectory and per cell. Note: The accuracy components of position accuracy covariance data are computed for the 2 variance components and the covariance component of the reported covariance matrix data.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. The requirement for calculating Position Accuracy Covariance Matrix data is specified in ED-142A for WAM system only and has been extended to multilateration systems in general (including surface applications).
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0123
Title	Position Accuracy Covariance Matrix Data Report on 0 values
Requirement	The SPM tool **shall** report on variance components equal to 0 of the reported Position Accuracy Covariance Matrix, for the whole OSV, per trajectory and per cell. Note: The components of the reported position accuracy covariance matrix data are 2 variance components and the covariance component.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. The reporting of such events is demanded in ED-142A section 6.8.4.7 for WAM system only and has been extended to multilateration systems in general (including surface applications).
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

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<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0124
Title	Position Accuracy Covariance Matrix data – Pass/fail coloring
Requirement	The SPM tool **shall** colour the obtained components of the Position Accuracy Covariance Matrix data in green if they are in the range between a lower limit of 0.5 and an upper limit of 1.5 whereas in red if not. Note: The components of the reported position accuracy covariance matrix data are 2 variance components and the covariance component.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. The requirement for calculating Position Accuracy Covariance Matrix data is specified in ED-142A for WAM system only and has been extended to multilateration systems in general (including surface applications).
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

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<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.4 Probability of False/Ghost Tracks and Density of False/Ghost Spurious Target Reports

4.2.1.4.4.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0081
Title	Density of False/Ghost – Report Statistic – OSV
Requirement	The SPM tool **shall** report on the Density of False/Ghost Target Report Statistic for the whole OSV. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Only the ED-117A requires the assessment of the probability of false target reports. The requirement has nevertheless been extended to WAM and optionally to ADS-B, including also the ghost reports density for all technologies.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information

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<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0082
Title	Density of False/Ghost - Report Statistic – trajectory
Requirement	The SPM tool **shall** report on the Density of False/Ghost Target Report Statistic for each affected trajectory. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Only the ED-117A requires the assessment of the probability of false target reports. The requirement has nevertheless been extended to WAM and optionally to ADS-B, including also the ghost reports density for all technologies.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0083
Title	Probability of False Tracks (PFT) – Report Statistic – OSV
Requirement	The SPM tool **shall** report the probability of false tracks statistic for the configured OSV. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Only WAM standard (ED-142A) is referring to false and ghost tracks. This requirement has nevertheless been extended to MLAT and optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0084
Title	Probability of Ghost Tracks (PGT) – Report Statistic – OSV

Requirement	The SPM tool **shall** report probability of ghost tracks statistic for the configured OSV. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Only WAM standard (ED-142A) is referring to false and ghost tracks. This requirement has nevertheless been extended to MLAT and optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.4.2 WAM and ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0085
Title	Probability of False Tracks (PFT) and Ghost Tracks (PGT) – Report Statistic – Pass/Fail coloring.
Requirement	The SPM tool **shall** colour (green vs. red) the reported Probability of False Tracks (PFT) and Ghost Tracks (PGT) statistic when comparing to the related threshold depending on Operating Environment using PFGT which is the sum of the PFT and PGT.

ATC Sector Type	PFGT

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		Low-Density ER: 5.5E-03 Medium-Density ER: 2.1E-03 High-Density ER: 7.2E-04 Low-Density TMA: 2.6E-03 Medium-Density TMA: 1.7E-03 High-Density TMA: 6.9E-04 High-Density APP2.5: 3.9E-05 High-Density APP2.0: 3.1E-05 (ED-142A Draft March 2020, REQ 78, Table 12) This requirement is optional for ADS-B sensor.
Status	<Validated>	
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. Only WAM standard (ED-142A) is referring to false and ghost tracks. This requirement has nevertheless been extended optionally to ADS-BED-142A, REQ 78 gives the above table for "a single *false track* or *ghost track* event at a time".	
Category	<Data>	

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

4.2.1.4.4.3 MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0086
Title	Density of False/Ghost – Report Statistic – Pass/fail coloring
Requirement	The SPM tool **shall** colour the reported Density of False/Ghost target report statistic in green if the threshold of ≤ 10^{-4} per Target Report is met, whereas as red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.5 Probability of Incorrect

4.2.1.4.5.1 WAM & ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0126
Title	Probability of Incorrect Statistic – OSV
Requirement	The SPM tool **shall** report on the Probability of Incorrect Statistic for the whole OSV. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. This is a new requirement related to PoI metric required in ED-142A. The requirement has been optionally extended to ADS-B.

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Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0127
Title	Probability of Incorrect Statistic – trajectory
Requirement	The SPM tool **shall** report on the Probability of Incorrect Statistic for each trajectory. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. This is a new requirement related to PoI metric required in ED-142A. The requirement has been optionally extended to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information

<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0128
Title	Probability of Incorrect Statistic – Pass/Fail coloring
Requirement	The SPM tool **shall** colour the reported Probability of Incorrect Statistic in green if the threshold of ▪ <0.1% is met for the Mode A Parameter ▪ <0.1% is met for the Target Identification Parameter ▪ <0.1% is met for the Pressure Altitude Parameter whereas as red if not met. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. This is a new requirement related to PoI metric required in ED-142A. The requirement has been optionally extended to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

4.2.1.4.6 Probability of correct identification

4.2.1.4.6.1 MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0087
Title	Probability of Identification Statistic – OSV
Requirement	The SPM tool **shall** report on the Probability of Identification Statistic for the whole OSV.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0088
Title	Probability of Identification Statistic – trajectory
Requirement	The SPM tool **shall** report on the Probability of Identification Statistic for each trajectory.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0089
Title	Probability of Identification Statistic – Pass/fail coloring
Requirement	The SPM tool **shall** colour the reported Probability of Identification statistic in green if the threshold of ▪ ≥97% is met for the Mode A Code Target Identification Parameter ▪ ≥97% is met for the Aircraft ID Target Identification Parameter, whereas as red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.7 Probability of false identification

4.2.1.4.7.1 MLAT Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0090
Title	Probability of False Identification Statistic – OSV
Requirement	The SPM tool **shall** report on the Probability of False Identification Statistic for the whole OSV.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0091
Title	Probability of False Identification Statistic – trajectory
Requirement	The SPM tool **shall** report on the Probability of False Identification Statistic for each trajectory.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0092
Title	Probability of False Identification Statistic – Pass/Fail coloring
Requirement	The SPM tool **shall** colour the reported Probability of False Identification statistic in green if the threshold of ▪ <0.01% is met for the Mode A Code Target Identification Parameter ▪ <0.01% is met for the Aircraft ID Target Identification Parameter, whereas as red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.4.8 Maximum Update Delay

4.2.1.4.8.1 WAM & ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0130
Title	Percentage below MUD -Report Statistic – OSV & trajectory

<table>
<tr><td>Requirement</td><td>The SPM tool shall report on the percentage of update delays (UD) being below the MUD requirement– applicable for the selected operational environment – for the whole OSV and per trajectory.
<table>
<tr><th>ATC Service Type</th><th>Mode 3/A Code ‘MA-MUD’</th><th>Aircraft Identification ‘AI-MUD’</th><th>Emergency & SPI ‘ES-MUD’</th></tr>
<tr><td>Low-Density ER</td><td>48s</td><td>185s</td><td>24s</td></tr>
<tr><td>Medium-Density ER</td><td>32s</td><td>80s</td><td>16s</td></tr>
<tr><td>High-Density ER</td><td>32s</td><td>80s</td><td>16s</td></tr>
<tr><td>Low-Density TMA</td><td>40s</td><td>155s</td><td>15s</td></tr>
<tr><td>Medium-Density TMA</td><td>20s</td><td>70s</td><td>15s</td></tr>
<tr><td>High-Density TMA</td><td>20s</td><td>n / a</td><td>15s</td></tr>
<tr><td>High-Density APP2.5</td><td>20s</td><td>n / a</td><td>15s</td></tr>
<tr><td>High-Density APP2.0</td><td>20s</td><td>n / a</td><td>15s</td></tr>
</table>
(ED-142A Draft Sept 2020, REQ 69, Table 8)

This requirement is optional for ADS-B sensor.</td></tr>
<tr><td>Status</td><td><Validated></td></tr>
<tr><td>Rationale</td><td>Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.</td></tr>
<tr><td>Category</td><td><Data></td></tr>
</table>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

[REQ]

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Identifier	REQ-14.84e-TS-COOP.0131
Title	MUD-Exceeded Event – trajectory
Requirement	The SPM tool **shall** report on events where the Maximum Update Delay requirement has been exceeded per trajectory. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements. This requirement has been introduced for the MUD assessment, which is required only in the ED-142A. The requirement has nevertheless been extended optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND

4.2.1.4.9 Position Ground Processing & Communication Latency

4.2.1.4.9.1 ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0093
Title	Position Ground Processing & Communication Latency Statistic – OSV
Requirement	The SPM tool **shall** report on the Maximum Position Ground Processing & Communication Latency within the whole OSV.
Status	<Validated>

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Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0094
Title	Position Ground Processing & Communication Latency Statistic – trajectory
Requirement	The SPM tool **shall** report on the Maximum Position Ground Processing & Communication Latency per Trajectory.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance

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<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0095
Title	Position Ground Processing & Communication Latency Statistic – Pass/Fail coloring
Requirement	The SPM tool **shall** colour the reported Position Ground Processing & Communication Latency statistic in green if the threshold of ≤1.5sec is met, whereas as red if not met.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.4 Reporting Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

4.2.1.5 Graphical Visualisation Output Function Requirements

Graphical Visualisation functionality requirements aim to specify the drill down analysis and visualisation of cases contributing to the performance metrics defined in the Section 4.2.1.2.

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Graphical Visualisation may also provide detailed charts with filtering mechanism in order to facilitate investigation of performance problems and identification of faulty aircraft adversely affecting the performance metrics.

4.2.1.5.1 General

[REQ]

Identifier	REQ-14.84e-TS-COOP.0096
Title	Graphical Display – Overall
Requirement	The SPM Tool **shall** provide graphical displays for the inspection of input ASTERIX data, internal/external reference data (if used) and the analysis results.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements. The graphical display will be used for detailed analysis and inspection of analysis results.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0097

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Title	Graphical Display – Geographic
Requirement	The SPM Tool **shall** provide a graphical visualization of geo-referenced data such as • Sensor position • OSV polygon • Target reports position • Reference data position in a 2D geographical frame.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements. The graphical display will be used for detailed analysis and inspection of analysis results.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0098
Title	Overlapped screening information

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Requirement	The SPM tool **should** overlap screening information over geographical data.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements. The purpose is not to provide/calculate a screening but to exploit available ones for display.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0099
Title	Filtering capabilities
Requirement	The SPM tool **shall** define filters on output visualization.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements. Filtering function on output visualization with different parameters such as: Range from sensor (from range min to range max) Flight Level (from range min to range max) • Target Identification • Mode S Address (ICAO 24-bit) • Mode A Code • Track number • internal trajectory identifier

	• Etc.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0100
Title	Cell Grid Visualization
Requirement	The SPM Tool **shall** display the cell-based calculation results geographically as a (2D) mosaic respecting the configured cell grid definition, the selected altitude band, the chosen OSV and the color coding of the reported performance result according to the pass/fail grades definition.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e

<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.5.2 Probability of Update and Long Gap

4.2.1.5.2.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0104
Title	PU & PLG – gap periods
Requirement	The SPM tool **shall** geographically visualise the gap events.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

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<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.5.3 Probability of False/Ghost Tracks and Density of False/Ghost Spurious Target Reports

4.2.1.5.3.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0106
Title	Visualization of False Target Reports
Requirement	The SPM tool **shall** geographically visualise the false target report events. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements. Even though the false target report assessment is specified only in ED-117A for surface applications, this requirement has been extended to WAM and optionally to ADS-B. ED-142A specifies false tracks, which are derived based on false targets.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0107
Title	Visualization of Ghost Target Reports
Requirement	The SPM tool **shall** geographically visualise the ghost target report events. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements. Even though the Ghost assessment is specified only in ED-142A for WAM applications, this requirement has been extended to multilateration systems in general and optionally to ADS-B. ED-142A specifies ghost tracks, which are derived based on ghost targets.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND
<ALLOCATED_TO>	<System Port>	SUR_WAM_GND
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.5.4 Probability of correct and false identification and incorrect

4.2.1.5.4.1 Common Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0108
Title	Visualization of Target Reports with False/Incorrect Identification
Requirement	The SPM tool **shall** geographically visualise the target report events with false/incorrect identification. This requirement is optional for ADS-B sensor.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements. This requirement has been extended to WAM and optionally to ADS-B.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

[REQ]

Identifier	REQ-14.84e-TS-COOP.0109
Title	Visualization of Target Reports with No Identification
Requirement	The SPM tool **shall** geographically visualise the target report events with no identification.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_MLAT_GND

4.2.1.5.5 Position Ground Processing & Communication Latency

4.2.1.5.5.1 ADS-B Specific Requirements

[REQ]

Identifier	REQ-14.84e-TS-COOP.0110
Title	Visualization of Target Reports exceeding Position Ground Processing & Communication Latency requirement
Requirement	The SPM tool **shall** geographically visualise the target report events reported as failing the Position Ground Processing & Communication Latency requirement.
Status	<Validated>
Rationale	Please refer to the introduction of §4.2.1.5 Graphical Visualisation Output Function Requirements.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Data>	Aircraft position reports and target information
<ALLOCATED_TO>	<Data>	Aircraft and vehicle position reports and target information
<ALLOCATED_TO>	<System Port>	SUR_ADS-B_GND

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4.2.1.6 Mode of Operation Requirements

The SPM Tool is expected to operate in two distinct modes: Manual (Offline) and Quasi Real-Time. Manual mode is aimed for one offline or occasional performance assessment of surveillance sensors with a human operator. In this mode, input data to be processed, configuration options and type of analysis to be performed can be specified by the operator. Quasi Real-Time mode corresponds to an automated mode of operation where only the input data is different for each performance assessment run. The exact mechanism of getting new input data is not specified as requirements, since different surveillance infrastructure may choose to implement or may have different choices; e.g., capturing data directly from sensors, requesting data from a recorder, getting data files from a network location, etc. Nonetheless, there needs to be a set of configuration options defining mode of operation, configuration data for automated run and how to locate the input data. The requirements related to mode of operation are given below:

[REQ]

Identifier	REQ-14.84e-TS-COOP.0111
Title	Manual mode of operation
Requirement	The SPM Tool **shall** implement a manual mode of operation, where all settings for a full performance assessment can be defined and the results are visualised interactively by an operator.
Status	<Validated>
Rationale	This requirement specifies the normal mode of operation, with the operator providing the parameters for retrieving input data, configuration options, type of assessment to be performed and visualising the assessment results/reports.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0112

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Title	QRT mode of operation
Requirement	The SPM Tool **shall** implement a QRT mode of execution as a fully automated and recurrent run of performance assessment analysis with new input data for a specified configuration.
Status	<Validated>
Rationale	This is the basis of the QRT mode: to be able to run in a programmed way for a fixed configuration and new input data at a frequency between 20 min and 24h. The input data does not need to be contiguous, uniform duration or increasing, in order to allow data gaps, different duration for different time of day or processing historic data.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0113
Title	QRT time programming
Requirement	The SPM Tool **shall** implement the QRT mode based on an assessment configuration as defined in Section 4.2.1.1 and a user defined execution schedule.
Status	<Validated>
Rationale	The execution schedule would define successive input data retrieval as well as at what times the automated analysis is run.
Category	<Data>

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Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0114
Title	Trend Metric Data base
Requirement	The SPM Tool **shall** implement a Trend Metric Data base mechanism to store the performance assessment measurements calculated as given in Section 4.2.1.3.
Status	<Validated>
Rationale	The exact mechanism for storing trend data is not specified, but input data properties, configuration identification and calculated metrics are expected to be stored to identify an individual run.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0115
Title	Trend Metric Data identifier

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Requirement	The SPM Tool **shall** store the following Trend Metric Data for each run: • time period of assessed input data, • configuration settings identification (including sensors in input data), • the performance assessment measurements.
Status	<Validated>
Rationale	These will be used for identifying each run and the calculated performance metrics, which will facilitate Trend Metric Data Analysis and Visualisation.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0118
Title	Trend Visualization
Requirement	The SPM Tool **shall** gather the stored Trend Metric Data performance assessment measurements and visualize a trend of the performance over time for the selected OSV at user-defined granularity.
Status	<Validated>
Rationale	The trend visualization is part of the quasi-real time monitoring. The trend visualization aims at displaying the temporal performance behaviour of a selected performance metric type over time.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0132
Title	Trend Visualization Display Period
Requirement	The SPM Tool **shall** display the trend of the performance for an user-selected display time period.
Status	<Validated>
Rationale	The trend visualization is part of the quasi-real time monitoring. The trend visualization display period aims at displaying the performance trend within a time period as selected by the user.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0119
Title	Trend Visualization Update
Requirement	The SPM Tool **shall** for each new time period of assessed input data update the visualization of the trend to include also the new performance measurement.

Status	<Validated>
Rationale	The trend visualization update is part of the quasi-real time monitoring. This is a new requirement.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

[REQ]

Identifier	REQ-14.84e-TS-COOP.0120
Title	Trend Data Performance Degradation Indication
Requirement	The SPM Tool **should** indicate performance values in the trend data exceeding defined performance thresholds.
Status	<Validated>
Rationale	The Trend Data Performance Degradation Indication is part of the quasi-real time monitoring.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

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[REQ]

Identifier	REQ-14.84e-TS-COOP.0135
Title	Trend Metric Data Analysis
Requirement	The SPM Tool **should** allow different representation types on a user defined data interval of the stored metric data such as - Histograms showing distribution of performance results (y=events, x= performance value) - Max, min and mean value
Status	<Validated>
Rationale	The Trend Metric Data Analysis supports the analysis of performance metric data evolution.
Category	<Data>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<SATISFIES>	<SESAR Solution>	PJ.14-W2-84e
<SATISFIES>	<Enabler>	CTE-S07a
<SATISFIES>	<Enabler>	CTE-S07b
<ALLOCATED_TO>	<Functional block>	En-route/TMA Cooperative Sensor Surveillance
<ALLOCATED_TO>	<Functional block>	Airport Surface Cooperative Sensor Surveillance

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5 Recommendation for Implementation

The SPM tools (for both sensor or “end-to-end” levels) do not affect or manipulate the surveillance chain. The software of the solution can be implemented in all operating environments (airport, TMA and Enroute) and there aren´t specific requirements about software performance. Each manufacturer has the freedom to choose the details of the software implementations following the functional requirements described in this document as long as the hardware guidelines from the manufacturer are followed.

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6 Assumptions

Assumption 1: It is assumed that ED-142A will only relate to systems including a tracker within the ATC SUR processing.

Assumption 2: It is assumed that trustworthy reference data is available for the performance assessment. The reference is assumed to contain the true aircraft position and other aircraft data items. The sensor under analysis is assessed against the reference data.

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7 References and Applicable Documents

7.1 Applicable Documents

Content Integration

[1] EATMA guidance material and report, Dec 2019

[2] EATMA Community pages

Content Development

[3] Concept of Operations, Dec 2019

System and Service Development

[4] Report of the progress on standardisation of Services, Information and Terminology, Oct 2019

Performance Management

[5] Performance Framework, Dec 2019

Validation

[6] Validation Strategy, Dec 2019

[7] Validation Targets W2, Jun 2020

System Engineering

[8] System Engineering - Methodology for the V&VP, V&VI and Demonstration Platform development, Jun 2019

Safety

[9] SESAR Safety Reference Material, Dec 2018

[10] Guidance to Apply SESAR Safety Reference Material, Dec 2018

Human Performance

[11] Human Performance - Guidance Reference Material, Aug 2020

Environment Assessment

[12] ENV - Guidance Reference Material, Dec 2019

Security

[13] SecRAM, Sep 2017

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7.2 Reference Documents

[14] ED-129B TECHNICAL SPECIFICATION FOR A 1090 MHZ EXTENDED SQUITTER ADS-B GROUND SYSTEM, March 2016

[15] ED-142 TECHNICAL SPECIFICATION FOR WIDE AREA MULTILATERATION (WAM) SYSTEMS, September 2010

[16] Draft ED-142A TECHNICAL SPECIFICATION FOR WIDE AREA MULTILATERATION (WAM) SYSTEMS, June 2020

[17] ED-117A MINIMUM OPERATIONAL PERFORMANCE SPECIFICATION FOR MODE S MULTILATERATION SYSTEMS FOR USE IN ADVANCED SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEMS (A-SMGCS), September 2016

[18] Draft ED-129C TECHNICAL SPECIFICATION FOR A 1090 MHZ EXTENDED SQUITTER ADS-B GROUND SYSTEM, February 2020

[19] Draft ED-261 SAFETY AND PERFORMANCE REQUIREMENTS STANDARDS FOR A GENERIC SURVEILLANCE SYSTEM, November 2020

[20] Initial Technical Specification (TS/IRS) for Surveillance Performance Monitoring (SPM) Tools for Cooperative Sensors (ADS-B, WAM, MLAT) (TRL6), D12.5.110 SESAR2020 PJ.14-W2-84e Initial TS/IRS, June 2021

[21] Technological Validation Plan (TVALP) for Surveillance Performance Monitoring (SPM) Tools for Cooperative Systems (ADS-B, WAM, MLAT) (TRL6), D12.5.200 SESAR2020 PJ.14-W2-84e TVALP, November 2021

[22] Technological Validation Report (TVALR) for Surveillance Performance Monitoring (SPM) Tools for Cooperative Systems (ADS-B, WAM, MLAT) (TRL6), D12.5.400 SESAR2020 PJ.14-W2-84e TVALR, June 2022

Appendix A Service Description Document (SDD)

Not applicable as the solution does not provide any services.

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