Contextual Note for TRL6 PJ.14-W2-84f Surveillance Performance Monitoring - End-to-end

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Authors of the document

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SURVEILLANCE PERFORMANCE MONITORING FOR END-TO-END

Abstract

This Contextual Note provides SESAR Solution PJ.14-W2-84f description for industrialisation consideration. Solution PJ.14-W2-84f targets ANSPs in TMA & En-route operational environments. In the first part of Wave 2, PJ.14-W2-84f achieved TRL4 maturity and it has achieved TRL6 maturity by the end of Wave2. This Contextual Note addresses the solution scope, the intended benefits and the validation approach.

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1 Purpose

This Contextual Note introduces SESAR Solution PJ.14-W2-84f Surveillance Performance Monitoring (SPM) at End-to-end of Surveillance Chain. It provides expected improvements to ATC, impact in the EATM Roadmap, main performance benefits expected and any relevant system impact. The solution has already achieved TRL4 maturity in the first part of Wave 2. PJ.14-W2-84f has achieved TRL6 maturity at the end of Wave 2 by adding Quasi Real-time monitoring and in-depth analysis functionality. This document also provides the Solution Data Pack containing certain SJU deliverables.

Surveillance Performance Monitoring (SPM) of End-to-end Surveillance Chain aims at enabling an improved performance monitoring of surveillance systems in line with the Performance Based Surveillance (PBS) approach. This Technological Solution focuses on the development of Surveillance Performance Monitoring Tools for End-to-end of Surveillance chain.

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2 Improvements in Air Traffic Management (ATM)

The SPM Tools specification is dependent on the standards for Surveillance Data Processing and Distribution Systems (SDPDS), which covers ATC (Air Traffic Control) surveillance trackers and fusion systems as well as individual surveillance sensors providing tracking service. The latest applicable standard for such systems is the EUROCONTROL Specification for ATM (Air Traffic Management) Surveillance System Performance (ESASSP) Ed 1.2 that became available in April 2021. ESASSP specifies the set of performance metrics and required performance for the TMA (Terminal Manoeuvring Area, 3 NM separation) and En-route (5 NM separation) operating environments applicable mainly to ANSPs (Air Navigation Service Provider).

This solution has first achieved TRL4 and then TRL6 maturity by the end of Wave 2. The official ESASSP Ed 1.2 standard was used for the technical specification and development of the SPM Tools. Two SPM Tool prototypes, namely EUROCONTROL SASS-C/VERIF and THALES AGATE, have been developed and validated for the TRL6 maturity. The validation activity focused mainly on the development of the required performance metrics, harmonisation of the tools and Quasi Real-time functionality.

The specification took into account the performance metrics as defined by the official ESASSP Ed 1.2. One of the objectives of the solution is the harmonisation of the tools. Recognising that there is a trend of the standards towards harmonisation, the choice has been made to harmonise various metric assessment methods. Solution tasks include tools specification aligned with existing and developing surveillance standards, quasi real-time assessment, and development of tool prototypes and verification of these prototypes. The results of tools verification are a potential input to the standardisation, in particular the ESASSP specification.

TRL6 development added Quasi Real-Time (QRT) functionality in order to carry out automated periodic performance assessment of the surveillance chain. In normal or manual mode of operation, Air Traffic Safety Electronics Personnel (ATSEP) carries out the performance assessment or investigation by configuring input data/settings and checks the performance metrics. The automated performance assessment can be carried out at user specified times with recorded surveillance data from the previous period. Performance metrics are calculated, stored and displayed from each such performance assessment. TRL6 validation has verified correct functioning of the Quasi Real-Time mode of operation.

This SESAR solution aims to develop SPM Tools as an enabler of 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 the correct functioning of the ATM surveillance function at the individual sensor level or at ATC end-to-end level. SPM of sensors is covered under SESAR Solution PJ.14-W2-84e with similar scope as this solution. This solution covers the SPM of end-to-end surveillance chain. SPM function and the location of SPM Tools within the ATM Surveillance is shown in Figure 11.
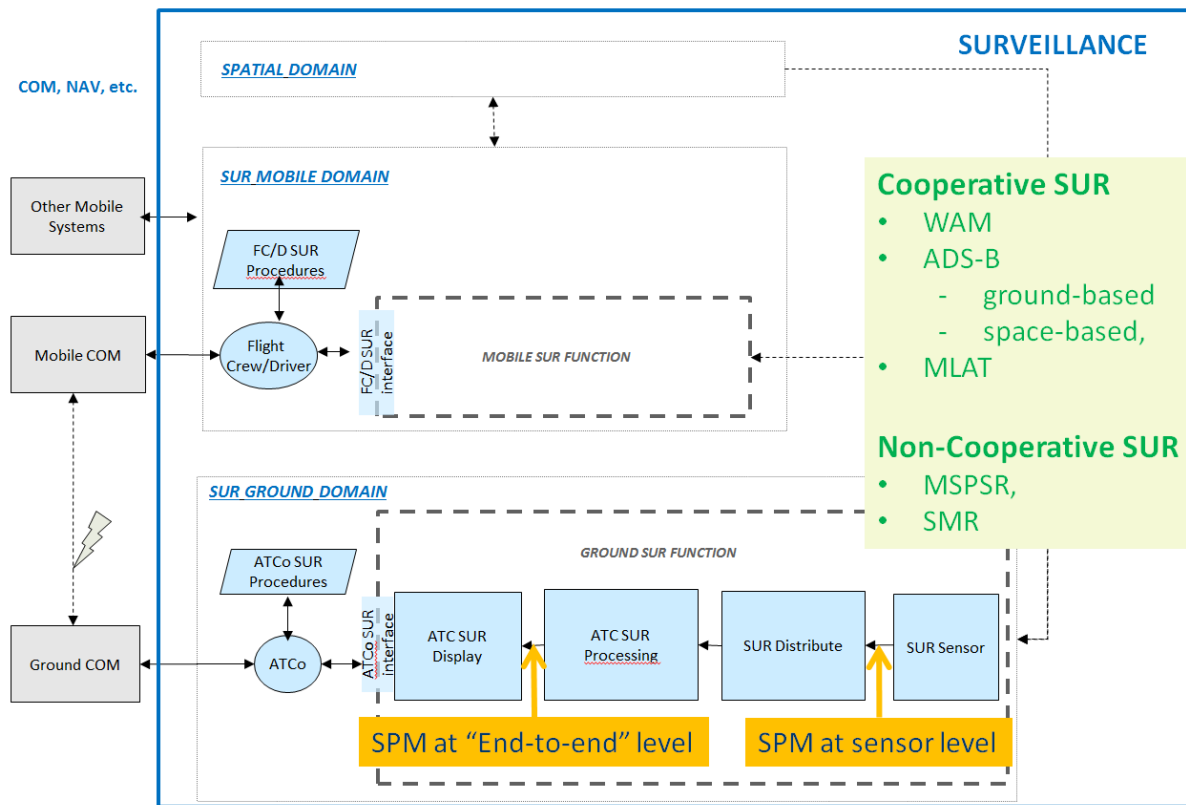
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Figure 11: Surveillance Performance Monitoring Tool within Surveillance.

A functional architecture overview for a generic SPM tool is shown in Figure 22. The SPM tool has main input interfaces from surveillance sensors and surveillance chain whose performance will be assessed and monitored. There can be additional input from external references like on-board GPS recordings or other data sources that can be used as reference. 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 optional 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. Optional graphical displays may enable inspection of the results from intermediate processing stages and the detailed analysis results of the SPM tool. Graphical displays may 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, can be filtered out by defining a filter as part of configuration data.

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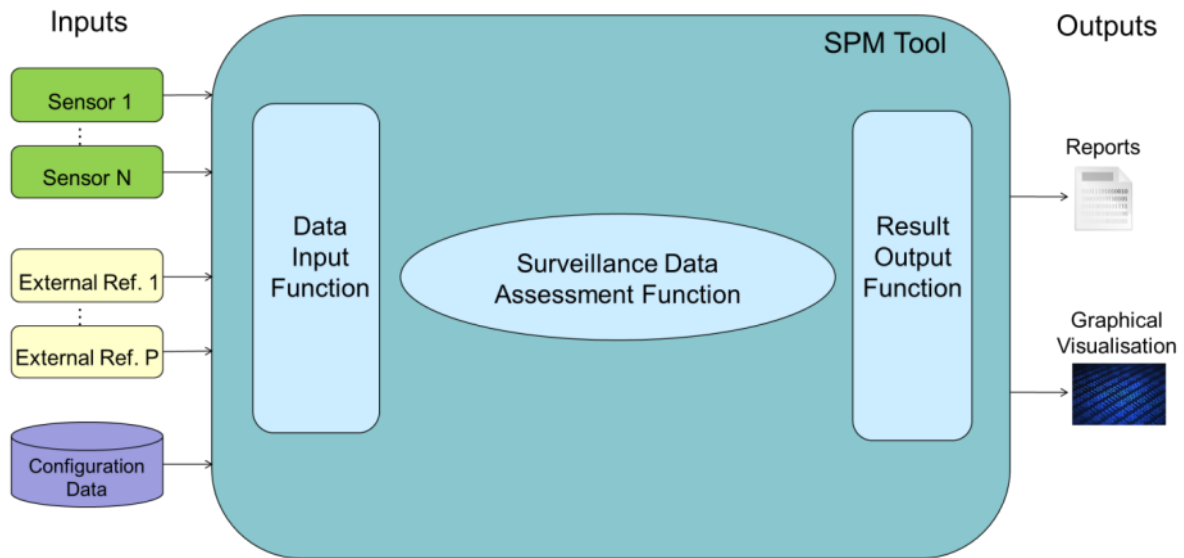
Figure 22: Functional architecture overview of a generic Surveillance Performance Monitoring Tool.

Main functions of the SPM tool can be summarised as:

- 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)

    o Reference generation and association
    o Computation of performance metrics

- Result Output Function (e.g. optional graphical interfaces for input/output data to/from the tool)

    o Geographical displays
    o Other graphical representations
    o Report generation

3 Operational Improvement Steps (OIs) & Enablers

This Technological Solution covers the enabler CTE-S07e (Surveillance Chain SPM Tool at En-route & TMA) and will support OI (Operational Improvement) step POI-0062-SUR: Surveillance Performance Monitoring for End-to-end Surveillance Chain. This solution is the principal contributor to the enabler CTE-S07e and it has full coverage of this enabler. The main objective of this enabler is to provide a harmonised performance monitoring for the end-to-end surveillance chain following the Performance Based Surveillance (PBS) paradigm.

Applicable Integrated Roadmap dataset is DS22. During SESAR Wave 2, this solution has passed through TRL4 and TRL6 maturity. In the previous phase, TRL4 maturity has been completed with acceptable risks related to tool harmonisation. TRL6 maturity has been achieved at the end of Wave 2 by succeeding in tool harmonisation.

This solution does not depend on or assumes availability of other SESAR solutions, OI steps or enablers. Nonetheless, there is another Technological Solution targeting similar enablers and OI steps for the surveillance sensors counterpart in parallel.

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4 Background and validation process

This SESAR Solution has followed the TRL6 validation approach as:

- Two SPM Tool prototypes for end-to-end surveillance chain, namely EUROCONTROL SASS-C/VERIF and THALES AGATE, have been developed in order to provide the required performance metrics as given by ESASSP Ed 1.2,

- Operational surveillance sensor data (Mode S radar and ADS-B) has been used as the basis of the traffic scenario. Operationally used tracker has been run with the sensor data input and resulting tracker output has been recorded.

- A single validation exercise using the combined validation platform of SASS-C/VERIF and AGATE prototypes has been executed. SASS-C/VERIF has created the reference trajectories from the sensor data, which were used by both SPM Tools. Both tools have calculated the performance metrics by comparing the tracker output to the reference trajectories.

- The calculated performance metrics from each tool have been recorded and compared to be within allowable tolerances. Deviations in calculated performance metrics is investigated and corrective actions are taken to resolve any discrepancies.

TRL6 validation demonstrated that both tools calculate the required performance metrics, the harmonisation of the SPM Tools is achieved and continuous monitoring can be performed with Quasi Real-Time functionality.

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5 Results and performance achievements

This solution aims to enable a harmonised and standards compliant performance monitoring of the end-to-end surveillance chain. Such monitoring aims to identify degradation trends early, using both off-line and quasi-real time processes. The solution is to be deployed by ANSPs in TMA & En-route operational environments. ANSPs will receive the following benefits:

- Compliance with the latest standards,

- Cost efficiency through increased automation,

- Increased trustworthiness of the performance assessments.

ANSPs would have to deploy new SPM Tools for end-to-end surveillance chain in order to demonstrate compliance with the latest standards to their national regulators. They will deploy either tools available on the market or those developed by this solution. The Cost-Benefit Analysis is based on costs being quantized as Air Traffic Safety Electronics Personnel (ATSEP) effort associated to the tool selection process and for the operational use of the selected tool.

The main performance benefit from this SESAR Solution is the cost efficiency through harmonised tool development and increased automation in order to reduce ATSEP effort. The cost savings provided by this solution is estimated to be 1,12 M€ for ANSPs. The main benefits of this solution are the avoided costs for alternative development. The ANSPs will benefit mainly from the less time spent during the selection process and operation of the SPM Tools due to validation by a larger community and automated operation.

6 Recommendations and Additional activities

Guidelines for deployment will need to be established as well as staff training for proper operation. Deployment guideline should include how to connect the SPM Tool in the surveillance processing chain, setting up parameters and configuration of surveillance data sources. Staff training should cover how the tool can be used for offline and quasi real-time performance assessment.

For deployment testing, the SPM Tool should be run with surveillance data from the intended operational environment. Furthermore, for verification of the Quasi Real-time operation, the SPM Tool should be operated for a longer period, e.g., around one month.

Future development should take into account upcoming ESASSP Ed 1.3, which aims to define reduced separation standards (including 3 NM En-Route and 2.5 NM Approach minimum separation). We expect that the ESASSP v1.3 will only specify tighter performance thresholds for the reduced separation applications and no new metrics/methodologies. Therefore, we expect that the incorporation of the standard update will require only minor updates to SPM Tool specification, namely metric thresholds for pass/fail criteria.

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7 Actors impacted by the SESAR Solution

This solution target ANSPs operating in the TMA & En-route operational environments. The principal impact is on Air Traffic Safety Electronics Personnel (ATSEP) effort through reduced effort for selection of the SPM Tool, streamlined day-to-day performance assessment and increased automation with the Quasi Real-Time functionality.

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8 Impact on Aircraft System

This solution has no impact on the aircraft system as it is used for the performance assessment of the ground surveillance infrastructure.

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9 Impact on Ground Systems

Surveillance Performance Monitoring and associated tools are passive consumers of the surveillance data and do not provide input back to the ATM operations. The basic functionality is checking that the surveillance system operates within the defined performance criteria and providing performance assessment reports to the Air Traffic Safety Electronics Personnel (ATSEP), reducing the workload. It is up to ATSEP to take the necessary actions to rectify the identified performance degradation. Therefore, no changes are required for the ground surveillance system with the deployment of the SPM Tools.

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10 Regulatory Framework Considerations

This solution requires no changes to the ground surveillance infrastructure or to on-board surveillance transponders. Therefore, there is no applicable SES or EASA regulatory framework.

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11 Standardization Framework Considerations

This solution has been developed in order to develop harmonised and standards compliant performance monitoring of the end-to-end surveillance chain. The applicable standard for the end-to-end surveillance chain is the EUROCONTROL Specification for ATM Surveillance System Performance (ESASSP) Ed 1.2. This standard specifies the set of performance metrics and the required performance for the TMA (Terminal Manoeuvring Area with 3 NM separation) and En-route (5 NM separation) operating environments applicable mainly to ANSPs (Air Navigation Service Provider). ED-261 GEN-SUR SPR serves as an overarching but not directly applicable standard, that serves as the foundation for future iterations of ESASSP. Future SPM Tools development should follow the upcoming ESASSP Ed 1.3 aiming reduced separation standards. Note that PJ.14-W2-84f has not initiated ESASSP Ed 1.3 but future work should also take on board the updated standard.

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12 Solution Data pack

The Solution Data Pack includes the following documents:

- **TS/IRS:** Final Technical Specifications for PJ.14-W2-84f TRL6 Surveillance Performance Monitoring - End-to-end, D12.7.120, Edition: 00.01.01, Oct 2022. This document provides the functional, non-functional and interface requirements for harmonised and ESASSP Ed 1.2 standards compliant performance assessment of the end-to-end surveillance chain.

- **TVALR:** Technological Validation Report for Solution PJ.14-W2-84f Surveillance Performance Monitoring - End-to-end at TRL6, D12.7.400, Edition: 00.01.00, Jul 2022. This document provides the results of the technological validation activities of the SPM Tool prototypes, namely EUROCONTROL SASS-C/VERIF and THALES AGATE.

- **CBAT:** PJ.14-W2-84f TRL6 Cost Benefit Analysis for Surveillance Performance Monitoring - End-to-end, D12.7.500, Edition: 00.01.02, Nov 2022. This document quantifies the efficiencies that will be achieved through deployment of SPM Tools developed by this solution.

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