|  |  |  |
| --- | --- | --- |
|  |  | |
|  | SESAR Solution PJ.05-05 TS IRS for TRL4 | |
|  | Deliverable ID: | D5.1.001 |
|  | Dissemination Level: | PU |
|  | Project Acronym: | Remote Tower |
|  | Grant: | 730195 |
|  | Call: | H2020-SESAR-2015-2 |
|  | Topic: | Remote Tower |
|  | Consortium Coordinator: | DLR (AT-One) |
|  | Edition Date: | 15 May 2019 |
|  | Edition: | 00.01.00 |
|  | Template Edition: | 02.00.02 |

|  |
| --- |
| INDUSTRIAL RESEARCH |



|  |  |  |
| --- | --- | --- |
| Authoring & Approval | | |
| Authors of the document | | |
| Name/Beneficiary | Position/Title | Date |
| Vidor Czvedler/LPS SR (B4) | PJ05 WP5 Solution Lead | 15/06/2018 |
| Ondrej Príboj/LPS SR (B4) | PJ05-05 Solution Member | 17/04/2019 |
| Vladimíra Čanádyová/LPS SR (B4) | PJ05-05 Solution Member | 17/04/2019 |
| Juraj Bartok/MicroStep-MIS | PJ05-05 Solution Member | 16/04/2019 |
| Pavol Nechaj/MicroStep-MIS | PJ05-05 Solution Member | 16/04/2019 |

|  |  |  |
| --- | --- | --- |
| Reviewers internal to the project | | |
| Name/Beneficiary | Position/Title | Date |
| Jörn Jakobi/DLR (AT-One) | PJ05 Project Manager | 09/05/2019 |
| Erik Mikloš/LPS SR (B4) | PJ05-05 Solution Member | 09/05/2019 |
| Pavol Nechaj/MicroStep-MIS | PJ05-05 Solution Member | 09/05/2019 |

|  |  |  |
| --- | --- | --- |
| Approved for submission to the SJU By - Representatives of beneficiaries involved in the project | | |
| Name/Beneficiary | Position/Title | Date |
| Ondrej Príboj/LPS SR (B4) | PJ.05 WP5 Solution Lead | 15/05/2019 |
| Jörn Jakobi/DLR (AT-One) | PJ.05 Project Manager | 15/05/2019 |

|  |  |  |
| --- | --- | --- |
| Rejected By - Representatives of beneficiaries involved in the project | | |
| Name/Beneficiary | Position/Title | Date |
| No rejection received |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Document History | | | | |
| Edition | Date | Status | Author | Justification |
| 00.00.01 | 12/01/2018 | Initiated | Vidor Czvedler | New document |
| 00.00.02 | 24/01/2018 | Updated | Vidor Czvedler | Document updated regarding new inputs |
| 00.00.03 | 26/01/2018 | Updated | Vidor Czvedler | Document updated regarding new inputs |
| 00.00.50 | 31/01/2018 | Interim | Vidor Czvedler | Updated in line with internal review |
| 00.00.60 | 28/06/2018 | Updated Interim | Vidor Czvedler | Interim version updated after assessment report |
| 00.00.70 | 18/04/2019 | Drafting final | Ondrej Priboj/Pavol Nechaj | Updating interim version after validation results |
| 00.00.80 | 26/04/2019 | Drafting final | Ondrej Priboj/Pavol Nechaj | Adding EATMA export and minor corrections |
| 00.00.90 | 13/05/2019 | Drafting final | Ondrej Priboj | Merging with SE-DMF |
| 00.01.00 | 15/05/2019 | Final | Ondrej Priboj | Document to STELLAR |

Copyright Statement

© – 2019 – SESAR PJ.05-05 Beneficiaries.

All rights reserved. Licensed to the SESAR Joint Undertaking under conditions.

Remote Tower

Remote Tower

This TS-IRS document is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 730195 under European Union’s Horizon 2020 research and innovation programme.

EU logo low res

Abstract

The impact of adverse weather on Airport Operations, Airspace User Operations and ATS Operations can be mitigated by the timely sharing of high quality, precise, trustworthy and best available meteorological information. Many airports utilize automated weather observation instead of full meteorological observation. However, automated observations, especially of visibility, significant weather phenomena or clouds can fail (e.g. standard sensors do not capture inhomogeneous visibility conditions or cloud cover situation correctly).

The Advanced Automated MET System for Remote Airport provides two options, how to cope with the current disadvantages. Both rely on cameras and multiple sensor analysis. At the core of the first option is processing by artificial intelligence algorithms, the second one includes concept of remotely located human MET Observer. The final result is distributed to the stakeholders via SWIM and presented at the Controller’s HMI. This document describes the Technical specification for PJ05-Solution 05 “Advanced Automated MET System for Remote Airport” targeting TRL4 maturity and respective technical requirements the system shall fulfil.

Table of Contents

[Abstract 4](#_Toc7179187)

[1 Executive summary 8](#_Toc7179188)

[2 Introduction 9](#_Toc7179189)

[2.1 Purpose of the document 9](#_Toc7179190)

[2.2 Scope 9](#_Toc7179191)

[2.3 Intended readership 9](#_Toc7179192)

[2.4 Background 10](#_Toc7179193)

[2.5 Structure of the document 10](#_Toc7179194)

[2.6 Glossary of terms 11](#_Toc7179195)

[2.7 Acronyms and Terminology 13](#_Toc7179196)

[3 SESAR Solution Impacts on Architecture 16](#_Toc7179197)

[3.1 Target Solution Architecture 16](#_Toc7179198)

[3.2 Changes imposed by the SESAR Solution on the baseline Architecture 22](#_Toc7179199)

[4 Technical Specifications 23](#_Toc7179200)

[4.1 Functional architecture overview 23](#_Toc7179201)

[4.2 Functional and non-Functional Requirements 30](#_Toc7179202)

[5 Implementation Options 50](#_Toc7179203)

[6 Assumptions 52](#_Toc7179204)

[6.1 Assumptions with respect to other SESAR solutions 52](#_Toc7179205)

[6.2 Assumptions with respect to EATMA 52](#_Toc7179206)

[6.3 Human Performance Assumptions 52](#_Toc7179207)

[6.4 Safety and Security assumptions 52](#_Toc7179208)

[6.5 Technical Assumptions 52](#_Toc7179209)

[7 References and Applicable Documents 53](#_Toc7179210)

[7.1 Applicable Documents 53](#_Toc7179211)

[7.2 Reference Documents 55](#_Toc7179212)

[Appendix A Service Description Document (SDD) 56](#_Toc7179213)

[A.1 Introduction 56](#_Toc7179214)

[A.2 Service Identification 56](#_Toc7179215)

[A.3 Operational and Business Context 56](#_Toc7179216)

[A.3.1 Operational Context 56](#_Toc7179217)

[A.3.2 Information Exchange Requirements 56](#_Toc7179218)

[A.3.3 Other Requirements 56](#_Toc7179219)

[A.4 Service Overview 56](#_Toc7179220)

[A.4.1 Service Taxonomy 56](#_Toc7179221)

[A.4.2 Service Levels (NfRs) 56](#_Toc7179222)

[A.4.3 Service Functions and Capabilities 56](#_Toc7179223)

[A.4.4 Service Interfaces 56](#_Toc7179224)

[A.5 Service interface specifications 57](#_Toc7179225)

[A.5.1 AutoMETARConsumer 57](#_Toc7179226)

[1. Operation AutoMETAR.AutoMETARConsumer.subscribeToAutoMETAR 57](#_Toc7179227)

[2. Operation AutoMETAR.AutoMETARConsumer.unsubscribeToAutoMETAR 57](#_Toc7179228)

[A.5.2 AutoMETARPublisher 58](#_Toc7179229)

[1. Operation AutoMETAR.AutoMETARPublisher.publishAutoMETAR 58](#_Toc7179230)

[A.6 Payload Data Diagrams 58](#_Toc7179231)

[A.7 Payload Data Types 58](#_Toc7179232)

[A.7.1 Payload Elements 58](#_Toc7179233)

[A.8 Service dynamic behaviour 58](#_Toc7179234)

[A.8.1 Service Interface AutoMETARConsumer 58](#_Toc7179235)

[A.8.2 Service Interface AutoMETARPublisher 58](#_Toc7179236)

[Appendix B Service Technical Design Document (STDD) 59](#_Toc7179237)

List of Tables

[Table 1: Glossary 13](#_Toc7179238)

[Table 2: Acronyms and terminology 15](#_Toc7179239)

[Table 3: SESAR Solution PJ.05-05 related OI step & Enablers 16](#_Toc7179240)

[Table 4: SESAR Solution PJ.05-05 Scope and related Functional Blocks/roles & Enablers 17](#_Toc7179241)

[Table 5: SESAR Solution PJ.05-05 linkage to the Enabler through the Operational Improvement Step 17](#_Toc7179242)

[Table 6: Deviations with respect to the SESAR Solution definition 18](#_Toc7179243)

[Table 7: List of Capability Configuration required for the SESAR Solution 21](#_Toc7179244)

[Table 8: List of changes due to the SESAR Solution 22](#_Toc7179245)

[Table 9: Architecture overview 23](#_Toc7179246)

[Table 10 Resource Orchestration view - Descriptions of Functions 27](#_Toc7179247)

[Table 11 Service description 29](#_Toc7179248)

[Table 12 Service Provisioning 29](#_Toc7179249)

[Table 13 System Port: IP\_GND at Communication Infrastructure\_CC 29](#_Toc7179250)

[Table 14 System Port: Transport Secured Web-Services at TWR (Step 2)\_CC 30](#_Toc7179251)

[Table 15: Service identification (I) 56](#_Toc7179252)

List of Figures

[Figure 1 Resource Connectivity Model (source: NSV-1, EATMA) 24](#_Toc7179253)

[Figure 2 Resource Orchestration view - [NSV-4] Advanced Automated MET System 26](#_Toc7179254)

[Figure 3 Infrastructure connectivity model (source: NSV-2 EATMA) 28](#_Toc7179255)

# Executive summary

Adverse weather brings unwelcome disruptions into aviation industry. The impact of adverse weather on Airport Operations, Airspace User Operations and ATS Operations can be mitigated by the timely sharing of high quality, precise, trustworthy and best available meteorological information. Many airports utilize automated weather observation instead of full meteorological observation. However, automated observations, especially of visibility, significant weather phenomena or clouds can fail (e.g. standard sensors do not capture inhomogeneous visibility conditions or cloud cover situation correctly).

The Advanced Automated MET System for Remote Airport provides two options, how to cope with the current disadvantages. Both rely on visible light and infrared cameras and multiple sensor analysis. At the core of the first option is processing by artificial intelligence algorithms, the second one includes concept of remotely located human MET Observer. The final result is distributed to the stakeholders via SWIM and presented at the Controller’s HMI.

This document describes technical specification for PJ.05-Solution 05 “Advanced Automated MET System”. This Solution is complementary solution for Remote Tower concept. While Remote Tower concept addresses providing air traffic services remotely, Advanced Automated MET System supports this concept by providing MET observations and MET reports remotely. However, Advanced Automated MET System is not limited to Remote Tower but can be used with benefits also independently. The document contains outputs of MEGA modelling and the list of functional technical requirements, which define proper operation of the system: imagery acquisition, visibility recognition, cloud recognition, phenomena recognition and composing of final MET report for users.

# Introduction

## Purpose of the document

Adverse weather brings unwelcome disruption to flight schedules and is the cause of approximately 13 % of Europe’s primary delays [41]. Yet the impact can be mitigated by the timely sharing of high quality, precise, trustworthy and best available meteorological information so that effective planning and actual decision making can be put in place. More precise MET information can assist flight planning, resource planning and route planning, and can help to avoid unnecessary delay.

Small and Other airports, targeted within this technical solution, are typical candidates for application of Remote Tower, and for the same reasons (it is difficult or too expensive to implement and staff a conventional manned facility), they often utilize automated weather observation (AUTOMETAR) instead of full meteorological observation (METAR). AUTOMETAR, in contrast to full METAR contains some weather elements reported in simplified form only and some are omitted completely.

This document provides the Technical specification for SESAR Solution PJ05-05 “Advanced Automated MET System”, that consists of two options – Automated and Semi-Automated (with MET Observer in the loop), with the initial maturity level being TRL2.

Both options are targeting TRL4 by the end of Wave 1, which aims at mitigating qualitative differences between METAR and AUTOMETAR.

## Scope

This document is the TS-IRS for Solution PJ.05-05: “Advanced Automated MET System” for TRL4 (V2) phase.

Solution PJ.05-05 aims to provide improved automated and semi-automated aeronautically significant MET observational data. Solution PJ.05-05 is expected to be supported by following enabler according to the DS-18a Dataset [45]:

* AERODROME-ATC-92 - Real-time airport weather observation service with artificial intelligence algorithms

This enabler is declared as optional part of SDM-0207 Remotely Provided Air Traffic Service for Multiple Aerodromes, operational improvement step which is part of Solution PJ.05-02.

## Intended readership

This Technical specification for solution PJ05-05 is written to provide useful information to the following audience:

* PJ05 (Remote Tower) to ensure consistency within the project
* PJ18 4DTM (4D Trajectory Management) for basic MET data acquisition and information services provision
* PJ19 CI (Content Integration) responsible for managing the content integration process to ensure the needed coherency between the different SESAR 2020 projects
* PJ20 AMPLE (Master Plan Maintenance) responsible for ATM Master Plan maintenance
* PJ22 SEABIRD (SE-DMF support)

## Background

Small/Other airports are typical candidates for application of Remote Tower, as it is difficult or too expensive to implement and staff a conventional manned facility. In SESAR programme, remote provision of air traffic control was examined, but no special attention has been given to provision of MET data remotely yet. But usually at Small/Other airports 24/7 MET service is missing and is fully/partially replaced by automated MET reporting, that is simplified in several regards. Remote provision of MET service can serve to local air traffic stakeholders at the airport of provision, but all aeronautical users in-flight or in planning phase can benefit from more comprehensive weather reports originated at these Small/Other airports.

Several members of the project team had previously solved partial problems concerning the remote met service provision (activities outside SESAR):

* Experimentation with cloud observation by static camera with fisheye lens in visible light
* Proof-of-concept of visibility recognition in industrial areas and in road traffic

Moreover, one of the project linked third party is a producer of standard automated AWOS system that is utilized by more than 300 airports in many countries [38]. That AWOS will be fully reused as technological base, upon which the new Remote Observer MET system is being built.

Remote provision and monitoring of full MET information (in comparison to human MET observations) is subject of validation exercise which will bring this technological solution to TRL4 maturity level.

## Structure of the document

This document is composed as follows:

* Section 1 proposes an executive summary usable as-is for communication purposes,
* Section 2 (this chapter) introduces the document and provides general information,
* Section 3 describes the SESAR Solutions Impacts on Architecture
* Section 4 contains Technical specification of proposed new system
* Section 5 deals with various option, how and where the new system can be implemented
* Section 6 lists the assumptions
* Section 7 lists references and applicable documents
* Appendix A provides the Service Description Document
* Appendix B provides the Service Technical Design Document

## Glossary of terms

|  |  |  |
| --- | --- | --- |
| **Term** | **Definition** | **Source of the definition** |
| Advanced Automated MET System | Advanced weather observing system, which is capable to observe automatically all the weather elements contained in METAR/SPECI including that one, where state-of-the-art AWOS systems fail (e.g. visibility, present weather, clouds) and subsequently produces AUTO-METAR/AUTO-SPECI without missing information or with higher quality information especially in inhomogenous weather conditions. | New |
| AUTO-METAR  AUTO-SPECI | The optional code word AUTO shall be inserted before the wind group when a report contains fully automated observations without human intervention. The ICAO requirement is that all of the specified elements shall be reported. However, if any element cannot be observed, the group in which it would have been encoded shall be replaced by the appropriate number of solidi. The number of solidi depends on the number of symbolic letters for the specific group which is not able to be reported; i.e. four for the visibility group, two for the present weather group and three or six for the cloud group, as appropriate. | WMO 306, Vol I. [43] |
| AWOS | Automated Weather Observing System (AWOS) is a fully configurable airport weather system that provides continuous, real time information and reports on airport weather conditions. | ICAO Doc 9837 [39]  [40] |
| Cloud amount | The fraction of the sky covered by the clouds of a certain genus, species, variety, layer, or combination of clouds. | ICAO Doc 9837 [39] |
| METAR  SPECI | Current aerodrome routine meteorological report (METAR) and aerodrome special meteorological reports (SPECI), which shall contain following elements:   * a) identification of the type of report; * b) location indicator; * c) time of the observation; * d) identification of an automated or missing report, when applicable; * e) surface wind direction and speed; * f) visibility; * g) runway visual range, when applicable; * h) present weather; * i) cloud amount, cloud type (only for cumulonimbus and towering cumulus clouds) and height of cloud base or, where measured, vertical visibility; * j) air temperature and dew-point temperature; and * k) QNH and, when applicable, QFE (QFE included only in local routine and special reports). | ICAO Annex 3 [42] |
| Present weather | Weather existing at a station at the time of observation. | ICAO Doc 9837 [39] |
| Prevailing visibility | The greatest visibility value, observed in accordance with the definition of “visibility”, which is reached within at least half the horizon circle or within at least half of the surface of the aerodrome. These areas could comprise contiguous or non-contiguous sectors. | ICAO Annex 3 [42]  ICAO Doc 9837 [39] |
| Remote MET Observer | MET Observer who observers weather from remote location | Solution PJ.05-05 |
| Visibility | Visibility for aeronautical purposes is the greater of:  a) the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background;  b) the greatest distance at which lights in the vicinity of 1 000 candelas can be seen and identified against an unlit background. | ICAO Annex 3 [42]  ICAO Doc 9837 [39] |
| Visibility point | A object on the horizon circle from the observation position with known distance from the point of observation | New |

Table 1: Glossary

## Acronyms and Terminology

|  |  |
| --- | --- |
| **Term** | **Definition** |
| **ANSP** | Air Navigation Service Provider |
| **AO** | Airport Operator |
| **APT** | Airport |
| **ATC** | Air Traffic Controller |
| **ATM** | Air Traffic Management |
| **ATS** | Air Traffic Service |
| **AU** | Airspace User |
| **AWOS** | Automated Weather Observing System |
| **CC** | Capability Configuration |
| **CR** | Change Request |
| **DS** | DataSet |
| **EATMA** | European ATM Architecture |
| **FB** | Functional Block |
| **GND** | Ground |
| **HMI** | Human-Machine Interface |
| **HTTP** | Hypertext Transfer Protocol |
| **ICAO** | International Civil Aviation Agency |
| **IER** | Information Exchange Requirement |
| **IR** | Infrared |
| **IRS** | Interface Requirements Specification |
| **MET** | Referring to meteorology |
| **METAR** | Meteorological Terminal Air Report |
| **QFE** | Atmospheric pressure at Field Elevation |
| **QNH** | Atmospheric pressure at Nill Height |
| **QoS** | Quality of Service |
| **SESAR** | Single European Sky ATM Research Programme |
| **SJU** | SESAR Joint Undertaking |
| **SOAP** | Simple Object Access Protocol |
| **SPECI** | Aviation selected special weather report |
| **SWIM** | System Wide Information Model |
| **TCP** | Transmission Control Protocol |
| **TLS** | Transport Layer Security |
| **TRL** | Technology Readiness Level |
| **TS** | Technical Specification |
| **VIS** | Visibility |
| **WMO** | World Meteorological Organization |
| **XML** | eXtensible Markup Language |

Table 2: Acronyms and terminology

# SESAR Solution Impacts on Architecture

## Target Solution Architecture

### SESAR Solution(s) Overview

|  |
| --- |
| PJ.05-05: Advanced Automated MET System |

Advanced Automated MET System will significantly enhance current possibilities of automated weather observation. This will be achieved by improving the monitoring of current weather situation while special attention will be given to inhomogeneous weather conditions with heightened aviation impact at remote aerodrome whereas data needed, will be gathered from both standard and advanced observing tools. This technological solution will support and complement usage of Remote Tower; however it will be independent and can be advantageously used also with conventional Towers.

|  |  |  |  |
| --- | --- | --- | --- |
| OI Step | | OI description | Open CR |
| POI-0001-MET | | Improved Weather Awareness through Enhanced Automated MET observation |  |
|  | EN code | EN description | Open CR | |
|  | AERODROME-ATC-92 | Real-time Airport Weather Observation service with Artificial Intelligence algorithms |  | |

Table 3: SESAR Solution PJ.05-05 related OI step & Enablers

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Type | Element | | EN Code | | EN/CR Title | | | Coverage |
| **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.05-05  Advanced Automated MET System | | Aerodrome Weather Information Management  AWOS  C06 Local MET Information  MET-GATE (PJ.05-05)  METEO-07c[[1]](#footnote-1)  T02 Local MET Information and Alerts  MET Observer | | Aerodrome-ATC-92 | | Real-time airport weather observation service with artificial intelligence algorithms | Fully | |

Table 4: SESAR Solution PJ.05-05 Scope and related Functional Blocks/roles & Enablers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Operational Improvement ID (from EATMA)** | **OI Validation Status** | **Enabler ID  (from EATMA)** | **Enabler V3 end date [DD/MM/YY]** | **Enabler Validation Status** |
| POI-0001-MET | * **Not Validated** | Aerodrome-ATC-92 | 31/12/2022 | * **Forecasted** |

Table 5: SESAR Solution PJ.05-05 linkage to the Enabler through the Operational Improvement Step

Weather observation and its reporting to all stakeholders (via standardized METAR message) is one of the basic services at each airport regardless its size. Precise MET information can serve to local air traffic stakeholders at the airport of provision, but all aeronautical users in-flight or in planning phase benefit from comprehensive weather reports originated at these airports.

Especially at Small/Other airports, as it is difficult or economically inefficient to implement and staff a conventional manned facility, a 24/7 manned MET service is usually missing and is fully or partially (e.g. during night time) replaced by automated MET reporting, simplified in several regards. Weather messages based only on automatic observations are designated by prefix AUTO.

AUTOMETAR from such locations contains some weather elements reported in simplified form only and some are omitted completely. The targeted improvements are in monitoring of prevailing visibility and its directional variations especially in inhomogeneous visibility conditions; aeronautically significant weather phenomena; and cloud amount in inhomogeneous cloud coverage conditions.

The Advanced Automated MET System has two implementation options:

* Fully-Automated MET System – the system is collecting meteorological data from a number of sensors and cameras located at a remote aerodrome. These data are then processed automatically and presented directly to the Controller responsible, by means of a suitable HMI.
* Semi-Automated MET System – this concept represents a ‘human-in-the-loop’ MET solution. The remote MET Observer receives meteorological data from a number of sensors and cameras that are located at one or more remote aerodromes. The remote MET Observer is responsible for their processing before these are presented at the Controller’s HMI.

At one airport, the first option can be implemented, while at another airport, implementation of second option can be more advantageous, according to local conditions. It is also possible (because these are two options of the same system), that the options will coexist at one airport, first option working part of day and the second the other part of day (according to human shifts availability).

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

PJ.18-04b dealing with new MET capabilities and Information Services supporting other PJs is currently working on reorganisation of EN and architecture all MET related EATMA elements. Several CRs were submitted in this matter and some of them are affecting also AERODROME-ATC-92.

|  |  |  |
| --- | --- | --- |
| **Enabler** | **Opt/Req** | **Deviation** |
| AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms | Required |  |

Table 6: Deviations with respect to the SESAR Solution definition

#### Relevant Use Cases

|  |  |  |
| --- | --- | --- |
| System Process | | Description |
| [NSV-4] Advanced Automated MET System | | Advanced Automated MET System significantly enhances current possibilities of automated weather observation. This is achieved by improving the monitoring of current weather situation while special attention is given to inhomogeneous weather conditions with heightened aviation impact at remote aerodrome whereas data needed are gathered from both standard and advanced observing tools (VIS and IR cameras). The targeted improvements are in monitoring of prevailing visibility and its directional variations especially in inhomogeneous visibility conditions; aeronautically significant weather phenomena; and cloud amount in inhomogeneous cloud coverage conditions and aeronautically significant cloud types. |
| Operational Use Case | | Description |
| **Fully automatic provision of ATC/AO with improved MET information** | | |
| **Item** | **Specification** | |
| **Purpose** | The use case describes process of Advanced Automated MET System in fully automated mode (without human interaction). | |
| **Stakeholder** | Airport Operator (AO), ATS Operator, MET Service Provider | |
| **Input** | Camera VIS and IR imagery  MET data from sensors | |
| **Output** | Automatic weather report | |
| **Control Constraint** | Local weather scenario | |
| **Pre-condition** | Camera images are pre-processed to be suitable for automatic image recognition  MET data are available | |
| **Post-condition** | AUTOMETAR has been delivered to relevant stakeholders | |
| **Process Flow** | 1. The system processes camera and MET data and by utilizing artificial intelligence algorithms provides cloud information also under inhomogeneous cloud cover conditions, where state-of-the-art AWOS systems fail. 2. The system processes camera and MET data and by utilizing artificial intelligence algorithms provides prevailing visibility information also under inhomogeneous visibility conditions, where state-of-the-art AWOS systems fail. The system provides directional visibility information according to valid regulations, too. 3. The system recognizes aeronautically significant phenomena by sensor combination and algorithms. 4. The system creates meteorological information in standard format, and sends it to relevant stakeholders 5. ATC receives MET information and uses it in his/her operational work 6. AO receives MET information and uses it in his/her operational work 7. Other SWIM or non-SWIM users receive MET information and use it in their operational work | |
| **Alternative Flow** | None | |

|  |  |
| --- | --- |
| **Semi-automatic provision of ATC/AO with improved MET information** | |
| **Item** | **Specification** |
| **Purpose** | The use case describes process of Advanced Automated MET System in semi-automated mode (with human interaction). |
| **Stakeholder** | Airport Operator (AO), ATS Operator, MET Service Provider, Remote MET Observer |
| **Input** | Camera VIS and IR imagery and video  MET data from sensors |
| **Output** | Automatic weather report |
| **Control Constraint** | Local weather scenario |
| **Pre-condition** | Camera images are pre-processed  MET data are available |
| **Post-condition** | The MET report has been delivered to relevant stakeholders |
| **Process Flow** | 1. Remote MET Observer processes camera and MET data using dedicated HMI to provide full cloud information. 2. Remote MET Observer processes camera and MET data using dedicated HMI to provide full visibility information. 3. Remote MET Observer recognizes aeronautically significant phenomena by previewing videos from camera and available sensors data. 4. Remote MET Observer finally creates meteorological information in standard format using dedicated HMI and sends it to relevant stakeholders. 5. ATC receives MET information and uses it in his/her operational work 6. AO receives MET information and uses it in his/her operational work 7. Other SWIM or non-SWIM users receive MET information and use it in their operational work |
| **Alternative Flow** | None |

#### Applicable standards and regulations

The solution complies with the following applicable standards:

* ICAO Annex 3 Meteorological Service for International Air Navigation [42]
* ICAO Doc 9837 Manual on Automatic Meteorological Observing Systems at Aerodromes [39]
* WMO 306, Manual on Codes Vol I. [43]

### Capability Configurations required for the SESAR Solution

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [Context] Aerodrome ATM-MET PJ.05-05 | | |  | | |
| **CC** | **Op Env** | **Capability** | | **Node** | **Stakeholder** | |
| Aerodrome ATM-MET (PJ.05-05) | Airport - Small  Airport - Other |  | | Meteorological Service Provision; | Air Navigation Service Provider; Civil MET Service Provider; | |
| Aerodrome ATM-MET (PJ.05-05) | Airport - Small  Airport - Other |  | | Meteorological Service Provision; | Air Navigation Service Provider; Civil MET Service Provider; | |
| Communication Infrastructure (PJ.05-05) |  |  | | Flight Deck; | Air Navigation Service Provider; | |
| TWR (Step 2) (PJ.05-05) |  |  | | Network Operations; | Air Navigation Service Provider; | |
| TWR (Step 2) (PJ.05-05) |  |  | | Network Operations; | Air Navigation Service Provider; | |

Table 7: List of Capability Configuration required for the SESAR Solution

## Changes imposed by the SESAR Solution on the baseline Architecture

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Enabler | Element type | Element name | Impact | Change |
| Aerodrome-ATC-92 |  | Real-time airport weather observation service with artificial intelligence algorithms |  | AutoMETAR Service creation;  Automated weather observation in conditions where it is difficult or too expensive to implement and staff a conventional manned facility. |

Table 8: List of changes due to the SESAR Solution

# Technical Specifications

## Functional architecture overview

*Functions required to perform needed Operational Activities can be allocated to Resources of a different type: Human Role, Infrastructure System or Functional Block.*

|  |  |  |
| --- | --- | --- |
| **Role** | **Functional Block** | **Function** |
| [NSV-4] Advanced Automated MET System | | |
|  | Aerodrome Weather Information Management |  |
|  | AWOS | AWOS; |
|  | C06 Local MET Information | C06 Local MET Information; |
|  | MET-GATE (PJ.05-05) | Prepare AutoMETAR Service; |
|  | Visibility/Cloud Automatic Detection | IR and VIS Camera; |
|  | T02 Local MET Information and Alerts | T02 Local MET Information and Alerts; |

Table 9: Architecture overview

### Resource Connectivity Model

Resource Connectivity diagram (Figure 1) describes interaction between Aerodrome ATM-MET PJ05-05 CC and TWR Step 2 PJ05-05 CC using AutoMETAR service.

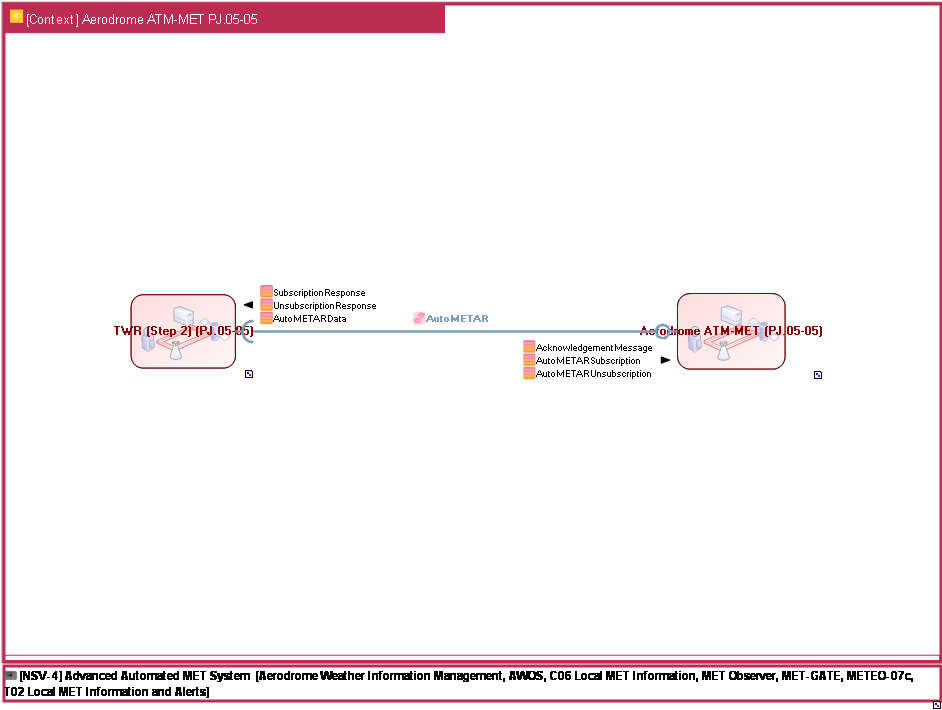


Figure 1 Resource Connectivity Model (source: NSV-1, EATMA)

### Resource Orchestration view

#### [NSV-4] Advanced Automated MET System

Resource Orchestration (Figure 2) describes interaction of Functions under Aerodrome ATM-MET PJ05-05 CC to prepare AutoMETAR service for TWR Step 2 PJ05-05 CC.

Advanced Automated MET System significantly enhances current possibilities of automated weather observation. This is achieved by improving the monitoring of current weather situation while special attention is given to inhomogeneous weather conditions with heightened aviation impact at remote aerodrome whereas data needed are gathered from both standard and advanced observing tools (VIS and IR cameras). The targeted improvements are in monitoring of prevailing visibility and its directional variations especially in inhomogeneous visibility conditions; aeronautically significant weather phenomena; and cloud amount in inhomogeneous cloud coverage conditions and aeronautically significant cloud types.

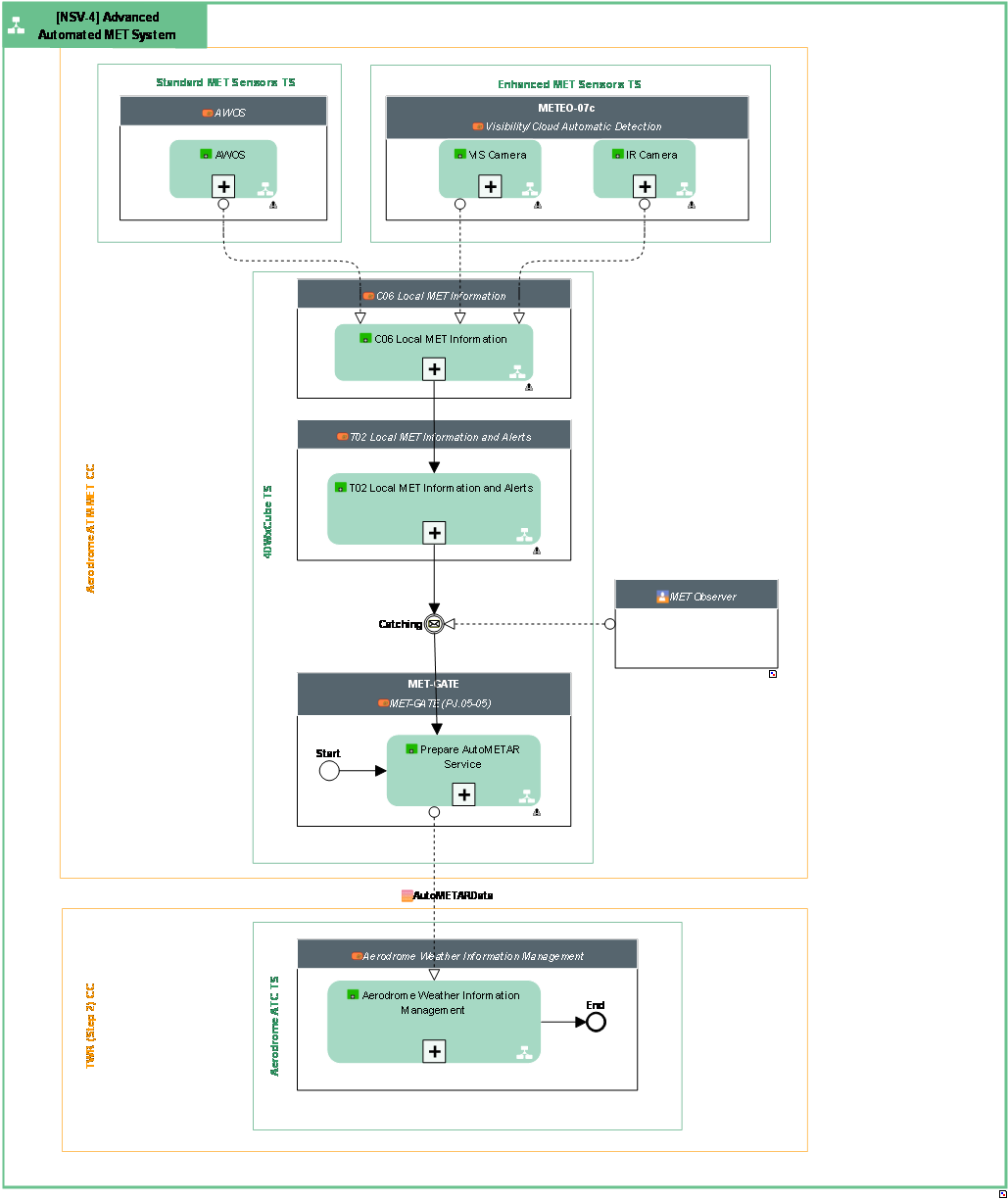


Figure 2 Resource Orchestration view - [NSV-4] Advanced Automated MET System

|  |  |
| --- | --- |
| Function | Description |
| Aerodrome Weather Information Management | This functional block provides, by means of SWIM technology, a common (current and forecasted) weather situation awareness to several systems and stakeholders.  Therefore it will provide inputs to various systems (e.g. Runway Management Tool) and various stakeholders at the same time.  The system will support the medium and short term planning and in particular Demand and Capacity Balancing (DCB). |

Table 10 Resource Orchestration view - Descriptions of Functions

### Infrastructure connectivity model

Infrastructure Connectivity diagram describes physically connection of CCs using system ports and services.

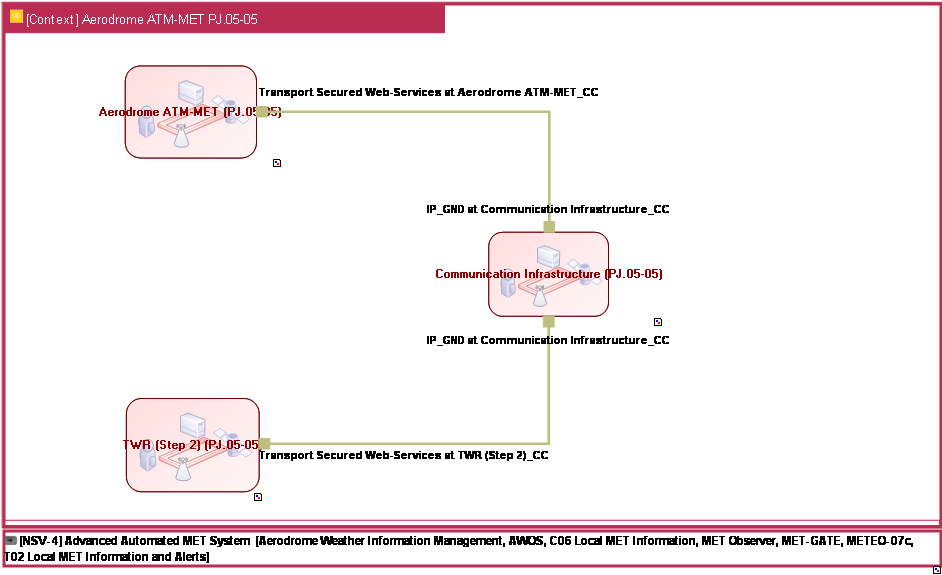


Figure 3 Infrastructure connectivity model (source: NSV-2 EATMA)

### Service view

#### Service description

|  |  |
| --- | --- |
| Service | Service description |
| AutoMETAR | AutoMETAR Service provides automated weather observation in conditions, where it is difficult or too expensive to implement and staff a conventional manned facility. AutoMETAR from remote locations contains weather elements reported by automatic sensors and devices. |

Table 11 Service description

The Solution provides AutoMETAR Service, but it also uses Remote Tower MET Service developed by PJ.18-04b [47] in order to provide all input data necessary for enhanced automated weather observation at the airport using Advance Automated MET System in a standardized way (especially Airport Integrated Camera Images which has not been addressed yet). However, this service was not validated within the scope of PJ.05-05 as it was not available before the start of its validation exercise. Therefore it is fully under the scope of PJ.18-04b and it will be also validated in the scope of PJ.18-04b.

#### Service Provisioning

| Interaction | Consumer CC | Consumer System | Provider CC | Provider System |
| --- | --- | --- | --- | --- |
| AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC | TWR (Step 2) (PJ.05-05) | Aerodrome ATC; | Aerodrome ATM-MET (PJ.05-05) | 4DWxCube; |

Table 12 Service Provisioning

#### Service Realization

##### Interaction AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC

**System Port:** IP\_GND at Communication Infrastructure\_CC

|  |  |
| --- | --- |
| **Protocol Stack** | **Protocol** |
| IP |  |

Table 13 System Port: IP\_GND at Communication Infrastructure\_CC

**System Port:** Transport Secured Web-Services at TWR (Step 2)\_CC

|  |  |
| --- | --- |
| **Protocol Stack** | **Protocol** |
| Transport Secured Web-Services |  |
|  | XML |
|  | SOAP |
|  | HTTP |
|  | TLS |
|  | TCP |
|  |  |

Table 14 System Port: Transport Secured Web-Services at TWR (Step 2)\_CC

## Functional and non-Functional Requirements

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0001 |
| Title | Camera(s) with VIS and IR channels |
| Requirement | Camera(s) shall be capable of capturing quality (resolution 1920x1080 in VIS, 640x480 in IR) images of airport surrounding and the sky in both VIS and IR channels. The system shall store raw images on sufficiently large storage. |
| Status | <in progress> |
| Rationale | Camera imagery is necessary input for cloud, visibility and aeronautically significant phenomena recognition. |
| Category | <Functional>, <Data> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | C06 Local MET Information  Visibility/Cloud Automatic Detection |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0002 |
| Title | Camera controller |
| Requirement | Camera controller shall exist, which provides the capability to rotate/tilt/zoom the camera in predefined repeatable cycles, non-regular scans and extract both video and imagery. |
| Status | <in progress> |
| Rationale | It is necessary to schedule and control camera. This requirement has been addressed by PJ.18-04b “Airport MET Camera” [48]. |
| Category | <Functional>, <IER> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | C06 Local MET Information  Visibility/Cloud Automatic Detection |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0003 |
| Title | Image pre-processing - image stitching |
| Requirement | A software shall exist, which pre-processes the raw images and prepares them for subsequent recognition. The system shall compose cloud imagery into a single sky picture (so called image “stitching”). |
| Status | <in progress> |
| Rationale | Raw images processing is necessary precondition for successful recognition. This requirement has been addressed by PJ.18-04b “Airport MET Camera” [48]. |
| Category | <Functional>, <IER> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Visibility/Cloud Automatic Detection  C06 Local MET Information  Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Function> | AWOS  VIS Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0004 |
| Title | Image pre-processing - blurring/removal of sensitive content |
| Requirement | According to local law requirements, a software for recognition of human faces and car identification plates shall be applied and the software shall blur/remove these parts of image from pictures, if applicable.. |
| Status | <in progress> |
| Rationale | As far as camera can capture public space partially, it shall meet the law. This requirement has been addressed by PJ.18-04b “Airport MET Camera” [48]. |
| Category | <Functional>, <IER> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0005 |
| Title | Camera imagery SWIM service |
| Requirement | The system shall provide SWIM compatible service for airport imagery distribution. |
| Status | <in progress> |
| Rationale | SWIM compatible interfaces facilitate data interchange between systems. This requirement is planned to be addressed by PJ.18-04b “Remote Tower MET Service” [47]. |
| Category | <Functional>, <IER>, <Interoperability> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  MET-GATE (PJ.05-05) |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0006 |
| Title | Airport surroundings layout – daylight visibility points |
| Requirement | The system shall have, in its internal database, the topology of daylight visibility points around the airport, including their distances from observation point. |
| Status | <in progress> |
| Rationale | To measure true prevailing visibility around the airport, the database of daylight visibility points in certain known distances shall be established, in accordance with visibility definition in ICAO Annex 3 [42]. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Function> | C06 Local MET Information |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0007 |
| Title | Airport surroundings layout – night-time visibility points |
| Requirement | The system shall have, in its internal database, the topology of night-time visibility points around the airport, including their distances from observation point. |
| Status | <in progress> |
| Rationale | To measure true prevailing visibility around the airport, the system shall establish database of night-time visibility points in certain known distances, in accordance with visibility definition in ICAO Annex 3 [42]. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Function> | C06 Local MET Information |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0008 |
| Title | Regular imaging of visibility points |
| Requirement | The system shall take photos of all visibility points at regular intervals. The intervals shall be configurable to allow for regular reporting each 30 or 60 minutes according to ICAO Annex 3 [42]. Meteorological Service for International Air Navigation regulation for METAR. |
| Status | <in progress> |
| Rationale | System needs photos of visibility points to be able to distinguish if they are visible or not. To provide true awareness of prevailing visibility and its directional variations, camera shall regularly scan points in all compass directions and various distances. This requirement has been addressed by PJ.18-04b “Airport MET Camera” [48]. |
| Category | <Functional>, <Data>, <IER> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information  Visibility/Cloud Automatic Detection |
| <ALLOCATED\_TO> | <Function> | IR Camera  VIS Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0009 |
| Title | Recognition of visibility point automatically (Fully automated mode) |
| Requirement | For each photo of visibility point, the system shall recognize automatically, if the point is visible or not. |
| Status | <in progress> |
| Rationale | The system shall know, which visibility points are seen, in order to calculate prevailing visibility and its directional variations. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  Visibility/Cloud Automatic Detection  C06 Local MET Information |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO. 0010 |
| Title | Recognition of visibility points by remote MET observer (Semi-automated mode) |
| Requirement | For each photo of visibility point, the HMI shall offer to the remote MET observer the possibility to mark, if the point is visible or not. The HMI shall offer functions for marking several points at once. |
| Status | <in progress> |
| Rationale | In semi-automated mode, the remote operator’s input to the system is crucial. It replaces the local MET observation. |
| Category | <Functional>, <Interface>, <HMI> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information |
| <ALLOCATED\_TO> | <Role> | MET Observer |
| <ALLOCATED\_TO> | <Function> | IR Camera  VIS Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0011 |
| Title | Prevailing visibility calculator |
| Requirement | The system shall calculate prevailing visibility also in inhomogeneous conditions (when visibility in one specific direction is different from visibility in other directions), from the information, which visibility points are visible. |
| Status | <in progress> |
| Rationale | The ICAO regulation (ICAO Annex 3 [42]) requires reporting of prevailing visibility (including directional variations, if occurring). The reports are received by ATC, AO, AU and all interested clients as inputs for their job. |
| Category | <Functional>, <Data> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information  Visibility/Cloud Automatic Detection |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera  Prepare AutoMETAR Service |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0012 |
| Title | Regular imaging of sky |
| Requirement | The system shall take the photos of the whole sky at regular intervals. The intervals shall be configurable to allow for regular reporting each 30 or 60 minutes according to ICAO Annex 3 [42]. |
| Status | <in progress> |
| Rationale | System needs photos of sky to be able to recognize cloud coverage. To provide true awareness of sky conditions also in inhomogeneous conditions, the camera shall regularly scan the whole sky. This requirement has been addressed by PJ.18-04b “Airport MET Camera” [48]. |
| Category | <Functional>, <Data>, <IER> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information  Visibility/Cloud Automatic Detection |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0013 |
| Title | Recognition of clouds on image automatically (Fully automated mode) |
| Requirement | For each composed image of sky, the system shall recognize the clouds on image automatically. |
| Status | <in progress> |
| Rationale | The cloud coverage information is a requirement of aeronautical users. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information  Visibility/Cloud Automatic Detection |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0014 |
| Title | Recognition of clouds on image by remote MET Observer (Semi-automated mode) |
| Requirement | For each composed image of sky, the HMI shall offer to the remote MET Observer the possibility and support him in the extent of the clouds layers assessment. |
| Status | <in progress> |
| Rationale | In semi-automated mode, the remote operator’s input to the system is crucial. It replaces the local MET observation. |
| Category | <Functional>, <Interface>, <HMI> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information |
| <ALLOCATED\_TO> | <Role> | MET Observer |
| <ALLOCATED\_TO> | <Function> | IR Camera  VIS Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO. 0015 |
| Title | Cloud coverage calculator |
| Requirement | The system shall calculate cloud cover, also in inhomogeneous sky conditions, taking into account scans of whole sky and recognized portion covered by clouds. |
| Status | <in progress> |
| Rationale | The ICAO regulation (ICAO Annex 3 [42]) requires reporting of clouds. The reports are received by ATC, AO, AU and all interested clients as inputs for their job. |
| Category | <Functional>, <Data> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  Visibility/Cloud Automatic Detection  C06 Local MET Information |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera  Prepare AutoMETAR Service |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0016 |
| Title | Recognition of phenomena by sensor combination |
| Requirement | System shall recognize phenomena by sensor combination and evaluation algorithms. |
| Status | <in progress> |
| Rationale | The phenomena information (precipitation, obscuration or other phenomena defined in ICAO Annex 3 [42] and WMO Manual No. 306, FM-15) [43] is requirement of aeronautical users. Phenomena sensors are mainly used in fully automated mode, but also Remote MET observer can utilize their outputs. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information  AWOS |
| <ALLOCATED\_TO> | <Function> | AWOS  C06 Local MET Information |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0017 |
| Title | Phenomena composing (Fully automated mode) |
| Requirement | The system shall compose phenomena information, based on sensors. |
| Status | <in progress> |
| Rationale | The ICAO regulation (ICAO Annex 3 [42]) requires reporting of phenomena group. The reports are received by ATC, AO, AU and all interested clients as inputs for their job. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information  AWOS |
| <ALLOCATED\_TO> | <Function> | C06 Local MET Information  AWOS  Prepare AutoMETAR Service |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0018 |
| Title | Regular video capture of phenomena (Semi-automated mode) |
| Requirement | Thy system shall capture short videos (5-10 sec) of phenomena at regular intervals. The intervals shall be configurable to allow for regular reporting each 30 or 60 minutes according to ICAO Annex 3 [42]. |
| Status | <in progress> |
| Rationale | Videos are important for the remote MET Observer to be able to recognize precipitation type, obscuration or other phenomena defined in METAR message (ICAO Annex 3 [42], WMO Manual No. 306, FM-15 [43]). This requirement has been addressed by PJ.18-04b “Airport MET Camera” [48]. |
| Category | <Functional>, <Data>, <IER> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0019 |
| Title | Recognition of phenomena by remote MET Observer (Semi-automated mode) |
| Requirement | In semi-automated mode, the HMI shall offer to the remote MET Observer the possibility to enter recognized phenomena. |
| Status | <in progress> |
| Rationale | The remote MET Observer’s input of recognized phenomena (precipitation type, obscuration or other phenomena defined in ICAO Annex 3 [42] and WMO Manual No. 306, FM-15 [43]) to the system using available inputs (videos, imagery, sensors) is crucial in semi-automated mode. It replaces the local MET observation. |
| Category | <Functional>, <HMI> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  C06 Local MET Information |
| <ALLOCATED\_TO> | <Role> | MET Observer |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0020 |
| Title | Phenomena composing by remote MET observer (Semi-automated mode) |
| Requirement | Using system’s HMI, the remote MET observer shall compose phenomena information, based on sensors and/or video input. |
| Status | <in progress> |
| Rationale | The ICAO regulation (ICAO Annex 3 [42]) requires reporting of phenomena group. The reports are received by ATC, AO, AU and all interested clients as inputs for their job. |
| Category | <Functional>, <HMI> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Role> | MET Observer |
| <ALLOCATED\_TO> | <Function> | Prepare AutoMETAR Service |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0021 |
| Title | Final report creation (Fully automated mode) |
| Requirement | The system shall compose final MET report according to ICAO Annex 3 [42], by adding elements measured by standard methods to the ones obtained by camera/artificial intelligence method. |
| Status | <in progress> |
| Rationale | The ICAO regulation (ICAO Annex 3 [42]) requires reporting of MET information. The reports are received by ATC, AO, AU and all interested clients as inputs for their job. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Function> | Prepare AutoMETAR Service |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0022 |
| Title | Final report creation by remote MET Observer (Semi-automated mode) |
| Requirement | Using system’s HMI, the remote MET Observer shall compose final MET report according to ICAO Annex 3 [42], by adding elements measured by standard methods to the ones obtained by his/her remote observation. |
| Status | <in progress> |
| Rationale | The ICAO regulation (ICAO Annex 3 [42]) requires reporting of MET information. The reports are received by ATC, AO, AU and all interested clients as inputs for their job. |
| Category | <Functional>, <HMI> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Role> | MET Observer |
| <ALLOCATED\_TO> | <Function> | Prepare AutoMETAR Service |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0023 |
| Title | SWIM distribution of final MET report |
| Requirement | SWIM service shall distribute final MET report. |
| Status | <in progress> |
| Rationale | The MET report shall reach its users. Relevant SWIM service was developed in SESAR1 [44] |
| Category | <Functional>, <IER>, <Interoperability>, <Interface> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management  MET-GATE (PJ.05-05) |
| <ALLOCATED\_TO> | <Function> | Prepare AutoMETAR Service |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0024 |
| Title | ATC HMI to display final MET report |
| Requirement | HMI shall display final MET report to ATC. |
| Status | <in progress> |
| Rationale | ATC uses MET information in his/her operational work |
| Category | <Functional>, <Interoperability>, <Interface>, <HMI> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0025 |
| Title | AO HMI to display final MET report |
| Requirement | HMI shall display final MET report to AO. |
| Status | <in progress> |
| Rationale | AO uses MET information in his/her operational work |
| Category | <Functional>, <Interoperability>, <Interface>, <HMI> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0026 |
| Title | Special camera usage by remote operator |
| Requirement | The system shall allow the remote operator to freely rotate/zoom camera to capture special weather situations in order to create better actual weather reports and short term aviation forecasts. |
| Status | <in progress> |
| Rationale | Due to variability of weather, it is sometimes necessary to use manual control of the camera by remote operator outside configured regular intervals. |
| Category | <Functional> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | C06 Local MET Information  Visibility/Cloud Automatic Detection |
| <ALLOCATED\_TO> | <Role> | MET Observer |
| <ALLOCATED\_TO> | <Function> | VIS Camera  IR Camera |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

[REQ]

|  |  |
| --- | --- |
| Identifier | REQ-05.05-TS-RAWO.0027 |
| Title | Quality of Service |
| Requirement | The quality of the MET reporting service produced by the validated system will not be deteriorated comparing to MET reporting service generated by state-of-the-art AWOS system. |
| Status | <in progress> |
| Rationale | It is a basic requirement that new system will not provide deteriorated service comparing to current one. |
| Category | <Performance> |

[REQ Trace]

|  |  |  |
| --- | --- | --- |
| Relationship | Linked Element Type | Identifier |
| <ALLOCATED\_TO> | <SESAR Solution> | PJ.05-05 |
| <ALLOCATED\_TO> | <Functional block> | Aerodrome Weather Information Management |
| <ALLOCATED\_TO> | <Service> | AutoMETAR.TWR (Step 2) (PJ.05-05)\_CC and Aerodrome ATM-MET (PJ.05-05)\_CC |
| <ALLOCATED\_TO> | <Enabler> | AERODROME-ATC-92\_Real-time Airport Weather Observation service with Artificial Intelligence algorithms |

# Implementation Options

There are two different options for solution implementation, namely fully automated mode and semi-automated mode) of Advanced Automated MET System:

1. Fully automated mode - the system performs cloud coverage and prevailing visibility calculation from camera pictures automatically, which is key function in fully automated mode. For phenomena recognition (precipitation, obscuration or other phenomena defined in ICAO Annex 3 [42] and WMO Manual No. 306, FM-15 [43]) it means that system is able to recognize phenomena using sensor combination and algorithms. The system in fully automated mode shall automatically use available inputs to compose from available inputs final meteorological report, which is distributed to the stakeholders (ATC, AO, AU and other SWIM users).
2. Semi-automated mode - pictures and videos from dual VIS and IR camera, along with data from other MET sensors at the airport, are available to human remote MET Observer, who manually determines cloud coverage, prevailing visibility and phenomena using these inputs presented in dedicated HMI. In semi-automated mode Remote MET Observer shall compose final meteorological report from available inputs using the dedicated HMI. The final meteorological report is subsequently distributed to the stakeholders (ATC, AO, AU and other SWIM users).

List of TREQ applicable for fully automated mode:

|  |
| --- |
| REQ-05.05-TS-RAWO.0001 |
| REQ-05.05-TS-RAWO.0002 |
| REQ-05.05-TS-RAWO.0003 |
| REQ-05.05-TS-RAWO.0004 |
| REQ-05.05-TS-RAWO.0005 |
| REQ-05.05-TS-RAWO.0006 |
| REQ-05.05-TS-RAWO.0007 |
| REQ-05.05-TS-RAWO.0008 |
| REQ-05.05-TS-RAWO.0009 |
| REQ-05.05-TS-RAWO.0011 |
| REQ-05.05-TS-RAWO.0012 |
| REQ-05.05-TS-RAWO.0013 |
| REQ-05.05-TS-RAWO.0015 |
| REQ-05.05-TS-RAWO.0016 |
| REQ-05.05-TS-RAWO.0017 |
| REQ-05.05-TS-RAWO.0021 |
| REQ-05.05-TS-RAWO.0023 |
| REQ-05.05-TS-RAWO.0024 |
| REQ-05.05-TS-RAWO.0025 |
| REQ-05.05-TS-RAWO.0027 |

List of TREQ applicable for semi-automated mode.

|  |
| --- |
| REQ-05.05-TS-RAWO.0001 |
| REQ-05.05-TS-RAWO.0002 |
| REQ-05.05-TS-RAWO.0003 |
| REQ-05.05-TS-RAWO.0004 |
| REQ-05.05-TS-RAWO.0005 |
| REQ-05.05-TS-RAWO.0006 |
| REQ-05.05-TS-RAWO.0007 |
| REQ-05.05-TS-RAWO.0008 |
| REQ-05.05-TS-RAWO.0010 |
| REQ-05.05-TS-RAWO.0011 |
| REQ-05.05-TS-RAWO.0012 |
| REQ-05.05-TS-RAWO.0014 |
| REQ-05.05-TS-RAWO.0016 |
| REQ-05.05-TS-RAWO.0018 |
| REQ-05.05-TS-RAWO.0019 |
| REQ-05.05-TS-RAWO.0020 |
| REQ-05.05-TS-RAWO.0022 |
| REQ-05.05-TS-RAWO.0023 |
| REQ-05.05-TS-RAWO.0024 |
| REQ-05.05-TS-RAWO.0025 |
| REQ-05.05-TS-RAWO.0026 |
| REQ-05.05-TS-RAWO.0027 |

# Assumptions

This section describes assumptions that have been made with regard to the requirements described in section 4.2 Functional and non-Functional Requirements of this document.

## Assumptions with respect to other SESAR solutions

Solution PJ.05-05 expects inputs from other SESAR solutions, because the Solution has dependency with PJ.18-04b. While output from “Airport MET Camera” [48] has been used in PJ.05-05 validation exercise, “Remote Tower MET Service” [47] is being validated in scope of PJ18-04b and it is assumed to be fully integrated into solution in next validation phase.

## Assumptions with respect to EATMA

**PJ.05-05\_ASSUMPTION\_5001:** It is assumed that the impacts on the Functional Blocks listed in Table 4 will be accepted by PJ.19 to be enhanced in EATMA.

**PJ.05-05\_ASSUMPTION\_5002:** It is assumed that a new ENs are introduced in EATMA in relation with PJ.18-04b.

## Human Performance Assumptions

**PJ.05-05\_ASSUMPTION\_5003:** It is assumed that a final meteorological report, which is distributed to the stakeholders (ATC, AO, AU and other SWIM users) is in accordance with the Meteorological Service for International Air Navigation – ICAO Annex 3 – 16th Edition 2007 [42]

## Safety and Security assumptions

**PJ.05-05\_ASSUMPTION\_5004:** It is assumed that The Advanced Automated MET System has been developed in line with the data protection standards and regulations.

**PJ.05-05\_ASSUMPTION\_5005**: All of the operational procedures applied by the AO or ATCO to control air traffic remain unchanged when using the outputs from Advanced Automated MET System.

## Technical Assumptions

**PJ.05-05\_ASSUMPTION\_5006:** It is assumed that AWOS is installed at the airport and is fully reused as technological base, upon which the new Remote Observer MET system is being built.

**PJ.05-05\_ASSUMPTION\_5007:** It is assumed that communication link between Remote Observer and Advanced Automated MET System at the airport has sufficient bandwidth and capacity to transfer all data including images and video.

# References and Applicable Documents

## Applicable Documents

Content Integration

1. B.04.01 D138 EATMA Guidance Material
2. EATMA Community pages
3. SESAR ATM Lexicon

Content Development

1. B4.2 D106 Transition Concept of Operations SESAR 2020

System and Service Development

1. 08.01.01 D52: SWIM Foundation v2
2. 08.01.01 D49: SWIM Compliance Criteria
3. 08.01.03 D47: AIRM v4.1.0
4. 08.03.10 D45: ISRM Foundation v00.08.00
5. B.04.03 D102 SESAR Working Method on Services
6. B.04.03 D128 ADD SESAR1
7. B.04.05 Common Service Foundation Method

Performance Management

1. B.04.01 D108 SESAR 2020 Transition Performance Framework
2. B.04.01 D42 SESAR2020 Transition Validation
3. B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition.
4. 16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model
5. 16.06.06-D51-SESAR\_1 Business Case Consolidated\_Deliverable-00.01.00 and CBA
6. [Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)](http://www.eurocontrol.int/sites/default/files/content/documents/sesar/business-case/EUROCONTROL%20Method%20to%20Assess%20Costs%20v1.0.pdf)
7. ATM Cost Breakdown Structure\_ed02\_2014
8. Standard Inputs for EUROCONTROL Cost Benefit Analyses
9. 16.06.06\_D26-08 ATM CBA Quality Checklist
10. 16.06.06\_D26\_04\_Guidelines\_for\_Producing\_Benefit\_and\_Impact\_Mechanisms

Validation

1. 03.00 D16 WP3 Engineering methodology
2. Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects
3. European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

System Engineering

1. SESAR 2020 Requirements and Validation Guidelines

Safety

1. SESAR, Safety Reference Material, Edition 4.0, April 2016
2. SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016
3. SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015
4. SESAR, Resilience Engineering Guidance, May 2016

Human Performance

1. 16.06.05 D 27 HP Reference Material D27
2. 16.04.02 D04 e-HP Repository - Release note

Environment Assessment

1. SESAR, Environment Reference Material, alias, “Environmental impact assessment as part of the global SESAR validation”, Project 16.06.03, Deliverable D26, 2014.
2. ICAO CAEP – “Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes” document, Doc 10031.

Security

1. 16.06.02 D103 SESAR Security Ref Material Level
2. 16.06.02 D137 Minimum Set of Security Controls (MSSCs).
3. 16.06.02 D131 Security Database Application (CTRL\_S)

## Reference Documents

1. ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.[[2]](#footnote-2)

1. <http://www.microstep-mis.com/index.php?site=src/references>
2. Manual on Automatic Meteorological Observing Systems at Aerodromes – ICAO Doc 9837 – 2nd Edition - 2011
3. <https://www.skybrary.aero/index.php/Automated_Weather_Observing_System_(AWOS)>

1. <http://www.eurocontrol.int/news/weather-resilience-forum-2015>
2. Meteorological Service for International Air Navigation – ICAO Annex 3 – 16th Edition –2007.
3. Manual on Codes Volume I.1 – WMO - No. 306 – 2011 edition (updated in 2016)
4. European ATM Service Description for the METAR Service – SESAR1 project 08.03.10 Information Service Modelling deliverables
5. Master Plan Dataset 18a.
6. PJ.20, WP2.2, Airport OE\_December 2017 Version (1\_0)
7. PJ18-04b AN for Remote Tower MET Service
8. PJ18-04b Prototype AN for Enhanced Airport (surface-based & remote sensing) MET Observations
9. Service Description Document (SDD)
   1. Introduction
   2. Service Identification

|  |  |
| --- | --- |
| **Name of the Service** | AutoMETAR |
| **Identifier** | MVgO34tYSHft |
| **Version** | EATMA Draft |
| **Architect(s)** | CZVEDLER Vidor |
| **Last Modification Date** | 4/17/2019 |

Table 15: Service identification (I)

* 1. Operational and Business Context
     1. Operational Context

|  |  |
| --- | --- |
| **Supported Activity** | **Activity Description** |

* + 1. Information Exchange Requirements
    2. Other Requirements
  1. Service Overview
     1. Service Taxonomy

|  |  |  |
| --- | --- | --- |
| **Supported Capability** | **Parent Capability** | **Level 1 Capability** |

* + 1. Service Levels (NfRs)
    2. Service Functions and Capabilities
    3. Service Interfaces

|  |  |
| --- | --- |
| **Service Name** | **Description** |
| AutoMETAR | AutoMETAR Service provides report based on automated weather observation in conditions, where it is difficult or too expensive to implement and staff a conventional manned facility. AutoMETAR from remote locations contains weather elements reported by automatic sensors and devices. |

|  |  |
| --- | --- |
| **Service Interface Definition** | **Description** |
| AutoMETARConsumer | The interface definition is used to support subscription/unsubscription to the AutoMETAR service. |
| AutoMETARPublisher | The interface definition is used for publishing the AutoMETAR service. |

* 1. Service interface specifications
     1. AutoMETARConsumer
        1. Operation AutoMETAR.AutoMETARConsumer.subscribeToAutoMETAR

Operation to enable a subscription for a AutoMETAR.

|  |  |  |
| --- | --- | --- |
| **Input** | **Service Payload** | **CLDM Data Entity** |
|  | AutoMETARSubscription |  |
| **Return** | **Service Payload** | **CLDM Data Entity** |
|  | SubscriptionResponse |  |

* + - 1. Operation AutoMETAR.AutoMETARConsumer.unsubscribeToAutoMETAR

Operation to enable a unsubscription for a AutoMETAR.

|  |  |  |
| --- | --- | --- |
| **Input** | **Service Payload** | **CLDM Data Entity** |
|  | AutoMETARUnsubscription |  |
| **Return** | **Service Payload** | **CLDM Data Entity** |
|  | UnsubscriptionResponse |  |

* + 1. AutoMETARPublisher
       1. Operation AutoMETAR.AutoMETARPublisher.publishAutoMETAR

Operation allowing the publication of a AutoMETAR.

|  |  |  |
| --- | --- | --- |
| **Input** | **Service Payload** | **CLDM Data Entity** |
|  | AutoMETARData |  |
| **Return** | **Service Payload** | **CLDM Data Entity** |
|  | AcknowledgementMessage |  |

* 1. Payload Data Diagrams
  2. Payload Data Types
     1. Payload Elements
  3. Service dynamic behaviour
     1. Service Interface AutoMETARConsumer
     2. Service Interface AutoMETARPublisher

1. Service Technical Design Document (STDD)



**Project PJ.05-05 Beneficiaries**



1. Proposed to be renamed to Integrated system of infrared and visual cameras to enable automatic detection of LVC in DS19. [↑](#footnote-ref-1)
2. [↑](#footnote-ref-2)