



System Requirements for Phase 2

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Abstract

The document collects and describes the technical requirements (functional and non-functional) which shall guide, during Phase 2, the development and implementation of Airport Safety Nets and Wind Shear HMI prototypes. Such System Requirements are derived from the Operational Requirements collected by the OSED, SPR and HF coming from P6.7.1, P6.9.2 and P6.5.5, and by ICAO documents.

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Executive summary

The document is focused on the Technical Requirements (functional and non-functional) which shall guide, during Phase 2, the development and implementation of a prototype for Airport Safety Nets and MET alerts HMI, during this document labelled as Airport Alerts HMI.

The document starts from the results of Phase 1, improving the maturity of project within the SESAR programme.

All the Aerodrome Functional Blocks interacting with the Airport Alerts HMI are also identified, as well as the external conditions and inputs affecting its behaviour and its operations.

Regarding Airport Safety Nets HMI, functional requirements are derived from OSED of Conflicting ATC Clearances and Conformance Monitoring by P6.7.1 and from OSED and HF requirements by P6.9.2.

In this phase the MET alerts working area is addressed, too. The current maturity of this item within the SESAR programme is not very advanced and only a few Operational Requirements are available at time of writing of this document. The functional requirements are derived from OFA 5.1.1, and in particular from P6.5.5 and from ICAO documents regarding Wind Shear.

Requirements are also provided for the external interfaces and to satisfy the installation-related constraints.

A significant section of the document is dedicated to non-functional requirements, focused on System Safety, System Security, Performance Characteristics, HW/SW features.

1 Introduction

The Technical Specification document contains descriptions and requirements that define functional and non functional specifications of Airport Alerts HMI.

1.1 Purpose of the document

The purpose of this document is to provide information regarding the Specification and the System Requirements of the Airport Alerts HMI (integrating Airport Safety Nets HMI and MET Alerts HMI) which satisfies the needs and expectations of the Tower Controllers within the SESAR programme.

The Technical Specifications provided by this document come from the Operational Projects 6.7.1 and 6.9.2 for Airport Safety Nets and from OFA 5.1.1 (in particular from P6.5.5) for MET alerts.

The information within this document shall enable system engineers to produce a set of Technical Requirements for the development of the Airport Alerts HMI and of its software components. They shall be specified according to the following inputs: operational (coming from previous studies and external studies) and technical aspects (coming from the related technical projects).

Through this document all the actors will be able to map the User Requirements, to analyse the rationale behind each requirement and, in general, to verify and ensure the overall coherence of the project.

1.2 Intended readership

According to the scope and dependencies of this project, the following can be interested in this document:

- **P6.7.1 – Airport safety support tools for pilots, vehicle drivers and controllers** as responsible of operational requirements production regarding airport safety nets functions.
- **P6.9.2 – Advanced integrated CWP (A-iCWP)** as responsible of operational requirements production regarding HMI design of A-CWP.
- **P6.5.5 – Integration of MET Data into APOC processes** as responsible of operational requirements regarding meteorological information and forecasts into airport operations.
- **P12.1.7 – Airport system specification drafting and maintenance** is interested in the document to identify and maintain the consolidated list of requirements derived from each WP12 primary projects.
- **P12.3.2 – Enhanced Surface Safety Nets** which has to define the tool that detects all the conflict on the airport and sends the alerts messages to HMI specified in this project.
- **P12.5.4 – Integrated Tower Working Position (iCWP) Design, Specification, Prototyping and Test/Validation** which is responsible of developing technical specifications and related prototype of A-CWP.
- **P12.6.3 – Enhanced MET-systems with CDM** which is responsible of developing technical specifications and related prototype of the system which produces MET alerts to be displayed.
- **P12.7.5 – Improved weather information systems** which is responsible of developing technical specifications and related prototype of the system that manages all MET information, interfacing with SWIM.

1.3 Inputs from other projects

The working area, i.e. MET alerts, introduced in this Phase doesn't have at the moment of drafting of this document so many operational requirements. So, for this Phase some external documents coming from ICAO are analysed:

- **ICAO** Special Implementation Workshop - Wind Shear System Acquisition (Bangkok 1-3 Dec 2010) – Summary of discussions
- **ICAO** Annex 3 – Meteorological service for International Air Navigation – 17th edition – 07/2010

1.4 Structure of the document

This document is divided into four chapters.

Section 1 is the introduction. It describes the purpose and scope of the document and the methodology used to derive the requirements, including the purpose of the system under analysis

Section 2 gives a general description of the Airport Alerts HMI

Section 3 describes the capabilities, conditions and constraints of the Airport Alerts HMI. In particular it contains the functional and non functional requirements.

In the section 4 there are some assumptions used for writing the document.

Section 5 describes the referenced documents

1.5 Requirements Definitions – General Guidance

The Requirements are produced to describe both functional and non functional requirements at system level. The purpose of component specification is to transform the operational, functional and non functional requirements and safety recommendation and other requirements that have been identified through requirements analysis of external inputs, into a coherent description of ATM capabilities and conditions that can be used to guide the system designers in the development of system design.

Requirements are structured by Requirement type, and then:

- Functional requirements (further decomposed according to section 2.3)
- Non Functional requirements
 - Adaptability Requirements
 - Performance Characteristics
 - Safety & Security Requirements
 - Maintainability Requirements
 - Reliability Requirements
 - Internal Data Requirements
 - Design and Construction Constraints

- Interface Requirements

These requirements will address the “what” and not the “how”, therefore they don’t aim at specifying the physical design of the component, but the functional description and the necessary logical interfaces with other functional blocks.

The technical requirements are written following the document “Requirements and VV Guidelines” (see [2])

In particular, all requirements must contain at least a subject and a statement where the subject is the object under discussion (e.g. system), and the statement is a condition, action, intended result or target objective.

The generic way to write a requirement is: **<Object> shall OR should OR may <verb> <Statement>** (standard ISO/IEC 15288)

- Requirements are marked by the use of the verb "shall".
- Recommendations are marked by the use of the verb "should".
- Permissions are marked by the use of the verb "may".

In order to enable the import of SE Data in the SESAR SE Repository, the description shall use the layout described in Templates and Toolbox User Manual [3].

The Id field contains the System project number, owner of the requirement.

The Rationale field may contain:

- Justification of the allocation
- Explanation about the requirement formulation

The REQ Trace table hereafter contains the down-links to the functional block that receive the allocated requirement. There can be several down linked functional blocks for a given requirement.

This document starts from the mirror one produced in Phase 1 [6], so there are some requirements no more valid and then tagged as “deleted” in Status field.

1.6 Functional block Purpose

This document addresses the Airport Alerts HMI component whose main scope is the alert presentation of hazardous situations regarding potential surface conflicts and meteorological events (such as headwind and wind shear). The HMI that will satisfy the requirements defined in this document will be then integrated into the Advanced Controller Working Position (project 12.5.4).

This Airport Alert HMI will receive real and potential conflicts, risks and dangerous situations from Surface Safety Nets server and from MET server. This information will be processed by the Airport Alerts HMI that will define what, when and how the alerts have to be presented to the Controller.

Alerts data presented on controller HMI, are mainly about:

- Conflicts on runways, taxiways, restricted and protected areas.
- Alerts related to deviations from ATC instructions or procedures.
- Alerts related to conflicting ATC clearances.

- Alerts related to Head Wind, Wind Shear and Micro Burst.

Each alert is managed to allow:

- Fully understanding of the situation, displaying all the needed information about the hazard.
- Classification of severity (information or alarm).
- Acknowledge and/or mute.

1.7 Functional block Overview

This project deals with the Controller HMI part that manages Alerts data.

Airport Alerts: HMI will receive alert reports from both Surface Safety Nets server and MET server. As soon as an alert is generated, it is sent to HMI that will display while it is active. Controller will also have the possibility to acknowledge an alert and/or muting it on his/her HMI. The acknowledgement of an alert is local to the HMI and it is not sent back to both SSN server and MET server.

Visualization of Airport Alerts: HMI will clearly display the reason of the conflict / hazard allowing the controller to easily be aware of what is happening and to take countermeasures.

Main constraints on this project are about:

- Information clearness: Controllers should be presented with a clear 'picture' of the actual traffic situation in their areas of responsibility, and with all the necessary traffic data to assist them in their control tasks. The controller shall be provided with clear and visible indication of conflicts as soon as the alert exists.
- Usability: The HMI should ensure a level of user workload which is consistent with efficient and effective activity. Moreover it should make controllers' work easier and simple.

1.8 Glossary of terms

Within the document there are a lot of names and acronyms that refers to different concepts. The following table can help the readability of the document.

Concept	HMI sub-function	HMI sub-functions (integrated in this phase)	Project	Component / system / server (physical concept)	Functional block (abstract concept)	Data flow
Used terms	Airport Alerts HMI / AA HMI	Airport Safety Nets HMI / ASN HMI	Enhanced Surface Safety Nets	Surface Safety Nets server	Conformance monitoring	Conformance monitoring alerts
					Aerodrome Safety Nets	ASN alerts
		MET Alerts HMI	Enhanced MET Alerts	MET server	Aerodrome Weather Information Management (AWIM)	MET alerts

1.9 Acronyms and Terminology

Term	Definition
A-CWP	Advanced Controller Working Position
A-SMGCS	Advanced Surface Movement Guidance and Control System
AA	Airport Alerts
AA HMI	Airport Alerts HMI
ADD	Architecture Definition Document
ANSP	Air Navigation Service Provider
ASN	Airport Safety Nets
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
AVOL	Aerodrome Visibility Operational Level
AWIM	Aerodrome Weather Information Management
CDM	Collaborative Decision Making
CWP	Controller Working Position
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
HF	Human Factor
HMI	Human Machine Interface
HW	Hardware
ICAO	International Civil Aviation Organisation
IRS	Interface Requirements Specification
INTEROP	Interoperability Requirements
MET	Meteorological
OFA	Operational Focus Area
OSD	Operational Service and Environment Definition

Term	Definition
SESAR	Single European Sky ATM Research Programme
SSN	Surface Safety Nets
SW	Software
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SE	System Engineering
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SPR	Safety and Performance Requirements
TAD	Technical Architecture Description
TS	Technical Specification
TWR	Tower
VV	Verification & Validation

2 General Functional block Description

2.1 Context

Increasing ground traffic on airports, especially on major hubs, demands more and more attention by the ATCOs. To support controllers in maintaining an overall situational awareness Airport Safety Nets are implemented to identify potentially hazardous situations and to notify the controller in time.

Heavy weather events can be serious safety hazards for inbound and outbound traffic. Therefore weather observation at the airport is crucial to safe takeoffs and landings, as well as to continuous traffic throughput with no or minimal delays. Observation of wind conditions, and measurement of general weather parameters support the early identification of critical weather conditions.

The objective of project 12.5.2 is to define and implement the proper HMI for tower controllers to interact with alerts generated by Surface Safety Nets and MET servers (Meteorological Alerting Systems). The AA HMI will clearly display the reason of the conflict/hazard, giving the controller improved situational awareness and, consequently, the ability to immediately take countermeasures or anticipatory adapt the traffic flow and the operational procedures to the changed situation.

Traffic conflicts and weather hazards are obviously of very different nature. However, to gain an additional benefit and support the controller in his workflows, the generated alerts have to be well integrated in the A-CWP. Their display might also depend on the controller's role and the HMI components he is using for his individual tasks, in particular:

- Controllers should be provided with a clear 'picture' of the actual traffic situation in their areas of responsibility, and with all the necessary traffic data to assist them in their control tasks. The controller should be provided with clear and visible indication of conflicts as soon as the alert exists.
- Weather information should be precise, continuous and up to date. The HMI should ensure a level of user workload which is consistent with efficient and effective activity. Moreover it should make controllers' work easier and simple.

Benefits deriving from AA HMI improvements are:

- This integrated alerting platform will help controllers in managing all conflicts on the ground.
- Better situation awareness for controllers. Reducing runway incursions, clearance violations and dangerous operations also with Meteorological hazarding situation.
- Reducing costs to ANSPs by reducing controllers' workload.
- Improving the use of runway and taxiways by giving more accurate situational awareness to controllers that will predict situations causing capacity problems.
- The display of alerts helps the controller to predict and prevent traffic conflicts.
- Detection and anticipation of bad weather and potentially hazardous conditions enable the controller to alert the concerned pilots and adapt traffic flow (e.g. separation) and operational procedures (e.g. de-icing).

2.2 Functional block Modes and States

2.2.1 AA HMI states

The state is a technical configuration of the system. The system can be in only one state at a time if it is possible to switch from one state to another by a supervision command.

The AA HMI can be configured in two different states to provide operational and test capabilities:

- Operational state identifies the AA HMI running in the operational environment for Tower ATC control purposes.
- Test state identifies the AA HMI running in the Tower ATC test environment.

2.2.2 AA HMI modes

The mode characterises the way the system is operating in respect to the availability of its functions.

The AA HMI can be in two different modes:

- Operational: In operational state, the AA HMI is designed to provide continuous operational service despite the failure of a function. This mode is the operational one which is the normal mode of operation of the system.
- Failed: In case of a significant set of functions is necessary for the continuation of the Tower ATC service are not available, the AA HMI is considered in failed mode.

2.3 Major Functional block Capabilities

The purpose of this system is to manage in the Controller Working Position the different alerts and warnings related to both Airport Safety Nets and MET hazards.

The nature of this system is a Human Machine Interface, and the capabilities in which the functional requirements can be grouped are:

- Airport Safety Nets alerts display:

These requirements describe the capability of displaying on the A-CWP the alerts detected by the SSN server, managing the way of presentation.

- MET alerts display:

These requirements describe the capability of displaying on the A-CWP the alerts related to hazardous meteorological situations (high wind speed, high headwind, wind shear, microburst), managing the way of presentation.

- Alerts acknowledgments:

These requirements describe the capability of acknowledging the alerts (locally to the A-CWP)

Some capabilities described in System Requirements of Phase 1 [6] are considered no more applicable because they don't come by SESAR Operational Inputs or considered redundant. In particular:

- Acquisition of SSN alerts: no more applicable because its requirements are redundant with the Interface ones.
- Alert HMI status display: this capability doesn't come by any Operational need and in the analysis performed, all the members of the projects agree that this capability is more related to be realised by a Technical Supervision function.
- AA HMI adaptation: this capability doesn't come by any Operational need and moreover this is more related for the Advanced Controller Working Position

In section 3.1, the related sub-sections will be included but all the requirements will be tagged as "deleted".

2.4 User Characteristics

Name	Description	Responsibilities	Number of users in the group	Interactions with the System
<i>Human actors interacting with the System</i>				
TWR Ground Controller	Ensure and monitor the safe and efficient movement of the aircraft over the surface between the stand to runway entry/exit points.	<p>Give clearances, instructions and permission to aircraft, vehicles and persons operating on the manoeuvring area with respect to safe and efficient traffic</p> <p>Coordinate with Runway controller runway entry / exit / crossing.</p> <p>Coordinate with TWR Clearance Controller for start-up and push-back process</p> <p>Monitor all aircraft and vehicle movements on the manoeuvring area and issue instructions where appropriate to ensure separation between aircraft and other ground mobiles.</p>	1 or more (not more than 1 per runway)	<p>Is notified about airport safety nets alerts and information</p> <p>Acknowledges alerts</p> <p>Is notified about the status of safety net servers</p>
TWR Runway Controller	Ensure and monitor safe landing and take-off of aircrafts with respect of sufficient spacing between aircrafts departures, of avoidance of collision with other traffic (aircrafts, vehicles) and obstacles	<p>Give clearances to flight crew for taking-off or landing</p> <p>Inform flight crew about take-off or landing conditions with respect to the runway condition and weather situation.</p> <p>Coordinate and give authorisation to the Tower Ground Controller for the crossing of runways by surface traffic.</p> <p>Give instructions to taxi to the take-off position for departing flights and operate the stop bars if required</p> <p>Manage ordered sequence of departures and landing.</p>	1 or more (not more than 1 per runway)	<p>Is notified about airport safety net alerts and information</p> <p>Acknowledges alerts</p> <p>Is notified about the status of safety net servers</p>

Name	Description	Responsibilities	Number of users in the group	Interactions with the System
TWR Supervisor ATS	Chief controller of the tower	<p>Manage runways usage in coordination with all concerned partners.</p> <p>Manage area and taxi closure</p> <p>Update limited visibility operations in coordination with airport authority and ACC/APP supervisor according to weather situation and infrastructure state.</p> <p>Coordinate with the Airport Operator regarding traffic emergencies/incidents on the movement area.</p> <p>Coordinate traffic flow with the ACC/APP Supervisor</p> <p>Organise shift between ATC positions.</p>	1	<p>Is notified about airport safety net alerts and information</p> <p>Acknowledges alerts</p> <p>Is notified about the status of safety net servers</p>
System actors interacting with the System				
Surface Nets Safety	Safety net server	<p>Compute and distribute unambiguous and in a timely manner safety nets alert, warning or information according to track data (surface and air), clearances and routes.</p> <p>Safety net refers to activities not only linked to the surface but also to take-off and landing paths.</p>	1	TWR CWP
Conformance Monitoring	Functional Blocks related to Surface Management and Monitoring	Checks the actual movements of vehicles and aircrafts with clearances.	1	Inform SSN in case of non-conformance
Operational Supervision	Functional block which disseminates all the aerodrome operational information	Stores operational information of the airport and updates all the functional blocks about the current configuration of the aerodrome.	1	TWR CWP
Aerodrome Weather Information Management		Gathers and stores information from different weather sources, e.g., temperature sensors, wind sensors, wind shear detection systems.	1	Provides information to AA HMI.
Support function	Recording & playback	Receive and record data from the CWP (reception and acknowledgment of safety net events)	1	TWR CWP
Aerodrome Flight Data Processing	Airport FPD	Functional block responsible to manage and disseminate all the information relative to the flight plans	1	TWR CWP

All not mentioned functional blocks from Figure 1 do not interact with the AA HMI.

2.5 Operational Scenarios

The Airport Alerts HMI component described here supports the safe execution of the operational procedures managing the traffic on runways, taxiways and apron. It is displaying warnings and alerts coming from the Surface Safety Nets server when detecting potential conflicts/incursions involving mobiles (and stationary traffic) on runways, taxiways and, where surveillance is available, in the apron/stand/gate area. The HMI also displays alerts to the controller in case of unauthorized/unidentified traffic or obstacles.

AA HMI enables the controller to de-conflict and separate traffic, i.e.

- To alert Air Traffic Control Officers (ATCOs) and Flight Crew when mobiles deviate from ATC instructions or procedures, potentially placing the mobile at risk.
- To provide an early detection of situations that if not corrected would end up in hazardous situations.

It provides alerting for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required level of safety.

Following Operational Scenarios can be applied;

- Conflicting ATC clearances
- Non conformance to ATC instructions or procedures
- Meteorological alerts

These are agreed and shared among related projects 6.7.1 and 12.3.2.

2.5.1 Conflicting ATC clearances

Conflicting ATC clearances provides an early detection of situations that if not corrected would end up in hazardous situations that would be detected in turn by the A-SMGCS Level 2, if in operation. This type of alert shall be applied to all mobiles and is a complement to the A-SMGCS level 2 currently in operation in several European airports.

The detection of Conflicting ATC Clearances is a support tool for the Tower Runway Controller and will be performed by the ATC system based on the knowledge of data such as the clearances given to aircraft or vehicles by the Tower Runway and Ground Controllers, the assigned runway and holding point.

Working procedures for the Tower Runway and Ground Controllers shall be adapted to ensure that all clearances given to aircraft or vehicles are input in the system. Tower Runway and Ground Controller should therefore be provided with a Human Machine Interface (HMI) to inform the system of the clearances given to aircraft or vehicles. The HMI should also be capable of displaying Alarm messages to the Tower Runway Controllers for the conflicting clearances detected by the ATC system.

The use cases defined to Conflicting ATC clearances are identified and explained in section 5 of [7] (6.7.1 Updated OSED for Conflicting ATC Clearances).

2.5.2 Non conformance to ATC instructions or procedures

The objective of the Non-Conformance to ATC instructions or procedures is to alert Air Traffic Control Officers (ATCOs) and Flight Crew when mobiles deviate from ATC instructions or procedures, potentially placing the mobile at risk.

A non-conformance to ATC instructions alert is generated by the system when a mobile's behaviour is not conforming to ATC clearances given by the controller. The inputs of the Controller in the system via the Controller Human Machine Interface (out of scope of AA HMI) are compared with the Surveillance data from the A-SMGCS Surveillance. And also the A-SMGCS surveillance and elements of the Flight Plan Data (such as aircraft flight type) are checked against published ATC procedures. Alerts shall be generated for infringements to any explicit ATC procedures.

The use cases defined to Non-Conformance to ATC instructions are identified and explained in section 5 of [8] (6.7.1 Preliminary OSED for Conformance Monitoring).

2.5.3 MET Alert

Meteorological data and in particular alerts of weather hazards are important information to support ATM. Such weather situations (e.g. wind shear) often occur on a short term basis disturbing safe airport operations have to be displayed to the ATC immediately. Alerts and warnings to display in an easy to understand text message and additional graphical layers integrated into existing ATC system are the best way of presenting.

Especially, CDM (Collaborative Decision Making) airports must be aware of adverse weather conditions which is a key component in the decision making process. Adverse weather conditions are the situations where airport capacity drops, causing airlines to cancel or delay flights, and the airport operators to introduce special procedures. Therefore the controller should be well informed about MET hazards on an aerodrome to take appropriate measures.

Airport processes depending on adverse conditions for instance are:

- De-Icing (removing of frost, ice, snow or slush from the airplane)
- Local Frost prevention (Precaution procedure against formation of local frost or ice)
- Low Visibility procedure (enhanced the separation process of starting/landing aircrafts due to reduced visibility)
- Information sharing (e. g. Operators/Airlines/ pilots/ ground handler briefings)
- CDM

These procedures must be activated when a certain threshold of meteorological data is exceeded. Hence MET alerts of different kind of MET phenomena shall be highlighted

Operations where safety decreases due to adverse weather are for instance:

- Safe aircraft and vehicle manoeuvring on taxiways and aprons (e.g. due to storm and wind shear)
- Safe aircraft operation on approach (touchdown zone) and departure (e.g. crosswind)
- Ground handling (e.g. due to thunderstorms and lightning)

Therefore the AA HMI shall display all necessary MET alerts to improve the situation awareness of the controllers. Dedicated MET alert text messages will be highlighted, selectable linked to a specialized MET layer/window where more details are available.

2.6 Functional

2.6.1 Functional decomposition

This section provides an overview of the functional breakdown of the Aerodrome ATC, derived from the TAD for Step 1 document [9] provided by project 12.01.07.

In following figure it is highlighted the HMI function and in particular it is derived the sub-function that deals with this project.

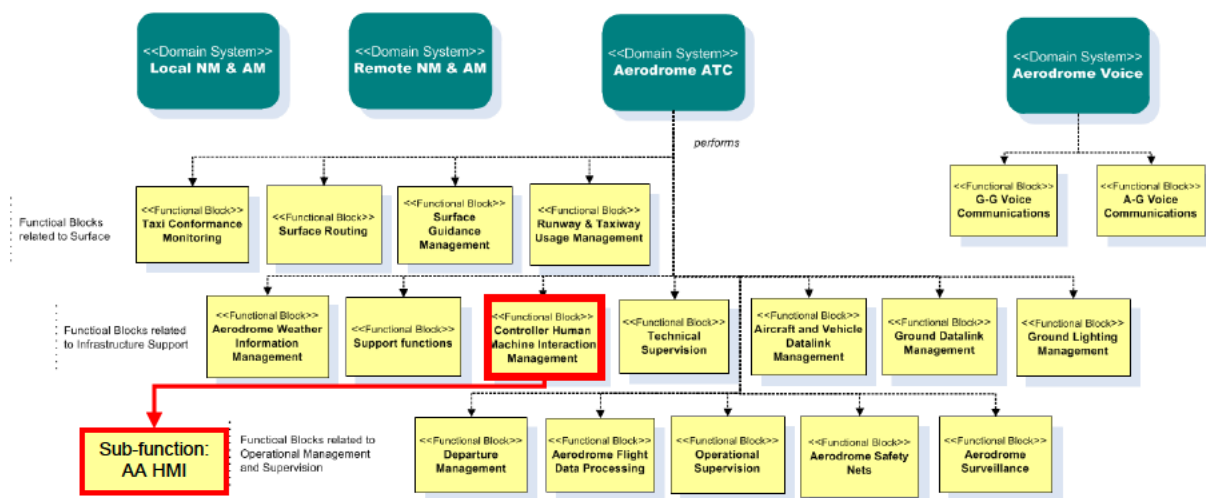


Figure 1: Aerodrome ATC Domain System - Functional Breakdown

The function of interest, as defined from project 12.01.07, is:

Controller Human Machine Interaction Management: This functional block provides controllers with a graphical user interface and with the means to interact with the Aerodrome ATC system.

In particular, a sub-function has been identified by this project:

Airport Alerts HMI: This sub-function provides controllers with a graphical user interface to visualise alerts from “Aerodrome Safety Nets”, “Conformance Monitoring” and “Aerodrome Weather Information Management” functional blocks, and to acknowledge them.

For a detailed description of each function, please refer to [9].

2.6.2 Functional analysis

2.6.2.1 Functional System Architecture

The AA HMI component main scope is the alert presentation of hazardous situations regarding potential surface conflicts concerning mobiles (aircrafts and vehicles) and meteorological conditions. The AA HMI that will satisfy the requirements defined in this document will be then integrated into the Integrated Controller Working Position (project 12.5.4).

Therefore, in this paragraph, we will focus the architecture on the AA HMI functionalities:

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- Display and handling of alerts from Surface Safety Nets functional block (Aerodrome Safety Nets and Conformance Monitoring)
- Display and handling of alerts from Aerodrome Weather Information Management functional block

Other functions that are general to the HMI (like Recording, Monitoring...) will not be considered since they are handled at the "Controller Human Machine Interaction Management" level.

The following figure presents the interactions of the sub-function "AA HMI" and the other functional blocks.

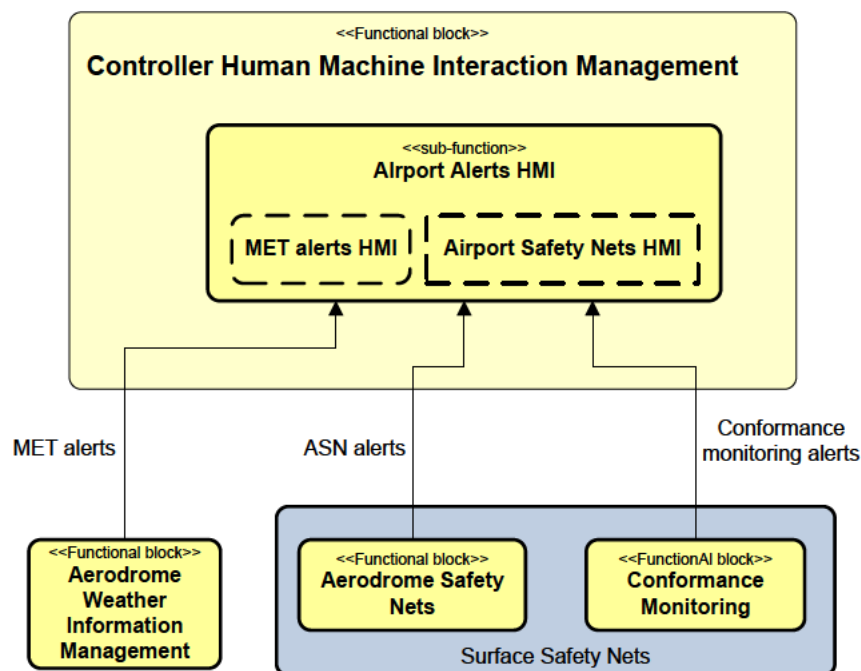


Figure 2: AA HMI Architecture

For the reasons previously explained, the links between the functional block "Controller Human Machine Interaction Management" and other functional blocks are not represented here (refer to SESAR project 12.05.04).

2.6.2.2 Definition of the External System Interfaces

The following table presents the interfaces between the AA HMI and the functional blocks external to the HMI.

Origin	Destination	Data Flow	Data Flow Type (Content description)	Criticality	Periodicity
Aerodrome Safety Nets	AA HMI	ASN Alerts	Aerodrome Safety Nets functional block provides alerts to the HMI when a conflict is detected.	C	On event or at regular intervals

Origin	Destination	Data Flow	Data Flow Type (Content description)	Criticality	Periodicity
Conformance Monitoring	AA HMI	Conformance Monitoring Alerts	Conformance Monitoring functional block provides alerts to the HMI when a non-conformance issue is detected.	C	On event or at regular intervals
Aerodrome Weather Information Management	AA HMI	MET Alerts	Aerodrome Weather Information Management functional block provides alerts to the HMI when a hazardous situation is detected.	C	On event or at regular intervals

Table 1 - Interfaces between AA HMI and other functional blocks

2.7 Service View

N/A.

3 Functional block Functional and non-Functional Requirements

3.1 Capabilities

In this section there are both requirements coming from Phase 1 of the project and the new ones. Among the requirements of Phase 1 there are several that are no more applicable, because objects of review, and that have been deleted. To ease the readability of the document, all the deleted requirements have been included into separate sections.

3.1.1 Airport Safety Nets alerts display Requirements

Identifier	REQ-12.05.02-TS-0002.0010
Requirement	The AA HMI shall continuously display alerts as long as the related alert reports come from SSN Server.

Identifier	REQ-12.05.02-TS-0002.0060
Requirement	The AA HMI shall display the alerts related to Airport Safety Nets in the track label and in an alert list

Identifier	REQ-12.05.02-TS-0002.0070
Requirement	The AA HMI shall display the alerts related to Airport Safety Nets on the electronic flight strips

Identifier	REQ-12.05.02-TS-0002.0090
Requirement	The AA HMI shall provide a dedicated window to display the list of received alerts

Identifier	REQ-12.05.02-TS-0002.0105
Requirement	The AA HMI shall include, for alerts related to ASN, in the alert list the identification of all the mobiles involved in a conflict, if received in alert reports from SSN Server.

Identifier	REQ-12.05.02-TS-0002.0120
Requirement	The AA HMI shall provide two stages of alert (INFORMATION and ALARM), according to the severity of received alert reports.

Identifier	REQ-12.05.02-TS-0002.0125
Requirement	When the alert report changes from INFORMATION to ALARM (and vice-versa), the AA HMI shall override the INFORMATION and visualise ALARM (and vice-versa)

Identifier	REQ-12.05.02-TS-0002.0130
Requirement	The AA HMI shall display INFORMATION alert using an "INFORMATION colour" (recommendation Yellow)

Identifier	REQ-12.05.02-TS-0002.0140
Requirement	The AA HMI shall display ALARM alert using an "ALARM colour" (recommendation Red)

Identifier	REQ-12.05.02-TS-0002.0150
Requirement	The AA HMI shall present the ALARM alerts before the INFORMATION alerts in the window dedicated to the alert list.

Identifier	REQ-12.05.02-TS-0002.0160
Requirement	The AA HMI shall never hide the ALARM alerts in the list visualisation.

Identifier	REQ-12.05.02-TS-0002.0165
Requirement	The AA HMI shall never hide the alerts until the end of the conflict.

Identifier	REQ-12.05.02-TS-0002.0220
Requirement	The AA HMI shall trigger an audio signal for the ALARM alerts

Identifier	REQ-12.05.02-TS-0002.0230
Requirement	The AA HMI shall stop the audio signal when the related alert situation is not received any longer or when the alert is acknowledged/muted by the user.

Identifier	REQ-12.05.02-TS-0002.0235
Requirement	The AA HMI may produce an intermittent with a short duration sound for audio signal

3.1.1.1 Deleted requirements

Identifier	REQ-12.05.02-TS-0002.0020
Requirement	After start-up, the AA HMI shall automatically display the existing alerting situation in conformance with the existing alerting status of the Safety Net Server.

Identifier	REQ-12.05.02-TS-0002.0030
Requirement	The AA HMI shall visually notify that an event is not valid any longer on every HMI where the event was displayed, as soon as the information is provided by the SSN Server.

Identifier	REQ-12.05.02-TS-0002.0040
Requirement	The AA HMI shall display the alerts at least in the position of controller responsible of area in which the conflict occurs.

Identifier	REQ-12.05.02-TS-0002.0050
Requirement	The AA HMI should allow excluding from the controller positions out of responsibility of the area in which the conflict occur, its alert visualisation.

Identifier	REQ-12.05.02-TS-0002.0080
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Requirement	The AA HMI should allow excluding from the controller positions out of responsibility of the area in which the conflict occur its alert visualisation.
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Identifier	REQ-12.05.02-TS-0002.0100
Requirement	The AA HMI shall display continuously alerts as long as related alert reports will come from SSN Server

Identifier	REQ-12.05.02-TS-0002.0110
Requirement	The AA HMI shall include in alerts list of different controller position all the occurred conflicts at the moment.

Identifier	REQ-12.05.02-TS-0002.0170
Requirement	The AA HMI shall display alerts with higher priority in such a way as to draw controller's attention more than alerts with lower priority.

Identifier	REQ-12.05.02-TS-0002.0175
Requirement	The AA HMI shall differentiate conflict with higher priority from the other ones, using a specific colour for target labels or a specific aural signal or inserting alert information on top of conflict pop-up window.

Identifier	REQ-12.05.02-TS-0002.0180
Requirement	The AA HMI shall allow to configure the alerts priority based on type of conflicts received by SSN server

Identifier	REQ-12.05.02-TS-0002.0190
Requirement	When the display of several alerts overlap, the AA HMI shall always display in priority the alerts with the status ALARM.

Identifier	REQ-12.05.02-TS-0002.0200
Requirement	The AA HMI may allow to adapt the amount of displayed information in the

	alerts list
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Identifier	REQ-12.05.02-TS-0002.0210
Requirement	The AA HMI should display conflicts involving aircrafts in a different way from conflicts involving vehicle.

Identifier	REQ-12.05.02-TS-0002.0240
Requirement	The AA HMI component shall provide the alerts related to runway conflicts always in foreground and never be hidden by other information

Identifier	REQ-12.05.02-TS-0002.0250
Requirement	The AA HMI should only allow to filter the display alerts which state is INFORMATION

3.1.2 MET alerts display Requirements

Identifier	REQ-12.05.02-TS-0008.0005
Requirement	The AA HMI shall continuously display alerts as long as the related alert reports come from MET Server.

Identifier	REQ-12.05.02-TS-0008.0010
Requirement	The AA HMI shall visualise a dedicated list containing all MET alerts detected by an external MET system.

Identifier	REQ-12.05.02-TS-0008.0020
Requirement	The AA HMI shall visualise an alert of "high wind-speed", containing the detection time, the wind direction and its value.
	High Wind Message
	<In Progress>
	It is important notify the controller about high wind-speed.

Identifier	REQ-12.05.02-TS-0008.0030
Requirement	The possible levels of severity for "high wind-speed" alerts are INFORMATION and ALARM, according to those present in the alarm message.

Identifier	REQ-12.05.02-TS-0008.0040
Requirement	The AA HMI shall visualise an alert of "high headwind", containing the detection time and the headwind value.
	MET Warning Wind
	<In Progress>
	It is important notify the controller about high headwind.

Identifier	REQ-12.05.02-TS-0008.0050
Requirement	The AA HMI shall visualise an alert of "wind-shear", containing the detection time, the headwind/tailwind change value, the affected runway, the related path (final approach / initial take-off) and the distance from runway threshold.

Identifier	REQ-12.05.02-TS-0008.0060
Requirement	The AA HMI shall visualise an alert of "microburst", containing the detection time, the headwind/tailwind change value, the affected runway and the related path (final approach / initial take-off) and the distance from runway threshold.
	MET Wind Shear Alerts 2
	<In Progress>
	It is important notify the controller about microburst events. This requirement is linked to ICAO Annex 3 - Chapter 7.4 Wind Shear Warnings and Alerts.

3.1.3 Alerts acknowledgment Requirements

Identifier	REQ-12.05.02-TS-0003.0015
Requirement	The AA HMI shall provide means for the controller to acknowledge the alerts

Identifier	REQ-12.05.02-TS-0003.0032
Requirement	The AA HMI shall provide means to mute alerts (without acknowledging

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	them)
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Identifier	REQ-12.05.02-TS-0003.0035
Requirement	The AA HMI shall not hide the alerts in action of "MUTE" button.

Identifier	REQ-12.05.02-TS-0003.0050
Requirement	The AA HMI shall allow to disable all the alerts related to ASN on individual runways

3.1.3.1 Deleted requirements

Identifier	REQ-12.05.02-TS-0003.0010
Requirement	The AA HMI shall allow the acknowledgment of alerts, hiding them at least on the controller position in which the acknowledgment has performed.

Identifier	REQ-12.05.02-TS-0003.0020
Requirement	The AA HMI shall visualise on the alerts list an "ACK" button to hide the alert.

Identifier	REQ-12.05.02-TS-0003.0030
Requirement	The AA HMI shall visualise on the alerts list a "MUTE" button to stop the audio signal of an ALARM. In this case the ALARM will not be hidden.

Identifier	REQ-12.05.02-TS-0003.0040
Requirement	The AA HMI shall not allow to disable or acknowledge runway conflicts

3.1.4 Acquisition of SSN alerts Requirements

This group of requirements is no more applicable because its requirements are redundant with those related to Interface. So, all the following requirements are tagged as "deleted".

Identifier	REQ-12.05.02-TS-0001.0010
Requirement	The AA HMI shall acquire from SSN server the alert reports

Identifier	REQ-12.05.02-TS-0001.0020
Requirement	The AA HMI should assign conflict responsibility to each working position depending on conflict type and the area where the conflict happens.

Identifier	REQ-12.05.02-TS-0001.0030
Requirement	The AA HMI shall allow the operator to assign conflict priorities depending on conflict type.

Identifier	REQ-12.05.02-TS-0001.0035
Requirement	The possible values of conflict priority should be 1 or 0

Identifier	REQ-12.05.02-TS-0001.0037
Requirement	The possible types of conflicts should be those received by alert reports, i.e.: <ul style="list-style-type: none">• Runway incursions• Area intrusion• Conflicting ATC clearances• Non conformance to ATC instructions• Non conformance to ATC procedures

Identifier	REQ-12.05.02-TS-0001.0040
Requirement	The AA HMI component shall assign higher priority to runway incursion alerts

Identifier	REQ-12.05.02-TS-0001.0050
Requirement	After start-up, the AA HMI shall automatically acquire the existing alerting

	situation from Safety Net Server.
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3.1.5 Alert HMI status display Requirements

This capability doesn't come by any Operational Need and in the analysis performed, all the members of the projects agree that this capability is more related to be realised by a Technical Supervisor.

3.1.6 ASN HMI adaptation Requirements

This capability doesn't come by any Operational need and moreover this is more related for the integrated Controller Working Position (i.e. P12.5.4). So, all the following requirements are tagged as "deleted".

Identifier	REQ-12.05.02-TS-0004.0010
Requirement	The AA HMI should provide means to manually change its configuration parameters.

Identifier	REQ-12.05.02-TS-0004.0020
Requirement	The AA HMI shall provide means to configure the conflict priorities without changing any software component

3.2 Adaptability

N/A.

3.3 Performance Characteristics

The performance requirements wrote during Phase 1 are not considered applicable because they was suggestion only that now don't come by any Operational requirements within SESAR programme.

So all the requirements listed in this section are tagged as "deleted".

Identifier	REQ-12.05.02-TS-0005.0010
Requirement	The AA HMI should be capable of sustained operation 24 hours a day throughout the year.

Identifier	REQ-12.05.02-TS-0005.0020
Requirement	The AA HMI shall respond to controller inputs within 250ms on average and never exceed a delay of 500ms.

Identifier	REQ-12.05.02-TS-0005.0030
Requirement	The AA HMI shall have a display latency of 250ms on average and never exceed a delay of 500ms

Identifier	REQ-12.05.02-TS-0005.0040
Requirement	The AA HMI shall continuously display alert data while they are received from SSN server.

3.4 Safety & Security

The requirements about safety written during Phase 1 are not considered applicable because they was suggestion only that now don't come by any Operational requirements within SESAR programme.

So all the requirements listed in this section are tagged as "deleted".

Identifier	REQ-12.05.02-TS-0006.0010
Requirement	The System may create a new log entry as soon as the information is provided by the Safety net Server.

Identifier	REQ-12.05.02-TS-0006.0020
Requirement	The alert state may be part of the log entry when an alert occurrence is logged.

3.5 Maintainability

N/A.

3.6 Reliability

The requirements about reliability written during Phase 1 are not considered applicable because they were only suggestions that are no longer operational requirements within SESAR programme.

So the requirement listed in this section is tagged as "deleted".

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Identifier	REQ-12.05.02-TS-0007.0010
Requirement	The AA HMI shall implement a self-checking system that alerts on failure.

3.7 Functional block Internal Data Requirements

Identifier	REQ-12.05.02-TS-0009.0045
Requirement	<p>An alert item related to Airport Alerts HMI shall contain at least the following information:</p> <ul style="list-style-type: none"> • type of conflict (Runway incursion, Conflicting ATC clearances, Area intrusion, Non-conformance to ATC instructions or procedures) • subtype of conflict (specific reason of conflict, ex. Line-up vs. Line-up) • severity of conflict (INFORMATION/ALARM) • identification of mobile(s) involved in conflict
	ASN Alert item content
	<In Progress>
	This essential information is used to correctly show the alert on the HMI.

Identifier	REQ-12.05.02-TS-0009.0050
Requirement	<p>An alert item related to MET hazard shall contain the following information:</p> <ul style="list-style-type: none"> - type of event (wind-shear, micro-bust, high winds-speed, high headwind) - severity of event (INFORMATION/ALARM) - time of detection - value of event - identification of area of event
	MET Alert content
	<In Progress>
	<p>The external system of MET hazards has to transmit the needed information to correctly display the alert.</p> <p>This requirement can't be linked to any Operational Requirements, but it is necessary to correctly perform its job.</p>

3.7.1 Deleted requirements

Identifier	REQ-12.05.02-TS-0009.0010
Requirement	An alert shall have a status attribute. The possible values are INFORMATION and ALARM.

Identifier	REQ-12.05.02-TS-0009.0020
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Requirement	The status attribute of an alert shall support an INFORMATION stage.
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Identifier	REQ-12.05.02-TS-0009.0030
Requirement	The status attribute of an alert shall support an ALARM stage.

Identifier	REQ-12.05.02-TS-0009.0040
Requirement	<p>An alert item shall contain the following information items:</p> <ul style="list-style-type: none"> • type of conflict (Runway incursion, Conflicting ATC clearances, Area intrusion, Non-conformance to ATC instructions, Non-conformance to ATC procedures) • type of mobile involved (aircraft, vehicle, unknown) • area of conflict (runway, taxiway, apron)

3.8 Design and Construction Constraints

Besides a display, AA HMI should be provided with an audio device and input devices (like keyboard and mouse). First one is needed to reproduce sounds when an alert is received from SSN server; second ones are needed to allow the controller to perform HMI input operations.

These input operations should be:

- Zoom and pan to focus on airport area where conflict is happening
- Conflict acknowledgements.

In any case the specific requirement is considered useless by all the members. So it is tagged as "deleted".

Identifier	REQ-12.05.02-TS-0010.0010
Requirement	The AA HMI shall have audio and input devices

3.9 Functional block Interface Requirements

Identifier	REQ-12.05.02-TS-0011.0012
Requirement	The AA HMI shall receive the alert reports from Surface Safety Nets functional block (Aerodrome Safety Nets functional block + Conformance Monitoring functional block).
	Interface with SSN functional block
	<In Progress>
	This requirement can't be linked to any Operational Requirements, but it is

	necessary to correctly perform its job.
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Identifier	REQ-12.05.02-TS-0011.0015
Requirement	The AA HMI shall receive the alert reports related to MET events from Aerodrome Weather Information Management functional block
	This requirement can't be linked to any Operational Requirements, but it is necessary to correctly perform its job.

Identifier	REQ-12.05.02-TS-0011.0020
Requirement	<p>The alert reports coming from SSN functional block shall have at least following information:</p> <ul style="list-style-type: none"> • Conflict type and subtype • Conflict severity (INFORMATION or ALERT) • Identification of involved mobile(s) (at least one of the following): <ul style="list-style-type: none"> ○ Track ID ○ Transponder code ○ Call sign • Date and time
	This requirement can't be linked to any Operational Requirements, but it is necessary to correctly perform its job.

3.9.1 Deleted requirements

Identifier	REQ-12.05.02-TS-0011.0010
Requirement	The AA HMI shall receive the alert reports from SSN Server.

Identifier	REQ-12.05.02-TS-0011.0025
Requirement	The AA HMI may provide target exclusions caused by the acknowledgement to SSN server.

Identifier	REQ-12.05.02-TS-0011.0030
Requirement	The AA HMI should receive the adaptation data and operational settings from Operational Supervision.

Identifier	REQ-12.05.02-TS-0011.0040
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Requirement	The AA HMI should receive the monitoring commands from Technical Supervision
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Identifier	REQ-12.05.02-TS-0011.0050
Requirement	The AA HMI should provide its working status to Technical Supervision

Identifier	REQ-12.05.02-TS-0011.0060
Requirement	The AA HMI may receive from Aerodrome Flight Data Processing controller responsibility of each flight to drive the ability of acknowledging the alert

Identifier	REQ-12.05.02-TS-0011.0070
Requirement	The AA HMI should send data (log screen) to Recording & Playback (Support Function)

4 Assumptions

Some requirements described in previous section don't come from SESAR operational requirements, due to a lack of inputs. This gap is mainly regarding MET alert area. To start the activities over this theme, ICAO documents are considered and in some case some inputs are derived from OFA 05.01.01 (in particular from project 06.05.05, even if this project deals more with CDM process).

In Airport Safety Nets area most of requirements came from P6.7.1 and from P6.9.2, but there are some other taken from Phase 1 and considered still valid that are referred to external studies. The traceability is described into "Rationale" field of requirements.

5 References

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5.1 Use of copyright / patent material /classified material

N/A

5.1.1 Classified Material

N/A

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