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# D6.1.002 SESAR Solution PJ.02-W2-21.1 SPR-INTEROP/OSED for V3 - Part I

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| 00.02.03 | 21/06/2023 | Final | DFS | Requirements have been updated using the latest SE-DMF requirements. |



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# AART

AIRPORT AIRSIDE AND RUNWAY THROUGHPUT

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

## Abstract

This Operational Service and Environment Definition Document contains the description of the Operational Improvement

AO-0104-B **Enhanced airport safety support tools for controllers at A-SMGCS Airports**

developed in the solution PJ.02-W2-21.1.

It presents the Safety, Performance and Interoperability requirements identified during the validation activities and describes the operational environment, the operational service, and procedures.

The Solution aims at enhanced Safety for airport operations as Support Tools for controllers at A-SMGCS Airports to detect potential and actual conflicting situations, incursions and non-conformance to procedures or ATC clearances, involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area as well as unauthorised/unidentified traffic. Controllers are provided in all cases with the appropriate predictive indications and alerts.

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# 1 Executive Summary

This SPR-INTEROP/OSED for the Solution **PJ.02-W2-21.1 — Extended Airport Safety Nets for Controllers at A-SMGCS Airports** covers OI step AO-0104-B - Extended Airport Safety Nets for Controllers at A-SMGCS Airports.

The Solution aims at enhanced Safety for airport operations. Safety Support Tools for controllers at A-SMGCS Airports detect potential and actual conflicting situations, incursions and non-conformance to procedures or ATC clearances, involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area as well as unauthorised/unidentified traffic. Controllers are provided in all cases with the appropriate predictive indications and alerts.

The Solution builds on the Airport Safety Nets defined and validated (V3) in SESAR1 Solution #02. The Conflicting ATC Clearances (CATC) and Conformance Monitoring Alerts for Controllers (CMAC) alerting functions are updated to improve operational utility and usability.

The updated and new alerts are provided in addition to the SESAR1 Solution #02 CMAC/CATC alerts and are deployed along with the Routing and Planning Service (SESAR Solution #22), on top of the already existing Runway Monitoring and Conflict Alerting (RMCA). The aim is to improve overall safety by providing more safety barriers to the corresponding Reason's model, each of the new improvements being independent of the others from a safety benefit point of view, provided that the alerts are composed for their individual operational environment, fine-tuned to the specific local procedures and conditions.

This solution is aimed at CATC and CMAC to be deployed at medium, large and very large airports equipped with A-SMGCS. The technical environment is defined by the SESAR Solution #02 and #22 baseline, which guarantees the interoperability with the Safety Support Service developed in the context of Solution #02. The alerts validated here fit seamlessly into the concepts of solution #02 and technically into the services of an A-SMGCS.

The Safety Tools offered by CATC, CMAC and RMCA shall be considered as an Airport Safety Support Toolbox that gives a framework to address all possible safety requirements at airports equipped with A-SMGCS.

This SPR-INTEROP/OSED for V3 part I provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), collected from the Safety Assessment Report (SPR-INTEROP/OSED part II), the Human Performance Assessment Report (SPR-INTEROP/OSED part IV), and the Security Assessment. The Performance Assessment Report (SPR-INTEROP/OSED part V) documents the performance achievements.

**Solution PJ.02-W2-21.1** replaces **Solution #02** by providing improved features of Solution #02 and extending the scope of the solution to the entire movement area, approach, and SIDs.

For CATC for runway operation, **Solution PJ.02-W2-21.1** provides two options. According to the local mode of operation at the destination airport, the mode of operation defined in Solution #02 or

alternatively the mode of operation with the support of reasonable assurance (ICAO Doc 4444) is available.





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# Introduction

## 1.1 Purpose of the document

This document[1] provides the requirements specification, covering operational, safety, performance and interoperability requirements related to SESAR Solution PJ.02-W2-21.1.

The SESAR Solution Development Life Cycle aims to structure and perform the work at project level and progressively increase SESAR Solution maturity, with the final objective of reaching V3 maturity level and delivering a SESAR Solution data pack for industrialisation and deployment. The SPR-INTEROP/OSED represents one of the key parts of this SESAR Solution data pack.

## 1.2 Scope

This is the SPR-INTEROP/OSED for Solution PJ.02-W2-21.1 for V3 phase; it consolidates all the requirements characterizing the solution, following the validation activities performed and reported in the D6.1.006 PJ.02-W2-21.1 VALR [17].

These requirements will cover Safety, Security, Human Performance, Performance, and operational aspects as well as the interoperability aspects related to the specific technology to support the SESAR Solution PJ.02-W2-21.1.

The geographic scope includes 13 very large, 12 large, and 3 medium airports equipped with A-SMGCS (see CBA, table 10 and appendix C [36]).

## 1.3 Intended readership

Intended audience for this SPR-INTEROP/OSED:

**Internal to SESAR 2020**

Project **PJ02** - Increased Runway and Airport Throughput – consistency with PJ.02-W2 solutions (PJ.02-W2-17, PJ.02-W2-21), alignment with ATM Master Plan managed by PJ.02-W2 PCIT.
Solution **PJ.02-W2-21.4** - Full Guidance Assistance to mobiles using 'Follow the Greens' procedures based on Airfield Ground Lighting (aprons/taxiways/runways).
**PJ19** (Content Integration) responsible for managing the content integration process to ensure the needed coherency (in terms of operational concept, architecture) between the different SESAR 2020 projects.
**PJ20** (Master Plan Maintenance) responsible for ATM Master Plan maintenance.

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



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**ANS providers** as interested in new developments that will enhance the safety of the airport operations.

**External to SESAR Programme**

- EUROCONTROL A-SMGCS Task Force.
- EUROCAE Working Group WG41.
- Post SESAR 2020 Wave 2 - Future audience involved in industrialisation (V4) and deployment activities (V5).

## 1.4 Background

Previous activities relevant to SESAR Solution PJ.02-W2-21.1:

**Internal to SESAR 1**

SESAR1 OFA01.02.01 performed the basic work on CATC and CMAC (OI AO-0104-A) in SESAR1. SESAR1 solution #02 (V3) is the reference to the CATC and CMAC alerts validated in PJ.02-W2-21.1.

Relevant documents:

- OFA01.02.01 Final OSED [13].
- OFA01.02.01 Updated SPR [31].

**Internal to SESAR 2020**

SESAR2020 Wave1 Solution PJ.03b-01 continued work and addressed OI AO-0104-B which reached Maturity Level V2.

Relevant document:

- Solution PJ03b-01 Final SPR-INTEROP/OSED V2 [27].

**External to SESAR Programme**

EUROCAE Working Group WG41 and the EUROCONTROL A-SMGCS Task Force incorporate the results coming from the SESAR solutions into the respective standardization process.

Relevant documents:

- EUROCAE Working Group WG41: ED-87E MASPS for A-SMGCS [19].
- EUROCONTROL Specification for A-SMGCS Services [15].





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## 1.5 Structure of the document

The SPR-INTEROP/OSED deliverable is composed of different parts.

Part I, this document, provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), related to the SESAR Solution PJ.02-W2-21.1 validated during validation activities at V3 maturity level. They are presented in the context of the Operational Service and Environment Definition (OSED), which describes the environment and assumptions that are applicable to the SPR and INTEROP requirements.

The document is completed by appendices including:

- The Benefit and Cost Mechanisms, showing how the SESAR Solution elements contribute (positively or negatively) to the delivery of performance benefits and the costs.

Parts II to V provide the series of assessments performed at SESAR Solution level that justify the SPR and INTEROP requirements:

- Part II: The Safety Assessment Report describes the results of the safety assessment work for the SESAR Solution [32].
- Part IV: The Human Performance Assessment Report describes the results of the Human Performance assessment work for the SESAR Solution [33].
- Part V: The Performance Assessment Report (PAR) that consolidates the performance results obtained in different validation activities at SESAR Solution level [34].

## 1.6 Glossary of terms

| Term | Definition | Source of the definition |
|---|---|---|
| **AERODROME-ATC-06b** | *A-SMGCS incorporating the function that detects Conflicting ATC Clearances (CATC) on the entire airport surface*<br><br>*The A-SMGCS Safety Support Service incorporates advanced tools for the detection of potential and actual conflicting ATC clearances involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area operations. The detection of CATC is based on clearances and instructions which are input by the ATCOs, and the position of mobiles from the A-SMGCS Surveillance Service. Appropriate predictive indications and alerts are provided to the Controllers.* | SESAR European ATM Portal – Working<br><br>Dataset 23<br><br>https://www.eatmportal.eu [30] |

| | | |
|---|---|---|
| **AERODROME-ATC-07b** | A-SMGCS incorporating the function that provides an advanced set of Conformance Monitoring Alerts for Controllers (CMAC) on the movement area<br><br>*The A-SMGCS Safety Support Service incorporates advanced tools for the detection of potential and actual non-conformance to procedures or ATC Clearances of mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area operations.*<br><br>*The Conformance Monitoring Alerts for Controllers (CMAC) capabilities are related to Stand Occupied Alert and appropriate predictive indications and alerts are provided to the Controllers.* | SESAR European ATM Portal – Working<br><br>Dataset 23<br><br>https://www.eatmportal.eu [30] |
| **AERODROME-ATC-115** | A-SMGCS incorporating the function that provides RMCA/CMAC vs ATC Clearance alerts<br><br>*The A-SMGCS Safety Support Service incorporates the function that provides RMCA/CMAC vs ATC Clearance alerts (when the ATC clearance entered by the controller conflicts with a RMCA or CMAC alert active on the same runway). Appropriate alerts are provided to the Controllers.* | SESAR European ATM Portal – Working<br><br>Dataset 23<br><br>https://www.eatmportal.eu [30] |
| **AERODROME-ATC-116** | A-SMGCS incorporating the function that provides Runway-Busy notifications<br><br>*The A-SMGCS Safety Support Service incorporates the function that provides Runway-Busy notifications (used to mark that a flight has been cleared to use the runway or a mobile is already using it). Appropriate notifications are provided to the Controllers.* | SESAR European ATM Portal – Working<br><br>Dataset 23<br><br>https://www.eatmportal.eu [30] |
| **A-SMGCS** | A system providing as a minimum Surveillance and can include Airport Safety Support, Routing and Guidance to aircraft and vehicles in order to maintain the airport throughput under all local weather conditions whilst maintaining the required level of safety. | [15] |
| **Alert** | An indication of an existing or pending situation during aerodrome operations, or an indication of abnormal A-SMGCS operation, that requires attention/action. | [14] |





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| **CATC** | CATC provides an alert when the Controller inputs an electronic clearance via the Human Machine Interface (HMI), which according to a set of locally agreed rules is not permitted from an operational and safety point of view when compared to any other previously input electronic clearance. | [15] |
| **Clearance** | A generic term used that covers instructions, approvals and clearances issued to mobiles by a Controller. | [15] |
| **CMAC** | CMAC provides Controllers with appropriate alerts when the A-SMGCS detects the non-conformance to procedures or clearances for traffic on runways, taxiways and in the apron/stand/gate area. | [15] |
| **Conditional Clearance** | A conditional clearance is a clearance issued by an air traffic controller which does not become effective until a specified condition has been satisfied.<br><br>*Conditional Clearances are applicable for all clearances that could cause clearance conflicts. Therefore, Conditional Clearances are an important component of the Safety Support Tools Set.* | [18] |
| **Conflict (abstract)** | An operationally undesirable situation between an aircraft/helicopter (a special kind of Mobile) and a Mobile. (Note that there cannot be a Conflict between two Mobiles where each of them is a vehicle. One Mobile always must be an aircraft/helicopter, hence this definition). | [14] |
| **EFS** | Electronic Flight Strip (EFS) - Throughout this document, the term EFS is used generically as the means to digitally input the clearances into the ATC System. Although EFS are used at many airports in Europe, Electronic Clearance inputs may also be performed using other ways such as via the radar label. | [13] |
| **False Alert** | Alert which does not correspond to an actual alert situation.<br><br>Note: It is important to understand that it refers only to false alerts and does not | [15] |





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| | address nuisance alerts (i.e. alerts which are correctly generated according to the rule set but are inappropriate to the desired outcome). | |
| **Mobile** | A mobile is either an aircraft, aircraft being towed or a vehicle.<br><br>Note: when referring to an aircraft or a vehicle, and not another obstacle, the term "Mobile" is preferred to "Target". The term "Target" is only used when considering an image of a mobile or other obstacle displayed on a surveillance screen. | [15] |
| **Nuisance Alert** | Alerts which are correctly generated according to the actual positions of the participating aircraft or vehicles and the rule set but are operationally inappropriate. | [15] |
| **Obstacle on RWY** | All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight. | [14] |
| **Predictive Indicaton** | The CATC predictive indication uses the CATC conflict prediction rules to determine potential clearance conflicts associated to the next clearance on a mobile´s planned route that has not yet been given to this mobile, showing that this clearance, if delivered, would be conflictual with another one given to another aircraft. The clearance conflict is displayed by the predictive indicator (see below). | |
| **Predictive Indicator** | A predictive indicator is a visual element on an Electronic Flight Strip (or any aircraft representation on the controller's main screen) associated to the next clearance on a mobile´s planned route that has not yet been given to this mobile, showing that this clearance, if delivered, would be conflictual with another one given to another aircraft. | [13] |





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| **Restricted Area** | An area on an aerodrome where the presence of a mobile is permanently or temporarily forbidden. | [15] |
| **Runway** | A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft. | [15] |
| **Runway Incursion** | Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft. | [15] |
| **Runway Protected Area** | The area around a particular runway the boundaries of which are defined by the runway holding positions (CAT I/II/III according to the prevailing weather (LVP conditions) and a line connecting the different adjacent holding positions. | [15] |

**Table 1: Glossary of terms**

## 1.7 List of Acronyms

| Acronym | Definition |
|---|---|
| **ANSP** | Air Navigation Service Provider |
| **A-SMGCS** | Advanced-Surface Movement Guidance and Control System |
| **ATC** | Air Traffic Control |
| **ATM** | Air Traffic Management |
| **ATS** | Air Traffic Service |
| **AVDR** | Alerts for Vehicle Drivers |
| **BIM** | Benefit Impact Mechanism |
| **CAT** | Category |
| **CATC** | Conflicting ATC Clearances |
| **CBA** | Cost Benefit Analysis |
| **CMAC** | Conformance Monitoring Alerts for Controllers |
| **CMAP** | Conformance Monitoring Alerts for Pilots |
| **CNS** | Communication Navigation and Surveillance |
| **CONOPS** | Concept of Operations |
| **CWP** | Controller Working Position |





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| **DEP** | Departure |
| **EASA** | European Aviation Safety Agency |
| **EATMA** | European ATM Architecture |
| **EFS** | Electronic Flight Strip |
| **GUI** | Graphical User Interface |
| **GRP** | Graphical Radar Picture |
| **HMI** | Human Machine Interface |
| **HP** | Human Performance |
| **HPAR** | Human Performance Assessment Report |
| **ICAO** | International Civil Aviation Organisation |
| **INTEROP** | Interoperability Requirements |
| **LVP** | Low Visibility Procedures |
| **KPA** | Key Performance Area |
| **NOV** | Node Operational View |
| **OFA** | Operational Focus Area |
| **OI** | Operational Improvement |
| **OSED** | Operational Service and Environment Definition |
| **PAR** | Performance Assessment Report |
| **RMCA** | Runway Monitoring and Conflict Alerting |
| **RPA** | Runway Protected Area |
| **RPAS** | Remotely Piloted Aircraft Systems |
| **R/T** | Radio Telephony |
| **RWSL** | Runway Status Lights |
| **RWY** | Runway |
| **SAC** | Safety Criteria |
| **SAR** | Safety Assessment Report |
| **SESAR** | Single European Sky ATM Research Programme |
| **SID** | Standard Instrument Departure |
| **SJU** | SESAR Joint Undertaking |
| **SPR** | Safety and Performance Requirements |
| **SRS** | Safety Requirements at ATS Service Level |
| **SURF-A** | Traffic alerts for pilots for airport operations |

| | |
|---|---|
| **TCL** | Taxiway Centreline Lights |
| **TLR** | Time to Leave Runway |
| **TMA** | Terminal Manoeuvring Area |
| **TTT** | Time To Threshold |
| **TS** | Technical Specification |
| **UC** | Use Case(s) |
| **VALR** | Validation Report |

**Table 2: List of acronyms**





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# 2 Operational Service and Environment Definition

The SESAR Solution PJ.02-W2-21.1 covers the Operational Improvement AO-0104-B which is within scope of the Key Feature "High Performing Airport Operations".

## 2.1 SESAR Solution PJ.02-W2-21.1: a summary

This solution updates and extends the Airport Safety Nets **Conflicting ATC Clearances** (CATC) and **Conformance Monitoring Alerts for Controllers** (CMAC) to cover the entire airport surface. It also improves the timing of CATC alerts for runway operations by predicting if an incident will occur due to conflicting clearances. This reduces possible nuisance alerts. Other new alerts are RMCA or CMAC vs clearance and Take Off vs Take Off (Converging SIDs).

Based on airport surveillance data and electronic environment integrating ATC clearances, taxi-routes and local procedures the Safety Support Tools for controllers upgrade the Advanced Surface Movement Guidance and Control System (A-SMGCS) to detect potential and actual conflicting situations, incursions and non-conformance to procedures or ATC clearances, involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area as well as unauthorised/unidentified traffic.

The solution targets traffic Safety on the entire movement area and during take-off and landing on medium, large and very large airports equipped with A-SMGCS.

Appropriate predictive indications and alerts are provided to controllers in all cases, increasing situational awareness and giving automated support to avoid hazardous situations. This is expected to bring benefits in terms of Safety, Resilience and Human Performance.

| SESAR Solution ID | SESAR Solution Title | OI Steps ID | OI Steps Title | Enabler ID | Enabler Title | OI Step/Enabler Coverage |
|---|---|---|---|---|---|---|
| **PJ.02-W2-21.1** | Enhanced Airport Safety Nets for Controllers at A-SMGCS Airports | **AO-0104-B** | Enhanced Airport Safety Nets for Controllers at A-SMGCS Airports | **AERODROME-ATC-06b** | A-SMGCS incorporating the function that detects Conflicting ATC Clearances (CATC) on the entire airport surface | **OI step/Enable:** **Fully** **Enabler:** Required |
| | | | | **AERODROME-ATC-07b** | A-SMGCS incorporating the function that provides an advanced set of Conformance | **OI step/Enable:** **Fully** |





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| | | | | | Monitoring Alerts for Controllers (CMAC) on the movement area | **Enabler:** Required |
| | | | | **AERODROME-ATC-115** | A-SMGCS incorporating the function that provides RMCA/CMAC vs ATC Clearance alerts | **OI step/Enable:**<br>**Fully**<br>**Enabler:** Required |
| | | | | **AERODROME-ATC-116** | A-SMGCS incorporating the function that provides Runway-Busy notifications | **OI step/Enable:**<br>**Fully**<br>**Enabler:** Required |

**Table 3: SESAR Solution PJ.02-W2-21.1 Scope and related OI steps/enablers**

Safety is enhanced for airport operations as support tools for controllers at A-SMGCS Airports detect potential and actual conflicting situations, incursions and non-conformance to procedures or ATC clearances, involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area as well as unauthorised/unidentified traffic. Controllers are provided in all cases with the appropriate alerts.

| The Solution is contributing to | |
|---|---|
| Key feature | High Performing Airport Operations |
| Essential Operational Change (EOC) | Airport and TMA performance |
| Capability | Controller Situational Awareness (surface);<br>Ground Collision Avoidance;<br>Trajectory Conformance Monitoring; |

| SESAR Solution ID | Title |
|---|---|
| PJ.02-W2-21.1 | Extended airport safety nets for controllers at A-SMGCS airports |

| OI Step code | OI Step title<br>(CR 07104 Update AO-0104-B (PJ02-W2-21.1)) | OI Step coverage |
|---|---|---|
| AO-0104-B | Extended airport safety nets for controllers at A-SMGCS airports | |
| Airport safety is improved at A-SMGCS Airports thanks to detection of potential and actual conflicting situations, incursions and non-conformance to procedures or ATC clearances, involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area as well as unauthorized / unidentified traffic. Appropriate predictive indications and alerts are provided to the Controllers. | | |

| CR name | EN code | Title<br>(EA Project) | Coverage |
|---|---|---|---|
| | AERODROME-ATC-06b | A-SMGCS incorporating the function that detects Conflicting ATC Clearances (CATC) on the entire airport surface | Required/Develop |
| | AERODROME-ATC-07b | A-SMGCS incorporating the function that provides an advanced set of Conformance Monitoring Alerts for Controllers (CMAC) on the movement area | Required/Develop |
| | AERODROME-ATC-115 | A-SMGCS incorporating the function that provides RMCA/CMAC vs ATC Clearance alerts<br>AERODROME-ATC-116 — A-SMGCS incorporating the function that provides Runway-Busy notifications | Required/Develop |
| | AERODROME-ATC-116 | A-SMGCS incorporating the function that provides Runway-Busy notifications | Required/Develop |

**Table 4: SESAR Solution PJ.02-W2-21.1 Scope and related OI steps**

Table 5 summarizes the High-Level Operational Requirements applicable to the SESAR Solution in the Concept of Operations.

| High Level Concept of Operations Requirement ID | High Level Concept of Operations Requirement | Reference to relevant Concept of Operations Sections e.g. Operational Scenario applicable to the SESAR Solution |
|---|---|---|
| **S21.1-HLOR-01**<br><br>**[28]** | The Enhanced Guidance Assistance to Aircraft and Vehicles shall detect conflicting situations and non-conformance, involving mobiles on runways, taxiways and apron/stand/gate areas,<br><br>to obtain | CONOPS 2019 [29]:<br><br>Section 2.4.2 Integrated Surface Management |

| | | |
|---|---|---|
| | • Increased Safety by enhancing situational Awareness for controllers<br>while :<br>• Minimising the level of false and nuisance alerts<br>• Considering all types of Airspace Users (including GA, Rotorcraft and Civil RPAS[2]) and vehicles<br>• Considering unauthorised and unidentified traffic<br>• enabled by Enhanced A-SMGCS, detecting conflicts and non-conformance to ATC clearances | Prospects of Wave2 Solution PJ.02-W2-21 Digital evolution of integrated surface management |
| | **Identified, addressed OI Steps**<br>AO-0104-B | |
| | **Specific Perimeter**<br>• Medium, Large and Very Large A-SMGCS airports<br>• Mixed mode single Runway or dependent runways operation<br>The alerting functions cover the entire airport surface | |
| | **Additional Background**<br>• All Weather<br>• Low Visibility Conditions | |

**Table 5: Link to Concept of Operations**

Table 6 in the TS/IRS [35] presents the Change Requests that have been raised in EATMA for the OI Steps and Enablers within the Solution.

[2] RPAS: This solution does not support the special requirements of RPAS needed for runway and ground operations at the airports considered in this context (see section 3.3.1.4).

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

No deviations with respect to the SESAR solution definition in EATMA Dataset 23 [30].

## 2.2 Detailed Operational Environment

### 2.2.1 Operational Characteristics

| Operational interactions per context (NOV-2) | Operating Environment |
|---|---|
| [NOV-2] [1] Extended Airport Safety Nets for Controllers at A-SMGCS Airports | Airport;<br>APT-Large;<br>APT-Medium;<br>APT-Very Large; |
| Comment | |
| RMCA, CATC and CMAC (as defined by SESAR Solution #02) are expected to be part of the operational environment at the main airports. The implementation of CATC and CMAC alerts needs to be discussed with local operational experts and regulators, in particular which alerts need to be implemented at the specific airport in question, which local parameters should be used for triggering the alerts and on which control positions they should be displayed.<br><br>The triggering of alerts shall be applied to all mobiles under ATC control that are moving on the taxiways and aprons. Most of the alerts require the availability of the A-SMGCS Surveillance and Routing Services. | |

### 2.2.2 Roles and Responsibilities

Solution PJ.02-W2-21.1 considers the detection and alerting of clearance conflicts and non-conformance of mobiles under ATC control from the controller's perspective. The alerts triggered are displayed only on the controller's HMI to support his/her decision process while controlling the traffic he/she is responsible for. It is the controller's task to decide what actions are adequate to solve the situation detected by the safety net. Therefore, alerts are not available to other actors involved in the detected situation (flight crew, vehicle driver) to avoid the risk of conflictive reactions.

The detection of CATC for Runway Operations is a safety support tool for the Tower Runway Controller who is responsible for managing departing and arrival flights on the manoeuvring area (mainly on the runway and on taxiways close to the runway).

The detection of CATC for Ground Operations and of CMAC are safety support tools for the Apron Manager, the Tower Ground Controller, the Tower Runway Controller, and the Tower Supervisor who are responsible for managing/monitoring mobiles on the movement area.

**Note**: the ATCO role is not changed by solution PJ.02-W2-21.1.

For more detail concerning roles and responsibilities (e.g,. the transfer between AoR) see the SESAR1 OSED [13] and the Eurocontrol A-SMGCS Specification [15], table 3.

| Node | Responsibilities |
|---|---|
| Aerodrome ATS | Performs all the aerodrome ATS operations. |

| | |
|---|---|
| | [RELATED ACTORS/ROLES]<br>Runway controller, ground controller, etc. |
| Airport Vehicle | Performs all the operational activities related to a support vehicle (not aircraft) in the airport manoeuvring area .<br><br>[RELATED ACTORS/ROLES]<br>Vehicle driver |
| Flight Deck | Performs all the on-board AU operations including flight execution/monitoring according to agreed trajectory, compliance with ATC clearances/instructions, etc.<br><br>[RELATED ACTORS/ROLES]<br>Flight Crew |

| Operational interactions per context (NOV-2) | | Operating Environment |
|---|---|---|
| [NOV-2] [1] Extended Airport Safety Nets for Controllers at A-SMGCS Airports | | Airport;<br>APT-Large;<br>APT-Medium;<br>APT-Very Large; |
| Node | Node instance | Node instance description |
| Airport Vehicle | Airport Vehicle | |
| Flight Deck | Flight Deck | |
| Aerodrome ATS | Tower ATC Control | Tower Ground Controller<br><br>The Tower Ground Controller is part of the controller team responsible for providing Air Traffic Services at controlled aerodromes. Their main task is the provision of ATS to aircraft and vehicles on the manoeuvring area. They must also ensure that airport maintenance vehicles carrying out necessary improvements on an active manoeuvring area do not interfere with the movement of aircraft. He will be assisted by an A-SMGCS, where available.<br><br>The Tower Ground Controller is responsible for:<br><br>Issuing taxi clearances to departing flight crews from the apron boundary or a given transfer point, to the holding point or a given transfer point;<br>Issuing taxi clearances to arriving flight crews from the runway exit or a given transfer point to the apron boundary or a given transfer point;<br>Monitoring the movements on the taxiways for compliance with the issued clearances. |

| | | |
|---|---|---|
| | | At some airports, these tasks apply to every mobile present on the taxiways, including vehicles. Furthermore, at some airports, the Tower Ground Controller is responsible for performing the duties of an Apron Manager (see above).<br><br>Tower Runway Controller<br><br>The Tower Runway Controller is responsible for the provision of air traffic services to aircraft within the control zone, or otherwise operating in the vicinity of controlled aerodromes (unless transferred to Approach Control/ACC or to the Tower Ground Controller), by issuing clearances, instructions and permission to aircraft, vehicles and persons as required for the safe and efficient flow of traffic. Generally, the Tower Runway Controller is responsible for managing the runway and issuing clearances to all mobiles to enter or cross a runway, and to aircraft for line-up, take-off and landing on the active runways. The Tower Runway Controller may be assisted by arrival, departure and surface management systems, where available.<br><br>Furthermore, in relation to the described operation on the ground, the additional responsibilities of the Tower Runway Controller are to:<br>Sequence departures;<br>Issue landing clearances to arriving flights and instructions to vacate the runway, as appropriate;<br>Give instructions to departing flights to taxi to the take-off position and to operate the stop bars, if required;<br>Give authorisation to the Tower Ground Controller for the crossing of runways by surface traffic;<br>Operate the aerodrome lighting system in co-operation with the Tower Ground Controller;<br>Issue essential local traffic information and essential aerodrome information;<br>Issue reports/observations of significant weather changes from that published;<br>Perform a flight information service within his area of responsibility;<br>Perform alerting service within his area of responsibility;<br>Trigger alerts and interventions of emergency vehicles in case of an incident or an accident. |

**Table 6: Roles and Responsibilities**

### 2.2.3 CNS/ATS description

This solution is an add-on to extend the Airport Safety Net CATC and CMAC functions validated V3 in SESAR1 Solution #02. The CNS Infrastructure and the Air Traffic Services required to execute the new CATC and CMAC functions are identical with the CNS Infrastructure and the Air Traffic Services for SESAR1 Solution #02.

| Technical constraint | description |
|---|---|
| A-SMGCS Surveillance data | The triggering of the majority of CATC and CMAC alerts requires the availability of accurate A-SMGCS Surveillance data, especially on and around the runway/s, the routes for mobiles and precise Controller inputs.<br>It is expected that the surveillance data has A-SMGCS quality: ALL targets are correctly located on the airport surface and clearly identified without ambiguity. |
| Vehicle transmitter | The detection of CATC and CMAC alerts involving vehicles that frequently operate on the manoeuvring area will require an operative vehicle transmitter ensuring detection and correct labelling by the A-SMGCS.<br>Non-cooperative vehicles will need to be tracked and manually identified and labelled. |
| HMI | An HMI will be necessary to permit the Clearances/Instructions given to aircraft and vehicles, and it will be imperative that Controllers make timely inputs to the HMI coincident with the R/T transmissions. |

**Table 7: Technical constraints**





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### 2.2.4 Applicable standards and regulations

Applicable standards

ICAO Advanced Surface Movement Control and Guidance Systems (A-SMGCS) Manual, Doc 9830 AN/452, First Edition 2004 [14] [14].

EUROCAE document ED-128 - Guidelines for Surveillance Data Fusion in Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Levels 1 and 2, issued in October 2007 [26].

ICAO Doc 4444 Procedures for Air Navigation Services -Air Traffic Management 16th Edition, 2016 [18].

ICAO Annex 14 Aerodrome Design and Operations, Volume I, Edition 7, 2016 [18].

EUROCAE document ED-117A - Minimum Operational Performance Specification (MOPS) for Mode S Multilateration Systems for Use in A-SMGCS, issued in September 2016[25].

EUROCAE ED-87E Minimum Aviation System Performance Standard (MASPS) for Advanced Surface Movement Guidance and Control Systems (A-SMGCS) [19].

EUROCONTROL Specification for Advanced-Surface Movement Guidance and Control System (A-SMGCS) Services, Edition 2.0, 22 April 2020 [15].

Applicable Regulations

Commission Regulation (EU) No 73/2010 on the quality of aeronautical data and aeronautical information, 26 January 2010 [21].

Commission Implementing Regulation (EU) No 716/2014 on the establishment of the Pilot Common Project (PCP), 27 June 2014 [22].

EASA Commission Regulation (EU) No 139/2014 laying down the requirements and administrative procedures related to aerodromes, 12 February 2014 (EASA Aerodrome IR) [23].

EASA Basic Regulation (EU) 2018/1139, 4 July 2018 [24].

This document contributes to the following Standards

EUROCONTROL Specification for Advanced-Surface Movement Guidance and Control System (A-SMGCS) Services [15].

EUROCAE ED-87E Minimum Aviation System Performance Standard (MASPS) for Advanced Surface Movement Guidance and Control Systems (A-SMGCS) [19].

The contribution to the abovementioned Standards has been documented in EATMA through STD-105 and STD-016. A detailed description of these Enablers is included in the PJ.02-W2-21.1 TS/IRS [35].





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## 2.3 Detailed Operating Method

### 2.3.1 Previous Operating Method

The term “Previous Operating Method” refers to the operating method of Solution #02 validated at the end of SESAR1 [13].

The previous operating method foresees conformance monitoring and conflicting clearance detection and management procedures mainly with respect to runway operations. I.e., little or no automated support is given to the Clearance and Ground ATCOs for the monitoring of the separation performances in the apron and taxiway segments of the ground route.

Two stages of alert are defined as follows:

- **Stage 1 alert is an INFORMATION alert.** It is used to inform the Controller of a potential hazardous situation. According to the situation, the Controller receiving a Stage 1 alert may take a specific action to resolve the situation.
- **Stage 2 alert is an ALARM**. It is used to inform the Controller that a critical situation is developing requiring immediate action.

In certain situations, it will be possible for more than one alert to be triggered for the same mobile. It is recommended to display the alert with the highest priority only in the radar/track label and/or EFS and display the full list of alerts prioritized in an alert window.

For more detail concerning the different Stages of alert and the display and prioritisation of alerts on the HMI see the SESAR1 OSED [13] and the Eurocontrol A-SMGCS Specification [15].

#### 2.3.1.1 Conflicting ATC Clearances (CATC for Runway Operations)

**The term ‘Conflicting’ in the title refers to the fact that certain electronic clearances input by a Controller do not comply with the local ATC rules/procedures, it does not mean that the aircraft/vehicles have ended up in conflict with each other.**

In the first SESAR programme the concept of CATC was developed focussing on runway movements only. The ATC System provides an alert when the Controller inputs an electronic clearance (see Table 8) via the HMI, which, according to a set of locally agreed rules, is not permitted from an operational and safety point of view when compared to any other previously input electronic clearance.

The detection of CATC provides an early prediction of a situation that, if not corrected, would end up in a hazardous situation, that in turn would normally be detected by the Runway Monitoring and Conflicting Alert (RMCA) function.

The HMI can be adapted to give a predictive indication to the Controller that if a specific clearance is input it triggers a CATC alert (this prediction function uses the CATC conflict detection by assuming that the next clearance to be given according to the route of a mobile is virtually entered and tested against other intersecting routes with an active clearance). This helps the Controller’s situational awareness and normally prevents an incident due to a wrong clearance being issued.



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| First Clearance Input | Second Clearance Input |
|---|---|
| LINE UP | LINE UP, CROSS, ENTER, TAKE OFF, LAND |
| CROSS or ENTER | LINE UP, CROSS, ENTER, TAKE OFF, LAND |
| TAKE OFF | LINE UP, CROSS, ENTER, TAKE OFF, LAND |
| LAND | LINE UP, CROSS, ENTER, TAKE OFF, LAND |

**Table 8: Situations for CATC Runway Alerts (see [13] for full details).**

As a convention CATC for runway operation alert identifiers are given as a combination of the clearances in conflict, with the first clearance issued on the left and the second clearance issued on the right of the alert identifier (example: for the CATC alert TOF/LND the Take Off clearance was given first).

### 2.3.1.2 Conformance Monitoring Alerts for Controllers (CMAC)

CMAC provides Controllers with appropriate alerts when the A-SMGCS detects the non-conformance to procedures or clearances for traffic on runways, taxiways and in the apron/stand/gate area.

The integration of EFS with information such as flight plan, surveillance, routing, published rules and procedures allows the system to detect inconsistencies and to alert the Controller.

The main benefit of this is the **early detection of Controller, Flight Crew / Vehicle Driver errors** that, if not detected and resolved, might result in a hazardous situation.

The current A-SMGCS RMCA still exists as a last-minute warning system based on the positions and speeds of the mobiles**.**

A summary of CMAC alerts is detailed below in Table 9 . Note: the identification of the alarms as INFORMATION (yellow) or ALARM (red) in this table might be assigned differently in a local implementation. The assignment depends on how critical the situation is that requires the ATCO's attention (for more details see [13], sections 3.2.3 and 3.2.4, or [15]).

| INFORMATION Alert Name | Brief description |
|---|---|
| **ROUTE DEVIATION** | A mobile deviates from its cleared route on a taxiway/taxilane. |
| **NO PUSH / NO TAXI APPROVAL** | An aircraft pushes-back or taxies without Clearance from a Controller. |
| **STATIONARY** | A mobile is given a Clearance (e.g., Push-Back, Taxi, Cross, Enter, Line-Up, Take-Off) but doesn't move within a certain time period, or an aircraft was taxiing and stops for a certain time period. |





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| | |
|---|---|
| **NO CONTACT** | An arriving aircraft is at a defined distance or time from the runway and has not contacted the Tower. |
| **NO TRANSFER** | A departing aircraft has taken off and is at a defined distance or time from the aerodrome and has not been transferred to the departure controller. |
| **NO TAKE-OFF CLEARANCE** | An aircraft is cleared to Line-Up and it takes-off without a Take-Off Clearance. |
| **NO LANDING CLEARANCE** | An aircraft is close to the runway without a Landing Clearance. |
| **LANDING ON THE WRONG RUNWAY** | An arriving aircraft is detected to be aligned to a runway that differs to the assigned runway. |
| **LINING-UP ON THE WRONG RUNWAY** | A departing aircraft is detected lining-up on a runway that differs to the assigned runway. |
| **RUNWAY TYPE** | An aircraft is assigned a runway that is not suitable for the aircraft type e.g., runway is too short. |
| **TAXIWAY TYPE** | An aircraft is assigned a taxiway that is not suitable for the aircraft type e.g., taxiway is limited to certain types of aircraft. |
| **RUNWAY CLOSED** | A runway assigned to an aircraft is closed. |
| **TAXIWAY CLOSED** | The assigned taxi route is planned to go through a closed taxiway. |
| **HIGH SPEED** | An aircraft taxies with speed exceeding x knots (x=parameter). |
| **ALARM Alert Name** | **Brief description** |
| **ROUTE DEVIATION** | A mobile deviates from its cleared route on a taxiway (close to an active runway). |
| **STATIONARY** | An arriving aircraft or mobile crossing a runway has stopped within the RPA and does not move within a certain time period. |
| **NO TAKE-OFF CLEARANCE** | An aircraft is cleared to Line-Up and it takes-off without a Take-Off Clearance. |
| **NO LANDING CLEARANCE** | An aircraft is close to the runway without a Landing Clearance. |
| **LANDING ON THE WRONG RUNWAY** | An arriving aircraft is detected to be aligned to a runway that differs to the assigned runway. |
| **RED STOP BAR CROSSED** | A mobile crosses a RED stop bar (Intermediate Holding Point or AoR boundary). |
| **LINING-UP ON THE WRONG RUNWAY** | A departing aircraft is detected lining up on a runway that differs to the assigned runway. |





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| | |
|---|---|
| **RUNWAY INCURSION** | A mobile is detected entering, or predicted to enter, the RPA without a Land / Line-Up / Take-Off / Cross / Enter Clearance. |
| **RUNWAY TYPE** | An aircraft is on a runway that is not suitable for the aircraft type. |
| **TAXIWAY TYPE** | An aircraft is on a taxiway that is not suitable for the aircraft type. |
| **RUNWAY CLOSED** | An aircraft has entered a closed runway. |
| **TAXIWAY CLOSED** | An aircraft has entered a closed taxiway. |
| **AREA INCURSION** | An unauthorised mobile is detected entering, or predicted to enter, a restricted area. |
| **HIGH SPEED** | An aircraft taxies with speed exceeding y knots (y=parameter). |
| **TAXIWAY CLOSED** | An aircraft has entered a closed taxiway. |

**Table 9: Description of CMAC Alerts (taken from [15], table 7).**

#### 2.3.1.3 Prioritisation of Alerts

The CATC and CMAC alerts above are not intended to replace RMCA, but to complement RMCA by predicting incidents before the RMCA Alerts trigger. Therefore, the RMCA alerts have a higher priority than other alerts.

In certain situations, it will be possible for more than one alert to be triggered for the same mobile, e.g., an aircraft LINING UP with no clearance will trigger an alert (CMAC - RWY INCURSION) with an aircraft on short final approach (RMCA).

It is also evident that it will be impossible for some alerts to be triggered at the same moment for the same mobile, e.g., a NO PUSH BACK alert will not be triggered for an aircraft on final approach with a NO LANDING alert.

While the titles of all alerts shall be displayed in the optional ALERT window, it is recommended that only one alert title shall be displayed in the radar/track label and/or the EFS of the concerned mobile. This alert title shall be the one having the highest priority according to requirements defined in section 6.1, REQ-06.07.01-OSED-CMAC.0040: The priorities may be defined as represented by the requirement. Other options can be defined based on specific local implementation preferences.

#### 2.3.1.4 General Aviation, Rotorcraft, Civil RPAS and vehicles

The following applies to Solution #02 and is equally applicable to Solution PJ.02-W2-21.1:

- All mobiles in the vicinity of the runway (e.g., on final approach, climb out and helicopters crossing) and mobiles moving within or about to enter the RPA are monitored by RMCA.
- **General Aviation and Rotorcraft** under Air Traffic Control are expected to follow the same instructions and clearances as the commercial aircraft considered in this solution. Especially rotorcraft is expected to hover along runways and taxiways to their destination. Exceptions





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can be helicopters that are stationed at an airport and have a special approach permit to fly directly to their helipad, which cannot conflict with the normal approach and departure.

- The solution does not support the special requirements of **RPAS** needed for runway and ground operations at the airports considered in this context. The Solution expects that the pilot is able to observe his surroundings during taxiing, take-off and landing. This is not generally guaranteed with RPAS. It also expects any mobile can maneuver like any other mobile. However, many RPAS have limited range and practically no diversion capability. Transmission delays and interruptions (C2Link break) can result in the pilot not being informed of the actions required to clarify the critical situation.

- **Vehicles** not under Air Traffic Control use designated airport roads. Vehicle drivers must be in possession of an apron driver's license and be trained in accordance with the special traffic regulations.

- Manned mobiles under air traffic control follow the tower controller's instructions and clearances. They are monitored by the Airport Safety Support Service





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## 2.3.2 New SESAR Operating Method

The term “new SESAR Operating Method” refers to the operating method validated V2 at the end of SESAR 2020 Wave 1 by solution PJ.03b-01 and aims to reach V3 by solution PJ.02-W2-21.1 at the end of Wave 2.

### 2.3.2.1 Extended Airport Safety Nets for Controllers at A-SMGCS Airports

NOTE: The following CATC Use Cases provide the opportunity to add Safety measures that extend the respective use case flow. These extensions can be considered as additional Safety Barriers:

1. **CATC Predictive Indication** – Based on the current clearance status of the route assigned to the considered mobile the controller is warned in advance if the next clearance to be given will cause a potential conflict with another mobile's cleared route (see 2.3.2.2.1 UC-CATC-01 Predictive Indication). This helps the Controller’s situational awareness and normally prevents an incident due to a wrong clearance being issued.

2. **Conditional Clearance** – A Conditional Clearance that is issued by the air traffic controller (see 2.3.2.2.3 UC-CATC-02 Conditional Clearance) to give way to another mobile.

3. **Runway Situational Notification** – During his daily work, the controller is specifically informed about the operational status of the runway via its colouring, in order to have an immediate information about the runway being occupied or affected by a conflict (see use cases UC-RWY-01 and UC-RWY-02).

The extensions can be considered as execution options which can also be used to extend the SESAR1 CATC Use Cases (for Predictive Indication see also [13], section 3.2.3).

#### 2.3.2.1.1 Extended CATC (for Ground Operations)

The new operating method introduces new situations for which a CATC alert is triggered. The situations are described in Table 10 where the first clearance is the one that is input first and the input of the second clearance triggers an alert.

| First Clearance Input | Second Clearance Input (triggers the alert) |
|---|---|
| *PUSH | PUSH, *TAXI |
| *TAXI | *PUSH, TAXI, CROSS** |
| CROSS** | TAXI |

**Table 10: New Situations for CATC Ground Alerts**

* NOTE: It is not relevant for the controller which clearance is given first, i.e., whether it is a PUSH/TAXI or a TAXI/PUSH.

** NOTE: CROSS/TAXI (Deadlock) or TAXI/CROSS (Deadlock) is a special case of TAXI/TAXI (deadlock) where the cleared route crosses a runway. The decisive factor here is that the mobile changes from





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one AoR to the next AoR and not that a runway is crossed (see 2.3.2.2.3.6 UC-CATC-08 Taxi vs Cross (Deadlock)).

#### 2.3.2.1.1.1 Push Back vs Push Back

**Data required –** Clearances, Airport data (Stand), Routes and Surveillance.

**Alert triggered –**

Local rules and procedures are taken into account in order to define which stands and associated push back trajectories are considered to conflict with each other.

1. If **AEA3430** is given Push Back and **CSA1372** is given Push Back from a Stand on the opposite side of the apron (see Figure 1, right side).
2. If **AAL63** is given Push Back and **TSC789** is given Push Back from an adjacent Stand on the apron where the push back trajectories are overlapping (see Figure 1, left side).

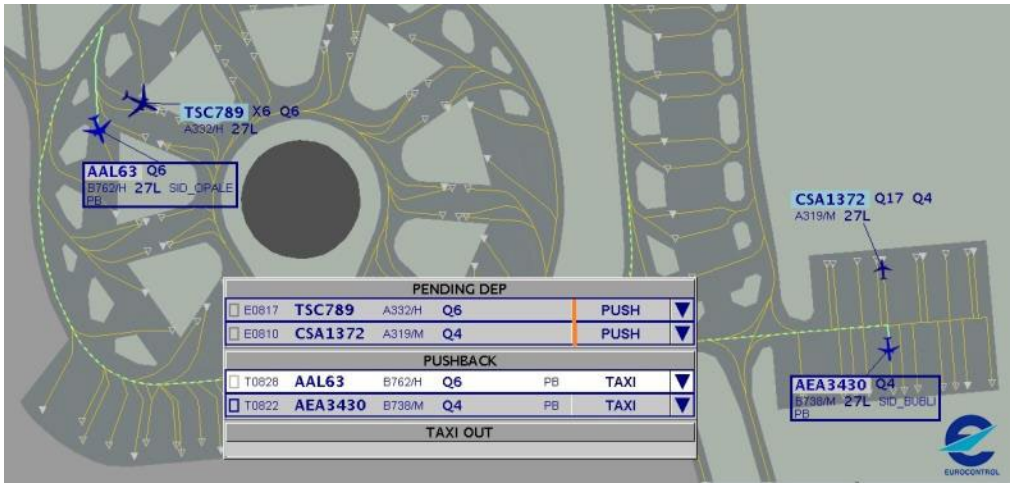


**Figure 1: CATC – Push Back vs. Push Back**

**Options –**

1. **Predictive Indication** to identify potential clearance conflicts before a clearance is entered, and
2. **Conditional Clearances** to protect the execution of the cleared route against potential conflicts,

are additional safety tools provided by the ATC system to cover the **Push back vs Push back** situation (see 2.3.2.2.2).

#### 2.3.2.1.1.2 Taxi vs Push Back

**Data required –** Clearances, Airport data (Stand), Routes and Surveillance.

**Alert triggered –**

Local rules and procedures need to be taken into account in order to define which taxiways and associated push back trajectories are considered to conflict with each other.





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1. If **KAL505** is given Taxi and **AAL45** is given Push Back with a Push Back trajectory that is predicted to impede the route of **KAL505** (see Figure 2).

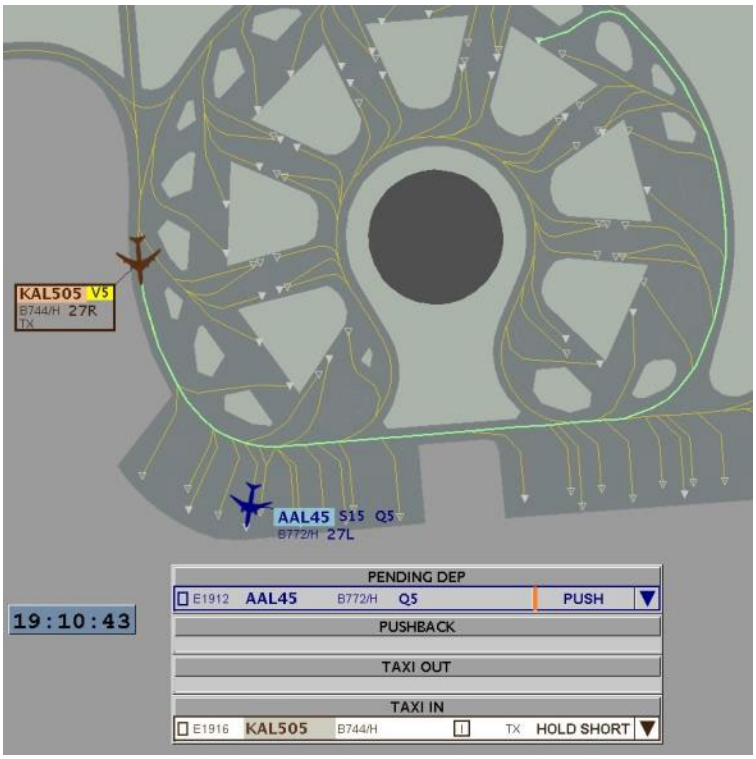


**Figure 2: CATC – Taxi vs. Push Back**

**Options –**

3. **Predictive Indication** to identify potential clearance conflicts before a clearance is entered, and
4. **Conditional** Clearances to protect the execution of the cleared route against potential conflicts,

are additional safety tools provided by the ATC system to cover the **Taxi vs Push back** situation (see 2.3.2.2.2).

#### 2.3.2.1.1.3 Push Back vs Taxi

**Data required –** Clearances, Airport data (Stand), Routes and Surveillance.

**Alert triggered –**

Local rules and procedures need to be taken into account in order to define which stands and associated push back trajectories are considered to conflict with which taxiways.

1. If **AZA654** is given Push Back and **IBE987** is given Taxi with a route that is predicted to be impeded by the Push Back of **AZA654** (see Figure 3).



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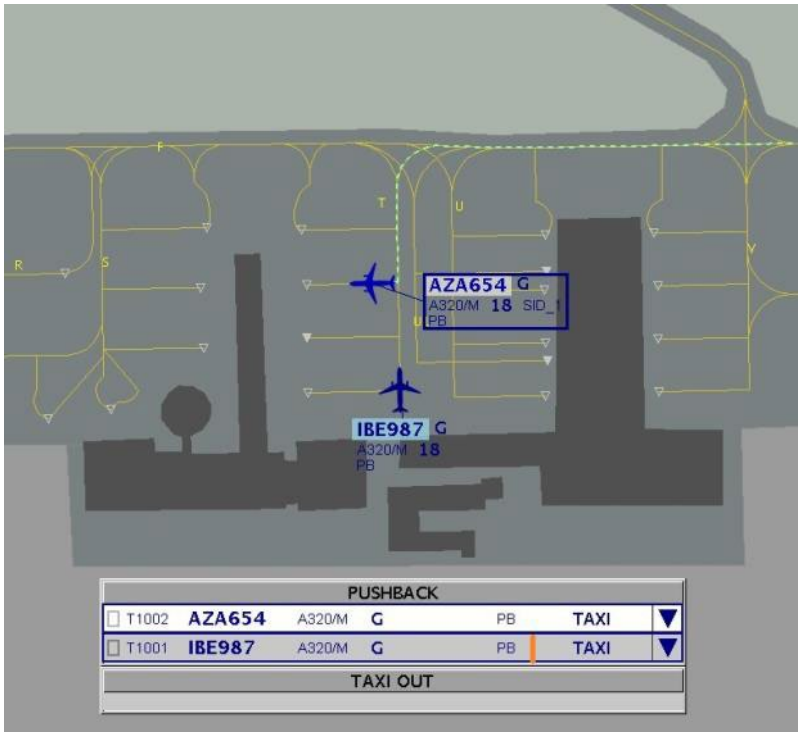


**Figure 3: CATC – Push Back vs. Taxi**

**Options –**

5. **Predictive Indication** to identify potential clearance conflicts before a clearance is entered, and
6. **Conditional Clearances** to protect the execution of the cleared route against potential conflicts,

are additional safety tools provided by the ATC system to cover the **Push back vs Taxi** situation (see 2.3.2.2.2).

#### 2.3.2.1.1.4 Taxi vs Taxi

**Data required –** Clearances, Routes and Surveillance.

**Alert triggered –**

Local rules and procedures need to be taken into account in order to define which stands and associated push back trajectories are considered to conflict with each other.

If **EZY578L** is given Taxi and **TAY125H** is at a stand that doesn't require a Push Back and is given taxi and its route is predicted to impede the route of **EZY578L** (see Figure 4).



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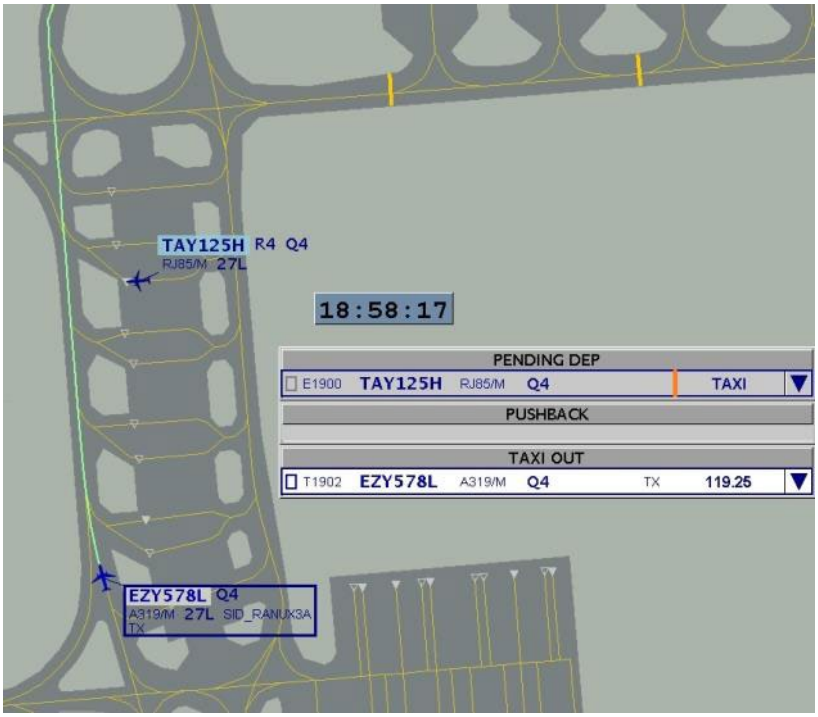


**Figure 4: CATC – Taxi vs. Taxi (from Stand)**

**Options –**

7. **Predictive Indication** to identify potential clearance conflicts before a clearance is entered, and
8. **Conditional Clearances** to protect the execution of the cleared route against potential conflicts,

are additional safety tools provided by the ATC system to cover the **Taxi vs Taxi** situation (see 2.3.2.2.2).

#### 2.3.2.1.1.5 Taxi vs Taxi (Deadlock)

**Data required –** Clearances, Routes and Surveillance.

**Alert triggered –**

Local rules and procedures need to be taken into account in order to identify potential deadlock situations.

If **AFL2010** has been given Taxi and **N605RT** has also been given Taxi and during the progress of taxiing the routes are predicted to end up in a **'deadlock situation'** (where the mobiles come face to face and are unable to take another route to avoid each other; see Figure 5).





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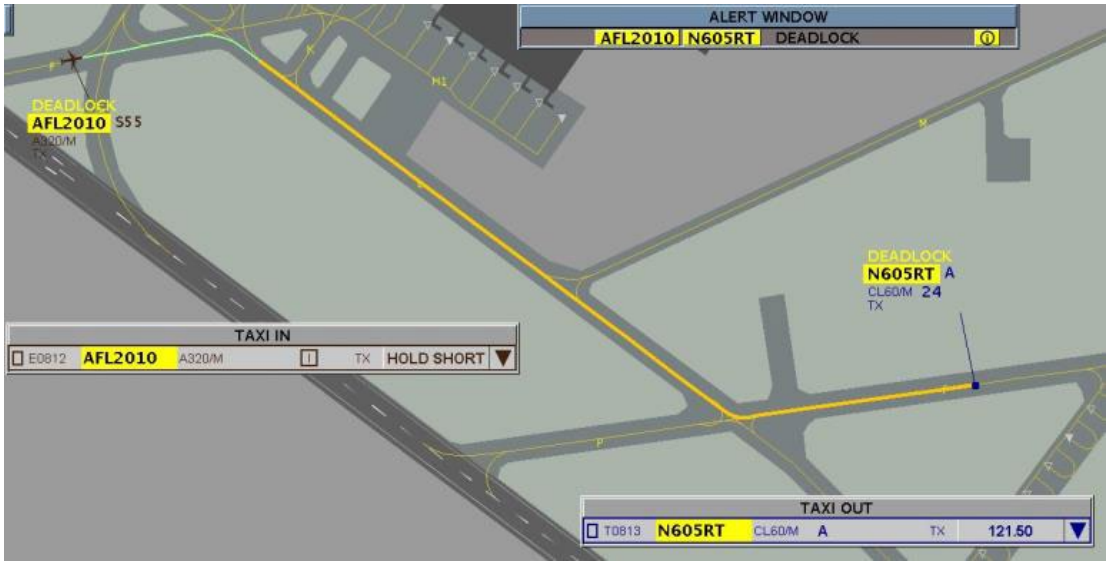


**Figure 5: CATC – Taxi vs. Taxi (Deadlock)**

**Options –**

9. **Predictive Indication** to identify potential clearance conflicts before a clearance is entered, and
10. **Conditional Clearances** to protect the execution of the cleared route against potential conflicts,

are additional safety tools provided by the ATC system to cover the **Taxi vs Taxi (Deadlock)** situation (see 2.3.2.2.2).

#### 2.3.2.1.1.6 Taxi vs. Cross or Cross vs. Taxi (Deadlock)

**Data required –** Clearances, Routes and Surveillance.

**Alert triggered –**

If **A** has been given Taxi and **B** has been given Cross and during the progress of taxiing the routes are predicted to end up in a **'deadlock situation'** (where the mobiles come face to face and are unable to take another route to avoid each other; see Figure 6).





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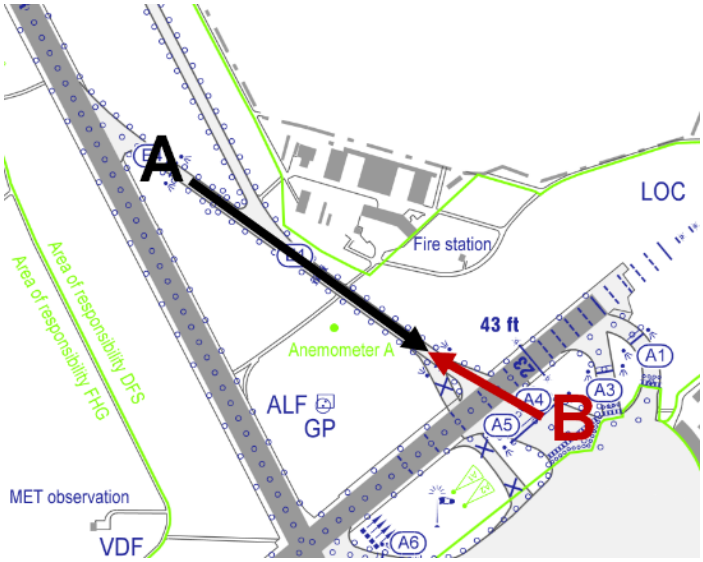


**Figure 6: CATC – Taxi vs. Cross (Deadlock)**

**Options –**

11. **Predictive Indication** to identify potential clearance conflicts before a clearance is entered, and
12. **Conditional Clearances** to protect the execution of the cleared route against potential conflicts,

are additional safety tools provided by the ATC system to cover the **Taxi vs. Cross or Cross vs. Taxi (Deadlock)** situation (see 2.3.2.2.2).

**Notes –**

The logic behind this alert is the same as for the second case of Taxi vs. Taxi (deadlock). This is a special case of Taxi vs. Taxi where the controllers issuing the clearances are responsible for different AoRs and therefore may not be aware of the clearance for the other aircraft. (see 2.3.2.2.3.6 UC-CATC-08 Taxi vs Cross (Deadlock)).

#### 2.3.2.1.2 Update of CATC (for Runway Operations)

Alerts supporting reasonable assurance

The concept of Conflicting ATC Clearances developed in the SESAR 1 program Solution #02 is based on the premise that clearances input to the ATC system (e.g., using Electronic Flight Strips (EFS)) do not conform to local ATC procedures. For example, this could be the commonly used rule that there shall be no more than one active clearance for a runway. This can be a major limitation at busy airports as it severely limits runway throughput.

The updated CATC detection considers the positions of the aircraft and predicts their movements. The alert is only triggered if the system must assume, based on the available data, that runway separation (according to ICAO DOC4444 [18]) will be infringed when the landing aircraft crosses the runway threshold. This procedure supports the “reasonable assurance” practice described in ICAO DOC 4444, which is successfully applied by controllers at some airports with high traffic demand.

The following Prerequisite (ICAO 4444 [18], section 7.10.2 Clearance to land) applies when using reasonable assurance: "*An aircraft may be cleared to land when there is **reasonable assurance** that the separation will exist when the aircraft crosses the runway threshold, provided that a clearance to land shall not be issued until a preceding landing aircraft has crossed the runway threshold.*". This prerequisite applies to LAND/LND, and similarly to TOF/LND and CRS/LND (see sections following below). When implementing the conflict detection that triggers these warnings, separation is considered assured when the first aircraft has left the runway.

Table 11 shows all runway related CATC alerts defined in Solution #02 (compare to Table 8 in section 2.3.1.1). The combinations highlighted in blue (**CRS/LND**, **TOF/LND**, and **LND/LND**) are the alerts for the conflicts where ATC is assumed to control runway traffic with reasonable assurance (depending on the local procedures). The respective conflict detection rules use the approach described in the previous paragraph to trigger the CATC alert. All other potential clearance conflict situations trigger a CALC alert according to the Solution #02 rule "only one active clearance on the runway". For the other clearance combinations, as defined in Solution #02, more than one active clearance for a runway triggers the corresponding CATC alert.

| First Clearance Input | Second Clearance Input | Alert identifier |
|---|---|---|
| LINE UP | LINE UP, CROSS, ENTER, TAKE OFF, LAND | |
| **CROSS** or ENTER | LINE UP, CROSS, ENTER, TAKE OFF, **LAND** | **CRS/LND** |
| **TAKE OFF** | LINE UP, CROSS, ENTER, TAKE OFF, **LAND** | **TOF/LND** |
| **LAND** | LINE UP, CROSS, ENTER, TAKE OFF, **LAND** | **LND/LND** |

**Table 11: CATC for runway operations defined by this solution for the use of reasonable assurance. Only the blue clearance combinations consider reasonable assurance.**

The use of reasonable assurance is a local decision recorded in the local operating instructions. According to this decision there are two use cases:

- If reasonable assurance is not used, CATC for runway operation as defined in Solution #02 is used and the "only one active clearance on the runway" rule applies to all possible clearance conflict scenarios.
- If reasonable assurance is used, CATC for runway operation as defined in ICAO Doc 4444 and applied by Solution PJ.02-W2-21.1 for CRS/LND, TOF/LNS, and LND/LND situations.

Both procedures are supported by Solution PJ.02-W2-21.1 to provide the best possible support to the controller.

In the case of runway operations using reasonable assurance, proper calibration of the alert trigger can significantly reduce the number of nuisance alerts and give the controller time to resolve clearance conflicts before the situation develops into a dangerous incident.





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#### 2.3.2.1.2.1 Land vs Land

**Data required –** Clearances, Airport data, Surveillance, Aircraft performances.

**Alert triggered –**

If **Aircraft A** has been given Landing clearance and **Aircraft B** is given Landing clearance with prediction that **Aircraft B** will cross the RWY threshold at the same time when **Aircraft A** will still occupy the RWY (see Figure 7).
$TLR_{AircraftA} > TTT_{AircraftB}$.
TLR predicted Time to Leave the RWY (for Aircraft A)
TTT predicted Time To the Threshold (for Aircraft B)

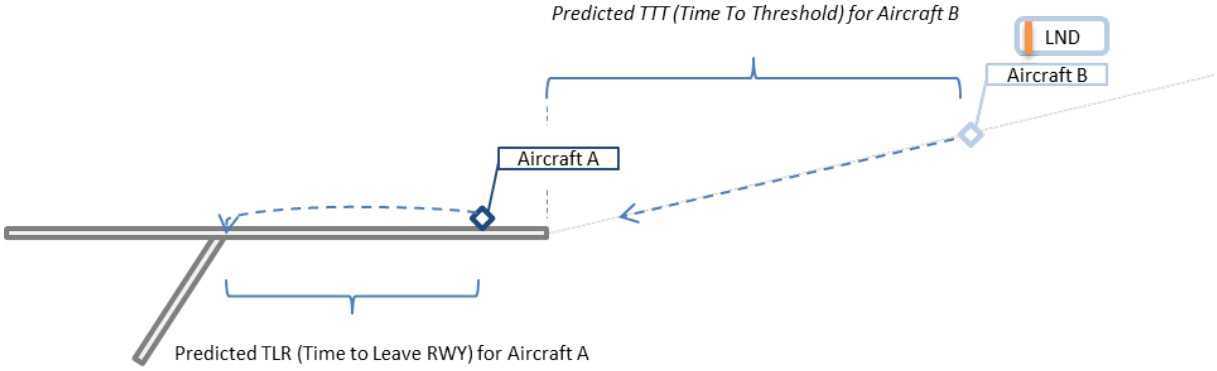


**Figure 7: Updated CATC – Land vs. Land**

**Options –**

The **Predictive Indication** to identify potential clearance conflicts before a LAND clearance is entered for Aircraft B is an additional safety tool provided by the ATC system to cover the **Land vs. Land** situation (see 2.3.2.2.2.1). See also the Notes below!

**Notes –**

- In the case of an early LAND clearance given to the approaching Aircraft B it is possible that no potential conflict is detected when the controller enters the clearance into the HMI (this is different to Solution #02 version of the alert). The alert is not triggered until the potential separation infringement has been calculated based on the rule outlined above. Consequently, the Predictive Indication does not indicate a potential clearance conflict before a potential separation infringement is calculated!
- This **Land vs Land alert alert** is an alternative to the SESAR1 Solution #02 **Land vs Land alert** (see [13], section 3.2.3.16). The alternate version of Land vs Land is not intended to replace the Solution #02 version.

#### 2.3.2.1.2.2 Take Off vs Land

**Data required –** Clearances, Airport data, Surveillance, Aircraft performances.

**Alert triggered –**

If **Aircraft A** has been given Take Off clearance and **Aircraft B** is given Landing clearance with prediction that the latter will cross the RWY threshold at the same time when **Aircraft A** will still occupy the RWY (see Figure 8).





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$TLR_{AircraftA} > TTT_{AircraftB}$.
TLR predicted Time to Leave the RWY (for Aircraft A)
TTT predicted Time To the Threshold (for Aircraft B)

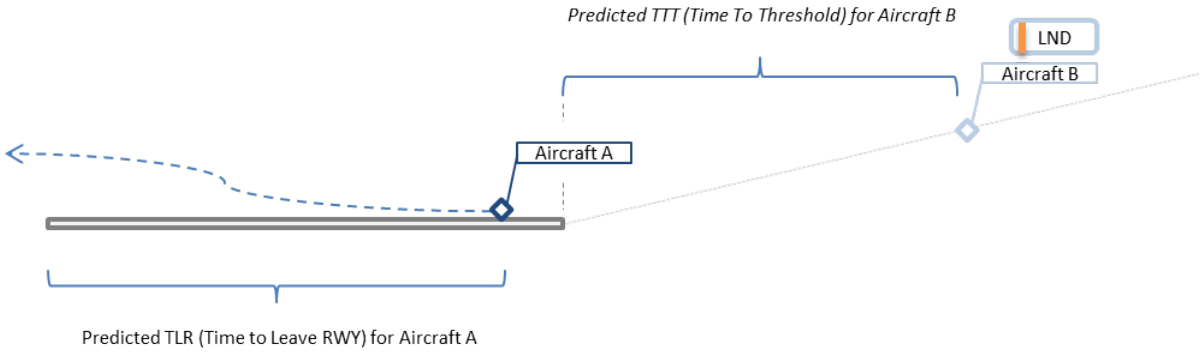


**Figure 8: Updated CATC – Take Off vs. Land**

**Options –**

The **Predictive Indication** to identify potential clearance conflicts before a LAND clearance is entered for Aircraft B is an additional safety tool provided by the ATC system to cover the **Take Off vs. Land** situation (see 2.3.2.2.2.1). See also the Notes below!

**Notes –**

- In the case of an early LAND clearance given to the approaching Aircraft B it is possible that no potential conflict is detected when the controller enters the clearance into the HMI. The alert is not triggered until the potential separation infringement is calculated based upon the calculation presented above. Consequently, the Predictive Indication does not indicate a potential clearance conflict before a potential separation infringement is calculated!
- In the case of a cancelled Take Off it is essential to not simply cancel the Take Off Clearance in the system. A mobile on an active runway always requires an assigned clearance. Without a clearance
  1. the mobile is not visible to the CATC detection, and
  2. the mobile will trigger a runway incursion.

  Therefore, the clearance status shall be switched to another clearance:
  1. TAXI in the case of Vacate or Exit instruction, or
  2. LINE-UP in the case the Take Off will be shortly resumed.
- This **Take Off vs Land alert** is an alternative to the SESAR1 Solution #02 **Take Off vs Land alert** (see [13], section 3.2.3.12).The alternate version of Take Off vs Land is not intended to replace the Solution #02 version.

#### 2.3.2.1.2.3 Cross vs Land

**Data required –** Clearances, Airport data, Surveillance, Aircraft performances.

**Alert triggered –**

If **Aircraft A** has been given Cross clearance and Aircraft **B** is given Landing clearance with prediction that the latter will cross the RWY threshold at the same time when **Aircraft A** will still occupy the RWY (see Figure 9).
$TLR_{AircraftA} > TTT_{AircraftB}$.





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TLR predicted Time to Leave the RWY (for Aircraft A)
TTT predicted Time To the Threshold (for Aircraft B)

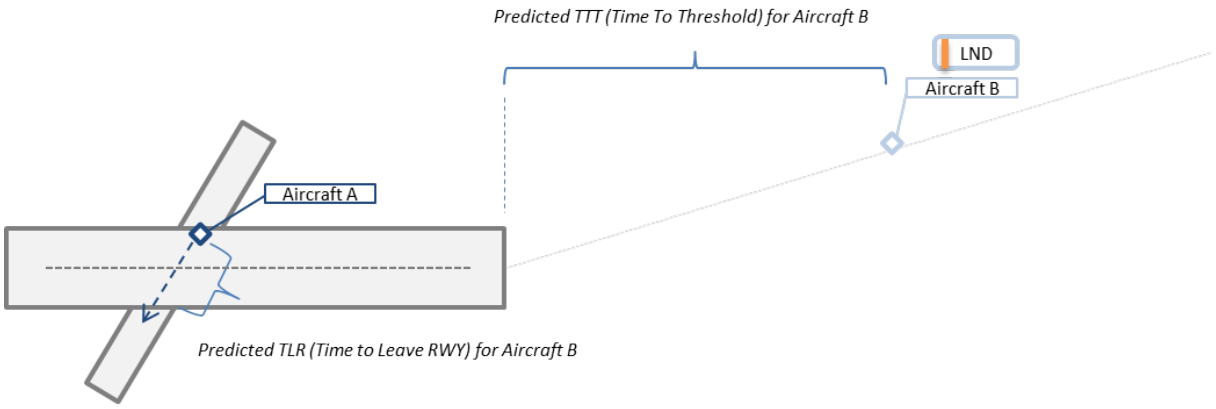


**Figure 9: Updated CATC – Cross vs. Land**

**Options –**

The **Predictive Indication** to identify potential clearance conflicts before a LAND clearance is entered for Aircraft B is an additional safety tool provided by the ATC system to cover the **Cross vs. Land** situation (see 2.3.2.2.2.1). See also the Notes below!

**Notes –**

- In the case of an early LAND clearance given to the approaching Aircraft B it is possible that no potential conflict is detected when the controller enters the clearance into the HMI. The alert is not triggered until the potential separation infringement is calculated based upon the calculation presented above. Consequently, the Predictive Indication does not indicate a potential clearance conflict before a potential separation infringement is calculated!
- This **Cross vs Land alert** is an alternative to the SESAR1 Solution #02 **Cross vs Land alert** (see [13], section 3.2.3.8). The alternate version of Cross vs Land is not intended to replace the Solution #02 version.

#### 2.3.2.1.2.4 Take Off vs Take Off (Converging SIDs)

**Data required –** Clearances, standard arrival and departure procedures.

**Alert triggered –**

Standard departure clearances given to pilots might under certain circumstances lead to a possible danger of infringed separation minima (see Figure 10). This is caused by the given airport layout and the defined standard arrival and departure procedures.





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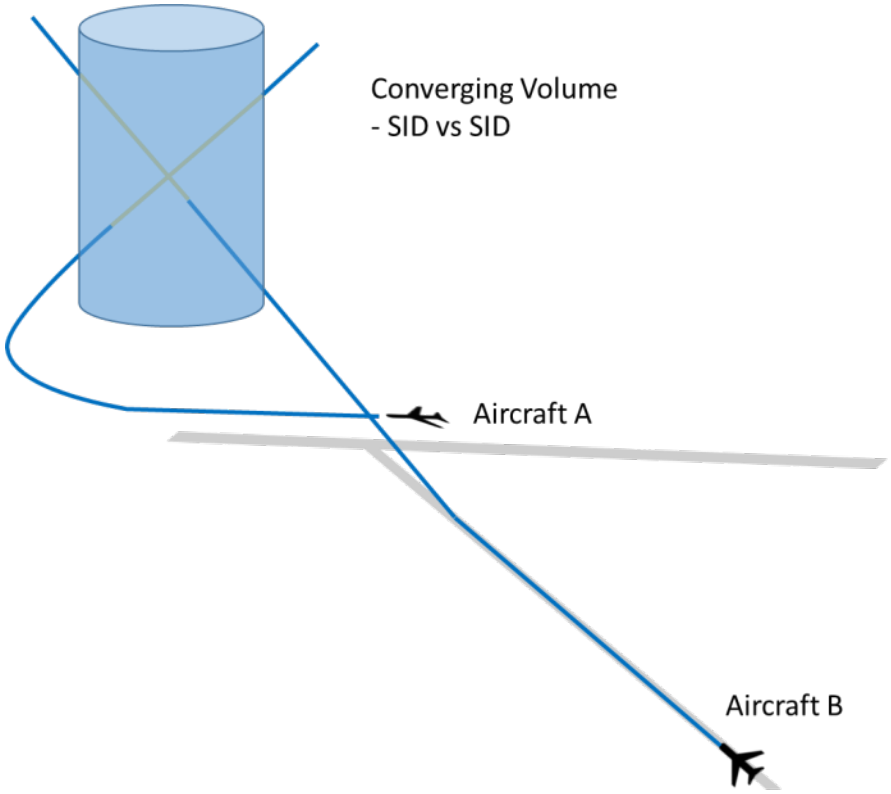


**Figure 10: CATC – Take Off vs. Take Off (Converging SIDs)**





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**Options –**

The **Predictive Indication** to identify potential clearance conflicts before a Take Off clearance is entered for Aircraft B is an additional safety tool provided by the ATC system to cover the **Take Off vs. Take Off (Converging SIDs)** situation (see 2.3.2.2.2.1).

**Notes –**

The **Take Off vs Take Off (Converging SIDs) alert** extends Solution #02 **Take Off vs. Take Off alert** (see [13], section 3.2.3.11).

#### 2.3.2.1.3 RMCA and CMAC Alerts vs ATC Clearance

SESAR1 trials identified that if there was an active RMCA alert or CMAC Alert associated with the runway (e.g., No Take Off or RWY Incursion) then there can be a link to the CATC concept where the controller would not normally give a clearance onto the runway whilst an active runway alert is in progress.

NOTE: RMCA/CMAC Alert vs ATC Clearance is not actually a CATC alert, i.e., there are no two active clearances in conflict. However, the alert is perfectly suited to be represented by the CATC Predictive Indication.

##### 2.3.2.1.3.1 RMCA Alert vs ATC Clearance

**Data required –** Clearances and Surveillance.

**Alert triggered –**

The Tower Runway Controller will receive an alert when there is an active RMCA alert and a clearance to use the same runway is input for a mobile waiting to cross/enter or an aircraft is waiting to line up/ take off (see example in Figure 11) or an aircraft approaching to land.

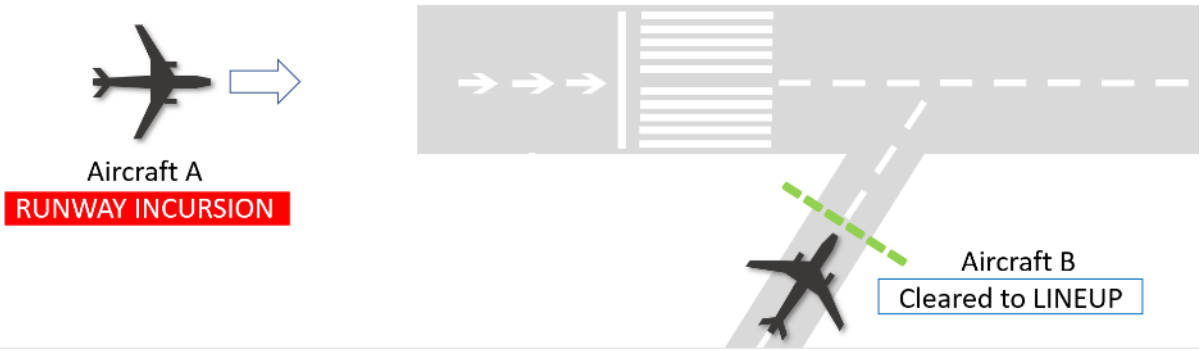


**Figure 11:** RMCA caused by Aircraft A landing soon without LAND clearance and Aircraft B given LINE UP by ATCO triggers a **RMCA vs Clearance Alert**

**Options –**

The **Predictive Indication** to identify potential clearance conflicts before a clearance is entered for Aircraft B is an additional safety tool provided by the ATC system to cover the **RMCA vs Clearance Alert** situation (see 2.3.2.2.2.1).



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#### 2.3.2.1.3.2 CMAC Alert vs ATC Clearance

**Data required –** Clearances and Surveillance.

**Alert triggered –**

The Tower Runway Controller will receive an alert when there is an active CMAC runway alert and a clearance is input in the following scenarios:

3. When a CMAC RUNWAY INCURSION Alert has been triggered and a clearance (Line Up, Cross, Enter, Take Off or Landing) is given for an aircraft for the same runway (see example in Figure 12).

4. When a CMAC NO TAKEOFF Clearance Alert has been triggered and an input Line Up, Cross or Enter is given for a mobile waiting in front of the departing aircraft on the same runway (see example in Figure 13).

5. When a CMAC NO LANDING Clearance Alert has been triggered and an input Line Up, Take Off, Cross or Enter is given for a mobile waiting in front of the arriving aircraft on the same runway (see example in Figure 14).
   **NOTE -** The $TLR_{AircraftA}$>$TTT_{AircraftB}$ prediction for TOF/LND and CROSS/LND does not apply here (see sections 2.3.2.1.2.2 and 2.3.2.1.2.3)!

6. When a CMAC WRONG RUNWAY Alert has been triggered and an input Line Up, Take Off, Cross or Enter is given for a mobile waiting in front of the arriving aircraft on the same runway (see example in Figure 15).

**Options –**

The **Predictive Indication** to identify potential clearance conflicts before a clearance is entered for Aircraft B is an additional safety tool provided by the ATC system to cover the **CMAC vs Clearance Alert** situation (see 2.3.2.2.2.1).


**Figure 12:** CMAC **RUNWAY INCURSION** Alert caused by Aircraft A entering RPA without clearance and Aircraft B given LAND by ATCO triggers a **CMAC vs Clearance Alert**.



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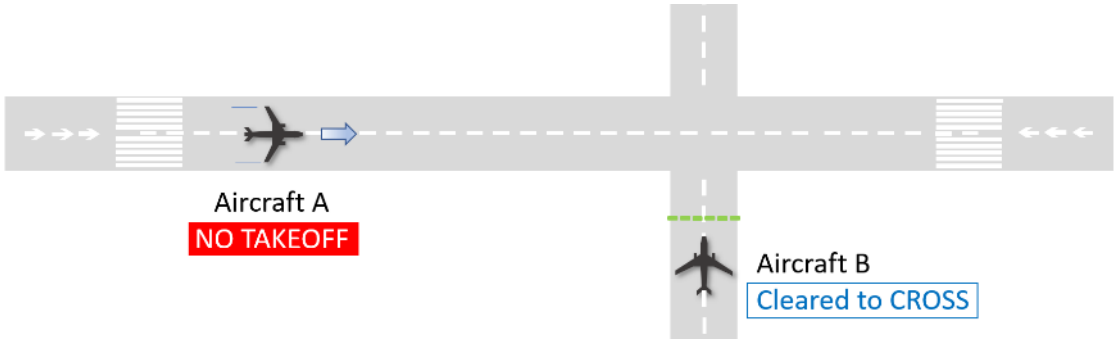


**Figure 13:** CMAC **NO TAKEOFF** Clearance Alert caused by Aircraft A taking off without clearance and Aircraft B given CROSS by ATCO triggers a **CMAC vs Clearance Alert**.


**Figure 14:** CMAC **NO LANDING** Clearance Alert caused by Aircraft A landing without clearance and Aircraft B given TAKEOFF by ATCO triggers a **CMAC vs Clearance Alert**.

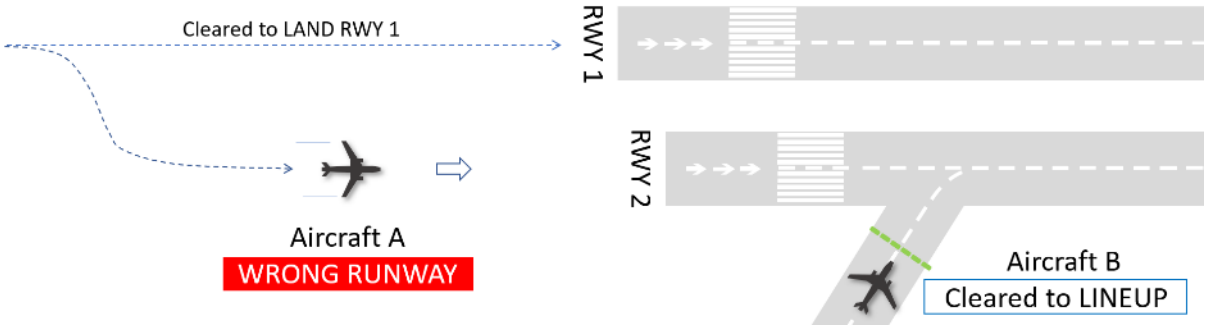


**Figure 15:** CMAC **WRONG RUNWAY** Alert caused by Aircraft A cleared for RWY 1 but landing on RWY 2 and Aircraft B given LINEUP on RWY 2 by ATCO triggers a **CMAC vs Clearance Alert**.

#### 2.3.2.1.4 Update of CMAC Alerts

##### 2.3.2.1.4.1 Stand Occupied Alert

**Data required –** Stand information

**Alert triggered –**

If the assigned parking stand of an arriving aircraft is occupied an information alert should be displayed to provide the Controller with situational awareness that they might need to hold the aircraft on a taxiway until the departing aircraft vacates the stand or until an alternative stand is allocated.

**Notes –**





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The CMAC Stand occupied alert should not be presented in the same way as other CMAC or CATC alerts as it is actually a planning alert and should therefore have a lower priority. A colour other than INFORMATION (yellow) and ALARM (red) would therefore be appropriate.

#### 2.3.2.1.5 Runway Situational Notifications

##### 2.3.2.1.5.1 Runway Busy

The Runway Busy Notification is not an alert per se, but rather an awareness augmentation tool available to the controller in order to constantly keep him informed about the operational status of a runway. This notification consists in colour-coding (typically, in yellow) the runway stripe on the GRP to remind the controller that the runway is currently occupied by a mobile, or if him or another controller have already granted the runway for usage by landing or departing traffic. The runway is the key shared resource for ATC/ATM, and as such is the most critical area where accidents/incidents can happen. While CATC alerts are inform the controller about any potential mistake in giving a clearance, the runway busy notification provides an even more proactive visual indication that a-priori prevents the controller from giving another clearance to use the runway.

Once the Runway Busy colouring happens, the controller is not requested to change his normal way of working, however the notification acts as a reminder and gives him/her a better situational awareness which will guide him/her to taking better traffic separations decisions. As soon as all the runway occupancy conditions cease, the runway colouring reverts to normal.

**Runway Busy trigger conditions –**

1. There is currently a target (vehicle or aircraft) on the runway, OR
2. a Landing, Line Up, Take-Off clearance has been given to at least one flight

**Runway Busy termination conditions –**

1. There is no target (vehicle or aircraft) on the runway, AND
2. landing / departing traffic previously cleared for runway usage have vacated it.

##### 2.3.2.1.5.2 Runway in Conflict

The **Runway In Conflict** Notification is an enhancement in the presentation of safety net alerts concerning the runway (RMCA, CMAC or CATC). During his routine work, especially in high-density traffic and peak hours, the controller is constantly receiving stimuli and simultaneously focussing on different movements and different portions of his/her area of interest. In heavy workload conditions, stress and fatigue, even if the safety nets alerts are in place and work correctly, they might be overlooked or ignored.

The Runway In Conflict Notification consists in colour-coding (typically, in red) the runway stripe on the GRP to immediately show to the controller that the runway is currently involved in at least one conflict. The notification is triggered simultaneously with the first safety net alert involving a runway (RMCA, CMAC or CATC). Once the Runway In Conflict colouring happens, the controller, in case he/she has not noticed the alert via the track labels on the GRP or via alert lists, will immediately assess the situation on the runway and recover his awareness about the impending danger, therefore being able to take necessary actions. As soon as all the alerting conditions cease, and the safety net alerts are removed, also the runway colouring reverts to normal.





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**Runway In Conflict trigger conditions –**

a RMCA alert is triggered, OR

a CMAC alert involving the runway (e.g. a landing on wrong runway) is triggered, OR

a runway CATC alert is triggered (e.g., LAND/LAND, LINEUP/LAND, CROSS/LAND, etc…);

**Runway In Conflict termination conditions –**

any safety net alert involving the runway cease to exist.

### 2.3.2.2 Use Cases

This section contains a detailed description of all use cases identified that are sufficient to depict how the SESAR Solution(s) works. This section includes the following use cases.

| | |
|---|---|
| Use Case (NOV-5) | [NOV-5][CATC-01] Predictive Indicator |
| Use Case (NOV-5) | [NOV-5][CATC-02] Conditional Clearance |
| Use Case (NOV-5) | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |
| Use Case (NOV-5) | [NOV-5][CATC-09-10-11-12] Updated CATC |
| Use Case (NOV-5) | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |
| Use Case (NOV-5) | [NOV-5][CMAC-01] Stand Occupied |
| Use Case (NOV-5) | [NOV-5][RWY-01] Runway Busy Notification |
| Use Case (NOV-5) | [NOV-5][RWY-02] Runway In Conflict Notification |

**Abnormal conditions**

The Use Cases do not consider abnormal conditions that affect the functionality of the safety support tools. Rather, the purpose of the tools as presented in the use cases is to detect abnormal traffic situations and inform the controller of these traffic developments using appropriate predictions and alerts that prompt the controller to intervene. It is the controller who then handles these abnormal traffic situations.

In the event of a technical malfunction, this is considered an abnormal condition of the A-SMGCS hosting the Safety Support Service:

In order to provide an error-free service, the safety support tools depend on the good functioning of their A-SMGCS environment, which consists of the A-SMGCS services (Surveillance, Routing and Planning, etc.) and their respective information supply chains. The logic of the conflict detection rules assumes that the information provided by the A-SMGCS services is correct and represents the real traffic situation. Consequently, incorrect information leads to abnormal conditions.

This also includes the entry of the clearance into the system by the controller, which must take place simultaneously with the clearance given via voice communication:





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If the clearance is not entered simultaneously, the mapping of the traffic in the A-SMGCS does not match the real traffic situation. This correctly leads to a CMAC alert, since the pilot does not have clearance for the action he is performing according to the system. This is an abnormal condition caused by the ATCO.

Entering an incorrect clearance, i.e., deviating from the clearance via voice communication to the pilot, also leads to an abnormal condition caused by the ATCO. However, such incorrect clearance entries are quickly identified and corrected.

Abnormal conditions can affect various aspects of information processing that can affect the functioning of the Safety Support Tools. Consequently, the dependencies on the information quality of the supplying services at the A-SMGCS level must be considered to determine the operational value of a degraded system. For example, if part of the surveillance is down, the safety support tools cannot monitor the running traffic and thus the mapping of the traffic in the A-SMGCS does not match the real traffic situation. In such a case it is better to switch off the Safety Support Service. This has to be decided on A-SMGCS level. Error reporting, recovery, latency or integrity impact, procedures to follow, etc. are to be handled at A-SMGCS level.

In the event of a malfunctioning A-SMGCS, the controller must be able to direct traffic without the assistance of the safety support systems. In principle, the controller's duties include observing and directing traffic and identifying potential conflicts. This is always his responsibility, regardless of whether the Safety Support Service is in operation or not.

#### 2.3.2.2.1 EATMA Extended Airport Safety Nets for Controllers at A-SMGCS Airports

The new operating method introduces several new situations for which a CATC or CMAC alert is triggered. The EATMA Use Cases (Extended Airport Safety Nets for Controllers at A-SMGCS Airports) are composed in the EATMA NOV-2 diagram in Figure 16.



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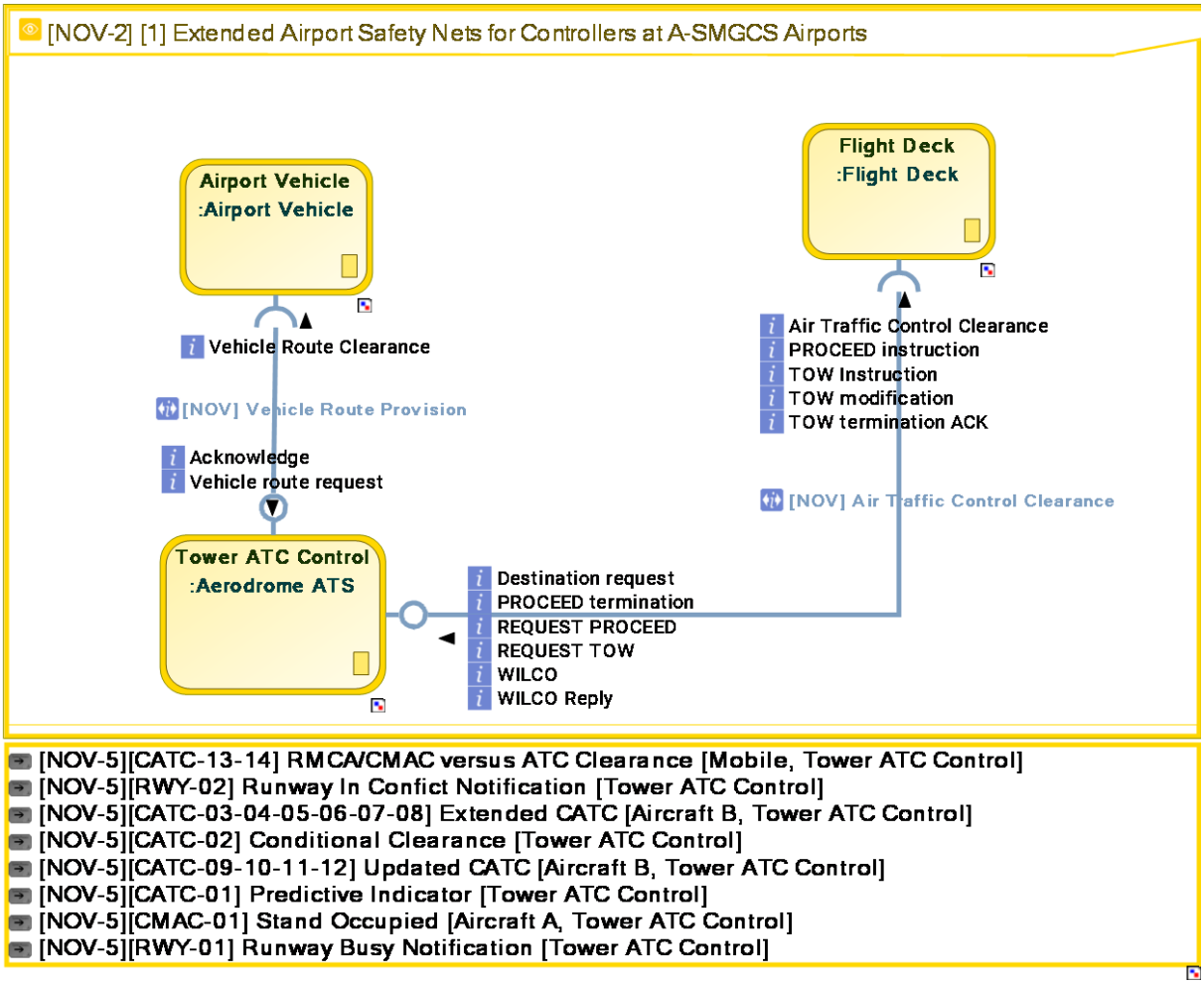


**Figure 16: EATMA NOV-2 Model Extended Airport Safety Nets for Controllers at A-SMGCS Airports**

#### 2.3.2.2.2 Common Use Cases

The Common Use Cases specified here are considered as components in the CATC Use Cases described in the subsequent sections. Both Use Cases below are optional, i.e., they extend the Parent CATC Use Case. Using the **Predictive Indication UC** and the **Conditional Clearance UC** provide additional activity options to avoid incidents at an early stage of the traffic development.

##### 2.3.2.2.2.1 UC-CATC-01 Predictive Indication

The CATC Predictive Indication is a safety support tool that makes use of the CATC conflict detection. Instead of triggering an CATC alert the Predictive Indication uses the conflict detection for a virtual (= not entered) clearance.

The HMI can be adapted to give a Predictive Indication to the Controller showing that if a specific clearance is entered it triggers a CATC alert. The clearance that is probed for a conflict is the next clearance to be given by the Controller according to the current clearance status of the route assigned to the considered mobile. This supports the Controller's situational awareness and normally prevents a predicted clearance conflict that is indicated to the Controller.



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Consequently, the CATC Predictive indication can be considered as an add-on that requires the CATC conflict detection to be implemented. Unlike the CATC Alert it does not indicate an actual CATC conflict. It only indicates a potential conflict before the controller enters the next clearance to be given according to the current clearance status of a mobile's route (NOTE: It is possible that there are several options (holding points) for the next entry of a clearance along the assigned route. All these options should be considered).

| | **UC-CATC-01 Predictive Indication** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-01 |
| **Name** | Predictive Indication UC |
| **Scope/Description** | This Use Case describes how the ATC system detects a potential CATC before it is entered by the Controller and how it will be presented on the Controller's HMI.<br>This Use Case is designed to be an optional element in other CATC Use Cases. |
| **Actors** | Tower Runway Controller/Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance and a means to input ATC clearances.<br>• The controller's HMI has a Predictive Indication GUI element that indicates a potential CATC to the controller (e.g. on the track label or the Electronic Flight Strip of the aircraft).<br>• A planned route is assigned to the aircraft assessed for potential CATC. |
| **Post conditions** | • The potential CATC is displayed on the Predictive Indication GUI element of the Controller's HMI (e.g., on the track label or the Electronic Flight Strip of the aircraft).<br>• If no potential CATC is detected, the GUI element Predictive Indication displays "no alert" [3]. |
| **Trigger** | This UC is triggered by a parent CATC UC. |
| **Nominal flow** | 1. The ATC system checks the expected next clearance entry according to the planned route for a potential CATC with a clearance given to another mobile.<br><br>2. The result of the CATC check is automatically displayed on the Controller's HMI.<br>• If the ATC system detects a potential CATC it flags the Aircraft with an indication for the potential CATC on the Controller's HMI.<br>•. If no potential CATC is detected, the GUI element Predictive Indication displays "no alert". |

[3] Information should always be displayed to clearly indicate the status: alert, no alert, out of order.

3. The Controller assesses the Predictive CATC Indication. If a potential CATC is signaled he either decides not to give the clearance or he decides that the situation is safe and ignores the Predictive Indication display.

**NOTE**: In case the controller decides to not enter the clearance the situation maybe still require additional actions to solve the critical situation!

4. This UC ends. Continue with the parent UC.

| | |
|---|---|
| **Failure Flow** | In case the CATC Safety Net function is not available the non-availability is indicated on the controller's HMI. |

#### 2.3.2.2.2.2 EATMA [CATC-01] Predictive Indication

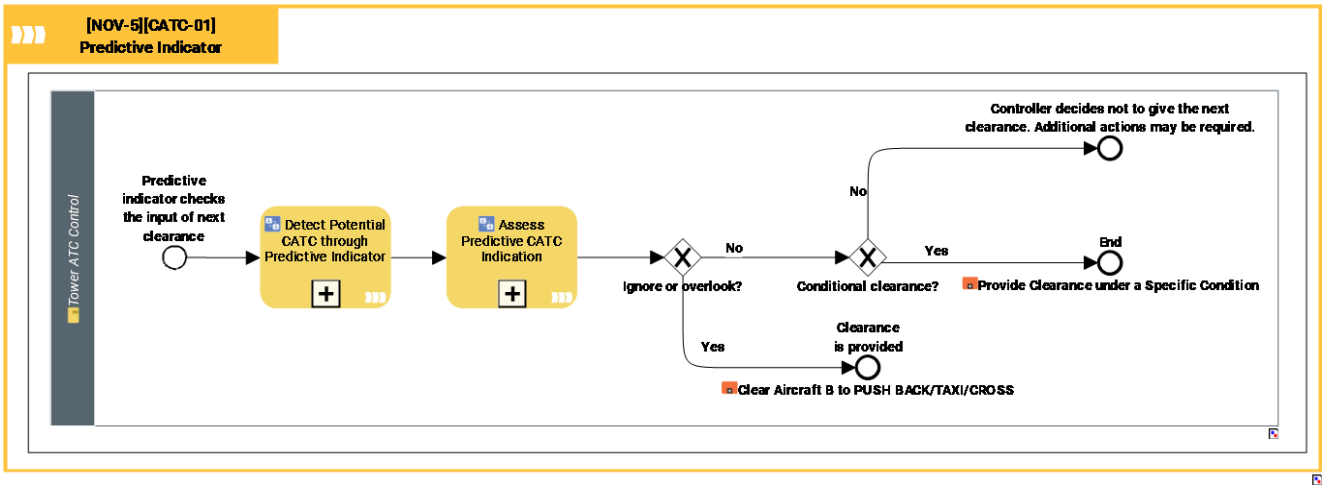


**Figure 17: EATMA NOV-5 Model [CATC-01] Predictive Indicator**

| Activity | Description |
|---|---|
| Assess Predictive CATC Indication | The Controller assesses the operational situation related to the Predictive CATC Indication provided. If a potential CATC is signaled he either decides not to give the next clearance or he decides that the situation is safe and ignores the Predictive Indicator display.<br><br>NOTE: In case the controller decides to not enter the clearance the situation may still require additional actions to solve the critical situation. |
| Detect Potential CATC through Predictive Indicator | Conflict with the ATC Clearance intended to be entered by the ATCO |

Table 12: Activities for [CATC-01] Predictive Indicator

| Issuer | Info Exchange | Addressee | Info Element | Info Entity |
|---|---|---|---|---|
| n/a | | | | |

Table 13: Information Exchange for [CATC-01] Predictive Indicator

#### 2.3.2.2.2.3 UC-CATC-02 Conditional Clearance

A Conditional Clearance is an instruction that is issued by an air traffic controller and only takes effect when a certain condition is met, e.g., CLEARED TO CROSS BEHIND THE LANDING AIRCRAFT ( **NOTE**: The aircraft referenced in the conditional clearance is clearly identified by the responsible air traffic controller and pilot). The controller issues the Conditional Clearance to the aircraft and enters the clearance including the condition into the ATC system. The **CATC service disables any alerts** between the cleared aircraft and the aircraft linked by the condition. It is the pilot's task to wait for the condition to occur before moving the aircraft according to the clearance given by the controller.

**NOTE**: The CATC service does not trigger an alert if the condition is violated! In case the pilot disregards the condition and enters the runway a RMCA or CMAC RUNWAY INCURSION alert is triggered (applies for conditional Cross, Enter, Line-up, Take-off) (if RMCA or CMAC service is in operation). No additional safeguard exists for conditional TAXI and PUSH BACK operations.

| | **UC-CATC-02 Conditional Clearance** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-02 |
| **Name** | Conditional Clearance UC |
| **Scope/Description** | This Use Case describes the use of Conditional Clearances when CATC service is in operation.<br>**NOTE**: This Use Case is designed to be an optional element in CATC Use Cases. |
| **Actors** | Tower Runway Controller/Tower Ground Controller/Apron Manager (collectively referred to as Controller), Pilot, Vehicle Driver |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance and a means to input ATC clearances.<br>• The controller's HMI provides means to enter conditional clearances. |
| **Post conditions** | • The condition is fulfilled, and the clearance becomes effective. |
| **Trigger** | This UC is triggered by a parent CATC UC. |
| **Nominal flow** | 1. The Controller issues a Clearance for a mobile A by R/T (or data link) under a specific condition (e.g., that aircraft B shall has passed) and enters the Clearance and the Condition on the Controller's HMI.<br>2. **Runway Operations only:** If the pilot (or vehicle driver) of mobile A violates the condition by entering the runway a **RMCA or CMAC RUNWAY INCURSION alert** is triggered to warn the Tower Runway Controller that a potential conflict situation has been detected. The Alert is displayed on the Tower Runway Controller's HMI.<br>3. The pilot (or vehicle driver) of mobile A waits for the condition to be satisfied (e.g., mobile B has passed) and then continues according to the active clearance. |





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4. This UC ends. Continue with the parent UC.

| | |
|---|---|
| **Failure Flow** | In case the CATC Safety Net function is not available the non-availability is indicated on the controller's HMI. |

#### *2.3.2.2.2.3.1 EATMA [CATC-02] Conditional Clearance*

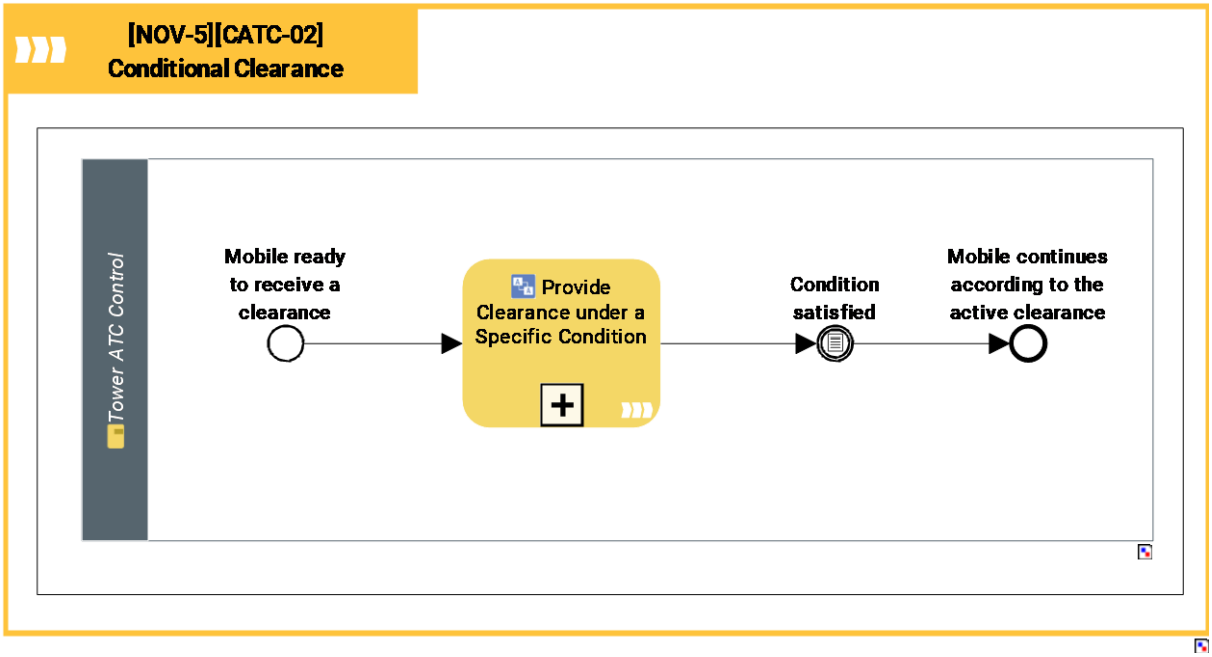


**Figure 18: EATMA NOV-5 Model [CATC-02] Conditional Clearance**

| Activity | Description |
|---|---|
| Provide Clearance under a Specific Condition | The ATCO provides a clearance under a condition that clearly determines the relative priority of movement (taxi, push back, enter, cross, line-up) with respect to another mobile's movement. |

**Table 14: Activities [CATC-02] Conditional Clearance**

| Issuer | Info Exchange | Addressee | Info Element | Info Entity |
|---|---|---|---|---|
| n/a | | | | |

**Table 15: Information Exchange for [CATC-02] Conditional Clearance**

### 2.3.2.2.3 Use Cases for Extended CATC (for Ground Operations)

The new operating method introduces several new situations for which an Extended CATC alert is triggered. The new situations are described as Use Cases in the sections below.

All Extended CATC Use Cases follow the same basic scheme that is visualised in the EATMA NOV-5 Model [CATC-03-04-05-06-07-08] Extended CATC in section 2.3.2.2.3.7,

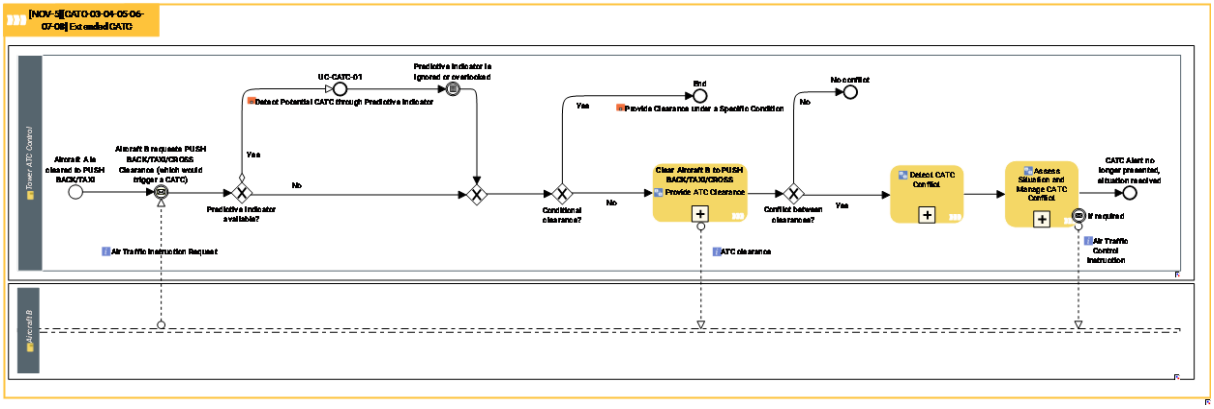


Figure 19.

### 2.3.2.2.3.1 UC-CATC-03 Push Back vs Push Back

| | **UC-CATC-03 Push Back vs Push Back** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-03 |
| **Name** | Push Back vs Push Back UC |
| **Scope/Description** | This Use Case describes how the Controller deals with a **Push back versus Push back CATC** alert, which is detected by the ATC system and how it is presented on the Tower Ground Controller's/Apron Manager's HMI. |
| **Actors** | Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• Planned routes are assigned to the aircrafts considered in this UC.<br>• The Push Back procedure is part of the route and includes the orientation of the aircraft after Push Back (e.g., "nose to the East").<br><br>• Aircraft A is parked on the apron and receives a PUSH BACK Approval via R/T (or data link) from the Controller .<br>• The Controller has entered the PUSH BACK clearance into the ATC system.<br>• Aircraft B is also ready for Push Back and parked next (or opposite) to Aircraft A on the apron. |
| **Post conditions** | The **Push Back vs Push Back CATC** is resolved, and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B requests PUSH BACK Clearance. |
| **Nominal flow** | 1. **Optional**: The Controller reads the Predictive CATC Indication for Aircraft B (continue with **Use Case Predictive Indication**).<br>If the Controller decides not to issue a PUSH BACK clearance for Aircraft B this UC ends here. |



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|---|---|
| | **Optional**: The Predictive Indicator indicates a potential Conflict → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3) |
| | 2. The Push Back Procedure routes of Aircraft A and Aircraft B overlap. The Aircraft A has not moved after receiving the push back clearance from the Controller.<br>3. The Controller clears aircraft B to PUSH BACK by R/T (or data link) and enters PUSH BACK on the HMI for Aircraft B.<br>**Optional**: The Controller clears aircraft B using a conditional PUSH BACK Clearance by R/T (or data link) and enters the PUSH BACK Clearance and the specific condition "PUSH BACK AFTER PUSH BACK <AIRCRAFT A>" on the HMI for Aircraft B → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3).<br>4. The input of the PUSH BACK clearance for Aircraft B by the Controller triggers the ATC system to check if the Push Back trajectory of aircraft B is overlapping with the cleared Push Back of aircraft A.<br>If the ATC system predicts that the Push back is safe **the UC ends here**.<br>5. The ATC system detects that the Push Back trajectory of aircraft A is blocking the Push Back trajectory of Aircraft B and triggers a **PUSH BACK vs PUSH BACK Alert** to warn the Controller of the potential conflict. The Alert is displayed on the Controller's HMI and clearly identifies the pair of aircraft involved and the reason for the alert.<br>6. The Controller verifies the situation and cancels the PUSH BACK Clearance for aircraft B by R/T and enters the change into the Controller's HMI.<br>**Optional**: The Controller cancels the Push Back clearance of Aircraft A or turns it into a Conditional Clearance.<br>7. The CATC alert is no longer presented to the ATCO.<br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Controller and the Flight Crew/Truckdriver will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

### 2.3.2.2.3.2 UC-CATC-04 Taxi vs Push Back

| | **UC-CATC-04 Taxi vs Push Back** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-04 |
| **Name** | Taxi vs Push Back UC |
| **Scope/Description** | This Use Case describes how the Controller deals with a **Taxi versus Push back CATC** alert, which is detected by the ATC system and how it is presented on the Tower Ground Controller's/Apron Manager's HMI. |
| **Actors** | Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• Planned routes are assigned to the aircraft considered in this UC.<br>• The Push Back procedure is part of the route and includes the orientation of the aircraft after Push Back (e.g., "nose to the East").<br><br>• Aircraft A received a TAXI Clearance via R/T (or data link) from the Controller .<br>• The Controller has entered the TAXI clearance into the ATC system.<br>• Aircraft B is ready for taxi out and parked at a stand requiring a Push Back approval. |
| **Post conditions** | The **Taxi vs Push Back CATC** is resolved, and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B requests PUSH BACK Clearance. |
| **Nominal flow** | 1. **Optional**: The Controller reads the Predictive CATC Indication for Aircraft B (continue with **Use Case Predictive Indication**).<br>If the Controller decides not to issue a PUSH BACK clearance for Aircraft B **this UC ends here**.<br><br>**Optional**: The Predictive Indicator indicates a potential Conflict → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3)<br><br>2. The Push Back Procedure route for Aircraft B, both in position as in time, is overlapping with the cleared taxi route of aircraft A. Aircraft A is taxiing slowly or is still far-out and it is unclear when it passes the parking position of Aircraft B.<br><br>3. The Controller clears aircraft B to PUSH BACK by R/T (or data link) and enters PUSH BACK on the HMI for Aircraft B.<br><br>**Optional**: The Controller clears aircraft B using a conditional PUSH BACK Clearance by R/T (or data link) and enters the PUSH BACK Clearance and the specific condition "PUSH BACK AFTER TAXIING < AIRCRAFT A>" on the HMI for Aircraft B → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3).<br>4. The input of the PUSH BACK clearance for Aircraft B by the Controller triggers the ATC system to check if the Push Back trajectory of aircraft B is overlapping with the cleared Taxi route of aircraft A.<br>If the ATC system predicts that the Push back is safe **the UC ends here**. |





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|---|---|
| | 5. The ATC system detects that the Push Back trajectory of aircraft B is overlapping with the cleared Taxi route of aircraft A and triggers a **TAXI vs PUSH BACK Alert** to warn the Controller of the potential conflict. The Alert is displayed on the Controller's HMI and clearly identifies the pair of aircraft involved and the reason for the alert.<br>6. The Controller verifies the situation and cancels the PUSH BACK Clearance for aircraft B by R/T and enters the change into the Controller's HMI.<br><br>**Optional**: The Controller stops Aircraft A instead of Aircraft B.<br>7. The CATC alert is no longer presented to the ATCO.<br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10.In the case of a false alert, the Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.3.3 UC-CATC-05 Push Back vs Taxi

| | **UC-CATC-05 Push Back vs Taxi** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-05 |
| **Name** | Push Back vs Taxi UC |
| **Scope/Description** | This Use Case describes how the Controller deals with a **Push back versus Taxi CATC** alert, which is detected by the ATC system and how it is presented on the Tower Ground Controller's/Apron Manager's HMI. |
| **Actors** | Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• Planned routes are assigned to the aircraft considered in this UC.<br>• The Push Back procedure is part of the route and includes the orientation of the aircraft after Push Back (e.g. "nose to the East").<br><br>• Aircraft A is parked on the apron and receives a PUSH BACK Approval via R/T (or data link) from the Controller .<br>• The Controller has entered the PUSH BACK clearance into the ATC system.<br>• Aircraft B is ready for taxi out after completing Push Back or from a stand not requiring Push Back. |
| **Post conditions** | The **Push Back vs Taxi CATC** is resolved and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B requests TAXI Clearance. |



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|---|---|
| **Nominal flow** | 1. **Optional**: The Controller reads the Predictive CATC Indication for Aircraft B (continue with **Use Case Predictive Indication**).<br>If the Controller decides not to issue a TAXI clearance for Aircraft B **this UC ends here**.<br><br>**Optional**: The Predictive Indicator indicates a potential Conflict → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3)<br>2. The Taxi route for Aircraft B is overlapping with the cleared Push Back Procedure of aircraft A. The Aircraft A has not moved after receiving the push back clearance from the Controller.<br>3. The Controller clears aircraft B to TAXI by R/T (or data link) and enters TAXI on the HMI for Aircraft B.<br><br>**Optional**: The Controller clears aircraft B using a conditional TAXI Clearance by R/T (or data link) and enters the TAXI Clearance and the specific condition "TAXI AFTER PUSH BACK <AIRCRAFT A>" on the HMI for Aircraft B → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3).<br>4. The input of the TAXI clearance for Aircraft B by the Controller triggers the ATC system to check if the Taxi trajectory of aircraft B is overlapping with the cleared Push Back of aircraft A.<br>If the ATC system predicts that the Taxiing of Aircraft B is safe **the UC ends here**.<br><br>5. The ATC system detects that the Taxi trajectory of aircraft B is overlapping with the cleared Push Back route of aircraft A and triggers a **PUSH BACK vs TAXI Alert** to warn the Controller of the potential conflict. The Alert is displayed on the Controller's HMI and clearly identifies the pair of aircraft involved and the reason for the alert.<br>6. The Controller verifies the situation and cancels the TAXI Clearance (issues a HOLD instruction) for aircraft B by R/T and enters the change into the Controller's HMI.<br><br>**Optional**: The Controller cancels the Push Back clearance of Aircraft A or turns it into a Conditional Clearance.<br>7. The CATC alert is no longer presented to the ATCO.<br><br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10.In the case of a false alert, the Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

### 2.3.2.2.3.4 UC-CATC-06 Taxi vs Taxi (no push back required)

| | **UC-CATC-06 Taxi vs Taxi (no push back required)** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-06 |
| **Name** | Taxi vs Taxi (no push back required) UC |
| **Scope/Description** | This Use Case describes how the Controller deals with a **Taxi versus Taxi (no push back required) CATC** alert, which is detected by the ATC system and how it is presented on the Tower Ground Controller's/Apron Manager's HMI. |
| **Actors** | Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• Planned routes are assigned to the aircraft considered in this UC.<br><br>• Aircraft A receives a TAXI Clearance via R/T (or data link) from the Controller .<br>• The Controller enters TAXI on the HMI for Aircraft A.<br>• Aircraft A starts taxiing on the taxiway (or on the apron).<br>• Aircraft B is parked at a stand not requiring a Push Back approval and is ready for Taxi. |
| **Post conditions** | The **Taxi vs Taxi CATC** is resolved and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B requests TAXI Clearance. |
| **Nominal flow** | 1. **Optional**: The Controller reads the Predictive CATC Indication for Aircraft B (continue with Predictive Indication UC).<br>If the Controller decides not to issue a TAXI clearance for Aircraft B **this UC ends here**.<br><br>**Optional**: The Predictive Indicator indicates a potential Conflict → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3)<br><br>2. The Taxi route for Aircraft B is overlapping with the cleared Taxi route of aircraft A. Aircraft A is taxiing slowly or is still far-out and it is unclear when it passes the taxiway section where both routes overlap.<br><br>3. The Controller clears aircraft B to TAXI by R/T (or data link) and enters TAXI on the HMI for Aircraft B.<br><br>**Optional**: The Controller clears aircraft B using a conditional TAXI Clearance by R/T (or data link) and enters the TAXI Clearance and the specific condition "TAXI AFTER TAXIING <AIRCRAFT A>" on the HMI for Aircraft B → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3).<br><br>4. The input of the TAXI clearance for Aircraft B by the Controller triggers the ATC system to check if the Push Back trajectory of aircraft B is overlapping with the cleared Taxi route of aircraft A.<br>If the ATC system predicts that the Taxiing of Aircraft B is safe **the UC ends here**. |





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| | |
|---|---|
| | 5. The ATC system detects that the Taxi trajectory of aircraft B is overlapping with the cleared Taxi route of aircraft A and triggers a **TAXI vs TAXI Alert** to warn the Controller of the potential conflict. The Alert is displayed on the Controller's HMI and clearly identifies the pair of aircraft involved and the reason for the alert.<br>6. The Controller verifies the situation and cancels the TAXI Clearance (issues a HOLD instruction) for aircraft B by R/T and enters the change into the Controller's HMI.<br><br>Optional: The Controller stops Aircraft A instead of Aircraft B.<br>7. The CATC alert is no longer presented to the ATCO.<br><br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10.In the case of a false alert, the Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.3.5 UC-CATC-07 Taxi vs Taxi (Deadlock)

| | **UC-CATC-07 Taxi vs Taxi (Deadlock)** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-07 |
| **Name** | Taxi vs Taxi (Deadlock) UC |
| **Scope/Description** | This Use Case describes how the Controller deals with a **Taxi versus Taxi (Deadlock) CATC** alert, which is detected by the ATC system and how it is presented on the Tower Ground Controller's/Apron Manager's HMI.<br><br>Deadlock situation: The mobiles end up face to face and are unable to take another route to avoid each other. |
| **Actors** | Tower Runway Controller/Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• Planned routes are assigned to the aircraft considered in this UC.<br><br>• Controller A and B are responsible for different movement areas (different AoR).<br>• Aircraft A receives a TAXI Clearance via R/T (or data link) from Controller A.<br>• The Controller A enters TAXI on the HMI for Aircraft A.<br>• Aircraft A starts taxiing on the taxiway (or on the apron).<br>• Aircraft B is ready for Taxi and is either parked at a stand not requiring a Push Back approval or has performed the pushback and is ready for Taxi. |
| **Post conditions** | The **Taxi vs Taxi (Deadlock) CATC** is resolved and the alert is no longer displayed on the Controller's HMI. |

| | |
|---|---|
| **Trigger** | Aircraft B requests TAXI Clearance. |
| **Nominal flow** | 1. **Optional**: The Controller reads the Predictive CATC Indication for Aircraft B (continue with **Use Case Predictive Indication**).<br>If the Controller decides not to issue a TAXI clearance for Aircraft B **this UC ends here**.<br><br>**Optional**: The Predictive Indicator indicates a potential Conflict → Continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3)<br>2. The Taxi route for Aircraft B is overlapping with the cleared Taxi route of Aircraft A on a taxiway without an alternative route to avoid a face to face deadlock situation. Aircraft A has not yet entered the AoR of Controller B or transferred to Controller B.<br>3. The Controller B clears aircraft B to TAXI by R/T (or data link) and enters TAXI on the HMI for Aircraft B.<br><br>**Optional**: The Controller clears aircraft B using a conditional TAXI Clearance by R/T (or data link) to give way to Aircraft A and enters the TAXI Clearance and the specific condition "TAXI AFTER TAXIING <AIRCRAFT A>" on the HMI for Aircraft B → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3). (Alternatively, the Controller reroutes Aircraft B)<br><br>4. The input of the TAXI clearance for Aircraft B by the Controller triggers the ATC system to check if the Push Back trajectory of aircraft B is overlapping with the cleared Taxi route of aircraft A and leads to a deadlock.<br>If the ATC system predicts that the Taxiing of Aircraft B is not causing a deadlock situation **the UC ends here**.<br><br>5. The ATC system detects the imminent deadlock situation and triggers a **TAXI vs TAXI (Deadlock) Alert** to warn the Controller of the potential conflict. The Alert is displayed on the Controller's HMI and clearly identifies the pair of aircraft involved and the reason for the alert.<br><br>6. The Controller verifies the situation and cancels the TAXI Clearance (issues a HOLD instruction) for aircraft B by R/T and enters the change into the Controller's HMI.<br><br>**Optional**: The Controller stops Aircraft A instead of Aircraft B.<br>7. The CATC alert is no longer presented to the ATCO.<br><br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.3.6 UC-CATC-08 Taxi vs Cross (Deadlock)

This UC is about an ATC clearance, that is given on a route across an AoR border. This clearance is normally given in connection with a transfer to the next controller. However, if the transfer is not early enough to inform the other controller that the aircraft is entering his/her AoR, it may cause a deadlock with an aircraft beyond the AoR limit. This UC is not only to be considered in the case of an aircraft crossing a runway (which is considered as an example here), but generally also in other traffic situations where an aircraft changes to another AoR.

The main difference when crossing the runway (compared to UC-CATC-07) is the opposite exitway, which is part of the next AoR and can be a longer route depending on the taxiway layout. An exitway usually has no alternative, so a cleared aircraft coming from the opposite direction can easily lead to a deadlock.

This deadlock can be easily detected by the ATC system if it considers cleared routes across AoR borders. If that is the case, the UC does not differ significantly from the UC-CATC-07 Taxi vs Taxi (Deadlock). Consequently, this UC is covered by the same requirement REQ-02.W2.21.1-SPRINTEROP-CA01.0006.

| | **UC-CATC-08 Taxi vs Cross (Deadlock)** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-08 |
| **Name** | Taxi vs Cross (DEADLOCK) UC |
| **Scope/Description** | This Use Case describes how the Controller deals with a **Taxi versus Cross (Deadlock) CATC** alert, which is detected by the ATC system and how it is presented on the Tower Runway Controller's/Tower Ground Controller's/Apron Manager's HMI.<br><br>Deadlock situation: The mobiles end up face to face and are unable to take another route to avoid each other. |
| **Actors** | Tower Runway Controller/Tower Ground Controller/Apron Manager |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• Planned routes are assigned to the aircraft considered in this UC.<br>• The ATC system considers cleared routes across AoR borders to detect potential conflicts.<br>• Aircraft A receives a TAXI Clearance via R/T (or data link) from the Tower Ground Controller/Apron Manager.<br>• The Tower Ground Controller/Apron Manager enters TAXI on the HMI for Aircraft A.<br>• Aircraft A is taxiing on the taxiway ending at the entry point to the RWY.<br>• Aircraft B is waiting to Cross at the opposite side of the RWY. |
| **Post conditions** | The Taxi vs Cross CATC is resolved and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B requests CROSS Clearance. |





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| | |
|---|---|
| **Nominal flow** | 1. **Optional**: The Tower Runway Controller reads the Predictive CATC Indication for Aircraft B (continue with **Use Case Predictive Indication**).<br>If the Controller decides not to issue a TAXI clearance for Aircraft B **this UC ends here**.<br><br>**Optional**: The Predictive Indicator indicates a potential Conflict → Continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3)]. The use of a Conditional Clearance depends on the planned route of aircraft A, e.g. if aircraft A is in Taxi-Out to depart from the RWY to be crossed by Aircraft B a Conditional Clearance gives way to aircraft A.<br>2. To cross the RWY aircraft B will enter the exitway used by aircraft A to enter the same RWY. Once both aircraft are moving on this taxiway there is no alternative route to avoid a face to face deadlock situation. As long as the aircraft is not transferred to the next Controller (and the controllers do not pay attention to this manoeuvre) nobody is aware of the imminent deadlock situation.<br>3. The Tower Runway Controller clears Aircraft B to CROSS via R/T and enters the CROSS Clearance on the HMI for Aircraft B.<br><br>**Optional**: The Controller clears aircraft B using a conditional TAXI Clearance by R/T (or data link) to give way to Aircraft A and enters the TAXI Clearance and the specific condition "CROSS AFTER <AIRCRAFT A>" on the HMI for Aircraft B → continue with **Use Case Conditional Clearance** (see 2.3.2.2.2.3).<br>4. The input of the CROSS clearance for Aircraft B by the Controller triggers the ATC system to check if the trajectory of aircraft B is overlapping with the cleared Taxi route of aircraft A and leads to a deadlock.<br>If the ATC system predicts that the Taxiing of Aircraft B is not causing a deadlock situation **the UC ends here**.<br><br>5. The ATC system detects the imminent deadlock situation and triggers a **TAXI vs CROSS (Deadlock)** Alert to warn the Tower Runway Controller of the potential conflict. The Alert is displayed on the Controller's HMI and clearly identifies the pair of aircraft involved and the reason for the alert.<br>6. The Tower Runway Controller verifies the situation and cancels the CROSS Clearance (issues a HOLD instruction) for aircraft B by R/T and enters the change into the Controller's HMI.<br><br>**Optional**: The Controller stops Aircraft A instead of Aircraft B if aircraft A has not entered the taxiway to the runway.<br>7. The CATC alert is no longer presented to the ATCO.<br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |





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**Failure Flow 2** 10. In the case of a false alert, the Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error.

### 2.3.2.2.3.7 EATMA [CATC-03-04-05-06-07-08] Extended CATC

The **EATMA NOV-5 Model [CATC-03-04-05-06-07-08] Extended CATC** in Figure 19 (see below) visualises the basic scheme of activities common to all Extended CATC Use Cases in the sections above.

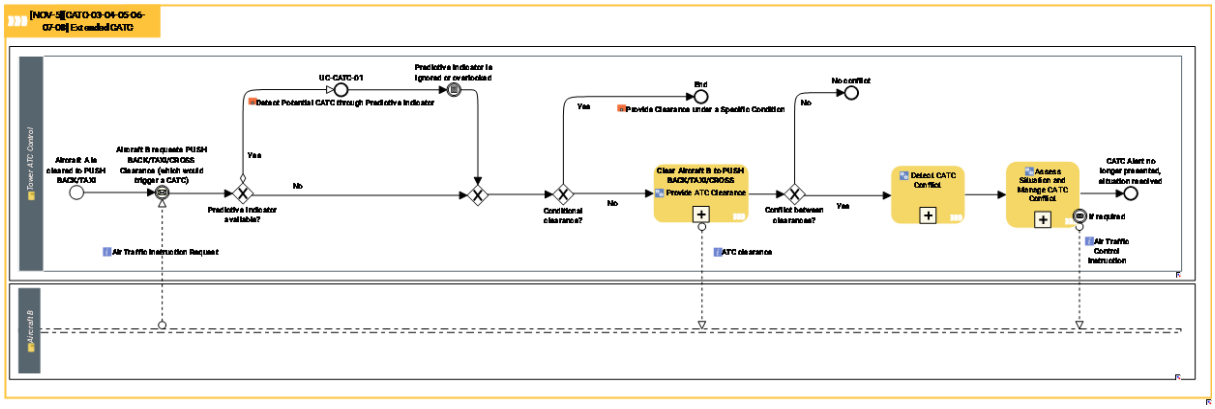


**Figure 19: EATMA NOV-5 Model [CATC-03-04-05-06-07-08] Extended CATC**

| Activity | Description |
|---|---|
| Clear Aircraft B to PUSH BACK/TAXI/CROSS | The Tower ATC controller provides the ATC clearance relevant for the aircraft B:<br>Push Back<br>Taxi<br>Cross |
| Assess Situation and Manage CATC Conflict | The Controller assesses the operational situation and manages the CATC conflict, taking appropriate measures, such as clearance cancellation (followed by an instruction, e.g., conditional clearance, HOLD instruction, etc.), clearance issue (e.g., GO AROUND), etc.<br>Ideally, the situation is resolved and the CATC is no longer presented to the Controller. |
| Detect CATC Conflict | CATC Alert presented to the Tower ATC Controller. |

**Table 16: Activities [CATC-03-04-05-06-07-08] Extended CATC**

| Issuer | Info Exchange | Addressee | Info Element | Info Entity |
|---|---|---|---|---|
| Aircraft B | If required o--> Tower ATC Control | Tower ATC Control | Request | |
| Tower ATC Control | If required o--> Aircraft B | Aircraft B | Air Traffic Control Instruction | ATC Instruction |





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| Issuer | Info Exchange | Addressee | Info Element | Info Entity |
|---|---|---|---|---|
| Tower ATC Control | Provide ATC Clearance o--> Aircraft B | Aircraft B | ATC clearance | |

**Table 17: Information Exchange for [CATC-03-04-05-06-07-08] Extended CATC**





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#### 2.3.2.2.4 Use Cases for Update of CATC (for Runway Operations)

The new operating method updates several situations for which an Updated CATC alert is triggered. The updated situations are described as Use Cases in the sections below.

**All Updated CATC Use Cases follow the same basic scheme that is visualised in the EATMA NOV-5 Model [CATC-03-04-05-06-07-08] Extended CATC in section 2.3.2.2.4.5,**

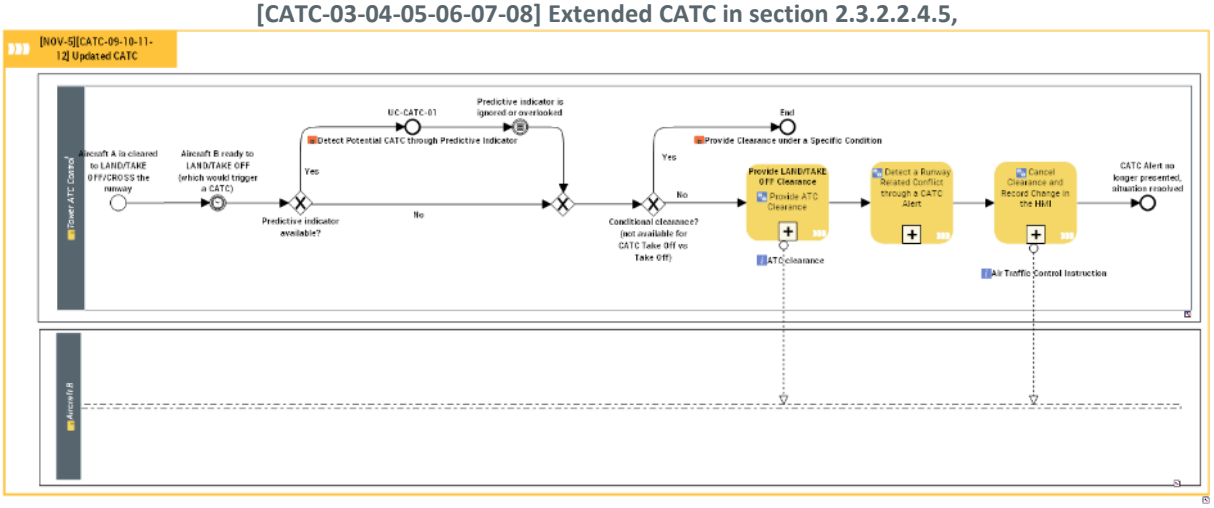


Figure 20.

##### 2.3.2.2.4.1 UC-CATC-09 Land vs Land

| | **UC-CATC-09 Land vs Land** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-09 |
| **Name** | Land vs Land UC |
| **Scope/Description** | This Use Case describes how the Controller deals with an updated **Land versus Land CATC** alert, which is detected by the ATC system and how it is presented on the Tower Runway Controller's HMI. |
| **Actors** | Tower Runway Controller. |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br><br>• The Tower Runway Controller has cleared Aircraft A to LAND.<br>• The Tower Runway Controller has entered the LAND clearance into the ATC system.<br>• Aircraft A lands on the RWY and does not immediately vacate the RWY.<br>• Aircraft B is on final approach and expects to be cleared to LAND. |
| **Post conditions** | The **LAND vs LAND CATC** is resolved and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B is on final approach |



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| | |
|---|---|
| **Nominal flow** | 1. **Optional**: The Tower Runway Controller reads the Predictive CATC Indication for Aircraft B which is on final approach (continue with **Use Case Predictive Indication**).<br>If the Tower Runway Controller decides not to issue a LAND clearance for Aircraft B **this UC ends here**.<br><br>**NOTE**: In case the Tower Runway Controller decides to not give the LAND clearance to aircraft B the situation may still require additional actions to solve the potential critical situation indicated by the Predictive CATC Indication, e.g. GO AROUND instruction by R/T to Aircraft B in approach, then input MISSED APPROACH on the HMI.<br>2. The Tower Runway Controller does not notice that Aircraft A still occupies the RWY and will not vacate before Aircraft B crosses the threshold.<br>3. The Tower Runway Controller issues a LAND Clearance via R/T for Aircraft B and enters the LAND Clearance into the ATC system.<br><br>4. The ATC system calculates the predicted position of Aircraft A when Aircraft B will cross the threshold of the RWY.<br>If the ATC system predicts that Aircraft A has vacated the RWY when Aircraft B crosses the RWY threshold the situation is considered safe and **the UC ends here**.<br>5.The ATC system detects that Aircraft A will still occupy the RWY when Aircraft B passes the threshold (calculated TLRAircraftA >TTTAircraftB) and triggers a **CATC LAND vs LAND Alert** to warn the Tower Runway Controller that a potential conflict situation has been detected. The Alert is displayed on the Tower Runway Controller's HMI, and clearly identifies the pair of aircraft involved and the reason for the alert.<br><br>6.The Tower Runway Controller verifies the situation and then issues a GO AROUND instruction by R/T to Aircraft B, then inputs MISSED APPROACH on the HMI.<br>7. The CATC alert is no longer presented to the ATCO.<br><br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Tower Runway Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Tower Runway Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.4.2 UC-CATC-10 Take Off vs. Land

| | **UC-CATC-10 Take Off vs Land** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-10 |

| | |
|---|---|
| **Name** | Take Off vs Land UC |
| **Scope/Description** | This Use Case describes how the Controller deals with an updated **Take Off versus Land CATC** alert, which is detected by the ATC system and how it is presented on the Tower Runway Controller's HMI. |
| **Actors** | Tower Runway Controller. |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br><br>• Aircraft A is cleared to TAKE-OFF from the RWY.<br>• The Tower Runway Controller has entered the TAKE-OFF clearance into the ATC system.<br>• Aircraft A does not accelerate to depart from the RWY.<br>• Aircraft B is on final approach and expects to be cleared to LAND. |
| **Post conditions** | The **Take Off vs Land CATC** is resolved and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B is on final approach |
| **Nominal flow** | 1. **Optional**: The Tower Runway Controller reads the Predictive CATC Indication for Aircraft B which is on final approach (continue with **Use Case Predictive Indication**).<br>If the Tower Runway Controller decides not to issue a LAND clearance for Aircraft B **this UC ends here**.<br><br>**NOTE**: In case the Tower Runway Controller decides to not give the LAND clearance to aircraft B the situation may still require additional actions to solve the potential critical situation indicated by the Predictive CATC Indication, e.g. GO AROUND instruction by R/T to Aircraft B in approach, then input MISSED APPROACH on the HMI.<br>2. The Tower Runway Controller does not notice that Aircraft A does not accelerate to take off and will not be clear of the RWY before Aircraft B crosses the threshold.<br>3. The Tower Runway Controller issues a LAND Clearance via R/T for Aircraft B and enters the LAND Clearance into the ATC system.<br><br>4. The ATC system calculates the predicted position of Aircraft A when Aircraft B will cross the threshold of the RWY.<br>If the ATC system predicts that Aircraft A is airborne when Aircraft B crosses the RWY threshold the situation is considered safe and **the UC ends here**.<br><br>5. The ATC system detects that Aircraft A will not be airborne when Aircraft B passes the threshold (calculated TLRAircraftA >TTTAircraftB) and triggers a **CATC TAKE-OFF vs LAND alert** to warn the Tower Runway Controller that a potential conflict situation has been detected. The Alert is displayed on the Tower Runway Controller's HMI, and clearly identifies the pair of aircraft involved and the reason for the alert. |





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| | |
|---|---|
| | 6. The Tower Runway Controller verifies the situation and then issues a GO AROUND instruction by R/T to Aircraft B, then inputs MISSED APPROACH on the HMI.<br>7. The CATC alert is no longer presented to the ATCO.<br><br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Tower Runway Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Tower Runway Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.4.3 UC-CATC-11 Cross vs. Land

| | **UC-CATC-11 Cross vs Land** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-11 |
| **Name** | Cross vs Land UC |
| **Scope/Description** | This Use Case describes how the Controller deals with an updated **Cross versus Land CATC** alert, which is detected by the ATC system and how it is presented on the Tower Runway Controller's HMI. |
| **Actors** | Tower Runway Controller. |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br><br>• Aircraft A is cleared to CROSS the RWY.<br>• The Tower Runway Controller has entered the CROSS clearance into the ATC system.<br>• Aircraft A moves too slow to cross the RWY in due time.<br>• Aircraft B is on final approach and expects to be cleared to LAND. |
| **Post conditions** | The **Cross vs Land CATC** is resolved and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B is on final approach |
| **Nominal flow** | 1. **Optional**: The Tower Runway Controller reads the Predictive CATC Indication for Aircraft B which is on final approach (continue with **Use Case Predictive Indication**).<br>If the Tower Runway Controller decides not to issue a LAND clearance for Aircraft B **this UC ends here**.<br><br>**NOTE**: In case the Tower Runway Controller decides to not give the LAND |

| | |
|---|---|
| | clearance to aircraft B the situation may still require additional actions to solve the potential critical situation indicated by the Predictive CATC Indication, e.g. GO AROUND instruction by R/T to Aircraft B in approach, then input MISSED APPROACH on the HMI.<br>2. The Tower Runway Controller does not notice that Aircraft A has not finished crossing and will not be clear of the RWY before Aircraft B crosses the threshold.<br>3. The Tower Runway Controller issues a LAND Clearance via R/T for Aircraft B and enters the LAND Clearance into the ATC system.<br>4. The ATC system calculates the predicted position of Aircraft A when Aircraft B will cross the threshold of the RWY.<br>If the ATC system predicts that Aircraft A has vacated the RWY when Aircraft B crosses the RWY threshold the situation is considered safe and **the UC ends here**.<br>5. The ATC system detects that Aircraft A will not have finished crossing the RWY when Aircraft B passes the threshold (calculated TLRAircraftA >TTTAircraftB) and triggers a **CATC CROSS vs LAND alert** to warn the Tower Runway Controller that a potential conflict situation has been detected. The Alert is displayed on the Tower Runway Controller's HMI, and clearly identifies the pair of aircraft involved and the reason for the alert.<br>6. The Tower Runway Controller verifies the situation and then issues a GO AROUND instruction by R/T to Aircraft B, then inputs MISSED APPROACH on the HMI.<br>7. The CATC alert is no longer presented to the ATCO.<br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Tower Runway Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Tower Runway Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.4.4 UC-CATC-12 Take Off vs. Take Off

| | **UC-CATC-12 Take Off vs Take Off** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-12 |
| **Name** | Take Off vs Take Off UC |
| **Scope/Description** | This Use Case describes how the Controller deals with an updated **Take Off versus Take Off CATC** alert, which is detected by the ATC system and how it is presented on the Tower Runway Controller's HMI. |
| **Actors** | Tower Runway Controller. |





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| | |
|---|---|
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• A defined converging volume that is used by aircrafts departing from RWY1 and RWY2 is used by the ATC system to check for conflicting Take Off's.<br><br>• Aircraft A on RWY 1 receives a TAKE OFF Clearance via R/T from the Tower Runway Controller.<br>• The Tower Runway Controller makes an input TAKE OFF on the HMI for Aircraft A.<br>• Aircraft A does not immediately take off from RWY 1.<br>• Aircraft B is ready for departure on RWY 2. |
| **Post conditions** | The **Take Off vs Take Off CATC** is resolved, and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Aircraft B is ready for departure |
| **Nominal flow** | 1. **Optional**: The Tower Runway Controller reads the Predictive CATC Indication for Aircraft B on RWY 2 (continue with **Use Case Predictive Indication**).<br>If the Tower Runway Controller decides not to issue a TAKE OFF clearance for Aircraft B **this UC ends here**.<br><br>2. The Tower Runway Controller does not notice that Aircraft A has a delayed take off on RWY 1 and therefore the converging volume will be occupied by Aircraft A at the same time as the departing Aircraft B is predicted to be airborne and reach the same volume.<br>3. The Tower Runway Controller issues a TAKE OFF Clearance via R/T for Aircraft B and enters the TAKE OFF Clearance into the ATC system.<br>4. The input of the TAKE OFF clearance for Aircraft B by the Tower Runway Controller triggers the ATC system to check if Aircraft A and Aircraft B will occupy the considered converging volume at the same time.<br>If the ATC system predicts that Aircraft A and Aircraft B will not simultaneously occupy the converging volume **the UC ends here**.<br><br>5. The ATC system detects that Aircraft A and B will pass through the considered converging volume at the same time and triggers an **CATC TAKE OFF vs TAKE OFF Alert** to warn the Tower Runway Controller that a potential conflict situation has been detected. The Alert is displayed on the Tower Runway Controller's HMI, and clearly identifies the pair of aircraft involved and the reason for the alert.<br>6. The Tower Runway Controller verifies the situation and then cancels the TAKE OFF clearance to Aircraft B and instructs it to stop or wait, then enters the TAKE OFF cancelation on the HMI.<br>Or, in case of Aircraft B is after departure and already changed to next frequency, then the Tower Runway Controller immediately informs the next responsible unit.<br>7. The CATC alert is no longer presented to the ATCO.<br><br>8. The Use Case ends. |

| | |
|---|---|
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the involved Tower Runway Controller(s) and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Tower Runway Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.4.5 EATMA [CATC-09-10-11-12] Updated CATC

The **EATMA NOV-5 Model [CATC-09-10-11-12] Updated CATC** in Figure 20 (see below) visualises the basic scheme of activities common to all Updated CATC Use Cases in the sections above.

This Use Case describes how the Controller deals with an updated

Land vs Land,
Take Off vs Land,
Cross vs Land,
Take Off vs Take Off (converging SIDs)

CATC Alert, which is detected by the ATC system and how it is presented on the Tower Runway Controller's HMI.

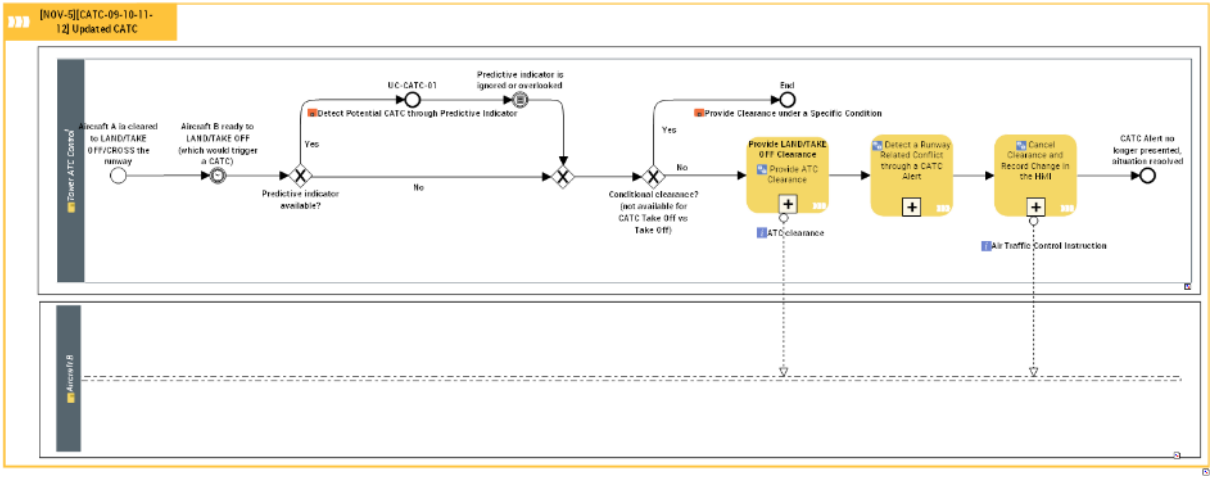


**Figure 20: EATMA NOV-5 Model [CATC-09-10-11-12] Updated CATC**

| Activity | Description |
|---|---|
| Cancel Clearance and Record Change in the HMI | The Controller cancels the clearance and records the cancellation on the HMI. If necessary, the Controller issues subsequent appropriate instructions following the clearance cancellation, e.g. stop or wait, Go around. |
| Detect a Runway Related Conflict through a CATC Alert | The Tower Runway Controller is warned about a runway related conflict situation that has been detected. He/she analyses the operational situation and takes appropriate action. |



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| | |
|---|---|
| | The Tower Runway Controller can observe the CATC Alert displayed on his/her HMI, clearly identifying the pair of aircraft involved and the reason for the alert. |
| Provide ATC Clearance | The Tower ATC controller provides a clearance to the mobile, either related to the movement area (i.e. PUSH BACK, TAXI, CROSS clearance) or runway related (i.e. LAND or TAKE OFF clearance) |

**Table 18: Activities [CATC-09-10-11-12] Updated CATC**

| Issuer | Info Flow | Addressee | Info Element | Info Entity |
|---|---|---|---|---|
| Tower ATC Control | Cancel Clearance and Record Change in the HMI o--> Aircraft B | Aircraft B | Air Traffic Control Instruction | ATCInstruction |
| Tower ATC Control | Provide LAND/TAKE OFF Clearance o--> Aircraft B | Aircraft B | ATC clearance | |

**Table 19: Information Exchange for [CATC-09-10-11-12] Updated CATC**

#### 2.3.2.2.5 Use Cases for RMCA/CMAC Alerts vs ATC Clearance

The new operating method introduces two new situations for which an RMCA/CMAC Alerts vs Clearance CATC alert is triggered. The new situations are described as Use Cases in the sections below.

**All Use Cases below follow the same basic scheme that is visualised in the EATMA NOV-5 Model [CATC-13-14] Extended CATC in section 2.3.2.2.5.3,**

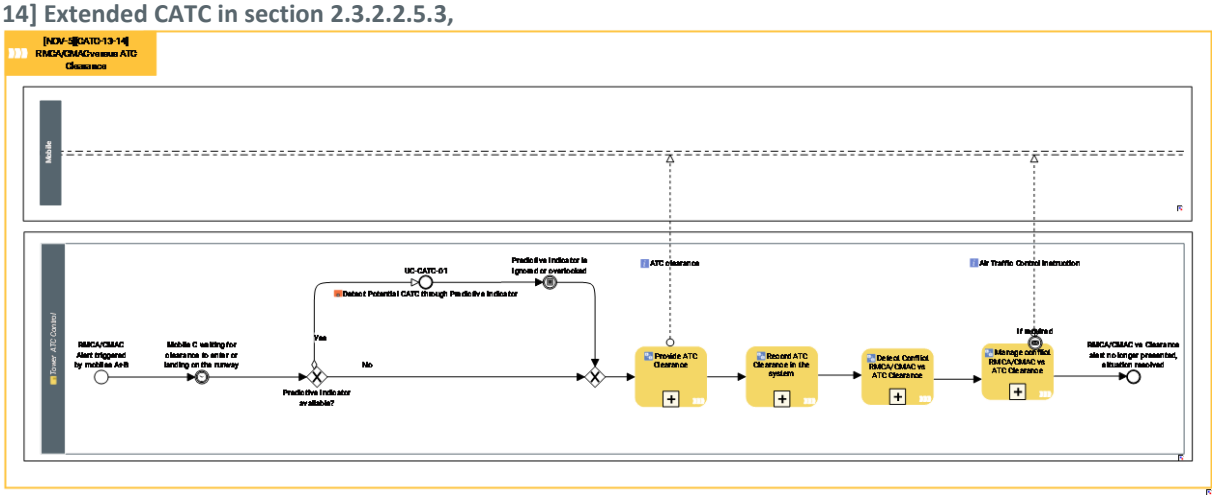


Figure 21.

##### 2.3.2.2.5.1 UC-CATC-13 RMCA vs Clearance

| **UC-CATC-13 RMCA vs Clearance** |
|---|

| | |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-13 |
| **Name** | RMCA vs Clearance UC |
| **Scope/Description** | This Use Case describes how the ATC system detects a **RMCA versus an ATC Clearance alert** and how it will be presented on the Tower Runway Controller's HMI.<br><br>**NOTE**: The ATC clearances triggering a CATC alert in this case are LAND, CROSS, ENTER, LINE-UP and TAKE-OFF. |
| **Actors** | Tower Runway Controller. |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br><br>• The mobiles A+B trigger an RMCA alert according to pre-defined triggering rules for the specific runway.<br>• The triggered RMCA alert is presented on the Tower Runway Controller's HMI.<br>• Mobile C is waiting to enter the runway. |
| **Post conditions** | The **RMCA vs Clearance** situation is resolved and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Mobile C is waiting for the clearance to enter the runway |
| **Nominal flow** | 1. **Optional**: The Tower Runway Controller reads the Predictive CATC Indication for Mobile C which is waiting for the clearance to enter or landing on the runway (continue with **Use Case Predictive Indication**).<br><br>If the Tower Runway Controller decides not to issue the clearance for Mobile C **this UC ends here**.<br><br>**NOTE** (LAND only): In case the Tower Runway Controller decides to not give the LAND clearance to Aircraft C the situation may still require additional actions to solve the potential critical situation indicated by the Predictive CATC Indication, e.g. GO AROUND instruction by R/T to Aircraft C in approach, then input MISSED APPROACH on the HMI.<br>2. The Tower Runway Controller does not notice that a RMCA Alert is active (the alert may be muted).<br><br>3. The Tower Runway Controller issues a LAND, CROSS, ENTER, LINE-UP or TAKE-OFF Clearance via R/T for Mobile C and enters the Clearance into the ATC system.<br><br>4. The input of the LAND, CROSS, ENTER, LINE-UP or TAKE-OFF clearance for Mobile C by the Tower Runway Controller triggers the ATC system to check if there is a RMCA Alert active for the runway.<br>If the ATC system detects that entering the runway is safe **the UC ends here**. |

| | |
|---|---|
| | 5. The ATC system detects that the input of LAND, CROSS, ENTER, LINE-UP or TAKE-OFF is not compatible with an active RMCA for the same runway and triggers a **RMCA vs Clearance alert** to warn the Tower Runway Controller that a potential conflict situation has been detected. The Alert is displayed on the Tower Runway Controller's HMI, and clearly identifies the Mobiles involved and the reason for the alert.<br>6. The Tower Runway Controller verifies the situation and cancels the Clearance given to Mobile C by R/T and enters the change into the Controller's HMI.<br>7. The CATC alert is no longer presented to the ATCO.<br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Tower Runway Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Tower Runway Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.5.2 UC-CATC-14 CMAC vs Clearance

| **UC-CATC-14 CMAC vs Clearance** | |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CATC-14 |
| **Name** | CMAC vs Clearance UC |
| **Scope/Description** | This Use Case describes how the ATC system detects a **CMAC alert versus a Clearance alert** and how it will be presented on the Tower Runway Controller's HMI.<br><br>**NOTE**: The clearances triggering a CATC alert in this case are LAND, CROSS, ENTER, LINE-UP and TAKE-OFF. |
| **Actors** | Tower Runway Controller. |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br><br>• An active CMAC runway alert has been triggered for Mobile A (Runway Incursion Alert, No Take Off Clearance Alert , No Landing Clearance Alert, Wrong Runway Alert).<br>• A mobile is waiting for the clearance to enter or landing on the same runway. |
| **Post conditions** | The **CMAC vs Clearance** situation is resolved, and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | Mobile B s waiting for the clearance to enter or landing on the runway |

| | |
|---|---|
| **Nominal flow** | 1. **Optional**: The Tower Runway Controller reads the Predictive CATC Indication for Mobile B which is waiting for the clearance to enter or landing on the runway (continue with **Use Case Predictive Indication**).<br><br>If the Tower Runway Controller decides not to issue the clearance for Mobile B **this UC ends here**.<br><br>**NOTE** (LAND only**)**: In case the Tower Runway Controller decides to not give the LAND clearance to Aircraft B the situation may still require additional actions to solve the potential critical situation indicated by the Predictive CATC Indication, e.g. GO AROUND instruction by R/T to Aircraft B in approach, then input MISSED APPROACH on the HMI.<br>2. The Tower Runway Controller does not notice that a RMCA Alert is active (the alert may be muted).<br>3. The Tower Runway Controller issues a LAND, CROSS, ENTER, LINE-UP or TAKE-OFF Clearance via R/T for Mobile C and enters the Clearance into the ATC system.<br><br>4. The input of the LAND, CROSS, ENTER, LINE-UP or TAKE-OFF clearance for Mobile B by the Tower Runway Controller triggers the ATC system to check if there is a CMAC Alert active for the runway.<br>If the ATC system detects that entering the runway is safe **the UC ends here**.<br><br>5. The ATC system detects that the input of LAND, CROSS, ENTER, LINE-UP or TAKE-OFF is not compatible with an active RMCA for the same runway and triggers a **CMAC vs Clearance alert** to warn the Tower Runway Controller that a potential conflict situation has been detected. The Alert is displayed on the Tower Runway Controller's HMI, and clearly identifies the mobiles involved and the reason for the alert.<br><br>6. The Tower Runway Controller verifies the situation and cancels the Clearance given to Mobile B by R/T and enters the change into the Controller's HMI.<br><br>7. The CATC alert is no longer presented to the ATCO.<br>8. The Use Case ends. |
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure, then the Tower Runway Controller and the Flight Crew will be relied upon to identify the potentially hazardous situation and to resolve the problem as quickly and safely as possible. This is often the case today at airports where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert, the Tower Runway Controller will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, will cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.5.3 EATMA [CATC-13-14] RMCA/CMAC vs Clearance

The EATMA NOV-5 Model [CATC-13-14] RMCA/CMAC vs Clearance in Figure 21 (see below) visualises the basic scheme of activities common to all Updated Use Cases in the sections above.

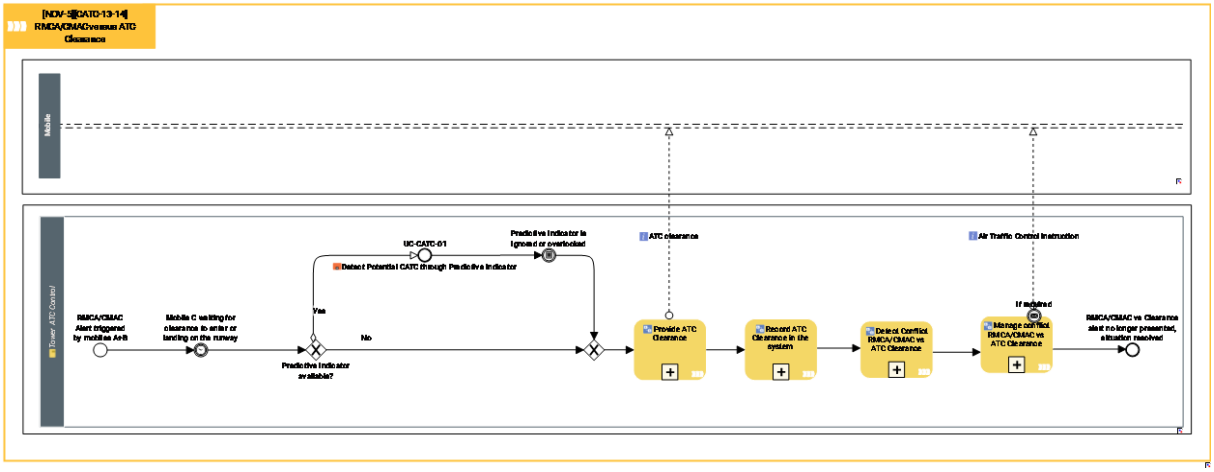


**Figure 21: EATMA NOV-5 Model [CATC-13-14] Updated CATC**

| Activity | Description |
|---|---|
| Provide ATC Clearance | Tower runway controller provides the ATC clearance relevant for the aircraft:<br>Line Up,<br>Cross,<br>Enter,<br>Take Off,<br>Landing. |
| Detect Conflict RMCA/CMAC vs ATC Clearance | A conflict is identified, where an ATC Clearance is provided for a runway where a RMCA/CMAC is occurring. |
| Manage conflict RMCA/CMAC vs ATC Clearance | The Tower runway controller is analysing the operational situation and is taking appropriate action. |
| Record ATC Clearance in the system | The clearance is entered into the ATC system by the Controller responsible. |

**Table 20: Activities [CATC-13-14] Updated CATC**

| Issuer | Info Flow | Addressee | Info Element | Info Entity |
|---|---|---|---|---|
| Tower ATC Control | If required o--> Mobile | Mobile | Air Traffic Control Instruction | ATCInstruction |
| Tower ATC Control | Provide ATC Clearance o--> Mobile | Mobile | ATC clearance | |

**Table 21: Information Exchange for [CATC-13-14] Updated CATC**

#### 2.3.2.2.6 Use Cases for Update of CMAC Alerts

The CMAC alert specified here complement the CMAC alerts specified in SESAR1 Solution #02.

#### 2.3.2.2.6.1 UC-CMAC-01 Stand Occupied Alert

If the parking stand of an arriving aircraft is occupied an information alert should be displayed to provide the Controller with situational awareness that he might need to hold the aircraft on a taxiway until the departing aircraft vacates the stand or until an alternative stand is allocated to the arriving aircraft.

| | **UC-CMAC-01 Stand Occupied** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-CMAC-01 |
| **Name** | Stand Occupied UC |
| **Scope/Description** | This Use Case describes how the Controller deals with a **Stand Occupied CMAC** alert, which is detected by the ATC system and how it is presented on the Tower Ground Controller's/Apron Manager's HMI. |
| **Actors** | Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance, routing and a means to input ATC clearances.<br>• A planned route (Taxi In) is assigned to the aircraft considered in this UC.<br>• In addition, information regarding the assigned parking stands for each aircraft is available in the ATC system.<br>• The ATC system is continuously verifying that any newly assigned parking stand does not conflict with an already allocated stand. |
| **Post conditions** | The **Stand Occupied CMAC** is resolved, and the alert is no longer displayed on the Controller's HMI. |
| **Trigger** | A parking stand is assigned to the aircraft taxiing in. (a trigger is not explicitly required here because the parking stand is continuously monitored) |
| **Nominal flow** | 1.The ATCO assigns a parking stand to the aircraft taxiing in and records it into the system, or the parking stand is still occupied by another aircraft.<br>2. The ATC system detects the already allocated stand for the new aircraft movement and triggers a **Stand Occupied Alert** that is displayed on the concerned Controller Working Positions HMI.<br>3. The responsible Controller verifies the situation and takes all necessary actions, including possible co-ordination with other involved Airport actors to de-conflict the occupied stand.<br>4. If the situation cannot be de-conflicted in advance because of a lack of available aircraft stands the Flight Crew of the concerned aircraft will be informed by the responsible Controller that they will have to wait until their assigned stand is vacated.<br>5. The responsible Controller updates the ATC system with the agreed de-conflicted stand management.<br>6. The ATC system verifies that the updated stand information is no longer conflicting.<br>7. The Stand Occupied CMAC Alert alert is no longer presented to the Controller.<br>8. The Use Case ends. |





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| | |
|---|---|
| **Failure Flow 1** | 9. In the case where an alert is not triggered due to an ATC system failure then the Tower Ground Controller/Apron Manager and Flight Crew will be relied upon to identify the potentially hazardous situation and resolve the problem as quickly and safely as possible. This is often the case today where these alerts do not exist. |
| **Failure Flow 2** | 10. In the case of a false alert the Tower Ground Controller/Apron Manager will assess the situation as soon as the alert is presented, and if the alert is deemed to be false, cancel the alert and inform the supervisor of the error. |

#### 2.3.2.2.6.2 EATMA [CMAC-01] Stand Occupied

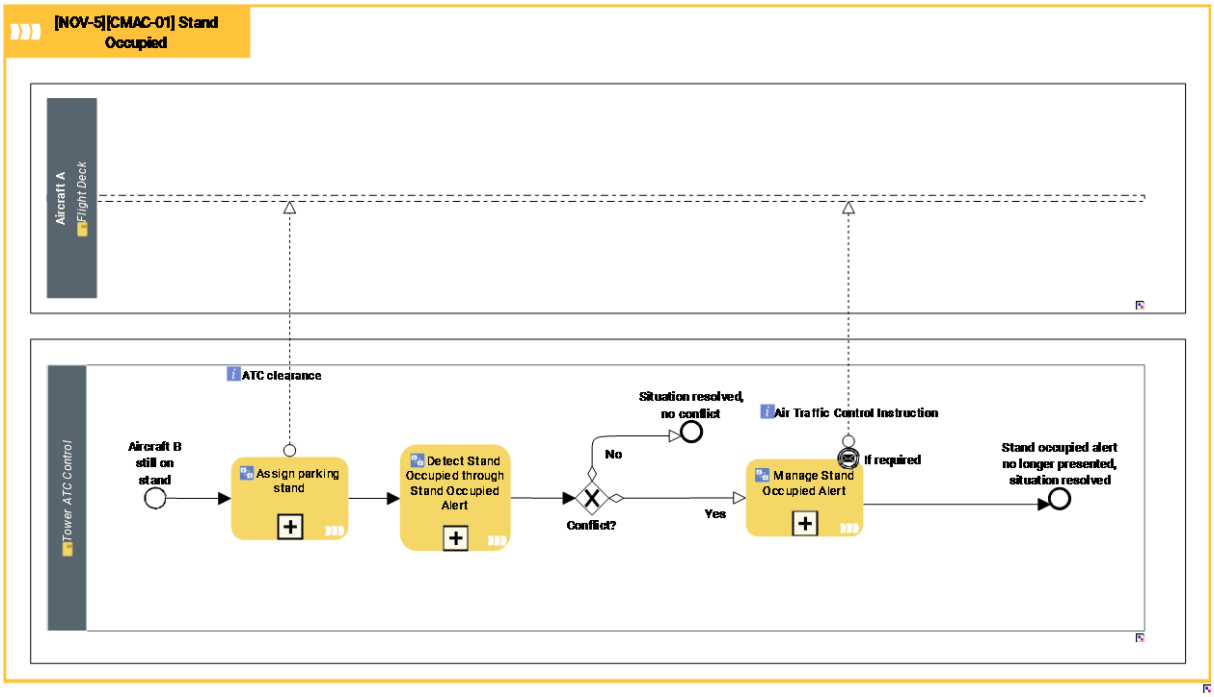


**Figure 22: EATMA NOV-5 Model [CMAC-01] Stand Occupied**

| Activity | Description |
|---|---|
| Detect Stand Occupied through Stand Occupied Alert | Aircraft B is on the stand that is also allocated to the arriving aircraft A. |
| Manage Stand Occupied Alert | The Tower ATC controller is analysing the operational situation and is taking appropriate action. |
| Assign parking stand | The ATCO assigns a parking stand to the aircraft taxiing in and records it into the system. |

**Table 22: Activities [CMAC-01] Stand Occupied**





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| Issuer | Info Flow | Addressee | Info Element | Info Entity |
|---|---|---|---|---|
| Tower ATC Control | Assign parking stand o--> Aircraft A | Aircraft A | ATC clearance | |
| Tower ATC Control | If required o--> Aircraft A | Aircraft A | Air Traffic Control Instruction | ATCInstruction |

**Table 23: Information Exchange for [CMAC-01] Stand Occupied**

#### 2.3.2.2.7 Use Cases for Runway Situational Notifications

##### 2.3.2.2.7.1 UC-RWY-01 Runway Busy Notification

| | **UC-RWY-01 Runway Busy Notification** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-RWY-01 |
| **Name** | Runway Busy Notification UC |
| **Scope/Description** | This Use Case describes how the Controller is notified about the status of the runway switching to “busy” and how this notification fits into the Controller’s routine job. |
| **Actors** | Tower Runway Controller/Tower Ground Controller/Apron Manager (collectively referred to as Controller) |
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance and a means to input ATC clearances.<br>• The controller's HMI has a Runway Busy Notification GUI element that indicates the runway operational status to the controller on the GRP. |
| **Post conditions** | • The notification is displayed on the GRP of the Controller's HMI (directly on the runway stripe.<br>• If the conditions cease to exist the notification disappears. |
| **Trigger** | • There is currently a target (vehicle or aircraft) on the runway, OR<br>• a Landing, Line Up, Take-Off clearance has been given to at least one flight. |
| **Nominal flow** | 1. As a result of the triggering conditions, the Controller is notified via his HMI about the busy status of the runway.<br>2. The Controller acquire the information and, if unaware, assesses the reason for the notification.<br>3. The Controller will conduct operations normally by taking into account the visible information in his decision-making process.<br>4. End of use case |
| **Failure Flow** | N/A |



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#### 2.3.2.2.7.1.1 EATMA [RWY-01] Runway Busy Notification

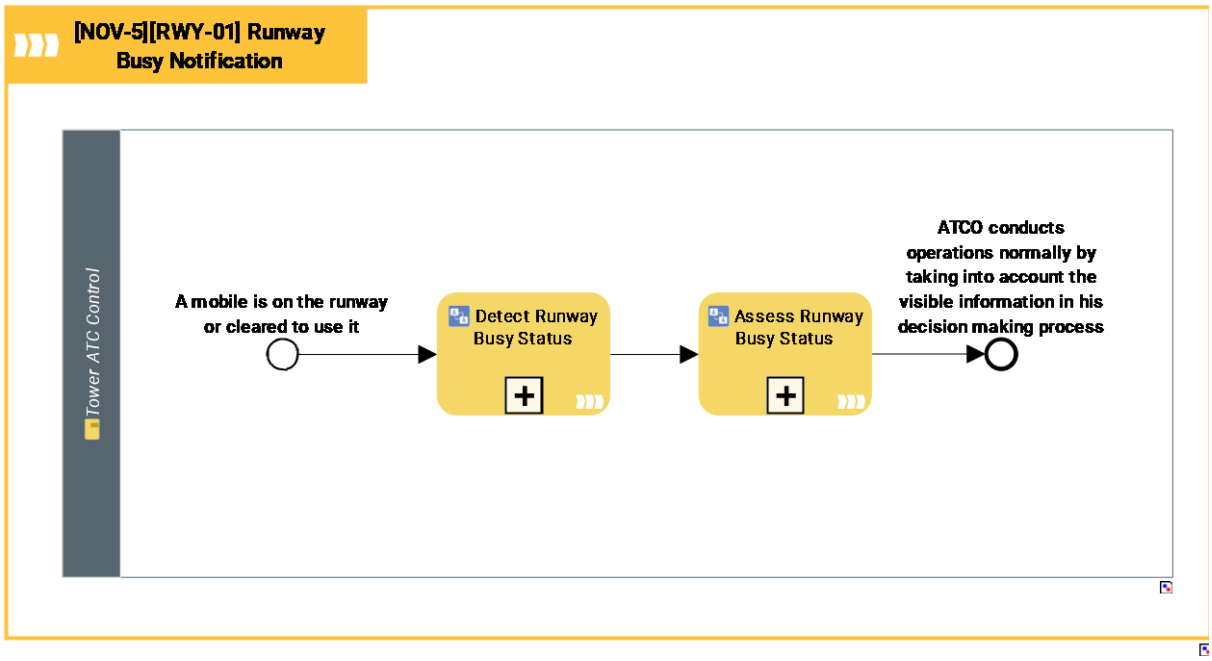


**Figure 23: EATMA NOV-5 Model [RWY-01] Runway Busy Notification**

| Activity | Description |
|---|---|
| Assess Runway Busy Status | The Controller acquires the information about the runway busy status and, if unaware, assesses the reason for the notification. |
| Detect Runway Busy Status | When a mobile is on the runway or cleared to use it, the Controller is notified about the busy status of the runway. |

**Table 24: Activities for [RWY-01] Runway Busy Notification**

| Issuer | Info Flow | Addressee | Info Element | Info Entity |
|---|---|---|---|---|

**Table 25: Information Exchange for [RWY-01] Runway Busy Notification**

### 2.3.2.2.7.2 UC-RWY-02 Runway In Conflict Notification

| | **UC-RWY-02 Runway In Conflict Notification** |
|---|---|
| **ID** | PJ.02-W2-21.1-UC-RWY-02 |
| **Name** | Runway In Conflict Notification UC |
| **Scope/Description** | This Use Case describes how the Controller is notified about the runway being involved in any conflict, and how this notification fits into the Controller's routine job. |
| **Actors** | Tower Runway Controller/Tower Ground Controller/Apron Manager (collectively referred to as Controller) |

| | |
|---|---|
| **Pre conditions** | • The ATC system is equipped with A-SMGCS surveillance and Safety Net alerting tool.<br>• The controller's HMI has a Runway Busy Notification GUI element that indicates a the runway operational status to the controller on the GRP. |
| **Post conditions** | • The notification is displayed on the GRP of the Controller's HMI (directly on the runway stripe.<br>• If the conditions cease to exist the notification disappears. |
| **Trigger** | One or more of the following conditions:<br>• a RMCA alert is triggered;<br>• a CMAC alert involving the runway (e.g. a landing on wrong runway) is triggered;<br>• a runway CATC alert is triggered (e.g., LAND/LAND, LINEUP/LAND, CROSS/LAND, etc…). |
| **Nominal flow** | 1. As a result of the triggering conditions, the Controller is notified via his HMI about a conflict happening on the runway.<br>2. The Controller acquire the information and, if unaware, assesses the reason for the notification.<br>3. The Controller will verify the alert(s) triggering the notification and treat them as any safety nets alert.<br>4. End of use case |
| **Failure Flow** | N/A |

#### *2.3.2.2.7.2.1 EATMA [RWY-02] Runway In Conflict Notification*

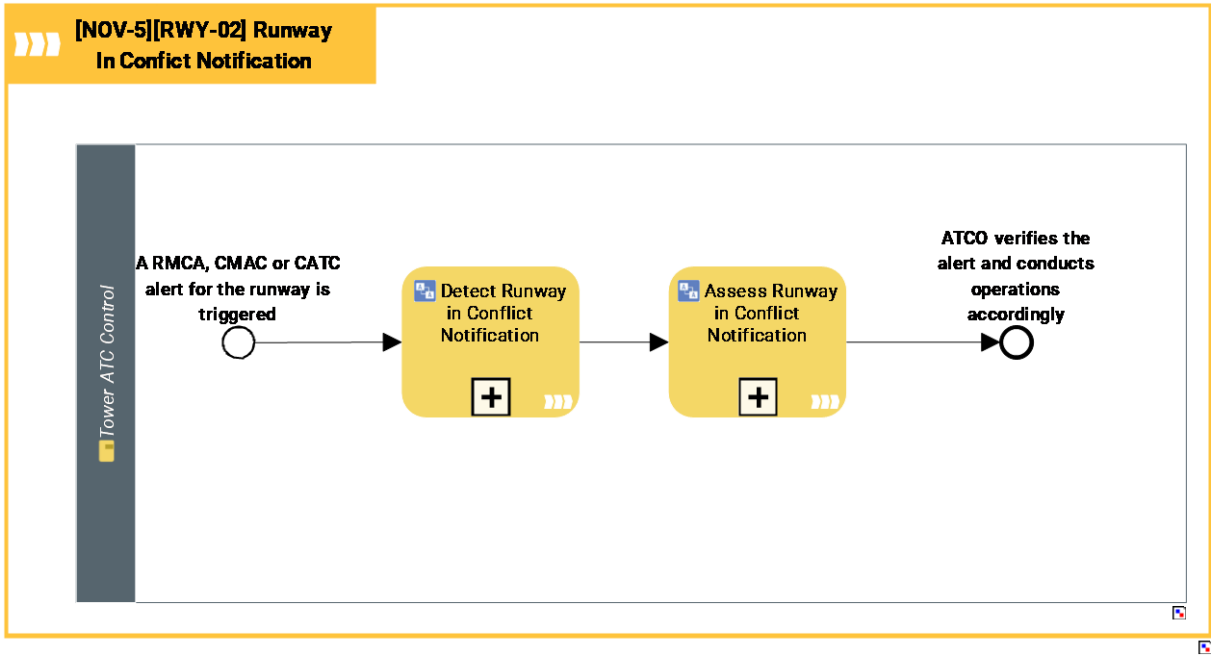


**Figure 24: EATMA NOV-5 Model [RWY-02] Runway In Conflict Notification**





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| Activity | Description |
|---|---|
| Assess Runway in Conflict Notification | The Controller acquire the information of the conflict in runway notification and, if unaware, assesses the reason for the notification. Then, the Controller will verify the alert(s) triggering the notification and treat them as any safety nets alert. |
| Detect Runway in Conflict Notification | As a result of a RMCA, CMAC or CATC alert for a runway, the Controller is notified about a conflict happening on that runway. |

**Table 26: Activities for [RWY-02] Runway In Conflict Notification**

| Issuer | Info Flow | Addressee | Info Element | Info Entity |
|---|---|---|---|---|

**Table 27: Information Exchange for [RWY-02] Runway In Conflict Notification**

| Info Element | Description |
|---|---|
| Air Traffic Control Instruction | Directives issued by [[air traffic control]] for the purpose of requiring a pilot to take a specific action. |
| Air Traffic Instruction Request | Query from flight crew/vehicle driver to get instructions. |
| ATC clearance | |

**Table 28: Info Elements for [RWY-02] Runway In Conflict Notification**





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### 2.3.3 Differences between new and previous Operating Methods

Table 29 below describes the improvements from previous Operating Methods (SESAR1 Solution #02) to the new Operating Methods (Solution PJ.02-W2-21.1).

| Previous Operating Method in SESAR1 Solution #02 | New Operating Method in Solution PJ.02-W2-21.1 |
|---|---|
| **AO-0104-A — Airport Safety Nets for Controllers at A-SMGCS Airports** | **AO-0104-B — Extended Airport Safety Nets for Controllers at A-SMGCS Airports** |
| | **Extended CATC (for Ground Operations)** |
| CATC is only available for Runway Operations. | CATC is extended to Ground Operations (Taxiways and Aprons). |
| | **Updated CATC (for Runway Operations** |
| • CATC for runway operations has limited use at airports where air traffic controllers use reasonable assurance because the high number of nuisance alerts is unacceptable as they draw the attention of the controllers. | • **Updated CATC**<br>Land vs. Land, Take-off vs. Land, and Cross vs. Land: The alert triggering rules are updated, and trigger conditions are fine-tuned, using prediction calculations to reduce the number of nuisance alerts. This supports the use of reasonable assurance by the ATCOs. |
| • There is no alert covering Take-off vs. Take-of f for converging SIDs in Solution #02. | • **Updated CATC**<br>Take-off vs. Take-off alert: the triggering conditions take account of the SIDs to cover a conflicting situation right after take-off. |
| • In Solution #02 there is no clearance conflict alert in case of an ongoing RMCA/CMAC incident. | • **RMCA/CMAC Alerts vs Clearance**<br>CATC alert is triggered when a line-up, take-off or landing clearance is given while an RMCA or CMAC alert (e.g., Runway Incursion) is active regarding another mobile on the same runway. |
| | **Update of CMAC Alerts** |
| • No alert will be raised if the stand for an incoming flight is occupied. | • New Stand Occupied alert. |
| | **HMI displays** |
| • Solution #02 only differentiates between the alert stages INFORMATION and ALARM. | • Further differentiation of the alert stages is possible to visually distinguish the severity of alerts (local customization). |
| • Predictive Indication considers only CATC for Runway Operations | • Predictive Indication considers new<br>○ Updated CATC for Runway Operations<br>○ Extended CATC for Ground Operations<br>○ RMCA/CMAC versus ATC Clearance |





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| | |
|---|---|
| • There is no indicator highlighting the runway's current conflict status in Solution #02. | • New Runway Busy and Runway In Conflict Notification. |

**Table 29: Improvements from previous to new operating method**

Table 30 below lists the differences between new (Solution PJ.02-W2-21.1) and previous Operating Methods (SESAR1 Solution #02).

| OI Step code – title (OI Step CR) | | |
|---|---|---|
| AO-0104-B - Extended airport safety nets for controllers at A-SMGCS airports (CR 07104 Update AO-0104-B (PJ02-W2-21.1)) | | |
| Activity | Impact | Change |
| Assess Predictive CATC Indication | Introduce | (see Activity description) |
| Assess Runway Busy Status | Introduce | (see Activity description) |
| Assess Runway in Conflict Notification | Introduce | (see Activity description) |
| Assess Situation and Manage CATC Conflict | Introduce | (see Activity description) |
| Detect a Runway Related Conflict through a CATC Alert | Introduce | (see Activity description) |
| Detect CATC Conflict | Introduce | (see Activity description) |
| Detect Conflict in Runway Notification | Introduce | (see Activity description) |
| Detect Conflict RMCA/CMAC vs ATC Clearance | Introduce | (see Activity description) |
| Detect Potential CATC through Predictive Indicator | Introduce | (see Activity description) |
| Detect Runway Busy Status | Introduce | (see Activity description) |
| Detect Runway in Conflict Notification | Introduce | (see Activity description) |
| Detect Stand Occupied through Stand Occupied Alert | Introduce | A Stand Occupied alert is introduced by the new concept. |
| Manage conflict RMCA/CMAC vs ATC Clearance | Introduce | New type of alerts detected |
| Manage Stand Occupied Alert | Introduce | New type of alert created |
| Provide Clearance under a Specific Condition | Introduce | (see Activity description) |

**Table 30: Differences between new and previous Operating Method**





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### 2.3.4 Airport Safety Support Toolbox

This solution regards the Safety Support Tools as a toolbox which provides a set of safety supporting CATC and CMAC tools (SESAR1 Solution #02 + SESAR2020 Solution PJ.02-W2-21.1) that can be used together with RMCA for use at any airport equipped with A-SMGCS. However, the tools must be well-chosen according to the local safety requirements. Some of the selected tools may need to be adjusted, e.g., by changing the detection rules to consider the specifics of the airport. Some of the tools require calibration to provide the required performance.

Additionally, specific sub-sets of tools can be selected for deployment at specific airports depending on local business cases and cost considerations.

The update of CATC for Runway Operations (section 2.3.2.1.2) is an example how the original Solution #02 tools can be adapted to support ATCOs at airports with high traffic demand who support better runway throughput by using reasonable assurance. Here the solution follows the local needs to provide better safety support. Nevertheless, the implementation of CATC for Runway Operations as specified by Solution #02 remains a suitable concept for operations at airports with lower traffic requirements.

Consequently, the Airport Safety Support Toolbox is not an out-of-the-box solution but offers a solution that can be very flexibly adapted to local needs and will also be open to meet new requirements in the future.





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# 3 Safety, Security, Performance and Interoperability Requirements (SPR-INTEROP)

## 3.1 Operational Requirements for Extended Airport Safety Nets for Controllers at A-SMGCS Airports (AO-0104-B)

### 3.1.1 CATC Alerts

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0002 |
| Title | CATC - PUSH BACK versus PUSH BACK |
| Requirement | The Tower Ground Controller shall receive an alert when issuing a PUSH BACK clearance that conflicts with a previously input PUSH BACK clearance according to local rules and procedures. |
| Status | <validated> |
| Rationale | The Controller needs to know when two PUSH BACK manoeuvres performed at the same time would impede each other (Ref. UC-CATC-03). |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0003 |

| | |
|---|---|
| Title | CATC - PUSH BACK versus TAXI |
| Requirement | The Tower Ground Controller shall receive an alert when entering a TAXI clearance via the HMI that conflicts with a previously input PUSH BACK clearance according to local rules and procedures. |
| Status | <validated> |
| Rationale | The Controller needs to know when a TAXIING aircraft will be obstructed by an aircraft performing a PUSH BACK manoeuvre (Ref. UC-CATC-05).<br><br>Note: Time and distance separation parameters of the aircraft concerned will be subject to a local implementation decision. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0004 |
| Title | CATC - TAXI versus PUSH BACK |
| Requirement | The Tower Ground Controller shall receive an alert when entering a PUSH BACK clearance via the HMI that conflicts with a previously input TAXI clearance according to local rules and procedures. |
| Status | <validated> |





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| | |
|---|---|
| Rationale | The Controller needs to know when an aircraft performing a PUSH BACK manoeuvre will impede a TAXIING aircraft (Ref. UC-CATC-04).<br><br>Note: Time and distance separation parameters of the aircraft concerned will be subject to a local implementation decision. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0005 |
| Title | CATC - TAXI versus TAXI Case 1 (no push back required) |
| Requirement | The Tower Ground Controller shall receive an alert when entering a TAXI clearance for an aircraft A to taxi onto a taxiway where the aircraft A would obstruct the path of another aircraft B taxiing. |
| Status | <validated> |
| Rationale | The Controller needs to know when an aircraft starting to TAXI from a stand or taxiway will obstruct another TAXIING aircraft (Ref. UC-CATC-06).<br><br>Note: Time and distance separation parameters of the aircraft concerned will be subject to a local implementation decision. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0006 |
| Title | CATC - TAXI versus TAXI Case 2 (Deadlock) |
| Requirement | The Tower Ground Controller shall receive an alert when a TAXI clearance is entered via the HMI and another TAXI clearance was input previously where the two cleared routes are in opposite directions on the same taxiway and are predicted to block each other (Deadlock Situation). |
| Status | <validated> |
| Rationale | The Controller needs to know when two TAXIING aircraft will end up in a deadlock on the same taxiway (Ref. UC-CATC-07).<br><br>The order of the clearances is not relevant. Also, CROSS versus TAXI leads to the same deadlock situation. provided that the clearances are entered almost simultaneously and in two different AoRs.<br><br>Note: Time and distance separation parameters of the aircraft concerned will be subject to a local implementation decision. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0009 |
| Title | Updated CATC – LAND versus LAND |
| Requirement | The Tower Runway Controller shall receive an alert when a LAND clearance is input for an aircraft while a LAND clearance was previously given to another aircraft on the same runway and the separation minima on the runway (according to ICAO DOC4444) are not expected to be achieved the moment the second landing aircraft crosses the runway threshold |
| Status | <validated> |
| Rationale | The Controller needs to know when two LAND clearances would impede each other resulting in the flights losing separation on the ground (Ref. UC-CATC-09).<br><br>Note: This requirement is an update of SESAR1 REQ-06.07.01-OSED-CATC.0024 to support the runway controller when using reasonable assurance to optimize separation. It does not supersede REQ-06.07.01-OSED-CATC.0024, which is valid even if local procedures do not allow reasonable assurance. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect a Runway Related Conflict through a CATC Alert |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0010 |

| | |
|---|---|
| Title | Updated CATC – TAKE OFF versus LAND |
| Requirement | The Tower Runway Controller shall receive an alert when a LAND clearance is input for an aircraft while previously a TAKE OFF clearance was input for another aircraft on the same runway and the separation minima on the runway (according to ICAO DOC4444) are not expected to be achieved the moment the landing aircraft crosses the runway threshold. |
| Status | <validated> |
| Rationale | The Controller needs to know when a TAKE OFF and a LAND clearance impede each other resulting in the flights losing separation on the ground (Ref. UC-CATC-10).<br><br>Note: This requirement details a possible implementation of SESAR 1 REQ-06.07.01-OSED-CATC.0021 to support the runway controller when using reasonable assurance to optimize separation. It does not supersede REQ-06.07.01-OSED-CATC.0021, which is valid even if local procedures do not allow reasonable assurance. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect a Runway Related Conflict through a CATC Alert |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0011 |
| Title | Updated CATC – CROSS versus LAND |

| | |
|---|---|
| Requirement | The Tower Runway Controller shall receive an alert when a LAND clearance is input for an aircraft while previously a CROSS clearance was input on another aircraft on the same runway and the separation minima on the RWY (according to ICAO DOC4444) are not expected to be achieved the moment the landing aircraft crosses the RWY threshold. |
| Status | <validated> |
| Rationale | The Controller needs to know when a CROSS and a LAND clearance would impede each other resulting in the flights losing separation on the ground (Ref. UC-CATC-11).<br><br>Note: A similar situation is given for LAND versus CROSS where the CROSS clearance is given after the LAND clearance and the separation minima on the RWY (according to ICAO DOC4444) are not expected to be achieved the moment the landing aircraft crosses the RWY threshold. However, it must be mentioned that local procedures may not allow CROSS clearance to be given if an aircraft with active LAND clearance is approaching.<br><br>Note: This requirement details a possible implementation of SESAR 1 REQ-06.07.01-OSED-CATC.0015 to support the runway controller when using reasonable assurance to optimize separation. It does not supersede REQ-06.07.01-OSED-CATC.0015, which is valid even if local procedures do not allow reasonable assurance. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect a Runway Related Conflict through a CATC Alert |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC |

[REQ]





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| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0013 |
| Title | CATC - TAKE OFF versus TAKE OFF (Converging SIDS) |
| Requirement | The Tower Runway Controller shall receive an alert if a TAKE OFF clearance is entered for an aircraft, while a TAKE OFF clearance was previously entered for another aircraft on a different runway and the cleared ground routes, or the air trajectories (SIDs) are converging according to local procedures/rules. |
| Status | <validated> |
| Rationale | The Controller needs to know when two TAKE OFF clearances, if given at the same time, would impede each other resulting loss of separation on the ground or in the air shortly after take-off (Ref. UC-CATC-12).<br><br>Note: This requirement details a possible implementation of SESAR1 REQ-06.07.01-OSED-CATC.0019. See also REQ-06.07.01-OSED-CATC.0018 for the ground part. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect a Runway Related Conflict through a CATC Alert |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0014 |
| Title | RMCA vs Clearance Alert |
| Requirement | The Tower Runway Controller shall receive an alert when a LINE UP/TAKE OFF/CROSS/ENTER or LAND clearance is entered via the HMI whilst an RMCA alert is active for the same runway. |
| Status | <validated> |

| | |
|---|---|
| Rationale | The Controller needs to know when it is not safe to clear a mobile onto the runway when an RMCA alert is in progress (Ref. UC-CATC-13). |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Conflict RMCA/CMAC vs ATC Clearance |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0015 |
| Title | CMAC vs Clearance Alert |
| Requirement | The Tower Runway Controller shall receive an alert when a LINE UP/TAKE OFF/CROSS/ENTER or LAND clearance is entered via the HMI whilst a CMAC alert (RWY Incursion, No Take Off, No Land or Wrong Runway) is active for the same runway. |
| Status | <validated> |
| Rationale | The Controller needs to know when it is not safe to clear a mobile onto the runway when a CMAC runway related alert is in progress (Ref. UC-CATC-14). |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Conflict RMCA/CMAC vs ATC Clearance<br><br>Detect a Runway Related Conflict through a CATC Alert |

| | | |
|---|---|---|
| | | Detect Potential CATC through Predictive Indicator<br><br>Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0020 |
| Title | Extended CATC – Alert State |
| Requirement | The Controller shall receive an alert when an Extended CATC (for Ground Operations) is detected. |
| Status | <validated> |
| Rationale | The Controller needs to know the severity of a CATC alert when it is triggered.<br><br>Note: It will depend on a local implementation decision whether the alert is an INFORMATION or an ALARM alert. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator<br><br>[NOV-5][CATC-09-10-11-12] Updated CATC<br><br>[NOV-5][CATC-03-04-05-06-07-08] Extended CATC<br><br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0021 |
| Title | CATC – Predictive Indication |
| Requirement | The Controller may be presented an indicator on the HMI that informs the Controller that the input of a specific clearance for a mobile will trigger a CATC alert. |
| Status | <validated> |
| Rationale | The Controller might find it useful to have an HMI indicator predicting that, if a clearance is input, it will conflict with another clearance and, consequently, trigger a CATC alert (Ref. UC-CATC-01). |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Potential CATC through Predictive Indicator |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0022 |
| Title | CATC – Conditional Clearance |
| Requirement | The Controller when issuing a clearance to a mobile may link the clearance to a condition and enter the clearance and condition in the HMI. |
| Status | <validated> |

| | |
|---|---|
| Rationale | The Controller uses the conditional clearance to pass mobile priorities via RT to the Flight Crew and into the HMI (Ref. UC-CATC-02).<br><br>Note: This requirement extends REQ-06.07.01-OSED-CATC.0027 Conditional Line-Up clearance Input. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Provide Clearance under a Specific Condition |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-02] Conditional Clearance |



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### 3.1.2 CMAC Alerts

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-CM01.0001 |
| Title | CMAC – Stand Occupied Alert |
| Requirement | The Controller should receive an INFORMATION Alert on the HMI when the allocated stand for an arrival flight is occupied. |
| Status | <validated> |
| Rationale | The Controller might find it useful to have an information alert for an occupied stand so that he can hold the arrival flight in a position on the ground which is not affecting other traffic (Ref. UC-CMAC-01). The alert would mainly be useful for the Tower Ground Controller but could be used by the Tower Runway Controller as well. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Stand Occupied through Stand Occupied Alert |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CMAC-01] Stand Occupied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-CM01.0002 |
| Title | CMAC – Coordinate stand change |
| Requirement | The Ground Controller shall have means to coordinate the stand change for incoming flights. |
| Status | <in progress> |

| | |
|---|---|
| Rationale | If the planning of the stands is not the responsibility of the controller, there must be a way to handle the allocation of stands with the respective actor. |
| Category | <Operational><Interoperability> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Manage Stand Occupied Alert |
| <ALLOCATED_TO> | <Activity View> | [NOV-5][CMAC-01] Stand Occupied |
| <ALLOCATED_TO> | <Sub-Operating Environment> | APT-Very Large<br>APT-Large<br>APT-Medium |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-CM01.0003 |
| Title | CMAC – Check stand occupancy |
| Requirement | The Ground Controller shall have access to the stand information to check the planned and current occupancy of the stands. |
| Status | <in progress> |
| Rationale | The Controller needs to verify that the assigned stand is occupied and to find an alternative stand for the incoming aircraft. |
| Category | <Operational><Interoperability> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Manage Stand Occupied Alert |
| <ALLOCATED_TO> | <Activity View> | [NOV-5][CMAC-01] Stand Occupied |



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| | | |
|---|---|---|
| <ALLOCATED_TO> | <Sub-Operating Environment> | APT-Very Large<br>APT-Large<br>APT-Medium |

### 3.1.3 Runway Situational Notifications

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-RWAY.0005 |
| Title | Runway in Conflict notification |
| Requirement | The Tower Runway Controller should receive a visual indication if a runway is affected by any alert. |
| Status | <validated> |
| Rationale | As a supplement to the normal alert visualization, a change of appearance on the HMI for the runway affected by a conflict (e.g. the runway is coloured in red) is a prompt hint to the controller to prioritize the problem (Ref. UC-RWY-02). |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Runway in Conflict Notification |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][RWY-02] Runway In Confict Notification |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-RWAY.0010 |
| Title | Runway Busy notification |
| Requirement | The Tower Runway Controller should receive a visual indication if a runway is currently occupied by any mobile or if a mobile has been cleared to use it. |
| Status | <validated> |

| | |
|---|---|
| Rationale | A change of appearance on the HMI for the busy runway (e.g. the runway is coloured in yellow) provides a reminder to the controller and reduces the risk that he/she gives a clearance to another mobile, thus potentially causing a CATC or a RMCA (Ref. UC-RWY-01). |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Runway Busy Status |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][RWY-01] Runway Busy Notification |



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## 3.2 Safety Requirements

The following Safety Requirements at ATS Service level (SRS) are taken from the SAR [33].

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-SAFE.0001 |
| Title | Safety Support Tools training for ATC |
| Requirement | ATC staff shall be trained in how to use the Safety Support Tools and how to recognize and manage alerts. |
| Status | <validated> |
| Rationale | The ATCO must understand the rules for raising the alerts, how they are displayed, and what action needs to be taken to resolve the corresponding situation. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator<br>[NOV-5][CATC-02] Conditional Clearance<br>[NOV-5][CATC-09-10-11-12] Updated CATC<br>[NOV-5][CATC-03-04-05-06-07-08] Extended CATC<br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance<br>[NOV-5][CMAC-01] Stand Occupied<br>[NOV-5][RWY-02] Runway In Confict Notification<br>[NOV-5][RWY-01] Runway Busy Notification |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0001 |





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| | |
|---|---|
| Title | ATCO awareness for CATC |
| Requirement | ATCO shall detect potential CATC through Predictive indicator |
| Status | <validated> |
| Rationale | The predictive indication and the runway notification provide the ATCO with the necessary information to avoid confliction clearances. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Potential CATC through Predictive Indicator |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0002 |
| Title | Predictive CATC indication |
| Requirement | ATCO shall assess Predictive CATC Indication. |
| Status | <validated> |
| Rationale | The controller must have completed the training on the use of Predictive CATC Indication. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Assess Predictive CATC Indication |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0003 |
| Title | Provision of conditional clearance |
| Requirement | ATCO shall provide clearance under a specific condition when operationally required |
| Status | <validated> |
| Rationale | The controller must have completed the training for issuing clearances under certain conditions. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Provide Clearance under a Specific Condition |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-02] Conditional Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0004 |
| Title | General CATC awareness |
| Requirement | ATCO shall be aware in advance of any potential CATC conflict. |
| Status | <validated> |
| Rationale | The controller must have an overview of the active clearances and be able to recognize whether a new clearance will lead to a clearance conflict. |

| | |
|---|---|
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Potential CATC through Predictive Indicator<br><br>Assess Predictive CATC Indication |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0005 |
| Title | Assess and manage CATC and CMAC alerts. |
| Requirement | ATCO shall assess situation and manage CATC and CMAC alerts |
| Status | <validated> |
| Rationale | It is the responsibility of the ATCO to assess conflicts and decide what actions are needed to address them. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Assess Situation and Manage CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0006 |

| | |
|---|---|
| Title | Clearance cancellation for pilot and in HMI |
| Requirement | ATCO shall cancel/hold clearance and record change in the HMI |
| Status | <validated> |
| Rationale | The ATCO must be able to notify the pilot of the cancel /hold of the clearance via voice communication and simultaneously enter the cancel/hold in the system. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Cancel Clearance and Record Change in the HMI |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC<br><br>[NOV-5][CATC-03-04-05-06-07-08] Extended CATC<br><br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0007 |
| Title | Record clearance in the system. |
| Requirement | ATCO shall record ATC Clearance in the system |
| Status | <validated> |
| Rationale | The controller must be aware that instructions for the pilot/driver must be entered into the HMI. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Record ATC Clearance in the system |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0008 |
| Title | CMAC vs ATC clearance conflict detection |
| Requirement | ATCO shall detect conflict CMAC vs ATC clearance |
| Status | <validated> |
| Rationale | Predictive Indication and Runway Notification provide the ATCO with the necessary information regarding a potential conflict between ongoing CMAC alert and an ATC clearance to be issued. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Conflict RMCA/CMAC vs ATC Clearance |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0009 |
| Title | Manage CMAC vs ATC clearance conflict |
| Requirement | ATCO shall manage CMAC vs ATC clearance alert |
| Status | <validated> |

| | |
|---|---|
| Rationale | The controller must understand why the CMAC vs. ATC clearance alert was triggered and what the options are to manage the conflict. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Manage conflict RMCA/CMAC vs ATC Clearance |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0010 |
| Title | Awareness of Occupied Stand |
| Requirement | ATCO shall be aware in advance of any detect stand occupied through Stand Occupied alert conflict |
| Status | <validated> |
| Rationale | The early awareness that the assigned stand of an arriving aircraft is still occupied allows the ATCO to take appropriate measures so that the ongoing traffic is not obstructed by the waiting aircraft on the taxiway or apron. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Stand Occupied through Stand Occupied Alert |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |

| | | |
|---|---|---|
| | | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CMAC-01] Stand Occupied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0011 |
| Title | Manage stand occupied alert |
| Requirement | ATCO shall manage stand occupied alert |
| Status | <validated> |
| Rationale | If the assigned parking stand of an arriving aircraft is occupied an information alert should be displayed to provide the Controller with situational awareness that they might need to hold the aircraft on a taxiway until the departing aircraft vacates the stand or until an alternative stand is allocated. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Manage Stand Occupied Alert |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CMAC-01] Stand Occupied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0012 |
| Title | Failure rate support |
| Requirement | The System/Equipment supporting the solution has to meet the defined failure rate. |
| Status | <validated> |
| Rationale | Equipment must be certified and maintained |

| | |
|---|---|
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0013 |
| Title | Awareness of operational runway status |
| Requirement | ATCO shall be constantly and immediately aware about the operational status of the Runway, whether it is busy or it is affected by any conflict. |
| Status | <validated> |
| Rationale | The runway notification shall constantly keep the ATCO informed about the operational status of a runway. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Assess Runway in Conflict Notification<br>Assess Runway Busy Status<br>Detect Runway in Conflict Notification<br>Detect Runway Busy Status |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][RWY-02] Runway In Confict Notification<br>[NOV-5][RWY-01] Runway Busy Notification |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0014 |
| Title | Awareness of potential RMCA vs ATC clearance conflict |
| Requirement | ATCO shall be aware in advance of any potential RMCA vs ATC clearance conflict. |
| Status | <validated> |
| Rationale | Predictive Indication and Runway Notification provide the ATCO with the necessary information regarding a potential conflict between ongoing RMCA alert and an ATC clearance to be issued. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Assess Predictive CATC Indication |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator<br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance<br>[NOV-5][RWY-02] Runway In Confict Notification |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0015 |
| Title | Manage RMCA vs ATC clearance conflict |
| Requirement | ATCO shall manage RMCA vs ATC clearance conflict. |
| Status | <validated> |
| Rationale | The controller must understand why the RMCA vs. ATC clearance alert was triggered and what the options are to manage the conflict. |
| Category | <Operational> , <Safety> |

[REQ Trace]





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| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Manage conflict RMCA/CMAC vs ATC Clearance |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0020 |
| Title | CATC/CMAC alert on RWY not shown to ATC |
| Requirement | The frequency of a RWY event in which the CATC/ CMAC alert is not shown to ATC by the system shall be no more than 5e-7 per Flight Hour |
| Status | <validated> |
| Rationale | ATC do not correctly detect RWY events because of lack of detection of CATC/ CMAC alert. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0021 |
| Title | CATC/CMAC alert on TWY not shown to ATC |
| Requirement | The frequency of a TWY event in which the CATC/ CMAC alert is not shown to ATC by the system shall be no more than 3,3e-3 per Flight Hour |
| Status | <validated> |





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| | |
|---|---|
| Rationale | ATC do not correctly detect TWY events because of lack of detection of CATC/ CMAC alert. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0022 |
| Title | CATC/CMAC alert on RWY incorrectly shown to ATC |
| Requirement | The frequency of a RWY event in which the CATC/ CMAC alert is incorrectly shown to ATC by the system shall be no more than 5e-7 per Flight Hour |
| Status | <validated> |
| Rationale | ATC do not correctly detect RWY events because of incorrect/incomplete information of CATC/ CMAC alert. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC<br><br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0023 |
| Title | CATC/CMAC alert on TWY incorrectly shown to ATC |
| Requirement | The frequency of a TWY event in which the CATC/ CMAC alert is incorrectly shown to ATC by the system shall be no more than 3,3e-3 per Flight Hour |
| Status | <validated> |
| Rationale | ATC do not correctly detect TWY events because of incorrect/incomplete information of CATC/ CMAC alert. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0024 |
| Title | RMCA/CMAC vs ATC Clearance alert not shown to ATC |
| Requirement | The frequency of a RWY event in which the RMCA vs CATC Alert or CMAC vs CATC alert is not shown to ATC by the system shall be no more than 5e-7 per Flight Hour |
| Status | <validated> |
| Rationale | ATC do not correctly detect RWY events because of lack of detection of RMCA vs ATC Clearance alert or CMAC vs ATC Clearance alert. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0025 |
| Title | RMCA/CMAC vs ATC Clearance alert incorrectly shown to ATC |
| Requirement | The frequency of a RWY event in which the RMCA vs CATC Alert or CMAC vs CATC alert is incorrectly shown to ATC by the system shall be no more than 5e-7 per Flight Hour |
| Status | <validated> |
| Rationale | ATC do not correctly detect RWY events because of incorrect/incomplete information of RMCA vs ATC Clearance alert or CMAC vs ATC Clearance alert. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0026 |
| Title | Stand Occupied CMAC alert not shown to ATC |
| Requirement | The frequency of a TWY event in which the Stand Occupied CMAC alert is not shown to ATC by the system shall be no more than 3,3e-3 per Flight Hour |





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| | |
|---|---|
| Status | <validated> |
| Rationale | ATC do not detect correctly conflicting parking instruction because of lack of detection of Stand Occupied CMAC alert. |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CMAC-01] Stand Occupied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SRS.0027 |
| Title | Stand Occupied CMAC alert incorrectly shown to ATC |
| Requirement | The frequency of a TWY event in which the Stand Occupied CMAC alert is incorrectly shown to ATC by the system shall be no more than 3,3e-3 per Flight Hour |
| Status | <validated> |
| Rationale | ATC do not detect correctly conflicting parking instruction because incorrect information of Stand Occupied CMAC alert. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CMAC-01] Stand Occupied |

## 3.3 Human Performance Requirements

The following Human Performance Requirements are taken from the HPAR [33].

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-HP.0001 |
| Title | CMAC Stand Occupied alert detectability |
| Requirement | The visual display of the CMAC Stand occupied alert shall be clearly distinguishable from CATC or CMAC alerts. |
| Status | <validated> |
| Rationale | The visual display of the CMAC Stand occupied alert indicates a planning issue. This shall be clearly identifiable as an alert of low criticality. Otherwise, it might be confused with a CATC or CMAC alert. Further differentiation of the alert stages is possible to visually distinguish the severity of alerts (local customization). |
| Category | <Operational> , <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect Stand Occupied through Stand Occupied Alert |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CMAC-01] Stand Occupied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-HP.0002 |
| Title | Support local procedures |
| Requirement | ATCOs shall be provided by a safety support service that supports the local ATC procedures and the corresponding practices (especially relevant for TOF/LND, LND/LND and CRSS/LND alerts) |
| Status | <validated> |

| | |
|---|---|
| Rationale | Validation exercises performed in different countries have demonstrated that there are two valid versions for LND/LND, CRS/LND and TOF/LND alerts: the version of Solution #02 in SESAR1 (i.e. for EXE03) and the version of PJ.02-W2-21.1 (i.e. for EXE01). |
| Category | <Human Performance> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect a Runway Related Conflict through a CATC Alert |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-09-10-11-12] Updated CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-HP.0003 |
| Title | Types of training |
| Requirement | The Safety Support Tools training should consist of two parts: theoretical and simulator training. |
| Status | <validated> |
| Rationale | ATCOs pointed out that it is essential to provide 2 types of training prior to the implementation of these alerts: Theoretical training (to correctly understand the activation and termination conditions of each alert) and Simulator training to become familiar with the alerts. |
| Category | <Human Performance> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |

| | | |
|---|---|---|
| | | Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator<br>[NOV-5][CATC-02] Conditional Clearance<br>[NOV-5][CATC-03-04-05-06-07-08] Extended CATC<br>[NOV-5][CATC-09-10-11-12] Updated CATC<br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance<br>[NOV-5][CMAC-01] Stand Occupied<br>[NOV-5][RWY-01] Runway Busy Notification<br>[NOV-5][RWY-02] Runway In Confict Notification |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-HP.0004 |
| Title | Training on interaction of surveillance, planning and routing, and safety support services |
| Requirement | The Safety Support Tools training shall address the surveillance and the routing and planning service. |
| Status | <validated> |
| Rationale | The Safety Support Tools are an integrated part of the A-SMGCS. The interaction of surveillance, routing and planning and safety support tools shall be considered in the training. |
| Category | <Operational> , <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-02] Conditional Clearance<br>[NOV-5][CATC-03-04-05-06-07-08] Extended CATC<br>[NOV-5][CATC-09-10-11-12] Updated CATC |

| | | |
|---|---|---|
| | | [NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance<br><br>[NOV-5][CMAC-01] Stand Occupied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-HP.0005 |
| Title | Training based on practical local examples |
| Requirement | The Safety Support Tools Training should be conducted using practical examples that include local traffic situations at the trainee's airport |
| Status | <validated> |
| Rationale | Air traffic controllers shall learn the specifics of the Safety Support Tools used at their airport and not the "similar" solution used at any other airport. Rational: It is expected that the Safety Support Tools require local implementation to get their full potential. |
| Category | <Operational> , <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator<br><br>[NOV-5][CATC-02] Conditional Clearance<br><br>[NOV-5][CATC-03-04-05-06-07-08] Extended CATC<br><br>[NOV-5][CATC-09-10-11-12] Updated CATC<br><br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance<br><br>[NOV-5][CMAC-01] Stand Occupied<br><br>[NOV-5][RWY-01] Runway Busy Notification<br><br>[NOV-5][RWY-02] Runway In Confict Notification |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-HP.0006 |
| Title | Continuous on-the-job knowledge support |
| Requirement | The Safety Support Tools Training should use continuous on-the-job knowledge support, i.e., refresher training, coaching, and dedicated contacts among colleagues. |
| Status | <validated> |
| Rationale | Changes to the airport layout, changes affecting the procedures, improvements of the conflict detection function, and changes to the HMI shall be communicated regarding their relevance for the understanding of the Safety Support Tools. |
| Category | <Human Performance> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-01] Predictive Indicator<br>[NOV-5][CATC-02] Conditional Clearance<br>[NOV-5][CATC-03-04-05-06-07-08] Extended CATC<br>[NOV-5][CATC-09-10-11-12] Updated CATC<br>[NOV-5][CATC-13-14] RMCA/CMAC versus ATC Clearance<br>[NOV-5][CMAC-01] Stand Occupied<br>[NOV-5][RWY-01] Runway Busy Notification<br>[NOV-5][RWY-02] Runway In Confict Notification |

## 3.4 Security Requirements

The following Security Requirements are taken from the Security Assessment performed by the solution. The Security Assessment is confidential and therefore not published.

[REQ]





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| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0001 |
| Title | Background Security Verification Checks (C4.1) |
| Requirement | Background verification checks on all staff shall be carried out in accordance with relevant laws, regulation, and ethics. The checks shall be proportional to the roles and responsibilities, in particular in respect to the business requirements (e.g., safety-critical function, developments), the classification of information to be accessed, and the perceived risks. |
| Status | <validated> |
| Rationale | This is to ensure that employees (both temporary and permanent) and third party users will need to reliably support and respect the security needs of their work environment. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SECU.0002 |
| Title | Staff Application of Security (C4.2) |
| Requirement | Staff shall apply security in accordance with the established policies and procedures. |
| Status | <validated> |
| Rationale | The employees must understand that the policies and procedures are to be carried out according to the specifications in order to commonly ensure the highest possible security level. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0003 |
| Title | Auxiliary Means Policy (C7.3) |
| Requirement | ATM equipment shall be provided with auxiliary means to compensate for deliberate compromising of power supply, overheating and fire. |
| Status | <validated> |
| Rationale | Means of avoiding disruption or destruction of technical support services help keep ATM systems alive. Redundant support services can also help. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0004 |
| Title | ATM Cabling Policy (C7.4) |
| Requirement | ATM cabling shall be protected from deliberate damage, eavesdropping or interference. |
| Status | <validated> |

| | |
|---|---|
| Rationale | The disruption in data transmission and falsification of data has a direct impact on the functionality of the systems dependent on it. By eavesdropping on data lines, confidential information can be compromised. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0005 |
| Title | Maintenance and Servicing Policy (C7.5) |
| Requirement | ATM equipment shall be maintained and serviced to ensure their availability and integrity. |
| Status | <validated> |
| Rationale | Regular maintenance and service help to keep the ATM systems alive. If not, this could be used as intentional “passive” security incident. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0006 |

| | |
|---|---|
| Title | ATM Software Controls Policy (C8.3) |
| Requirement | Detection, prevention, and recovery controls to protect ATM software against malicious code and appropriate user awareness procedures shall be implemented. |
| Status | <validated> |
| Rationale | Malicious code can propagate on its own once a vulnerability is found through which it can penetrate. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0007 |
| Title | Back-up Policy (C8.4) |
| Requirement | Backup copies of ATM information and software shall be taken and tested regularly in accordance with an agreed backup policy. |
| Status | <validated> |
| Rationale | Backup copies are important precautions for recovering from a cyber attack |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0008 |
| Title | Monitoring Procedures (C8.5) |
| Requirement | Procedures for monitoring the use of ATM services and information processing facilities shall be established and the results of the monitoring activities reviewed regularly. |
| Status | <validated> |
| Rationale | Monitoring of ATM services and information processing facilities helps to detect activities that indicate a security breach. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0009 |
| Title | ATM Logging Protection Procedures (C8.6) |
| Requirement | ATM logging facilities and log information shall be protected against tampering and unauthorised access. |
| Status | <validated> |
| Rationale | The deletion of log entries that were caused by unauthorized access must be prevented to detect and document the unauthorized access. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0010 |
| Title | Fault Logging and Resolution Procedures (C8.7) |
| Requirement | Faults shall be logged, analysed, and appropriate action taken. |
| Status | <validated> |
| Rationale | The errors encountered may indicate unauthorized access and malicious modifications to the ATM system. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0011 |
| Title | ATM Networks Policy (C9.1) |
| Requirement | ATM Networks shall be adequately managed and controlled, in order to be protected from threats, and to maintain security for the ATM systems and applications using the network, including information in transit. |
| Status | <validated> |
| Rationale | |
| Category | <Security> |





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[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br>Tower Ground Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0012 |
| Title | Information Transfer Policies (C9.2) |
| Requirement | Formal exchange policies, procedures, and controls shall be in place to protect the exchange of ATM services and information through the use of all types of communication facilities. Agreements shall be established for the exchange of ATM services and information and software between the Responsible Organization and external parties. |
| Status | <validated> |
| Rationale | Formal exchange policies help maintain the security of ATM services, information, and software exchanged within an organization and with external entities. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-SECU.0013 |
| Title | Electronic Messaging Protection Policy (C9.3) |
| Requirement | Information conveyed by electronic messaging shall be appropriately protected . |

| | |
|---|---|
| Status | <validated> |
| Rationale | Confidential information can be protected by encryption. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1)<br><br>Tower Ground Controller (PJ.02-W2-21.1) |

## 3.5 Interoperability Requirements (INTEROP)

**Focus on Airport Safety Nets Operational interoperability:**

Concerning the eventual co-existence of alerts in the airport environment, airport ground-based and airborne alerts use cases were reviewed by AUs, ATCO, pilots, and safety experts during a dedicated workshop organized by PJ03b PCIT on 15-16 November 2017 (see [27]). The following alerts were considered:

**Ground-based Airport Safety Nets:**

- Airport Safety Nets for Controllers (RMCA, CMAC, CATC)
- Airport Safety Nets for Vehicle Drivers (AVDR)
- Airport Safety Nets for pilots and vehicle drivers: Runway Status Lights (RWSL).

**Airborne Safety Nets**

- Conformance Monitoring Alert for Pilot: CMAP
- Airborne Safety Net for Pilots: SURF-A

The completed analyse shows that alerts can coexist in the same airport environment without issue from a Flight Crew, Vehicle Driver or Controller perspective.

Nevertheless, it was reminded that alerts for ATCOs (RMCA, CMAC, CATC) are not intended to be uplinked and presented to Vehicle drivers or pilots. Indeed, they are designed, tuned, and validated only for the intended end-user, namely Tower Controller. Therefore, the following requirement is defined:





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| | |
|---|---|
| Identifier | **REQ-02-W2-21.1-SPRINTEROP-IN01.0001** |
| Title | **Independence of Airport Safety Nets** |
| Requirement | The Airport Safety Support Service for Controllers shall be independent from any other safety net designed for pilots or vehicle drivers |
| Status | <in progress> |
| Rationale | ATCO is provided with alerts designed and tuned for its own needs, taking into consideration local procedures and ATCO Human Factors. Consequently, ground-based alerts for ATCO shall not be uplinked to the aircraft for Flight Crew alerting purposes. Likewise, ATCO shall not be provided for alerting purposes with alerts calculated by on-board systems for the Flight Crew. This does not prevent displaying on-board alerts on CWP for information purposes. |
| Category | <Operational> |

**Operational integration of AO-0104-B into the ATM System**

As a result of SESAR1, the need to ensure operational interoperability of entering a runway clearance while an RMCA/CMAC alert is in progress was identified. Indeed, the Controller needs to know when it is not safe to clear a mobile onto the runway when an RMCA/CMAC alert is in progress. Thus, the proposal to establish a link between RMCA/CMAC alerts and Clearances results in the requirements REQ-02-W2-21.1- SPRINTEROP-CA01.0014 and 0015.

**Technical integration of AO-0104-B into the ATM System**

No new interoperability requirements are needed with respect to the baseline defined for Solution #02, with exception for the CMAC Alerts (see section 3.1.2).

## 3.6 Performance Requirements

For performance requirements regarding Safety see section 3.2. For other performance requiremints see EUROCAE ED-87E MASPS [19]and EUROCONTROL Specification for A-SMGCS Service [15].





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# 4 References and Applicable Documents

## 4.1 Applicable Documents

### Content Integration

[1] PJ19 D5.11 EATMA Guidance Material and Report (2019), ed 01.00.01, 28/10/2019

[2] EATMA Community Wiki https://ost.eurocontrol.int/sites/eatmac

[3] SESAR ATM Lexicon

### Content Development

[4] B4.2 PJ19 CI D2.5 SESAR Concept of Operations (CONOPS 2019), ed 01.00.00, May 2019

### Performance Management

[5] PJ19.04 D4.7 Performance Framework (2019), ed 01.00.01, 30/11/2019

[6] PJ19-W2 D4.1 Validation Targets - Wave 2, ed 00.01.00, 30/06/2020

[7] 16.06.06 D26 Guidelines for Producing Benefit and Impact Mechanisms, ed 03.00.01, 23/06/2016

### Safety

[8] SAM EUROCONTROL Safety Assessment Methodology, Edition 2.0

[9] SESAR Safety Reference Material – Edition 04.01, December 2018

[10] Guidance to Apply SESAR Safety Reference Material – Edition 03.01, December 2018

### Human Performance

[11] To be updated from HPAR

### Security

[12] To be updated from SRA

## 4.2 Reference Documents

[13] SESAR D32 P06.07.01 Final OSED for Conflicting ATC Clearances and Conformance Monitoring Alerts for Controllers, V00.01.01 Dated 10/11/2016.

[14] ICAO Advanced Surface Movement Control and Guidance Systems (A-SMGCS) Manual, Doc 9830 AN/452, First Edition, Canada 2004.

[15]EUROCONTROL Specification for Advanced-Surface Movement Guidance and Control System (A-SMGCS) Services – Specification, Edition 2.0, Dated 22 April 2020, EUROCONTROL-SPEC-171.

[16]ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.

[17]SESAR Solution PJ.02-W2-21.1 – D6.1.006 - Validation Report (VALR) for V3, edition 00.01.02, 24 May 2023.

[18]ICAO Doc 4444 Procedures for Air Navigation Services -Air Traffic Management 16th Edition, 2016.

[19]EUROCAE ED-87E Minimum Aviation System Performance Standard (MASPS) for Advanced Surface Movement Guidance and Control Systems (A-SMGCS), April 2022, supersedes ED-87D.

[20]ICAO Annex 14 Aerodrome Design and Operations, Volume I, Edition 7, 2016.

[21]Commission Regulation (EU) No 73/2010 on the quality of aeronautical data and aeronautical information, 26 January 2010.

[22]Commission Implementing Regulation (EU) No 716/2014 on the establishment of the Pilot Common Project (PCP), 27 June 2014.

[23]EASA Commission Regulation (EU) No 139/2014 laying down the requirements and administrative procedures related to aerodromes, 12 February 2014 (EASA Aerodrome IR).

[24]EASA Basic Regulation (EU) 2018/1139, 4 July 2018.

[25]EUROCAE document ED-117A - Minimum Operational Performance Specification (MOPS) for Mode S Multilateration Systems for Use in A-SMGCS, issued in September 2016.

[26]EUROCAE document ED-128 - Guidelines for Surveillance Data Fusion in Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Levels 1 and 2, issued in October 2007.

[27]SESAR PJ03B Solution 01 SPR-INTEROP/OSED V2 -D2.1.120, 31 July 2019.

[28]PJ19-W2 CI - D2.0.002 High Level Operational Requirements for Wave 2 Solutions, ed. 00.01.01, 07/12/2020

[29]SESAR Concept of Operations (CONOPS 2019) – Wave 1 PJ 19 / D2.5

[30]EATMA Dataset 23 (https://www.eatmportal.eu)

[31]P06.07.01 - D29 SPR for "Conflicting ATC Clearances" and " Conformance Monitoring for Controllers", ed. 00.01.01, 20/11/2013

[32]SESAR Solution PJ.02-W2-21.1- D6.1.002 - SPR-INTEROP/OSED for V3 -Part II-SAR, Edition 00.01.02, 24 May 2023.

[33]SESAR Solution PJ.02-W2-21.1- D6.1.002 - SPR-INTEROP/OSED for V3 -Part V-HPAR, Edition 00.01.01, 24 May 2023.

[34]SESAR Solution PJ.02-W2-21.1- D6.1.002 - SPR-INTEROP/OSED for V3 - Part V-PAR, Edition 00.01.02, 24 May 2023.

[35]SESAR Solution PJ.02-W2-21.1- D6.1.008 – TS/IRS for V3, Edition 00.02.00, 24 May 2023

[36]SESAR Solution PJ.02-W2-21.1- D6.1.010 – CBA for V3, Edition 00.01.03, 24 May 2023

# Appendix A Cost and Benefit Mechanisms

## A.1 Stakeholders identification and Expectations

| Stakeholder | Involvement (in the validation) | Why deploying the solution matters to stakeholder |
|---|---|---|
| ANSP | To provide cost estimates for ground system upgrades. These cost estimates will not only come from ANSPs but from the industry as well. The provision of cost estimates is not related to the involvement in validation. | Need to deploy the Solution so that their systems have the functionality to provide the alerts and information to the relevant controllers. |
| Tower Runway Controller<br>Tower Ground Controller | To ensure working methods will be acceptable. | Their working methods will adapt to respond appropriately to the alerts and information. Avoiding conflicting clearances avoids the associated peaks in workload. |
| Airport | n/a | Depending on the ownership of assets the airport may need to deploy/maintain surveillance means to provide inputs to the ANSP systems. However, in many cases the deployment and maintenance of surveillance means is the responsibility of the ANSPs.<br><br>Will avoid having to handle the consequences of any collisions (with other aircraft or vehicles) at the level of the affected mobiles or from closed runways/taxiways. |
| Flight Crew | n/a | An increase in safety of ground movements and will experience fewer last-minute changes to clearances |
| Airspace User - FOC | n/a | Will avoid having to handle the consequences of any collisions (with other aircraft or vehicles) – Insurance claims, fixing the damage, finding replacement aircraft, cancelling flights, rescheduling subsequent rotations, etc. |
| Ground Handlers | n/a | Will avoid having to handle the consequences of any collisions (with other aircraft or vehicles) |

**Table 31: Stakeholder's expectations**





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## A.2 Benefits mechanisms

Table 32 shows an overview of the available BIMs. It shows the stakeholders for which a BIM has been produced.

| Stakeholders | AO-0104-B |
|---|---|
| ANSP | Yes |
| Tower Runway Controller | Yes |
| Tower Ground Controller | Yes |
| Tower Clearance Delivery Controller | - |
| Flight Crew[4] | Yes |
| Airport | Yes |
| Airspace User | Yes |

**Table 32: BIM Overview**

| Supported Capability | Validation Target | Indicator | Value |
|---|---|---|---|
| Controller Situational Awareness (surface)<br><br>Ground Collision Avoidance<br><br>Trajectory Conformance Monitoring | Resilience RES1 PJ.02-W2-21.1 [RESULT] | % loss of airport capacity avoided | 19,82 % (local) |
| | Resilience RES4 PJ.02-W2-21.1 [RESULT] | minutes of delays | 1761,8 Minutes (local) |
| | Resilience RES5 PJ.02-W2-21.1 [RESULT] | number of cancellations | 6,7 (local) |
| | Safety SAF3.X PJ.02-W2-21.1 [RESULT] | RWY-collision accident | 64,1 %<br>(52,7 % at ECAL level) |
| | Safety SAF4.X PJ.02-W2-21.1 [RESULT] | TWY-collision accident | 55,5 %<br>(45,7 % at ECAL level) |

**Table 33 Mandatory PIs Assessment Summary [34]**

[4] Flight crew is included here because once PJ.02-W2-21.1 is operational, they will benefit as the alerts will result in fewer hazardous events occurring at airport. The solution has no impact on the Flight Crew working methods.





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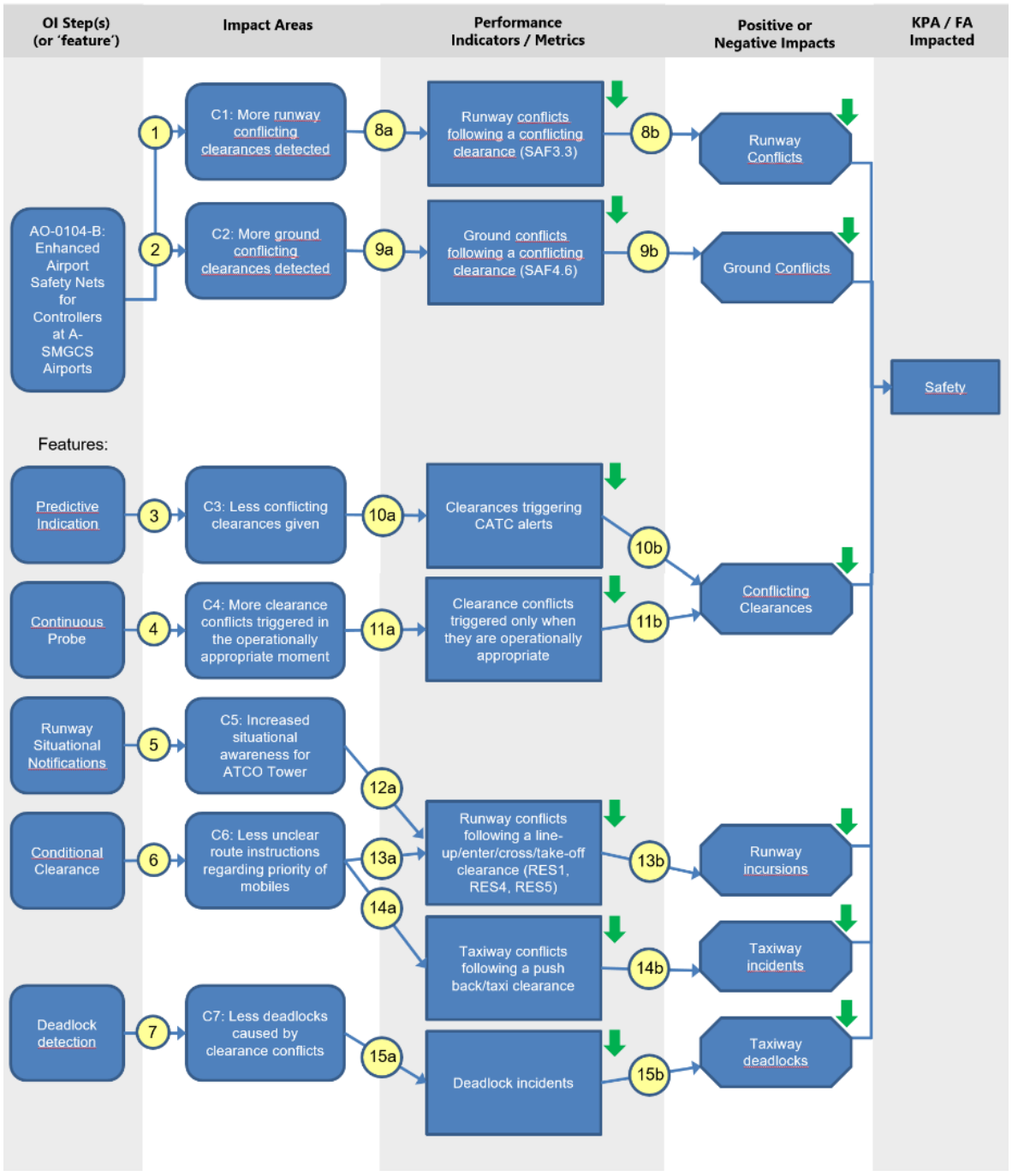


| | |
|---|---|
| 1 | C1: **More runway conflicting clearances detected**<br>The CATC for Runway Operation will detect more runway conflicting clearances: The alert will be triggered only in cases when the system – based on data available – assumes that the separation on the RWY will be infringed at the time the landing aircraft crosses the RWY threshold.<br>A TOF/TOF (converging SIDs) alert will be triggered when the trajectories of departing aircraft are detected to be converging immediately after take-off and the second aircraft is cleared for take-off (and still on the ground). |

| | |
|---|---|
| | A RMCA/CMAC vs. ATC Clearance alert will be triggered when an aircraft is cleared to use a runway although a runway incursion has been detected (and still needs to be resolved). |
| 2 | C2: **More ground conflicting clearances detected**<br>The CATC for Ground Operation will detect more conflicting clearances in ground operations, e.g., an alert will be triggered when a push-back or taxi clearance is given and is predicted to lead to conflicting trajectories with another aircraft already cleared for Push-back or Taxi. |
| 3 | Feature: **Predictive Indication**<br>C3: Less conflicting clearances given<br>The Predictive Indication is a decision support tool that gives notice of a potential conflicting clearance before it is given to the flight crew. |
| 4 | Feature: **Continuous Probe**<br>C4: More clearance conflicts triggered in the operationally appropriate moment<br>The new safety net continuously checks the active clearances for potential conflicts to account for changing traffic conditions and triggers alerts only when operationally appropriate, i.e., not too early and not too late to give the controller the time to solve the conflict. |
| 5 | Feature: **Runway Situational Notifications**<br>C5: Increased situational awareness for ATCO Tower<br>The Runway Situational Notifications act as awareness support tool that indicates current runway usage status (Runway Busy Notification) and alert status for active RMCA, CMAC, and CATC alerts (Runway In Conflict). |
| 6 | Feature: **Conditional Clearance**<br>C6: Less unclear route instructions regarding priority of mobiles<br>Controllers use Conditional Clearances to clearly state the priority of mobiles when communicating the cleared route to the flight crew via R/T. The new safety net considers conditional clearances in monitoring and detection of potential conflicts. |
| 7 | Feature: **Deadlock Detection**<br>C7: Less deadlocks caused by clearance conflicts<br>The new safety net recognizes potential deadlock situations caused by conflicting clearances. |
| 8a | Detecting more runway conflicting clearances will result in fewer conflicts to occur on the runway (or in the immediate vicinity of the runway) as the delivery of a clearance could lead to a conflict with another aircraft already cleared for a movement. |
| 8b | Fewer conflicts following a conflicting runway clearance will decrease the overall number of conflicts, which leads to Safety. |
| 9a | Detecting more ground conflicting clearances will result in fewer conflicts happening on taxiways and apron areas as the delivery of a push-back or taxi clearance could lead to a conflict with another aircraft already cleared for push-back or taxi. |
| 9b | Fewer conflicts following a conflicting ground clearance will decrease the overall number of conflicts, which affects Safety. |
| 10a | Prediction of conflicting clearances along the planned route supports the decision making by the controller and, if a potential conflict of clearances is detected, the controller may wait until the situation clears. |
| 10b | If the controller considers the predictive indication display this reduces the number of conflicting clearances given to the flight crew. Reducing the number of conflicting clearances given to the flight crew affects Resilience. |





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| | |
|---|---|
| 11a | The ATC system is continuously checking the active clearances and, if it detects a clearance conflict, it takes in account time or distance to the location of the predicted conflict (or other condition-depended rules) to reduce the number of nuisance alerts. |
| 11b | Reducing the number of nuisance alerts reduces the total number of triggered alerts. Reducing the number of nuisance alerts affects Resilience. |
| 12a | The controller perceives the Runway Busy or Runway In Conflict notification and has the opportunity to decide whether or not to issue an Enter/Cross/Line Up/Take Off clearance.<br>In the case of a Runway Busy notification, the controller could link the clearance to a condition. |
| 13a | Conditional clearances are used to constitute the priority of mobiles at runway entries and between parking positions and taxiways. |
| 13b | If the controller uses conditional clearances (enter, cross, line-up) at runway entries, this reduces the number of conflicting clearances with aircraft landing or taking off. Reducing the number of conflicting clearances at runway entries affects Resilience. |
| 14a | Conditional clearances are used to constitute the priority of mobiles between parking stands and between parking stands and taxiways. |
| 14b | If the controller uses conditional clearances to constitute the priority of mobiles between parking stands and between parking stands and taxiways this reduces the number of conflicting clearances given to the flight crew. Reducing the number of conflicting clearances given to the flight crew affects Resilience. |
| 15a | Depending on the airport layout it is possible that clearances given by different controllers (responsible for different AoR) cause a deadlock situation with the aircraft ending up nose to nose. Deadlocks are also possible if route trajectories overlap on a taxiway without alternative routes. |
| 15b | The safety net conflict detection recognizes potential deadlock situations caused by conflicting clearances. This reduces the number of deadlocks and avoids impact on the surrounding traffic flow. Reducing the number of deadlocks affects Resilience. |





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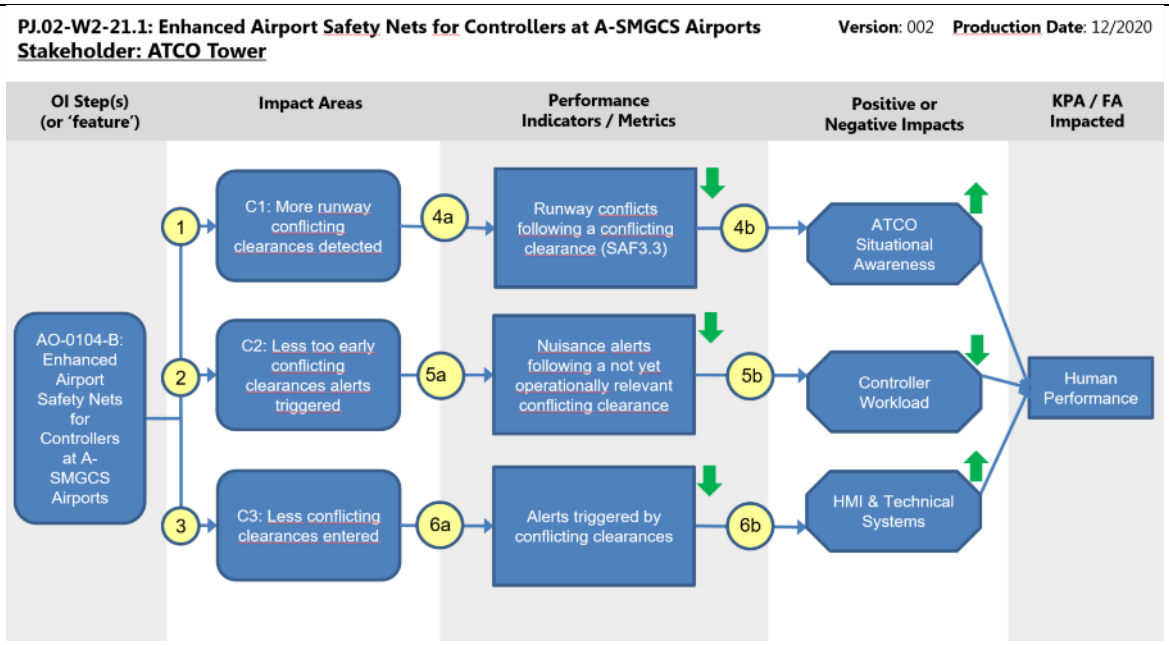


| | |
|---|---|
| 1 | C1: **More runway conflicting clearances detected**<br>The CATC for Runway Operation will detect more runway conflicting clearances: The alert will be triggered only in cases when the system – based on data available – assumes that the separation on the RWY will be infringed at the time the landing aircraft crosses the RWY threshold.<br>A TOF/TOF (converging SIDs) alert will be triggered when the trajectories of departing aircraft are detected to be converging immediately after take-off and the second aircraft is cleared for take-off (and still on the ground).<br>A RMCA/CMAC vs. ATC Clearance alert will be triggered when an aircraft is cleared to use a runway although a runway incursion has been detected (and still needs to be resolved). |
| 2 | C2: **Less too early conflicting clearances alerts triggered**<br>An alert triggered before the conflicting clearances become operationally remarkable (i.e., needs attention) would be considered as a nuisance alert by the controller. The CATC for Runway Operation is configured to avoid nuisance alerts.<br>For example: No alert will be raised if the preceding aircraft is predicted to have left the runway when the landing aircraft will be at the runway threshold. |
| 3 | C3: **Less conflicting clearances entered**<br>The controller is supported by the Predictive Indication in his decision whether it is safe to enter the next clearance according to the planned route of a mobile. If the Predictive Indicator on the HMI predicts that entering the clearance will trigger a CATC Alert it is the controller´s decision what the appropriate next action is, for instance, …<br>… to ignore the prediction because the controller´s assessment of the situation is that it is safe to enter the clearance;<br>… to wait until the Predictive Indication predicts that entering the clearance will not trigger a CATC Alert;<br>… to enter the clearance as Conditional Clearance;<br>… to alter the planned route before entering the next clearance.<br>This results in significant fewer conflicting clearances entered. |





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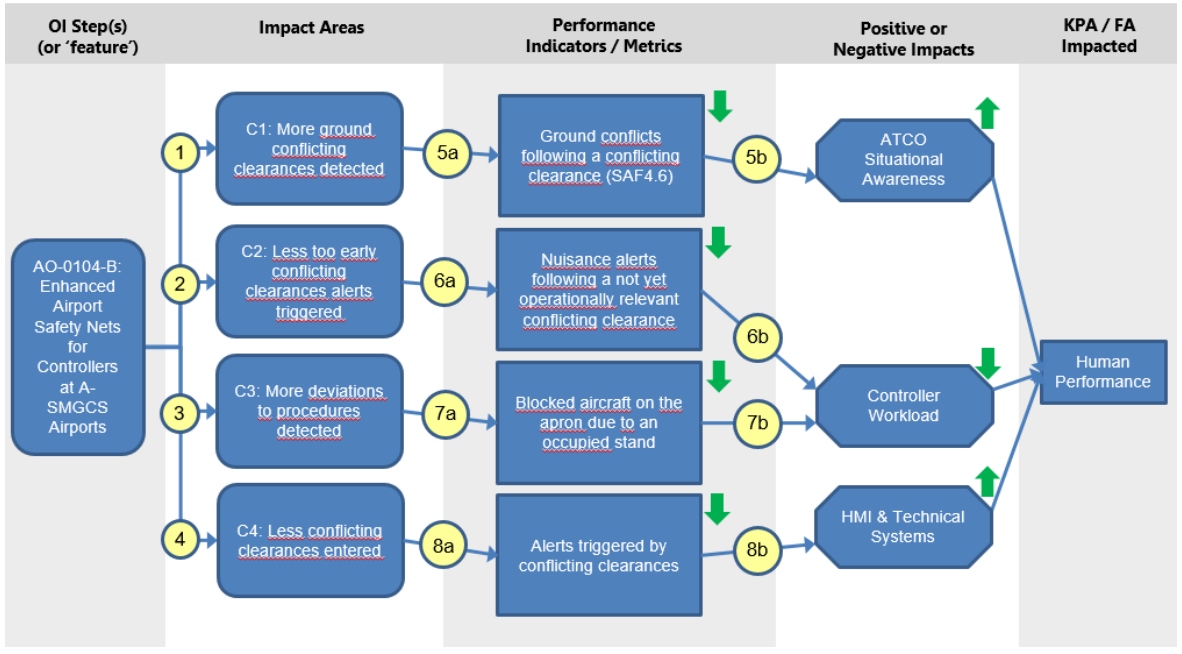
| | |
|---|---|
| 4a | Detecting more runway conflicting clearances will result in fewer conflicts to occur on the runway (or in the immediate vicinity of the runway) as the delivery of a clearance could lead to a conflict with another aircraft already cleared for a movement. |
| 4b | Providing predictive indications about potentially conflicting clearances (if given/input) and having fewer conflicts following a conflicting runway clearance will increase the Controller's situational awareness, which affects Human Performance. |
| 5a | Not triggering alerts on non-conflicting runway clearances will result in fewer nuisance alerts for the Controllers. |
| 5b | Having fewer nuisance alerts to be managed by the Controllers will keep the controller's workload (related to this solution) on a neutral level, which affects Human Performance. |
| 6a | The predictive indication supports the ATCO in assessing the current situation and to decide whether it is safe to enter the next clearance (according to the planned route) or not. |
| 6b | If the controller considers the predictive indication in his decision whether to enter a clearance or not this reduces the number of CATC Alerts. The use of this HMI tool affects Human Performance. |




| | |
|---|---|
| 1 | C1: **More ground conflicting clearances detected**<br>The CATC for Ground Operation will detect more conflicting clearances in ground operations, e.g., an alert will be triggered when a push-back or taxi clearance is given and is predicted to lead to conflicting trajectories with another aircraft already cleared for Pushback or Taxi. |
| 2 | C2: **Less too early conflicting clearances alerts triggered** |



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| | |
|---|---|
| | An alert triggered before the conflicting clearances become operationally relevant (i.e., require attention) would be considered a nuisance alert by the air traffic controller. The CATC for Runway Operation is configured to avoid nuisance alerts.<br>For example: No alert will be raised if a taxiing aircraft is still far away from a potentially conflicting mobile, e.g., the other mobile pushing back onto the taxiway the aircraft is taxiing on. |
| 3 | C3: **More deviations to procedures detected**<br>The controller will be alerted by more deviations to procedures detected by CMAC: To complement the set of CMAC alerts already defined in SESAR 1 Solution #02, an alert will be triggered when an aircraft is arriving to an occupied stand; |
| 4 | C4: **Less conflicting clearances entered**<br>The controller is supported by the Predictive Indication in his decision whether it is safe to enter the next clearance according to the planned route of a mobile. If the Predictive Indicator on the HMI predicts that entering the clearance will trigger a CATC Alert it is the controller´s decision what the appropriate next action is, for instance, …<br>… to ignore the prediction because the controller´s assessment of the situation is that it is safe to enter the clearance;<br>… to wait until the Predictive Indicator predicts that entering the clearance will not trigger a CATC Alert;<br>… to enter the clearance as Conditional Clearance;<br>… to alter the planned route before entering the next clearance.<br>This results in significant fewer conflicting clearances entered. |
| 5a | Detecting more conflicting clearances on the ground results in fewer conflicts on taxiways and apron areas, e.g., issuing a Pushback or Taxi clearance could result in a conflict with another aircraft already cleared for Pushback or Taxi. |
| 5b | Providing predictive indications about potentially conflicting clearances (if given/input) and having fewer conflicts following a conflicting ground clearance will increase the Controller's situational awareness, which affects Human Performance. |
| 6a | Not triggering alerts on non-conflicting runway clearances will result in fewer nuisance alerts for the Controllers. |
| 6b | Having fewer nuisance alerts to be managed by the Controllers will keep the controller's workload (related to this solution) on a neutral level, which affects Human Performance. |
| 7a | Recognizing that the assigned stand of an inbound aircraft is still occupied leads to fewer blocked aircraft on the apron areas since the controller can initiate a mitigation action in good time. |
| 7b | An early warning of an occupied stand makes it easier for the controller to deal with this situation, as he has more time to coordinate another stand and there will therefore be fewer situations with blocked aircraft on the apron areas due to an occupied stand. This reduces the workload on the controller (in case the blocking needs to be managed), which affects Human Performance. |
| 8a | The predictive indication supports the ATCO in assessing the current situation and to decide whether it is safe to enter the next clearance (according to the planned route) or not. |
| 8b | If the controller considers the predictive indication when deciding whether or not to issue a clearance, this reduces the number of CATC alerts. Using this HMI tool affects Human Performance. |





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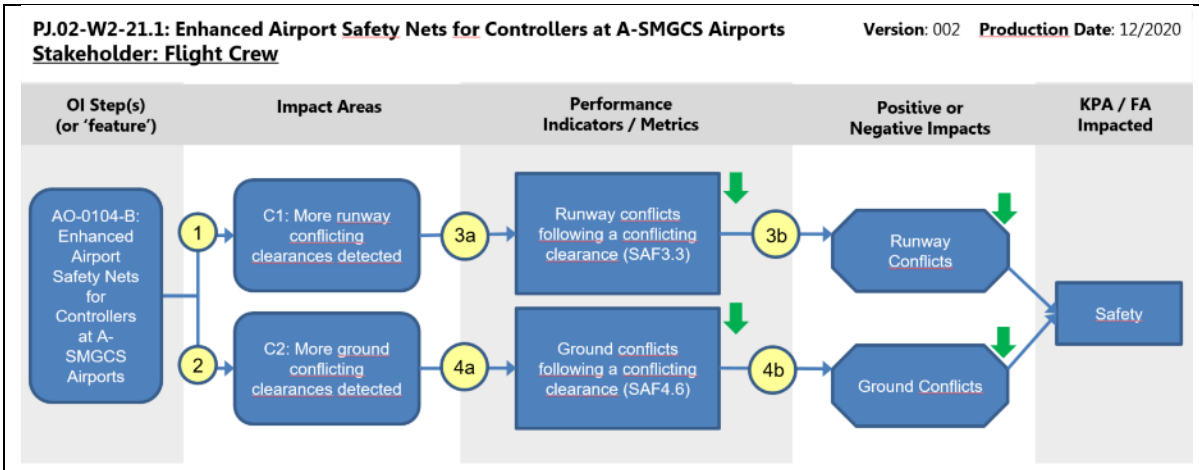


| | |
|---|---|
| 1 | C1: **More runway conflicting clearances detected**<br>The CATC for Runway Operation will detect more runway conflicting clearances: The alert will be triggered only in cases when the system – based on data available – assumes that the separation on the RWY will be infringed at the time the landing aircraft crosses the RWY threshold.<br>A TOF/TOF (converging SIDs) alert will be triggered when the trajectories of departing aircraft are detected to be converging immediately after take-off and the second aircraft is cleared for take-off (and still on the ground).<br>A RMCA/CMAC vs. ATC Clearance alert will be triggered when an aircraft is cleared to use a runway although a runway incursion has been detected (and still needs to be resolved). |
| 2 | C2: **More ground conflicting clearances detected**<br>The CATC for Ground Operation will detect more conflicting clearances in ground operations, e.g., an alert will be triggered when a push-back or taxi clearance is given and is predicted to lead to conflicting trajectories with another aircraft already cleared for Pushback or Taxi. |
| 3a | Detecting more runway conflicting clearances will result in fewer conflicts to occur on the runway (or in the immediate vicinity of the runway) as the delivery of a clearance could lead to a conflict with another aircraft already cleared for a movement. |
| 3b | Fewer conflicts following a conflicting runway clearance will decrease the overall number of conflicts, which affects Safety. |
| 4a | Detecting more conflicting clearances on the ground results in fewer conflicts on taxiways and apron areas, e.g., issuing a Pushback or Taxi clearance could result in a conflict with another aircraft already cleared for Pushback or Taxi. |
| 4b | Fewer conflicts following a conflicting ground clearance will decrease the overall number of conflicts, which affects Safety. |





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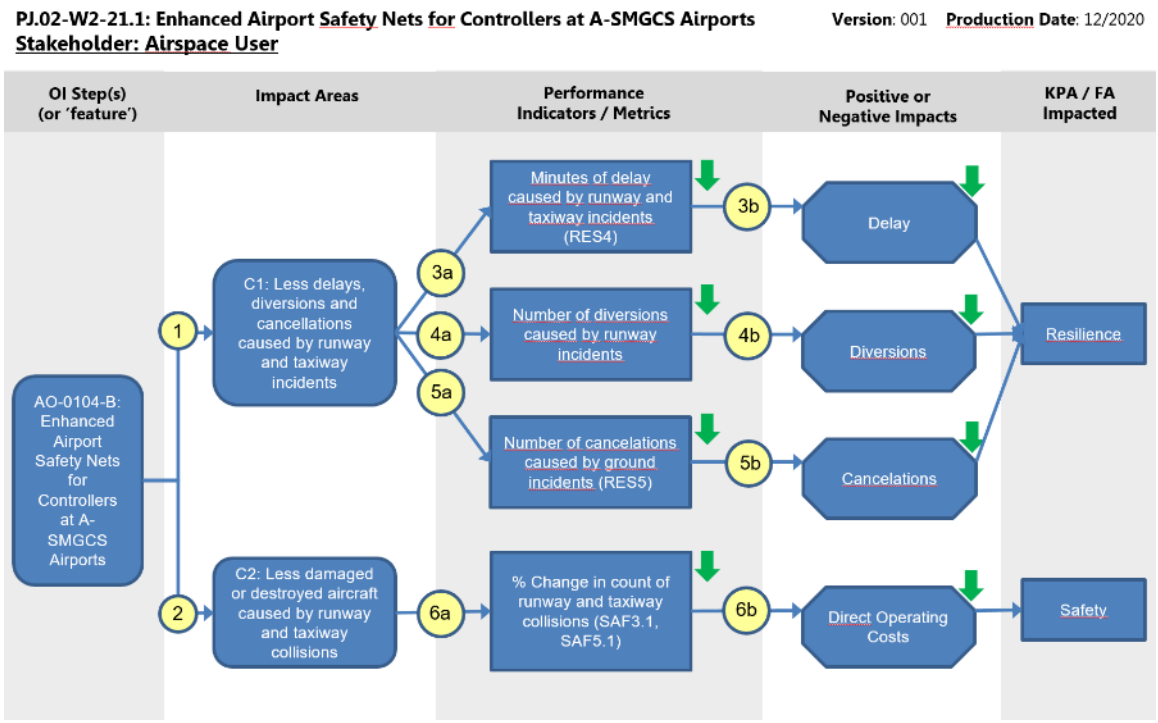


| | |
|---|---|
| 1 | C1: **Less delays, diversions and cancellations caused by runway and taxiway incidents**<br>The CATC informs the controller of potential runway and taxiway incidents caused by conflicting clearances. This reduces delays, diversions and cancellations. |
| 2 | C2: **Less damaged or destroyed aircraft caused by runway and taxiway collisions**<br>The new safety net informs the controller of potential runway and taxiway incidents caused by conflicting clearances. This reduces the number of runway and taxiway collisions. |
| 3a | Impact on AUs measured through delays resulting from capacity degradation due to runway and taxiway incidents. |
| 3b | Less runway and taxiway incidents reduce the minutes of delay. This improves the resilience of the AU planning and operation. |
| 4a | Impact on AUs measured through delays resulting from capacity degradation due to runway and taxiway incidents. |
| 4b | Less runway and taxiway incidents reduce the number of diversions. This improves the resilience of the AU planning and operation. |
| 5a | Impact on AUs measured through delays resulting from capacity degradation due to runway and taxiway incidents. |
| 5b | Less runway and taxiway incidents reduce the number of cancelations. This improves the resilience of the AU planning and operation. |





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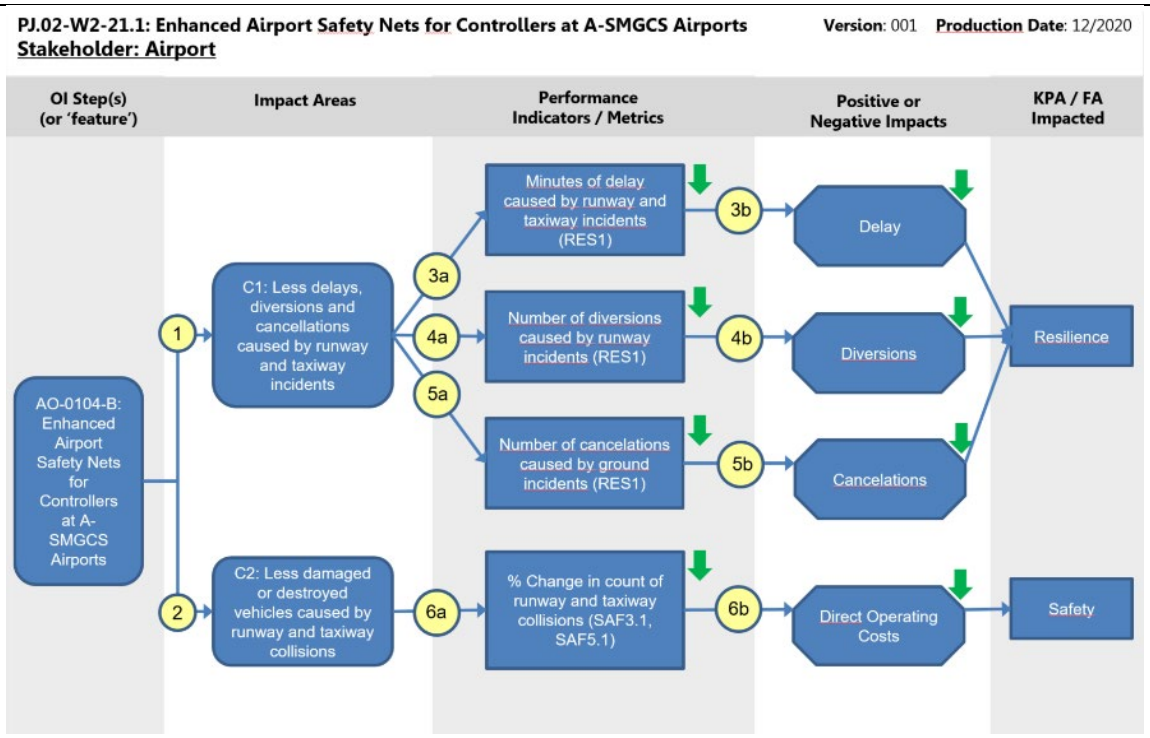
| | |
|---|---|
| 6a | Detecting more conflicting clearances will result in fewer collisions on runways and taxiways. |
| 6b | Less runway and taxiway collisions reduce the cost of repair or replacement (AUC3) |




| | |
|---|---|
| 1 | C1: **Less delays, diversions and cancellations caused by runway and taxiway incidents**<br>The new safety net informs the controller of potential runway and taxiway incidents caused by conflicting clearances. This reduces delays, diversions and cancellations. |
| 2 | C2: **Less damaged or destroyed vehicles caused by runway and taxiway collisions**<br>The new safety net informs the controller of potential runway and taxiway incidents caused by conflicting clearances. This reduces the number of runway and taxiway collisions. |
| 3a | Impact on Airport measured through delays resulting from capacity degradation due to runway and taxiway incidents. |
| 3b | Less runway and taxiway incidents reduce the minutes of delay. This improves the resilience of Airport planning and operation. |
| 4a | Impact on Airport measured through delays resulting from capacity degradation due to runway and taxiway incidents. |

| | |
|---|---|
| 4b | Less runway and taxiway incidents reduce the number of diversions. This improves the resilience of Airport planning and operation. |
| 5a | Impact on Airport measured through delays resulting from capacity degradation due to runway and taxiway incidents. |
| 5b | Less runway and taxiway incidents reduce the number of cancelations. This improves the resilience of Airport planning and operation. |
| 6a | Detecting more conflicting clearances will result in fewer collisions on runways and taxiways. |
| 6b | Less runway and taxiway collisions reduce the cost of repair or replacement (AUC3) |





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# Appendix B Deleted Requirements

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0007 |
| Title | CATC - TAXI versus CROSS |
| Requirement | The Tower Ground Controller and the Tower Runway Controller shall receive an alert when a TAXI clearance is input for an aircraft while another aircraft has previously received a CROSS clearance where the two cleared routes are in opposite directions on the same taxiway and are predicted to block each other (Deadlock Situation). |
| Status | <deleted> |
| Rationale | The Controller needs to know when two taxiing / crossing aircraft will end up being deadlocked on the same taxiway (Ref. UC-CATC-08).<br><br>Note: The sequence of the clearances is not relevant. CROSS versus TAXI leads to the same deadlock situation. The crucial condition is that the clearances are entered nearly at the same time.<br><br>Note: Time and distance separation parameters of the aircraft concerned will be subject to a local implementation decision.<br><br>Note: This requirement is an update of REQ-03b.01SPRINTEROP-CA01.0007.<br><br>DELETED: this requirement is not validated in PJ.02-W2-21.1 |
| Category | <Safety> , <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |
| <ALLOCATED_TO> | <ActivityView> | [NOV-5][CATC-03-04-05-06-07-08] Extended CATC |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0008 |
| Title | CATC - CROSS versus TAXI |
| Requirement | The Tower Ground Controller and the Tower Runway Controller shall receive an alert when a CROSS clearance is input for an aircraft while another aircraft has previously received a TAXI clearance where the two cleared routes are in opposite directions on the same taxiway and are predicted to block each other (Deadlock Situation). *Note: Time and distance separation parameters of the aircraft concerned will be subject to a local implementation decision.* |
| Status | <deleted> |
| Rationale | The Controller needs to know when two taxiing / crossing aircraft will end up being deadlocked on the same taxiway (Ref. opposite of UC1.5).<br><br>DELETED: this requirement is not validated in PJ.02-W2-21.1 |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect CATC Conflict |
| <ALLOCATED_TO> | <Role> | Tower Ground Controller (PJ.02-W2-21.1)<br><br>Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.W2.21.1-SPRINTEROP-CA01.0012 |
| Title | Updated CATC – LAND versus CROSS |
| Requirement | The Tower Runway Controller shall receive an alert when a CROSS clearance is input for an aircraft while previously a LAND clearance was input on another aircraft on the same runway and the separation minima on the RWY (according to ICAO DOC4444) is not achieved when the crossing aircraft vacates the runway. |
| Status | <deleted> |
| Rationale | The Controller needs to know when a LAND and a CROSS clearance would impede each other resulting in the flights losing separation on the ground (opposite of Ref. UC1.8).<br><br>DELETED: this requirement is obsolete because it is already covered by REQ-02.W2.21.1-SPRINTEROP-CA01.0011. |
| Category | <Operational> , <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |
| <ALLOCATED_TO> | <Activity> | Detect a Runway Related Conflict through a CATC Alert |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-W2-21.1) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02-W2-21.1-SPRINTEROP-CM01.0002 |
| Title | CMAC – NO TAXI Clearance Alert |
| Requirement | The Tower Controller shall receive an Alert when an aircraft is moving on a taxiway without having received a TAXI instruction. This includes when it is being guided by a means such as activated TCL (Follow the Greens) and it overruns the activated TCL. |
| Status | <deleted> |





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| | |
|---|---|
| Rationale | The Controller needs to know when aircraft are moving without authorisation (Ref. UC-CMAC-02).<br><br>DELETED: Work on REQ-02-W2-21.1-SPRINTEROP-CM01.0002 is continued by PJ.02-W2-21.4 |
| Category | <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | 02-W2-21.1 |

Beneficiaries contributing to Solution PJ.02-W2-21.1









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