International Civil Aviation Organization
North American, Central American and Caribbean Office

WORKING PAPER

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Automatic Dependent Surveillance – Broadcast OUT Implementation Meeting for the NAM/CAR Regions (ADS-B/OUT/M)

Ottawa, Canada, 21-23 August 2019

Agenda Item 5: Other Business

NEW VERSION OF THE GLOBAL AIR NAVIGATION PLAN AND NAM/CAR CHALLENGES

(Presented by the Secretariat)

EXECUTIVE SUMMARY

This Working Paper provides information on the new version of Doc 9750, Global Air Navigation Plan and information on surveillance for the assessment of the Surveillance Task Force that is part of the ANI/WG.

Action:	Suggested actions are presented in Section 5.
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
References:	• https://www4.icao.int/ganpportal/ • https://www4.icao.int/ganpportal/ASBU/PerformanceObjective

1. Introduction

1.1 The new version of the Global Air Navigation Plan (GANP) is expected to be approved in the 40th ICAO Assembly to be held in ICAO Headquarters from 24 September to 4 October.

1.2 The new version of the GANP boosts the evolution of the global air navigation system to comply with the growing expectations of the aviation community. The GANP provides a series of operational enhancements to increase capacity, efficiency, predictability and flexibility to warranty the interoperability of the systems and the harmonization of the procedures.

1.3 The GANP explains the different responsibilities of each stakeholder (States, Organizations, airports community, Air Navigation Service Providers, users, industry, among others to assure an interoperable and harmonized aviation system.

1.4 The Basic Building Block (BBB) is also introduced, that describe the base of any robust air navigation system, identify essential services that must provide each State in air navigation services, airport services, air traffic management, search and rescue, meteorology and information management, and CNS aeronautic infrastructure assets.

1.5 GANP Sixth Edition has a multilayer structure comprehends two global levels; global (global strategic planning) and technical (ASBU), as well as the regional (Regional Air Navigation Plan) and nationals (National Air Navigation Plan).

1.6 The main concept was updated in the frame of the Aviation System Block Upgrade (ASBU). ASBU pillars are classified in three groups:

1. Operative subprocesses: ACDM, APTA, NOPS
2. Information topics: SWIM, AMET, DAIM, FICE
3. Technological topics: COMS, COMI, NAVS, ASUR (previous roadmaps)

1.7 The ICAO six-step method is established. Steps 1 and 2 help to know the system, its strengths, weaknesses, opportunities and threats, as well as how it functions, acting to establish objectives. Based on these objectives, they can be established in step 3 and 4, and potential solutions can be identified to achieve objectives on weaknesses and threats of a system. Once a group of potential solutions has been identified, a cost-benefit analysis, an assessment on the environment impact and on security and human factor has to be done to identify an optimal solution.

1.8 In the framework of the GANP performance, a list of key performance indicators (KPI), linked with relevant objectives of the performance objectives catalogue, is provided to establish objectives through the quantification of objectives. A list of possible solutions to be considered as part of Step 4 is the ASBU framework, with its functional description, enhancements and its benefits of associated performance.

1.9 Step 5 manages a coordinated deployment of the solution agreed by all the stakeholders, dependant on the previous steps. Finally, Step 6 consists on monitoring and reviewing of the system after a complete implementation of the solution.

1.10 Additionally, ICAO requests the States to incorporate to their Air Navigation Plans anything related to the ICAO Global Aviation Safety Plan (GASP) and the Global Aviation Security Plan (GASeP). In the case of the GASP, safety is critic when air navigation operational enhancements are planned, in line with the GANP, to determine if these enhancements can be implemented safely. A risk assessment provides information to identify dangers that can suffer from, for example:

a) any planned modification in the use of the airspace;
b) the introduction of new technologies or procedures; or
c) as a result of the dismantling of older navigation aids.

1.11 In addition to the challenges related with safety and its risks, the GASP supports the implementation of the GANP as it requires an adequate infrastructure to support the provision of essential services described in the BBB. The BBB framework describes the spinal cord of any robust air navigation system, defining the essential air navigation services that should be provided by the international civil aviation in accordance with ICAO Standards and Recommended Practices (SARPs) and the ICAO Procedures for air navigation services (PANS).

2. Discussion

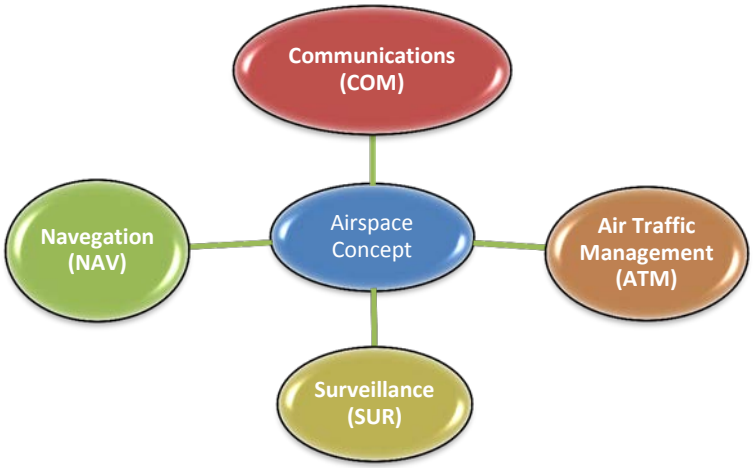
2.1 As a result of the ANI/WG/04 Meeting held in Miami, United States, in August 2018, it was concluded that the States have been making investments in CNS infrastructure and that despite of the increased capacities none operational benefit has been reached. Hence, it was requested to define three regional objectives that can be used to reach the operational benefits regionally.

2.2 The ANI/WG/05 Meeting held in Mexico City in May 2019, approved de following operational objectives to be developed regionally:

1. Efficiency/capacity: Operational longitudinal separation reduction in the region.
2. Predictability/efficiency: standardization of the aeronautical message information (AIM/SWIM).
3. Environment: CO2 emission reduction.

2.3 One of the actions that have been developed in the recent years is the establishment of PBN routes, which have made more efficient some airspace areas in the States, but standardized regional procedures have not been implemented, in spite of having the CNS infrastructure to do it.

2.4 Within an airspace concept, the PBN requirements are affected by communications, ATS surveillance and ATM services; NAVAID infrastructure and required functional capacities to comply with the ATM application. PBN requirements also depend on some grade of redundancy to warranty an adequate continuity of functionality

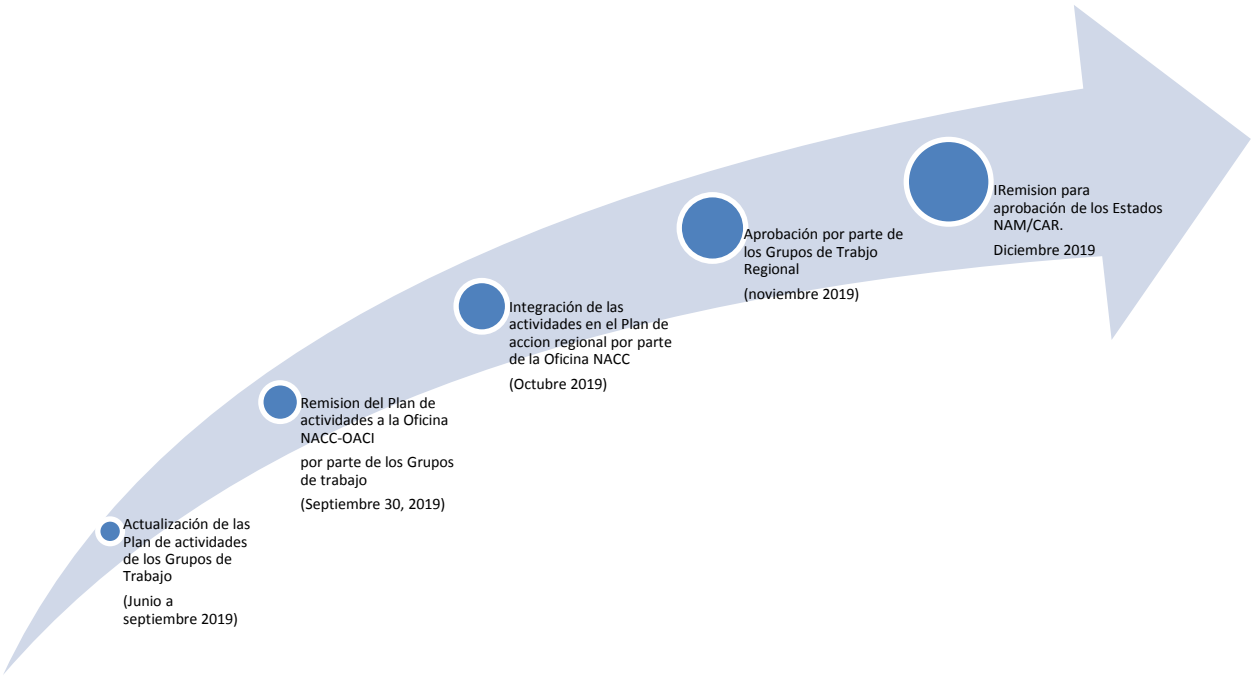


2.5 Surveillance infrastructure contributes directly to comply with the regional objective number 1, regarding efficiency and the increase of capacity of operational management regionally.

2.6 Currently, under the new ANI/WG structure, regional task forces have committed to support the following activities:

1. Aligning the activities to be developed under their responsibility to contribute reaching the three regional objectives.
2. Sending their updated working plans to the ICAO NACC Regional Office by 30 September 2019.

2.7 Once the working plans are received, the ICAO NACC Regional Office will integrate them in one plan, with dates and responsible personnel, and according to the results of the ICAO 40th Assembly this plan will be updated.



3. Activities to be analysed by the Surveillance Task Force

3.1 Today more than ever, the region needs to carry out jointly work among all the related parties and obtain benefit from this and of the agreements that can be reached on CNS and ATM standardization to support the regional growth.

3.2 With the approval of the new GANP version in the next ICAO Assembly the responsibilities of the States, air traffic providers, users, industry and Regional Offices will be updated.

3.3 However, there are identified challenges, national and regional operative requirements with expired implementation dates, without the compliance of these implementation requirements met to date. Among them we can underline the following:

3.3.1 Safety alarms:

3.3.2 Air Safety alarms:

1. Airborne collision avoidance system (ACAS) implementation, Traffic Alert and Collision Avoidance System/Traffic Collision and Avoidance System (TCAS), Version 7.1. Requires an analysis to agree harmonized implementation and standardization regionally. Even though some States have indicated that have implemented it.

3.3.3 Ground safety alarms:

1. Ground safety alarms are an integral part of the ATM system. They are used primally based in ATS surveillance data, providing warning gaps to information control personnel to assess a situation and the proper actions to be done. In this regard, counting with the information from the States on management capacity of the ATM systems regarding safety is required.

2. **Appendix A** to this Working Paper provides information on the GANP requirements linked to these implementations.

3.4 The Secretariat, through the 2017 Surveillance Meeting in Lima, Perú, and having ratified the request in the ANI/WG/04 Meeting, requested to the States sending to the ICAO NACC Regional Office the information of their surveillance infrastructure. To date, the following information is available:

No	States	Surveillance Infrastructure
1	Cuba	Complete
6	Central America and COCESNA	Complete
1	United States	Complete
1	Mexico	Sent but incomplete
1	Trinidad and Tobago	Complete

3.5 Ten of the 22 NAM/CAR States have completed this requirement, hence, it is necessary the pending States to send this information as soon as possible. This information is necessary to ratify:

1. Regional coverage area
2. Surveillance information overlapping areas and the possibility to boost surveillance data sharing among the States
3. Identify areas in the region where surveillances data is lacking and support implementation studies of the satellite ADS-B
4. Support the development of the Regional Airspace Concept and the PBN implementation

5. Support the development of the surveillance data management applications that ICAO Headquarters is creating to support management in the States.

3.6 Although a new GANP version is expected to be in force immediately after the ICAO 40th Assembly next October, it will be necessary the States to make an analysis of the minimum infrastructure they should have, included the surveillance infrastructure.

3.7 Finally, the new GANP version requires an analysis of the ASBU requirements, regarding the implementation objectives of the different blocks, new capacities and the consideration to take into account for its implementation. **Appendixes B and C** to this Working Paper provide information correspondent to the directly related ADS-B implementations or other surveillance systems.

4. Recommendation

4.1 It is recommended that the NAM/CAR Surveillance Task Force, part of the ANI/WG, includes within its tasks (September 2019 to August 2020) the following activities:

1. Development of a document that includes the considerations and requirements to achieve harmonized implementation of the TCAS Version 7.1 and to achieve the operational and safety benefits of its implementation.
2. Coordinate the collection of the management capacity information of the safety alarms of the different ATM systems and make the necessary recommendations to the States that are going to modernize or buy new ATM systems.
3. Coordinate with the States that have not delivered their surveillance infrastructure its prompt delivery and establish mechanisms that assure updated information.
4. Coordinate the assessment by the States of the raised surveillance requirements according to the BBB.
5. Once the new GANP version is approved, coordinate the analysis of the ASBU implementation, which is supported by the ADS-B or other surveillance system.

4.2 It must be taken into account that the success of any project to be developed is based in the involvement of all the stakeholders, therefore, to assure the success of the activities management it must be warrantied that the States and their air traffic providers, users (airlines) and industry are integrated.

5. Suggested actions

5.1 The Meeting is invited to:

a) review the information provided in this Working Paper;
b) adopt, as part of the working plan of the Surveillance Task Force, activities indicates in Section 4 of this Working Paper; and
c) any required other actions.

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APPENDIX A
ASBU ELEMENTS

https://www4.icao.int/ganpportal/ASBU

ACAS-B1/1 ACAS Improvements

Main Purpose
To provide airborne collision avoidance as a last resort safety net for pilots.

New Capabilities
The traffic alert and collision avoidance system (TCAS) version 7.1 provides short-term improvements to existing airborne collision avoidance systems (ACAS) to reduce nuisance alerts as well as to enhance the logic for some geometries (i.e., Uberlinghen accident). This will reduce trajectory deviations and increase safety in cases where there is a breakdown of separation.

Description
TCAS systems selectively interrogate nearby aircraft to determine their position and velocity (using Mode C/S replies); this information is passed through "threat logic" to determine proximate traffic, issue traffic alerts, and issue collision avoidance "resolution advisories" to flight crews. Resolution advisories provide flight crews with vertical guidance (climb, descend, remain level, do not descend/climb) as appropriate to avoid collisions.

Modern "hybrid surveillance" TCAS systems use ADS-B information to reduce the interrogations needed to perform some of these functions – however, resolution advisories are only issued based on interrogation/reply information (ADS-B data is not used).

Maturity Level
Ready for implementation

Human Factor Considerations
1. Does it imply a change in task by a user or affected others? No

2. Does it imply processing of new information by the user? Yes

New resolution advisories.

3. Does it imply the use of new equipment? Yes

4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS
Tactical-During ops

OPERATIONS
Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)

ACAS-B2/1 New collision avoidance system

Main Purpose

To provide airborne collision avoidance as a last resort safety net for pilots (improving functionality provided in BBB and Block 0).

Implementation must minimize "nuisance alerts" while maintaining or improving existing levels of safety, and must be able to more quickly adapt to changes in procedures and the environment. Also, this successor system must be capable of accommodating reduced separation minima and other new procedures such as 4D trajectory management.

New Capabilities

Implementation of a new airborne collision avoidance system will enable more efficient operations and airspace procedures while complying with safety regulations. Fewer "nuisance alerts" will reduce pilot and controller workload as personnel spend less time responding to such alerts, increasing safety. Operation-specific collision avoidance logic can be engaged via the pilot's use of their ADS-B-In system for a particular application.

Description

ACAS systems use ADS-B information and selective interrogations of nearby aircraft to determine their position and velocity; this information is passed through "threat logic" to determine proximate traffic, issue traffic alerts, and issue collision avoidance "resolution advisories" to flight crews. Resolution advisories provide flight crews with vertical guidance (climb, descend, remain level, do not descend/climb) as appropriate to avoid collisions.

In order to achieve a high level of safety, the alerting criteria used by current ACAS systems often overlap with the horizontal and vertical separation associated with many safe and legal procedures (e.g., visual separation operations). ACAS monitoring data from the U.S. indicate that as many as 90% of observed resolution advisories (RAs) are due to the interaction between ACAS II alerting criteria and normal ATC separation procedures (e.g., 500 feet IFR/VFR separation, visual parallel approach procedures, level-off with a high vertical rate, or VFR traffic pattern procedures). This new ACAS system will address this deficiency.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **No**
2. Does it imply processing of new information by the user? **No**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **No**

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	ACAS-B1/1 - ACAS Improvements
Relation-operational need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-benefit	ASUR-B2/1 - Evolution of ADS-B and Mode S

ACAS-B2/2	New collision avoidance capability as part of an overall detect and avoid system for RPAS
Main Purpose	As part of a detect and avoid system, to provide the airborne collision avoidance function as a last resort safety net for RPAS' pilots. Implementation will minimize "nuisance alerts" while maintaining safety, and will quickly adapt to changes in procedures and the environment. Also, this system must accommodate the particularities of RPAS.
New Capabilities	Implementation of a new airborne collision avoidance function of a detect and avoid system will enable a new capability for RPAS. The systems will be tailored to provide the last resort collision avoidance function including horizontal resolution advisories (in addition to the vertical resolution advisories provided by current collision avoidance systems).
Description	ACAS systems for RPAS use multiple surveillance sensor inputs to determine the position and velocity of nearby aircraft; this information is passed through "threat logic" to determine proximate traffic, issue alerts, and issue collision avoidance "resolution advisories" to RPAS' pilots. Resolution advisories include both horizontal (turn left or right) and/or vertical guidance (climb, descend, remain level, do not descend/climb) as appropriate to avoid collisions.
Maturity Level	Validation
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? Yes 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? Yes 4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	ACAS-B2/1 - New collision avoidance system
Relation-technology need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology benefit	ASUR-B2/1 - Evolution of ADS-B and Mode S

SNET

SNET-B0/1 Short Term Conflict Alert (STCA)

Main Purpose

To assist the air traffic controller in preventing collision between aircraft, using position data from ground surveillance.

New Capabilities

STCA systems alert the controller when a given separation between two aircraft is actually lost or may be lost within a given amount of time.

Description

Surveillance data from ground radars and ADS-B stations is used to track aircraft. For each pair of aircraft which are sufficiently close, a short term conflict alert is raised if at least one of the following tests is true:

- (current proximity test) their current horizontal separation is lower than a horizontal threshold and their current vertical separation is lower than a vertical threshold; or
- (linear prediction test) at any of their future positions within a given amount of time (warning time), as linearly extrapolated from their current track, their horizontal separation will be lower than a horizontal threshold and their vertical separation will be lower than a vertical threshold.

The horizontal and vertical thresholds may be different in each test but are equal or lower than the ATC separation standards for the airspace covered by the STCA system. The warning time for the linear prediction may depend on the control unit specificities but is typically equal to or lower than 2 minutes.

The above parameters may be configured differently in defined geographic areas of the control unit. Additionally, inhibitions of alerts may be set up for a list of aircraft and for defined geographic areas.

On noticing the alert, the controller has to analyse the situation and, if deemed necessary, issue an avoiding instruction to one or both aircraft, with the appropriate emergency phraseology.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **No**

2. Does it imply processing of new information by the user? **Yes**

3. Does it imply the use of new equipment? **Yes**

4. Does it imply a change to levels of automation? **No**

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology option	ASUR-B0/2 - Multilateration cooperative surveillance systems (MLAT)
Relation-technology benefit	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)

SNET-B0/2 Minimum Safe Altitude Warning (MSAW)

Main Purpose

To assist the air traffic controller in preventing controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.

New Capabilities

MSAW systems warns the controller about the increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.

Note: MSAW systems are providing protection on all aircraft in particular those not equipped with Ground Proximity Warning Systems.

Description

Surveillance data (including tracked pressure altitude), flight data (including cleared flight levels) and environment data (including terrain and obstacle data) are input to the MSAW system to generate the alerts to the controller working position.

On noticing the alert, the controller has to analyse the situation and, if deemed necessary, issue an instruction to the aircraft, with the appropriate emergency phraseology.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? No

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-operational benefit	SNET-B0/1 - Short Term Conflict Alert (STCA)
Relation-technology benefit	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)

SNET-B0/3 Area Proximity Warning (APW)

Main Purpose
APW is designed, configured and used to make a significant positive contribution to the prevention of accidents arising from unauthorized penetration of an airspace volume.

New Capabilities
APW systems warn the air traffic controller about unauthorised penetration into the airspace (either restricted or controlled) by a flight (either controlled or uncontrolled).

Description
Surveillance data (including tracked pressure altitude), flight data (including cleared flight levels and RVSM status) and environment data (including airspace volumes) are input to the APW system to generate the alerts to the controller working position(s).

On noticing the alert, the controller has to analyse the situation and, if deemed necessary, issue an instruction to the aircraft, with the appropriate emergency phraseology.

Maturity Level
Ready for implementation

Human Factor Considerations
1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? No

PLANNING LAYERS
Tactical-During ops

OPERATIONS
Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)

SNET-B0/4	Approach Path Monitoring (APM)

Main Purpose APM is a ground-based safety net intended to warn the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles during final approach.

New Capabilities APM is designed, configured and used to make a significant positive contribution to avoidance of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles during final approach.

Description Surveillance data (including tracked pressure altitude), flight data (including concerned sectors) and environment data (including terrain and obstacle data) are input to the APM system to generate the alerts to the controller working position(s).

On noticing the alert, the controller has to analyse the situation and, if deemed necessary, issue an instruction to the aircraft, with the appropriate emergency phraseology.

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? No

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)

SNET-B1/1 Enhanced STCA with aircraft parameters

Main Purpose Assist the air traffic controller in preventing collision between aircraft, using position data from ground surveillance and flight intent reported by aircraft.

New Capabilities Using aircraft intent parameters allows STCA systems to reduce the number of unnecessary alerts, to increase the number of relevant alerts and to alert earlier, compared to the basic STCA system in Block 0.

Description This enhanced STCA works the same as the basic STCA system in Block 0, but stops the linear extrapolation of the vertical position of an aircraft when it reached the Selected Flight Level information reported from ADS-B or downlinked from Mode S transponders.

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? No

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology need	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
Evolution	SNET-B0/1 - Short Term Conflict Alert (STCA)

SNET-B1/2 Enhanced STCA in complex TMAs

SNET-B1/2 Enhanced STCA in complex TMAs

Main Purpose Assist the air traffic controller in preventing collision between aircraft, using position data from ground surveillance and taking into account possible crew intents linked to traffic patterns and ATC practices in complex TMAs.

New Capabilities Taking into account traffic patterns and ATC practices allows STCA systems to reduce the number of unnecessary alerts, to increase the number of relevant alerts and to alert earlier, compared to the basic STCA system in Block 0.

Description This enhanced STCA works the same as the basic STCA system in Block 0, but, in addition of the current proximity test and the linear prediction test, performs the following tests:

- (level-off prediction test) The vertical positions of aircraft in vertical evolution are extrapolated to level-off at the next reasonable FL.
- (turn prediction test) The horizontal positions of aircraft in proximity of a final approach path are extrapolated to turn in alignment with this final approach path.

Care is also taken to setup a specific set of alerting parameters (horizontal threshold, vertical threshold and warning time) for each approach area within the TMAS, where unnecessary alerts could affect runway throughputs.

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **No**
2. Does it imply processing of new information by the user? **Yes**
3. Does it imply the use of new equipment? **Yes**
4. Does it imply a change to levels of automation? **No**

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology option	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
Evolution	SNET-B0/1 - Short Term Conflict Alert (STCA)

SURF

SURF-B0/1	Basic ATCO tools to manage traffic during ground operations
SURF-B0/2	Comprehensive situational awareness of surface operations
SURF-B0/3	Initial ATCO alerting service for surface operations
SURF-B1/1	Advanced features using visual aids to support traffic management during ground operations
SURF-B1/2	Comprehensive pilot situational awareness on the airport surface
SURF-B1/3	Enhanced ATCO alerting service for surface operations
SURF-B1/4	Routing service to support ATCO surface operations management
SURF-B1/5	Enhanced vision systems for taxi operations
SURF-B2/1	Enhanced surface guidance for pilots and vehicle drivers
SURF-B2/2	Comprehensive vehicle driver situational awareness on the airport surface
SURF-B2/3	Conflict alerting for pilots for runway operations
SURF-B3/1	Optimization of surface traffic management in complex situations

SURF

SURF-B0/1	Basic ATCO tools to manage traffic during ground operations

Main Purpose

To improve safety and efficiency during ground operations by providing proper indications to pilots and vehicle drivers.

New Capabilities

The guiding and routing service is delivered using visual aids and signals on the platform. Information is managed by the controller to provide pilots and vehicle drivers all necessary information to taxi and avoid incursion on the runway.

Description

This element represents the provision of guidance and routing information to the pilot in order to manage the traffic in a safe and efficient way by the controller:

- to confirm the routing of all aircraft and vehicles according to the defined identification procedures;
- to prevent incursions on the runway using visual aids, stop bars in particular.

The Controller monitors and commands the lighting systems.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No

2. Does it imply processing of new information by the user? Yes

3. Does it imply the use of new equipment? No

4. Does it imply a change to levels of automation? No

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

SURF-B0/2 Comprehensive situational awareness of surface operations

Main Purpose
To better maintain ATCO awareness of ground operations.

New Capabilities
The surveillance service of A-SMGCS provides airport traffic situational awareness through the position, identification and tracking of aircraft and vehicle suitably equipped on the aerodrome surface. Information is presented on the controller and airport operator display independent of visibility conditions and controller line of sight.

Description
This service represents the provision of surveillance information to the controller in order to manage the traffic in a more efficient way and allows the controller:

- to confirm the identity of all participating vehicles according to the defined identification procedures;
- to prevent collisions between all aircraft and vehicles especially in conditions when visual contact cannot be maintained;
- to manually correlate (link a target with a call sign) targets for the rare cases where there is an operational need to, e.g. areas of poor cooperative surveillance coverage and the need to track non-cooperative targets such as towed aircraft;
- to detect and indicate the position of potential intruders.

Maturity Level
Ready for implementation

Human Factor Considerations
1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? No
4. Does it imply a change to levels of automation? No

PLANNING LAYERS
Tactical-During ops

OPERATIONS
Taxi-out Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology option	ASUR-B0/2 - Multilateration cooperative surveillance systems (MLAT)
Relation-technology benefit	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)

SURF-B0/3 Initial ATCO alerting service for surface operations

Main Purpose Detection by the ATCO of potentially unsafe situations with regard to runway operations.

New Capabilities The ATCO will be provided with a short term conflicting alerting tool (A-SMGCS initial alerting service) that monitors movements on or near the runway and detects conflicts between an aircraft and another vehicle as well as runway incursion by intruders. Appropriate alerts will be visualized on the ATCO display.

Description This element represents the first step of A-SMGCS alerting service and is based on A-SMGCS surveillance. It takes into account elements such as:

- the runway configuration of the airport (e.g. one, two or more runways);
- the associated procedures (e.g. multiple line ups and reduced separation on the runway when approved by the ATS authorities);
- the position and type of the aircraft and vehicles (e.g. arrival, departure or vehicle) according to the set time parameters and their relative speeds and positions when within or about to enter a predefined area around the runway;
- aircraft in the vicinity of the runway (e.g. on final approach, climb out and helicopters crossing);
- meteorological conditions.

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? No
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology option	ASUR-B0/2 - Multilateration cooperative surveillance systems (MLAT)
Relation-technology benefit	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
Evolution	SURF-B0/1 - Basic ATCO tools to manage traffic during ground operations

SURF-B1/1	Advanced features using visual aids to support traffic management during ground operations

Main Purpose To improve surface operations with the aim to reduce taxi time and fuel burn, potential mistakes.

New Capabilities Advanced features including "Follows the Greens" (FTG) and Variable Message Panels are used to optimize routing during taxi operations. The lighting system is used to direct the aircraft, making the guidance safer, as errors are minimized.

Lighting system for other vehicles than aircraft is connected to the SMGCS in order to optimize ground circulation and prevent collision.

Description Advanced features including FTG and Variable Message Panels are used to optimize routing during taxi operations. The lighting system is used to direct the aircraft, making the guidance safer, as errors are minimized.

Lighting system for other vehicles than aircraft is connected to the SMGCS in order to optimize ground circulation and prevent collision.

Maturity Level Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? No

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	SURF-B0/1 - Basic ATCO tools to manage traffic during ground operations
Relation-operational need	ACDM-B0/1 - Airport CDM Information Sharing (ACIS)

SURF-B1/2	Comprehensive pilot situational awareness on the airport surface

Main Purpose To improve ground operations based on increasing pilot's situational awareness and safety especially at taxiway and runway intersections, as well as for aircraft landing and taking off.

New Capabilities In addition to display of the airport layout (showing taxiways, runways, fixed obstacles) and the own aircraft position, the pilot has an improved situational awareness thanks to the additional display of surrounding traffic (incl. both aircraft and optionally airport vehicles).

Description The pilot can visualize surrounding traffic to be presented on traffic computer and display. Different technologies enable this capability, among which ADS-B OUT/ADS-B IN. In order to maximize the benefits, it is suitable that all aircraft be equipped in a homogeneous manner. However, a transition period can be observed and a partial equipage will result in the display of only the appropriately equipped aircraft.

Maturity Level Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? **No**
2. Does it imply processing of new information by the user? **Yes**
3. Does it imply the use of new equipment? **No**
4. Does it imply a change to levels of automation? **No**

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-operational need	CSEP-B1/1 - Basic airborne situational awareness during flight operations (AIRB)

SURF-B1/3 Enhanced ATCO alerting service for surface operations

Main Purpose
The enhanced A-SMGCS alerting service anticipates potential runway conflicts, runway incursion and other hazardous situations on the aerodrome surface.

New Capabilities
Early detection of aircraft and vehicles that are not following given clearances/ instructions or provision of alerts when clearances given by the controller do not comply with local ATC rules/procedures.

Description
The A-SMGCS Alerting service for controllers is complemented with the detection of conflicting ATC Clearances (CATC) given by the controller (e.g. Line-up versus Land on same runway) and with the detection of non-conformance to procedures or instructions (e.g. route deviation). An electronic clearance input means is used by the controller to make the clearances known to the system. Surveillance data and routing information are also used by the logic to generate alerts to the controller.

Maturity Level
Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? No
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS
Tactical-During ops

OPERATIONS
Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	SURF-B0/2 - Comprehensive situational awareness of surface operations
Evolution	SURF-B0/3 - Initial ATCO alerting service for surface operations
Relation-operational need	SURF-B1/4 - Routing service to support ATCO surface operations management

SURF-B1/4	Routing service to support ATCO surface operations management

Main Purpose To improve pre-departure and departure sequencing by provision of accurate taxi times and efficient routing service.

New Capabilities The A-SMGCS routing service calculates individual routes for mobiles for representation to the controller in order to support the runway sequencing strategy.

Description The A-SMGCS routing service calculates individual routes for mobiles based on known airport parameters and constraints or following an interaction by the controller. The controller is presented with planned or cleared routes and has means to modify these routes or to create new route if necessary. Information is updated in real time in order to improve predictability of surface operations.

Maturity Level Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	SURF-B0/2 - Comprehensive situational awareness of surface operations
Relation-operational need	RSEQ-B0/1 - Arrival Management
Relation-operational need	RSEQ-B0/2 - Departure Management

SURF-B2/1 Enhanced surface guidance for pilots and vehicle drivers

Main Purpose
To improve the guidance of pilots and vehicle drivers on the aerodrome surface. Depending from the level of equipage of aircrafts and vehicles, the operational objective may be achieved either by airport ground equipment or through on-board capabilities.

New Capabilities
Automatic triggering of airport ground signs according to the route and clearances issued by ATC.

Description
The A-SMGCS guidance service is using the routing service in conjunction with ATCO inputs to allow the automated switching of Taxiway Centreline Lights (TCL) and/or stop bars. The guidance service improves the movement of mobiles on the movement area and reduces the workload of controllers.

Maturity Level
Validation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? No
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	SURF-B0/1 - Basic ATCO tools to manage traffic during ground operations
Evolution	SURF-B1/1 - Advanced features using visual aids to support traffic management during ground operations

SURF-B2/2	Comprehensive vehicle driver situational awareness on the airport surface

Main Purpose

Expansion of situation awareness to vehicle's drivers by the provision of own position and surrounding traffic position on a display in the vehicle. Considered vehicles can be small UAS used for airport specific functions. The vehicle driver is informed about potential and actual risk of collision with aircraft and infringement of restricted or closed areas.

New Capabilities

Information regarding the surrounding traffic (including both aircraft and airport vehicles) during taxi and runway operations is displayed in the vehicle driver's cockpit. The system detects hazardous situations and provides the vehicle driver with the appropriate alert, either generated by the on-board system or uplinked from a centralized airport function.

Description

For the vehicles operating on the manoeuvring area of the airport, a display on-board of the vehicle is showing the surrounding traffic and own position to enhance the situational awareness of the vehicle driver and providing the appropriate alerts to ensure safer operations of vehicles on the manoeuvring area.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

SURF-B2/3	Conflict alerting for pilots for runway operations
Main Purpose	To improve safety during runway operations by providing traffic indication and alerts to pilots and/or vehicle drivers.
New Capabilities	The on-board system detects potential and actual risk of collision with other traffic during runway operations and provides the pilot with the appropriate alert.
Description	This enhancement represents a key on-board feature to significantly decrease the risk of conflict with any mobile on or near the runway, improving safety on airport surface. Aircraft data is broadcasted with the proper level of performance and quality in order to provide adequate alerts to the pilots. Broadcasted aircraft data can also be presented on board airport ground vehicles
Maturity Level	Standardization
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? No 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? No 4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	SURF-B1/2 - Comprehensive pilot situational awareness on the airport surface

SURF-B3/1 Optimization of surface traffic management in complex situations

Main Purpose The objective of this element is to achieve the expected performance of the surface management taking account of all aspects of ground operations.

New Capabilities Taking in account all aspects of ground operations and based on optimization algorithms, the A-SMGCS routing and guiding service is providing automation for the management of surface traffic in complex situations following ACDM agreed strategies. The controller workload is reduced. The ATCO keeps the ability to be in manual mode.

Description Using the capabilities provided in the previous blocks, the management of surface traffic in complex situations can be automated. The controller keeps the possibility to operate in manual, semi-automated or automated mode.

Maturity Level Concept

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? No
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	SURF-B1/3 - Enhanced ATCO alerting service for surface operations
Relation-operational need	SURF-B2/1 - Enhanced surface guidance for pilots and vehicle drivers
Relation-operational need	SURF-B2/2 - Comprehensive vehicle driver situational awareness on the airport surface

WAKE

WAKE-B2/1	Wake turbulence separation minima based on 7 aircraft groups
WAKE-B2/2	Dependent parallel approaches
WAKE-B2/3	Independent segregated parallel operations
WAKE-B2/4	Wake turbulence separation minima based on leader/follower static pairs-wise
WAKE-B2/5	Enhanced dependent parallel approaches
WAKE-B2/6	Enhanced independent segregated parallel operations
WAKE-B2/7	Time based wake separation minima for arrival based on leader/follower static pair-wise
WAKE-B2/8	Time based wake separation minima for departure based on leader/follower static pair-wise
WAKE-B3/1	Time based dependent parallel approaches
WAKE-B3/2	Time based independent segregated parallel operations
WAKE-B4/1	En-route Wake Encounter Ground based Prediction
WAKE-B4/2	En-Route Wake Encounter on-board flight management/mitigation

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APPENDIX B
ASBU ELEMENTS

https://www4.icao.int/ganpportal/ASBU

CSEP

CSEP-B1/1	Basic airborne situational awareness during flight operations (AIRB)

Main Purpose

To improve traffic situational awareness in all phases of flight.

New Capabilities

- AIRB facilitates out-the-window visual acquisition of airborne traffic within visual range and traffic situational awareness for traffic beyond visual range.
- It enhances traffic situational awareness and quicker visual acquisition of targets through basic airborne situational awareness during flight operations enabled by the use of a cockpit display traffic information (CDTI).
- It supplements the flight crew's out the window scan and radio communications listening.
- It supports the flight crew in integrating information from these sources into a comprehensive and accurate traffic picture including long traffic detection range.
- It also enables communication with surrounding aircraft on common/local frequency (e.g. turbulence reports, uncontrolled airfield operations).

Description

The use of cockpit displays to provide the flight crew with a graphical depiction of traffic using relative range and bearing, supplemented by altitude, flight ID and other information. This element represents the use of the cockpit display traffic information (CDTI) with appropriate ADS-B data filtered for traffic situational awareness. The CDTI is capable of merging data with TCAS. It is recommended to use the display where ACAS information is already provided (if ACAS-equipped)

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? No
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? No

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology benefit	ACAS-B1/1 - ACAS Improvements

CSEP-B1/2	Visual Separation on Approach (VSA)
Main Purpose	To assist pilots in maintaining own separation during successive visual approach procedures. VSA is defined to support aircraft performing successive visual approach and landing operations.
New Capabilities	VSA is a situational awareness capability that offers a support tool for pilots to conduct existing procedures described in PANS-ATM (6.5.3.4 and 6.5.3.5). It assist the flight crew in maintaining own separation and quicker visual acquisition of preceding aircraft during successive visual approach procedures enabled by the use of a CDTI. It supplements the flight crew's out the window scan and radio communications listening.
Description	This element is used to support existing procedures, i.e., the pilot can use the traffic display to support his visual scan of the preceding aircraft during the approach procedure if the preceding aircraft is transmitting ADS-B OUT surveillance data.
Maturity Level	Ready for implementation
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? No 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? Yes 4. Does it imply a change to levels of automation? No

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology benefit	ACAS-B1/1 - ACAS Improvements

CSEP-B2/1 Interval Management (IM) Procedure

Main Purpose The objective of the IM application is to achieve and/or maintain an assigned spacing between one aircraft and the designated aircraft (referred as the reference aircraft), using the guidance on the flight deck that enables the pilot to actively manage the spacing relative to the reference aircraft.

New Capabilities This element allows management by the pilot of the assigned spacing from a reference aircraft using airborne tools.

Description The air traffic controller chooses to use IM operations to manage the interval between aircraft when the aircraft need to be spaced closely together in an orderly manner or their timing synchronized. This is accomplished by the air traffic controller providing a clearance to the IM aircraft which includes the assigned interval. The assigned interval can be defined in time or distance. The pilot is responsible for identifying the reference aircraft (designated by the air traffic controller) and to implement the IM clearance. While some IM clearances will keep the IM aircraft on its current route and result only in speed management, other clearances may include a controller-defined path lengthening or shortening.

Maturity Level Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology benefit	ACAS-B1/1 - ACAS Improvements
Relation-benefit	ASUR-B2/1 - Evolution of ADS-B and Mode S

CSEP-B2/2	Cooperative separation at low altitudes
Main Purpose	To maintain own separation with respect to manned aviation and other UAS in the UTM airspace.
New Capabilities	A dedicated function to support separation assurance is provided to the UAS, which is supported by detection capability as well as a guidance to remain well clear of any other UAS. Note: in the UTM, this function may be automated and not operated by a remote pilot.
Description	The UAS is capable of building a traffic picture associated to a separation assurance functionality enabling to establish and maintain the required separation from any other vehicle aka "remain well clear" using ADS-B IN for manned aviation and broadcast technologies to be determined for UAS to UAS.
Maturity Level	Validation
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? Yes 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? Yes 4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	CSEP-B1/1 - Basic airborne situational awareness during flight operations (AIRB)
Relation-technology need	ASUR-B2/2 - New community based surveillance system for airborne aircraft (low and higher airspace)

CSEP-B2/3	Cooperative separation at higher airspace
Main Purpose	To maintain own separation with respect to manned aviation and other UAS in the upper airspace.
New Capabilities	A dedicated function to support separation assurance is provided to the UAS, which is supported by detection capability as well as a guidance to remain well clear of any other UAS. Note: in the UTM, this function may be automated and not operated by a remote pilot.
Description	The UAS is capable of building a traffic picture associated to a separation assurance functionality enabling to establish and maintain the required separation from any other vehicle aka "remain well clear" using ADS-B IN for manned aviation and broadcast technologies to be determined for UAS to UAS.
Maturity Level	Validation
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? Yes 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? Yes 4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	CSEP-B1/1 - Basic airborne situational awareness during flight operations (AIRB)
Relation-technology need	ASUR-B2/2 - New community based surveillance system for airborne aircraft (low and higher airspace)

CSEP-B3/1 Interval Management (IM) Procedure with complex geometries

Main Purpose

The objective of the IM application is to achieve and/or maintain an assigned spacing between one aircraft and the designated aircraft (referred as the reference aircraft), using the guidance on the flight deck that enables the pilot to actively manage the spacing relative to the reference aircraft supported by data link to facilitate exchange of complex clearances in a diversity of operational environments.

New Capabilities

This element allows management by the pilot of the assigned spacing from a reference aircraft using airborne tools and data link in a diversity of operational environments.

Description

The air traffic controller chooses to use IM operations to manage the interval between aircraft when the aircraft need to be spaced closely together in an orderly manner or their timing synchronized. This is accomplished by the air traffic controller providing a clearance to the IM aircraft which includes the assigned interval. The assigned interval can be defined in time or distance.

The pilot is responsible for identifying the reference aircraft (designated by the air traffic controller) and to implement the IM clearance. While some IM clearances will keep the IM aircraft on its current route and result only in speed management, other clearances may include a controller-defined path lengthening or shortening.

Maturity Level

Concept

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	ASUR-B2/1 - Evolution of ADS-B and Mode S
Relation-technology need	COMS-B3/1 - Extended CPDLC (B2 incl. Adv-IM and dynamic RNP) for dense and complex airspace
Evolution	CSEP-B2/1 - Interval Management (IM) Procedure

CSEP-B3/2	Remain Well Clear (RWC) functionality for UAS/RPAS
Main Purpose	Aims at maintaining own separation with respect to any manned and/or unmanned aircraft in all phases of flight.
New Capabilities	"Remain well clear" is a dedicated function to support separation assurance is provided to the aircraft, which must remain independent of the collision avoidance logic (ACAS). While the detection capability can be the same, the objective of the function is different and must be supported by a specific logic based on separation minima developed to suit the new operations.
Description	The remote pilot ensures separation from suitably equipped aircraft (manned and/or unmanned) thanks to a traffic picture (CDTI) associated to a separation assurance functionality enabling to establish and maintain the required separation (remain well clear) in all phases of flight.
Maturity Level	Validation
Human Factor Considerations	

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	ASUR-B2/1 - Evolution of ADS-B and Mode S
Relation-operational need	ACAS-B2/2 - New collision avoidance capability as part of an overall detect and avoid system for RPAS

CSEP-B4/1	Airborne separation
Main Purpose	Aims at maintaining own separation with respect to one aircraft via a delegation of responsibility from the ATCO to the flight crew in all phases of flight.
New Capabilities	A dedicated function to support separation assurance is provided to the aircraft, which must remain independent of the collision avoidance logic (ACAS-Bx). While the detection capability can be the same, the objective of the function is different and must be supported by a specific logic based on airborne separation minima developed to suit the new operations.
Description	Airborne Separation = temporary delegation of responsibility to the flight deck for separation provision with suitably equipped designated aircraft. The flight crew ensures separation from suitably equipped designated aircraft as communicated in new clearances, which relieve the controller from the responsibility for separation between these aircraft. However, the controller retains responsibility for separation from aircraft that are not part of these clearances. The flight crew/remote pilot is provided with a traffic picture (CDTI) associated to a separation assurance functionality enabling to establish and maintain the required separation (remain well clear for RPAS).
Maturity Level	Validation
Human Factor Considerations	

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology need	ASUR-B2/1 - Evolution of ADS-B and Mode S
Relation-operational need	ACAS-B2/1 - New collision avoidance system

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APPENDIX C
ASBU ELEMENTS

https://www4.icao.int/ganpportal/ASBU

GADS

GADS-B1/1	Aircraft Tracking
Main Purpose	To provide support to the ATSU Alerting Service in areas without ATS surveillance with an update rate of the aircraft position of at least once per 15 mins. The objective is to assist the relevant stakeholders in the timely identification and location of aircraft in distress, to reduce reliance on the procedural methods for determining aircraft position and helping to ensure the availability and sharing of aircraft position data.
New Capabilities	Aircraft operator will be able to track the aircraft, detect missing position reports, notify if necessary the relevant ATSUs and timely share relevant information including last known position(s).
Description	Aircraft tracking is one of the Global Aeronautical Distress and Safety System (GADSS) functions (ref, GADSS ConOPS V6). Aircraft tracking is a process, established by the operator, that maintains and updates, at standardised intervals, a ground-based record of the four dimensional position of individual aircraft in flight. (ICAO Annex 6)
Maturity Level	Ready for implementation
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? Yes 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? Yes If the aircraft operator is not already tracking its aircraft. 4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS
Tactical-Pre ops | Tactical-During ops

OPERATIONS
En-route

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	GADS-B1/2 - Contact directory service
Relation-technology option	COMS-B0/2 - ADS-C (FANS 1/A) for procedural airspace
Relation-technology option	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology option	ASUR-B1/1 - Reception of aircraft ADS-B signals from space (SB ADS-B)
Relation-technology option	COMI-B0/5 - Satellite communications (SATCOM) Class C Data
Relation-technology option	COMI-B1/3 - SATCOM Class B Voice and Data
Relation-technology option	COMS-B1/2 - PBCS approved ADS-C (FANS 1/A+) for procedural airspace

RATS

RATS-B1/1 Remotely Operated Aerodrome Air Traffic Services

Main Purpose To provide ATS at aerodromes not from a traditional on-site tower, but remotely from either a local or a distant location. The service provided may be a control service or flight information service as appropriate.

New Capabilities Provision of an aerodrome ATS from a remote location using digital video or surveillance technologies, or non-surveillance procedures.

Description This element represents the provision of Aerodrome Control or Aerodrome Flight Information Services (AFIS) at aerodromes from other than an on-site facility. This could be achieved by utilizing either video surveillance, digital surveillance, procedural processes, or a combination thereof, which is commensurate with the complexities and traffic demands at the aerodrome. A Remote Tower Centre (RTC) will be remotely connected to one or more aerodromes and consist of one or more Controller Working Positions (CWP), dependent on the requirements of the connected aerodrome(s).

Maturity Level Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes
2. Does it imply processing of new information by the user? Yes
3. Does it imply the use of new equipment? Yes
4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology benefit	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-technology benefit	ASUR-B0/2 - Multilateration cooperative surveillance systems (MLAT)
Relation-technology benefit	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
Relation-operational benefit	SURF-B0/1 - Basic ATCO tools to manage traffic during ground operations
Relation-information need	AMET-B1/1 - Meteorological observations information
Relation-information need	AMET-B1/2 - Meteorological forecast and warning information
Relation-information need	AMET-B1/4 - Dissemination of meteorological information