SEAMLESS ATM ELEMENTS ANALYSIS

The document presents the output of the ASBU Block 1 modules and regional items analysis. All the items were analyzed according to following criteria: urgency, cost and complexity of implementation, technology maturity; and classified to be included or not to the Asia/Pacific Seamless ATM Plan Review 2016 (or 2019).

Asia/Pacific Seamless ATM Plan Review 2016

Seamless Element Analysis Summary
DECISION MATRIX

- High cost - High complexity	**2019:** • B1-SURF (high density) • B1-RSEQ (high density) • CRV implementation • B1-TBO(only DCL) • Pre VoIP • B1-NOPS (high density)	**2022** • B1-RPAS (high density) • B1-APTA (high density) • B1-FICE (all) • B1-ASEP(high density) • B1-SURF (all) • B1-RSEQ (all) • B1-TBO(all) • B1-FRTO (all)*	**2025 or may not universally implemented:** • B1-RATS
- Medium cost	**2019:** • B1-CDO • B1-SAR	**2022:** • B1-AMET (all) • B1-SWIM (all) • B1-SNET • VoIP	**2022:** • B1-WAKE
- Low cost (to system or to users) - Low complexity(change to the	**2019:** • B1-ACDM (high density) • Language Proficiency • Ballistic rocket launch/space re-entry • Airport Master Plan *The dynamic trajectories may not be implemented globally	**2019:** • B1-DATM (all)	**2019:**

- Urgent (challenges are current)
- Medium urgency
- Not urgent or nice to have technology but not essential or not mature

Contents

Seamless Element Analysis Summary
ASBU B1-ACDM

1. Item Classification (Global or Regional)

Global

B1-ACDM Optimized Airport Operations through A-CDM Total Airport Management

2. Background

Optimized Airport Operations through A-CDM Total Airport Management

B1-ACDM enhances the planning and management of airport operations and allows their full integration in the air traffic management using performance targets compliant with those of the surrounding airspace. This entails implementing collaborative Airport Operations Planning (AOP) and where needed an Airport Operations Centre (APOC).

Facilitating technology/services:

- **B0-SURF, B0-RESQ, B0-ACDM, B0-NOPS**
- **ATFM**
- **ATM system/ATM network manager**
- **AMAN/DMAN**

Facilitating technology/services:

- **B1-SURF, B1-RESQ, B1-NOPS**

3. Key Performance Area (KPA)

- **Safety** – enhanced safety by increased situational awareness of all the stakeholders ;
- **Access and equity** – enhanced runway throughput;
- **Efficiency** – reduction in on-ground and in-air holding is expected; enhanced predictability of airport operations;
- **Airspace capacity** – increased capacity, optimize the utilization of airport resources;
- **Global Interoperability** – better integrate the airports into the ATM Network;
- **Economical** – through collaborative procedures, comprehensive planning and pro-active action to foreseeable problems a major reduction in on-ground and in-air holding is expected thereby reducing fuel consumption;
- **Other** –Through collaborative procedures, comprehensive planning and pro-active action to foreseeable problems a major reduction in on-ground and in-air holding is expected thereby reducing noise and air pollution in the vicinity of the airport.

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Recommended ASBU Upgrades

B1-ACDM Airport CDM: *the decision making process at the airport is enhanced by sharing up-to-date relevant information and by taking into account the preferences, available resources and the requirements of the stakeholders at the airport.* The collaborative Airport Operations Planning (AOP) and Airport Operations Centre (APOC) enhance the planning and management of the airport operation and allow full integration with ATM.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

Aerodromes

All the high density international aerodromes should implement collaborative Airport Operations Planning (AOP) and where practicable an Airport Operations Centre (APOC).

- **PASL Phase III (expected implementation by November 2022)**

Aerodromes

All the international aerodromes should implement collaborative Airport Operations Planning (AOP) and where practicable an Airport Operations Centre (APOC).

6. Implementation Process

Global Readiness:

- Standards readiness → est.2018;
- Avionics availability → N/A;
- Ground systems availability → 2018;
- Procedures available → 2018;
- Operations approvals → 2018.

Priority of implementation:

2 (Safety and efficiency constraints affecting the airport operators)

7. Justification

The priority 2 of the implementation with was based on the safety and efficiency criteria. The implementation of the element does not require advanced technology, therefore expected implementation by 7 November 2019 should be considered. The B1-ACDM module is not critical for the implementation, nevertheless it enhances airport capacity, therefore should be considered by the high density aerodromes.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Procedural changes and building confidence and understanding of each partners operational processes;
- The human-machine interface for the automation aspects;

Air Navigation Service Provider:

- The identification of human factors considerations is an important enabler in identifying processes and procedures for this module;

Civil Aviation Authority:

- Regulatory/standardization;
- Approval plans;

Manufactures:

- N/A;

Regional:

- Political constraints within the Asia/Pacific Region reduce the potential for effective coordination.

9. Stakeholders

ANSPs, CAAs, Operators, Airports, Ground Handling Services, Pilots, ATC, AIS, Customs Services

10. References

1. ICAO Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. Annex 14 (basic SARPS for definition and applicability of A-CDM, AOP and APOC)
3. ICAO Doc. 4444, Procedures for Air Navigation Services — Air Traffic Management
4. ICAO Doc. 9971,CDM Manual
5. EUROCAE ED-141: Minimum Technical Specifications for Airport Collaborative Decision Making (Airport-CDM) Systems
6. European Union, OJEU 2010/C 168/04: Community Specification ETSI EN 303 212 v.1.1.1: European Standard (Telecommunications series) Airport Collaborative Decision Making (A CDM
7. EUROCONTROL A-CDM Programme documentation, including an Airport-CDM Implementation Manual
8. ICAO Doc. 9981, Procedures for Air Navigation Services — Aerodromes (amended)

In preparation:

1. ICAO, Doc.4444PANS-ATM / Provisions to support airport CDM and ATFM (2016)
2. ICAO, Doc.9981 PANS-AERO / Procedures for CDM/A-CDM (2016)
3. ICAO, Doc 9971 - Manual on Collab ATFM, Part III (Doc 9971) / Airport CDM guidance material (2016)

Seamless Element Analysis Summary
ASBU B1-AMET

1. Item Classification (Global or Regional)

Global

B1-AMET Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service).

2. Background

B1-AMET

This module improves the current baseline case where ATM decision makers manually determine the amount of change in capacity associated with an observed or forecast meteorological condition (for example, thunderstorm activity), manually compare the resultant capacity with the actual or projected demand for the airspace or aerodrome, and then manually devise ATM solutions when the demand exceeds the meteorologically-constrained capacity value. This module also improves in-flight avoidance of hazardous meteorological conditions by providing more precise information on the location, extent, duration and severity of the hazard(s) affecting specific flights. B1-AMET module acknowledges the need for space weather information services in support of safe and efficient international air navigation.

Required technology/services:

- **B0-AMET, B0-SWIM**
- **IAVW, WAFS, TCAC**
- **Regional Advisory System for Hazardous Weather, RHWACs**

Facilitating technology/services:

- **B0-FRTO, B0-RSEQ, B0-NOPS, B1-RSEQ, B1-NOPS, B1-SWIM**

3. Key Performance Area (KPA)

- **Safety** – meteorological information improvements lead to increased situational awareness by pilots, AOCs and ANSPs, including enhanced safety through the avoidance of hazardous meteorological conditions and mitigation of space weather events. Avoided the risks posed to flight safety regarding communications, navigation (including the global positioning system (GPS)) and avionics, as well the risk to the health of aircraft occupants (i.e. flight crew and passengers) due to radiation exposure;
- **Access and equity** – access to the current and updated MET information;
- **Efficiency** – improved meteorological information in reference to the number of user-preferred profiles that can be accommodated, more efficient operations due to real time rerouting in case of meteorological threat ;
- **Airspace capacity** – optimized usage of airspace capacity, thus achieving arrival and departure rates;
- **Global Interoperability** – globally accessible information ;
- **Economical** – reduction in costs through reduced arrival and departure delays;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Recommended ASBU Upgrades

B1-AMET: *Meteorological information supporting enhanced operational efficiency and safety*
Full ATM-Meteorology integration is needed to ensure that meteorological information is included in the logic of a decision process and the impact of the meteorological conditions on the operations including the support to the cross-polar and trans-polar routes with space weather forecasts. The module will consist of the following elements:
• Element 1: Meteorological information (raw metro information),
• Element 2: Meteorological information translation (automated process),
• Element 3: ATM impact conversion (determines the anticipated meteorologically-constrained capacity of the airspace or aerodrome and compares this to the projected demand) ,
• Element 4: Meteorological information integrated decision support (meteorological information integrated decision support, comprised of automated systems and processes that create ranked mitigation strategies for consideration and execution by ATM decision makers).

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

  Nil

- **PASL Phase III (expected implementation by November 2022)**

ATM Systems

All States should implement new SARPs as necessary develop as part of B1-MET, in particular, provisions concerning MET-ATM integration, MET for terminal area, space weather, include the forecasts and alerts from the Hazardous Weather Advisory Centers (RHWACs) and the Radioactive Materials Information.

6. Implementation Process

Global Readiness:

- Standards readiness → 2018;
- Avionics availability → 2018;
- Ground systems availability → 2018;
- Procedures available → 2018;
- Operations approvals → 2018.

Priority of implementation:

2 (Safety and efficiency constraints)

7. Justification

The B1-AMET technology, for example: WXXM is not yet mature. ICAO is currently working on the standards development, planning to be completed by 2018; therefore the implementation of the module should be considered as expected implementation by November 2022.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Space weather events such as solar radiation storms, solar flares, geomagnetic storms and ionospheric disturbances that impact earth pose a risk to flight safety,

impacting communication, navigation systems, on board avionics and also posing a risk to the health of aircraft occupants; [ASBU]

- Training in the concepts behind the automation capabilities will be necessary to enable the effective integration of decision support tools into operations.; [ASBU]

Air Navigation Service Provider:

- Appropriate governance and cost recovery arrangements for the provision of space weather information services on a global and regional basis; [ASBU]
- Procedures will need to be developed, and changes to cultural aspects of how decision making is done today will need to be considered; [ASBU]

Civil Aviation Authority:

- Creation of standards for IWXXM compliant METAR, SPECI, TAF and SIGMET exchange;
- Training in the concepts behind the automation capabilities will be necessary to enable the effective integration of decision support tools into operations;
- Development of global standards for meteorological information exchange, with emphasis on the exchange of 4-D (latitudinal, longitudinal, vertical and temporal) digitized meteorological information; [ASBU]

Manufactures:

- N/A;

Regional:

- N/A;

9. Stakeholders

ICAO, ANSPs, CAAs, Metrological Service Providers, Manufacturers, Operators, Pilots, ATC,AIS

10. References

1. Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. Annex 3 - Meteorological Service for International Air Navigation,

3. ICAO Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information
4. ICAO Doc. 9377 Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services
5. ICAO Doc.8896 Manual of Aeronautical Meteorological Practice
6. ICAO Doc. 9691 Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds
7. ICAO Doc. 9766 Handbook on the International Airways Volcano Watch
8. International civil aviation requirements for information related to non-nuclear phenomena, WMO
9. ICAO Doc. 9974 Manual on Flight Safety and Volcanic Ash – Risk Management of Flight Operations with Known or Forecast Volcanic Ash Contamination
10. WMO, Manual on the Global Data-processing and Forecasting System
11. ICAO, DRAFT of the Concept of Operations for Radioactive Materials Information Centers in support of International Air Navigation

In preparation:

1. ICAO, Annex 3 / Requirements for digital information/ Provisions for new format/ Requirements for the provision of METAR/SPECI, TAF and SIGMET in digital form (2016)
2. ICAO, Doc 10003 - Manual on Digital Exchange of AMET Information/ Manual on the digital exchange of information/Guidance on the digital exchange of meteorological information (2016)

1. Item Classification (Global or Regional)

Global

B1-APTA Optimized Airport Accessibility - the enhanced reliability and predictability of approaches, increasing safety, accessibility and efficiency.

2. Background

B1-APTA Optimized Airport Accessibility

The B0-APTA has implemented the Performance-based Navigation (PBN) procedures with vertical guidance and GLS (CAT I). The B1-ATPA progress further with the universal implementation of performance-based navigation (PBN) and Ground-based Augmentation System (GBAS) Landing System (GLS) approaches. In addition, PBN and GLS (CAT II/III) procedures will be implemented to enhance the reliability and predictability of approaches to runways increasing safety, accessibility and efficiency.

Required technology/services:

- **B0-APTA, B0-FRTO**
- **PBN**
- **Enhanced GNSS and its augmentations**
- **Ionosphere Threat Model Parameter Definition**
- **Local safety assessment of transitioning to GLS**

Facilitating technology/services:

- **B0-CDO, B1-CDO**
- **eTOD (electronic Terrain and Obstacle Data)**
- **Multi-Mode Receiver (MMR)**
- **ILS/MLS, DME, VOR/NDB, RNP APCH as backup systems during transition**

3. Key Performance Area (KPA)

- **Safety** – stabilized approach paths;
- **Access and equity** – precision approach possible, where ILS cannot be implemented due to obstacle constraints or cost benefits analysis;
- **Efficiency** – cost savings related to the benefits of lower approach minima: fewer diversions, overflights, cancellations and delays; cost savings related to higher airport capacity by taking advantage of the flexibility to offset approaches and define displaced thresholds;
- **Airspace capacity** – increased capacity by increased runway throughput and more flexible use of terminal airspace with the potential use of curved approaches, precision-aided departure paths and instrument services to multiple runway ends;
- **Global Interoperability** – N/A;
- **Economical** – reduced capital investment cost and lower ongoing maintenance, as one station covers all runways at an airport compared to one ILS installation required for each runway end easier and less frequent flight calibration inspections than ILS. [Airservices Australia] Aircraft operators and ANSPs can quantify the benefits of lower minima by modelling airport accessibility with existing and new minima. Operators can then assess benefits against avionics and other costs. The GLS CAT II/III business

case needs to consider the cost of retaining ILS or MLS to allow continued operations during an interference event. The potential for increased runway capacity benefits with GLS is complicated at airports where a significant proportion of aircraft are not equipped with GLS avionics;

- **Other** – environmental benefits through reduced fuel consumption - reduced greenhouse gas emissions.

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-APTA *Optimized Airport Accessibility*: Performance-based navigation (PBN) and Ground-based Augmentation System (GBAS) Landing System (GLS) Cat II/III approaches is a key enabler for the high density airports to increase the safety and the airport capacity by the increased runway throughput and more flexible use of terminal airspace.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**
  Nil
- **PARS Phase III (expected implementation by November 2022)**

Aerodrome Operations

All high density international aerodromes (100 000 scheduled movements per annum or more) with multiple runways should implement Ground-based Augmentation System (GBAS) Landing System (GLS) approaches (SCATII/III), subject to a cost benefit analysis.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2016 (GLS Cat II and Cat III, est. Nov 2016)[GANP]
- Avionics availability → est. 2018 GBAS (CATII) receiver(GPS antenna(s), VHF antenna, associated processing equipment) [ASBU]
- Ground systems availability → three or more GPS antennas, central processing system VHF Datalink antenna (ready); [GANP]
- Procedures available → est. 2018 (Doc.8168 tom II – procedures under development) [ICAO Standardization Roadmap]
- Operations approvals → est. 2022 (States regulations est. 2020-2021 est. 2021-2022 first OPS approvals)[RO expertise]

Priority of implementation:

1 (Safety; Regional perf. dashboard B1-APTA mitigates CFIT and RS criteria)

7. Justification

The priority 1 of the implementation with was based on the safety criteria (Regional perf. dashboard B1-APTA mitigates CFIT and RS). The implementation of the element requires

advanced technology, which is not yet mature, therefore expected implementation by November 2022 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Cost as the main challenge, phasing with ILS obsolescence, more interesting on large aerodromes with multiple runway ends;
- A single powerful jamming device can temporally deny service for an entire airport or degrade the performance;[7]
- Thread of loss of signal continuity in all approach phases and especially the final approach phase;

Air Navigation Service Provider:

- New procedures for instrument flight procedures will need to be developed for GLS CAT II/III to become operational;
- Identification of human factors considerations (e.g. wrong GBAS database insertion); [ASBU]
- Accuracy, integrity, continuity, availability of a GBAS signal.
- Potential interference sources:
- in-car GPS/GNSS jamming devices (the so-called personal privacy devices (PPDs);
- GPS/GNSS repeaters, spoofers, existing aeronautical navigation systems (e.g. DME and TACAN);

Civil Aviation Authority:

- New criteria for instrument flight procedures will need to be developed for GLS CAT II/III to become operational;
- Regulatory/standardization, implementation plans should reflect available aircraft, ground systems and operational approvals;

Manufactures:

- GBAS Aircraft Subsystem Continuity of Service;

Must guarantee that the risk of loss of integrity due to SIS geometry dependent causes is less than 10-6during any 15 seconds in the approach; [Eurocontrol]

- Availability of avionics and the extent of operational use of multi-constellation, multi-frequency GNSS [ASBU] (not certain that there will be standards for such avionics by 2018);
- Ionospheric errors of GNSS signals, Ionosphere Threat Model Parameter Definition.
- Integration of capability in the aircraft avionics;
- Certification of onboard equipment;
- Different equipment certification standards due to the regional diversity in ionospheric conditions;
- On-board antenna gain variation factor, AGVF, and transmission line loss variation factor, TLVF;
- Define “reasonable” spatial separation assumptions between a VDB transmitter

and an aircraft VHF navigation receiver antenna in the operational environment of an airport;

Regional:

- Ensure that a GBAS system is robust enough to operate at low latitudes requirement for a GBAS ionospheric threat model; [2]
- Set regional airworthiness standards and operational approvals;
  - The SCINTEX and GTEX Formats to be adopted as ICAO APAC standard for exchange of GNSS data.[7]

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Training Organizations, Pilots, ATC, Procedure Designers, AIS

10. References

1. Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. Review outcome of Fifth Meeting of Ionospheric Studies Task Force (ISTF/5) Ishigaki, Okinawa, Japan, February 2015.
3. ICAO Annex 6
4. ICAO Annex 10 — *Aeronautical Telecommunications*., to support GLS CAT II/III approaches
5. ICAO Doc 9613, *Performance-based Navigation (PBN) Manual*
6. ICAO, Guide for ground based augmentation system implementation,2013
7. "CAT II/III GBAS Implementation Challenges", Presentation by Nadia Sokolova, NKG General Assembly 2014
8. http://www.eurocontrol.int/gbas
9. Navigation System Panel (NSP) Second Meeting NSP/2-WP/37 form 12/11/15
10. Navigation System Panel (NSP) Report of the Meeting of the GBAS WG (GWG) Montreal, Canada Dec 1st – Dec 4th 2015

In Preparation:

1. ICAO, Annex 6 - Part I / SARPS to embed PBN into traditional operations (2016)
2. ICAO, Annex 10 - Vol I / Standards to cover GBAS use as a landing aid under Cat II/III (2018)
3. ICAO, Doc. 8168 PANS-OPS Vol II (Doc 8168) / Procedure design criteria for GBAS Cat II/III
4. ICAO, Doc 9849 - GNSS Manual (Doc 9849) / Update of manual to cover GBAS use as a landing aid under Cat II/III

1. Item Classification (Global or Regional)

Global

B1-ASEP Increased Capacity and Efficiency through Interval Management - the organization of traffic flows and aircraft spacing.

2. Background

B1-ASEP Increased Capacity and Efficiency through Interval

Interval management (IM) improves the organization of traffic flows and aircraft spacing. This enable to create operational benefits through precise management of intervals between aircraft with common or merging trajectories, thus maximizing airspace throughput while reducing ATC workload along with more efficient aircraft fuel burn reducing environment impact.

Required technology/services:

- **B0 - ASEP**
- **Voice or CPDLC communication**
- **ADS-B IN**
- **Cockpit Display of Traffic Information (CDTI)**
- **Airborne Separation Assistance System (ASAS)**
- **Avionics component (FIM equipment /spacing functions with advisories)**

Facilitating technology/services:

- **Additional new CPDLC messages**

3. Key Performance Area (KPA)

- **Safety** – increased pilot situational awareness when conducting visual approaches in marginal conditions. Reduced ATC instructions and workload per aircraft without unacceptable increase in flight crew workload; [ASBU Working Document]
- **Access and equity** – N/A;
- **Efficiency** – continued optimized profile descents (OPDs) in medium density environments expected to allow OPDs when demand <=70%capacity) are enabled with minimal additional delay by reducing controller interaction; [ASBU Working Document];
- **Airspace capacity** – enhanced capacity due to the precise management of intervals between aircraft with common or merging trajectories;
- **Global Interoperability** – N/A;
- **Economical** – consistent, low variance spacing between paired aircraft (e.g., at the entry to an arrival procedure and on final approach) resulting in reduced fuel burn. [ASBU Working Document] ;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-ASEP *Increased Capacity and Efficiency through Interval Management*. Interval management improves management of air traffic flows and aircraft spacing.
Is based on ADS-B IN applications to achieve or maintain an interval or spacing from a

designated aircraft. ATC is provided with a new set of (voice or data link) clearances directing, for example, that the flight crew establish and maintain a given time spacing from a reference aircraft. These new clearances will reduce the use of ATC vectoring and speed control.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**

  Nil
- **PARS Phase III (expected implementation by November 2022)**

En-route Operations

All high density FIRs should implement interval management through ADS-B IN, new CPDLC massages, ASAS and CDTI deployment.

- **PARS Phase IV (expected implementation by November 2025)**

En-route Operations

All high density FIRs should implement interval management through ADS-B IN, new CPDLC massages, ASAS and CDTI deployment.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2015 [ASBU Working Document]
- Avionics availability → est. 2020 [ASBU Working Document]
- Ground systems availability → est. 2015 [ASBU Working Document]
- Procedures available → est. 2018 [ASBU Working Document]
- Operations approvals → est. 2020 [ASBU Working Document]

Priority of implementation:

1 (Safety and efficiency constraints)

7. Justification

The priority 1 of the implementation with was based on the safety and efficiency criteria. The implementation of the element does require advanced technology like for example: Airborne Separation Assistance System (ASAS), which is not mature yet, therefore expected implementation by 7 November 2022 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Possibility of wake turbulence encounter in IMC;

- In case of the high pilot workload the takeover of the responsibility to the ATC should be considered;
- Pilot training on the new procedures and technology;

Air Navigation Service Provider:

- Development of Air and ground procedures for interval management;
- ATC training on the new procedures and technology;

Civil Aviation Authority:

- N/A;

Manufactures:

- N/A;

Regional:

- N/A.

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Training Organizations, Pilots, ATC

10. References

1. Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. Feasibility and Benefits of a Cockpit Traffic Display-Based Separation Procedure for Single Runway Arrival and Departures; Dr. Anand R. Mundra, David A. Domino, John R. Helleberg, Arthur P. Smith,
3. EUROCAE ED-195 rev A / RTCA DO-328 rev A, Safety, Performance and Interoperability Requirements Document for Airborne Spacing – Flight Deck Interval Management (ASPA-FIM)

In preparation:

1. ICAO, Doc.4444 PANS-ATM / Phraseology and message set for interval management/Separation minima for interval management/ (2020)
2. ICAO, Doc. 9994 - Airborne Surveillance Manual (Doc 9994) / Guidance to support interval management procedures

1. Item Classification (Global or Regional)

Global

B1-CDO Improved Flexibility and Efficiency in Continuous Descent Operations (CDOs) using VNAV - the enhanced vertical flight path precision during descent.

2. Background

B1-CDO Improved Flexibility and Efficiency in Continuous Descent Operations (CDOs) using VNAV

The **B0-CDO** has implemented the performance-based airspace and arrival procedures allowing an aircraft to fly their optimum profile using continuous descent operations (CDOs). Main difference brought by the **B1-CDO** module in the introduction of Baro – VNAV, which enhances the vertical flight path precision during descent, arrival, and enables aircraft to fly an arrival procedure not reliant on ground based equipment for vertical guidance. The main benefit is higher utilisation of airports, improved fuel efficiency, increased safety through improved flight predictability and reduced radio transmissions and better utilization of airspace.

Required technology/services:

- **Barometric vertical navigation (Baro - VNAV) avionics capability**

Abbreviations:

Baro-VNAV - PBN with vertical navigation (VNAV) is an altimetry-based capability which enables an equipped aircraft to precisely descend on a vertical path, as computed by avionics equipment such as the flight management computer (FMC), within a tolerance set in feet, while providing the flight crew with navigation performance information though avionics monitoring and alerting.

3. Key Performance Area (KPA)

- **Safety** – precise altitude tracking along a vertical descent path leads to improvements in overall system safety; [ASBU Working Document]
- **Access and equity** – N/A;
- **Efficiency** – enabling an aircraft to maintain a vertical path during descent allows for development of vertical corridors for arriving and departing traffic thus increasing the efficiency of the airspace. Additionally, VNAV promotes the efficient use of airspace through the ability for aircraft to fly a more precisely constrained descent profile allowing the potential for further reduced separation and increased capacity; [ASBU Working Document]
- **Airspace capacity** – PBN with VNAV allows for added accuracy in a continuous descent operation (CDO). This capability allows for the potential to expand the applications of standard terminal arrival and departure procedures for improved capacity and throughput, and improve the implementation of precision approaches; [ASBU Working Document]
- **Global Interoperability** – N/A ;
- **Economical** – VNAV allows for reduced aircraft level-offs, resulting in fuel and time

savings; [ASBU Working Document]

- **Other** – VNAV allows for enhanced predictability of flight paths which leads to better planning of flights and flows. [ASBU Working Document]

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-CDO *Improved Flexibility and Efficiency in Continuous Descent Profiles (CDOs) using VNAV*. The arrival procedure with CDOs using VNAV allows the aircraft to fly close to its optimal profile enabling fuel savings and enhanced predictability. VNAV contributes to terminal airspace design and efficiency due to an aircraft's ability to maintain a vertical path during descent thus allows for development of vertical corridors for arriving and departing traffic thus increasing the efficiency of the airspace.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**

Terminal operations

All high density international aerodromes should implement approaches with the Continuous Descent Operations (CDOs) using VNAV as far as practicable.

Note: refer to RTCA DO-236CB, Minimum Aviation System Performance Standards: Required Navigation

- **PARS Phase III (expected implementation by November 2022)**
  Nil

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2016; [ASBU Working Document]
- Avionics availability → ready; [ASBU Working Document]
- Ground systems availability → est. 2018; [ASBU Working Document]
- Procedures available → ready; [ASBU Working Document]
- Operations approvals → est. 2018 [ASBU Working Document]

Priority of implementation:

1 (Reduces CFIT – Controlled Flight Into Terrain)

7. Justification

The priority 1 of the implementation with was based on the safety criteria – reduction of CFIT – Controlled Flight Into Terrain. The implementation of the element does require advanced technology Baro - VNAV, which is already mature, therefore expected implementation by 7

November 2019 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Flight crews require training in the proper use of the VNAV functions of the avionics equipment such as the FMC;
- New standard procedures guide the flight crews on which altitude tolerances may be selected for a particular phase of flight;

Air Navigation Service Provider:

- New procedure design and trials;
- ATC training on new procedures;
- Collaboration between stakeholders like ANSP, airlines, airports;

Civil Aviation Authority:

- Standards for procedure approvals;

Manufactures:

- The human-machine interface for the automation aspects of this performance improvement will need to be considered;

Regional:

- Low level of the B0-CDO implementation. (States which have implemented: Hong Kong, India, Malaysia, Maldives, Singapore).

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Training Organizations, Pilots, ATC, Airspace designers

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. ICAO,Doc.9931 Continuous Descent Operations (CDO) Manual
3. EUROCAE ED-75D, MASPS Required Navigation Performance for Area Navigation
4. RTCA DO-236C, Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation
5. Boeing Document D6-39067-3, RNP Capability of FMC Equipped 737, Generation 3
6. Boeing Document D243W018-13 Rev D, 777 RNP Navigation Capabilities, Generation 1

In preparation:

1. ICAO, Annex 6 - Part I / Next Steps for Continuous Descent Final Approach Operations (CDFA) Provisions (2016)
2. ICAO, Annex 6 - Part II / Next Steps for Continuous Descent Final Approach Operations (CDFA) Provisions (2016)
3. ICAO, Annex 6 - Part III / Next Steps for Continuous Descent Final Approach

Operations (CDFA) Provisions (2016)
4. ICAO, Doc. 8168 PANS-OPS Vol I / Next Steps for Continuous Descent Final Approach Operations (CDFA) Provisions (2016)
5. ICAO, Doc. 8168 PANS-OPS Vol II / Next Steps for Continuous Descent Final Approach Operations (CDFA) Provisions (2016)
6. ICAO, Doc. 4444 PANS-ATM / Procedures and phraseologies for SID/STAR (2016)

1. Item Classification (Global or Regional)

Global

B1-DATM Service Improvement through Integration of all Digital ATM Information - the efficient management of the ATM information.

2. Background

B1-DATM Service Improvement through Integration of all Digital ATM Information

This module addresses the need for increased information integration and will support a new concept of ATM information exchange fostering access via internet protocol-based tools. This includes the cross-exchange of common elements with the initial introduction of the ATM Information Reference Model (AIRM), which integrates and consolidates ATM information. Exchange models such as AIXM, FIXM (for flight and flow information; and aircraft performance-related data), WXXM (for meteorological information) and others relate their concepts to the AIRM fostering convergence, re-use, and collaborative alignment.
The long term objective is the establishment of a network-centric information environment, also known as system-wide information management (SWIM).

Required technologies/services:

- **B0-DATM, B0-AMET, B1-SWIM**
- **AMHS, SWIM systems**
- **FIXM,AIXM, WXXM, AIRM**
- **ADS-B height measuring system**

Facilitating technology/services:

- **B1-AMET, B1-FICE**

3. Key Performance Area (KPA)

- **Safety** – reduced probability of data errors or inconsistencies; reduced possibility to introduce additional errors through manual inputs;[GANP]
- **Access and equity** – greater timeline access to up to date information by wider set of users;[GANP]
- **Efficiency** – reduced processing time for new information, increased ability of the system to create new applications through the availability of standardized data;
- **Airspace capacity** – N/A;
- **Global Interoperability** – Essential for global interoperability;
- **Economical** – less fuel consumption due to more optimized routes;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-DTAM *Integration of Digital Information Management (AIM) Information.* Service improvement through ATM information reference model, integrating all ATM information, using common formats (ULM/XML and WXXM) for metrological information and FIXM for flight and flow information internet protocols enables the up-to-date access to the

information by the variety of stakeholders.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

ATM Systems

All high density FIRs should implement ATM information reference model, integrating all ATM information, using common formats (ULM/XML and WXXM) for meteorological information, FIXM for flight and flow information and internet protocols.

- **PASL Phase III (expected implementation by November 2022)**

ATM Systems

All FIRs should implement ATM information reference model, integrating all ATM information, using common formats (ULM/XML and WXXM) for meteorological information, FIXM for flight and flow information and internet protocols.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018 [ASBU]
- Avionics availability → N/A; [ASBU]
- Ground systems availability → est. 2018; [ASBU]
- Procedures available → est. 2018; [ASBU]
- Operations approvals → est. 2018. [ASBU]

Priority of implementation:

1 (Quality and timely delivery of relevant information to the flight crew affecting safety and efficiency of the flight)

7. Justification

The priority 1 of the implementation with was based on the safety and efficiency criteria related to quality and timely delivery of relevant information to the flight crew affecting safety and efficiency of the flight. The implementation of the element requires advanced technology, which is still under development, therefore expected implementation by 7 November 2022 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Procedural changes and building confidence and understanding of each partner

operational processes; [ASBU]
- The human-machine interface for the automation aspects**;**

Air Navigation Service Provider:
- The identification of human factors considerations is an important enabler in identifying processes and procedures for this module;

Civil Aviation Authority:
- Regulatory/standardization: to be determined;
- Approval plans: to be determined;

Manufactures:
- human-machine interfaces;

Regional:
- Slow B0-DATM implementation may delay the B1-DATM;
- Data insertion quality.

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Meteorological Service Providers, Operators, Airports, Pilots, ATC, AIS, AIM

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. ICAO, Doc. 4444, Procedures for Air Navigation Services — Air Traffic Management
3. ICAO, APAC State AIS AIM Transition Table
4. ICAO, Annex 15 – Aeronautical Information Services
5. ICAO, Doc 8126 – AIS Manual

In preparation:

1. ICAO, Annex 3 / Amendment on the requirements of the use of improved NOTAM system for MET
2. ICAO, Annex 4 / Final amendment on the transition from AIS to AIM (2016)
3. ICAO, Annex 15 / Exchange (Models 2016)
4. ICAO, Doc 4444, PANS-ATM / Requirements for flight and flow information (2018)
5. Doc #### - PANS-AIM / PANS-AIM planned for availability in (2016)
   Doc 8126 - AIS Manual / Guidance to support PANS-AIM (2018)

1. Classification of the item: Global (from GANP)/Regional (regional needs)

Global

B1-FICE - Increased Interoperability, Efficiency and Capacity through Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure.

2. Background

The baseline for this module is the present process for submission of the flight plan (FPL) through ICAO standardized FPL/2012 messages (Amendment 1 to the PANS-ATM) and automated standard for information exchange through a set of messages and the limited need for direct speech coordination (B0-*FICE*). Introduce FF-ICE, Step 1 providing ground-ground exchanges using a common flight information references model (FIXM) and extensible markup language (XML) standards formats. Application between ATS to facilitate exchange between ATM service provider (ASP), airspace user operations and Airport Operations

Required technology:

- **B0-FICE, B0-DATM, B0-TBO,B0-FRTO, B0-SWIM, B1-AMET**
- **ATM System**
- **AMHS**

Facilitating technology:

- **B1-DATM, B1-SWIM, B1-RSEQ**

3. Key Performance Area (KPA)

- **Safety** – more accurate flight information. [GANP]
- **Access and equity** – greater equity in airspace access; greater access to timely and relevant information for decision support and more autonomy in decision making leading to opportunities for better delivery of business and individual objectives[3];
- **Efficiency –** better knowledge of aircraft capabilities allows trajectories closer to the airspace user preferred trajectories.[GANP]
- **Airspace capacity** – reduced air traffic controller workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases. [GANP]
- **Global Interoperability** - FF-ICE/1 will provide global interoperability to information management; a new mechanism for FPL filing and information sharing will facilitate flight data sharing amongst ATM actors.[Eurocontrol]
- **Economical** – new services have to be balanced by the cost of software changes in ATM service provider (ASP), airline operations center (AOC) and airport ground systems. [GANP]
- **Other**- FF-ICE, Step 1 for ground application will facilitate collaborative decision-making (CDM), the implementation of the systems interconnections for information-sharing, trajectory or slot negotiation before departure, providing better use of capacity and better flight efficiency[GANP]; the use of new mechanism for FPL filling

and information-sharing will facilitate flight data-sharing among the actors. [GANP]

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

1. Asia/Pacific ASBU Implementation

Critical ASBU Upgrades

B1-FICE *Ground-Ground Integration and Interoperability*: FF-ICE, Step 1 for ground-ground application facilitate the collaborative decision making (CDM), applicable between ATM service providers, airspace user operations and airport operations. Reduces controller workload and increases data integrity supporting improved capacity.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

1. PASL Phase II (expected implementation by 7 November 2019)

Nil

2. PASL Phase III (expected implementation by X November 2022)

ATM Systems

All the high density international aerodromes should implement the Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure.

3. PASL Phase IV (expected implementation by X November 2022)

All the international aerodromes should implement the Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure.

6. Implementation Process

Global Readiness

- Standards readiness → est. 2016 [GANP]
- Avionics availability → N/A
- Ground systems availability → 2018 [GANP]
- Procedures available → est. 2020 [RO expertise]
- Operations approvals → est. 2020 [RO expertise]

Priority of implementation:

1 (Global interoperability constraint)

7. Justification

The priority 1 of the implementation with was based on the safety and global interoperability

criteria. The implementation of the element requires advanced technology, which is not developed yet, therefore expected implementation by November 2022 should be considered.

8. Challenges/Barriers

(regulatory provisions, human performance, fleet equipage/training/airworthiness/ops approval, ground systems/infrastructure and associated lead-time, OPS procedures, management and system user training…ect.)

Global:

Airlines and Airports:

- The use of FF-ICE, Step 1 will require significant changes in the procedures for flight information submission;

Air Navigation Service Provider:

- Human-machine interface for the automation aspects;
- Safety cases of the changes to the systems;
- Interaction with other parties and use of shared data;

Civil Aviation Authority:

- New systems certification and approvals;

Manufactures:

- Human-machine interaction should be considered during design phase for the systems;

Regional:

- The ANSPs will have to invest and implement AIDC at the end of B0 cycle, the upgrade to FF-ICE may have to be postponed;
- The implementation of FF-ICE Step 1 will challenge for the APAC States because of its complexity and current poor implementation progress of the AIM.

9. Stakeholders

ICAO, ANSPs, CAAs, Aircraft Manufacturers, ATM system providers, Operators, ATC, Pilots, Dispatchers, Airports, Handling Services

10. References

1. Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP)
2. Doc 9965, “Manual on Flight and Flow-Information for a Collaborative Environment (FF-ICE)”
3. ICAO, “*Flight & Flow Information for a Collaborative Environment (FF-ICE), a concept to Support Future ATM Operations”*
4. FAA, Eurocontrol, “FIXM, Development- Collaboration, Partnership, Success- presented by Maureen Keegan, August 27 2015
5. ICAO Doc 4444, “*Procedures for Air Navigation Services — Air Traffic Management*.”
6. 12th Air Navigation Conference, Agenda Item 3: Interoperability and data-through

globally interoperable system-wide information management, Montreal November 2012
7. www.fixm.aero

In preparation:

1. ICAO, Annex 2 / New services associated to extended flight plan (2018)
2. ICAO, Annex 11 / New rules related to flight planning (2018)
3. PANS-ATM (Doc 4444) / Procedures for flight and flow information for pre-departure use
   PANS-ATM (Doc 4444) / Requirements for flight and flow information

1. Item Classification (Global or Regional)

Global

B1-FRTO Improved Operations through Optimized ATS Routing - the enhanced operations thought PBN, closer and consistent route spacing, curved approaches, parallel offsets and reduction of holding area size.

2. Background

B1-FRTO Improved Operations through Optimized ATS Routing

B0-FRTO has implemented Flexible Use Airspace and User Proffered Routes (UPR), Dynamic Re-route Planning (DARP) and CDM. **B1-FRTO** provides through performance-based navigation (PBN), enhanced FUA and dynamic sectorization, closer and consistent route spacing, curved approaches, parallel offsets and the reduction of holding area size.
The module will consist of the following elements:

- **Element 1: Free routing** (Free routing corresponds to the ability for flights to file a flight plan with at least a significant part of the intended route which is not defined according to published route segments but specified by the airspace users).
- **Element 2: Reduced route spacing** (A key tenet of the PBN concept is to combine the accuracy and functionality of navigation in specifications which can be tailored to the intended operations resulting in reduced route spacing).
- **Element 3: Dynamic sectorization** (The dynamic sectorization is applied in real-time by selecting the most suitable configuration of the airspace)

Required technology/services:

- **B0-SNET (required Phase I/II element 160 – CPAR), B0- CCO, B0-FICE**
- **FUA, dynamic sectorization**
- **LARA (Local And sub Regional - Airspace management support system)**
- **WGS-84, PBN**

Abbreviations:

LARA - Local And sub Regional - Airspace management support system. LARA provides real-time exchange of airspace management data between the actors involved. It facilitates collaborative decision-making and helps to enhance situational awareness throughout the airspace management process. In addition the capability of connecting neighbouring LARA systems allows for seamless cross-border coordination between different States and facilitates. Interfaces to Air Traffic Control (ATC) Systems. [EUROCONTROL].

3. Key Performance Area (KPA)

- **Safety** – enhanced safety by increased situational awareness of all the stakeholders;
- **Access and equity** – enhanced affected airspace accessibility for users, due to accurate time window and optimized size of designated airspace for the rocket launch/space re-entry activity;
- **Efficiency** – reduction of the airline's additional airborne time and delays;
- **Airspace capacity** – increased capacity, optimized use of airspace resources;
- **Global Interoperability** – N/A;
- **Economical** – minimized cost of delays for flights affected by the activity, probability of the compensation for airlines per each commercial launch;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-FRTO *Improved operations through Optimized ATS Routing.* Provides through performance-based navigation (PBN), enhanced FUA and dynamic sectorization and free routing - an consistent route spacing, curved approaches, parallel offsets and the reduction of holding area size.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**
  Nil

- **PASL Phase III (expected implementation by November 2022)**

En-route Operations

All Category S upper controlled airspace and Category T airspace supporting high density aerodromes should implement enhanced FUA and dynamic sectorization.

6. Implementation Process

Global Readiness:

- Standards readiness → ready; [GANP]
- Avionics availability → ready; [GANP]
- Ground systems availability → ready; [GANP]
- Procedures available → est.2018; [GANP]
- Operations approvals → est.2018; [GANP]

Priority of implementation:

2 (Safety and efficiency constraints)

7. Justification

The priority 2 of the implementation with was based on the safety and efficiency criteria. The implementation of the element requires advanced technology, therefore expected implementation by November 2022 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- New procedures for pilots;

Air Navigation Service Provider:

- Use of free routing may be limited to traffic under a certain density in order for controllers to be able to perform conflict detection and resolution with limited automation, ATC needs flight data coordination and processing and enhanced ATC conflict prediction tools; [GANP]
- A safety assessment which considers operational errors is required for the introduction of the reduced route spacing;
- Identification of human factors consideration, risk mitigation strategies such as training, education and redundancy; [GANP]

Civil Aviation Authority:

- Approvals;

Manufactures:

- N/A;

Regional:

- Fragmented and militarized airspace will be a barrier to the effective implementation of dynamic trajectories in Asia/Pacific

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Airports, Pilots, ATC

10. References

1. ICAO Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. ICAO, Annex 11
3. ICAO, Annex 10
4. ICAO, PANS-OPS Volume 1
5. ICAO, PBN Manual
6. ICAO, GNSS Manual
7. ICAO, presentation Workshop on development of National Performance Framework for Air Navigation Systems (Nadi, Fiji, 28 March-1 April 2011);

In preparation:

1. ICAO, Annex 6 - Part I / Standards on the use of PBN on Conventional routes (2016)
2. ICAO, PANS-ATM (Doc 4444) / Separation minima for RNP2, advanced RNP (2018)

3. ICAO, Doc.8168 PANS-OPS Vol I / Procedures for the use of PBN on Conventional routes. EN-ROUTE/ Pilot requirements on FRT
4. ICAO, Doc. 8168 PANS-OPS Vol II / Instrument flight procedures for FRT/ New procedure design requirements to support RNP2 and Advanced RNP. New charting requirements including PBN information box and magnetic bearings on PBN routes/ Instrument flight procedures for FRT (2018)
5. ICAO, Doc 9613 - PBN Manual / Update n on FRT functionality to align with Do 236c (2018)
6. ICAO, Doc 330 - Circular on Civil/Military Coop. in ATM / Guidance on cooperation on ATM between civil and military entities (Improve the contents of Cir.330 and upgrade it to ICAO Manual) (2016)

Seamless Element Analysis Summary
ASBU B1-NOPS

1. Item Classification (Global or Regional)

Global

B1-NOPS Enhanced Flow Performance through Network Operational Planning - the enhanced process for air traffic flow management.

2. Background

B1-NOPS Enhanced Flow Performance through Network Operational Planning

Introduces enhanced processes to manage flows or groups of flights in order to improve overall traffic flow. The resulting increased collaboration among stakeholders in real-time, facilitating user preferences and system capabilities will result in better use of airspace with positive effects on the overall cost of ATM.

Required technology/services:

- **B0 D-ATM (AIS - AIM Transition)**
- **B0-FRTO, B0-NOPS**
- **Full FUA** (The full FUA introduces mechanisms, in conjunction with the more dynamic ATS routes (Module B1-FRTO) to make the airspace and its use as flexible as possible and a continuum that can be used in an optimal manner by the civil and military users).
- **User driven prioritization process (UDPP)** (User driven prioritization process is designed to allow airspace users to intervene more directly in the implementation of flow regulations, in particular in cases where an unplanned degradation of capacity significantly impacts the realisation of their schedule).
- **ATFM slots**
- **Enhanced ATFM algorithms and techniques**
- **Identification and mitigation of capacity constraints tools**

3. Key Performance Area (KPA)

- **Safety** – the module is expected to further reduce the number of situations where capacity or acceptable workload would be exceeded; [ASBU Working Document]
- **Access and equity** – enhanced accessibility of airspace due to the increased capacity;
- **Efficiency** – reduction of flight penalties supported by airspace users; [ASBU Working Document]
- **Airspace capacity** – better use of the airspace and ATM network, with positive effects on the overall cost-efficiency of ATM. Optimization of DCB measures by using assessment of workload/complexity as a complement to capacity; [ASBU Working Document];
- **Global Interoperability** – enhanced global interoperability due to unified technology;
- **Economical** – the business case will be a result of the validation work being undertaken; [ASBU Working Document]
- **Other** – some minor improvement to environment is expected compared to the module's baseline. [ASBU Working Document] ;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-NOPS *Enhanced Flow Performance through Network Operational Planning*. Introduces enhanced ATFM processes to improve the overall flow. The main improvement is the increased collaboration among stakeholders in real-time regarding use preferences and system capabilities. This results in better use of airspace with positive effects on the overall cost of ATM

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

En-route Operations

All high density FIRs (detailed in the Asia/Pacific eANP) should enhance the ATFM and CDM in accordance with the ATFM Framework in order to enhance and monitor the airspace capacity.

Note: refer to the Asia/Pacific ATFM Framework for Collaborative ATFM para.7.6, 7.7,7.8, 7.11, 7.18, 7.19, 7.21, 7.23, 7.26, 7.27,7.28, 7.30, 7.31, 8.9.

Note: *full flexible use of airspace (FUA) not yet incorporated into the Asia/Pacific ATFM Framework for Collaborative ATFM.*

- **PASL Phase III (expected implementation by November 2022)**
  Nil

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018 [ASBU Working Document]
- Avionics availability → N/A;
- Ground systems availability → est. 2018; [ASBU Working Document]
- Procedures available → est. 2018; [ASBU Working Document]
- Operations approvals → est. 2018 [ASBU Working Document]

Priority of implementation:

1 (Safety and efficiency constraints affecting the air operators in the Asia/Pacific Region)

7. Justification

The priority 1 of the implementation with was based on the safety and efficiency criteria. The implementation of the element does not require advanced technology, and aligns with the *Asia/Pacific ATFM Framework for Collaborative ATFM* requirements, therefore expected

implementation by 7 November 2019 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- The new procedures will require training adapted to the collaborative nature of the interactions, in particular between ATFM units and airline operations personnel;[ASBU Working Document]

Air Navigation Service Provider:

- Improvement of the ATFM algorithms and techniques; [ASBU Working Document]
- New procedures to exploit the new techniques: for ATC to communicate in-flight measures to crews; for informing operators before departure; [ASBU Working Document]
- Identification of human factors considerations is an important enabler in identifying processes and procedures; [ASBU Working Document]
- UDPP rules and application requirements need to be defined; [ASBU Working Document]

Civil Aviation Authority:

- Coordination agreement with the ANSPs and military authority;

Manufactures:

- N/A;

Regional:

- Difficulties in the implementation of the full Flexible use of Airspace due to poor civil-military cooperation in Asia/Pacific Region.

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Pilots, ATC, Central Flow Management Units (to create)

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU Working document
2. ICAO, Doc. 9971 - Manual on Collab ATFM, Part II / Guidance on implementation of ATFM
3. ICAO, Asia/Pacific Framework for Collaborative ATFM Version 1.0 September, 2015
4. EUROCONTROL concept advanced flexible use of airspace (AFUA)

In preparation:

1. ICAO, Doc.4444 PANS-ATM / Provisions to support airport CDM and ATFM/ Procedures on implementation of ATFM/ Enhanced separation minima addressing: - 45 ‘ RNAV arrival and departure separation-Lateral/(2016)
2. ICAO, Doc. 330 - Circular on Civil/Military Coop. in ATM (Circ. 330) / Guidance on cooperation on ATM between civil and military entities (Improve the contents of

Cir.330 and upgrade it to ICAO Manual) (2016)

1. Item Classification (Global or Regional)

Global

B1-RATS Remotely Operated Aerodrome Control - the cost efficient ATS solution for small rural airports.

2. Background

Launch/Space re-entry activity management

Remotely operated aerodrome control concerns the provision of ATS to aerodrome(s) from a facility which is not located at the aerodrome itself. [GANP, ASBU]

The main target for the single and multiple remote tower services are small rural airports, which today are struggling with low business margins. Both ATC and AFIS aerodromes are expected to benefit. [GANP, ASBU] Moreover, the proposed solution may be implemented as a standby installations and a contingency solution for medium to high density airports.

There will be to different solutions:

- Remote provision of ATS for single aerodromes
- Remote provision of ATS for multiple aerodromes
- Remote provision of ATS for contingency situations

Currently, Australia, Europe, Japan and the United States are all actively engaged in integrating RTS into future airspace systems.

Required technology:

- **B0-CCO, B0-FICE**
- **A-SMGCS**
- **Visual surveillance cameras/systems**
- **CWP (Controller Working Positions)**
- **RTC (Remote Tower Centre)**
- **High definition video cameras**
- **Signal light gun (SLG) and microphones**

Facilitating technology:

- **HMI technologies**

3. Key Performance Area (KPA)

- **Safety** – situational awareness in low visibility conditions using visual enhancements; [GANP, ASBU]
- **Access and equity** – small airports more accessible; greater possibility to extend opening hours when through remote operations; [GANP, ASBU]
- **Efficiency** – more efficient use of staff resources, airport opening hours flexibility; [GANP, ASBU]
- **Airspace capacity** – greater capacity in low visibility or contingency conditions; [GANP, ASBU]
- **Global Interoperability** – N/A;
- **Economical** – lower operating costs for the aerodrome, lower cost of providing ATS to the airspace users; [GANP, ASBU]. Previous CBA indicated a reduction in staff costs of 10-35% depending on the scenario. Other savings arise from reduced capital costs, particularly savings from not having to replace and maintain tower facilities and equipment and from a reduction in tower operating costs. [GANP,ASBU]. The CBA concluded that remote tower does produce positive financial benefits for ANSP;

- **Other** – higher levels of standardization/interoperability across remote aerodrome systems and procedures. [GANP,ASBU]

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

ASBU Elements Which may Not Be Universally Implemented

B1-RATS *Remotely Operated Aerodrome Control.* Provides a safe and cost-effective air traffic services (ATS) from remote facility to one or more aerodromes. Can have also a significant importance in case of contingency situation occurrence.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**

Aerodromes

The Remotely Operated Aerodrome Towers should be considered where practicable.

- **PARS Phase III (expected implementation by November 2022)**

Aerodromes

The Remotely Operated Aerodrome Towers should be considered where practicable.

6. Implementation Process

Global Readiness:

- Standards readiness →est. 2018; [GANP]
- Avionics availability → est. 2018; [GANP]
- Ground systems availability → est. 2018; [GANP]
- Procedures available → est. 2018; [GANP]
- Operations approvals → est. 2018. [GANP]

Priority of implementation:

3 (Implementation does not related to global interoperability priority)

7. Justification

The priority 3 of the implementation with was based on “not urgent” criteria. The Remotely Operated Aerodrome Towers are not directly contributing to the global ATM interoperability. In addition, the implementation of the element requires advanced technology, therefore expected implementation by November 2022 should be considered where practicable.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Constraints at some airports due to the single operational viewpoint from a central, high up perspective;[GANP]
- The remote facility will also require maintenance; [GANP]
- In cases of complete failure, there is no possibility for reduced operations; [GANP,ASBU]
- Cases of partial failure; [GANP,ASBU]
- Loss of visual reproduction when operating remotely; [GANP,ASBU]
- Hardware malfunctions;
- Cyber security issues like viruses;
- Hacking of data transfer between aircraft and ground form;

Air Navigation Service Provider:

- New fall back procedures are required in case of full or partial failure of the RTC→
- Identification of human factors, risk mitigation strategies such as training, education and redundancy;
- Adequate contingency measures must be established;

Civil Aviation Authority:

- Certification of new methods for separation of aircraft;
- Regulatory/standardization needs and Approval Plan;

Manufactures:

- N/A;

Regional:

- Political constraints within the Asia/Pacific Region that reduce the potential for effective coordination.

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Training Organizations, ATC/AFISO

10. References

3. ICAO Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
4. ECA Position Paper “Remote Tower Services”

In Preparation:

1. ICAO, Annex 11 / Provisions on remotely operated ATS (2018)
2. ICAO, Doc.4444 PANS-ATM / Procedures on remotely operated ATS (2018)

1. Item Classification (Global or Regional)

Global

B1-RPAS Initial Integration of Remotely Piloted Aircraft (RPA) Systems into non-segregated airspace - implementation of basic procedures.

2. Background

B1-RPAS Initial Integration of Remotely Piloted Aircraft (RPA) Systems into non-segregated airspace

Implementation of basic procedures for operating remotely piloted aircraft (RPA) in non-segregated airspace, including detect and avoid.

Required technology/services:

- **DAA (Detect and Avoid) system**
- **C2 (Command and Control) datalink**
- **WRC spectrum**

3. Key Performance Area (KPA)

- **Safety** – mitigate increasing number of incidents all over the world related to the use of RPSAS; pro-active development and implementation of the procedures can result in avoidance of severe safety issues in the foreseeable future;
- **Access and equity** – mitigate the issue of current very limited access the airspace due to lack of developed procedures and standards;
- **Efficiency** – efficient operation of all types of aircrafts in the airspace;
- **Airspace capacity** – developed procedures and ATM systems enabling to increase the airspace capacity to integrate the RPAS;
- **Global Interoperability** – RPAS integrated into the civil aviation operations;
- **Economical** – increase of GDP of the States using RPAS for commercial purposes and non-commercial purposes;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-RPAS *Remotely Piloted Aircraft*: Initial integration of RPA into non-segregated airspace applies to non segregated airspace and at aerodromes. Implementation will cover detect and avoid system introduction and all necessary security systems supporting the RPAS operations.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**
  Nil

- **PARS Phase III (expected implementation by November 2022)**

RPAS Operations

All the high density FIRs and high density international aerodromes should comply with ICAO Annexes by implementation of basic procedures for the RPAS operations in the non-segregated airspace and at aerodromes.

- **PASL Phase IV (expected implementation by November 2025)**

RPAS Operations

All the FIRs and all the aerodromes should comply with ICAO Annexes by implementation of basic procedures for the RPAS operations in the non-segregated airspace and at aerodromes.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2020; [ICAO Standardization Roadmap]
- Avionics availability → est. 20XX (? - Detect and avoid systems need);
- Ground systems availability → N/A;
- Procedures available → est. after 2020; [ICAO Standardization Roadmap]
- Operations approvals → est. after 2020. [ICAO Standardization Roadmap]

Priority of implementation:

1 (Safety constraints, if the procedures would not be developed and implemented the series safety hazards can appear in the foreseeable future)

7. Justification

The priority 1 of the implementation with was based on the safety and efficiency criteria. The implementation of the element requires advanced technology like Detect and Avoid System, therefore expected implementation by November 2022 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Design, develop and approve appropriate training for detect and avoid system;
- Identification of human factors, especially human-machine interactions;
- assured reliability of (C2 Command and Control) links in case of loss of control;
- RPAS communication failure case**,** Visual Line of Sight (VLOS) RPAS restrictions (height/altitude; proximity of airports);
- Wild life affected by RPAS;

Air Navigation Service Provider:

- Limited access to airspace by a new category of users, development of the procedures and ensure safety of the RPAS operations;
- Unauthorized takeover of the control of RPAS, ensure that no one can take over the control of RPA in act of violence to remote pilot – develop the security standards and procedures;

Civil Aviation Authority:

- Lack of separation standards (diversity in the mass and speed of the RPASes), development of appropriate standards and procedures;
- Airworthiness certification for RPA (diversity in the RPAS characteristic taken into account mass and performance), development the certification standards;
- Operator certification, development the operator certification standards;

Manufactures:

- Increased situational awareness, design, development of detect and avoid system;
- Minimum flight altitude of RPA due to latency in the response to ATCO instructions problem, design and develop the solution;

Regional:

- Implementation synchronization, good synchronization of airborne and ground deployment is required;
- Regional human performance and safety standards in the region are very worrying in perspective of mass use of drones in APAC Region, strong law against use of the small RPAS in the vicinity of has to be developed even before B1-RPAS implementation.

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Training Organizations, Remote Pilots, ATC

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. ICAO, Doc 10019 - Manual on RPAS (Doc 10019) / Initial guidance on airworthiness, operations, licensing, command and control, ROI-7-2014-2
3. detect and avoid, ATM and aerodromes
4. “ANSP Considerations for RPAS Operations”, CANSO 2014
5. “Integrating UAV in Airspace: challenges and efforts” Coordinates , January 2015

In preparation:

1. ICAO, Annex 1 / Licensing for remote pilots (2018)
2. ICAO, Annex 6 - Part II / Provisions for the carriage of flight recorders in UASs (2020)
3. ICAO, Annex 10 - Vol III / Standards for C2 link for RPAs (2018)
4. ICAO, Annex 10 - Vol II / Procedures for loss of C2 link with RPA (2018)
5. ICAO, Annex 10 - Vol IV / Develop technical provisions for RPA Detect and Avoid Capabilities (2020)

6. PANS-ATM (Doc 4444) / RPA separation Procedures and wake turbulence separation criteria

Seamless Element Analysis Summary
ASBU B1-RSEQ

1. Item Classification (Global or Regional)

Global

B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management

- the efficient management terminal operations.

2. Background

B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management

B0-RSEQ implemented AMAN/DMAN arrivals and departures management.

B1-RSEQ introduces integration of surface management with arrival/departure sequencing. It will improve runway management and increase airport performance and flight efficiency.

Required technology/services:

- **B0-RSEQ, B0-SURF, B0-ACDM**
- **AMAN/DMAN and TBFM** (Time Based Flow Management (TBFM) will enhance airspace efficiency by using the capabilities of the TBFM decision-support tool).
- **RNAV/RNP procedures**
- **ASDE-X** (Airport Surface Detection Equipment, Model X, or ASDE-X, is a runway-safety tool that enables air traffic controllers to detect potential runway conflicts by providing detailed coverage of movement on runways and taxiways/USA)**or A-SMGCS** (Advanced Surface Movement Guidance & Control System/Europe) **with SMAN** (Surface Manager) **function**

Facilitating technology/services:

- **B1-SWIM, B1-SURF, B1-APTA**

3. Key Performance Area (KPA)

- **Safety** – enhanced precision in surface movement tracking;
- **Access and equity** – N/A;
- **Efficiency** – predictability and accuracy of departure times, surface management decreases runway occupancy time, higher departure rate;
- **Airspace capacity** – time-based metering will optimize usage of terminal airspace and runway capacity;
- **Global Interoperability** – enhances global interoperability of the ATM systems;
- **Economical** – reduction in fuel burn;
- **Other** – reduction in environment impact.

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Recommended ASBU Upgrades

B1-RSEQ *Improved Airport Operations through Departure, Surface and Arrival Management*

This module will enable surface management, extended arrival metering, and departure/surface integration. Departure management automation will eliminate conflicts and provide smoother departure operations and streamlined synchronization with adjacent

ATC authority.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**

Aerodrome Operations

All high density international aerodromes should integrate arrival/departure management (AMAN/DMAN) with the surface management systems: A-SMGCS with SMAN or ASDE-X.

- **PARS Phase III (expected implementation by November 2022)**

Aerodrome Operations

All international aerodromes should integrate the arrival/departure management (AMAN/DMAN) with the surface management systems: A-SMGCS with SMAN or ASDE-X.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018; [ASBU Working Document]
- Avionics availability → est. 2018; [ASBU Working Document]
- Ground systems availability → est. 2018; [ASBU Working Document]
- Procedures available → est. 2018; [ASBU Working Document]
- Operations approvals → est. 2018; [ASBU Working Document]

Priority of implementation:

2 (Safety and efficiency constraints)

7. Justification

The priority 2 of the implementation with was based on the safety and efficiency criteria. The implementation of the element requires an advanced technology, but therefore expected implementation by 7 November 2019 should be considered. May be considered to be delayed.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Identification of human factors considerations in identifying processes and procedures; [ASBU]

Air Navigation Service Provider:

- Complexity of development and implementation of technology and procedures;
- Provide the systems and operational procedures necessary for time-based flow management (TBFM); [ASBU]

- Automation support is needed for air traffic management in airspace with high demand; [ASBU]
- Training on the required automation is needed for ATM personnel; [ASBU]

Civil Aviation Authority:

- Regulatory/standardization - updates required for surface management, surface CDM, and operations;
- Approval plans - to be determined;

Manufactures:

- N/A;

Regional:

- Low implementation of AMAN/DMAN may delay implementation of the B1-RSEQ

9. Stakeholders

ICAO, Space Agencies, CAAs, ANSPs, ATC, Airlines, AIS providers, ATC, Pilots

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU Working document
2. ICAO, Annex 10, Volume II
3. ICAO, Doc. 9705
4. ICAO, Doc 4444. Procedures for Air Navigation
5. ICAO Doc 997 (updates for RTA)

In preparation:

1. ICAO, Doc.4444, PANS-ATM / Phraseology and message set for interval management (2020)
2. ICAO, Doc. 8168, PANS-OPS Vol I / Operational procedures to include RTA (2018)
3. ICAO, Doc. 9994 - Airborne Surveillance Manual / Guidance to support interval management procedures (2020)
   ICAO, Doc 9997 - PBN OPS App Manual / Updated OPS approval Manual to include RTA (2018)

Seamless Element Analysis Summary
ASBU B1-SNET

1. Item Classification (Global or Regional)

Global

B1-SNET - Increased Effectiveness of Ground-based Safety Nets, introduction of the Approach Path Monitor (APM) safety net system - the efficient management of the approach path.

2. Background

B1-SNET - Increased Effectiveness of Ground-based Safety Nets, introduction of the Approach Path Monitor (APM)

Ground-based Safety Nets on Approach enhances safety by reducing the risk of controlled flight into terrain accidents on final approach through the use of an approach path monitor (APM). APM warns the controller of increased risk of controlled flight into terrain during the final approaches. The major benefit increase as traffic density and complexity increase.

Required technology/services:

- **APM**
- **ATM System**
- **SSR/Mode-S**
- **ADS-B Out**
- **WAM**

Facilitating technology/services:

- **eTOD** (electronic Terrain and Obstacle Database)

3. Key Performance Area (KPA)

- **Safety** – reduction of the number of major incidents [GANP]. The introduction of the APM (Approach Path Monitor) will result in the reduction in CFIT; the systematic presentation of deviations from the glide path to controllers, as provided by APM, is a major safety contribution;
- **Access and equity** –N/A;
- **Efficiency** – reduction of the false alerts will decrease the workload of the ATC, therefore will increase the efficiency;
- **Airspace capacity** – reduction of the false alerts will decrease the workload of the ATC, therefore will increase the airspace capacity;
- **Global Interoperability** – N/A;
- **Economical** – the business case for this element is entirely made around safety and the application of ALARP (as low as reasonably practicable) in risk management;[GANP]
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-SNET *Ground Based Safety Nets on Approach*: introduction of Approach Path Monitor (APM).

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**
  Nil
- **PARS Phase III (expected implementation by November 2022)**

Safety Nets

ATS surveillance systems should enable Approach Path Monitor APM.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018; [ICAO Standardization Roadmap]
- Avionics availability → est. 2016; [Eurocontrol (2)]
- Ground systems availability → est. 2020;
- Procedures available → est. 2018 [ICAO Standardization Roadmap]
- Operations approvals → est. 2018 first trials, 2021 generalized to all approaches [RO expertise]

Priority of implementation:

1 (Safety; Regional perf. dashboard B1-SNET mitigates CFIT and RS)

7. Justification

The priority 1 of the implementation with was based on the safety criteria, especially the "Regional perf. Dashboard". B1-SNET mitigates CFIT and RS. The implementation of the element requires advanced technology, which is not mature yet, therefore expected implementation by November 2022 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Trust of users ATCO of in the systems, before starting first operations, APM dataset shall be sufficiently trialed, air traffic controllers must receive training, aimed at creating an appropriate level of trust in the concerned safety net;

Air Navigation Service Provider:

- Nuisance and false alerts must be reduced to a minimum;
- Data safety analysis, all pertinent APM data shall be made available for off-line analysis; [Eurocontrol(3)]
- Different approach profiles, APM may need to take into account the type of flight, in order to apply appropriate parameters. Different parameters may be applied in the case of system degradation (e.g. unavailability of one or more radar stations);[Eurocontrol(3)]

Civil Aviation Authority:

- Harmonization within and between countries; [EUROCONTROL (3)]

Manufactures:

- The performance of APM will also be sensitive to the quality accuracy of the QNH data erroneous QNH values may produce too many nuisance alerts, insufficient warning, or both, [EUROCONTROL(3)] In the design of the ATM System \ and associated procedures, ensure correct data propagation of QNH (from MET service provider up to ATM and AIM systems); System may be implemented an automatic detection of large jumps in QNH as an additional barrier;

Regional:

- Lack of funds to purchase the APM / No ATM system, APM should be included in the baseline of the procurement to avoid specific upgrade later;
- Incorrect management of QNH;
- Cost effective use of resources, standardization of APM enables cost-effective use of resources and is in particular a critical success factor for smaller ANSP.[Eurocontrol]

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, ATM System Suppliers, Operators, Training Organizations, ATC, Pilots

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. Eurocontrol, “Safety Nets Ensuring Effectiveness”, May 2011
3. Eurocontrol, Specifications for Approach Path Monitor, May 2009
4. ICAO Annex 15, Chapter 10 - Terrain and Obstacle Data, Appendix 8 "Numerical requirements for Terrain and obstacle data
5. ICAO, Doc. 4444 PANS-ATM

In preparation:

1. ICAO, Doc #### - Manual for Ground-based Safety Nets / Contains guidance on STCA, MWAS and Area Proximity Warnings (2016)
2. ICAO, Doc #### - Guidance on Ground-Based Safety Nets / Update to include Approach Path Monitoring (2018)

Seamless Element Analysis Summary
ASBU B1-SURF

1. Item Classification (Global or Regional)

Global

B1-SURF - Enhanced Safety and Efficiency of Surface Operations – SURF - the efficient surface operations management.

2. Background

B1-SURF Enhanced Safety and Efficiency of Surface Operations

This module provides enhancements to surface situational awareness, including both cockpit and ground elements, in the interest of runway and taxiway safety, and surface movement efficiency. Cockpit improvements including the use of surface moving maps with traffic information (SURF). The module implements additional capabilities by taking advantage of cooperative surveillance.*

*Note: GANP assume the SURF-1A to be a part of the B0-SURF module)

Required technology/services:

- **B0-SURF**
- **ADS-B Out**
- **Airborne Traffic Situational Awareness system (ATSAW)**
- **Equipped ground vehicles**
- **Compatible runway/taxiway lighting**

Facilitating technology/services:

- **TIS-B (**Traffic Information Services-Broadcast, or TIS-B, is a component of the ADS-B technology that provides free traffic reporting services to aircraft equipped with ADS-B Receivers. TIS-B allows non-ADS-B transponder equipped aircraft that are tracked by radar to have their location and track information broadcast to ADS-B equipped aircraft).

3. Key Performance Area (KPA)

- **Safety** – enhanced situational awareness, detection of potentially unsafe situation on the ground, especially in case of conditional clearances and identifying another traffic on the maneuvering area; [GANP] Reduction of collisions on the ground;
- **Access and equity** – N/A;
- **Efficiency** – improvement of the taxi operations efficiency - reduction of taxi times;
- **Airspace capacity** – enhanced capacity due to greater efficiency of the ground operations;
- **Global Interoperability** – contributes to global interoperability;
- **Economical** – analysis based on safety benefits;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-SURF *Enhanced Safety and Efficiency of Surface Operations – SURF, SURF-1A and Enhanced Vision System (EVS).* Provides enhancements to surface situational awareness,

including both cockpit and ground elements, in the interest of runway and taxiway safety, and surface movement efficiency. Cockpit improvements including the use of surface moving maps with traffic information (SURF). The module implements additional capabilities by taking advantage of cooperative surveillance.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**

Aerodromes:

High density international (ICAO codes 3 and 4) aerodromes and aircraft operator operating from there aerodromes should implement the EVS and runway safety alerting logic (SURF-1A) in accordance with EUROCAE document EUROCAE/RTCA documents ED-159/DO-312/ ED-165.

- **PARS Phase III (expected implementation by November 2022)**

Nil

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018; [ASBU Standardization Roadmap]
- Avionics availability → est. 2019; [ASBU Working Document]
- Ground systems availability → N/A; [ASBU Working Document]
- Procedures available → est. 2015; [ASBU Working Document]
- Operations approvals → est. 2018. [ASBU Working Document]

Priority of implementation:

1 (Safety constraints related to Runway Safety (RS), but only the high for density aerodromes)

7. Justification

The priority 1 of the implementation with was based on the safety criteria. The implementation of the element requires advanced technology, which is mature already, therefore expected implementation by 7 November 2019 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Aircraft using this SURF capability will require ADS-B IN avionics compliant with DO-317A/ED194; [GANP]
- Surrounding aircraft will require a certified ADS-B OUT capability (or a TIS-B ground function) to provide targets for the capability; [GANP]
- Human factor: the flight crew must be aware that there can be surrounding aircraft that are not displayed on the traffic display for various reasons; [GANP]

- Human factor: flight crews should be trained to avoid excessive head-down time to the detriment of regular out the window scans; [GANP]

Air Navigation Service Provider:

- Surrounding aircraft without ADS-B OUT capability, emitting non-qualified data, or out of the display volume, and traffic display de-cluttering for traffic on ground; [GANP]

Civil Aviation Authority:

- Approvals;

Manufactures:

- Human-machine interaction consideration;

Regional:

- Political constraints within the Asia/Pacific Region that reduce the potential for effective coordination.

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Airports, Operators, ATC, Pilots, Handling Services

10. References

1. ICAO Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. ED-194/DO-317A
3. ICAO, Annex 6 - Part I, II,II/ SARPs to support low visibility operations
4. ICAO. Doc 9365 - Manual of All WX OPS / Guidance on provisions to support low visibility operations
5. Aerodrome map standards developed by RTCA SC-217/Eurocae WG-44
6. PANS-OPS (operational use of SURF capability)
7. FAA Advisory Circular AC120-28D Criteria for Approval of Category III Weather Minima for Take-off, Landing, and Rollout
8. FAA Advisory Circular AC120-57A Surface Movement Guidance and Control System

In Preparation:

1. ICAO, Annex 6 - Part I / Technology for runway safety (on- board equipment) provisions (2016)
2. ICAO, Annex 6 - Part I / Technology for runway safety (on- board equipment) provisions (2018)
3. ICAO, Annex 6 - Part II / SARPS to address lighting systems considerations for low visibility operations (2018)
4. ICAO, Annex 10 - Vol I / Develop provisions for ARAIM (2018)
5. ICAO, Annex 10 - Vol IV / Provisions on the situational awareness on the airport surface AND provisions on low-cost users of uncontrolled airspace and ground vehicles (2018).

Seamless Element Analysis Summary
ASBU B1-SWIM

1. Item Classification (Global or Regional)

Global

B1-SWIM Performance Improvement through the application of System-Wide Information Management (SWIM) – the efficient flight data sharing and management.

2. Background

System-Wide Information Management (SWIM)

Implementation of system-wide information management (SWIM) services (applications and infrastructure) creating the aviation intranet based on standard data models, and internet-based protocols to maximize interoperability.

Required technology/services:

- **B0-DATM, B1-DATM**
- **Migrate to IP-based regional network (APAC: CRV)**
- **Identify Publishers and Subscribers (ATFM/ATM/AIM/MET service providers) and contract appropriate data and quality in LOA/contracts**
- **Upgrade to SWIM compliant systems (Flight Object-enabled ATM system, AIXM capable AIM system**
- **Establish/update IT security policy**

Facilitating technology/services:

- **B0-FICE (AIDC), B0-AMET, B0-DATM**

3. Key Performance Area (KPA)

- **Safety** – SWIM will help to improve aviation safety through better and more efficient decision making. Pilots, controllers and dispatchers will have the same information in near real time and should be able to react a lot earlier and in a more efficient manner;
- **Access and equity** – easier access to the operational data for all airspace users;
- **Efficiency** – using better information allows operators and service providers to plan and execute better trajectories and reduce passenger delays;
- **Airspace capacity** – increased airspace capacity due to more efficient flow of the aircrafts, reduced flight congestions;
- **Global Interoperability** – harmonized format and definition allow greater integration as per the Global Air Traffic management Operational Concept ;
- **Economical** – further reduction of operational costs; all information can be managed consistently across the network, limiting customized developments, flexibility to adapt to state-of-the-art industrial products and making use of scale economies;
- **Other** – fuel is burnt and resources used more efficiently with positive effects on the environment; further reduction of paper usage more cost-efficient flights as the most up to date data is available to all stakeholders in the ATM system.

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-SWIM *Performance Improvement through the Application of System-Wide Information Management (SWIM)*. The System Wide Information Management (SWIM) will complement human-to-human with machine-to-machine communication, and improve data distribution and accessibility in terms of quality of the data exchanged. SWIM is a key enabler to facilitate the Global ATM Operational Concept is a net-centric operation, where the air traffic management (ATM) network is considered as a series of nodes, including the aircraft, providing or using information. The scope extends to all information that is of potential interest to ATM including: trajectories, surveillance data, aeronautical information of all types, meteorological information etc.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**
  Nil
- **PASL Phase III (expected implementation by November 2022)**

ATM Systems

- The System Wide Information Management (SWIM) components: Flight Object-enabled ATM; AIXM capable and AIM systems, should be implemented in the high density FIRs and High density international aerodromes.
- **PASL Phase IV (expected implementation by November 2025)**

ATM Systems

The System Wide Information Management (SWIM) components: Flight Object-enabled ATM; AIXM capable and AIM systems, should be implemented in all FIRs and international aerodromes.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018; [ICAO Standardization Roadmap]
- Avionics availability → N/A;
- Ground systems availability → est. 2018; [ASBU]
- Procedures available → est. 2018; [ICAO Standardization Roadmap]
- Operations approvals → est. 2018. [ICAO Standardization Roadmap]

Priority of implementation:

1 (Related to global interoperability and safety constraint s)

7. Justification

The priority 1 of the implementation with was based on the safety and efficiency criteria. The implementation of the element requires advanced technology, which is not mature yet, therefore expected implementation by November 2022 should be highly considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- New procedures regarding access to and delivery of information;[ASBU]
- Human factor/human-machine interface for the automation aspects;[ASBU]
- Smooth transition from current operations (AFTN/AMHS into SWIM);

Air Navigation Service Provider:

- Training requirements development;[ASBU]
- Sensitive data/message distribution;
- Update of LOAs;
- Need to know of other type of messages not generated by ANSPs or airline, such as International Search and Rescue, administrative message coordination, such as maintenance notice, unknown messages, etc; [ACP WG I/17 - IP/01]
- Develop and execute complex use cases;
- The validation of systems and processes;
- Unknown/corrupted data/message coordination;

Civil Aviation Authority:

- New standards and guidance needed to address all formatting/template;[ASBU]
- Need for to follow SWIM global interoperability framework;
- To establish messaging standards, governance and interoperability business rules;

Manufactures:

- Ensure the human factor issues while designing the system;

Regional:

- Poor cooperation of States in Asia/Pacific Region may delay the SWIM implementation;
- Ensure the required quality and timeliness in a secure environment in terms of human performance.

9. Stakeholders

ICAO, Space Agencies, CAAs, ANSPs, ATC, Airlines, AIS providers, ATC, Pilots, MET Service Providers, Handling Services

10. References

1. Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU Working Document
2. Annex 15 — Aeronautical Information Services

3. ICAO Doc. 8126, Aeronautical Information Services Manual
4. ICAO DRAFT Doc. 10039, Manual on System Wide Information Management (SWIM) Concept
5. ICAO Doc. 9882 Manual on Air Traffic Management System Requirements
6. "FIXM - Flight Information Exchange Model," 2012. [Online]. Available: http://www.fixm.aero/
7. "WXXM - Weather Information Exchange Model," FAA/Eurocontrol, 2011. [Online]. Available: http://www.wxxm.aero
8. ICAO, Circular 335 — Air Traffic Management Service Delivery Management (ATM SDM) Description

In preparation:

1. Annex 10 - Vol III / Provisions to support SWIM (2018)
2. ICAO, Annex 11 / Provisions on making use of SWIM (2018)
3. ICAO, Annex 15 / Provisions on the use and support of SWIM (2018)
4. ICAO, PANS-ATM (Doc 4444) / Requirements for flight and flow information (2018)
5. ICAO, Doc 10039 - Manual on the SWIM Concept / First Edition (2016)/Explains the general SWIM concept, global interoperability framework, the transition to SWIM
6. ICAO, Doc 10039 - Manual on the SWIM Concept / Second Edition (2018) Explains the general SWIM concept, global interoperability framework, the transition to SWIM PANS-AIM will address all information formats and templates referenced in Annex 15 (2016)

1. Item Classification (Global or Regional)

Global

B1-TBO - Improved Traffic synchronization and Initial Trajectory-Based Operation

- efficient flight trajectory and ground operations management.

2. Background

B1-TBO - Improved Traffic synchronization and Initial Trajectory-Based Operation

To improve the synchronization of traffic flows at en-route merging points and to optimize the approach sequence through the use of 4DTRAD (Initial 4D operations) capability and airport applications, e.g., D-TAXI. This module is a step towards the goal to introduce trajectory-based operations that uses the capabilities of aircraft flight management systems to optimize aircraft flight trajectories in four dimensions including time.

Required technology/services:

- **B0-TBO, B0-RSEQ, B1-FICE, B1-SWIM**
- **FMS/CPDLC**
- **New ADS-C and data link functionality**
- **AMAN**
- **4DTRAD** (4DTRAD requires the availability of sophisticated air ground data exchange that include the use of new ADS-C and data link functionality beyond current capabilities and performance requirements)
- **Data link operational terminal information service (D-OTIS)** (meteorological and operational flight information and NOTAMs of the departure and destination aerodrome).
- **Departure clearance (DCL), Data link TAXI (D-TAXI)**

Facilitating technology/services:

- **Enhanced ground-ground data interchange**

3. Key Performance Area (KPA)

- **Safety** – safety at/around airports by a reduction of the misinterpretations and errors in the interpretation of the complex departure and taxi clearances; [ASBU Working Document]
- **Access and equity** –N/A;
- **Efficiency** – reduction of inefficient ATC tactical interventions through early planning of traffic en-route and in the arrival management phase;[ASBU Working Document]
- **Airspace capacity** – positively affected because of the reduction of workload associated to the establishment of the sequence close to the convergence point and related tactical interventions; [ASBU Working Document]
- **Global Interoperability** – increased predictability of the ATM system for all stakeholders through greater strategic management of traffic flow between and within FIRs en-route and terminal airspace using the aircraft RTA capability or speed control to manage a ground CTA; [ASBU Working Document]
- **Economical** – aircraft will be able to plan better and adhere more accurately to arrival schedules leading to better planning for airlines due to increased flight predictability and fuel efficiency; [ASBU Working Document]
- **Other** – environmentally friendly trajectories.

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-TBO *Improved Traffic synchronization and Initial Trajectory-Based Operation* Improves the synchronization of traffic flows at en-route merging points and to optimize the approach sequence through the use of 4DTRAD capability and airport applications, e.g. DCL, D-TAXI. In addition, introduction of Datalink Departure Clearance (DCL) will enhance the efficiency of the ATC-Pilot pre-departure communication, what has direct impact on the airport capacity.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**

All the high density FIRs should implement data-link Departure Clearance (DCL) compliant with EUROCAE WG78/RTCA SC 214 standards.

- **PARS Phase III (expected implementation by November 2022)**

En-route and terminal operations

All the high density FIRs should implement D-TAXI, D-OTIS and new ADS-C and data compliant with the EUROCAE WG78/RTCA SC 214 standards.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018; [ASBU Working Document]
- Avionics availability → est. 2016; [ASBU Working Document]
- Ground systems availability → est. 2016; [ASBU Working Document]
- Procedures available → est. 2018; [ASBU Working Document]
- Operations approvals → est. 2018; [ASBU Working Document]

Priority of implementation:

1 (Priority related to B0-TBO, one of the 10 Asia/Pacific Regional Priorities Adopted by APANPIRG/25, 2014)

7. Justification

The priority 1 of the implementation with was based on the safety and efficiency criteria. The implementation of the element requires advanced technology, therefore expected implementation of the DCL by 7 November 2019 should be considered. Other elements of B1-TBO are planned to be introduced by 2022.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Automation support is needed for both the pilot and the controller which therefore will have to be trained to the new environment;

Air Navigation Service Provider:

- The identification of human factors considerations is an important enabler in identifying processes and procedures;

Civil Aviation Authority:

- New systems certification and approvals;

Manufactures:

- Human-machine interaction has to be taken into account during design process;

Regional:

- 4D trajectory implementation in Asia/Pacific Region may be delayed to

9. Stakeholders

ICAO, ANSPs, CAAs, Manufacturers, Operators, Training Organizations, Pilots, ATC

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU
2. ICAO Doc. 9694, Manual of Air Traffic Services Data Link Applications
3. ICAO, Doc, Global Operational Data Link Document (GOLD) Ed 2
4. EUROCAE WG78/RTCA SC 214 standards
5. EUROCAE ED-100A/RTCA DO-258A, Interoperability requirements for ATS applications using ARINC 622 data communications
6. EUROCAE ED-122/RTCA DO-306, Safety and performance standard for air traffic data link services in Oceanic and remote airspace (Oceanic SPR Standard)
7. EUROCAE ED-154/RTCA DO-305, Future Air Navigation System 1/A – Aeronautical telecommunication network interoperability standard (FANS 1/A – ATN B1 Interop Standard)
8. EUROCAE WG-78/RTCA SC-214 Safety and performance requirements and interoperability requirements
9. EUROCONTROL, 4DTRAD: Initial 4D – 4D Trajectory Data Link (4DTRAD) Concept of Operations, December 2008

In preparation:

1. ICAO, Annex 2 / TBO requirements (2018)
2. ICAO, Annex 6 - Part I / Standards on RTA for commercial operations (2018)
3. ICAO, Doc.4444 PANS-ATM / ATM procedures for RTA/ TBO requirements (2018)
4. ICAO, Doc. 8168 PANS-OPS Vol I / Flight Procedures on RTA (2018)
5. ICAO, Doc. 9613 - PBN Manual / Navigation Specifications in RTA (2018)
6. ICAO, Doc. 9997 - PBN OPS App Manual / Updated OPS approval Manual to include RTA
7. ICAO, Doc 9997 - PBN OPS App Manual / Updated OPS approval Manual to include RTA (2018)
8. ICAO, Doc. 9869 - Manual RCP / Guidance on performance-based communication and surveillance (2016)

1. Item Classification (Global or Regional)

Global

B1-WAKE Increased Runway Throughput through Dynamic Wake Turbulence Separation
- the efficient prediction of turbulence occurrence.

2. Background

B1-WAKE Increased Runway Throughput through Dynamic Wake Turbulence Separation
The module introduces the improved throughput on departure and arrival runways through the dynamic management of wake turbulence separation (minima based on the real-time identification of wake turbulence hazards. New turbulence procedures and separation minima that will assure the safety towards wake turbulence criteria of innovations using the leader/follow pair-wise static set of standards.

Required technology:

- **ADS-B**
- **Dynamic Pair Wise Separations (D-PWS) Dynamic Pair Wise Separations.** **(**Developed as part of the European Wake Turbulence Categorization and Separation Minima, RECAT-3 allows for the dynamic adjustment of aircraft spacing, using wake turbulence measurement, real-time weather conditions and data from air and ground systems)
- **Wake Turbulence Mitigation for Departures (WTMD) System**
- **X-band radar**
- **Lidar scanner**
- **Display to the air traffic controller the required wake separation between aircraft arriving on the parallel runways**.

Facilitating technology:

- **SWIM**

3. Key Performance Area (KPA)

- **Safety** – thanks to wake detection through airborne or ground systems, the risk of wake turbulence encounters is reduced to almost zero. Flight crews have access to wake turbulence detection systems, they have heightened awareness of surrounding wake turbulence events; [Eurocontrol]
- **Access and equity** – N/A;
- **Efficiency** – dynamic scheduling. ANSPs have the choice of optimizing the arrival/departure schedule via pairing number of unstable approaches. Changes brought about by this element will enable more accurate crosswind prediction. Real-time aircraft and weather data-sharing allows tactical self-adjustments in spacing and evasion maneuvers to be made to avoid wake vortex encounters; [ASBU Working Document/Eurocontrol]
- **Airspace capacity** – better wind information around the aerodrome to enact reduced wake mitigation measures in a timely manner. Aerodrome capacity and arrival rates will increase as the result of reduced wake mitigation measures. [ASBU Working Document] ;
- **Global Interoperability** – N/A;
- **Economical** – N/A;
- **Other** –N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical ASBU Upgrades

B1-WAKE *Increased Runway Throughput through Dynamic Wake Turbulence Separation.* The module introduces the Dynamic Pair Wise Separations (D-PWS) / RECAT-3 technology and new turbulence procedures and separation minima that will assure the safety towards wake turbulence criteria of innovations using the leader/follow pair-wise static set of standards.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PARS Phase II (expected implementation by 7 November 2019)**
  Nil
- **PARS Phase III (expected implementation by November 2022)**

Terminal operations

Where economically practicable, all high density international aerodromes should implement Dynamic Pair Wise Separations (D-PWS) / RECAT-3, Wake Turbulence Mitigation for Departures (WTMD) System.

6. Implementation Process

Global Readiness:

- Standards readiness → est. 2018; [ASBU Working Document]
- Avionics availability → N/A; [ASBU Working Document]
- Ground systems availability → est. 2018; [ASBU Working Document]
- Procedures available → est. 2018; [ASBU Working Document]
- Operations approvals → est. 2018; [ASBU Working Document]

***** Initial D-PWS is being developed for SESAR 1 (2015/2016) and further developments will be made in SESAR 2020 Wave 2 (2018/2020).[Eurocontrol]

Priority of implementation:

3 (and efficiency constraints)

7. Justification

The priority 3 of the implementation with was based on the efficiency criteria. The implementation of the element requires advanced technology, which is not mature yet, therefore expected implementation by November 2020 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- The human-machine interface for the automation aspects of this performance improvement;

Air Navigation Service Provider:

- Training will be required for controllers in the use of new pair-wise static matrix of aircraft type wake turbulence separation pairings and decision support tools;

Civil Aviation Authority:

- Regulatory/standardization, approval plans;

Manufactures:

- N/A;

Regional:

- Lack of implementation of the B0-WAKE will delay the implementation of the B1-WAKE.

9. Stakeholders

ICAO, CAAs, ANSPs, ATC, Airlines, AIS providers, ATC, Pilots, MET Service Providers

10. References

1. ICAO, Doc. 9854, Doc. 9750(GANP), Doc.1004 (GASP), ASBU

In preparation:

1. ICAO, Doc. 4444 PANS-ATM / Provisions on improved Wake Turbulence Criteria (2018)
2. ICAO, Doc. 4444 PANS-ATM / Provisions for wake turbulence separation Chapter 5 + 8 - RECAT Phase 1 - 6 categories (2016)

Seamless Element Analysis Summary
Launch/Space Re-entry Activity Management

1. Item Classification (Global or Regional)

Regional

Launch/Space re-entry activity management - the efficient management of rocket/missile launches and space re-entry activity to minimize disruption to other airspace users.

2. Background

Launch/Space re-entry activity management

Almost monthly rocket launches are taking place in the Asia/Pacific Region. To facilitate these launches and space re-entry activities, large portions of airspace are affected. Poor coordination impacts airspace users by the costs of additional airborne time and delays, which can exceed USD250,000 for each launch, according to IATA. In addition, there were potential safety issues related to these activities if not properly considered and coordinated and inevitably, an adverse environmental impact.

Facilitating technology/services:

- **B0 D-ATM (AIS - AIM Transition)**

3. Key Performance Area (KPA)

- **Safety** – enhanced safety by increased situational awareness of all the stakeholders;
- **Access and equity** – enhanced affected airspace accessibility for users, due to accurate time window and optimized size of designated airspace for the rocket launch/space re-entry activity;
- **Efficiency** – reduction of the airline's additional airborne time and delays;
- **Airspace capacity** – increased capacity, optimized use of airspace resources;
- **Global Interoperability** – N/A;
- **Economical** – minimized cost of delays for flights affected by the activity, probability of the compensation for airlines per each commercial launch;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical Regional Upgrades

Launch/Space re-entry activity management: *the efficient management of rocket/missile launch and space re-entry activity to minimize disruption to other airspace users.* The coordination of all the stakeholders will be enhanced by: coordination agreements between the State civil aviation authority and the launch/re-entry agency concerned; strategic coordination conducted between the State civil aviation authority prior the activity and tactical management of the launch/re-entry activity.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

<u>En-route</u>

All States with Agencies that conduct ballistic launch or space re-entry activities should ensure:

- the development of written coordination agreements between the State civil aviation authority and the launch/re-entry agency concerned;
- that strategic coordination is conducted between the State civil aviation authority and any States affected by the launch/re-entry activity at least 14 days prior to the proposed activity, providing notice of at least:
  - three days for the defined launch window; and
  - 24 hours for the actual planned launch timing;
- that consideration of affected airspace users and ANSPs is made after consultation, so that the size of the airspace affected is minimized and the launch window is optimized for the least possible disruption to other users ; and
- that communication is established with affected ANSPs to provide accurate and timely information on the launch/re-entry activity to manage tactical responses (for example, emergencies and activity completion).
- **PASL Phase III (expected implementation by November 2022)**

Nil

6. Implementation Process

Global Readiness:

- Standards readiness → est.**?** (No ICAO standards exist)
- Avionics availability → N/A;
- Ground systems availability → N/A;
- Procedures available → N/A;
- Operations approvals → N/A;

Priority of implementation:

1 (Safety and efficiency constraints affecting the air operators in the Asia/Pacific Region)

7. Justification

The priority 1 of the implementation with was based on the safety and efficiency criteria. The implementation of the element does not require advanced technology, therefore expected implementation by 7 November 2019 should be considered. The ballistic launch and space re-entry activities cause major problems for airspace users in Asia/Pacific Region, creating potential safety issues and delays related to poor coordination of these activities.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Coordination with the other affected ANSPs;

Air Navigation Service Provider:

- Poor civil-military coordination constraints related to some States;

Civil Aviation Authority:

- Coordination agreement with the ANSPs and military authority;

Manufactures:

- N/A;

Regional:

- Political constraints within the Asia/Pacific Region that reduce the potential for effective coordination

9. Stakeholders

ICAO, Space Agencies, CAAs, ANSPs, ATC, Airlines, AIS providers, ATC, Pilots

10. References

1. Annex 11 (paragraph 2.18)
2. Annex 15 (paragraph 5.1.1.4)
3. ICAO Circular 330 Civil/Military Cooperation in Air Traffic Management
4. Asia/Pacific Seamless ATM Plan

Seamless Element Analysis Summary
Voice communications over IP between ATS units

1. Item Classification (Global or Regional)

Regional

Voice communications over IP between ATS units (VoIP) - the introduction of Voice over IP (VoIP) for voice communications between ATS units.

2. Background

Voice communications over IP between ATS units (VoIP)

Most ATM voice communication systems are currently using analog technology; however, in recent years voice and data have been converging where all communications are switched and transmitted together using a common networking infrastructure. As a consequence, it is economically beneficial for the future ATM communication between ATS units to migrate to a common infrastructure for voice and data services. In addition, ATM services may reap benefits from an enhanced connectivity (potentially all ATS units, airport operators or military units connected to CRV will be reachable, subject to security policies) and more integration with the ATM system (HMI) at an improved cost over the current systems.

Required technology/services:

- IP network compliant with safety and performance requirements;

Facilitating technology/services:

- IPV6 protocol;
- Analog/digital VoIP converter where Analog Voice is implemented;

3. Key Performance Area (KPA)

- **Safety** – N/A;
- **Access and equity** – N/A;
- **Efficiency** – potentially all ATS units connected to CRV will be reachable ;
- **Airspace capacity** – N/A;
- **Global Interoperability** – enhanced global interoperability of voice facilities through a common standard;
- **Economical** – cost of ground-to-ground voice communications potentially reduced by 20%;
- **Other** – N/A;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Recommended Regional Upgrades

Voice over Internet Protocol (VoIP):

The VoIP technology is planned to be implemented by 2022 to replace the current analogical technology. States may choose to upgrade their ATM voice communication systems in compliance with the EUROCAE ED-137 standards before migrating to VoIP, or implement Analog/digital VoIP converters meanwhile. In addition, ANSPs should perform the safety case as Voice communications are a critical service.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

<u>En route</u>

In preparation of phase III, all States should upgrade their ATM voice communication systems or implement analog/digital VoIP converters in compliance with the EUROCAE ED-137 standards (interoperability standards for VOIP ATM components).

- **PASL Phase III (expected implementation by November 2022)**

<u>En route</u>

All States should implement the VoIP communications between ATS units where economically beneficial, in compliance with the EUROCAE-ED-137B standard (interoperability standards for VOIP ATM components).

6. Implementation Process

Global Readiness:

- Standards readiness → available;
- Avionics availability → N/A;
- Ground systems availability → available;
- Procedures available → N/A;
- Operations approvals → N/A.

Priority of implementation:

2 (Enabler for the B0-FICE, B0-DATM, B1-FICE, B1-DATM, B1-SWIM, B1-AMET)

7. Justification

The VoIP technology is newly used in aviation technology currently being implemented in Europe and US. Considering that many Asia/Pacific States do not use the digital communication yet, which is an enabler for the VoIP, the expected implementation date of X November 2022 should be considered.

8. Challenges/Barriers

Global:

Airlines and Airports:

- N/A;

Air Navigation Service Provider:

- VoIP network system may cause path length variation or packet losses, therefore, depending on the performance of the underlying infrastructure, an issue in communication quality due to "data delays" or "jitters" may arise;
- Essential to ensure the operating conditions to maintain the service quality equivalent to the current system;

- Perform the local cost benefit analysis the business;
- Perform the safety case;
- Consider proper integration/interface between ATM systems and VCS
- Allocate and validate performance requirements ;
- Develop operating procedures;
- Train ATCOs and engineering staff (VCS).
- Coordinate the migration to VoIP with other States; consider LOA (for quality of service and procedures)

Civil Aviation Authority:

- Safety oversight of the changes;

Manufactures:

- Ensure the security of the systems;

Regional:

- Many States in Asia/Pacific Region still use the analogical ground-ground communication; there is a need of transition to the digital technology.

9. Stakeholders

ICAO, CAAs, ANSPs, ATC, VCS Manufacturers

10. References

1. Annex 10
2. ICAO Doc. 9896 Manual for the ATN using IPS standards and Protocols
3. ICAO Doc. 9880 Manual on detailed technical specifications for the Aeronautical Telecommunication Network (ATN) using the ISO/OSI standards and protocols
4. EUROCAE VoIP ATM System Operational and Technical Requirements (ED136)
5. EUROCAE Interoperability Standards for VoIP ATM Components (ED137B)
6. EUROCAE Network Requirements and Performances for VoIP ATM Systems (ED138)

Seamless Element Analysis Summary

Common aeRonautical Virtual private network

1. Item Classification (Global or Regional)

Regional

Common aeRonautical Virtual private network (CRV)

2. Background

Common aeRonautical Virtual private network (CRV)

The implementation of the ATN should take into account the need for cost-effective evolution in terms of network capacity, requirements and time-frame and allow for a progressive transition from existing communication networks and services to a uniform, harmonised and integrated communications infrastructure, capable of supporting the implementation of future aeronautical services such as Flight and Flow Information in a Collaborative Environment (F-FICE), System-Wide Information Management (SWIM) applications, etc.
States/Administrations of APAC region have developed the response named CRV through the CRV Task Force, the Common aeRonautical Virtual private network.

Services carried by CRV network:

- voice ATM communications
- AMHS data
- ATS surveillance data
- AIDC data
- AIM data
- ATFM data
- SWIM data
- Other.

Required technology/services:

- **CRV procurement**

Facilitating technology/services:

- **Network Address Translation (NAT)**

3. Key Performance Area (KPA)

- **Safety** – enhanced connectivity will contribute to the increased safety;
- **Access and equity** –airlines can connect for B2-FICE and SWIM - additional connectivity beyond the initial AFTN-like routing network, including both regional and inter-regional connectivity;
- **Efficiency** – rationalization of network services with a common Network Operating Center, escalation procedures and central customer services
- **Airspace capacity** – N/A;
- **Global Interoperability** – interoperability with other regional networks: Europe's Pan-European Network Service, (PENS), FAA's Telecommunication Infrastructure (FTI), South America's REDDIG and MEVA;
- **Economical** – reduced telecommunication costs; reduced procurement time and effort, as each ANSP will require only the initial connection to the CRV;
- **Other** – enhance information security;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical Regional Upgrades

Common aeRonautical Virtual private network (CRV)

The objective of the CRV is to offer a safe, secure, robust and cost effective telecommunications transport service to the States. The scope of the CRV is to provide a cross-border cost-effective telecommunications network for States in the ICAO Asia/Pacific Region.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

Common network services

All ACC serving high density FIR connected to CRV (Common aeRonautical Virtual private network) and CRV interconnected with EUR, MID and AFI regions.

- **PASL Phase III (expected implementation by November 2022)**

Common network services

All ACC are connected to CRV, migration of AMHS applications onto CRV is completed.

6. Implementation Process

Global Readiness:

- Standards readiness → available (Except IPv6 address block, still to be allocated)
- Avionics availability → N/A;
- Ground systems availability → available;
- Procedures available → N/A;
- Operations approvals → N/A.

Priority of implementation:

1 (Technology enabling other priorities 1 areas: for SWIM and FF-ICE)

7. Justification

The expected implementation by 7 November 2019 is targeted due to the urgent need of the Region and its position as enabler for SWIM and FF-ICE.

8. Challenges/Barriers

Regional:

Airlines and Airports, Air Navigation Service Providers, Military:
Each CRV user should:

- take responsibility for its own IT security;
  Perform the safety case, including contingency steps;
- Allocate and validate performance requirements;
- Develop operating procedures and train engineering staff
- Migrate its applications as promptly as possible to allow mutual benefits of all users, in accordance with the CRV implementation plan;

Civil Aviation Authorities:

- Safety oversight of the changes;

Manufacturers:

- CRV selected contractor must meet the requirements

9. Stakeholders

ICAO, CAAs, Manufacturers, ANSPs, ATC, AIS providers

10. References

1. Annex 10
2. ICAO Doc.9896 ATN Manual for The ATN Using Internet Protocol Suite (IPS)
3. ICAO Doc. 9880 Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols
4. ICAO Doc.7030 Supplementary Provisions
5. ICAO Doc.9673 Regional Air Navigation Plan
6. CRV documentation (CONOPS, preliminary safety assessment, cost benefit analysis, tender package, implementation plan)

Seamless Element Analysis Summary
B1-SAR

1. Item Classification (Global or Regional)

Regional

B1-SAR Improved Safety and Efficiency through the initial application of Regional SAR Initiatives

2. Background

B1-SAR Improved Safety and Efficiency through the initial application of Regional SAR Initiatives

Increases in both aviation and maritime traffic throughout the Asia/Pacific region places additional importance on the ability for States to be adequately prepared for potentially increased demand for aeronautical and maritime SAR services. It is essential for States to cooperate, collaborate and in some cases assist with resources to neighbouring and sub-regional RCCs. Considering that many of the Asia/Pacific States have the challenging responsibility for providing a SAR service over vast and remote areas, including three of the world's five oceans, the importance for States with oceanic SAR responsibility to cooperate, collaborate and share resources with their neighbouring and regional/sub-regional RCCs is essential. In addition, The B1-SAR is an enabler for implementation of the Global Aeronautical Distress and Safety System (GADSS).

B1-SAR will consists of the following elements:

- SAR Regulatory and Coordination Mechanisms
- SAR Facilities and Assets
- SAR Information
- SAR Improvement

Required technology/services:

- **406 MHz Emergency Locator Transmitters (ELTs)**
- **Cospas-Sarsat system**
- **Aircraft tracking system (under development)**
- **Rescue Coordination Centres (RCCs)**
- **Joint Rescue Coordination Centres**
- **SAR Library**
- **Quality Assurance (QA) programmes**

Facilitating technology/services:

- **Galileo/SAR Return Link Service (RLS)**
- **Next generation of 406 MHz distress beacons, including ELTs**

3. Key Performance Area (KPA)

- **Safety** – quicker response times to safety of life events, with better information providing SAR Mission Coordinators the opportunity to better match the SRU with the emergency requirement. Improved civil/military;
- **Access and equity** –N/A;
- **Efficiency** – enhanced sharing of SRUs and information leading to more efficient responses that involve less time searching;
- **Airspace capacity** – N/A;
- **Global Interoperability** – enabler for implementation of the Global Aeronautical Distress and Safety System (GADSS);
- **Economical** –N/A;
- **Other** – reduced emissions as a result of reduced fuel burn of airborne, maritime and land based SRUs;

4. Proposed text for the Asia/Pacific Seamless ATM Plan V 2.0 chapter 5

Critical Regional Upgrades

B1-SAR Improved Safety and Efficiency through the initial application of Regional SAR Initiatives. B0-SAR Enhanced Search and Rescue provisions. This module develops critical Search and Rescue features like: State SAR Plan, international SAR agreements, SAR exercise (SAREX), Rescue Coordination Centers (RCCs), centralized SAR information source, SAR Quality Assurance (QA) programmes.

5. Proposed text for the Asia/Pacific Seamless ATM Pan V 2.0 chapter 7

- **PASL Phase II (expected implementation by 7 November 2019)**

Search and Rescue

All States should ensure appropriate SAR capability by complying with the provisions of the Asia/Pacific SAR Plan.

- **PASL Phase III (expected implementation by November 2022)**
  Nil

6. Implementation Process

Global Readiness:

- Standards readiness → available;
- Avionics availability → N/A;
- Ground systems availability → available;
- Procedures available → available;
- Operations approvals → N/A.

Priority of implementation:

1 (The safety and urgency constraint)

7. Justification

The priority 1 of the implementation with was based on the safety and urgency criteria. The deficiencies with urgent mitigation need in the Asia/Pacific SAR service were identified.

8. Challenges/Barriers

Global:

Airlines and Airports:

- Equip the aircrafts with the next generation of 406 MHz distress beacons, including ELTs;
- Establish aerodrome emergency plans that provide for co-operation and co-ordination with RCCs;

Air Navigation Service Provider:

- Provide adequate ATC resources (either an ATS supervisor or other staff) that can provide relief within Area Control Centres (ACCs) to allow timely SAR alerts and information to RCCs;
- Establish effective cooperation agreements between all the RCCs and JRCCs;

State and Civil Aviation Authority:

- Establish or enhance the legal foundation for a State SAR organization and its framework, resources, policies and procedures compliant with the *Asia/Pacific SAR Plan*;
- Provide sufficient and highly qualified SAR staffing;
- Conduct studies to align, as far as practicable, aeronautical and maritime Search and Rescue Regions (SRRs); and SRRs and Flight Information Regions (FIRs);
- Provide all necessary resources;
- Develop of State SAR Plan;
- All States should conduct regular SAREX (Search and Rescue Exercises)

Manufactures:

- N/A

Regional:

- Absence of established appropriate legal framework designating, recognizing, supporting and giving authority to national SAR authorities, RCCs and SMCs;
- Inadequate funding and equipping of SAR authorities and in particular, resourcing of RCCs;
- Absence of an appropriate SAR organizational framework;
- Absence of a national SAR committee;
- Lack of clarity of responsibilities for each component of the SAR system;
- Absence of bilateral/multi-lateral/international SAR Agreements;
- Inadequate civil/military cooperation; and

- Complacency about, or lack of recognition of, the importance or priority given to SAR.
- Lack of resources to establish appropriate facilities and SRUs,
- Cospas-Sarsat facilities or sharing access with other States;
- Lack of local, State and regional agreements between agencies to facilitate sharing of SAR resources, including SRUs;
- Lack of Civil/Military SAR cooperation, including use of military facilities and SRUs;
- Lack of regional and local training of RCC staff and SRUs.
- Lack of QA and improvement plans and procedures;
- Lack of established information support processes;

9. Stakeholders

ICAO, States, CAAs, ANSPs, RCCs, JRCCs, ATC, Pilots

10. References

1. Annex 12
2. Asia Pacific Search and Rescue (SAR) Plan
3. ICAO Doc.7300
4. ICAO Doc.9672 Regional Air Navigation Plan (RANP)
5. International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual