ICAO GANP PORTAL

ASBU ELEMENTS

ACAS | AMET | ASUR | COMS | APTA | COMI | CSEP | ACDM | DAIM | FICE | FRTO | GADS | B1 | B0

☑ Functional Description | ☑ Enablers | ○ Deployment Applicability | ☑ Performance Impact Assessment

ACAS

ACAS-B1/1	ACAS Improvements	Operational

Main Purpose

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

New Capabilities

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

Description

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

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

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

New resolution advisories.

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

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

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Certification	TCAS version 7.1 certification	SARPs for TCAS version 7.1, which provides short-term improvements to previous airborne collision avoidance systems (ACAS). Reference: ICAO Annex 6, ICAO Annex 10 Volume IV technical requirements (amendment 85 to Annex 10, Volume IV).	CAA Aircraft manufacturer	2014
Operational procedures	Operations	Procedures for the operation of ACAS including phraseology	Procedures for the operation of ACAS including phraseology. References: ICAO Doc 4444 (PANS-ATM), ICAO Doc 8168 (PANS-OPS), ICAO Doc 9863 Airborne Collision Avoidance System (ACAS) Manual.	ANSP Aircraft operator	2010
Airborne system capability	Aircraft system	TCAS II version 7.1 avionics	TCAS II version 7.1 avionics. References: EUROCAE ED-143 or RTCA DO-185B	Aircraft manufacturer	2008
Regulatory provisions	Operational Approval	TCAS II version 7.1 operational approval	Responsibility of State of the operator. References: ICAO Annex 6 Part I	CAA	2014
Airborne system capability	Surveillance	Avionics for extended hybrid surveillance (optional)	Avionics standards for Extended Hybrid Surveillance. References: EUROCAE ED-221A or RTCA DO-300A, Change 1	Aircraft manufacturer	2015
Training	-	Training requirements for TCAS version 7.1 operations	Pilot training for TCAS version 7.1, which provides information on new TCAS RA alert wording.	Aircraft operator	2012

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Safety		Improve mid-air collision avoidance (safety net)	++	

ACDM

ACDM-B0/1	Airport CDM Information Sharing (ACIS)	Operational

Main Purpose

To generate common situational awareness, which will foster improved decision making within aerodromes, by sharing relevant surface operations data among the local stakeholders involved in aerodrome operations.

New Capabilities

Stakeholders will be able to collaborate and take actions towards the achievement of a set of defined milestones by being aware of the status of an individual flight measured against known target times and milestones.

Description

This element represents the first collaboration step among stakeholders involved in aerodrome operations. It consists in the definition of common specific milestones for several flight events taking place during surface operations. The stakeholders involved have to, based on accurate operational data, achieve the agreed milestones.

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products
Relation-operational benefit	SURF-B0/2 - Comprehensive situational awareness of surface operations

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Operations	Surface operation milestones procedure	Reference: Manual on Collaborative Air Traffic Flow Management (ATFM) ICAO Doc 9971	Airport operator ANSP Aircraft operator Ground handling agent	2013

Ground system infrastructure	Airport systems	ACIS system	A simple A-CDM dialog system to a more advanced A-CDM Information sharing platform (ACISP) to achieve A-CDM information sharing.	Airport operator ANSP Aircraft operator Ground handling agent	2013
Training	-	Training requirements for ACIS	Training in the operational standards and procedures	Airport operator ANSP ATM network function Aircraft operator Ground handling agent	2013
Operational procedures	Phraseology	ACIS Phraseology	Phraseology for the implementation of ACIS. References: Procedures for Air Navigation Services-Air Traffic Management (Doc 4444)	ANSP Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

ACDM-B0/2	Integration with ATM Network function	Operational

Main Purpose: Airport CDM operations will be enriched by enhanced arrival information from the ATM network and, at the same time, network operations will benefit from more accurate departure information from CDM airports.

New Capabilities: To connect airport operations to the ATM network.

Description: This element consists in feeding arrival information from the network into A-CDM and, at the same time, coordinate specific departure milestones. The involved stakeholders have to, based on accurate operational data, achieve the agreed milestones.

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

OPERATIONS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

Taxi-out | Departure | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	RSEQ-B0/1 - Arrival Management
Relation-operational need	RSEQ-B0/2 - Departure Management
Relation-benefit	SURF-B0/2 - Comprehensive situational awareness of surface operations
Relation-benefit	FICE-B0/1 - Automated basic inter facility data exchange (AIDC)
Relation-operational need	NOPS-B0/4 - Initial Airport/ATFM slots and A-CDM Network Interface

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Operations	Procedures for turnaround integration	Procedures for: integration of aircraft turnaround with ATM/ATFM objectives. References: Manual on Collaborative Air Traffic Flow Management (ATFM) (Doc 9971)	Airport operator, ANSP, ATM network function, Aircraft operator	2013
Operational procedures	Phraseology	Phraseology for turnaround integration	Phraseology for the integration of the turnaround within the network. . References: Procedures for Air Navigation Services-Air Traffic Management (Doc 4444).	ANSP, Aircraft operator	2013
Ground system infrastructure	-	A-CDM system/platform-ATFM system interconnectivity	Interconnection of ACDM and the network using data exchange models.	Airport operator, ANSP, ATM network function, Aircraft operator	2013
Training	-	Training requirements for the integration of the turnaround	Training in the operational standards and procedures	Airport operator, ANSP, ATM network function, Aircraft operator, Ground handling agent	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

ACDM-B1/1	Airport Operations Plan (AOP)	Operational

Main Purpose

To enhance the planning and management of airport operations and allow their fully integration in the ATM network and enhance collaboration between airport stakeholders.

New Capabilities

Airport stakeholders will be able to better communicate and coordinate among themselves to develop and maintain dynamically joint plans and to execute those in their respective area of responsibility.

Description

This element consists of a collaborative airport operations plan (AOP) which encompasses “local” airport information and shared information with the ATM network in order to develop a synchronized view for the integration of local airport operations as well as aircraft operations into the overall ATM network.

The AOP includes an airport performance framework and steers with specific performance indicators and targets aligned with the regional/national performance frameworks, building upon A-CDM. Information on resources and aircraft operation plans is available to the different operational units on the airport and elsewhere in ATM.

The AOP may be managed and monitored by the Airport Operations Centre (APOC).

Maturity Level

Standardization

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	ACDM-B0/1 - Airport CDM Information Sharing (ACIS)
Relation-operational need	ACDM-B0/2 - Integration with ATM Network function
Relation-operational need	NOPS-B1/3 - Enhanced integration of Airport operations planning with network operations planning
Relation-information need	AMET-B1/1 - Meteorological observations information
Relation-information need	AMET-B1/2 - Meteorological forecast and warning information
Relation-benefit	ACDM-B1/2 - Airport Operations Centre (APOC)

Relation-benefit	SURF-B1/1 - Advanced features using visual aids to support traffic management during ground operations
Relation-benefit	SURF-B1/5 - Enhanced vision systems for taxi operations
Relation-benefit	FICE-B2/2 - Filing Service
Relation-benefit	FICE-B2/4 - Flight Data Request Service
Relation-information need	AMET-B1/3 - Climatological and historical meteorological information
Relation-information need	DAIM-B1/7 - NOTAM improvements

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Ground system infrastructure	Airport systems	AOP	Develop the Airport Operations Plan module	Airport operator	2019
Operational procedures	-	CDM information management processes	Definition of roles, responsibilities and processes to fully integrate airports in the ATM network. References: Manual on Collaborative Air Traffic Flow Management (ATFM) (Doc 9971)	Airport operator ANSP ATM network function Aircraft operator	2019
Training	-	Training requirements for AOP	Training in the operational standards and procedure	Airport operator ANSP ATM network function Aircraft operator Ground handling agent	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

ACDM-B1/2	Airport Operations Centre (APOC)	Operational

Main Purpose

The integration of all stakeholders, both landside and airside, into a coherent decision making entity/process (and team), using the shared information and capabilities provided through the AOP.

New Capabilities

The APOC is an additional but important means by which the efficiency of the overall airport operations will be further enhanced. This will be achieved by bringing all stakeholders together in a physical facility, using the shared information and capabilities of the AOP (ensuring thereby a coherent overall airport performance monitoring), decision making and steering process, addressing all phases of operations (strategic planning, through operation to post operations).

Description

The APOC will bring stakeholders together in a physical entity (team) enabling them to better communicate and coordinate, to develop and dynamically maintain joint plans which are executed in their respective areas of responsibility at the airport.

Its main information source is the Airport Operations Plan, which integrates information from the appropriate process monitors, collating it into consistent, timely and reliable knowledge for the airport's various operational units, in particular the APOC.

The APOC will be equipped with a real-time monitoring system, a decision support system and will apply a set of collaborative procedures that build upon the capabilities of the AOP. This will ensure that the management of landside and airside airport processes will be fully integrated.

Maturity Level

Standardization

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	ACDM-B1/1 - Airport Operations Plan (AOP)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Operations	Operational procedures to support operations within the APOC	Procedures for data sharing, management and decision making within the APOC. References: Manual on Collaborative Air Traffic Flow Management (ATFM) (Doc 9971) Manual on the System-wide Information Management (SWIM) Concept (Doc 10039)	Airport operator ANSP ATM network function Aircraft operator Ground handling agent	2019

Ground system infrastructure	-	APOC information sharing system	Implementation of a system for information sharing between the APOC actors.	Airport operator ANSP ATM network function Aircraft operator Ground handling agent	2019
Ground system infrastructure	-	APOC monitoring and decision support systems	Implementation of real-time monitoring and decision support systems within an operational facility able to accommodate representation from all stakeholders.	Airport operator ANSP ATM network function Aircraft operator Ground handling agent	2019
Ground system infrastructure	-	Physical APOC	Designation and equipage of a physical infrastructure as an APOC.	Airport operator ANSP	2019
Training	-	Training requirements for APOC	Training and competency monitoring in the use of procedures, responsibilities and decision support tools.	Airport operator ANSP ATM network function Aircraft operator Ground handling agent	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

AMET

AMET-B0/1	Meteorological observations products	Information

Main Purpose: Meteorological observations in support of flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning.

New Capabilities: Provision of observations of additional meteorological parameters/elements. More automated observations. Higher temporal and spatial resolution for lightning, radar and satellite information.

Description

This element represents the provision of meteorological observational products including:

- Automatic Weather Observation System (AWOS) information (including real-time exchange of wind and RVR data)
- Local reports (MET REPORT / SPECIAL)
- Aerodrome reports (METAR / SPECI)
- Lightning information
- Ground-based weather radar information
- Meteorological satellite imagery
- Aircraft meteorological report (ie. ADS-B, AIREP, AMDAR etc.)
- Vertical wind and temperature profiles
- Volcano Observatory Notice for Aviation (VONA)
- Wind shear alerts

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology benefit	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
Relation-technology benefit	COMS-B0/2 - ADS-C (FANS 1/A) for procedural airspace
Relation-technology need	COMI-B0/7 - ATS Message Handling System (AMHS)
Relation-technology benefit	COMI-B0/1 - Aircraft Communication Addressing and Reporting System (ACARS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Regulatory provisions	National regulatory framework	National framework amendment for the provision of meteorological observations products	Amendment to national regulations to include changes to the provision of quality-assured meteorological observation products to support flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management • Doc. 4444 - Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM)	CAA	2013
Operational procedures	Information exchange	Procedures for the provision of meteorological observations products	Procedures for changes to the provision of quality-assured meteorological observation products, including additional meteorological parameters and higher spatial and temporal resolution observations. References: • WMO No.8 - Guide to Meteorological Instruments and Methods of Observation • WMO No.306 - Manual on Codes – International Codes • WMO No.731 – Guide to Meteorological Observing and Information Distribution Systems for Aviation Weather Services • WMO No.732 - Guide to Practices for Meteorological Offices Serving Aviation • WMO No.782 – Aerodrome Reports and Forecasts • WMO No.1100 - Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services • Doc. 7488 – Manual of the ICAO Standard Atmosphere • Doc. 8896 - Manual of Aeronautical Meteorological Practice • Doc. 9328 - Manual of Runway Visual Range Observing and Reporting Practices • Doc 9837 - Manual on Automatic Meteorological Observing Systems at Aerodromes	ANSP MET Information Service Provider	2013
Airborne system capability	Aircraft system	Transmission of meteorological observations data from aircraft	Onboard sensors and communication means for the measurement and transmission of meteorological data by: ACAR, Mode-S, ADS-B & ADS-C.	Aircraft manufacturer	2013

Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of meteorological observations products	Meteorological instrumentation, IT systems and communications infrastructure for the measurement, storage, display and transmission (including AFS) of meteorological observations products. References: • WMO No.8 - Guide to Meteorological Instruments and Methods of Observation • Annex 10 - Aeronautical Telecommunications	Airport operator ANSP MET Information Service Provider	2013
Training	-	Training requirements for the provision of meteorological observations products	Training for meteorological personnel and aviation industry stakeholders on meteorological observations products. References: • WMO No. 1083 – Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology • WMO No.1205 – Guide to Competency	Airport operator ANSP CAA Aircraft operator MET Information Service Provider	2013

AMET-B0/2 Meteorological forecast and warning products Information

Main Purpose

Meteorological forecasts, advisories and warnings in support of flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning.

New Capabilities

Improved visualisation of meteorological forecast products. Greater resolution (spatial and temporal) of gridded WAFS information (e.g. wind, temperature, icing, turbulence, CB clouds).

Description

This element represents the provision of meteorological forecast (including advisory and warning) products including:

- World Area Forecast System (WAFS) gridded products
- Significant Weather (SIGWX)
- Low-level Area Forecast (GAMET)
- Aerodrome Forecast (TAF)
- Trend Forecast (TREND)
- Take-off Forecast
- Tropical Cyclone Advisory (TCA)
- Volcanic Ash Advisory (VAA)
- AIRMET
- SIGMET
- Aerodrome Warning
- Wind Shear Warning

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	AMET-B0/1 - Meteorological observations products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	National regulatory framework	National framework amendment for the provision of meteorological forecast products and warnings	Amendment to national regulations to include changes to the provision of quality-assured meteorological forecast and warning products to support flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management • Doc. 4444 - Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM)	CAA	2013

Operational procedures	Information exchange	Procedures for the provision of Meteorological forecast products and warnings	Procedures for changes to the provision of quality-assured meteorological forecast and warning products, including improved visualisation and higher spatial and temporal resolution of gridded products. References: • WMO No.306 - Manual on Codes – International Codes • WMO No.732 - Guide to Practices for Meteorological Offices Serving Aviation • WMO No.782 – Aerodrome Reports and Forecasts • WMO No.1100 - Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services • Doc. 7488 – Manual of the ICAO Standard Atmosphere • Doc. 8896 - Manual of Aeronautical Meteorological Practice • Doc. 9691 - Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds • Doc. 9766 - Handbook on the International Airways Volcano Watch (IAVW) • Regional SIGMET Guides	ANSP MET Information Service Provider	2013
Training	-	Training requirements for the provision of meteorological forecast products and warnings	Training for meteorological personnel and aviation industry stakeholders on meteorological forecast and warning products. References: • WMO No. 1083 – Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology • WMO No.1205 – Guide to Competency	Airport operator ANSP CAA Aircraft operator MET Information Service Provider	2013
Ground system infrastructure	Information exchange	Systems and infrastructure to support the provision of meteorological forecast and warning products	IT systems and communications infrastructure for the storage, forecasting, display and transmission (including AFS) of meteorological forecast and warning products. References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice	MET Information Service Provider	2013

AMET-B0/3	Climatological and historical meteorological products	Information

Main Purpose	Climatological products in support of the design and planning of infrastructure, flight routes and airspace management. Historical meteorological observations, forecasts, advisories and warnings in support of incident and accident investigations.
New Capabilities	Nil

Description

This element represents the provision of climatological products including:

- Aerodrome climatological tables;
- Aerodrome climatological summaries.

This element also represents the provision of historical products including meteorological observations, forecasts, advisories and warnings.

Maturity Level

Ready for implementation

Human Factor Considerations

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

2. Does it imply processing of new information by the user? No

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

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

PLANNING LAYERS

Post operations

OPERATIONS

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	AMET-B0/1 - Meteorological observations products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	National regulatory framework	National framework amendment for the provision of climatological meteorological information products	Amendment to national regulations to include changes to the provision of climatological and historical meteorological products in support of the design and planning of infrastructure, flight routes and airspace management and to support incident and accident investigations. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management	CAA	2013

Operational procedures	Information exchange	Procedures for the provision of climatological meteorological information products	Procedures for changes to the provision of climatological and historical meteorological, including aerodrome climatological tables and summaries. References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice	MET Information Service Provider	2013
Training	-	Training requirements for the provision of climatological meteorological information products	Training for meteorological personnel and aviation industry stakeholders on climatological and historical meteorological products. References: • WMO No. 1083 – Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology • WMO No.1205 – Guide to Competency	Airport operator ANSP CAA Aircraft operator MET Information Service Provider	2013
Ground system infrastructure	Information exchange	Systems and infrastructure to support the provision of climatological meteorological products	IT systems and communications infrastructure for the storage, display and transmission (including AFS) of climatological meteorological products. References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice	MET Information Service Provider	2013

AMET-B0/4	Dissemination of meteorological products	Information

Main Purpose

Dissemination of meteorological products in support of flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning

New Capabilities

Commencement of the exchange of meteorological information using the ICAO Meteorological Information Exchange Model (IWXXM), being the conversion of Traditional Alphanumeric Code (TAC), using an IWXXM schema, into XML/GML.

Description

This element represents the dissemination of meteorological products using a variety of formats and means.

Formats include:

- TAC
- Gridded
- Graphical (i.e., PNG format)
- BUFR code
- IWXXM (in XML/GML)

Dissemination means includes aeronautical fixed service (AFTN with increasing use of AMHS), and via secure internet services (ie. WIFS/SADIS).

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	AMET-B0/1 - Meteorological observations products
Relation-operational need	AMET-B0/2 - Meteorological forecast and warning products
Relation-technology need	COMI-B0/7 - ATS Message Handling System (AMHS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	National regulatory framework	National framework amendment for meteorological information exchange	Amendment to national regulations to include changes to the dissemination of meteorological products in support of flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • Annex 10 – Aeronautical Telecommunications • Annex 15 - Aeronautical Information Services	CAA	2013

Operational procedures	Information exchange	Procedures for meteorological information exchange	Procedures for changes to the dissemination of meteorological products, including the exchange of meteorological information using the ICAO Meteorological Information Exchange Model (IWXXM). References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice • Doc. 9377 – Manual on the Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services • Doc. 9855 - Guidelines on the use of the Public Internet for Aeronautical Applications • Doc. 9880 - Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols • Doc. 9896 – Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocol • Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information • ICAO Guidelines for the Implementation of OPMET Data Exchange using IWXXM • Regional OPMET Interface Control Documents • Regional OPMET Bulletin Exchange Handbooks	ANSP MET Information Service Provider	2013
Ground system infrastructure	Information exchange	Communications infrastructure for meteorological information exchange	Ground system infrastructure and dissemination systems for meteorological products, including message switching systems and the roll-out of the Aeronautical Message Handling System (AMHS) to replace the Aeronautical Fixed Telecommunications Network (AFTN). References: • Doc. 9880 - Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols • Doc. 9896 – Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocol; • Regional OPMET Interface Control Documents • Regional OPMET Bulletin Exchange Handbooks	ANSP MET Information Service Provider	2013

Training	-	Training for meteorological information exchange	Training for meteorological and aviation IT personnel, including NOC/ROC/RODB/IROG personnel on the exchange of meteorological products. References: • Regional OPMET Interface Control Documents • Regional OPMET Bulletin Exchange Handbooks	ANSP MET Information Service Provider	2013
Information exchange model	Meteorological information	ICAO Meteorological Information Exchange Model (IWXXM) V1-V2	ICAO Meteorological Information Exchange Model (IWXXM) schema used to enable the provision meteorological information in XML/GML form. Version 1.1 supported Annex 3 amendment 76 (2013). Version 2.1 supported Annex 3 amendment 77 (2016). References: • Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information • ICAO Guidelines for the Implementation of OPMET Data Exchange using IWXXM • WMO IWXXM Wiki: https://wiswiki.wmo.int/tiki-index.php?page=IWXXM&structure=WIS+up	ANSP MET Information Service Provider	2013

AMET-B1/1 Meteorological observations information Information

Main Purpose

Meteorological observations information in support of automated decision processes or aids and performance based requirements, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.

New Capabilities

Commencement of change from product-centric to data-centric information. Commencement of space weather and sulphur dioxide (SO2) services. Enhanced hazardous weather services. Indroduction of new and enhanced space-based observations. Introduction of new observational information from both un-manned and manned aircraft (ie. observations from lidar).

Description

Meteorological observations will begin to transition from traditional alphanumeric code (TAC) form to data-centric information to better support the common understanding on the various operational constraints, capabilities and needs. The following SWIM-compliant observational parameters and phenomena will begin to be made available to users and will include:

- Wind speed and direction (aerodrome) including gusts
- Wind speed and direction from departure to Top of Climb (TOC) and then Top of Descent (TOD) to landing
- Wind speed and direction en-route
- Air temperature and dew point temperature (aerodrome)
- Air temperature and dew point temperature (or equivalent, i.e. humidity) from departure to TOC and then TOD to landing (including the following derived outputs: freezing level, lower tropospheric temperature inversions)
- Air temperature and dew point temperature (or equivalent) en-route
- Pressure (aerodrome) (i.e. QNH/QFE)
- Visibility (aerodrome) (horizontal, slant, vertical), Runway visual range (RVR)

- Cloud type (of operational significance)
- Cloud coverage, bases, tops and layers
- Thunderstorms, Lightning, Convection (TCU & CB)
- Precipitation (ie. drizzle, rain, freezing rain, snow, hail)
- Weather (ie. dust storm, sand storm, funnel cloud, squall, smoke, haze, mist, fog)
- Icing, including airframe and engine
- Liquid Water Content, Iced Water Content
- Turbulence, Mountain waves, Wind shear
- Fronts
- Radioactive clouds, Toxic chemicals
- Tropical cyclones
- Volcanic ash
- Sulphur dioxide (SO2) and other hazardous gases
- Aerodrome surface (runway) temperature, state
- Sea temperature, state and wave height (seaports)
- Space weather events
- Tsunami, Flood

Characteristics of the meteorological information include:

- Time (ie. observation time)
- Units of measurement
- Resolution (spatial)
- Geo Location (2D/3D/4D context, point, line or polyhedron)
- Movement
- Severity, Accumulation, Intensity
- Range (Max. – Min.)
- Variations
- Data sample period
- Auto or Human (Observed, Measured or Calculated)
- Amendment / Correction
- Operational Status
- Source
- Thresholds
- Format (TAC, Gridded, Graphical, IWXXM)
- Data quality flag
- Runway identification or location identifier
- Effects/impact on aviation systems (i.e. communications, navigation & surveillance systems)
- Radiation (exposure)

An increase in the use of performance measures (via compliance, availability and regularity indices) of meteorological observations.

Maturity Level

Standardization

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	AMET-B0/1 - Meteorological observations products
Relation-technology benefit	COMS-B1/2 - PBCS approved ADS-C (FANS 1/A+) for procedural airspace
Relation-technology need	COMI-B0/7 - ATS Message Handling System (AMHS)
Relation-technology need	COMI-B0/1 - Aircraft Communication Addressing and Reporting System (ACARS)
Relation-technology need	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	National regulatory framework	National framework amendment for the provision of meteorological observations information	Amendment of national regulations to include the provision of quality-assured meteorological observations information in support of automated decision processes or aids and performance based requirements, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management • Procedures for Air Navigation Services – Meteorology (PANS-MET) – being developed • Doc. 4444 - Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM)	CAA	2019

Operational procedures	Information exchange	Procedures for the provision of meteorological observations information	Procedures for changes to the provision of quality-assured meteorological observations information, including space weather. References: • WMO No.8 - Guide to Meteorological Instruments and Methods of Observation • WMO No.306 - Manual on Codes – International Codes • WMO No.731 – Guide to Meteorological Observing and Information Distribution Systems for Aviation Weather Services • WMO No.732 - Guide to Practices for Meteorological Offices Serving Aviation • WMO No.782 – Aerodrome Reports and Forecasts • WMO No.1100 - Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services • Doc. 7488 – Manual of the ICAO Standard Atmosphere • Doc. 8896 - Manual of Aeronautical Meteorological Practice • Doc. 9328 - Manual of Runway Visual Range Observing and Reporting Practices • Doc 9837 - Manual on Automatic Meteorological Observing Systems at Aerodromes • Doc. 10100 – Manual on Space Weather Information in Support of Air Navigation	ANSP MET Information Service Provider	2019
Airborne system capability	Aircraft system	Transmission of meteorological observations information from aircraft	Onboard sensors and communication means for the measurement and transmission of meteorological information by: ACAR, Mode-S, ADS-B & ADS-C	Aircraft manufacturer	2019
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of meteorological observations information	Meteorological instrumentation, IT systems and communications infrastructure for the measurement, storage, display and transmission (including AFS) of meteorological observations information. References: • WMO No.8 - Guide to Meteorological Instruments and Methods of Observation • Annex 10 - Aeronautical Telecommunications	Airport operator ANSP MET Information Service Provider	2019
Training	-	Training requirements for meteorological observations information	Training for meteorological personnel and aviation industry stakeholders on meteorological observations information. References: • WMO No. 1083 – Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology • WMO No.1205 – Guide to Competency	Airport operator ANSP CAA Aircraft operator MET Information Service Provider	2019

AMET-B1/2	Meteorological forecast and warning information Information
Main Purpose	Meteorological forecast and warning information for automated support for decision processes or aids and performance based requirements, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision processes.
New Capabilities	Commencement of change from product-centric to data-centric information. Commencement of space weather and sulphur dioxide (SO2) services. Enhanced hazardous weather services. First steps in the provision of probabilistic information derived from ensemble prediction systems.

Description	Meteorological forecasts and warnings will begin to transition from traditional alphanumeric code (TAC) form to data-centric information to better support the common understanding on the various operational constraints, capabilities and needs. The following SWIM-compliant forecast parameters and phenomena will begin to be made available to users and will include:
	• Wind speed and direction (aerodrome) including gusts and operationally significant wind shifts
	• Air temperature and dew point temperature (aerodrome)
	• Upper level:
	  • Wind (speed and direction), including departure to Top of Climb (TOC) and then Top of Descent (TOD) to landing
	  • Air temperature and dew point temperature or equivalent (i.e. humidity), including height of freezing level and lower tropospheric temperature inversions
	• Flight level and temperature of tropopause
	• Geopotential altitude for flight levels
	• Pressure (aerodrome) (i.e. QNH, QFE)
	• Visibility (aerodrome), Runway visual range (RVR)
	• Cloud type (of operational significance)
	• Cloud coverage, bases, tops and layers
	• Thunderstorms, Lightning, Convection (TCU & CB)
	• Precipitation (ie. drizzle, rain, freezing rain, snow, hail)
	• Weather (ie. dust storm, sand storm, funnel cloud, squall, smoke, haze, mist, fog)
	• Icing (airframe and engine),
	• Liquid Water Content, Iced Water Content
	• Turbulence, Mountain waves, Wind shear
	• Fronts
	• Radioactive clouds, Toxic chemicals
	• Tropical cyclones
	• Volcanic ash
	• Sulphur dioxide (SO2) and other hazardous gases
	• Aerodrome surface (runway) temperature, state
	• Sea temperature, state and wave height (seaports)
	• Space weather events
	• Tsunami, Flood
	
	Characteristics of the meteorological information include:
	• Time (ie. issue time, validity, commencement/cessation, lead time)
	• Units of measurement
	• Resolution (temporal & spatial)
	• Geo Location (2D/3D/4D context, point, line or polyhedron)
	• Movement

- Severity, Accumulation, Intensity
- Range (Max. – Min.)
- Variations
- Probability of occurrence
- Confidence/Uncertainty of forecast
- Reliability
- Data sample period
- Auto
- Change indicator/period
- Amendment / Correction
- Operational Status
- Source
- Thresholds
- Format (TAC, Gridded, Graphical, IWXXM)
- Data quality flag
- Runway identification or location identifier
- Effects/impact on aviation systems (i.e. communications, navigation & surveillance systems)
- Radiation (exposure)

Human-readable meteorological advisory and warning products start to be derived from the meteorological information/data to better suit user needs and can be based on user defined thresholds. Meteorological information to be used to assess impact.

Verification of quality (accuracy) of forecast parameters. An increased use performance measures (via compliance, availability and regularity indices) of forecast parameters.

Maturity Level: Standardization

Human Factor Considerations:

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	AMET-B0/2 - Meteorological forecast and warning products
Relation-operational need	AMET-B1/1 - Meteorological observations information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Regulatory provisions	National regulatory framework	National framework amendment for the provision of meteorological forecast and warnings information	Amendment to national regulations to include changes to the provision of meteorological forecast and warning information in support of automated decision processes or aids and performance based requirements, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management • Procedures for Air Navigation Services – Meteorology (PANS-MET) – being developed • Doc. 4444 - Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM)	CAA	2019
Operational procedures	Information exchange	Procedures for the provision of meteorological forecast and warnings information	Procedures for changes to the provision of quality-assured meteorological forecast and warning information, including commencement of the change from product-centric to data-centric information, space weather, enhanced hazardous weather services and the provision of probabilistic information derived from ensemble prediction systems. References: • WMO No.306 - Manual on Codes – International Codes • WMO No.732 - Guide to Practices for Meteorological Offices Serving Aviation • WMO No.782 – Aerodrome Reports and Forecasts • WMO No.1100 - Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services • Doc. 7488 – Manual of the ICAO Standard Atmosphere • Doc. 8896 - Manual of Aeronautical Meteorological Practice • Doc. 9691 - Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds • Doc. 9766 - Handbook on the International Airways Volcano Watch (IAVW) • Doc. 10100 – Manual on Space Weather Information in Support of Air Navigation • Regional SIGMET Guides	ANSP MET Information Service Provider	2019

Training	-	Training requirements for Meteorological forecast and warning information	Training for meteorological personnel and aviation industry stakeholders on meteorological forecast and warning information. References: • WMO No. 1083 – Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology • WMO No.1205 – Guide to Competency	Airport operator ANSP CAA Aircraft operator MET Information Service Provider	2019
Ground system infrastructure	Information exchange	Systems and infrastructure to support the provision of meteorological forecast and warning information	IT systems and communications infrastructure for the storage, forecasting, display and transmission (including AFS) of meteorological forecast and warning information. References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice	MET Information Service Provider	2019

AMET-B1/3	Climatological and historical meteorological information	Information

Main Purpose

Climatological information in support of the design and planning of infrastructure, flight routes and airspace management. Historical meteorological observations, forecasts, advisories and warnings in support of incident and accident investigations.

New Capabilities

Enhanced climatological data.

Description

This element represents the provision of climatological information for the range of meteorological parameters and phenomena and their associated characteristics (metadata).

This element also represents the provision of historical information including meteorological observations and forecasts and their associated characteristics (metadata).

Climatological information services will be required to support the design and planning of infrastructure, flight routes and airspace management. The following climatology parameters and phenomena will begin to be made available to users and will include:

- En-route winds
- Airport parameters (i.e. air and surface temperature, wind, precipitation, etc.)

Characteristics of the climatological information will include:

- Averages (daily/monthly/yearly) over 10, 20, 30, 50 years
- Extremes over 1, 5, 10, 20, 30 years, since start of measurement

Maturity Level

Standardization

Human Factor Considerations

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

PLANNING LAYERS

Post operations

OPERATIONS

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	AMET-B0/3 - Climatological and historical meteorological products
Relation-operational need	AMET-B1/1 - Meteorological observations information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Procedures for the provision of climatological meteorological information	Procedures for changes to the provision of climatological and historical meteorological information, including en-route winds and enhanced information for the terminal area. References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice	MET Information Service Provider	2019
Training	-	Training requirements for climatological meteorological information	Training for meteorological personnel and aviation industry stakeholders on climatological and historical meteorological information. References: • WMO No. 1083 – Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology • WMO No.1205 – Guide to Competency	Airport operator ANSP CAA Aircraft operator MET Information Service Provider	2019

Regulatory provisions	National regulatory framework	National framework amendment for the provision of climatological meteorological information	Amendment to national regulations to include changes to the provision of climatological and historical meteorological information in support of the design and planning of infrastructure, flight routes and airspace management and to support incident and accident investigations. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management • Procedures for Air Navigation Services – Meteorology (PANS-MET) – being developed	CAA	2019
Ground system infrastructure	Information exchange	Systems and infrastructure to support the provision of climatological meteorological information	IT systems and communications infrastructure for the storage, display and transmission (including AFS) of climatological meteorological information. References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice	MET Information Service Provider	2019

AMET-B1/4 Dissemination of meteorological information Information

Main Purpose ? Dissemination of meteorological information in support of automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.

New Capabilities ? Meteorological information in ICAO Meteorological Information Exchange Model (IWXXM) form starts to replace traditional alphanumeric code (TAC) products. Human-readable products will start to be derived from the IWXXM information (rather than the other way around). The introduction of web services allows for progressive replacement of fixed line dissemination systems.

Description

This element represents the dissemination of meteorological products using a variety of formats, including:

- Tailored products (human-readable)
- Impact-translated products
- Gridded
- Graphical (PNG and BUFR to be phased out)
- ICAO Meteorological Information Exchange Model (IWXXM) format
- Traditional alphanumeric code (TAC) – being phased out

Dissemination means include aeronautical fixed service (ie. AMHS) and via secure internet services (ie. WIFS/SADIS). Commencement of SWIM-compliant web service capability to access the exact meteorological information required by users (in terms of geographical coverage, resolution etc).

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	AMET-B0/4 - Dissemination of meteorological products
Relation-operational need	AMET-B1/1 - Meteorological observations information
Relation-operational need	AMET-B1/2 - Meteorological forecast and warning information
Relation-technology need	COMI-B0/7 - ATS Message Handling System (AMHS)
Relation-information need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information
Relation-information need	DAIM-B1/2 - Provision of digital Aeronautical Information Publication (AIP) data sets

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Operational procedures	Information exchange	Procedures for the dissemination of meteorological information	Procedures for changes to the dissemination of meteorological information, including the exchange of meteorological information using the latest version of the ICAO Meteorological Information Exchange Model (IWXXM). References: • Doc. 8896 - Manual of Aeronautical Meteorological Practice • Doc. 9377 – Manual on the Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services • Doc. 9855 - Guidelines on the use of the Public Internet for Aeronautical Applications • Doc. 9880 - Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols • Doc. 9896 – Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocol • Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information • Doc. 10039 - Manual on System Wide Information Management (SWIM) Concept • ICAO Guidelines for the Implementation of OPMET Data Exchange using IWXXM • WMO No.731 – Guide to Meteorological Observing and Information Distribution Systems for Aviation Weather Services • Regional OPMET Interface Control Documents • Regional OPMET Bulletin Exchange Handbooks	ANSP MET Information Service Provider	2019
Ground system infrastructure	Information exchange	Communication infrastructure for meteorological information exchange	Ground system infrastructure and dissemination systems for meteorological information, including the implementation of the Aeronautical Message Handling System (AMHS). References: • Doc. 9880 - Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols • Doc. 9896 – Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocol; • Regional OPMET Interface Control Documents • Regional OPMET Bulletin Exchange Handbooks	ANSP MET Information Service Provider	2019

Information exchange model	Meteorological information	ICAO Meteorological Information Exchange Model (IWXXM) V3	ICAO Meteorological Information Exchange Model (IWXXM) schema used to enable the provision meteorological information in XML/GML form. Version 3 supporting Annex 3 amendment 78 (2018). References: • Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information • ICAO Guidelines for the Implementation of OPMET Data Exchange using IWXXM • WMO IWXXM Wiki: https://wiswiki.wmo.int/tiki-index.php?page=IWXXM&structure=WIS+up	ANSP MET Information Service Provider	2019
Training	-	Training for the dissemination of meteorological information	Training for meteorological and aviation IT personnel, including NOC/ROC/RODB/IROG personnel on the exchange of meteorological information. References: • Doc. 10003 - Manual on the Digital Exchange of Aeronautical Meteorological Information • ICAO Guidelines for the Implementation of OPMET Data Exchange using IWXXM • Regional OPMET Interface Control Documents • Regional OPMET Bulletin Exchange Handbooks	ANSP MET Information Service Provider	2019
Regulatory provisions	National regulatory framework	National framework amendment for the dissemination of meteorological information	Amendment to national regulations to include changes to the dissemination of meteorological information in support of automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support. References: • Annex 3 - Meteorological Service for International Air Navigation • WMO No.49 Vol II - Technical Regulations - Basic Documents No. 2, Volume II – Meteorological Service for International Air Navigation • WMO No.49 Vol IV - Technical Regulations - Basic Documents No. 2, Volume IV – Quality Management • Procedures for Air Navigation Services – Meteorology (PANS-MET) – being developed • Annex 10 – Aeronautical Telecommunications • Annex 15 - Aeronautical Information Services	CAA	2019

APTA-B0/1	PBN Approaches (with basic capabilities)	Operational

Main Purpose

This element represents the use of PBN in design of approach procedures to provide more flexibility to airspace planners to manage the use of airspace, and to facilitate access to airports. It includes the provision of instrument approach procedures with vertical guidance in support of stabilized approaches.

New Capabilities

Development of PBN instrument approach procedures that are independent of ground based navigation aids. The use of new approach design criteria can often achieve the lowest possible minimums due to optimized lateral and vertical paths.

The PBN procedures also support stabilized approach operations for aircraft equipped with advisory Baro-VNAV functionality. Stable vertical paths can be established using vertical guidance for aircraft equipped with either advisory Baro-VNAV functionality or by using SBAS.

Description

PBN approaches allow for guided lateral paths and optionally, with associated advisory vertical paths based on Baro-VNAV functionality for aircraft so equipped. Such Baro-VNAV functionality enables stabilized decent operations on the final segment of the approach at airports which do not have ground infrastructure to support precision approaches. These procedures can also be implemented to allow continued approach operations in the case of failure of an existing ILS or traditional non precision approaches that are based on ground navigation aids.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	NAVS-B0/3 - Aircraft Based Augmentation Systems (ABAS)
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Operational procedures	Design	PBN approach (with basic capabilities) procedures design and use.	These operational procedures should be designed and used (aircraft operation criteria) as specified in ICAO Doc 8168 PANS-OPS Vol II and I or equivalent.	ANSP	2013
Operational procedures	Design	PBN approach (with basic capabilities) validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. References: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2013
Operational procedures	Operations	SOPs for PBN approaches (with basic capabilities)	Procedures for the crew to follow to fly a PBN approach. Defined in the Ops Manual. Reference: Doc 9613 (PBN Manual)	Aircraft operator	2013
Operational procedures	Operations	Contingency procedures for PBN approaches (with basic capabilities)	Procedures for the crew to follow in case of abnormal events. Defined in the Ops Manual. Reference: Doc 9613 (PBN Manual)	Aircraft operator	2013
Airborne system capability	-	Aircraft capability for PBN approach (with basic capabilities)	Aircraft eligible for RNP APCH Navigation specification as defined in Doc 9613 (PBN Manual) and listed in the Aircraft Flight Manual.	Aircraft manufacturer Aircraft operator	2013
Training	-	Training requirements for PBN approaches (with basic capabilities)	Crew trained to fly PBN approaches (with basic capabilities). References: As defined in Doc 9613 (PBN Manual). PBN approaches (with basic capabilities) training for Air traffic controllers. References: As defined in Doc 9613 (PBN Manual). PBN approaches (with basic capabilities) training for Procedure designers, Airspace planners. References: PANS-OPS Vol II and Doc 9992 Manual on the Use of Performance-Based Navigation (PBN) in Airspace Design	ANSP Aircraft operator	2013
Operational Authorization	-	Operational Authorization for PBN approaches (with basic capabilities)	Aircraft operator flying a PBN approach should have an operational authorization related to the specified performance of the procedure, as described in Doc 9997 (PBN Ops Approval Manual).	CAA Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Equip additional RWY ends with instrument approaches	++	KPI10: Airport peak throughput
Capacity	Capacity, throughput & utilization	Reduce approach minima (ceiling & visibility)	++	KPI10: Airport peak throughput

APTA-B0/2 PBN SID and STAR procedures (with basic capabilities) Operational

Main Purpose

Use of PBN capabilities allows more flexible placement of arrival and departure routing without the need for ground based infrastructure to support these routes.

New Capabilities

The flexibility of arrival path design supports the ability to connect en-route to the approach in an optimal manner, enabling better airspace management, reduced path distance, and reduced noise footprint. A precisely defined arrival path supports more optimum descent planning in operations and provides a building block for reducing ATC intervention during descent.

This flexibility is also applicable to providing more optimum departure paths to the exit of terminal airspace. These new capabilities are essential elements to support the development of Continuous Descent Operations/Continuous Climb Operations (CDO/CCO).

Description

This element represents the use of PBN in design of arrival and departure procedures to provide more flexibility to airspace planners to manage the use of airspace for enhancing arrival and departures in terminal areas. It provides the basic capability to support the implementation of CDO and CCO operations.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element

Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	PBN SID and STAR Procedures (with basic capabilities) procedure design and use	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent.	ANSP	2013
Operational procedures	Design	PBN SID and STAR Procedures (with basic capabilities) validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. References: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design).	ANSP CAA	2013
Operational procedures	Operations	SOPs for PBN SID/STAR (with basic capabilities)	Procedures for the crew to follow to fly a PBN SID/STAR. Reference: Defined in the Ops Manual Reference: Doc 9613 (PBN Manual)	Aircraft operator	2013
Operational procedures	Operations	Contingencies for PBN SID/STAR (with basic capabilities)	Procedures for the crew to follow in case of abnormal events. Defined in the Ops Manual Reference: Doc 9613 (PBN Manual)	Aircraft operator	2013
Airborne system capability	-	Aircraft capability for PBN SID/STAR (with basic capabilities)	Aircraft eligible for applicable Navigation specification as defined in Doc 9613 (PBN Manual) and listed in the Aircraft Flight Manual.	Aircraft manufacturer Aircraft operator	2013
Operational Authorization	-	Operational Authorization for PBN SID/STAR (with basic capabilities)	Aircraft operator flying a PBN SID/STAR should have an operational authorization related to the specified performance of the procedure, as described in Doc 9997 (PBN Ops Approval Manual)	CAA Aircraft operator	2013

Ground system infrastructure	Navigation	NAVAIDS to support the applicable navigation specification used for SID/STAR (with basic capabilities)	Depending on the navigation specification used, suitable ground based navigational aids will be required. See Doc 9613 (PBN Manual) for details.	ANSP	2013
Training	-	Training requirements for PBN SID/STAR (with basic capabilities)	Crew trained to fly PBN SID/STAR (with basic capabilities). References: As defined in Doc 9613 (PBN Manual). PBN SID/STAR (with basic capabilities) training for Air traffic controllers. References: As defined in Doc 9613 (PBN Manual). PBN SID/STAR (with basic capabilities) training for procedure designers, airspace planners. Ref Doc 8168 (PANS OPS Vol II); Doc 9992 (PBN airspace design Manual); Doc 9906 (Vol 2)	ANSP Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Increase airport arrival rate	++	KPI11: Airport throughput efficiency
Capacity	Capacity, throughput & utilization	Mitigate local airspace capacity constraints if this is the problem	++	KPI10: Airport peak throughput
Capacity	Capacity, throughput & utilization	Mitigate noise constraints if this is the problem	++	KPI10: Airport peak throughput
Efficiency	Vertical flight efficiency	Reduce permanent (airspace and approach procedure design) and semi-permanent (ATFCM measures) altitude constraints along the descent portion of traffic flows, in en-route and terminal airspace	++	KPI19: Level-off during descent

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Vertical flight efficiency	Reduce permanent (airspace and departure procedure design) and semi-permanent (ATFCM measures) altitude constraints (level capping) along the climb portion of traffic flows, in terminal and en-route airspace	++	KPI17: Level-off during climb

APTA-B0/3	SBAS/GBAS CAT I precision approach procedures	Operational

Main Purpose: Introduction of SBAS and GBAS CAT I procedures allow for reduced minima at aerodromes situated in areas of significant terrain, where ILS is not possible.

New Capabilities: Implementation of CAT I at airports, where ILS is precluded, increases accessibility.

It also provides a building block for aircraft with equipment such as SVS, EVS HGS to operate to decision altitudes below standard CAT I Minimums using Special operational Authorizations. For aircraft with such approvals, this increases airport availability in weather conditions that would otherwise preclude operations.

Description: This element represents the use of augmented GNSS systems to allow aircraft operation with a more precise vertical and lateral navigation capability. It also includes the development of SA CAT I operations below existing minima.

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	NAVS-B0/2 - Satellite Based Augmentation Systems (SBAS)
Relation-technology need	NAVS-B0/1 - Ground Based Augmentation Systems (GBAS)

Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	Cat I Precision Approach Procedure design and use	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent.	ANSP	2013
Operational procedures	Design	Cat I Precision Approach procedure validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. References: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2013
Operational procedures	Operations	SOPs for Cat I Precision Approaches	Procedures for the crew to follow to fly a Cat I Precision Approach. Reference: Ops Manual defines SOPs	Aircraft operator	2013
Operational procedures	Operations	Contingencies for Cat I Precision Approaches	Procedures for the crew to follow in case of abnormal events. Reference: Ops Manual defines SOPs	Aircraft operator	2013
Airborne system capability	Navigation	Aircraft capability for Cat I Precision Approaches	TSO C145 or C146 or equivalent required for SBAS avionics. TSO C161A required for GBAS CAT I	Aircraft manufacturer Aircraft operator	2013
Ground system infrastructure	Navigation	Ground based system for Cat I Precision Approach	GBAS Ground Station SBAS Ground stations Ref Annex 10 Vol I	Airport operator ANSP	2013
Training	-	Training requirements for Cat I Precision Approach Procedures	Crew trained to fly Cat I precision approaches. Reference: Doc 8168 (Vol I). Cat I Precision Approach training for ATC. Reference: Doc 8168 (Vol I). Cat I Precision Approach training for procedure designers, airspace planners. Ref : Doc 8168 (PANS OPS Vol II); Doc 9906 (Vol 2)	ANSP Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Equip additional RWY ends with instrument approaches	++	KPI10: Airport peak throughput
Capacity	Capacity, throughput & utilization	Reduce approach minima (ceiling & visibility)	++	KPI10: Airport peak throughput

APTA-B0/4 CDO (Basic) Operational

Main Purpose: Reduce fuel burn by not requiring application or power during descent.

New Capabilities: ATC procedures to facilitate uninterrupted descent, reducing ATC/Pilot interaction.

Description: Arriving aircraft are allowed to descend continuously from top of descent by employing minimum engine thrust, ideally in a low drag configuration, prior to the Initial Approach Fix (IAF).

Maturity Level: Ready for implementation

Human Factor Considerations:

1. Does it imply a change in task by a user or affected others? Yes

In ATC.

2. Does it imply processing of new information by the user? No

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	APTA-B0/2 - PBN SID and STAR procedures (with basic capabilities)
Relation-operational benefit	RSEQ-B0/3 - Point merge
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	Development of CDO (Basic) procedures	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent, with reference to Doc 9931 (CDO Manual)	ANSP Aircraft operator	2013
Operational procedures	Design	CDO (Basic) procedures validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. References: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2013
Operational procedures	Operations	SOPs for CDO (Basic) operations	Procedures for the crew to follow to facilitate the flying of a CDO. OPS Manual defines SOPs	Aircraft operator	2013
Operational procedures	Operations	Contingencies for CDO (Basic)	Procedures for the crew to follow in case of abnormal events. Reference: Ops Manual defines SOPs	Aircraft operator	2013
Airborne system capability	Aircraft system	Aircraft Capability for CDO (Basic)	Eligibility for the applicable PBN navigation specification (if required) and vertical path capability, as defined in Doc 9613 (PBN Manual) and listed in the Aircraft Flight Manual (AFM)	Aircraft manufacturer Aircraft operator	2013
Ground system infrastructure	Navigation	NAVAIDS to support the applicable navigation specification used for CDO (Basic)	Depending on the navigation specification used, suitable ground based navigational aids will be required. See Doc 9613 (PBN Manual) for details.	ANSP	2013
Training	-	Training requirements for CDOs (Basic)	Crew trained to fly CDOs (Basic) CDO (Basic) training for Air traffic controllers CDO (Basic) training for procedure designers, Airspace planners. References: Doc 9906 (Vol 2); Doc 9992	ANSP Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Vertical flight efficiency	Avoid efficiency penalties attributable to non-optimum ToD (descent starts before or after the optimum ToD)	++	KPI19: Level-off during descent
Efficiency	Vertical flight efficiency	Avoid tactical lengthening of arrival path (eg vectoring, holding, trombone extension) because this leads to level flight	++	KPI19: Level-off during descent
Efficiency	Vertical flight efficiency	Reduce descent inefficiency attributable to altitude constraints imposed by ATM	++	KPI19: Level-off during descent

APTA-B0/5 CCO (Basic) Operational

Main Purpose: Reduce fuel burn by not requiring level-offs during climb.

New Capabilities: ATC procedures to facilitate uninterrupted climb, reducing ATC/Pilot interaction.

Description: Departing aircraft are allowed to climb continuously, to the greatest possible extent, by employing optimum engine thrust. An optimal continuous climb should start on take-off and allow the aircraft to climb efficiently using climb profiles that reduce controller pilot communications and segments of level flight until the top of climb.

Maturity Level: Ready for implementation

Human Factor Considerations:

1. Does it imply a change in task by a user or affected others? Yes

In ATC.

2. Does it imply processing of new information by the user? No

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	APTA-B0/2 - PBN SID and STAR procedures (with basic capabilities)
Relation-information need	AMET-B0/1 - Meteorological observations products

Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	Development of CCO (Basic) procedures	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent, with reference to Doc 9993 (CCO Manual)	ANSP, Aircraft operator	2013
Operational procedures	Design	CCO (basic) procedures validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. Ref: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP, CAA	2013
Operational procedures	Operations	SOPs for CCO (Basic) operations	Procedures for the crew to follow to facilitate the flying of a CCO. OPS Manual defines SOPs	Aircraft operator	2013
Operational procedures	Operations	Contingencies for CCO (Basic)	Procedures for the crew to follow in case of abnormal events. Reference: Ops Manual defines SOPs	Aircraft operator	2013
Airborne system capability	Aircraft system	Aircraft Capability for CCO (Basic)	Eligibility for the applicable PBN navigation specification (if required) and vertical path capability, as defined in Doc 9613 (PBN Manual) and listed in the Aircraft Flight Manual (AFM)	Aircraft manufacturer, Aircraft operator	2013
Ground system infrastructure	Navigation	NAVAIDS to support the applicable navigation specification used for CCO (Basic)	Depending on the navigation specification used, suitable ground based navigational aids will be required. See Doc 9613 (PBN Manual) for details.	ANSP	2013
Training	-	Training requirements for CCOs (Basic)	Crew trained to fly CCOs (Basic). Reference: Training to support the CCO concept. ATC trained to provides CCOs (Basic). Reference: Training to support the CCO concept. CDO (Basic) training for procedure designers, Airspace planners. References: Doc 9906 (Vol 2); Doc 9992	ANSP, Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Vertical flight efficiency	Reduce permanent (airspace and departure procedure design) and semi-permanent (ATFCM measures) altitude constraints (level capping) along the climb portion of traffic flows, in terminal and en-route airspace	++	KPI17: Level-off during climb

APTA-B0/6 PBN Helicopter Point in Space (PinS) Operations Operational

Main Purpose Helicopter unique capabilities allow IFR operations that start or terminate from any suitable point in space (PinS), as long as visual conditions support take-off/landing capability from that point.

New Capabilities Facilitating arrivals and departures to landing locations which do not otherwise support such operations.

Description PBN PinS operations include arrivals and departure procedures, specific to helicopters, that allow visual landing and take-off operations from heliports or other landing locations.

Maturity Level Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Operational procedures	Design	Helicopter PBN Point in Space (PinS) procedure design	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent.	ANSP	2013
Operational procedures	Design	Helicopter PBN Point in Space (PinS) procedure validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should be in accordance with Doc 8168 (PANS OPS Vol II). Ref: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design) The publication of the procedures should be in accordance with Doc 8168 (PANS OPS Vol II).	ANSP CAA	2013
Operational procedures	Operations	SOPs for Helicopter PBN Point in Space (PinS) operations	Procedures for the crew to follow to facilitate the flying of a CDO. OPS Manual defines SOPs	Aircraft operator	2013
Operational procedures	Operations	Contingencies for Helicopter PBN Point in Space (PinS) operations	Procedures for the crew to follow in case of abnormal events. Reference: Ops Manual defines SOPs	Aircraft operator	2019
Airborne system capability	Aircraft system	Aircraft capability for PBN Helicopter Point in Space (PinS) operations	Requires applicable PBN Navigation specification, as defined in Doc 9613 (PBN Manual) and listed in the Rotorcraft Flight Manual (RFM)	Aircraft manufacturer Aircraft operator	2013
Operational Authorization	-	Operational Authorization PBN Helicopter Point in Space (PinS) operations	Aircraft operator flying a PBN Helicopter Point in Space (PinS) operation should have an operational authorization related to the specified performance of the procedure, as described in Doc 9997 (PBN Ops Approval Manual)	CAA Aircraft operator	2013
Training	-	Training requirements for Helicopter PBN Point in Space (PinS)	Crew trained to fly Helicopter PBN Point in Space (PinS) procedures. Ref.: As defined in Doc 8168 (PANS OPS Vol I) Helicopter PBN Point in Space (PinS) training for ATC Helicopter PBN Point in Space (PinS) training for procedure designers, Airspace planners. References: Doc 8168 (PANS OPS Vol II); Doc 9906 (Vol 2).	ANSP Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Mitigate local airspace capacity constraints if this is the problem	++	KPI10: Airport peak throughput
Capacity	Capacity, throughput & utilization	Reduce approach minima (ceiling & visibility)	++	KPI10: Airport peak throughput

APTA-B0/7 Performance based aerodrome operating minima – Advanced aircraft Operational

Main Purpose

Standard Aerodrome operating minima are predicated upon aircraft equipped with the minimum required equipment (the basic aircraft) for that approach. These aerodrome operating minima relate directly to the established types and categories of operations and the associated infrastructure requirements (e.g. runway lights, approach lights). Aircraft with more advanced equipage can take advantage of existing infrastructure to obtain special authorizations for enhanced approach operations to lower minimums than basic aircraft can use.

New Capabilities

Advanced Aircraft are those aircraft with equipment in addition to that required for a Basic Aircraft for a given approach or landing operation. Examples of additional equipment could include EVS, HUD and/or autoland. The additional equipment allows the aircraft to operate to lower RVR values and/or to lower DH than would be achievable with a basic equipped aircraft. PB AOM are derived are derived by taking account of the combined capabilities of an Advanced Aircraft, and available ground facilities.

Description

For advanced aircraft, Improvements include:

- EVS operations using existing Type A or Type B CAT I procedures, requiring natural vision from 100 ft, but with significantly reduced RVR
- Lower that standard CAT I (SA CAT I) operations by means of HUD or autoland. CAT II operations with less infrastructure (SA CAT II) by means of HUD or autoland.
- EVS to land operations, using existing CAT I facilities but without the need to have natural visual references before landing.

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	APTA-B0/3 - SBAS/GBAS CAT I precision approach procedures
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	National regulatory framework	Operational credits	Provisions for operational credits to enable lower minima based on advanced aircraft capabilities. Reference: Annex 6 Part I	CAA	2013
Operational procedures	Operations	SOPs for Performance-based Aerodrome Operating Minima (Advanced aircraft)	Procedures for the crew to operate to minima determined by the combination of aircraft equipage and ground infrastructure. Defined in the Ops Manual. Reference: Doc 9365 (AWO Manual)	Aircraft operator	2013
Operational procedures	Operations	Contingency procedures for Performance-based Aerodrome Operating Minima (Advanced aircraft)	Procedures for the crew to follow in case of abnormal events. Defined in the Ops Manual	Aircraft operator	2013
Operational procedures	Operations	ATC procedures for Performance-based Aerodrome Operating Minima (Advanced aircraft)	Procedures for ATC to use in order to facilitate the use of performance-based minima at aerodromes. Low visibility operating plan for aerodrome ATC	ANSP	2013

Operational procedures	Operations	Aerodrome procedures for Performance-based Aerodrome Operating Minima (Advanced aircraft)	Procedures for ground operations by aircraft with advanced capabilities	Airport operator	2013
Airborne system capability	Aircraft system	Advanced aircraft capability	SBAS and GBAS as required EVS and HUD installation Reference: Doc 9365 (AWO Manual)	Aircraft manufacturer Aircraft operator	2013
Operational Authorization	-	Operational Authorization for Performance-based Aerodrome Operating Minima (Advanced aircraft)	Aircraft operator conducting PBAOM operations for low visibility operations require a specific approval detailing the operational credit applied Reference: Doc 9365 (AWO Manual)	CAA Aircraft operator	2013
Ground system infrastructure	Navigation	NAVAIDS to support the intended operation	Pre threshold terrain information for advanced aircraft operations SBAS/GBAS ground stations (as required)	Airport operator ANSP	2013
Training	-	Training requirements for Performance-based Aerodrome Operating Minima (Advanced aircraft)	Crew trained to fly using Performance-based Aerodrome Operating Minima (Advanced aircraft). Training on the use of advanced aircraft equipment such as EVS Reference: Doc 9365 (AWO Manual). ATC trained to understand implications of Performance-based Aerodrome Operating Minima (Advanced aircraft). Training for ATC on the application of operational credits for advanced aircraft and the effect on determining minima used by crews.	ANSP Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Reduce approach minima (ceiling & visibility)	++	KPI10: Airport peak throughput

APTA-B0/8	Performance based aerodrome operating minima – Basic aircraft	Operational

Main Purpose

For Basic aircraft, improvements include:

- Instrument approaches to non-instrument runways, improving airport access
- Flexibility to gradually improve the ground infrastructure with consequent improvements in operating minima

New Capabilities

New approach procedures can be added based on GNSS, without the need for any additional ground infrastructure. Non-instrument runways can support an instrument approach procedure, but with relatively high minima. Reduction of this minima is achieved by upgrading the runway to at least a non-precision runway, along with other improvements such as lighting and visual aids.

Description

Aerodrome operating minima are predicated upon the aircraft with the minimum equipment required (the basic aircraft). These aerodrome operating minima relate directly to the established types and categories of operations and the associated infrastructure requirements. An airport operator can choose to upgrade ground based infrastructure to add approach capability and/or to enable lower minimums for increased airport availability for all operations. Examples of such infrastructure upgrades include runway lighting, approach lighting, centreline lights. This also includes upgrade of runway from non-instrument to non-precision.

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	Design of approach procedures to non-instrument runways	Procedures should be designed in accordance with published criteria. Reference: Doc 8168 (PANS OPS Vol II)	ANSP	2013

Operational procedures	Design	Validation, approval and publication of approach procedures to non-instrument runways	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. Ref: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2013
Operational procedures	Operations	SOPs for operations using instrument approaches to non-instrument runways	Additional requirements for operating crews should be detailed in the Ops Manual.	Aircraft operator	2013
Operational procedures	Operations	Contingencies for operations using instrument approaches to non-instrument runways	Specific contingencies associated with operations to non-instrument runways should be detailed in the Ops manual	Aircraft operator	2013
Airborne system capability	Aircraft system	Aircraft capability for operating in instrument approaches to non-instrument runways	Aircraft eligible for applicable Navigation specification as defined in Doc 9613 (PBN Manual) and listed in the Aircraft Flight Manual.	Aircraft manufacturer Aircraft operator	2013
Ground system infrastructure	-	Ground based infrastructure to support the desired operating minima	Minimum requirement is a non-instrument runway for basic aircraft Additional elements may be used to reduce operating minim (lighting, visual aids etc.)	Airport operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Equip additional RWY ends with instrument approaches	++	KPI10: Airport peak throughput

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Reduce approach minima (ceiling & visibility)	++	KPI10: Airport peak throughput

APTA-B1/1 PBN Approaches (with advanced capabilities) Operational

Main Purpose
PBN approaches with advanced functionality allow for the introduction of more flexible approaches including the use of RF legs within the Final Approach Segment (FAS) and RNP.

New Capabilities
Use of advanced functionality as included in A-RNP and RNP AR (RF legs).

Description
This element represents the use advanced features of PBN in design of approach procedures to provide more access to airports in challenging environments, where conventional procedures are unsuitable.

Advanced RNP is the navigation specification which encompasses all elements of PBN (but excluding RNP AR APCH). It requires an FMS based on a TSO-C.

With A-RNP Ops approval, an operator can conduct any PBN operation except RNP AR APCH. RNP AR APCH requires a Specific Approval.

Maturity Level
Standardization

Human Factor Considerations
1. Does it imply a change in task by a user or affected others? Yes

2. Does it imply processing of new information by the user? No

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	APTA-B0/1 - PBN Approaches (with basic capabilities)
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	PBN approach (with advanced capabilities) procedures design and use	These instrument flight procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) and Doc 9905 (Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual).	ANSP	2019
Operational procedures	Design	PBN approach (with advanced capabilities) validation, approval, and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. Ref: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2019
Operational procedures	Operations	SOPs for PBN approaches (with advanced capabilities)	Procedures for the crew to follow to fly a PBN approach. Defined in the Ops Manual Reference: Doc 9613 (PBN Manual)	Aircraft operator	2019
Operational procedures	Operations	Contingency procedures for PBN approaches (with advanced capabilities)	Procedures for the crew to follow in case of abnormal events. Defined in the Ops Manual Reference: Doc 9613 (PBN Manual)	Aircraft operator	2019
Airborne system capability	Navigation	Aircraft capability for PBN approach (with advanced capabilities)	Aircraft eligible for RNP AR APCH Navigation specification, Advanced-RNP navigation specification as required. Defined in Doc 9613 (PBN Manual) and listed in the Aircraft Flight Manual.	Aircraft manufacturer Aircraft operator	2019
Operational Authorizatio n	-	Operational Authorization for PBN approaches (with advanced capabilities)	Operations based on RNP AR APCH require a specific approval. Advanced-RNP requires an operational authorization Reference: Doc 9997 (PBN Ops Approval Manual)	CAA Aircraft operator	2019

Training	-	Training requirements for PBN Approaches (with advanced capabilities)	Training for ATCOs, procedure designers, airspace planners and crew to fly PBN Approaches (with advanced capabilities). References: Doc 9613 (PBN Manual). Additional training on the use of advanced capabilities in procedure design: PANS-OPS Vol II Doc 9905 (Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual) Doc 9992 (Manual on the Use of Performance-Based Navigation (PBN) in Airspace Design) Doc 9906 (Vol 2)	ANSP Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Equip additional RWY ends with instrument approaches	++	KPI10: Airport peak throughput
Capacity	Capacity, throughput & utilization	Reduce approach minima (ceiling & visibility)	++	KPI10: Airport peak throughput

APTA-B1/2 PBN SID and STAR procedures (with advanced capabilities) Operational

Main Purpose Advanced PBN functionality further supports flexibility of route placements in airspace design.

New Capabilities Use of advanced functionality to enable more flexibility in airspace design, such as RF legs outside of the Final Approach Segment. Introduction of RNP AR Departures.

Description This element represents the use advanced features of PBN in design of arrival procedures to provide more flexibility in airspace design, leading to greater efficiency in the terminal area and increased capacity.

Advanced RNP is the navigation specification which encompasses all elements of PBN (but excluding RNP AR APCH). It requires an FMS based on a TSO-C115d.

With A-RNP Ops approval, an operator can conduct any PBN operation except RNP AR APCH. RNP AR APCH requires a separate Ops approval.

Maturity Level Standardization

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	APTA-B0/2 - PBN SID and STAR procedures (with basic capabilities)
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	PBN SID and STAR Procedures (with advanced capabilities) procedure design and use	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent.	ANSP	2019
Operational procedures	Design	PBN SID and STAR Procedures (with advanced capabilities) validation, approval, and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. Ref: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2019
Operational procedures	Operations	SOPs for PBN SID/STAR (with advanced capabilities)	Procedures for the crew to follow to fly a PBN SID/STAR. Defined in the Ops Manual Reference: Doc 9613 (PBN Manual)	Aircraft operator	2019

Operational procedures	Operations	Contingencies for PBN SID/STAR (with advanced capabilities)	Procedures for the crew to follow in case of abnormal events. Defined in the Ops Manual. Reference: Doc 9613 (PBN Manual)	Aircraft operator	2019
Airborne system capability	-	Aircraft capability for PBN SID/STAR (with advanced capabilities)	Aircraft eligible for applicable Navigation specification as defined in Doc 9613 (PBN Manual) and listed in the Aircraft Flight Manual.	Aircraft manufacturer Aircraft operator	2019
Operational Authorization	-	Operational Authorization for PBN SID/STAR (with advanced capabilities)	Aircraft operator flying a PBN SID/STAR should have an operational authorization related to the specified performance of the procedure, as described in Doc 9997 (PBN Ops Approval Manual)	CAA Aircraft operator	2019
Ground system infrastructure	Navigation	NAVAIDS to support the applicable navigation specification used for SID/STAR (with advanced capabilities)	Depending on the navigation specification used, suitable ground based navigational aids will be required. Reference: Doc 9613 (PBN Manual)	ANSP	2019
Training	-	Training requirements for PBN SID/STAR (with advanced capabilities)	Training for ATCOs, procedures designers and crew to fly PBN SID/STAR (with advanced capabilities). References: Doc 9613 (PBN Manual); Additional training for advanced capabilities as defined in Doc 9613 (PBN Manual) Reference: Doc 8168 (PANS OPS Vol II) Doc 9906 (Vol 2)	ANSP Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Increase airport arrival rate	++	KPI11: Airport throughput efficiency
Capacity	Capacity, throughput & utilization	Mitigate local airspace capacity constraints if this is the problem	++	KPI10: Airport peak throughput
Capacity	Capacity, throughput & utilization	Mitigate noise constraints if this is the problem	++	KPI10: Airport peak throughput

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Vertical flight efficiency	Reduce permanent (airspace and approach procedure design) and semi-permanent (ATFCM measures) altitude constraints along the descent portion of traffic flows, in en-route and terminal airspace	++	KPI19: Level-off during descent
Efficiency	Vertical flight efficiency	Reduce permanent (airspace and departure procedure design) and semi-permanent (ATFCM measures) altitude constraints (level capping) along the climb portion of traffic flows, in terminal and en-route airspace	++	KPI17: Level-off during climb

APTA-B1/3 Performance based aerodrome operating minima – Advanced aircraft with SVGS Operational

Main Purpose
Use of advanced features on aircraft permit operations using lower than standard minima on existing procedures. This builds on the Block 0 element for PB AOM (Advanced Aircraft) and enables the use of Synthetic Vision Guidance Systems (SVGS).

New Capabilities
Definition of more precise approaches down to SA CAT I minima by use of SVGS.

Description
This element builds on the PB AOM concept to allow operations for advanced aircraft utilizing the concept of operational credit. The use of guidance systems based on synthetic vision expands on the previous capability to use SVS for situational awareness only.

Maturity Level
Standardization

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element

Evolution	APTA-B0/7 - Performance based aerodrome operating minima – Advanced aircraft
Relation-operational need	APTA-B0/3 - SBAS/GBAS CAT I precision approach procedures
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	National regulatory framework	Operational credits	Provisions for operational credits to enable lower minima based on advanced aircraft capabilities. Reference: Annex 6 Part I	CAA	2013
Operational procedures	Operations	SOPs for Performance-based Aerodrome Operating Minima (Advanced aircraft with SVGS)	Procedures for the crew to operate to minima determined by the combination of aircraft equipage and ground infrastructure. Defined in the Ops Manual. Reference: Doc 9365 (AWO Manual)	Aircraft operator	2019
Operational procedures	Operations	Contingency procedures for Performance-based Aerodrome Operating Minima (Advanced aircraft with SVGS)	Procedures for the crew to follow in case of abnormal events. Defined in the Ops Manual	Aircraft operator	2019
Operational procedures	Operations	ATC procedures for Performance-based Aerodrome Operating Minima (Advanced aircraft with SVGS)	Procedures for ATC to use in order to facilitate the use of performance-based minima at aerodromes. Low visibility operating plan for aerodrome ATC	ANSP	2019

Operational procedures	Operations	Aerodrome procedures for Performance-based Aerodrome Operating Minima (Advanced aircraft with SVGS)	Procedures for ground operations by aircraft with advanced capabilities	Airport operator	2019
Airborne system capability	Aircraft system	Advanced aircraft capability with SVGS	SBAS and GBAS as required SVGS and HUD installation Reference: Doc 9365 (AWO Manual)	Aircraft manufacturer Aircraft operator	2019
Ground system infrastructure	Navigation	NAVAIDS to support the intended operation with SVGS	Pre threshold terrain information for advanced aircraft operations SBAS/GBAS ground stations (as required)	Airport operator ANSP	2019
Training	-	Training requirements for Performance-based aerodrome operating minima (Advanced Aircraft with SVGS)	Crew trained to fly using Performance-based Aerodrome Operating Minima (Advanced aircraft with SVGS) Training on the use of advanced aircraft equipment such as SVGS Reference: Doc 9365 (AWO Manual) ATC trained to understand implications of Performance-based Aerodrome Operating Minima (Advanced aircraft with SVGS) Training for ATC on the application of operational credits for advanced aircraft and the effect on determining minima used by crews.	ANSP Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Reduce approach minima (ceiling & visibility)	++	KPI10: Airport peak throughput

APTA-B1/4	CDO (Advanced)	Operational
Main Purpose	Increase the ability CDO operations to contribute to terminal airspace efficiency.	
New Capabilities	High accuracy vertical navigation permits more precise paths to be flown by arriving aircraft.	

Description

This element builds on the basic CDO capabilities and adds advanced vertical path management. This gives the ability to more precisely define the path flown by arriving aircraft, which allows for more flexible and efficient use of airspace. Compromise between aircraft optimal performance and airspace optimal efficiency can be achieved.

PBN with vertical navigation (VNAV) which is an altimetry-based capability is used and allows an equipped aircraft to precisely descend on a vertical path, as computed by avionics equipment, while providing the flight crew with navigation performance information through avionics. To this end, vertical windows in procedure design enable CDOs, particularly where SID/STARs cross each other.

Initially the benefits will be realised for airspace outside of the TMA, and for less congested environments.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

2. Does it imply processing of new information by the user? No

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	APTA-B0/4 - CDO (Basic)
Relation-operational need	APTA-B0/2 - PBN SID and STAR procedures (with basic capabilities)
Relation-operational benefit	RSEQ-B0/3 - Point merge
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	Development of CDO (advanced) procedures	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent, with reference to Doc 9931 (CDO Manual)	ANSP Aircraft operator	2019

Operational procedures	Design	CDO (advanced) procedures validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. Ref: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2019
Operational procedures	Operations	SOPs for CDO (advanced) operations	Procedures for the crew to follow to facilitate the flying of a CDO. OPS Manual defines SOPs	Aircraft operator	2019
Operational procedures	-	Contingencies for CDO (advanced)	Procedures for the crew to follow in case of abnormal events. Reference: Ops Manual defines SOPs	Aircraft operator	2019
Airborne system capability	Aircraft system	Aircraft Capability for CDO (advanced)	Eligibility for the applicable PBN navigation specification with vertical navigation (VNAV) capability Reference: Doc 9613 (PBN Manual)	Aircraft manufacturer Aircraft operator	2019
Ground system infrastructure	Navigation	NAVAIDS to support the applicable navigation specification used for CDO (advanced)	Depending on the navigation specification used, suitable ground based navigational aids will be required. Reference Doc 9613 (PBN Manual).	ANSP	2019
Training	-	Training requirements for CDOs (advanced)	Crew trained to fly CDOs (advanced) CDO (advanced) training for Air traffic controllers CDO (advanced) training for procedure designers. References: Doc 9906 (Vol 2) Doc 8168 (PANS OPS Vol II)	ANSP Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Vertical flight efficiency	Avoid efficiency penalties attributable to non-optimum ToD (descent starts before or after the optimum ToD)	++	KPI19: Level-off during descent
Efficiency	Vertical flight efficiency	Avoid tactical lengthening of arrival path (eg vectoring, holding, trombone extension) because this leads to level flight	++	KPI19: Level-off during descent

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Vertical flight efficiency	Reduce descent inefficiency attributable to altitude constraints imposed by ATM	++	KPI19: Level-off during descent

APTA-B1/5	CCO (Advanced)	Operational

Main Purpose: Increase the ability CCO operations to contribute to terminal airspace efficiency.

New Capabilities: High accuracy vertical navigation permits more precise paths to be flown by departing aircraft.

Description: This element builds on the basic CCO capabilities and adds advanced vertical path management. This gives the ability to more precisely define the path flown by departing aircraft, which allows for more flexible and efficient use of airspace. Compromise between aircraft optimal performance and airspace optimal efficiency can be achieved.

PBN with vertical navigation (VNAV) which is an altimetry-based capability is used and allows an equipped aircraft to precisely ascend on a vertical path, as computed by avionics equipment, while providing the flight crew with navigation performance information through avionics. To this end, vertical windows in procedure design enable CCOs, particularly where SID/STARs cross each other.

Initially the benefits will be realised for airspace outside of the TMA, and for less congested environments.

Maturity Level: Standardization

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	APTA-B0/5 - CCO (Basic)
Relation-operational need	APTA-B0/2 - PBN SID and STAR procedures (with basic capabilities)
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design	Development of CCO (advanced) procedures	These procedures should be designed and used as specified in Doc 8168 (PANS-OPS Vol II and I) or equivalent, with reference to Doc 9993 (CCO Manual)	ANSP Aircraft operator	2019
Operational procedures	Design	CCO (advanced) procedures validation, approval and publication	A flight inspection and/or validation of the procedures might be required before publication. The publication of the procedures should follow Annex 4. Ref: ICAO Doc 8071 (Volume I — Testing of Ground-based Radio Navigation Systems) Doc 9906 (Quality Assurance Manual for Flight Procedure Design). Doc 9906 Vol 6 (Quality Assurance Manual for Flight Procedure Design)	ANSP CAA	2019
Operational procedures	Operations	SOPs for CCO (advanced) operations	Procedures for the crew to follow to facilitate the flying of a CCO. OPS Manual defines SOPs	Aircraft operator	2019
Operational procedures	Operations	Contingencies for CCO (advanced)	Procedures for the crew to follow in case of abnormal events. Reference: Ops Manual defines SOPs	Aircraft operator	2019
Airborne system capability	Aircraft system	Aircraft Capability for CCO (advanced)	Eligibility for the applicable PBN navigation specification with vertical navigation (VNAV) capability Reference: Doc 9613 (PBN Manual)	Aircraft manufacturer Aircraft operator	2019
Ground system infrastructure	Navigation	NAVAIDS to support the applicable navigation specification used for CCO (advanced)	Depending on the navigation specification used, suitable ground based navigational aids will be required. See Doc 9613 (PBN Manual) for details.	ANSP	2019
Training	-	Training requirements for CCOs (advanced)	Crew trained to fly CCOs (advanced). Training to support the CCO concept. ATC trained to provides CCOs (advanced). Training to support the CCO concept. CCO (advanced) training for procedure designers. Reference: Doc 9906 (Vol 2)	ANSP Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Vertical flight efficiency	Reduce permanent (airspace and departure procedure design) and semi-permanent (ATFCM measures) altitude constraints (level capping) along the climb portion of traffic flows, in terminal and en-route airspace	++	KPI17: Level-off during climb

ASUR

ASUR-B0/1	Automatic Dependent Surveillance – Broadcast (ADS-B)	Technology

Main Purpose

To support the provision of Air Traffic Services and operational applications at reduced cost and increased surveillance coverage.

New Capabilities

ADS-B provides precise position/velocity information in all airspace (accuracy not range-dependent as with radar). It also provides aircraft call sign and precise position/velocity information to nearby aircraft with ADS-B-In receivers.

ADS-B can also support State aircraft airspace access, however it should, when possible, leverage benefits from dual-use of State aircraft capabilities to reduce cost and technical impact.

Description

ADS-B provides an aircraft's identification, position, altitude, velocity, and other information to any receiver (airborne or ground) within range. The broadcasted aircraft position/velocity is normally based on the global navigation satellite system (GNSS) and transmitted at least once per second.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	NAVS-B0/3 - Aircraft Based Augmentation Systems (ABAS)
Relation-benefit	NAVS-B0/2 - Satellite Based Augmentation Systems (SBAS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Ground system infrastructure	Surveillance	ADS-B ground stations	ADS-B ground stations receive information from aircraft and transmit it to one or more Service Delivery Points Reference material: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapter 2,3 and 5 ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter RTCA/EUROCAE MOPS: DO-260/ED-102, DO-260A, or DO-260B/ED-102A EUROCAE ED-129, ED-129A or ED-129B ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2008
Ground system infrastructure	Surveillance	*Service Delivery Point(s) for ADS-B information	Service Delivery Point(s) receive ADS-B information provides it to ATC automation for processing and display to controller Reference material: Guidance material: ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2008
Ground system infrastructure	Technical systems	HMI that supports controller awareness	Human Machine Interface (HMI) of the Air Traffic Controller Working Position (ATCo CWP) Reference: Guidance material: ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2008
Airborne system capability	Surveillance	SSR Mode S transponder with extended squitter version 0, version 1 and version 2	Reference: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapter 2,3 and 5 ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter RTCA/EUROCAE MOPS: DO-260/ED-102, DO-260A, or DO-260B/ED-102A ICAO Doc. 9924 Aeronautical Surveillance Manual	Aircraft manufacturer Aircraft operator	2008
Training	-	Training requirements ADS-B implementation	Depending on the ANSP implementation, some controller training on new symbology may be required. If phraseology is changed by an ANSP, then controller and pilot training on the new phraseology is required. If new ANSP equipment is installed, then training for maintenance personnel may be required (see ICAO Doc 8071).	ANSP	2008

Airborne system capability	Navigation	Basic Aviation GNSS receiver with RAIM	Position source. Basic Aviation GNSS receiver with RAIM. Such a receiver must comply with the technical performance requirements of either [E]TSO-C129, or [E]TSO-C196, or [E]TSO-C145/-C146. (Note that the US/Europe and equivalent ADS-B mandates require more – see FAA AC 20-165 or EASA CS-ACNS).	Aircraft manufacturer Aircraft operator	2008

ASUR-B0/2 — Multilateration cooperative surveillance systems (MLAT) — Technology

Main Purpose To provide an alternative to radar surveillance by using available aircraft transponders.

New Capabilities MLAT allows cooperative surveillance in rough terrain such as in mountainous regions or on airport surfaces where surveillance systems requiring a rotating radar dish had performance difficulties. It may also be integrated with ADS-B ground stations to provide a surveillance capability that is more resilient to GNSS function failure.

Description MLAT is a new technique providing independent cooperative surveillance. The MLAT system interrogates an aircraft and the transponder reply is received by multiple receivers located in different places. The reply's times of arrival difference at the receivers allows the position of the source of signals to be determined, with an accuracy that is dependent on the number of receivers and their location relative to the aircraft. MLAT systems do not require a rotating radar dish and were initially deployed on airports to provide surface surveillance of aircraft. The technique is now used to provide surveillance over wide area (wide area MLAT system - WAM), sometimes in conjunction with ADS-B. MLAT requires more ground stations than ADS-B, but has the early implementation advantage of using existing aircraft transponders.

Maturity Level Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Ground system infrastructure	Surveillance	MLAT ground stations	MLAT ground stations interrogate aircraft transponders and receive/process transponder replies to determine aircraft position; this information is then transmitted to Service Delivery Point(s) Reference material: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapters 2,3,5 and 6. ICAO Doc 9871 Technical Provisions for Mode S Services and Extended Squitter RTCA/EUROCAE MOPS: DO-181D/ED-73C or subsequent versions ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2008
Airborne system capability	Surveillance	SSR Mode A, C and S transponders	References: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapter 2,3 and 5 ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter RTCA/EUROCAE MOPS: DO-181D/ED-73C or subsequent versions ICAO Doc. 9924 Aeronautical Surveillance Manual	Aircraft manufacturer Aircraft operator	2008
Ground system infrastructure	Surveillance	Service Delivery Point (s) for MLAT information	Service Delivery Points(s) receive MLAT information and provide it to ATC automation for display to controller Reference: Guidance material: ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2008
Training	-	Training requirements MLAT implementation	If new ANSP equipment is installed, then training for maintenance personnel may be required (see Doc 8071).	ANSP	2008

ASUR-B0/3	Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)	Technology

Main Purpose To obtain additional information from an aircraft transponder in support of the provision of Air Traffic Services.

New Capabilities SSR-DAPS enables ATM systems to obtain additional information from an aircraft transponder, via interrogation by a cooperative surveillance system (Mode S radar or MLAT). This additional information can be used to increase controller awareness and reduce the volume of air-ground voice communications, and/or to improve the performance of tracking systems or safety net systems such as STCA and MSAW.

Description

Downlink of Aircraft Parameters (DAPS) includes both Controller Access Parameters (CAPs) and System Access Parameters (SAPs). Possible CAPs include Magnetic Heading, Indicated Airspeed / Mach Number, Barometric rate of climb/descent, and Selected Altitude (which can also be consider a SAP). SAPs include Roll Angle, Track Angle Rate, True Track Angle, and Barometric Pressure Setting.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Airborne system capability	Surveillance	SSR Mode A, C and S transponders	References: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapter 2,3 and 5 ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter RTCA/EUROCAE MOPS: DO-181D/ED-73C or subsequent versions ICAO Doc. 9924 Aeronautical Surveillance Manual	Aircraft manufacturer Aircraft operator	2008
Ground system infrastructure	Surveillance	Mode S cooperative surveillance system	Mode S cooperative surveillance system with DAPS capability interrogates aircraft transponders to retrieve data; this information is then provided to the ATC automation system. Reference material: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapter 2,3 and 5 ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter: RTCA/EUROCAE MOPS: DO-181D/ED-73C or subsequent versions ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2008

Ground system infrastructure	Technical systems	*HMI that supports controller awareness for CAPs and automation processing for SAPs	Reference: Guidance material: ICAO Doc 9924 Aeronautical Surveillance Manual	ANSP	2008
Training	-	Training requirements SSR-DAPS implementation	Depending on the ANSP implementation, some controller training on new symbology or alerts may be required. If phraseology is changed, or new phraseology is introduced by an ANSP, then controller and pilot training on the new phraseology is required. If new ANSP equipment is installed, then training for maintenance personnel may be required (see Doc 8071).	ANSP	2008

ASUR-B1/1 Reception of aircraft ADS-B signals from space (SB ADS-B) Technology

Main Purpose To provide surveillance coverage in locations where ground stations siting is not possible or not currently provided.

New Capabilities SB ADS-B provides precise position/velocity information in airspace where it is not cost-effective or even feasible to place ground surveillance infrastructure.

Description ADS-B provides an aircraft's identification, position, altitude, velocity, and other information to a receiver on an orbiting satellite. The broadcasted aircraft position/velocity is normally based on the global navigation satellite system (GNSS) and transmitted at least once per second. Aircraft ADS-B signals are received on one or more orbiting satellites, and this information is passed through a data network to a Service Delivery Point at an Air Traffic Service facility (or facilities).

Maturity Level Standardization

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Relation-operational need	NAVS-B0/3 - Aircraft Based Augmentation Systems (ABAS)

Relation-benefit	NAVS-B0/2 - Satellite Based Augmentation Systems (SBAS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Ground system infrastructure	Technical systems	HMI that supports controller awareness	Human Machine Interface (HMI) of the Air Traffic Controller Working Position (ATCo CWP) Reference: Guidance material: ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2008
Airborne system capability	Surveillance	SSR Mode S transponder with extended squitter version 0, version 1 and version 2	Reference: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapter 2,3 and 5 ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter RTCA/EUROCAE MOPS: DO-260/ED-102, DO-260A, or DO-260B/ED-102A ICAO Doc. 9924 Aeronautical Surveillance Manual	Aircraft manufacturer Aircraft operator	2008
Ground system infrastructure	Surveillance	*ADS-B receivers on orbiting satellites	ADS-B receivers on orbiting satellites receive information from aircraft and transfer this information to ground Service Delivery Point(s). Reference: Technical standards and guidance material: ICAO Annex 10 Volume IV Chapter 2,3 and 5 ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter: RTCA/EUROCAE MOPS: DO-260/ED-102, DO-260A, or DO-260B/ED-102A EUROCAE ED-129A or ED-129B ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2015
Ground system infrastructure	Surveillance	Service Delivery Point(s) for satellite ADS-B	Service Delivery Point(s) receive information and transfer it to ATC automation for processing and display to controller. Reference: Guidance material: ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2015

Training	-	Training requirements SB ADS-B	If this capability is used to apply new separation minima per PANS-ATM, controller training is required. Depending on the ANSP implementation, some controller training on new symbology may be required. If phraseology is changed by an ANSP, then controller and pilot training on the new phraseology is required. If new ANSP equipment is installed, then training for maintenance personnel may be required (see ICAO Doc 8071).	ANSP	2018
Airborne system capability	Navigation	Basic Aviation GNSS receiver with RAIM	Position source. Basic Aviation GNSS receiver with RAIM. Such a receiver must comply with the technical performance requirements of either [E]TSO-C129, or [E]TSO-C196, or [E]TSO-C145/-C146. (Note that the US/Europe and equivalent ADS-B mandates require more – see FAA AC 20-165 or EASA CS-ACNS).	Aircraft manufacturer Aircraft operator	2008

COMI

COMI-B0/1	Aircraft Communication Addressing and Reporting System (ACARS)	Technology

Main Purpose ? The Aircraft Communications Addressing and Reporting System (ACARS) is a digital datalink system for transmission of messages between aircraft and ground stations via VHF or satellites.

New Capabilities ? ACARS provides the network for the controller and pilot with the ability to exchange datalink messages and thus provides a backup to voice communications. It also provides for airline operational control messaging.

Description ? ACARS is a digital datalink network system which transmits and routes messages between aircraft and ground stations via VDL Mode 0/Mode2 radios or satellites.

Maturity Level ? Ready for implementation

Human Factor Considerations

PLANNING LAYERS ?

Tactical-During ops

OPERATIONS ?

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS ?

Type of Dependencies	ASBU Element
Relation-technology option	COMI-B0/3 - VHF Data Link (VDL) Mode 0/A
Relation-technology option	COMI-B0/4 - VHF Data Link (VDL) Mode 2 Basic
Relation-technology option	COMI-B0/5 - Satellite communications (SATCOM) Class C Data
Relation-technology option	COMI-B0/6 - High Frequency Data Link (HFDL)
Relation-technology benefit	COMI-B1/2 - VHF Data Link (VDL) Mode 2 Multi-Frequency
Relation-technology benefit	COMI-B1/3 - SATCOM Class B Voice and Data

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Protocols	Communication infrastructure	ACARS Protocols	AEEC 618- Air Ground Character-Oriented Protocol. (AEEC 620 Datalink Ground System Standard and Interface Specification) ARINC 622- ATS Datalink Applications over ACARS Air-Ground Network. AEEC 623- Character-Oriented Air Traffic Services. ARINC 633 is the air-ground definition for sending XML over ACARS	ANSP Aircraft manufacturer	2013
Airborne system capability	Communication infrastructure	ACARS Airborne Radio Transceiver	ACARS is a digital datalink system for transmission of short messages between aircraft and ground stations via airband radio or satellite. AEEC 618- Air Ground Character-Oriented Protocol. AEEC 620 Datalink Ground System Standard and Interface Specification ARINC 624 is a standard for aircraft onboard maintenance system	Aircraft manufacturer Aircraft operator	2013
Ground system infrastructure	Communication infrastructure	ACARS Ground Radio Transceiver	ACARS is a digital datalink system for transmission of short messages between aircraft and ground stations via airband radio or satellite. AEEC 618- Air Ground Character-Oriented Protocol. AEEC 620 Datalink Ground System Standard and Interface Specification	ANSP Ground systems supplier	2013
Space system infrastructure	Communication infrastructure	ACARS Space Radio Transceiver	Inmarsat Classic Aero Standard and Iridium Standard (includes a satellite data unit, a high power amplifier and an antenna with a steerable beam).	Satellite provider	2013

COMI-B0/2	Aeronautical Telecommunication Network/Open System Interconnection (ATN/OSI)	Technology

Main Purpose: ATN/OSI provides a bit-oriented multi-layer protocol for exchanging ATS messages between the aircraft and ground system.

New Capabilities: The ATN/OSI provides an alternative, dedicated ATS protocol for exchanging flight safety messages.

Description: The ATN/OSI provides a dedicated ATS commuications protocol for the usage of B1 data link applications (e.g. CPDLC and CM).

Maturity Level: Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology benefit	COMI-B1/2 - VHF Data Link (VDL) Mode 2 Multi-Frequency
Relation-technology benefit	COMI-B1/3 - SATCOM Class B Voice and Data
Relation-technology benefit	COMI-B3/1 - VHF Data Link (VDL) Mode-2 Connectionless
Relation-technology need	COMI-B0/4 - VHF Data Link (VDL) Mode 2 Basic

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Protocols	Communication infrastructure	ATN/OSI protocol	ICAO Doc. 9880- Manual on Detailed Technical Specifications for the ATN/OSI.	ANSP	2013
Airborne system capability	Communication infrastructure	ATN/OSI Airborne Router	ICAO Doc. 9880- - Manual on Detailed Technical Specifications for the ATN/OSI. Connectivity is to be accomplished over multiple subnetwork types. The ATN currently recognizes a limited set of subnetworks: SSR Mode Select (Mode S), Very High Frequency (VHF) Digital Link (VDL), Aeronautical Mobile Satellite Service (AMSS), Gatelink, and High Frequency (HF).	ANSP Aircraft manufacturer	2013

Ground system infrastructure	Communication infrastructure	ATN/OSI Ground Router	ICAO Doc. 9880- Manual on Detailed Technical Specifications for the ATN/OSI.	ANSP	2013

COMI-B0/3	VHF Data Link (VDL) Mode 0/A	Technology

Main Purpose

VDL Mode 0/A is a data communications subnetwork that supports transmission of data link messages.

New Capabilities

- Introduction of a datalink to support domestic data communications operations.
- a supplement to voice communications
- Exchanges aviation data (AOC, CPDLC and ADS)

Description

VDL Mode 0/A is a narrow-band transceiver operating in the VHF aviation protected spectrum band which will transmit data to and from the aircraft to support data communications. The VHF digital radio system is based on the double side band AM multi-shift keying modulation to transfer 2400 bps.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Protocols	Communication infrastructure	“Plain Old” ACARS (POA) protocol	AEEC 758 - Communications Management Unit ARINC 771 - Low-earth orbiting aviation satellite communication systems	ANSP Aircraft manufacturer	2013
Airborne system capability	Communication infrastructure	VDL Mode 0/A airborne Analog Radio	AEEC 618 - Air/ground character-oriented protocol specification	ANSP Aircraft manufacturer	2013
Ground system infrastructure	Communication infrastructure	VDL Mode 0/A Ground Analog transceiver	Datalink Ground System Standards and Interface Specification (ARINC 620). Defines the interfaces to the ACARS Ground System Operated by a Datalink Service Provider.	ANSP Ground systems supplier	2013

COMI-B0/4	VHF Data Link (VDL) Mode 2 Basic	Technology

Main Purpose

VDL Mode 2 Basic is a data communications subnetwork that supports transmission of data link messages. It provides higher performance than VDLM0/A.

New Capabilities

- Provides an Increase in data capacity over VDL Mode O/A
- Exchanges aviation data (AOC, CPDLC and ADS)
- More efficient use of spectrum

Description

VDL Mode 2 is narrow-band transceiver operating in the VHF aviation protected spectrum band, which will transmit data to support data communications between the aircraft and ground. It consists of a set of air-ground protocols that increase the data rate to 31.5 kbits.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	COMI-B0/3 - VHF Data Link (VDL) Mode 0/A

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Protocols	Communication infrastructure	VDL-M2 operational Usage & Protocol	VDL-M2 is the primary VDL mode being implemented operationally to support Controller Pilot Data Link Communications. • ICAO Doc 9776 VDL2 Technical Manual • VHF air-ground Digital Link (VDL) Mode 2; Technical characteristics and methods of measurement for ground-based equipment ETSI EN 301 841-1 • RTCA DO 224 Minimum Aviation System Performance Standard) • ARINC 631 VHF Digital Link (VDL) Mode 2 implementation provisions	ANSP	2013

Airborne system capability	Communication infrastructure	VDL-M2 Digital Airborne Radio Transceiver	Aircraft must be fitted with a digital connection to a VHF Digital Radio (VDR) transceiver. • AEEC 631-B • DO-281B (RTCA Minimum Aviation System Performance) • ED-92B (EUROCAE MOPS)	ANSP	2013
Ground system infrastructure	Communication infrastructure	VDL-M2 Digital Ground Radio Transceiver	VHF Digital Link Mode 2 system uses digital radios to improve the performance of VHF analog data link. VDL Mode 2 provides a data rate of 31.5 kbit/second using a radio channel that is the same width as the channel used by the VHF analog data link system, providing a data rate of only 2.4 kbit/second. • DO-224C (RTCA Minimum Aviation System Performance Standard)	ANSP	2013

COMI-B0/5 Satellite communications (SATCOM) Class C Data — Technology

Main Purpose: To provide surveillance and communications where VHF usage is not possible or practicle.

New Capabilities: Supports improvement of surveillance and communication in airspace where procedural separation is being applied.

Description: Satellite-based, narrow-band communication provided by multiple service providers that can be used for safety and routing communciations.

Maturity Level: Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Protocols	Communication infrastructure	SATCOM Class C Usage and Data Protocol	SATCOM Performance Class C covers the performance requirements included in the current AMS(R)S SARPs and is applicable to systems already standardized in ICAO (such as Inmarsat Classic Aero, MTSAT and Iridium SBD) as well as the Inmarsat SBB system which was recently included in the AMS(R)S Manual. Class C is effectively covering remote and oceanic operations (Performance specification DO-306/ED-122). NGSS DO-210/DO-262	ANSP Satellite provider	2013
Airborne system capability	Communication infrastructure	SATCOM Class C Management Unit (Airborne Radio Transceiver)	AMSRS Satellite SARPS with Section for INMARSAT and Iridium AEEC 741, 761, 781-7 SATCOM Class C Form, Fit and Function	Aircraft manufacturer Satellite provider	2013
Ground system infrastructure	Communication infrastructure	SATCOM Class C Ground Radio Transceiver	Minimum Aviation System Performance Standards (MASPS) for the aeronautical mobile-satellite (R) service (AMS(R)S) as used in aeronautical data links.	ANSP	2013
Space system infrastructure	Communication infrastructure	SATCOM Class C Space Radio Transceiver	Aeronautical Mobile Satellite (Route) Service Manual (Doc 9925) with a section that addresses Satcom Performance Class C	Satellite provider	2013
Space system infrastructure	Communication infrastructure	Communication satellites for class C	Inmarsat I4, MTSAT and Iridium.	Satellite provider	2013

COMI-B0/6	High Frequency Data Link (HFDL)	Technology

Main Purpose: To communicate in areas where SATCOM and VHF are not available.

New Capabilities: HFDL is a communications media used to exchange data messages between aircraft end-systems and corresponding ground-based HFDL ground stations.

Supports improvement of surveillance in airspace where procedural separation is being applied.

Description: The HFDL includes the HFDL network and avionics. Specifically this means the introduction of an airborne communications router (e.g. Communications Management Unit) and an HFDL radio.

Maturity Level: Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Protocols	Communication infrastructure	HF Datalink operational Usage & Protocol	HFDL is an ACARS communications media that is used to exchange data between aircraft end-systems and ground based stations. • ARINC Specification 635-4: HF Data Link Protocols • ARINC Characteristic 753-2: HF Data Link System • ARINC Report 634: HF Data Link System Design Guidance Material • ICAO Doc. 9741 HFDL	ANSP Aircraft manufacturer	2013
Airborne system capability	Communication infrastructure	HFDL data radio transmission	To use High Frequency Data Links an aircraft needs to be equipped with a Communications Management Function or equivalent. This allow for airborne communications to interface with many aircraft communications systems. • DO-265 HFDL MOPS	ANSP Aircraft manufacturer	2013
Ground system infrastructure	Communication infrastructure	HFDL ground radio transmission	• DO-277 MASPS	ANSP Aircraft manufacturer	2013

COMI-B0/7 ATS Message Handling System (AMHS) Technology

Main Purpose

- Supports improved communication over AFTN
- Provide flight information coordination between ANSPs at adjacent FIRs, and with relevant military units, support separation assurance, potentially providing, when used in conjunction with other enablers (e.g. navigation capabilities), reduced separation.

New Capabilities

- AMHS makes use of higher speed communication than AFTN. It also allows the use of bit-oriented communications allowing greater flexibility in message types. Attachments to messages can also be supported thus allowing the exchange of graphics. Provides direct communication between adjacent FIRs using data communication to minimize the use of voice communication.
- Increase performance to handle large files
- Implement AFTN/AMHS gateway
- Initiate the standardization of IP interface and addressing scheme

Description

The AMHS is served as ICAO mandated communication for data exchange between ANSPs (ICAO Doc. 9880 and Annex X). AMHS is served as enabler for

1. Flight Plan/Clearance
2. AIDC: Flight transfer
3. MET data

ATS voice service is used for emergency coordination and/or normal coordination when data communication service is not available.

AMHS is expected to be utilized to carry traffic for AIDC/Flight Plan/MET until SWIM is ready in Block 2. This is due to ANSPs need time to upgrade/implement adaptors to support SWIM interface. In the meantime, AMHS will accommodate SWIM compliance data message (IWXXM) as required. It is noted that AMHS would not be able to support FF-ICE and FIXM data.

The interface is based on IP over legacy dedicated point-to-point circuits.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology benefit	COMI-B1/1 - Ground-Ground Aeronautical Telecommunication Network/Internet Protocol Suite (ATN/IPS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Protocols	Communication infrastructure	AMHS operational Usage & Protocol	ATS Message Handling Systems (AMHS) is a standard for aeronautical ground-to-ground communication. AMHS was first implemented by Avitech GmbH in 1996 and the first European AMHS connection was operational in 2005. The AMHS is a set of end systems that work together to allow cooperation between human and automated users. • ICAO Doc 4444, Procedures for Air Navigation Services Air Traffic Management • ICAO Doc 7030, Regional Supplementary Procedures • ICAO Doc 10037 Edition 1 • Global Operational Datalink Manual (GOLD) • ICAO Doc 9869 Second Edition • Performance-Based Communication and Surveillance (PBCS) Manual	ANSP	2013
Ground system infrastructure	Communication infrastructure	Aviation Authority to Aircraft pilot data transmission	ICAO Doc 9880 Part II defines two fundamental levels of service within AMHS: basic and extended. The basic AMHS performs an operational role similar to the Aeronautical Fixed Telecommunication Network with some enhancements. • ED122/DO306, including Change 1 & 2, Oceanic Remote Safety and Performance Requirements • ED100A/DO258A, FANS 1/A Interoperability Requirements	ANSP	2013

COMI-B1/1 Ground-Ground Aeronautical Telecommunication Network/Internet Protocol Suite (ATN/IPS) — Technology

Main Purpose

To provide for a more modern, more efficient, cost-effective, and robust data communications network infrastructure.

New Capabilities

It enables the efficient integration of technologies with improved integrity to support air to ground aeronautical safety services and regularity of flight communications.

Description

The ATN/IPS internetwork consists of IPS nodes and networks operating in a multinational environment in support of Air Traffic Service Communication (ATSC) as well as Aeronautical Industry Service Communication (AINSC), such as Aeronautical Administrative Communications (AAC) and Aeronautical Operational Communications.

This evolution will support enhanced civil-military cooperation and coordination functions, if interoperability and military information security aspects are considered.

Maturity Level

Standardization

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology benefit	COMI-B1/4 - Aeronautical Mobile Airport Communication System (AeroMACS) Ground-Ground

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Protocols	Communication infrastructure	IPS Protocol	The Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols Doc 9896	ANSP	2019

COMI-B1/2 VHF Data Link (VDL) Mode 2 Multi-Frequency Technology

Main Purpose

- Supports transmission of data link message sets to supplement current voice operations, thus reducing voice channel congestion; while increasing productivity and capacity.
- Supports increased subnetwork capacity and reduces interference over the standard VDL Mode 2 system.

New Capabilities

- Provides an increase in data capacity over VDL Mode 2
- Exchanges aviation data (AOC, CPDLC and ADS)
- Provides a supplement to voice communications
- More efficient use of spectrum

Description

VDL Mode 2 Multi-Frequency consists of a set of air-ground protocols that increase the data rate to 31.5 kbits. It allows transmission from a character oriented protocols to digital or bit based protocols while using VHF air and ground narrow-band transceiver operating in the VHF aviation protected spectrum band, which will transmit textual data to and from the cockpit to support data communications between the pilot and the air traffic controller.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	COMI-B0/4 - VHF Data Link (VDL) Mode 2 Basic

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Protocols	Communication infrastructure	VDL-M2 MF operational Usage & Protocol	• ICAO Doc 9776 VDL2 Technical Manual • ED-92B (EUROCAE MOPS) • DO-281B (RTCA Minimum Operational Performance Standard) • AEEC 631-B • RTCA DO 224	ANSP Aircraft manufacturer	2019
Airborne system capability	Aircraft system	Airborne VDL M-2 MF autotune functionality	VDL Mode 2 frequency management capability allow for auto-tune of an aircraft, from the VDL common signaling channel to an alternate VDL frequency, and back to the common signaling channel. The auto-tune command is the primary building block to instruct aircraft to tune to VDL frequencies, which enables service providers to actively manage traffic load among VDL frequencies. • DO-281B (RTCA Minimum Operational Performance Standard) • AEEC 631-6 • ED-92B (EUROCAE MOPS)	ANSP Aircraft manufacturer	2019
Ground system infrastructure	Communication infrastructure	Ground VDL M-2 MF autotune functionality	VDL Mode 2 frequency management capability allow for auto-tune of an aircraft, from the VDL common signaling channel to an alternate VDL frequency, and back to the common signaling channel. The auto-tune command is the primary building block to instruct aircraft to tune to VDL frequencies, which enables service providers to actively manage traffic load among VDL frequencies. • DO-224C (RTCA Minimum Aviation System Performance Standard) • DO-343A Minimum Aviation System Performance Standards (MASPS) for the Aeronautical Mobile-Satellite (R) Service (AMS(R)S) for FANS1/A+ • RTCA DO-262 MOPS	ANSP Aircraft manufacturer	2019

Main Purpose

- Supports introduction of SATVOICE and SATDATA as a complement to HF voice communications.
- Provides for oceanic and domestic broadband IPS based safety critical data link operations.
- Supports safety critical, safety and regularity of flight operations.

New Capabilities

- Use of SATCOM voice for all types of ATS communications (routine and emergency/urgency communications).
- Provide high-speed IP based broadband networks.
- Improved security
- Lower cost than the traditional circuit switched services (Classic Aero).

Description

SATCOM System is a broadband, IP based communication system that provides voice and high-speed data communications between the aircraft and the air-traffic controller.

Two constellations are expected to provide this service (INMARSAT and Iridium).

SATCOM Class B (SB-S): SwiftBroadband is available over the Inmarsat 4 satellite constellation, providing near global coverage. SwiftBroadband includes SB-S avionics, the satellite modem that accesses the service, and the aircraft antenna capable of receiving SwiftBroadband and related equipment such as diplexer, LNA, HPA and cabling.

SATCOM Class B (Certus)The Iridium NEXT (Certus) Satellite Network, with its constellation of 66 Low Earth Orbit (LEO) satellites, is a global mobile satellite communication network, with coverage of the entire Earth, including polar regions, offering ATC voice and data service.

This evolution will support enhanced civil-military cooperation and coordination functions, if interoperability and military information security aspects are considered.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B1/1 - Meteorological observations information
Relation-information need	AMET-B1/2 - Meteorological forecast and warning information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Protocols	Communication infrastructure	SATCOM Class B usage and protocols	SB-S is the INMARSAT Satellite System (2019). SATCOM Performance Class B covers more stringent (compared to Class C) performance requirements and will be applicable to commercial SATCOM systems, (i.e. the Iridium Next and the Inmarsat SB-S supporting safety services. SATCOM Performance Class B covers the performance requirements of initial 4D operations and the Baseline 2 (B2) requirements defined by RTCA and EUROCAE. Performance Class B requirements will cover remote, oceanic as well as continental/domestic operations. Global Operational Data Link Document (GOLD) Manual (Doc 10037), the PBCS Manual (DOC 9869) and the Satellite Voice Guidance Material (SVOM, Doc 10038) Performance specification DO-306/ED-122; DO-290/ED-120 Interoperability Specification DO-258A/ED-100A DO-280B/ED-112B Certus is the Iridium Next Satellite System (2025). SATCOM Performance Class B covers more stringent (compared to Class C) performance requirements and will be applicable to commercial SATCOM systems, (i.e. the Iridium Next and the Inmarsat SB-S supporting safety services. SATCOM Performance Class B covers the performance requirements of initial 4D operations and the Baseline 2 (B2) requirements defined by RTCA and EUROCAE. Performance Class B requirements will cover remote, oceanic as well as continental/domestic operations. Performance specification DO-306/ED-122 DO-350A/ED-228A Interoperability Specification DO-258A/ED-100A DO-351A/ED-229A RTCA DO 262 MOPS Certus Technical Manual The AMS(R)S manual (Doc 9255), separate chapter for the IridiumNext (Certus) system Global Operational Data Link Document (GOLD) Manual (Doc 10037), the PBCS Manual (DOC 9869) and the Satellite Voice Guidance Material (SVOM, Doc 10038)	ANSP Aircraft manufacturer	2019

Airborne system capability	Communication infrastructure	SATCOM Class B Management Unit (Airborne Radio Transceiver)	AEEC Characteristic, 771 / 781 (INMARSAT; 2019) RTCA DO 262 MOPS Certus Technical Manual (Iridium;2025) AEEC 771-2 SATCOM Class B Form, Fit and Function (Iridium;2025)	Aircraft manufacturer	2019
Ground system infrastructure	Communication infrastructure	SATCOM Class B Ground Radio Transceiver	RTCA DO-343 MASPS (INMARSAT;2019) DO-343B Minimum Aviation System Performance Standards (MASPS) for the Aeronautical Mobile-Satellite (R) Service (AMS(R)S) For FANS1/A+ and ATN/IPS (Iridium;2025)	ANSP Aircraft manufacturer	2019
Space system infrastructure	Communication infrastructure	Communication satellites for class B	Swift Broadband Safety Satellite (2019): The AMS(R)S manual (Doc 9925), separate chapter for the Inmarsat SB-Safety systems Certus Satellite (2025): Performance specification DO-306/ED-122 DO-350A/ED-228A Interoperability Specification DO-258A/ED-100A DO-351A/ED-229A	Satellite provider	2019

COMI-B1/4 — Aeronautical Mobile Airport Communication System (AeroMACS) Ground-Ground — Technology

Main Purpose

- Reduced Separation
- Improved situational awareness
- Reduced Cost
- Improved Efficiency

New Capabilities

- Broadband Communications
- Supports Safety communications
- IPS Based System
- Improved Security

Description

AeroMACS is a broadband wireless communications system. It can provide network connectivity on the airport surface for fixed wireless communications and can be used only for the safety critical and regularity of flight. The fixed assests supported by AeroMACS include multilateration sensors, weather sensors, surface radar and fixed navigation aids.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	-	AeroMACS operational description	• ED222 / Do345: Aeronautical Mobile Airport Communications System (AeroMACS) Profile Doc. • Doc 10044: AeroMACS Technical Manual	ANSP	2017
Ground system infrastructure	Airport systems	AeroMACS Mobile Station (Ground Radio Unit)	•ED223 / Do346: Minimum Operational Performance Standards (MOPS) for the AeroMACS. •ICAO ANNEX-10, Volume III, Chapter 7: AeroMACS SARPs	Airport operator	2017
Ground system infrastructure	Communication infrastructure	AeroMACS Base Station	EUROCAE ED-227: AeroMACS MASPS	ANSP	2017

COMS

COMS-B0/1	CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace	Technology

Main Purpose

Supports :

- reduction of voice channel congestion and increase of capacity in domestic airspace,
- improvement of communication and surveillance in airspace where procedural separation is being applied.

New Capabilities

As a complement to voice communications, controller–pilot data link communications (CPDLC) provides the controller and the pilot with the ability to communicate through exchange of data link messages.

Description

Depending on the specific implementations, other advantages associated with CPDLC include:

1. in certain airspace, direct controller-pilot communications (DCPC) where it was not previously available;
2. allowing the flight crew to print messages;
3. allowing messages to be stored and reviewed as needed;
4. reducing flight crew-input errors by allowing the loading of information from specific uplink messages, such as route clearances or frequency change instructions, into other aircraft systems, such as the FMS or radios;
5. allowing the flight crew to request complex route clearances, which the controller can respond to without having to manually enter a long string of coordinates;
6. reducing flight crew workload by supporting automatically transmitted reports when a specific event occurs, such as crossing a waypoint and the loading of clearance information directly into the flight management system; and
7. reducing controller workload by providing automatic flight plan updates when specific downlink messages (and responses to some uplink messages) are received.

For domestic airspaces, **ATN B1 CPDLC services** provide management of the ATC data link and voice communications, check of ATC microphone stuck and exchange of a limited set of ATC clearances and requests. The vast majority of ATN B1 aircraft do not support any automatic integration of CPDLC instructions into the aircraft Flight Management System.

For procedural airspaces, **FANS 1/A CPDLC services** provide management of the ATC data link and voice communications, exchange of an extensive set of ATC clearance and requests, reporting of aircraft derived information (including Position Reporting). The vast majority of FANS 1/A aircraft support automatic integration of CPDLC instructions into the aircraft Flight Management System (even though implementations are not harmonized across the fleet due to lack of standardization).

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	COMI-B0/1 - Aircraft Communication Addressing and Reporting System (ACARS)
Relation-technology option	COMI-B0/2 - Aeronautical Telecommunication Network/Open System Interconnection (ATN/OSI)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Communication service	CPDLC procedures and monitoring	Requirements and guidance to support deployment of CPDLC operations, such as : Annex 10 Vol II ICAO Doc 4444, Procedures for Air Navigation Services Air Traffic Management ICAO Doc 10037 Edition 1 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2013
Airborne system capability	Communication service	FANS 1/A CPDLC aircraft system	Technical standards to ensure operational and technical interoperability, such as : Annex 10 Vol II ED100/DO258, FANS 1/A Interoperability Requirements	Aircraft manufacturer Aircraft operator	2002
Airborne system capability	Communication service	ATN B1 CPDLC aircraft system	Technical standards to ensure operational and technical interoperability, such as : Annex 10 Vol II ED110B/DO280B, ATN B1 Interoperability Requirements ED120/DO290, Domestic SPR	Aircraft manufacturer Aircraft operator	2007
Ground system infrastructure	Communication service	FANS 1/A CPDLC Ground System	Technical standards to ensure operational and technical interoperability, such as : Annex 10 Vol II ED100/DO258, FANS 1/A Interoperability Requirements	ANSP Ground systems supplier	2002
Ground system infrastructure	Communication service	ATN B1 CPDLC Ground System	Technical standards to ensure operational and technical interoperability, such as : Annex 10 Vol II ED110B & ED120 ED100/DO258, FANS 1/A Interoperability Requirements	ANSP Ground systems supplier	2007
Training	Communication service	Training requirements for CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace	Flight Crew Training, Maintenance and Flight Operations Training, controllers training ICAO Doc 10037 Edition 1 Global Operational Data link Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2013
Regulatory provisions	Equipage requirements or/and mandates	CPDLC Requirements and/or mandates	Airspace requirements and separation standards, with associated means of compliance. References: Amendment of Regional Supplementary Procedures – Doc 7030 (PAC, NAT and EUR)	ANSP CAA Aircraft operator	2013
Regulatory provisions	SMS	CPDLC Safety Management System	Requirements to support local safety cases. References: Annex 19 Annex 11 PANS ATM 4444	ANSP	2013

COMS-B0/2 ADS-C (FANS 1/A) for procedural airspace Technology

Main Purpose	Supports improvement of surveillance in airspace where procedural separation is being applied.
New Capabilities	ADS-C (FANS 1/A) provides aircraft position and projected route information (i.e. next two waypoints ahead of aircraft).
Description	The ADS-C capability provides automatically, without pilot intervention, an ATS unit with information concerning the aircraft position and projected profile for the flight at time intervals, events or on demand dictated by the ground needs.
Maturity Level	Ready for implementation
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? Yes 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? Yes 4. Does it imply a change to levels of automation? Yes

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	COMI-B0/1 - Aircraft Communication Addressing and Reporting System (ACARS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Communication service	ADS-C procedures and monitoring	Requirements and guidance to support deployment of CPDLC operations, such as : Annex 10 Vol II ICAO Doc 4444, Procedures for Air Navigation Services Air Traffic Management ICAO Doc 10037 Edition 1 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2013
Airborne system capability	Communication service	FANS 1/A ADS-C aircraft system	Technical standards to ensure operational and technical interoperability, such as : Annex 10 Vol II ED100/DO258, FANS 1/A Interoperability Requirements	Aircraft manufacturer Aircraft operator	2002
Ground system infrastructure	Communication service	FANS 1/A ADS-C Ground System	Technical standards to ensure operational and technical interoperability, such as : Annex 10 Vol II ED100/DO258, FANS 1/A Interoperability Requirements	ANSP Ground systems supplier	2002

Training	Communication service	Training requirements for ADS-C (FANS 1/A) for procedural airspace	Flight Crew Training, Maintenance and Flight Operations Training and air traffic controllers ICAO Doc 10037 Edition 1 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2013
Regulatory provisions	Equipage requirements or/and mandates	ADS-C Requirements and/or mandates	Airspace requirements and separation standards, with associated means of compliance. References: Amendment of Regional Supplementary Procedures – Doc 7030 (PAC and NAT)	ANSP CAA Aircraft operator	2013
Regulatory provisions	SMS	ADS-C Safety Management System	Requirements to support local safety cases. References: Annex 19 Annex 11 PANS ATM 4444	ANSP	2013

COMS-B1/1 — PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace — Technology

Main Purpose

Supports:

- reduction of voice channel congestion and increase of capacity in domestic airspace,
- introduction of performance-based reduced separation minima in procedural airspace.

New Capabilities

FANS 1/A+ CPDLC systems (along with associated air-ground network and physical layers) are demonstrated compliant with RCP240 (procedural) and RCP130 (domestic).

Description

In procedural airspace, RCP240 authorized CPDLC (FANS 1/A+) provides the controller with intervention capability, allowing when used in conjunction with other enablers (e.g. ADS-C and navigation capabilities), reduced separation minima and thus capacity increase.

In domestic airspace, RCP 130 compliant CPDLC (FANS 1/A+) provides a complementary means of communications for en-route routine communications and the extension of CPDLC for ground operations (e.g. departure clearance).

PBCS will also enhance airspace access for State aircraft as it would offer opportunities for application of performance-equivalence.

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	COMS-B0/1 - CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Communication service	CPDLC procedures and monitoring	Requirements and guidance to support deployment of CPDLC operations, such as : Annex 10 Vol II ICAO Doc 4444, Procedures for Air Navigation Services Air Traffic Management ICAO Doc 10037 Edition 1 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2013
Operational procedures	Communication service	Datalink performance requirements and monitoring	Guidance to support deployment of Performance Based operations, such as: ICAO Doc 9869 Third Edition Performance-Based Communication and Surveillance (PBCS) Manual	ANSP Aircraft manufacturer Aircraft operator Communication service provider	2019
Airborne system capability	Communication service	FANS 1/A+ CPDLC aircraft system	Technical standards to ensure operational and technical interoperability, such as: Annex 10 Vol II ED122/DO306, including Change 1 & 2, Oceanic Remote Safety and Performance Requirements ED100A/DO258A, FANS 1/A+ Interoperability Requirements	Aircraft manufacturer Aircraft operator	2007
Ground system infrastructure	Communication service	FANS 1/A+ CPDLC Ground System	Technical standards to ensure operational and technical interoperability, such as : Annex 10 Vol II ED122/DO306, including Change 1 & 2, Oceanic Remote Safety and Performance Requirements ED100A/DO258A, FANS 1/A+ Interoperability Requirements	ANSP Ground systems supplier	2007
Training	Communication service	Training requirements for PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace	Controllers training, Flight Crew Training, Maintenance and Flight Operations Training. ICAO Doc 10037 Edition 2 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2019

Regulatory provisions	Equipage requirements or/and mandates	CPDLC PBCS Requirements and/or mandates	Airspace requirements and separation standards, with associated means of compliance. References: Amendment of Regional Supplementary Procedures – Doc 7030 (PAC and NAT) Annex 6 Annex 11 Annex 15 ICAO Doc 9869 Second Edition Performance-Based Communication and Surveillance (PBCS) Manual	ANSP CAA Aircraft operator	2016
Regulatory provisions	SMS	CPDLC PBCS Safety Management System	Requirements to support local safety cases. References: Annex 19 Annex 11 PANS ATM 4444	ANSP	2013
Regulatory provisions	Operational Approval	PBCS Approval	Requirements and guidance for PBCS operational authorization in Annex 6 and Doc 9869, 3rd Edition	CAA Aircraft operator	2019

COMS-B1/2	PBCS approved ADS-C (FANS 1/A+) for procedural airspace	Technology

Main Purpose ? Supports introduction of performance-based reduced separation minima in procedural airspace.

New Capabilities ? FANS 1/A+ ADS-C systems (along with associated air-ground network and physical layers) are demonstrated compliant with RSP180.

Description ? ADS-C (FANS 1/A) RSP180 authorized provides separation assurance, allowing when used in conjunction with other enablers (e.g. CPDLC and navigation capabilities), reduced separation minima and thus capacity increase.

PBCS will also enhance airspace access for State aircraft as it would offer opportunities for application of performance-equivalence.

Maturity Level ? Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS ?

Tactical-During ops

OPERATIONS ?

En-route

DEPENDENCIES AND RELATIONS ?

Type of Dependencies	ASBU Element

Evolution	COMS-B0/2 - ADS-C (FANS 1/A) for procedural airspace

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Communication service	ADS-C procedures and monitoring	Requirements and guidance to support deployment of CPDLC operations, such as : Annex 10 Vol II ICAO Doc 4444, Procedures for Air Navigation Services Air Traffic Management ICAO Doc 10037 Edition 1 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2013
Airborne system capability	Communication service	FANS 1/A+ ADS-C aircraft system	Technical standards to ensure operational and technical interoperability, such as: Annex 10 Vol II ED122/DO306, including Change 1 & 2, Oceanic Remote Safety and Performance Requirements ED100A/DO258A, FANS 1/A+ Interoperability Requirements	Aircraft manufacturer Aircraft operator	2007
Ground system infrastructure	Communication service	FANS 1/A+ ADS-C Ground System	Technical standards to ensure operational and technical interoperability, such as: Annex 10 Vol II ED122/DO306, including Change 1 & 2, Oceanic Remote Safety and Performance Requirements ED100A/DO258A, FANS 1/A+ Interoperability Requirements	ANSP Ground systems supplier	2007
Training	Communication service	Training requirements for PBCS approved ADS-C (FANS 1/A+) for procedural airspace	Controllers training, Flight Crew Training, Maintenance and Flight Operations Training. ICAO Doc 10037 Edition 1 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2016
Regulatory provisions	SMS	ADS-C Safety Management System	Requirements to support local safety cases. References: Annex 19 Annex 11 PANS ATM 4444	ANSP	2013
Regulatory provisions	Equipage requirements or/and mandates	ADS-C PBCS Requirements and/or mandates	Airspace requirements and separation standards, with associated means of compliance. References: Amendment of Regional Supplementary Procedures – Doc 7030 (PAC and NAT) Annex 6 Annex 11 Annex 15 ICAO Doc 9869 Second Edition Performance-Based Communication and Surveillance (PBCS) Manual	ANSP CAA Aircraft operator	2016

Operational procedures	Communication service	Datalink performance requirements and monitoring (ADS-C)	Guidance to support deployment of Performance Based operations, such as: ICAO Doc 9869 Second Edition Performance-Based Communication and Surveillance (PBCS) Manual	ANSP Aircraft manufacturer Aircraft operator Communication service provider	2016
Regulatory provisions	Operational Approval	PBCS Approval (RSP 180)	Requirements and guidance for PBCS operational authorization in Annex 6 and Doc 9869, 2nd Edition	CAA Aircraft operator	2016

COMS-B1/3 SATVOICE (incl. routine communications) for procedural airspace — Technology

Main Purpose Increase quality of voice communications in procedural airspace without VHF coverage.

New Capabilities Use of SATVOICE for all types of ATS communications (routine and emergency/urgency communications).

Description A priority level is used by dedicated networks and the aircraft system to pre-empt calls of lower priority, if necessary, and establish precedence for incoming calls of higher priority (usually routine ATS communication will be Priority 2 out of 4, Priority 1 being dedicated to distress/urgent calls).

PBCS will also enhance airspace access for State aircraft as it would offer opportunities for application of performance-equivalence.

Maturity Level Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology need	COMI-B0/5 - Satellite communications (SATCOM) Class C Data

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Equipage requirements or/and mandates	Requirements for the use of SATVOICE	Annex 10 , Volume III Annex 4 PANS-ATM (Doc 4444) PANS-AIM (Doc 10066)	ANSP, CAA, Aircraft manufacturer, Aircraft operator, Communication service provider, Satellite provider	2016
Regulatory provisions	SMS	SATVOICE Safety Management System	Requirements to support local safety cases. References: Annex 19 Annex 11 PANS ATM 4444	ANSP	2013
Operational procedures	-	SATVOICE procedures	Doc 10038, Satellite Voice Operations Manual (SVOM)	ANSP, Aircraft manufacturer, Aircraft operator	2019
Operational procedures	-	SATVOICE performance monitoring	Reference: Performance-Based Communication and Surveillance (PBCS) Manual, Second Edition.	ANSP, Aircraft manufacturer, Aircraft operator, Communication service provider	2016
Airborne system capability	Aircraft system	SATVOICE airborne system	References: Annex 10, Volume III Manual on the Aeronautical Mobile Satellite (Route) Service. (Doc 9925)	Aircraft manufacturer, Aircraft operator	2016
Ground system infrastructure	-	SATVOICE ground system	References: Annex 10, Volume III Manual on the Aeronautical Mobile Satellite (Route) Service. (Doc 9925)	ANSP, Ground systems supplier	2016
Training	-	Training requirements for SATVOICE	SATVOICE training for flight crew, radio operator and air traffic controller References: Doc 10038, Satellite Voice Operations Manual (SVOM), Edition 1	ANSP, Airspace user	2019

CSEP

CSEP-B1/1	Basic airborne situational awareness during flight Operational operations (AIRB)
Main Purpose	To improve traffic situational awareness in all phases of flight.

New Capabilities

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

Description

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

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

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Certification	Certification of CDTI for airborne situational awareness	References: ICAO Annex 10 Volume IV basic technical requirements ICAO Doc 9994 ADS-B IN equipment/function compliant with DO-317B/ED194A (2015)	CAA Aircraft manufacturer Aircraft operator	2015
Operational procedures	Operations	SOPs for the use of CDTI for AIRB	References: PANS-OPS (Doc 8168) operation of ADS-B IN traffic display (2016) Standard Operating Procedures	Aircraft operator	2013

Airborne system capability	Surveillance	ADS-B IN equipment/function	ADS-B IN equipment/function compliant with DO-317B/ED194A (2015)	Airspace user Aircraft manufacturer	2015
Airborne system capability	Aircraft system	CDTI	Cockpit Display of Traffic Information (CDTI). The CDTI may be shared with ACAS information traffic display but we should not assume this capability is only for ACAS-equipped aircraft. References:	Aircraft manufacturer Aircraft operator	2013
Training	-	Training requirements for AIRB	The appropriate use of the traffic display could be evaluated during recurrent training on ACAS. The equipage of AIRB capability is unknown to ATC. The use of AIRB must remain transparent to ATC. References:	Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Safety		Improve mid-air collision avoidance (safety net)	++	
Safety		Improve separation provision (at a planning horizon > 2 minutes)	++	

CSEP-B1/2 Visual Separation on Approach (VSA) Operational

Main Purpose To assist pilots in maintaining own separation during successive visual approach procedures. VSA is defined to support aircraft performing successive visual approach and landing operations.

New Capabilities VSA is a situational awareness capability that offers a support tool for pilots to conduct existing procedures described in PANS-ATM (6.5.3.4 and 6.5.3.5). It assist the flight crew in maintaining own separation and quicker visual acquisition of preceding aircraft during successive visual approach procedures enabled by the use of a CDTI. It supplements the flight crew's out the window scan and radio communications listening.

Description This element is used to support existing procedures, i.e., the pilot can use the traffic display to support his visual scan of the preceding aircraft during the approach procedure if the preceding aircraft is transmitting ADS-B OUT surveillance data.

Maturity Level Ready for implementation

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

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

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Certification	Certification of CDTI for airborne situational awareness	References: ICAO Annex 10 Volume IV basic technical requirements ICAO Doc 9994 ADS-B IN equipment/function compliant with DO-317B/ED194A (2015)	CAA Aircraft manufacturer Aircraft operator	2015
Airborne system capability	Surveillance	ADS-B IN equipment/function	ADS-B IN equipment/function compliant with DO-317B/ED194A (2015)	Airspace user Aircraft manufacturer	2015
Airborne system capability	Aircraft system	CDTI	Cockpit Display of Traffic Information (CDTI). The CDTI may be shared with ACAS information traffic display but we should not assume this capability is only for ACAS-equipped aircraft. References:	Aircraft manufacturer Aircraft operator	2013
Training	-	Training requirements for VSA	Training should be developed and given for the system functions, indications and interactions for each application/capability. The equipage of ADS-B IN is unknown to ATC. The use of ADS-B IN must remain transparent to ATC.	Aircraft operator	2013
Operational procedures	Operations	SOPs for the use of CDTI for VSA	References: ICAO Doc 8168 - PANS-OPS; operation of ADS-B IN traffic display (2016)	Aircraft operator	2016

Airborne system capability	Surveillance	ADS-B OUT equipment/function	ADS-B OUT capability required for the reference aircraft	Aircraft operator	2015

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Safety		Improve separation provision (at a planning horizon > 2 minutes)	++	

CSEP-B1/3 Performance Based Longitudinal Separation Minima — Operational

Main Purpose Reduced separation allowing more flights to operate in their optimum flight levels.

New Capabilities The ability of aircraft to accurately navigate along a specified path and the ability to provide via data communication the position, intent and current navigation performance of the aircraft allow flights to be cleared to fly at reduced longitudinal separations.

Description 50 NM, 30 NM and 5 minutes longitudinal separation have been made conditional on Required Communication Performance 240 (RCP 240) and Required Surveillance Performance 180 (RSP 180). Application of the separation may also require an RNP approval.

(*Table to be inserted)*

Maturity Level Standardization

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	COMI-B0/3 - VHF Data Link (VDL) Mode 0/A
Relation-technology option	COMI-B0/4 - VHF Data Link (VDL) Mode 2 Basic
Relation-technology option	COMS-B0/1 - CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace

Relation-technology option	COMS-B1/1 - PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace
Relation-technology option	COMS-B0/2 - ADS-C (FANS 1/A) for procedural airspace
Relation-technology option	COMS-B1/2 - PBCS approved ADS-C (FANS 1/A+) for procedural airspace
Relation-technology option	NAVS-B0/3 - Aircraft Based Augmentation Systems (ABAS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Operational Approval	Operational Approval for performance-based longitudinal separation	PBN, PBCS (when required)	CAA	2019
Operational procedures	Design and operations	Procedures for PBLoSM	Design and use of operational procedures shall be designed and used for the application of reduced longitudinal separation minima Reference : ICAO PBN, PBCS and GOLD manual	ANSP	2019
Ground system infrastructure	Surveillance	Surveillance systems for PBLoSM	To support RSP 180	ANSP	2019
Ground system infrastructure	Navigation	Navigation systems for PBLoSM	To support RNP 2, 4 or 10	ANSP	2019
Ground system infrastructure	Communications	Communication systems for PBLoSM	To support RCP 240	ANSP	2019
Training	-	Training requirements for PBLoSM	ATCO Training and Flight Crew Training Train for PBN Reduced Longitudinal Separation Minima Provide training to staff prior to implementation	ANSP Aircraft operator	2019
Airborne system capability	Communication service	Communication capabilities for PBLoSM	Aircraft and crew approvals for appropriate RNP specifications Reference: Aircraft and crew approvals for RCP 240 and ADS-C/CPDLC	Aircraft manufacturer Aircraft operator	2019

Airborne system capability	Navigation	Navigation capabilities for PBLoSM	Aircraft and crew approvals for appropriate RNP specifications	Aircraft manufacturer Aircraft operator	2019
Airborne system capability	Surveillance	Surveillance capabilities for PBLoSM	Aircraft and crew approvals for appropriate RNP specifications Reference: Aircraft and crew approvals for RSP 180	Aircraft manufacturer Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Improve what's needed to reduce longitudinal separation minima	++	KPI06: En-route airspace capacity
Capacity	Capacity, throughput & utilization	Take advantage of increased navigation precision (airspace with PBN operations) to implement route networks and airspace structures with smaller lateral and vertical safety buffers	++	KPI06: En-route airspace capacity

CSEP-B1/4 Performance Based Lateral Separation Minima Operational

Main Purpose To increase airspace capacity and allow optimum utilization of available airspace.

New Capabilities The ability of aircraft to accurately navigate along a specified path and the ability to provide via data communication the position, intent and current navigation performance of the aircraft allow flights to be cleared to fly at reduced lateral separations.

Description This element describes the application of lateral separation of 23 NM between any combination of RNP 4 and RNP 2 approved aircraft operating on parallel or non-intersecting tracks.

Maturity Level Standardization

Human Factor Considerations

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

PLANNING LAYERS

OPERATIONS

Tactical-During ops

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology option	COMI-B0/3 - VHF Data Link (VDL) Mode 0/A
Relation-technology option	COMI-B0/4 - VHF Data Link (VDL) Mode 2 Basic
Relation-technology option	COMS-B0/1 - CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace
Relation-technology option	COMS-B1/1 - PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace
Relation-technology option	COMS-B0/2 - ADS-C (FANS 1/A) for procedural airspace
Relation-technology option	COMS-B1/2 - PBCS approved ADS-C (FANS 1/A+) for procedural airspace
Relation-technology option	NAVS-B0/3 - Aircraft Based Augmentation Systems (ABAS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Operational Approval	Operational Approval for performance-based lateral separation	Approval of PBN, PBCS	CAA	2019
Operational procedures	Design and operations	Procedures for PBLaSM	Design and use of operational procedures for the application of reduced lateral separation minima Reference : ICAO PBN, PBCS and GOLD manual	ANSP	2019
Training	-	Training requirements for PBLaSM	ATCO training ATCO and Flight Crew training Performance Based Lateral Separation Minima Provide training to staff prior to implementation	ANSP Aircraft operator	2019
Airborne system capability	Communication service	Communication capabilities for PBLaSM	Aircraft and crew approvals for RCP 240	Aircraft manufacturer Aircraft operator	2019
Airborne system capability	Navigation	Navigation capabilities for PBLaSM	Aircraft and crew approvals for appropriate RNP specifications	Aircraft manufacturer Aircraft operator	2019
Airborne system capability	Surveillance	Surveillance capabilities for PBLaSM	Aircraft and crew approvals for RSP 180	Aircraft manufacturer Aircraft operator	2019

Ground system infrastructure	Communications	Communication systems for PBLaSM	To support the specified RCP	ANSP	2019
Ground system infrastructure	Navigation	Navigation systems for PBLaSM	To support the specified RNP	ANSP	2019
Ground system infrastructure	Surveillance	Surveillance systems for PBLaSM	To support the specified RSP	ANSP	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Improve what's needed to reduce lateral separation minima	++	KPI06: En-route airspace capacity

DAIM

DAIM-B1/1	Provision of quality-assured aeronautical data and information	Information

Main Purpose: The main purpose of this element is to ensure that aeronautical data and information comply with quality standards in order to meet the needs of airspace users and support the safety of flight operations.

New Capabilities: Provision of high quality aeronautical data and information; consistent interpretation and timely exchange of aeronautical data and information; and, automatic management, processing, verification, usage and exchange of aeronautical data and information.

Description

This element ensures that processes, procedures and systems are improved to allow for an enhanced quality of aeronautical information products and services. This element includes:

1. Implementation of quality management systems to ensure that aeronautical data and information comply with the required standards.
2. Use of common reference systems (spatial – WGS84 and temporal- AIRAC) to facilitate consistent interpretation of aeronautical data and information and facilitate their timely exchange.
3. Full move into an automated data-centric environment so that the management, processing, verification, usage and exchange can be done in a structured, automatic manner and human intervention is reduced.
4. Aeronautical data and information is of high quality if it is aggregated and provided by authoritative sources. This requires to properly control relationships along the whole data chain from the origination to the distribution to the next intended user (formal arrangements with data originators, neighbouring States, data and information service providers and others).

Maturity Level

Standardization

Human Factor Considerations

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

PLANNING LAYERS

Strategical | Pre-tactical

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Procedures for the provision of aeronautical information services in an AIM environment	ANSPs should define in an AIM Manual of operations the procedures to be followed for the provision of quality assured aeronautical information. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management ICAO Doc 8126 - Aeronautical Information Services	ANSP	2018

Operational procedures	Quality	Procedures for the application of a quality management system to the AIM processes.	ANSPs should define in a Quality Manual the procedures to be followed to apply a quality management system to the AIM processes. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 9839 - Manual on the Quality Management System for Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated aeronautical information management systems and infrastructure.	Automated systems and infrastructure to support the collection, processing, distribution and quality control of the aeronautical information products and services.	ANSP	2018
Training	-	Training requirements for the provision of quality-assured aeronautical data and information	Training for AIS/AIM personnel	ANSP	2018
Regulatory provisions	National regulatory framework	National framework for the provision of quality assured aeronautical data and information	Development of State Regulatory framework to support the provision of quality-assured aeronautical data and information. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management	CAA	2018
Regulatory provisions	Formal arrangements	Formal arrangements for data quality assurance	Formal arrangements between ANSP and the aeronautical data originators to ensure data quality. Reference ICAO documents: Aeronautical Data Catalogue (PANS – Aeronautical Information Management, Appendix 1)	ANSP CAA	2018

DAIM-B1/2	Provision of digital Aeronautical Information Publication (AIP) data sets	Information

Main Purpose: To make available digital AIP data and information in an interoperable manner and mutually-understood manner.

New Capabilities: Provision of digital AIP data sets. This will facilitate the exchange of aeronautical information that becomes easy to be integrated and filtered, thus increasing cost effectiveness and efficiency.

Description

The need for interoperable exchange of AIP data and information requires providing them in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing sections of the AIP by digital AIP data sets. Therefore, this element supports the migration to a data-centric environment where aeronautical data and information (AIP) will be provided in a structured and digital form through the use of information exchange models (e.g. AIXM).

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

2. Does it imply processing of new information by the user? No

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

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Procedures for the provision of digital AIP data set	Updated AIM Manual of operations to include information about the provisions of digital AIP data sets. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS - Aeronautical Information Management Doc 8126 - Aeronautical Information Services	ANSP	2018
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018

Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital AIP data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital Aeronautical Information Publication (AIP) data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital AIP data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital Aeronautical Information Publication (AIP) data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital AIP data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital Aeronautical Information Publication (AIP) data sets	Development of State Regulatory framework to support the provision of digital Aeronautical Information Publication (AIP) data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DAIM-B1/3	Provision of digital terrain data sets	Information

Main Purpose

To make available digital terrain data and information in an interoperable manner and mutually-understood manner.

New Capabilities

Provision of terrain data as digital data sets. This will facilitate the exchange of terrain data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description

The need for interoperable exchange of terrain data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing terrain data by digital terrain data sets. Therefore, this element supports the migration to a data-centric environment where terrain data will be provided in a digital form and in a structured way.

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Information exchange	Procedures for the provision of digital terrain data set	Updated AIM Manual of operations to include information about the provisions of digital terrain data sets. ICAO reference documents : Annex 15 - Aeronautical Information Services PANS- Aeronautical Information Management Doc 8126 - Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital terrain data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital terrain data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital terrain data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital terrain data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital terrain data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018

Regulatory provisions	National regulatory framework	National framework for the provision of digital terrain data sets	Development of State Regulatory framework to support the provision of digital terrain data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DAIM-B1/4 Provision of digital obstacle data sets Information

Main Purpose To make available digital obstacle data in an interoperable and mutually-understood manner.

New Capabilities Provision of obstacle data as digital data sets. This will facilitate the exchange of obstacle data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description The need for interoperable exchange of obstacle data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing obstacle data by digital obstacle data sets. Therefore, this element supports the migration to a data centric environment where obstacle data will be provided in a structured and digital form through the use through the use of information exchange models (e.g. AIXM).

Maturity Level Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018
Operational procedures	Information exchange	Procedures for the provision of digital obstacle data set	Updated AIM Manual of operations to include information about the provisions of digital obstacle data sets. Reference ICAO document: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital obstacle data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital obstacle data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital obstacle data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital obstacle data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital obstacle data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital obstacle data sets	Development of State Regulatory framework to support the provision of digital obstacles data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DAIM-B1/5 Provision of digital aerodrome mapping data sets Information

Main Purpose: To make available digital aerodrome mapping data and information in an interoperable and mutually-understood manner.

New Capabilities: Provision of aerodrome mapping data as digital data sets. This will facilitate the exchange of aerodrome mapping data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description: The need for interoperable exchange of aerodrome mapping data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing aerodrome mapping data by digital aerodrome mapping data sets. Therefore, this element supports the migration to a data centric environment where aerodrome mapping data will be provided in a structured and digital form through the use through the use of information exchange models (e.g. AIXM).

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018

Operational procedures	Information exchange	Procedures for the provision of digital aerodrome mapping data set	Updated AIM Manual of operations to include information about the provisions of digital aerodrome mapping data sets. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital aerodrome mapping data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital aerodrome mapping data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital aerodrome mapping data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital aerodrome mapping data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital aerodrome mapping data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital aerodrome mapping data sets	Development of State Regulatory framework to support the provision of digital aerodrome mapping data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2019

DAIM-B1/6	Provision of digital instrument flight procedure data sets	Information

Main Purpose To make available digital instrument flight procedure data in an interoperable and mutually-understood manner.

New Capabilities: Provision of instrument flight procedure data as digital data sets; and, compliance with the navigation specifications, consistency in design, coding and operation of performance-based navigation (PBN) procedures to avoid differences in the aircraft behaviour in response to the coded path terminators by the use specific criteria for coding instrument flight procedures. This will facilitate the exchange of instrument flight procedure data that becomes easy to integrate and easily filtered, thus increasing cost effectiveness and efficiency.

Description: The need for interoperable exchange of instrument flight procedure data requires providing the data in digital form and complying with digital data exchange requirements. This element consists in the replacement of existing instrument flight procedure data by digital instrument flight procedure data sets. In addition, it includes consistent coding of procedures to match the procedure design intent and ensure more repeatable flight paths. Applying new rules for coding Instrument flight procedures will limit the number of allowable path terminators for PBN procedures in compliance with the PBN Navigation Specifications. Therefore, this element supports the migration to a data centric environment where instrument flight procedure data will be provided in a structured and digital form through the use of information exchange models (e.g. AIXM).

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Departure | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018

Operational procedures	Information exchange	Procedures for the provision of digital instrument flight procedures data set	Updated AIM Manual of operations to include information about the provisions of digital instrument flight procedure data sets. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2018
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of digital instrument flight procedures data sets using AIXM	Automated systems and infrastructure to support the processing and distribution of the digital instrument flight procedures data sets.	ANSP	2018
Ground system infrastructure	Information exchange	Airspace user systems to be updated to leverage the benefits of digital instrument flight procedure data sets using AIXM.	Automated systems and infrastructure for the users to make use of the digital instrument flight procedures data sets.	Airspace user	2018
Training	-	Training requirements for the provision of digital instrument flight procedure data sets	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2018
Regulatory provisions	National regulatory framework	National framework for the provision of digital instrument flight procedures sets	Development of State Regulatory framework to support the provision of digital instrument flight procedures data sets Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

DAIM-B1/7	NOTAM improvements	Information
Main Purpose	To provide timely and relevant information about status and condition of the ANS infrastructure to the next intended users via NOTAM.	

New Capabilities: Identification of clear operational conditions to determine when a NOTAM shall or shall not be originated, thus ensuring that the information provided meets the needs of the users; provision of digital NOTAMs to enhance the quality of the information provided and allow the graphical representation and better filtering of information to assist operators in retrieving the relevant information.

Description: In order to meet the operational needs of the users, it is essential to provide information that is timely and fit for purpose. This can be done by refining the criteria to ensure that the users receive the right information. This element consists in the identification of clear operational conditions under which a NOTAM shall or shall not be originated and replacement of paper NOTAMs by a digital version through the use of information exchange models (e.g. AIXM).

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	DAIM-B1/1 - Provision of quality-assured aeronautical data and information
Relation-information need	DAIM-B1/2 - Provision of digital Aeronautical Information Publication (AIP) data sets
Relation-information need	DAIM-B1/4 - Provision of digital obstacle data sets
Relation-information need	DAIM-B1/5 - Provision of digital aerodrome mapping data sets
Relation-information need	DAIM-B1/6 - Provision of digital instrument flight procedure data sets

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Information exchange model	Aeronautical Information	Aeronautical Information Exchange Model (AIXM) v 5.1	The objective of the Aeronautical Information Exchange Model (AIXM) is to enable the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). Reference material: AIXM Confluence site/AIS Manual Volume 4	ANSP	2018

Operational procedures	Information exchange	Procedures for the provision of an enhanced NOTAM service	Updated AIM Manual of Operations to include information about the provisions of NOTAM. Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	ANSP	2019
Ground system infrastructure	Information exchange	Automated systems and infrastructure to support the provision of NOTAM using AIXM.	Automated systems and infrastructure to support the processing and distribution of NOTAM	ANSP	2019
Ground system infrastructure	Information exchange	Airspace user systems need to be updated to leverage the benefits of digital NOTAM using AIXM.	Automated systems and infrastructure for the users to make use of NOTAM	Airspace user	2019
Training	-	Training requirements for the provision of enhanced NOTAM	Training for AIS/AIM personnel, Airspace users	ANSP Airspace user	2019
Regulatory provisions	National regulatory framework	National framework for the provision of NOTAM	Development of State Regulatory framework to support the provision of NOTAM Reference ICAO documents: Annex 15 - Aeronautical Information Services PANS – Aeronautical Information Management Doc 8126 – Aeronautical Information Services	CAA	2018

FICE

FICE-B0/1	Automated basic inter facility data exchange (AIDC)	Information

Main Purpose	To improve the efficiency of coordination and tranfer of control between ATS units.
New Capabilities	Replacement of voice communication between ATS units by automatic message exchange.

Description

This element represents a first automation step in the evolution of the coordination and transfer of control between neighbouring ATS units to guarantee that all related and necessary flight information will be available to the other unit as per agreement.

Maturity Level

Ready for implementation

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-technology benefit	COMI-B0/7 - ATS Message Handling System (AMHS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	SMS	Apply SMS	Apply Safety Management System in accordance with the national requirements and guidance.	ANSP	2013
Ground system infrastructure	Flight and Flow information	HMI and FDPS	Upgrade the ground system to support the composition, exchange and processing of messages.	ANSP	2013
Operational procedures	Flight and flow information	Procedures for AIDC	Procedures for message composition and exchange. References: PANS-ATM ICAO Doc 4444 - Procedures for Air Navigation Services and regional interface control (ICD) documents.	ANSP	2013
Ground system infrastructure	Flight and Flow information	Interconnectivity	Connectivity between ATSU systems through IP, AMHS, etc.	ANSP	2013
Training	Flight and Flow information	Training requirements for AIDC	Training for ATCO and CNS staff regarding AIDC.	ANSP	2013

Regulatory provisions	National regulatory framework	National regulatory framework amendment for the use of AIDC	If applicable, CAA may need to amend the national regulatory provisions on the use of AIDC. References: PANS-ATM (ICAO Doc 4444) and Regional Interface Control (ICD) documents.	CAA	2013

FRTO

FRTO-B0/1	Direct routing (DCT)	Operational

Main Purpose: Direct routings are established with the aim of providing airspace users with additional flight planning route options on a larger scale across FIRs such that overall planned leg distances are reduced in comparison with the fixed route network.

New Capabilities: Direct routings (DCTs) are established at national and regional levels and made available for flight planning (with published conditions of use). DCTs should be considered as an early iteration of the Free Route Airspace (FRA) concept. Direct routing operations allow airspace users to optimize flight and fuel planning.

Description

DCTs could be implemented in a limited way e.g.:

- time constraint (fixed or depending on traffic/availability);
- traffic constraint (based on flow and/or level of traffic);
- flight level;
- lateral constraints;
- entry/exit conditions.

The extension of direct routings within and across the FIR boundaries also requires Network and ANSPs ground system upgrades for airspace management and flight data processing.

The following procedures and process might need to be considered:

- identify the direct routing airspace volume (lateral and vertical) and applicable time;
- direct routings may co-exists with ATS route structure;
- identify direct routing entry and exit points;
- adapt airspace design and ensure direct routing horizontal and vertical connectivity;
- ATFM direct routing procedures;
- adapt the LoA with adjacent ATS units;
- publish relevant data for direct routing in AIP;
- airspace management procedure for the implementation of direct routings;
- ATC procedures to cover direct routing co-ordination and transfer of control, trajectory change in direct routing; environment, conflict detection.

The ATM system upgrades of FDP and CWP, if required, are related to:

- upgrade of network flight planning and ASM/ATFM system for DCTs;
- direct routing clearances;
- rerouting capabilities in cases the direct routing traversed the military airspace; differentiation between different traffic type airspaces;
- direct route beyond AoR;
- calculation of 4D trajectory with AoI;
- editing function for 4D trajectories.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

ATM planning | Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	NOPS-B0/1 - Initial integration of collaborative airspace management with air traffic flow management

Relation-operational need	FRTO-B0/2 - Airspace planning and Flexible Use of Airspace (FUA)
Relation-operational need	FRTO-B0/4 - Basic conflict detection and conformance monitoring
Relation-information need	FICE-B0/1 - Automated basic inter facility data exchange (AIDC)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design and operations	DCT Procedures	Design and use of operational procedures for direct routes. Reference: EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 1: European Airspace Design Methodology - Guidelines - Edition December 2018 (https://www.eurocontrol.int/publications/european-route-network-improvement-plan-ernip-part-1-european-airspace-design)	ANSP ATM network function Aircraft operator	2013
Ground system infrastructure	ATC systems	ATC system upgrades for monitoring aids functions	ATC systems to be upgraded for DCT clearances, notification and co-ordination data exchanges and management of relevant airspace data. Reference: EUROCONTROL specification for the on-line Data exchanges (OLDI) https://eurocontrol.int/sites/default/files/publication/files/EUROCONTROL%20Specification%20OLDI%204.3.pdf	ANSP	2013
Ground system infrastructure	CFSP systems	Upgrade of AOs Flight Planning Systems for DCTs	AO-CFSPS systems to be upgraded to enable flight planning of DCTs Reference: EUROCONTROL NM Flight Planning Requirements document December 2018 https://www.eurocontrol.int/publications/nm-flight-planning-requirements-guidelines	Aircraft operator	2013
Training	-	Training requirements for direct routing	ATCO Training, AO Training, ATM Network Training Training for DCT Provide training to staff prior to implementation	ANSP ATM network function Aircraft operator	2013
Ground system infrastructure	ATM systems	ATFM system for FUA	Upgrade ATFM/flight planning systems to support FUA Reference: EUROCONTROL NM Flight Planning Requirements document December 2018 (https://www.eurocontrol.int/publications/nm-flight-planning-requirements-guidelines)	ATM network function	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route network design	++	KPI04: Filed flight plan en-route extension

FRTO-B0/2 Airspace planning and Flexible Use of Airspace (FUA) Operational

Main Purpose

Establish the Flexible Use of Airspace (FUA) process and improve data exchange between civil and military stakeholders by automation to enable a more efficient use of airspace based on transparency and due regard to national security needs.

New Capabilities

Deployment of automated airspace management (ASM) support systems to manage the airspace reservations based on the airspace user needs and resulting from civil-military collaborative decision-making process and more flexibly according to the airspace user needs.

Description

This element addresses strategic/long term airspace management, pre-tactical planning and tactical operations. Automated ASM support systems improve airspace management processes and flexible airspace planning including time horizon specifications in all flight phases (strategic, pre-tactical and tactical time horizon) by providing mutual visibility on civil and military requirements. They also support flexible airspace planning according to civil and military ANSPs and airspace user requirements, including permit cross border and use of segregated areas operations regardless of national boundaries.

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

ATM planning | Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	FRTO-B0/1 - Direct routing (DCT)
Relation-operational need	NOPS-B0/1 - Initial integration of collaborative airspace management with air traffic flow management

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Operational Approval	Operational approval to provide FUA	Follow regulations for regulatory approval Reference : ICAO Circular 330 Civil/Military Coordination European Union Regulation (EC) No 2150/2005 of 23 December 2005 laying down common rules for the flexible use of airspace. https://www.eurocontrol.int/articles/flexible-use-airspace-fua-mandate	CAA ICAO	2013
Operational procedures	Design and operations	FUA Procedures for Dynamic Airspace Management	Design and use of operational procedures Reference: EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 1: European Airspace Design Methodology - Guidelines - Edition December 2018 https://www.eurocontrol.int/publications/european-route-network-improvement-plan-ernip-part-1-european-airspace-design EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 3: Airspace Management Handbook - Edition December 2018 https://www.eurocontrol.int/sites/default/files/publication/files/ernip-part-3-asm-handbook-edition-5-v5-5.pdf	ANSP Aircraft operator	2013
Ground system infrastructure	ATM systems	Tools and System to support FUA	Tools to be implemented and existing systems upgraded to conduct FUA operations. Reference European Route Network Improvement Plan (ERNIP) - Part 3: Airspace Management Handbook - Annex 12 Edition December 2018 (https://www.eurocontrol.int/sites/default/files/publication/files/ernip-part-3-asm-handbook-edition-5-v5-5.pdf) EUROCONTROL Local And sub-Regional Airspace Management support system (https://www.eurocontrol.int/services/local-and-sub-regional-airspace-management-support-system-lara)	ANSP	2013
Training	-	Training requirements for FUA	Training for FUA Provide training to staff prior to implementation	ANSP Aircraft operator	2013

Ground system infrastructure	ATM systems	ATFM system for FUA	Upgrade ATFM/flight planning systems to support FUA Reference: EUROCONTROL NM Flight Planning Requirements document December 2018 (https://www.eurocontrol.int/publications/nm-flight-planning-requirements-guidelines)	ATM network function	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Access and equity		Improve airspace reservation management	++	
Efficiency	Flight time & distance	Facilitate direct routing of portions of the flight (if this does not cause network problems)	++	KPI05: Actual en-route extension
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route & airspace availability as known at the flight planning stage	++	KPI04: Filed flight plan en-route extension
Efficiency	Flight time & distance	Reduce need for tactical ATFM rerouting to circumnavigate airspace closed at short notice	++	KPI05: Actual en-route extension
Efficiency	Flight time & distance	Reduce need to avoid airspace because of lack of confirmation that it will be open	++	KPI04: Filed flight plan en-route extension
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during climb to avoid Special Use Airspace	++	KPI17: Level-off during climb
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during cruise to avoid Special Use Airspace	++	KPI18: Level capping during cruise
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during descent to avoid Special Use Airspace	++	KPI19: Level-off during descent

FRTO-B0/3	Pre-validated and coordinated ATS routes to support flight and flow	Operational

Main Purpose

A collection of routes that have been pre-validated and coordinated with impacted air route traffic control centers and airspace users.

New Capabilities

There are three main options for the flexible routings:

- Preferred Routes
- Playbook Routes
- Coded Departure Routes (CDR)

Description

There are many instances when ATC needs to move air traffic away from, or into, a particular area of airspace. When this happens, traffic managers will typically implement reroutes – a common route, or set of routes, that they want aircraft to use in a particular area. These routes are predetermined and applied to the certain sector/airport accordingly. Routes are available through ANSP database and are published for the airspace users.

Preferred routes are the normal, everyday routes that ATC would like operators to file. These routes were developed to increase system efficiency and capacity by having balanced traffic flows among high-density airports, as well as de-conflicting traffic flows where possible. Preferred routes are those that operators will most commonly file.

Playbook routes are a set of standard routes that ATC can utilize to fit a particular set of circumstances, when the preferred routes are not available. These routes were created to allow for rapid implementation as needed.

CDRs are a combination of coded air traffic routings and refined coordination procedures, designed to reduce the amount of information that needs to be exchanged between ATC and flight crews.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	FRTO-B0/1 - Direct routing (DCT)
Relation-operational need	FRTO-B0/2 - Airspace planning and Flexible Use of Airspace (FUA)
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products
Relation-information need	AMET-B0/4 - Dissemination of meteorological products

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design and operations	Procedures on flexible routing tools	Design and operational procedures for ANSPs and AOs on how to use flexible routing tools.	ANSP Aircraft operator	2013
Ground system infrastructure	ATM systems	Tools and system to support Flexible routing	ANSP implemented tools to support preferred, playbook, and CDR routes. Reference: https://www.fly.faa.gov/Products/products.jsp	ANSP	2013
Ground system infrastructure	CFSP systems	Upgrade of AOs Flight Planning Systems for Flexible routings (optional)	AO-CFSPS systems to be upgraded to enable flight planning of flexible routings. Although AOs can just look up these routes on the weblink, they can also integrate these data into their flight planning system and have it in their tool. Reference: https://www.fly.faa.gov/Products/products.jsp	Aircraft operator	2013
Training	-	Training requirements for flexible routings	Training provided to TMC, ATCO, FOC on how to use flexible routing	ANSP Aircraft operator	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity shortfall & associated delay	Establish/update/publish the catalogue of strategic ATFM measures designed to respond to a variety of possible/typical/recurring events degrading the airspace system (e.g. predefined action plans)	++	
Flexibility		Improve flexibility of the Air Navigation System	++	

FRTO-B0/4	Basic conflict detection and conformance monitoring	Operational

Main Purpose Reduction of ATCO's workload via early and systematic conflict detection and conformance monitoring.

New Capabilities: Deployment of basic conflict detection tools (Medium Term Conflict Detection Tool- MTCD) and conformance monitoring warnings.

Description: MTCD assists the controller in conflict identification and planning tasks by providing automated early detection of potential conflicts; facilitating identification of flexible routing/conflict free trajectories; identifying aircraft constraining the resolution of a conflict or occupying a flight level requested by another aircraft.

The monitoring aids (MONA) function provides the controller with warnings if aircraft deviate from a clearance or planned trajectories and reminders related to the ATCO instructions to be issued. MONA might include the flight progress monitoring as well as the lateral, longitudinal, vertical and Cleared Flight Level (CFL) deviations.

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	FRTO-B0/1 - Direct routing (DCT)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design and operations	ATC Procedures for Medium Term Conflict Detection (MTCD) and Monitoring Aids (MONA)	Design and use of operational procedures	ANSP	2013

Ground system infrastructure	ATC systems	ATM system Upgrades for MTCD and MONA functions	ATC systems to be upgraded to ensure conformance monitoring of flights and conflict detection for ATC planning purposes. Reference: EUROCONTROL Monitoring Aids (MONA) specification 3 March 2017. This document provides system requirements for Monitoring Aids (MONA).https://www.eurocontrol.int/standards?page= Reference: EUROCONTROL Medium-Term Conflict Detection (MTCD) specification 3 March 2017.This document provides system requirements for Medium-Term Conflict Detection (MTCD). https://www.eurocontrol.int/standards?page=4 EUROCONTROL Trajectory Prediction Specification Edition 2.0 March 2017 (https://www.eurocontrol.int/publications/trajectory-prediction-specification)	ANSP	2013
Training	-	Training requirements for MTCD and MONA	ATCO Training Provide training to staff prior to implementation	ANSP	2013

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Reduce ATCO workload (en-route)	++	KPI06: En-route airspace capacity
Safety		Improve early detection of conflicting ATC Clearances (CATC) (en-route / departure / approach)	++	
Safety		Improve separation provision (at a planning horizon > 2 minutes)	++	
Safety		Reduce number of vertical & lateral navigation errors during flight (cases of non-conformance with clearance)	++	

FRTO-B1/1	Free Route Airspace (FRA)	Operational

Main Purpose

The Free Route Airspace (FRA) concept brings significant flight efficiency benefits and a choice of user preferred routes to airspace users.

As a step to full trajectory-based operations, the FRA concept brings increased flight predictability, reduced uncertainty for the ATM network function, which in turn can lead to potential capacity increases for ATM, which will also benefit the user.

New Capabilities

FRA is a specified volume of airspace within which users may freely plan a route between a defined entry point and a defined exit point, with the possibility to route via intermediate (published or unpublished) waypoints, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control.

FRA enables airspace users to fly as close as possible to what they consider the optimal trajectory without the constraints of a fixed route network structure.

Description

FRA implementation can be customized for instance:

- laterally and vertically;
- during specific periods;
- with a set of entry/exit conditions;
- with initial system upgrades.

The extension of FRA within and across the FIR boundaries also requires upgrades of the ATM network function system and the ANSPs ground system for airspace management and flight data processing.

The following procedures and process might need to be considered:

- FRA airspace volume (lateral and vertical) and applicable time (not necessary H24 7/7);
- FRA entry and exit points, arrival transition point and departure transition point, and intermediate points;
- adapt airspace design and ensure FRA horizontal and vertical connectivity;
- ATFM FRA procedures;
- adapt the LoA with adjacent -and military- ATS units;
- publish relevant data for FRA in AIP;
- charts for FRA operations;
- airspace management procedure for the implementation of free routes operation;
- ATC procedures to cover free route co-ordination and transfer of control, trajectory change in a free route environment, conflict detection.

The upgrades of ATM systems for flight data processing and controller working postition, if required, are related to:

- ATC clearances beyond AoR;
- differentiation between different traffic type airspaces;
- calculation of 4D trajectory with AoI;
- editing function for 4D trajectories;
- coordination point management for FRA;
- coordination with military agencies;
- enhance conflict management and controller HMI functions to support conflict detection and resolution.

Maturity Level

Standardization

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

PLANNING LAYERS

ATM planning | Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	NOPS-B1/5 - Full integration of airspace management with air traffic flow management
Relation-operational need	FRTO-B1/4 - Dynamic sectorization
Relation-operational need	FRTO-B1/3 - Advanced Flexible Use of Airspace (FUA) and management of real time airspace data
Relation-information need	FICE-B0/1 - Automated basic inter facility data exchange (AIDC)
Relation-operational need	FRTO-B1/5 - Enhanced Conflict Detection Tools and Conformance Monitoring
Relation-information need	DAIM-B2/2 - Daily Airspace Management information to support flight and flow
Evolution	FRTO-B0/1 - Direct routing (DCT)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design and operations	Procedures for FRA Airspace Design	Design and use of operational procedures. Reference: EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 1: European Airspace Design Methodology - Guidelines - Edition December 2018 https://www.eurocontrol.int/publications/european-route-network-improvement-plan-ernip-part-1-european-airspace-design	ANSP ATM network function	2019

Ground system infrastructure	ATM systems	ATC System Upgrade for FRA	AATM system upgrades for MTCD and MONA functions. ATC systems to be upgraded to ensure conformance monitoring of flights and conflict detection for ATC planning purposes Reference: EUROCONTROL Monitoring Aids (MONA) specification 3 March 2017. This document provides system requirements for Monitoring Aids (MONA).https://www.eurocontrol.int/standards?page= Reference: EUROCONTROL Medium-Term Conflict Detection (MTCD) specification 3 March 2017.This document provides system requirements for Medium-Term Conflict Detection (MTCD). https://www.eurocontrol.int/standards?page=4 EUROCONTROL Trajectory Prediction Specification Edition 2.0 March 2017 https://www.eurocontrol.int/publications/trajectory-prediction-specification	ANSP	2019
Ground system infrastructure	CFSP systems	Upgrade of AOs flight planning systems for FRA	AO-CFSPS systems to be upgraded to enable flight planning of FRA operations. Reference: EUROCONTROL NM Flight Planning Requirements document December 2018 https://www.eurocontrol.int/publications/nm-flight-planning-requirements-guidelines	Aircraft operator	2019
Training	-	Training requirements for FRA	ATCO Training: FRA Training Provide training to staff prior to implementation Reference: EUROCONTROL European Free Route Airspace Developments 2016 https://www.eurocontrol.int/sites/default/files/publication/files/free-route-airspace-brochure-20161216.pdf AO and ATM Network Function Training: FRA Training Provide training to staff prior to implementation Reference: EUROCONTROL European Free Route Airspace Developments 2016 https://www.eurocontrol.int/sites/default/files/publication/files/free-route-airspace-brochure-20161216.pdf	ANSP ATM network function Aircraft operator	2019
Ground system infrastructure	ATM systems	ATFM system for FRA	Upgrade ATFM/flight planning systems to support FRA	ATM network function	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route network design	++	KPI04: Filed flight plan en-route extension

FRTO-B1/2 Required Navigation Performance (RNP) routes Operational

Main Purpose

RNP routes should be deployed within en-route airspace where Free Route Airspace (FRA) is not planned or if FRA is deployed the RNP routes should ensure the connectivity between FRA and TMAs.

The objective is to provide consistent navigation using the most appropriate PBN type, infrastructure and navigation applications.

New Capabilities

Performance-based navigation (PBN) specifications allow aircraft to fly a specific path between two 3D-defined points in space. The new capability refers to the Implementation of PBN/RNP routes within en-route airspace.

Description

With the introduction of a RNP navigation specification, the advantages gained from RNAV will be further enhanced by on-board performance monitoring and alerting and the execution of more predictable aircraft behavior.

Design of optimized routes which may include closely spaced parallel routes, Fixed Radius Transition (FRT) and Tactical Parallel Offset (TPO) functionality in en-route, supported by infrastructure and system improvements to support PBN routes.

The adequate navigation infrastructure is required. GNSS or DME ground infrastructure needs to be optimised to support RNP operations and main reversionary capability in case of GNSS outages.

PBN requires a full digital chain, to critical data quality levels, for aeronautical data provided to the airborne systems. The system improvements for controller support tools which might be required are covered by other FRTO elements (MTCD, monitoring aids) or other threads (Safety Nets).

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	APTA-B0/1 - PBN Approaches (with basic capabilities)
Relation-operational need	APTA-B1/1 - PBN Approaches (with advanced capabilities)
Relation-operational need	SNET-B0/1 - Short Term Conflict Alert (STCA)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Operational Approval	Operational approval to provide RNP Routes	Provide appropriate terrestrial navigation infrastructure to support RNP operations - ground based stations Reference: ICAO Docs, 9613 (Ed 5 – when it is released), Airspace Design – 9992, Operation Approval – 9997. Annexes 6, 11 and 15 (for the data) and the PANS, 4444, 8168 and the new PANS AIM	CAA ICAO	2019
Operational procedures	Design and operations	Procedures to design the RNP routes	Design and use of operational procedures Reference: EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 1: European Airspace Design Methodology - Guidelines - Edition December 2018 https://www.eurocontrol.int/publications/european-route-network-improvement-plan-ernip-part-1-european-airspace-design European Airspace Concept Handbook for PBN Implementation Edition 3.0 2013 https://www.eurocontrol.int/sites/default/files/publication/files/handbook-pbn-implement-2013-ed-3a.pdf	ANSP	2019
Airborne system capability	Aircraft system	Install appropriate RNP equipment	Equip aircraft eligible for RNP operations as defined in ICAO DOC 9613	Aircraft manufacturer Aircraft operator	2019
Ground system infrastructure	ATC systems	Adapt ATC ground system HMI for RNP routes	Upgrade HMI to provide presentation of PBN equipage to ATC	ANSP	2019
Training	-	Training requirements for RNP routes	Flight Crew Training: Train flight crews in RNP Provide training to staff prior to implementation ATCO Training: Train ATCOs in RNP Provide training to staff prior to implementation	ANSP Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Overcome capacity limitations attributable to route network design	++	KPI06: En-route airspace capacity
Capacity	Capacity, throughput & utilization	Take advantage of increased navigation precision (airspace with PBN operations) to implement route networks and airspace structures with smaller lateral and vertical safety buffers	++	KPI06: En-route airspace capacity

FRTO-B1/3 Advanced Flexible Use of Airspace (FUA) and management of real time airspace data — Operational

Main Purpose

FUA and airspace mangement (ASM) need to be enhanced with collaborative airspace data sharing between all ATM actors, negotiation procedures, system support and real time ASM data integration.

New Capabilities

FUA procedures are enhanced by ASM data sharing between the ATM network function, ASM actors, airspace users and ATC. ASM data regarding the planning and tactical management of airspace reservations are continuously exchanged and integrated in real time between the ATM systems. Continuous exchange of ASM data between civil and military national actors will be enhanced.

Description

Automated ASM systems to ensure uninterrupted data flow between ATM Network functions and the neighbouring ASM systems from the pre-tactical planning to the real time airspace status.

ASM is enhanced by automated data exchange services during the pre-tactical and tactical execution phases continuously in real time. ASM information is shared between ASM systems and ATS units/systems, and communicated to the ATM network function in the tactical and execution phases. These data, consisting of pre-notification of activation, notification of activation, de-activation, modification and release are collected, saved and processed. Furthermore, these data need to be exchanged between ASM stakeholders and made available to other actors and relevant airspace users not involved in ASM processed.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

OPERATIONS

Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	FRTO-B0/2 - Airspace planning and Flexible Use of Airspace (FUA)
Relation-operational need	FRTO-B1/1 - Free Route Airspace (FRA)
Relation-operational need	NOPS-B1/5 - Full integration of airspace management with air traffic flow management

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Operational Approval	Operational approval to provide Advanced FUA	Follow regulations for regulatory approval Reference : ICAO Circular 330 Civil/Military Coordination European Union Regulation (EC) No 2150/2005 of 23 December 2005 laying down common rules for the flexible use of airspace. https://www.eurocontrol.int/articles/flexible-use-airspace-fua-mandate	CAA, ICAO	2019
Operational procedures	Design and operations	Procedures for Exchange of Real Time Airspace Data	Design and use of operational procedures. Reference: EUROCONTROL Centralised Advanced Flexible Use of Airspace Support Service Concept of Operations (CONOPS) Edition 2.1 October 2014 EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 3: Airspace Management Handbook - Edition December 2018 https://www.eurocontrol.int/sites/default/files/publication/files/ernip-part-3-asm-handbook-edition-5-v5-5.pdf ICAO Guidance for Civil/Military Cooperation Reference: 10088 ICAO Doc Civil Military co-operation	ANSP, ATM network function, Aircraft operator	2019
Ground system infrastructure	ATM systems	System Upgrades for Exchange of Real Time Airspace Data	Upgrade systems for partners to exchange real time data Reference: EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 3: Airspace Management Handbook - Annex 12 Edition December 2018 https://www.eurocontrol.int/sites/default/files/publication/files/ernip-part-3-asm-handbook-edition-5-v5-5.pdf	ANSP, ATM network function	2019

Ground system infrastructure	ATC systems	Integration and Management of ASM real-time Data	Upgrade systems to handle real time data in ATM systems and AU flight planning systems Reference: EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 3: Airspace Management Handbook - Annex 12 Edition December 2018 https://www.eurocontrol.int/sites/default/files/publication/files/ernip-part-3-asm-handbook-edition-5-v5-5.pdf EUROCONTROL Local And sub-Regional Airspace Management support system https://www.eurocontrol.int/services/local-and-sub-regional-airspace-management-support-system-lara	ANSP	2019
Training	-	Training requirements for Advanced FUA	Training for the real time ASM data exchanges Provide training to staff prior to implementation	ANSP ATM network function Aircraft operator	2019
Ground system infrastructure	CFSP systems	Upgrade of AOs flight planning systems for FUA	Upgrade systems to handle real time data in AU flight planning systems Reference: EUROCONTROL European Route Network Improvement Plan (ERNIP) - Part 3: Airspace Management Handbook - Annex 12 Edition December 2018 https://www.eurocontrol.int/sites/default/files/publication/files/ernip-part-3-asm-handbook-edition-5-v5-5.pdf	Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Access and equity		Improve airspace reservation management	++	
Efficiency	Flight time & distance	Facilitate direct routing of portions of the flight (if this does not cause network problems)	++	KPI05: Actual en-route extension
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route & airspace availability as known at the flight planning stage	++	KPI04: Filed flight plan en-route extension
Efficiency	Flight time & distance	Reduce need for tactical ATFM rerouting to circumnavigate airspace closed at short notice	++	KPI05: Actual en-route extension

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Efficiency	Flight time & distance	Reduce need to avoid airspace because of lack of confirmation that it will be open	++	KPI04: Filed flight plan en-route extension
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during climb to avoid Special Use Airspace	++	KPI17: Level-off during climb
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during cruise to avoid Special Use Airspace	++	KPI18: Level capping during cruise
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during descent to avoid Special Use Airspace	++	KPI19: Level-off during descent

FRTO-B1/4	Dynamic sectorization	Operational

Main Purpose

Dynamically adapt ATC sectorization to respond to traffic demand without increasing the number of controllers working position in use.

New Capabilities

This tool will provide real-time support to the operations room supervisor to select the most appropriate sector configuration according to the traffic demand and complexity, taking into account predefined sector configuration as well as the change of the ATC sector shapes by adding/removing the elementary sectors.

Description

The sectorization tool enables the dynamic management of a large number of possible sector configurations. Based on the volume of pre-defined ATC sector configurations, the automated system continuously evaluates traffic demand and complexity in the future and proposes optimum sectorization solutions.

This tool supports real-time shaping of the airspace volumes allocated to the physical controller working position by adding/removing elementary sectors in order to respond to the predicted traffic demand and complexity.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

OPERATIONS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops | Post operations

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	NOPS-B1/6 - Initial Dynamic Airspace configurations
Relation-operational need	FRTO-B1/2 - Required Navigation Performance (RNP) routes
Relation-operational need	NOPS-B1/4 - Dynamic Traffic Complexity Management

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design and operations	ATC Operational Supervisor Procedures for Dynamic Sectorization	Design and use of operational procedures	ANSP	2019
Ground system infrastructure	ATC systems	ATC System Tools for Support of Dynamic Sectorization	ATC system Upgrade relevant to dynamic handling of airspace volumes	ANSP	2019
Training	-	Training requirements for dynamic sectorization	ATCO/Operational Supervisor Training for Dynamic Sectorization Provide training to staff prior to implementation	ANSP	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Capacity	Capacity, throughput & utilization	Improve flexibility of sector configuration management	++	
Capacity	Capacity, throughput & utilization	Improve flexibility to modify sector configuration at short notice to cope with traffic pattern variations	++	

FRTO-B1/5 Enhanced Conflict Detection Tools and Conformance Monitoring Operational

Main Purpose

Enhancements of basic mid-term conflict detection (MTCD)/ monitoring alert (MONA) functions and thus further improving the ATCO productivity and reducing the workload.

New Capabilities

Conflict Detection Tools (CDT) will include enhancements to MTCD (up to 20 minutes planning horizon) function, plus tactical functions based on a shorter look-ahead time, typically from 10 to 2 minutes ahead. MTCD will be complemented by basic a conflict resolution advisor and a what if function.

Monitoring aids (MONA) provide controllers with reminders and warnings and are enhanced via the integration of Aircraft Derived Data (ADD). The provision of a trajectory warning with respect to downlinked parameters, as well as the additional reminders for change of frequency and manual coordination enhance support provided to controllers.

Description

CDT provides real-time assistance to the en-route controllers (both planning and tactical) in conflict detection and resolution. It is based on new approaches that enhance and refine the existing tools yielding more efficient and usable services.

MTCD aids the planning ATCO by showing only the most probable conflicts within the predefined look-ahead time, discarding detected conflicts with lower probabilities. The MTCD includes the what if probe function showing the problems that would occur if the given clearances is applied and identify the contextual traffic that may impair the manual identified conflict resolution.

The tactical tool is based on the tactical trajectories and identifies the conflicts within the sectors, including the what-if capabilities.

MONA provides the en-route controller with warnings if aircraft deviate from the calculated ground system trajectory or the ATCOs tactical clearances (e.g. heading, vertical rate).

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	FRTO-B0/4 - Basic conflict detection and conformance monitoring
Relation-operational need	FRTO-B1/1 - Free Route Airspace (FRA)
Relation-operational need	FRTO-B1/6 - Multi-Sector Planning

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design and operations	ATC procedures for enhanced CDT and MONA	Design and use of operational	ANSP	2019
Ground system infrastructure	ATC systems	ATC system upgrades for enhanced CDT and MONA functions	Upgrade ATC systems to provide enhanced monitoring capabilities as well as detection of planned/tactical conflicts Reference: EUROCONTROL Monitoring Aids (MONA) specification 3 March 2017. This document provides system requirements for Monitoring Aids (MONA).https://www.eurocontrol.int/standards?page= Reference: EUROCONTROL Medium-Term Conflict Detection (MTCD) specification 3 March 2017.This document provides system requirements for Medium-Term Conflict Detection (MTCD). https://www.eurocontrol.int/standards?page=4 EUROCONTROL Trajectory Prediction Specification Edition 2.0 March 2017 https://www.eurocontrol.int/publications/trajectory-prediction-specification	ANSP	2019
Training	-	Training requirements for enhanced CDT and MONA	ATCO Training for CDT and MONA Provide training to staff prior to implementation	ANSP	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Safety		Improve early detection of conflicting ATC Clearances (CATC) (en-route / departure / approach)	++	
Safety		Reduce number of vertical & lateral navigation errors during flight (cases of non-conformance with clearance)	++	

FRTO-B1/6 Multi-Sector Planning Operational

Main Purpose

This element is applicable only to en-route sectors that are currently staffed by two ATCOs (planning and tactical).

The multi-sector planning (MSP) function defines a new organization of controller team(s) and new operating procedures to enable the planning controller to provide support to several tactical controllers operating in different adjacent sectors.

This function might reduce the ATCO workload related to intra/inter centre coordination. The workload conversion to potential capacity gains might vary considerably depending on the sector configurations.

New Capabilities

New tools and operating procedures are needed for the planning controller to provide support to several tactical controllers operating in different sectors. The Multi Sector Planning (MSP) controller ensures suitable coordination agreements between sectors and assists in managing the workload of the tactical controllers.

Description

The ATM system functions are enhanced to allow a single planner role to be associated to multiple sector tactical roles and the planner and tactical roles to be combined on a controller work position. The multi-sector planner needs to have an access to flight data, system tracks, trajectory, warnings and tools for the airspace of several ATC sectors allocated to him.

The multi-sector planner needs to provide an extended planner functions within the sectors allocated to this role, including the coordination function.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	FRTO-B1/3 - Advanced Flexible Use of Airspace (FUA) and management of real time airspace data
Relation-operational need	FRTO-B1/5 - Enhanced Conflict Detection Tools and Conformance Monitoring

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Design and operations	ATC procedures for MSP	Design and use of operational procedures	ANSP	2019

Ground system infrastructure	ATC systems	ATC system Upgrade for Support of MSP Role	Upgrade ATC systems with the capabilities to support the planning controller taking the responsibility of more than one sector. The tactical responsibilities are distributed to several tactical controllers. Reference: EUROCONTROL Medium-Term Conflict Detection (MTCD) specification 3 March 2017.This document provides system requirements for Medium-Term Conflict Detection (MTCD). https://www.eurocontrol.int/standards?page=4 EUROCONTROL Trajectory Prediction Specification Edition 2.0 March 2017 https://www.eurocontrol.int/publications/trajectory-prediction-specification	ANSP	2019
Training	-	Training requirements for MSP	ATCO Training Provide training to staff prior to implementation	ANSP	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI
Cost effectiveness		Reduce costs in the Air Navigation System	++	

FRTO-B1/7 Trajectory Options Set (TOS) Operational

Main Purpose

To give airspace users greater flexibility and control over their trajectory with respect to airspace constraints.

New Capabilities

Airspace users have the capability to develop and file a set of desired reroute options (called a Trajectory Options Set or TOS) that is the operator's preference for routing around airspace constraints.

From these options, ATFM will choose the one that the operator is expected to fly. Operators have te capability to receive and process these notifications.

Description

Trajectory Options Sets (TOS) are used when airspace users are participating in Collaborative Option Programs (CTOP). These work as follows:

1. ATFM creates an airspace boundary and establishes flow control on any air traffic that crosses that boundary. (This is a NOPS action).
2. Airspace Users based on the notice of the airspace constraint develop and submit in advance of the issuance of the program, a set of desired reroute options (called a Trajectory Options Set or TOS) that is the operator's preference for routing around the constraint.
3. CTOP uses the preferred options to automatically assign delays or reroutes to flights in order to dynamically manage the demand as conditions change.

Maturity Level

Standardization

Human Factor Considerations

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational benefit	FRTO-B1/1 - Free Route Airspace (FRA)
Relation-operational benefit	FRTO-B1/2 - Required Navigation Performance (RNP) routes
Relation-operational benefit	FRTO-B1/3 - Advanced Flexible Use of Airspace (FUA) and management of real time airspace data
Evolution	FRTO-B0/3 - Pre-validated and coordinated ATS routes to support flight and flow

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Regulatory provisions	Advisory circular	CTOP advisory circular	Guidance to customers how to manage flights in the constrained area Reference: FAA AC 90-115	CAA	2019
Operational procedures	Operations	Operational procedures for the use of CTOP	Operational guidelines on CTOP usage	ANSP, Aircraft operator	2019

Ground system infrastructure	ATM systems	Tools and system to support CTOP	Tools and systems in place at ANSP to support CTOP operations Reference: https://cdm.fly.faa.gov/?page_id=983	ANSP	2019
Ground system infrastructure	CFSP systems	CSFP to support CTOP	Tools and systems in place at AOs to support CTOP operations Reference: https://cdm.fly.faa.gov/?page_id=983	Aircraft operator	2019
Training	-	Training requirements for CTOP	ATM Training, Flight Dispatcher training Training is provided on how to use CTOP system to increase flight operation efficiency	ANSP Aircraft operator	2019

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

GADS

GADS-B1/1	Aircraft Tracking	Operational

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

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

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Search and rescue	Procedures for aircraft tracking	Operator aircraft tracking policy, process and procedures. References: ICAO Annex 6 – Aircraft Tracking and ICAO Circular 347 - Aircraft Tracking Implementation Guidelines	Aircraft operator	2018
Airborne system capability	Search and rescue	Airborne aircraft tracking system	Airborne aircraft tracking capability. Note: copy table in the circular. Reference: ICAO Annex 6 – Aircraft Tracking and ICAO Circular 347 - Aircraft Tracking Implementation Guidelines.	Aircraft operator	2018
Ground system infrastructure	Search and rescue	Data link for aircraft tracking	Airborne aircraft tracking capability. Note: copy table in the circular. Reference: ICAO Annex 6 – Aircraft Tracking and ICAO Circular 347 - Aircraft Tracking Implementation Guidelines.	Aircraft operator	2018
Ground system infrastructure	Search and rescue	Ground aircraft tracking system	System with capability to process and monitor aircraft tracking data. Airborne aircraft tracking capability. Note: copy table in the circular. Reference: ICAO Annex 6 – Aircraft Tracking and ICAO Circular 347 - Aircraft Tracking Implementation Guidelines.	Aircraft operator	2018

Training	Search and rescue	Aircraft tracking training	Aircraft Operator procedures for detecting missing position reports and notifying ATSU's	Aircraft operator	2018

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

GADS-B1/2	Contact directory service	Operational

Main Purpose: To ensure that Point of Contact (PoC) information is available and can be accessed by Rescue Coordination Centres (RCCs), ATSUs and aircraft operators in support of emergency situations.

New Capabilities: Access to point of Contact information of relevant ATSUs and aircraft operators.

Description: Point of Contact repository is part of the Global Aeronautical Distress and Safety System (GADSS) and is used to enable timely contact between the persons relevant to an emergency situation involving an aircraft in a specified area.

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Strategical | Tactical-Pre ops | Tactical-During ops | Post operations

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Operational procedures	Search and rescue	Procedures for contact directory service	Procedures for maintaining PoC information and making PoC updates available. Procedures for using PoC repository. Reference: ICAO Circular 347 - Aircraft Tracking Implementation Guidelines	ANSP Aircraft operator RCC	2018

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

ICAO GANP PORTAL

ASBU ELEMENTS

NOPS | NAVS | WAKE | TBO | SURF | RSEQ | OPFL | RATS | SNET | SWIM | B1 | B0

☑ Functional Description | ○ Enablers | ○ Deployment Applicability | ○ Performance Impact Assessment

NAVS

NAVS-B0/1 Ground Based Augmentation Systems (GBAS) Technology

Main Purpose

Support Precision Approach and landing operations at a specific airport (one system may support all runway ends). As an option, may support arrival and departure phases of flight.

New Capabilities

- Category I performance using GBAS Approach Service Type C (GAST-C).
- As an option, PBN in terminal area (RNAV 1 and RNP 1 operations) can be supported using GBAS positioning service.

Description

This element introduces improved accuracy, integrity and availability through a local airport based differential satellite navigation and monitoring system. A local network of reference receivers is deployed at or near an airport. Observations from these reference receivers are used to compute corrections for each satellite as well as to monitor for system integrity. The information is broadcast to users via a VHF Data Broadcast link (operating in the 108 to 118 MHz band).

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | Arrival

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

NAVS-B0/2 Satellite Based Augmentation Systems (SBAS) Technology

Main Purpose

Support PBN in all phases of flight with an increased accuracy, integrity and availability compared to ABAS. Increases accuracy and integrity for the vertical guidance.

New Capabilities: Support all PBN navigation specifications, with a deployment emphasis over RNP APCH down to LPV or LP minima at 250 ft (APV I performance) or 200 ft /550 m (Category I performance)

Description: This element introduces improvements in the availability, accuracy and integrity of satellite navigation through a wide area differential satellite navigation position and integrity monitoring system. A network of ground reference systems is deployed in a region and connected via a data-network. Observations from the reference systems are used to monitor satellite signals and produce correction and integrity information which is then broadcast over a geostationary satellite link to aircraft. The LPV service volume is mainly determined by the distribution of the monitoring network, depending on the implementation, a wider service volume may be achieved supporting RNP 0.3 and RNP 0.1 performance.

Maturity Level: Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

NAVS-B0/3 Aircraft Based Augmentation Systems (ABAS) Technology

Main Purpose: Support non-precision (LNAV) and vertically guided (LNAV/VNAV) approaches with BaroVNAV and other terminal and enroute navigations.

New Capabilities: ABAS supports all PBN navigation specifications with the exception of RNP APCH down to LPV/LP minima. Specific ABAS configurations are required to support RNP AR APCH.

Description: This element supports non-precision and vertically guided approaches using GNSS lateral navigation and barometric vertical guidance.

Maturity Level: Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

NAVS-B0/4	Navigation Minimal Operating Networks (Nav. MON)	Technology

Main Purpose

- To adjust conventional navaids networks through the increased deployment of satellite based navigation systems and procedures to ensure the necessary levels of resilience for navigation.
- To provide a minimum level of capabilities to accommodate State aircraft operations where there is a mismatch in terms of aircraft equipage.
- To make a more efficient use of the frequency spectrum

New Capabilities

Provision of a navigation backup.

Description

This element allows the rationalization of the ground based conventional infrastructure through the definition of minimal networks of ground navaids. Consultations and agreements from airspace users and aircraft operators are required to define this element.

The MON should be revisited with the introduction of new navigation capabilities.

Maturity Level

Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

NAVS-B1/1	Extended GBAS	Technology

Main Purpose

To support precision approach and landing operations at a specific airport (one system may support all runway ends). As an option, may support arrival and departure phases of flight

New Capabilities

- CAT II operations utilizing GBAS Approach Service Type C (GAST C) in conjunction with enhanced ionospheric monitoring and airplane augmentations.
- Category II/III operations supported by GBAS Approach Service Type D (GAST D).
- Enhanced VHF Data Broadcast (VDB) airborne equipment performance to support interoperability of VDB, ILS and VOR in the 108 - 118 MHz band.

Description

This element introduces improved accuracy, integrity and availability through a local airport based differential satellite navigation and monitoring system. A local network of reference receivers is deployed at or near an airport. Observations from these reference receivers are used to compute corrections for each satellite as well as to monitor for system integrity. The information is broadcast to users via a VHF Data Broadcast link (operating in the 108 to 118 MHz band). This element extends the capability of Block 0 by adding improved ionospheric error monitoring and mitigation as well as enhanced VDB receiver performance to support interoperability and coexistence of ILS, VOR and VDB at any airport.

Maturity Level

Standardization

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | Arrival

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

NOPS

NOPS-B0/1	Initial integration of collaborative airspace management with air traffic flow management	Operational

Main Purpose

Introduce ASM/ATFM techniques, procedures and tools for the initial establishment of an integrated collaborative airspace management and air traffic flow and capacity management process applicable to the strategic through to the tactical phases of operations.

New Capabilities

Collaborative airspace planning process is extended by harmonizing the ASM/ATFM rules and procedures for the establishment, allocation and use of airspace structures in response to ATFM requirements.

Description

This element represents the initial step to enhancing the common situational awareness supporting optimum availability of airspace and ATC capacity to meet air traffic demands. It will result in a dynamic/rolling process supporting the enhancement of network operations. It will improve the cross border operations and optimise network operations based on the richest and more accurate information. It requires the implementation of new tools/systems and processes notably:

- ASM/ATFM process for the provision of the airspace use plan;
- Improved ASM/ATFM process for the provision of updated airspace use plan;
- System/tools for provision of airspace plan to ATM network function;
- Improved notification process for the ASM/ATFM purposes;
- Improved accuracy of airspace booking;
- Interoperability between local ASM and ATFM systems.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Coordination between different airspace planning actors is more efficient and the need for paper/phone coordination is minimised.

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

Integrated airspace planning implies an utilisation of new data stream.

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

ASM tool.

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

The manual process of airspace notification is semi-automated.

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-operational need	FRTO-B0/2 - Airspace planning and Flexible Use of Airspace (FUA)

NOPS-B0/2 Collaborative Network Flight Updates Operational

Main Purpose

Improve ATFM situation awareness in order to facilitate re-routings and coordinated application of ATFM measures.

New Capabilities

Seamless exchange and processing of correlated position information, flight activation status and up to date flight plan information for airborne flights. Such data are required within the Area of Responsibility (AOR) of the ATFM unit, but also within the Area of Interest (AOI) of the ATFM unit for all flights entering the ATFM area.

Description

This element will ensure:

- Effective interface between ATC and ATFM with regard to deviations from the current flight plan.
- Enhanced tactical flow management service based on real-time aircraft position data and flight activation information resulting to more accurate ATFM measures and thus better use of scarce airspace resources.

It will require implementation ATFM/ATC systems related to provision, processing and presentation of ATFM messages.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Manual notification disappeared.

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

ATFM message, CPRs and flight plan proposals are new items that were not previously exchanged.

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products

NOPS-B0/3 Network Operation Planning basic features Operational

Main Purpose

The Network Operation Planning provides an overview of the situation from strategic planning through real time operations with ever increasing accuracy up to and including the day of operations by a common situational awareness for all ATFM actors within and adjacent to the ATFM area and allowing network wide demand and capacity balancing.

New Capabilities

A Network Operations Plan will be accessible online by stakeholders for consultation and update as needed.

Description

Network Operation Planning is based on enhanced participation in a dynamically updated collaborative planning process. This requires the sharing of the latest flight status and intentions; airport and airspace component, associated demand and capacity balancing measures in a frequently updated plan which is aimed to be realised as target by all actors. The elements and formats of the plan need to be established and harmonized, taking into account the requirements of the users of these plans. It will be possible for them to access and extract data for selected areas to support their operation and, if required, to create their specific operations plan.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops

OPERATIONS

Departure | En-route | Arrival

Tactical-During ops

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products
Relation-information need	AMET-B0/3 - Climatological and historical meteorological products

NOPS-B0/4 Initial Airport/ATFM slots and A-CDM Network Interface — Operational

Main Purpose

Initial integration of airports into the ATM network function.

New Capabilities

Stakeholders will be able to share relevant airport and flight turnaround information with ATM network function resulting in better predictability and better use of existing capacity whilst considering user preferences and requirements.

Description

The first objective is the A-CDM (Airport Collaborative Decision Making) integration with ATFM via exchanges of specific messages. The second objective is to ensure ATFM slot adherence and limited ATFM slot swapping in order to meet airline demands in line with capacity declarations.

Convergence is ensured between airport slots, and flight plans, together with airport slot monitoring processes in order to improve consistency. That will require the deployment of new systems and processes for A-CDM and ATFM slot swapping:

- ATFM and airports system modules related to data exchanges for A-CDM
- Tools for airport and ATFM slot monitoring post-ops

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Phone coordination is reduced.

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

ATFM data presentation and scenario management are new data streams.

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

Network Operation planning is a new tool, it might require specialised equipment for data access.

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

Manual process is semi-automated.

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | Arrival | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	ACDM-B0/1 - Airport CDM Information Sharing (ACIS)
Relation-operational need	ACDM-B0/2 - Integration with ATM Network function

NOPS-B0/5 Dynamic ATFM slot allocation Operational

Main Purpose: Provision of dynamic departure ATFM slot allocation including Calculated Take-off Time (CTOT) for regulated flights to avoid ATFM congestions.

New Capabilities: ATM network function to provide the departure ATFM slots, including CTOT for regulated flight to all concerned operational stakeholders. ANSPs/ Airport/ AU to be capable to receive and process CTOT and update Estimated Take-off Time (EOBT) in accordance with the agreed operational procedures.

Description: The CTOT is defined as a time at which the aircraft shall take-off. CTOT is sent to AU / ATS when a flight becomes regulated (e.g. new flight entering the system, new period of regulation in the system, change of runway in use) at a system parameter time before the last received EOBT.
AU/ATS/Airport need to adhere with the CTOT. The calculation of take-off times takes into account the off-block times and an average taxiing time for the runway in use at the airfield concerned.

Maturity Level: Ready for implementation

Human Factor Considerations:

1. Does it imply a change in task by a user or affected others? Yes

Constrains need to be handled.

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

CTOT and DPI are new items.

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

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

Instead being active user, only monitoring of data exchange and reacting in abnormal situations.

PLANNING LAYERS

Tactical-Pre ops

OPERATIONS

Departure

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

NOPS-B1/1 Short Term ATFM measures Operational

Main Purpose

Short Term ATFM Measures (STAM) intends to smooth sector workloads by reducing traffic peaks through short-term applications of minor ground delays, appropriate flight level capping, timing and modalities of ATC re-sectorisation These measures are capable of reducing the traffic complexity for ATC with minimum curtailing impact on the airspace users.

New Capabilities

Stakeholders can optimize capacity throughput by adopting and improving the tactical capacity management procedures with the use of STAM.

Description

The rigid application of ATFM measures based on standard capacity thresholds as the pre-dominant tactical capacity measure needs to be replaced by a close working relationship between ANSP, AU and ATM Network function, which monitors both the real demand and the effective capacity of sectors having taken into account the complexity of expected traffic situation.

In order to close the gap between ATC and ATFM, new tools and local operational procedures need to be developed. The aim is to improve the efficiency of the system using flow management techniques close to the real time operations with direct impact on tactical capacity management and tactical action on traffic.

The target of the Short Term ATFM Measures is to replace en-route measures for situations where the capacity is nominal. These measures are capable of reducing the traffic complexity for ATC with minimum constraints for the airspace users. STAM tools and procedures are based on accurate short-term occupancy counts. The tactical capacity management procedures can be supported by the ATFM Tools (system based STAM with the hot-spot detections in the network view, the “what-if” function and capabilities of promulgation and implementation of STAM measures, including CDM). This will require the introduction of:

- Pre-tactical and Tactical Demand Capacity Balancing (DCB) evaluation tools;
- DCB tool based on occupancy counts;
- Enhanced monitoring techniques;
- DCB Coordination tools;
- DCB What-if function;
- DCB Network impact assessment;
- ATFM procedures to enable application of flow management closer to real time.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

New task for all ATFM actors.

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

STAM measures are new items.

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

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

Reduced need for late and tactical interventions.

PLANNING LAYERS

Tactical-Pre ops

OPERATIONS

En-route Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element

Evolution	NOPS-B0/3 - Network Operation Planning basic features

NOPS-B1/10 Collaborative Trajectory Options Program (CTOP) Operational

Main Purpose

Collaborative Trajectory Options Programs are Traffic Management Initiatives (TMI) that allow ATFM to choose the best possible balance between ATFM dalay and rerouting by using airspace user provided Trajectory Option Sets (TOS) to mitigate the operational impact of weather or traffic demand airspace constraints.

New Capabilities

ATFM has the capability to receive and process Trajectory Option Sets (TOS) provided by airspace users. These are ranked trajectories that represent the operator's preference for the trade-off between receiving ATFM delay and routing around airspace constraints.

When there is an airspace constraint, ATFM has the flexibility to use the trajectory options provided by all participating operators to optimize the choice between accepting a subset of the flights to use the available airspace capacity, applying ATFM delay to others, and rerouting the remaining traffic around the constraint.

Finally, ATFM has the capability to electronically notify the participating airspace users of the chosen trajectory that they are expected to fly.

Description

CTOP works as follows:

1. ATFM creates an airspace boundary and establishes flow control on any air traffic that crosses that boundary.
2. Airspace Users based on the notice of the airspace constraint develop and submit in advance of the issuance of the program, a set of desired reroute options (called a Trajectory Options Set or TOS) that is the operator's preference for routing around the constraint.
3. CTOP uses the preferred options to automatically assign delays or reroutes to flights in order to dynamically manage the demand as conditions change.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	FRTO-B1/7 - Trajectory Options Set (TOS)

NOPS-B1/2	Enhanced Network Operations Planning	Operational

Main Purpose

The Network Operations Planning needs to be enhanced to achieve collaborative planning with the support of services which can be automated (B2B interfaces/SWIM services).

New Capabilities

Tools and procedures to be deployed to enhance Network Operations planning.

Description

The Network Operations Planning process will be enhanced to continuously provide up-to-date situational information on all components of the network. Furthermore, it will provide access to initial network performance objectives and support to network performance assessment in post-operations.

The required technological platform will use the state-of-the-art technologies for creation of a virtual operations room for the physically distributed network operations, in support of collaborative Network Operations Planning. These interfaces will support the network collaborative dynamic/rolling processes from strategic to real-time operations, including capabilities for online performance monitoring integrated and feeding back into the collaborative network planning.

The information and dialogue tools shall be accessed via different interfaces. Access to information is done in a secure way, tailored according to stakeholders needs and subject to access control rules, so that only those who have an operational need to access particular information are able to do so. A common interface to all stakeholders needs to be developed to enable the collaborative decision-making processes used to build and execute the Network Operations Planning.

The following new features will be introduced:

- Enhanced Network Operations Planning interfaces (B2B/SWIM based);
- Initial steps related to the Network Operations Planning extended functions (crisis management and network disruption);
- Tools for on-line performance monitoring;
- Tools for network impact assessments.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

New role and responsibilities for some ATFM actor.

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

New info stream are handled as impact assessment and crisis management.

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

New platform and interfaces are needed.

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

New function were added , those that did not exist before.

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	NOPS-B0/3 - Network Operation Planning basic features
Relation-information need	AMET-B1/3 - Climatological and historical meteorological information
Relation-information benefit	FICE-B2/4 - Flight Data Request Service
Relation-operational benefit	SWIM-B2/1 - Information service provision
Relation-operational benefit	SWIM-B2/2 - Information service consumption

NOPS-B1/3	Enhanced integration of Airport operations planning with network operations planning	Operational

Main Purpose

Integrate the airport operations planning into the network operations planning.

New Capabilities

The airport operations plan will be a single common and collaborative agreed dynamic/rolling plan available to all airport stakeholders. This plan will be integrated with the enhanced network operations planning.

Description

The airport operations plan will contain all data and information related to the different status of planning phases and will be a dynamic/rolling plan, which naturally evolves over time. The integration of airport operations planning within the network operations planning provides a dynamic/rolling picture of the network situation to be used by all operational stakeholders to prepare their plans and their inputs to the network CDM processes.

The data exchanges are based on the subset of B2B/SWIM services that are most widely available to all stakeholders, communicating with local airport A-CDM systems to exchange relevant operational information.

This element is a step prior to the full integration of the airport operations planning to the network operations planning.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Yes, manual coordination is automated.

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

AOP/NOP interfaces contain a full set of new data exchange items.

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

In some cases. New modules and interfaces.

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

Reduced need for phone coordination.

PLANNING LAYERS

ATM planning | Strategical | Pre-tactical | Tactical-Pre ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	NOPS-B0/4 - Initial Airport/ATFM slots and A-CDM Network Interface
Relation-operational need	ACDM-B1/1 - Airport Operations Plan (AOP)
Relation-operational need	NOPS-B1/2 - Enhanced Network Operations Planning
Relation-operational benefit	SWIM-B2/1 - Information service provision
Relation-operational benefit	SWIM-B2/2 - Information service consumption

NOPS-B1/4 Dynamic Traffic Complexity Management Operational

Main Purpose

Enhanced traffic complexity assessment by automation.

New Capabilities

The predicted complexity coupled with traffic demand enables the ATM Network function to take timely action to better address demand and capacity balancing, or request the trajectory changes in coordination with ATC and Airspace Users.

Description

The rigid application of ATFM measures based on standard capacity thresholds as the pre-dominant tactical capacity measure needs to be replaced by a close working relationship between ANSPs and ATM Network function, which would monitor both the real demand and the effective capacity of sectors having taken into account the complexity of expected traffic situation. The local traffic complexity assessment continuously monitors sector demand and evaluate traffic complexity (by applying predefined complexity metrics) according to a predetermined qualitative scale. It provides support in the determination of solutions in order to plan airspace, sectors and staff to handle the predicted traffic. The local complexity assessment would benefit by receiving processing and integrating the ATM Network function information in order to supplement the local traffic counts with the relevant flight plan data. This will improve the quality of the planned trajectory and further enhance the traffic complexity management.

Maturity Level

Standardization

Human Factor Considerations	1. Does it imply a change in task by a user or affected others? Yes New task to manage traffic complexity. 2. Does it imply processing of new information by the user? Yes New stream of data. 3. Does it imply the use of new equipment? Yes It could be module of existing system or separate system. 4. Does it imply a change to levels of automation? Yes Mental activates are automated, complexity tool provides additional data to facilitate the traffic de-confliction well in advance.

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

NOPS-B1/5	Full integration of airspace management with air traffic flow management	Operational

Main Purpose	Ensure a continuous, seamless and iterative airspace management and air traffic flow management approach.
New Capabilities	Fully dynamic/rolling ASM/ ATFM integration process supporting information collection, processing and sharing with all concerned stakeholders.

Description

The full dynamic/rolling ASM/ATFM process focuses on improving airspace planning. It will ensure a continuous, seamless and iterative airspace planning and management/allocation based on airspace requests at any time period within strategic, pre-tactical and tactical ASM levels. It will result in a rolling process, supporting the enhancement of dynamic Network Operations Planning. The real time ASM data exchanges relates to the automated exchange services of ASM data during the tactical phase continuously in real time. ASM information (real-time Airspace Reservation status) is shared between different systems and Stakeholders and communicated to ATFM in the tactical phase.

Several new improvements are introduced as:

- Process/system modules supporting a full rolling ASM/ATFM and dynamic ASM/ATFM process allowing data sharing to all operational stakeholders,
- Process/System changes for initial Collaborative Decision Making (CDM) between ATFM function and the local designated authorities and between neighboring ASM actors.
- ASM information sharing addresses requirements aiming to improve the notification to airspace users based on automated data exchange processes
- Procedural and system modules for exchange of real time airspace status data;
- The Flexible Use of Airspace (FUA) process is improved with more dynamic airspace management enabling dynamic responses to airspace requests (or very short term changes)
- Real-time ASM coordination is further enhanced through "what-if" functionalities and automated support to airspace booking and airspace management.
- Real-time ASM data are exchanged between ASM support systems and ATC system
- Integration and management of ASM real-time data into ANSPs' ATM systems and into AUs flight planning systems;

The full dynamic/rolling ASM/ATFM process will be supported by the sharing of civil-military airspace data and by continuously updating Airspace Reservation information with other demand information among the authorized operational stakeholders in order to enhance the coordination of Cross-Border Operations, and to optimise the whole network operations based on the most timely and correct information. The process is enhanced with "what-if" functionalities enabling a better use of available capacity. ASM real-time data exchanges consisting of pre-notification of activation, notification of activation, de-activation, modification and release of airspace are collected, saved and processed in order to be exchanged between stakeholders and be made available to ATM actors, including Airspace Users (AUs). ATM systems need to be upgraded to exchange real-time ASM data messages containing real time activation status of predefined airspace structures with local ASM support systems and to display airspace status data at the Controller Working Position (CWP).

Maturity Level

Standardization

Human Factor Considerations

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

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

Real time ASM data is new data stream.

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

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

Automation increased compared with B0.

PLANNING LAYERS

OPERATIONS

Strategical | Pre-tactical | Tactical-Pre ops

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	NOPS-B0/1 - Initial integration of collaborative airspace management with air traffic flow management
Relation-operational need	FRTO-B1/1 - Free Route Airspace (FRA)
Relation-operational need	FRTO-B1/2 - Required Navigation Performance (RNP) routes
Relation-operational need	FRTO-B1/3 - Advanced Flexible Use of Airspace (FUA) and management of real time airspace data
Relation-operational need	FRTO-B1/4 - Dynamic sectorization

NOPS-B1/6 Initial Dynamic Airspace configurations Operational

Main Purpose: ASM solutions and initial dynamic airspace configurations for ATFM planning, synchronisation of traffic flows and demand/capacity balancing

New Capabilities: Availability of optimised Airspace solutions/Initial Dynamic Airspace configurations based on traffic demand and dynamic sectors management taken into account for ATFM purposes.

Description

This element addresses the following ASM/ATFM improvements:

- Airspace solutions
- Pre-defined airspace configurations
- ANSPs/ ATM Network function data exchanges pertinent to pre-defined airspace configurations

The ASM solutions process is aimed at delivering ASM options/solutions that can help reducing or even alleviate the ATFM measures and address capacity issues identified in any particular area as well as to improve flight efficiency assessing impact on capacity and ensuring the synchronised availability of optimized airspace structures based on traffic demand and dynamic sectors management.

The Airspace configurations are pre-defined and coordinated airspace structures and ATC dynamic sectorisation, to meet the ATFM and airspace needs in terms of capacity and/or flight efficiency. The implementation of pre-defined airspace configuration exchange covers the improvements of ATFM systems, to allow exchange of predefined airspace configurations information.

The decisions required for dynamic sectorisation could benefit from real time exchanges with ATM Network function for ATFM planning, synchronisation of traffic flows and demand/capacity balancing. The notification of Airspace Configurations will be based on automatic flows of information between the different stakeholders supported by the ATM Network function. The airspace configurations and flexible sector configurations are already used when the flows and constraints can be predicted well in advance (e.g. weekend routes or seasonal flows of traffic).

A more efficient and dynamic process involving the ATM Network function, ATC would require new functionalities and procedures and well defined collaborative decision making processes at pre-tactical level. The ANSPs systems needs to support the dynamic sectorisation by dynamic resizing and change of sector shapes and volumes based on pre-defined airspace configurations.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Utilisation of pre-defined airspace configuration.

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

Airspace structure and ATC sectorisation are new data information.

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

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

Manual Task are semi-automated.

PLANNING LAYERS

Strategical | Pre-tactical

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	FRTO-B0/1 - Direct routing (DCT)
Relation-operational need	FRTO-B0/2 - Airspace planning and Flexible Use of Airspace (FUA)

Relation-operational need	FRTO-B0/3 - Pre-validated and coordinated ATS routes to support flight and flow
Relation-operational need	FRTO-B1/1 - Free Route Airspace (FRA)
Relation-operational need	FRTO-B1/2 - Required Navigation Performance (RNP) routes
Relation-operational need	FRTO-B1/3 - Advanced Flexible Use of Airspace (FUA) and management of real time airspace data
Relation-operational need	FRTO-B1/4 - Dynamic sectorization

NOPS-B1/7 Enhanced ATFM slot swapping — Operational

Main Purpose
Improve the Airspace Users driven ATFM slot swapping process

New Capabilities
The swapping of ATFM measure impacted flights within the same ATFM measure will be extended to all ATFM measure impacted flights.

Description
ATFM slot swapping allows Airspace Users (AU) to request a rearrangement of their own flights subject to an ATFM measure in order to better suit their needs. The enhanced ATFM Slot Swapping improves the slot swapping currently used by Airspace Users (AU), by allowing the function to be extended gradually to all airspace users, by re-prioritizing their flights during the pre-departure part of operations. The Enhanced Slot swapping increases flexibility for Airspace Users; and provides a wider range of possibilities, by facilitating the identification of possible swaps for an ATFM Measure impacted flight (through B2B/SWIM-based Network Operations Planning interfaces) and by reducing the rate of rejection of swap requests by refining current processes. The AUs requests for these changes in flight priority will be introduced at the initiative of the AUs themselves, airport authorities or the ATM Network function.

Maturity Level
Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Change of tasks for many ATFM actors.

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

New data stream for slot swapping and airport slot monitoring.

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

Change of system and interfaces.

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

Coordination is semi-automated.

PLANNING LAYERS

Tactical-Pre ops

OPERATIONS

Departure

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element

Evolution	NOPS-B0/4 - Initial Airport/ATFM slots and A-CDM Network Interface
Relation-operational need	NOPS-B1/2 - Enhanced Network Operations Planning
Relation-operational benefit	SWIM-B2/1 - Information service provision
Relation-operational benefit	SWIM-B2/2 - Information service consumption

NOPS-B1/8 Extended Arrival Management supported by the ATM Network function — Operational

Main Purpose

ATM Network function contributions to extended Arrival Management.

New Capabilities

Extended Arrival Management information is taken on board by the Network ATM function to improve the quality of the ATFM service.

Description

The ATM Network function involvement in extended Arrival Management process is addressed by this element. It does include the following elements:

- Enhancements of ATFM Planned Trajectory about the accuracy/predictability of estimates to meet the extended arrival management operational requirements;
- Provision of ATFM Planned Trajectory to ANSPs;
- Reception and processing of ANSPs extended Arrival Management info by ATM Network function;
- ATFM assessment tool for extended Arrival Management.

Bilateral agreements need be established between the sectors involved that can be in different ATC units and also in different countries, including the ATM Network function for the notification purposes. The ATFM procedures need to be revised for the management of the extended Arrival Management information.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Propagation of delay further en-route will increase the task for some ATFM actors.

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

AMAN delay is propagated further en-route and the Network function is notified.

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

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

Some ATFM actors got new tasks for the optimisation of arrival traffic flows.

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element

Relation-operational need	RSEQ-B1/1 - Extended arrival metering

NOPS-B1/9 Target Times for ATFM purposes Operational

Main Purpose

Use of Target Times for ATFM purposes including an initial level of arrival sequencing in case of an arrival ATFM measure.

New Capabilities

Calculation and provision of Target Times by the ATM Network function in addition to CTOT, for the most penalised measure.

Description

In order to improve the flight predictability at the entry of the congested area, a target time of entry at the congested area (most penalised measure) will be provided by ATM Network function. At this stage, the target times will be applied for ATFM purpose only, including an initial level of arrival sequencing in case of an arrival ATFM measure. The ATM Network function will provide the calculated Target Time (TT) at the most penalising measure reference point in addition to Calculated Take-Off Time (CTOT) to all concerned users. TT will be distributed by data exchanges with the concerned Stakeholders. Stakeholders using TTs should be able to receive, extract and present the target times delivered by ATM Network function. ANSPs have access to the relevant information on flights that are subject to a Target Time to manage these flights as required in accordance with local procedures that need to be developed. The Flight Operating centres should provide Target Times to pilots prior to departure; pilots should endeavour to adhere to the Target Times to the extent possible.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

Target time adherence by AUs and ANSPs.

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

Target time to be presented to affected users.

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

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

AUs and ANSPs to process and comply with target times.

PLANNING LAYERS

Tactical-Pre ops

OPERATIONS

En-route Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational need	RSEQ-B1/1 - Extended arrival metering

OPFL-B0/1	In Trail Procedure (ITP)	Operational

Main Purpose: To enable aircraft to reach a more satisfactory flight level for flight efficiency or to avoid turbulence for safety.

New Capabilities: The procedure couples the capability of the controller to receive the current position and intent from a pair(s) of aircraft with the ability of the trailing aircraft to space itself accurately from the preceding aircraft(s) to allow for the safe issuance of the ITP clearance.

Description: ITP is primarily intended to help facilitate access to optimum flight levels for aircraft operating in airspace where no ATS surveillance service is available. The ITP aircraft must acquire and process position broadcast (ADS-B) data from up to two non-manoeuvring aircraft. Aircraft identification, altitude, position and ground speed of reference aircraft would be assessed by the ITP aircraft's on-board equipment (on-board decision support system) to determine whether an ITP climb or descent is possible. Based on the processed broadcast data from the reference aircraft(s), a pilot can make an ITP climb or descent request to air traffic control (ATC). Pilots are responsible for using the on-board equipment to evaluate the situation and provide the required information to the controller.

Maturity Level: Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

OPFL-B1/1	Climb and Descend Procedure (CDP)	Operational

Main Purpose: The CDP was designed to improve service to appropriately equipped aircraft by providing an air traffic controller with another option for initiating an altitude change when existing separation minima do not allow an aircraft to climb or descend through the altitude of a blocking aircraft.

New Capabilities: The capability for the controller to request current position and intent from pair(s) (ADS-C capability) aircraft provides the situational awareness to allow the controller to use the simultaneous reporting of position to support the procedure at less than the nominal separation.

Description: The CDP utilizes existing ADS-C aircraft equipage and air traffic control (ATC) capabilities to allow more flights to achieve their preferred vertical profiles. Integral to the CDP is the use of advanced communication and surveillance capabilities (i.e. ADS-C and CPDLC). The CDP is conceptually modelled after existing in-trail distance measuring equipment (DME) rules set forth in the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444), paragraph 5.4.2.3.4. Aircraft pair distance verification is performed by the ground automation system using simultaneous ADS-C demand contract reports.

Maturity Level: Standardization

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

RATS

RATS-B1/1	Remotely Operated Aerodrome Air Traffic Services	Operational

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

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

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

Maturity Level: Standardization

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

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

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

RSEQ

RSEQ-B0/1	Arrival Management	Operational

Main Purpose: To optimize sequencing for arrivals.

New Capabilities: Arrival management metering and sequencing by ATC is based on inbound traffic prediction information, and decision making support.

Description: This element represents management of arrival sequences, thereby allowing aircraft to fly more efficiently to the necessary fix and to reduce the use of holding stacks, especially at low altitude.

Based on inbound traffic prediction information and decision making support, ATC operational techniques (metering points, speed-control, Time-To-Gain/Time-To-Lose, etc.) will be used to sequence inbound flights at minimum separation on final approach (time or distance based) so as to optimise runway utilization. Time-based metering (as opposed to time-based separations) is the practice of planning a sequence of traffic by time rather than distance. Typically, the relevant ATC authorities will assign a time in which a flight must arrive at the aerodrome or at a specific control point, and/or advises subject flights of speed changes as required to achieve the optimal separation on final approach. Besides inbound traffic predication information, input can include aerodrome capacity, terminal airspace capacity, aircraft capability, wind and other meteorological factors. Time-based metering is the primary mechanism in which arrival sequencing is achieved.

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information benefit	AMET-B0/1 - Meteorological observations products
Relation-information benefit	AMET-B0/2 - Meteorological forecast and warning products
Relation-operational benefit	WAKE-B2/1 - Wake turbulence separation minima based on 7 aircraft groups
Relation-operational benefit	WAKE-B2/4 - Wake turbulence separation minima based on leader/follower static pairs-wise
Relation-operational benefit	WAKE-B2/7 - Time based wake separation minima for arrival based on leader/follower static pair-wise
Relation-operational benefit	SURF-B0/2 - Comprehensive situational awareness of surface operations
Relation-operational benefit	SURF-B1/4 - Routing service to support ATCO surface operations management
Relation-operational benefit	ACDM-B0/1 - Airport CDM Information Sharing (ACIS)
Relation-operational benefit	ACDM-B0/2 - Integration with ATM Network function

RSEQ-B0/2	Departure Management	Operational

Main Purpose: To optimize departure operations.

New Capabilities: Departure management sequences the aircraft for optimized utilization of ground infrastructure and efficiently meet en-route and destination airport constraints, taking on board user preferences.

Description: Departure management, like its arrival counterpart, serves to optimize departure operation to ensure the most efficient utilization of aerodrome and terminal resources. Slots assignment and adjustments will be supported by departure management automation like department management or departure flow management. Dynamic ATFM slot allocation will foster smoother integration into overhead streams and help airspace users to better meet metering points and comply with other ATM requirements. It will sequence aircraft, based on the ground and airspace structure, wake turbulence, aircraft capability, en-route and destination ATFM constraints, and airspace users' preferences. This will serve to increase aerodrome throughput and compliance with allotted departure time. Where Airport CDM is implemented, departure management will interface with the associated A-CDM processes (including the pre-departure sequencing of A-CDM) in determining optimal departure sequencing.

Maturity Level: Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information benefit	AMET-B0/1 - Meteorological observations products
Relation-information benefit	AMET-B0/2 - Meteorological forecast and warning products
Relation-operational benefit	ACDM-B0/1 - Airport CDM Information Sharing (ACIS)
Relation-operational benefit	ACDM-B0/2 - Integration with ATM Network function
Relation-operational benefit	SURF-B1/4 - Routing service to support ATCO surface operations management
Relation-operational benefit	WAKE-B2/1 - Wake turbulence separation minima based on 7 aircraft groups
Relation-operational benefit	WAKE-B2/4 - Wake turbulence separation minima based on leader/follower static pairs-wise
Relation-operational benefit	WAKE-B2/8 - Time based wake separation minima for departure based on leader/follower static pair-wise
Relation-operational benefit	SURF-B0/2 - Comprehensive situational awareness of surface operations
Relation-operational benefit	APTA-B0/2 - PBN SID and STAR procedures (with basic capabilities)
Relation-information benefit	NOPS-B0/5 - Dynamic ATFM slot allocation

RSEQ-B0/3	Point merge	Operational

Main Purpose: To allow merging of arrival flows.

New Capabilities: Sequencing using pre-defined legs equidistant from a point that are used for shortening or stretching the arrival path.

Description

This element represents a procedural concept that uses existing technology to merge arrival flows. Its purpose is to improve and harmonize arrival operations by enabling continuous descent operations (CDO) and increasing arrival predictability, thereby enhancing airport capacity and limiting the environmental impact of aircraft emissions. Point Merge is based on a specific route structure that is made of a point (the merge point) with pre-defined legs (the sequencing legs) equidistant from this point that are used for shortening or stretching the arrival path.

Maturity Level

Ready for implementation

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

2. Does it imply processing of new information by the user? No

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational benefit	WAKE-B2/1 - Wake turbulence separation minima based on 7 aircraft groups
Relation-operational benefit	WAKE-B2/4 - Wake turbulence separation minima based on leader/follower static pairs-wise
Relation-operational benefit	WAKE-B2/7 - Time based wake separation minima for arrival based on leader/follower static pair-wise
Relation-information benefit	AMET-B0/1 - Meteorological observations products

RSEQ-B1/1 Extended arrival metering Operational

Main Purpose

To enhance predictability and ATM decision compliance.

New Capabilities

Synchronization between adjacent FIRs, arrival management taking into account extended metering requirements.

Description

Extended metering will enhance predictability and ATM decision compliance. The ATS units will be able to meter across FIR boundaries. Extended metering will enable ATS units to continue metering during high volume traffic and will improve metering accuracy. This will also facilitate synchronization between adjacent FIRs. With extended metering, delays can be shifted to higher attitudes or even to the departure gate, where it can be more efficiently absorbed by incoming flights. This metering will provide extended arrival management, increasing arrival management effectiveness and benefits (e.g. in terms of reduced holding time) while reducing approach ATC workload. Extended metering may set requirements on flights pre-departure, if departing within the arrival metering range of the destination airport.

Maturity Level

Standardization

Human Factor Considerations

1. Does it imply a change in task by a user or affected others? Yes

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	RSEQ-B0/1 - Arrival Management
Relation-operational benefit	NOPS-B1/8 - Extended Arrival Management supported by the ATM Network function
Relation-information benefit	AMET-B1/1 - Meteorological observations information
Relation-information benefit	AMET-B1/2 - Meteorological forecast and warning information
Relation-operational benefit	APTA-B1/4 - CDO (Advanced)
Relation-information benefit	SWIM-B2/1 - Information service provision
Relation-information benefit	FICE-B3/1 - Flight information management services for enhanced trajectory operations

SNET

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

Main Purpose

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

New Capabilities

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

Description

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

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

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

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

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

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

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

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

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

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

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

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

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

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

SNET-B0/3 Area Proximity Warning (APW) Operational

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

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

Description

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

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

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

SNET-B0/4 Approach Path Monitoring (APM) Operational

Main Purpose

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

New Capabilities

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

Description

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

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Arrival

DEPENDENCIES AND RELATIONS

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

SNET-B1/1 Enhanced STCA with aircraft parameters Operational

Main Purpose

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

New Capabilities

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

Description

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure En-route Arrival

DEPENDENCIES AND RELATIONS

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

Relation-technology need	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
Evolution	SNET-B0/1 - Short Term Conflict Alert (STCA)

SNET-B1/2 Enhanced STCA in complex TMAs Operational

Main Purpose

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

New Capabilities

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

Description

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

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

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

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

SURF

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

Main Purpose

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

New Capabilities

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

Description

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

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

The Controller monitors and commands the lighting systems.

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

SURF-B0/2 Comprehensive situational awareness of surface operations — Operational

Main Purpose

To better maintain ATCO awareness of ground operations.

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

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

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

Maturity Level: Ready for implementation

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Taxi-in

DEPENDENCIES AND RELATIONS

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

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

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

New Capabilities

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

Description

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

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

Maturity Level

Ready for implementation

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

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

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

Main Purpose

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

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

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

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

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

Maturity Level — Standardization

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Taxi-in

DEPENDENCIES AND RELATIONS

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

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

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

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

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

Maturity Level Ready for implementation

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

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

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

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

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

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

Maturity Level Standardization

Human Factor Considerations

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

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

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

Main Purpose

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

New Capabilities

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

Description

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

Maturity Level

Standardization

Human Factor Considerations

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Taxi-in

DEPENDENCIES AND RELATIONS

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

SURF-B1/5 Enhanced vision systems for taxi operations Operational

Main Purpose: Allow for improved navigation by visual reference, even during conditions of low-light or weather obscuration such as fog.

New Capabilities: The addition of cockpit enhanced vision capabilities will improve flight crew awareness of own ship position, and reduce navigation errors during periods of reduced visibility. In addition, improved situational awareness of aircraft position will allow for more confidence by the flight crew in the conduct of the taxi operation during periods of reduced visibility and ensure accurate application of received clearances.

Description: Additional avionics add electromagnetic sensors outside the visible light spectrum (e.g., infrared cameras, millimetre wave radar). These sensors will allow for improved navigation by visual reference, even during conditions of low-light or weather obscuration such as fog. Presentation to the flight crew may be through an instrument panel display or via heads-up display (HUD), etc.

Maturity Level: Standardization

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Taxi-out Taxi-in

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information benefit	AMET-B0/1 - Meteorological observations products

TBO

TBO-B0/1	Introduction of time-based management within a flow centric approach.	Operational

Main Purpose: Provides for more efficient flight operation by using time-based scheduling versus more tactical measures such as holding to manage tactical synchronization.

New Capabilities: Strategic and tactical time based management are introduced via initial decision-making processes for network operations (demand capacity balancing) and runway sequencing (traffic synchronization).

Description: Individual time-based initiatives are available in decision making processes related to network operations or flight sequencing. The individual time-based initiatives are not synchronized, and any synchronization of individual time advisories is left to the tactical ATCO. The main focus is on the traffic flow activity without consideration to individual flights or gate-to gate focus.

Maturity Level: Ready for implementation

Human Factor Considerations

PLANNING LAYERS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.

TBO-B1/1	Initial Integration of time-based decision making processes	Operational

Main Purpose: Provides initial support to network operations by integrating network applied constraints into local arrival and departure management. Overall operations are still locally conducted with time-based decision-making tools.

New Capabilities: Network operations and runway sequencing are the main contributors. Coordination is conducted between the two contributors. Some strategic and tactical decisions are locally coordinated but not necessarily fully synchronized.

Description: Information about individual and some sets of flights are available for time-based decision-making tools. Some pre-departure and in-flight synchronization is conducted locally via ATCO and automation. Flights are subject to local/regional initial synchronization processes.

Maturity Level: Standardization

Human Factor Considerations

PLANNING LAYERS

OPERATIONS

Strategical | Pre-tactical | Tactical-Pre ops | Tactical-During ops

Taxi-out | Departure | En-route | Arrival | Taxi-in

DEPENDENCIES AND RELATIONS

There are currently no dependencies.