ICAO GANP PORTAL

ASBU ELEMENTS

ASUR | COMI | COMS | NAVS | B0 | B1 | B2 | Concept | Validation | Standardization | Ready for implementation | Taxi-out | Departure | En-route | Arrival | Taxi-in | Turn-around | ATM planning | Pre-tactical | Tactical-Pre ops | Strategical | Post operations | Tactical-During ops

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

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

ASUR-B2/1	Evolution of ADS-B and Mode S	Technology

Main Purpose

To provide new types of data in support of Air Traffic/MET Services and vehicle-to-vehicle applications.

New Capabilities

New aircraft/atmospheric information is provided via ADS-B and/or cooperative radar interrogation to support emerging ANSP/MET and vehicle-to-vehicle applications in an early TBO environment.

Description

RTCA and EUROCAE are working jointly to prepare the next version of the Mode S transponder MOPS and the ADS-B MOPS. Changes include: correction of issues identified since the MOPS were last published, to support new collision avoidance systems, to support new Detect and Avoid systems, to support the ADS-B-In Interval Management application, to support potential commercial space operations (in the atmosphere), to reduce 1090MHz spectrum congestion, to downlink certain meterological parameters, to improve ADS-B reception performance, and to remove unused capabilities. Within, this timeframe, ADS-B vehicle-to-vehicle applications are potentially provided in a different spectrum in lower airspace.

This evolution offers opportunities for compliance based on performance-equivalence for State aircraft.

Maturity Level

Validation

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	ASUR-B0/1 - Automatic Dependent Surveillance – Broadcast (ADS-B)
Evolution	ASUR-B0/2 - Multilateration cooperative surveillance systems (MLAT)
Evolution	ASUR-B0/3 - Cooperative Surveillance Radar Downlink of Aircraft Parameters (SSR-DAPS)
Evolution	ASUR-B1/1 - Reception of aircraft ADS-B signals from space (SB ADS-B)
Relation-operational need	NAVS-B0/3 - Aircraft Based Augmentation Systems (ABAS)
Relation-benefit	NAVS-B0/2 - Satellite Based Augmentation Systems (SBAS)
Relation-benefit	NAVS-B2/2 - Dual Frequency Multi Constellation (DF MC) SBAS
Relation-benefit	NAVS-B2/3 - Dual Frequency Multi Constellation (DF MC) ABAS

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 3	Reference: Technical standards and guidance material: Future revision ICAO Annex 10 Volume IV Chapter 2,3 and 5 Future revision ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter: RTCA/EUROCAE MOPS: DO-260C/ED-102C, DO-181F/ED-73F (TBC) Future revision ICAO Doc. 9924 Aeronautical Surveillance Manual	Aircraft manufacturer Aircraft operator	2022

Ground system infrastructure	Surveillance	ADS-B receivers and/or cooperative radars	ADS-B receivers and/or cooperative radars receive information from aircraft and transfer this information to Service Delivery Point(s). Reference material: Technical standards and guidance material: Future revision ICAO Annex 10 Volume IV Chapter 2,3 and 5 Future revision ICAO Doc. 9871 Technical Provisions for Mode S Services and Extended Squitter RTCA/EUROCAE MOPS: DO-260C/ED-102C, DO-181F/ED-73F, ED-129B (or subsequent revision) Future revision ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2022
Ground system infrastructure	Surveillance	Service Delivery Point(s) for ADS-B v3	Service Delivery Point(s) receive information and transfers it to ATC automation for processing and display to controller. Reference: Guidance material: Future revision of ICAO Doc. 9924 Aeronautical Surveillance Manual	ANSP	2022
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-B2/2 — New community based surveillance system for airborne aircraft (low and higher airspace) — Technology

Main Purpose

To support the provision of separation services by operators for aircraft operating at very low altitudes (<500 ft) and higher airspace.

New Capabilities

A community based network solution for surveillance at a lower lifecycle cost is provided using operator reported positions into that network to support conflict detection and resolution. It substitutes shared information for visual recognition of other aircraft.

Description

Within this timeframe, vehicle identities/positions/velocities may be shared using an aviation network. Information is provided to the ANSP on aircraft location to detect airspace infringement (low altitudes) and support operator to operator (even if provided by third party acting on the operators behalf) conflict management. It extends to higher airspace to support new entrants.

Maturity Level

Concept

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

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)
Relation-benefit	NAVS-B2/2 - Dual Frequency Multi Constellation (DF MC) SBAS
Relation-benefit	NAVS-B2/3 - Dual Frequency Multi Constellation (DF MC) ABAS

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Ground system infrastructure	Surveillance	“Public” network-based cooperative surveillance	“Public” network-based cooperative surveillance system collects, processes and shares “target” information; this information is then provided as needed to ANSP personnel.	ANSP	2024

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

OPERATIONS

Tactical-During ops

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 ?

OPERATIONS ?

Tactical-During ops

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

COMI-B2/1 Air-Ground ATN/IPS Technology

Main Purpose: To improve integrity of the information.

New Capabilities: This element:

- provides more efficient data communications;
- improves information integrity.

Description: A new network infrastructure based on Internet Protocol (IP) that promises to use Commercial-Off-The-Shelf (COTS) products to support air to ground aeronautical safety services and regularity of flight communications.

Maturity Level: Validation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element

Relation-technology option	COMI-B1/2 - VHF Data Link (VDL) Mode 2 Multi-Frequency
Relation-technology option	COMI-B1/3 - SATCOM Class B Voice and Data
Relation-technology benefit	COMI-B3/1 - VHF Data Link (VDL) Mode-2 Connectionless
Relation-technology benefit	COMI-B3/2 - SATCOM Class A voice and data
Relation-technology benefit	COMI-B3/4 - Links meeting requirements for safety critical communication
Relation-technology benefit	COMI-B3/3 - L-band Digital Aeronautical Communication System (LDACS)
Relation-technology benefit	COMI-B2/2 - Aeronautical Mobile Airport Communication System (AeroMACS) aircraft mobile connection

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
Airborne system capability	Communication infrastructure	IPS Airborne Router	Aviation Profiles for Internet Protocol Suite (IPS) ICAO ANNEX-10, Volume III, IPS SARPs ARINC Project Paper 858 IPS technical requirements	Aircraft manufacturer Aircraft operator	2025
Ground system infrastructure	Communication infrastructure	IPS Ground Router	IPS MASPS	ANSP	2025

COMI-B2/2 Aeronautical Mobile Airport Communication System (AeroMACS) aircraft mobile connection — Technology

Main Purpose

To reduce separation and improve situational awareness.

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 communications to mobile assets (e.g. Aircraft, emergency vehicles, baggage trucks). It is used to transmit safety critical and regularity of flight information.

Maturity Level

Validation

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 mobile connection operational description	• ED222 / Do345: Aeronautical Mobile Airport Communications System (AeroMACS) Profile Doc. • Doc 10044: AeroMACS Technical Manual	ANSP	2031
Airborne system capability	Communication infrastructure	AeroMACS Mobile Station (Avionics Radio Unit)	• ED223 / Do346: Minimum Operational Performance Standards (MOPS) for the AeroMACS. • ICAO ANNEX-10, Volume III, Chapter 7: AeroMACS SARPs • ARINC 766: Aeronautical Mobile Airport Communication System (AeroMACS) Transceiver and Aircraft Installation Standards	Aircraft manufacturer Aircraft operator	2031
Ground system infrastructure	Communication infrastructure	AeroMACS Base Station for mobile connection	EUROCAE ED-227: AeroMACS MASPS	ANSP	2031

COMI-B2/3 — Links meeting requirements for non-safety critical communication — Technology

Main Purpose

To:

- reduce operational cost;
- improve performance;
- take advantage of new technologies sooner;
- enable the global exchange of non-safety information.

New Capabilities

- Improved resiliency
- Reduced operational costs
- Improved capacity
- Broadband communications
- Enable a single IP-based global operating network

Description

Broadband satellite and cellular services are used to support non-safety critical communications. By adopting the use of available infrastructure and possibly the use of a multi-sensor concept these systems meet performance requirements, in effect leading to reduced system cost, while improving the overall performance of the network and the system resiliency.

Maturity Level

Validation

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
Airborne system capability	Communication infrastructure	Commercial airborne data transfer	In the future commercial provider (Ex. AWS, Azure, Google) may increase their range and service offerings to allow implementation of radio systems that can be used to transfer data from airborne systems to ground systems.	ANSP Communication service provider	2025
Ground system infrastructure	Communication infrastructure	Commercial ground data transfer	To reduce congestion on current air traffic control towers, commercial cellular infrastructure and systems already in place can be used to relay data.	ANSP Communication service provider	2025
Space system infrastructure	Communication infrastructure	Commercial satellite data transfer	To relay messages via satellites while saving the cost on implementation, commercial broadband satellites and constellation systems (Ex. Amazon, Google, SpaceX) can be used to relay data.	ANSP Satellite provider	2025

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

COMS-B2/1 — PBCS approved CPDLC (B2) for domestic and procedural airspace — Technology

Main Purpose

Provision of Air Traffic Services (ATS), with the extension of data link communications use in support of various ATM enhancements among which:

- Trajectory-based operations, with new CPDLC messages to uplink route amendments (with standardized automation rules to ensure consistent Flight Management System implementation among the aircraft fleet),
- Surface operations, with new CPDLC TAXI (D-TAXI) messages.

New Capabilities

New generation of CPDLC application, named Baseline 2, designed to:

- perpetuate legacy data link operations in procedural and domestic airspace,
- introduce new data link services (e.g. 4D trajectory exchange, D-TAXI).

Description

Baseline 2 data link capabilities (CPDLC and ADS-C) support provision of data communications in all operational environments e.g., continental, oceanic, and surface in support of provision of air traffic control services.

Baseline 2 CPDLC has been designed to be independent of the underlying technologies.

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

Maturity Level

Validation

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

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

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	COMS-B0/1 - CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace
Evolution	COMS-B1/1 - PBCS approved CPDLC (FANS 1/A+) for domestic and procedural airspace
Relation-technology need	COMI-B0/2 - Aeronautical Telecommunication Network/Open System Interconnection (ATN/OSI)
Relation-benefit	COMI-B2/1 - Air-Ground ATN/IPS

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
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
Operational procedures	Communication service	CPDLC (B2) 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 2 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2024

Airborne system capability	Communication service	Baseline 2 CPDLC aircraft system	Technical standards to ensure operational and technical interoperability, such as: Annex 10 Vol II ED228A/DO350A, Baseline 2 Safety and Performance Requirements ED229A/DO351A, Baseline 2 Interoperability Requirements ED230A/DO352A, Baseline 2 FANS 1/A Accommodation Interoperability Requirements ED232A/DO353A, Baseline 2 ATN B1 Accommodation Interoperability Requirements	Aircraft manufacturer Aircraft operator	2016
Ground system infrastructure	Communication service	Baseline 2 CPDLC Ground System	Technical standards to ensure operational and technical interoperability, such as: Annex 10 Vol II ED228A/DO350A, Baseline 2 Safety and Performance Requirements ED229A/DO351A, Baseline 2 Interoperability Requirements ED230A/DO352A, Baseline 2 FANS 1/A Accommodation Interoperability Requirements ED232A/DO353A, Baseline 2 ATN B1 Accommodation Interoperability Requirements	ANSP Ground systems supplier	2016
Training	Communication service	Training requirements for PBCS approved CPDLC (B2) for domestic and procedural airspace	Controllers training, Flight Crew Training, Maintenance and Flight Operations Training. ICAO Doc 10037 Edition 2 Global Operational Data link Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2019
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
Regulatory provisions	SMS	CPDLC PBCS (B2) Safety Management System	Requirements to support local safety cases. References: Annex 19 Annex 11 PANS ATM 4444	ANSP	2013

COMS-B2/2	PBCS Approved ADS-C (B2) for domestic and procedural airspace	Technology

Main Purpose

Provision of Air Traffic Services (ATS), with the extension of data link communications use in support of various ATM enhancements among which:

- Trajectory-based operations, in particular with ADS-C Extended Project Profile (i.e. predicted route ahead of the aircraft, up to 128 waypoints with their predicted level, speed and time).

New Capabilities

New generation of ADS-C applications, named Baseline 2, designed to:

- perpetuate legacy data link operations in procedural airspace
- new data link services (e.g.4D trajectory exchange)

Description

Baseline 2 data link capabilities (CPDLC and ADS-C) support provision of data communications in all operational environments e.g., continental, oceanic, and surface in support of provision of air traffic control services.

Baseline 2 ADS-C has been designed to be independent of the underlying technologies.

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

Maturity Level

Validation

Human Factor Considerations

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

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

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

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

PLANNING LAYERS

Tactical-Pre ops | Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	COMS-B1/2 - PBCS approved ADS-C (FANS 1/A+) for procedural airspace
Relation-technology need	COMI-B0/2 - Aeronautical Telecommunication Network/Open System Interconnection (ATN/OSI)
Relation-benefit	COMI-B2/1 - Air-Ground ATN/IPS

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Communication service	Datalink performance requirements and monitoring (B2 ADS-C)	Guidance to support deployment of Performance Based operations, such as: ICAO Doc 9869 Fourth Edition Performance-Based Communication and Surveillance (PBCS) Manual	ANSP; Aircraft manufacturer; Aircraft operator; Communication service provider	2024

Operational procedures	Communication service	ADS-C (B2) 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 2 Global Operational Datalink Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2024
Airborne system capability	Communication service	Baseline 2 ADS-C aircraft system	Technical standards to ensure operational and technical interoperability, such as: Annex 10 Vol II ED228A/DO350A, Baseline 2 Safety and Performance Requirements ED229A/DO351A, Baseline 2 Interoperability Requirements ED230A/DO352A, Baseline 2 FANS 1/A Accommodation Interoperability Requirements ED232A/DO353A, Baseline 2 ATN B1 Accommodation Interoperability Requirements	Aircraft manufacturer Aircraft operator	2016
Ground system infrastructure	Communication service	Baseline 2 ADS-C Ground System	Technical standards to ensure operational and technical interoperability, such as: Annex 10 Vol II ED228A/DO350A, Baseline 2 Safety and Performance Requirements ED229A/DO351A, Baseline 2 Interoperability Requirements ED230A/DO352A, Baseline 2 FANS 1/A Accommodation Interoperability Requirements ED232A/DO353A, Baseline 2 ATN B1 Accommodation Interoperability Requirements	ANSP Ground systems supplier	2016
Training	Communication service	Training requirements for PBCS approved ADS-C (B2) for domestic and procedural airspace	Controllers training, Flight Crew Training, Maintenance and Flight Operations Training. ICAO Doc 10037 Edition 2 Global Operational Data link Manual (GOLD)	ANSP Aircraft manufacturer Aircraft operator	2019
Regulatory provisions	SMS	ADS-C PBCS (B2) 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 (RSP 160)	Requirements and guidance for PBCS operational authorization in Annex 6 and Doc 9869, 4th Edition	CAA Aircraft operator	2024

COMS-B2/3	PBCS approved SATVOICE (incl. routine communications) for procedural airspace	Technology

Main Purpose: Supports introduction of reduced separation minima in procedural airspace.

New Capabilities: SATVOICE systems are demonstrated compliant with a new RCP specification (to be developed).

Description: In procedural airspace, PBCS approved SATVOICE systems provides the controller with intervention capability, allowing when used in conjunction with other enablers (e.g. ADS-C or space-based ADS-B 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: Validation

Human Factor Considerations:

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

PLANNING LAYERS

Tactical-During ops

OPERATIONS

En-route

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	COMS-B1/3 - SATVOICE (incl. routine communications) for procedural airspace
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	SMS	SATVOICE PBCS SMS for procedural airspace	Requirements to support local safety cases. References: Annex 19 Annex 11 PANS ATM 4444	ANSP	2013
Operational procedures	-	SATVOICE PBCS operational procedures for procedural airspace	PANS-ATM (Doc 4444), Procedures for Air Navigation Services — Air Traffic Management Doc 10038, Satellite Voice Operations Manual (SVOM), Edition 2	ANSP Aircraft manufacturer Aircraft operator	2024

Operational procedures	-	SATVOICE PBCS performance monitoring for procedural airspace	Performance-Based Communication and Surveillance (PBCS) Manual, Edition 4	ANSP Aircraft manufacturer Aircraft operator Communication service provider	2024
Airborne system capability	Aircraft system	SATVOICE PBCS airborne system for procedural airspace	Annex 10, Volume III Manual on the Aeronautical Mobile Satellite (Route) Service. (Doc 9925)	Aircraft manufacturer Aircraft operator	2024
Ground system infrastructure	-	SATVOICE PBCS ground system for procedural airspace	Annex 10, Volume III Manual on the Aeronautical Mobile Satellite (Route) Service. (Doc 9925)	ANSP Ground systems supplier	2024
Regulatory provisions	Operational Approval	SATVOICE PBCS operational approval for procedural airspace	Requirements and guidance for PBCS operational authorization in Annex 6 and Doc 9869, 4th Edition.	CAA Aircraft operator	2024
Training	-	Training for SATVOICE PBCS for procedural airspace	Doc 10038, Satellite Voice Operations Manual (SVOM), Edition 2	ANSP Aircraft operator	2024

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.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Navigation	GBAS Cat I Instrument flight procedures	Instrument flight procedures validated and published. Reference: ICAO Doc 4444 PANS Air Traffic Management; ICAO Doc 8168 PANS Aircraft operations ; ICAO Doc 9849 Global Navigation Satellite System (GNSS) Manual; ICAO Doc 9365 Manual of All-Weather Operations; ICAO EUR Doc 013 European guidance material on All Weather Operations at Aerodromes and ICAO Doc 8071 Manual on Testing of Radio Navigation Aids.	ANSP Aircraft operator	2013
Airborne system capability	Navigation	GBAS receiver GAST C	GBAS receivers. Reference: ICAO Annex 10 Vol I technical requirements; RTCA/EUROCAE MOPS.	Aircraft manufacturer Aircraft operator	2013
Ground system infrastructure	Navigation	GBAS ground stations GAST C	GBAS ground stations. Reference: ICAO Annex 10 Vol I; provisions supporting system certification/approval by the designated authority; RTCA/EUROCAE MOPS.	Airport operator ANSP Ground systems supplier	2013
Training	Navigation	Training requirements for GBAS for CAT I	Adaptation of aircrews due to ILS look alike concept implementation and procedures designers. Reference: States/Regions regulations.	Airport operator ANSP Aircraft operator	2013

Space system infrastructure	Navigation	GNSS core constellation	Core constellation. Reference: documentation specific to each core constellation defining provisions supporting performance commitment.	Ground systems supplier Satellite provider	2013

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.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Operational procedures	Navigation	SBAS instrument flight procedures	Procedures validated and published. Reference material: ICAO Doc 4444 PANS Air Traffic Management; ICAO Doc 8168 PANS Aircraft operations or United States Standards for Terminal Instrument Procedures (TERPS); ICAO Doc 9849 Global Navigation Satellite System (GNSS) Manual; ICAO Doc 9613 Performance-based Navigation (PBN) Manual and ICAO Doc 8071 Manual on Testing of Radio Navigation Aids.	ANSP Aircraft manufacturer Aircraft operator	2013
Airborne system capability	Navigation	SBAS receiver	SBAS receivers integrated with aircraft navigation systems. Reference: ICAO Annex 10 Vol I technical requirements; RTCA/EUROCAE MOPS.	Aircraft manufacturer Aircraft operator	2013
Ground system infrastructure	Navigation	SBAS ground stations	Ground stations to provide a wide area monitoring network. No local airport infrastructure is required. However, a network of ground reference systems and a highly reliable data network with processing facilities and satellite signal generation capability is required. References: ICAO Annex 10 Vol I; document specific to each SBAS; provisions supporting system certification/approval by the designated authority and performance commitments.	SBAS service provider	2013
Training	Navigation	Training requirements for SBAS	Adaptation of aircrews due to ILS look alike concept implementation and procedures designers. Reference: ICAO Doc 9613 Performance-based Navigation (PBN) Manual and States/Regions regulations.	ANSP Aircraft manufacturer Aircraft operator	2013
Space system infrastructure	Navigation	GNSS core constellation	Core constellation. Reference: documentation specific to each core constellation defining provisions supporting performance commitment.	Ground systems supplier Satellite provider	2013
Space system infrastructure	Navigation	GNSS augmentation satellites	These satellites broadcast the SBAS messages to the different users. Reference: document specific to each SBAS provider	SBAS service provider	2013

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.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Navigation	ABAS instrument flight procedures	ABAS instrument flight procedures validated and published. Reference: ICAO Doc 4444 PANS Air Traffic Management; ICAO Doc 8168 PANS Aircraft operations or United States Standard for Terminal Instrument Procedures (TERPS); ICAO Doc 9849 Global Navigation Satellite System (GNSS) Manual; ICAO Doc 9613 Performance-based Navigation (PBN) Manual and ICAO Doc 8071 Manual on Testing of Radio Navigation Aids.	ANSP Aircraft operator	2013
Airborne system capability	Navigation	ABAS avionics	ABAS without Baro-VNAV capability to support non-precision (LNAV) or with Baro-VNAV capability to support vertically guided (LNAV/VNAV) approaches. ABAS is capable of supporting other phase of flight such as oceanic, en-route and terminal operations. Reference: ICAO Annex 10 Volume I and ICAO Doc 9613 Performance-based Navigation (PBN) Manual for technical requirements; RTCA/EUROCAE MOPS.	Airport operator Aircraft manufacturer	2013

Space system infrastructure	Navigation	GNSS core constellation	Core constellation. Reference: documentation specific to each core constellation defining provisions supporting performance commitment.	Ground systems supplier Satellite provider	2013
Training	Navigation	Training requirements for ABAS	Pilot training requirements for RNP APCH and procedure designers. Specific training required for RNP AR APCH.	ANSP Aircraft operator	2013

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.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Other	Navigation	Plan for minimal operating networks (MON).	Airspace users consultation, dedicated studies and safety cases are required to mitigate the withdrawal of existing ground networks. References: ICAO Regional Air Navigation Plans	ANSP CAA Aircraft operator	2013

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.

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Space system infrastructure	Navigation	GNSS core constellation	Core constellation. Reference: documentation specific to each core constellation defining provisions supporting performance commitment.	Ground systems supplier Satellite provider	2013
Airborne system capability	Navigation	GBAS receiver GAST D	GBAS receivers. Reference: ICAO Annex 10 Vol I technical requirements; RTCA/EUROCAE MOPS.	Aircraft manufacturer Aircraft operator	2019

Ground system infrastructure	Navigation	GBAS ground stations GAST D	GBAS ground stations. Reference: ICAO Annex 10 Vol I; provisions supporting system certification/approval by the designated authority; RTCA/EUROCAE MOPS.	Airport operator ANSP Ground systems supplier	2019
Operational procedures	Operations	GBAS Cat II/III Instrument flight procedures	Instrument flight procedures validated and published. Reference: ICAO Doc 4444 PANS Air Traffic Management; ICAO Doc 8168 PANS Aircraft operations ; ICAO Doc 9849 Global Navigation Satellite System (GNSS) Manual; ICAO Doc 9365 Manual of All-Weather Operations; ICAO EUR Doc 013 European guidance material on All Weather Operations at Aerodromes and ICAO Doc 8071 Manual on Testing of Radio Navigation Aids.	ANSP Aircraft operator	2019
Training	-	Training requirements for GBAS for CAT II/III	Adaptation of aircrews due to ILS look alike concept implementation and procedures designers. Reference: States/Regions regulations.	Airport operator ANSP Aircraft operator	2019

NAVS-B2/1 Dual Frequency Multi Constellation (DF MC) GBAS — Technology

Main Purpose

More robust and less vulnerable to atmospheric propagation perturbations, supports Cat I,II, III GBAS landing operations in all regions of the world.

New Capabilities

GBAS provide dual frequency and multi constellation additional augmentation information.

Description

This element builds upon the basic GBAS systems introduced within Block 1.

New core constellations and signals: (e.g. Beidou, Galileo) or dual frequencies such as GPS, GLONASS will enhance satellite based navigation services through GBAS.

DF MC GBAS will provide additional navigation augmentation information.

Maturity Level

Validation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element

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

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Space system infrastructure	Navigation	New core constellations	New satellite constellations (Beidou, Galileo) or dual frequencies such as GPS or GLONASS provide opportunities to enhance satellite based navigation services by increasing performance and robustness to failures.	Satellite provider	2019
Operational procedures	Navigation	DF MC GBAS Cat I, II, III Instrument flight procedures	New core constellations (Beidou, Galileo) and signals (GPS, GLONASS) will provide opportunities to enhance satellite based navigation services through GBAS. New signals/constellations are expected to support existing procedures with an increased performance/robustness, therefore, additional procedures might be validated and published. Reference: ICAO Doc 4444 PANS Air Traffic Management; ICAO Doc 8168 PANS Aircraft operations ; ICAO Doc 9849 Global Navigation Satellite System (GNSS) Manual; ICAO Doc 9365 Manual of All-Weather Operations; ICAO EUR Doc 013 European guidance material on All Weather Operations at Aerodromes and ICAO Doc 8071 Manual on Testing of Radio Navigation Aids.	ANSP Aircraft operator	2025
Airborne system capability	Navigation	DFMC GBAS receiver	New core constellations (Beidou, Galileo) and signals (GPS, GLONASS) will provide opportunities to enhance satellite based navigation services through GBAS. Dual Frequency multi constellation (DFMC) GBAS receivers. Reference: ICAO Annex 10 Vol I technical requirements; RTCA/EUROCAE MOPS.	Aircraft manufacturer Aircraft operator	2025
Ground system infrastructure	Navigation	DFMC GBAS ground stations	New core constellations (Beidou, Galileo) and signals (GPS, GLONASS) will provide opportunities to enhance satellite based navigation services through GBAS. DFMC GBAS ground stations at the airport are required. Reference: ICAO Annex 10 Vol I; provisions supporting system certification/approval by the designated authority; RTCA/EUROCAE MOPS.	Airport operator ANSP Ground systems supplier	2025

NAVS-B2/2	Dual Frequency Multi Constellation (DF MC) SBAS	Technology

Main Purpose
- To increase availability and expand coverage.
- To reduce cost through the reduction of the need for ground stations.

New Capabilities: More robust and wider area landing services, including Cat I autoland, possibly Cat II (R&D on-going).

Description: This module builds upon the basic SBAS systems introduced within Block 0.

New core constellations and signals: (e.g. Beidou, Galileo) or dual frequencies such as GPS, GLONASS will enhance satellite based navigation services through SBAS.

DF MC SBAS provide dual frequency and multi constellation additional navigation signals.

Maturity Level: Validation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	NAVS-B0/2 - Satellite Based Augmentation Systems (SBAS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year

Operational procedures	Navigation	Enhanced SBAS instrument flight procedures	New core constellations (Beidou, Galileo) and signals (GPS, GLONASS) will provide opportunities to enhance satellite based navigation services through SBAS. New signals/constellations are expected to support existing procedures with an increased performance/robustness, therefore, additional procedures might be validated and published. Reference material: ICAO Doc 4444 PANS Air Traffic Management; ICAO Doc 8168 PANS Aircraft operations or United States Standards for Terminal Instrument Procedures (TERPS); ICAO Doc 9849 Global Navigation Satellite System (GNSS) Manual; ICAO Doc 9613 Performance-based Navigation (PBN) Manual and ICAO Doc 8071 Manual on Testing of Radio Navigation Aids.	ANSP Aircraft manufacturer Aircraft operator	2025
Airborne system capability	Navigation	DFMC SBAS receiver	New core constellations (Beidou, Galileo) and signals (GPS, GLONASS) will provide opportunities to enhance satellite based navigation services through SBAS. Dual Frequency multi constellation (DFMC) SBAS receivers integrated with aircraft navigation systems. Reference: ICAO Annex 10 Vol I technical requirements; RTCA/EUROCAE MOPS.	Aircraft manufacturer Aircraft operator	2025
Ground system infrastructure	Navigation	DFMC SBAS ground stations	New core constellations (Beidou, Galileo) and signals (GPS, GLONASS) will provide opportunities to enhance satellite based navigation services through SBAS. Ground stations will provide a wide area monitoring network. No local airport infrastructure is required. However, a network of ground reference systems and a highly reliable data network with processing facilities and satellite signal generation capability is required. References: ICAO Annex 10 Vol I; document specific to each SBAS; provisions supporting system certification/approval by the designated authority and performance commitments.	SBAS service provider	2025
Space system infrastructure	Navigation	New core constellations	New satellite constellations (Beidou, Galileo) or dual frequencies such as GPS or GLONASS provide opportunities to enhance satellite based navigation services by increasing performance and robustness to failures.	Satellite provider	2019

Space system infrastructure	Navigation	GNSS DFMC augmentation satellites	These satellites broadcast the DFMC SBAS messages to the different users. Reference: document specific to each SBAS provider	SBAS service provider	2025

NAVS-B2/3 Dual Frequency Multi Constellation (DF MC) ABAS — Technology

Main Purpose More robust navigation services (in particular versus loss of a single frequency, or of a single constellation).

New Capabilities ABAS algorithms use dual frequency and multi constellation additional signals. Only horizontal (2D) enhanced ABAS navigation services are expected within Block 2. Vertical (3D) enhanced ABAS navigation services will be introduced within Block 3.

Description This element builds upon the basic ABAS systems introduced within Block 0.

New core constellations and signals: (e.g. Beidou, Galileo) or dual frequencies such as GPS, GLONASS will enhance satellite based navigation services through ABAS.

DF MC ABAS will use additional navigation signals and new integrity algorithmes (A-RAIM).

Maturity Level Validation

Human Factor Considerations

PLANNING LAYERS

Tactical-During ops

OPERATIONS

Departure | En-route | Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Evolution	NAVS-B0/3 - Aircraft Based Augmentation Systems (ABAS)

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Space system infrastructure	Navigation	New core constellations	New satellite constellations (Beidou, Galileo) or dual frequencies such as GPS or GLONASS provide opportunities to enhance satellite based navigation services by increasing performance and robustness to failures.	Satellite provider	2019

Training	Navigation	Training requirements for enhanced ABAS	In principle no additional training than for NAV-B0/3 will be required. Reference: Pilot training requirements for RNP APCH and procedure designers. Specific training required for RNP AR APCH.	ANSP Aircraft operator	2025
Operational procedures	Navigation	Enhanced ABAS instrument flight procedures	New core constellations (Beidou, Galileo) and signals (GPS, GLONASS) will provide opportunities to enhance satellite based navigation services through ABAS. New signals/constellations are expected to support existing procedures with an increased performance/robustness, therefore, additional procedures might be validated and published. Reference: ICAO Doc 4444 PANS Air Traffic Management; ICAO Doc 8168 PANS Aircraft operations or United States Standard for Terminal Instrument Procedures (TERPS); ICAO Doc 9849 Global Navigation Satellite System (GNSS) Manual; ICAO Doc 9613 Performance-based Navigation (PBN) Manual and ICAO Doc 8071 Manual on Testing of Radio Navigation Aids	ANSP Aircraft operator	2025
Airborne system capability	Navigation	DFMC ABAS receiver	DFMC ABAS receiver integrated with aircraft navigation systems. Reference: ICAO Annex 10 Volume I technical requirements; RTCA/EUROCAE MOPS.	Aircraft manufacturer Aircraft operator	2025