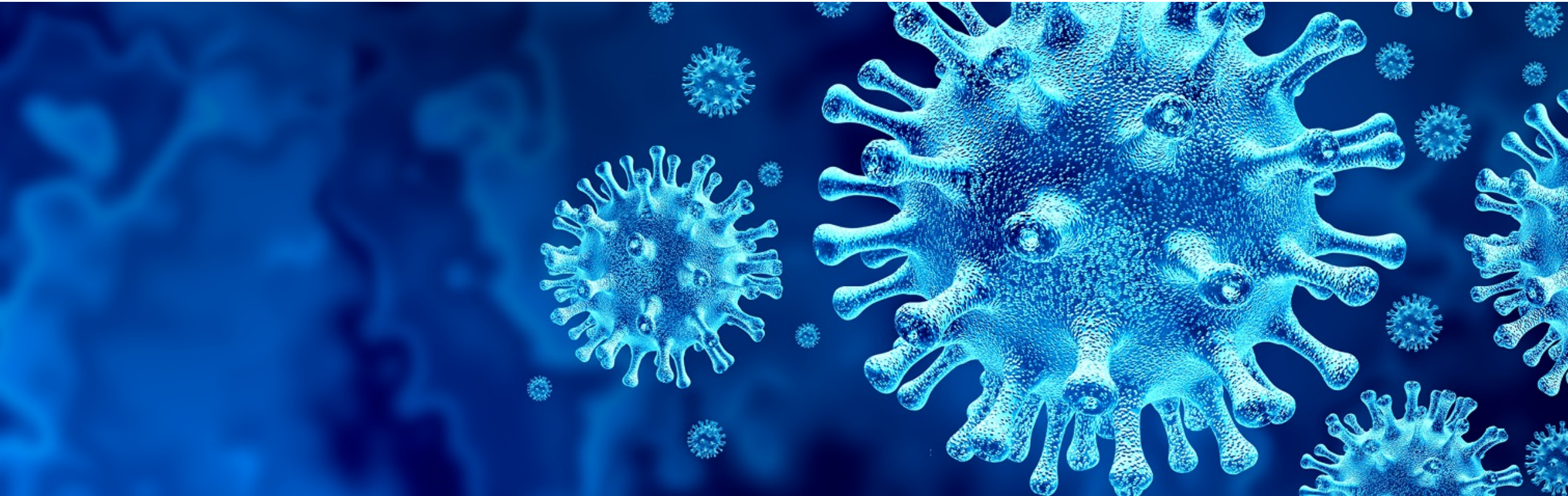


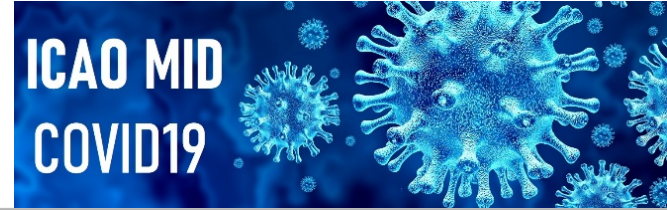


ICAO MID

1-3 December 2020

CNS SG/10 Meeting





Agenda Item 4

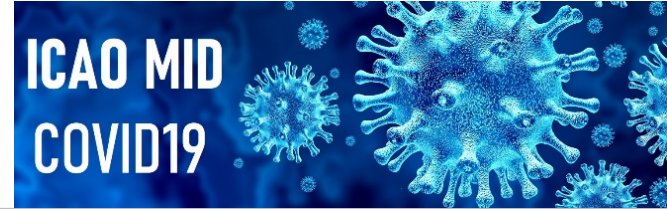
Navigation Matters

- Navigation Minimal Operating Networks
- Review the Guidance on GNSS Implementation in the MID Region
- Outcome of NAV AIDS Flight Inspection Webinar



NAVS: Navigation

NAVS-B0/1	Ground Based Augmentation Systems (GBAS)	Technology			
NAVS-B0/2	Satellite Based Augmentation Systems (SBAS)	Technology			
NAVS-B0/3	Aircraft Based Augmentation Systems (ABAS)	Technology			
NAVS-B0/4	Navigation Minimal Operating Networks (Nav. MON)	Technology			
NAVS-B1/1	Extended GBAS	Technology			
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NAVS-B2/3	Dual Frequency Multi Constellation (DF MC) ABAS	Technology			



ASUR		Priority	Applicability	Performance Indicator*
NAVS B0/1	Ground Based Augmentation Systems (GBAS)	Priority 2		
NAVS B0/2	Satellite Based Augmentation Systems (SBAS)	Priority 2		
NAVS B0/3	Aircraft Based Augmentation Systems (ABAS)	Priority 1	All States	Indicator: % of States requiring aircrafts' equipage with the Aircraft Based Augmentation System (ABAS) to enable PBN Operations
NAVS B0/4	Navigation Minimal Operating Networks (Nav. MON)	Priority 1	All States	Indicator: % of States developed the plan of rationalized conventional navaids network to ensure the necessary levels of resilience for navigation
NAVS B1/1	Extended GBAS	Priority 2		



NAVS-B0/4

Navigation Minimal Operating Networks (Nav. MON)

Technology



Main Purpose ?

- To adjust conventional nav aids 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 nav aids. 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

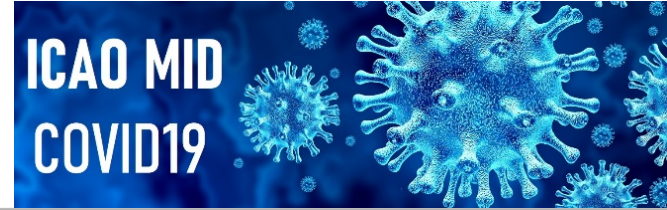
Airspace users consultation, dedicated studies and safety cases are required to mitigate the withdrawal of existing ground networks



Guidance on GNSS Implementation in the MID Region

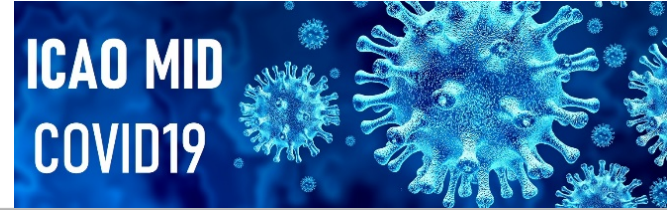
- *States Should introduce rationalizing terrestrial navigation aids, retaining a minimum network of terrestrial aids necessary to maintain safety of aircraft operations; in accordance with AN-Conf/12 recommendations 6/10. Some ILSs may be retained to support precision approach and to mitigate GNSS outage.*
- *Removal of conventional ground infrastructure should be planned carefully to ensure that safety is not compromised, such as by performance of safety assessment, consultation with users through regional air navigation planning.*

STRATEGY FOR RATIONALIZATION OF CONVENTIONAL RADIO NAVIGATION AIDS AND EVOLUTION TOWARD SUPPORTING PERFORMANCE-BASED NAVIGATION is at attachment H, Annex 10, Vol I



Action by the meeting:

The meeting is invited to discuss the means to support States in developing their Navigation Minimal Operating Networks (Nav. MON) plan inline with ICAO SARPs and Regional requirements.



Agenda Item 4

Navigation Matters

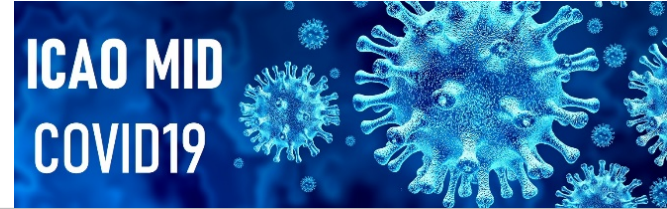
- Navigation Minimal Operating Networks
- Review the Guidance on GNSS Implementation in the MID Region
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ICAO MID DOC 011

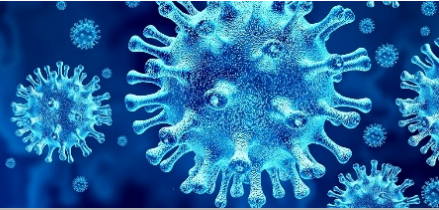
Guidance on GNSS Implementation in the MID Region

- The first edition of the Guidance on GNSS Implementation in the MID Region – ICAO MID DOC 011 was endorsed by MSG/6 meeting in December 2018.
- This document is divided into three parts; Part one includes information about the GNSS and Augmentation systems worldwide, and ICAO GANP Navigation Roadmap.
- Part II identifies the current conventional Navigation aids infrastructure in the MID Region. And focuses on the SBAS Systems that may extends their services to the MID states.
- Part III addresses the GNSS vulnerabilities due to intentional and unintentional sources of interference and to certain ionospheric effects. Also, it defines mitigation strategies to be deployed by States to reduce the likelihood and impact of the GNSS interference.



NAVS: Navigation

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NAVS-B0/2	Satellite Based Augmentation Systems (SBAS)	Technology			
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NAVS-B2/3	Dual Frequency Multi Constellation (DF MC) ABAS	Technology			



4-GBAS

Transition from ILS to GBAS should be based on an economic assessment, an operational assessment and from a safety and security perspective. Cost benefits analysis should be conducted taking on consideration that one GBAS can be used for several runways ends and even in some cases more than one Airports.

5- Cost Benefits Analysis

The use of GNSS in PBN applications reduces the overall running cost of Navigation infrastructure. Also deploying GBAS reduces the cost for ground infrastructure since a single GBAS ground station can provide approach guidance to all runways at an airport. GBAS can increase the Airport capacity, because it does not have sensitive areas that must be protected. However, the CBA is very dependent on specific operational and airport infrastructure aspects.

States may consider the following factors during the process of estimating the cost associated with competing alternative in CBA:



a) CAPEX

a.1 Installation Cost;

- *One GBAS costs around 1.5 -2 M euro (equal to the cost of 3 ILSs).*
- *ILS(s) must be retained to ensure the service continuity during the GNSS/GBAS outage.*

a.2 Training for operational and technical staff.

b) OPEX

b.1 Cost of Flight Check (Calibration).

b.2 Maintenance costs (Preventive, Reactive, maintenance Contract, less Spare parts).

It has been reported by several CBA studies, that GBAS initial investment is higher than for ILS, and lower OPEX. However, Net Present Cost need to be calculated based on Airport infrastructure and operational requirements.

6- GBAS Implementation in the MID Region

Currently GBAS is not implemented in the MID Region.



ASUR		Priority	Applicability	Performance Indicator*
NAVS B0/1	Ground Based Augmentation Systems (GBAS)	Priority 2		
NAVS B0/2	Satellite Based Augmentation Systems (SBAS)	Priority 2		
NAVS B0/3	Aircraft Based Augmentation Systems (ABAS)	Priority 1	All States	Indicator: % of States requiring aircrafts' equipage with the Aircraft Based Augmentation System (ABAS) to enable PBN Operations
NAVS B0/4	Navigation Minimal Operating Networks (Nav. MON)	Priority 1	All States	Indicator: % of States developed the plan of rationalized conventional navaids network to ensure the necessary levels of resilience for navigation
NAVS B1/1	Extended GBAS	Priority 2		



NAVS: Navigation

NAVS-B0/1	Ground Based Augmentation Systems (GBAS)	Technology			
NAVS-B0/2	Satellite Based Augmentation Systems (SBAS)	Technology			
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NAVS-B2/3	Dual Frequency Multi Constellation (DF MC) ABAS	Technology			



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.

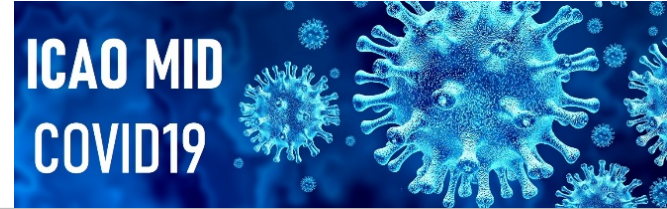
Description  This element supports non-precision and vertically guided approaches using GNSS lateral navigation and barometric vertical guidance.

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.



NAVS: Navigation

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NAVS-B0/2	Satellite Based Augmentation Systems (SBAS)	Technology			
NAVS-B0/3	Aircraft Based Augmentation Systems (ABAS)	Technology			
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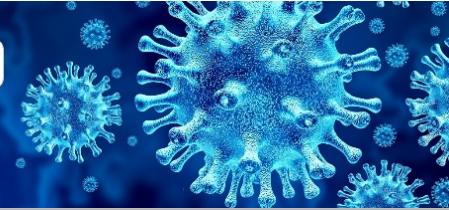


Air Navigation Conference 13

Recommendation 2.2/2 — Global navigation satellite system (GNSS) evolution

That States:

- a) when defining their air navigation strategic plans, take advantage of the improved robustness and performance offered by dual-frequency, multi constellation (DFMC) global navigation satellite system (GNSS) to deliver incremental operational benefits and encourage related industry developments;
- b) avoid, in principle, prohibiting the use of available GNSS elements if they perform according to ICAO Standards and Recommended Practices (SARPs) and can meet all safety and regulatory requirements for the intended operations;
- c) avoid mandating equipage or use of any particular GNSS core constellation or augmentation system unless clear operational benefits are offered in return and appropriate consultations have been made with the relevant airspace users;
- d) ensure implementation of ICAO provisions for publication of information related to the use of GNSS elements in aeronautical information publications (AIP);

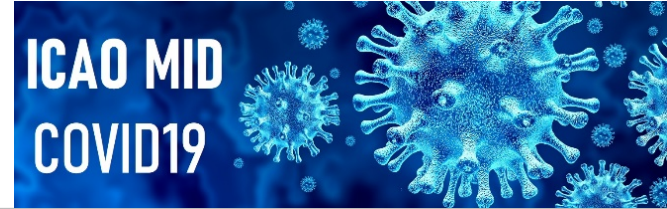


Air Navigation Conference 13

e) take timely action to meet the long-term goal whereby every State accepts for lateral navigation use all GNSS elements that are compliant with SARPs, thus creating a positive environment for DFMC GNSS.

That ICAO:

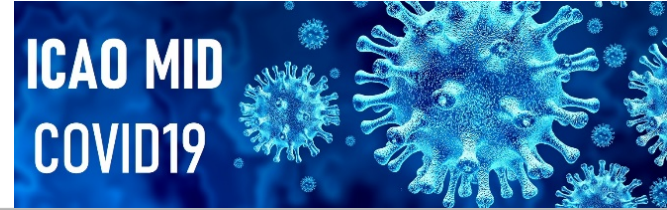
- f) continue the development of SARPs and guidance material for existing and future GNSS elements in coordination with recognized standards-making organizations;**
- g) further develop provisions intended for States and organizations that provide GNSS services regarding publication of service performance standards, regular performance assessment and timely notification of events that may affect the service; and**
- h) develop additional guidance addressing technical and regulatory aspects to assist States in their acceptance and use of existing and future GNSS elements.**



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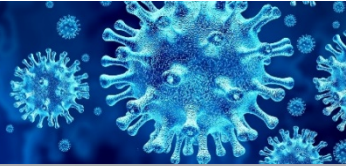


Review the SBAS parts in ICAO MID DOC 011



Action by the meeting:

The meeting is invited to review and update the Guidance on GNSS implementation in the MID Region.



Thank you for your Attention