



FLASH INFOS

Panorama de l'actualité de l'ASECNA

SPECIAL
ISSUE

« SBAS FOR AFRICA & INDIAN OCEAN,
a new era for satellite navigation in Africa »

C O N T E N T S

- ✈ Editorial by Mohamed Moussa,
Director General
- ✈ Interview with Louis Bakienon,
Director of Operations
- ✈ Launch of the pre-operational
service, a crucial step forward
- ✈ Benefits of SBAS services for
airspace users in Africa
- ✈ A few words with LCL Idrissou
Abdou Ahabou, Manager
Flying at Asky Airlines
- ✈ A few words with Fabrice
Dayne, B777 First Officer,
Member of the Airspace
Program Board at Air France
- ✈ ASECNA at the heart of the
SBAS worldwide development
- ✈ Our SBAS programme and its
phase B study
- ✈ The operating principles of our
SBAS



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Editorial by Mohamed Moussa, Director General

In a profoundly changing world, innovative and enabling technologies, especially satellite ones, constitute key enablers to prepare the future and to evolve in an increasingly competitive environment.

Among those technologies, satellite navigation provides both the opportunity for a significant improvement of aviation safety, and the capability to provide intrinsically global services, beyond the traditional borders of States and organisations.

For this reason, the deployment of satellite-based augmentation services (SBAS) is a key strategic direction of my vision for the future of the ASECNA, fully endorsed by our Member States.

SBAS services will indeed enable us to boost flight safety and efficiency in our airspace, but also to strengthen and extend our positioning as provider of high value-added services.

Since the beginning of my mandate, I have requested that the development of these services be expedited to meet the growing needs of the airspace users on one hand, and on the other for reasons of positioning in the value chain and of strategic independence. ASECNA must build its own capability for an autonomous provision of those services, to avoid dependence from third parties.

In the frame of my policy for the unification of the African Sky, I have also asked that our SBAS initiative be enlarged at a continental scale, for the benefit to all the Africa Union Member States. This initiative, called «SBAS for Africa & Indian Ocean», is now a key enabler of the



Single African Air Transport Market (SAATM) and of the Space Policy of the African Union.

At international level, I am glad that we are now recognised as SBAS provider by ICAO in the Annex 10 to the Chicago Convention, which considers our future system as the SBAS solution for Africa.

Beyond this recognition, our SBAS programme has made considerable progress over the last years. I am pleased to hereby share with you some of these recent developments, including the launch of the broadcast tests of our pre-operational service, and some views from airspace users on the need for SBAS services in Africa.

Mohamed MOUSSA

Interview with Louis Bakienon, Director of Operations



Louis Bakienon, Director of the SBAS program

What are the operational advantages of SBAS services for ASECNA?

The main asset of the SBAS technology is to provide continental navigation service, without requiring local infrastructure. This technology is particularly adapted to our operational environment where isolated and remote areas are vast and numerous, lack air navigation infrastructure and are often difficult to access. It also provides the opportunity to deliver services in large areas which are not served by airlines today.

SBAS services will enhance navigation operations for all phases of flight, from en-route down to approaches. They will improve RNAV routes availability and provide flexibility for more direct trajectories. They offer an effective solution for equivalent ILS CAT-I services “everywhere every time”. All the runway thresholds not served today by ILS will henceforth be provided with precision approach services, although they do not have local ground infrastructure.

SBAS services will thereby improve significantly

- and sustainably flight safety and efficiency.
- These benefits will be much higher than in the other continents, since barely 15% of runway thresholds are served with precision approaches.

What are the SBAS services deployment strategy and status that you lead?

- Our deployment strategy is based on a progressive approach in terms of coverage and performances, and considers the expandability towards the next generation of GNSS. It involves three essential steps.

- The initial stage includes the definition of the SBAS system architecture and the provision of a pre-operational service which primarily aims to carry-out technical tests and to undertake field demonstrations in Western and Central Africa. We are very pleased that this first milestone is now completed, with the start in last August of the broadcast test for the signal-in-space.

- The second step involves the operationalisation of the safety-of-life services. The first operational services, based on the current SBAS technology called L1 mono-frequency, will be available from 2024, with an incremental deployment in the airspace of our Member States and then a progressive extension to cover the entire continent.

- Finally, the last phase is expected beyond 2028-2030, with a migration of the SBAS services towards the next GNSS generation technology, called DFMC for Dual Frequency Multi Constellation and which standardisation is on-going at ICAO and RTCA/EUROCAE levels. This migration will improve the robustness of the services and will allow to consider more advanced operations such as CAT-I autoland.

- Today, with the completion of the phase B of our programme, the SBAS system architecture is specified and preliminary designed. The progressive services areas and related performances are validated, and the development and deployment plans are developed.

Interview with Louis Bakienon, Director of Operations

The next step is to carry-out the phases C/D of the programme, aiming to develop, qualify and deploy the SBAS system and to put it in operation.

What is the status of SBAS adoption by airspace users?

SBAS benefits are nowadays widely acknowledged by airlines, which integrate increasingly SBAS in their navigation strategy. SBAS services are in exponential development in the world, and avionics solutions are more and more available at lower cost.

SBAS capabilities are today available in standard-fit or as customer option in the Airbus A220 and A350, ATR 42- and 72-600, Embraer ERJ-135-140-145 and Bombardier Q-Series families, to name just a few of them. From 2025-27, it is expected that all new aircraft will offer SBAS capabilities, while the retrofit solutions for older aircraft are more and more available.

In 2030, the SBAS will be the baseline navigation system, as GPS is today.

In the context, a growing number of our airspace

users, such as ASKY or Air France, are not only interested in our SBAS services, but are also calling for expediting their deployment.



Launch of the pre-operational SBAS service, a crucial step forward

First essential step of our SBAS services provision plan, the broadcasting tests for our pre-operational service has started in last August.

Its main objectives are to carry-out technical trials, to build competencies for operations and to undertake field demonstrations in the aviation domain for aircraft and rotorcraft, and also for the additional services under study such as Precise Point Positioning (PPP) and Emergency Warning Services to populations (EWS).

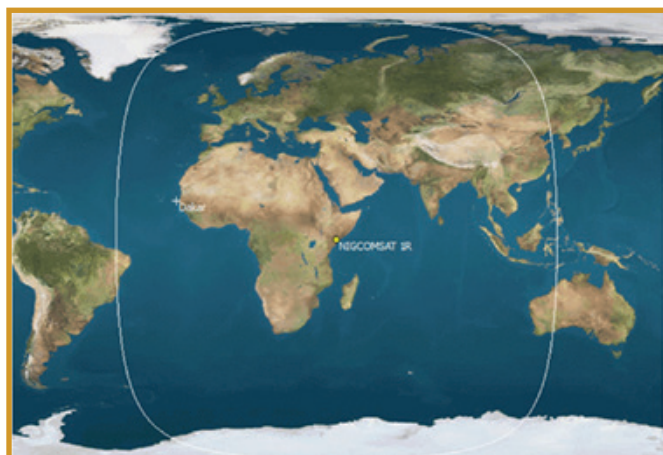
This initial service will be based on the broadcast of a test signal-in-space, from a pre-operational infrastructure deployed with the support of the Thales Alenia Space company and of its Nigerian partner Nigcomsat LTD. This infrastructure is composed of the SAGAIE GNSS stations network, a demonstrator, an uplink station and the GEO satellite NigComSat-1R.

This test signal will be compliant to the ICAO Standards and Recommended Practices (Annex 10) and to the Minimum Operational Performance Standards from RTCA (DO-229E). It includes a message type MT0 to prevent any use for safety critical applications, including any use by aircraft equipped with certified SBAS receivers.

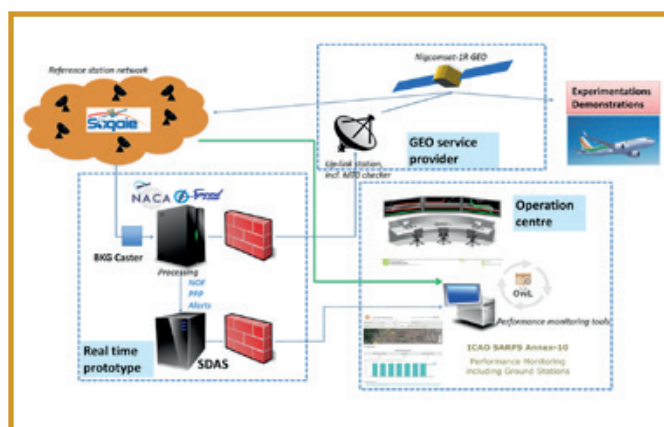
Followed by the international community, the provision of the pre-operational service is major step forward in the development of satellite navigation in Africa.



SAGAIE GNSS stations network



NigComSat-1R satellite coverage area



Pre-operational SBAS infrastructure

ASECNA will host the next international meeting of SBAS providers

The 37th meeting of the SBAS Interoperability Working Group will be held in November 2020 in the Indian Ocean in Madagascar.

Benefits of SBAS services for airspace users in Africa

Multiple benefits

SBAS services will bring many benefits for airspace users with SBAS-capable aircraft, for all phases of flight. Foremost among them are:

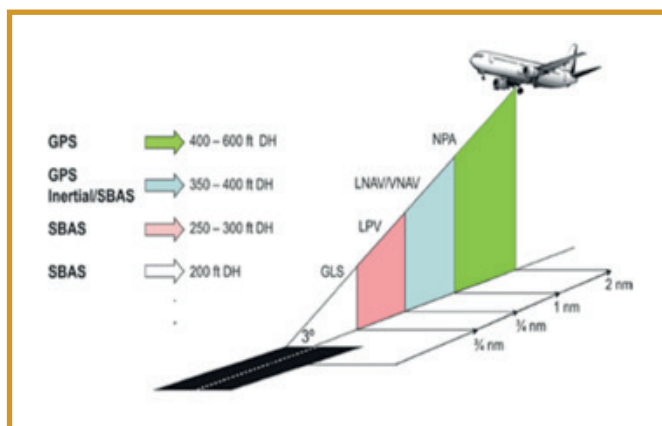
- ➔ Reduction of the risk of Controlled Flight Into Terrain (CFIT)
- ➔ Reduction of delays and diversions
- ➔ Reduction of flight time through:
- ➔ Elimination of the operational practice of landing at the opposite QFU
- ➔ Optimisation of approach trajectories
- ➔ Optimisation of en-route trajectories in ADS-B airspace

For approach and landing operations, the main benefit is the improvement of flight safety with the reduction of CFIT risk through a vertical and horizontal geometric guidance service in the final approach segment (FAS).



SBAS approach from flight deck (A350, Airbus courtesy)

The second benefit for airlines is the reduction of delays and diversions through lower operational minima (250 feet and 200 feet for SBAS APV-I and SBAS CAT-I approaches respectively) improving airport accessibility in bad weather conditions and low visibility.



SBAS approaches operational minima

Nowadays, few airports are equipped with ILS and when it so, it is generally only at one runway end. In this operational environment, some airlines prefer to land with tailwind on the opposite QFU equipped with ILS, lengthening often the approach trajectory, to avoid a non-precision approach and a potential diversion. This operational practice, more and more frequent in our airports, increase flight time and thereby fuel consumption. With SBAS, precision approaches will be available on all runway thresholds, eliminating this practice for the benefit of airlines.

SBAS services will also allow to reduce flight time through the optimisation of approach trajectories, essentially with the implementation of Radius to Fix (RF) curved segment to reach more directly the Final Approach Fix (FAF).



Example of RF segment at Lomé Airport (DXXX, QFU 22)

Finally, the en-route operations will benefit from optimised routes when combined with ADS-B surveillance.

Net profits for airspace users higher than 800 million USD

The above benefits have been quantified in a recent cost-benefit analysis (CBA) carried by ASECNA in conjunction with the EGIS-AVIA company, and with the

support of the EGNOS-Africa Joint Programme Office (JPO). The outcomes of this study were presented during a virtual workshop held on 29 July 2020 with the effective participation of the partner airlines: Air Côte d'Ivoire, ASKY, Air Senegal and Air France.

This study has assessed the profitability of the use by airlines, on the 2025-2045-time period, of the future SBAS services to be provided by the Agency for the continent.

It shows conservatively that the net profits generated for airlines SBAS operations in the ASECNA airspace will be higher than 350 million USD. For the SBAS operations in the entire sub-Saharan airspace, the net profits will be higher than 800 million USD. During the same period, more than 7 million tonnes of CO₂ emissions will be avoided.

In terms of global return on investment, use of SBAS services will produce a net profit for airlines higher than 7 USD for each USD spent.

As regard to the payback period, the initial investment of airlines to acquire the SBAS capability will be recovered between 2 and 4 years after starting the use of the services.

It is worth noting that this study, focused on airlines, did not cover the benefits for Air Navigation Services Providers, for Airport Operators, and for States and the society.

A few words with LCL Idrissou Abdou Ahabou, Manager Flying at Asky Airlines

1) What do you think of the SBAS services in Africa?

Despite the efforts made by African States, travelling between two States by land and rail remains an issue. Air transport remains the most practical mode of transportation for inter-States connections.

According to IATA, the traffic volume will still double within the next 15 years to reach 400 million PAX. Considering this forecast, M. Tewolde GebreMariam, CEO of Ethiopian Airlines, the first African airline, stated in last November: "Africa is the future of aviation. When the worldwide traffic will be doubled in the future, it will be quadrupled in Africa. The potential of the air transport market is tremendous. In surface area, Africa can contain China, USA, Europe and India. That sums it all up". This is fully in line with the essential objectives of the Single African Air Transport Market (SAATM).

This growth will only be achieved if the passenger expectations are met, including to arrive to destination and not to a diversion airport. During difficult seasons, such as harmattan, a lot of flight are unfortunately diverted. The main reasons, due to multiple economic, geographic and environmental factors, are that the destination airport is not served by precision approaches, or that the weather conditions do not allow to land at the QFU which would be so equipped.

This is exactly where SBAS with its numerous advantages provides a unique opportunity to develop air transport in Africa, and is thereby a key enabler to the SAATM. SBAS allow indeed to provide equivalent CAT-I service on the large number of runway ends not served by ILS, and to ensure service continuity during the ILS maintenance and renewal periods, improving thereby the accessibility of most the airports to customer satisfaction.

2) What these services will bring to the ASKY operations?

The young company ASKY AIRLINES does not need any introduction. It has built its reputation by basing its operations on the following main principles: safety of operations before economy, passenger comfort and punctuality. The vision of the company is to connect African cities, whence the name A(frican)SKY.

It is therefore obvious that the contribution of SBAS to

the African continent can benefit to ASKY. In addition to the advantages already mentioned, ASKY will be able with SBAS to expand flight services provision on a large area comprising cities which airports are not equipped with conventional nav aids. ASKY will also achieve savings through the availability improvement and the optimisation of RNAV routes, leading to shorter flight trajectories and thereby to a lower fuel consumption, with the corollary of reduction of CO2 emissions, of flight time and of delays and diversions. ASKY, like any other airline, is expecting a reduction of operational costs with lower fuel loads and less flight preparation.

From air safety perspective, first priority of ASKY, the deployment of SBAS will contribute to prevent CFIT through a geometric guidance, not dependent on barometric references. Unavailability of ILS will no longer be an issue, and more diversion options will be available.



LCL Idrissou Abdou Ahabou, Manager Flying at Asky Airlines

A few words with Fabrice Dayne, B777 First Officer, Member of the Airspace Program Board at Air France

1) What is your vision of SBAS in Africa?

With its undeniable qualities, SBAS will be part of the future of air navigation. The coverage of the AFI region will complement the existing systems, by offering many improvements regarding Performance Based Navigation (PBN).

As such, we are convinced of the major interest of SBAS services in Africa, in an operational environment which is specific for airspace users in terms of infrastructure, meteorology and environment. We are therefore supporting the SBAS programme of ASECNA, as we are confident that the navigation based on SBAS will quickly supersede conventional navigation, especially ILS CAT-I.

2) Which benefits do you expect?

Benefits are expected regarding all our fundamentals, which are safety, environment and customer satisfaction.

Regarding flight safety, our core business, we have to face the specificities of the AFI region in which a major part of the safety events reported by our flight crew occur: lack of runway centreline lights, no approach light systems on non-ILS QFU, PAPIs issues ... Facing these issues, most of our flight crew prefer to land at night with tailwind in order to benefit from ILS guidance. Besides, few runway ends which can be used as en-route alternate airports are today served by ILS.

SBAS LPV approaches provide many advantages compared to LNAV/VNAV approaches. The provision of a geometric guidance appeals to us, as it allows us to reduce unstable approaches and CFIT. Independency from QNH increases safety, as it eliminates mis-settings and avoids, in high temperature environment, steep approaches leading to hard and long landings.

With regard to environment, use of SBAS services will generate a reduction of fuel consumption and of CO2 emissions. Operations will be more flexible, and it will be henceforth possible to fly more direct trajectories, and to select closest alternate airports, lowering fuel loads. In addition, noise exposure will be reduced. With time, SBAS services will also make possible the implementation of displaced thresholds on a same runway and of multiple glide slopes, allowing to increase runway throughput by reducing separation between aircraft.

Finally, for our clients, the number of diversions at destination, mainly for bad weather conditions, will be reduced thanks to the deployment of approach procedures with lower minima.

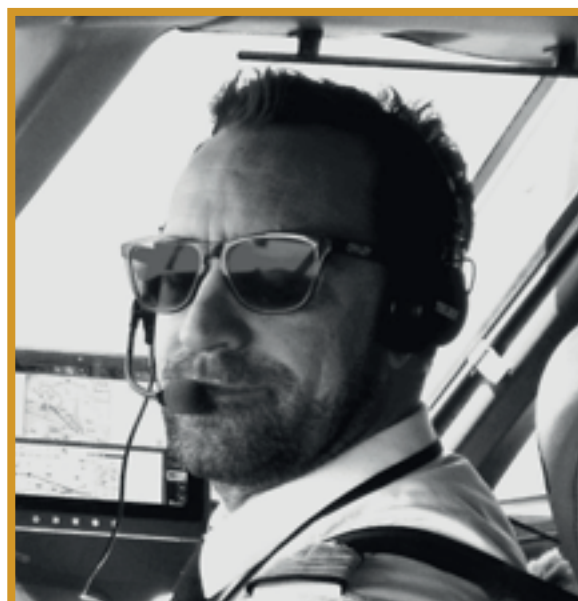
3) What is the implementation status of SBAS within Air France?

SBAS is a key element of our multi-fleet CNS strategy, for both new and legacy aircraft.

Our Airbus A350 will be delivered with the SBAS capability. To date, six A350 are in operation, and will be soon joined by 30 additional ones. Our A350 pilots are already operating SBAS and provide excellent feedback on LPV approaches!

Our future A220, which first of the 60 ordered will be delivered in fall 2021, will be also SBAS capable.

To take maximum advantage from SBAS services in Africa, our ambition is to equip our long-haul fleet as well, including our 80 B777 and B787. Unfortunately, Boeing is lagging behind in this domain, and we have high hopes, with other airlines, of convincing them to expedite the development of SBAS solutions for these aircraft types, so as to be able to fully use the SBAS services provided by ASECNA as they are available!



Fabrice Dayne, B777 First Officer, Member of the Air France Airspace Program Board

ASECNA at the heart of SBAS worldwide development

With its « SBAS for Africa & Indian Ocean » programme, ASECNA is at the heart of the worldwide SBAS infrastructure which development is flourishing.

At ICAO level, the programme is today recognised and ASECNA has been assigned a service provider identifier (n°7) as part of the Annex 10, Volume 1. Our SBAS is now part of the nine (09) operational or under development SBAS in the world. This result has been made possible thanks to the major achievements over the last year, endorsed by the Navigation System Panel (NSP) and the Air Navigation Commission.

In terms of relationships with its peers of the SBAS domain, ASECNA plays an active role within the SBAS Interoperability Working Group (IWG), gathering USA, Europe, China, Russia, Japan, India, South Korea, Australia and thus ASECNA. This group, meeting twice a year, provides a cooperation platform between SBAS providers, essentially on the following topics:

- ✈ Harmonisation of SBAS development and modernisation plans
- ✈ Technical interoperability to ensure seamless transition between SBAS service areas
- ✈ Research and development cooperation on key SBAS technologies
- ✈ Support joint SBAS promotion and adoption

The SBAS IWG is co-chaired by USA and Europe. Its structure includes a technical sub-group (TSA) and an operational sub-group (OSG). The latter pursues the development of enhanced cooperation and combined efforts to accelerate user adoption and penetration of SBAS services. It is co-chaired

by ASECNA and the French CAA.

The last SBAS meeting was held in India in last February. In the margins thereof, the first outreach event on the SBAS adoption in aviation was organised. This event, co-chaired by M. Louis Bakienon, Director of Operations, gathered airlines (Air France, Japan Airlines, Qatar Airways, Go Airlines, Indi'Go ...), aircraft manufacturers (Airbus, Boeing, ATR...) and avionics manufacturers (Collins Aerospace ...). It gave impetus for enhanced consultations between the different stakeholders, with the shared objective to expedite the integration of SBAS in the navigation strategy of each.

Identifier	SBAS
0	WAAS (US)
1	EGNOS (Europe)
2	MSAS (Japan)
3	GAGAN (India)
4	SDCM (Russia)
5	BDSBAS (China)
6	KASS (Korea)
7	SBAS for Africa & Indian Ocean (Africa)
8	SPAN (Australia/NZ)

SBAS services providers (ICAO Annex 10)



EGNOS



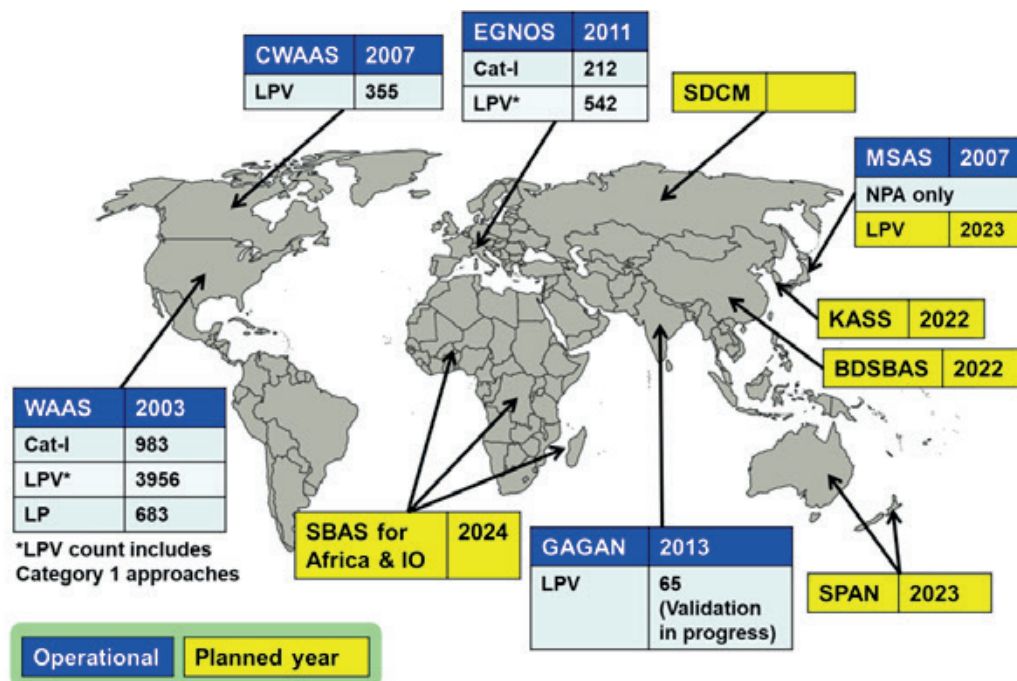
gagan



KASS



Members of the SBAS Interoperability Working Group (IWG)



Deployment status and plans of SBAS LPV procedures in the world



Participants to the 36th meeting of the SBAS IWG (New Delhi, February 2020)

Our SBAS programme and its phase B study



Project team of the SBAS programme phase B study

The SBAS programme has been set-up by Decision of the Director General. It structures all the activities and projects contributing interdependently and transversally to the objectives formulated for SBAS services provision. In line with the Agency's Strategic Orientation Plan, these objectives are:

- ✈ Provide autonomously, in the ASECNA area and then within the AFI region, SBAS services to enhance navigation (PBN) and surveillance operations, and thereby to improve significantly and sustainably flight safety and efficiency
- ✈ Strengthen and extend the positioning of ASECNA as provider of high value-added services, and prepare its future by increasing its international reach and leadership

The SBAS services targeted are safety-of-life (SoL) services, offering a guarantee through an integrity function alerting the user in case of malfunction, allowing thereby use for aircraft operations. Three different levels are specified for these services according to the targeted operations:

- ✈ En-route down to non-precision approaches (NPA) operations
- ✈ Approaches with vertical guidance down to LPV minima, with a theoretical decision height of 250 feet (APV-1)
- ✈ Approaches with vertical guidance down to LPV minima, with a theoretical decision height of 200 feet (CAT-I)

Each service level is specified in terms of accuracy, availability, continuity and integrity, with values established in line with the applicable provisions of the ICAO Annex 10.

Additionally, the programme pursues ancillary services such as an open service (OS) dedicated to mass market applications, and a data access services (SDAS) for research and added-value applications. Additional services are also under study.

The services deployment plan is incremental and comprises several evolutions, starting from a progressive coverage of the airspace under our responsibility, then extended to the rest of the continent.

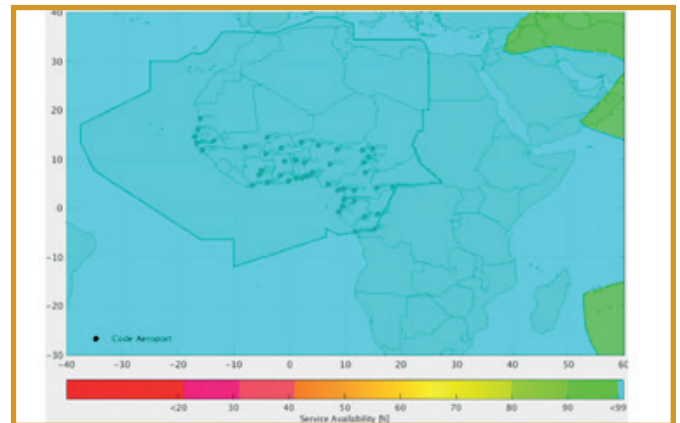
The programmatic approach adopted ensures an integrated and end-to-end management of all the activities and projects contributing to the services provision and to their adoption and use, while addressing all the transversal enablers. The latter include the policy action, governance and cooperation frameworks, the economic model and financing, the transformation of competencies, the management of intellectual property rights and of spatial resources, the standardisation, and the communication and visibility.

The preliminary architecture definition study, also called phase B, is a flagship project of this structured framework. The essential objectives of this study are:

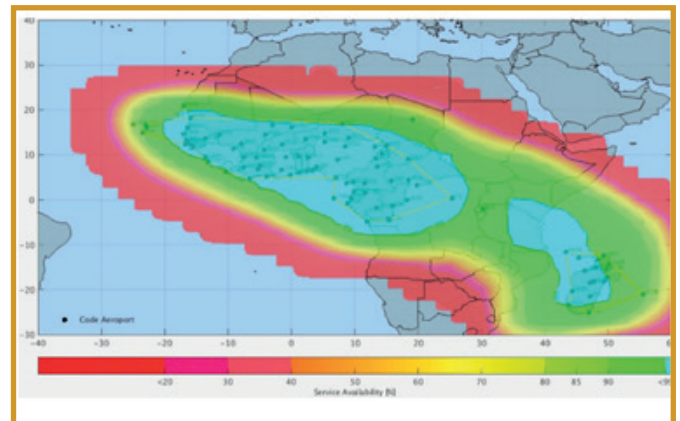
- Define the best architecture option for the SBAS system with a commitment in terms of progressive service areas and related performances, according to the established evolution plan
- Proceed to the preliminary design of the SBAS system in compliance with this architecture
- Plan the development, deployment and entry into operations of the SBAS system (phases C/D) and the migration to DFMC as well
- Provide a pre-operational service and undertake field demonstrations

This study, financed by the European Union, has been awarded after an international competition to an industrial consortium led by Thales Alenia Space France. Started in February 2019, this study is now almost completed, only the field demonstrations remaining to be undertaken before end of the year, should the sanitary situation allows it.

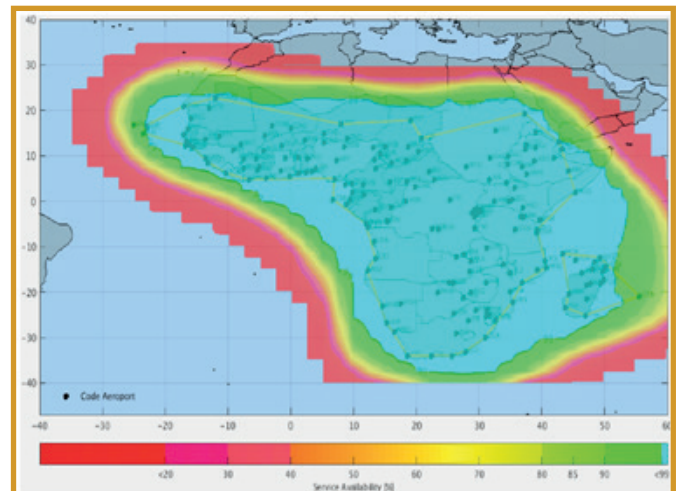
The following maps show the great potential for the service areas and related service availability, as far as some evolutions of the incremental services provision plan are concerned. They have been generated through massive simulations using the correction algorithms specifically developed for our environment.



En-route/NPA service availability



**APV-1 service availability
(ASECNA airspace)**



**APV-1 service availability
(further evolution)**

The operating principles of our SBAS

Like the other satellite-based augmentation systems, our SBAS aims to augment GNSS core constellations, such as GPS and GALILEO, by computing and broadcasting correction messages to the users (aircraft), thereby improving the navigation performances, and providing an integrity function.

GNSS core constellations have indeed important limitations, especially regarding the vertical accuracy and the availability, mainly for reasons related to observation of satellites. They do not guarantee the positioning, nor they alert users in case of errors.

GNSS core constellations are therefore only used for horizontal navigation operations, from en-route down to non-precision approaches, for which only lateral guidance is provided.

Through augmented performances, positioning with SBAS not only allows to provide a better horizontal guidance, but also and more importantly a vertical guidance, used for more advanced navigation operations such as precision approaches, equivalent to ILS CAT-I.

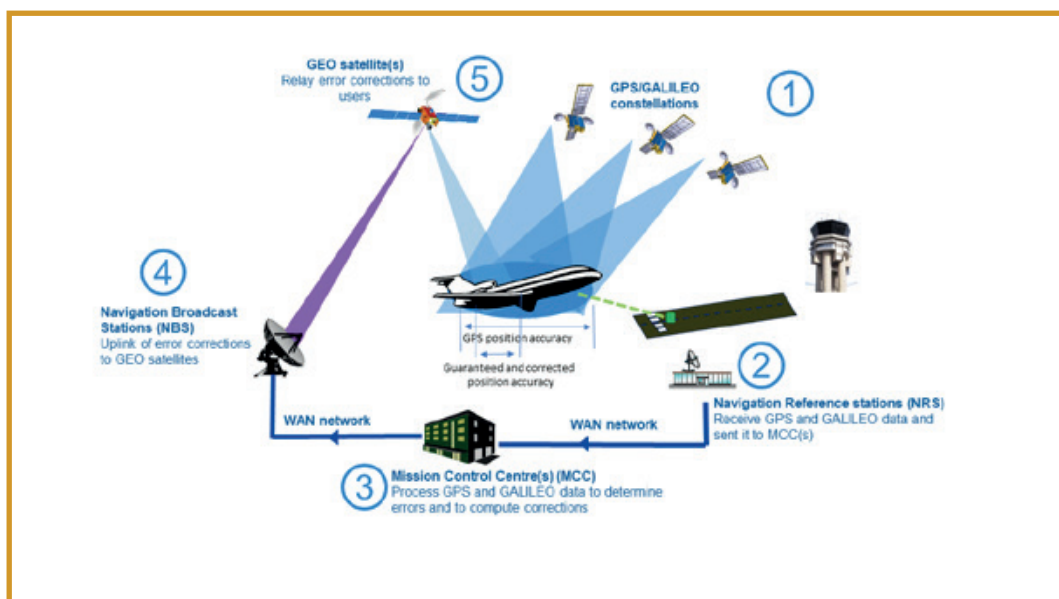
SBAS correction messages are computed by a ground segment and broadcasted to every aircraft in the service areas through one or several geostationary satellites, which constitutes the space segment. The

- correction messages are calculated by dedicated processing and check-set systems in the Mission Control Centres (MCC), using the GPS and GALILEO constellations data collected by a network of reference stations (NRS) whose geographic distribution allows to optimise the observations of the satellites and the propagation conditions of their signal. The messages are then transmitted to the space segment via the uplink stations (NBS).

- Thus, this global infrastructure enables to provide a navigation service on a continental scale, without the need for local navigation and landing aids at airports.

- The ionosphere of the equatorial region has a specific dynamic compared to high and mid- latitudes, leading to perturbations of GPS and GALILEO signals propagation. Dedicated and advanced correction algorithms have been developed, thanks to the research and development activities carried out together with the French Space Agency (CNES) in the frame of the SAGAIE project, positioning ASECNA at the cutting-edge of this technology issue in the world.

- Our SBAS signal will be compliant to ICAO and RTCA standards, and thus interoperable with the other SBAS, ensuring a seamless transition for aircraft flying to or arriving from other SBAS service areas.



« SBAS for Africa & Indian Ocean » operating principles



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