SBAS Implementation & Regional initiatives

NAM/CAR/SAM workshop on Radio Navigation

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01

What is SBAS?

1.1 Introduction – What is SBAS?

- SBAS is a satellite-based augmentation system that can improve safety and efficiency in the Latin America and Caribbean region.

A Satellite Based Augmentation System (SBAS) augments and corrects Global Navigation Satellite System (GNSS – GPS, Galileo,…) signals to provide instant, accurate & reliable positioning

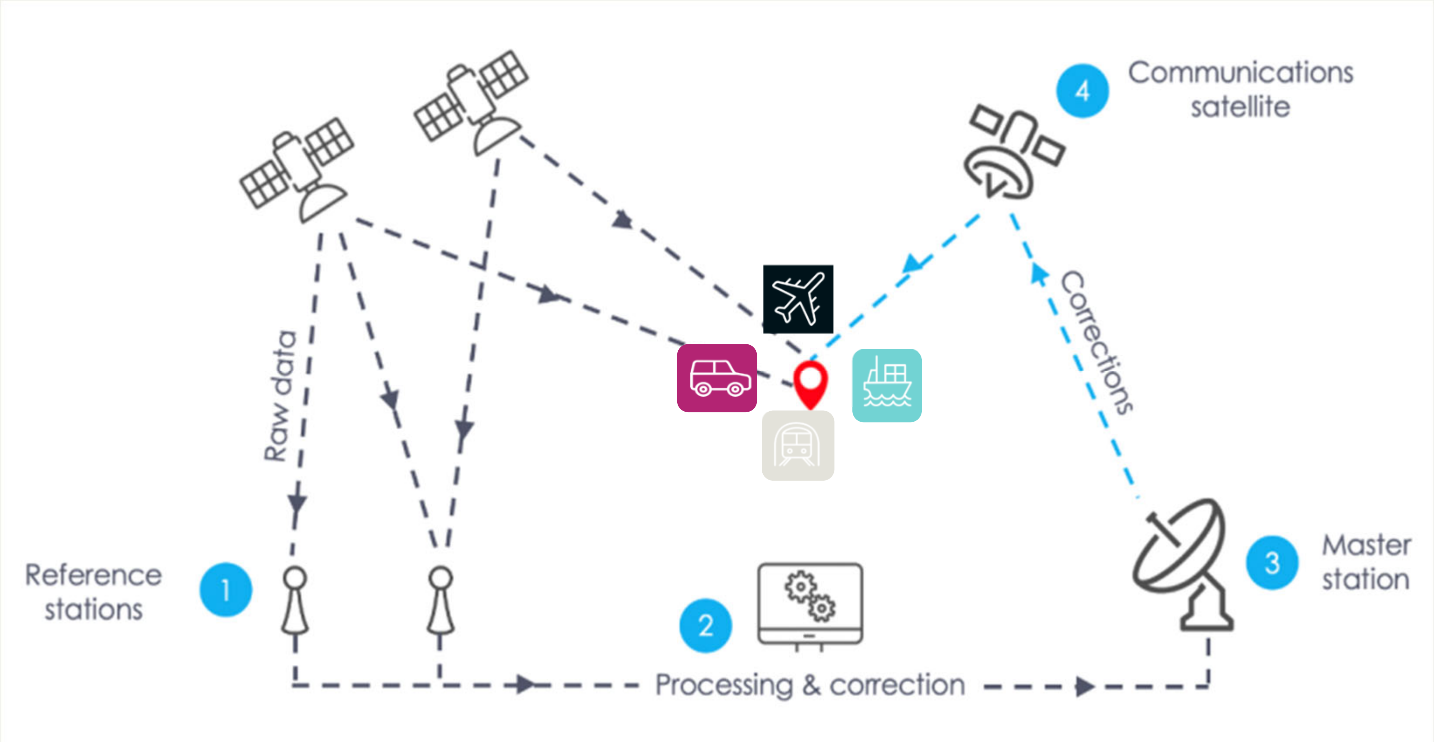
- ✓ Accuracy
- ✓ Integrity
- ✓ Availability
- ✓ Continuity

SBAS with integrity feature allows SoL - Safety of Life positioning service and application

Deliver accurate and reliable positioning information at no additional cost for the user

1.2 What is SBAS – How does it work?

1. Collect raw positioning data & transmit the signals for processing and correction
2. Calculate corrections
3. Uplinks the correction signal to the communication satellite
4. Transmit the correction signal across a region to number of receivers



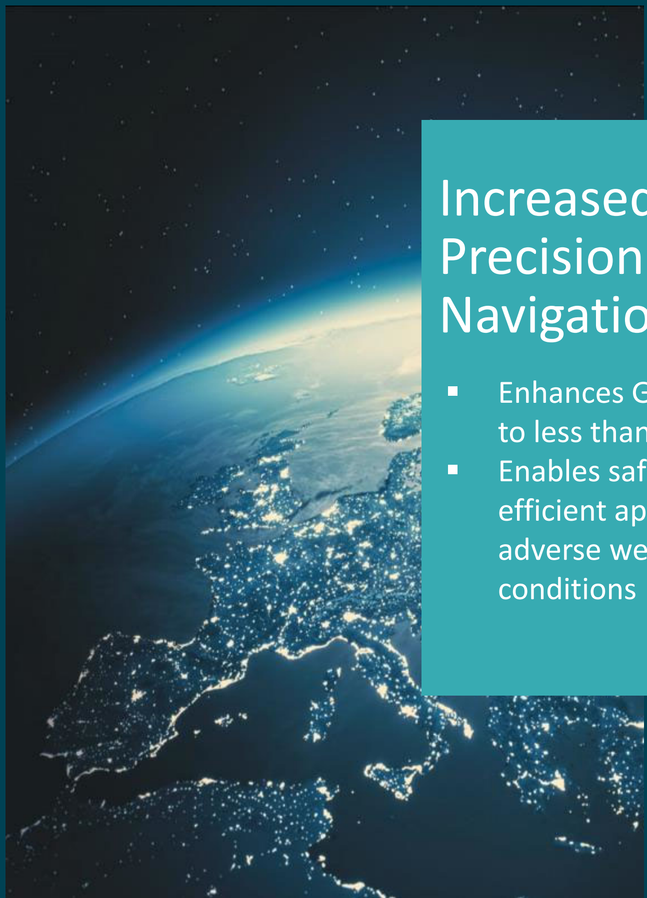
Source: https://greatbustardsflight.blogspot.com/

1.3 What is SBAS ? – Components – EGNOS example

- Ground Segment
- Space Segment
- User segment

The coverage area provided by an SBAS service is fully dependent on the deployed ground infrastructure, and in particular the location of the reference & monitoring stations

1.4 Benefits of SBAS for Aviation



Safety

- Provides rapid alerts in case of GNSS signal fail
- SBAS enhances the **efficiency**, **safety**, and **profitability** of aviation operations, offering a clear return on investment for airlines, airports, and operators
- Reduces **dependence on ground-based infrastructures** like Instrument Landing Systems (ILS)

Increased Precision in Air Navigation

- Enhances GNSS accuracy to less than one meter
- Enables safer and more efficient approaches in adverse weather conditions

Fuel and Operational cost saving

- Optimized flight paths reduce fuel consumption
- Decreases the number of diversions and cancellations due to low visibility conditions.

Reduce Infrastructure needs

- Eliminates the need for costly ground-based navigation systems at EVERY airport
- Lower maintenance and operation costs in the long term

Increased Airport accessibility

- Enables precise landing at smaller or remote airports without expensive installations
- Expands market opportunities for regional and low–cost airline

Environment

- Reduces CO_2 emissions by optimizing flight routes and landing procedures
- Contributes to a more sustainable and efficient aviation industry

1.5 Specific examples and some figures

The figures may vary depending on the region, airline type, and operations, impact of the system:

Fuel Savings

- **Reduction of non-optimized routes:** SBAS allows for more direct flights paths, potentially saving between 3% and 5% on fuel consumptions for long-haul flights.
- **Example**: If an airline spends about **$1,000** on fuel per flight hour, and a 6-hour flight with SBAS can reduce fuel consumption by 3%, the savings per flight would be **$300**. For a fleet performing **100 similar flights per month**, this represents monthly savings of **$30,000** and annual savings of **$360,000**.

Lower cost of diversions and delays

- In adverse weather conditions, SBAS improves landing accuracy, preventing diversions to alternate airports. Each diversion can cost between **$10,000 and $50,000** per flight in additional fuel, crew time, and passenger handling.
- **Example**: If an airline avoids 10 diversions per month due to SBAS's accuracy, with an average cost of **$25,000 per diversion**, it results in monthly savings of **$250,000** and annual savings of **$3 million**

Lower reliance on ground infrastructure (ILS)

- Implementing and maintaining an ILS (Instrument Landing System) at an airport costs between **$1 million and $2 million**, in addition to annual maintenance costs ranging from **$100,000 to $200,000**. SBAS reduces the need to install ILS at small or medium-sized airports by providing a satellite-based approach method.
- **Example**: If a regional airport can avoid installing an ILS thanks to SBAS, it could save between **$1.5 million and $2 million** in installation and **$100,000 annually in maintenance**

Insurance savings

- By improving operational safety through more accurate approaches and departures, insurance premiums for airlines and operators can be reduced by **2-5%**
- **Example**: If an airline pays **$10M** annually in insurance premiums, and SBAS could reduce these costs **by 3%**, this will represent and annual saving of **$300K**.

02

Evolution of the SBAS LATAM Initiative 2000–2025

2.1 Evolution of SBAS LATAM initiative - I

2000 – 2006 | CAR/SAM Test Bed (CSTB)

Led by: ICAO NACC/SAM with support from FAA & ESA.

Objective: first test bed to validate SBAS use in the region.

Key outcomes:

- Preliminary validation of integrity and coverage.
- Identification of **ionospheric challenges** specific to LATAM.

2002 – 2006 | EDISA (EGNOS Development and Infrastructure in South America)

Led by: ESA + local institutions (Brazil, Argentina, Chile, etc.).

Objective: transfer EGNOS know-how to LATAM.

Key outcomes:

- Deployment of RIMS stations in South America.
- First Europe–LATAM collaboration on SBAS technology.

2.1 Evolution of SBAS LATAM initiative - II

2004 – 2013 | SACCSA (South America and Caribbean SBAS Augmentation Study)

Led by: ICAO (NACC and SAM), supported by the Inter-American Development Bank (IDB).

Phases:

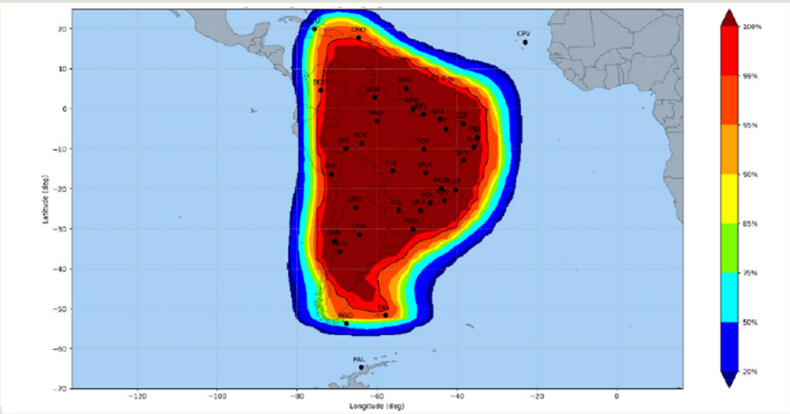
- **SACCSA I:** Feasibility study. Technical validation and ionosphere modeling.
- **SACCSA II:** GEO test-bed transmissions and consolidation of results.

Key outcomes:

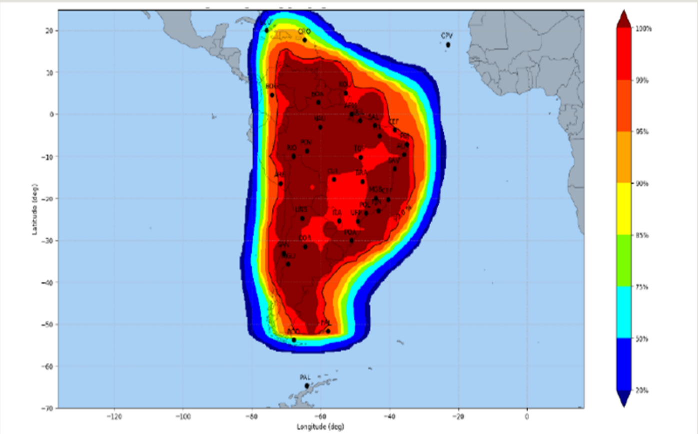
- Proposal for a regional SBAS architecture.
- Confirmation of the need for **tailored ionospheric models**.
- Need for multinational collaboration to move the project forward.

2.1 Lessons Learned

- The technical challenge of providing SBAS corrections with the ionosphere high activity of the equatorial region of South America was one of the barriers for SBAS in the past.
- Today, thanks to the studies performed with ANGA - SBAS in Africa - and the adaptation of the algorithms to those ionospheric conditions, this barrier is not an issue anymore, and the SBAS in Latin America could finally become a reality.
- During **GREPECAS/21** meeting in Santo Domingo and in April 2025 during **Regional Workshop on SBAS for LATAM stakeholders** in Peru, Thales Alenia Space presented the latest results of SBAS performance assessments in LATAM region.
- Next steps should be to perform on site demonstrations on the most critical areas.



Source: TASF - APV-I service level under nominal iono conditions (2021)



Source: TASF - APV-I service level under active iono conditions (2023)

2.1 Evolution of SBAS LATAM initiative - III

2019 – 2022 | Institutional Priority (GREPECAS)

Action: GREPECAS elevates SBAS to a **strategic regional priority**.

Key outcomes:

- Governance models discussed.
- First **Cost-Benefit Analyses (CBAs)** launched to justify investment.

2023-2025 | EU SCENIC project

Action: Support to the Commission Regarding EU Space Programme International Cooperation

Key outcomes:

- Technical assessment for SBAS in LATAM region
- CBA and strategy and roadmap development

2.1 Evolution of SBAS LATAM initiative - IV

2024-2025 | EU LAC APP II project (EASA):

Action: Support Civil aviation sector for the Latin America and the Caribbean

Key outcomes:

- Data gathering (traffic, status of CNS infrastructure, ..)
- Benchmarking study and SBAS enablers
- Initial quantitative SBAS benefits
- Transfer of knowledge:
  - ➔ Regional workshop on SBAS for the CAR/SAM Region: Lima, April 2025.

2.2 Regional Workshop on SBAS for LATAM stakeholders

In April 2025, in Peru, EASA (European Union Aviation Safety Agency) organised a Regional Workshop on SBAS for LATAM stakeholders with the support of ICAO and the European Commission.

The objective was to present the results of the EU–Latin American and Caribbean Aviation Partnership Project II (EU-LAC APP II), including preliminary Cost-Benefit Analyses (CBAs), and to clarify the latest technical advances of SBAS algorithms to address past ionospheric challenges and demonstrate the maturity of the technology worldwide.

Addressed to ATM/ANS managers, inspectors and experts of the civil aviation authorities, Air Navigation Service Providers, Airlines, Experts from the Ministry of Transport and Ministry of Agriculture of your country, Maritime and Road Transport Authorities

As an outcome of this event, the need to establish an SBAS LATAM Working Group was identified, led by ICAO with the collaboration of key experts (organisations, institutions, airlines and industry).

This group has defined six strategic pillars:

- Governance & institutional model assessment
- Ionosphere monitoring & modeling (building on ANGA experience, validated for LATAM)
- Demonstrator & Operational validation in strategic regions
- Specific CBAs (benefits vary significantly by specific stakeholders)
- Capacity building & training to prepare regional industry for implementation of the system
- Realistic implementation roadmap and potential financial mechanisms

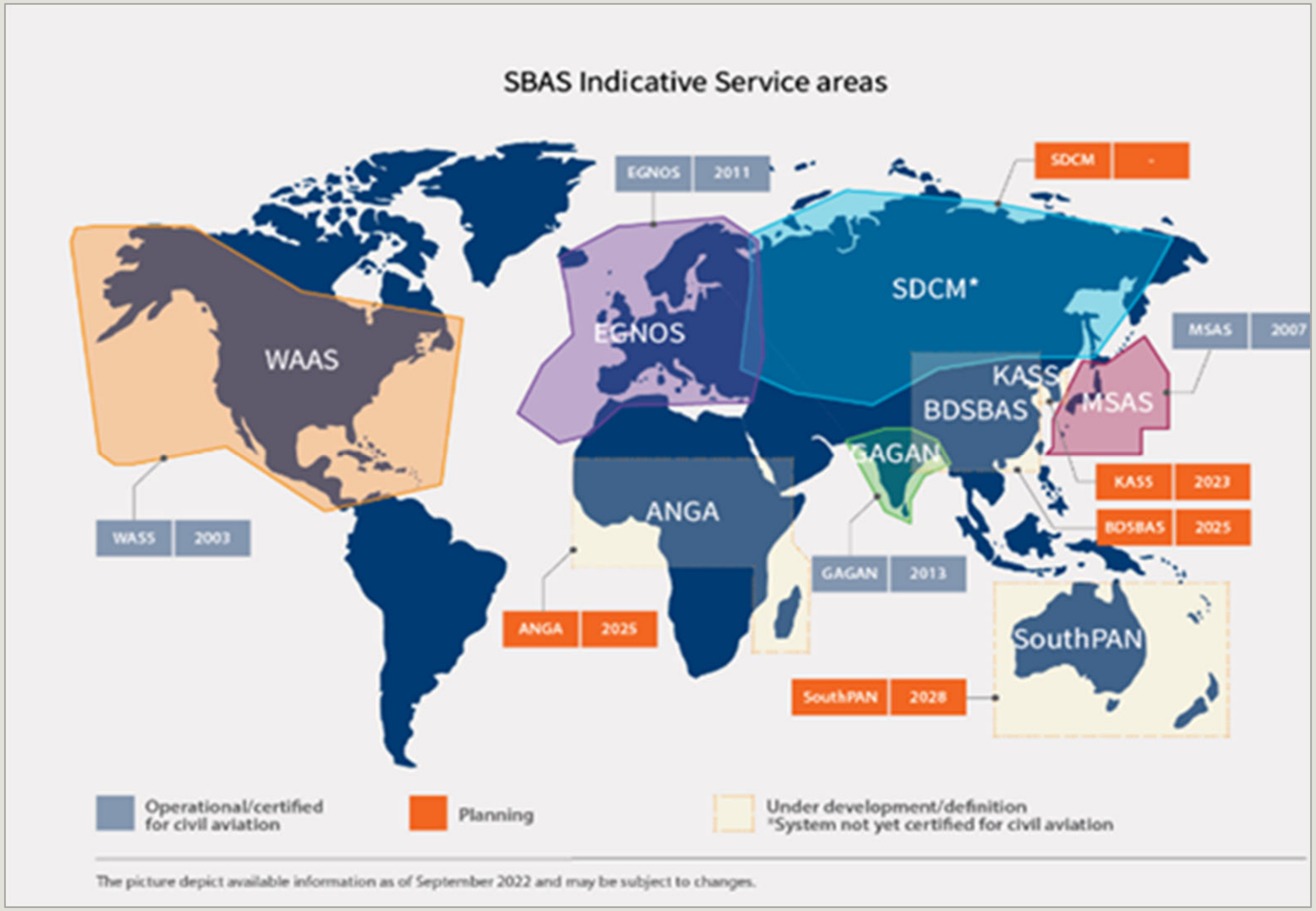
2.3 EASA SBAS benefits study for different LATAM countries

1. Top 5 countries in aircraft movements in the region **are Brazil, Mexico, Colombia, Peru and Argentina**, all of them with more than 18% of General Aviation and Military traffic (2023 data)
2. LAC region will experience a high increase of traffic in the coming years, **being Peru, Chile and Colombia the countries with higher growth rates**
3. Still several International Airports in the region are not equipped with ILS, some of them due to the surrounding complex orography
4. In several countries the **ILS infrastructure is reaching soon to the its end of life of use**, which will imply a high investment in infrastructure renovation in the short-term
5. PBN deployment in the region of APV (BARO/VNAV) is reaching high percentage of runways but still there is room for improvements in several countries, as for example Dominican Republic, Mexico, Peru and Panama
6. Average accident ratios in the region are below the world average, being **Brazil, Colombia, Argentina and Dominican Republic, the countries showing higher number of accidents during the flight approach and landing phases**
7. **Airports in Peru historically are the ones experiencing the worst weather conditions in the region, followed by specific airports in Colombia, Mexico and Chile**
8. **Brazil, Argentina, Mexico and Dominican Republic concentrate the airports with higher delays in the region**

03

Regional initiatives

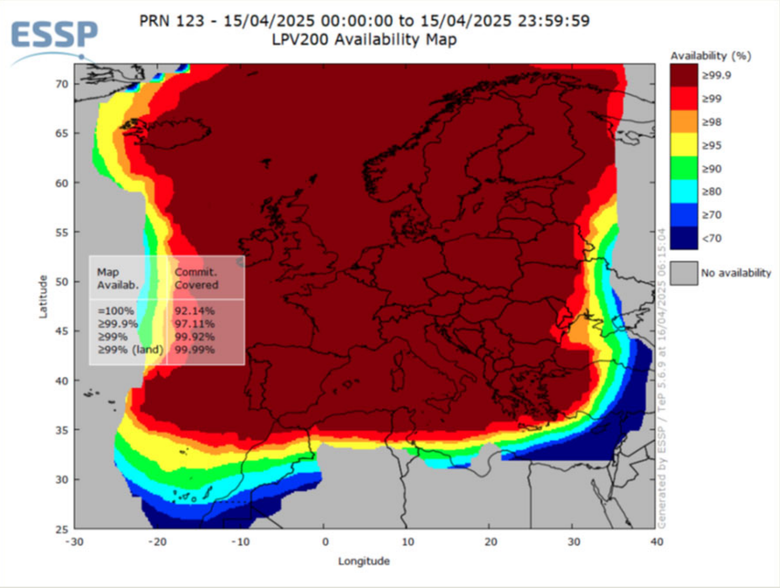
3.1 Worldwide SBAS intitiatives



SBAS services and related initiatives around the world

3.2 Global SBAS programmes

- Safety of life service operational since 2011
- Gradual DFMC service starting in 2028
- Supports all types of operations, including LPV-200 procedures
- As of December 2024, over 1000 LPV approaches published at 450 airports
- EGNOS cost around 1,1 B euros

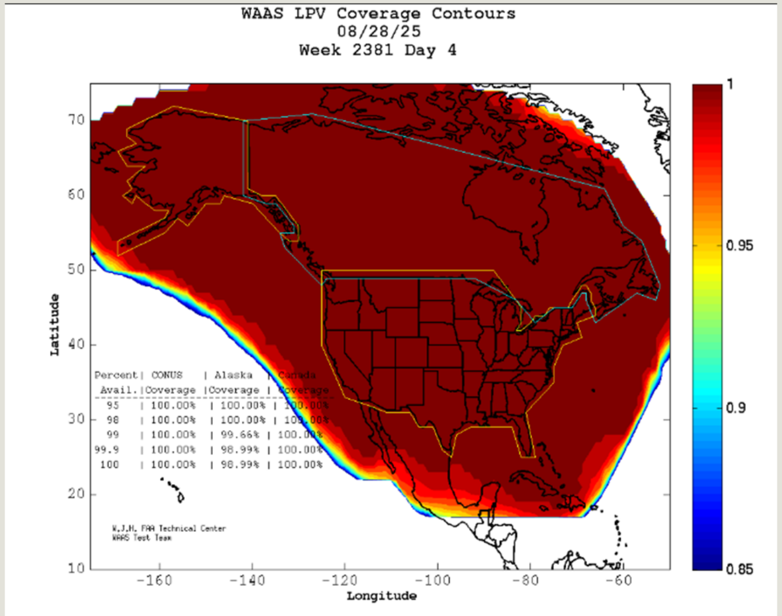


Source: ESSP website

3.2 Global SBAS programmes

WAAS
Wide Area Augmentation System

- Operational since 2003
- Plans dual frequency service around 2030
- Supports all types of operations, including LPV-200 procedures
- As of March 2024, over 4,149 LP and LPV approaches at 2013 airports in USA and 781 LPVs published in Canada

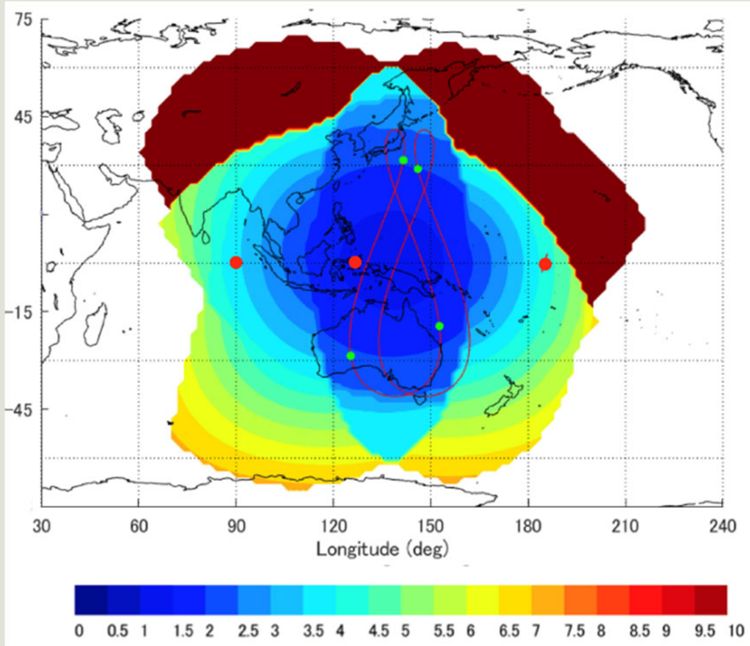


Source: FAA website

3.2 Global SBAS programmes

Quasi-Zenith Satellite System (QZSS)

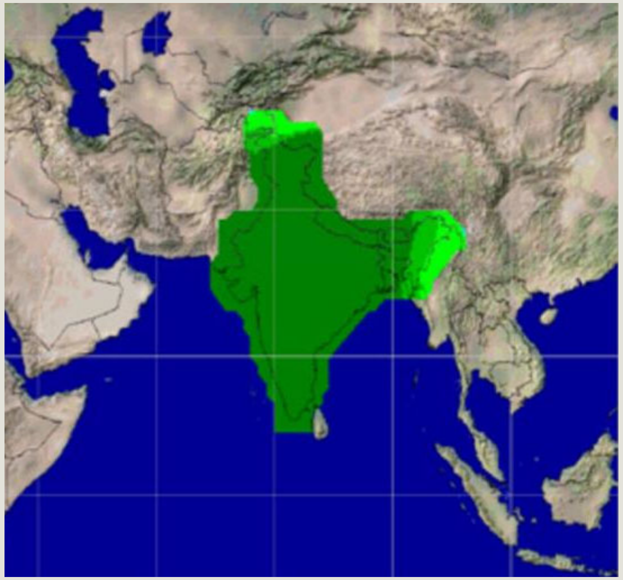
- Operational since 2007
- Supports en-route, terminal and non-precision approach operations.
- LPV250 trials with limited time through NOTAM at 17 airports in JAPAN
- R&D activities for LPV200
- DFMC activities on-going



Source: GNSS Asia

3.2 Global SBAS programmes

- APV-1 certification since 2015
- Supports all types of operations
- As of September 2023, 8 LPVs published serving 5 airports, and additional 16 LPVs in progress

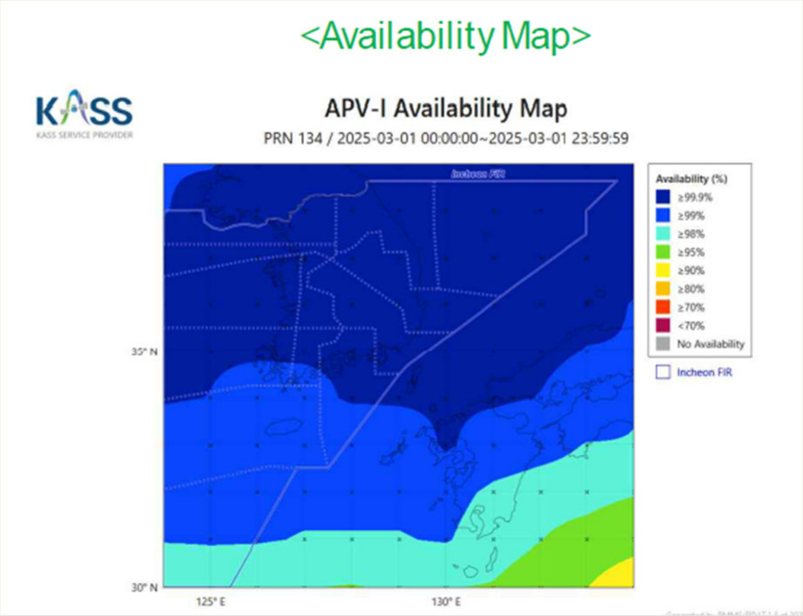


Source ESA website

3.2 Global SBAS programmes

Korea Augmentation Satellite System

- Designed and implemented by Thales Alenia Space
- Developed in partnership with the Korea Aerospace Research Institute (KARI) on behalf of the Korean Ministry of Land, Infrastructure and Transport
- Commissioned in 2024

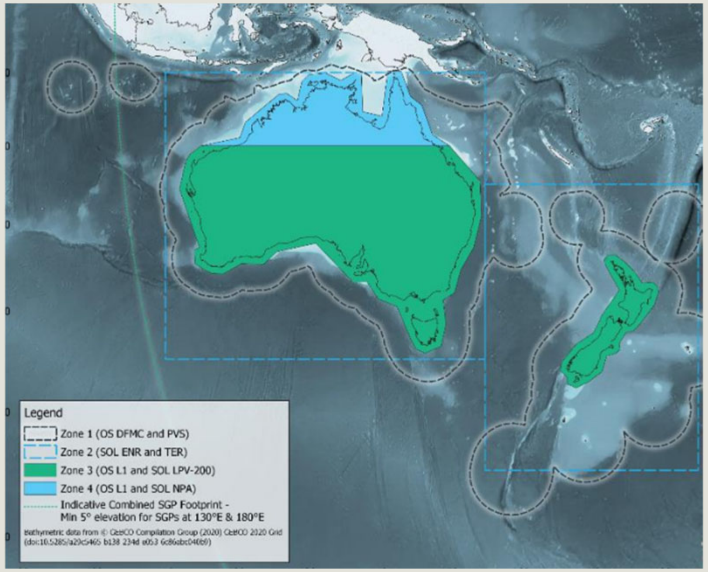


Source: KASS presentation in Lima, April 2025

3.2 Global SBAS programmes

SouthPAN

- Awarded by the government of Australia to Lockheed Martin for a $1.18 billion contract
- Expected to be fully operational by 2028
- Will be provided as a service for 19 years with an option to extend
- Aviation services expected in 2028

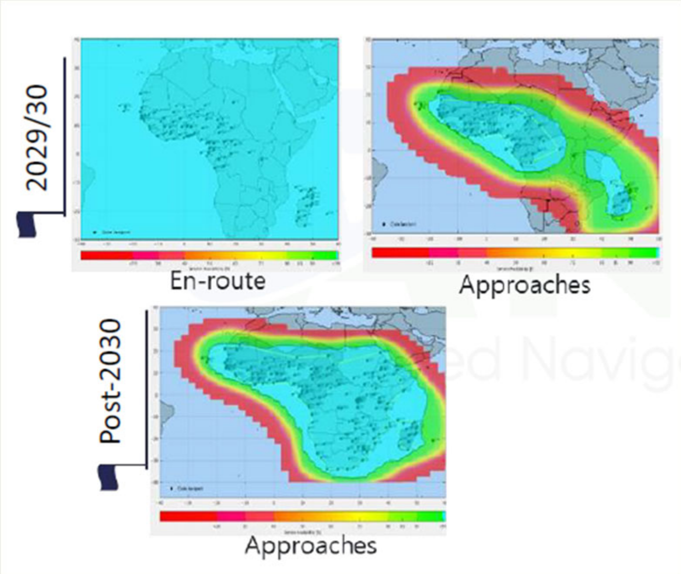


Source: https://www.gps.gov/cgsic/meetings/2024/reynolds.pdf

3.2 Global SBAS programmes

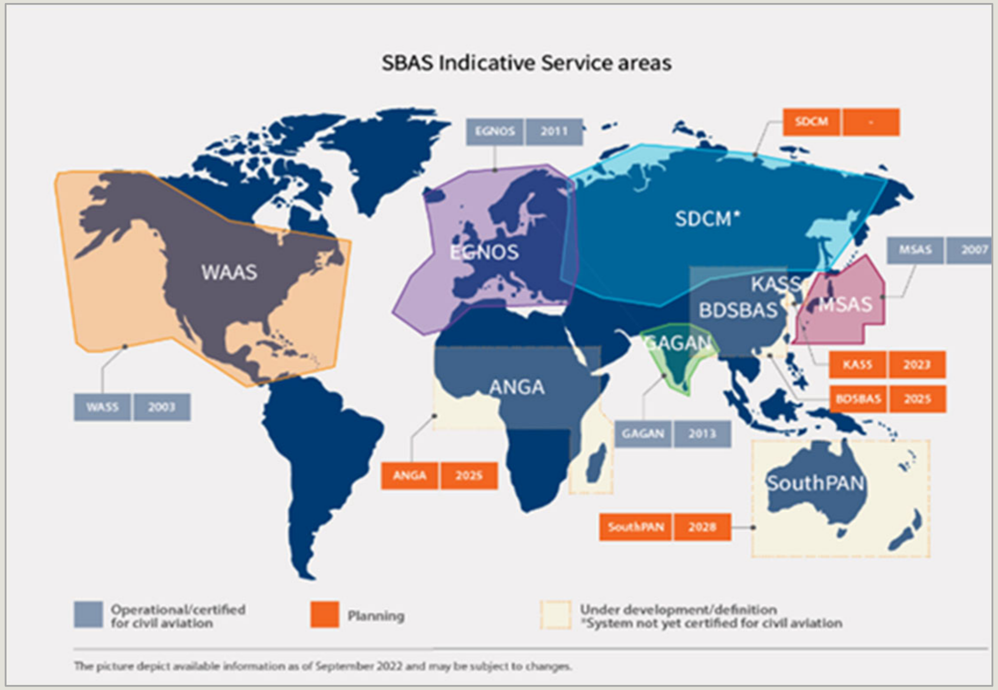
ANGA
Augmented Navigation for Africa

- Since 2021, Test Bed providing SBAS services using NigComSat-1R GEO satellite. It was upgraded to DFMC in 2023
- Phase C for ANGA deployment to be started in 2025



Source: ANGA presentation Lima April 2025

3.2 Global SBAS programmes



SBAS services and related initiatives around the world

- **SDCM** (Russia)
  - Under development
  - Augmentation of GPS and Glonass
- **BDSBAS** (China)
  - In test undergoing certification

04

Conclusions

4.1 Key conclusions

Proven Benefits

SBAS enhances GNSS performance — accuracy, availability, integrity — with clear impact on aviation safety and efficiency.

Solid Regional Legacy

CSTB, EDISA and SACCSA built strong technical know-how and revealed the specific ionospheric challenges in LATAM and how to solve it.

Institutional Momentum

GREPECAS, ICAO, EASA and EC have positioned SBAS as a strategic regional priority.

Turning Point (2025)

The EASA's Workshop and creation of the SBAS LATAM Working Group mark the shift from studies to implementation planning.

Clear Roadmap Ahead

Six strategic pillars provide a structured pathway towards a regional SBAS deployment.

THANK YOU !

¡GRACIAS!

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