INTERNATIONAL CIVIL AVIATION ORGANIZATION

Advanced Air Navigation Technologies and Implementation

Innovative air traffic management and communication systems

Mayda Ávila

Regional Officer, Communications, Navigation and Surveillance (CNS)

International Civil Aviation Organization (ICAO)

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Second Meeting of the North American, Central American and Caribbean Working Group (NACC/WG) Airspace Management and Capacity Balancing Task Force and Eleventh Meeting of the CANSO IATA ICAO Free Route Airspace Team (CIIFRA) (AMCB/TF/2/CIIFRA/11)
Mexico City, Mexico, 20 to 24 April 2026

AGENDA

- ❑ *Introduction to ADS-B, CPDLC, ADS-C, and AIDC*
- ❑ *CPDLC/ADS-C Initiative*
- ❑ *Technical Overview of ADS-B (Automatic Dependent Surveillance–Broadcast)*
- ❑ *GNSS Interference*
- ❑ *Monitoring Operation Network (MON)*
- ❑ *SBAS: SUPPORTING AVIATION*
- ❑ *National Air Navigation Plan: Strategic Vision*
- ❑ *Conclusions*

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INTRODUCTION TO ADS-B, CPDLC, ADS-C, AND AIDC

ADS-B Surveillance

ADS-B technology allows aircraft to broadcast precise location data enhancing airspace surveillance and safety.

CPDLC and ADS-C Communication

CPDLC and ADS-C enable effective digital messaging between pilots and air traffic controllers improving communication.

AIDC Coordination

AIDC supports seamless data exchange between air traffic control centers to enhance operational coordination and efficiency.

IMPORTANCE OF AIR NAVIGATION MODERNIZATION

Enhanced Safety

Modern air navigation technologies increase flight safety by improving situational awareness and reducing collisions.

Improved Efficiency

Satellite-based navigation allows optimized flight paths, reducing fuel consumption and delays.

Increased Airspace Capacity

Advanced data link communications enable handling more aircraft safely in congested airspace.

CPDLC (CONTROLLER-PILOT DATA LINK COMMUNICATIONS) AND ADS-C FUNCTIONALITIES

Title:
Regional Implementation of CPDLC in the CAR Region

Objective:
Deploy **digital ATS communications (CPDLC)** to enhance safety and efficiency.

Problem:
Heavy reliance on voice communications
Increasing traffic and complexity
Lack of regional coordination strategy

Solution / Activities:
Regional workshop (ICAO NACC)
Technical missions (Oakland & Mexico)
SME and State participation
Development of CONOPS and roadmap

Expected Results:
Reduced communication errors
Improved controller workload management
Enhanced operational efficiency
Regional CPDLC implementation roadmap

PURPOSE AND SCOPE OF AIDC (ATS INTERFACILITY DATA COMMUNICATION)

Title:
Implementation of AIDC between Kingston FIR and Bogotá FIR

Objective:
Enable **automated ATS coordination** between CAR and SAM regions.

Problem:
Dependence on voice coordination
Increased workload and delays
Risk of coordination errors

Solution / Activities:
SME support for AIDC implementation
System configuration and interoperability
On-site validation (Jamaica)
Operational testing

Expected Results:
Automated flight data exchange (EST, ACP, TOC)
Reduced controller workload
Improved safety and efficiency
Foundation for regional AIDC expansion

TECHNICAL OVERVIEW OF ADS-B (AUTOMATIC DEPENDENT SURVEILLANCE–BROADCAST)

Satellite Navigation Dependency

ADS-B uses satellite navigation systems to determine and broadcast precise aircraft location automatically.

Real-Time Position Broadcasting

Aircraft automatically transmit their exact position to ground stations and other aircraft continuously.

Enhanced Surveillance Accuracy

ADS-B provides high accuracy and reliable surveillance for improved air traffic management and safety.

TYPES AND SOURCES OF GNSS INTERFERENCE

Intentional Jamming

Deliberate transmission of signals to block or degrade GNSS signal reception, affecting navigation accuracy.

Unintentional Interference

Electronic devices can unintentionally emit signals that interfere with GNSS, reducing reliability of positioning.

Atmospheric Effects

Natural atmospheric conditions like ionospheric disturbances can degrade GNSS signal strength and accuracy.

IMPACT ON AIR NAVIGATION AND SAFETY

Surveillance Service Degradation

Interference reduces the effectiveness of air traffic surveillance systems, complicating flight monitoring and control.

Navigation Service Disruptions

Navigation systems can be disrupted by interference, raising risks for accurate flight path guidance.

Importance of Mitigation

Identifying and addressing interference is essential to preserve air navigation safety and reduce flight risks.

MONITORING OPERATION NETWORK (MON): DETECTION AND MITIGATION STRATEGIES

Title:
Development of MON for GNSS Resilience in CAR Region

Objective:
Ensure **navigation continuity during GNSS outages** through a Minimum Operational Network (MON).

Problem:
Increasing GNSS interference (jamming/spoofing)
High dependency on GNSS (PBN operations)
No regional contingency strategy

Solution / Activities:
SME development of MON framework
Regional infrastructure assessment
GNSS risk analysis
Integration with CAR/SAM initiatives

Expected Results:
Regional MON concept and roadmap
Improved CNS resilience
GNSS contingency capability
Alignment with ICAO Assembly A42 priorities

OPERATIONAL SCENARIOS AND EXPECTED OUTCOMES

CAR Region Frequency Management Validation Project

Objective:
Establish a **validated and harmonized regional frequency database** to ensure interference-free CNS operations.

Problem:
Inconsistent and outdated frequency data
Increasing interference (VHF COM/NAVAIDs)
Lack of regional baseline for Frequency Finder
Weak preparation for WRC-27

Solution / Activities:
3-week validation session at ICAO NACC
Participation of 2 CAR SMEs
Cross-check with AIPs and regional database
Support WRC-27 regional coordination

Expected Results:
Harmonized regional frequency registry
Reduced interference risks
Improved spectrum management
Strengthened CAR position for WRC-27

SBAS: SUPPORTING AVIATION

Satellite-Based Augmentation System (SBAS) enhances the Global navigation satellite system (GNSS) performance through corrections and integrity monitoring, enabling navigation capabilities consistent with ICAO SARPs.

In aviation, SBAS may support approach procedures with vertical guidance (e.g., LPV), improve positioning accuracy, and provide timely integrity alerts, contributing to operational safety and efficiency depending on implementation context.

SBAS is a system that makes global positioning system (GPS) provide accurate and reliable for airplanes. Overall, it improves safety, reduces delays, lowers costs, and makes flying more efficient and dependable.


SBAS OPERATION
SUPPORTING ALL FLIGHT PHASES
WHAT IS SBAS?
SBAS augments GNSS signals with accuracy corrections, integrity monitoring, and fast alerts to enable safer and more precise navigation throughout all flight phases.
Accuracy
Integrity
Alerts
SBAS GROUND SEGMENT
MONITORING STATIONS
Collect GNSS data
MASTER CONTROL STATION
Procecses data and generates corrections and integrity information
UPLINK STATION
Sends data to the SBAS GEO satellite
GNSS SATELLITES
SBAS GEO SATELLITE
(Transmits Corrections and Integrity)
CRUISE
CLIMB
CRUISE
DESCENT
APPROACH & LANDING
TAKE-OFR
SBAS IN ACTION
SBAS improves the navigation solution at every stage, providing:
• Higher accuracy
• Integrity monitoring
• Fast alerts
• Improved availability
1. TAKE-OFF
Accurate position and guidance for safe runway departure and initial climb.
Accuracy
Integrity
2. CLIMB
Reliable navigation for efficient ascent and route tracking.
Accuracy
Availability
3. CRUISE
Optimized route monitoring for fuel efficiency and airspace management.
Accuracy
Continuity
4. DESCENT
Precise guidance for smooth descent and efficient path management.
Accuracy
Integrity
5. APPROACH
Enables LPV approaches with vertical guidance, similar to ILS Cat I.
Precision
Integrity
6. LANDING
Supports safe landings, even at airports without ground-based precision systems.
Safety
Availabality
THE SBAS ADVANTAGE THROUGHOUT THE JOURNEY
ENHANCED SAFETY
Integrity monitoring and fast alerts reduce risk.
GREATER EFFICIENCY
More direct routes and optimized operations.
WIDER ACCESS
Precision-like approaches at more airports.
ENVIRONMENTAL BENEFITS
Reduced fuel burn and lower emissions.
GLOBAL HARMONIZATION
Meets ICAO Standards and supports PBN.
From take-off to landing, SBAS delivers the accuracy, integrity, and reliability modern aviation needs.

AND AVIATION APPLICATIONS OF SBAS

SBAS provides real-time integrity monitoring, which is critical in aviation:

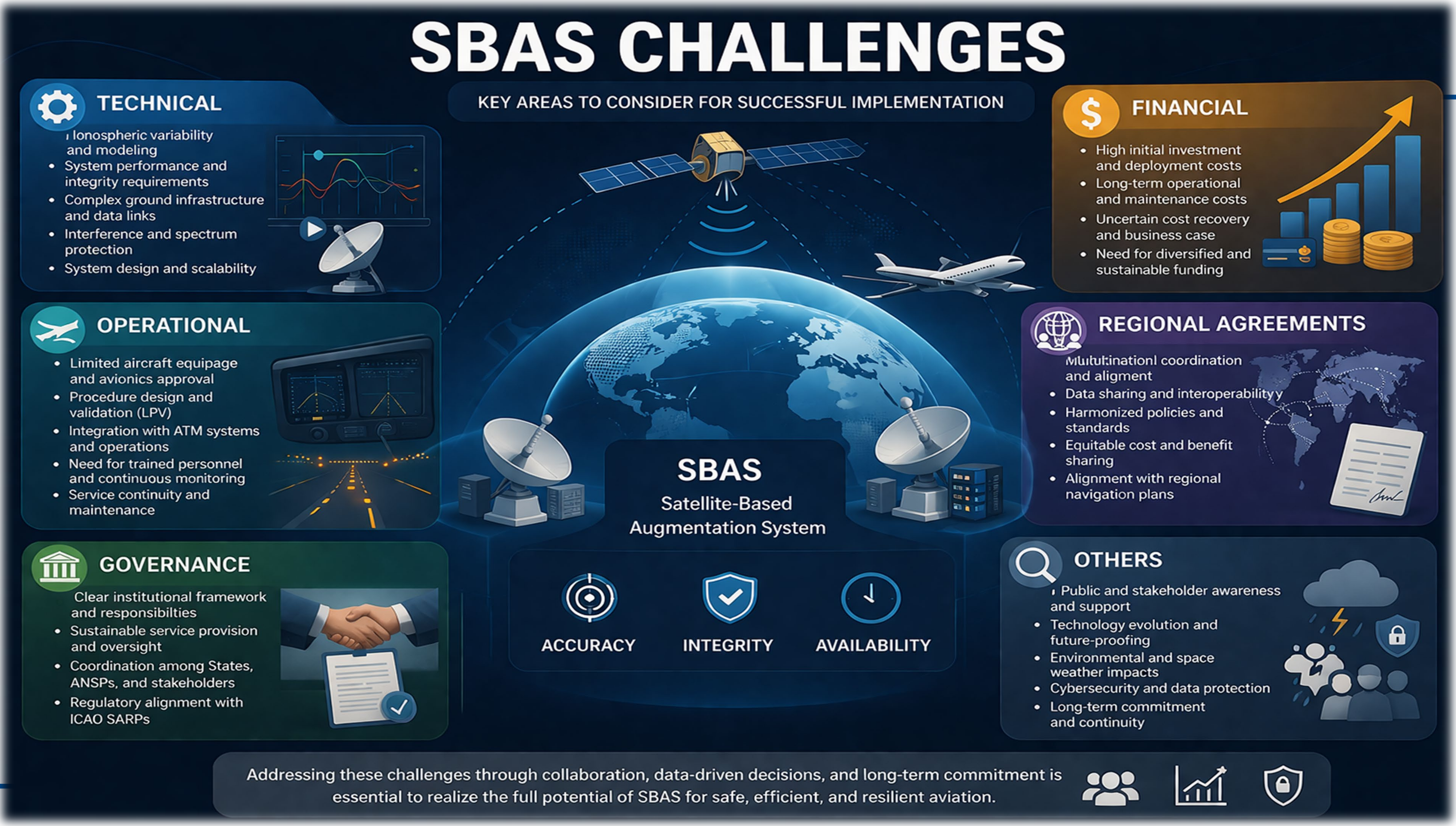
- ❑ SBAS provides real-time integrity monitoring, which is relevant for certain aviation application.

Potential:

- ❑ Detects GNSS signal anomalies (e.g., satellite faults, interference)
- ❑ Issues alerts within seconds (Time-to-Alert requirement)
- ❑ Ensures navigation data can be trusted for safety-critical operations

Operational impact:

- ❑ Supports precision-like approaches (LPV) without ground ILS
- ❑ May contribute to reduces risk of controlled flight into terrain (CFIT)
- ❑ May enhances situational awareness for pilots
- ❑ Precision Approach capability (LPV)
- ❑ Increase capability and efficiency duo support PBN (Performance-Based Navigation)
- ❑ SBAS reduces dependence on certain conventional navigation aids
- ❑ Improved access to remote aerodromes
- ❑ Support to navigation resilience (GNSS interference context)
- ❑ Environmental Benefits


SBAS CHALLENGES
KEY AREAS TO CONSIDER FOR SUCCESSFUL IMPLEMENTATION
TECHNICAL
Ionospheric variability and modeling
System performance and integrity requirements
Complex ground infrastructure and data links
Interference and spectrum protection
System design and scalability
OPERATIONAL
Limited aircraft equipage and avionics approval
Procedure design and validation (LPV)
Integration with ATM systems and operations
Need for trained personnel and continuous monitoring
Service continuity and maintenance
GOVERNANCE
Clear institutional framework and responsibilties
Sustainable service provision and oversight
Coordination among States, ANSPs, and stakeholders
Regulatory alignment with ICAO SARPs
FINANCIAL
High initial investment and deployment costs
Long-term operational and maintenance costs
Uncertain cost recovery and business case
Need for diversified and sustainable funding
REGIONAL AGREEMENTS
Mulutinationl coordination and aligment
Data sharing and interoperabilityy
Harmonized policies and standards
Equitable cost and benefit sharing
Alignment with regional navigation plans
OTHERS
Public and stakeholder awareness and support
Technology evolution and future-proofing
Environmental and space weather impacts
Cybersecurity and data protection
Long-term commitment and continuity
SBAS
Satellite-Based Augmentation System
ACCURACY
INTEGRITY
AVAILABILITY
Addressing these challenges through collaboration, data-driven decisions, and long-term commitment is essential to realize the full potential of SBAS for safe, efficient, and resilient aviation.

NATIONAL AIR NAVIGATION PLAN: STRATEGIC VISION

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OBJECTIVES OF THE NATIONAL AIR NAVIGATION PLAN

Enhancing Safety

Improving air navigation safety by adopting advanced technologies and standardized procedures nationwide.

Increasing Capacity

Expanding airspace capacity to manage more flights efficiently through harmonized navigation procedures.

Environmental Performance

Reducing environmental impact by optimizing flight paths and using greener navigation technologies.

ALIGNMENT WITH ICAO GLOBAL AIR NAVIGATION PLAN

ICAO Strategic Alignment

The plan supports ICAO's strategic goals to maintain global aviation standards and safety.

International Compliance

Ensures that air navigation systems comply with international regulations and agreements.

Interoperability in Air Traffic

Promotes seamless communication and coordination across international air traffic management systems.

Contribution to Global ATM

Enhances the efficiency and safety of the global air traffic management network.

STAKEHOLDER INVOLVEMENT AND IMPLEMENTATION ROADMAP

Collaborative Stakeholder Engagement

Effective implementation relies on cooperation among government agencies, service providers, airlines, and international partners.

Clear Implementation Roadmap

A structured roadmap with defined milestones and performance metrics guides the project's progress and success.

Conclusion

Advanced Navigation Technologies

Technologies like ADS-B, CPDLC, ADS-C, and AIDC are revolutionizing air traffic management worldwide.

Strategic Regional Cooperation

Collaboration between Jamaica and Colombia enhances safety and efficiency in regional air traffic management.

GNSS Monitoring Support

Robust GNSS monitoring underpins navigation accuracy and supports national aviation plans.

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ICAO Headquarters
Montréal
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Nairobi
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Lima

Thank You!