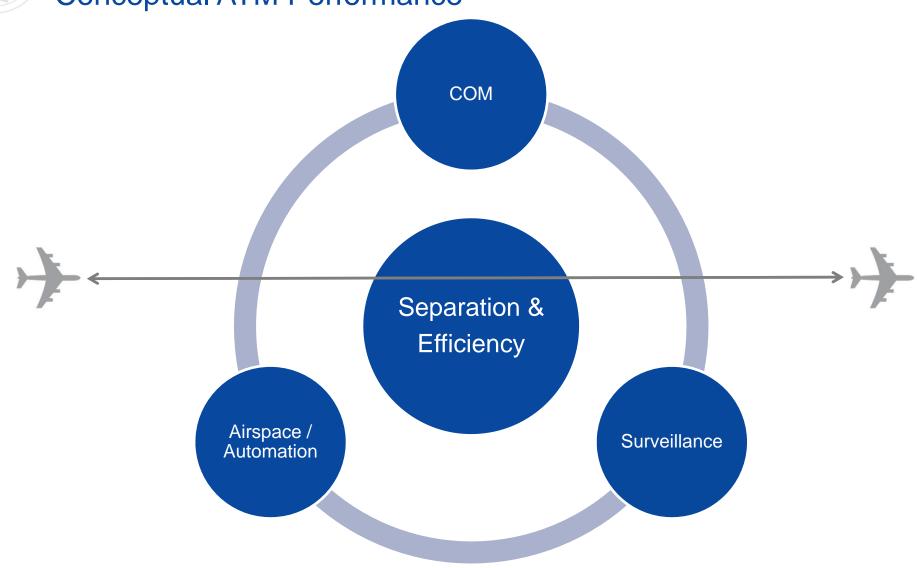


Singapore, November 11, 2014





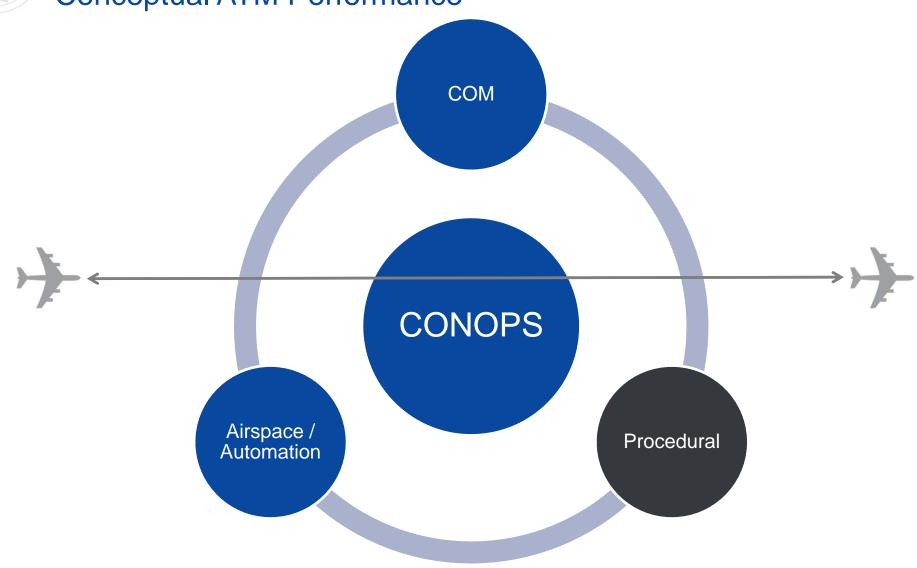
Conceptual ATM Performance







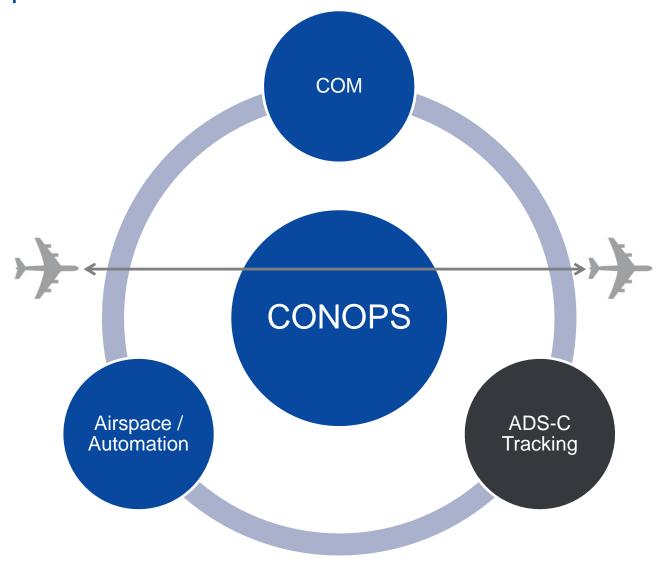
Conceptual ATM Performance







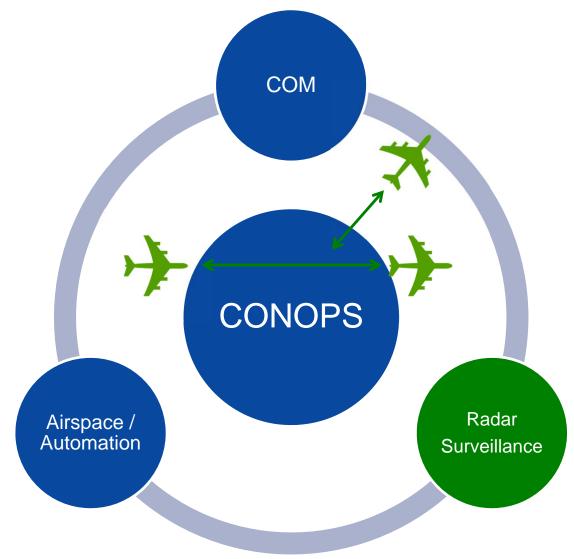
Conceptual ATM Performance







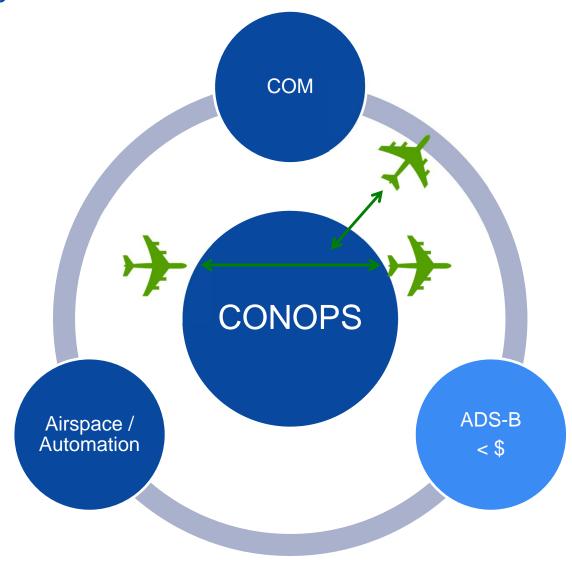
Enabling ATM Performance







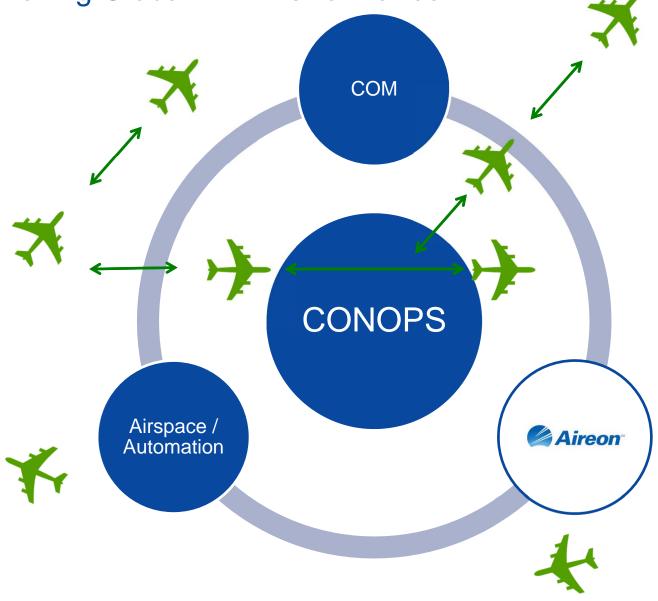
Improving ATM Performance







Improving Global ATM Performance







Today's surveillance challenges:

Physical:

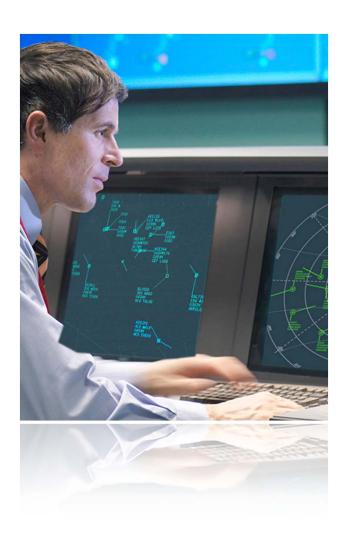
No surveillance over oceans and remote terrain.

Cost

- Installation cost of radar / ground stations
- Maintenance costs for remote sites
- ADS-C Equipage & subscription

Operational

- SWIM / Data sharing / Border safety
- Flow Management
- Contingency of signals
- Downtime of physical structures
- Lack of harmonization
- Differences in separation standards







Resulting in challenges for airlines

- Safety
- High infrastructure costs
- Varying equipage mandates
- Equipage costs
- Inefficient routes based on corridors
- Inefficient separation based on tracking
- No optimum flight paths
- Flow restrictions
- Lack of service predictability
- Situational awareness
- Flight tracking









"Don't develop CONOPS around space based ADS-B but enable ADS-B into the ATM system to work anywhere in your FIR with surveillance performance"

Sole source sensor surveillance

 Provide a signal, suitable for surveillance, to an ATM system where it currently does not exist to enhance safety, efficiency and operational performance

Multi sensor surveillance

 Augment existing ADS-B or radar surveillance to fill gaps, improve performance, lower infrastructure costs, improve safety, share surveillance data and provide seamless contingency









Instant Surveillance Across Any FIR

Low cost coverage of oceanic and remote areas

Fill gaps / Eliminate Line of Sight / MLAT Contingency signal for backup purposes

Safety Enhancement

Surveillance where it currently does not exist Extend your visibility across FIR boundaries.

Infrastructure Cost Reduction / Avoidance

Reduce or avoid maintenance or replacement costs of physical ground infrastructure

Improve Customer Experience

Flexible routing for airlines over ocean and remote regions, enable new route structures







- No investment: Utilize existing ADS-B equipment
- Safety Enhancement

Eliminate surveillance gaps over oceans and regions with limited/unreliable infrastructure

- Operational Efficiencies / Fuel Savings
 Optimized flight paths, altitudes, airspeeds.
 More direct routing, allow tactical avoidance
- Service Predictability

Global harmonization of surveillance, seamless transitions between FIR's

ATM Infrastructure Savings (ANSP Costs)

Reduction of ground based infrastructure costs

Avoidance of investments in ground infrastructure





Cost Benefit Analysis

A standard cost benefit analysis model has been designed in close cooperation with NAV CANADA and our other investors to be used for regional analysis, prospect customers and more detailed business cases.

The basics of the service are simple

- The costs model for space based ADS-B is similar to any other surveillance signal
- ANSPs pay monthly operating costs for radar / ADS-B but also a high upfront costs
- Space based ADS-B will be a signal provided to the ANSP with monthly or annualized costs, charged to the ANSP the same way they pay for radar or ground based ADS-B but without the upfront investment.

Cost Benefit

- In the case of the North Atlantic it was a no brainer, the fuel benefits far outweigh the costs of the system: 450 litres per NAT crossing, 2.9 billion over the life of the system
- For ANSP benefits we will look at the benefits of not replacing a radar, not investing in new ADS_B ground, removing ADS-C or VSAT backup, removing expensive SWIM data sharing needs, dual feeds for ACC backup, double coverage





Template Cost Benefit Analysis

Business Case

Net Benefits Future Benefits Safety Benefits

Traffic & Airspace

Annual by Flow % ADS-B

> Route Structure

FAST TIME SIMULATION (Optional)

Optimal routing, Fuel burn by Flow

BADA

Airline Benefits

Climb Profile by Flow

Climb Benefit

Reduce Fuel Costs & GHG

BADA

Time Savings by Flow

Delay Benefit

Reduce Fuel Costs & GHG

infrastructure

Reduction

Infra Costs

Reduced Need

of Current

System Cost

Investment Cost Avoidance

ANSP Benefits

Infra Costs

Avoided Future

Investment

(GANP, ASBU)

Incremental O&M Costs

Training Comm Other/ATM

One-Time Costs

ATC Comm SB-ADS-B (Aireon)

ANSP Costs

Total Annual **Benefits**

Total Annual Costs

Enhanced Safety

Collision Risk Model, Existing Structure, Added Surveillance



Net Benefits

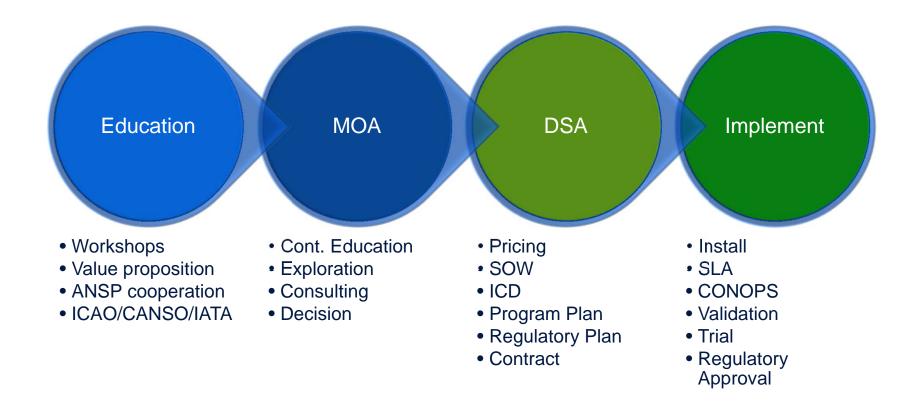
Benefits Start Years of Benefit **Discount Rate**

Cash Flow, NPV





ANSP Implementation Roadmap





MOA Process

•Introduce the system:

- •MOA Process
- Aireon System
- Performance
- ANSP Airspace
- Regulatory
- Services
- •Example CONOPS

Education

Exploration

- •Learn from the customer:
- Airspace
- Constraints
- •OPS
- •Strategic plans
- Airlines
- •GAP Analysis

•Help the customer:

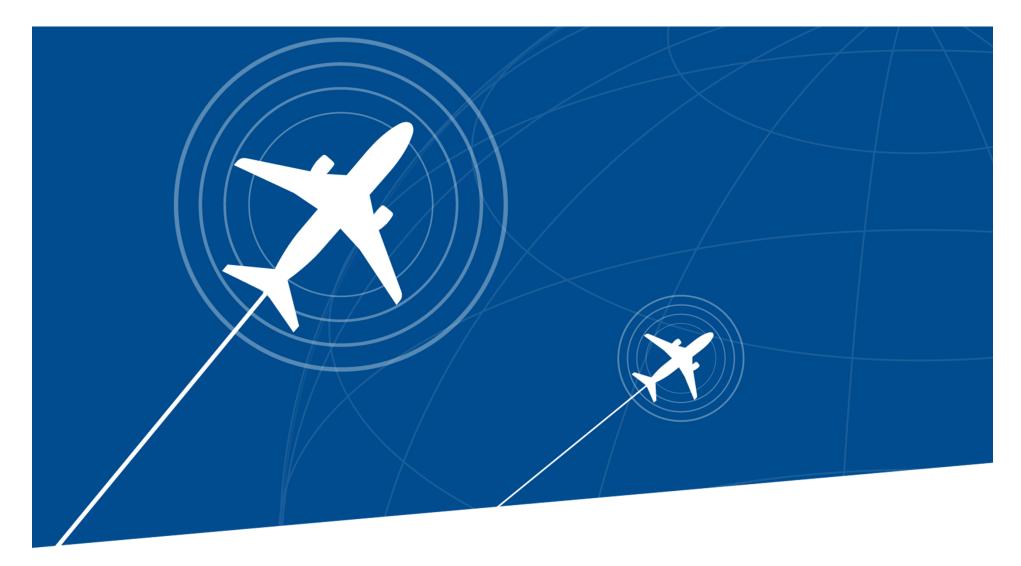
- •CONOPS
- Business case
- Safety Case
- •Technical Requirements
- <u>Is there a value</u> proposition?

Consulting

Decision

- •Sign:
- •Negotiate Price
- •SOW
- •ICD
- •Program Plan
- Contract





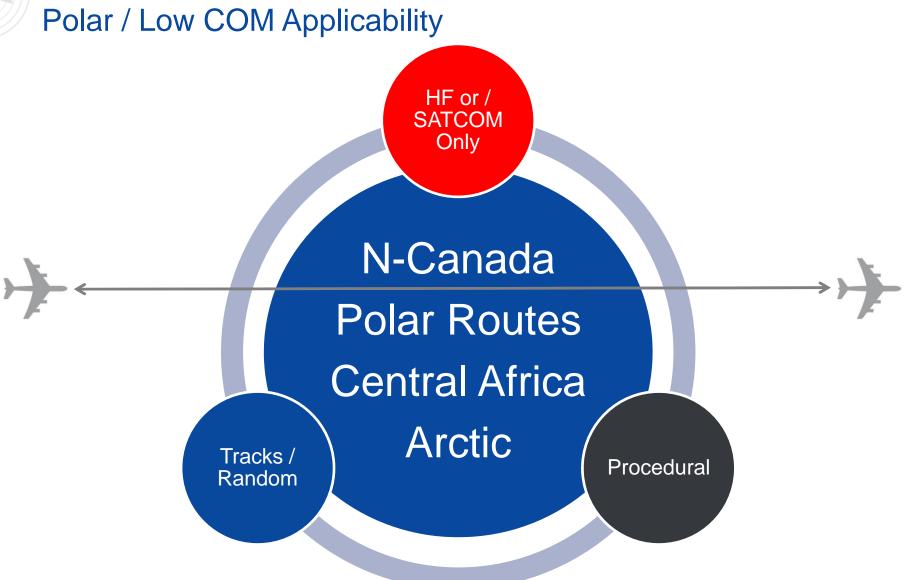
Possible scenarios

Developing new CONOPS with ANSP partners













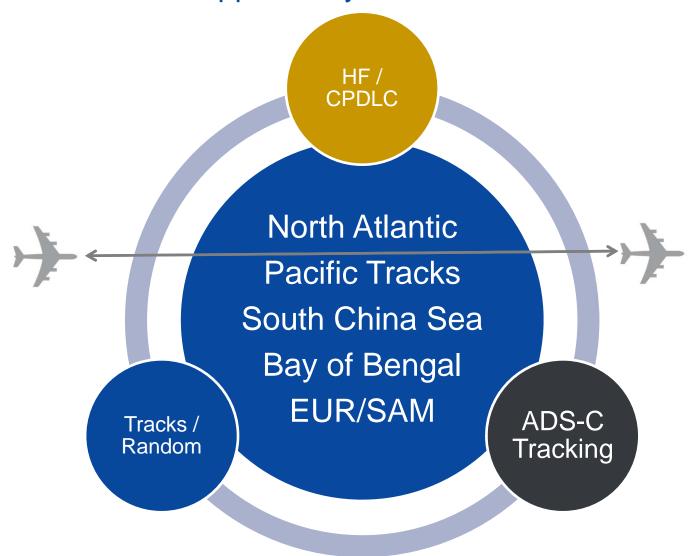
Polar / Low COM Applicability Safety Predictability HF or / SATCOM Cost Only Avoidance N-Canada Polar Routes Central Africa Arctic Tracks / 🚄 Aireon Random







Oceanic / Remote Applicability







Oceanic / Remote Applicability

Random

HF / CPDLC SafetyReducedSeparation

RouteOptimization

- SWIM

CostAvoidance

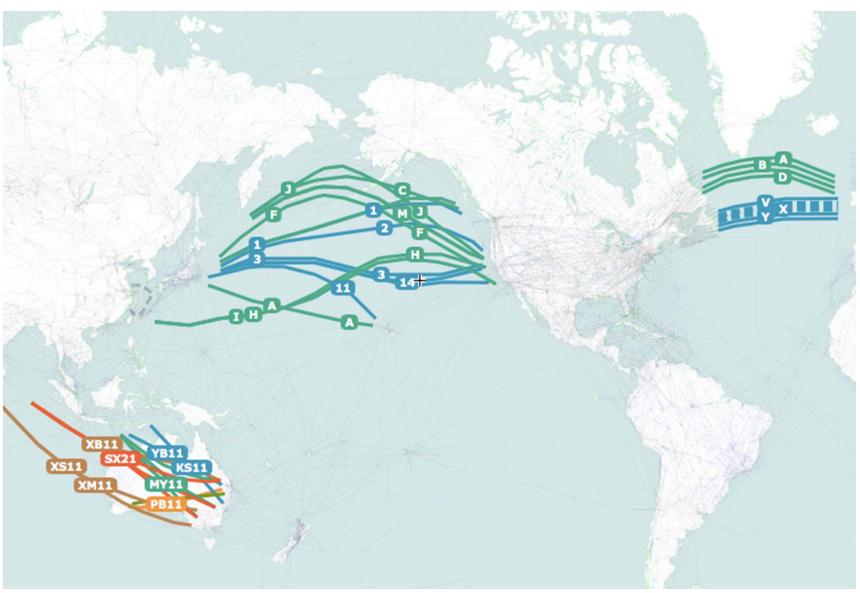
🚄 Aireon

North Atlantic
Pacific Tracks
South China Sea
Bay of Bengal
EUR/SAM





Oceanic







Remote

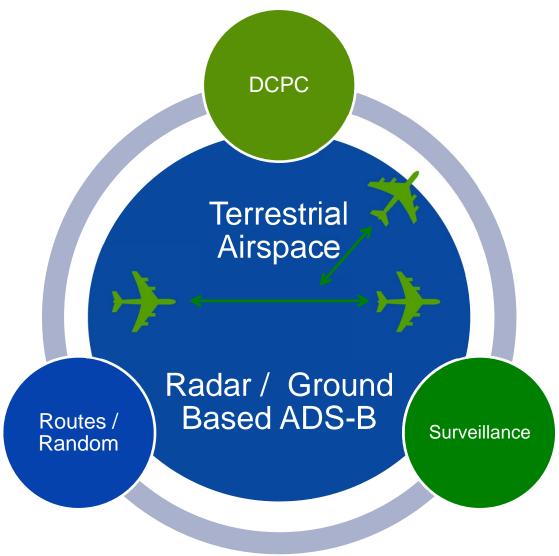




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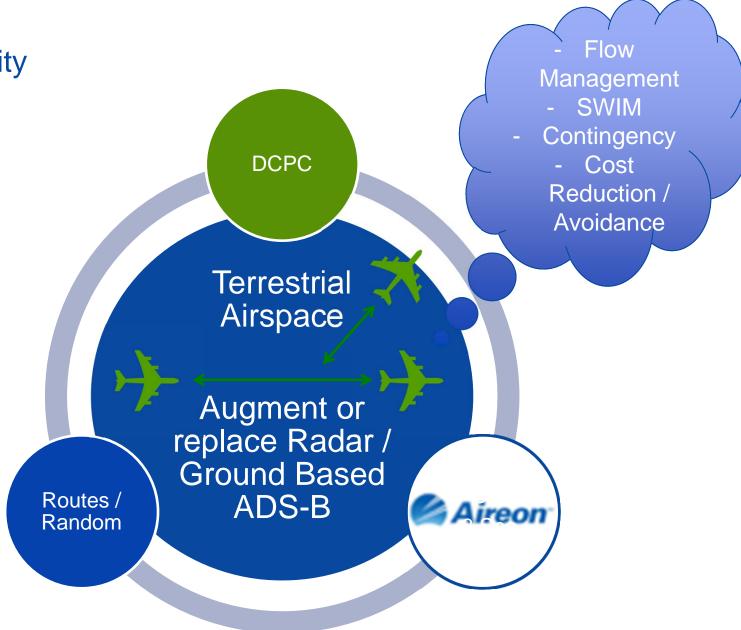








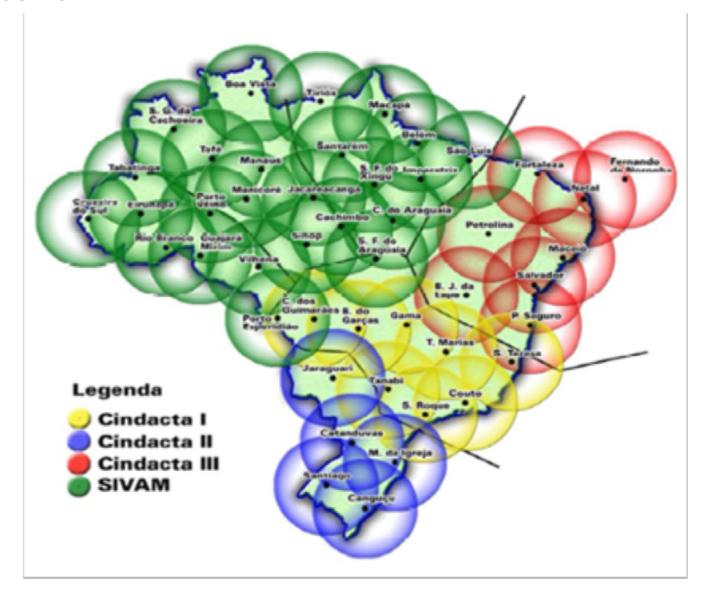








Terrestrial









Making it a reality

The path to implementation







Early ANSP engagement is key

- Partnership approach
- Development of operational requirements
- Identification of quick wins
- Identification of airline / ANSP benefits
- Early engagement of regulators / ICAO
- Introduction into regional ATM plans
- Development of cross border agreements
- Airline equipage, deliver early benefits
- Validation & Operational Trials
- Regulatory Approval
- Implementation





