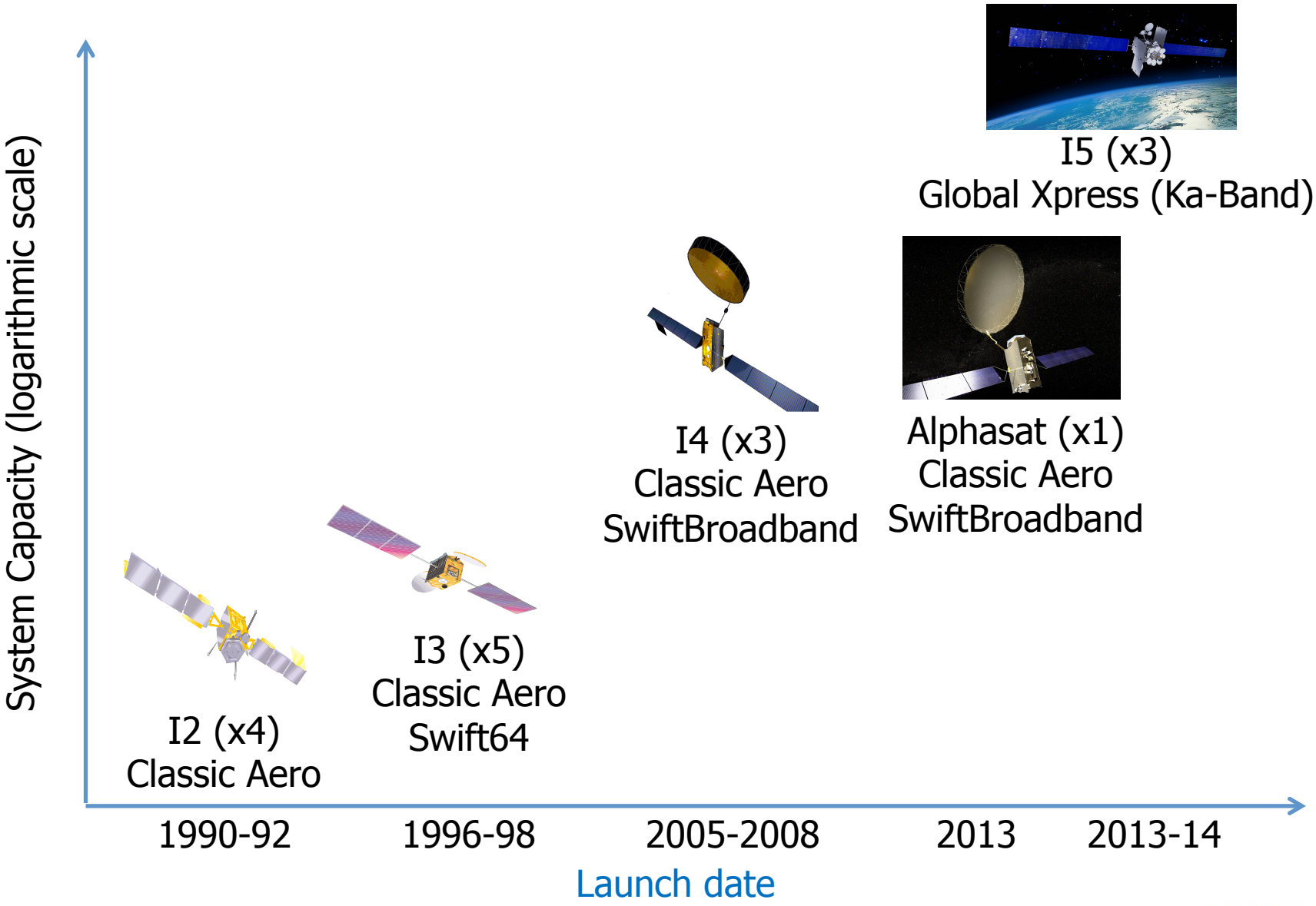
Inmarsat Aviation Safety Services Update

FIT/20 & ISPACG/27,

Auckland NZ, 26th February 2013

Steve Kong

Inmarsat Satellites & Aeronautical Services



2013 – L-band: Significant Milestones

More Inmarsat Ground Earth Stations

Next Generation Safety Services

4th Inmarsat I-4 (Alphasat)

Funding for trials phase for Continental Safety Capability

Satellite Coverage & Network Harmonization

Classic Aero & SwiftBroadband

New Classic Aero GES Racks

I-3/I-4 GES Harmonization Description

Recent Opportunities & Objectives:

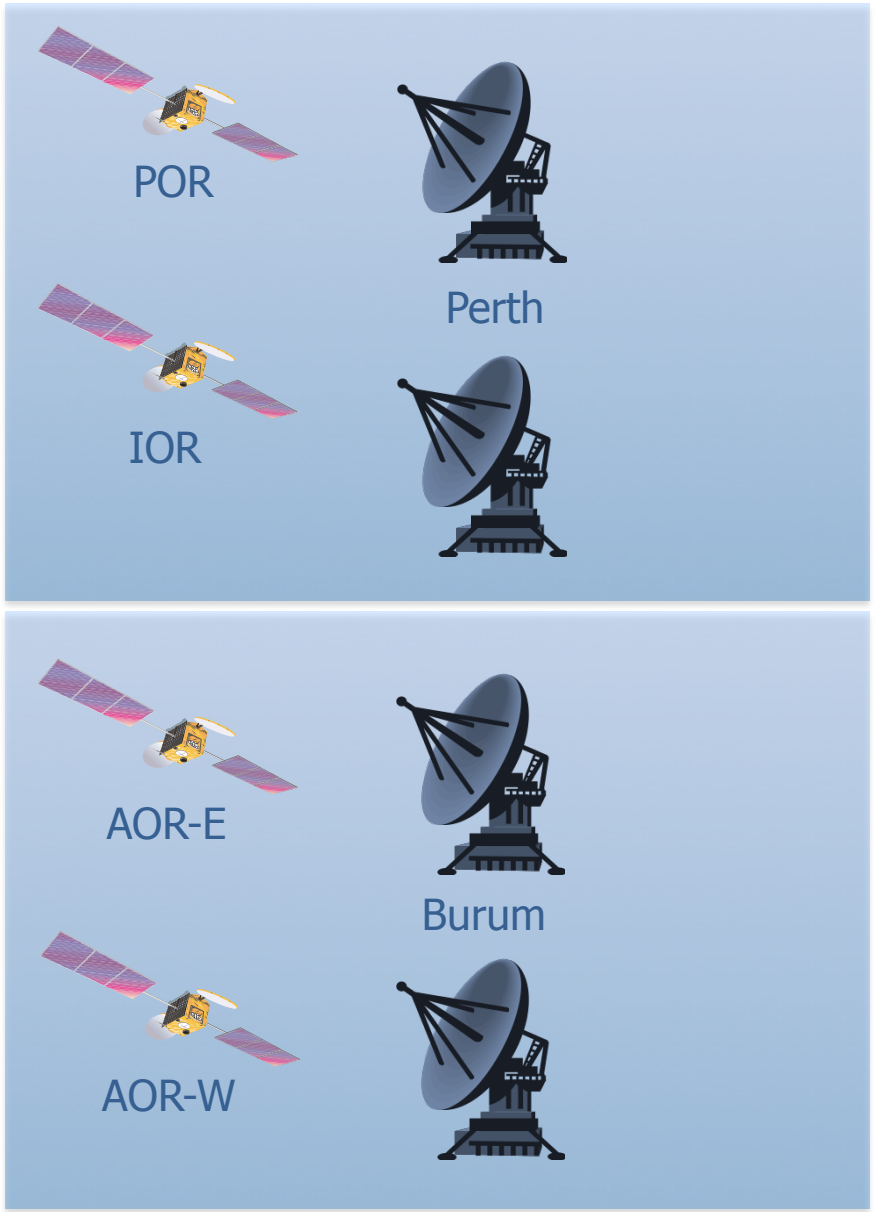
- Re-organizing technically and commercially
- Realizing efficiencies in spectrum and operations
- New SED stations deployed for the I-3 networks (January 2013)
- Locations at Perth (Australia) and Burum (Netherlands)

Benefits/Provisions:

- Simplifies and uses same GES hardware and interconnects existing on I-4
- Harmonized performance monitoring, troubleshooting, service notifications and general fault-finding tools
- Consistent network architecture for continued ICAO GOLD performance monitoring
- For use as backup to I-4 stations post I-3 satellite constellation EOL
- Aero-H+ users: Managed migration to Classic Aero I-4 Network

I-3 GES: 2013 Staggered Transition*

* Illustrative & in No Particular Order



Santa Paula [202]

Perth [205]

Perth [305]

EIK [301]

Aussaguel [103]

EIK [104]

EIK [002]

Aussaguel [005]

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Teams involved in Perth POR transition 03:00 UTC Tuesday 26th Feb

1. NOC London for coordination of the activity
2. SED GES System Experts at Perth
3. T&T GES System Experts at Perth
4. GES Manufacturer – SED
5. Inmarsat Ops-Engineering
6. London Support team (networks, voice, packet switched data etc.)
7. SITA teams
8. Fucino I4 Classic Aero System Experts

Two telecon bridges running, one technical transition, one SITA/Inmarsat management

Perth POR Transition

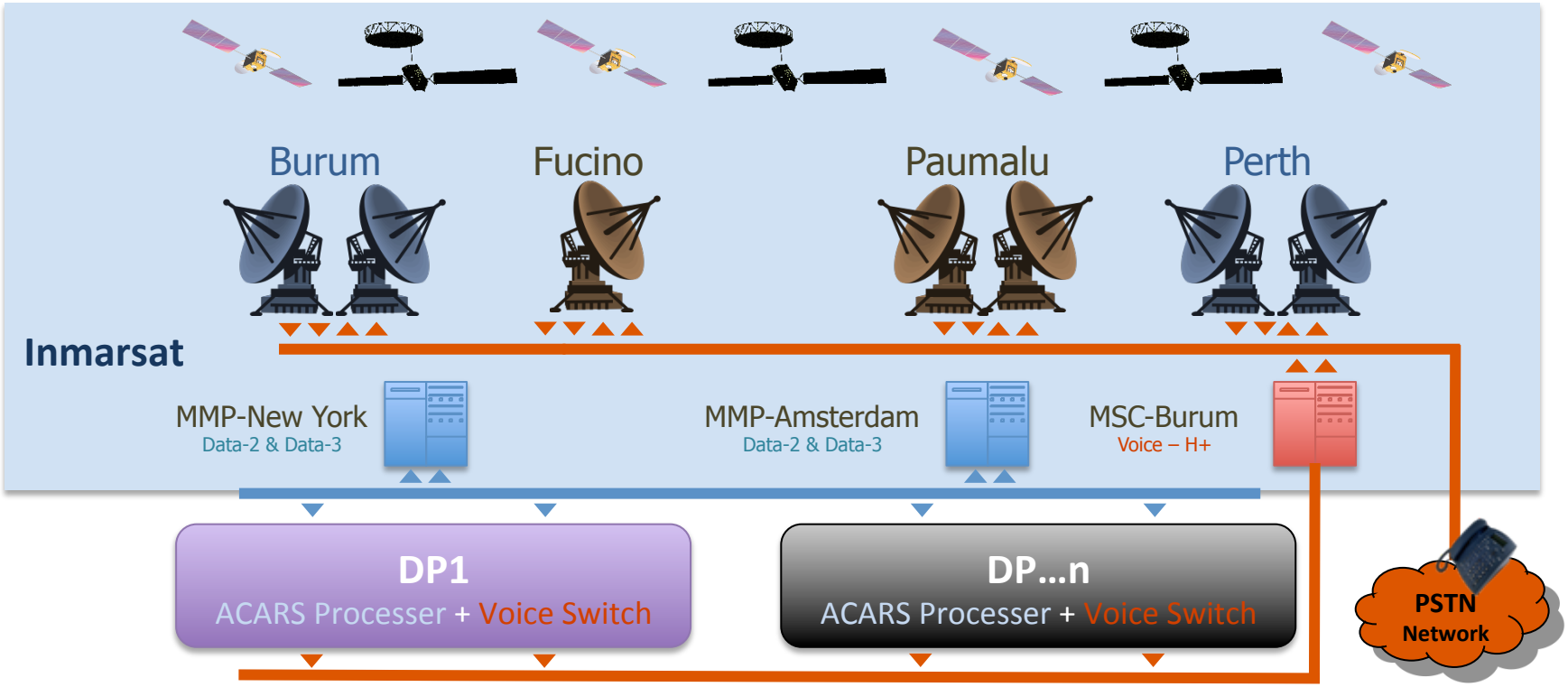
- Summary sequence of events:
  - T-XX mins – transition team characterise population of logged-on aircraft
  - T-15 mins – team block new log-ons and voice calls from T&T GES
  - T-Transition:
    - GES team remove POR uplink carriers
    - After a few minutes, GES team activate the SED GES carriers – Establish P channels and associated System Tables / Spot Beam map
    - Aircraft begin to log-on, FANS datalink messaging re-establishes
    - Team assess all okay, process continues
    - Team make GtA voice (Q9) calls and PS call tests
    - Team make AtG voice calls and ATS (Q12) voice calls
    - Transition team monitors AES log-on to expected traffic load and confirms AES activity with DP, continually assessed
  - T+5 mins & T+30 mins – Roll Back Check Points
  - T+120mins – Decision point: confirmation of successful transition to the SED GES or roll-back to the T&T GES
  - T+8 hours – team to continue to monitor the performance of the GES
  - If transition successful, transition team released. Return to normal operations. Reviews with SITA at T+32 hrs, T+56 hrs and T+7 days

Note: At any point roll-back to the T&T GES can be actioned

Monitoring during transition

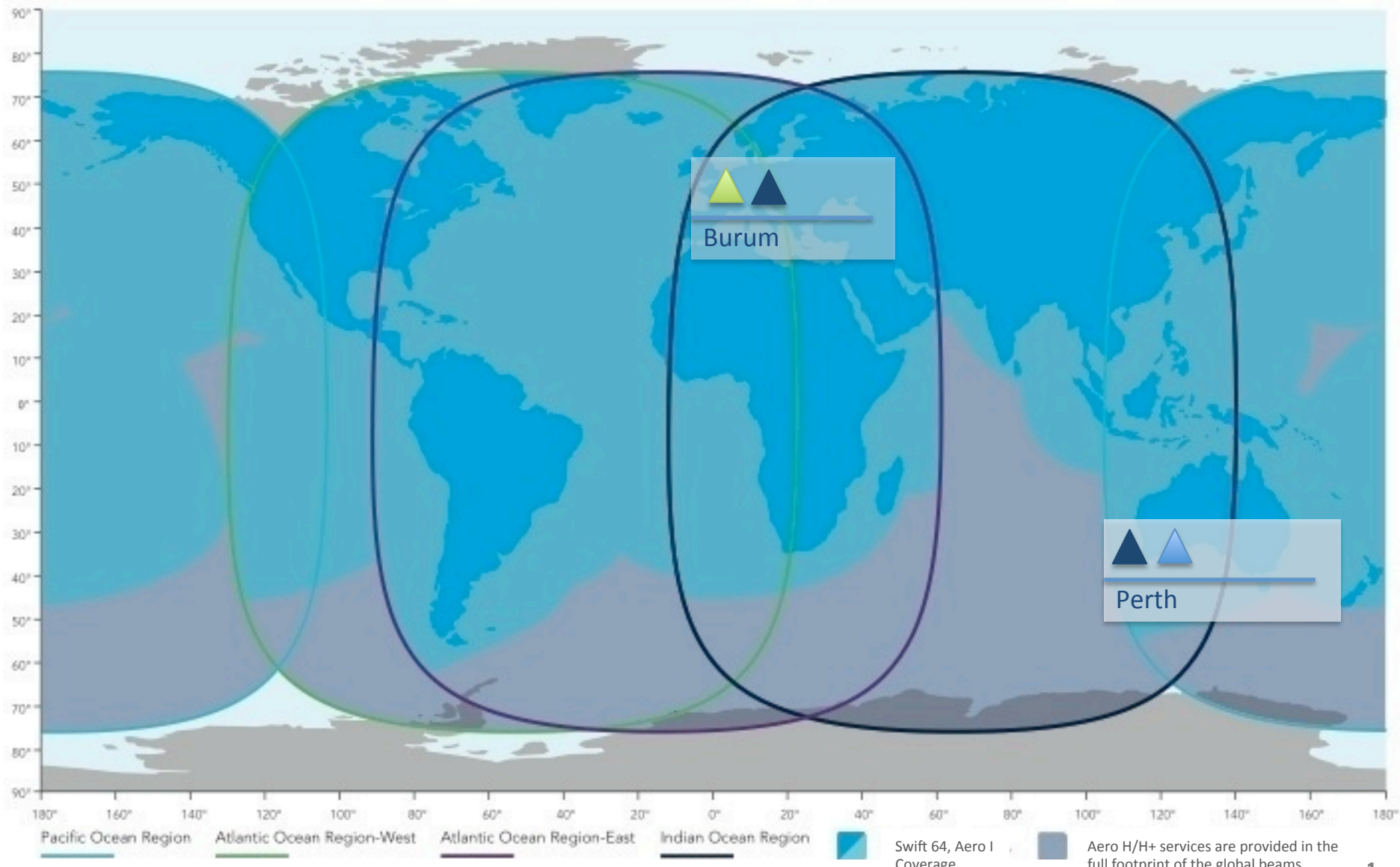
- Inmarsat:
  - Number of logged-on aircraft
  - Voice performance: Ground-to-Air and Air-to-Ground, different priority levels, availability of network
  - Data: Availability of network
  - Data: FANS ADS Latency monitored
- SITA:
  - ACARS Repeat (Uplink) & Reject Rates (Downlink)
  - Traffic Viewer Filter for Uplink Rejects (Affecting particular airlines)
  - POR aircraft logons and migration to other regions
  - SITA OPS tied into POR1 for real time logon rejects (delayed reports at SITA)

Satellite & Network Harmonization



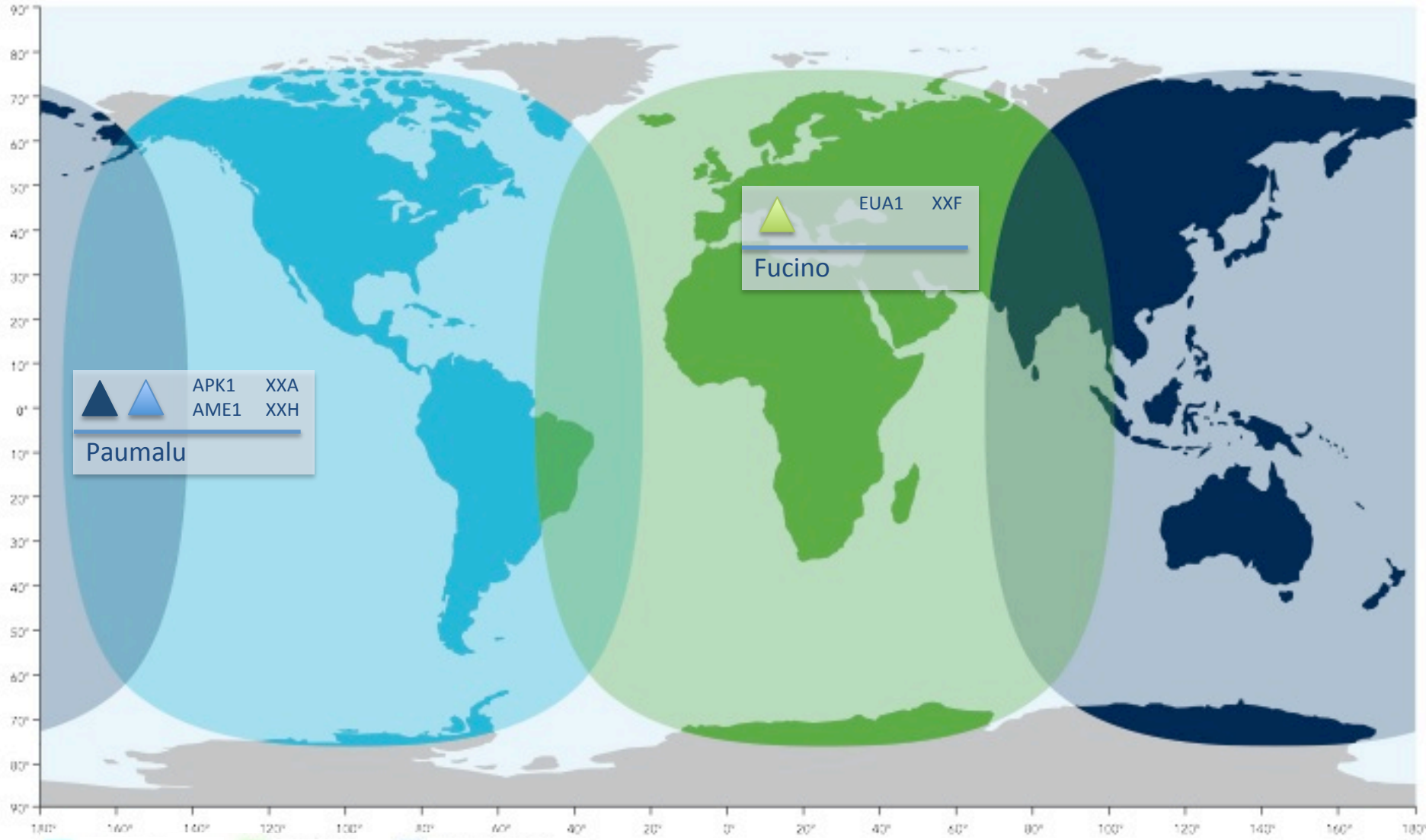
End State: Simplified network access to Classic Aero on I3 and I4 constellations

I-3 Classic Aero Safety Coverage Map



This map depicts Inmarsat's expectations of coverage, but does not represent a guarantee of service. The availability of service at the edge of coverage areas fluctuates depending on various conditions. SwiftBroadband coverage February 2009.

I-4 Classic Aero Safety Coverage Map



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Classic Aero Services + Sunset Info
Service Consolidation

	Voice (H+)	Voice (H)	Voice (I)	Data-2	Data-3	Secure Voice	Broadcast Data	PC Data & Fax
	SAFETY & NON-SAFETY SERVICES				NON-SAFETY SERVICES			
Inmarsat-3 Thrane GES	✓	✓	✓	✓	✓	✓	✓	✓
Inmarsat-3 SED GES	✓	✓*	✓	✓	✓	✗	✗	✗
Inmarsat-4 SED GES	✓	✗	✓+	✓	✓	✗	✗	✗

* Sunset 2016

+ Service envisaged 2016 to sunset of Aero I

- Sunset Intention: (GES-by-GES in 2013)
  - PC Data & Fax
  - Broadcast Data (CN50)
  - Secure Voice (CN11)

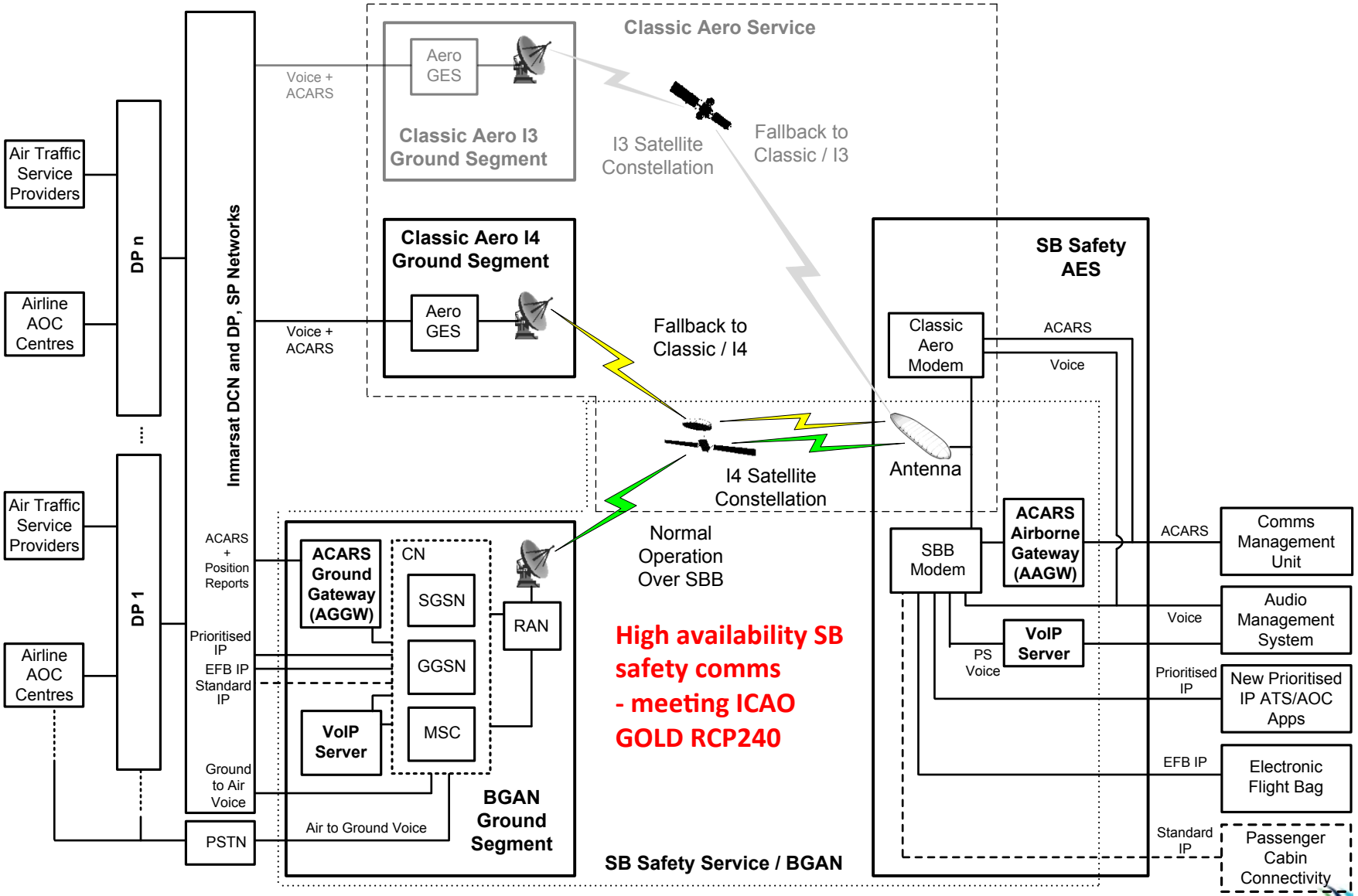
Solutions can be found via Swift64 & SwiftBroadband

Roadmap & Timelines

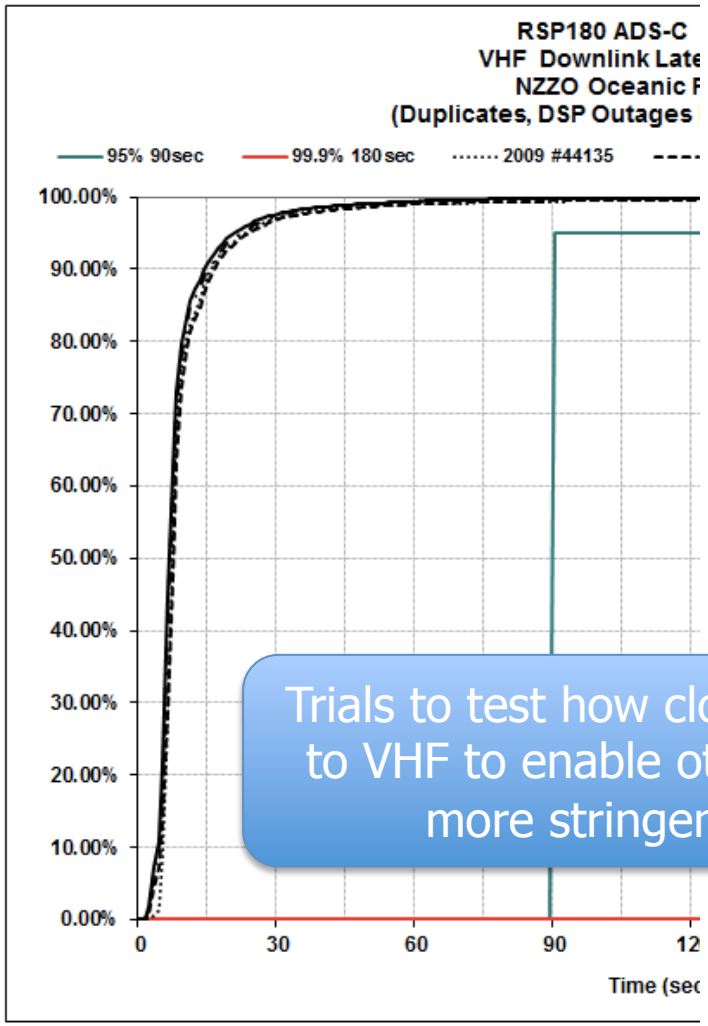
SwiftBroadband Safety Trials

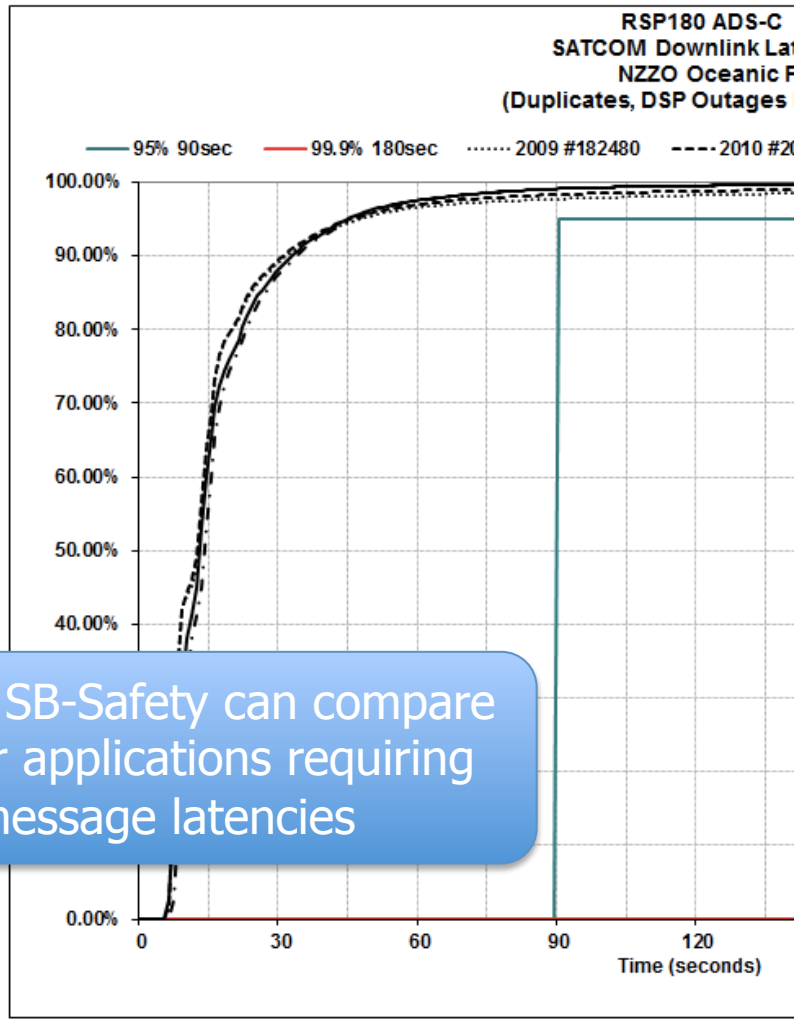
Airline Programme & Incentives

Harmonized Safety Services: Classic & SBB



SwiftBroadband Data Link Challenge





Trials to test how close SB-Safety can compare to VHF to enable other applications requiring more stringent message latencies

Existing VHF
90%: 15 secs
50%: 7 secs

Existing SATCOM
90%: 30 secs
50%: 15 secs

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SwiftBroadband Safety Benefits

Low Cost Terminals

- 2 MCU SDU size with Enhanced Low Gain Antenna
- Opex expected at least 30% less than Classic Aero
- Anticipate up to 100 lbs in weight + drag savings

Low Cost + Light Weight Terminals

Flight Deck Communications

- Target: Reduce ACARS data link message times
- Support for VoIP

Advanced Features

- Aircraft Position Reporting and Tracking
  - Additional to WPR and ADS-C ACARS based messaging
  - Message rate configurable
- Private Network (from Cabin SBB/Ka/Ku Links)
- Prioritised IP link
  - EFB Applications
  - Maintains up to 200, 300, or 400 kbps (per antenna type)

SwiftBroadband Flight Tracking

Next Generation Avionics

Flight Deck + Cabin or Flight Deck Only Solutions

- Multitude of capabilities to include reversion to Classic Aero

ARINC 781 6 MCU
IGA or HGA

- 1 x SBB Safety Channel
  - 2 x Voice, 1 x ACARS, 1 x IP Data
- Up to 3 x SBB Channels
  - For AIS or PIES Domains
- Up to 300 or 400 Kbps

ARINC 781 2 MCU
ELGA, IGA or HGA

- 1 x SBB Safety Channel
  - 2 x Voice, 1 x ACARS, 1 x IP Data
- Data Arbitration
  - For support to AIS Domains
- Up to 200, 300 or 400 Kbps

+More

- Does not require wiring or rack changes
- e.g.: Same internal avionics from latest A781 systems, but packaged in A741/A761 form factors?

PARC CWG Project Plan: Objectives

Venue	Date	Objectives
PARC CWG 27	2012 – Williamsburg, VA (June)	• Conclude FOICA • Request SwiftBroadband Safety Project
PARC CWG 28	2012 – Livermore CA (October)	• Start SBB Safety Services Project • Report on GOLD testing @ test benches
PARC CWG 29	2013 – Phoenix (Mid April)	• Begin Bizjet Installations • Report on GOLD testing @ Airframe Manufacturers

Trials Incentives

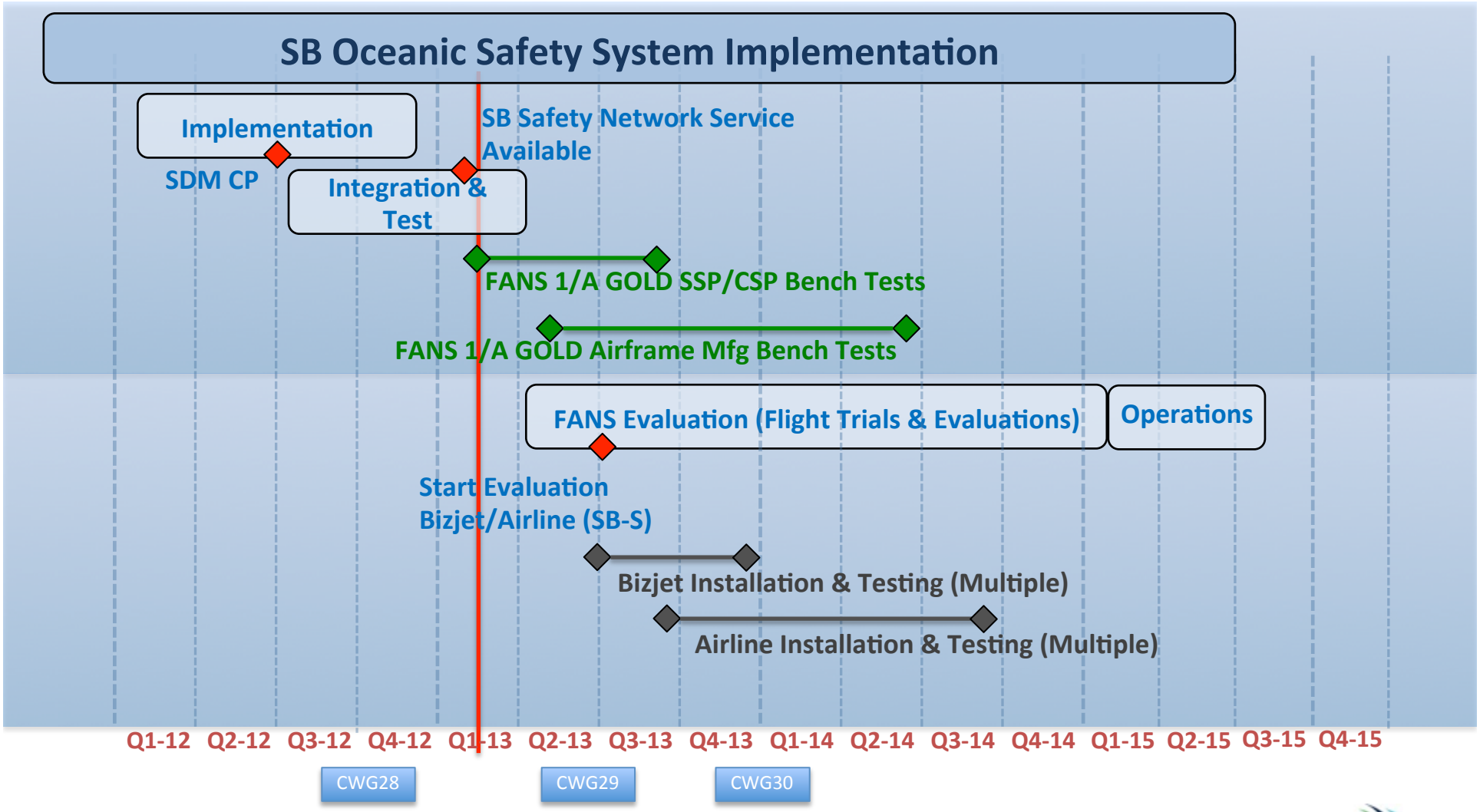
- Support from Inmarsat, Service Providers and Equipment Manufacturers
  - Free Airtime* for duration of trials
  - Savings on avionics
  - Consider STC Packages

* For SwiftBroadband Safety Voice and Data use in the Flight Deck: Subject to Fair Use Policies

PARC CWG Project Plan: Timeline

Target High Level Implementation Phases

Timescales subject to internal approvals and external dependencies



Inmarsat Aviation Services Roadmap

SwiftBroadband (I4 network)

Classic Aero H+ (I3 and I4 networks)

Classic Aero I (Supported at least until end 2018)

Swift 64 (Supported at least until end 2018)

Classic Aero H (Closure end 2016)

H Service Sunset

Service Provider & Airline Consultation process ends March 31st 2013
Provide your input on Aero-H

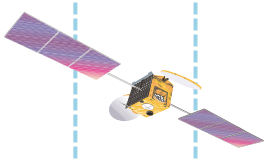
PC Data & Fax

Broadcast Data (CN50)

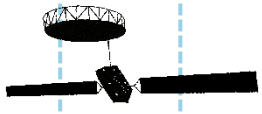
Secure Voice (CN11)

Closure
GES by GES Transition

I-3 GES Harmonization



I-3 Constellation Est. End-of-Life

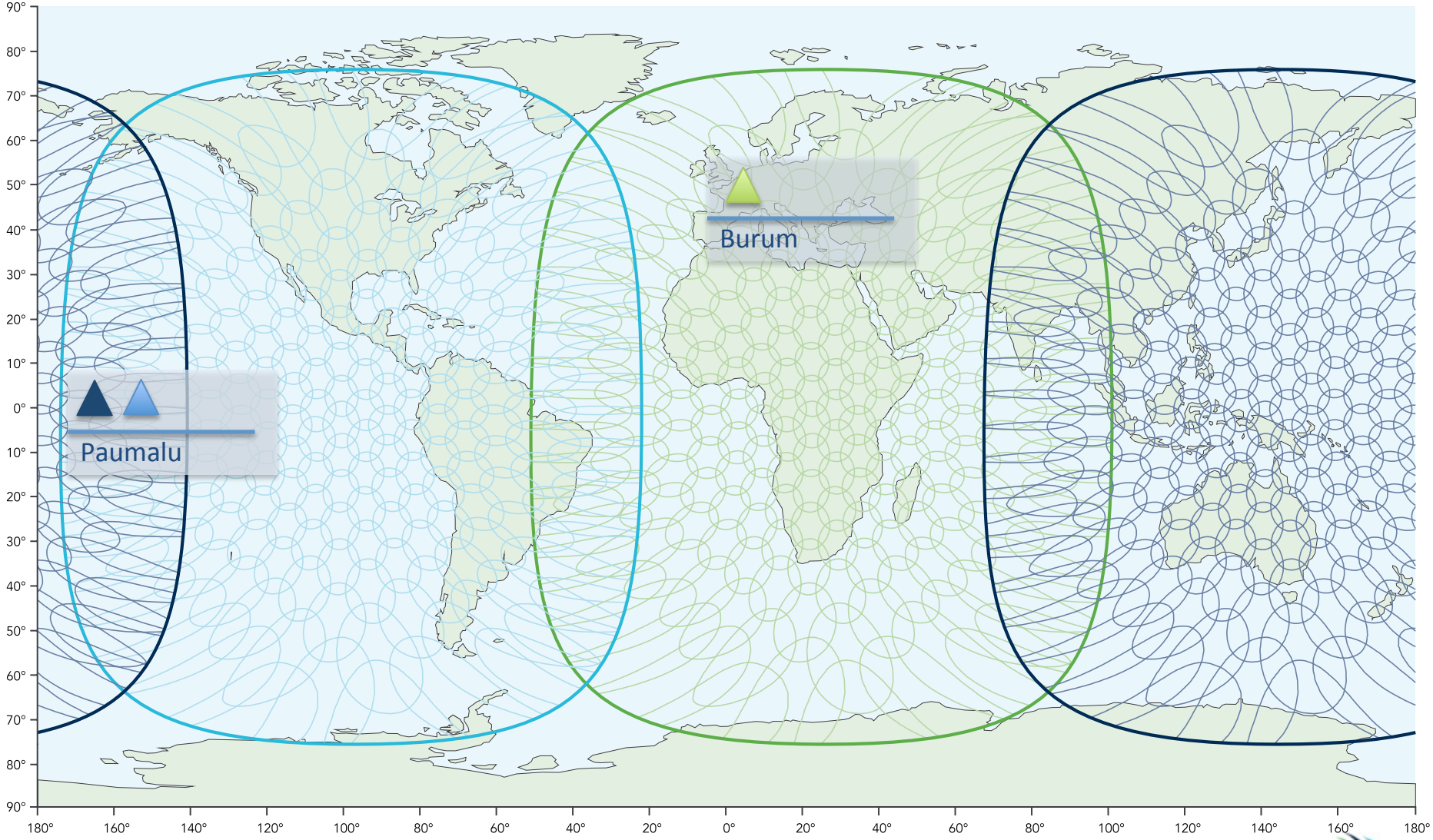


I-4 Constellation Est. End-of-Life

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

I-4 SwiftBroadband Safety Coverage Map

Spot Beams for Voice & Data (FANS1/A)



I-4 Americas I-4 EMEA I-4 Asia-Pacific

This map depicts Inmarsat's expectations of coverage, but does not represent a guarantee of service. The availability of service at the edge of coverage areas fluctuates depending on various conditions. SwiftBroadband spot beam coverage February 2009.

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Summary of Network Redundancy

Classic Aero Only Aircraft

- Use I-3 and I-4 Satellites and networks
- Availability of 99.9% to 99.99% via 2 x networks
- Overlapping I-3 Satellite Coverage until approximately 2018

2 x Networks

SwiftBroadband Safety and Classic Aero Aircraft

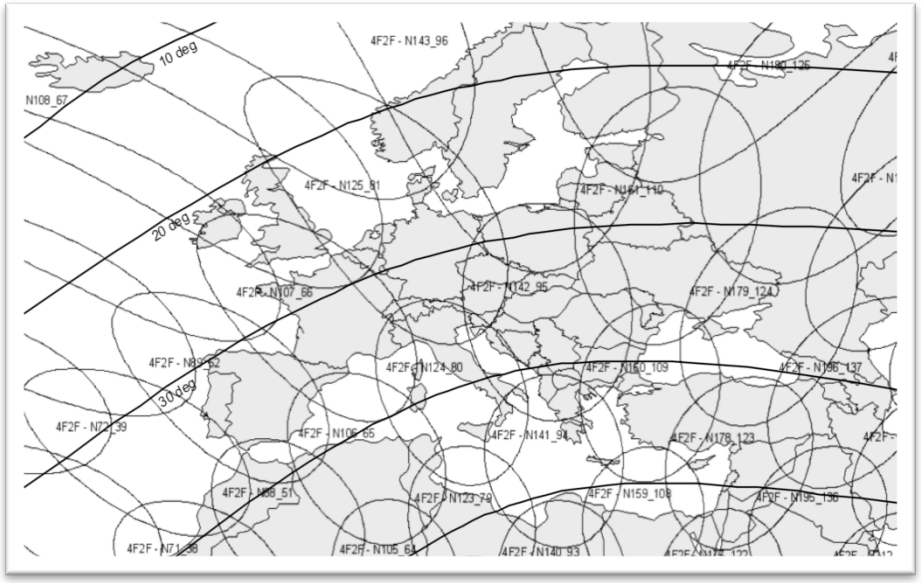
- Use SwiftBroadband Safety on I-4 Satellites and network
- Use Classic Aero as fall-back on I-4 and I-3 Satellites and networks
- Availability of more than 99.99% via 3 x networks
- Overlapping I-3 Satellite Coverage until approximately 2018

3 x Networks

SwiftBroadband Safety Only Aircraft

- Use SwiftBroadband on I-4 Satellites and network
- Availability reaching 99.99% via 1 x network
- Post 2017 network enhancements for continental airspace satcom

1 x Network



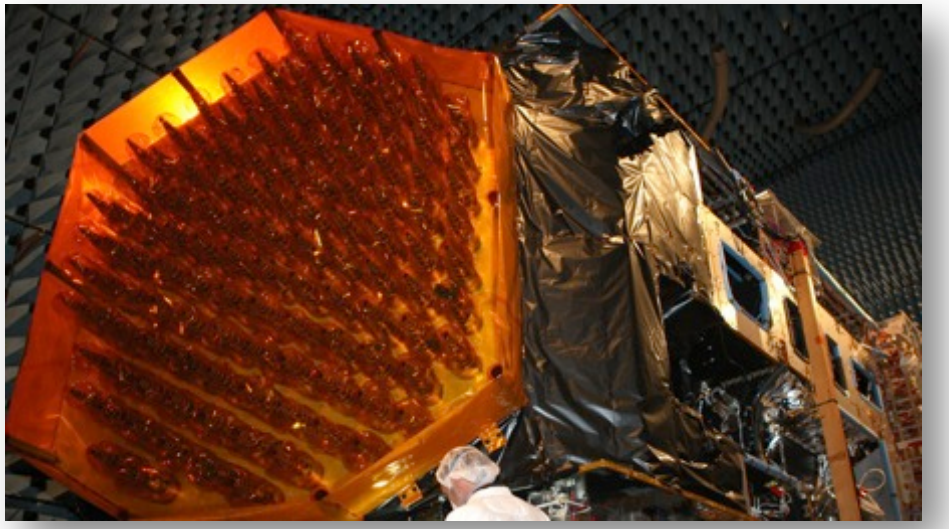
Next Generation Safety Services Continental

ESA IRIS Programme – ARTES 10

ESA: Iris Pre-Cursor Programme

Alphasat I-XL

Test Completion: Jan 2013
Reflector: 11 m/36 ft Diameter
Launch Mass: 6.5 tons
Power: 12 kW
Launch: 2013 – Ariane5



European Space Agency commits to funding SB safety services

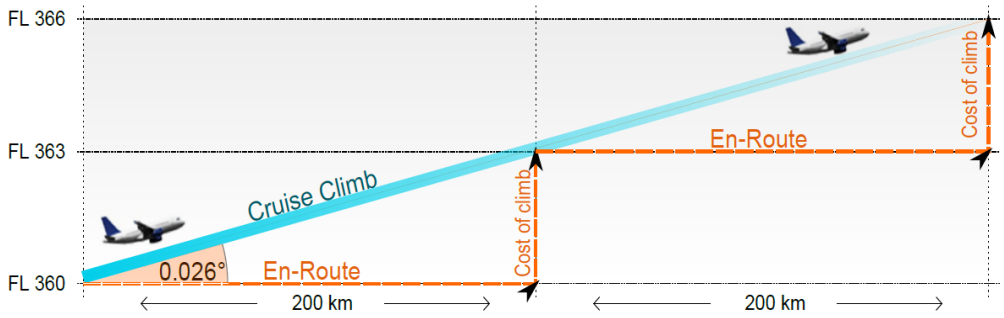
07-JAN-13

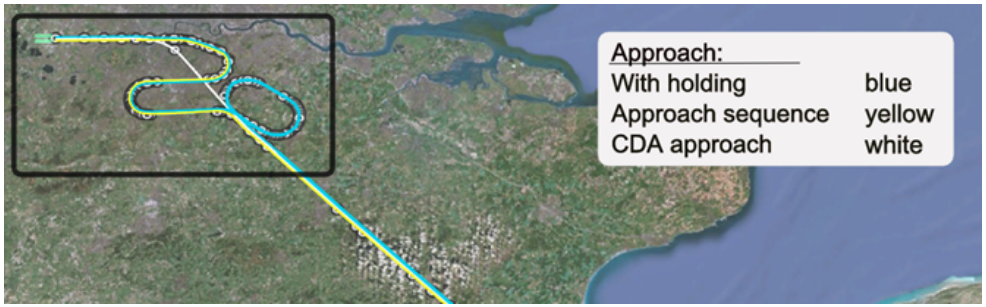
Inmarsat has received confirmation of a major funding commitment to validate SwiftBroadband Safety as part of the future European air traffic management infrastructure.

A total of €11.5 million (about US$14.6 million) has been approved at the European Space Agency (ESA) 2012 Ministerial Council, with the UK as main contributor, followed by Norway, Ireland and Portugal. Under the ARTES-10 Iris programme, SwiftBroadband will be upgraded to provide a satellite overlay to terrestrial VHF networks through the SESAR (Single European Sky ATM Research) air traffic control modernisation programme.

Initial 4D Trajectory Management
Fuel Saving Techniques

- **Cruise Climb** uses automated exchanges between aircraft and ground systems to enable a gradual climb as the weight of the aircraft decreases
- Aircraft flying higher flight levels can benefit from lower fuel consumption, less drag and better engine efficiency

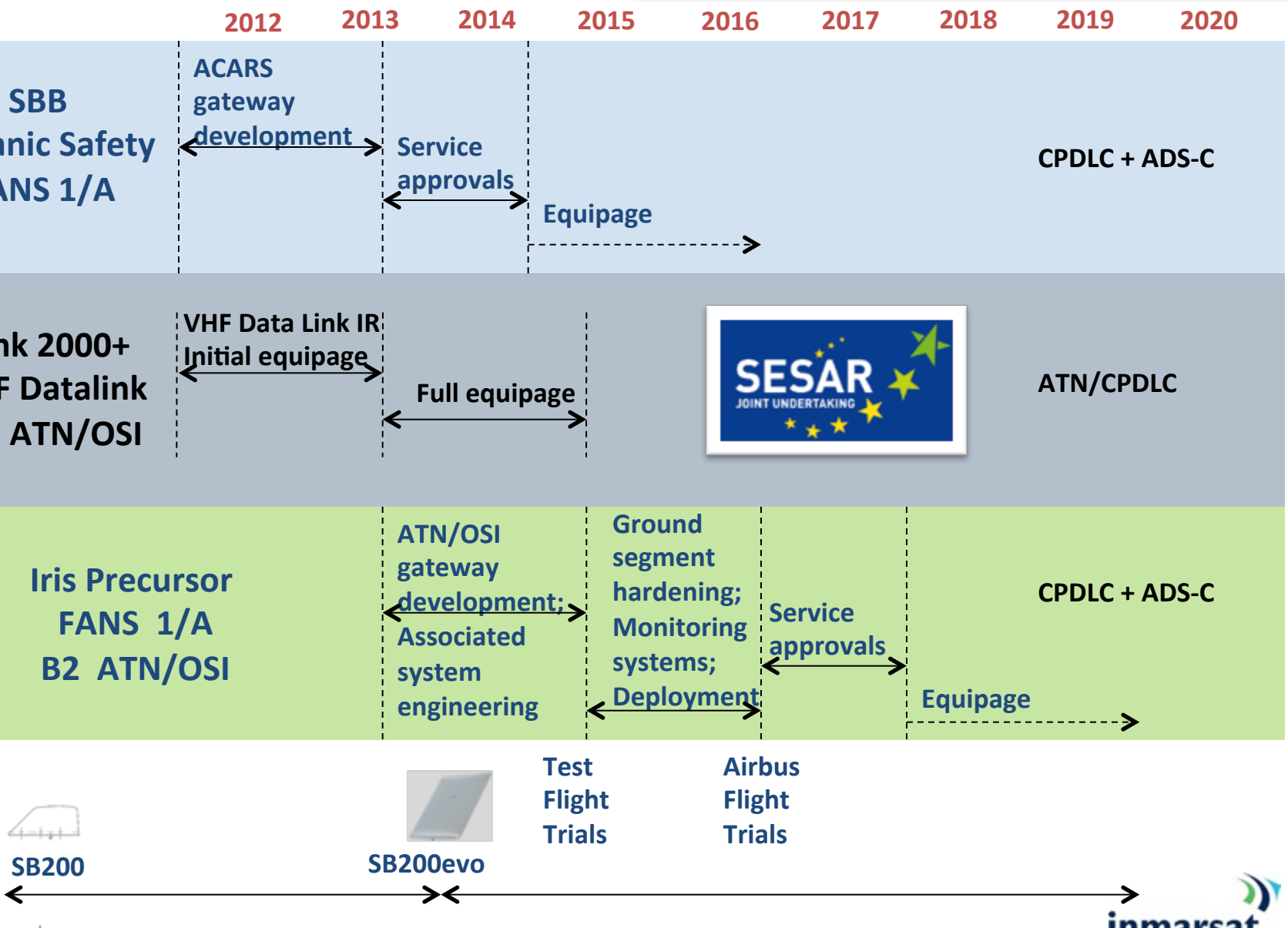




- **Continuous Descent Approach** removes stack holding prior to landing
- Analysis for A320 aircraft using CDA at Heathrow shows that it is possible to save up to 300kg of fuel per approach*

* Source: Helios

Timeline Envisaged



Summary

I-3/I-4 GES Harmonization

- GES OR-by-GES OR Transitions
- Alphasat I-XL addition to follow

Next Generation Safety Services

- Smaller, lighter, less expensive, faster FANS1/A with private IP Network, e.g: for EFB
- 2013 – FANS1/A Trials – Incentives based on first come, first served
- 2017 – Initial-4D Trials of Continental Data Link Applications

Action

- 2013 – SwiftBroadband Safety Trials Programme

Questions?