Inmarsat Aviation Safety Services
Update

ICAO NAT PBCS Workshop, Paris, 20-22 February 2013
Andrew Ives, Gary Colledge
Inmarsat Satellites & Aeronautical Services

- **I2 (x4)** Classic Aero Swift64 (1990-92)
- **I3 (x5)** Classic Aero SwiftBroadband (1996-98)
- **I4 (x3)** Classic Aero SwiftBroadband (2005-2008)
- **I5 (x3)** Global Xpress (Ka-Band) (2013-14)
- **Alphasat (x1)** Classic Aero SwiftBroadband (2013)

Launch dates:
- 1990-92
- 1996-98
- 2005-2008
- 2013
- 2013-14

System Capacity (logarithmic scale)
2013 – L-band: Significant Milestones

- More Inmarsat Ground Earth Stations
- 4th Inmarsat I-4 (Alphasat)
- Funding for trials phase for Continental Safety Capability
- Next Generation Safety Services
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

- POR
- Perth
- IOR
- EIK [301]
- Aussaguel [103]
- EIK [104]
- EIK [002]
- Aussaguel [005]
- Perth [205]
- Perth [305]
- Santa Paula [202]
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
- 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+120mins – Decision point: confirmation of successful transition to the SED GES or roll-back to the T&T GES
- Transition team continue to monitor the performance of the GES until T + 8 hours
- 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
Inmarsat monitoring during transition

To include:

▷ 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
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

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.
### Classic Aero Services + Sunset Info
#### Service Consolidation

<table>
<thead>
<tr>
<th></th>
<th>Voice (H+)</th>
<th>Voice (H)</th>
<th>Voice (I)</th>
<th>Data-2</th>
<th>Data-3</th>
<th>Secure Voice</th>
<th>Broadcast Data</th>
<th>PC Data &amp; Fax</th>
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<tbody>
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<td>SAFETY &amp; NON-SAFETY SERVICES</td>
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<td>Inmarsat-3 SED GES</td>
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<td>✓ +</td>
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<td>✓</td>
<td>✗</td>
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<tr>
<td>NON-SAFETY SERVICES</td>
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> Sunset Intention: (GES-by-GES in 2013)

- PC Data & Fax
- Broadcast Data (CN50)
- Secure Voice (CN11)

*Sunset 2016
+ Service envisaged 2016 to sunset of Aero I

Solutions can be found via Swift64 & SwiftBroadband
Roadmap & Timelines
SwiftBroadband Safety Trials
Airline Programme & Incentives
Harmonized Safety Services: Classic & SBB

- High availability SB safety comms - meeting ICAO GOLD RCP240
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
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

▷ 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)
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

<table>
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<tr>
<th>Venue</th>
<th>Date</th>
<th>Objectives</th>
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<tbody>
<tr>
<td>PARC CWG 27</td>
<td>2012 – Williamsburg, VA (June)</td>
<td>• Conclude FOICA&lt;br&gt;• Request SwiftBroadband Safety Project</td>
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<tr>
<td>PARC CWG 28</td>
<td>2012 – Livermore CA (October)</td>
<td>• Start SBB Safety Services Project&lt;br&gt;• Report on GOLD testing @ test benches</td>
</tr>
<tr>
<td>PARC CWG 29</td>
<td>2013 – Phoenix (Mid April)</td>
<td>• Begin Bizjet Installations&lt;br&gt;• Report on GOLD testing @ Airframe Manufacturers</td>
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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

SB Oceanic Safety System Implementation

- Implementation
- Integration & Test
- SB Safety Network Service Available
- FANS 1/A GOLD SSP/CSP Bench Tests
- FANS 1/A GOLD Airframe Mfg Bench Tests
- FANS Evaluation (Flight Trials & Evaluations)
- Operations

Start Evaluation
Bizjet/Airline (SB-S)

Bizjet Installation & Testing (Multiple)
Airline Installation & Testing (Multiple)

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)

**I-3 GES Harmonization**
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016

**I-3 Constellation Est. End-of-Life**
- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- 2023

**I-4 Constellation Est. End-of-Life**

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

**Closure**
- GES by GES Transition
- PC Data & Fax
- Broadcast Data (CN50)
- Secure Voice (CN11)
I-4 SwiftBroadband Safety Coverage Map
Spot Beams for Voice & Data (FANS1/A)

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.
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

▸ **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

▸ **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
Next Generation Safety Services
Continental  ESA IRIS Programme – ARTES 10
**ESAs 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

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*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

<table>
<thead>
<tr>
<th>Year</th>
<th>Events</th>
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<tbody>
<tr>
<td>2012</td>
<td>ACARS gateway development</td>
</tr>
<tr>
<td>2013</td>
<td>Service approvals</td>
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<tr>
<td>2014</td>
<td>Equipage</td>
</tr>
<tr>
<td>2015</td>
<td>CPDLC + ADS-C</td>
</tr>
<tr>
<td>2016</td>
<td>SB200evo Service approvals</td>
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<tr>
<td>2017</td>
<td>Link 2000+ VHF Datalink Initial equipage</td>
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<tr>
<td>2018</td>
<td>Full equipage</td>
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<tr>
<td>2019</td>
<td>ATN/CPDLC</td>
</tr>
<tr>
<td>2020</td>
<td>Iris Precursor FANS 1/A B2 ATN/OSI</td>
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<tr>
<td></td>
<td>ATN/OSI gateway development; Associated system engineering</td>
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<tr>
<td></td>
<td>Ground segment hardening; Monitoring systems; Deployment</td>
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<tr>
<td></td>
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**SB200**

**SB200evo**

**Test Flight Trials**

**Airbus Flight Trials**
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?