Inmarsat Update

ICAO IPACG FIT/33

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Agenda

Update on Classic Aero
  - Current status
  - Network improvements
  - Cybersecurity

Update on SB Safety and IRIS
  - SB-S 1.0 Service
    - Current status
    - Terminal availability
    - China AGGW
    - Message timing analysis
  - SB-S 2.0 Service development and terminals
  - IRIS
Classic Aero ADS-C over 1 day: 16 Sep ‘19 compared with 10 Sep ‘20

Blue indicates avionics still using I3 satellite identifiers in Owner Requirements Tables (ORT)
Orange indicates those using I4 identifiers
I-6 Constellation

- Two I-6 satellites are being constructed by Airbus Defence and Space. Both are currently scheduled for launch in 2021
  - Based on Airbus’ Eurostar platform in its E3000e variant, which exclusively uses electric propulsion for orbit raising
  - Designed to remain in service for a minimum of 15 years
  - Features Ka-band payloads hosted on L-band satellites
- The Inmarsat-6 satellites confirm our commitment to L-band services, and will support a new generation of capabilities for global safety services
Classical Aero GES Software and Hardware Upgrades

- Due to essential maintenance at Paumalu, the dormant half of the Perth GES was modified to carry APAC traffic as of 17 June
- Enhanced the Radio Frequency System (RFS) at Fucino — Completed
- GES software upgrade for new T-channel enhanced management software, for the mitigation of certain mis-bursting terminals (operating from 19th February)
- Updates to support SATVOICE VoIP Service — Completed
- Refresh of GES hardware with upgrade to software 9.2.0, including cybersecurity enhancements:
  - Virtualising the system on powerful new servers
  - Includes Paumalu and Fucino, Burum and Perth GESs, completed 10 Sep 2020
- After almost 14 years of Interoperability with the Inmarsat Classic Aero System, the JCAB MTSAT service was closed on the 6th February 2020
SATVOICE VoIP Service

- Fast satellite VoIP with current Classic Aero network & equipage
- Enables direct controller pilot communications

≈ 15 sec GTA call setup
Cybersecurity

- Inmarsat is continually reviewing its internal infrastructure and services to ensure that we understand the latest risks and threats.

- We are applying this across the Inmarsat enterprise, including to both the Classic Aero and SB-Safety infrastructure.

- Inmarsat is evolving its services to include additional security controls that are appropriate for the type of risk and technology being used.

- Inmarsat is ISO 27000 certified, ensuring we have a complete information security management system in place.

Cybersecurity Operations Centre
- 24/7/365 Monitoring
- Highly skilled security experts
- Threat Intelligence
- Immediate response
- Investigations & Forensics
- Proactive and reactive
Cybersecurity

- Inmarsat’s cybersecurity infrastructure, following the ISO 27000 framework, includes ensuring that:
  - Inmarsat’s life-cycle and configuration management processes are complete
  - We have processes in place to address:
    - Security hardening for data interfaces,
    - Operating system improvement (for cyber protection/patches),
    - Process controls (such as whitelisting),
    - Malware and AV detection and prevention software, and
    - Cybersecurity reporting mechanisms
- Through the ISMS processes and life-cycle management, we will continue to:
  - Evaluate and improve our processes to ensure they are effective
  - Continually test our security controls to ensure they are effective at meeting the evolving threat landscape
SB-S 1.0 Service Status

• An FAA PARC (Performance-based Aviation Rulemaking Committee) service performance evaluation was conducted on SB-S 1.0, involving over two years of in-service operation, during which the FANS/ACARS message latency and service availability was analysed and reported, demonstrating that the system met the required Performance-Based Communications and Surveillance (PBCS) requirements.

• Following this, SB-S 1.0 entered commercial operations on 17th April 2018.

• The Inmarsat Distribution Partners Collins, SITA and CTTIC are providing SB-S 1.0 services to a number of passenger and bizjet aircraft.

• Over 100 SB-S 1.0 aircraft are now in commercial service.
### SB-S 1.0 ADS-C Data from 1 Sept 2017 to 13 Sept 2020

<table>
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<th>Ocean Region (No.)</th>
<th>(4F1) APAC (5)</th>
<th>(4F3) AMER (7)</th>
<th>(AF1) EMEA (6)</th>
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<td>19,367</td>
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SB-S 1.0 Terminals

- SB-S 1.0 **Aviator 300D** terminals are available from Cobham now for Class 7 and Class 6 antennas
- Supports all the SB-S services, providing a single channel of voice to the cockpit
- Voice service access is via a voice call dialler unit

- Avionica is developing a lightweight, cost-effective terminal for the retrofit market
- **satLINK SBS** expected to be available 2021, ACARS over SB-S IP support, IP-broadband connectivity support for EFB
- Class 7 and Class 6 broadband IP services support
China SB-S 1.0 ACARS Ground Gateway (AGGW)

• New SB-Safety dual ACARS Gateway installed at Beijing SAS, with additional backup dual gateway installed at Paumalu, with CTTIC as CSP

• AGGW integration and test complete:
  o All ISAT Data Comms Network (DCN) infrastructure components integrated and tested
  o First Chinese SB-Safety test terminal sent and received ACARS messages through the CTTIC AGGW gateway to the ADCC Global Message Processor – Aug ‘19
  o Alpha evaluation with first aircraft underway – Sep ‘20

• Planning Beta evaluation

• Project completion expected Q4 2020
Initial CPDLC latency up & downlink KPI analytics

Conditions:

- Example analysis of 2019 data
- Cobham Aviator 300D (HGA) & 350D (IGA)
- FANS/ACARS messages
- 3 Ocean Regions
- Only uplink transactions that have an associated downlink (i.e. involving pilot response) have been analysed
- CPDLC data cleansed for unrealistic delivery times; any delay less than the minimum Gateway-Satellite-Aircraft delay, has been removed

Note: This is an early example of the analytics capability – threshold values and results still undergoing validation.
Evolution to add SB-S 2.0

- Inmarsat has now evolved its SB-Safety portfolio to include SB-Safety 2.0 to meet the enhanced security requirements of aircraft manufacturers and regulatory requirements
  - With SB-S 2.0, the Packet Switched (PS) services in the Aircraft Control Domain (ACD), i.e. ACARS, PS voice, and position reporting, are additionally protected through the implementation of an air-to-ground Virtual Private Network (VPN) tunnel that is mutually authenticated between the aircraft satellite terminal and the Inmarsat ground infrastructure utilising an Inmarsat (PKI) solution
- SB-S ACARS Ground Gateways may now be configured in two ways:
  - As an AGGW gateway, as part of the SB-S 1.0 service, supporting SB-S 1.0 terminals
  - As a GDGW gateway, as part of the SB-S 2.0 service, supporting SB-S 2.0 terminals such as the Cobham Aviator S and Honeywell Aspire 400, providing PKI VPN tunnel authentication between the terminal and the GDGW
- Additional security controls are being applied to the SB-S 1.0 and SB-S 2.0 gateways
  - COTS VPN is established between SB-S 2.0 GDGWs and CSP networks
- SB-S 2.0 service expected to become available end 2020 (subject to confirmation)
Cobham SB-S 2.0 Terminals

The Cobham Aviator S series of terminals support the enhanced security VPN for ACARS and PS voice and are being made available line-fit on Airbus and Boeing aircraft

- **Aviator 200S**
  - 2 MCU terminal operating with Enhanced Low Gain Antenna (Class 4), or HELGA
  - Single SwiftBroadband RF channel

- **Aviator 700S**
  - 2 MCU terminal with 2 MCU HPA and DLNA, operating with High Gain Antenna (Class 6)
  - Dual SwiftBroadband RF channels
Honeywell SB-S 2.0 Terminals

The Honeywell Aspire 400 series of terminals also support the enhanced security VPN for ACARS and PS voice and are being made available line-fit on Boeing aircraft

- **Aspire 400**
  - 2 MCU terminal operating with Enhanced Low Gain Antenna (Class 4), or HELGA
  - Single SwiftBroadband RF channel
  - 2 x 2MCU terminal operating with Intermediate Gain Antenna (Class 7)
  - Dual SwiftBroadband RF channels
  - 2 x 2MCU terminal operating with High Gain Antenna (Class 6)
  - Dual SwiftBroadband RF channels
Retrofit & Linefit SB-S

SB-S: Retrofit
Available now

A320/neo
737
767

2021

A320/neo
A330
737NG/MAX
777X

2022

A350

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Iris

- Inmarsat is leading the ESA Iris partnership to enable satellite based ATM in dense continental airspace.
- Iris will support ATN B1 / B2 services in multilink with VDL.
- Flight trials on Airbus and NLR test aircraft validated prototype implementations.
- The service is designed to support the same ATS applications and meeting the performance for VDLm2 (WG-78/SC-214).
- The ground infrastructure is now deployed at Burum and Paumalu. Avionics vendors are implementing the multilink management. Arrangements are being made to equip up to 20 narrow-bodied aircraft for an initial operational service.
- Initially focused on Europe (ATN/OSI), the global infrastructure will enable the service to be supported elsewhere.
- An early implementation of ATN/IPS capability is also planned.
Iris/SB-S 2.0 Architecture with VPN Authentication