Inmarsat Update
for Cross Polar Working Group

Lisa Bee
Director, Air Traffic Services
Inmarsat Aviation
23 Oct 2019
Singapore
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**I-3 to I-4 Transition Complete**

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<th>Timing</th>
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<td>May 9(^{th}) 2018</td>
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<td>Pacific Ocean Region (POR) I-3 to I-4 Asia/Pacific (APAC)</td>
<td>August 29(^{th}) 2018</td>
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<td>Atlantic Ocean Region East (AORE) I-3 services moved from 15.5W to 54W (I-3 F5 satellite)</td>
<td>October 30(^{th}) 2018</td>
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<td>Indian Ocean Region (IOR) I-3 to I-4 Alphasat EMEA</td>
<td>December 12(^{th}) 2018</td>
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The resulting network configuration consists of three I-4 satellites: 4F1 (APAC), 4F3 (AMER), AF1 (EMEA), and; one I-3 satellite, 3F5 (AORE).
Map depicts Inmarsat’s expectations of coverage, but does not represent a guarantee of service. Availability of service at the edge of coverage areas fluctuates depending on various conditions.
Blue indicates operators avionics still using I3 satellite identifiers in Owner Requirements Tables (ORT)

Orange, those using I4 identifiers
NAT Coverage and Satellite Availability

• Inmarsat safety communications services are predicated on single satellite coverage.

• Since 1999, Inmarsat has always exceeded annual availability requirements of 99.9%*
  – Space segment availability from 2014 through 2018 was better than 99.99% per year for
    Inmarsat-3s and 99.99% per year for the Inmarsat-4s, with the exception of 2018, when
    the availability was 99.9%.

• Airbus are delivering two L-band/Ka-band satellites.

• The first Inmarsat-6 satellite is scheduled for launch in 2020; the second in 2021.

• The I-3 F5 satellite is not planned for decommissioning before December 2021, and after the
  two new I-6 satellites have entered commercial service.

• The I-6 satellites are intended to fully complement the I-4 satellite coverage in order to provide
  extensive satellite coverage for the NAT airspace.

*In accordance with reporting requirements established by IMO Resolution A.1001(25)
A programme of GES upgrades was put in place to support the I3 to I4 migration

Validation of new activation and provisioning enhancements (as part of Laurentides GES s/w build) — Completed

GES software upgrade 9.1.1: Laurentides, Perth, Burum, Fucino, Paumalu — Completed

Updates to support SATVOICE VoIP Service — Completed

Enhanced T-channel resource management — Contracted, due for delivery Q4

Planning to enhance the Radio Frequency System (RFS) at Fucino before the end of the year

Planning to re-host Paumalu, Fucino, Burum and Perth on new hardware
Evolving SATVOICE Capability

- SATVOICE for Routine ATS Communication & LRCS Voice
  - FAA trials and Safety Risk Management Panel
- SATVOICE VoIP Service
  - New secure one step VoIP fast G2A dialling service
  - New A2G service offering Caller Line Identification (CLI) and Priority calling (P-digit) to selected destination addresses
  - Enabler for Direct Controller Pilot Communication (DCPC)
- Nav Canada and Civil Aviation Authority Singapore
SATVOICE over PSTN

2-stage ground-to-air dialup for security

- Communications present the most significant constraint to reduced separation minima

> 30 seconds GTA call setup time
SATVOICE VoIP Service

- Fast satellite voice today with current Classic Aero network & equipage

≈ 15 sec GTA call setup

- Enables direct controller pilot communications

- Enables tactical intervention

Dial AESid

For selected destination numbers deliver CLI and P-digit to VoIP circuit

1-stage secure dialler (VoIP)

VoIP

ANSP

Inmarsat Voice Switch

CSP

SSP

RF

CS
(Classic and SB5)
SB-Safety Aircraft in Operation

- SB-Safety entered commercial service on 17 April 2018
- Now in use on over 50 aircraft using Cobham Aviator 300D or 350D SB-Safety terminals

~20 a/c operating with FANS/ACARS
  - Hawaiian Airlines
  - United Airlines
  - Shenzhen Airlines
  - 2 Business jets
  - VVIP aircraft

- All with excellent satcom datalink performance
SB-S 1.0 ADS-C Data from 1 June 2017 to 2 September 2019
SB-Safety Aircraft and Terminals

- Airbus committed to SB-Safety as a line-fit offering on new A320/A330/A350 aircraft, in service circa 2020
  - Airbus selected Cobham as a supplier for their Lightweight Cockpit Satcom programme
- Boeing committed to SB-Safety as a line-fit offering on new 777X and 737 MAX aircraft, in service circa 2020
  - Cobham and Honeywell providing the SB-S terminals
- Cobham and Honeywell production terminals due to be available in 2020
  - Will include VPN security layer, PKI operations
- Avionica lightweight, cost-effective terminal for retrofit market due to be available in 2020
SB-Safety Programme Status

- SB-S ACARS Ground Gateways may now be configured in two ways:
  - As AGGW as part of SB-S 1.0 service, supporting terminals such as Cobham Aviator 300D
  - As GDGW as part of SB-S 2.0 service, supporting terminals such as Cobham Aviator S and Honeywell Aspire 400, providing PKI VPN tunnel authentication between the terminal and the GDGW

- Additional security controls being applied to AGGW (SB-S 1.0) gateways

- SB-S 2.0 service expected to become available in H1 2020
SB-Safety Service and Enhancements

- SB-Safety gateway upgrade August 2019
  - AGGW upgrade (Functional and Security enhancements) deployed at Burum and Paumalu

- SB-Safety ACARS Gateway at Beijing SAS
  - AGGW undergoing integration and test
  - First ACARS g-t-a & a-t-g messaging between a test bench terminal and ADCC GMP passed – end August

- PBCS RCTP Assessment
  - ADS-C data presented to ICAO SAT-PT as contribution to new SATCOM SARPS developments showing compliance with DO-350 message latency targets
  - Initial CPDLC timing analysis from Hawaiian Airline A321 neo data (thanks to HAL for pioneering this work)
**PBCS RCTP Assessment**

**INITIAL A321neo SB-S UPLINK FANS/ACARS CPDLC message delivery timing AGGW to SDU (5 – 1)**

**Conditions:**
- All A321neo data from Jan 1, 2018
- Cobham Aviator 350D (HGA)
- FANS/ACARS messages
- Pacific transoceanic routes (AMER and APAC)
- One a/c known to have RF issue during this period
- Data could include test transmissions
- Only uplink transactions that have an associated downlink (i.e involving pilot response) have been analysed (1,675 records)
- CPDLC data cleansed for unrealistic delivery times; any delay less than the minimum Gateway-Satellite-Aircraft delay, have been removed

**Note:** RCP 130 and 240 RCTP network allocations also include terrestrial CSP (CNP) latency. These charts only show SSP message latency.
PBCS RCTP Assessment

INITIAL A321neo SB-S DOWNLINK FANS/ACARS CPDLC message delivery timing SDU to AGGW (4 – 6)

Conditions:

• All A321neo data from Jan 1, 2018
• Cobham Aviator 350D (HGA)
• FANS/ACARS messages
• Pacific transoceanic routes (AMER and APAC)
• One a/c known to have RF issue during this period
• Data could include test transmissions
• Only uplink transactions that have an associated downlink (i.e. involving pilot response) have been analysed (1,675 records)
• CPDLC data cleansed for unrealistic delivery times; any delay less than the minimum Aircraft-Satellite-Gateway delay, have been removed

Note: RCP 130 and 240 RCTP network allocations also include terrestrial CSP (CNP) latency. These charts only show SSP message latency.
Iris Programme Update
Fundamental Drivers for EU Continental Aeronautical Satellite Communications

**EU Airspace Today**
- <1 billion passengers
- <5,000 Air Transport Aircraft
- <10 million flights/yr

**EU 2025:**
- +300 million passengers
- +30% fleet growth
- +45% air traffic growth

VHF Voice and Data Networks are congested and in some cases saturated. Cannot sustain long term air traffic growth, modernisation and trajectory-based ops.

Continental SatCom use will complement VHF voice and data networks, providing the capacity needed to support air traffic growth & modernisation into 2030’s.

Trajectory-Based Operations will enable optimised flights in terms of time and fuel burn, reducing delays and CO2 and allow increase end to end capacity.

Satellite has been recognised as a key contributor to the modernisation of European ATM.
Iris Objectives

- Public-Private Partnership initiated by the European Space Agency in 2011 to enable continental satellite communications, based on SB-S and IP services for Air Traffic Management as an alternative to congested VHF channels.

- Iris IOC started in 2018, with an objective to move from demonstration to implementation, validation and operations

- Existing VHF Datalink System (VDL M2) is saturated and is forecast to reach capacity limits around ~2025. Iris will compliment VDL and will bring additional capacity in the near term, while also preparing for the long-term transition to multilink.

- Enable the transition to a global standard with preparation of ATN/IPS that would allow airlines to have seamless Satcom based ATM connectivity and service worldwide

- Support and complement the SESAR project’s vision for efficient ATM which heavily relies on data link services and the Future Communications Infrastructure (FCI) to enable the core concepts such as Trajectory Based Operations.

- Enable new users to access the aeronautical communications infrastructure, in particular Remotely Piloted Aircraft Systems (RPAS), General Aviation, military and helicopters.
Initial Operational Capability (IOC)

Security Extensions
ATN/OSI MultiLink
IOC Service Provision and Certification
Initial ATN/IPS
IPS Design
Commercial Service (AOC, EFB)
System I&T
Flight Trials

Future Operational Capability (FOC)

FOC System Requirements, System Analysis & Design
Pre-Development
Pre-Development I&T
V&V Tools Development
System V&V
FOC ATN/IPS Design and Implementation

Project Wide Activities
System Safety, Business Case, Marketing + Stakeholder Engagement (incl SESAR), Coordination with SESAR
Thank you!

Lisa.bee@Inmarsat.com