

ISPACG/32, Nada Fiji, 10-12 April 2018

INMARSAT UPDATE ISPACG/32 APRIL 2018 q

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> inmarsat aviation





INMARSAT AVIATION





SOS: Classic Aero & SB-Safety

Worldwide safety and operations to the cockpit using the L-band with premium reliability



Global Xpress

Seamless, superfast broadband available globally. Unconstrained Ka-band ideally suited to larger, long haul aircraft with global cabin connectivity requirements

European Aviation Network

A regional complement to GX. S-band satellite and complementary ground network over EU 28 states to meet the need across high traffic areas and airport hubs –ideal for **short/medium haul** aircraft

Proven networks and continued investments to ensure capacity and quality of service meets airline needs now – and in the future





GLOBAL, INTEGRATED, FIT-FOR-PURPOSE NETWORKS ENABLE THE CORRECTLY CONNECTED AIRCRAFT

Inmarsat Aviation is the only owner & operator of both L-band and K-band MSS







THE FUTURE OF THE CONNECTED FLIGHT DECK FOR AIRLINE OPERATIONAL EFFICIENCY ADVANTAGES

The Connected Aircraft will enable better real-time decision making, better situational awareness, the ability to diagnose situations in real-time and even the potential to intervene. IP-based flight data streaming offers day to day operational benefits alongside improvements in safety and flight data recovery.







The connected aircraft revolution



- > An A380 generates 4 GB of data per flight
- > A B787 generates up to 500 GB of data per flight

= Up to 30TB of data per aircraft per month (10,000 x more than current generation)



INMARSAT I3 – 20+ YEARS OF SERVICE

- Launched 1996-98
- Built by Lockheed Martin, Matra Marconi Space Payload
- Thousands of GMDSS Distress Calls carried
- Hundreds of millions of ADS-C messages carried
- 4x increase in NAT capacity, estimated \$3Bn saved by airlines in fuel, reduced CO2
- 3 of 4 I3s now approaching EOL, transitioning traffic to I4 constellation



CONSTELLATION UPDATE

102

		8 8
IN FLIGHT		
INMARSAT-	3 Five satellites launched 1996-98	
INMARSAT- L-BAND	4 Four satellites launched 2005-13	
	F1 F2 F3 F4 (ALPHASAT)	
INMARSAT-	5 Three satellites	
KA-BAND	launched 2013-15	
	FI	
	F2 F3	
PLANNED		
INMARSAT- KA-BAND	5 F4	
EAN SATELLI S-BAND	re	
INMARSAT- L- AND KA- BANDS	5 F1 F2	

Extract from Inmarsat PLC Annual Report and Accounts April 2017

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Expected operational life

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TRANSITION TO THE 14 CONSTELLATION

- The first stage of the service migration will take place at the end of Q1 this year.
- Classic Aero has operated successfully over our I-4 satellites since 2009 and I4 is now the predominant carrier of FANS data
- Our primary objective is to ensure that the transition process is simple and seamless for our service providers and end-users.
- We have been working closely with terminal manufacturers to ensure that terminals can operate over the I-4 satellites with the minimum of user intervention.





13 TO 14 TRANSITION SCHEDULE

The migration will take approximately 9 months to complete, commencing end of Q1 18. Our approach is to migrate these services satellite-bysatellite, starting with AOR-W

Our primary objective is to ensure that the transition process is simple and seamless for our service providers and end-users.

Please work with your terminal supplier to keep up to date with all Service Bulletins and Service Information Letters, which will advise on any necessary actions.







CAPACITY INCREASES, GES UPGRADES & ENHANCEMENTS (1/2)

- 22nd November 2016: New frequency plan implemented on 3F1 IOR GES, adding an extra R600 channel
- 25th January 2017: Extra two T1200 channels in EMEA, plus two for APAC
- GES upgrades to v9.0.8: 6th June Paumalu, 8th June Fucino, 12th June Perth, 14th June – Burum
- 12th July: Extra R10.5k channel added to APAC at 09:53 UTC
- 18th July: Extra R channel added to APAC at Paumalu
- 25th July: Extra R10.5k channel activated in AMER and APAC
- 11th August: Reconfigured T600 & T1200 channels in AMER and APAC



CAPACITY INCREASES, GES UPGRADES & ENHANCEMENTS (2/2)

Air-to-Ground Caller Line Identification (CLI): In response to ground voice network operator and ATS demand, following positive trials in Aug 17 Inmarsat enabled Classic GESs to deliver CLI. Objective(s):

- Less call failure due to CLI omission
- Ability to identify aircraft calling
- Supports rapid ground to air contact for future CONOPS further information]

GES upgrade 9.0.9: 27th Nov through 7th Dec



[See AC20-150B and ICAO Doc. 10038 'Satellite Voice Operations Manual' for

CLASSIC AERO: ADS-C SURVEILLANCE SERVICES ~135,000 ADS-C REPORTS EVERY DAY: ~ 50,000,000 ADS-C REPORTS PER YEAR



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Current ADS-C Reporting Rates from 30' to 64" Multiple Inmarsat initiatives to support reduced oceanic separations with ADS-C surveillance I4 constellation predominant carrier of FANS data

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ADS-C CAPABILITY AND PERFORMANCE*

Coverage: Global and airline AOC Integrity: communication capability • Update rate: **Reliability:** 99.9 Availability: 99.9

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- Accuracy: GPS position derived information transmitted to ATC facilities
 - Built-in conformance monitoring system based on two-way
 - Current aircraft avionics are certified to provide updated position reports as frequently as every 64 secs. Technically capable to provide every second.

*PBCS will monitor aircraft operational function



Satellite Communications Performance

- Slant range
- Total distance travelled by message
- Number of network nodes
- Processing time









LEO NETWORK

Air	
TCAS ANT	





Ground



*Boeing example. Airbus similar





Longitudinal separation minima for RNP-4 and RCP 240

Published: ICAO Doc 4444

Longitudinal	Surveillance	Other
50 NM	ADS-C	ADS-C
30 NM	ADS-C	ADS-C
15 NM CDP	ADS-C	ADS-C I

ICAO SASP developing: values may change with new collision risk modeling

Longitudinal	Surveillance	Other
20 NM*	ADS-C \approx 5 minutes	New air
< 20 NM**	ADS-C \approx (4 min to 64 sec)	New air
16***	ADS-B \leq 60/15 sec + ADS-C	New air
14 NM***		14 NM f
		airspace
		extent c

*SASP WG30/WP27 ** SASP WG30/Action Item 23 ***SASP WG30/WP09



- periodic reports each 32 minutes. RCP 240
- periodic reports each 12 minutes. RCP 240
- near simultaneous demand reports. RCP 240

- space monitoring criteria. New RCP 240 communication model.
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- for airspace with little convective weather: requires additional, more stringent e performance criteria for lateral deviation events (# or % deviation events and of deviations).





Lateral separation minima for RNP-4 and RCP 240

Published: ICAO Doc 4444, 5.1.4.2.1.6.b

Lateral	Surveillance	Other
23 NM	ADS-C/RSP180	5 NM LDE

Under SASP development, values may change with additional collision risk modeling:

Lateral	Surveillance	Other
22 NM*	ADS-B \leq 60 secs, ADS-C/RSP180	
16 NM		16 NM for a airspace per extent of de

* ICAO SASP WG30/WP19 ISPACG/32, Nada Fiji, 10-12 April 2018



conformance monitoring. RCP 240

E conformance monitoring.

pace monitoring criteria.

P 240 communication model (allocations based on observed nce)

airspace with little convective weather: requires additional, more stringent erformance criteria for lateral deviation events (# or % deviation events and leviations).



SEPARATION STANDARDS SUMMARY

- GEO satellite system performance (latency, update rate, link budget, capacity, availability) compares favorably to LEO satellite systems.
- Much of the anticipated benefit in terms of reduced separation from ASEPS derives from requirements such as airspace monitoring, airspace performance, and external system configuration.
- Benefits from ASEPS minima can be achieved with either spacebased ADS-C or ADS-B to provide operators and ANSPs options that best fit different operational and business models.







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INMARSAT ADVANCED OCEANIC AIR TRAFFIC SERVICES









- Increased airspace capacity
- Increased safety
- Reduced fuel consumption
- Optimised air corridor usage taking weather and traffic into account
- Extended visibility beyond FIR boundaries (multiple ANSP regions)
- Short Timescales for uptake ~ No equipage change, minimal touch
- Longer-term ~ SB-S equipage for advanced lightweight, cost-effective, proven surveillance and satellite communications capabilities



INMARSAT ADVANCED SURVEILLANCE

- Dynamic ADS-C position reports, e.g., 10min, 3min, 2 min, 64 sec (Classic Aero) \bullet
 - Dynamic ADS-C reports down to 15 sec (SwiftBroadband-Safety)
- Global Tracking Database Real-Time Tracking Information for ANSP & Operators \bullet
- Direct Controller Pilot Communications (Sat Voice) at <15sec intervention time •
- Subscription based flat-fee cost enabling predictable cost
- Supported by all existing Inmarsat Classic and SB-S equipped aircraft \bullet
 - Installed on +90% of transoceanic flights



HOW MUCH DOES IT COST?

- Inmarsat customers subscribe to a bundled service that supports all aircraft communications needs: AOC ACARS, CPDLC, ADS-C, Sat Voice, etc.
- ADS-C position reports are very small and use a small proportion of total data
- The average Atlantic crossing requires that aircraft provide position reports using SatCom for approximately 3 hours included in communications bundle



SB-S - HIGH SPEED, HIGH VOLUME COMMUNICATIONS

SwiftBroadband-Safety



kbps

31

kbps

10.5

kbps

2.4

kbps

0.3

Classic Aero

VDL

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FANS 1/A OVER SBB EVALUATION – PROGRESS SINCE DLUF (SEPT 17)

- Hawaiian FANS Evaluation eight B767, continued good performance overall. Two A321 neo now in operation, one in scheduled service
- United Airlines FANS installs (3 of 4 complete)
 - Three B767 aircraft now in operation mainly on NAT, fourth awaited. Good performance
- Two Shenzhen A320s operational began June/July, 2017: 'ACARS over SBB' – good performance
- Two Shenzhen Boeing 737 AOC ACARS planned



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olete) NAT,











INMARSAT I4 NETWORK SUPPORTING SB-SAFETY



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internetworking

ADCC ACARS processing



HAL B767/RC IMS (ARINC) PBCS PACIFIC REGION RCP & RSP MONITORING REPORT (2 YEARS)

PBCS Monitoring Report					
Region ->	Pacific	Period \rightarrow	Multiple		
		RCP			
Specification \rightarrow	RCP 240	Application \rightarrow		CPDLC	
Colour Key		95% RCP 240 benchmark		99.9% RCP 240 benchmark	
Meets Criteria >	Transaction Counts	АСР	АСТР	АСР	АСТР
Under Criteria but above 99.0% →	(WILCO Received)	<=180 sec	<=120 sec	<=210 sec	<=150 sec
Under Criteria ->		End-to-End	Network	End-to- End	Network
	ANSP/Co	ntrol area (CTA)			
FAA OAK (KZAK) July to Dec 2015	447	>99.5%		>99.5%	
FAA OAK (KZAK) Jan to June 2016	1901	>99.0%		>99.0%	
FAA OAK (KZAK) July to Dec 2016	2170	>99.0%		>99.0%	
FAA OAK (KZAK) Jan to June 2017	2235	>99.0%		>99.5%	
JCAB Fukuoka (RJJJ) Jan to Jun 2016	e 211	99.53%	100%	99.53%	100%
JCAB Fukuoka (RJJJ) July to De 2016	c 199	100%	100%	100%	100%
JCAB Fukuoka (RJJJ) Jan to Jun 2017	e 188	98.94%	99.47%	99.47%	100.00%



Regional PBCS Monitoring Report - RSP						
Region →	Pacific	Period →	Multiple			
RSP						
Specification →	RSP 180	Application \rightarrow	ADS-C			
Colur Key		95% RSP 180 benchmark	99.9% RSP 180 benchmark			
Meets Criteria ->	Report	ASP	ASP			
Under Criteria but above 99.0% →	Counts	<=90 sec	<=180 sec			
Under Criteria ->		End-to-End	End-to-End			
	ANSP/FIR - July	to December 2015 (C	NG 35)			
FAA OAK (KZAK)	9467	97.0%	99.0%			
FAA Auckland (NZZO)	325	>98%	>99.0%			
FAA Boeing (ACAT)	26543	>99%	>99.0%			
FAA Fukuoka (RJJJ)	1134	>99%	100.0%			
	ANSP/FIR - Jan	uary to June 2016 (CV	/G 36)			
FAA OAK (KZAK)	32830	>97.0%	>99.0%			
FAA Auckland (NZZO)	711	>98%	>99.0%			
FAA Boeing (ACAT)	76288	>99.0%	>99.0%			
FAA Fukuoka (RJJJ)	3755	>99.0%	>99.0%			
	ANSP/FIR - July	to December 2016 (C	NG 37)			
FAA OAK (KZAK)	53226	>96.0%	>98.0%			
FAA Auckland (NZZO)	990	>97.0%	>99.0%			
FAA Boeing (ACAT)	78866	>99.0%	>99.0%			
FAA Fukuoka (RJJJ)	4965	>99.0%	>99.0%			
ANSP/FIR - January to June 2017 (CWG 38)						
FAA OAK (KZAK)	60062	>96%	>98.0%			
FAA Auckland (NZZO)	Null	Null	Null			
FAA Boeing (ACAT)	N/A	N/A	N/A			
FAA Fukuoka (RJJJ)	4472	99.49%	99.82%			

REMINDER: LATENCY TIMING POINTS





OPERATOR/AIRCRAFT TYPE





AIRCRAFT FLIGHTS OPERATING AOC ACARS OVER SWIFTBROADBAND – INTEGRAL POSN REPORTING



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• Aircraft not operating FANS ADS-C are monitored using integral posn reports





FANS 1/A OVER SBB RECOMMENDATIONS

Comment period closed on Feb 12th, comments being reviewed.

Recommendation 1:

That the FAA accepts FANS 1/A over SwiftBroadband as a viable medium for FANS 1/A operations in airspace which require application of RSP 180 and RCP 240 for reduced aircraft separations.

Recommendation 2:

That the FAA consider advocating internationally, that aircraft using the SwiftBroadband sub-network are eligible for operations that require compliance to CPDLC RCP 240 and ADS-C RSP 180 specifications supporting reduced separations.











INMARSAT DESIGNED, OWNED AND OPERATED



nmarsat M2MAP: Operating normally



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