Dual Satellite Simultaneous Service

Certification Considerations

Presented to: 2018 iCNS
By: Dave Robinson
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Overview

Safe, efficient air travel requires reliable communications. Historically, HF has been recognized as the long-range communication system (LRCS). However, satellite communications now offer alternate solutions for LRCS, (SATCOM) has been recognized as a viable complement/supplement/alternative to HF.
Scope

This discussion offers a description of challenges implementing and operating dual satellite communication systems and certification considerations.

• The first consideration is as a fully equipped Supplement/Complement/Alternate capable of both safety of flight and regularity of flight voice and data communications and

• The second consideration is to offer SATCOM as Routine vs. Emergency communication
AMS(R)S communication by Satellite Service Providers are capable of sending ATS and Regularity of Flight Communication operating under Federal Aviation Regulations Part 121 and 135 for data and voice communication equipage and service for LRCS. This includes large transport type aircraft and smaller regional type aircraft, which currently have 2 HF radios for procedural/oceanic airspace.
Safety/Security Consideration

- Dual Satellite Simultaneous Service considers the **primary** Satellite system will be used for **routine** ATS communication.

- The second Satellite acts as an active redundant, secondary, supplement or alternate system capable of **Prioritization, Pre-emption** and **Precedence (PPP)**.
Rationale for Dual SATCOM

Support for the use of **NGSS** as a full complement, supplement or alternative of HF systems:

- HF systems are complex, heavy, consume a lot of electrical power, cooling and space
- HF systems are time consuming to install, and prone to installation issues
- HF performances effects: Propagation, interferences, congested spectrum, atmospheric noise (ionosphere formation, solar eruptions)

**NGSS INMARSAT/IRIDIUM offer:**

- Current Aircraft are equipped with one Satcom System today
- Reduced equipment footprint (Avionics, Antenna and Cabling)
- Improved performance (QoS), (RCTP)
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<tr>
<th>Regulation</th>
<th>Description</th>
<th>Requirement</th>
<th>Discussion</th>
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<tbody>
<tr>
<td>CFR Title 14, Part 25.1307(d)</td>
<td>Two communication systems, separate antennas or common antenna acceptable if reliable.</td>
<td>Two Independent Long Range Communication Systems (LRCS)</td>
<td>“Independence”</td>
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<td></td>
<td></td>
<td>Two Independent Antennas/reliable single antenna</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Bus bar power supply</td>
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<td>Part 121.99</td>
<td>Two-way communications with ATC and AOC over entire route.</td>
<td>No holes in coverage on qualified routes</td>
<td>ATC and AOC</td>
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<td></td>
<td></td>
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<td>Distinction is made between “Flight Crew” communication and “Certificate Holder” communication services, see FAA AGC “Rule Interpretation” Memo dated, Dec 6, 2011</td>
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<tr>
<td>Part 121.122</td>
<td>SATVOICE required for ETOPS&gt;180min</td>
<td>Supports voice</td>
<td>Voice vs ACARS Data see FAA AGC “Rule Interpretation” Memo dated, Dec 6, 2011</td>
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## Regulatory Compliance cont.

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<th>Regulation</th>
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| ICAO Annex 10, Vol II, paragraph 4.4.1.1.3 and 4.4.1.1.5 | Message Categories and Priorities | Air ground communications that include the conditions contained to support flight safety and regularity “messages prioritization”.

| FAA AC 20-150B, Section 6.1.2 | Airworthiness Approval for Satellite Voice Equipment Supporting ATS Communication | Note: Some **ATS facilities** may not be capable of providing SATVOICE services. In areas requiring one LRCS, that system **must be HF-voice**. |

<p>| FAA, AGC Memo, 2011 | Interpretation as to whether part 121 air carriers can use data communication instead of voice communication | To permit communication systems other than “<strong>radio</strong>” we conclude that 121.99(a) currently allows a certificate holder conducting non-ETOPS domestic or flag operations to substitute <strong>text-messaging</strong> technology in <strong>lieu of voice</strong> communication capability over a route or a portion of a route during <strong>normal operating</strong> conditions. |</p>
<table>
<thead>
<tr>
<th>TSO</th>
<th>Title</th>
<th>FAR</th>
<th>Title</th>
<th>Description</th>
<th>Discussion</th>
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<tr>
<td>C159</td>
<td>Next Generation Satellite System Equipment (NGSS)</td>
<td>121.99</td>
<td>Communication facilities</td>
<td>(b) the communications systems between each airplane and the dispatch office must be independent of any system operated by the United States.</td>
<td>TSO-C159d will support the installation of NGSS for Procedural, Remote/Continental and Domestic ATS and Regularity of Flight Communication.</td>
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<td>121.345</td>
<td>Radio equipment</td>
<td></td>
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<td>121.351</td>
<td>Communication and navigation equipment for extended over-water operations and for certain other operations.</td>
<td>(e) of this section, after February 15, 2008 for ETOPS beyond 180 minutes, each certificate holder conducting flag operations must have a second communication system. That system must be able to provide immediate satellite-based voice communications of landline-telephone fidelity. The system must be able to communicate between the flight crew and air traffic services, and the flight crew and the certificate holder.</td>
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<td>135.165</td>
<td>Communication and navigation equipment: Extended over-water or IFR operations</td>
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Interpretation of Independence

• **ARINC:** A dual Satellite installation operating separately with no or minimal interaction.

• **Airbus:** An architecture in which no single failure of a Satellite can cause the complete loss of Communication

• **FAR Rule:** Systems, Services, Data Types, Redundancy, Performance, Normal/Routine Operations
Potential Technical Solutions

• Dual similar SATCOM (2 Inmarsat or 2 Iridium)
• Dual dissimilar SATCOM (1 Inmarsat and 1 Iridium)

Pros and Cons
• Similar- Offers more bandwidth, the systems may be used in parallel
• Dissimilar- Higher availability due to separate space and ground segments
• Options based on AC and routes (polar) other desired services
Other Technical Solutions

Aircraft Earth Station (AES) integration

- 2 AES fully redundant separate antenna
- 2 AES with shared antenna
- 2 AES dissimilar service providers
- Full ICAO address of given aircraft
- Air-to-Ground and Ground-to-Air voice capability
- Dual domain service capable (ACD-AISD)
- Subnetwork security solution (VPN)
Aircraft Domains

- Air Passenger Communications (APC)
- Aircraft Control Domain (ACD)
- Airline Information Services Domain (AISD)
- Airline Operational Control (AOC)
- Airline Administrative Control (AAC)
- Internet
- Airline IP-VPN
- ACARS
- Air Traffic Services (ATS)
- Aircraft Control Domain
- Airline Operational Control
- Airline Administrative Control

- IFEC
- Passenger Information & Services Domain (PIES)
- GX for Aviation
- Safety
- Operation
- Security & Reliability Benefits
- SB-S
Example Configurations

Figure 1  Aircraft Radio Configurations
SATCOM Propagation

• Inmarsat L-band satellite communication signals operate using **Bent Pipe** technology while Iridium utilizes **Mesh Network** technologies, with LoS and BLOS propagation mode.

• Direct path between the aircraft satellite antenna and ground station. The satellite link passes through both the **troposphere** and the **ionosphere** unlike HF which bounces off the ionosphere.
SATCOM Propagation
Ionosphere’s RF Propagation
Way Forward

Actively work with authorities to promote the necessary regulatory changes:

- Regulatory Interpretation
- Oceanic Control Area FIR’s and ANSPs
- ICAO SARPS/TM/SUPPs
- FAA/EASA TSOs and ACs
- State Authority Guidance
- Provisions in RTCA MOPS/MASPS
- Security solution
- Supports ATN/IPS and Legacy applications
Questions?

David Robinson
Email:  David.W.Robinson@faa.gov
Phone:  202.267.9057

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