A Layered Approach to Provide Truly Global Inflight Connectivity

Multi-Orbit, Multi-Band Solutions

SUMMARY

The aviation industry is entering a new era of digital transformation, driven by the increasing passenger expectations and operational demands for seamless, high-performance, truly global connectivity. Traditional single-orbit, one network fits all solutions are no longer sufficient to meet these needs. A multi-orbit, multi-band inflight connectivity provider like Gogo offers a future-ready, layered approach – delivering superior performance, truly global coverage, and redundancy.

This whitepaper explores the technical and operational advantages of multi-orbit, multi-band solutions, considerations for choosing a solution, and outlines how aircraft owners and operators can unlock greater value by partnering with a provider that supports this flexible, layered approach.

INTRODUCTION

Passengers today expect the same level of connectivity in the sky as they do on the ground. Owners and operators are also increasingly dependent on real-time data for operational efficiency, from flight tracking and weather updates to predictive maintenance and crew communications.

However, inflight connectivity is challenged by dynamic variables: global flight paths, varying bandwidth requirements, latency-sensitive applications, and weather-related interference. The answer lies in leveraging multiple satellite orbits and frequency bands, creating a highly adaptable, reliable system.

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USER EXPERIENCE AND CONSIDERATIONS

Replicating the seamless connectivity experience of home or office environments in an aircraft poses unique challenges. Factors such as latency, capacity, and service consistency must be carefully considered. Supporting and securing these networks and understanding the nuances of each is important as well.

- **Latency:** The time it takes for data to travel between the aircraft and the ground. GEO satellites have the highest latency, while LEO and MEO offer lower latency.
- **Capacity:** The amount of bandwidth available for onboard applications. Bandwidth demands are increasing, driven by applications like video streaming and conferencing.
- **Service Consistency:** Maintaining uninterrupted connectivity during flight, despite satellite transitions and beam changes.
- **Supportability:** Proactive monitoring, connectivity forecasting and 24/7 support is fundamental to any challenge that may arise.
- **Security:** Data privacy and anonymity should be taken into consideration. Service providers should be transparent with how they protect your traffic.

Internet Speed vs. Bandwidth: What's the Difference?

Internet speed and bandwidth are related but are different measurements of connection quality. These terms seem synonymous but are often confused. Speed refers to the maximum rate you can transmit data, typically measured as megabits per second (Mbps). Bandwidth refers to the maximum amount of data your connection can handle at any moment, also measured as Mbps. A true measure of internet performance has to do with throughput.

UNDERSTANDING MULTI-ORBIT AND MULTI-BAND CONNECTIVITY

Multi-Orbit Defined

A multi-orbit approach integrates connectivity from satellites in different orbital planes:

Geostationary Earth Orbit (GEO)	
Pros	Wide coverage with fewer satellites, consistent connectivity, lower implementation and maintenance costs, optimal for dedicated regional capacity.
Cons	Higher latency, limited coverage in far northern and southern latitudes.
Medium-Earth Orbit (MEO)	
Pros	Balances coverage and latency, fewer satellites than LEO, complete global coverage.
Cons	Requires more satellites and ground stations than GEO.
Low-Earth Orbit (LEO)	
Pros	Lowest latency, global coverage, the latest advancements in technology due to the low-lifespan of satellites.
Cons	Requires a large number of satellites, complex implementation and maintenance, inter-satellite links needed for trans-oceanic coverage.

Multi-Band Explained

Using multiple frequency bands enables the system to dynamically adapt to bandwidth, performance, and weather conditions:

- ***Frequency Bands:***

  L-band: Reliable for cockpit communications, even in adverse weather.

  Ku-band and Ka-band: High-bandwidth for data-intensive applications.

Together, a multi-orbit, multi-band architecture ensures connectivity wherever and whenever it's needed, optimized for both performance and reliability.

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KEY BENEFITS OF A LAYERED APPROACH

1. **Truly Global, Uninterrupted Coverage**
   With access to multiple orbits, connectivity can seamlessly transition between satellites, avoiding coverage gaps – even over oceans, polar regions, or countries with strict regulations. This ensures service continuity on long-haul and transcontinental flights.
2. **Enhanced Redundancy and Resilience**
   If one network or frequency band becomes congested or experience interference (e.g. weather degradation), the onboard system can automatically switch to an alternative. This intelligent failover capability dramatically reduces service interruptions.
3. **Optimized Performance for All Use Cases**
   Passenger streaming, crew communications, cockpit data sharing, and aircraft telemetry each have different bandwidth and latency needs. A multi-band, multi-orbit solution dynamically advocates the best path for each application, enhancing quality of service.
4. **Operational Efficiency & Cost Control**
   Real-time aircraft monitoring, predictive maintenance, and enhanced crew connectivity reduce operational costs and delays. The ability to balance bandwidth loads across multiple networks also enables better cost management and flexible pricing models.

GOGO'S VISION AND RECOMMENDATIONS

Gogo's vision is to enable the digital transformation of flight operations by providing consistent, high-performance truly global airborne connectivity. To achieve this, we recommend a layered approach that combines multiple satellite constellations, and frequency bands. This unique offering of capabilities brings:

- Seamless network integration with automatic switching
- Global infrastructure partnerships to support all bands and orbits
- Proven service reliability and aircraft STCs
- End-to-end solutions, from antenna systems to software-defined network management

Throughput: An Easy Analogy

Think about driving, bandwidth is the highway, and cars are the data. The more cars on the highway, the more traffic. This traffic and the speed in which the cars are moving is "throughput". Regardless of the traffic, the speed limit of the highway doesn't change.

If you're on a video call, you might notice the quality degrade as someone begins streaming a movie. As different applications and services require different amounts of data, performance may vary as well. Essentially, throughput is the actual amount of data that is successfully transferred from one point to another in a given amount of time.

CONCLUSION: BUILDING THE FUTURE OF CONNECTED AIRCRAFT

The future of airborne connectivity will be shaped by advancements in satellite technology and evolving user demands.

- Software-defined satellites will enable dynamic allocation of capacity.
- Inter-satellite links in LEO constellations will improve trans-oceanic coverage.
- Airborne terminals will continue to evolve, with a focus on modularity and compatibility with future satellite designs.

Gogo is committed to delivering future-proof connectivity solutions that meet the needs of the aviation industry. By adopting a layered approach and embracing technological advancements, we aim to provide seamless, secured, high-performance airborne connectivity for years to come.

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