For many years, airplanes have been the last frontier of the satellite industry. While demand for In-Flight Connectivity (IFC) has never been higher, finding a sustainable business model has been challenging. The numerous technical, regulatory and financial hurdles are daunting, particularly as the gap between user expectations and today’s reality continues to widen. Fortunately, there are some disruptive new technologies on the horizon that promise to change the game.

First-generation IFC systems were largely based on legacy technologies, adapted to the airborne environment. While these early solutions proved that IFC was technically possible, their low efficiency and poor performance often resulted in an unsatisfactory user experience and high bandwidth costs.

Panasonic Avionics Corporation is an industry pioneer, with a long-term vision. Based on its decades of experience with In-flight entertainment, Panasonic understands that delivering a great user experience requires purpose-built technologies, optimized for the unique aero environment.
**New Satellites Need New Modems:**

In many ways, the evolution of the VSAT industry is a parallel of the cellular industry. The insatiable need for connectivity, coupled with limited Radio Frequency (RF) spectrum, has resulted in constant pent-up demand and high costs.

In the cellular industry, operators aggressively deployed faster 4G and LTE networks to help meet this demand. However, in order to take full advantage of these new networks, customers also had to upgrade their handsets. There was no benefit to running an old 2G phone on a state-of-the-art LTE network.

The same is true in the satellite world. Panasonic is investing millions of dollars to develop and launch next-generation High Throughput Satellite (HTS) and Extreme Throughput Satellite (XTSTM) networks to deliver unprecedented capacity to its customers. However, in order to realize the benefits of these new networks, a new satellite modem was needed.

The modem is a small, often overlooked, device, but it plays a critical role in the IFC ecosystem. Its primary function is to convert raw satellite capacity (measured in MHz), into usable bandwidth (measured in Mbps). However, the modem also performs several other critical functions, like beam switching, Doppler correction and TV reception.

Leveraging Panasonic’s deep aeronautical expertise and our advanced Newtec Dialog® multi-service platform, we jointly set off to design a next-generation aero modem that would maximize the performance of Panasonic’s new HTS/XTSTM networks while dramatically improving the experience for their customers.

**Next-Generation Waveforms:**

A waveform is essentially a sophisticated algorithm used to convert data into radio waves. The relative yield of this conversion process is known as spectral efficiency.
The resulting ratio of Mbps per MHz is the single most important factor in most satellite business models because it directly impacts the cost and quality of the service.

Spectral efficiency depends primarily on two factors – the strength of the satellite signal and the characteristics of the waveform used. While more efficient antennas and high-powered spot beams increase the signal strength, the waveforms ultimately determine spectral efficiency.

Panasonic’s next-generation modem will support the most efficient waveforms available on the market today. The forward channel (towards the plane) will use the latest Satcom standard, DVB-S2X, which is optimized for HTSs and wide-band transponders. The return channel (from the plane) will leverage Newtec’s advanced Mx-DMA® technology, with Very Low Signal to Noise (SNR) ratio MODCODs. Together, these technologies will deliver more than 50% more data using the same satellite capacity, greatly improving the speed of the service.

**The Doppler Effect:**

The most common manifestation of the Doppler effect is the change in pitch of a passing ambulance siren. As the vehicle moves towards an observer, the frequency of the sound waves increases. As a vehicle moves away, the frequency decreases.

The Doppler effect can impact all types of waves, including radio waves used in satellite communications. As an airplane moves relative to the satellite, these frequency shifts can corrupt transmissions and annoy customers.

Early aero modems took a brute force approach to mitigate the Doppler effect by simply incorporating a margin of error or “guard band” on their transmissions. As long as the frequency shift did not exceed the margin of error, the
signal would survive. The downside of this method is that it required extra satellite capacity, resulting in higher costs and less available bandwidth for customers.

In Panasonic’s next-generation modem, the Doppler effect will be tracked and corrected in real-time. Advanced algorithms will continuously predict frequency shifts and Newtec’s Mx-DMA return technology will compensate every second, resulting in more reliable and efficient transmissions, with less overheads.

**Seamless Beam Switching**

Satellite coverage areas are known as “footprints” or “beams”. As airplanes fly around the world, they often need to switch beams to maintain continuous connectivity. In the past, these beam switches required modems to essentially reboot as they changed settings, interrupting service for several minutes. With the advent of HTSs, the problem will only get worse. Since HTSs use an array of powerful spot beams to provide coverage for long-haul flights, the number of required beam switches (and service interruptions) will increase dramatically.

To mitigate this issue, Panasonic’s next generation modem has three receivers to enable “make-before-break” beam switches. As a plane approaches the edge of a beam, the modem tunes its second receiver to the frequency of the new beam, before losing the first one. Once stable connectivity is established with the new beam, traffic is seamlessly switched and the first receiver is freed-up for the next transition. The third receiver provides even more flexibility, by allowing the plane to simultaneously receive data from two overlapping beams. As an example, this allows Panasonic customers to receive video and data concurrently, using wide beams for video and spot beams for data.
Software Defined Modem

Installing equipment on airplanes is extremely difficult and expensive due to the strict regulations and tight schedules. As a result, Panasonic and Newtec have designed a modem that is fully software defined, using a powerful Field Programmable Gate Array (FPGA). Unlike the more common Application-Specific Integrated Circuit (ASIC) chips, an FPGA ensures that waveforms can be upgraded in the future, without having to replace hardware. In addition to extending the life of the modem, this architecture will also reduce downtime and risk.

Multi-service Platform:

While the focus of this article has been on aviation, one of the most important features of Panasonic’s next-generation aero modem is that it is fully compatible with the Newtec Dialog multi-service VSAT platform. With a diverse modem portfolio and three return technologies, Newtec Dialog will give Panasonic the flexibility to expand into new markets in the future. By combining the most appropriate modems and return technologies,

Newtec Multi-service Platform

Panasonic can competitively address a wide range of applications on the same network, including: maritime, mining and oil & gas. In addition to maximizing economies of scale, this approach also reduces business risks by diversifying revenue streams.

So, What Does It All Mean?

At the end of the day, airline passengers just want reliable broadband connectivity at an affordable price. On the other hand, airlines and IFC
providers want to keep passengers happy while making a reasonable profit. Up to now, satisfying all requirements has been nearly impossible. However, as Panasonic enters into the second and third generations of its IFC technology, it is quickly approaching the tipping point. Soon airplanes will simply be another place where people expect to be connected, without a second thought.

About Kevin McCarthy...

Kevin McCarthy serves as Newtec’s VP of Market Development, specializing in mobile satellite communications. McCarthy has been in the satellite industry for over 15 years. He holds a Bachelors degree from the Johns Hopkins University, a Master’s degree in Computer Information Systems from the University of Miami, and a Master’s degree in Finance from the Florida International University.

Before joining Newtec, McCarthy worked for MTN Satellites Communications, where he served in various roles, including SVP of Network Engineering and most recently CEO. McCarthy started his career at Norwegian Cruise Line, as a
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