In 2017, the first thing an average person does upon waking up in the morning is latch onto a smartphone or tablet. It likely happens even before the first sip of coffee. Many of us, especially business executives, immediately scan the electronic inbox in quest of e-mails that might have arrived during the downtime of sleep. We live in a world of constant connectivity in which being disconnected – even for a few hours to rest – is considered a disadvantage. This need to be continuously connected has gone beyond just a subjective want. Even though a majority of the populace can get by just fine without constant connectivity, for many c-suite executives and governmental leaders, access to time-critical information has become an imperative. Irrespective of actual need, if the end user perceives being connected is a necessity then by default it’s a requirement.

And having unfettered access to the online world is now considered the norm, even when traveling by air. The technological challenges, logistical constraints, and infrastructure are moot to the consumer. They expect the cell phone or WiFi icon to illuminate while on the go – be it in a coffee shop, city park, grocery store, or business jet at 45,000 feet. They don’t care how it works, they just care that it does. What happens behind the scenes is the realm of the experts, like those at SmartSky.

History of SmartSky

SmartSky President Ryan Stone is a leading expert in air-to-ground (ATG). He has a background in nuclear engineering so he’s well-versed in the physics of radio propagation and attenuation.

How he translated his knowledge into business aviation began with Jetpool, LLC (now Davinci Jets) around 2008. An observation revealed that some clients balked when it came to equipping an aircraft with connectivity options. The consensus was that, although WiFi was highly desirable, the cost of installation was only justifiable if the speed was equal or better than that of a home or office network.

Stone’s desire to provide true high speed connectivity led to the formation of SmartSky Networks in 2011. The company is a fusion of aviation and technology and consists of top talent from both industries. Stone’s ultimate vision is to transform aviation through “disruptive communication.” And he intends to accomplish it by using ingenious engineering in a non-traditional way.

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A cabin wireless access point (router) on SmartSky’s network can simultaneously interface with multiple devices over WiFi and adapt to new products as they come online.
Satellite systems have a problem with latency

Since you can’t run a fiber optic cable to an aircraft in flight, connectivity currently requires a satellite or a terrestrial antenna (or network of antennas).

Satellite-based communication is a powerful tool but it has some inherent flaws. The time it takes a signal to travel from one point to another and back is called latency. In other words, it’s the time between when a request is made and when it’s fulfilled. Think of ordering a pizza: latency is the time between when the call is placed and when the pizza actually arrives at the doorstep. A typical latency time for an airborne satellite system is over 500 milliseconds, whereas a home fiber optic connection will come in around 20 milliseconds. A difference of 480 milliseconds may not seem like a lot, but in the world of electrical engineering it’s the difference between waiting for a pizza delivery driver and pulling a slice out of the fridge at home; it’s significant, especially when transferring large amounts of data and when using virtual private network (VPN), the cloud, and corporate servers.

Latency is a function of distance, so a satellite in a high geostationary orbit is already at an operational disadvantage. One way to overcome that problem is reducing the orbital altitude. Unfortunately, a lower orbit induces another negative; the signal (or spot beam) won’t cover as much area. Elon Musk has suggested that the answer is more satellites in low earth orbit. In theory, inundating the sky with satellites increases coverage area and shortens latency. However, this is an expensive endeavor and the ever-increasing amount of satellites and debris orbiting the globe presents its own set of problems.

Alternatively, SmartSky Networks purports it can trim latency to 100 milliseconds using proprietary technology delivered from the ground.

Beamforming is the key to 4G airborne connectivity

According to Stone, communication technology is important but what matters most is spectrum. Since there’s a finite amount available, the only way to optimize efficiency is to reuse what’s there.

SmartSky began the foray into communications by finding a dormant patent application for seamless handover of cellular signals in an ATG network. Today the company holds a myriad of patents and uses beamforming along with LTE-based technology to provide 4G (4th generation) speed on the 2.4 GHz band. If that number sounds familiar, it’s because it’s the one most associated with all WiFi devices (and is categorized as unlicensed by the authorities). The band itself is 83.3 MHz wide and SmartSky uses 60 MHz of it to deliver data. That’s 20 times that of the closest ATG competition.

One of the biggest challenges is sending a signal to and from a Cessna Citation on 2.4 GHz without interference from other devices using the same frequency. These run the gambit from routers to home thermostats. Further, the radio signal must be laser-focused in order to deliver 4G speed – unlike a typical radio wave, which radiates in all directions simultaneously. The solution employed by SmartSky is to use phased array technology – a staple in military communications – modified for civilian use.

In simple terms a phased array system uses a group of small antennas in close proximity to transmit simultaneously. The net effect is that the signal is amplified in a single direction but is canceled in all others. Electronic timing and processing refines the output. Stone touts that the SmartSky Networks methodology can generate 20,000 beams compared to the 63 beams produced by the very best Ka band satellite.

It’s important to note that the ATG beams are completely exclusive in that they’re not being shared with other aircraft. Onboard users can expect the same capabilities as on the ground, including the ability to talk and text using a personal phone and stream video for a conference or entertainment.

Historically, the forward link (from ground to air) of data exchange has been the most troublesome as it typically lags behind the speed of the return link (aircraft to ground). But that is not the case here as the bidirectional capability of the SmartSky system allows data traffic to move quickly off the aircraft – an enormous benefit for trend analysis and maintenance functions. Additionally, there’s no interference with the 2.4 GHz WiFi signal on the ground – a major achievement in itself.

SmartSky believes in making the inflight (customer) portion of its service as simple as possible. By keeping system complexity in the ground portion of their network, they can minimize inflight issues with aircraft equipment that is lightweight.
Low-latency and a high-speed uplink and downlink delivers an uninterrupted stream of data sufficient for video conferencing, live streaming, and connecting to corporate servers.

and low drag. The basics consist of a duplex blade antenna, high-performance blade antenna, cabin wireless access point (CWAP), and radio. Functionality is based on operating in the contiguous US above 10,000 ft. That’s a service level guarantee, not a physics limitation. SmartSky’s network uses existing cellular towers as their platforms for its ground-based equipment to reduce infrastructure costs. The 10,000 ft threshold also allows for fewer antennas. These savings are reflected in lower costs to the consumer. And in all likelihood, if an aircraft is operating at an airport in proximity to a designated tower, the system will work just fine at a lower altitude.

What’s better, satellite or ATG airborne connectivity?

One might think that the president of an ATG communication system would immediately eschew a satellite system in favor of his own methodology. But that’s not the case with Ryan Stone. Rather than seeing the 2 systems as competitors, he sees them as complementary. The goal should be to get the best connectivity possible given the prevailing mission. It makes sense that business aircraft that only fly domestically will definitely benefit from a 4G ATG installation.

However, where an aircraft is based can also affect service. When operating in congested airspace, 3G ATG is subject to a lot of buffering, and demand for satellite bandwidth can outweigh capacity. For example, an aircraft operating in and out of TEB (Teterboro NJ), FLL (Ft Lauderdale Intl, FL), or SJC (San Jose CA) may see a noticeable difference as compared to the same airframe in ICT (Wichita KS).

The SmartSky 4G beamforming capability is the equalizer because all aircraft receive the same level of service despite the location. In addition, the small profile of an ATG system makes it ideal for light jets, turboprops and perhaps even high-end reciprocating twins.

On the other hand, flight departments flying international missions operating medium to heavy jets may want to consider both a satellite and ATG system installed in their aircraft. SmartSky Networks provides a CWAP or allows customers to use one of their choice (and receive an installation credit in the process). The latest generation of routers, like the Satcom Direct SDR, will make a seamless changeover between satellite and ATG networks as the aircraft transitions through phases of flight.

What’s offered by SmartSky

VP of Sales Alan Goodnight points out that, like the rest of the world, the business aviation market segment depends on connectivity and demand is only headed in 1 direction. His intent is to provide that connectivity at a price that delivers the best value on a per megabyte basis.

Satcom Direct has been selected as the exclusive customer service and support provider, and subscription plans are designed based on anticipated monthly usage. Overage fees are assessed on a per megabyte basis as well. Introductory hardware pricing is being advertised at $93,000, exclusive of the cost of installation, which is expected to be similar to other ATG system installation costs.

Something unique about the SmartSky architecture is what’s self-described as an open connectivity ecosystem. The interface between the CWAP (router) incorporates technologies that have the flexibility and adaptability to keep up with the rapidly evolving world of smartphones, tablets, and other personal electronic devices. SmartSky’s system is open in that it interfaces with many different off-the-shelf CWAPs, so users can pick the one they like best.

Of course, there’s no real standard installation job given the variability of aircraft. As a result, SmartSky Networks has partnered with some leading type-specific subject matter experts to make the installation process as easy as possible. These partners include Bombardier, Chicago Jet Group, Clay Lacy, Duncan Aviation, Jet Aviation, Pentastar, Pro Star Aviation, StandardAero, Textron, and WestStar Aviation.

The SmartSky Networks complete system is still in the development and demonstration phase but is expected to be fully operational nationwide in 2018. For those interested, now is a good time to get an installation scheduled as demand for 4G LTE-based communications will only increase.

Editor’s note: This article is the continuation of a series on airborne connectivity providers that started in our July 2017 issue. For more, see PP Jul 2017, p 54.

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