Constellations Podcast

Episode 147 – In-flight Connectivity, Seamless Air Travel and the Physics of Networks in the Sky

Speaker: John Peterson, Executive Director of Aviation, Iridium – 29 minutes

John Gilroy: Welcome to Constellations, the podcast from Kratos. My name is John Gilroy and I'll be your moderator. As you may know, in-flight connectivity is not a new concept. For nearly 20 years, airlines have been offering satellite connectivity to commercial passengers, and most passengers just accept that service on a plane is not going to perform quite the way that it does on the ground. During today's podcast, we'll discuss the common challenges and new technologies advancing in-flight connectivity meant to improve performance in the overall end user experience. On the flight deck today we have John Peterson, Iridium's Executive Director of Aviation to help us better understand the evolution of mobile connectivity for the aviation business segment.

Okay, big John, we're going to jump right in here. Let's start with some discussion on the market itself. In the recent Euroconsult Report, 'Ground Segment Market Prospects', August 2022, it was said that from the mobility sector, the new terminal market for Aero is expected to show the highest growth rate among Satcom applications with a 12%, 10-year compound annual growth rate or CAGR. What do you think are the main drivers for that estimated growth?

John Peterson: Well, John, first, thank you for the opportunity to talk to you and your audience and to show the value that Iridium's bringing aviation is a privilege and I appreciate that opportunity. There are a number of factors that are driving this growth. I've been doing this ever since the very beginning when SwiftBroadband came to market and Viasat came out with its Ku-band probably 20 years ago, I've been following it ever since. The largest drivers of growth are really the basic economics you see in every market and it has to do with size, weight, power, cost. Then there's one more thing in the world of connectivity and it's called speed. So when you put all of those together, we have seen the terminals are getting smaller, the antennas are becoming more sophisticated, the equipment is becoming less expensive, the capacity is becoming greater, which is making the speeds much faster and the costs are coming down exponentially.

When you see costs in the cabin space that are going from dollars per megabyte to pennies per megabyte, the affordability of it and the value it brings to passengers just drive the model. But let's not forget, the economy, the market, has two unique and specific services that have to be provided to an aircraft. The

first is the Ku and the Ka and ever since SpaceX and Starlink got in there, it became super sexy and everybody got real interested in it. That is really what is used for the cabin services, but we can't forget about the fact that when you're going from A to B, the most important thing is you get there on time, your tickets are low cost, and it's a comfortable flight. That's what connectivity does for the front of the bus up on the flight deck for the pilots.

John Gilroy: John, we have listeners all over the world, all kinds of levels of sophistication and understanding of concepts we're talking about today. So let's just set the stage for maybe some of the novices here. So give us some examples of how in-flight satellite connectivity has traditionally worked for the aviation market.

John Peterson: So in-flight satellite connectivity all started in the very beginning with a very low data rate service that works on what we call L-Band. That's the frequency it works on and the wonderful thing about that is it goes through moisture and clouds, it works in all weather conditions. It was used to provide really clear voice services globally so the voice was much better than an HF radio, which was invented back in World War II, and it was used for very basic data services in order to get data to the air traffic controllers to tell them where you are and when you're going to arrive. And that's where it all started.

Then the business aviation community thought it was great to have that and they wanted to keep the executives, the high net-worth individuals, in the back of the aircraft connected. This is before the internet so what they wanted was phone services. Then as the internet came out and email was invented, the people wanted to start using it for phone services and email services. And John, you may not remember this, but at one time we got a smoking fast internet service at 64 kilobits per second, and people would pay as much as $18 a megabyte to get that 64 kilobits per second on a business jet.

Today, we use what are called Ka and Ku frequencies, much higher frequencies. They don't work so well through moisture, so you get some big clouds in the sky and the service doesn't come through. That makes its availability not effective for it to be used as a safety service for the pilots, but it's a great service for the passengers because now what we're seeing are speeds that go as fast as a hundred megabits per second and the prices of this are in the pennies per megabyte.

John Gilroy: I was in a classroom last night and telling my students that everyone's got challenges. Wealthy people have challenges, people in college have challenges, people looking for jobs have challenges. Challenges are just full of everyone's life. So in your world, in your market, what are some of the challenges to delivering faster and more reliable service on an aircraft?

John Peterson: So for Iridium, our focus area is really providing the safety to the cockpit, to the flight deck, to the pilots and the crew. The challenge in that is making sure that the system and the network has availability that ensures that those messages get through no matter what the weather conditions are and no matter where that aircraft is in the world. As we all can appreciate, when an aircraft is flying, you don't want to see the equipment get so hot that it smokes, catches on fire or creates some hazard to other pieces of equipment on the aircraft because it'd be very dangerous. This is where Iridium and our value added manufacturers excel. They're very good at taking what we have for our modems and our satellite capacity, and turning that into a product that can be used on an aircraft.

John, it's interesting, you have to have an appreciation for these things. When you think about your iPhone or your Android phone and you think about how small it can be and how flat it can be, and it has an antenna on it and it works no matter where you go in the world and it connects and it works fairly seamlessly. Those antennas and that technology and making that work when the satellite is over 500 miles away from the antenna and the aircraft is going over 400 miles an hour, 500 miles an hour.

And you put those things together and it's a very interesting physics problem to ensure that the quality of the service that's provided is such that no matter how bumpy the flight is, no matter how bad the weather is, no matter where that aircraft is in the world, whether it's in the Arctic or over the Amazon, that call has got to get through and it's got to be just as clear or the message has to get through and it has to be just as reliable as what you would expect right now on this podcast communicating over our internet connections. There can be no exceptions. Those challenges are wonderful physics problems for our antenna manufacturers and for value added manufacturers of our products. And it takes a little longer to get that stuff to market.

John Gilroy: John, on the way over here, I drove through Ashburn, Virginia, the largest amalgamation of data centers in the world and talked to a lot of people about data centers. There's lots of new technology. I mean, it's changing quickly in so many aspects and the technology's changing in your world too. So tell us about some of the new technologies here that are reducing or eliminating some of those problems you just enumerated.

John Peterson: With capacity and with what we do at Iridium, it's really more about how we enable applications where they didn't work before. And I would give you a couple of examples as to how that is. The first one I would give you is the traditional satellite communication systems that existed in aviation were just two big, too heavy and too expensive for someone who flies on a small aircraft, let's say a piston type aircraft that you would see flying around or a two engine aircraft with two propellers on it flying around. And in places other than the United States, when those aircraft take off and leave the ground, whatever

weather information they had when they left is all the weather information they have. As anyone who lives in places like Colorado or lives in the Asia-Pacific region, the weather now is not the weather an hour from now. The winds now are not the winds an hour from now, particularly during tycoon season or monsoon season and things like that.

So the ability to get an accurate weather update of graphical weather while they're in flight is non-existent. The most they can do is radio ahead to the airport. If it's an airport that actually has a tower that's manned. If it isn't, then they're in even worse shape. So now there are these very small, very affordable Satcom systems they can take onto their airplane with them that allow them to get that information. Now they can leave with a greater level of confidence that they have choices when they get to the other side, whether they have to go to an alternate destination or they can plow on through to their originally planned route. That is something that our technology brings.

Another one that's more of an airliner way that our technology works is a lot of the Ku Ka systems that I spoke to, so despite the fact that the cost of those systems from a megabyte perspective has come down so low, the capital expense, the dollars, you got to shell out to buy the system, those things are in the low six figures. Not every airline in the world wants to shell out that much capital or can afford to shell out that much capital to get some data on the aircraft. But in time, those same airlines are losing millions of dollars a year because when the food cart comes down the aisle, people hand them credit cards that are either stolen or there's no money left on them. When that happens, the airline's done because they've already served the food, the passenger has left the aircraft and there's nothing they can do to get that money back.

John Peterson: What's a really low cost way that the crew can do very simple things like transact a credit card no matter where they are in the world and the crew could possibly pull gate information no matter where they are in the world? And that's where our solutions come in because now for a few thousand dollars, they can put a solution on the aircraft that is tens of dollars a month to maintain and they can provide that information to the crew and it becomes very affordable. And the return on investment to an airline is within months because the cost to apply that service to the aircraft versus what they avoid in lost revenue from fraudulent activities is fantastic. We're really happy to see that our value added resellers are able to be creative. Like AirFi in the Netherlands, they're able to be creative and they're able to find different ways, different niches in the marketplace to apply technology in a cost effective way. We're real happy to be a part of that.

John Gilroy: John, that credit card story really kind of paints the picture of the value you can bring to the aviation community here. Because I'm such a sophisticated gentleman in doing the research for this interview, I went to Twitter and I

looked at your company on Twitter and I scrolled down and I saw a real good visual depiction of what a satellite network looks like around the earth. I got a satellite question for you here. So, what are the advantages of leveraging these LEO satellite constellations for aviation networks?

John Peterson: I'll tell you, there are a number of different things, but let me comment on two. The first one I want to comment on, the closer the satellite is... The speed at which data travels, the speed of light is fixed. So naturally the closer the satellites are to the earth, the less time it takes for the data to get to the satellite, get to the ground, and then return back to the user up through the satellite. That's latency. The latency is quite a bit less. When you have lower latency, you have a better experience in both voice and data services. Your applications are snappier and they work more like you would expect from a cell phone tower. And your voice services don't have that delay when one person stops talking and the other person starts talking over top of them. That's one.

The second area is Iridium is quite unique. When Iridium first began, they invented the ability, they were the first to be able to do cross satellite links. What that means is I can be on the Arctic circle and talking to the satellite that's directly above me and my voice conversation will bounce across the satellite through space and it will come down in Tempe, Arizona where it gets on the internet and somebody can hear my conversation. That is unique. Iridium is the only satellite constellation in the world that is successfully doing it, and we did it on our first generation satellites and we continue it on our second generation satellites. So that crosslink capability also provides a great deal of security as well because now data can go up to the satellite, bounce across the satellites and come down on the ground where it can then be VPNd to a customer. And we're real excited about having that distinct advantage.

Traditional satellites, the way they work, even when you talk about the low earth orbit satellites, what they do is... Bent pipe is what we call them. The message goes up to the satellite and the satellite has to send it right back down to the ground again for a teleport on the ground to hear it. If you're over the ocean, it's not a convenient place to put a teleport. While the constellation may be global, the service isn't global because the satellite in the air has to see a teleport on the ground because there's no crosslinks, nothing to do with the data if it can't see a teleport on the ground.

John Gilroy: John, the Constellations podcast was launched back in 2017. It was a small step for man, but a giant leap for podcasting. For the first time, you got to listen to leaders who focused on innovations in satellite and space networks. Today, thousands of people from all over the world listen to Constellations and thanks to you, we've grown into more than just a podcast. Now, you can sign up for the Constellations Newsletter to receive articles on current industry issues, podcast summaries and contributed blog posts at constellationspodcast.com. Well, John, we began this interview talking about ground segment little and then we moved

upstream to the network. Well, let's try to bring these two together. Let's try to connect them together. So what are the hardware and software components that are necessary to make this LEO connectivity work on an aircraft?

John Peterson: Let's kind of follow a packet of data and talk about it that way. So John, you're sitting on an aircraft and you want to send a text message to one of your many fans or you want to send a tweet out to one of your many followers that are out there. So what you want to do is you send the message. That packet of data goes across the wifi system on the aircraft. It goes into what we call an aircraft equipment modem. And it goes from that modem to the antenna, from the antenna to the satellite. From the satellite, to a ground earth station. That ground earth station may be in Norway, it may be in the United States, it may be in South America. It hits whatever ground Earth station is closest to where that message was originated.

From the ground earth station, it is VPN'ed, tunneled through the internet securely to Tempe, Arizona where it is then turned over to the internet. So all of those things must exist. In Leesburg, Virginia, we have our pilots for our satellites who work there 24 hours a day, seven days a week. And yes, satellites flying at 17,000 miles an hour above the earth must be piloted. Somebody must fly them just like you fly an aircraft. So all of the software that's associated with that activity is homegrown software unique to our experience. Then the other software that is included in this is all of the traditional software you would see in any of your cloud services. You have all of your firewalls, you have all your switches, you have all of your servers, and some of this stuff exists on private clouds and other ones exist on the public clouds like Amazon or Azure.

John Gilroy: John, earlier you differentiated between the communication requirements for the pilot and the Ka Ku band and then the passengers. Okay, let's do a further differentiation here. What about the difference between commercial applications and UAVs?

John Peterson: That is such a fascinating topic. So what we're trying to do, the big difference between the commercial aviation and the UAVs is in commercial aviation, everybody's trying to figure out how to download a website onto their phone or download the weather into the flight deck. In UAVs, obviously it's unmanned, so there isn't anyone on the aircraft obviously. So everything about UAVs is getting information from the UAV to the pilot who's on the ground. And we have shown, and we are very excited working with our partners, we have shown that the reliability that a safety network solution like Iridium has, the global capability so you don't have to add infrastructure to the ground to fly the UAVs, and the manner in which we make the product. So more data goes up to the satellite and less data goes down to the aircraft. Those are the areas where we're invested in the time that we're putting in.

Another part of the UAV market is UAVs want to get onto the network and off of the network very quickly. They want to get on, they want to give their status, and then they want to get off and continue to fly the mission because UAVs are autonomous, so nobody has to really be doing anything with it in terms of flying. They just need consistent updates so they know it's healthy.

John Gilroy: Earlier I mentioned data centers and most people think of that as being infrastructure. Of course they do. So let's talk about infrastructure in your world. What ground system infrastructure is required to support LEO for these aviation networks?

John Peterson: The first thing is in Tempe, anyone who wants to work with our Iridium service capabilities, our network, they have to be co-located inside of Tempe. We want to maintain security and we want to make sure that we understand who is getting on and off of our network. So they have to bring in their servers, their firewalls, their switches, and they've got to rack them just like you would in any data center like Amazon Web Services or anybody else. You've got to rack those appliances inside of our data center and then we turn the data directly over to that value added reseller that is co-located with us, and then they then put that out onto the internet.

So they use their different tools with respect to filtering tools, so you don't clog up an aircraft network with unnecessary information like backing up your cloud. They put in things like conditioning tools so that you can use more of the data for uplink and less of the data for downlink. Then they have other tools related to bots to ensure that the network and when they're using the network, they aren't driving up their costs unnecessarily. So all of those sorts of tools exist when they interact with our network

John Gilroy: In the aviation market, there's all kinds of new technologies out there. Theoretically, if an airline wants to adopt new technologies or platforms, what does that migration investment generally entail? Is it possible to use a combination of new and existing components?

John Peterson: Yes. Aviation as such the certification path is so long and so expensive that the ability to make the old and the new coexist is very important. One of the large challenges that aviation is confronted with today and is working through is trying to make it so that a UAV can fly in the same airspace as a manned aircraft without a visual line of sight pilot on the ground flying the UAV. That challenge is where the satellite services are becoming very helpful because of the availability of the network is always on. You don't have to worry about losing towers. There's always a satellite overhead. And the ability to know where all the other aircraft are because aircraft have transponders on them. And those transponders can be listened to by low earth orbit satellites as well.

So the ability to see all the other aircraft that are around your UAV so that you can ensure that you maintain safe separation and spacing as you fly cooperatively in that airspace. These are the areas where satellite is becoming very helpful because the cost to put ground infrastructure in, in order to fly UAV safely in a mixed airspace is very expensive and it takes a long time. And who's going to pay for it?

John Gilroy: John Peterson, hold onto your hat. We're going to use a four letter word. Here we go. The four letter word is cost. C-O-S-T. Because whenever the topic of in-flight connectivity comes up, cost comes up all the time, especially for the end users like my daughter flying to Seattle in two weeks or something. What are some innovations that are helping to deliver advanced satellite connectivity to airlines in a cost effective way?

John Peterson: One of the things is the newest generation satellites have more capacity and capacity is a commodity and it's a very simple thing. Old satellites may have had capacity that would allow you to have a thousand users and each of them gets one megabit per second. Pick arbitrary numbers. The newest generation satellites are allowing hundreds of thousands of users in giving them a hundred megabits per second. When you have more capacity and you can bring on more users, your cost per megabyte goes down dramatically. Because you can use more users to fill that capacity, you don't have to charge as much money per user.

That is the biggest change that we are seeing and that is why as we see Starlink go up with thousands of satellites increasing the capacity, as we see the ViaSat-3s go up with terabytes satellites, these gigantic satellites that have all this capacity, Iridium next went up for L-band and for safety that has dramatically more capacity than we ever had on our previous satellites. These are the sorts of things that are driving down the cost models so that it is more affordable for the people and you can get to a broader number of users

John Gilroy: From a recent article in Avionics International, some airlines are finding creative ways to offset the investment costs of adding or upgrading connectivity to their aircraft. Can you share your knowledge on what they're doing?

John Peterson: The one would be an example that I provided just a bit earlier, John. One is defraying the cost of fraudulent credit card transactions. So that is an easy one. A second one is getting better visibility in real time of the aircraft and all of the other aircraft, as well as cross-referencing that with weather so they can catch the winds, they can optimize their takeoff and landing in order to save on fuel. Another one is the ability to defray cost by charging people for certain services. As the cost of the service goes down, the amount that they have to charge the passenger goes down, and so the capture rate goes up, which makes it more cost effective to add the services to the aircraft.

Finally, there's a lot of work being done today in telemetry. They say that data is the new gold. Isn't that what kind of came out over Covid? So you have all of these old industrial enterprises with large installed bases suddenly saying, "We can do productive maintenance, we can do predictive analytics, we can do all of these other things for a fee so that you can lower your operating costs." And that's the next horizon in aviation and data on the aircraft. That's an area where a lot of money is being spent in analytics and in real time data transactions in order to figure out what the perfect algorithm is.

John Gilroy: John Peterson, in an attempt to be transparent, I'll tell the audience here that I tried to connect you on LinkedIn earlier today. While I was on LinkedIn, there was an article or some kind of a feed about satellite to cell technology. It's just like it's everywhere. I mean, is it in the 7-Eleven now? It seems to be so popular. Everyone's talking about it. So what effect, if any, will new developments and satellite direct to cell technology have on the aircraft delivery service?

John Peterson: So I'm a product marketing guy at heart, you can never miss an opportunity to have a good pitch. The one thing that satellite to cell technology is going to do is it's going to bring the value of satellite technology top of mind to billions of consumers. As opposed to today, it's sort of a niche product that somebody has to seek out because they have a specific problem they're trying to solve. And I think by doing that, we're going to see more creativity and innovation from people trying to take advantage of that because they just didn't know. Who would ever think that I could have an Android phone with Snapdragon in it and I can be in the middle of the Rocky Mountains and I can point it up to the sky and I can get an emergency message out because I'm lost? Of course, John, you know I would never get lost. It would probably be the person I'm with fault that we would be lost.

But those are the sorts of things that are unprecedented. Or you're out fishing in a boat, you're a completely irresponsible person and a huge storm came in while you were fishing and you're not going to make it back to shore. And I can just point my phone to the sky and I can get a message out with my last known location so they can come get me. These are things that never existed in the mind of the common person. Now they exist. We have all sorts of products like Garmin inReach, and we've had satellite phones forever and those sorts of things.

But as I said, that's somebody trying to solve a specific problem, looking for a solution and finding satellite and then looking for somebody to buy it from. So if you think of the ease of purchase, it's very complex. Now all of a sudden the phone you bought at the local store has a satellite service with it that you can use simply by pressing a button. That's fantastic. What that does for us is going to be unprecedented in terms of growth because once people realize what's available to them, it's unbelievable how much innovation comes.

John Gilroy: Crystal ball time here, John. So looking to the future, what do you think is next for connectivity, technology, and aviation? How do you think it would look in 10 years?

John Peterson: What we're going to see is we're going to see a better blending of satellite and terrestrial services. Just like we're seeing now with a safety service working over a phone, we're going to see more of that happening as we move forward. We're going to see areas where as there's more capacity put in space, you're not going to realize that the email you're doing went to a cell tower, then went up to a satellite, and they dropped it somewhere else. As the interconnected satellites become more and more commonplace, we're going to see things like banking transactions don't happen on the ground anymore. We're going to see next level security where things don't flow through the internet arbitrarily through switches globally that you have no control over. We are going to see the aviation community use more reliable satellite links that work everywhere in the world seamlessly as opposed to the traditional clunky VHF towers that have been out there since World War II. We're going to see things that work in an interconnected manner more seamlessly because it's the best way to handle the packet at that moment in time.

John Gilroy: Wow. After this interview, I think many of my listeners here are going to really look forward to a better flight experience down the road. I'd like to thank our guest, John Peterson, Executive Director of Aviation at Iridium.

John Peterson: Thank you so much, John. I appreciate the opportunity to talk to your audience.