

As inflight connectivity and wireless IFE offerings proliferate on board, charging options for personal devices are becoming a necessity for airlines that want to keep passengers happy.



On a power trip

Stephanie Taylor finds that when it comes to in-seat power, the success of USB doesn't spell the end for traditional AC outlets.

Things have moved on significantly from when personal electronic devices (PEDs) like tablets and smartphones were a twinkle in the eye, laptops only needed 60 W or 70 W to charge and passengers had to use a unique connector to power those laptops in flight using Astronics' EmPower DC system.

However, the aviation industry's adoption of universal power standards hasn't necessarily made things easier for suppliers.

BUILT TO LAST

They're now constantly future-proofing the strongest, fastest power solutions being used on the ground for inflight use, with Edward Butler, principal engineer at Pascall Electronics,

pointing out that once in-seat power systems (ISPS) are installed, they're usually flying for between seven and 10 years, on the same cycle as inflight entertainment (IFE) solutions.

Today, the majority of airlines that supply USB power to passengers are doing so through USB A sockets supporting a current of 500 mA (2.5 W), while 2.1 A outlets (up to 10.5 W) are becoming increasingly common. To put this into perspective, the consumer market is now beginning a more broad adoption of USB 3 (which Panasonic refers to as Power Delivery 2.0), capable of supplying about 100 W of power – over nine times as much as the 'high-power USB' of today – as well as providing the ability to transfer data at a speed of up to 5 Gbps.

In an even more current development, USB 3 has been overtaken by USB C, the difference between the two being that the former doesn't have a reversible connector, whilst the latter does. This feature isn't brand new to the cabin environment though.

PROBLEM SOLVED

UK-based Inflight Peripherals (IFPL) has been manufacturing reversible connectors for a while in a bid to ruggedise the hardware. Mark Reed, the company's business development engineer, explains, "Airlines don't always place USB sockets in a prominent location. Some of them are down under the seat, so if you're foraging around to plug in, it doesn't always end well.

For premium cabins, solutions that provide both AC and USB power are the order of the day.

"We designed a connector where orientation is unimportant," Reed continues. "The nice thing is that the passenger is unaware we've fixed a problem for them. They generally don't think about what goes on behind the scenes. They just want it to work."

Even though the industry standard for USB connector life is only 5,000 insertions, IPFL's reversible connectors can withstand 60,000 insertions (30,000 in each orientation).

USB'S USP

USB C would naturally be better for airlines, then, but so far it's only being used by Apple's 2015 MacBook Pros and Google's second-generation Chromebook Pixel. Butler says, "If USB 3 requires a socket change, I'm not sure many airlines will be updating their ISPS. This is an industry that lags behind the home environment by a number of years.

"Nonetheless, we know why it's moving towards USB 3. If you're a regular flier, you've probably seen much of the prime content on the IFE. That's why a lot of people watch pre-downloaded content on PEDs – but that means you're likely to run out of battery power, sooner or later!"

Phil Brace, manager of IFEC and airborne power, Pascall Electronics, continues, "If a passenger plugs in their exhausted phone on a 10-hour flight, only having access to a 500 mA power source won't really matter because the device will probably be fully charged at the end of the journey. However, as the processing power of tablets increases, as well as the energy density of their batteries, a flat battery means you are going to need an increased USB current to charge it. If you're on a one- or two-hour flight with only 500 mA, your tablet's battery will only be partially charged by the time you land. That may or may not be a problem, depending on passenger expectations."

This is where the 110 V AC power comes in. "110 V AC outlets are typically 75 W to 95 W systems, so if an airline has AC installed, a passenger with a USB 3 device can still bring along their adapter and charge it that way," Butler explains. Jens Brey, KID-Systeme's product manager of cabin systems, says his company's AC power systems have gone from



75 W when they were first introduced in 1999 to 200 W today.

There's an interesting paradox here regarding what constitutes a premium product. During the recent APEX Expo, Sandy Stelling, managing director, customer research and development at Alaska Airlines, said that although the carrier offers both 110 V AC and USB power at each seat, "USB is the runaway winner with customers in terms of brand perception".

Despite this, Dennis Markert, Astronics' director of business development and technical services, reveals, "Looking forward, we are being asked to provide many single-aisle carriers with information indicating that they may be partial to providing first- and business-class passengers with both 110 V AC and high-power USB, but only high-power USB in economy class. I believe we'll see more of this." Is this because, as Butler says, frequent fliers – certainly business travellers – have a higher demand for power?

This isn't to say that USB can't provide the power most passengers need. Butler expounds, "One of our airborne power supplies could support over 30 seats using 30 sockets at 2.1 A, and that's even when you factor in the inefficiencies of the cabling loom and USB socket voltage conversion. That's also assuming all 30 seats are using USB charging to its full potential of 2.1 A, when in reality we know they don't. A lot of sockets we have evaluated start to throttle back, current limiting at around 1.8 A."

Butler also acknowledges that different types of airlines may take differing approaches. "People think the retrofit market is typically about high-power systems, but it's not. Take a low-fare carrier. If they want to provision in-seat power for people, we've often said that if a passenger plugs in their device and it is being charged, they will appreciate the benefit of the service. In these cases, it probably

doesn't matter whether they're receiving 200 mA or 2.1 A, unless a particular expectation has been set."

Brey explains that USB is a popular option in the narrowbody market because it has only a limited impact on the overall weight of the aircraft cabin. "Today, USB power needs approximately 150-180 g per passenger, including the power converter. AC power is about 500-700 g per passenger."

LONG LIFE

Markert thinks another reason behind the endurance of 110 V AC is down to consistency. "Not all of our systems come with USB as part of the offering, and this is by design. We still need to support our long-standing installed base with equipment and products that are viewed as legacy products. For example, if an airline wants to add another aircraft to their fleet, they may want to use the same cabin configuration and in-seat power products to offer the same passenger experience, or may not want to pay for a seat service bulletin to switch to the latest product offering."

"One of the things that could impact the provision of AC power on board is the airlines' perception of its utilisation and value to passengers," Brace argues. He also notes that "wear and tear makes it easier for things to fall out of the sockets, especially when people are using so many different and often bulky adapters. However, the systems are inherently safe, as the socket will only supply power when something's properly plugged into it, and that's a regulatory requirement."

Astronics' model 1325 USB power supply is designed to enable as many as four USB outlets to simultaneously charge personal devices at up to 2.1 A each.



KID-Systeme developed its outlet safety features based on a Lufthansa Technik patent. Brey says, "If a passenger is playing with a needle in the power outlet, for example, they will never get power out of it. If their PED has a failure and there is a short between the power cord and the PED, this will be detected and the power will be switched off immediately."

Regulatory requirements also exist to ensure energy efficiency, and although Markert states that airlines don't specifically impose an efficiency requirement on Astronics, he says, "As we move towards the 'electric aircraft', it's becoming more of a topic of discussion."

He continues, "Very inefficient cabin equipment will introduce heat and could have negative thermal implications. This inefficiency will require additional cooling to keep the cabin temperature at an acceptable level." There is also a safety consideration with regards to the newer, high-power USB solutions. Butler comments, "There comes a point in the socket life cycle where the USB A contacts get worn

out and it's not sensible to be passing a large amount of current through them." Markert accepts that "as the newer aircraft platforms move toward electric cooling, these are certainly important considerations".

ROOM FOR IMPROVEMENT

Efficiency is why inductive charging hasn't taken off just yet. Cedric Rhoads, senior director of product management for Panasonic Avionics, avers, "At 70%, it's not yet as efficient as we would like it."

Although Rhoads says efficiency should increase to 80% in the forthcoming generation, he also acknowledges that, like USB C, "inductive charging isn't broadly accepted across PEDs. Maybe 20% are supporting it as native to the design.

"Panasonic is watching very carefully where inductive charging is moving in terms of standardisation. A lot of people see the inherent value of cableless charging, but what we're hopeful for in our industry – and I think the seating vendors would concur – is getting to

something more easily and inexpensively implemented through standardisation. Right now, Apple doesn't want to standardise its technology around a specific vendor, and if you exclude Apple, you take away 50% of the market," Rhoads notes.

KID-Systeme unveiled a wireless charging solution as part of a business-class seat in partnership with Recaro at Aircraft Interiors Expo in 2014. Brey says that airlines thought it was a great idea, but goes on, "Today, wireless systems are limited in power – they can only provide 5 W. If you wirelessly charge a smartphone, it will take you a good few hours, whereas a wired charge will do it in one hour.

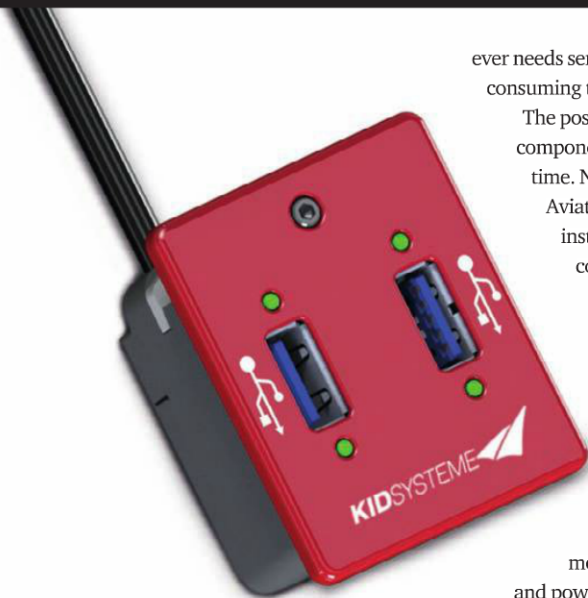
"Furthermore, tablets need about 20 W to charge, so there's no wireless charging available today that will allow it. The efficiency of our current systems is between 87% and 89%, but for wireless charging it's between 62% and 70%, which generates heat and has to be compensated for by the air conditioning."

As well as supporting inductive charging, Panasonic's Jazz concept seat (which debuted this year at Aircraft Interiors) features multiple 2 A USB ports. Rhoads opines that the USB market focus is currently on power rather than data transfer, but concedes, "There are some interesting ideas about USB as an interface standard for high data throughput, so for example, one of the challenges of USB has been what it does for content protection with respect to digital rights management.

"If you look at HDMI, it has a high-definition content protection mechanism built into it. USB doesn't have that, but I think it will evolve to the point where the manufacturers like Apple and Samsung will start to support that, because it's become a much more universal data interface standard."

Reed says IFPL is working with W L Gore, which produces rugged aircraft-compliant cabling, to future-proof for USB 3 and USB C, because "the whole digital ecosystem must be capable of accommodating their speed and power. You have to introduce a data hub underneath the seat that would have one high-speed signal going in and three coming out to go to distribution points in all three seats. If the connectors aren't fast enough, the system will

KID-Systeme offers double USB outlet units, which give airlines additional options when it comes to installation.



glitch. If you're just loading files, the USB is self-buffering, so it will just wait to catch up. If you're streaming, you'll get horrible freezing.

"Do you remember the sales pitch about the HB pencil? You sell the paper and the pencil sharpener too – it's about what goes with it. It's one of those gimmicks that has a lot of truth in it," Reed suggests.

In a further complementary design move, IFPL noticed that "if you look at a laptop, the connector is right up against the edge of the casing, which means that all the leverage is on the connector itself. We recess it against the light guide [a feature of the company's reversible USB jacks], which means the plastic is helping to support it," Reed explains.

Despite Stelling saying at APEX Expo that in-seat power was going down well with passengers, she confided that Alaska was looking at ways to make the boxes below the seat smaller, as some passengers were having trouble fitting their bags under the seat in front. Butler notes, "The seat has its own STC, so instead of anything that involves extensive amendments to the seat, airlines choose to attach the power unit in an enclosure to the seat rails. This can be inconvenient to the passengers."

Brace adds, "It's a maintenance issue too. If the power system is highly reliable, you can fit the solution out of the way, but obviously if it

ever needs servicing it will be more time consuming to get at."

The positioning of the system components also impacts installation time. Niall Kearns, SVP sales at Eirtech Aviation Services, outlines the typical installation process for his company's ISPS offering. "The power supply module support structures are installed first.

There can be up to 14 for a narrowbody aircraft. These can all be installed during one overnight stop if required. All the seats having the in-seat power installed need to be modified, seat harness installed,

and power distribution cabling is installed in the cabin. This can also be completed at the same time as the structure installations, over several night stops or during an inspection maintenance period."

Eirtech says its ISPS weighs in at only 0.8 lb per seat. "We mount the power supply module remotely from the seat, and only the USB outlet and minimal wiring is attached to the seat," Kearns says. "Normally, Eirtech installs the power units in the side walls of narrowbody aircraft and underfloor on the larger widebody aircraft."

KID-Systeme has developed double USB outlet units which enable airlines to install two such units in a triple seat row. This gives passengers access to a minimum of one outlet and means there are only two wires going to the outlet from the converter instead of three.

COST ISSUES

With installation considerations in mind, as well as the airline's budget, the power system supplier will consider the layout of passenger accommodations for the aircraft concerned. This will determine where the copper cabling will run.

"You've obviously got power loss through voltage drops over long runs of cable; if you have a larger cable to minimise your voltage drops, you add more weight and therefore more cost.

A distributed power architecture often provides the best balance," comments Brace.

Pascall also provides power units for inflight entertainment systems, where you're likely to find a USB socket, often as part of the monitor surround. Does installing USB as part of the IFE system avoid both the floor power boxes and the extra cabling cost?

Brace says that whilst it may reduce wiring, certain IFE systems still rely on floor power boxes underneath the seat, although it's likely to be only one per seat group. He comments that IFE integrators are working hard to provide clean and elegant IFE installations, being innovative with the locations of power supplies and other signal distribution boxes to maximise the under-seat area for passenger comfort and baggage stowage.

Perhaps airlines could invest more back into their in-seat power offerings if they looked at the service as a way of generating ancillary revenue, but Markert points out, "Many of these airlines are providing and charging for connectivity. We have been told that charging for inflight Wi-Fi and also charging for passenger power may be perceived negatively if passengers are already paying for internet access. It's also because in-seat power is required for the successful implementation of the BYOD [bring your own device] model which includes content delivery."

To use Reed's words, in-seat power is part of a much broader digital ecosystem, so even stand-alone power is only referred to as such in literal terms.

Brey agrees that wireless inflight connectivity is the main factor behind growing demand for in-seat power installation. He estimates, "KID-Systeme's connectivity systems have been flying since 2007 and are now in action on more than 600 aircraft. About 80% of aircraft with connectivity have a demand for SKYpower to charge PEDs."

Markert concludes that it's no longer a case of "Should I install in-seat power?" but rather "Which ISPS should I install?" With suppliers actively exploring every future option, it won't be long until those choices multiply, just like the current and the data transfer rate of the new high-power USBs. ■