As the name suggests, Lumexis's Fiber-To-The-Screen (FTTS) IFE system employs a fibre-optic network, which provides weight and bandwidth benefits.

High-wire performers

Henry Canaday explores the advances being made in the onboard electrical infrastructure that delivers power and content to seats.

Modern passengers want a home entertainment system and full use of smartphones and other devices, all in a seat 18 inches wide flying at 30,000 feet or higher. Airlines and bizjet operators are struggling to satisfy these appetites with the latest generation of inflight entertainment and connectivity (IFEC) solutions.

But for all the cool personal and seatback devices to work, there must be a solid system for getting both power and content to the seats. Wires, converters, switches and other devices must convert engine power into power for IFEC, lighting and space conditioning. Copper or fibre-optic cables must connect seats with servers, antennas and, ultimately, the ground.

Choosing the best power and content infrastructure can involve complicated trade-offs in terms of cost, weight, size, capacity, reliability, maintainability and durability. The good news is all the choices are getting better, fast. IFEC providers can arrange all or most of the needed infrastructure, or operators can assemble their own systems from various suppliers.

Let's start with an IFEC-maker's view. Zodiac Inflight Innovations provides several basic products, according to Brian Simone, vice-president of the RAVE IFE product line. There is RAVE Centric embedded seatback IFE, RAVE Broadband for Wi-Fi connectivity and RAVE Cellular for GSM and SMS text. RAVE Broadband is now focused on Ka-band connections, but could work with other options.

All RAVE products integrate well, which minimises the 'box count' – very important in putting together inflight systems. For example, RAVE Centric IFE can add wires for an access point and thus stream IFE to passenger devices. And passengers can connect to broadband through the seatback. This thorough integration of RAVE capabilities is not flying yet, but is feasible, given design of equipment. "Bits and pieces are flying, but the fully integrated solution is new," Simone says.

Zodiac will soon deliver its RAVE Broadband solution to provide access to the Ka-band Global Xpress network on all new Airbus aircraft. Simone says Zodiac wants to integrate its equipment with supporting data and power systems. "We want to be a common provider, mixing and matching, to minimise infrastructure requirements and avoid adding line-replaceable units that perform similar functions."

The company generally uses copper cables for data, although some aircraft now have fibre backbones. Zodiac can use fibre backbones and then run copper cables through the cabin. And it can provide all or just parts of the necessary infrastructure, including servers and cabling to seats and into its devices.

Simone sees a steady evolution in the infrastructure market. For example, there are

new cables with high data capacity but weighing just fractions of ounces. "That could be interesting. Weight is at a premium, but you must balance weight with price. No one will pay a million dollars for lightweight cable."

Reliability is also key in cabin infrastructure. Simone says both copper and fibre cables have their advantages and disadvantages, and Zodiac monitors these alternatives carefully.

ADEPT AT ADAPTING

In addition to line-fitting of Airbus aircraft, Zodiac can arrange retrofits of its RAVE products, either through service bulletins or supplemental type certificates. The firm has been working mostly with Airbus, but hopes to land some Boeing deals and is talking to Bombardier. It primarily focuses on mainline jets.

Simone argues that connectivity will be the inflight industry's primary goal in the next five years. "Passengers want to stay connected with data, text, Facebook, Amazon Prime content. IFEC providers must adapt to that market, and we have the tools to do that."

Lumexis is one IFE supplier that has chosen to go with fibre cabling. The company has been providing its Fiber-To-The-Screen (FTTS) system to airlines since 2010. Alongside this, it now offers the wireless FTTS Second Screen option, and it has introduced a wireless/seat-centric hybrid IFE solution, iPAX.

Now in its fourth generation, FTTS employs an Android 5.1.1 operating system, which enables a wide range of applications. Lumexis uses central processing units that run at up to 2.5 GHz in all its visual display units, which yields more capabilities but a smaller power requirement.

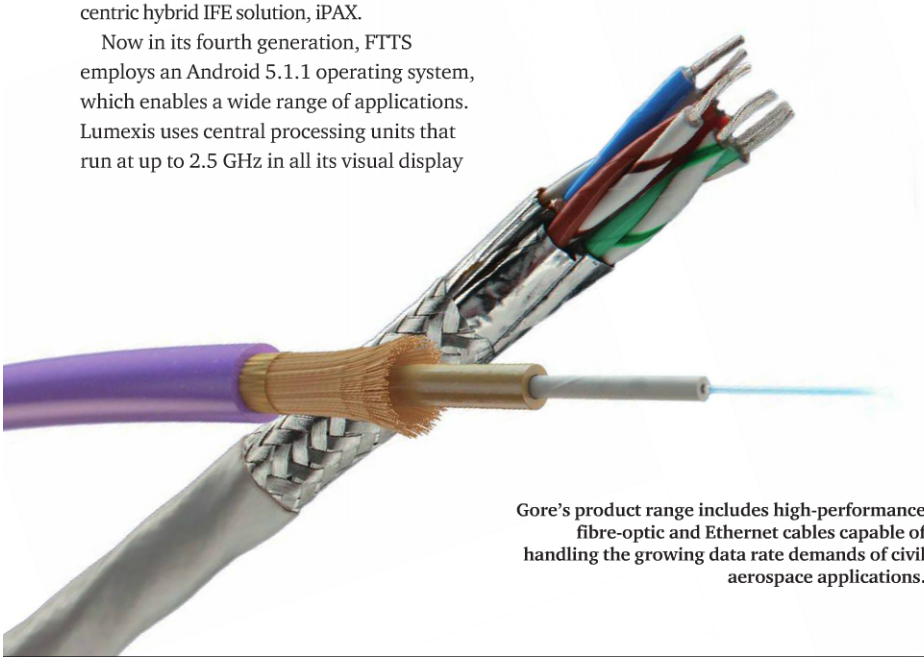
The iPAX system is Lumexis's light, in-seat IFE and ancillary sales platform designed for narrowbody aircraft. iPAX's liquid-crystal display has the highest dot pitch screen in IFE, according to sales VP Jon Norris.

FTTS Second Screen lets passengers use personal devices in their seats without interrupting entertainment running on seatback monitors. Lumexis's IFE systems offer USB plugs that can charge laptops and smartphones at up to 2.1 A. A smart chip in the USB identifies the device to be charged and applies the correct current. Norris notes that the port is integrated in the display bezel, saving weight.

All these cool tools run off fibre cables that are light and thin enough to fit into tight spaces, can expand in functions and have no radio frequency emissions.

But copper cables for data transmission are also improving fast. W L Gore & Associates civil aircraft product specialist Adrian Milne is seeing a big increase in the amount of data used in aircraft, especially for passenger connectivity, where Gore Aerospace Cables are employed.

As part of the wireless inflight entertainment revolution, airlines have found ways to get IFE onto passengers' own devices. "They used to say we're trying to get rid of cables and go wireless," Milne notes. "But the sheer amount of data needs a high-speed backbone connection."



Gore's product range includes high-performance fibre-optic and Ethernet cables capable of handling the growing data rate demands of civil aerospace applications.

Another big change in aircraft systems is in the wireless access points at the 802.11n standard that carry 200 Mbps. Now Kontron has launched access points that can operate at 1 Gbps, five times faster. "There's a huge increase in Wi-Fi demand using similar infrastructure, as speeds increase from Ku and Ka satellite bands," Milne notes. "So there is a lot more capacity going into the aircraft, and you have to have a higher-speed Ethernet."

So Gore now offers a high-speed Cat 6a Ethernet cable that fits into the terminals designed for older, less capacious cables. These were contacts for four-wire cables that carried data at 100 Mbps. Now Gore's eight-wire cables can carry data at 10 Gbps for up to 65 metres, yet fit the same connections. That's 100 times more data going through each second, all through the same contacts.

HUNGRY FOR DATA

Another new Gore product is its high-speed digital USB 3.0 cable for direct connections to passenger devices, which are now switching to USB 3.0. The cable enables a 5 Gbps speed, 10 times faster than the old 500 Mbps pace.

And Gore now has an HDMI 2.0 cable designed for the 4K monitors that some airlines are putting into business class. Milne predicts these sharper monitors will eventually go into coach as well.

Developers of infrastructure for aircraft cabins must recognise that data speeds are increasing by multiples of five or 10 continuously. In the old days of embedded IFE, five-year-old systems were still relevant. No more. Consumer devices now set the pace of cabin demands, so data appetites are voracious and get more so every year. Gore watches consumer electronics closely and develops cabin connections that will meet new needs, even before airlines perceive them. Cat 6a will be followed by Cat 7, and USBs will also continue to improve.

All of the above cables are copper. But Gore also works with fibre cables. One concern about

A Pascall technician tests one of the company's power products.

fibre has been its robustness, or relative lack of it, so Gore has developed a crush-resistant fibre cable. Another limit has been the cost of fibre transceivers at each end. Milne predicts transceiver prices will come down and more fibre cables, especially for backbones, will be used in aircraft.

EFFICIENT CONNECTIONS

"Copper has a lot of life left and is definitely more mature than fibre," Milne summarises. "But fibre is out there as an alternative. There's a perception that as you pull seats out during C checks, dirt gets into fibre termini. But we have 80 years' experience with copper. Maybe fibre is just different, and we have to learn to work with it."

The latest IFEC is also changing the demands for electric power, which is where Pascall Electronics comes in. Pascall makes power conversion products for aircraft cabins. These are mostly customised AC/DC converters, which transform alternating current from aircraft power buses to direct current, and DC/DC converters, which step up or down voltage levels according to equipment requirements.

The ultimate aim is supplying power most efficiently to IFEC equipment and to the USB sockets that passengers use to charge personal devices. Manager Phil Brace says Pascall also makes devices embedded in other firms' equipment, including the satellite communication terminals used for L-, Ka- or Ku-band satellite links.

Brace notes that connectivity requirements are increasing, as passenger expectations move toward the same levels of connectivity available at home. Power requirements for next-generation connectivity vary, but one common aim is boosting the efficiency of power conversion. "There is a big drive to consume less power, even if there is, in theory, surplus power available. This is all due to reducing fuel burn."

Power needed for IFEC is increasing slightly due to embedded USB charging and connectivity. What might have been a 65 W seat-box power system can now be an 85 W system to include personal device charging power. The USB charging socket can be integrated with the seatback IFEC or separately installed.

Pascall's systems typically work with 115 V buses that run at a fixed 400 Hz frequency or at frequencies varying from 360 Hz to 800 Hz. Pascall converters usually step down 115 V at the aircraft bus to 28 V for cabling within the cabin, a safe and standard voltage for cabin use. After cable routing, a protected point-of-load converter within the USB socket steps it down to 5 V for passenger devices.

Greater bandwidth for passenger communications does not always mean more power for seats. But increased demand for personal device charging does increase power needs. Device chargers integrated with seatback screens have typically supported up to 500 mA. There are now systems available that provide a separate USB socket as a retrofit to supply up to 2.1 A.

IFEC-integrated USB connections can also transfer data, enabling passengers to order food or transfer video content from smartphones to the larger seatback screens. But the higher-power USB solutions allow quicker recharging of an exhausted tablet or phone on a short flight.

Brace says there are now 'smart sockets' that can determine what kind of device is being charged and even, as part of the IFE, calculate how much a passenger should pay for charging it.

Pascall's converters are highly reliable, so they need little or no maintenance. This lets aircraft operators install them under floors, behind walls or above overhead luggage bins – places mechanics do not access routinely. Less reliable devices must be installed underneath seats, taking foot and stowage room away from passengers. "Airlines demand clean and elegant seat installations, and passengers want foot space guaranteed, regardless of the seat," Brace notes.

Brace is proud of the reliability of his company's equipment. "We call it fit and forget. You install it once and then typically come back seven to 10 years later, when IFE is upgraded or power units are removed for refurbishment as part of planned maintenance."

Pascall products fully comply with all relevant standards, including RTCA's DO-160 and Boeing and Airbus qualification requirements. Brace says some other power suppliers must have their equipment supplemented with external filters and additional hold-up capacitors before an installation can be certified.

ONGOING WORK

For the future, Pascall is working in several directions. It wants to further improve the efficiency of power conversion. At present, to meet regulatory requirements, conversion is done in two or three stages. Efficiencies of 90% plus at each stage can yield a cumulative system efficiency of 85% or more. Improving the total efficiency would reduce power requirements and, by reducing power dissipated as heat, further improve reliability.

Pascall also wants to get size and weight down, and improve power density. "As much as possible, we want to use solid-state, surface-mounted components to improve assembly efficiency and throughput," Brace adds.

For as aircraft power is increasing, so are the demands placed upon it. Actuation systems are evolving away from hydraulic toward electrical systems, power buses are moving from 115 V to 230 V, and designers are expanding the use of primary and secondary power systems for the more electric aircraft. Nothing electric stays still, in flight. ■