By collaborating with recognised third-party vendors, airlines are beginning to combine a seamless blend of brand identity with hyper-personalisation, to close the digital gap between the cabin and the home.

IFE&C systems evolution & developments and their potential

The future of in-flight entertainment and connectivity (IFE&C) is often thought about in terms of seatback displays, hardware and wireless access points (WAPS) in the cabin. However, the future of IFE is as much about content, software and analytics, and delivering these together. Creating a hyper-personalised passenger entertainment experience has the capability to increase airlines' ancillary revenue streams.

According to Lufthansa Systems' senior director of passenger experience solutions, Jan-Peter Ganse, passengers will see better and more immersive displays and software solutions.

"These will phase in with connectivity and passengers' own content," says Ganse. "Passengers will get on board and swipe their phones against the seatback to give them a hyper-personalised experience. Synchronising passengers' personal electronic devices (PEDs) will allow the IFE display to recognise them and work out their preferences so that passengers are entertained in a fun way."

Connectivity allows recommended content to be provided to the airline from streaming providers like Hulu and Netflix. Onboard entertainment will converge into a living room experience. Ganse explains that if passengers download Lufthansa's app over their phones, or type in their details into the IFE, the system will first display 'Hello and welcome back'.

The system will then display: 'We have already downloaded your Netflix playlist and we have some cool movies that we think you will enjoy. You watched Star Wars last time, why don't you watch Star Trek this time?'

Interfacing with streaming services, the IFE system will be able to make other intelligent content suggestions, such as 'You've started watching the first 10 episodes of Game of Thrones. Episode 11 is now available for you to watch on this flight'.

"Passengers may have seen the films already," says David Thomas, vice president of business development at IFPL. "Or the diversity of films is not what they want to see. In future, airlines will see more passengers bringing their own content onboard."

Diversity of content will see airlines becoming more open, collaborating with companies within and outside the aviation industry, including e-commerce vendors, live TV, and sports sponsorships; as well as app-developers and on-line streaming services.

Cooperating with influential brands and content providers will give airlines the opportunity to use these third-party vendors to drive ancillary revenue streams.

Ganse says that collaborations offer more than just advertising opportunities. Integrating on-line stores like Amazon Prime and Apple music allows airlines to get to know passengers better and close a digital gap, at the same time as giving the passenger meaningful content and online services.

Marketplace

Panasonic Marketplace is a cloud enabled e-commerce platform allowing airlines to create and launch their own onboard storefronts.

Marketplace provides a full suite of web tools and automation to enable the airlines to generate ancillary revenue. It can do this by designing and launching storefronts for their third-party vendors and partners.

In addition, it allows passengers to access and order complimentary items, such as toothbrushes or to specify a time when they would prefer breakfast.

"We harvest data and store it in a data lake, so that airlines can drive analytics to determine passenger trends and preferences," says product manager Dinesh Sardana.

Personalisation means that two travellers could receive different offers or advertisements. Establishing a session with the IFE through a loyalty ID, password or app will make curating their shopping experience easier.

Marketplace uses data to automatically learn in the background. By analysing individual browsing patterns, the IFE will learn what is piquing a passenger's interest. This will allow the system to predict passenger demographics, likes and preferences and curate a more personalised experience.

"It comes down to scale and segmentation. Having a large scale makes it easier to calculate behaviour patterns. Amazon has a very large scale, giving them the capability to differentiate between individuals. By analysing passengers' browsing scroll-length, we can gain user insights," says Sardana.

"If a passenger fast-forwards to a point in a movie, or pauses at a certain section of a film, on-line analytics can calculate if the user is male or female and what the passenger is looking at, such as a jacket or a car," explains Sardana.

Airlines can track sales on a per-flight basis and then decide what are the best

stores to offer passengers. This can be done on an individual route, or destination level. "Performing analytics on each flight, across many airlines will give a total view on how the ancillary revenues are performing," explains Sardana.

This enables airlines to easily see what the top-selling items are, and which are the top vendors. From these insights it is possible to make intelligent decisions about the kind of stores the airline needs, for example, entertainment, accessory or food-based.

"Marketplace can provide analytics, so airlines can drill down the behaviour of passengers. This allows airlines to optimise pricing, and make seasonal offers for Christmas, Thanksgiving or even Valentine's Day. Airlines can also run promotions for these events," says Sardana.

Marketplace can facilitate on-board and destination fulfilment. This means in-flight menus could be tailored to a passenger's individual dietary requirements and personal tastes at a brand level, provided the passenger submits requirements before the flight and on-board preparation allows.

"When you look at Marketplace and the Arc map platform, then combine them and add analytics and advertisements, it is possible to find ways to offer free on-board connectivity. One way is to offset costs against advertising revenue. Integration of digital payments rewards can be developed by way of free services or airline loyalty points.

"We can make all kinds of collaborations that activate offers. For example, buy from the kids' menu and get access to free in-flight games. Or purchase a connectivity option and get free Spotify for the rest of the flight.

"Imagine a passenger flying to Barcelona every year. He or she could be awarded coupons to the top restaurants in the city. If their PED device is paired to the IFE, it will be easy for the traveller to access their coupons and redeem them. Payments can be made in advance with e-Wallet, and bookings could be made through airline app," says Sardana.

One key development for IFE is to simplify complex payment systems to a one-click service that is like Amazon. "We want to make payments very simple. If you look at millennials, most are now used to digital payments, and this is where the trend is evolving," says Venkat Eswara, director of product management & product marketing at SaaS.

"On connected aircraft you will be able to perform security checks. We believe that digital wallets are the future," explains Eswara.

Marketplace can efficiently manage non-sellable items. Passengers will order complimentary items as they want to consume them. This will eliminate the need to distribute food, drink or condiments on the basis that the passenger may not want, and result in carrying fewer unwanted items and wasting less produce.

Arc Inflight Map Platform

Arc Inflight Map Platform is integrated within the Panasonics NEXT and X Series IFEC system.

Arc is one of the very first personalised maps to be introduced. It is designed for use in 4,000 horizontal pixel high-resolution. Arc can interface with Marketplace, and has embedded analytic software. Arc's omni-channel capability allows the system to work on seatback, overhead and handsets, plus it can be synchronised with mobile apps, web portals and smartwatches.

Moving maps have always been popular, so updating the map experience with a wide range of map styles, from satellite-based images to street views, greatly elevates the passenger experience.

Andrew Mohr, Panasonic Avionics Corporation, head of innovation, office of the chief technology officer, says: "We have focused on a substantially modernised design and feature-set for the traditional map application. We even designed a unique and highly customisable colour pallet, and if the airline wants to do something that is more in line with their branding, then we can support that."

As well as incorporating advertising, Arc has over 20 unique views that include high-resolution maps, camera views and enhanced points of interest. Real-time augmented reality (AR) window views can be generated and layered with timelines.

"We can add interactive timelines specific to a passenger's route so that they can request a notification, for example, when the aircraft is going to cross the equator and take a selfie," explains Mohr. "Or they can ask to be notified when they are flying over a specific country, so that they can have a look at it."

If a passenger likes a view they would like to follow, he can click on it and the map will transition to that view. Arc allows passengers to learn about the places they are flying over. By clicking on the map the system can inform users of population size and other area details, such as elevation.

Arc can also introduce the crew, the countries they are from and the languages they speak.

Time zone view can overlay information on the map, helping passengers understand the time zones they are in or travelling through. Arc can also cycle between views or put the system back into an automated view.

"We can design the map to suit the airline. If operators are not operating over certain regions, we can remove data for that region and optimize the areas

most relevant to their passengers," says Mohr.

Collaborating with flight tracking developers FlightAware, Arc can inform passengers of precise runway and gate arrival times. Passengers that upload their itinerary will have the capability to track current and connecting flights. Arc can translate this information by displaying maps that track each aircraft's progress.

Enlisting the wellbeing app-developer Calm, Arc can visualise jetlag by using a map of the globe to enhance that learning experience. For example after a period of time the system could prompt the passenger to drink water. Six hours later the system could prompt the passenger to eat a light snack and so on.

By integrating with Marketplace, Arc is a gateway to worldwide vendors that will be able to offer destination fulfilment of their products. The systems can also visualise non-monetary revenue streams via the airline's app.

"Arc can turn a generic map into a personalised map. It can be combined into the airline's customer loyalty programme," says Mohr adding, "a possible scenario could be to show all the flights a passenger has flown"

Adding this level of personalisation through Arc makes more passengers utilise the airline's app.

Gaming

Bringing ground gaming expectations into the air is the next big IFE trend. It is one that has the potential to influence ancillary revenue streams and tap into a billion-dollar industry.

Gaming services are amplifying the IFE experience by offering passengers mobile app games. Working with digital game provider Toca Boca, which creates digital toys, Panasonic is bringing mobile Android and iOS gaming technology to the seatback.

Because of the success of in-flight gaming, Panasonic is adding more games to its current catalogue of titles.

Gaming is associated with younger adults, but data suggests that adults are playing these games as well.

"We have seen a 39% increase in play duration and engagement since adding these games. They are competing with Solitaire already, because Solitaire has traditionally been the number one in IFE games," say Sarah Eales, service product line manager at Panasonic Avionics. She adds that forecasted engagement rates will increase as the games get recognised.

Toca Boca's business development manager Carlos Rocha says: "These games are already on the mobile market. We have introduced content that mobile consumers have ranked highly in the gaming charts. Bringing it over to IFE will elevate the family experience."

The touchscreen-based content is developed on the Android system, so IFE developers can import the exact same games that are available on a mobile device to the aircraft.

Picking titles that are familiar, the whole catalogue of games targets a multitude of gaming experiences. According to Eales, it is about hitting all the different targets. She explains: "We use a lot of Gameloft games and choose the ones that cross multiple categories, such as puzzles and action adventure."

Ranked in the top five mobile games, Toca Boca and Toca Kitchen Two are two of the most successful games available; as there is no text or speech, content is easily applicable to the airline industry.

A thing of focus is the quirkiness and silliness of the game, creating good family content. Strong characters create endless experiences that are especially appealing to children.

"The future of in-flight gaming is to close the onboard digital gap, so that passengers can play the games they are engaged with on and off the flight," says Eales. "We hope to have a lot more games and bring in a lot more partners, so we can improve the in-flight experience and give people what they know and expect. Today, good reliable gaming is becoming a possibility in the air."

There are many opportunities for airlines to offer additional in-game products to further drive ancillary revenue. For example, airlines can embed their own advertising campaigns, so that they can have the same advertisements displayed on the IFE screen and in the game.

Cloud-based gaming

"We are looking at the market to see what games will best suit our customers and then what platform will best accommodate these ideas," says Ganse. "I am strongly in favour of on-line gaming onboard the aircraft. We are also looking into solutions as to how we can introduce innovative onboard gaming ideas to the IFE system."

According to Ganse, the next evolution will involve using a non-cache, cloud-based gaming service. But most of these console-based games rely on a high latency internet connection. Streaming them via a satellite connection means that they do not work very well. "In future, cloud-based games can be a possibility, especially if these services can be cached onboard," says Ganse. "There is a huge gaming industry out there, especially if eSports can be brought to the aircraft. This will be very valuable to airlines and passengers alike."

Latency speed

Bandwidth is the amount of data that can be transferred per second and latency is delay. Measured in milliseconds, latency is the time it takes data to travel between its source and destination.

If latency speeds are higher than around 120ms, cloud-based gamers with lower latency speeds may have an advantage - making it a very uneven playing experience.

By using geostationary (GEO) satellites Viasat can supply onboard internet with a typical latency speed of 600 to 700ms, which equals the amount of time it takes for data to travel approximately 35,800 kilometres (22,300 miles) to the spacecraft and then it must travel back to the aircraft. Because of this, GEO satellite systems are not ideal for inflight multi-player cloud-based games.

Vice president and general manager of Viasat's commercial aviation business Don Buchman explains: "Distance and the laws of physics come into play when looking at speeds of GEO satellite systems. The lower the satellite orbit the lower the latency, which yields faster speeds. However, if a satellite is in a lower orbit, this does not mean that speeds will be faster - the satellite system must have enough bandwidth. If the system is congested, the latency can be higher than a GEO system"

According to Buchman, there are multiple applications that are not affected by latency, including video-streaming, audio-streaming and web-browsing.

In addition to GEO satellites, there are low-earth orbit (LEO) and mid-earth orbit (MEO) satellites. The investment in these types of satellite constellations are estimated to be $3-$15 billion, depending on the operator and constellation. But because there are a lot of unknown factors, costs could even be higher.

Buchman does note potential future interoperability among LEO, MEO and GEO networks. For example, today Viasat has successfully demonstrated the ability to access and operate service over GEO and MEO satellite networks with its hybrid Ku-/Ka-band aero terminal.

Boeing's connected cabin

Using augmented reality (AR) and virtual reality (VR) allows the mapping of star constellations and landmarks. Installing cameras on the top and the bottom of the aircraft can give passengers a real-time sky and ground experience that is enhanced by AR and VR.

The system will allow passengers, who are not seated by a window, to visualise a landmark on the ground, giving them a better understanding of world. Passengers can select from different views and add a combination of informative layers and filters.

Using a VR headset adds a further dimension of passenger interactivity. Alternatively, the system will interface with a PED or seatback IFE system.

Connected Cabin is also looking at using Plastic Organic Light Emitting Diode (POLED) displays, which are thin enough to contour to the ceiling architecture.

Daniel K. Bittner, connected digital systems innovation manager, says, "If we put a POLED display on the aircraft ceiling and interface it with the camera technology, we can create a view into the sky."

"We have created scenes for the inside of the aircraft. One could be a dinner scene, another a night scene. Because we can display any video there are plenty of possibilities. The goal is seeing how the scenes best enhance the passenger experience," describes Bittner.

An idea is to make the cabin a destination area by creating a virtual environment that will inspire passengers. "If you are flying to Hawaii, we can play a Hawaii scene. A passenger could have dinner in Hawaii before arriving," adds Bittner.

Airlines can set triggers that will automatically activate a scene when the aircraft is near a certain landmark or destination. Boeing is looking into ways where ancillary revenue streams can be embedded in the scenes showing promotions or advertisements

By displaying content innovatively, the system will have the ability to appeal to all passengers on board the aircraft. Travel guide scenes will influence rather than force passengers to take note of top destinations and hotels. Interfacing purchasing options within the passenger's

By connecting to cameras mounted on the aircraft and using POLED technology, it will be possible to create scenes that turn the cabin of the future into a destination.

seatback will allow them to book flights and holidays with ease.

"One of the things we have been talking about is 'cool' branding opportunities. Boeing is a partner of the Seattle Seahawks (US NFL Team), so we have developed a Seahawks scene," says Bittner.

Cabin lighting that changes colour is also used to enhance the scene. "If you are in a dark cabin and someone has the reading light on, we can tone the light down for you without spoiling the experience for the other passengers'," adds Bittner.

The global control of the cabin is managed by flight attendants. Individual lighting systems and mood lighting are set by the passenger. According to Bittner, however, certain functions will be locked, such as the seatback's full-brightness function, especially when other passengers are trying to sleep.

Boeing's Connected Cabin is developing ways to integrate all of these technologies to create a seamless experience across the aircraft.

WiFi technologies

Most cache on-board IFE systems have the capacity to store 400 hours of content. The smallest server in WiFi Technologies' Air Streamer range can store 4,000 hours. Utilising 50 terabyte (Tb) of storage capacity; the largest Air Streamer can store up to 40,000 hours of music, movies and magazines.

Yves Hendrickx, chief executive officer at WiFi Technologies, says: "Air Streamer transmits the WiFi signal at -41 decibel (db) and not at -75db, which is commonly associated with IFE. The

difference in a single decibel doubles the range as well as the streaming capacity." The quality of the signal, which uses advanced proprietary software, means that a single Air Streamer can supply 500 users at once.

The system uses a ground-based server, which mirrors the one onboard the aircraft. Hendrickx explains: "Content is uploaded to the master server first. Then it is transferred to the aircraft via a 4G network."

When connected to a 4G network connection, IFE content can be updated and amended while an aircraft is at the terminal. Refreshing the content each time an aircraft lands enables the latest content, news magazines or events to be streamed from the server. "The system can upload 10 news programmes of 30 minutes duration in 35 minutes," says Hendrickx.

Autonomous uploads mean that there is no need for flight-crew intervention or specialist assistance from ground service agents.

The use of a server means that any faults are likely to be software-related. This translates to little on-board maintenance. "Almost all issues can be resolved remotely from the master server," says Hendrickx.

There is enough capacity within the server to store large on-board sales catalogues. If the aircraft has connectivity, orders can be processed by the vendor in real-time.

Air Streamer records all the sales data so the airline will be awarded commission for completed sales.

Air Streamer is Federal Aviation Administration (FAA), European Aviation Safety Agency (EASA) and DO160

compliant. The 1.6Kg system can be installed overnight. The system draws power from the aircraft's electrics. There is no requirement for lithium batteries, which, according to Hendrickx, reduces risk of fire.

With an Iridium connection to WiFi Technologies' Air Sat system, Air Streamer has the capability to offer passengers an unlimited short message service (SMS) message feature at no extra cost to the airline.

In future, WiFi Technologies plans a solution that incorporates easy-to-install seatback screens. The idea is to offer an affordable answer when retrofitting IFE systems to a cabin during refurbishment. "This will allow airlines to renegotiate terms with the leasing company," adds Hendrickx.

IFPL charge-to-charge

The ability for passengers to charge PEDs in flight makes USB power part of the overall passenger IFE experience. IFPL has designed a USB outlet that monetises usage.

IFPL's vice president of business development, David Thomas, explains that the difference between profit and loss at airlines can be down to ancillary revenues. "Ancillary revenues are now a huge driver for airlines, especially in the low-cost arena where passengers choose services that they want on a pay-as-you-go basis."

Streaming and watching content drains PED batteries reasonably quickly. Older devices are often not 100% battery efficient and lose charge quickly. When passengers bring their own powerpacks they would rather not use them. When they get off the aircraft, passengers may have another three or four hours of travel ahead of them, and want to save power.

Monetising USB power with Charge-to-Charge focuses on a simple-to-install system for line or retro fit. "What we came up with is a clever USB outlet that does not require a change to all the existing architecture."

Adding smart technology in the USB outlet allows it to be turned on and off by the PED. Modifying the airline app with some simple coding allows the operator to charge the customer to turn the power on and off.

"The passenger buys a token when

Consumer electronics companies are starting to produce devices that are only compatible with Bluetooth headphones. Using Bluetooth technology in the cabin improves headset compatibility.

buying a ticket or through the app. Otherwise, a passenger can buy it on board the aircraft. This can be done through a QR code from the cabin crew or from the in-flight magazine," explains Thomas. The app then recognises that the passenger has bought a token for power. When the passenger plugs in, the device confirms payment and simply turns the power on to charge.

The system encourages a passenger to download the airline app, giving the operator the ability to promote and push other ancillary revenue products and advertising. Combining the system with a WiFi package when passengers buy tickets, creates a virtual class structure.

"A low-cost operator could charge one euro for a sector's worth of power. With a 10% take-up rate on an aircraft that is flying six to seven sectors per day, the airline can generate an ancillary revenue stream of €40,000-50,000 per aircraft per year," says Thomas. He forecasts this amount to be higher, since more people are expected to plug into a charging outlet.

"If the take-up rate is 20%, that ancillary revenue jumps to €100,000 per annum. Charging passengers for as little as two or three years will easily cover the cost of installation on the aircraft," says Thomas.

When passengers connect, the system can download a small advert via metadata to the PED. If there is a wireless server onboard, the system can automatically play an advert as soon as passengers connect.

"It will be up to the airline as to what that experience will be. It could be a two-minute advert or a 10-second one. Again, the clever thing is that the PED captures the metadata and feeds that information back to the airline and the advertising agency to demonstrate that the advertising is being done," says Thomas.

As the system is software-based, it is very low maintenance. The system uses IFPL's reversible USB port, which can handle 40,000-60,000 insertions and has 10 times the reliability of a traditional outlet.

IFPL bluetooth headset

The baseline with consumer electronics is wireless, so more companies are moving towards Bluetooth technology. As a result, some electronic acoustic solution companies are no longer producing headsets with a wired connection.

This is creating a problem for passengers who bring their own headsets onboard. "Passengers who spend $300 on a state-of-the-art Bluetooth headset can find themselves without the facility connect it to the IFE system," maintains Thomas. This results in their using the free '50-cent' wired item supplied by the airline.

Headphone incompatibility can also be a problem. "Because of mismatches with impedance, passengers plugging their own headphones into an IFE system can experience really loud or really quiet volume on all settings," says Thomas.

Using Bluetooth eliminates this, because when the sound gets converted to digital, the volume is standardised. IFPL has created a combination 3.5 millimetre audio jack-plug with Bluetooth audio.

Pairing devices is done through capacitive touch. Holding a button down for a few seconds starts the pairing process that connects a headset to the aircraft's IFE system.

There are several options to monetise Bluetooth connectivity. "Since using IFE is part of the passenger's baseline experience, it is unlikely that an airline would charge for Bluetooth. A better ancillary revenue would be to sell a range of Bluetooth headsets on board in different price brackets," says Thomas.

Airfi Aero

Airfi is a standalone portable inflight entertainment media box. The system enables passengers to access onboard media content. This includes movies, magazines and music from the Airfi server streamed to their PEDs via WiFi.

Airfi is internet browser-based, so passengers can access the stored content without having to download an airline app. Because passengers are streaming directly from the Airfi server they are not using any of their personal data.

Airfi has an add-on system call Leo that connects to the Meridian satellite network. The Leo system uses two small receivers which are connected to the Airfi box, and stick to the aircraft's window. Passengers connecting to Leo through Airfi can then send SMS messages and use messaging services, such as Whatsapp and e-mail.

Airlines do not need to apply for a standard type certificate (STC) to fit Airfi. This saves on installation cost and time. Because of the system's ease of installation, it is ideally suited to operators of older aircraft that do not have any pre-existing IFE architecture installed.

Typically a single aircraft will need four Airfi units to supply the wireless content to 200 passengers; assuming there is a 100% take rate.