

Developments in aircraft external and internal connectivity, and IFE technology have led to the rapid evolution of passenger IFE systems. Airlines now have a variety of system choices, and the ability to offer differentiated services between service type and passenger cabins.

Airline IFE & cabin connectivity strategies

Passengers' in-flight experience has changed significantly in recent years, and expectations have increased accordingly. The past few years have seen the advent and development of wireless and standalone in-flight entertainment (IFE) systems.

Wireless systems are based on airline-supplied devices, bring-your-own-device (BYOD), or personal electronic device (PED) systems. BYOD and PED systems stream IFE content to passengers' personal devices, such as tablet computers, smartphones or Android devices using cabin connectivity.

Standalone systems are portable devices, usually tablet computers, with pre-loaded IFE content. They therefore do not require cabin connectivity.

There is some expectation that wireless and standalone IFE systems may be able to replace traditional embedded systems to an extent, or perhaps complement those systems. There are several variations of a wireless IFE system, as well as advantages and disadvantages. There is one type of standalone system. It is still too early to tell what strategy airlines may follow, but some trends are emerging.

In-flight experience

Technological development means the range of entertainment that can be delivered to each passenger seat have increased and improved significantly.

Traditional or embedded systems have evolved. The levels of embedded IFE system used varies with flight length cabin class.

Embedded systems continue to develop and are still popular with airlines. More long-haul services now have embedded IFE systems, with larger high definition (HD) seatback screens. The accompanying selection of audio and visual content is larger.

Lumexis is one IFE system vendor.

"We are constantly driving down the weight of our embedded system," says John Norris, vice president of sales at Lumexis. "We only have a server and a cable serving each seat. There are two fibre optic cables to provide content, and no under-seat boxes. This saves weight. The system is full HD and provides thousands of movies. There is also a power cable to each seat. We estimate there is little weight saving now between an embedded and a wireless system. I think lightweight seatback systems are likely in the future."

Embedded IFE services have been free in all cabins on long-haul services. Service level between premium and economy cabins is now being differentiated by provision of larger screens and content selection, and additional services, such as electric ports for charging laptops and other PEDs.

The traditional in-flight service on short-haul services has been limited, mainly because most passengers are unable to watch a full movie on a flight shorter than three hours. Moreover, the cost and weight of a full embedded system is excessive compared to the benefit of enhancing the in-flight experience with free IFE service.

A minority of airlines equip aircraft used for short- and some medium-haul services with drop-down screens installed in the cabin ceiling. This provides a limited service. Most short-haul aircraft, however, have no IFE system.

As Norris points out, 45% of Airbus and Boeing narrowbodies delivered in recent years have no IFE system, while 33% have been equipped with overhead, drop-down TV-sized screens. Only 20% have an embedded system installed, and just 2% have a wireless IFE system.

A few short-haul services, however, do provide an IFE service. One particular change in in-flight products and services is provision of internet access. This is growing, and used extensively in the US.

IFE developments

The advent of external and internal connectivity in recent years has stimulated change in IFE services. The two together make access to the internet possible. Internal connectivity provides WiFi signals in the passenger cabin, which is used to stream IFE content.

External connectivity for cabin services is provided by either satcom or air-to-ground (ATG) connectivity systems. WiFi signals are transmitted from wireless access points (WAPs) in the cabin ceiling.

"Long-haul aircraft now require satcom connectivity anyway for the new-generation navigation systems," says Duc Huy Tran, director of airline sales and marketing for air transport cabin at Rockwell Collins. "This means satcom systems with higher data transmission rates can be added relatively easily for the cabin. This provides internet access."

The most basic services possible through internet access are e-mail, internet surfing, and text messaging. On-line shopping in real-time is also possible because of credit card authentication. The use of e-mail and text messaging requires data transmission rates of 1-2 Megabits per second (Mbps). Phone calls require similar rates, although this service is either seldom used or disallowed by some carriers. Basic internet access and web browsing require data transmission rates of at least 3Mbps.

Higher-level on-line services include making phone calls, accessing live TV, and streaming audio and visual content from ground-based services. While each of these higher level services requires high data transmission rates, there are differences and people may be unaware of which services require the highest transmission rates. "Live TV is not really a problem in terms of internet data transmission speeds. Only one feed per TV channel is required, irrespective of how many people are watching the



channel,” says Norbert Mueller, senior vice president of BoardConnect at Lufthansa Systems. “In contrast, video-on-demand (VoD) or streamed visual content and movies requires one channel per viewer, so data transmission rates have to be many times higher.”

Each TV channel requires a data transmission rate of about 1Mbps, regardless of the number of passengers watching the same channel. JetBlue provides 36 TV channels on board, and so requires a data download rate of at least 36Mbps from the Viasat system.

This compares to streaming live movie content which requires a higher data transmission rate of 1-2Mbps per passenger. Mueller comments that VoD requires a rate of about 70Mbps.

While long-haul aircraft already have some form of external connectivity that can make it easier to provide internet access, the US domestic market has seen a lot of development in providing the internet in the cabin. This is made possible either through satcom systems, or by ATG cellular systems.

JetBlue uses Viasat’s satcom system in domestic US airspace, and has high data download rates. The Viasat system allows JetBlue to provide more than 100 live TV channels. JetBlue also provides internet access, and both services are provided on a complimentary basis. It is expensive to provide in-flight internet access, however, and the system is sponsored by Verizon.

In addition to Viasat, two other main providers, Gogo and Global Eagle Entertainment (GEE), provide paid-for internet access on US domestic flights.

Many aircraft operating US domestic routes now have ATG systems fitted. Gogo’s original service ATG provides data downlink rates of up to 3Mbps per

aircraft. ATG4, the second version of Gogo’s ATG, launched in 2012, has a higher downlink rate of 10Mbps per aircraft. Gogo has four US customers for ATG4, collectively operating 550 aircraft with the system. About 1,800 aircraft in the US are fitted with ATG and ATG4.

Gogo has recently launched a Ku-band Satcom service, called 2Ku-band, with a higher downlink rate than regular Ku-band. This has a downlink rate of up to 70Mbps.

Meanwhile, GEE offers its Ku-band service with a downlink rate of 10Mbps. GEE’s system has a high enough downlink rate to also supply live internet protocol (IP) TV. This system is used by Southwest Airlines.

Internet access is often provided free in premium cabins, but is more likely to be charged for in economy classes. The most advanced IFE systems also provide internet access through the screen, normally in premium cabins as part of a complimentary service.

The take-up rate of paid internet access on US domestic services, however, is relatively low at less than 10%. The take-up rate of on-board internet on JetBlue is 23% across its whole route network, and 45% on long-haul routes.

The other main development is internal connectivity, which has led to the development of wireless IFE systems. With WiFi signals, visual and audio content can be streamed from the aircraft’s IFE server to tablet devices or smartphones. The devices can be provided free or for a small fee by the airline, or the system works on a BYOD/PED basis. This provides an airline with an alternative to a traditional embedded system.

The WiFi signal can also be used by

The most prestigious airlines are classed by some as luxury airlines. These carriers have installed high-specification embedded IFE systems in recent years. These can include secondary screens for use as control panels, USB ports for passengers to charge laptops, and the provisioning of WiFi in the cabin so that passengers can use their PEDs.

the passenger for internet access on their own device, when the aircraft also has external connectivity.

A third, simpler IFE solution is for an airline to provide a standalone in-flight service using loaned portable and pre-loaded devices, such as iPads, each weighing about 1lb or 0.5Kg. Rather than content being streamed wirelessly, the tablets are pre-loaded with audio and visual content, and loaned to passengers. The devices have content loaded off the aircraft, but can be charged on-board. The system means an aircraft does not need the hardware of an IFE server and WAPs to provide a WiFi signal.

Portable and pre-loaded systems need no other hardware, which should lead to savings in installation costs, weight, and on-going maintenance over embedded and wireless systems. Portable systems, offer a low-cost and simple alternative.

An example is Bluebox Avionics’ Bluebox IFE portfolio, which includes a portable IFE system using iPads. “An iPad has enough battery power to operate for 10 hours and can store 70 or more movies,” says Kevin Clark, chief operating officer at Bluebox Avionics. “There is the option of using the device to surf the internet if the aircraft has internal WiFi and external connectivity.”

Modern IFE services

Through external connectivity with high data transmission rates, JetBlue has high-resolution seatback screens on all its services, together with a free internet access service called Simply Surf. This allows the passenger to watch live TV, send and receive e-mails, use social media, stream live content from providers such as Netflix and Hulu, and do internet shopping. JetBlue has provided live TV since beginning operations in 2000 to differentiate itself from other carriers.

While internet access and the use of PEDs has given passengers more control of the in-flight experience, it has also increased or stimulated demand for charging ports in passenger seats, which use PEDs to make use of the internet. This is usually the case in premium cabins, but is increasingly being seen in premium economy cabins, and even in economy cabins on aircraft used for long-haul services.

The possibility of internet access, live

TV, live streamed content from external sources, and wirelessly streamed content from the aircraft's IFE server make it possible for airlines to provide a wide range of cabin entertainment services. Moreover, some claim it makes it possible for an airline to switch from a traditional embedded IFE system. Further implications are that in-flight services could be extended to more cabins or short-haul services. It therefore raises the issue of what choice an airline should make between an embedded, wireless or portable IFE system.

Airline classes

IFE system selection is influenced by the passenger cabin and length of flight. Services can broadly be divided between long-haul and short-haul, with the dividing line being a flight time of about three hours in respect to traditional IFE services. Longer flights allow movies to be watched, and so justify installation of more comprehensive IFE systems.

Traditional embedded IFE services are provided by airlines in all cabin classes on medium- and long-haul services. The differentiation between premium and economy cabin classes in this case is the provision of additional or enhanced services in premium cabins, or providing

IFE free of charge. Recent developments are ports for charging laptop computers and other PEDs, or free internet access. The most prestigious major airlines offer the most advanced and comprehensive IFE systems. Francois Rodriguez, chief strategy and marketing officer at SITA OnAir says select major airlines, operating long-haul services, could be regarded or classed as luxury airlines. "This group includes airlines like Emirates, Etihad, Qatar Airways and Singapore Airlines," says Rodriguez. "They offer the largest HD screens, and have the largest content selection. They also often provide a secondary screen in the seat arm, and this is used as remote control. This can be used to provide alerts for items such as news or sports, while the main screen is being used to watch movies, for example."

The latest generation embedded systems also have ports for charging PEDs. USB ports, in particular, are located in seat frames. Airlines have to be cautious, however, when choosing the right gauge of USB port. "The three levels available are 0.50 amps, 0.95 amps, and 2.10 amps," says Norris. "While the two smallest ports provide sufficient power for some devices, including earlier variants of the iPad and iPhone, the 2.10 amp port is required for latest versions of

the iPad and iPhone."

"Airlines want to provide the very best services for long-haul premium passengers to build loyalty," says Harry Gary, vice president of sales and marketing at Zodiac Aerospace. "They therefore want to provide both embedded and wireless IFE. This way passengers can use seatback screens and their PEDs. Ideally these would be linked, as is the case with our RAVE IFE system."

"Airlines also want to provide IFE for long-haul economy class passengers, either seatback or wireless, or both in some cases," continues Gray. "It is likely to remain free of charge for most airlines, particularly seatback access. Some may choose wireless content, however, such as films. Most airlines that provide connectivity to economy passengers charge for it, but there is a movement to complimentary WiFi."

"Some major airlines are looking at cheaper alternatives," says Rodriguez. "In fact Philippine Airlines has removed the embedded system on its long-haul routes. This has been replaced with iPads and a wireless system in business class". This is an exception, however.

Most short-haul airlines have not offered IFE services. The cheapest options for them are a wireless system without internet access and with PEDs, or a

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standalone system with airline-loaned tablets with pre-loaded content. Lufthansa and Virgin Australia use Lufthansa Systems' BoardConnect wireless system with PEDs.

Some airlines have used drop down screens in the ceiling on short-haul aircraft. Rodriguez points out that some airlines are removing them because they have limited content, and are heavy and expensive. These are now being replaced by wireless systems in some cases. "The provision of seatback IFE is just starting in the short-haul market, so it is hard to identify trends. It looks like airlines will certainly charge for connectivity, and maybe IFE content as well," says Gray. "Many airlines have not provided embedded IFE on short-haul in the past, and wireless IFE provides a cost-effective way of doing so."

There are some major airlines that fall between traditional long- and short-haul operators. Trans-continental or coast-to-coast US services, and many intra-Asian routes, are medium-haul operations with flights of three to six hours. Many do not have embedded IFE systems, and only in the US have internet access. While medium-haul services have limited IFE provision, this is changing. Hawaiian Airlines, for example, is using a portable IFE system on its 767s using iPad minis.

Another airline category that has little or no current IFE service is the low-cost and holiday airlines, many of which are in West Europe. These airlines have relatively simple cabin service with short seat pitch. While embedded systems cannot be justified, wireless IFE or portable systems may provide the possibility to generate ancillary revenues.

"Low-cost and holiday airlines are likely to select a wireless system, or one

with connectivity," says Tran.

Providing internet access, however, can be expensive. "A wireless system can generate ancillary revenues, since the passenger has to go through the airline's home page," says Tran. "This presents an opportunity for advertisers. A wireless system can also be used for on-board shopping. Moreover, low-cost or holiday airlines can also charge passengers to watch movies or listen to music."

Rodriguez has defined a new category of airline referred to as lifestyle airlines. "These are positioned in the market as strong brands, and include carriers, such as Virgin America, JetBlue and EasyJet. They are no longer low-cost airlines," says Rodriguez. "They are embracing wireless systems, and this is because most passengers now carry on PEDs. In fact, 81% carry on smartphones, and 40% carry on smartphones and tablets."

A standalone system with portable devices may be suitable for airlines that do not expect to generate any ancillary revenues, but want a low-cost solution.

Embedded vs wireless

A main issue raised by the advent of wireless and portable systems is whether airlines will use just one type of IFE system, or combine two types in a hybrid. This depends on cabin class and the service being operated. Short-haul services are more likely to use a single type of IFE system.

A wireless system has an IFE server, several WAP points in the cabin ceiling to distribute WiFi signals, a set of tablet devices to loan to passengers, and a storage rack for the tablets.

Passengers use their own PEDs in a BYOD system. This reduces the hardware

Lufthansa Systems's BoardConnect is one example of a wireless IFE system now available to airlines. Airlines have the option of providing tablet computers to passengers, or relying on passengers to use PEDs. Airlines should be aware of the several technical issues that affect wireless systems.

provided by the airline.

In both systems, WiFi signals stream audio and visual content from the server to the handheld devices.

An option with both types of wireless system is to also equip the aircraft with external connectivity, such as Ku- or Ka-band Satcom; or Gogo's ATG if the aircraft is operated domestically in the US. This provides the external connectivity for internet access.

A problem, however, is that internet access on aircraft has poor downlink rates in many cases, and the service is also relatively expensive to provide. Because uptake rates by passengers have been low, some airlines are hesitant to provide the service. Some carriers have considered getting the service sponsored. One possible group of sponsors is advertisers that display to passengers when they make initial internet contact while on board, or when they are accessing various on-board products such as live TV.

"A drawback of streaming content from ground-based sources is that streamed movies require the highest rate of external connectivity data transmission," says Mueller. "We have disks on our aircraft IFE servers with a 800 gigabyte capacity. We are increasing this to one terabyte. This can store hundreds of movies, so it negates the need to have an external connectivity system with an ultra-high data transmission rate."

There are, therefore, several permutations of wireless systems, with different product and content offerings, and different levels of hardware and equipment, and varying amounts of weight. The issue is whether airlines will use these instead of, or as well as, traditional embedded systems.

Norris comments that the low take-up rate of wireless and portable systems by airlines to date indicates that they have a long way to go. "Many airlines are staying with embedded systems for the time being, and a hybrid of embedded with PEDs on a wireless network is most likely for a large number of carriers."

Wireless issues

Several issues need to be considered in relation to a wireless system.

The first is that most passengers use IFE systems to view movies. Content is

divided between early window (EW) and late window (LW) content. EW comprises movies that are currently being shown in movie theatres, or that have been recently released. The same applies to recorded TV shows. "There is no clear dividing line between EW and LW content," says Mueller. "The definition is made by the movie studios, and changes with each title. It also varies with each studio. For TV shows, it also varies by country, TV network, and by title."

The problem with EW versus LW content is that the movie studios only allow EW content to be streamed to airline-owned devices. An airline cannot legally stream EW content onto PEDs. This limitation means that a BYOD wireless IFE system is limited to LW content. Most airlines are using BYOD systems, and relying on passengers to bring their PEDs.

"The first drawback of this is that 85% of the content watched on IFE systems, where both LW and EW are available, is EW material," says Norris.

Airlines must be clear which studios have provided each IFE vendor with licences to stream EW and LW movies to airline-owned devices, and LW movies to PEDs. "The main Hollywood film studios are Sony, Disney, Paramount, Fox, Warner Brothers and Universal," says Mueller. "We have licences from all six of

these studios for both types of content."

The next issue for consideration is that the film studios, and other content providers, need to have copyright protection in the form of digital rights management (DRM). "To have access to high-quality content, any wireless IFE system needs to DRM-encrypt that content, and then deliver DRM licenses to users to allow viewing," says Clark. "Some wireless systems have that licence delivery function on the server, but a problem arises when the licence delivery function is controlled from the ground, and has to be accessed from the aircraft. This means the aircraft has to be equipped with an external connectivity system, if it is not present. We developed our Bluebox wireless system with the DRM licence delivery function on our self-contained server, so that the aircraft does not need external connectivity."

It is also necessary to convince the film studios and audio content providers that the airline and IFE vendor have enough security in the system to prevent any content from being stolen or downloaded by passengers, in the case of LW content when using a BYOD/PED system, and EW and LW content when using airline-owned devices.

The security systems also have to be tested by the IFE vendors to satisfy the film studios. "Our BoardConnect wireless

system has been tested by the six main film studios' security experts," says Mueller. "Also, if the IFE vendor wants to access movie content, it must have approval from the Motion Picture Association of America."

One technical issue is that the airline needs to have a supplemental type certificate (STC) to instal an IFE server, the several WAPs, and associated wiring looms. One STC is required by each airline for each aircraft type it operates.

Another technical issue is that the IFE system has to be constantly updated to handle a large number of different PEDs that are in the market. "New variants of smartphones and tablets are frequently released, so frequent software changes to the IFE server are required if the system is a BYOD/PED set-up," says Norris. "The IFE provider is almost in a situation that it never finishes designing the system."

While it is possible to make frequent updates for tablets and some smartphones, the number of android devices is so large that it is harder for IFE vendors to make it possible for all devices to operate with the system.

A related issue is that passengers need to have the relevant application downloaded onto PEDs to allow them to connect to the IFE system. This has to be done prior to before boarding.

Once in operation, there are further

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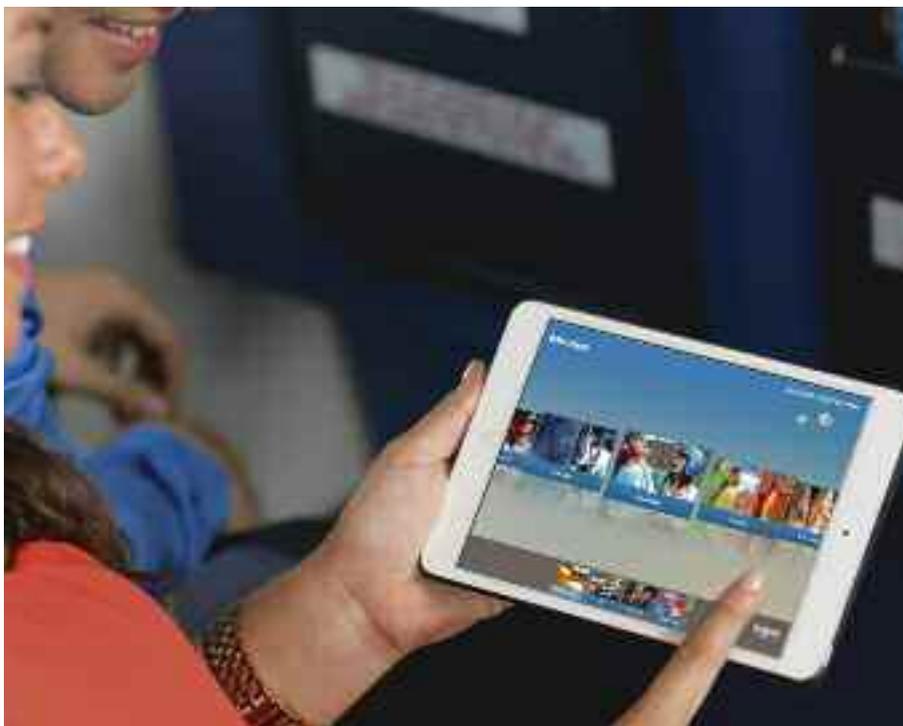
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considerations for wireless systems that use airline-owned devices. The airline needs to have security systems in place to prevent theft. Devices may be provided on a complimentary basis during flights, or on a rental basis, so all devices need to be tracked and collected at the end of each flight.

Airline-owned devices also need to be cleaned and re-charged. There are various devices on the market to stack and charge iPads and other tablets, either on the aircraft or at the outstation. All devices, however, at least need a storage facility on the aircraft.

Airlines also need to keep at least one spare set of devices per aircraft while another is in use. The spare set can be kept in a storage cart that also has charging capabilities, or has to be held at each outstation where they are charged.

There is also the issue of providing maintenance and upgrades for the viewing tablets and devices.

Logistics and tracking make an airline-owned system unpopular with airlines and flight attendants. Flight attendants also have to provide IT support services.

An advantage to both types of wireless IFE systems is that there is less of a distinction between cabin classes with the WiFi signal throughout the cabin. Some degree of cabin distinction is achieved by providing a higher bandwidth in the forward cabin sections, or by charging economy passengers for it.

Overall, there are a lot of technical issues and passenger frustrations associated with wireless systems using airline-owned devices. More airlines are, therefore, opting for a system with PEDs.

An example of a wireless system with PEDs is Lufthansa Systems'

BoardConnect product. This is used by Lufthansa on 20 A321s, by Virgin Australia on about 100 aircraft, by El Al, and by Pacific operator Air Calin. Virgin Australia uses airline-owned devices, but also provides the option of using PEDs. The other three carriers use the system with PEDs alone. "Virgin Australia is working successfully with relatively young LW content on its system," says Mueller.

One drawback of this solution is that airlines cannot provide EW content, which is in demand from most passengers. This may lead to airlines choosing to provide a hybrid of an embedded system with WiFi signals and external connectivity that allows the use of PEDs.

Mueller comments that a wireless system with PEDs causes the least problems of all the options available. "One particular advantage is that it merges well with external connectivity systems, which are likely to be present on long-haul aircraft," says Mueller. "Passengers can therefore use PEDs for uses such as e-mail and regular internet browsing."

Portable systems

Bluebox Avionics provides a standalone IFE system based on iPads. These tablets are loaned or rented to passengers during flight.

Content on the Bluebox system is acquired by airlines from other providers after buying the hardware. "Bluebox devices are approved to carry EW content, which satisfies the high percentage of passengers that require this content," says Clark. "Tablets can also be loaded with LW content."

Bluebox Avionics is one provider of portable IFE systems. The advantage over wireless systems is that tablets are pre-loaded with content and consequently do not require wireless connectivity to stream content from a server.

A standalone system with portable devices represents a simple choice for an airline that wants to minimise investment. "The system does not require a server, hardwiring to the WAPs, and WAP aerials in the cabin ceiling," says Clark. "This saves weight and on-going maintenance costs. In a pure standalone configuration, no external connectivity is required either. Singapore-based Scoot Airlines uses a standalone system on its six 777-200ERs, and uses iPads as tablet devices. The whole system is light, and only requires the content to be periodically updated.

"A standalone system is at least 50Kg (110lbs) lighter than a wireless system," continues Clark. "There is a larger weight difference between a standalone system and an embedded one."

A standalone system, however, still requires a storage rack on the aircraft. A second set of tablets will also be required, either on the aircraft or at each outstation. Bluebox Avionics has designed a case containing a battery to charge a spare device. Clark comments that an iPad can work for about 10 hours before running out of charge.

A standalone system is an attractive solution for an airline with an old legacy embedded system installed on a fleet that will be phased out within a relatively short period of time. It is also an attractive option for an airline operating medium-haul routes. Hawaiian Airlines is one example. A similar system would be suited to trans-US and trans-Asia Pacific routes.

Bluebox Avionics has enhanced the standalone or portable devices so that they also connect wirelessly to the aircraft's IFE streaming server. The system can, therefore, become a hybrid of a standalone system with pre-loaded devices that have EW content, and also have a wireless connection. The advantage of this is that streaming provides a higher volume of content and choices for the passenger compared to pre-loaded devices.

"There are two variants of this hybrid system," says Clark. "One is with internal connectivity only, so that the passenger can see what is available on the server. The other variant has internal and external connectivity, so that the passenger can access both the IFE server and the outside world via the internet." **AC**

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