In-flight connectivity systems are being installed and upgraded onto the world's fleet at an ever-growing pace. This article assesses the cost of installation and maintenance of these systems, how passengers perceptions to in-flight connectivity are changing, and the additional benefits airlines can receive from these systems.

The cost of installing in-flight phones

In-flight phone and Internet connectivity is one of the fastest growing areas in commercial aviation, with the major providers announcing an ever-growing number of customers.

Traditionally, the use of mobile phones in-flight has been prohibited, and in-flight Internet connections have been unavailable. Now that the technology is legal, available and fast enough to deal with requirements in most parts of the world, more and more aircraft are being configured to use these systems.

The connectivity options available, the cost of installation and maintenance, and how passenger perceptions are changing all need to be assessed for airlines to make an economically informed decision about the merits of equipping their aircraft. Also analysed are the costs of installing and maintaining other revenue-generating hardware, such as handheld devices, and any other benefits to airlines of installing these in-flight connectivity systems.

In-flight connectivity

There are two types of connectivity between an aircraft and the outside. The most common worldwide is via satellite communication (SatCom). There are four levels of SatCom available.

The first is provided by Iridium. This is the cheapest and lowest bandwidth system. "Iridium is the cheapest, lightest SatCom system available," says Wale Adepoju, chief executive officer at IMDC. This is because Iridium connects to a lower orbit constellation of satellites. Coverage is reliable, but it is not as sophisticated as the other systems available. There is a lower data transfer rate, and Iridium is not suitable for higher data usage requirements such as voice calls. From a passenger perspective, Iridium is only really sufficient for e-mails and the in-flight use of credit cards.

The second level of SatCom is provided by Inmarsat. Called Inmarsat Classic, this is now standard equipment on widebodied aircraft such as the A330/A340, A380, 747, 767, 777 and 787. It is also required for extended-range twin-engine operations (ETOPs) certification for long-haul twinjets. "It is a highly reliable, robust SatCom system, which can even pick up a canoe in the Atlantic Ocean," says Adepoju. Inmarsat Classic uses a network of 3-4 higher-orbiting satellites, and is more expensive than Iridium, as it provides a higher data transfer rate of 10Kb per second. From a passenger perspective this allows for a limited number of voice calls or SMS text messages. The retrofit of Classic onto an Iridium-only configured aircraft is relatively simple and inexpensive.

Inmarsat provides the third level of SatCom, called Swift Broadband. This is a significant step up from Iridium and Inmarsat Classic in terms of data transfer rate, providing 432Kb per second. Unlike Iridium and Inmarsat Classic, Swift Broadband is not yet certified for operational use, so it cannot be used by pilots or air traffic control (ATC) for operational purposes. For the passenger however, Swift Broadband gives a much higher capability in terms of voice calls, text messages, and faster Internet usage.

In terms of installation, Inmarsat dictates the exact specifications of the antenna required to use the system, so all connectivity suppliers using the Inmarsat Swift Broadband system are subject to the same costs.

The fourth level of SatCom, Ku-band, is the highest level currently available. This has a maximum data transfer rate of 25Mb per second. Like Swift Broadband, Ku-band is not authorised for operational uses. For the passenger, however, Ku-band allows a large number of simultaneous voice calls, a high data transfer for Internet usage, and live TV in the cabin.

"The cost per Mb on Ku-band is much lower than for Swift Broadband, which allows for large savings on data transfer," says Adepoju. Unlike Swift Broadband, however, there is no wholesaler for Ku-band antennas, so the cost of Ku-band systems can vary more than the Inmarsat systems.

The cost of upgrading from Inmarsat Classic to Swift Broadband or Ku-band is in fact very similar, even though the types of antenna required for Swift broadband and Ku-band are different. Depending on the supplier used (particularly for Ku-band), the cost of upgrading is $50,000-$100,000. This is the same as upgrading from a completely unconnected aircraft (that is, with no Iridium), because parts from other systems may not be re-usable, and the airline would simply have to buy new equipment to configure Swift Broadband or Ku-band. The cost of upgrading a widebody or narrowbody is similar because the connectivity equipment required is the same whatever the size of the aircraft. The costs of configuring different fleets, whether they are A320s or A380s for example, are therefore close.

The second type of connectivity between an aircraft and the outside is air-to-ground connectivity. This requires a network of ground transmitters, sending continuous signals to an aircraft during its flight. This type of connectivity cannot be used over water, so its use is limited for most airlines. The exception is US domestic operations, where this type of connectivity is widespread. Aircell is the exclusive provider of these signals in the

The cost of retrofitting aircraft with the required connectivity hardware for in-flight phones and other devices for internet connection is up to $500,000. This is small compared to the cost of a comprehensive in-flight entertainment system.

US, and more of Aircell's GoGo in-flight Internet systems are being installed on US domestic-only fleets. This air-to-ground connectivity provides a strong, consistent WiFi signal to aircraft configured with the system, but does not currently allow the use of cellular signals.

Connectivity providers

There are two main providers of in-flight connectivity systems worldwide: OnAir and Aeromobile. Both provide cellular and WiFi signals to passengers inside the cabin. OnAir offers airlines two connectivity solutions, which can be purchased singly or together: Mobile OnAir and Internet OnAir. Ian Dawkins, chief executive officer at OnAir states "MobileOnAir's technology enables people to use their mobile devices as they do on the ground, by creating a GSM network inside the aircraft cabin. Costs are in line with international roaming rates and appear on passengers' regular mobile phone bills."

OnAir and Aeromobile are in effect mobile phone network providers that customers connect to while on-board, in the same way a mobile phone connects to a local network while in a foreign country. Passengers using this service are charged roaming fees as they would be if using their phone abroad. This keeps it simple for the passenger who is simply billed by their own mobile phone provider. Airlines that install this system share revenues from roaming fees with OnAir and Aeromobile.

The WiFi product offered by OnAir is called Internet OnAir. "OnAir provides a WiFi hotspot in the aircraft, which passengers can access like any other hotspot in hotels, airports and elsewhere: they simply enter their credit card details and start browsing," adds Dawkins.

"Both OnAir products use Swift Broadband, Inmarsat's L-band solution, which provides consistent global coverage. OnAir has been a Swift Broadband distribution partner since 2006," continues Dawkins. This means that to install one or both of the OnAir products, an airline must also upgrade to Inmarsat Swift Broadband if it does not already have it. This will be done at the same time as installation of the OnAir product to minimise downtime of any particular aircraft.

"For the future, however, OnAir will offer services over Global Xpress, Inmarsat's global Ka-band solution, which will be available from 2013. OnAir is one of only two Global Xpress distribution partners," says Dawkins. Ka-band is a version of K-band technology and operates at the same bandwidth speed as Ku-band. OnAir customers, will be able to use Internet broadband speeds similar to those found on the ground. Mobile OnAir customers include Aeroflot, Air Asia, Air New Zealand, British Airways, Qatar Airways, Royal Jordanian and TAM. Customers with both Mobile OnAir and Internet OnAir include Egyptair, Oman Air and Saudi Arabian.

Aeromobile, in conjunction with Panasonic Avionics Corporation, is the other major provider of in-flight connectivity and can provide cellular signals, WiFi signals, or both to its customers. Panasonic manages the delivery and maintenance of the physical hardware required for these signals, while Aeromobile provides the roaming service inside the aircraft cabin. "Aeromobile provides the capability for voice, text and data transfer. 2.5G cellular technology is currently provided inside the cabin, but first installations to upgrade to 3G will start next year," says Jack Gordon, senior marketing manager at Aeromobile. 2.5G shows the generation of cellular technology used, with most smartphones at least 2G. Many are 3G, while 4G will be the standard in the future.

Three products provide the mainstay of the Aeromobile/Panasonic partnership: eXPhone, eXConnect, and eXTV. "Swift Broadband is the minimum requirement for eXPhone and provides enough bandwidth for voice, data, and text services for passengers," says Gordon. "Swift is not strong enough for eXConnect and eXTV, however, which requires the installation of Ku-band SatCom on the aircraft." Customers of Aeromobile/Panasonic include Lufthansa, Virgin Atlantic, Cathay Pacific, Turkish Airlines, Thai Airways and Emirates.

Vendors such as Aeromobile and OnAir also have a vested interest in what SatCom technologies are available, as their ability to offer their services to passengers depends on the level of SatCom installed on any particular aircraft. "The cost of installing the Aeromobile product depends on the in-flight entertainment (IFE) package ordered by the airline, as well as the level of SatCom currently installed," says Gordon. "There is not much difference in the costs of installation between aircraft type, but there is a one-off cost for certification of our systems."

When considered against the cost of a complete IFE package, the costs of adding an OnAir or Aeromobile connectivity system are relatively small. "The cost of retrofitting an aircraft with different connectivity systems is $150,000-500,000," estimates Adepoju. "Much of this depends on the system chosen by an airline. A Ku-band connection with live TV capability will be more expensive than a slower connection offering just e-mail capability." The cost of a complete IFE system could be $4-5 million for a large widebody, so the added cost of an in-flight connectivity system is relatively small in comparison.

To install an in-flight connectivity system simply requires the installation of an avionics box to the aircraft. "The added maintenance costs are minimal on an on-going basis," says Gordon. This is

While in-flight phones are now technically possible, many passengers still have the perception that they are not permitted. Passengers also have the perception that in-flight roaming charges are higher than on the ground, and this deters them from utilising the facilities.

because in terms of physical hardware, there is very little extra to maintain. Airlines will have a budget for IFE maintenance costs and the in-flight connectivity hardware will be added into this, but will amount to a minimal increase. Software updates to keep certain systems up to date may be more of a cost issue if these updates require downtime to install. Again, however, this is likely to have a minimal effect on cost.

Installing connectivity systems throughout a whole fleet can take a significant amount of time, particularly for the larger airlines. The process is often tied in with regular maintenance checks. By the time a fleet is installed with one system (for example, 2G), communications on the ground have often advanced (for example, 4G). This makes it difficult to match connectivity speeds on the ground with those available in the air. As more aircraft are updated with Ku-band technology, this gap may shrink and passengers will see less of a difference between their Internet connection in the air and on the ground.

A third in-flight connectivity provider, Aircell, provides WiFi signals via air-to-ground transmitters, to airlines flying domestically in the US. There are political and legal issues concerning the use of cellular signals in-flight over US airspace and until this is resolved, this type of technology will be unavailable to those airlines with US domestic operations. Aircell has an exclusive licence to supply US domestic carriers with WiFi signals, through its GoGo system. Similarly to OnAir and Aeromobile, it costs $50,000-100,000 to install the Aircell system on an aircraft *(see Generating revenue from in-flight phones & technology products, Aircraft Commerce, December 2010/January 2011, page 12).*

Since Aircell is providing connectivity in a domestic-only environment, roaming charges cannot be widely applied, so potential revenue from providing a cellular signal would be minimised anyway, even if it were available. The biggest issue for Aircell, therefore, in this environment is providing connectivity over water, in particular for the US domestic route to Hawaii. Air-to-ground transmitters will not work on this route for obvious reasons, so a SatCom solution is required.

Major US airlines may choose to have a split fleet of SatCom- and non-SatCom-configured aircraft. Aircraft that fly internationally could have Aeromobile or OnAir systems using SatCom technology, while the domestic fleet will only have Aircell air-to-ground technology. Those international aircraft could therefore be used on the Hawaii route. Aircell customers include American Airlines, Delta Airlines, Air Tran, United Airlines, US Airways, Virgin America and others.

Passenger perceptions

Until relatively recently, passengers have been unable to use mobile phones in-flight in any capacity. This has created a popular perception that even now mobile phones cannot be used in-flight. This perception has to be changed for any of the companies involved to earn revenue from in-flight connectivity.

Traditionally, passengers turn off their mobile phone pre-flight, store it in their hand baggage, and then only re-use it on arrival. Passengers need to be informed that they can use their mobile phone in-flight, either via WiFi or cellular signals.

"The announcements made by airlines in the past have created the perception that mobile phone usage in-flight is unsafe," says Adepoju. "In fact the opposite is true, and mobile phones can amplify signals sent to an aircraft."

Advertising campaigns, newsletters and, perhaps most importantly, passenger announcements in-flight are changing this perception, however. Airlines that have invested in in-flight connectivity systems want to gain a return on investment so they want their passengers to know that in-flight connectivity is available.

"Fewer people are worried now about mobile phones and safety in-flight," adds Adepoju. "Instead, the problem is the perception of high price." Foreign roaming charges are expensive, especially when compared to a passenger's tariff in their home country. There is now a perception that in-flight roaming charges must be even higher, because they are being connected 30,000 feet or more above the ground. "Few people look in detail at their roaming tariffs," says Adepoju.

This creates an impression that in-flight phone calls are doubly expensive and puts people off using mobile phones in-flight, so that mobile phones continue to be stowed away during flights.

"The cost of in-flight phone calls and data usage has been steadily decreasing and are now comparable to roaming charges on the ground," says Gordon. "Examples show that in-flight calls are not as expensive as perceived."

As of October 2011, only 8.6% of commercial jet aircraft had any form of in-flight connectivity for the passenger. This is likely to increase, therefore, as both the perceptions about safety and price decrease among passengers. In two years' time, it is likely that this percentage will be significantly higher.

Handheld devices

It is not just passengers that can benefit from the increased connectivity that will be found on-board more and more aircraft in the coming years. Providers of IFE and in-flight retailing also stand to make use of these systems.

GuestLogix is one such provider, with its on-board store technology platform available on handheld devices, and the software required to manage the retailing process. Most of its handheld devices

The use of Ku-band on aircraft allows for a high volume of calls, a high rate of data transfer for Internet usage, and live TV in the cabin.

currently installed on aircraft work offline, because many of its customers are yet to install in-flight connectivity systems across all of their fleet. This means that credit card payments are not authorised until the aircraft has landed and the device can connect to ground connectivity systems. The major disadvantage of working offline is that this runs the risk of credit card fraud.

"Chip and pin has helped with credit card fraud tremendously. Real-time credit card authorisation will take this to the next level however," says Richard Cushing, senior vice president and general manager at GuestLogix Europe. "Real-time credit card authorisation is a bi-product of connectivity, and allows all parties to generate more revenue than offline systems."

This is because the risk of credit card fraud is even further reduced with real-time authorisation, increasing the safety of on-board transactions for the airline. The value of products sold on board can therefore be increased significantly, and means the potential for greater revenues for the airlines, retailers and GuestLogix.

Debit cards cannot currently be used by passengers to pay for on-board retail products, because they carry a higher risk of fraud than credit cards. Real-time authorisation opens up the potential for debit card use on-board, and further broadens the potential customer base for airlines. This increases the potential for added revenues for the airline.

"In-flight connectivity is a real opportunity to expand the product line available to passengers," says Cushing. "We can sell them products related to their destination. This makes the GuestLogix solutions even more flexible for our customers. We have agreements with theatres, car-hire companies, and hotels to sell these destination-related products to the passenger."

This is achievable because in-flight connectivity systems, in particular higher bandwidth solutions such as Swift Broadband and Ku-band, allow for real-time processing. Without this, products such as theatre tickets would not be available because there is always the risk that sales on the ground will render potential tickets sold in-flight unavailable. In-flight connectivity and real-time processing capabilities cuts this risk.

GuestLogix do not just provide this type of capability through handheld devices, however. GuestLogix software can be built into an integrated IFE package for an airline. On-board retail, and in particular real-time destination-related products, can then be provided to a passenger through the seatback IFE screens. "GuestLogix is an enabler of in-flight shopping, with an expertise in transactions. This can be provided through both handheld devices and seatback IFE, dependent on the nature of the customer," states Cushing.

"The costs of installation are also driven by the nature of the airline customer's model," says Cushing. "The cost of the handheld devices is not dependent on the size of the aircraft, so the number required per aircraft depends on the airline's needs. LCCs regard ancillary revenues from on-board retail as a vital source of income, and so may buy more devices than a legacy carrier."

An LCC is also less likely to have an integrated IFE system on-board, and so can only sell via handheld devices.

A legacy carrier on the other hand is more likely to have seatback IFE on its long-haul aircraft, meaning that on-board retail can be split between handheld devices and IFE. This is more likely to be the case, as more of the world's passenger fleet upgrades to faster forms of in-flight connectivity.

"The number of devices required is also related to the number of hubs from which an airline operates. An LCC with multiple hubs for point-to-point services will require more devices than a legacy carrier with one or two major hubs," adds Cushing.

GuestLogix uses a capital-free model to sell its devices and software to an airline. This means there is little up-front capital required by an airline to acquire the devices. GuestLogix simply takes a small transaction charge for each purchase made by a passenger. The costs of installation are therefore even more minimal for these devices.

The on-going maintenance costs of the handheld devices are also minimal. "We provide reliable and robust devices. The biggest maintenance issue comes from a device that has been mistakenly dropped to the ground by an attendant. Our devices have a safety mechanism, which secures and encrypts all data if it thinks it is being broken into. So if a device is dropped, it can lock up, and be reconfigured back at base," says Cushing.

In 2010, GuestLogix devices were operational on 1.0 billion trips out of a total of 2.8 billion made by the world's major airlines, equating to a global market share of about 40%. This is divided into 90% of flights in the US, 40% in Europe and 10% in the Asia Pacific region. GuestLogix is targeting Asia Pacific as a major area for growth in on-board retail.

Passenger spend for on-board retail averages $10-15, depending on the time of day, but can be as high as $65 for those who buy duty-free products in-flight. This is expected to rise as in-flight connectivity levels become more prevalent, increasing the amount of flights with real-time credit card authorisation, and therefore increasing the value of products sold on-board. This represents a lot of added value for airlines, and will become even more important with fuel prices ever rising. AC