Digital Transformation Monitor

Inflight entertainment and communication: Technologies and market

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Up until recently, the aeronautical communications market was still limited to operational communications between aircraft cockpits and control towers. It is now expanding by integrating data communications for passengers and increasing coverage to a global level. It is still a limited market, but will grow over the next few years. To support this market set to boom, new technologies have emerged and satellite is not the only one, as cellular technologies have entered the market.

Terrestrial versus satellite, two complementary technologies?

Satellite, the logical and traditional solution for inflight entertainment

Wide coverage ideal for long haul flights and broadcast

By nature, the main benefit of satellite is to provide wide coverage all around the world. If inflight Wi-Fi is still not very common in airplanes, basic voice and messaging services have been traditionally provided on long haul flight thanks to satellite technology, the main drawback residing in the cost of the service as well as the high latency that is typical of Geostationary satellites located at more than 36,000 km above the earth.

Because of this wide coverage capacity, satellite is also very efficient in broadcasting content. This is also the reason why satellite has been quite logically used to provide Inflight Entertainment, especially live TV and radio programs on-board.

Historically expensive but capacity set to explode

Satellite capacity has been however historically expensive, which has in part prevented the market to develop. In order to start providing services, satellite operators indeed need to support very high costs for satellite procurement, launch and operation cost. A GEO communication satellite, as an example can easily cost more than 200 million USD to purchase and launching it is rather in the 50 to 100 million USD range depending on the weight the launcher used and the associated insurance.

In the last few years, the cost of satellite connectivity has significantly improved thanks to both technological development and increased competition in the industry. New satellite support even more capacity, which in turn results in reduced cost. As an example, ViaSat 2 satellite, launched in April 2017, now supports throughput up to 350 Gbps in the downlink and ViaSat 3, due to be launched in 2019 for the American continent will provide a capacity of 1 Tbps, more than the combined capacity of current satellite communication systems.

Eventually, this means that for approximately the same investment, more capacity can be provided, which necessarily means a reduced cost and price per Mb/Gb. This trend will be supported also by the dynamic around Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) constellations that must significantly improve both the latency and the capacity available. A system such as OneWeb, which will comprise hundreds of small and light satellites, will for instance provide a total worldwide capacity of more than 6.5 Tbps. And since it is easily scalable, capacity can be easily expanded based on the demand.

Air to Ground (ATG), the alternative approach

Limited coverage but reduced cost

As such terrestrial communication may seem less adapted to provide inflight communication services. Traditionally, terrestrial communication technologies have been used for the communication with the cockpit but those technologies only support voice and narrowband usage. Indeed, the low frequency band required to reach the plane is very limited in bandwidth available and is as such unpractical for any technology to provide broadband or any service that would require some capacity.
Higher frequency band with more spectrum available could be used, but not with significant challenges to be overcome because of elevation and speed acting as a deterrent to signal propagation in the air.

This does not mean however, that terrestrial technologies cannot be used for inflight entertainment and communication. Air to Ground (ATG) is indeed less practical from the coverage standpoint than satellites technologies but turns out to be less expensive to deploy provided the network is focusing on most common flight routes. Further, since the round trip between the plane and the plane elevation and the ground is reduced as compared to satellite located at more than 36,000 km in the outer space, latency is also greatly reduced, which is the second benefit of using ATG technologies.

Mainly developed in the US over an aging technology

In the US, Gogo, funded as Aircell in the 1990s, has developed a dedicated network of more than 200 sites deployed all over the country and located under most important domestic flight path. It is greatly responsible for developing this market. Initially providing voice and messages only services to the business aviation, it launched inflight Wi-Fi services on commercial aircrafts in 2008.

Between 3 and 10 Mbps... per aircraft

Based on a US flavor of 3G (CDMA EVDO rev A and rev B), Gogo Air To Ground network can reach throughput up to 10 Mbps per aircraft in the downlink in its latest development but typical bandwidth per user is far less important as it is split between users in the aircraft.

4G and more spectrum required to remain competitive

While such throughput where sufficient when the system was launched and the market still in its infancy, Gogo ATG system finds it today difficult to compete with new higher capacity satellite based solutions. Users are complaining of very slow speed and historical customers of Gogo have threaten to switch to other providers resulting in Gogo proposing to install another technology developed in-house but based on satellite.

In Europe, where the inflight connectivity market has not yet seen such development, Deutsche Telekom and Inmarsat are to launch a hybrid satellite and ATG solution in the second half of 2017. Based on LTE technology, the same used by 4G operators all around the world and much more spectrum, the system must provide throughputs up to 75 Mbps when covered by the terrestrial network. This network will be made up of around 300 cell sites located in 28 European countries under highest traffic flight path. It must thus provide competitive inflight connectivity services for the European market.

Complementary rather than competing

While satellite and terrestrial networks are traditionally pitted against each other, complementarities exist between the two technologies as partly highlighted by the Inmarsat and Deutsche Telekom partnership.

First, there is a geographical complementarity. ATG networks can indeed only be deployed on the land and because of the necessity to increase the number of sites to increase coverage, the economy of ATG network will necessarily reside in deploying the network only under highest traffic flight path. Satellites on the other hand have by nature a very wide coverage from the outset and are ideal to cover the connectivity holes, especially for intercontinental flights where large oceans or wide low density territories are passed over.

The second complementarity is to be found in the usage. While terrestrial networks are very good for point to point communication such as individual smartphone web browsing, they are less efficient when it comes to broadcasting the same content to multiple users. Broadcast is traditionally used for TV and live content but it could also be used for large software updates in the future.

Eventually, the two technologies could be used simultaneously with some type of traffic going through ATG network when available and some other type of traffic would be broadcasted by satellite. Under the Inmarsat and Deutsche Telekom plan, the European Aviation Network will only use one technology at a given time, automatically switching between the two when necessary. In the future however a better integration of both technologies could support this scenario.

A market still in its infancy but set to boom

Diverse approaches to inflight entertainment

Video and TV watching still the preferred activities on long haul flights

In the last few years, inflight entertainment has been dominated by the consumption of media content, mostly movies and series stored in the plane and provided through the individualised (but once shared) inflight entertainment system. According to a study by the IATA (International Air Transport Association) carried out in 2015(1) watching movies or TV is the top activity during long haul flights shared by 74% of passengers and the second most frequent activity during Short haul flight.
Companies may decide to provide the service free to business class, but as a pay service for economy class.

A market set to boom
Ubiquitous connectivity, except in the air where price is still a barrier

Despite the omnipresence of broadband wireless connectivity on the ground, air has been relatively preserved from the demand of being always connected, anytime anywhere with consumer understanding the singularity of providing connectivity 10,000 m above the ground... as well as its cost. This cost however is probably the first barrier for inflight Wi-Fi consumption. A survey carried out by Honeywell in 2014 among 1045 Americans revealed that 85% of the respondents would use Wi-Fi on all flights if it was free. Should the price barrier disappear, the 8 million daily flight passengers worldwide necessarily consumed more internet services on-board.

Personal devices wide adoption (laptop, smartphones and tablets,) is changing media consumption, even in the air

90% of American Airline passengers have their own device when they fly

With the increased penetration of personal and mobile devices such as smartphone and tablet however, the mode of media consumption is gradually changing. According to IATA(2), 51% of passengers would prefer to use their own devices onboard to access entertainment options, which should not be limited to media consumption but also include game and other content consumption. Indeed, onboard entertainment systems are often slow and unfriendly to use for something else than passive usage such as video watching.

Mobile devices in turn are much more intuitive and powerful and because they are personal, they are by definition more adapted to each passenger habits.

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This phenomenon is a game changer for airlines companies that need to adapt their entertainment offering. It also means that individual seat screens won’t be necessarily required anymore in the future. For airlines companies, removing built-in screens is also synonym of reduction in weight and as a result more fuel saving. More importantly it is an opportunity to differentiate more from competing airlines by proposing more customized entertainment experience. Some airlines have already taken this direction. In January 2017, American Airlines for instance announced that the 100 Boeing 735 Max recently ordered would not feature seat-back video screens(3).

Various level of connectivity and offerings

The connectivity offerings available vary in terms of scope. Several service components can be proposed ranging from access to a content and services portal from a passenger’s own device, tablet or smartphone, using Wi-Fi. Usually free. The services are generally hosted on board the aircraft. Access to live TV channels is sometimes included.

Those services are not provided directly by the airlines but by dedicated Inflight Entertainment service provider such as Panasonic, who is the market leader. Those providers then buy satellite capacity to satellite operators.

Some of the types of inflight services often available are listed below:

- Content and services portal access from a passenger’s own device, tablet or smartphone, using Wi-Fi. Usually free. The services are generally hosted on board the aircraft. Access to live TV channels is sometimes included.
- Messaging capability often limited to most common application for a low fee. Southwest for instance offer this service for 2 USD
- The ability to use a cellular service at international roaming rates (mainly SMS), using a passenger’s mobile phone and the operator’s SIM card.
- Full access to Internet as part of a plan. The price depends on the duration of the flight and the class of the passenger; for example, some companies may decide to provide the service free to business class, but as a pay service for economy class.

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Growing competition between airlines favor wider adoption

The less expensive connectivity option will not only result from the increased capacity but also from the increased competition between airlines for which connectivity is increasingly seen as a differentiator.

As of March 2017, eight carriers offered free Wi-Fi when more than 50 other offered this service as a premium. In a Honeywell survey of 2014, 17% of respondents admitted that they had changed the airline because of a better inflight Wi-Fi offering. According to Inmarsat, the number of connected aircrafts is to grow to 15,000 in 2020 from 6000 in 2016(4).

A business model still to be found

Three business models are currently practiced in the aviation sector.

- **Wholesale**: An operator (like Panasonic) sets a fixed rate per aircraft for providing connectivity and sells a number of connections. The airline can then decide whether or not to charge this cost to passengers. This is the most common scenario, but some airlines offer this service for free.

- **Revenue sharing (retail)**: The operator and airline jointly set a price to offer passengers to access Internet services. They then share the revenues. The operator manages the customer relationship and takes a larger share of the revenue (around 60-70%). However, this share is negotiable and usually reduces as the usage rates on board increases (the operator is thus taking less financial risk).

- **The third model** relates only to Gogo, which installs its own equipment for a tiny fee (outdoor antenna installed in one day) and then charges its rates to airlines. The airlines only take a small share of the revenues because they make very little financial effort.

Despite the strong perceived interest of passengers for inflight connectivity, the ideal business model still needs to be found. Consumers are eager to consume data in the air, but not at any cost. Carriers must thus find the sweet spot between completely free Wi-Fi and growing additional revenues from new value added services, all the more aircraft equipment is a sizeable investment.

### 3 What is the role of 5G for inflight communication?

#### 5G to support increased requirements

Even though a standardisation process for 5G is not finished, there is already a broad consensus on what differentiates 5G from 4G and 3G. If both peak and average throughputs will be significantly improved - something that will necessarily benefit inflight connectivity, 5G will also focus on satisfying the need of multiple industries and use cases rather than just the mobile broadband use case.

Practically this means that multiple Gigabits per second peak throughput will be supported with an average throughput targeted of 50 Mbps. Meanwhile, very limited throughput for very energy efficient operation will also be supported, for instance for tiny sensors that must be able to operate during 20 years with the same battery.

For those diverse and sometimes opposite requirement to coexist, multiple services will be capable of running independently on the same infrastructure with dedicated Quality of Service. A critical application requiring 1 ms latency will thus possibly run alongside more common mobile broadband services. In the plane, critical communication and services in the cockpit will possibly use the same connection used by the inflight entertainment system.

Fundamentally, 5G will be more a collection of technologies with the flexibility required to adapt to the requirement of each user rather than one single technology, as it is sometimes perceived.

#### A possible integration of satellite to 5G

Beyond the internal improvements that will necessarily benefit Air To Ground networks, 5G flexibility will also foster the support and integration of other competing technologies, such as satellite.

Complementarity between the two technologies will thus be significantly improved. This will be made thanks to the use of similar frequency bands but also through technological adaptations. For instance, it will be possible to steer traffic between ATG and satellite technology depending both on data traffic congestion and use cases.

Standardisation effort regarding satellite and 5G will also create commonalities between the two technologies that will enable more interoperable and affordable equipment. This will eventually foster equipment cost reduction and thus drive the increased penetration of connectivity in the air.

### References

1. IATA 2015 global passenger survey  

2. IATA annual review 2017  


4. Inmarsat 2016 annual report :  
About the Digital Transformation Monitor

The Digital Transformation Monitor aims to foster the knowledge base on the state of play and evolution of digital transformation in Europe. The site provides a monitoring mechanism to examine key trends in digital transformation. It offers a unique insight into statistics and initiatives to support digital transformation, as well as reports on key industrial and technological opportunities, challenges and policy initiatives related to digital transformation.


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