NEW LOOK

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5G-CONNECTED DRONES

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'The entire shift went into quarantine'

DFS chief on how German ANSP dealt with outbreak

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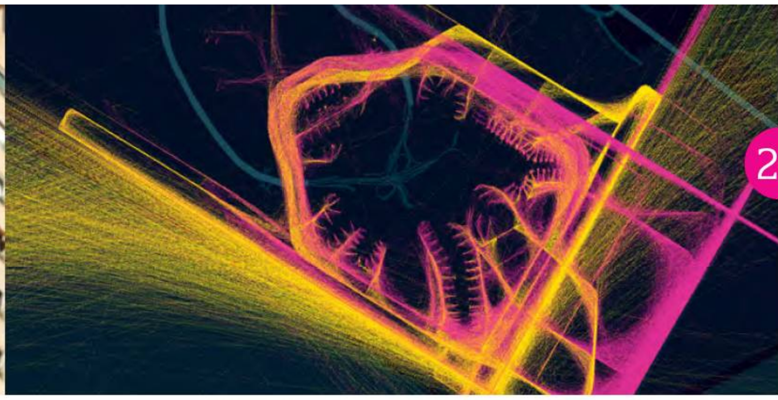

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Mobile netwo

rk technology flies high

There are two ways to provide broadband connectivity to aircraft: via satellite and via direct-air-to-ground connectivity (A2G).

Satellite-based solutions have been around for quite some time, some only partially available for certain regions, others with nearly global coverage. However, air-to-ground is a relatively new development.

The first air-to-ground network was a 3G-based low bandwidth / low performance system in the United States. The modern variant is based on 4G technology and provides a high-performance solution up to 100Mbps. Today, this is deployed across 41 countries in Europe as part of the European Aviation Network (EAN).

EAN is actually a hybrid satellite/air-to-ground solution. The majority of the capacity is provided by the air-to-ground segment over land and up to 150km out to sea, while the satellite segment covers the gaps farther out to sea (for example, over the Bay of Biscay or the North Sea between the UK and Norway).

Other countries and regions have shown a strong interest in this technology and there are talks to extend the EAN network to neighbouring territories. Spectrum assignment applications are running in the Middle East. Additionally, there is active interest from Australia, New Zealand, Indonesia, Vietnam and India, just to name a few examples. In China, activities for a 5G-based air-to-ground solution in the 4.9GHz band were started early in 2019, with the first rollout envisaged for 2021.

In order to have a mass deployment of high-bandwidth connectivity for aircraft, air-to-ground is indispensable. To understand why, you need to consider the technical differences between satellite and air-to-ground.

State-of-the art satellite with narrow spot-beams can provide comparatively high bandwidth per beam, but the capacity is distributed over a large area compared to air-to-ground cells and is therefore shared by many aircraft. Additionally, the capacity is shared with terrestrial and maritime users (satellites are not dedicated to aviation). While today the capacity is sufficient to cope with a few equipped aircraft, it does not scale to mass adoption over dense air routes.

The cells of air-to-ground are small in comparison to satellite and each serves a small number of aircraft simultaneously. Unlike satellite, capacity can be scaled up by adding more cells where they're needed. Another difference comes from air-to-ground being fully dedicated to aviation purposes, having its own spectrum resources independent from terrestrial networks.

Another advantage of air-to-ground is the much lower latency compared to satellite service. Due to the greater distance between the satellite and the ground, and the two legs the signal has to travel (from the ground to the satellite, then back from the satellite to the aircraft), messages via satellite experience a delay from between 400m up to more than 1,000m, while an air-to-ground solution induces a delay of just 30-50m.

The air-to-ground technology implemented for EAN is highly reliable and secure because it follows the same design rules for public safety networks already used in high volumes around the world. Low latency and high availability are both crucial when used for unmanned aircraft system traffic management (UTM) and air traffic management (ATM). This is a real disruption to the ATM market largely driven by upcoming drone requirements.

And let's not forgot, the cost of an air-to-ground installation is much lower when compared to satellite systems, with the cost per bit being at least 10 times less.

UAVs and the future of ATM

Today, transfer of control and payload data of unmanned aerial vehicles (UAVs) is often done in license-exempt bands.

Another means to provide connectivity is by using 4G and 5G cellular networks deployed by mobile network operators. It has been shown by trials in several locations that normal cellular networks for terrestrial users provide quite good coverage even at altitudes of 2000ft /610m above ground.

For large UAVs at higher altitudes, satellite links are used. Today, these are mainly drones for military use controlled across long distances, but in the future passenger drones will require this and cannot afford an expensive connection with a long-delay SAT link. A new solution for these purposes is an air-to-ground system like the EAN network in Europe.

Four different options for communications have been mentioned in this discussion. Let's consider the differences between each one and a possible path forward for their usage.

License-exempt bands

Pros: No spectrum license required and no spectrum fees, therefore fast to deploy; low latency; many products available; potentially high capacity; low cost; low power consumption.

Cons: Limited range due to low RF power; mainly line-of-sight and near-line-of-sight; many use-cases involve sharing the same spectrum (Wi-Fi, Bluetooth), so no guaranteed quality of service.

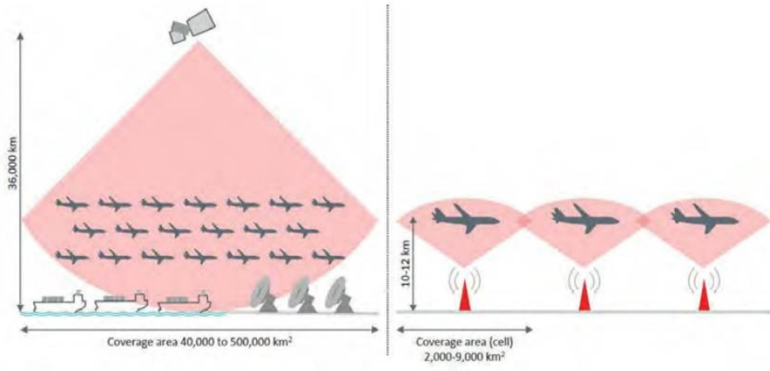
Target market: Non-safety critical use; amateurs and semi-professionals; short distance between control station and UAV; low altitude and low UAV speed.
Typical applications: Photographers using drones to take pictures from an unusual angle; farmers inspecting crops.

Existing cellular networks

Pros: Doesn't require deployment of your own infrastructure; own spectrum not required; wide-area coverage; non-line-of-sight operation possible; low latency; depending on network and condition, altitudes up to 2,000ft feasible; LTE and 5G modems for UAVs are low cost; low power consumption.
Cons: Fee-based subscription to mobile network operator; no control over the radio network planning; not possible to rely on coverage at different altitudes; as mobile networks continually evolve and are constantly optimised with the ever-changing demand of the customers on the ground, they don't form a reliable base for high-quality aviation networks.
Target market: Non-safety-critical professional usage; non-line-of-sight/long distance; low to medium UAV speed.
Typical applications: Delivery drones for parcel service; traffic supervision via camera drone by police.

Satellite transmission

Pros: Very wide area of coverage (some satellite operators offer worldwide service); non-line-of-sight operation possible; can be used from ground to very high altitudes; high-speed UAVs.
Cons: Expensive, big and heavy; long latency; no real-time data exchange; comparatively high power consumption.
Target market: Large UAV, mainly for military use; safety critical with restrictions (latency, requires a minimum of autonomy of UAVs).
Typical applications: Military drones for observation deep inside enemy territory.



Air-to-ground, such as EAN

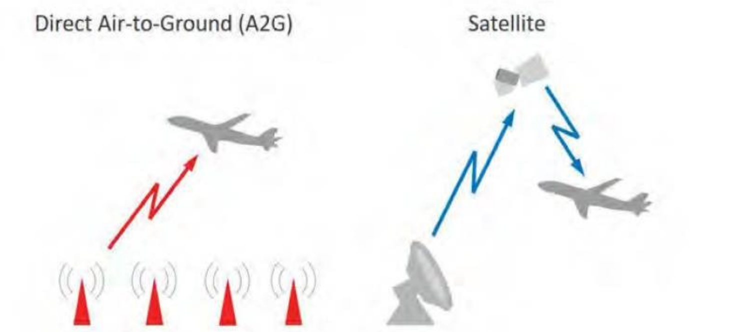
Pros: Dedicated network exclusive for aviation; quality-of-service (QoS) control; low latency; LTE and 5G modems for UAVs are very low cost; low power consumption; good even for high-speed UAVs and at altitudes of more than 50,000ft /16,000m; can be complemented by standard commercial terrestrial networks.
Cons: New technology for ATM requires new operational rules.
Target market: Mass market up to safety-critical and professional use, including non-line of-sight/long distance; high UAV speed.
Typical applications: Remote control and supervision of passenger drones; high-altitude drones for wide-area monitoring such as pollution control; camera and surveillance drones for public safety; high-bandwidth add-on to ATM for reporting weather and wind conditions, helping to assign fuel-efficient flight vectors.

Conclusion

No existing means of connecting aircraft and UAVs is universal. Safety-critical connectivity for passenger drones needs at least two complementary solutions.

With air-to-ground deployments going on around the world we face a real disruption in ATM technology. Enabling the smooth integration of traditional and future UAVs on a single, high-reliability broadband network needs a new direction. Use of existing air-to-ground technology, such as EAN, for UTM is a step toward an advanced alternative to support many of the UAV use cases.

In the short-term, existing air-to-ground networks can complement existing ATM communication systems with a broadband channel to share information and drive new use cases. The sky is the limit. **ATM**



About...

THE AUTHOR

Thorsten Robrecht is founder and CEO of SkyFive. He previously spent 19 years with Nokia and seven years with Airbus.

SKYFIVE

SkyFive was spun off from Nokia in 2019 to create a specialist company for aviation connectivity solutions. The SkyFive team has led the development of air-to-ground technology from early research to large-scale implementation across Europe. The disruptive air-to-ground solution and unique competence constitutes a new crossover between aviation and telecommunications.