AERIAL AUTOMATIC

Tristan Wood *explains why 'heterogeneous' connectivity is the only way ahead*

Some forecasts predict the drone economy exceeding $90-billion globally by the end of the decade as numerous industries realise the potential to transform their operations, from enterprise and logistics to first responders and defence.

The market materialised in the late noughties, originally out of a military requirement but was also quickly adopted in civilian life, initially for aerial photography and video. News, media and broadcasters followed not long after.

In the ensuing two decades the commercial and civil market has experienced exponential growth, attaining a worldwide value of $2.9-billion by 2018, more than doubling in size since then. According to Statista, excluding defence, its market value is forecast to reach $4.7-billion by 2028, with nearly 1-million drones expected to be in operation in the UK alone by 2030 (PwC, 2022).

Today, UAVs are making themselves indispensable in myriad other sectors, including disaster recovery, search & rescue, weather tracking, geotechnical mapping, precision crop monitoring, through to law enforcement and border control. As increasing investment pours into this still nascent industry annually, the development of hundreds of more applications are underway, including those more left of field, such as patient drug-delivery.

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As the market develops, so the world around it needs to adapt quickly, with more infrastructure required to maintain safe operations in the face of growing volumes of traffic, and with that, complexity and risk. This goes beyond just 'hard' infrastructure, such as take-off and landing sites and air traffic management control systems, but necessarily includes services such as cyber security, insurance and fleet financing.

While governments and regulators work hard to clear the way for the safe, ubiquitous application of UAS, a major focus for their attention will concern aircraft visibility and identification. However, nothing will take the place of the need for robust communication and safety, especially when it comes to BVLOS operations.

Policymakers around the world are fine-tuning their approach, balancing privacy, security and environmental concerns with the many benefits UAS clearly offer. A decade ago, the US Federal Aviation Administration began offering exemptions for drone companies to operate including for use cases in insurance, construction and agriculture. Today it's a global conversation, with many authorities, including those in China, India and the UK, exploring how to create a regulatory and licensing framework to support such a fast-growing but inherently risk-bearing industry.

All UAS applications raise two principal safety concerns: aerial collisions and loss of control. Mid-air collisions can occur if the pilot cannot see or avoid crewed aircraft in time, especially when flying sub-500 feet, and so this includes helicopters, aircraft taking off and landing, or agricultural aircraft maintaining crops at low altitude. In the US, reports of drone-sightings from pilots, police and the public have increased five-fold over the past year, and the same goes for the rest of the world including in China, Dubai and the UK where a number of near-miss incidents have occurred and been reported.

The second category, loss of control, can result from a system failure or if the drone flies beyond its signal range, or from frequency interferences and hackers. While onboard systems like RTH (Return To Home) and DAA (Detect And Avoid) reduce some of the risk in these situations, mission-critical tasks fail with potentially unacceptable consequences. However, there's an even bigger problem – no connectivity at all.

So, how do you guarantee connectivity when only 20 percent of the globe is covered by terrestrial networks? And if satellite is the answer, even with 'low cost' LEO arriving on the scene, Starlink among them, what's the cost penalty for always-on must-have connectivity?

Commercial drones that use conventional RF (Radio Frequency) datalinks generally employ 2.4GHz or 5.8GHz frequencies, both of these falling within the unlicensed industrial, medical and scientific (ISM) segments of the spectrum. It's tried and tested, scalable and generally safe this side of the horizon, but not for BVLOS, nor is it robust enough to allay hijacking and jamming.

UAVs that use licensed and regulated cellular communications will use either LTE/4G, which uses a range of frequencies below 6GHz, or 5G connectivity, which offers connection speeds that are hundreds of times faster still and ideally suited for resource-heavy operations such as real-time HD footage during autonomous deployment.

These can be single or multi-sim, including e-sim, and while these services have the potential to offer a good range, they are completely dependent on physical infrastructure and cell towers, which excludes remote territories and about 80 percent of the globe's surface! Finnish telecommunications business Nokia has recently partnered with Swiss mobile provider Swisscom to deploy a nationwide drones-as-a-service (DaaS) network across Switzerland. Public safety agencies such as police and fire services will be able to request a drone flight from Swisscom Broadcast, not dissimilar to a ride-sharing service, to access real-time data and provide live situational awareness reporting of incidents. In territories where cellular companies can collaborate like this, and importantly where there's already infrastructure in place, these are great solutions. Unfortunately, most of the globe's surface is nowhere near a terrestrial network and is unlikely to be any time soon.

NEARLY 1-MILLION DRONES ARE EXPECTED TO BE IN OPERATION IN THE UK ALONE BY 2030

Satellite technology, with high uptime and reliability, can offer global always-on communication and control. Historically, satellite technology has been expensive to integrate and generally been deployed on large, high-endurance and military UAVs flying over large distances and at high altitude. Few commercial deployments have been able to justify the capital and operational costs, the power budget and equipment weight associated with satellite connectivity, especially when they may be operating at low elevations where line of sight to satellite may be compromised.

Despite recent advances in telecommunications technology – from 5G and disruptive low-cost LEO satellite services – no single network service can address the exponential demand for seamless connectivity on the move. Nor is there any provider which can offer a single comprehensive solution that can address coverage, bandwidth, reliability and most importantly cost.

As we have seen, all technologies have their advantages, so what if one could blend all of these together, with none of their downsides? The answer is true hybrid – or more accurately, a heterogeneous connection to provide the most resilient solution to always-on, ubiquitous connectivity well beyond the horizon, independent of the coverage of terrestrial infrastructure and not solely reliant on satellite.

Designed to meet the challenges presented by speed and mobility as an asset moves through different areas of network coverage, smart networking enables a dynamic connection to various operators using a range of underlying communication technologies such as 3G, 4G, 5G, wi-fi and satellite.

True hybrid is not a failover or redundancy technology, neither being the same thing anyway. At their core, true hybrid networks become 'heterogenous' – turning a single bonded connection – fixed line, cellular, satellite, point to point radio, whatever the underlay or infrastructure – into one

seamless connection. The benefits of which, for the user, are off the grid. A heterogeneous connection also enables intelligent management of physical, virtual and financial resources to suit an almost limitless range of conditions.

Central to hybrid is SD-WAN – a technology that uses software-defined networking concepts

BEING ABLE TO INTEGRATE EXISTING CONNECTIVITY WITH FUTURE SERVICES IS A POWERFUL PROPOSITION

to distribute network traffic across a Wide Area Network (WAN). This architecture creates a virtual overlay that bonds underlying private or public WAN connections, such as wi-fi, 3G, 4G/LTE, 5G, LEO, GEO & MEO satellite. As a result, hybrid SD-WAN networking can agnostically combine and transition between these networks.

In this way, multiple network technologies are able to work seamlessly together, actively sharing the load and resources, by combining and binding together a potentially unlimited variety of bearers into a single 'pipe'.

Delivering a faster and, crucially, more reliable service, a hybrid platform adapts to a range of variables associated with each bearer's performance and any other environmental conditions affecting it, in order to optimise performance and manage costs. Similar to how voice calls are routed for minimum cost, settings in a hybrid environment can be adjusted to use the most cost-effective option, like prioritising cellular over satellite if it is performing well enough. The same approach can be taken for QoS to ensure important applications perform well despite limited network capacity and changing bandwidth and latency. Being able to integrate existing with future connectivity services is also a powerful proposition enabled by the inherent agnostic characteristics of software defined network technology.

The concept of a UAV – fitted for example with a world-first solution like RazorLink, which Inmarsat has embedded within its newly launched maritime-focused NexusWave – agnostically making use of any carrier network, based on location, cost or quality of service, has too long been a guarded secret. But it shouldn't be. And in UAS and many other sectors, the market opportunities are seemingly unlimited for the adoption of true hybrid.

Many other industries spanning defence, space exploration, connected and autonomous vehicles, emergency services, telehealth, cloud-based HPC, as well as AI and machine learning, require more than just connectivity – they demand an 'intelligent connection'.

Few theatres in life push the boundaries of technological innovation more than defence, and in Ukraine we have watched and read daily news about the impact of drones in changing the course of combat, both in attack and defence.

As well as their destructive power, UAVs as airborne observation platforms significantly enhance situational awareness and the creation of a common operating picture. They can also be a crucial aid by acting as a relay point, connecting tactical units with the command post. With hybrid connectivity, drones or other assets can move seamlessly between networks, picking and choosing bearers of opportunity based on any range of preset criteria.

There are plenty of use cases where military drones will play a crucial role in the future, including swarms of drones or other distributed systems. However, their capabilities will only be fully realised with the robust connectivity that true hybrid alone can guarantee.

Now transpose this into the civil sector, where the power of heterogenous networks are fully harnessed and the possibilities are endless to transform the ability of UAV to comprehensively address tasks across all industries, and to do so safely and efficiently for the first time – and potentially moreover at less cost. ●

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