The Use of Drones in Telecoms

Stewart De Jong

BE. Tech Mahindra Consulting

Abstract

Drones, or to give them their correct name, Unmanned Aerial Vehicles (UAVs), are generally defined as re-usable aircraft which do not have a human pilot on board. They can be operated remotely (by a human operator), or autonomously by remote or on-board computers.

The term “Drone” dates back to the 1920s and originates from the name given to the remotely operated planes used by navies as target practice. Of course, drones as we know them today have their roots in military applications, with tactical use dating back to the 1960s. Most military drones are usually (but not exclusively) of a fixed wing design, powered by aircraft engines and capable of travelling hundreds of miles. They tend to be used in an observational capacity or for payload delivery.

The civilian drone market has emerged relatively recently. While some larger fixed wing drones have found use in the commercial sector (primarily for survey purposes), the game changer for civilian use has been the introduction of cheap, lightweight, battery powered “quadcopters”. These drones are often fitted with (relatively) low cost optics and are capable of either storing the visual data on board or transmitting it wirelessly to an operator on the ground. Using unlicensed RF spectrum for both control and remote viewing applications, civilian drones tend to be relatively straightforward and easy to control, often with built in safety features such as “return to base” functionality and even collision avoidance. Although they only have a limited range, such drones have found uses in the hobbyist market and also in commercial applications.

As of March 2018, there were more than one million civilian UAVs registered in the U.S. alone, of which around ten per cent were for registered for commercial use. The civilian drone hardware market is dominated by Chinese companies and Chinese drone manufacturer, DJI, is the largest with an estimated 74% of the civilian market in 2018.

Civilian drones are also becoming more widely used for certain applications by the military, generally because of the low cost nature of consumer product. In 2018, Israeli military began using DJI Mavic and Matrice series drones for light reconnaissance missions because they were easier to use and had higher reliability. DJI drones are also the most widely used “commercial” unmanned aerial system that the US Army has employed.

Current Commercial Use Cases

Today, drones have a number of potential commercial applications. However, the extent to which the use cases can be developed are often constrained by the restrictions of local legislation (such as limitations on drone weight, the need to maintain visual contact with the drone, the altitude at which a drone can fly) and other health and safety requirements.

The use cases can be broadly categorised as follows;

Surveying and Mapping – Drones are increasingly being used for photogrammetry purposes (i.e. making accurate measurements from photographs). The use of GPS (with additional Ground Control Points where necessary) enables precise, measurable photogrammetric outputs to be made from images taken by drones.

Construction and Real Estate Management – In addition to their surveying and mapping potential, drones can provide an effective means of monitoring progress during construction. They can also be used in a policing manner to ensure regulations are adhered and site safety is maintained. Drones fitted with specialist infra-red cameras can be used to identify building hot spots and areas of unnecessary heat loss when carrying out maintenance. They also provide a cheap and effective means of assessing the condition of dangerous or difficult to access areas such as rooftops or unsafe buildings.

Asset and Inventory Management – Aerial footage from drones can provide information about owned assets and can assist stock-taking in areas such as railway, utilities, roads, infrastructure and mining where there is often a large volume of raw material.

In agriculture drones can be used to assess the condition of crops.

Maintenance and Monitoring - Use of drones can be an expedient way to facilitate the assessment of difficult to access, or remote infrastructure.

Delivery of Goods – Use of drones and other autonomous vehicles as a delivery tool has been mooted by a number of companies involved in logistics, for the delivery of anything from small packages to pizzas. Delivery of medicines has long been seen as a potential application (particularly to destinations which might otherwise be difficult to access) and in the UK in 2020, as a result of the Coronavirus outbreak, special dispensation was given by the Civil Aviation Authority to deliver medicines to the Isle of White, from the mainland, by fixed wing drone. The fact that such dispensation was needed however highlights the limitations to exploiting commercial applications at the present time

Surveillance & Security – Drones can be used for a variety of surveillance purposes from providing site security surveillance to monitoring crowds at sports events and festivals. Use of infra-red/night vision technology can aid visibility in unlit areas or at night. Such activities have been performed for some time by the military and by civilian police forces and the technology is now crossing over into commercial use. Applications such as “Drone in a box” are becoming available (where surveillance drones are flown and charged autonomously as an alternative to patrolling sites) and the recent Coronavirus outbreak has led to the development of applications to monitor social distancing in real time.

Filming and Photography – While most drones are capable of providing usable video, specialist drones using gyroscopic technology and barometric sensors can can provide the stable platforms required to take movie quality footage. Nowadays, not only are they replacing helicopters and cranes for aerial scenes but also jibs for action sequences. The motorcycle chase in the James Bond film, Skyfall (2012, MGM Colombia) is an example.

Current Use Cases in Telecoms

Drone technology is already in limited use with some network operators and tower owners but, currently its use is far from ubiquitous.

Tower / Tower Based Equipment Inspections - Tower climbing is recognized as a hazardous and relatively expensive task. Increasingly, drones are being used to conduct tower inspections and/or "tower based" equipment inspections; capturing 2D pictures and video of towers and the equipment located on them. This information is then used to aid routine inspection or remote diagnosis of faults. The data captured by these devices can be used immediately but can also be stored for future reference and comparison as well.

In addition to providing a safer alternative to climbing towers, drones can carry out routine audits and inspections faster than when done manually and the process is usually less labour intensive. A single tower climb (which is a multi-person task) can cost anywhere between $2,000 and $5,000, depending upon the scope and height. Drones however are lightweight and cheap to deploy by comparison and only require one operator on site.

In 2016 AT&T launched a programme using drones to inspect its cell towers. Verizon also uses drones to inspect tower sites affected by severe weather.

Line-of-Sight Testing - Drones can be used for line-of-sight testing (where line-of-sight refers to there being a clear path between two antennas). They can be deployed to identify obstacles that would degrade signal transmission (such as trees, buildings and hill tops) and this information can then be used to determine the ideal location and height for antenna positioning.

Signal Strength/Coverage Testing - Drones can be used to conduct signal strength/coverage testing. This has potential application both indoors and outdoors (stadia for example). AT&T has used drones to test signal strength across different regions in the US and Nokia has performed similar experiments.

Temporary Cell Sites - There have been (limited) examples of drones being used to help get telecommunications infrastructure back online in the wake of a disaster. AT&T has demonstrated flying "COWS" (cells on wings) which can be used to help boost signal strength in the short-term for areas impacted by a disaster and it is understood that this technology was deployed in Puerto Rico following Hurricane Maria.

In In 2017 EE announced plans to use tethered drones in the UK to extend mobile coverage to areas that have a weak signal strength, supporting their ability to meet their obligations under the Emergency Services Network requirements (although things have gone very quiet on this since). When powered from a ground based source, tethered drones can accurately maintain their position (unlike a balloon) and are capable of almost unlimited flight time.

Orthomosaics, 360 degree views and 3D Photogrammetry

To date the use of drones in Telecoms has focussed on the “drone technology” itself. However, as drones have become more accurate, more reliable, more self-aware (in respect of their surroundings) and better at capturing images, the focus is shifting to how the output from drones can be used digitally.

The next generation of use cases (not only in telecoms but in other areas too) are primarily concerned with the post processing of digital image data captured by drones.

Photogrammetry (as identified earlier) is the science of obtaining reliable information about physical objects through the process of recording, measuring and interpreting photographic images. Both drone technology and photogrammetric software modelling technology have evolved sufficiently that it is now possible to create accurate representations of three dimensional structures (such as towers) from the image and positioning data collected by drones.

A number of companies now offer cloud based solutions which enable operators to pre-plan and then execute drone missions capable of capturing sufficient detail to create a 3D photogrammetric representation of a tower site and its assets.

Using commercially available low-cost drone technology it is possible (within one to five hours depending on the size of the tower) for a drone operator to complete a pre-planned, reproducible, tower survey mission that will enable the following to be produced;

- A comprehensive set of 2D images / video of the tower site and its equipment,
- An orthomosaic representation of the site and its immediate surroundings,
- 360-degree panoramic spheres centred around the structure,
- A 3D photogrammetry model of sufficient accuracy to identify the components of the structure and equipment mounted on it (plus any ground mounted equipment).

The 3D photogrammetry model of a site is created from the multiple geo-located 2D images taken by the drone. The images are post processed (usually as a service) and the output is then made available to the client. Once created the model is of sufficient detail to determine the following;

- Accurate measurements of the tower, equipment on the tower and ground based equipment.
  For antennas mounted on the tower the acuity is such that it should be possible to determine such information as;
  - Latitude and Longitude
  - Altitude above ordnance datum of structure base
  - Height of equipment above structure origin
  - Physical dimensions of equipment
  - Azimuth of equipment
- Identification of equipment type for all structure mounted equipment
- Measure of ‘available’ tower and ground based space
- Identification of certain defects, such as rust (using AI/ML).
- Identification of physical changes compared to previous surveys.

The data can be enriched with other site data (inventory, technical, supplier or topographical information) to create a complete site package capable of,

- Maintaining detailed inventory/asset records along with physical location and condition.
- Identifying structural defects.
- Identifying space available for future build/ site share/ new tenants.
- Performing RF coverage assessment and making best serving tower decisions
- Planning and designing the addition of new equipment.

Software Solution Providers

Post processing software for 3D photogrammetry and orthomosaics is available from a number of companies. Visabeira/Aeroprotechnik and Airmap/Hangar are two examples of companies offering services in this space. These companies specialise in providing site modelling solutions (not just for towers but other structures too).

Visabeira and Airmap’s business model is to provide a cloud based service capable of providing a pre-planned drone mission to capture the data and then post processing the drone footage to create the resultant 3D photograms and orthomosaics etc. The output is then stored in the cloud and accessible by the client.

The Software Solution Provider’s business model doesn’t include attending site to fly the drone themselves. Instead, they create downloadable autonomous drone missions (or flight plans) that ensure the correct data is captured. These can be executed by local pilots. All that the local pilot requires is compatible drone hardware. Responsibility for operating the drones either belongs to the end user (towerco or operator) or a local packaged service provider.

Drone Operation

A site visit to collect the drone footage is required in all cases. An operator is required not only to supervise the drone flight but also to set out the ground control points (which either enhance or replace GPS positioning data) needed to increase the accuracy of the photogrammetry.

In most countries drone operators are required to be certified to at least a basic level, with additional permissions being required for urban environments or protected airspace.

Benefits to Operators

In general the use of drones can offer the following benefits to tower companies and operators when compared with traditional human based methods.

Ease/Speed of deployment

Drone operators can be dispatched quickly and the process on site is less disruptive than that of climbing a tower (or other structure).

Safety

Deploying a drone is considerably safer than climbing a tower (or other structure)

Cost

Climbing a tower is generally considered a skilled two man job. It is also relatively time consuming. Drone operation is a one man job and less time consuming.

In addition to the above factors the use of orthomosaics, 360 degree views and 3D Photogrammetry, creates something that was not previously possible and gives further potential benefits,

- Helps to accurately identify the space available for future build/ site share/ new tenants.
- Enables RF coverage assessment and aids best serving tower decisions
- Assists the planning, design and installation of new equipment.

Limitations

There are a number of limitations to the exploitation of drone technology however,

Regulatory

Primarily on safety grounds there are a number of regulatory restrictions around both hobbyist and commercial use of drones. Restrictions and permissions will vary from country to country but usually limitations are applied in two key areas

- **Size/weight** – in most countries drone weight is limited but correct operator certification should enable the commercial the use of low cost drones (such as the DJI Mavic Pro and DJI Phantom) used by companies like Visabeira and Airmap.

- **Operator presence –** completely autonomous flight (i.e. without an operator involved) is usually prohibited.

- **Line of Sight Use** –In general, "line of sight" between operator and drone is required to be maintained for commercial use.

Operating frequencies

Commercial drones operate in unlicensed spectrum (some of which is shared with Wi-Fi users). Modern drones can usually operate on a number of frequencies (usually 2.4 GHz and 5.8 GHz) and so this should not usually be a problem. Drones are usually fitted with collision avoidance and return to base software such that in the event of a communication failure the drone can be safely recovered.

Range

The distance that small, low cost drones can travel is limited. The DJI Mavic Pro for example has a maximum control range of 4.3 miles (only when line of sight is maintained).

Battery life / Flight time

Most low cost commercial drones have a flight time of 30 minutes or less.

Non-interventionist technology – while drones can be used for identification of defects they cannot be used to fix them. If you want to fix something on a tower then somebody has to climb up it.

Weather

Both wind and rain can affect a drone's ability to fly and to collect reliable data. Wind speed limitations are around 25mph, while rain can risk degrading a drone's optical capabilities (as can dense fog).

Where can Tech Mahindra add Value

In the “current” use cases, drone technology tends to contribute only a small part to the provision a wider service. MNOs and tower companies are not interested in drones per se, but in how they can augment traditional activities, such as

- **Equipment/tower inspections** – drone inspections usually performed as part of (planned or reactive) maintenance activity.
- **Line of sight inspection** – drone flights usually performed as part of the plan and build activity.
- **Signal strength/coverage testing** – drone flights likely to be performed as part of a wider signal strength / coverage testing campaign.
- **Temporary Cell sites** – Niche but part of a wider temporary coverage service portfolio.

As such, in the “current” use cases, drones primarily benefit the provider of the wider service (i.e. equipment maintenance, plan and build activity, signal testing, temporary site provision). If TechM provides that wider service then drones could be useful, otherwise the opportunity is limited.

In the case of Orthomosaics, 360 degree views and 3D Photogrammetry the position is slightly different. It is a new use case (rather than an augmentation of an existing one) and TechM could potentially participate in a number of ways;

Software Solution Provider

The software solution provider is key to the proposition and stands to gain the most. Airmap and Visabeira derive economies of scale by selling to multiple clients in a range of industries (not just telecoms) globally. In generally 3D modelling and photogrammetry is well understood and TechM may be able to exploit combining this capability with AI/ML to create an enhanced offering.

Drone Operator

Drone operation is a skilled task (but not a highly skilled one). Most companies offering drone services are either relatively small outfits, or larger ones offering it as a complimentary service to enhance their existing site services (such as maintenance or rope access). Drone operation

needs to be provided locally and it could be possible for TechM to provide such services directly to a tower owner (as part of a larger services package), assuming that it could obtain the required certifications and that the volume of work justified it.

Service Provider/Prime

Since the Software Solution Providers are only really interested in providing a cloud based post processing solution, and most Drone Operators lack the scale to work with large tower companies, there is space for a company such as TechM to “prime” a relationship with a tower company. The only concern here is whether our value add is sufficient to justify the premium we would require.

Integrator

Tower companies will benefit from integrating the output from the Software solution provider with their other systems and data. TechM is well placed to do this.

Customers

Within the telecoms sector, tower owners have the strongest case for using many of the drone based telecoms technologies described above.

Mobile operators can also benefit from drone based technology for certain other activities (equipment inspection and maintenance, line of sight surveys and disaster relief scenarios) although the use of drones is often only a small part of such activities.

Top US tower companies (source Wirelessestimator.com)

Rank	Company	Tower Count
1	American Tower	40,586
2	Crown Castle	40,039
3	SBA Communications	14,873
4	United States Cellular Co.	4,207
5	Vertical Bridge	3,198
6	InSite Wireless Group	1,196
7	Peppertree Capital (AT&T Towers to close 2019/2020)	1,023
8	BNSF Railroad	941
9	Time Warner	653
10	Uniti	651

http://wirelessestimator.com/top-100-us-tower-companies-list/

Conclusions

The opportunity to exploit drones further exists within the Telecoms sector, where their use is far from ubiquitous.

The current commercial use cases tend to aid the providers of wider services (such as maintenance) and unless TechM already performs such a service (for a tower company or an operator) then it is unlikely to be able to exploit any of these opportunities.

The new use case of creating site information using orthomosaics, 360 degree views and 3D photogrammetry provides an opportunity however. TechM could operate as a “prime” for such services which could lead to the potential for integration with a company’s wider site asset information. Potentially, it could even be a software solution provider (although this is probably less likely given that solutions from other companies already exist).

References

1. https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle
2. https://en.wikipedia.org/wiki/Photogrammetry
3. https://www.vodafone.com/business/news-and-insights/white-paper/the-rise-of-drones
4. https://www.rcrwireless.com/20180309/how-telecom-operators-can-benefit-from-drones-tag27-tag99
5. https://hangar.com/
6. https://www.aeroprotechnik.com/

About Tech Mahindra

Tech Mahindra represents the connected world, offering innovative and customer-centric information technology experiences, enabling Enterprises, Associates and the Society to Rise™. We are a USD 5.2 billion company with 125+K professionals across 90 countries, helping 973 global customers including Fortune 500 companies. Our convergent, digital, design experiences, innovation platforms and reusable assets connect across a number of technologies to deliver tangible business value and experiences to our stakeholders. Tech Mahindra is the highest ranked Non-U.S. company in the Forbes Global Digital 100 list (2018) and in the Forbes Fab 50 companies in Asia (2018).

The Mahindra Group is a USD 21 billion federation of companies that enables people to rise through innovative mobility solutions, driving rural prosperity, enhancing urban living, nurturing new businesses and fostering communities. It enjoys a leadership position in utility vehicles, information technology, financial services and vacation ownership in India and is the world's largest tractor company, by volume. It also enjoys a strong presence in agribusiness, aerospace, commercial vehicles, components, defense, logistics, real estate, renewable energy, speedboats and steel, amongst other businesses. Headquartered in India, Mahindra employs over 2,40,000 people across 100 countries.

About Tech Mahindra's Business Excellence Services

We are the Business Excellence team, Tech Mahindra's consulting unit. We help clients achieve business objectives in the digital era

- We work with clients to develop and implement digital transformation strategies that impact their products and business models
- We help our clients transform their operations and processes in line with this strategy
- We also help them build a key enabler for achieving these objectives: agility and automation in the technology function
- Our program and change management services ensure on-track implementation of the various transformation initiatives

All of these services are underpinned by proven methodologies, frameworks and tools. These are based on design thinking approaches that ensure stakeholder buy-in at each stage. Our clients find our global experience, collaborative approach, and the ownership we bring to ensure outcomes in every one of our engagements, as a key differentiator.

Contact us at befutureready@techmahindra.com

BE. Tech Mahindra Consulting