Rise of
the Drones

The future is exciting.
Ready?

vodafone

Telecoms operators, such as Vodafone, are uniquely positioned to become pivotal in the rapidly developing commercial unmanned aerial vehicles (UAV), or Drone, market. Drone applications enable various types of companies to transform their operations and gain efficiency, in terms of cost and time, by capturing and analysing datasets to improve decision-making.

Opportunities exist in the areas of:

- **Drone-Powered Business Solutions (DPBS)**
- **Drone Traffic Control Centres (DTCC)**

US$84bn
by 2025

US$10bn
by 2020

Drone-Powered Business Solutions

The range of commercial applications for drone-powered solutions is growing at pace. It is estimated that this market may be valued at **US$84bn by 2025** (Grand View Research Inc)[1], with other estimates suggesting the market for small drones will reach **US$10bn by 2020.** Due to the costs and expertise required to provide these solutions, it is not viable for individual organisations to establish their own capabilities, and there is an opportunity for specialist service providers. Telecoms operators are well position to develop these capabilities by building on their existing strengths in connectivity, cloud, big data and analytics, as well as capitalising on the partnerships they already have in place to augment these capabilities. The services that telecoms operators could offer include:

- **Drone procurement**
- **Data delivery**
- **Data processing**
- **End-to-end commercial drone services**
- **On-demand live video data acquisition**
- **Fully autonomous system operated at a client's premises**

Telecoms companies are also likely to be significant users of drone-powered business solutions (DPBS) in areas such as monitoring infrastructure and providing temporary signal coverage in geographically challenging areas, or for specific events.
By becoming a provider of these services, telecoms operators will be able to meet their own needs, quickly gain a critical mass of skills and experience and then offer these services to the market — achieving economies of scale and building new revenue streams.

Drone Traffic Control Centre

Telecoms operators, including Vodafone, are in talks with regulators of airspace in many countries, proposing how they could contribute to effective drone traffic control centres (DTCC). Telecoms operators directly, or via joint ventures, could supply the technical services required for a DTCC, such as supplying and managing data storage, connectivity, cybersecurity, professional services and applications such as drone traffic management systems and real-time reporting and analytics. Telecoms operators could also establish the management functions that would be required in the creation of a drone operations centre (DOC).

Drones are ready for take-off

The current information revolution is powered by the ability to collect, transfer, store and analyse increasingly large datasets to create actionable insights. Drone technology is providing new ways of gathering data through a range of sensors and cameras. Drones also rely on the use of data and (AI) capabilities for them to function effectively and, at times, autonomously. A major growth area is in the provision of specific software to integrate the drone technology into industry-specific business processes.

Commercial drone usage is proliferating, mainly due to the advancements in underlying technologies (such as sensors, cameras, Global Positioning Systems [GPS], and batteries), a positive regulatory environment and investor enthusiasm. The Federal Aviation Administration (FAA) projects3 that the number of commercial drones in the U.S. will reach almost three million by 2020 — quadruple the number in 2016.

Drone-Powered Business Solutions

Applications for DPBS are emerging rapidly across a range of industries to tackle an ever-increasing variety of business problems. The main benefits are seen in the areas of increased automation, improved operational efficiency, enhanced visibility and accelerated decision making.

Several categories of DPBS are emerging. These include:

Surveying & mapping

Providing precise and measurable photogrammetric outputs to improve the speed and quality of decision making for many stakeholders.

Real estate & construction

Construction sites surveyed up to 20 times faster than via ground-based land teams, enabling stakeholders to monitor progress through constantly updated images and measurements from the site. Drones also reduce risk of accident, ensuring regulations are adhered to and providing evidence where accidents have occurred.

Asset inventory & management

Providing information about owned assets and performing stock-taking in areas such as railway, utilities, roadways, and infrastructure. Some seed companies marketing to the agriculture industry are giving farmers free drones and training them to survey their crops.

Maintenance & monitoring

Assessing conditions of infrastructure that may be located over a vast or remote area.

Delivery of goods

Light packages can be delivered quickly to destinations otherwise difficult to access, or remote. Amazon have already announced ambitions in this space and UPS recently used a drone to deliver medicine to an island near Boston.

Surveillance

Monitoring behaviour, activities, operations, or other changing information to enable real-time decision making.

Filming & photography

Drones equipped with 3-axis gyros, barometric sensors, and GPS are utilised by an advanced flight control system to provide a very stable platform for filming.

Drone use in telecommunications

In addition to the opportunity for telecoms operators to become providers of drone-powered services, they stand to become a significant user of these services themselves. The key application areas in telecoms are maintenance monitoring, asset management and network planning/implementation.

Drones are able to inspect installed equipment at the top of towers or over large areas with greater speed – lowering costs and reducing the risks to staff. The drones can take pictures, videos, measurements and readings.
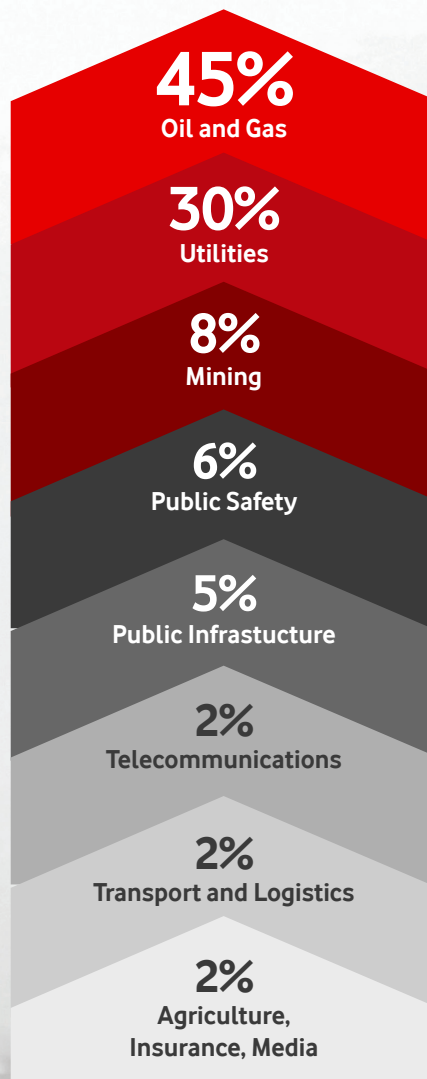
AT&T launched a programme in October 2016 that uses drones to inspect cell towers. Verizon also uses drones to inspect tower sites affected by severe storm flooding. AT&T uses drones to test signal strength across different regions in the US. Nokia has performed similar experiments in the United Arab Emirates (UAE). EE uses 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.

Telecom operators as a provider of drone-powered solutions

In addition to the benefits drone-powered solutions can provide to telecoms operators, there is also an opportunity for telecoms operators to provide these solutions as services to other organisations. They already have capabilities in the key areas of collecting, transferring, storing and processing vast quantities of data. These capabilities are fundamental to the current growth in initiatives such as the Internet of Things (IoT).

With the telecoms market maturing and operators seeking new commercial opportunities, the potential market for drone-powered solutions is significant. It is estimated that the total potential global market for drone-powered solutions is US$127bn according to research by PwC4. An estimate by Grand View Research Inc puts the value at US$84bn by 20255.

The forecasted market for DPBS in the Gulf countries is segmented by industry as described in Figure 2 below:

45%
Oil and Gas

30%
Utilities

8%
Mining

6%
Public Safety

5%
Public Infrastucture

2%
Telecommunications

2%
Transport and Logistics

2%
Agriculture,
Insurance, Media

In addition to the technical capabilities of telecoms operators, they also have strengths in business fundamentals, such as their financial stability, capacity to invest, ability to build partnerships, market reach (through their network of clients) and their expertise in marketing and selling new products.
Telecoms operators can provide the connectivity required for data transfer so that drones can be tracked by airspace regulators and receive real-time air traffic information. There is the possibility of drone-to-drone communication to support the avoidance of collisions.

For these reasons it is necessary for any organisation to make a substantial investment in people, processes and technology if they are to create an in-house drone-powered systems capability. They may also need to obtain relevant licenses and approvals from regulators, which can be costly and time consuming. Unless an organisation has a forecast high level of usage of drone-powered solutions and sufficient investment, it is more likely that they would seek the services of a specialist provider of Drones as a Service (DaaS).

With the use of drones so beneficial to telecoms operators, there is a need for them to gain some level of expertise and experience in their use. With the existing capabilities of telecoms operators in connectivity, cloud and big data, there is a compelling case for them to build practices specialising in the provision of drone-powered solutions for their own use and to supply DaaS to other organisations. For example, Verizon has acquired Skyward, a drone company which enables users to connect their drones wirelessly and receive data plans on its network. Telecom operators also possess the mature cloud infrastructure suitable for managing, storing and archiving data, and for delivering insightful reports (such as interactive maps and 3D models) to clients.

Services enabling drone-powered solutions

To support the range of drone-powered solutions across the industry sectors, there are a common set of core services that an organisation would need to provide:

- Drone procurement
- Drone operations
- Data storage and delivery
- Data processing and analytics

Drone procurement

Provision of the physical device (drone) with the information systems, sensors, and additional features that enable it to capture data and execute critical tasks. There are a vast range of drone types for different uses, and the specialisations continue to proliferate. Telecoms operators would need to partner with established organisations who develop drones, but could help their clients with the selection process, and may develop commercial models where they rent or lease drones to these clients.

Drone operations

Service providers could offer DaaS to their clients, providing skilled pilots with the necessary licenses and certifications. It should be possible for operators to recruit or train their own pilots, as they will have a critical mass of work and training is likely to be a matter of weeks.

Data processing and analytics

Telecoms operators can build on the skills, capacity and systems within their existing data analytics functions to establish teams who can process and analyse the data collected by drones. There would be specialist knowledge required to process image data to transform it into meaningful geospatial products and 3D models, but this should not be out of reach for telecoms operators.

In Europe, some telecom operators have built large analyst teams, only to find that there was less opportunity to exploit customer data due to new legislation such as GDPR. It would be possible to retrain these resources. Where there are not sufficient or appropriate resources available the operator could partner with a specialist organisation for a period of time, with the ambition of bringing the work fully in-house at a future date.

Data storage and delivery

Telecom operators already use a range of big data platforms, often hosted in the private or public cloud. These can be deployed to store and manage the data collected by drones and can make this data available to internal teams or agencies to undertake the required data visualisation and analysis.

Multiple business models

There are a number of business models that telecoms operators could adopt to offer drone-powered services.

These include:

- Drone operations centre (DOC)
- Mobile drone surveillance unit (MDSU)
- Autonomous drone systems (ADS)

Drone Operations Centre

A drone operations centre (DOC) could be established to provide end-to-end drone-powered solutions. These solutions could be offered as services on a project basis. These could be costed and contracted based on a number of factors relating to duration, or specifics such as area to be surveyed, data captured, or level of analysis.

Mobile Drone Surveillance Unit

One of the main potentials of drone-powered services is surveillance. Telecom operators could establish a mobile drone surveillance unit to provide video coverage for specific events.

Teams of drone pilots would be made available to clients, and for this type of service it is likely that data would be streamed live to teams of analysts who would be able to undertake advanced functions such as thermal imaging, face recognition and crowd counting.

Typical uses of this service could be security, emergency operations and traffic management.

Autonomous Drones Systems

A service could be provided utilising autonomous drone systems, where the supplier would establish the required infrastructure for the client and offer maintenance and support services. These support services could also include the storage and analysis of the data captured by the drones.

One of the commonly discussed use cases for drones is in package delivery. The usage of drones in this space is likely to be for specialist applications such as delivery of medical products, or delivery to remote or hard-to-reach locations. Semi-automated drone systems could be provided for the task, using GPS to guide the drone to the target destination and return back to base.

Drone Technology Providers

The marketplace for drone technology is expanding fast, and a large number of suppliers are competing. Early players tended to provide hardware and software such as Airware and Kespry, however some of the newer market entrants are specialising in software alone

such as DroneDeploy, Skycatch and Propeller. Other significant providers of drone technology include 3D Robotics, Phoenix Drone Services LLC, PrecisionHawk, senseFly Ltd, Pix4D, Aerobo, Cyberhawk Innovations Ltd, Eagle-Eye Drone Service, Skylark Drones and FlyWorx.

Drone Traffic Control Centres

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Drone Technology Providers

Government bodies, including air space regulators, are reviewing the growth in commercial and domestic drone usage and are trying to reach the right balance between enabling future capabilities and public safety. There is general support for the usage of drones and regulatory and legal frameworks are being developed to establish conditions for drone usage and define the obligations of operators in this emerging area of technology.

Different countries are at varying levels of maturity with their proposed regulations for drone operators, but most are focussing on the areas of:

- Licensing - requiring a license to be obtained before being allowed to conduct drone flights
- Training - ensuring pilots undergo a thorough programme of theoretical and practical training, and pass a security check
- Insurance - making it mandatory to have public liability insurance
- Registration - having drones registered and have identification numbers displayed on them

There are requirements for geographic restrictions regarding where drones may operate, including proximity to airports, prisons and other areas where public safety may be a concern. Experiments are taking place using "geo-fencing" to restrict drone access to certain areas, or at least report on activity that contravenes these restrictions. Drone operators must also comply with regulations regarding altitude, timing, line of sight, frequency of communications and privacy of third parties.

Typical functions that a DTCC would undertake include:

- Manage a database of drones
- Undertake tracking and monitoring of drone traffic
- Provide tools to enable tracking of drones, such as a dongles or chips
- Collate and disseminate information of restricted areas
- Authorise requests for drone operations

Although it is likely that DTCCs will be run by government departments, there will be benefit in outsourcing the technology required to specialist providers, which could sit well with the capabilities of telecoms providers, such as Vodafone. In the United States, AT&T is collaborating with NASA to develop a drone traffic management system. It is likely that generically the ecosystem will be based on tracking and monitoring via Long-Term Evolution Machine-to-Machine (LTE-M) or Low Power Wide Area Network (LoRa) technologies that are tailored for IoT connectivity. Vodafone is well placed in both of these areas of technology, but substantial expenditure on the network and infrastructure will be necessary to fully support the IoT connectivity.

Telecoms operators could also provide solutions for the detection of unregistered drones, through the use of sensors (acoustic, optical and Wi-Fi), radio frequency detectors and radars.

Technology	Description	Capabilities	Target Services
Systems & Applications	Developing software required for the DTCC	Limited experience in software development and deployment	Partner with Software Vendor
Data Storage	Providing infrastructure data management platforms	Large data centres used for Telco operations	Offer services directly
Data Transfer	Establishing and maintaining the required connectivity	Range of enterprise scale options including 4G, IoT and WiFi	Offer services directly
Security	Ensuring security through people, processes and systems	Core competency and capabilities receiving investment and growing	Offer services directly
Professional Services	Providing integration, testing and implementation services	Experience with required technology, though less mature in terms of delivery	Partner with Systems Integrator

Conclusion

Drone technology has already evolved from niche applications to becoming a significant market for a range of critical business services. This forecast rapid rate of adoption will bring with it technical, social and legal challenges. However, drones are making a real impact on a number of industries, and quietly transforming the enterprise as we know it – much like how personal IP-based telephony quietly became ubiquitous overnight.

Telecoms operators are very well placed to offer services and solutions that will address these challenges and enable the benefits of drone technology to be realised safely and securely, as well as providing new sources of business and revenue to counter the erosion of existing revenue streams. Telecoms operators not only have the skills and technical capabilities to provide drone-powered solutions, but they are also likely to be big users of these solutions. Becoming a drone service provider will enable them to achieve economies of scale, whilst building their capabilities, expertise and experience.

Vodafone in the news

Vodafone to protect the skies with trials of the World's first IOT Drone tracking and safety technology

On 20 February 2018 Vodafone announced the commencement of trials of the world's first air traffic control drone tracking and safety technology. Vodafone's pioneering approach uses innovative 4G Internet of Things (IoT) technology to protect aircraft from catastrophic accidents as well as prevent inadvertent or criminal drone incursions at sensitive locations such as airports, prisons and hospitals.

Commercial civilian drones are too small to be tracked by conventional radar. They present a serious risk to pilots worldwide, particularly in the immediate vicinity of airfields and airports. Drones are also used for criminal purposes such as drug smuggling and delivering contraband to prisoners. Additionally, security and intelligence services are increasingly concerned that terrorists could use drones adapted to carry small but lethal explosive payloads to attack locations targeted using GPS.

The risk to aircraft is growing at an exponential rate. Analysis from the Single European Sky Air Traffic Management Research (SESAR) project indicates that by 2050 drones will log more than 250 million flying hours per year over densely populated areas of the European Union, seven times the cumulative annual flying hours of conventional crewed aircraft.

The Vodafone IoT drone tracking and safety technology trials support the objectives of the European Aviation Safety Agency (EASA), with whom Vodafone has collaborated. EASA is currently developing new pan-European rules to regulate the operation of drones.

The new technology developed by Vodafone also enhances the European Union's potential to become the centre of global innovation in drone technology in line with the European Commission's "U-space" vision for innovative and safe drone operations.

http://www.vodafone.com/content/index/media/vodafone-group-releases/2018/iot-drone-tracking.html

Tethered drones for temporary emergency 4G coverage

It was reported in Unmanned Systems News that "Vodafone Group's New Technologies and Innovation Team experimented with using a tethered drone in an uncovered area of Northern Andalucía with mobile relays mounted on Elistair Safe-T tethering station.

With its unlimited power supply, the drone hovered at altitudes of up to 80 meters for periods of over a day with Vodafone CrowdCell, and delivered 4G coverage of up to 3 Megabits per second."

Using 5G Networks to control drones

For mobile operators, 5G offers the exciting promise of being able to slice the network to accommodate a wide range of applications with very different reliability and throughput requirements, but there are some management challenges to address before it can take off. Dawn Bushaus looks at the progress so far.

If you can use 5G network slicing to enable drones as a service, you can deliver pretty much anything as a service. That's how Dr. Lester Thomas, Chief Systems Architect, Vodafone Group, sees it.

The company is championing an ongoing TM Forum Catalyst proof-of-concept project, now called ZOOM platform for IoT and anything as a service, which

is working on 5G slicing for internet of things (IoT) applications, including offering unmanned aerial vehicles (often referred to as UAVs or simply drones) as a service for precision farming.

"We've chosen drones because it's a crazy application," Thomas says. "If I can demonstrate 5G slicing for drones, I can certainly demonstrate it works for other things like smart meters, smart cities and digital health."

Vodafone's platform model is one the company has been working on as part of the Catalyst program and TM Forum's Zero-touch Orchestration, Operations and Management (ZOOM) project. Thomas serves as ZOOM's co-leader.

1 https://www.grandviewresearch.com/press-release/global-drone-data-services-market
2 https://www.marketsandmarkets.com/Market-Reports/small-uav-market-141134567.html
3 https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2016-36_FAA_Aerospace_Forecast.pdf
4 https://press.pwc.com/News-releases/global-market-for-commercial-applications-of-drone-technology-valued-at-over--127-bn/s/ac04349e-c40d-4767-9f92-a4d219860cd2
5 https://www.grandviewresearch.com/press-release/global-drone-powered-business-solutions-market

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