GSMA Internet of Things Case Study
Ground-to-air LTE communication services for industrial drone applications

EXECUTIVE SUMMARY

With the increasing use of drones for industrial applications, China Unicom has launched an innovative business service project to enable unmanned aerial vehicles (UAVs) to fly at higher altitudes and over longer distances. The Internet & Industrial UAV project employs Unicom's mobile network to provide industrial drones with ground-to-air communication services for BLOS/BVLOS (beyond-line-of-sight/ beyond-visual-line-of-sight) operation. Designed to serve the needs of government and enterprise customers, the project aims to guarantee reliable real-time and efficient transmission for telemetry data, control commands, and high-definition video during flight.

China Unicom's UAV cloud platform also provides value-added services, such as data collection and distribution, intelligent analysis and forecasting for UAV industrial drone operators. As part of the service offering, China Unicom takes care to submit all flight applications to the relevant aviation authorities.

The project is supporting industrial flight missions by hybrid wing high-altitude long-endurance UAVs (see Figure 1) with a flying height of 1,000 meters.

Figure 1 Hybrid wing high-altitude long-endurance UAV

To enable ground-to-air communications, the UAV is equipped with a LTE module developed by China Unicom, as well as the different payloads relevant for the task in hand, such as photoelectric pods, a tilt camera or multi-spectral camera. Unicom's tests have found that during the mission flight, the UAV ground control centre in Beijing can stably receive video signals, picture information, and tracking information transmitted through China Unicom's LTE network, which is able to support telematics information and control tasks for the UAV.

Figure 2 Natural Gas and Petroleum Pipeline Inspection

The service distribution platform operated by China Unicom relays the information acquired by the drone from the ground control centre to the local network management centre.

China Unicom is working with petroleum company partners and local government to deliver different types of inspections::

- Natural gas and petroleum pipeline inspection.
- Optical cable inspection.
- River pollution inspection.

Figure 3 Natural Gas and Petroleum Pipeline Inspection

Natural gas and petroleum pipeline inspection

With China Unicom's support, UAVs are being used to inspect a 500km natural gas and petroleum pipeline. The UAVs enable petroleum companies to collect video and/or pictures of the pipeline, and identify potential faults and issues, such as an oil stealing point, man-made damage and overgrown vegetation.

China Unicom says the replacement of manual operations with UAVs is achieving outstanding results in safety, cost reduction and efficiency: The solution has cut the time it takes to perform an inspection by about 40% and the human costs by 57%. The UAV service is set to generate RMB 30 million income per year for China Unicom.

Optical cable inspection and river pollution inspection

China Unicom is helping local governments to inspect rivers and identify areas polluted by waste. UAVs have also been used to collect video footage of optical cables and identify areas of potential damage.

Objectives and challenges

China Unicom's Internet & Industrial UAV project was designed to overcome the challenges of using traditional point-to-point wireless communication for UAVs, relating to the high cost of deploying and maintaining appropriate infrastructure. China Unicom's mobile networks provide a ready-to-use infrastructure that can support real-time monitoring of UAVs and communications with the aircraft.

Designed to meet the needs of government and enterprise customers, the approach taken by China Unicom can be broken down into the following steps:

- Design the wireless transmission model and the overall measurement and control link architecture.
- Plan and calculate the airspace coverage scheme.
- Design a base station antenna pattern that meets the UAV flight route target and ensures sufficient communications coverage.
- Develop a base station antenna with a servo system to achieve real-time tracking of UAVs, ensure coverage distance and signal strength, and avoid interference.
- Ensure efficient and error-free transmission of measurement and control information, together with reliable transmission of video image information.
- Separate the flight area from the live network and exclude interference from geography, neighbours, and distant communities and users by dividing the frequency bands, selecting the private networks, and differentiation of FDD/TDD networks. The selection of the frequency bands used for such private network is determined to avoid interference with the ground network or to reduce it to an acceptable level.
- Develop an on-board "customer premise equipment" (CPE) module to enable data communication during the flight of the UAV.
- Establish a cloud platform for drones, and provide one-stop quality services, such as airspace applications, meteorological security, insurance services, and regulatory registration to ensure a safe flight.

China Unicom also tested various types of UAV control interfaces, as well as developing a series of value-added services, such as data storage, distribution and analysis, and artificial intelligence technology to maximise the value from the collected data.

Figure 4 For optical cable inspection

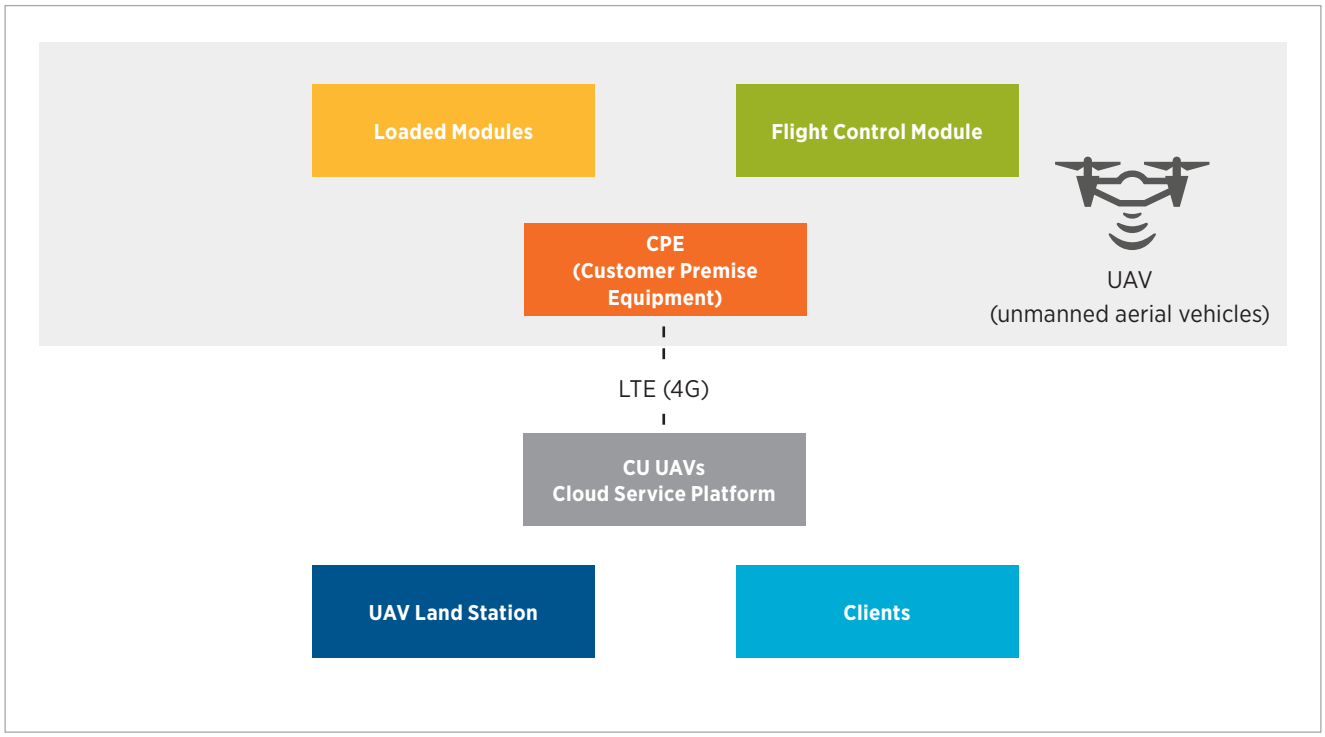
How mobile networks can support drones

The China Unicom mobile network is handling all UAV flight measurement and the control link. The information collected by different payload modules (such as photo-electric pods, a tilt camera or multi-spectral camera) are compressed and sent to the UAV CPE. The CPE aggregates the data and then transmits it over the cellular IP channel to the appropriate receiver of the data, such as a ground drone cloud service platform, the ground control station or client (see Figure 5).

China Unicom's mobile network ensures real-time reliable communication for telemetry data, control commands, and high-definition video during the flight. As a result, UAV flights are no longer limited by flight distance and altitude, making drones better suited to industrial applications.

China Unicom's solution can support a wide variety of capabilities, such as flight monitoring and control, collaborative intelligent scheduling, identity management, control planning, flight planning, data collection and storage, real-time distribution, intelligent analysis and other capabilities.

Figure 5 China Unicom's Internet & Industrial UAV



Conclusions and lessons learned

Up to now, mobile networks have generally been used to support UAVs that are operating below 120 meters of altitude. At higher altitudes, operators have had to use relatively expensive wireless or satellite communications, which are not suitable for small and medium-sized industrial UAVs.

With its new LTE-based measurement and control method, China Unicom's cost effective and versatile Internet & Industrial UAV solution can remove the distance and altitude constraints. The solution is using existing base stations enhanced with optimised antenna gain by altering the direction, and supported by a dedicated cloud platform for industrial UAVs, an ad-hoc LTE module, data centres and other resources.

China Unicom continues to explore the UAV market, developing solutions for government/industrial/transportation customers in the 5G era, and sharing its learnings with other vertical industries. The operator is also piloting the use of artificial intelligence systems for image/video analysis. The goal is to build an innovative business model by:

1. Developing multi-industry applications for drones: such as agricultural, electric, smart city.
2. Participating in the definition of global standards.
3. Carrying out a forward-looking study around 5G mobile networks.
4. Developing AI capabilities and products for processing data acquired by drones and data from the cloud platform.

About the GSMA

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with over 350 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces the industry-leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

For more information, please visit the GSMA corporate website at www.gsma.com.

Follow the GSMA on Twitter: @GSMA.

Further reference materials:

www.gsma.com/drones

About China Unicom

China United Network Communications Group Co. Ltd. ("China Unicom") established in January 2009 with the merger of former China Netcom and former China Unicom. China Unicom, ranked in Fortune Global 500, is the only Chinese telecom operator listed in the stock exchanges of New York, Hong Kong and Shanghai

The Company is committed to being a creator of smart living trusted by customers, connecting the world to innovate and share a good smart living, improving the quality of products and services continuously to fulfill customer needs. Future products and services will be developed in a "smart" way. Internet of Things, cloud computing, Big Data and other technologies will be used for the smart processing on data and information.
The Company's telecommunication network covers China and connects to the world. It provides full range and high quality information and telecommunication services, including mobile broadband (WCDMA, LTE FDD, TD-LTE), fixed-line broadband, GSM, fixed-line local access, ICT, data communications and other related value-added services. As at the end of 2017, the Company had mobile billing subscribers of about 284 million, in which 4G subscribers of about 175 million, fixed-line broadband subscribers of about 77 million, and fixed-line local access subscribers of about 60 million.

In the future, the Company will engage in new technology evolution for 5G network and IOT network, step up new investment in IOT products (like drones, smart home system,connected vehicles), Industry with internet, Artificial intelligence, 5G business services to become a creator of smart living trusted by customers.

www.chinaunicom.com.hk