TRANSFORMATIVE IoT
BEYOND CONNECTIVITY

How China Mobile Is Harnessing IoT Big Data Solutions to Create Value in Strawberry Production

INTRODUCTION

Like most markets the production of Strawberries in China is competitive. Prices are sensitive to the quality of the fruit and to supply and demand – with prices higher in the early season when the green-house crops start to ripen, but open field crops are not yet ready. Limited early supply keeps prices buoyant and the higher crop price directly improves the farmers' income and profit.

The profit margin is also affected by costs of production, such as the number of workers required to manage and harvest the crop, and the amount of inputs such as water and fertiliser used. Profit is not the only consideration however, as climate and environmental factors have the attention of governments and policy makers across the world, China has committed to the UN's Sustainable Development Goals which means becoming fully self-sufficient in staple foods by the end of the decade without increasing resource inputs to agriculture[1]. The Government's plan includes zero-growth targets for the use of fertilisers by 2020, and limiting national water consumption to below 700 billion cubic metres by 2030[2].

The challenge for the greenhouse strawberry producer in China is to maximise profitability by maximising yield & quality, extending the growing season by bringing the first crop harvest forward and optimising inputs such as water and fertiliser for the best returns and minimal environmental impact.

Set against this backdrop, China Mobile have worked together with LinkDotter, a specialist agricultural tech firm, and a strawberry producer, to demonstrate how mobile operators can drive value in smart agriculture – in this case in strawberry production – through IoT Big Data technology solutions.

The solution described in this case study demonstrates how mobile operators are not only able to offer network connectivity solutions such as NB-IoT and LTE-M, designed

[1] http://sdg.iisd.org/news/china-releases-national-plan-to-implement-sdgs/
[2] http://en.people.cn/n/2015/0601/c98649-8900480.html

specifically for the IoT, but are also able to harness existing capabilities such as platform expertise, customer insight knowledge, industry reach and distribution infrastructure, to develop value propositions for many markets, including agriculture.

THE OPPORTUNITY – MAXIMISING YIELD, QUALITY AND AGRICULTURAL INCOME

The greenhouse harvest can start earlier than in open fields due to the ability to control the air and soil temperature. The earlier the fruit is available, the longer the producer can benefit from the higher profit margin and income.

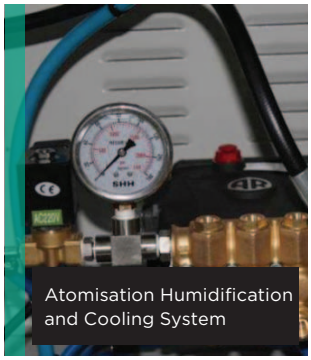
Producing in the greenhouses does not just benefit the harvest by enabling higher air and soil temperatures, it also allows the producer to better manage the growing environment. Optimising important growth factors such as the temperature, amount of light, water and nutrients available, enables the producer to maximise the yield and quality and influence the timing of the growth cycle and subsequently harvest times.

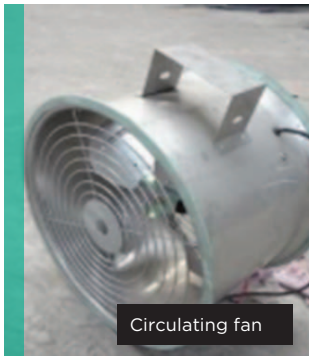
China Mobile IoT Company is working together with LinkDotter, a specialist agriculture tech firm that provide IoT based hardware and digitise crop data analytics, to pilot a solution with a local strawberry producer in Shunyi District, Beijing. This pilot is designed to optimise the environmental growth factors within five winter greenhouses, covering and area of 5 mu[3] in total (5 mu is the equivalent of about 0.33 hectares or 0.8 acres), using connected IoT sensors and big data analytics.

HOW CHINA MOBILE IOT ARE DELIVERING VALUE BEYOND CONNECTIVITY

The selected greenhouses have been equipped with IoT sensors to collect data about the growth environment, including light intensity, air and growing substrate conditions (CO2 concentration, temperature, humidity and substrate moisture levels) and leaf moisture. Devices including a Drip Fertigation[4] System, Substrate Heating System, Atomisation Humidification and Cooling System, and a Circulating Fan have also been deployed to adjust the environmental factors. Crop growth expertise and analytics is provided by the LinkDotter Agri-master (耘管家) software, known as the Butler App[5].

[3] Mu is the unit of area that is often used in south Asia. 1 Mu corresponding to 1/15 ha.
[4] Fertigation is a crop management practice that allows a timely supply of water through drip irrigation coupled with an accurate rate of fertiliser application, thereby simultaneously improving crop nutrient uptake and water use efficiency (WUE). https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/fertigation
[5] http://www.linkdotter.com





China Mobile IoT Company provides the connectivity for data transfer from all of the agricultural IoT sensors, some of which it also supplies, to the China Mobile IoT Company OneNET Platform. OneNET is a Platform as a Service (PaaS) cloud solution on which LinkDotter run their Agri-master Software as a Service (SaaS). OneNET stores the aggregated IoT big data for access and analysis by the Agri-master application. This capability, "beyond connectivity", developed by China Mobile IoT Company provides the critical element required for the various parts of the ecosystem to come together and deliver a full solution.

The China Mobile IoT and LinkDotter partnership arose from the LinkDotter membership of the China Mobile OneNET Certification Programme (OCP[6]). This programme is dedicated to growing the IoT solution ecosystem. The pilot solution, created from the partnership, demonstrates how functionality and expertise can be drawn from across the IoT ecosystem to deliver a solution to optimise strawberry yield and quality, and extend the growing season, in a cost effective way. Of course the solution is not restricted to strawberry production as it can be used for a wide variety of both greenhouse and open field crops.

BUSINESS MODEL

The Shunyi District strawberry pilot illustrates how mobile operators can deliver value to customers in the agricultural sector and develop new revenue streams beyond connectivity.

China Mobile's Standard Agriculture Service Package comprises a range of connectivity options including NB-IoT – a dedicated

[6] The OneNET Certification Program (OCP) is an initiative of the China Mobile IoT Alliance Open Platform Executive Committee. It aims to introduce quality partners to the China Mobile OneNET platform establish platform standards, and promote synergy to provide a full range of value services to corporate customers. It has five types of partner; hardware, software, solution, marketing and innovation, and venture partners. OCP provides multiple benefits for OneNET partner companies, such as corporate certification, marketing, cost advantages and technical support. https://open.iot.10086.cn/ocp/

low power, wide area technology that supports the IoT need for scalability at low cost. The Standard Agriculture Service Package also provides access to the OneNET PaaS Package and the Analytics Application (SaaS) from LinkDotter.

The China Mobile IoT Company Standard Agriculture Product, which bundles the service package described above with cost effective agricultural devices, is designed to be affordable to small farmers and local producers. China Mobile will be launching three editions of the Standard Agriculture Product later in 2019.

China Mobile IoT Company also produce a range of NB-IoT devices and have the ability to recommend (via the OneNET Certification Programme) and supply a wider range of devices sourced from third parties. China Mobile IoT Company observed that the existing devices available in the market were prohibitively priced for the non-government agricultural sector, due to the relatively high costs per unit. However, by working at an ecosystem level, building a data driven proposition and harnessing a strong distribution channel, China Mobile IoT Company are able to sell at volume to the agricultural sector. Economies of scale provide for a cost effective solution which benefits both the customer and every supplier in the value chain. The estimated cost saving in IoT investment for the Shunyi District strawberry pilot using China Mobile IoT Company supplied devices was approximately 70% compared to devices available on the market.

With a focus on bringing together expertise to meet customer need, the business model allows for a great deal of flexibility. OCP partners, such as LinkDotter, can work with customers directly and resell the operator components such as the connectivity and the OneNET PaaS. This may be particularly suitable for end customers that require a local project partner to provide an on-site integration service. The business model structure also enables the operator to address other vertical markets and also to work directly with any customer to directly develop customised solutions.

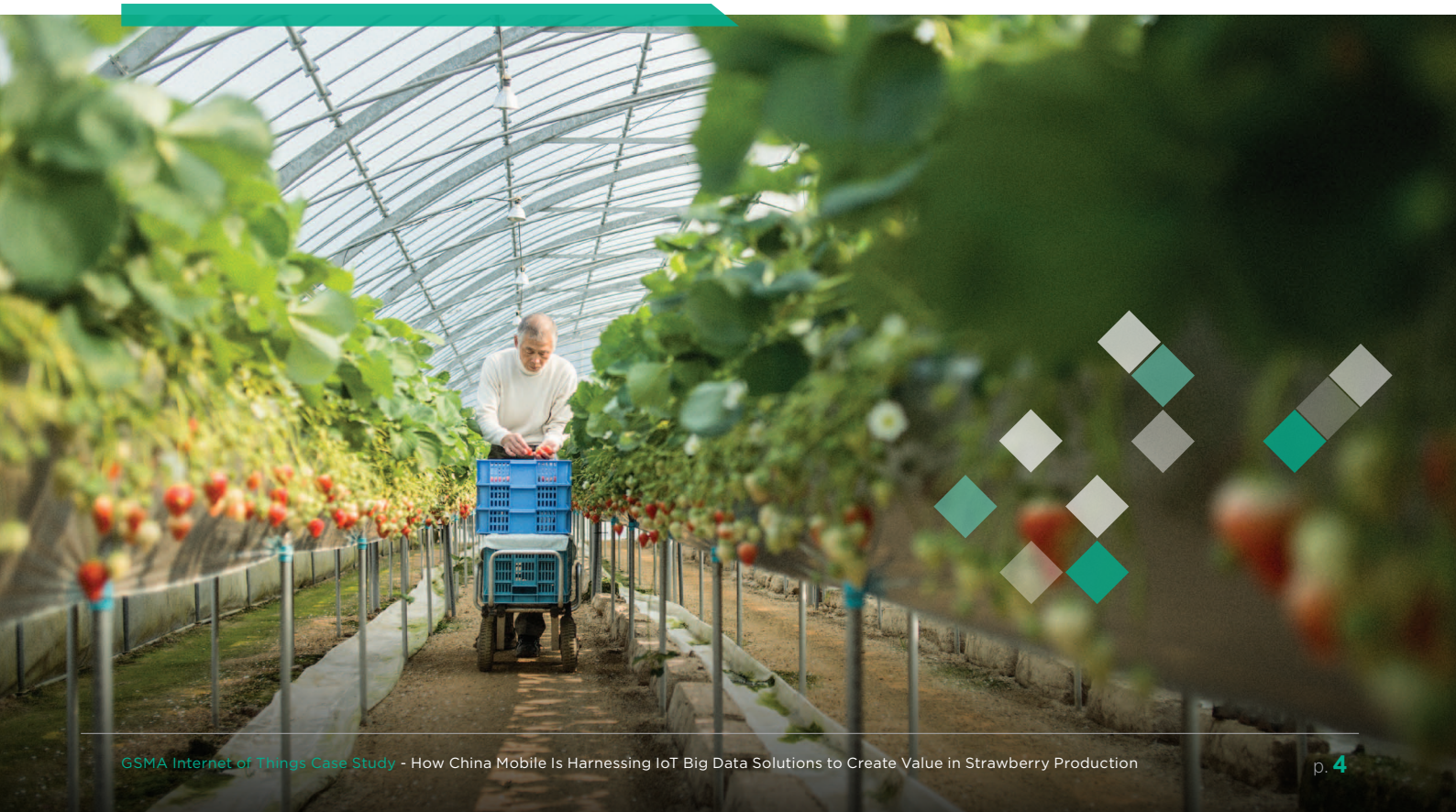
RESULTS

China Mobile IoT played a pivotal role in bringing together experts from across the ecosystem to deliver a comprehensive pilot solution for growing strawberries in Shunyi District, Beijing.

The pilot was successful, resulting in an increase in revenue and profitability for the strawberry producer.

Strawberry production normally runs from December to June in the greenhouse. The winter greenhouses equipped with the IoT solution produced the first crop of strawberries 20 days before the traditional greenhouses allowing for produce to be sold at a premium price.

These greenhouses equipped with IoT sensors increased production by more than 100% compared to the traditional strawberry greenhouse, and the cumulative production for the season reached 5000kg per mu (approximately 75,000kg per



ha) compared to 2250kg per mu (approximately 33,750kg per ha) in the traditional strawberry greenhouse. The producer also reported a higher quality of crop from these greenhouses.

The IoT solution not only optimised the growing conditions for the strawberries, but reduced the amount of manual labour required to observe the fruit status and adjust the systems controlling the heating, humidity and moisture levels, reducing the labour costs by 50% per kg of strawberries. The volume of water and fertiliser was also reduced by 50% per kg of harvested strawberries resulting in lower cost to the producer and lower environmental impact.

The IoT solution required an initial investment of 120,000 RMB across the five winter greenhouses. The subsequent annual costs, including maintenance, crop inputs (fertiliser, water) and utilities for the five greenhouses is around 30,000 RMB, compared to 20,000 RMB for five traditional greenhouses.

The increase in yield and quality delivered a higher rate of return for the producer. Taking into account the yield only[7], the IoT greenhouse returned a profit increase of approximately 75% over the traditional greenhouses, providing a return on investment in the first year. As a result of this success, the producer has plans to extend the solution his businesses in other locations.

CONCLUSIONS

China Mobile IoT Company continue to demonstrate that operators have a role beyond connectivity in the IoT in China. The operator has been a significant force in the development of the IoT ecosystem, driving the business and technical environment that supports organisations to work together to deliver comprehensive solutions to industry verticals such as agriculture.

The OneNET PaaS provides comprehensive and accessible cloud storage with a simple interface so specialist applications can access big data collected form IoT devices and perform necessary analytics and AI.

The OneNET Certification program ensures specialist industry firms understand the possibilities available through IoT technology solutions, and the programme provides access to rich partnership opportunities benefitting those partner companies, China Mobile and the end customer.

[7] The calculation is based on strawberries priced at 20 RMB per Kilo and excludes any premium pricing for early season availability or higher quality produce.

Finally the China Mobile IoT Company customer insight expertise and distribution infrastructure has enabled the partnership to develop a cost effective solution that drives results for farmers and is profitable for all parties in the value chain.

In this project, the network of regional offices belonging to China Mobile - China Mobile IoT Company's parent company – provided access to a strong understanding of the crop producer's needs, and the challenges with the existing technology solutions. LinkDotter brought crop management expertise and together the partnership developed a solution that can not only address strawberry growers but other greenhouse crop producers, opening up a significant new customer base.

NEXT STEPS

Following the successful pilot for the Shunyi District strawberry project, which has produced a return on IoT investment in the first year, plans are underway to extend the IoT solution to greenhouse production in other cities. Linkdotter has extend its IoT Solution to greenhouse production in more than 9 provinces, including Shanxi, Shandong, Jiangsu, Fujian and Neimenggu.

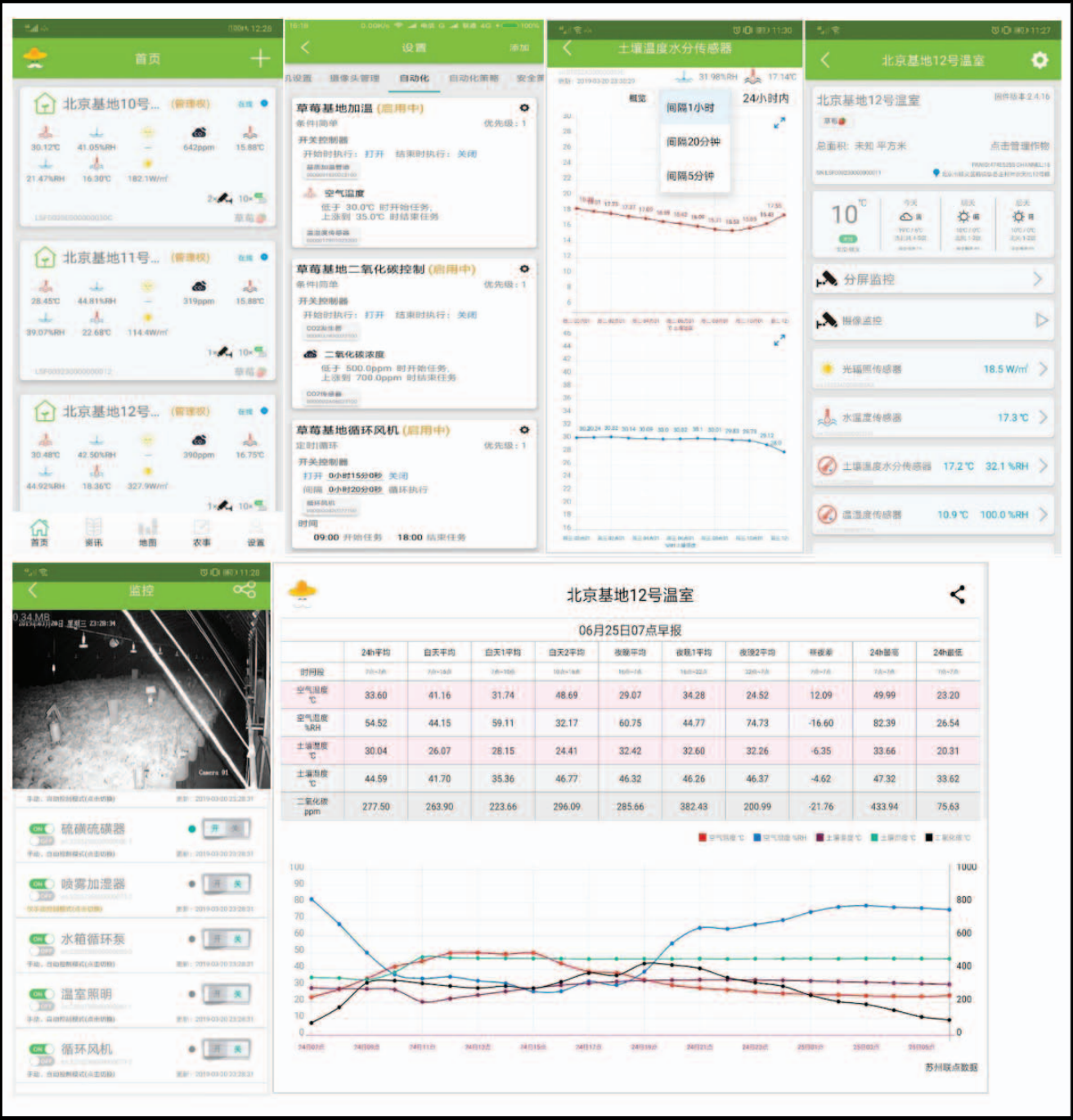
The IoT solution is not only applicable to strawberry crops. This commercial pilot was developed from an earlier China Mobile IoT Company proof of concept, addressing table grape production in Hebei Province, and illustrates how the model can potentially be adapted to any greenhouse production.

China Mobile IoT Company are also exploring the opportunity for 5G and leading the innovation in 5G services for smart agriculture. Developments include 5G enabled camera monitoring and field farming with 5G connected UAV.

Finally, the nature of the business model and technical infrastructure allows for significant flexibility in its application. This provides China Mobile IoT Company with the opportunity to develop propositions beyond the agricultural sector in other industry verticals such as transport, traffic management, the sharing economy and manufacturing[8].

[8] https://www.gsma.com/iot/report-growing-iot-in-china/

THE LINKDOTTER BUTLER APP



The LinkDotter Butler application enables the producer to monitor the greenhouse environment, view the status of, and data recorded from, individual sensors and set automatic controls for the management devices to adjust the environment. For example when the substrate moisture level drops below the optimum level, the fertigation system will be triggered. The Butler application also provides a dashboard of historical data.

Images, L-R Clockwise: Home screen, Automatic control settings, individual sensor data report, greenhouse overview, data report, situation monitor.

MOBILE IOT : NB-IOT AND LTE-M

IoT deployments are made more effective through the use of optimised licensed standard technologies 'Narrowband IoT' (NB-IoT) and 'LTE for Machines' (LTE-M). These technologies work in complement to existing mobile operator networks offering:

- Substantial improvements to transmission ranges suiting wide area deployments and better in-building penetration
- Much improved power consumption enabling long life battery operation
- Rapid deployment and configuration leveraging mobile network capabilities
- Carrier grade security
- Bi-directional communications enabling data uploads, control, remote configuration and patching
- Scalability, reliability and quality of service

For more information see **gsma.com/iot/mobile-iot/**

OneNET

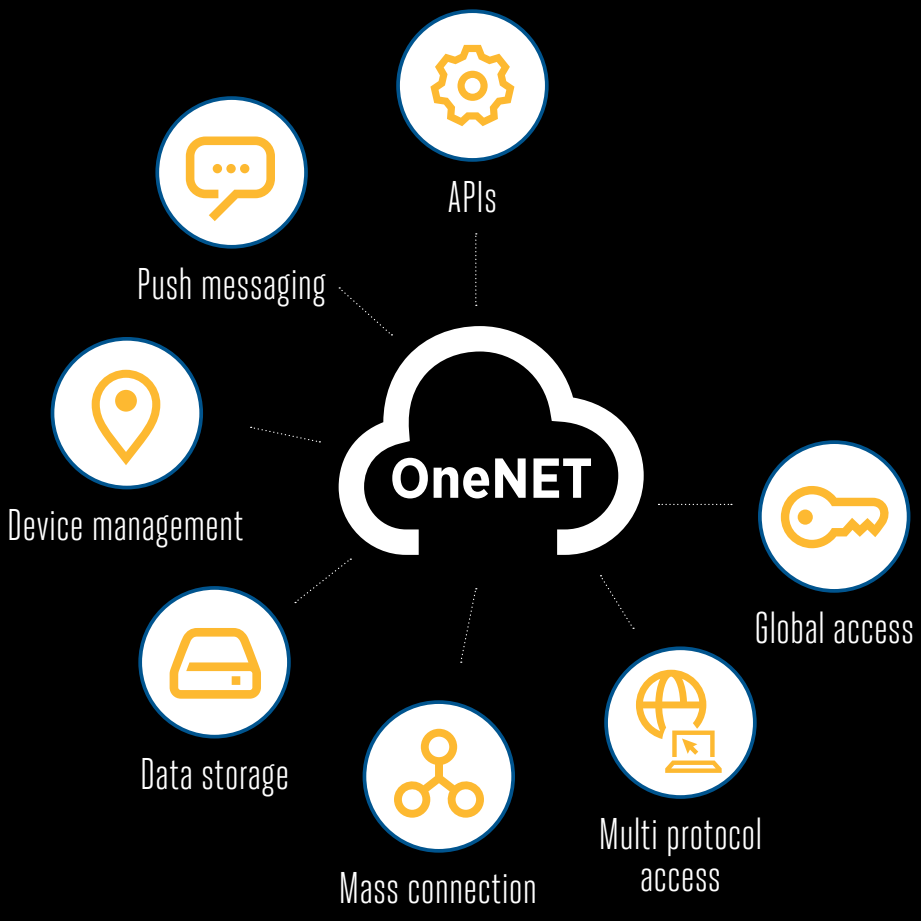
OneNET is an open IoT platform from China Mobile that supports data aggregation from IoT devices over a range of network environments and protocols. The data can be accessed by applications, analytics services or intelligent hardware through a range of APIs and app templates.

It has a number of core features and these include bulk data storage, massive scalability (supporting many millions of connected IoT devices), secure data transmission and a broad range of communications protocols.

OneNET is an IoT platform that provides effective support for NB-IoT deployments having the capability to receive data from IoT sensors at scale and make that data available to third-party application platforms for further processing. The platform supports rapid rollout of IoT devices, and provides a range of APIs supporting efficient operation of those devices. Capabilities of the platform include reading and writing APIs for device attributes, caching and push messaging.

The OneNET Device Management Platform (DMP) offers integrated SIM card management, device statistics, OTA (Over The Air) device updates and fault tracking to allow for full operational support with troubleshooting, relationship management between machine and SIM, terminal status query and terminal remote upgrade. Customers using the OneNET platform have access to a management portal, which can also be configured to interface to external systems.

The OneNET platform supports various protocols and APIs enabling data to be transferred to the platform from IoT devices, and, extracted from the platform for integration into developer applications.



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 or the GSMA Internet of Things programme at www.gsma.com/IoT.

Follow the GSMA on Twitter: @GSMA.

About the GSMA Beyond Connectivity campaign

Delivering seamless IoT connectivity has been a crucial element in helping operators to launch new services such as low power wide area (LPWA) networks, using NB-IoT and LTE-M technologies and create added value and sustainable growth. Now leading IoT operators are building on this and their reputation as trusted industry partners by delivering value added services beyond connectivity.

These end-to-end solutions include services across big data, machine learning, analytics, edge computing and distributed ledger technologies. They are delivering substantial benefits to customers such as increased productivity, reduced costs and automated business processes as well as driving innovative new products and services, new lines of business and new business models. Services beyond connectivity are transforming businesses and industries.

www.gsma.com/BeyondConnectivity

About China Mobile IoT Company

China Mobile IoT Company Limited is a wholly owned subsidiary of China Mobile. Based on the overall strategy of China Mobile, China Mobile IoT Company aims to become the supporter of IoT business services, the provider of IoT chips & modules and the promoter of IoT products & applications. In practice, China Mobile IoT focuses on operating IoT private networks, designing IoT chips and modules, smart vehicle applications, smart home applications and wearables, development and operation of the IoT card connection management platform OneLink and the IoT open platform OneNET, delivering IoT solutions.

Overall this makes a comprehensive architecture known as “Cloud-Pipeline-Device”. The China Mobile IoT Company collaborates with China Mobile provincial and professional companies to provide the community with the most advanced IoT technologies. Following the philosophy of openness, cooperation and sharing, China Mobile IoT strives to become a China based, leading global IoT Company which promotes IoT applications in various industries.

About LinkDotter

Suzhou United Data Technology Co., Ltd. (referred to as Linkedter, English LinkDotter) is a leading provider of Internet of Things, “Big Data” and cloud computing solutions in China, and a provider of system solutions for smart agriculture.