



# Shenzhen – Internet of Things Case Study

## Introduction

Supply of water and gas to consumers in Shenzhen has historically been a challenge. However, significant investment in improving the delivery of both of these utility services across Shenzhen and wider Chinese markets is gathering pace. Across China, significant investment in infrastructure is occurring with 40,000km of new gas pipeline newly connecting 470m people, and equivalent investment in water infrastructure to better control issues such as leakage and infrastructure management. China Telecom and Huawei have partnered with Shenzhen Water and Shenzhen Gas to demonstrate the benefits that NB-IoT connected smart meters would bring to both utility companies.

## Shenzhen Water

Many issues have significantly affected the ability of the Shenzhen Water Company to provide a good quality of service in the past. Issues such as water leakage caused by the poor management of water infrastructure and disputes caused by inaccuracy of water meters directly affect the satisfaction of consumers with Shenzhen Water Group. Additionally, the cost of water in Shenzhen is increased by the cost of serving the existing water meter fleet with manual labour.

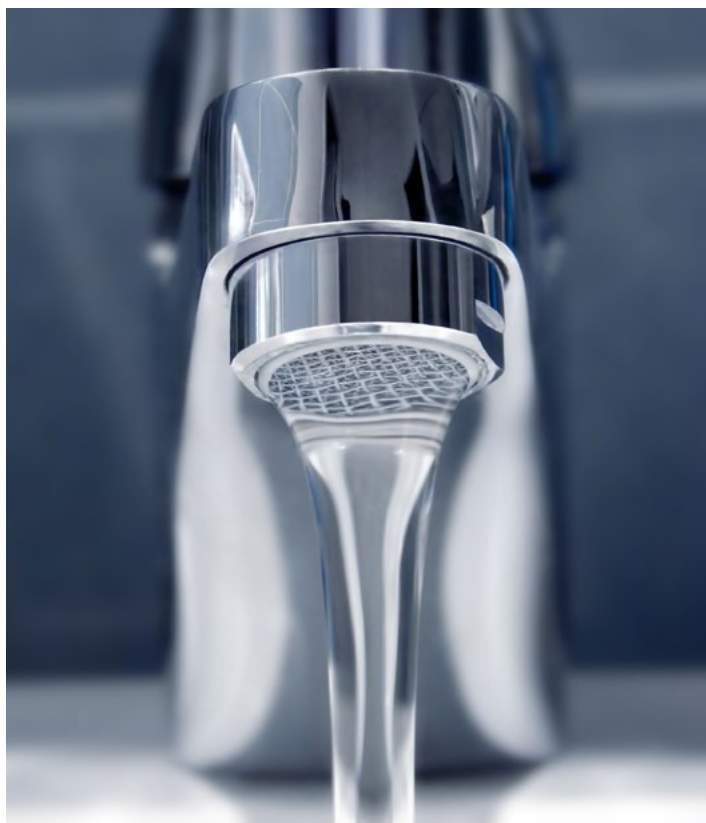
China Telecom has partnered with the Shenzhen Water Group, Huawei and Ningbo water meter company to jointly promote a new IoT water management platform, based around the deployment of NB-IoT powered water meters across Shenzhen.

## Shenzhen Gas

Shenzhen Gas has a large fleet of existing gas meters, which are installed in a variety of hard to reach locations, such as indoors and underground, meaning that existing communications networks have struggled to maintain connectivity with all meters. The meter success rate is low, data transmissions are so far unstable and power consumption is too high.

Against this background, Shenzhen Gas, China Telecom, Huawei and Goldcard have jointly trialled NB-IoT gas meters to try and solve some of the challenges that the industry faces with today's smart gas meters.





## Shenzhen Water NB-IoT Deployment

China Telecom is leading the deployment of this NB-IoT trial, having signed a collaboration agreement with the other partners. China Telecom are responsible for the NB-IoT network planning and deployment, as well as the use of their IoT platform. Shenzhen Water have built the requirements for the pilot, as well as identifying an appropriate location for the deployment. Huawei are providing the NB-IoT chipsets and network equipment, and Ningbo water meter are responsible for the development and manufacture of the NB-IoT equipped water meters.

The aim of the NB-IoT trial is to demonstrate that NB-IoT is a good solution for smart water meters. As part of the trial, the wide coverage areas and low power attributes of NB-IoT will be tested. China Telecoms NB-IoT network is designed to offer strong signal penetration, so that water meters, even when installed underground or in basements, are still able to connect to the NB-IoT network.

### Benefits to Shenzhen Water

NB-IoT will deliver some significant benefits to Shenzhen Water Group, including:

**Reliability of Transmission** – as NB-IoT is based upon LTE networks, it shares high quality attributes associated with the technology. This means that messages can be sent and received reliably and regularly, that the network is stable, and that it is standardised globally. All of this gives Shenzhen Water group the confidence to rollout NB-IoT water meters without the need for additional backups and infrastructure needed for outage scenarios.

**Signal Penetration** – NB-IoT is designed for improved coverage over existing networks, with up to a 20dB gain. This means that water meters in hard to reach locations such as indoors or underground are much more likely to be able to connect to the NB-IoT network than other networks. Planning for water meter installation is thus more straightforward as network coverage is better, and meters can be located in convenient locations for the water company, rather than having to compromise to gain network coverage.

**Open Data Formats** – as NB-IoT offers enough bandwidth to support many data formats and protocols, the Shenzhen Water Group can use open data formats to ensure that data integration with the Chain Telecom platform is as seamless as possible. Using agreed data formats also means that other data sources can be combined to create big data analysis, so water consumption can be compared to weather conditions for example.

### Outcomes and Lessons Learned

The initial deployment of NB-IoT connected water meters has been a success, and has significantly improved the experience for Shenzhen Water Group customers. In the past, customers would have to allow meter readers into their properties, but now these readings can all be taken remotely and in real-time, without the water company having to rely on its customers granting them access.

Water usage and water flow analysis is now much easier to undertake. The smart water meters can also send flow information periodically, so water flow across the network can be measured and leaks identified for further investigations. If there are large flow issues or blockages, alarms can be activated so that remedial action is taken much more quickly than previously.

## Shenzhen Gas NB-IoT Deployment

In March 2017, a number of smart gas meters manufactured by Goldcard were deployed in partnership with Shenzhen Gas, China Telecom and Huawei for trial of NB-IoT communications in a range of different scenarios and locations using 800MHz spectrum.

By using NB-IoT, Shenzhen Gas, China Telecom, Goldcard and Huawei are able to take advantage of standardised data gathering and IoT platforms, where the whole end-to-end management of network operations can be conducted centrally by either the gas company or mobile operator. As part of the trial, the partners have implemented a new framework for smart gas metering, which allows new applications to be rolled out on the network quickly. This is hosted on the eCloud jointly developed by China Telecom and Huawei, with a data structure specifically formulated for the Chinese gas industry. This means that gas suppliers and their partners across China can take advantage of these new technologies.

The partners wanted to test the successful completion of a number of different scenarios, including pre-paid and post-paid billing and payments, valve controls, various meter parameter changes, different communications configurations and data integrity protection. As such, the trial has been designed to test a number of different scenarios and ensure that gas meters can be connected even in difficult to reach locations, such as inside metal meter cabinets or inside large buildings.

The targets the NB-IoT enabled gas meters were to be measured against were designed to be stringent and in-line with the expectations of the gas industry performance requirements. These included a meter reading success rate of over 99%, ability to conduct meter readings on demand and successful reads even when the signal received by the meter is very weak.



### Benefits to Shenzhen Gas

In the gas market, NB-IoT enables stable, real-time data collection and control of smart gas meters to enable remote operations and new gas services. This in turn improves customer satisfaction and the efficiency of the gas industry processes as well as create new business opportunities for gas utilities.

**Improved efficiency** – NB-IoT can reduce costs of operations for Shenzhen Gas by allowing real-time data analysis and prompt troubleshooting, which decreases the operational costs and improves operation efficiency.

**Data security** – End-to-end security management of the NB-IoT gas solution ensures data integrity. NB-IoT is only used by mobile network operators on licensed spectrum. This means that risk of interference is minimised and data security can be assured. As NB-IoT networks are based on existing mobile technology, they are easily deployed by mobile operators, and the enhanced coverage these networks offer ensures that all meters can be connected, removing the need to use multiple network types to obtain data.

**Improved power consumption** – NB-IoT devices running on battery power can last up to 10 years. This is due to optimised communications profiles and low-power signal requirements. This means that meter maintenance costs can be minimised, as there is no need to visit meters and update components on a regular basis. Gas meters are also free to be located in any location along a pipeline; there is no need to locate gas meters close to power supplies or in specific areas to ensure network coverage. This gives the gas supplier a great deal of flexibility in how they rollout their gas smart meters, and the rollout programme can be optimised to ensure the lowest cost installation.

**Interoperability** – In terms of massive connectivity, NB-IoT allows for both large scale deployments and a unified platform to accommodate diverse IoT applications. This platform assures protocol compatibility between applications of different manufacturers thus simplifying their integration. This means that gas meters from numerous manufacturers are able to access the network in a common way, allowing gas suppliers to interconnect networks using different gas meters.

### Outcomes and Lessons Learned

The results of the Shenzhen Gas trial with China Telecom, Huawei and Goldcard were as follows:

- NB-IoT has significant coverage advantages over other networks (up to 20dB over GPRS networks).
- The power consumption of NB-IoT is much lower than that of GPRS.
- The coverage delivered in field tests was good with an average uplink rate of 13 kbps and an average downlink rate of 7.8 kbps, which is sufficient for meter reading.
- Meter services were successfully completed on the meter head-end service platform, including user registration, tariff adjustment, pre-payment data, remote valve control, remote meter reading and remote parameter configuration, all of which meet the test case requirements.
- The meter reading success rate was 100% in standard operations.
- By comparing the actual readings on gas meters with the data collected by the system, the meter reading accuracy was also 100%.

The outcomes of the trial were very positive, with NB-IoT showing that it was capable of meeting all of Shenzhen Gas' stringent requirements, and connected all meters that were deployed.

In addition to the physical trial, a larger scale scenario was also conducted virtually. This trial was designed to simulate communications to 3 million meters within a 200 minute window. Various commands were simulated, including registration, meter readings, payments and valve control. The results of this trial were also very positive, with NB-IoT demonstrating that the average response time is 640ms, with data collected from every device within 60 seconds of first communication, averaging 30 seconds across all 3 million meters. NB-IoT proved that it is suitable for use in smart gas meters, even at this large scale, and is clearly a good option for connecting large fleets of smart gas meters in the future.



### Conclusion

Both the Shenzhen Gas and Shenzhen Water NB-IoT deployments have proven to be a success, with all meters deployed being able to connect in a secure manner, and offering a much improved service over previous iterations of the respective metering services. The deployments have demonstrated that NB-IoT can collect the required data and control of the required parameters across both gas and water meters, demonstrating the NB-IoT is flexible, scalable and

fit for a variety of different use cases, whilst allowing each industry to develop their service as they see fit.

The trials have proven that mobile operators are good partners for gas or water suppliers looking to deploy smart meters, and the IoT platforms and services that they are able to offer are a strong fit for industry needs. NB-IoT is a good choice for Chinese utilities, and able to meet their specific objectives through scalability, security and functionality.

Note – The GSMA Shenzhen Gas NB-IoT Case Study is based on the “NB-IoT Smart Gas Solution white paper” that was published in September 2017 as a joint effort from Shenzhen Gas, China Telecom, Goldcard and Huawei.

The white paper can be accessed at <http://www.huawei.com/en/news/2017/9/NB-IoT-Smart-Gas-Solution-WhitePaper>



The GSMA Internet of Things programme is an initiative to help operators add value and accelerate the delivery of new connected devices and services in the IoT. This is to be achieved by industry collaboration, appropriate regulation, optimising networks as well as developing key enablers to support the growth of the IoT in the longer term. Our vision is to enable the IoT, a world in which consumers and businesses enjoy rich new services, connected by an intelligent and secure mobile network

For more information visit the website:

[www.gsma.com/smartcities](http://www.gsma.com/smartcities)

