



Full 5G Connection at the Shunde Factory of Midea Kitchen and Water Heater Appliances Division



Technologies such as 5G, big data and AI are adopted by traditional enterprises in digital transformation. The 5G + industrial Internet innovation in Midea factory has proven the capabilities of 5G in terms of large uplink rate, integrated positioning, one network serving multiple purposes and high reliability, and created great values for the customer. China Unicom Guangdong Co., Ltd. will continue to leverage the advantages of 5G to meet the needs of key industries and boost high-quality economic development in Guangdong.

Feng Huajun

President of the Government and Enterprise BG of China Unicom Guangdong Co., Ltd.

Partners



Case Overview

Established in 1968, Midea Group ranks the first in China's home appliance industry in terms of revenue. In line with Midea Group's strategy of "full digitization and full intelligence", the Shunde factory of Midea Kitchen and Water Heater Appliances Division has formulated its own strategy of intelligent manufacturing based on 5G + industrial Internet. In collaboration with China Unicom and Huawei, it has worked out a map of 5G + intelligent manufacturing application scenarios, planning to launch 23 scenarios and over 600 point locations in 2021, 35 scenarios and over 2,000 point locations in 2022, and another 55 scenarios in 2023. In this way, it aims to fully realise interconnection based on 5G network at the factory level, and set a benchmark for 5G intelligent manufacturing at the national level.

Leveraging the customized private network, edge cloud, and four platforms (slice management platform, AI analysis platform, private network self-service platform, and integrated positioning platform) of China Unicom, the factory has achieved full 5G coverage. As of the end of October 2021, the factory had launched a total of 16 scenarios in five major categories, including intelligent logistics, quality management, equipment management, flexible production lines, and industry park safety, 327 5G point locations, and had realised 5G integrated positioning and intelligent warehousing for commercial uses in factory

scenarios for the first time, making full use of the 5G network for multiple purposes.

Full 5G connection reduced the overall cost of the factory by RMB 32 million, leading to significant breakthroughs in reduction in energy consumption by logistics equipment, intensive management of equipment and paperless drive. As a result, the company has won many awards such as China's Benchmark for Smart Factories, the 4th China Quality Award, Foshan Industrial Internet Demonstration and Benchmark Project, Forbes China Top 10 Industrial Internet Enterprises in 2021. Jointly led by Midea, China Unicom and Huawei, the project engaged more than 20 partners in the fields of 5G terminals, industrial equipment, application integration and AI algorithms to promote the development of the industrial chain. The successful project has been replicated and promoted in large scale in the upstream and downstream of the industrial chain (such as Annto Logistics, Midea Wuhu Kitchen and Bath Base and Midea Foshan Shunde Base), within Midea Group, and in the home appliance/electronics manufacturing industry. The three parties will join hands to apply 5G in more scenarios, work out more solutions, and continue to empower external parties with the help of the industrial Internet platform of Midea, contributing to intelligent manufacturing in China.



Industry Challenges

China's home appliance manufacturing industry has reached a value of about RMB 1.5 trillion, mainly including production units such as electronics, stamping, injection molding, powder impregnation, final assembly, finished products and logistics, hence a typical discrete manufacturing industry. Currently, the industry mainly faces the following challenges:

Frequent adjustments to production lines

In the home appliance industry, orders are placed in small amount and many batches. The rapid iteration of products leads to frequent adjustments to production lines and high cost. That's why the industry is in need of flexible production.

Disadvantages of traditional in-plant logistics system

Too many process breakpoints, offline processes and repetitive operations. Manual operation is required for communicating and recording logistics information, recording and reporting information on material shortage, confirmation of material shipping by phone, making inventory of finished products, etc. Using traditional WiFi network for information transmission often causes such problems as insufficient access capability, network disconnection and high latency, which compromises the efficiency and accuracy of in-plant logistics, and further restricts the improvement in production efficiency.

Strict process requirements and high local AI quality inspection costs

Faced with fierce competition, manufacturers have to follow strict requirements for production processes and quality control to gain a sound reputation and a significant market share. Using AI for quality inspection requires local deployment of dedicated hardware, resulting in high cost, heavy maintenance workload, and low resource utilization.

A large number of production equipment and high operation and maintenance costs

There are over 1,000 pieces of production equipment in a single factory, many of which are imported. Due to the COVID-19 pandemic, equipment manufacturers are not be able to quickly send technicians for troubleshooting on site in case of any equipment failure, which delays production. In addition, the monitoring of equipment status requires regular manual inspection, which means high labour input and low inspection efficiency.

With the help of 5G high-quality mobile connections and in combination of the edge cloud, AI, big data and other technologies, the above problems may be addressed by establishing digital construction scenarios that feature large uplink rate, precise positioning, high reliability, low latency and ultra-flexibility.

Solutions and Benefits

01 5G in-plant intelligent logistics

The 5G + in-plant intelligent logistics system adopts 5G integrated positioning for the real-time and accurate positioning of key elements such as trucks, forklifts and tractors to obtain the location and status of vehicles and the cargo. It also matches the physical logistics with the information flow in the Manufacturing Execution System (MES) and Warehousing Management System (WMS) of Midea to realise real-time display of cargo information, automatic inventory, consistent accounting and intelligent management. Compared with the traditional single positioning technology, this system features wide integration and fast switching, which can meet the complex needs for the ways and accuracy of positioning in different production areas, further improve positioning accuracy, reduce environmental dependence and network latency, and connect data silos. At the same time, compared with the cumbersome automation system, this system features lightweight and low-cost deployment, greater flexibility, and maximized utilization of 5G network for multiple purposes, providing a new option for the industry.

5G integrated positioning uses the original 5G network coverage of Midea to obtain wireless signals of terminals through the base stations of digital indoor system, and deploys positioning algorithms

on the edge cloud to calculate the results of 5G positioning and other positioning technologies through dynamic filtering algorithms. Finally, these results are reported to the applications of Midea through the standard interfaces. This network, without additional network building or maintenance, serves multiple purposes and features low building cost, large bandwidth, low latency, and wide connection to support the positioning of a large number of terminals in the factory and quick response.

The 5G + intelligent logistics solution has helped Midea Kitchen and Water Heater Appliances Division achieve labour reduction, paperless office and improved efficiency, saving RMB 8.89 million in labour costs and RMB 100,000 in paper costs, and earning RMB 1.74 million as a result of improvement in efficiency. This solution has been replicated and promoted in the upstream and downstream of the supply chain such as Annto Logistics, Midea Wuhu factory, and Midea production bases to increase both efficiency and value in the manufacturing chain through end-to-end 5G intelligent logistics. The widespread application of this solution will further boost the capabilities of 5G positioning and industry maturity, and contribute to the formulation of industry standards for 5G positioning by the ISO.



5G+ Smart Manufacturing



02 5G predictive maintenance & AR remote assistance

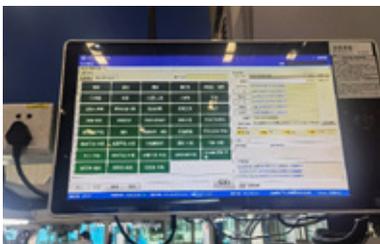
The powder impregnation lines are imported and need on-site guidance and maintenance by foreign experts in case of any equipment failures. However, it is a challenge for foreign experts to arrive on site due to the COVID-19 pandemic, resulting in high maintenance and repair costs, long affected period and lowered production efficiency. Furthermore, manual spot check on the production equipment in all workshops is conducted twice a day. In a single workshop, there may be hundreds of items to be checked. The heavy workload could easily lead to negligence or recklessness.

Additionally, manual check makes it impossible to record the process.

First, the status parameters of the powder impregnation lines are monitored online through the 5G network. The equipment operation model is established for the analysis of real-time data and failures and the prediction of failures. The maintenance schedule is formulated in advance to ensure the early detection, prevention and handling of hidden dangers and defects. Second, AR technology is used to support online simultaneous translation of multiple languages with the support of 5G network featuring large bandwidth, low latency and high quality. This enables real-time remote guidance by foreign experts, visualization of daily spot checks, and exploded view of key parameters and components.

03 5G + AR glasses for remote inspection of goods

The goods produced for an order cannot be released for shipping until on-site inspection and acceptance by the customer, which often causes a backlog of goods. Due to the COVID-19 pandemic, on-site inspection is subject to travel restrictions and may be a challenge to pandemic control at the factory. The on-site operators wearing 5G AR glasses communicate with and transmit the videos needed for inspection to customers in real time through the 5G network featuring large bandwidth and low latency, which provides customers with the same experience as on-site inspection and acceptance, thus improving the stock turnover rate.

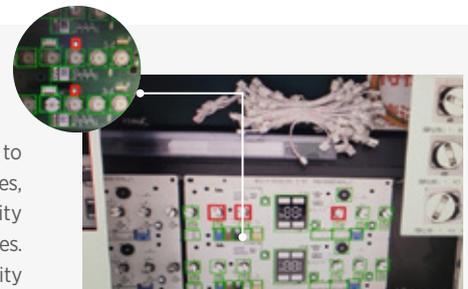


04 5G cloud-based IPCs

There are about 500 IPCs in the factory, which are locally deployed in various workstations. Workers provide product feedback and installation issues to the MES through the UIs on the IPCs. Currently, IPCs are highly priced and generally run much slower after two years of operation. Their maintenance is challenging as the Group's IT team is incapable of maintenance and the vendor has to do the job, which is costly. In addition, due to the frequent adjustments to production lines to meet the order requirements, the local deployment of a large number of servers and network cables results in elevated cost of production line transformation and compromised production efficiency. Moreover, as IPCs connect and interact with the interfaces of SCADA, MES, etc., it is difficult to debug and maintain the interfaces. The factory virtualises the IPCs on MEC and only retains the thin clients locally to connect code scanners and screens, and connects terminals and edge cloud through the high-quality 5G network to achieve centralized management of operation and maintenance. This solution reduces the cost of deploying IPCs locally, improves the efficiency of centralized operation and maintenance, and decreases the network cables to be deployed, contributing to enhanced flexibility of production lines.

05 5G + AI for quality inspection

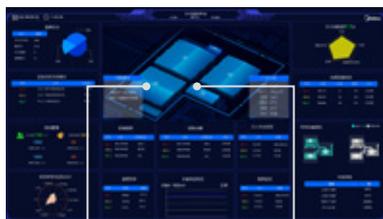
In the production lines such as electronics, metal plates and final assembly, it is required to conduct quality checks on many intermediate parts and processes (such as PCBs, metal plates, label positions, bottom plate screws, and manual inspection actions). Traditionally, quality inspections were done manually, which gave rise to such risks as mistakes, omissions and reverses. This resulted in uncontrollable inspection effect and high labour cost. Alternatively, quality inspections were conducted through AI algorithms in locally deployed servers, which led to high costs due to procurement of equipment, deployment of network cables, and operation and maintenance, and high energy consumption.



Through the terminal-edge-cloud architecture with 5G + cloud + AI, photo information is collected using HD industrial cameras on the terminal side, inference operations are conducted with MEC on the edge side, and AI data training is performed on the cloud. Leveraging the large bandwidth and low latency features of 5G network, it is able to quickly complete quality inspections, interact with MES, and realise automatic determination of unqualified goods and automatic alarm during scanning, which helps to improve the finished product quality, reduce the repair cost and workstations for manual inspection, enhance the utilization of server resources, and make maintenance easier.

06 5G intelligent management of mold shelves

In the stamping process, molds need to be changed frequently every day according to the requirements of different batches of orders. Workers receive mold location tasks and recommended shelves through the vehicle-mounted tablets, drive forklifts into the shelf area, scan the code to locate the corresponding molds, and take them out and deliver them to the production lines. Traditionally, the vehicle-mounted tablets were connected through WiFi network, which was often unstable and disconnected. As a result, the tablets may not be able to receive instructions or scan codes. Resolving one single problem could take up to 20 minutes, resulting in low mold delivery efficiency, or even worse, production line downtime. By connecting the vehicle-mounted tablets and code scanners through the 5G network, the stability of data transmission is guaranteed. As a result, the time for changing molds is reduced by more than 20% on average, thereby lowering the production line downtime and improving the production efficiency.



07 5G-based industry park management

The industry park security relies fully on inefficient manual defense, control and management without visualised management and effective means of early warning and alert. 5G cameras and sensors deployed in the industry park enable real-time data collection across the park, early warning and alert. The industry park security, fire protection, environmental protection, and other systems are connected for intelligent management.

- 5G intelligent cameras are installed in key areas of the industry park to take photos of illegal behaviors related to vehicle parking, zebra crossing, PPE, etc.;
- Sensors and infrared cameras are put in place to monitor high fire hazard zones in the industry park;
- 5G mobile AI monitoring equipment is used to monitor temporary constructions at different sites;
- The on-site monitoring equipment is connected with the EHS system to send the monitoring results to the system and use it for event recording, early warning and control.

This solution reduces the accident rate in the industry park by 12% and the time to review and approve dangerous operations by 90%, and lowers the security cost.

Summary and Next-steps

In this project, Midea Group, China Unicom and Huawei have figured out what it takes to be successful, which is detailed as follows. When planning 5G business scenarios, we must take into consideration the company's strategy of digital transformation or intelligent manufacturing, have a profound understanding of the production process to identify the actual needs, and make good top-level designs to create true values. During the implementation of the project, all parties involved must cooperate with each other, and make good use of and develop partnerships to take advantage of each other's resources. A good business model should be designed so that all providers of network equipment, terminal equipment, application integration, and cloud services may obtain commercial benefits. For new scenarios and new needs, we should constantly innovate network capabilities (for example, 5G high-precision positioning), and drive technical upgrade and iteration from the business side, which will ultimately benefit the business and form a virtuous circle. However, some challenges are encountered during the project. The cost of transformation to 5G business scenarios and the cost of terminals are very high and need to be reduced through empowering an ecosystem and large-scale promotion of a successful case. Understanding the industrial production process and designing a 5G network for it are not easy. In network design, factors such as latency, bandwidth and reliability must be taken into full consideration to meet business requirements, which is more demanding than traditional network design. After 5G terminals are launched in large scale, they have to be managed in a professional industry park management platform.

Next Steps

- 1 Expanded connections: Based on the map of 5G digitalization of the factory, network connections and application scenarios will be further expanded to connect over 2,000 terminals by 2022.
- 2 Further application scenarios: 5G positioning will be further explored and used in more application scenarios. Terminals with higher-precision positioning and lower power consumption will be explored to promote the evolution of intelligent logistics and unmanned technologies and the formulation of industry standards for 5G positioning.
- 3 More reliable private network: In response to the company's demand for high reliability and high SLA of the private network, we will continue to launch and innovate highly reliable private network solutions (such as dual transmission and selective-receiving mode, continuous MEC in spite of network disconnection, and slicing), build an industry park self-service platform, manage and monitor the private network in a unified manner, and quickly identify faults.
- 4 Concentration of services on the edge: Based on the operator MEC, AI quality inspection, AR remote maintenance and other services will be centralized on the edge cloud. At the same time, we will also explore the centralization of production control equipment such as PLCs and IPCs on the cloud to give full play to synergistic network and business and intensive operation.
- 5 Continuous empowering external parties: Through M-IoT industrial Internet platform of Midea, we will continue to empower many other industries with innovative solutions.