



A “NEW FORCE” IN TECH INNOVATION AND DEVELOPMENT

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A “NEW FORCE” IN TECH INNOVATION AND DEVELOPMENT

Science and technology, the most powerful weapons of a country, enable a country to be stronger, an enterprise to outperform peers and the people to live a better life. As an enabler of digital economy, China Unicom fully leveraged technological innovation, a key factor to overall development, focused on technological innovation in key areas, deepened the deployment of innovative business, and devoted continuous efforts to seek breakthroughs, thus facilitating the transformation and upgrade of the economy and the society as well as the shift of growth drivers.

Measures adopted in 2019

- Achievements were made in technological innovation system and regulations through actively promoting technological management innovation.
- Built a comprehensive technical support hub to support network leadership and facilitate Internet-oriented transformation.
- Commercialised the results of product research and development, provided application solutions and established high-end knowledge base to provide innovative support and reference for the Company's decision-making. Developed a value chain cooperation ecosystem to deepen internal and external cooperation.

Actions to be taken in 2020

- Further improve technological innovation system, mechanism and process. For the research of futuristic technologies, make reasonable deployment in key R&D fields and carry out R&D activities under the guidance of the technology development plan.
- Continue to commercialise technology R&D, and consistently innovate on application solutions to strengthen industry development of China.
- Enhance the coordination between cloud computing, big data and IoT capabilities and government & enterprise businesses. Nurture industry ecosystem through innovative capital and business cooperation.

DEVELOPING FUTURISTIC TECHNOLOGIES

China Unicom proactively played its role as an innovation engine, intensified efforts to seek breakthrough in core information technologies, and made contributions to the building of a cyber superpower by virtue of its own innovation capability.

Propelling the evolution of 5G technology

In active response to the national 5G strategy, China Unicom devoted itself into research and development and trials of 5G technology, and took the lead in the completion of a number of 5G standards-based specifications and projects, which have greatly advanced the progress of 5G development. It was the first operator to complete the Non-Standalone (NSA) trials in China, and initiated the new Standalone (SA) network trials in 11 pilot cities. Further, it completed the in-field and out-field trials of 5G carrier network and drove the decoupling of 5G carrier network equipment from different manufacturers.

The issue of “China Unicom White Paper on General Technical Requirements for 5G Industry Terminals” and “China Unicom White Paper on 5G Common Modules” provides guidelines for the value chain partners on research and development and innovation of 5G industry terminal products.



Taking a cloud business-driven approach

Focusing on a cloud business-driven approach, China Unicom formulated the overall development strategy of cloud business featuring cloud and network integration, security and reliability, multi-cloud collaboration and service customisation. Underpinned by the cloud business, the Company established a new integrated product system through enhancing the full-stack component capacity of Heavenly Palace and Smart Enterprise platforms and integrating intelligent network, IoT, big data, industrial Internet applications and other products, thereby providing complete solutions for vertical industries. In 2019, the resources on our cloud platform included 267,000 virtual central processing units (vCPUs), 876.2T memory and 26.4PB of storage capacity, and the percentage of cloudified resource pool increased to 62.3%

☉ Enriching cloud products and services

- In terms of public cloud, China Unicom persistently expanded the supply capacity of “WO Cloud” products and cooperated with the partners to provide customers with integrated cloud computing services under the “WO Cloud” brand. Currently, more than 250 basic and application products have been rolled out on “WO Cloud” public cloud, 45 application products are provided on WO Cloud market and 116 functions have been launched on “WO Cloud” public cloud platform.
- In terms of private cloud, continuous efforts were devoted to build safe and reliable cloud platform and cloud products, including 312 functional points under four major categories. China Unicom succeeded in proprietary research and development of core technologies, and obtained more than 100 software copyright certificates.
- In terms of industry cloud, China Unicom continued to explore and practise in key industries, and provide customers with professional and high-quality industry cloud solutions and products by leveraging on the unique advantages of WO Cloud in cloud network integration as well as multi-cloud collaboration.
- In terms of cloud-network integration, China Unicom vigorously advanced the construction and deployment of intelligent networks and built new networks integrating cloud and network.
- In terms of cloud integration service, China Unicom relied on the localised operation and service teams to strengthen self-implementation capability, improved the professional operation and service capabilities such as cloud integration, cloud migration and cloud security, and rendered customers one-stop services including consultation on cloudification planning, solution development, implementation of the integration, cloud migration and security defence.
- In terms of the application of cloud platforms, the Heavenly Palace and Smart Enterprise platforms were rolled out in Guangdong, Sichuan, Shandong, Beijing, Jiangsu, Henan and other provinces, providing robust support to applications such as computing, transactions and big data.

☉ Improving WO Cloud product system

- China Unicom formulated four major plans which focus on the promotion of “31411” projects, i.e. construction of three-layer cloud pool, cloud networking, four major platforms, WO Cloud products and cloud markets.
- Backbone cloud pools with certain industry attributes have been established in 31 provinces to support provincial business and specialized local industry applications, as well as industry cloud business.
- Based on business demand, China Unicom created edge nodes in line with industry standards for local networks or major customers, so as to cater for the edge cloud demands such as 5G and IoT.
- Sub-brands including “Ling Cloud”, “Zhi Cloud” and “Jie Cloud” are under planning.

In respect of WO Cloud products, the Company was granted “Trusted Cloud – GPU Trusted Cloud Certificate”, “Trusted Cloud – Cloud Service Enterprise Credit Rating AAA Certificate” and “Trusted Cloud – Cloud Distribution Service Certificate” by China Academy of Information and Communications Technology. China Unicom Wo Cloud Multi-Cloud Management Platform, Beijing Resource Pool System of China Unicom WO Cloud Platform and WO Cloud Content Distribution System have received Grade III security certification. In 2019, China Unicom WO Cloud was included in the list of “Cloud Platforms Passed Cloud Computing Service Security Assessment” published by the Cyberspace Administration of China. In addition, China Unicom was accredited with “2019 Leading Company for Cloudification of Millions of Enterprises” and “2019 Excellent Industry Solution for Cloudification of Enterprises” at the 2019 Annual Conference for Cloudification of Millions of Enterprises and the Cloud Ecology Summit.

In 2019, China Unicom consistently optimised WO Cloud products and services, and implemented the projects such as Liuzhou Government Services Cloud (Phase II), Xining Traditional Chinese Medicine Hospital in Qinghai and Handan Education Cloud. Meanwhile, it continued to provide quality services to Qinghai Government Service Cloud, China Tower, High Court and other customers.

☉ Strengthening big data capabilities

China Unicom vigorously cemented its basic big data capabilities, carried through the national big data strategy and implemented the “Big Data Capability Enhancement Plan”. By virtue mainly of proprietary research and development, the Company constructed an open and shared, safe and controllable, and industry-leading big data capability system, in an effort to become a data intelligent service expert trusted by users, as well as a key player in building digital China.

• **Consolidating proprietary research and development capabilities:** Through enhancing proprietary modelling capabilities, the Company is capable of PB-level technical data processing as well as real-time analysis and modelling for extremely large datasets. It has developed a matrix of industry models covering 10 industries such as finance and education.

• **Enhancing data asset integration capability:** Processing more than 180T incremental data, 16,000 sheets and 500,000 characters per day, the Company has developed an entire life-cycle data management and governance system, and realised value-oriented operation of internal and external tenant data models.

Serving over **1,000** online and offline customers

Providing various data services with a daily average of over **3 million** times

- **Strengthening security capability:** Through building a proprietary, safe and controllable big data security system, the Company has been equipped with security management and control capability covering the entire life cycle of data, thereby protecting national data and user privacy.
- **Building basic AI capabilities:** Breakthroughs were made in computer vision capabilities for faces, license plates and objects through self-developed AI application innovation platform. As at the end of 2019, we provided more than 20 proprietary capabilities such as face recognition and image recognition/search.
- **Enriching product capabilities:** The Company's products vertically cover finance, public security, population, regulation and other industries and fields, and horizontally constitute a multi-tier product system, serving over 600 tourist attractions, and over 200 government organisations, financial institutions and Internet companies.

The Company initiated the construction of a data middle platform and launched a data security platform internally to enable data interoperability among various scenarios, and expanded data sharing and accessibility to build a data middle platform ecosystem within the Group while ensuring data security. Meanwhile, it started to develop data quality system, with audit ratios for 31 provinces' online logs remaining below 120%. The establishment of customer insight system, customer scenario perception system and centralised operation system for existing customers has empowered the Company's marketing efforts and operational decision-making.

China Unicom established joint laboratories with four universities including Beijing Institute of Technology, and engaged in strategic cooperation with Aisino Corporation and State Grid Xiong'an Financial Technology Group. The market share of China Unicom's big data business increased from 32.1% at the end of 2018 to 53.7% in 2019, ranking first in the telecom industry.

Enhancing the value of IoT

Centered on the basic platform, China Unicom's IoT business aggregated upstream and downstream partners in the value chain for collaborative innovation through connectivity services, application services, component services and solution integration services and contributed to the digital transformation of cities. It strives to become a value enabler in the era of IoT and enable people to enjoy smart life. China Unicom ranked 4th among the world's top 500 IoT enterprises in 2019.

Strengthening platform development

- **Improving capability of connectivity management platform:** The carrying capacity and various capabilities of the cellular connectivity platform were optimised in a continuous manner, with an average of 2.2 billion API calls per month.
- **Building capabilities of equipment management platform:** The Company developed capabilities of equipment management platforms for industrial sector, public utilities, safety and others. Currently, the equipment management platforms serve more than 1,000 customers.
- **Advancing application enablement:** The Company kept enhancing customer-oriented platform capabilities such as real-name registration system and 2C ordering. Meanwhile, riding on the general demand of the industry and the development of innovative technology, it has built up the vision intelligence (VI) capability.
- **Deepening proprietary platform research system:** Having received the CMMI3 certification, the Company's software sophistication has reached a new level. Thanks to its stronger internal research team, the Company undertook all platform upgrades on its own in 2019.

Improving product system

Focusing on four major areas including smart manufacturing, smart city, digital supply chain and consumer electronics, the Company developed nearly 40 IoT products and solutions to bolster its nationwide IoT business. It supported nearly 100 projects in 2019, such as Guangdong smart water supply management project, Liaoning manhole cover project, Jiangsu Nanjing smart construction site project and Zhejiang bearing quality inspection project.

187 million

 IoT connections


Established IoT Joint Laboratory with Intel



Established IoT + Blockchain Joint Innovation Center with Wanxiang Blockchain

◎ Building Industry Ecosystem

- **Cementing our alliance:** China Unicom IoT Industry Alliance counted 304 partners along the IoT value chain as members.
- **Expanding the joint innovation mechanism:** In 2019, the Company established IoT joint innovation centres with 13 leading enterprises from various industries to carry out joint research and development on innovative products. It actively cooperated with external alliances and associations. For example, it participated in the compilation of the “White Paper on Supporting the Development of Smart Cities through Intelligent Lighting” of the Lighting Association.
- **Innovation Accelerators:** Collaborating with the government, professional institutions and other resources, China Unicom aims to empower the IoT industry clusters through the spiral model of “Industry + Capital + Base”, and strive to build a leading IoT innovation ecological centre within 3-5 years.

🔬 Focusing on Breakthroughs in New Technology

◎ Accelerating AI Innovation and Empowerment

China Unicom takes artificial intelligence (AI) as an important strategic tool to enhance technological competitiveness and gives full play to the steering role of AI.

- Self-developed the China Unicom Network AI Experimental Platform and completed the certification of the ITU intelligent network grading standard. China Unicom led the formation of the first ITU-T smart education standard based on next-generation AI technology, and released the ITU-T intelligent network grading standard.
- Provided support for implementation of more than 10 intelligent applications and related solution design, such as analysis and application of smart work orders and inspection of equipment rooms by smart robots. An AI-based intelligent platform for IPRAN network featuring alarm, analysis and positioning has been put into application, boosting the efficiency by over 85%.
- Hosted various AI competitions and online AI forums.

◎ Contributing to the Rise of Quantum Communications Industry

China Unicom proactively carried out network technology research, demonstration and application based on quantum encrypted communication, propelled ITU-T to establish the quantum encrypted communication focus research team, built the world’s first pre-commercial quantum encrypted trunk line between Beijing and Xiong’an, and developed various applications such as quantum encrypted video conferencing system. The Company was granted the most distinguished award at the 2019 World Summit of Information Society.

🔬 Further developing standards and regulations

China Unicom promoted technological management innovation through a series of measures such as setting up a science and technology committee, exploring the establishment of a shared capital pool, and improving the TIC evaluation system and the technological innovation incentive system, thus creating a positive environment for technological innovation.

- In terms of international standards, China Unicom held more than 100 positions in a number of important international standards and open-source organisations, including more than 20 key management positions, and almost covering all important organisations in international communication and IT fields. The Company led the formation of 38 new standards and the publication of 24 standards. It joined more than 40 domestic technical organisations, and led more than 50 CCSA industry standards and participated in 280 CCSA standards.
- China Unicom participated in the project “NB-IoT Key Technology Research and Development, Standardisation and Application”, which was accredited with the first prize by China Institute of Communications. It also participated in two projects including 3GPP International Standards which were awarded the first prize by CCSA.
- A number of systems have been developed to cater for the needs of production, including Heavenly Palace System 2.0, WO Sales (Bee Action) System and Natural Person System, which greatly boosted production efficiency and powered the business development.

China Unicom has put in place database resources and a service team for the whole Company, providing patent-related services to more than 8,800 persons from 25 provincial-level branch companies, 13 subsidiaries and 10 departments at headquarters. The proportion of provincial-level branches and subsidiaries as major inventors of application patents increased from 9% to nearly 15%.

Responsibility performance indicator	2019
International standard documents (article)	500
Industry standards (item)	280
Number of patent applied (item)	1,439
Number of patents granted (item)	658

EMPOWERING INDUSTRIAL UPGRADE

China Unicom vigorously explored the deep integration of technology and industry, and consistently promoted technological innovation to facilitate industrial upgrade and empower the transformation of growth drivers, fostering new cutting edges for China's high-quality development.

Deployment in smart education

China Unicom believes in the in-depth integration of information technology with education and learning. Focusing on digital campus and the application of big data and artificial intelligence in education, China Unicom further opened up its capabilities and nurtured ecosystem, so as to contribute more to education informatisation and drive education modernisation.

Leveraging on big data and AI technology, China Unicom Zhejiang branch developed a comprehensive service platform for the new scheme of college entrance examination to help parents and examinees to submit their college preferences in a reasonable and efficient manner, so as to narrow or even eliminate the differences and inequities caused by information asymmetry, enable more examinees to submit college preferences on an equal footing, and help the examinees choose appropriate universities and majors rationally.



China Unicom's comprehensive service platform for Zhejiang's new scheme of college entrance examination

China Unicom Guangdong branch proactively leveraged on its expertise in 5G and education informatisation to facilitate balanced allocation of educational resources. Through 5G + AR/VR, it realised remote interaction and immersive learning, enabling the quality education resources to be shared among different campuses, schools and regions, and more students in remote areas to enjoy such quality education resources.



Interactive Teaching and Learning at Guangdong Experimental Middle & High School

Innovative Smart Medical Care

China Unicom focuses on cloudification of hospitals and regional healthcare informatisation, continuously deepens the integration of new technologies and healthcare services, facilitates the interoperability of regional medical data and sharing of quality medical resources, promotes the implementation of hierarchical diagnosis and treatment system, and tackles the "difficulties in accessing affordable medical treatment", thereby enabling people to enjoy basic medical and healthcare services in a convenient manner and realising balanced allocation of medical service resources.



5G-aided cross-city emergency transport in Liaoning



Remote ultrasonic medical consultation in Sichuan



Live footage of a surgery proceeded through remote medical guidance in Heilongjiang



Intelligent mobile unit for emergency and critical care

China Unicom Sichuan branch assisted the affiliated hospital of Northern Sichuan Medical College in remote support of AIDS prevention and treatment in Meigu County, Liangshan Prefecture. The “5G + Remote Medical Care” model greatly improved the quality of diagnosis and treatment in Meigu County, and helped break geographical barriers and limitations on available medical resources, letting more people enjoy high-quality and convenient assistance.



Remote medical consultation at Northern Sichuan Medical College

Advancing smart transportation

China Unicom actively develops big data product system and city vehicle management product system, and provides 5G + smart transportation and logistics solutions. By further optimising resource allocation, it helps improve the efficiency of urban transportation and reduce pollutant emissions, bringing positive changes to economic development, social life and ecological environment.



Travelling around the airport via face recognition

China Unicom designed a smart travel integrated service system for Beijing Daxing International Airport, which comprehensively utilised the latest “5G + AI” technology and built three-dimensional smart travel services based on three perspectives, namely “travelling around the airport via face recognition”, “intelligent experience via Internet connection” and “managing baggage via a chip card”, bringing brand new intelligent travel experience to passengers and helping Beijing Daxing International Airport build a fresh image as the new national gate.

Through intelligent transformation of road berths and the comprehensive management of unmanned parking lots, China Unicom Changzhou branch effectively advanced the perception of urban comprehensive parking system, and addressed the inconvenience and disorder in parking for the residents.



Smart parking lot in Changzhou, Jiangsu

Developing smart public administration services

Actively responding to the appeal of the state and the real needs of the society, China Unicom is committed to building and operating new smart cities, with a view to improving operational efficiency of the government, strengthening scientific decision-making ability and enhancing perception of the public and enterprises. By building a new smart city platform and nurturing core capabilities of new smart cities such as integrated urban perception and AI-based data governance, China Unicom endeavoured to support the building of digital government and a co-built, co-managed and co-shared social governance paradigm.

China Unicom Xining branch in Qinghai assisted the local government in building the “Internet + government services” platform, realising “one number, one window, one website, one gate and one time” service for the public. Currently, there are 300 high-frequency service matters, 400 “physically present one time at most” service matters and 100 “only subject to remote processing” service matters on the platform.



Qinghai Government Services Platform

The Jiaxing “Smart People’s Congress” online platform built by China Unicom Jiaxing branch in Zhejiang enables the general liaison station to share information with 74 liaison stations as well as centralised deployment and management, providing information support for scientific and democratic decision-making of the People’s Congress and its Standing Committee and an efficient information platform to facilitate the performance of duties by the deputies to the People’s Congresses.

Contributing to smart agriculture

China Unicom constantly drives the innovative integration of new technologies and smart agriculture applications, and provides comprehensive support, from research and development, planting to sales, for the social value enhancement of agricultural products, building a smart agriculture ecosystem.

China Unicom Guangdong branch assisted the local government in building a big data platform for 5G precise cultivation of see-mew rice, which enabled intelligent perception and precise management in the whole production cycle of see-mew rice in Zengcheng. This project will greatly promote the standardised application of rice cultivation in China. It could also be applied in other crop cultivation processes, which will significantly facilitate the revitalisation of agriculture and rural areas.



Data from 5G real-time monitoring on rice growing environment

Building smart factories

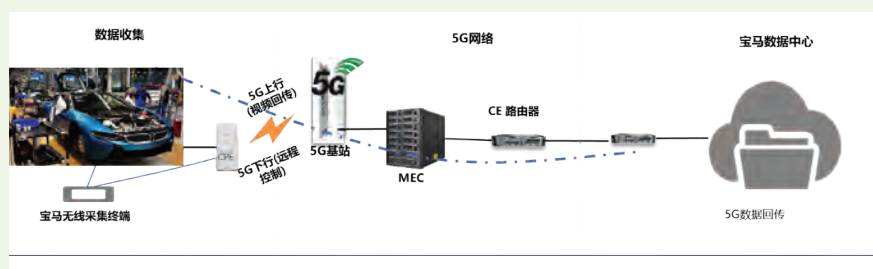
China Unicom is committed to becoming an enabler and service provider of 5G + AI industrial Internet. Building on 5G + industrial edge cloud and data service core capabilities, it supports the transformation and upgrade of China's manufacturing industry, leading to improved efficiency and optimised operation. It helps large enterprises build "5G all-connected smart factories" while offering small and medium manufacturing enterprises with industrial internet platforms aggregating regional industry clusters as well as application services.

China Unicom Guangdong branch helped Yangjiang City, a city lauded as "the Capital of Knives and Scissors in China", to build the hardware, knife and scissor industry cluster cloud platform, which provides enterprises with a full range of services covering research and development, design, production, sales and supply chain. It facilitated the evolution of innovative entities from single enterprise to multiple enterprises, innovative processes from sequential to parallel processes, and the innovative systems from closed to open systems, contributing to the transformation and upgrade of small and medium enterprises, and creating a new model for industry cluster development.



Yangjiang hardware, knife and scissor industry cluster cloud platform

China Unicom Liaoning branch took full advantage of the high bandwidth, low latency, high reliability and other features of 5G network for innovation. It conducted comprehensive cooperation with BMW Brilliance in intelligent manufacturing and industrial vision. It built the first automobile production base of BMW Group in the world leveraging 5G + MEC applications, and successfully applied 5G + MEC in the production process, effectively improving the production efficiency.



Networking solution for data collection