



# REINFORCING INNOVATION

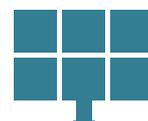
TO CONSOLIDATE THE BASE OF  
THE DIGITAL ECONOMY



# REINFORCING INNOVATION TO CONSOLIDATE THE BASE OF THE DIGITAL ECONOMY



China Telecom takes sci-tech self-reliance as strategic support for the Company's growth, and accelerates the construction of intelligent integrated digital information infrastructure that is "high-speed and ubiquitous, aerial-ground in one, cloud-network integrated, intelligent and agile, green and low-carbon, secure and controllable".



### ACCELERATING THE CONSTRUCTION OF NEW INFRASTRUCTURE

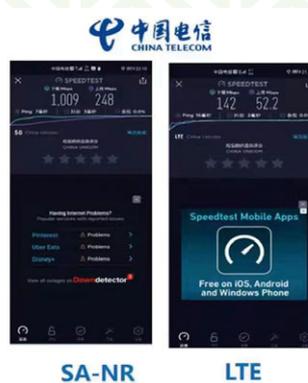
China Telecom adheres to the cloud-network integration development direction of “Network around, Cloud central, Network adaptive to cloud, Cloud and network as one”. With the key attributes of “security and controllability” and “green and low-carbon”, China Telecom actively builds digital information infrastructure and continuously consolidates the foundation of digital economic development.

#### Adhering to network around

Thoroughly implementing new development philosophy, the Company carried out 5G network co-building and co-sharing with China Unicom across the country, and accelerated the construction of 5G network capabilities. The number of 5G base stations in use reached approximately 690,000, with the 5G network covering all cities and counties and certain developed towns across the country, resulting in the world’s largest 5G SA co-building and co-sharing network. China Telecom constructed a 320,000-kilometre four-region, six-axle, eight-hub multi-channel optical cable network artery. CN2-DCI (multi-service carrying network) and OTN (optical transmission network) for government and enterprises cover all eight hub nodes and datacentres in major cities across the country. The backbone network bandwidth exceeds 300Tbps. The Company implemented the all-fibre network upgrade plan, and completed the ROADM (Reconfigurable Optical Add/Drop Multiplexer) all-fibre transmission network covering the whole country with the world’s largest capacity. The Company expanded deployment of the new metropolitan network to 17 provinces across the country around business development. It strengthened gigabit-led strategy and 300Mbps popularisation, and newly built 1.47 million 10G PON (Passive Optical Network) ports, with the gigabit network covering 160 million households. The traffic cleaning capacity of Cloud Dam exceeds 5Tbps, and the security capability pool covers more than 50 nodes in key cities across the nation, which continuously enhanced the intelligent network operation capability and operational efficiency.

#### Hefei branch has completed full coverage of 5G signal in the city’s subways

In late 2021, Hefei branch successfully completed 5G communications system renovation projects on Hefei Metro Lines 1, 2, and 3. Following the 5G coverage of Metro Lines 5 and 4, Hefei branch enabled full coverage of 5G signals in the subways in Hefei.





### Shanghai branch took the lead in launching 2000Mbps home broadband

On 22 November 2021, Shanghai branch officially launched a 2000Mbps home broadband package, bringing users a high-quality experience such as millisecond-level network latency and ultra-gigabit high bandwidth.

### Adhering to cloud central

The Company proactively positions itself as the source of original cloud computing technology, continues to strengthen the construction and deployment of cloud, and enhances problem-tackling efforts in the key core technologies of cloud computing. It can provide customers with full-stack cloud services such as public cloud, private cloud, dedicated cloud, hybrid cloud, and edge cloud, and built the largest telco-operated cloud in the world. In November 2021, China Telecom released e-Surfing Cloud 4.0, which is distributed, independent, controllable, secure and trustworthy.

Fully leveraging the edge in cloud-network resources, the Company continuously optimises the “2+4+31+X+O” cloud resources and datacentre layout around China’s “East-to-West Computing Resource Transfer” initiative and the project for an integrated big data centre. The Company has more than 700 IDC sites, over 6,000 edge facility rooms and over 50,000 integrated access offices, and has built a distributed cloud with more than 250 cloud resource pool nodes and 430 edge cloud nodes covering 270 cities in 31 provinces. The total scale of computer power reaches 2.1EFLOPS.



### Official launching of the first phase of China Telecom Beijing-Tianjin-Hebei Big Data Intelligent Computing Power Centre

The China Telecom Beijing-Tianjin-Hebei Big Data Intelligent Computing Power Centre project covers an area of 246 acres, with a planned total gross floor area of 372,000 square metres and a total investment of approximately RMB10.2 billion. The first phase of the project was officially launched at the end of 2021.



## China Telecom launched e-Surfing Cloud 4.0

On 12 November 2021, the e-Surfing Cloud Forum of the 2021 International Digital Technology Exhibition cum e-Surfing Intelligent Ecology Expo was held in Guangzhou. At the expo, China Telecom launched a fully upgraded e-Surfing Cloud 4.0, featuring polymorphism, multiple chip architectures in one cloud, one layer of cloud and network, unified bottom architecture, centralised coordination and maintenance. Meanwhile, the upgrading of products and technologies has brought an overall enhancement in computing power, storage, and network of the e-Surfing Cloud, enabling the cloud migration of social management, public services, ecological environment and other industries leveraging “5G + industry cloud + AI”, helping the digital transformation of thousands of industries.

## Adhering to network adaptive to cloud, cloud and network as one

In accordance with the three principles of network resources allocation as required by cloud, network configuration adaptive to cloud, network and cloud deployed as one, the Company actively promoted network cloudification, and achieved “network deployment following cloud” and one-stop service acceptance. The cloud-network POP (network service provision point) is built adaptive to cloud to achieve simultaneous launch of the standardisation and modularisation of cloud-network capabilities. The backbone core nodes in Beijing-Tianjin-Hebei, Yangtze River Delta, Guangdong-Hong Kong-Macau, Guizhou and other regions are migrated to large-scale parks, and key parks are enabled with direct access to the backbone network. With new metropolitan network pilot, large-capacity CUPS vBRAS is deployed in Shanghai, Jiangsu, and Zhejiang, where the control plane of service access equipment became cloud-based and the forwarding plane became pool-based to achieve centralised service management and network efficiency enhancement. The Company completed the industry’s first 5GC (5G core network) three-layer decoupling pilot based on its proprietary CT cloud deployment in Shanghai and Sichuan. As cloud-based deployment of traditional network was being promoted, the mastery of cloud-network core technology was also significantly enhanced.



## Chengdu branch commenced the operation of the first MEC intelligent edge datacentre in China

In 2021, the first MEC intelligent edge datacentre in China independently built by Chengdu branch was put into operation in the Future Medical City, Eastern New District, Chengdu and the network edge sank to the user park synchronously with cloud to realise the localisation of business application data with low latency, so as to enhance the network experience of users.



**Sichuan branch completed the pilot deployment of 5GC three-layer decoupling**

Based on the proprietary CT cloud resource pool, Sichuan branch completed the cloud deployment of 5GC network elements, realising agile and elastic expansion of the 5G core network, which effectively enhanced resource utilisation efficiency.

**MAINTAINING NETWORK AND INFORMATION SECURITY**

China Telecom has always been at the forefront of network development and security. With the vision of “safeguarding network security and providing first-class services”, it consolidates the security foundation of information infrastructure, enhances intelligent security services and builds a network security ecology.

**Maintaining the security of network and information**

In compliance with the *Cybersecurity Law of the People’s Republic of China* and other laws and regulations, the Company conscientiously implements relevant requirements of the Ministry of Industry and Information Technology, the Ministry of Public Security and other ministries and commissions on network and information security, and cooperates with government departments to combat network crime and other work.

The Company continued to increase investment in the research and development of security technologies in cloud-network, quantum, and others. It plans to build a security core with architectural and logical unity, thus increasing cloud-network security protection capabilities. The Company actively expands the industry-leading portfolio of products and services such as DDoS attack protection, e-Surfing Security Brain, Graded Protection Assistant, Trusted Communications, and Internet Fraud Prevention.



**China Telecom released “Security Brain” service**

China Telecom e-Surfing Security Brain provides standardised security services such as traffic control, intrusion prevention, attack blocking, virus detection and removal, and online behavior auditing, which would help government and enterprise customers to build a cloud-network-terminal coordinated protection system, i.e. cloud-side operation analysis, edge-side threat blocking, and terminal-side personal protection.

## Maintaining smooth communications

The Company faithfully fulfills its mission of ensuring secured and smooth communications, with coordinated efforts on the normalised prevention and control of Covid-19 Epidemic. It makes every effort to fight against natural disasters such as earthquakes, typhoons, floods and landslides and provides communications assurance of major activities. China Telecom provided disaster relief and communications assurance against floods and typhoons in Henan, Zhejiang, Shanxi, Fujian, Hubei, Shaanxi, Guizhou and other provinces. The Company focuses on key regions and coordinates the whole network, and conducts online and offline coordination and put equal effort on communications assurance and Epidemic prevention. Communications assurance work for 8 major events including the Shanghai International Import Expo, the Boao Forum for Asia and the 14th National Games was successfully completed. In 2021, more than 670,000 personnel, 180,000 vehicles, and 110,000 sets of communications equipment were dispatched for emergency communications.



### All-out effort on communications assurance by Xiamen branch for the prevention and control of the Epidemic in Xiamen

In July 2021, an overseas import-related Covid-19 infection case occurred in Xiamen City. Xiamen branch quickly established a service assurance team to actively connect with the city's big datacentre and district health bureaus, assuring communications for the nucleic acid diagnostic of all people in the city.



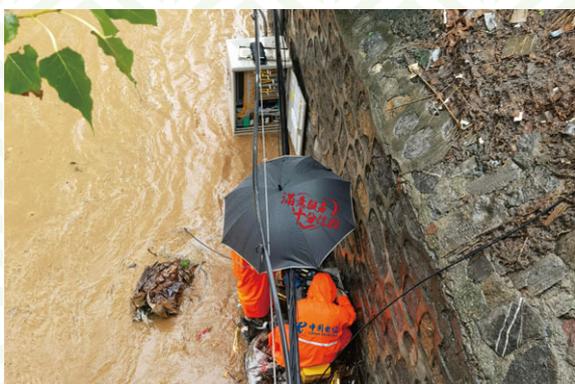
### Shanghai branch assisted the successful convening of the 4th CIIE

On 10 November 2021, the 4th China International Import Expo ("CIIE") concluded in Shanghai. From 5G communications assurance to digital network escort, Shanghai branch once again participated in the CIIE with various 5G innovative applications.



### China Telecom supported “In-Fa” typhoon rescue and disaster relief through cross-regional coordination

In 2021, Typhoon No. 6 “In-Fa” came furiously and severely affected Zhejiang Province. Soon after the disaster happened, China Telecom launched a cross-regional emergency communications assurance plan, in which it organised Guangdong branch’s backbone team of the air emergency communications platform, taking 17 hours of non-stop overnight travel. By using the air emergency communications platform, the team provided the Ningbo emergency command centre and the surrounding victims with an air emergency communications network consisting of high-throughput satellite routing networks, supporting disaster relief.



### Henan branch made every effort to assure smooth communications in heavy rain

In July 2021, wide-area extreme heavy rainfall occurred in many places of Henan. Henan branch overcame difficulties such as the shortage of communications equipment and materials, and immediately established a flood prevention and rescue team to transport communications materials to the frontline of disaster relief as soon as possible. It made every effort to repair facility rooms and base stations for sound communications and ensure unimpeded communications for people.

## STRENGTHENING SCI-TECH INNOVATION

China Telecom attaches great importance to the key role of sci-tech innovation in promoting high-quality development of the economy, society and enterprise. It regards the self-reliance and self-enhancement of sci-tech as the strategic support for enterprise development, and focuses on four major R&D directions, namely forward-looking research, cloud-network integration, network and information security and digitalised platform. Systematically, China Telecom promotes sci-tech innovation in aspects such as strengthening the layout of sci-tech innovation system (RDO), independent control of core technologies, increasing and optimising innovation achievements, enhancing the building of sci-tech talent team, deepening the innovation of systems and mechanisms, and promoting the construction of R&D ecology, as substantial steps towards the goal of “becoming a technology-oriented enterprise that independently controls key core technologies and becoming first-tier national sci-tech innovation enterprises”.

### Strengthening independent sci-tech innovation

The Company strengthens the strategic supporting role of sci-tech innovation to the enterprise, and continues to enhance the transformation of sci-tech achievements and strives to expand its influence in the industry. More than 220,000 units of the proprietary 5G frequency-shifting MIMO (Multiple-Input Multiple-Output Technology) indoor distribution systems have been deployed in 31 provinces, representing a decrease of approximately 55% in the comprehensive energy consumption per unit area as compared with that of the digital indoor distribution systems. The proprietary lightweight UPF (User Plane Functions) is the first in the world to complete N4 interface open verification, and has been included in the first batch of the *“Recommended List for Sci-tech Innovation Achievements of Central Enterprises”* issued by State-owned Assets Supervision and Administration Commission (“SASAC”) of the State Council. The proprietary base station smart energy-saving system has been deployed in 2,010,000 fan areas in 31 provinces, saving over 100 million kwh of electricity annually.

The Company strives to achieve breakthroughs in sci-tech awards, patents and international standards. The ultra high capacity intelligent backbone router developed jointly with partners won the second prize of the National Science and Technology Progress Award. “Tiantong One” satellite mobile communications application system project was selected as “2021 World Leading Internet Technology Achievements”. Authorised invention patent “Multimode Antennas and Base Stations” won excellence award of the 22nd China Patent Award. In 2021, the number of domestic invention patents and PCT (Patent Cooperation Treaty) applications of the Company increased by 2 times and 8 times respectively, and the Company led and jointly led the completion of 46 international standards throughout the year. 981 of its manuscripts were accepted by the International Organisation for Standardisation. At present, 47 employees of the Company hold managerial positions such as directors, chairman and reporters of the International Organisation for Standardisation.



#### **Lightweight UPF included in the *Recommended List for Sci-tech Innovation Achievements of Central Enterprises* issued by SASAC**

The lightweight UPF independently developed by the China Telecom Research Institute addresses the problem of unified access to new fixed-mobile integrated edge bearing equipment, supports data diversion, security enhancement services, and capacity opening. It has advantages such as 100 Gbps ultra-high throughput, extremely low latency at microsecond level, flexible adaptation of software and hardware decoupling, and customisation for enterprise customers.



The R&D team of the ultra-large-capacity intelligent backbone routers won the second prize of the National Science and Technology Progress Award

### Promoting scientific cooperation and ecological construction

The Company enhances industry-academia-research ecological cooperation, and strengthens the integration of upstream and downstream innovative resources. China Telecom cooperates with national laboratories, well-known universities and scientific research institutes as well as industrial chain partners to carry out joint technology problem-tackling and propels the deployment and application of major problem-tackling achievements such as quantum, cloud network, security and AI.

In terms of quantum communications, the Company promotes the application of quantum communications technology and domestic commercial password technology, achieving commercial debut of the first quantum-encrypted call product by a telecom operator.

In terms of fundamental network, the Company promotes joint research and development in network equipment and operation platform, explores the transformation from traditional order-based procurement model to new embedded cooperation model, and accelerates replacement and upgrade of self-developed domestic products.

In terms of cloud computing, China Telecom carries out strategic cooperation in hardware chips, software systems and other technologies, and creates an upgraded innovative consortium.

### Strengthen intellectual property management

The Company continued to establish a sound intellectual property management system and strengthened the protection of intellectual property rights. The Company organised training and promotion for the protection and requirements of use of intellectual property rights in respect of pictures, fonts and audiovisual materials used in corporate operation and management, and issued relevant work guidelines. The Company organises activities to promote the rule of law and governance, such as the “World Intellectual Property Day” and the “National Intellectual Property Rights Promotion Week”, to raise the awareness on intellectual property rights among all employees. In 2021, the Company continuously stepped up the application for invention patents concerning 5G, cloud-network integration, network and information security etc., increased efforts on the patent protection for key core technologies and products, and strengthened the layout and application of overseas patents, to enhance the international influence and competitiveness of intellectual property rights, and build a moat for intellectual property rights.