

# Win Win



## Landing in Shenzhen

## The airport of the future

Moving towards the  
F5G era together

Huawei's digital  
transformation in  
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Building the first  
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Publication Registration No.:

Yue B No. L015060029

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## ICT: The key to economic recovery

In a world that's been reshaped by COVID-19, digitalization is set to become the new normal. ICT has already demonstrated unprecedented socioeconomic value, with online education, online office applications, and digital entertainment helping people cope with lockdown and stay safe at home.

Emergency field hospitals have connected medical specialists remotely, solving temporary shortages in healthcare resources. And specialist applications like taking temperature and tracking the pandemic have assisted with prevention and control.

But it would be a mistake to think of these examples as special scenarios for extraordinary times. The global pandemic has both accelerated the pace of digital transformation for industries and society and also unlocked new development opportunities for the digital economy. By 2025, the total value of the digital economy is projected to grow from today's US\$17 trillion to US\$23 trillion, at which time it will account for about 25 percent of global GDP. The digital economy will help the global economy rebound, with key technologies like 5G, cloud, AI, IoT, and machine reasoning (MR) becoming integrated into varied industries, bringing new thinking, models, and practices.

Already, 81 commercial 5G networks have been deployed globally, attracting more than 90 million subscribers. 5G is driving the dramatic acceleration of digital transformation across industries. F5G (fifth-generation fixed network technology) is supporting 100G to the campus, 10G to the building, and gigabit to the home in a range of use cases, including private leased lines, data centers, smart cities, and smart homes.

The coordinated development of 5G + F5G will unleash new momentum in the digital economy and fixed-mobile convergence will provide a foundation for high-quality interconnectivity. But, the COVID-19 outbreak has also made the digital divide more apparent in areas like education and access to edtech resources. Building a more inclusive digital world in the post-pandemic era is an issue that will require the attention of the whole of society.

Like electricity 100 years ago, ICT will permeate every aspect of industry and society. Harnessing its capabilities in networks, cloud, AI, and devices, Huawei will work with industry partners to drive digital transformation and intelligent upgrades across all sectors to help develop the digital economy.

*Layla Zhang*

Layla Zhang, Editor-in-Chief



09/2020  
www.huawei.com  
Issue 37

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Our mission is to build airports that are safe, green, smart, and passenger-friendly, and to pioneer smart airport construction in China. ”

Chen Jinzu, General Manager  
Shenzhen Airport Group

# Landing in Shenzhen: The airport of the future

Shenzhen Airport is a pioneer of digital transportation in the air travel arena. Unable to find replicable use cases either at home or abroad, the airport developed its own smart strategy and set out to find the right partners to enable its One Airport, One Dream vision. Adopting smart digital tech, the airport can now address major passenger pain points like delays and respond more effectively to black-swan events such as the pandemic.

By Xu Shenglan

In 2019, Shenzhen Airport's annual passenger throughput exceeded 50 million, with international passenger volume surpassing 5 million for the first time. But taking a place as one of the world's busiest airports began stretching the airport's infrastructure. Chen Jinzu, general manager of Shenzhen Airport Group, explains the new technology and services

that will keep planes on time and passengers happy.

## Keeping it human is the smart move

**WinWin: Tell us about your One Airport, One Dream vision.**





We looked at transformation from the user point of view, so our focus was on using technology to optimize service operations, improve services with technological innovation, and create an experience-rich digital airport.



**Chen Jinzu:** Our mission is to build airports that are safe, green, smart, and passenger-friendly, and to pioneer smart airport construction in China. We began looking at smart technologies back in 2017. And in September of that year, we signed an MOU with the International Air Transport Association (IATA) to join the New Experience in Travel and Technologies (NEXTT) initiative, making us the only airport in mainland China to do so.

Since 2018, traveling through Shenzhen Airport has become more convenient, with fewer delays and a better experience due to smart technology based on imperceptible whole-process self-service. Passengers can use apps like WeChat's applet to check in online. And along with Spring Airlines, we're the first airline to provide open, shared self-service check-in kiosks across all domestic airlines, so passengers don't have to waste time looking for a particular airline's kiosks. We've also launched smart services like self-service bag drop offs, baggage tracking via RFID, and self-service boarding.

Facial-recognition, appointment-based security checks, and full-process self-service security checks have made security smoother and friendlier. And as part of the first batch of pilot airports implementing the Civil Aviation Administration's Passenger Easy Security

Check program, Shenzhen Airport has also launched an "Easy Security Check" platform, which allows passengers to book the smart security channel online.

Punctual flights are at the top of all passengers' wish lists, so Shenzhen Airport has strengthened precision management, the control of flights, and monitoring key phases through the digital transformation of each operational stage. In 2019, the average flight clearance delivery rate for the full year was close to 88 percent, ranking the airport among the top of China's major airports. Our outbound flight punctuality was sixth out of all major airports globally.

We use an AI-powered system to automate and allocate terminal stands within one minute for the 1,000-plus flights arriving and departing from Shenzhen Airport every day, a task that originally took four hours to complete manually. Algorithms have further improved contact stand rates and passenger boarding bridge turnaround times, allowing millions of passengers to experience near-boarding gate travel at Shenzhen Airport every year, giving the convenience you expect from a smart airport.

We looked at transformation from the user point of view, so our focus was on using technology to optimize





service operations, improve services with technological innovation, and create an experience-rich digital airport. This smart technology will help passengers experience Shenzhen's warmth.

## Starting with a dream

**WinWin: What challenges is Shenzhen Airport facing in the digital transformation process?**

**Chen:** In the early planning stages of digital transformation and smart airport construction in 2017, we cast our gaze around China and abroad, but we found no use cases to learn from. So, we set out on our own path and found three main challenges:

**Whether to transform or not.** Specifically, we asked if we could unify understanding about integrating systems, services, processes, and the organization so that transformation was in fact viable.

**The scope of transformation.** Were we transforming a single service, architecture or system, or transforming

all services, processes, and systems?

**How to achieve integration.** How could we integrate infrastructure; service systems; and planning, construction, and O&M through digital transformation?

**Problem 1:** We had to work out IT organizational governance, which required a coordinating department to implement the project. Two departments were possible – a group-level IT center responsible for group-level planning and system-building and an IT company, a public company controlled by the group, which was responsible for O&M services and some software development. But, we were missing a department that could plan and carry out the project with a global view.

So, the group's management decided to reform and integrate these two units into one business department, which became the digital management center. The department then formed three sections delineated by service attributes: planning management, construction management, and operations management.

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Building ICT infrastructure and an integration platform is a major, long-term undertaking where you don't necessarily see the immediate value, but which has long-term benefits.

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At the airport group level, planning management integrates the planning and aggregation of all requirements. After a plan is formulated, the construction management department organizes and manages the project build. It's then over to the operations management department, which takes on the management planning, construction, and O&M systems.

After more than two years of trial and error, current operations are very smooth. We've unified requirements, in turn enabling immediate response and good communications.

**Problem 2:** Tackling deployment, as our smart airport project involves three concurrent programs: the future airport, electrical installation for airport satellite terminals, and upgrading and transforming Terminal 3.

Each program contains hundreds of projects, so the wrong choice in terms of construction model would mean big headaches farther down the road. For partners, we insisted on companies with a proven track record of scale, quality, and competence. Huawei is an example of a company with scale, as it has technology, capability, and strategy. Second, the construction model was very important. Huawei is responsible for the total design, implementation, and oversight of our current implementation process for four main reasons: First,

unifying the technical architecture and plan would be impossible if we were dealing with different vendors. Second, one-time bidding is simpler to manage and faster. Third, Huawei can coordinate technology and planning during implementation. Fourth, is turnkey project construction: companies can coordinate and implement internal production and plans and in accordance with a blueprint. Packaging the programs together can boost construction efficiency and quality and help drive all projects forward.

**Problem 3:** Timing construction. Instead of charging ahead without a plan, we wanted to be more systematic. So we set up three stages, each with different goals: build the basic platform, build the applications on the platform, and realize full smartification.

## Platform + ecosystem

**WinWin:** In 2019, the airport handled 1,100 flights and 170,000 passengers per day on average, making it one of the busiest airports in the world. How did technology help to cope with this?

**Chen:** Building ICT infrastructure and an integration platform is a major, long-term undertaking where you don't necessarily see the immediate value, but which



During the outbreak, Shenzhen Airport has used smart technology to improve the accuracy and scientific-basis of pandemic prevention, so that passengers can have peace of mind when they travel.



has long-term benefits. We started envisaging the platform as a foundation, comprising an integrated platform and five general platforms. The integrated platform unifies and enables data exchange between different internal and external service systems. It can launch and recombine services to support various new service functions and processes. The five general platforms are big data, video services, converged communications, geographic information services, and IoT. Together, the six platforms support 40 application systems, which provide various services.

Shenzhen Airport and Huawei have also built a Future Airport Digital Platform based on the platform + ecosystem concept. The platform is based on Huawei's ICT infrastructure. The industry ecosystem, which we've built with our partners, features four service systems: big operations control, big security, big services, and big management. This in turn has enabled us to develop a new model comprising one map operations, one network security, and one line service.

Big operations control includes smart airport operations control and smart resource allocation; big security provides active smart security guarantees and collaborative emergency management; and big services cover personalized, automated, and fully connected services, as well as whole-process, visualized services.

We've digitally transformed each operational stage to create an airport operations control brain. At the center of big operations control is air traffic control, which we transformed into the one map approach. Our Intelligent Operations Center (IOC) provides visual information services for ramp control, air traffic control towers, operations command, and security. It has helped us enable efficient multi-party coordination. In the area of aircraft stand allocation, we've implemented a smart stand allocation project, thanks to which the contact stand performance at Shenzhen Airport has increased dramatically.

Millions of passengers every year can board without taking a shuttle bus. By linking up the ground service system, assured phases acquisition system, A-CDM, and integrated system, we've slashed delays, exceeding an unprecedented air traffic clearance rate of 80 percent for 23 consecutive months as of July 2020.

For passenger flow, we developed the one line travel flow and transformed services. We carried out digital transformation on the complete process, both online and offline, including whole-process imperceptible self-service, with a self-service check-in ratio of 77 percent. We're the first to implement facial-recognition self-service security verification, and we've achieved 100 percent coverage of self-service equipment at domestic boarding gates.



For most passengers, so-called smart airports aren't just about cutting-edge technologies. Any future smart electronic devices must provide more convenient services that meet needs and boost experience.



With facial-recognition boarding, it only takes 1 to 2 seconds for each passenger to pass the gate, doubling boarding efficiency. Shenzhen Airport's WeChat applet provides a full range of online services for passengers. With smart transportation precision push messages, we can collaborate with public transportation services and quickly respond to passengers with online smart services. Finally, the service management platform enables refined management.

**WinWin: Safety is of course the civil aviation industry's top priority. How does Shenzhen Airport use tech and management platforms to respond to safety issues?**

**Chen:** To cover every scenario, we carried out digital transformation of all zones in the airport and our front- and back-end systems, improving the precision of the big security system and implementing smarter methods. We built a dedicated modular security data room and large-capacity security cloud storage. We reconstructed more than 9,500 channels of HD video, implementing 90-day storage and a smart application for video surveillance across the entire airport. We deployed smart security management and control systems and built four secondary platforms in the terminal, airside, public, and cargo areas, which formed an overall security control system with unified supervision and hierarchical monitoring.

Finally, a smart video analysis platform provides active prediction of potential hazards.

## Protecting passengers with tech

**WinWin: During the coronavirus pandemic, how has Shenzhen Airport optimized and upgraded its technology to maximize the safety of passengers?**

**Chen:** During the outbreak, Shenzhen Airport has used smart technology to improve the accuracy and scientific-basis of pandemic prevention, so that passengers can have peace of mind when they travel. The airport is the city's first "line of defence" against the virus. When the pandemic started, we blocked all entry and exit. As the outbreak was brought under control in China but began to spread around the world, this required us to implement strict controls on inbound international flights and passengers. So controlling this became our top priority.

Shenzhen Airport's IOC played a major role in our response. For one thing, it helped us build a special epidemic database, so we could analyze and investigate the status of outbreaks in relation to passengers and flights, international flight trends, international route trends, passengers with fevers,



and quarantined passengers. At the peak, the system provided smart real-time screening and tracking of more than 700 people a day.

Data was released uniformly through the IOC platform, providing unified real-time data to various offices and departments, including the airport epidemic prevention office, airport quarantine station, provincial/municipal health commission, municipal prevention and control leading group, municipal transportation authority, State-owned Assets Supervision and Administration Commission, and the airport emergency center. This facilitated the development of targeted epidemic prevention strategies.

The IOC's scenario-based video technology supported real-time dynamic monitoring of all stands and channels on the ramp, and flight and passenger screening, which allowed us to check all key flights, and not miss a single person or flight.

The airport is a gateway connecting the city and outside world, so stopping the spread of the virus was a top priority. We responded to requirements from the authorities for prevention and control. We installed infrared thermal imaging cameras at the entrances of the terminal building and ground transportation center (GTC), and at all jet bridges and in the arrivals

area for full thermal imaging coverage. Normally staff use infrared thermometers to measure passengers' temperatures, transferring those with a reading above 37.3 °C to the pandemic prevention department for re-examination and isolation. But since infrared thermometers only have an effective range of 3 to 5 cm, this necessitates close contact between passengers and airport staff, increasing the risk of infection. Also, multiple staff are needed to check passengers one by one and keep order, so it's very inefficient.

We switched to binocular infrared thermal imaging cameras (with black-body correction) to detect the forehead temperatures of passengers entering and leaving the airport. Passengers passing through the camera are captured in under a second and the temperature of each passenger is displayed by color in real time on a computer screen for staff at the temperature checkpoint. The system notifies staff with audio and light warnings, so they can deal with any issues immediately, greatly increasing speed and efficiency.

Airports generally check whether passengers are wearing masks at temperature checkpoints at entrances and exits, but to detect whether they're wearing masks in all other areas of the terminal, airports have to rely on video surveillance manned

by staff. Due to fatigue and lapses in concentration, accuracy and efficiency are impossible to guarantee and the inspection cycle is very slow.

We deployed smart robots to patrol the airport's security zone in mid-March this year. The robots can inspect whether passengers and staff entering the airport security zone are wearing masks with an effective detection distance of 3 to 5 meters and up to 98 percent mask detection accuracy. We can then carry out different measures depending on whether it's a passenger or a worker.

If the offender is a passenger, a voice message will be played kindly reminding them to wear a mask. If it's airport staff, a real-time image is taken and sent to the back-end along with location information. This is transmitted via 5G to the cloud where intelligent video analysis on edge computing devices enables backtracking and data analysis of historical data, which can be accurately linked to predetermined management and control strategies, so that personnel can then be notified in time to handle any transgression on-site, providing a more efficient and intelligent method of controlling the pandemic.

## Soaring high on the wings of smart technology

**WinWin:** How did Shenzhen Airport and Huawei build a new IT and data governance system starting with the top-level design? And what technologies can we expect to see in the future?

**Chen:** For most passengers, so-called smart airports aren't just about cutting-edge technologies. Any future smart electronic devices must provide more convenient services that meet needs and boost experience. That's the core purpose.

Shenzhen Airport will continue working with Huawei to extend the scope of passenger services to all touchpoints, including public areas and airside areas; integrate offline and online resources; and expand out to new scenarios, such as smart shopping, smart commerce, and VIP precision services. This is at the heart of creating a new passenger-centered service model.

Huawei has used algorithms to help Shenzhen Airport improve the efficiency of aircraft stand utilization. However, there are still problems like hitting airport capacity and guaranteed resources becoming strained. We will work with our partners to digitalize resource allocation rules and allocation experience, supported by strong computing power and algorithms. This will provide smart dispatch and management of the entire resource chain, with a focus on key guaranteed resources such as check-in islands, security channels, boarding gates, baggage carousels, and ground services.

New technologies like 5G and AI will completely revolutionize digital transformation of the entire civil aviation industry, including airports. We will see 5G-based aircraft taxiing guidance, driverless vehicles in the ramp area, unmanned aerial vehicles, and even onboard wireless communications for aviation. These technologies will integrate tech with civil aviation services and increase the speed and quality of digital transformation.

Alongside the rapid iteration of digital technology, we must maintain our strategic direction and roadmaps and turn plans into reality step by step. But, we must also keep an eye on development trends and explore new technologies to ensure we stay ahead of the curve and avoid a situation where the project falls behind and becomes immediately out of date once it's deployed. That's why we will keep in mind the "One Airport, One Dream" concept. [www](#)

# How sharing education resources gives children wings to fly

In China, differences in the geographical conditions, economic development, and the allocation of resources have led to disparities in education capabilities between east and west and between urban and rural areas. But, ICT can level the playing field.

By Liang Yali, Xu Shenglan



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Teachers should embrace ICT like big data, AI, and IoT to select resources suited to their teaching styles and students' learning needs, digitalize traditional resources, and improve IT capabilities.

—Chen Sanlin, the Director of Peng'an County's Education, Science and Technology, and Sports Bureau



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**P**eng'an County is situated in the northeast of Sichuan Province in the west of China. Containing 21 townships, 322 villages, and a population of 730,000, curriculum reform isn't enough to solve the inequalities facing basic education in this underdeveloped county.

Chen Sanlin is the Director of Peng'an County's Education, Science and Technology, and Sports Bureau. He explained how Peng'an County is using ICT to boost education resources to benefit over 70,000 teachers and students in the county.

## The sharing network

**WinWin: Sharing high-quality educational resources will disrupt the traditional ways schools are run. How should education managers, schools, and teachers respond to this?**

**Chen Sanlin:** In 2018, the Ministry of Education issued the Education Informatization 2.0 Action Plan, which proposed a “3, 2, 1” development goal.

“3” refers to teaching applications for all teachers, learning applications for all school-age children, and digital campus construction for all schools. “2” refers to boosting digital applications and boosting digital literacy for teachers and students. And “1” refers to building a large-scale Internet + Education platform.

As we've advanced into the 2.0 era of education digitalization, the focus has shifted from the quantitative change of the 1.0 era to qualitative change, from emphasizing application-driven, integrated development to innovation and ecosystem transformation. As such, the way we view educational resources, technical literacy, education governance, and ways of thinking needs to change. Sharing digital resources, exceptional teachers, and educational data across ICT platforms will help us upgrade educational service supply and governance.

Education managers need to coordinate national and provincial public resources, introduce high-quality commercial resources, and organize schools and teachers to create local resources. This will help



build an extensive, high-quality resource library that's suitable for all academic stages and subjects. Establishing a big data management application platform for regional educational resources will guide and standardize the utilization of these resources by schools and teachers.

For schools, building digital campuses should be key. They need to improve teachers' ability to use digital resources, optimize external resources, and create original resources. They must also coordinate the construction and application of resources with teachers' professional growth, classroom teaching reforms, and students' all-round development. This will increase how much resource utilization contributes to improving the quality of teaching and the development of high-quality schools.

Subject teachers are the key to whether educational and teaching resources can have the effect they're meant to. Teachers should embrace ICT like big data, AI, and IoT to select resources suited to their teaching styles and students' learning needs, digitalize traditional resources, and improve IT capabilities.

**WinWin: Please introduce the development strategy behind Peng'an County's digital education platform.**

**Chen:** Our platform is based on Huawei's high-speed optical fiber network. It connects 80 public schools in cities, towns, and villages. It allows rural schools to regularly coordinate their course schedules and teacher resources with schools in the city, and lets them share the same network, set of resources, and even teachers.

The network harnesses the wide coverage of the optical network, integrating various applications that cover all administrative divisions, directly affiliated departments, and schools in the county's education system. It means that system managers, teachers,

students, and parents can all use the platform for education management, teaching applications, online learning, and family-school collaborative education.

**WinWin: Dual-teacher learning (where an online lecturer and local classroom teacher work together) using digital platforms is increasingly popular. What do you think of this teaching model and how can students in remote areas benefit from it?**

**Chen:** Thanks to the high-quality, all-optical campus network, we can operate high-quality remote interactive recording and streaming systems in urban and rural schools. Live streaming classrooms, synchronous interactive classrooms, specialist distance learning classrooms, and dual-teacher classrooms have established an assistance and guidance mechanism between urban and rural schools and strong and weak schools, helping to improve the standard of education in remote areas.

We believe that dual-teacher learning has several advantages. First, it increases the reach of resources and promotes the balanced development of education. Weaker, remote, and rural schools can share teachers and teaching resources with leading schools and urban schools. Second, it improves the teaching abilities of exceptional teachers, training them to lead multiple classes and improve their standard of synchronous and interactive teaching. Third, dual-teacher learning trains local teachers, which is especially useful for teachers who are weak in certain subjects.

**WinWin: What specific benefits do you think education digitalization has?**

**Chen:** Education digitalization is not just about teaching information and resources. It affects all aspects of classroom teaching. It touches directly on students' key and overall competencies. When children



Going forward, we will optimize the county's education big data management platform, unify ID authentication, boost interaction and sharing, and further integrate education and technology.



in both urban and rural areas use the same network and set of resources, equal access to educational resources eliminates any psychological inferiority.

Education IT and online courses enable all children to receive high-quality instruction in subjects that are typically neglected in rural areas such as music, PE, art, and English. They can also participate equally in high-quality online educational activities as well as different styles of learning using technology.

At the same time, the application of ICT means there are more channels and diverse content available. Family-school collaborative education is also more frequent and effective. Attention to students with learning issues is improved, so they can quickly improve learning outcomes.

## Smart classrooms and learning potential

**WinWin:** With reference to the all-optical campus, how is Peng'an using digital technology to redefine

**the teaching space?**

**Chen:** The all-optical campus network provides a stable technological support platform for various education and teaching applications. Harnessing this, we've set up a metropolitan area network management center at the local end, an MOOC recording and streaming center, an educational TV recording and broadcast center, a video conference center, and the Peng'an big data management platform for smart education.

We've built an application system to cover areas like smart classrooms, smart reading, smart training, and smart ethics, and we've used application software to build a learning space for teachers and students.

Going forward, we will optimize the county's education big data management platform, unify ID authentication on various applications by ensuring the interoperability of the underlying data, boost interaction and sharing, and further integrate education and technology.

**WinWin: What strategies exist for teacher training in the digitalization context?**

**Chen:** In 2016, Peng'an county launched the Go Out, Come In scheme. Teachers were sent out to shadow at business training centers, higher education institutions, and schools that are leaders in digital transformation in Sichuan and elsewhere. We invited government and education experts to give lectures, guidance, and to talk to us. In total, 100 teachers received training in education digitalization leadership, 200 received training in education IT, and 350 received subject training. These teachers are tested and monitored at work to ensure the training is effective.

## Optical fiber leads the way

**WinWin: What role is fiber playing in education digitalization in Peng'an?**

**Chen:** The key to the qualitative leap in education digitalization in Peng'an from 1.0 to 2.0 is the all-optical campus network that Huawei built for the whole county. It's like a network of highways that provides basic support for various applications to operate quickly, securely, and efficiently. There are two main areas where it's really shown value. First, it integrates the application of education digitalization in the county, with this network environment enabling us to coordinate video conferencing and office automation. The second is that it offers stronger security and intelligence than a traditional network. Network operations status and user information can be controlled in real time, and O&M efficiency is very high.

**WinWin: Although Peng'an has achieved some major, even breakthrough, achievements in education digitalization, it will inevitably face difficulties and challenges in the future. How do you view these**

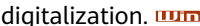
**challenges?**

**Chen:** We face challenges in four main areas: construction, application, technology, and management.

**Construction:** A long-term mechanism for special investment in education digitalization has not yet been established for developing regions. At the same time, building digital applications requires heavy funding, and so we anticipate more local and national funding.

**Applications:** Despite China issuing many digital industry standards, their implementation is still patchy. There isn't a stable model for smart education for the region or schools. Therefore, with the large-scale deployment of some applications, we get a stream of overlapping and redundant projects and zombie applications, which leads to huge losses and waste.

**Technology:** Schools, teachers, and students want digital education systems, platforms, resource tools, and products to be simpler, convenient, smart, and efficient. Only then will things be more conducive to promoting modern IT and wide resource coverage, as well as achieving balance in educational resources and improving digital literacy for teachers and students.

**Management:** Issues exist with the management, maintenance, and iterative updates of IT infrastructure. Electronic devices, for example, inevitably suffer failures and have a limited lifespan. The maintenance and renewal of this infrastructure will demand extensive funds and the corresponding technological power. This will require education authorities, school administrators, and teachers to also be aware of sustainability issues to avoid resistance against digitalization. 

# Moving towards the F5G era together

5G and the Fifth Generation Fixed Network (F5G) will complement each other to become the foundation for a fully connected, intelligent world. As a key player in the global fixed network industry, Huawei will contribute to fixed network standards and promote the commercial use of F5G innovations. Our aim is to drive a thriving fixed network industry.

By David Wang, Executive Director of the Board, Huawei



global economy. In GCI 2018, we forecasted that an additional US\$23 trillion in economic potential will be available by 2025 if each country measured in the GCI increased its annual ICT infrastructure investment by 8 percent. Elevating ICT infrastructure to the level of Intelligent Connectivity is a crucial step for countries aiming to achieve sustainable growth.

Wireless and fixed networks are the foundation of the connectivity industry. They have different use cases, but are well coordinated and inseparable. Currently, wireless networks are entering the 5G era. Built on globally unified standards, 5G is going beyond individuals and homes to revolutionize industries, enabling them to develop and prosper. So far, countries around the world have explored over 300 5G 2B use cases across more than 20 industries, including media, education, healthcare, connected vehicles, intelligent manufacturing, and smart mining.

**H**uawei's Global Connectivity Index (GCI) shows that Intelligent Connectivity can help address some of society's most pressing challenges, including healthcare, hunger, education, inclusion, environmental conservation, safe cities, and crisis response. Intelligent Connectivity is also a key engine powering the

## The increasing importance of fixed networks

In China alone over the past few months, employees from nearly 18 million companies worked remotely from home, 230 million students studied at home, and



Intelligent Connectivity can help address some of society's most pressing challenges, including healthcare, hunger, education, inclusion, environmental conservation, safe cities, and crisis response.



12 million people saw a doctor online every day. The home has blurred the boundaries between living and entertainment and has become a productivity center that offers the same functions as schools, hospitals, offices, theaters, and e-commerce stores. Home broadband has become the fourth pillar of critical infrastructure, alongside transportation, water, and electricity.

Broadband networks are playing an increasingly important role in advancing society and the economy. The World Bank's study found that a 10-percent increase in broadband penetration would increase GDP growth by 1.38 percent on average. According to the *White Paper on Development and Employment in China's Digital Economy (2019)*, China's 180 million kilometers of optical fiber supports a digital economy worth 31.3 trillion yuan.

This April, China's National Development and Reform Commission and the Ministry of Industry and Information Technology (MIIT) clarified the scope of China's New Infrastructure campaign for the first time, proposing to drive the optimization and upgrade of optical fiber networks. Other countries like the UK, Portugal, Spain, and France are also rolling out their

all-optical network strategies to boost high-quality economic development.

As operators of broadband networks, major global telecom carriers are actively deploying gigabit broadband and 5G networks and extending broadband networks from homes to enterprises. Leading carriers in China, Europe, and the Asia Pacific region have launched high-quality private line services over all-optical networks. This has accelerated the digital transformation of government, finance, healthcare, and other sectors. The social and economic value of broadband networks is being pushed even further.

## Addressing fragmentation in the fixed network industry

Like the wireless network industry, the fixed network industry started to evolve from the analog age back in 1980 and has continued to evolve over the past 40 years. In the wireless network industry, five generations of evolution has seen a shift from fragmentation to inclusion. In the analog age, there were eight incompatible technology standards for wireless. With 5G, wireless has now converged on one unified standard. Countries around the world are exploring 5G

2B use cases, and over 300 such projects have been launched. So far, the global wireless network industry has fostered a diverse ecosystem and set in motion a virtuous business cycle.

ITU's statistics show that nearly 1 billion households worldwide have no access to fixed broadband. Of the 1 billion households connected to fixed broadband, only 53 percent have access to optical fiber. Several reasons have led to the slowdown in fixed broadband deployment.

- Many standards organizations exist, including International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE), Broadband Forum (BBF), and Optical Internetworking Forum (OIF). These organizations lack coordination.
- The evolution from one generation to the next isn't clear cut, many different technologies exist, and scattered investment has made it difficult to achieve economies of scale.
- Carriers are primarily responsible for the construction, operations, and maintenance of fiber broadband networks. Facing huge financial and operational pressures, as well as social responsibility, carriers are now stuck in a situation where their revenue doesn't grow along with the increase in network rollouts.
- Fixed networks lag far behind wireless networks in terms of the maturity of applications and ecosystems.

There's no denying that the fixed network industry has achieved excellent results and is moving towards the all-optical era. Fiber networks have many advantages such as limitless bandwidth, long-distance transmission,

and anti-electromagnetic interference. They also save energy and are eco-friendly. If fixed network standards and the ecosystem can be as unified and as prosperous as wireless networks, then the scale of the industry and its role in the global economy would grow by several times.

ETSI launched the Industry Specification Group (ISG) F5G in February 2020 and defined the key generations of fixed broadband evolution. Huawei believes that this will be a key milestone on the road towards a thriving fixed network industry, and usher in a brand-new era.

## Huawei positions itself as an F5G enabler and explorer

The ISG F5G has turned the paradigm of Fiber-to-the Home into Fiber-to-Everything-Everywhere, aiming to extend fiber coverage to every desk, room, base station, machine, and data center. ETSI has also defined three major features of the F5G era: full-fiber connection (FFC), enhanced fixed broadband (eFBB), and guaranteed reliable experience (GRE). This new vision indicates the direction the fixed network industry is taking.

Huawei believes that it can realize the vision of F5G from three aspects: high bandwidth, inspired experiences, and all-optical connectivity. In terms of high bandwidth, the aim is to connect households to gigabit networks, buildings to 10 gigabit networks, and campuses to terabit networks. Inspired experiences include millisecond-level latency, zero packet loss, and five nines availability. All-optical connectivity means extending fiber to every room, desk, and machine to connect hundreds of thousands of objects every square kilometer.

As a key player in the global fixed network industry, Huawei will embrace the F5G era and be an explorer



Fiber networks have many advantages such as limitless bandwidth, long-distance transmission, and anti-electromagnetic interference. They also save energy and are eco-friendly.



and industry enabler. Over the course of the journey from F1G to F4G, Huawei launched SDH chips, MSAN, 100G, OTN, and other key technologies and products. As we move towards the F5G era, Huawei has proposed the Intelligent OptiX Network strategy, and launched innovative technologies and products, such as 10G PON, Wi-Fi 6, eAI ONT, 200G and 400G, and next-generation OTN (NG OTN). We've remained committed to innovation in optical transport, access, and devices to guarantee an inspired user experience.

- In the full-fiber connectivity domain, Huawei has launched Edge ONT products to enable fiber to the room (FTTR), and PON modules to enable fiber to the machine and fiber to the desk. In addition, Huawei is the first vendor in the industry to launch NG OTN, which is designed to meet the private-line needs of SMEs.
- In terms of eFBB, Huawei has launched 10G PON and Wi-Fi 6 products for commercial use, and has started researching 50G PON technology. Our 200G and 400G optical transmission solutions have been deployed on a large scale, showcasing our commitment to continuously increasing the spectral efficiency and transmission distance of optical fiber.
- Regarding GRE, Huawei has launched eAI ONT

products that use artificial intelligence to identify key services. We've built end-to-end, experience-guaranteed transmission pipelines through Wi-Fi 6 air interface slicing, OLT slicing, and NG OTN hard slicing. Built on end-to-end hard slicing, our premium OTN private lines can provide high-quality private line services for large enterprises and SMEs.

## Opening a new chapter in fixed networks together

Moving forward, 5G and F5G will complement each other and create synergy to become the foundation of a fully connected, intelligent world.

Huawei will contribute to ETSI's standards for fixed networks, and we will maintain our strategic investments in fixed networks. Based on ETSI's standards, we will promote the commercial use of F5G innovations in the optical transport and optical access domains. We will continue to explore new use cases to drive a thriving fixed network industry, and make greater contributions to the industry.

We invite all global players across the fixed network industry to join the F5G industry ecosystem and embrace the F5G era. Together, we will realize our shared vision of fiber to everything, everywhere. [www.huawei.com](#)

# Why sustainability matters more than ever

The Earth is made up of 7.5 billion people, but only half the world has access to digital technology and its benefits. To ensure that everyone can enjoy the same digital rights, Huawei is committed to helping close this digital divide by finding new ways to empower the unempowered.

By Gary Nugent, Chief Executive Officer, Informa Tech

A key facet of the global drive to closing the digital divide is the Sustainable Development Goals (SDGs), which the UN set out in 2015. The SDGs comprise 17 goals that form a "blueprint to achieve a better and more sustainable future for all" by 2030. It's estimated that the US\$12-trillion investment required to achieve the SDGs will help lift hundreds of millions of people out of poverty to live better, more equal, and healthier lives.

Leaders in international development agree that digital literacy is an essential component to each of the 17 SDGs, and that one of the most impactful ways to open up opportunities to people throughout the world is through digital inclusion. Informa Tech is no exception. Established under Informa Group in early 2019, Informa Tech connects, educates, and informs the global technology community through research, media, training, and events, with the aim of inspiring technologists to build a better world. In 2019 and through the first half of 2020, we held a series of talks with the Informa Tech CEO Gary Nugent on sustainability.

**WinWin: What is Informa Tech's sustainability**



**strategy?**

**Gary Nugent:** A better world is more often than not a sustainable world, and therefore sustainability is an integral part of everything we do – whether it's how we drive digital inclusion; manage our environmental





Leaders in international development agree that digital literacy is an essential component to each of the 17 SDGs, and that one of the most impactful ways to open up opportunities to people throughout the world is through digital inclusion.



and societal impact; change the face of our industry in terms of diversity and inclusion; or catalyze the “tech for good” movement in areas such as diversity, social mobility, last-mile connectivity, new business startups, resource scarcity, talent development, well-being, health, and climate change.

When it comes to sustainability and sustainable business, Informa runs a FasterForward initiative, which commits us to a series of activities between 2020 and 2025. We believe that the key to progress is measurement – our FasterForward strategy commits us to moving faster to achieve net zero carbon and zero waste, embed sustainability in every one of our brands, and multiply the positive impact that our products and operations have globally.

**WinWin: What progress have you made over the last decade in sustainability?**

**Nugent:** A huge part of our mandate is to drive digital inclusion by connecting people to knowledge. We host events and provide research, training, and media to technology communities and technologists around the world.

- Events

To name a few: Black Hat – held in both the US and Asia – is one of the largest communities of information security professionals. AfricaCom, which focuses on economic empowerment and social mobility through digital technology, is the largest education and networking event for telecoms, media, and tech professionals on the continent. Omdia, our recently launched research brand that brings together all our analyst expertise into one team, is helping our community build deep insights and connect the dots across the industry. London Tech Week has become the seminal meeting of the best and brightest minds in the digital and related industries to explore the possibilities of a digital-first world, with huge support from government and industry. We also plan to bring this format to other parts of the world in the future.

- Diversity

In Informa Tech, we’ve achieved 50/50 gender representation across our management levels. Through our joint venture with Founders Forum, we

run a number of programs, including AccelerateHER, which focuses on addressing the underrepresentation of women in tech, championing trailblazers in promoting gender equality, and upsetting tired stereotypes. This year we've also partnered with ColourinTech to launching Black Tech Fest in October to help raise the voice and representation of people of color in our industry.

- Environment

We're embedding the FasterForward fundamentals into all our events to significantly reduce our environmental impact in every aspect – obviously COVID-19 has seen the majority of our events go virtual this year, and we view this format as an integral part of our events' portfolio going forward. There's always more that we can do, but we're making solid progress – we incorporate impactful and sustainable business practices in the work of our colleagues every day.

**WinWin: What's your plan for the next few years?**

**Nugent:** At Informa, we're committed to becoming carbon neutral as a business and also across our products by 2025. We pledge to halve the waste generated by our products and events by 2025, and become zero waste and net zero carbon by 2030, or earlier. We believe these are ambitious but achievable targets, as we're continuing to focus on energy efficiency in our operations and supply chain, particularly by engaging with partners such as venues, stand contractors, and digital providers. Where possible, we hope to explore how these initiatives can also create cost savings that can be reinvested into the business's overall environmental performance.

We achieved our first step in this program in 2020 when our business operations were externally certified

as CarbonNeutral®, and we're now working to extend this to our products and events.

**WinWin: What are your thoughts on our TECH4ALL initiative?**

**Nugent:** We love it. Huawei's TECH4ALL centers on developing digital inclusion and empowerment initiatives with measurable outcomes "to leave no one behind." One of its many goals is to help accelerate the UN's SDGs. Huawei has done a very good job at identifying powerful use cases that our community can emotionally connect with. You're also demonstrating how relatively simple it is for the technology we see and use around us every day to play a role in building a better digital world and how it doesn't have to be rocket science – all aspects of tech can be turned into a tool for good. Where Huawei has its TECH4ALL initiative, we have our FasterForward initiative. Informa Tech's purpose to "inspire the technology community to create a better world," and both really focus on sustainability across the industry. It's really good to see such high alignment between the broader goals of Huawei and Informa Tech.

**WinWin: What benefits can technology bring to digital inclusion?**

**Nugent:** The communications network is the foundation for how people collaborate, share knowledge, learning, and experience. The ability to connect everybody on this planet to access knowledge, people, and information is incredibly powerful. It's a great leveler that drives social and economic equality.

Of course in creating a network, security is paramount to ensure the protection of data, privacy, and personal freedom. In a world of open communications and collaboration, how we ensure a secure and safe environment is fundamental.



AI is driving change at a faster pace than we've ever seen before and this is enabling global inclusion – accelerating growth for emerging markets and emerging economies.



I think the other key technology that can bring benefits to digital inclusion is AI. AI is driving change at a faster pace than we've ever seen before and this is enabling global inclusion – accelerating growth for emerging markets and emerging economies. The sort of progress that it took the western world 50 years to achieve can now be achieved in 5 or 10 years and occur anywhere in the world.

**WinWin: Could you tell us more about how you will drive your FasterForward approach?**

**Nugent:** We've created 12 fundamental rules for sustainability across our events business, which we can track and measure with a view to increasing targets and criteria annually. One of the fundamentals focuses on how we embed sustainability into our core business by creating programs to drive inclusion or sustainable development across our community and help customers progress on key SDG topics.

By embedding sustainability inside every one of our brands, we aim to help our customers accelerate sustainable development in their specialist markets. We have many exciting initiatives in place, like AccelerateHER, Tech for Good, and our partnership with ColourinTech. We've been focusing on how to bring more diversity into the ICT industry and on supporting the development of women and people of color to create a

much more balanced picture, which we think is essential for the prosperity of the industry moving forward.

Environmental sustainability is also very high on our agenda, which is highly aligned to Huawei's mission of reducing carbon emissions and recycling and renewing in the supply chain. Huawei highlights the use of renewable power as key, and we're also committed to rolling out renewable power throughout our events business to become carbon neutral and zero waste by 2030.

**WinWin: What are Informa Tech's expectations of working with Huawei?**

**Nugent:** We like to do business with companies that align to our cultural values and share common goals when it comes to responsible and sustainable development. Our expectations are of mutual respect and the aspiration of friendship. A long and successful partnership of course relies on shared objectives and shared ethical and moral principles. I'm impressed by Huawei's commitment to inclusion through its TECH4ALL initiative. One of the things that struck me and which has always struck me from past conversations with Huawei is how aligned our visions are – not just in terms of the areas of technology we focus on, but also in terms of the role information technology plays in creating a better world for everybody to live in. 

# Huawei's digital transformation in the new normal

Digital transformation is never easy and it's become even more difficult due to the pandemic. How do we bring the value of digital platforms into full play in the new normal? Huawei follows a 1-3-5 strategy: 1 goal, 3 tasks, and 5 transformations. Guided by this, we've powered digitalization in innovation, office operations, marketing, sales, services, manufacturing, supply, and procurement.

By Tao Jingwen, Director, President of the Quality, Business Process & IT Mgmt Dept, Huawei



efficiency, and (3) develop forward-looking insights into new business models that lead to sustainable growth. Huawei has implemented a series of transformation strategies to achieve this goal.

## Three tasks

We believe that three things need to be done to drive digital transformation. First, we should offer the best possible services to our users and customers. Since customer experience is the main driver of transformation, we need to set high standards for this. Second, our services should fit in specific business scenarios. Third, we should create robust digital platforms that can provide services for every scenario. Huawei's digital platforms serve all of its business departments. The main indicator for a platform's performance is how quickly it responds to service requests.

## One goal

**M**ost enterprises want digital transformation to (1) boost business results and customer satisfaction, (2) improve internal management and

## Five transformations

Huawei officially launched its digital transformation program in 2016. We proposed that digital transformation isn't simply for introducing new technologies, but to help



Our ERP system currently serves more than 1,700 enterprises worldwide and supports a sales volume of US\$100 billion. Migrating such a massive business volume to the cloud is like replacing an aircraft's engine while it's in the air. The process is extremely complex.



the company grow. The transformation program covers the following five aspects:

**First, transform mindset.** A company's digital transformation should be led by its board of directors or business leaders, not just its CIO or CTO. Because transformation requires insight into issues relating to the company's future development, such as what problems we should solve for customers and how we can improve efficiency. The department responsible for digital transformation should cultivate more engineers. I think a company's digital transformation is an engineering program. There's no "best" technology, only the technology that best fits a particular enterprise.

**Second, transform organizations,** including those managing digital transformation. The digital transformation of most enterprises may be managed by CIOs, but Huawei has set up a dedicated organization consisting of the heads of all business departments. Huawei has also established the Transformation Management Committee chaired by its rotating chairman.

**Third, transform the culture.** Many enterprises have realized the importance of the middle office, but who wants to work in the middle office? In most

enterprises, IT personnel prefer jobs in the front office, because their work will be more visible in the front office than in the middle office. We need to transform our corporate culture from this perspective.

**Fourth, transform methods.** Huawei has proposed three lines of digital transformation: business objects, business processes, and business rules. Huawei has also developed a complete set of methods to guide its business and IT departments in transformation.

**Fifth, transform models.** Since most traditional enterprises are not cloud-native enterprises, they face a common problem during digital transformation: How do they migrate the systems that they've developed for decades to the cloud? Huawei, for example, needs to migrate its Enterprise Resource Planning (ERP) system to the cloud. However, the ERP system currently serves more than 1,700 enterprises worldwide and supports a sales volume of US\$100 billion. Migrating such a massive business volume to the cloud is like replacing an aircraft's engine while it's in the air. The process is extremely complex. Therefore, digital transformation isn't just about evaluating the relationship between existing systems and future development, it's also – and more importantly – about managing these existing systems better.

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During the initial outbreak, Huawei's IT and digitalization departments quickly deployed and adjusted our remote office solution to support our global R&D teams.

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## Accelerating digitalization in the new normal

Huawei has accelerated digitalization following the COVID-19 outbreak, while furthering its transformation progress over the past few years. We aim to maintain customer connections, customer satisfaction, and business volume like before in the new normal.

Huawei is currently facing a more complex market environment. As the pandemic is still a global threat, we cannot meet with customers, conduct transactions, or host exhibitions, so we're unable to regularly organize promotions or sales activities like we used to.

Huawei resumed work on February 3, and since then remote office, remote training, and remote delivery have become the new normal for our operations. How do we bring the value of digital platforms into full play in the new normal?

With more than 190,000 employees around the world, Huawei relies on global collaboration to keep most of its business up and running. Without strong remote R&D and office platforms, for example, the global pandemic would have already disrupted our mobile phone business, as the majority of our testing is done in Wuhan.

During the initial outbreak, Huawei's IT and digitalization departments quickly deployed and adjusted our remote office solution to support our global R&D teams. This solution allowed them to work remotely, regardless of what they needed to do, and ensured the continuation of not just our R&D activities, but also our general daily operations worldwide.

The number of global conferences hosted on our WeLink remote office platform increased multiple times during the pandemic. Despite this, not a single service interruption occurred, even during peak hours with tens of thousands of concurrent conferences. Last year, Huawei also released a public version of WeLink with free-of-charge primary services and charged additional services.

The pandemic has changed the way we engage with our customers. We have moved all our physical exhibitions, including exhibition halls, online. Although this year's Mobile World Congress in Barcelona was canceled, we hosted virtual exhibitions for our customers through online platforms. They could watch all our previously planned new product launches comfortably from home, while listening to Huawei experts' explanations on cutting-edge technologies and trends. They were even able to participate in online one-on-one Q&A sessions with our onsite expert teams.

During this pandemic, Huawei's travel expenses in the first quarter of 2020 dropped sharply. Despite this, through our digital platforms, our employees were able to "visit" four of our customers' CEOs and senior management across three continents in a single day, something unimaginable before the pandemic.

With digital platforms, Huawei has greatly enhanced its corporate marketing and product promotion efforts both in terms of quality and reach. In the past, customer-facing summits were held separately for different countries. Now, Huawei can hold online meetings with more than 20 countries simultaneously.

This is a pleasant surprise for our customers, providing them with unprecedented experiences. Digital transformation has also brought changes to many of our business models. In the very short period of time between the Chinese Spring Festival holiday and February, Huawei opened up our digital marketing capabilities and demonstrated our strengths in this field to customers around the world.

In addition, digital platforms have made contactless and all-online transactions possible. During the pandemic, network requirements in Italy almost doubled and our customers wanted to expand their network capacities. But there was a problem with signing contracts. Since we were unable to meet with our customers face to face, we couldn't sign the contracts. No contract means no delivery. To address this, Huawei built a customer-facing, end-to-end system for contactless order receipt and contract-signing. This system even determines transaction prices. This has protected the majority of Huawei's business transactions from being affected by the pandemic.


The global pandemic has complicated global supply chains, though. In the past, things were simple – customers placed orders and we delivered. But now

smartphone production can be halted because of the low supply of a single screw. This would result in millions of phones failing to be shipped on time, causing billions in economic losses.

Given the circumstances, we needed to create a larger data repository that reflects the comprehensive relationships between supplier data and Huawei's material and asset data. By providing digital services across our supply chain, Huawei has successfully proceeded with digital procurement and digital supply management during the pandemic. Another benefit of digital platforms is that they make supply chain risk management and control even more comprehensive.

In the new normal, it's more important than ever to ensure secure and stable network operations. Online offices, remote work, and online learning have made our lives more convenient since the outbreak of COVID-19, but they also present many security issues. Maintaining the security and stability of our digital platforms poses a big challenge. These platforms have to stand up to external attacks, and can become unstable if users use them improperly. In addition, a surge in services can also bring challenges. We need to pay special attention to and address the security posture and stability of our digital platforms.

Enterprises must have strategic determination, stay confident, and persevere if they want to succeed in digital transformation. Top-layer design is crucial, but so is action. Instead of just talking the talk, we have to walk the walk. We must work hard to successfully transform, and when we encounter problems, we must adapt quickly.

We must stick to the generally correct direction and inspire passion across the organization. Those at the top must have vision and passion so that the broader team can follow their lead and stay dedicated. 

# Transforming enterprise private lines for business growth

Global technology researcher Omdia shares its survey results on network transformation, explains the features enterprises require from networks, and gives key recommendations for enterprise transformation.

By Sandra Oboyle, Principal Analyst, Omdia

## The key business drivers and applications of private lines

**E**nterprises in all verticals are becoming more application-driven. And they rely on their networks to support those applications, as well as content data and business transactions.

Enterprise business critical communications and operations, and the digital economy as a whole, are underpinned by always-on, high-performance, secure, and ultra-fast networks. Large organizations require private networks with committed bandwidth, high network availability, high reliability, and guaranteed low latency for business-critical applications.

In the first half of 2020, Omdia surveyed companies ranging in size from 25 to more than 10,000 employees across Western Europe and Russia, the Middle East, Africa, Asia/Pacific, and Latin America. Omdia analysts interviewed network and IT executives from the healthcare, transport, financial services, and manufacturing sectors. They shared their private line requirements, experiences, and concerns.

### What the survey showed:

- Enterprises are re-evaluating their networks to meet heightened performance expectations.
- Dedicated, secure network connectivity is critical to link data centers, private and public cloud, and key enterprise sites.

## Enterprise network transformation

The nature of networks and IT operations is shifting. Digital transformation is driving data center and business expansion, and new applications are being added to networks, including more video conferencing

**Figure 1: Primary drivers of network spending 2018-2020**

Organization's network services spending	Responses
Increased public cloud adoption	42%
Expansion into new cities/countries	28%
Adding enterprise applications to the network	27%
Increased video conferencing usage	26%
Adoption of big data/analytics	23%
Data center consolidation	21%
Building new data centers (new sites)	19%
Digital initiatives	14%

Source: Omdia survey of 1,800 multinational enterprises





To be successful, IT and network systems must be solid and resilient, but also agile and flexible enough to cope with new digital demands and a faster pace of business change.



usage. This is reflected in the top five business priorities for global enterprises, as shown in Figure 1.

To be successful, IT and network systems must be solid and resilient, but also agile and flexible enough to cope with new digital demands and a faster pace of business change.

With the move to cloud-centric applications, enterprise networks must ensure applications are delivered with a consistently high level of performance and end-to-end security.

Many enterprises turn to high-performance secure private networks and hybrid private and public clouds to transform IT infrastructure. As new enterprise applications and services move to the cloud, customers are more sensitive to latency as well as data security, control, compliance, and the confidentiality of sensitive business data.

While large enterprises cannot abandon their data centers, they're still shifting rapidly to hybrid cloud strategies to take advantage of cloud economics. Governments are evaluating similar IT modernization. These initiatives for large organizations have a common thread: moving from an on-site focus to

hybrid premises, while a cloud environment requires a high-performance and highly secure network.

## Cloud connectivity drives demand for optical private lines

Private-line networks enable enterprises to run critical business applications securely, protect confidential data, and meet regulatory and compliance requirements.

Many enterprises use wide area network (WAN) services from network providers to connect their headquarters, data centers, offices, factories, warehouses, and branch sites. WAN services can be costly and slow to provision, and they can lack the scalability and bandwidth required to support new enterprise applications.

Enterprises are re-architecting their existing WANs with high-performance network backbones between their enterprise sites, cloud locations, and data center sites. They're increasingly using optical lines to build private-line networks for very high-speed and secure transport among major sites and data centers to create private clouds and to achieve secure connections to public clouds.

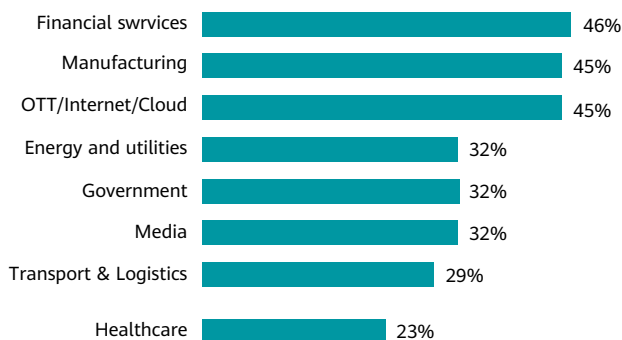
In a multi-cloud situation where an enterprise may use multiple public cloud services, managing secure connectivity and assuring high performance is a priority. Hybrid cloud presents a similar challenge: Enterprises need to manage computing, applications, services and connectivity securely across a mix of on-premises infrastructure, private cloud services, and public cloud.

The most important features for cloud connectivity are high availability, high bandwidth/port speeds, and committed bandwidth. Optical private lines and Layer 1 connectivity are in demand for data center connectivity because they support high bandwidth, dedicated connectivity for guaranteed bandwidth, and higher availability SLAs.

## Market demand for optical private lines in enterprise verticals

Financial services companies, manufacturers, OTT enterprises, and cloud providers are among the leading adopters of optical private-line services, as shown in Figure 2.

**Figure 2: Optical private line deployment by vertical sector**



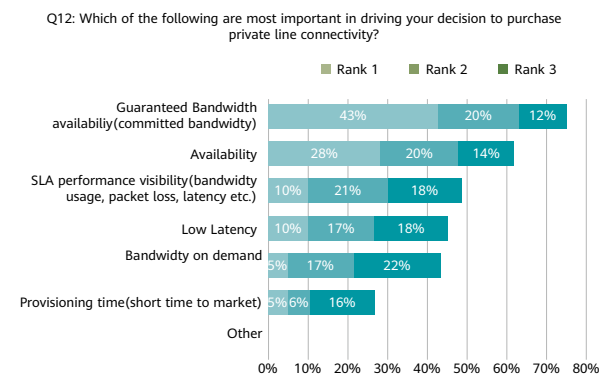
Governments and the financial sector have high requirements on network availability and security via dedicated private lines. Financial trading has an additional stringent low-latency requirement: for high-frequency trading, every millisecond – even every microsecond – can make a difference.

Given the choice between lower-cost shared network resources and premium dedicated resources, the financial industry tends to choose premium services. The financial services industry easily justifies services that are high bandwidth and low-latency and that keep traffic on-net end-to-end.

## Key enterprise purchase criteria for private lines

High availability and bandwidth: In the digital economy, downtime is lost revenue. Therefore, availability is a top priority for enterprises, as shown in Figure 3. Government and financial services companies demand the highest-availability network performance. These sectors will pay a premium for a high-quality service, with guarantees on availability, failover protection, and low-latency public safety and financial trading networks.

**Figure 3: Leading enterprise criteria for private lines**



Source: Omdia private line enterprise survey, February 2020



Service providers need to consider the next generation of optical private lines for enterprises that deliver a premium user experience for business-critical cloud applications, backed by competitive performance SLAs.



**Security:** Clients concerned about protecting their data want private-line networks because they are inherently secure. End-to-end private lines ensure the physical isolation of dedicated resources, with no comingled traffic.

**SLA performance and real-time visibility:** Enterprises expect to be able to monitor network performance in terms of availability, bandwidth usage, latency, and other metrics in real time. Service providers need to offer a one-stop, self-service portal where customers can access SLAs, receive quotes, place orders, adjust bandwidth, monitor real-time KPIs, and view billing and maintenance schedules.

**Low latency:** Latency is a leading differentiator for high-bandwidth services. Customers have heightened latency requirements, and discerning customers want to know not just average latency, but deterministic latency performance for both primary and failover routes.

**Bandwidth flexibility:** Long-term traffic planning can be complex. This challenge is amplified in the cloud era, where enterprises may have unpredictable bandwidth needs. Enterprises benefit from partners that offer burstable or adjustable bandwidth, making their services more flexible.

## Key recommendations

- Service providers should offer new premium performance SLAs for private-line services. These include high availability guarantees and differentiated latency options, and precise SLA monitoring and reporting through self-service customer portals. More flexible private line bandwidth in smaller increments and at different price points would also provide value to enterprise customers.
- Enterprises across all sectors are interested in minimizing business risk through higher network availability, committed bandwidth, guarantees for low-latency SLAs, and built-in network security. Service providers need to consider the next generation of optical private lines for enterprises that deliver a premium user experience for business-critical cloud applications, backed by competitive performance SLAs.
- Service providers can offer a wider range of pricing options and smaller bandwidth increments for optical private lines as a way to differentiate their enterprise network services' portfolios. This would make optical private lines more attractive to a broader set of organizations to connect their sites, cloud locations, and data centers. [UWM](#)



## New trends in 5G FWA for homes & enterprises

Wireless broadband access will transform home broadband services with gigabit home and 10-gigabit enterprise coverage, solve the dilemma operators face of having to increase speeds without increasing prices, and help them become all-around players in the market.

By Walter Wang, President, Wireless & Cloud Core Network Marketing & Solution Sales, Huawei

In the past few years, 4G and 5G wireless broadband access – or Fixed Wireless Access (FWA) – has enjoyed sustained double-digit growth in subscriber numbers, thanks to advantages like plug-and-play, zero-wait,

and multi-site. It is the fastest-growing home broadband technology and 5G's commercial rollout has only accelerated this momentum. So, how will FWA change home broadband services in the 5G era?

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When evolving 4G to 5G, the biggest improvement for FWA isn't enhanced user experience thanks to faster speeds, but the fact that 5G FWA creates more business possibilities and dramatically reduces single-line costs.

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## New capabilities: Gigabit home and 10-gigabit enterprise

5G's most significant change is the dramatic increase in speed. Ookla's Speedtest showed average 5G downlink data rates of 340 to 6,200 Mbps in five countries, including Saudi Arabia, Finland, and South Africa, where FWA is the main conduit for 5G. That downlink rate is three to eight times faster than the average wired broadband speed across all countries over the same period.

Huawei believes that we will see gigabit access for homes and 10-gigabit access for enterprises in most regions within a few years, as 5G coverage expands, Massive MIMO becomes widespread, more wireless spectrum is upgraded to 5G, mmWave is adopted, and advances in CPE are introduced.

## New models: Increasing speeds without increasing prices

Subscribers invariably want faster and more reliable

broadband connectivity, but shy away from paying extra for it. While China is one of the world's most successful countries in terms of broadband upgrades with FTTH/O penetration increasing from 21 percent in 2013 to 90 percent in 2018, ARPU from Chinese operators' broadband services has barely moved over the same time period.

In a survey of thousands of South Korean, US, and UK subscribers, two-thirds of people expressed willingness to pay the same price as current home broadband tariffs to get faster next-gen broadband, while some think tariffs should fall. This puts operators in the position of having to increase speeds without increasing prices.

When evolving 4G to 5G, the biggest improvement for FWA isn't enhanced user experience thanks to faster speeds, but the fact that 5G FWA creates more business possibilities and dramatically reduces cost per line (including network investment and subscriber connection costs). In a typical 5G network environment, for example, the cost per line for a broadband service that provides an average of 100 Mbps during busy hours can be up to 60 percent

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5G slicing gives operators the ability to monetize different service experience requirements for the first time. Operators can configure 5G slices for different types of users to better meet specific needs.

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lower than a typical 4G network environment, offering an ideal solution to the speed-price dilemma. Huawei predicts that most homes will be able to enjoy the smooth experience of gigabit broadband connectivity at current broadband prices within the next few years.

## New services: All-around players

Apart from tariff models, 5G FWA has shown a similar development trend as fixed networks, and will remain aligned with fixed networks in terms of service deployment. More exciting is that 5G will fully enable large-scale commercialization of FWA services, whereas commercial FWA services were never realized in the 4G era.

For example, FWA leased line services, which require high reliability, have already been commercially rolled out in Kuwait. New solutions like EN-DC and Super Uplink enhance the upstream guarantee capabilities of 5G leased lines, while an innovative dual CPE + AR router solution enables 99.99% or higher reliability.

We will also see the standardization and commercial adoption of 5G Ethernet. 5G Ethernet provides a layer 2 Ethernet service for enterprise users that's easier to deploy, operate, and maintain. 5G Ethernet will completely redress FWA's final weakness: enterprise services.

The 5G FWA+TV service will enable TV services, which wasn't possible in the 4G era. Offering multicast support on the network side, the 5G FWA+TV solution will help operators slash core network and backbone transmission bandwidth, dramatically reducing the massive data traffic generated by 4K Ultra HD streaming media. This will help mobile operators to easily implement quad play (broadband, mobile, landline phone, and TV), allowing them to compete with integrated operators on a level playing field.

5G slicing gives operators the ability to monetize different service experience requirements for the first time. Operators can configure 5G slices for different types of users to better meet specific needs, for example, latency-sensitive gamers, enterprise users

who demand reliability, and online students and video conferencers who require higher video quality. Slicing can monetize experience, presenting a new opportunity in the 5G era.

Several leading operators in Europe and Asia Pacific have begun to propose light enterprise applications on 5G FWA networks. Because it doesn't require complex integration or new development, we can expect the commercial deployment of services such as 5G FWA MPLS, 5G SD-WAN and 5G broadband backup links in 2020.

In places like the UK and China, operators are streaming important sporting events and galas live in HD using 5G. There is broad potential for commercial scenarios such as these, ranging from music concerts, rallies, and cruise liners, to construction sites and industrial workshops, to holiday properties and seasonal business venues. 5G FWA is a fast and convenient way to fulfill the requirements of these types of scenarios.

## New industries: New home & industry scenarios

In the 3G and 4G eras, innovators and how they innovated were restricted to the consumer market. However, only a year after 5G commercialization, we're pleased to see that FWA innovation has emerged in a range of areas including ToC (To Consumer), ToH (To Home) and ToB (To Business).

The once-quiet customer premises equipment (CPE) sub-industry has also slowly livened up, with almost all mainstream smartphone manufacturers having launched 5G CPE products. Aside from the broadband market itself, major manufacturers view CPE as a key gateway to the smart home market in the future. Today the 5G CPE market consists

of outdoor models boasting lightweight window-mounted DIY, indoor models with plug-and-play advantages, and OTT 2-in-1 models with built-in multimedia capabilities.

Even more exciting is that many innovative cross-sector products have emerged in the industry. For example, TD Tech's quad-proof (shock, EMC, water, and salt spray) industrial-grade CPE brings 5G to various complex and demanding industrial scenarios. Meanwhile, the first commercial 5G PC has been unveiled in the US. It features an integrated 5G wireless module for anytime, anywhere connectivity.

## Home FWA popularity will surge

In 2001, when the first mobile phone with a camera function was unveiled, many people thought it was a gimmick. After all, its 0.11-megapixel image quality paled in comparison to the photographic capabilities of the high-end 5.4-megapixel cameras of the time. Today, however, more than 90 percent of the world's photos are taken using mobile phones, thanks to their portability, ease of use, and continuous improvements in image quality.

Similarly, users have been adopting FWA since the 3G era thanks to its plug-and-play features, portability, and continuous improvements in connection speed. In the 4G era, FWA surpassed DSL in terms of user experience and saw widescale growth. In the first year of 5G rollout – 2019 – the number of new FWA users worldwide, excluding in China, leapt past the number of FTTH users. We believe that 5G-powered FWA will become the broadband choice for most homes around the world within the next few years and unlock a new blue ocean of cross-sector innovation across a multitude of industries for operators and industry chain players. 



# Why international collaboration in research is essential for Europe

By Abraham Liu, Chief Representative to EU Institutions, Huawei

**R**esearchers and scientists from all over the world are working together to find a vaccine to combat the coronavirus, with companies from Europe, China, USA, Australia, and Canada at the forefront of seeking medical solutions to tackle COVID-19. But there is one common denominator in the work of all these specific research programs: they bring scientists together from different parts of the world to work on this incredibly important field of health research.

The pursuit of scientific excellence doesn't

stop at a defined geographical border. If governments or companies want to deliver the most innovative products and solutions to the marketplace, they should pursue a policy of international collaboration and engagement. In other words: ensuring that the best scientists in the world are working together in the pursuit of a common purpose. For example, this can relate to collaborative research activities in combating chronic health disorders, tackling climate change, and building the greenest and most energy-efficient cities of the future.





That is the central work philosophy of Huawei: we don't want to see national boundaries when it comes to science; we want to see an open approach to science.



Advances in ICT underpin the innovative development of all vertical industries. The energy, transport, health, industrial, financial, and agriculture sectors are being modernized and transformed via the process of digital ingenuity. For example:

- 5G now means that medical operations can be carried out remotely.
- Advances in artificial intelligence (AI) can help identify COVID-19 via cloud applications.
- Innovations in IoT ensure more efficient water systems by automatically identifying faults and leaks.
- Today, 25 percent of all traffic congestion in cities is caused by people looking for parking spaces. This can be dramatically reduced by properly using data centers and integrating video, voice, and data services into traffic-light and parking systems.
- 5G will enable autonomous vehicles because the latency response times for carrying out instructions are now much lower than was the case for 4G. Car companies are now using server computers to test new vehicle models as opposed to deploying physical cars.
- 85 percent of all traditional banking services are now carried out online. Advances in AI are also leading the fight in combating credit card fraud.
- Using sensors to identify the blood pressure and heartbeat levels in cattle can increase milk production can increase by 20 percent.

At the core of all these advances is a very strong commitment by both the public and private sectors to invest in basic research. This includes areas such as mathematical algorithms, environmental sciences, and energy efficiency. But, international collaboration and engagement is the key component in delivering the digital transformation that we're witnessing today.

If a company wants to deliver the most innovative ICT products into the marketplace, then it should co-operate with the best scientific talent in the world to develop them. That is the central work philosophy of Huawei: we don't want to see national boundaries when it comes to science; we want to see an open approach to science.

## How we're supporting ICT research in Europe

Europe is home to many of the best researchers and scientists in the world. One-third of all scientific

publications that are subject to global peer review emanate from Europe. Twenty percent of all global R&D takes place in Europe. The ICT sector now underpins research across a range of vertical sectors including in energy, transport, industry, financial services, environmental, agriculture, and smart city sectors.

Huawei is committed to continuing its policy of international engagement in delivering new innovative ICT products and solutions into the marketplace. Huawei employs over 2,400 researchers in Europe, 90 percent of whom are local hires. Our company works with over 150 universities in Europe on a range of different research activities. We run 23 research centers in 12 countries in Europe, with our EU headquarters based in Munich, Germany. Huawei has signed more than 240 technology partnership agreements with research institutes in Europe.

Huawei is an active participant in EU research and science initiatives. Huawei has taken part in 19 projects under the 7th EU research and technological framework programme (FP7) 2007-2013. We have engaged in a further 25 different research collaborations under the Horizon 2020 research, innovation, and science initiative between 2014 and 2020. Together with leading research institutes from Europe, Huawei has developed a variety of expertise covering 5G, cloud, and device technologies. We've developed the ICT platforms that will build the smart cities of the future, deliver e-health opportunities, and quickly bring autonomous driving into mainstream society. Huawei isn't a new player in Europe on the research front. We set up our first research center in Stockholm Sweden in the year 2000, so we've been embedded in Europe on the research side for 20 years now.

## Supporting future EU research activities

The objectives of Horizon Europe (2021-2027)

will be successfully implemented through positive international collaboration. This research, innovation, and science program of the EU will help make Europe fit for the digital age, strengthen the industrial and competitive nature of the EU economy, build a green economy, tackle climate change, and implement the sustainable development goals of the UN.

Huawei can and will help the EU fulfil these vitally important social and economic policy goals. The European Commission, the European Parliament, and the EU Council of Ministers will soon conclude the final parameters and scope of this Horizon Europe program. A budget of around €94 billion will be allocated to research activities under both Horizon Europe and the new EU recovery instrument over the next seven years.

The priority areas that will receive substantial funding under Horizon Europe are as follows:

- Digital and industry
- Health
- Inclusive and secure societies
- Climate and the environment
- Food and natural resources

So, let's look at how Horizon Europe will be backing the European industrial sector via research engagement in the digital sphere. Support for manufacturing technologies, advanced materials, AI, robotics, high-performance computing, big data, and the next-generation Internet will move center stage in terms of how Horizon Europe will boost the competitiveness of the European economy.

Representatives from research, educational, public and private bodies from over 180 countries in the world have taken part in research projects under Horizon 2020 from 2014 to 2020. Open collaboration and the pursuit of excellence within the research domain have been central



Research and science sectors are economic instruments in themselves. Countries that invest in R&D deliver higher economic returns. And this is particularly the case for countries that invest heavily in ICT research.



elements of EU research programs in the past. This will continue to be the case in the broadest sense under Horizon Europe 2021-2027.

## The research sector is an economic instrument in itself


It's now very clear that the EU is guiding the research and science sectors to implement broader EU strategies. In other words, the research and science sectors are economic instruments in themselves, no longer separated from mainstream economic activity. Countries that invest in R&D deliver higher economic returns. And this is particularly the case for countries that invest heavily in ICT research. We should recall that the digital economy is growing three times faster than the global economy. So countries that invest in ICT research will come out of the economic difficulties that we're all facing today quicker than other countries.

The same principle applies to private sector companies. Enterprises that invest heavily in R&D can and will innovate more quickly and develop more environmentally friendly products.

That's why Huawei welcomes the findings of the

2019 European Commission industrial scoreboard for research and development. This survey analyzed the levels of financial investment into research from 2,500 companies globally. Each company had to invest a minimum of €30 million into R&D per annum. According to this European Commission 2019 survey, R&D investment by Huawei was the fifth highest in the world.

Over the past three years, Huawei has invested close to 15 percent per annum of its global revenues into research programs. This has helped ensure that we've remained one of the most innovative companies in the world within the ICT ecosystem. And we will support the same or even higher levels of investment into our research activities over the coming years. The company will also increase its levels of research engagement and investment in Europe over the next five years, too.

The private, public, research, and educational communities from all parts of the world – by working together with a common sense of purpose – can and will tackle the serious global challenges facing us today. We believe that research activities in Europe can deliver EU economic and social policy goals. Where we are united we will succeed. Where we are divided we will fail. 



## Infrastructure planning needs to come first for telcos

Cloud-network convergence and cloud-network synergy will help operators accelerate digital transformation. But this depends on infrastructure construction. And to build stable, reliable, flexible, and efficient infrastructure, strategic thinking and advance planning are a must.

By Zhang Jun, Senior Consultant, Carrier BG, Huawei

### A new test of infrastructure

China's Internet traffic soared 50 percent during the pandemic, and in hard-hit areas like Wuhan, it shot up by up to 70 percent. Despite this, networks weren't congested, services weren't interrupted, and performance wasn't

reduced.

In the initial period of the outbreak, over 63,000 new 4G and 5G base stations were built in China. Moreover, a 5G base station was built in Wuhan's Huoshenshan Hospital in just 24 hours, and a communications network was deployed in Leishenshan Hospital in 36



A Speedtest report on the impact of COVID-19 on Internet performance revealed that the Internet download rate in China is still rising, even after the pandemic's peak in February.



hours. Feats like this can only be achieved with the support of strong network infrastructure. In these cases, local operators had carried out long-term systematic planning – and it paid off.

As of Q1 2020, 456 million broadband users were split between China's three major providers, and broadband penetration was about 90 percent. Fiber network users accounted for 93 percent of this figure and average access bandwidth was over 160 Mbps.

In Europe, data from the Portuguese national telecommunications authority ANACOM reveals that in the last week of its state of emergency – April 27 to May 2 – data traffic rocketed by 55 percent. Altice Portugal, a subsidiary of the European telecommunications and media giant Altice, had formulated a fiber strategy years ago. And so its fiber network provided solid guarantees in the fight against the pandemic. As of September 2019, FTTH/FTTB coverage was 78 percent in Portugal, and even in rural areas FTTP coverage was up to 53 percent, similar to Europe's generally high levels.

Since there will always be uncertainty, planning and

building stable, reliable, flexible, and efficient network infrastructure is a fundamental requirement for operators.

## Creating new value in the post-pandemic era

A Speedtest report on the impact of COVID-19 on Internet performance revealed that the Internet download rate in China is still rising, even after the pandemic's peak in February. What this confirms is that the home is now an important place for work, study, and entertainment. And it means that home broadband above 100 Mbps is now a basic requirement.

## New services for new times

China Unicom has launched Dual-gigabit Learning Broadband on top of its integrated gigabit package. The service employs AI to reduce online education service latency by over 50 percent. The telco also added an online education benefits pack to improve high-quality online education products, enhance user experience, and consolidate the value of the pipeline.

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By meeting the various digital transformation needs of government and industry, operators can establish service application ecosystems, improve overall competitiveness, and differentiate themselves from OTT cloud services.

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Meanwhile, physical activities have been shifting from offline to online, with remote commercial connectivity services for remote offices, education, and telemedicine all on the rise.

Leveraging its advantages in cloud-network convergence, China Telecom has launched cloud conference, online collaborative office, distance education, and various other IT products and services for its corporate customers. The operator has continued to consolidate its cloud-based digital transformation based on the idea of creating service ecosystems.

As early as 2016, China Telecom determined the strategic direction of its digital transformation, moving network, services, and IT to the cloud and establishing the layout for its cloud-network converged infrastructure, comprising two cores, 31 regions, and X edge nodes. In 2018, the telco began its “decade one, optical transformation; decade two, cloud transformation” strategy.

Today, China Telecom has built more than 300 cloud nodes across the country, allowing the network to move with the cloud, giving convenient access to cloud

and uninterrupted access between clouds and meeting user needs for on-demand, low-latency cloud access.

## How operators can thrive

In the post-pandemic era, new industries and applications are emerging beyond the consumer market. Methods of production and lifestyles will change, creating conditions that can help operators avoid the dumb pipe scenario brought about by over-the-top (OTT) services and instead empower them to provide new digital transformation services for society.

First, operators have resource advantages such as network connections and data center (DC) server rooms. They can leverage trust-based relationships established with government and industry through long-term cooperation. And they can build edge computing through cloud-network convergence to lower latency and achieve “cloud in the network and network in the cloud”.

By meeting the various digital transformation needs of government and industry, operators can establish



Cloud-network convergence and cloud-network synergy will help operators accelerate digital transformation, but doing so is infrastructure-dependent. Infrastructure is the road and whoever builds the road first can reach the competitive window of opportunity first.



service application ecosystems, improve overall competitiveness, and differentiate themselves from OTT cloud services. At the same time, cloud-network convergence will solve the issue of how to move services to the cloud for operators and lay a solid foundation for virtualization to move networks to the cloud and digitalize their own operations by moving IT to the cloud.

Second, operators can leverage their ability to control network connections and cooperate with the OTT supply chain. Through cloud-network synergy, they can meet SMEs' needs for on-demand multi-cloud and improve the user experience. Although the user experience is reflected in the cloud, the key support is still in the network. In the Internet era, bandwidth and latency will always be competitive strengths.

In the future, cloud-network convergence and cloud-network synergy will help operators accelerate digital transformation, but doing so is infrastructure-dependent. Infrastructure is the road and whoever builds the road first can reach the competitive window of opportunity first.

## Strategic and systematic

Digital transformation requires strategic thinking and planning. And with it, stable, reliable, flexible, and efficient infrastructure architecture is the key to operators' sustainable development.

Telecommunications networks have two major characteristics. The first is end-to-end, which means network infrastructure construction requires global vision plus a network-wide perspective and coordination capability to improve efficiency. The second is economies of scale, whereby operators must expand the network and scale of services to reduce costs.

Systematic planning is an effective way to build things on a larger scale through collaborative planning. Changing the features of infrastructure, like base stations, DC server rooms, and fiber networks after deployment, is difficult due to their wide coverage and long construction periods. Therefore, strategic thinking, including top-level design and systematic planning, is necessary to avoid redundant construction and strengthen operators' strategic confidence and ensure

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In terms of enterprise service response time, TTM is a key competitive strength. TTM largely depends on infrastructure readiness, including fiber networks and DC server room resources.

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enterprises' ability to achieve sustainable development.

A real-world example involves the systematic planning of a fiber network for a CBD with 163 buildings covering around three square kilometers. Before the operator carried out systematic network planning, it relied mainly on user demand to sets its fiber deployment planning. Up to that point, it had built 51.2 km of optical cables, covering 98 buildings. The operator decided to adopt a unified fiber network planning concept (when you plan the fiber network considering B2B/B2C/B2H service requirements). It planned fiber cable coverage for the 163 buildings in one go, finding it required only 31.5 km of cable. And the average cost of fiber cable for a single building was only about one-third the cost of the original project.

Fiber networks aren't point-to-point. Instead, they require structured and flexibly configurable fiber. Good planning can greatly reduce the cost of fiber construction and a flexible wiring design can improve the utilization efficiency of fiber resources. More importantly, a fiber network can ensure that there are fiber access points near every building (within 200 meters), which can slash service response time. In terms of enterprise service response time, TTM is

a key competitive strength. TTM largely depends on infrastructure readiness, including fiber networks and DC server room resources.

Infrastructure is a physical entity that determines whether all services, technologies, and network plans can ultimately be deployed. The systematic planning of infrastructure requires coordinating service goals, the direction of technology evolution, and network planning where service planning drives technical planning and technical planning drives network planning. It also requires coordination between various specializations, including front- and back-end departments such as marketing, planning and construction, and O&M, as well as cross-supply chain and even cross-industry cooperation. It's a complex and systematic project that if coordinated well can provide operators immense cost-savings and flexible architecture that's stable long-term. But if it's done poorly, it may limit operators' large-scale development.

In systematic planning, infrastructure integration should be considered, especially the integration of fixed and mobile sites. As long as these sites are integrated, the fiber network, transmission network, IP network, and access network will naturally merge.





Without fiber, network capabilities won't be strong and without cloud, service development won't be good. China's strong IT infrastructure has been achieved using systematic planning-based thinking and methods, and this has laid a solid foundation for the development of 5G, cloud, and AI.



Also, systematic planning must have a high-value focus. This means a holistic approach to network planning. Construction should be implemented in a planned and step-by-step manner based on high-value areas and service development priorities.


When the business division cannot produce a business plan, operators must still use a digital transformation strategy to guide infrastructure planning. Because the infrastructure planning and construction cycles are long, you cannot use the "toothpaste-squeezing" method. If you wait for service requirements to plan and build the infrastructure, you'll miss a valuable competitive window of opportunity. You also won't get long-term stable and efficient network architecture, because the network design will lack a global and network perspective.

Without fiber, network capabilities won't be strong and without cloud, service development won't be good. China's strong IT infrastructure has been achieved using systematic planning-based thinking and methods, and this has laid a solid foundation for the development of 5G, cloud, and AI.

2020 is an especially significant year. The pandemic

has had a huge and far-reaching impact on global socioeconomic development. How can operators seize opportunities in an era of accelerating digital transformation, leverage high-quality network connectivity to build a foundation to develop the digital economy, and become the distribution centers of the value chain again?

Huawei believes that in addition to focusing on what's ahead of them and exploring new business models and service types, operators should also focus on what's below their feet, and begin strategic planning and deployment of infrastructure for 2025 as soon as possible. Because infrastructure forms an operator's roots, service and commercial innovation can bear fruit only when the roots are firmly established.

The question today is not whether or not operators should go down the road of digital transformation, but whether they should go fast or slow. If you go fast you will seize the advantage. When implementing a digital transformation strategy, cloud-network convergence/cloud-network synergy is the difficult part, but infrastructure planning is the priority. And so that needs to come first. 

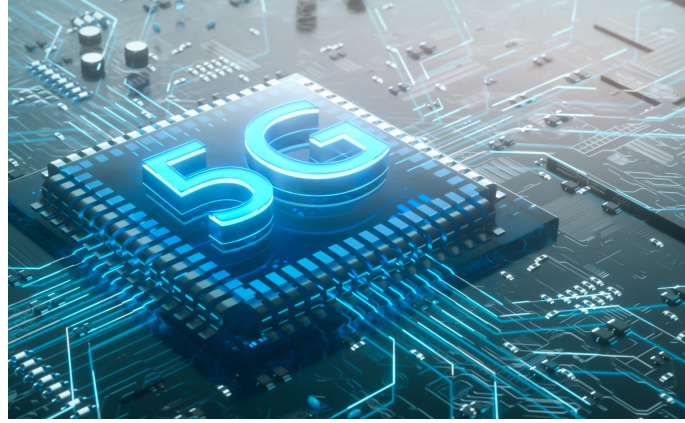
# Hangzhou

## A story of "5G+F5G"

The integrated development of 5G + F5G (fixed 5G) can meet the high-quality interconnection needs of new infrastructure in fixed, mobile, and fixed-mobile hybrid scenarios, infuse intelligence in industry verticals, and boost the digital economy.

By Wang Wensheng, General Manager, China Mobile Hangzhou





**H**angzhou serves as a window through which we see how China is building its digital economy. Home to 9.2 percent of listed Internet companies in China and ranking first in terms of net talent inflow, the city of 7.6 million already boasts outstanding digital credentials. It's also enjoyed sustained upward trends in economic development, urban governance, and living standards.

Hangzhou's pioneering "urban brain" established a precedent for urban digital governance. Today it covers 48 application scenarios with 11 major systems, for example, for public transportation, urban management, health, and local governance, and 158 digital "cockpits" that produce an average of 120 million pieces of collaborative data per day.

Its pioneering epidemic management and control health code has been used in more than 100 cities nationwide, allowing the city to contribute to epidemic prevention and control

on a national scale and the return to work and production through smart technology.

As a major driving force behind Hangzhou's new infrastructure, China Mobile Hangzhou is deploying 5G + F5G as the city's ICT foundation.

## How 5G + F5G boosts the digital economy

The coordinated deployment of 5G + F5G networks is the cornerstone of shaping consumption patterns, innovating applications, and creating a thriving ecosystem for industry sectors.

Alongside wireless 5G, fixed communication technology has also advanced to its fifth generation in the shape of F5G underpinned by 10G PON, Wi-Fi 6, and optical cross-connect (OXC).

The ITU defines three major application

“5G and F5G scenarios adopt different approaches but achieve similar effects, each with its own strengths. Together, though, they can complement each other and create synergy.”

scenarios for 5G: high bandwidth eMBB, massive connectivity with mMTC, and low latency with uRLLC. Correspondingly, ETSI defines three major application scenarios for F5G: Tbps-level bandwidth with eFBB, 100,000 connections per square kilometer with FFC, and  $\mu$ s-level experience with GRE. 5G and F5G scenarios adopt different approaches but achieve similar effects, each with its own strengths. Together, though, they can complement each other and create synergy.

5G is geared to massive thing-to-thing connectivity and scenarios like HD video, AR/VR, industrial automation, autonomous driving, and drones. F5G focuses on fixed connection scenarios like 100G to the campus, 10G to the building, and gigabit to the home. It can be used in a range of use cases such as financial leased lines, data centers, urban video surveillance, future communities, and smart homes. Combining 5G and F5G and enabling 5G + F5G to everywhere and everything will unleash the full potential of the digital economy.

## A 5G leader explores F5G application innovation

China Mobile Hangzhou has built the first 5G city. We led large-scale pilots for commercial 5G networks and built a rich network environment, and we were also the first operator in the world to release multiple new 5G technologies. We've established leadership in five 5G areas: technology, networks, applications, operations, and ecosystem.

From our foundation in 5G, China Mobile Hangzhou has proposed a complete infrastructure concept: the "F5G Tree". F5G supports a stable and reliable network carrying capacity based on optical fiber carriers, providing deep roots and a firm foundation.

F5G includes a range of technologies: OXC technology is used in backbone nodes to support one-hop direct connection of any two points in the optical network. 200G high-speed transmission technology has doubled fiber



transmission capacity. NG OTN technology has achieved a hundred-fold increase in the number of connections in the metro network. 10G PON has realized a tenfold increase in access bandwidth in the access network. And Wi-Fi 6 has doubled the number of connections in home networks. These optical connections extend to all levels of the network.

The roots provided by the F5G Tree manifest in the continuous extension of optical connections, constant improvement in bandwidth, and performance optimization indicator for network experience. Collaboration between the home network, access network, and fiber network ensures an end-to-end connection experience that forms the F5G trunk. Together with end-to-end slicing and what we call gold, silver, and bronze pipes, the trunk enables differentiated service quality.

China Mobile Hangzhou has promoted the application of F5G in a broad range of scenarios like data centers, urban video

surveillance, and future communities. From the F5G Tree, we can grow the leaves and branches of digital Hangzhou.

## Making Hangzhou the first 5G + F5G city

China Mobile Hangzhou's strategic goal is to evolve Hangzhou from China's top 5G city into its first 5G + F5G city. The focus will be on key areas such as digital economy, digital governance, and digital life. By building world-leading ICT infrastructure, we will lay a solid foundation for new infrastructure in Hangzhou.

**Technology leadership:** China Mobile Hangzhou has already built the world's first autonomous and controllable 5G SA cloud network. This year we will also promote an 800G high-speed transmission network.

**Network leadership:** We were the first and only operator selected as the China Mobile 5G benchmark city. This year we will push large-

“This year we will pioneer an availability map of VIP leased private lines for government and enterprises, enabling the precise scheduling of network resources and allowing enterprise customers to choose dedicated cloud/blockchain-based migration services on demand.”

scale deployment of OXC to achieve one-hop connection between any two points across the city's network.

**Application leadership:** China Mobile

Hangzhou has built benchmark applications in a range of areas like 5G+ Industrial Internet, 5G+ smart transportation, and 5G+ blockchain. This year we will promote terabit-level optical transmission for interconnect applications in data centers.

**Operations leadership:** China Mobile

Hangzhou has pioneered automatic 5G service provision. This year we will pioneer an availability map of VIP leased private lines for government and enterprises, enabling the precise scheduling of network resources and allowing enterprise customers to choose dedicated cloud/blockchain-based migration services on demand.

**Ecosystem and experience leadership:** China

Mobile Hangzhou has already established a 5G industry alliance, 5G joint innovation

center, and 5G innovation park. This year we will also promote the comprehensive application of gold, silver, and bronze pipes and E2E slicing to promote the growth of the 5G + F5G ecosystem, leveraging high-quality experience.

China Mobile Hangzhou and Huawei have also released the industry's first white paper on the 5G + F5G digital city, which sets out the 5G+F5G concept, including construction solutions for 5G + F5G scenarios; 5G + F5G operational capabilities; and how 5G + F5G will enable the digital economy, digital governance, and digital life. The white paper also outlines the Hangzhou model of the 5G + F5G city and provides a useful reference for building 5G + F5G in other cities.

Looking ahead, China Mobile Hangzhou will continue to build world-leading ICT infrastructure, maximize the synergy of 5G + F5G technology, and drive the intelligent evolution of industry, thus demonstrating the power of technological synergy. [www](#)

# What a next-gen factory looks like with smart 5G

The fourth industrial revolution will be characterized by digitalized, networked, and smart industry powered by next-gen ICT and the Industrial Internet. Moreover, 5G will become a key enabler of digital transformation across various industry verticals that can in turn underpin national economies and, in this case, a pioneering 5G-connected factory.

By Liu Hao



“Forecasts show that the 5G smart manufacturing market will be worth US\$232 billion by 2025 and that China will spend more than 520 billion yuan (US\$74.3 billion) on 5G equipment for industry application by 2030.”

**G**lobally the manufacturing industry is becoming more intelligent, flexible, service-oriented, and high-end.

The demand for high-performance wireless networks in smart manufacturing is on the rise, with 5G able to guarantee high-quality and flexible networking capabilities for production systems and integrate data from all links in the chain.

5G's capabilities in speed, bandwidth, latency, reliability, massive connectivity, coverage, and security can meet the strict requirements of industrial services and promote the rapid rollout of the Industrial Internet. Forecasts show that the 5G smart manufacturing market will be worth US\$232 billion by 2025 and that China will spend more than 520 billion yuan (US\$74.3 billion) on 5G equipment for industry application by 2030.

## Inextricably linked

Recognizing the crucial symbiosis of 5G and industry, China's Ministry of Industry and Information Technology (MIIT) announced the 5G Industrial Internet 512 Project in November 2019, which aims to boost the use of 5G in industry scenarios and in turn drive the development of

5G technologies – industry is the main use for 5G and in turn the main driver of 5G technological development.

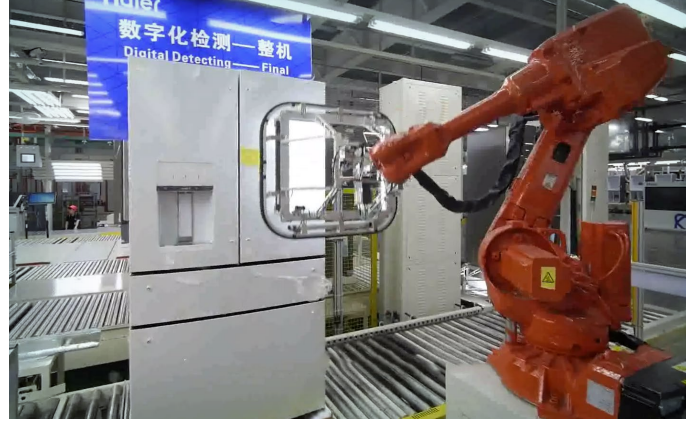
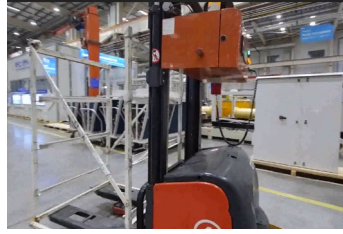
The smart factory is an important test site for the real-world application of 5G. Fixed-line still dominates the Industrial Internet, because manufacturers previously relied on wired technology to connect production facilities. However, with 5G, wireless technology is not only more suitable for complex manufacturing environments, it's also far less expensive than line upgrades.

That's why short-range wireless communication technologies like Wi-Fi and Bluetooth have been widely adopted in the manufacturing industry in the past few years. However, they're not suitable for scenarios that are sensitive to packet loss, data silos, and security risks.

5G is the cornerstone of the networkization, digitalization, and smartification of manufacturing and connected factories, as well as their diverse requirements.

## The 4 key elements of 5G





For 5G network capabilities to meet the demands of smart factories, we need to consider four key elements: connectivity, computing, security, and simplicity.

**Reliable connectivity** is the foundation of wide access, large bandwidth, and low latency.

Powerful heterogeneous **edge computing platforms** are required to handle the wide variety of application scenarios in enterprise campuses.

**Data security and privacy** via a closed-loop data environment in enterprise campuses is a strict requirement of every enterprise.

**Simplicity** is an obvious preference of both operators and enterprises when it comes to O&M and edge computing on private networks.

## Why MEC matters

Multi-access edge computing (MEC) is one of the key technologies that can support low latency and increase bandwidth rates for 5G. MEC enables applications, content, and some service processing and resource-scheduling

functions of the core network to be deployed on the network edge, closer to the access point. Services can be processed at the local network edge, which boosts QoE through application, content, and network orchestration.

MEC can be broadly applied in scenarios like industrial manufacturing, autonomous driving, and smart grids, as well as in typical campuses such as factories, cargo ports, and power substations.

## Creating a world first

Haier – a pioneer in smart home appliances and the Industrial Internet – teamed up with China Mobile and Huawei to create the world's first smart 5G connected factory. The partners also succeeded in redefining enterprise organizational methods, business models, and ICT deployment with AI and 5G.

Located in Qingdao, Haier's smart 5G connected factory for refrigerators creates a complex, multi-scenario system that incorporates smart devices, machine vision, AR, remote control, and cloud automated guided vehicles (AGVs) – all powered by 5G. The network

“Multi-access edge computing (MEC) is one of the key technologies that can support low latency and increase bandwidth rates for 5G.”

boasts key technologies such as cloud native ultra-distributed architecture, dynamic intelligent network slicing, high-performance heterogeneous MEC, and a 5G virtual industrial private network. It provides key service capabilities like robust data security, simplified deployment and operations, algorithm app security, and a complete maintenance model.

The network enables flexible and efficient mass-customized production and provides managers with real-time, high-precision insights into production processes and operating status. It also automates data perception in all processes, decision-making for all events, and the iteration of full-cycle scenarios.

The machine vision system, which comprises industrial cameras, has high network requirements: upstream bandwidth of between 50 Mbps and 200 Mbps, end-to-end communication latency of less than 10 ms, and reliability requirements above 99.9999 percent.

In traditional models, the execution and

processing ends of machine vision systems are local to the factory and typically use cables.

This creates a large spatial footprint, high per camera cost of detection, data silos, complex line maintenance and software upgrades, and long deployment and debugging times.

Haier, China Mobile, and Huawei deployed 5G base stations and 5G MEC edge nodes that, due to large bandwidth, low latency, high computing power, and cloud collaboration capabilities, could power a centrally deployed machine vision solution provided by HCvision.

Haier can now realize cloud management, the self-optimization of algorithms, and security guarantees that ensure enterprise data does not leave the campus. It has also smashed bottlenecks in traditional machine vision such as high costs, efficiency limits, unstable quality, and complex maintenance. Due to lower costs and simple maintenance, Haier can enable fine-grained functions like detecting cracks on fridge doors and optical character recognition (OCR).



The new system has also enhanced product quality, reduced equipment downtime and failures, boosted production efficiency, and reduced investment costs.

Massive data volumes can be collected at high speed through the 5G network, with data from multiple cameras and plants quickly aggregated on the 5G MEC edge node. The resulting data goldmine can be used for deep learning and self-optimization in the cloud, greatly improving the accuracy of product detection.

The factory is the first example of a cloud machine vision system integrated with 5G and edge computing in an industrial manufacturing environment.

A range of other typical factory services have also been developed, including AR-assisted maintenance, safety behavior recognition, and AGV smart navigation. The AR-assisted maintenance service, for example, is deployed on the edge-side using edge computing, with the data computed locally. Remote specialists

can assist and guide the maintenance work of on-site technicians in real-time using lightweight AR glasses, saving time and cost, and solving issues with the old system like unstable Wi-Fi signals, dizziness, and cumbersome AR glasses.

For the safety behavior recognition service on the production environment, detection software is deployed on the edge side to guarantee HD video backhaul for accurate identification. The solution solves problems like high staff turnover, complex management, and replacing missing operators in specific roles. It also reduces the complexity of producing direct-current electrical goods and the difficulty of routing cables in some old factories.

The AGV smart navigation service migrates modules that require complex computing capabilities, like positioning, navigation, image recognition, and environmental perception of AGV operations, to the 5G MEC edge node. AGV smart navigation and real-time remote control functions powered by continuous 5G coverage have drastically improved the efficiency and

“The factory is the first example of a cloud machine vision system integrated with 5G and edge computing in an industrial manufacturing environment.”

operating accuracy of inspections, detection, and automated recognition.

## AI + 5G = Smart IoT

In the future, AI combined with 5G will result in more scenario-based IoT smart products, smart integrated solutions, and AI applications, thanks to data-based simulation modeling verification, efficient production collaboration, and accurate quality control. This will optimize productivity indicators such as production efficiency, manufacturing costs, and non-warehousing rates. It will also strengthen the competitiveness of smart manufacturing and provide replicable cases of how to evolve smart connected factories. Haier's smart factory has already attracted much attention, both in industry and other sectors, as a model for transformation. It's the only case from China selected by the GSMA as an edge computing PoC project for "enabling operators to deliver value in new areas beyond connectivity."

At HUAWEI CONNECT 2019, Haier, HCvision, China Mobile, and Huawei announced the world's first 5G + Machine Vision solution for smart factories. Working together, the smart

manufacturer, application provider, operator, and equipment vendor have developed the first cloud machine vision system that integrates 5G and edge computing for industrial manufacturing environments. The solution provides an important reference for rolling out 5G MEC applications in other scenarios, including smart logistics, smart campus, and smart homes. It's also an important solution for empowering cross-domain, cross-platform, and cross-industry development.

The MIIT awarded the partners' 5G MEC Device-Edge-Cloud solution for smart factories top prize at the 2nd Blossom Cup 5G Application Contest. The project has also won other awards, including the MEC Best Use Case Award from Communications World's 2019 ICT Year-End List.

Integrated development of 5G Industrial Internet will bring huge socioeconomic benefits for the industry, and promote the digitalization, networkization, and smartification of industrial enterprises. Haier, China Mobile, and Huawei will continue collaborating on the integration of next-gen ICT like 5G, cloud, big data, AI, and smart manufacturing, and making advances in Industrial Internet that are replicable globally. [www](#)

# Minsheng Bank's journey to intelligence with IP backbone

The banking industry has always been at the vanguard of technology. And now, the global pandemic is accelerating the use of fintech in the shape of remote, online, real-time, and automated technologies. Aligned with these trends, Minsheng Bank and Huawei have built a next-gen financial IP backbone network that will create new business opportunities.

By Xie Dapeng, Li Qiang & Shao Lingchao, Network Division,  
Information Technology Department, China Minsheng Bank



“In 2019, Minsheng Bank formulated its *Fintech Strategic Development Plan (2019–2022)*, focusing on two major development models: Finance + Internet and Internet + Finance.

Over the past two decades, the banking industry has transformed the way it does things by integrating networking technologies and ramping up digital transformation. Both the financial lives of today's end users and the digital infrastructure that carry banks' services have been tangibly impacted by fintech.

COVID-19 has strengthened this impact, shifting the banking industry's thinking ever closer to digital tech.

## The financial IP backbone

Founded in 1996, Minsheng Bank was China's first national joint-stock commercial bank set up by private enterprises. In the 24 years since then, the Chinese economy has expanded rapidly and Minsheng Bank has grown from a small bank with a capital of just 1.38 billion yuan (US\$197.4 million) into a huge commercial bank that ranks 232nd in the Fortune Global 500. It holds 6.7 trillion yuan in assets, operates almost 2,600 branches, and employs nearly 59,000 staff.

Minsheng Bank's digital backbone network connects the data nodes of nearly 2,600 branches and the head office. The network has helped the bank develop rapidly, formed an important part of its digital infrastructure, and carried five types of services: video, voice, production, office, and testing services. However, as these services slowly increased, the network's capabilities began to fall short and a range of issues began to emerge:

- Due to the traditional pure IP forwarding adopted when the network was built, the frequent local link congestion and low global resource utilization began to occur once service volumes increased. And as optimizing the network is dependent on manual intervention and difficult to achieve, the bank was forced to buy leased line bandwidth from a telco on a long-term basis to ensure smooth services.
- It wasn't possible to completely isolate critical and non-critical service traffic on the production network, especially non-critical large-bandwidth services such as bulk transmission. As a result, bandwidth



was squeezed for critical services, making it difficult to achieve differentiated SLAs and resource scheduling.

- Stable continuous services were threatened by several factors: network O&M relied on traditional SNMP data collection and manual command lines, device O&M targeted nodes so network data couldn't be organized to support the execution of service logic, and fault location relied on expert experience in troubleshooting. And due to exponential growth in online financial service traffic, service faults were even more difficult to trace and locate using traditional O&M.

To better encourage fintech development, we began to implement a top-down integrated development strategy. In 2019, Minsheng Bank formulated its *Fintech Strategic Development Plan (2019–2022)*, focusing on two major development models: Finance + Internet and Internet + Finance. The plan aims to enhance platform enabling and digital operations and services capabilities, promote the deep integration of data and services,

and continuously improve customer service experience and service efficiency.

To serve the new development strategy and underpin digital transformation, Minsheng needed to upgrade and consolidate its financial backbone network. We arrived at the following basic design principles for our next-gen financial backbone network:

**Service-oriented:** A converged network for carrying various bank services like production, office, video, voice, and testing services that enables dynamic resource adjustment based on different service requirements to satisfy the diverse assurances of SLAs for different services.

**Future-oriented:** A flexible software-defined networking (SDN) and segment routing (SR) network protocol with traffic engineering capabilities, based on industry best practice, to build a next-gen smart IP backbone network for finance.

**Smart O&M:** improved level of network O&M automation, reduced dependence on traditional

manual methods, and improved O&M efficiency to build an ultra-reliable network.

## The smart SDN brain

The CloudWAN solution is based on Huawei's expertise in wide-area IP backbone networks. Offering intelligent ultra-broadband, intelligent connectivity, and intelligent O&M, the full-service smart network solution exactly matched our requirements.

The new intelligent IP backbone network deploys NetEngine series routers at the device forwarding layer, supports a full range of interfaces such as PCM/E1/SDH/GE/10GE on the client-side, and meets our interface access requirements in production and office scenarios. It also supports 100GE/400GE network-side interfaces, which can adapt to future growth forecasts in bandwidth.

In the convergence layer/core layer, high cost-performance 400GE will replace 100GE and become the next-gen networking technology. Huawei launched the industry's first end-to-end 400GE solution, and is the only industry vendor that can provide 10 km/40 km/80 km full-range 400GE optical modules.

By deploying NetEngine routers, Minsheng Bank's backbone network can be continually upgraded into an ultra-broadband network with stable architectural topology to quickly meet future service development needs.

To improve the backbone network's resource utilization and stop congestion in the shortest path in traditional static networks, we needed to build a network that could guarantee

the needs of various services and balance resources.

Last-generation RSVP-TE and new-generation SR are both traffic engineering technologies. However, RSVP-TE is extremely complex in terms of deployment and maintenance, as every device/node in the network must maintain every tunnel state. This requires higher equipment performance standards and pushes up project costs, drawbacks that have led to a very limited number of RSVP-TE deployments worldwide.

In contrast, next-gen SR traffic engineering allows traffic engineering for services based on dynamic programming, minimizes expenditure on equipment, and simplifies deployment and maintenance. SR executes intelligent path calculations based on network-wide topology link information collected by the iMaster-NCE controller. This allows the service flow head node to determine complete and optimal routing paths based on service bandwidth and latency requirements, helping to solve the problems of insufficient network flexibility and difficulties in traffic optimization that have plagued networks with growing services for years.

Acting as the network brain, the iMaster NCE controller offers SDN controller capabilities and provides integrated equipment management and O&M analysis functions. It is the industry's leading three-in-one, one-stop management platform for management, control, and analysis. The iMaster NCE controller connects various types of data silos and platforms, abstracts different forms of service logic, evolves service provisioning from single-point device-by-device





deployment to targeting service logic blocks, and supports end-to-end delivery targeting the entire network. The one-stop solution shortens the provisioning time of new service networks from months, when multiple departments had to collaborate, to days. The iMaster NCE controller's analysis module fully visualizes the network black box, harnessing real-time insights into all-network dynamics provided by telemetry, and organizes the collected network data into a knowledge graph, so the location and cause of faults can be determined within minutes. iMaster NCE is a "super helper" that dramatically increases the level of automation in network-wide O&M and greatly reduces the workload of network O&M.

## Moving on from best effort

The enabling power of the new financial backbone has reinvigorated Minsheng Bank's network.

With the bank's services integrated into the next-gen IP backbone network, network forwarding capability has been upgraded from traditional best-effort delivery to dynamic routing based on service types and different SLA requirements. This has helped Minsheng overcome the persistent problem of partial link congestion in the traditional IP network. Load balancing has been enabled on link resources, overall utilization has increased by 15 to 20 percent, and reduced dependency on leased lines has slashed rental costs.

The COVID-19 pandemic in 2020 changed the way the world looks at things. The demand for intelligent, automated, non-contact, online,

and real-time services across all industries has never been stronger. Minsheng Bank's smart financial backbone network has performed impressively – after the outbreak, the number of online customer visits and online transactions increased substantially, making the value of online finance even more apparent.

Although the network was hit by increased traffic during this period, resources remained balanced and stable network-wide. Service operations were smooth and service requirements were fully guaranteed. For network O&M personnel, the network iMaster NCE platform's capabilities – including one-stop centralized management, control, and analysis, real-time monitoring, and automated and efficient service delivery – drastically reduced reliance on on-site O&M manpower and departmental collaboration.

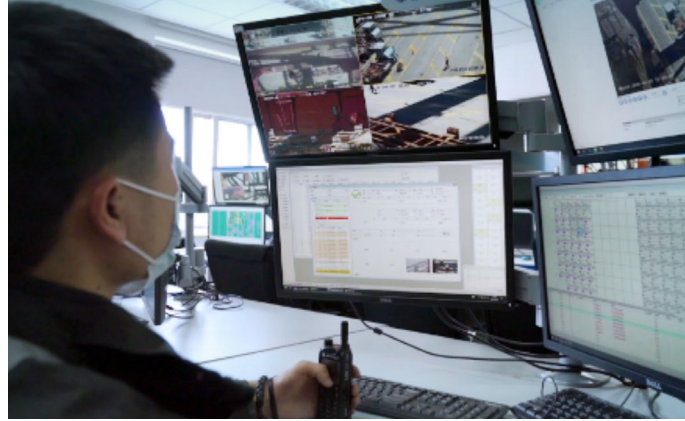
By introducing new concepts and technological innovations, Minsheng Bank has re-consolidated its position as a modern fintech bank. In the future, the bank and Huawei will continue to explore an evolutionary path towards the IPv6 era, enable advanced technologies such as SRv6, and continue to increase network intelligence, taking Minsheng's strategy of becoming a technology bank to the next level. [WINWIN](#)

# Unlocking four industry firsts with N郑 5G smart port

As part of China's New Infrastructure strategy, China Mobile Zhejiang, Zhejiang Seaport Group, Shanghai Zhenhua Heavy Industries, and Huawei joined forces to develop 5G smart port applications, creating a project that will help boost post-pandemic economic recovery.

By Huang Yanhui





**A**longside the prevention and control of COVID-19, economic recovery is at the top of the agenda for governments across the world. In that regard, ports act as a weather vane for economic vitality.

China's Ningbo-Zhoushan port (NBP) is one of the top three busiest ports in the world, ranking first globally in cargo throughput for 11 consecutive years. Comprising 19 port areas with over 620 berths, NBP serves more than 100 vessels with over 10,000 tons of capacity every day. Nationally, the port was one of the first places to resume operations during the pandemic, representing a huge step in spurring the resumption of national and global logistics systems.

Ports have a strong need for improving operating efficiency. Daily rent for large vessels can reach hundreds of thousands of dollars – an extra hour of waiting or procedures can mean tens of thousands of dollars flushed down the drain. The biggest requirement for a key port such as NBP, which operates 24/7, 365 days a year, is to boost automation and efficiency. However, due to the impact of the coronavirus, NBP has faced massive challenges to keep running during the pandemic,

as workers have stayed away.

What's the solution? NBP can only reduce costs and increase efficiency by applying new technologies, such as 5G, edge computing, artificial intelligence (AI), and autonomous driving, that will make port services digital, automated, and smart.

To achieve this, Huawei, China Mobile Zhejiang, and a team of partners are working with the port operator, Zhejiang Seaport Investment and Operations Group, to develop smart 5G applications.

Back in 2018, Huawei helped China Mobile Zhejiang build the country's first 5G port application pilot at NBP. In April 2019, they successfully verified remote gantry crane operations, management, and video backhaul applications based on the 5G network. Also in 2019, they launched the world's first independent, controllable 5G VoNR service between the port and Hangzhou. Today, NBP enjoys full 5G network coverage, with the pilot port applications in regular commercial use, realizing huge cost and efficiency gains.

Normal port procedures involve humans and machines working together, which is both labor-

“Daily rent for large vessels can reach hundreds of thousands of dollars – an extra hour of waiting or procedures can mean tens of thousands of dollars flushed down the drain.”

intensive and complex. Unloading cargo ships, for example, is divided into three steps: First, quay-side cranes lift the cargo from the cargo ship on to container trucks at the terminal. Second, the trucks transport the goods from the terminal to a yard. Third, gantry cranes unload the containers from the truck into the yard.

At NZP, 5G smart port services cover the core operating procedures, including three main 5G applications for unloading cargo ships: smart cargo handling, automated logistics with unmanned trucks, and remote control of the gantry crane.

## Smart cargo handling

Cargo handling involves counting, damage checks, and stowage. The main purpose of cargo handling is to confirm whether the goods unloaded from/loaded onto the cargo ship match the information from the vehicle that receives and delivers the goods.

Port quays can be harsh, high-risk environments. They're affected by cold sea breezes in winter, scorching sun in summer, the constant movement of trucks, and falling objects from gantries or containers, all of which create a constantly challenging environment for cargo handlers. Moreover, information records rely on the handlers' powers of observation, which limits accuracy and efficiency.

The 5G solution provides 15 channels of high-definition (HD) cameras, with 5G backhaul installed on each quay-side gantry crane. The HD video captured by the cameras is distributed locally through multi-access edge computing (MEC) deployed in the port server room, so that the data does not leave the port area. A machine vision analysis application and smart cargo handling system are integrated on the MEC platform, enabling AI recognition of video images powered by the supercomputing capabilities of MEC heterogeneous hardware. The object recognition system covers information and statuses, including container number and type, terminal truck operation number, and single container load position and lane number. Achieving 95 percent accuracy, the system completes recognition within seconds and automatically issues confirmation notices to truck drivers and bridge crane operators, so the loading and unloading process remains uninterrupted.

Using the 5G network and MEC, the cargo handlers can work from an air-conditioned smart cargo command center.

## Automated logistics with unmanned trucks

With the port operating 24/7, container truck drivers work in three shifts a day and driver

fatigue is common. Moreover, the twistlocks of gantry cranes and locking points in the container have to be aligned to within a centimeter of accuracy, calling for a very high level of driving experience and skill – the shortage of truck drivers is a big issue for ports. Although traditional automated guided vehicles (AGVs) can solve this problem, the difficulty of reconstructing ports for their use, plus their lack of flexibility and high cost, limit their application.

Automated logistics with unmanned trucks is based on 5G's precise positioning capabilities and MEC. A 360-degree video of the interior and exterior of self-driving trucks from multi-channel HD cameras is transmitted to the MEC control room in real time through a 5G end-to-end slicing network. Coupled with technologies like vehicle-road coordination, high-precision positioning, and automated command positioning, the solution improves the positioning accuracy of container trucks in the port area from meters to centimeters. Thanks to these advantages, self-driving trucks have replaced the traditional geomagnetically controlled remote driving system.

The unmanned truck drives to a designated location under the quay-side crane and then parks. Once the crane places a container on the vehicle and confirms it, the truck starts up automatically and its steering wheel turns automatically. The truck identifies the environment of the road, and can decelerate, brake, turn, avoid objects, and park on its own, choosing the optimal route to its designated location.

5G unmanned trucks have transformed cargo transportation, slashing labor costs. For instance, the Meishan port area of NZP requires 800 drivers working in three shifts to drive over 200 container



trucks, costing close to 100 million yuan (US\$14.03 million) a year. Moreover, 5G unmanned trucks have significantly improved the port's operating efficiency and safety, evolving the port from a labor-intensive industry to automated, smart, and unmanned.

## Remote-controlled gantry cranes

After the unmanned truck has parked in the designated location in the yard, the gantry crane operator grabs the container on the truck and places it in a set area. In the past, operators had to climb to the top of the 30-meter high cranes every day and then work for 12 hours non-stop in a drafty metal cab. They were also prone to neck and shoulder strain due to prolonged tilting of the head while operating cranes.

In the 5G remote gantry crane operations system, E2E network slicing and MEC support a 5G private network with ultra-low latency, ultra-high reliability, and large upstream bandwidth, meeting the service requirements for remote PLC (programmable logic controller) crane control, and real-time, multi-channel HD video backhaul.

Unlike optical fiber and Wi-Fi, the 5G communication system provides ultra-large bandwidth, ultra-low latency, and massive connectivity. There are no bulky fiber optic cables to migrate when reconstructing yards or moving

gantry cranes, and it avoids the low reliability and insufficient upstream bandwidth of Wi-Fi.

NZP has currently transformed six gantry cranes with the solution and put them into regular operation. With the 5G slicing network and MEC, average E2E latency is cut to between 8 and 10 milliseconds, PLC reliability is 99.999 percent, and upstream bandwidth for HD video backhaul is 1 Gbps.

Crane operators can control the gantry cranes remotely using backhauled multi-channel HD video in real time from a central control room. Only picking up the containers requires human-guided remote control and one operator can easily operate three or four cranes simultaneously, compared with one operator per crane before.

## Four industry firsts

On May 15, 2020, Huawei, China Mobile Zhejiang, Zhejiang Seaport Group, and Shanghai Zhenhua Heavy Industries signed a strategic agreement to develop 5G demo applications for the Ningbo 5G+ Smart Port. The project will achieve four firsts:

- **The first port to use E2E network slicing and MEC with guaranteed service-level agreements (SLAs) for key port services.** Huawei helped China Mobile Zhejiang to deploy an E2E network slice, including 5G customer premises equipment (CPE); wireless, bearer, and core networks; and CSMF, NSMF, and other network elements. China Mobile Zhejiang is also the first telco to set up and launch a 5G online store to enable 5G smart ports.
- **The first port to verify 5G gantry crane remote control and put it into regular use.** Six 5G-powered gantry cranes have been reconstructed and verified. The 5G solution has been verified to meet both the upstream bandwidth and stable low latency required for the remote control of multiple gantry cranes.
- **The first port with an end-to-end uplink enhancement solution that meets the large uplink demands of port gantry cranes, container trucks, video surveillance, and other services.**
- **The first port with a slicing package network (SPN) intelligent bearer network dedicated channel solution.** FlexE-based network slicing enables smart ultra-wide guarantees for the port's bandwidth requirements, alongside next-gen routing protocol segment routing (SR). With the iMaster Network Cloud Engine (NCE), the solution provides intelligent connections, ensuring the low latency requirements of port production services are met. Intelligent O&M based on NCE and In-situ Flow Information Telemetry (iFIT) meets the high-reliability requirements of port services.

The Ningbo 5G+ Smart Port strategic agreement will help the port put a full range of 5G services into regular operation, including unmanned-truck-based automated logistics, smart cargo handling, and video AI. It will also promote enterprise application planning, industry-specific design, implementation, acceptance, and standards for 5G communications, edge computing, AI, image recognition, and autonomous driving at ports. 5G technology can help build world-class ports by driving digital transformation and, in the post-pandemic era, sound the clarion call for economic recovery. [WWW](#)

# AI-accelerated broadband keeps classes running

AI-accelerated broadband for online education is providing powerful support for online learning during the pandemic. Jointly developed by China Unicom Beijing, Huawei, and VIPKID, the multi-purpose connection solution transforms home broadband from a single-purpose service into one that supports three major functions: online education, online office, and entertainment.

By Qin Yang, Deputy General Manager, China Unicom Beijing



“Users are willing to pay for a better experience and the key is finding the best solution so that broadband products can meet the needs of the vast number of users.”

China has fully entered the optical fiber era, with 93 percent of broadband users on fiber connections. In 2019, China's fixed broadband subscribers – some 380 million people, accounting for 84 percent of all Internet users in the country – enjoyed access speeds of over 100 Mbps. Today, fiber broadband has become essential infrastructure in people's lives, as much so as water and electricity.

## Educating past bottlenecks

Online education has increased in popularity in recent years with both parents and students, thanks to convenient teaching methods and high-quality teaching resources. User numbers in China have grown rapidly, hitting 300 million during lockdown.

This has in turn required that home broadband, formally a single-purpose connection service for traditional Internet access and entertainment, transform into a multi-purpose connection service that can support three major functions: online education, online office, and

entertainment.

The popular education scenario of 1080P 1-to-1 online classes requires a broadband network with at least symmetrical uplink and downlink, high stability, and a speed of 35 Mbps.

Even with many subscribers paying for 200 Mbps broadband packages or even higher, 20 percent to 30 percent still experience Internet stuttering and even dropped connections during online classes.

## What's the problem?

After analyzing a large number of users, we found that more than 94 percent access online education services through Wi-Fi. A high number of users experience signal interference from nearby Wi-Fi networks, Bluetooth, and home appliances. In addition, Wi-Fi signals can be severely attenuated when passing through walls, as user residences are complex and diverse in form, causing deterioration in speed and stability and service latency of up to 500 ms or higher.

When factors such as these cause classes to





lag or lead to dropped connections, normal communication between teachers and students is impossible. Blurry images and sound that cuts in and out can result missed content and, in the long-term, declining interest in online classes – a particular worry for parents.

These problems are also a headache for educators. For example, one company, which runs about 200,000 online classes per day, experiences a drop rate of 5 per 1,000 and a "gray class" rate of 19 percent where the lag time exceeds 5 percent of the class time. Complaints and demands for compensation or refunds from parents because of low course satisfaction can result in severe revenue losses for education providers. Unsurprisingly, they're eager to look for solutions to dropping, blurry images, and stuttering.

Like everywhere, education in China is a family priority. A 10-minute interruption in a 25-minute online English class can equate to US\$10 loss for parents, equivalent to one-third of the cost of their whole broadband package. Rather than waste 10 dollars when a connection is dropped, they'd prefer to spend the money on protecting the service experience so that their children can

enjoy uninterrupted lessons.

Users are willing to pay for a better experience and the key is finding the best solution so that broadband products can meet the needs of the vast number of users. This isn't just a practical problem facing China Unicom – it's a new business opportunity.

## Combining business & technology innovation

In April 2019, China Unicom Beijing teamed up with Huawei and VIPKID to develop an eAI-based (embedded AI) smart accelerated broadband solution for online education. They also launched a package that combined 5G, gigabit broadband, premium learning content, and an AI-accelerated modem for online education.

The technology behind eAI smart acceleration for online education is provided by powerful AI capabilities and the OptiXstar gigabit optical modem (or optical network terminal (ONT)). The ONT can rapidly identify online education services and perform targeted acceleration, reducing latency by more than 50 percent

and ensuring a smooth experience for online education.

For end-users, China Unicom's smart accelerated broadband solution for online education has five core values:

- **High-quality, high-end dual gigabit** (5G + gigabit fiber broadband) network services, ensuring high-quality networks for learning.
- **Smart and stable acceleration** based on the OptiXstar ONT for online education.
- **Large eye-friendly screens and HD videos** for an immersive learning experience.
- **A virtual private assistant** for users that quickly and intelligently solves network problems at any time. This is enabled by the WO Home networking service for seamless Wi-Fi coverage from China Unicom.
- **Premium courses** from VIPKID and Dami Online School.

With AI acceleration, China Unicom's high-speed broadband has become the new infrastructure of the smart home. And the addition of VIPKID's premium content allows users to experience high-quality online education anytime, anywhere. Thanks to intelligent O&M, operators can monitor the online education service experience from a range of dimensions without having to step outside.


VIPKID smart acceleration reduces the latency of UHD online classes by more than 50 percent. And when children are in class, parents can still use broadband to watch video and surf the

Internet without worrying about affecting their children's learning.

## Exploring AI service acceleration

China Unicom's introduction of eAI smart accelerated broadband for online education represents a turning point in our broadband services. Transforming from price war into value war supports home network assurance, contributes to the whole-society effort of keeping classes running during the pandemic, and will help the operator easily meet the new requirements of online education in the 4K/VR era of the future.

Smart AI acceleration has also added an extra engine to China Unicom's Smart WO Home strategy for the Internet+ era. In the future, China Unicom will continue to explore more scenarios for AI service acceleration, not only to deliver special experience guarantees for high-value services, such as home office, high-quality 4K video, cloud VR games, and VR cinema, but also to provide private network services for different groups, including business elites, teachers/students, social media influencer marketing, and vloggers.

China Unicom believes in the principles of openness, cooperation, development, and shared success. We will continue to bring together the industry ecosystem, work with upstream and downstream companies, help develop the industry, and drive advancements in home Internet. This will enable the whole industry to take big strides toward the era of gigabit full-fiber and smart acceleration. 

# HUAWEI Mate30 Pro<sup>5G</sup>

CO-ENGINEERED WITH



## 5G Rethink Possibilities

Kirin 990 5G SoC | SuperSensing Cine Camera\*



consumer.huawei.com  
\*SuperSensing Cine Camera = 40MP Wide-Angle Camera + 8MP Telephoto Camera + 3D Depth Sensing Camera.  
HUAWEI Mate 30 = 40MP Wide-Angle Camera + 16MP Ultra-Wide-Angle Camera + 8MP Telephoto Camera.  
\*Product color, shape, interface and functions for reference only. The actual product may vary.  
CEGM199999H21V



# HUAWEI MateBook X

## Light, Artistically.