VIP Voices

Hutchison Drei Austria: Empowering Austria's Digital Future

U Mobile: Making Great Strides in Connecting Malaysia

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Hutchison Drei Austria:
Empowering Austria's Digital Future

Matthias Baldermann, CTO of Drei

Hutchison Drei Austria, a leading telecommunication service provider, plays a pivotal role in Austria's digital journey. Commencing 5G operations in 2019, Drei is now poised to expand 5G coverage into rural areas with its newly acquired 5G spectrum. In an interview with ZTE Technologies, Matthias Baldermann, CTO of Drei, talks about the company's 5G deployment plan, business opportunities enabled by 5G, and the increasingly important role of telecommunication in thepost-COVID-19 time.

In your opinion, which industries will drive the introduction of 5G in Austria?

First and foremost, we—the Austrian network operators—being supported, of course, by the network equipment suppliers. We will not only upgrade to 5G in the existing network nationwide, but also set up additional 5G locations in very rural regions. In this way, 5G will bring super-fast Internet even to very remote regions with none or poor coverage so far. Private households and businesses in rural areas will benefit greatly from 5G, and many are gaining access to fast broadband Internet for the first time. But 5G brings more than just fast Internet. It will above all become an economic driver for many other industries.

Which industries do you have in mind here?

5G improves all dimensions of previous mobile communications by several orders of magnitude. In addition to a much higher-performance and faster broadband (eMBB), it will open up new possibilities for a variety of IoT applications (mMTC): in other words, millions of sensors that contribute to simpler, more cost-effective and more sustainable solutions in all areas of the industry and social life. On the other hand, 5G is the foundation for the so-called mission-critical services—applications that meet the highest requirements in terms of reliability and fastest response times (latency) in order to support real-time computing in extreme situations (uRLLC).

Numerous 5G applications are already emerging. The health/e-health sector, the agricultural sector (smart farming), cities (smart city, for example, real-time traffic control) and, of course, the domestic industry (Industry 4.0, campus networks) will particularly benefit in the future.

What challenges do you think lie ahead before 5G becomes widely available?

We have already taken the first steps. On the one hand, Drei has secured spectrum in all bands important for the development of a future-proof 5G network—in the 3.5 GHz band for urban areas with high traffic volumes, as well as in the recently auctioned spectrum in the 700/1500 MHz bands for the nationwide coverage of rural and tourist regions in best quality.

On the other hand, we have already started our 5G expansion in 2019. The first few hundred 5G locations are in operation.

With the auctioned frequency spectrum in the 700 MHz band, we have also committed ourselves to significantly improve broadband coverage in rural areas and along roads and traffic routes with 5G. In particular, we will provide 5G to 738 rural communities across Austria.

Now we will keep this promise. We will expand our network with great vigor in the coming years and upgrade to 5G nationwide. The planned network investments will be in the high 3-digit million range.

But we also need the right general framework. It is important to shorten the lead time to obtain required building permits and to reduce the rental fees for publicly owned sites.

What strategies will you focus on in developing 5G for business customers?

Our business customers will benefit from 5G in multiple ways. Our entire network will be more efficient, faster and available everywhere. Moreover, 5G brings a portfolio of new characteristics and features specifically designed for the industry, which in combination open up new possibilities. Here are two examples:

Every business customer has very specific needs and individual requirements and use cases. With network slicing—a new functionality within 5G networks—we can provide every business customer with a tailor-made profile for the portfolio of their services and use cases.

Campus networks will gain high significance in the industry as a combination of highly available 5G-based private networks to serve industrial halls and large sites, where vehicles, plant components, sensors and industrial robots can be monitored, tracked and controlled in real time—and all this wireless, flexible, with the highest precision in milliseconds, interference-free and with the highest security standards.

What initiatives have you taken to support the vision of a "Digital Austria"?

We as Drei and jointly with the mobile industry have made it our business to ensure that Austria takes a pioneering role in the expansion of 5G in Europe. This is in the knowledge that a rapid 5G expansion will act as a motor for the Austrian economy and provide important momentum for many innovations. Moreover, our commitment to the rapid 5G expansion in Austria has become an integral part of the 5G frequency spectrum requirements and will be fulfilled in the coming years.

Particularly in this year, at the height of the corona crisis in spring, we were involved in the government initiative "Digital Team Austria" for small and medium-sized enterprises. Together with our technology partner ZTE, we provided 2,000 companies routers and three months of free internet. The campaign specifically helped small businesses to better master constraints and home office situations during the lockdown.

We see that the crisis has brought a boost to digitization for many domestic companies. Many Austrians flexibly worked from home during the lockdown, collaborated in virtual meetings and communicated remotely—and a good portion of this new pattern will certainly be retained in the future. We want to continue to support these companies with our Drei Digitalimpuls initiative and will also maintain to contribute in government initiatives. After all, every Euro invested in the digitization of Austria has a double or triple effect—an investment into the future enabling Austria to become an even more attractive business location and innovation hub.

How do you see the telecommunications industry in the post-COVID-19 time?

Over the entire first half of the year, our customers made 17% more calls than in the previous year. During the first weeks of the lockdown, our customers made almost two thirds more phone calls and used the Internet one third more intensively. Between January and June 2020, our customers used 32% more

data than in the first six months of 2019.

While normality is returning in many areas of life, most new online habits have remained. People in Austria use the phone considerably more, including young people. In addition to the classic voice telephony minutes, telephoning via internet by using collaboration tools such as Zoom or Skype has also increased significantly. In other areas, too, usage was significantly higher than in the same period of the previous year, with social media more than doubled. Use of our Drei TV increased by a third.

Telecommunication has always been important. These days, however, the essential role of powerful, stable and high-quality mobile networks for communication in today's society is becoming all the more apparent— both privately and as a foundation for our economy.

Furthermore, the changes in the work environment that we see today as a reaction to Covid will certainly have a positive effect in the future. We will certainly use more flexible home office and a reasonable share of business trips will be replaced by virtual meetings. A small contribution to the environment—supported by new insights and powerful mobile communications.

For the future, what do you expect from ZTE?

We want to continue to regard ZTE not only as a supplier, but as a partner who is aware that the quality of their equipment and technologies is the basis for the satisfaction of our customers and thus for our success in the Austrian market. We expect that ZTE will continue to develop and provide high-quality, future-proof and innovative network equipment, end devices and functionalities in the future. We wish to continue the close dialogue between our experts who plan, operate and optimize our network with ZTE's R&D teams in the very open and constructive manner we have jointly established and benefited on both sides. **ZTE** **TECHNOLOGIES**

U Mobile: Making Great Strides in Connecting Malaysia

Source: The Star

U Mobile CTO Woon Ooi Yuen

As a strong contender in the Malaysian market, U Mobile is catching up rapidly with aggressive network expansion. U Mobile CTO Woon Ooi Yuen talks about the achievements, the milestones it wants to further achieve under the Jalinan Digital Negara (JENDELA) action plan as well as some of his thoughts about 5G implementation.

What are U Mobile's core strengths and network strategy for a highly competitive market like Malaysia?

Despite being the youngest telco, we have been able to make huge strides in this highly competitive landscape by adopting a challenger mindset.

The progress we have made on the network front especially over the last two to three years is a record in the industry in Malaysia. Today, our 4G sites have grown to over 7200, enabling us to achieve over 80% 4G availability nationwide and over 90% in West Malaysia.

Our progress on the network front has also gained recognition from Opensignal, which awarded us with the Rising Star award at their Global Awards 2020 for being one of the most improved telcos in the world for four metrics—Video Experience, Download Speed, Upload Speed Experience and 4G Availability. We are delighted that our efforts have been so widely recognized.

For any telco, apart from a robust network that is capable of bringing the best experience to our customers, we also need products and services that appeal to the market. Today, we have come to be known as an industry pioneer for various products and services including truly unlimited prepaid and postpaid plans that were the most affordable in the market at that time. We were also the first telco to offer free 1 GB of data per month for prepaid customers and we also enabled postpaid customers to use existing data to roam in foreign countries for free.

What do you foresee to be your biggest challenges for 5G rollout in Malaysia?

Currently, we are working very closely with the Malaysian Communications and Multimedia Commission and the industry on JENDELA, which is Malaysia's national action plan to improve coverage and quality of experience nationwide.

This initiative will see all the telcos collaborate in various ways including maximizing the invested infrastructure to realize JENDELA's aspirations of having 96.9% 4G coverage nationwide, increasing mobile speeds to 35 Mbps and enabling 7.5 million premises to have access to gigabit speed broadband connectivity.

For U Mobile, we also have in place various milestones to meet the aspirations of the blueprint too. For the first phase, which is from now to the end of 2022, customers will enjoy even better 4G coverage as we are targeting to increase 432 U Mobile 4G sites across Malaysia. Our customers will also have their user experience improved expon entially by 2022 as we are upgrading the capacity of more than 4,222 4G sites of our own.

5G is under phase 2 of this JENDELA plan and roll-out is slated to be after 2022. When the roll-out happens, apart

from the cost of building the network that will involve brand new 5G equipment, additional fibre backhaul for site capacity and potentially even new towers to ensure a denser 5G network, we also have to consider the cost of acquiring the 5G spectrum.

Another aspect to consider is the commercial viability of 5G and to ensure that, telcos will need to develop next generation of products and services that are catered for industries such as manufacturing, medical and education to grab the opportunities since retail consumers may not be as willing to pay for the technology upgrades.

Operators are conducting 5G trials. What did you learn from these trials?

U Mobile has partnered with ZTE to conduct various 5G trials in verticals such as medical, tourism and gaming. With the support of ZTE, U Mobile has also been the first telco in Malaysia to enable customers to test 5G outside the confines of a store. All these use cases as we call them are vital in our planning for 5G roll-out.

Through these use cases, my team and I are able to have a better understanding of the relationship between network capabilities, device behaviours and how the 5G technology will influence various verticals in the future.

The insights also enable us to develop a 5G strategy more effectively and accurately, such as identifying collaboration potential with partners from within and outside the telco industry.

Finally, the knowledge also enables us to effectively develop the next generation

of products and services that are suited for this technology upgrade.

Where do you think operators should direct their focus to reap the full benefits of 5G?

5G really presents new opportunities for telcos especially with industry 4.0 revolution. Hence, through use cases, telcos will be able to identify what the new revenue streams are and have a strong foundation for the eventual roll-out. In short, now is the time to experiment, experience and establish what is the best path forward with this much anticipated technology upgrade.

Apart from use cases, telcos should also be in continuous dialogue with various vertical industries, related government agencies and industry related organizations such as GSMA to gain further insights that will help shape 5G strategies.

Which do you think are the most critical 5G use cases?

While consumers will benefit from 5G, businesses are expected to be the greatest beneficiary as businesses evolve towards Industrial Revolution 4.0 where everything is connected, processed and digitized.

Apart from the businesses, I believe that the medical field is set to benefit too. We observed from our medical use case that 5G mobile connectivity will enable patients who ordinarily have no access to a medical consultation of a specialist, as the technology enables doctors to view high-quality and reliable clinical, physiological and diagnostic parameters in real time over a video call.

How is ZTE helping you in developing the network and future strategy? What do you expect for the future?

ZTE has been a long-term partner of U Mobile and we have been working together since our inception. ZTE has seen us through the technological evolution from 3G to 4G and is now paving the way for future 5G. With the support of ZTE, we have been able to future proof with an advanced network that is scalable and also capable of smooth transition.

Throughout our years of working together, ZTE has also provided us with a lot of insights especially on future technology and network roadmap. The information is invaluable as we are able to plan our technology evolution and network plans in a more effective manner.

We hope ZTE will keep up the great work and see us through our next phase of network evolution.

Can you highlight some of the key projects that you are set to embark on in 2021?

First, we are very committed to realizing the aspirations of the JENDELA plan put forth by the government. Apart from adding new 4G network sites, we are also increasing the capacity of our existing 4G sites.

Second, we will be working towards a better understanding of how we may bring an even better experience to our customers.

Third, U Mobile will be conducting more 5G trials. This year we were one of the first telcos to conduct 5G SA roaming with Starhub in Singapore where we managed to achieve download speeds of over 1.3 Gbps and a latency of under 5 ms. We will continue to conduct more of such trials to gain insights.

U Mobile CTO Woon Ooi Yuen (Left) and Steven Ge, CEO of ZTE Malaysia at the launch of Fast Forward with U Mobile 5G live trial in Kuala Lumpur

Finally, this pandemic has shown how important connectivity is. Without it, students are unable to study through e-learning, frontliners for COVID-19 can't communicate and working from home would be challenging for a large number of us. This sudden shift in customer's connectivity usage patterns arising from the movement control orders has caused a lot of strain on our network, resulting in congestion in different areas. The good news is that we managed to quickly upgrade our network despite it being a mammoth task with the restrictions on movements. As a result, we managed to reduce the congestion quickly, and based on the latest Opensignal results, our network experience is actually better than before. Our job now is to ensure this network experience continues to improve. **ZTE TECHNOLOGIES**

An Operator's Road Towards Mid- and Long-Term 5G Development

Ding Guanghe
Wireless Solution Architect, ZTE

With 5G launches starting across the globe in 2019, the road to 5G is becoming clearer. There had been over 80 live commercial 5G networks globally by the end of H1 2020. It can be seen that 5G enables new services such as 4K/8K videos, cloud games, and VR services, and more importantly, expands into vertical industries to facilitate digital transformation and upgrade of many industries. Besides opportunities, 5G also brings new challenges. For operators, how to develop 5G in the future is both a practical issue and a long-term strategy. Leveraging its rich experience in ICT industry and deep understanding of 5G, ZTE proposes to operators an road to their mid- and long-term 5G development, which covers three aspects: network foundation building, industry empowerment and operation transformation.

Road of Building a Cost-Effective Network

To build a 5G network, operators will face great challenges in investment due to larger site scales and higher single-site equipment costs. The coexistence of 2G/3G/4G/5G networks and differentiated 2B and 2C services aggravate the network construction difficulty and O&M complexity. From a mid- and long-term perspective, operators could build a highly cost-effective 5G network by making a top-level network design, high-performance network planning and low TCO network planning.

Top-Level Network Design

5G spectrum planning is the top priority in top-level network design, which needs to consider industry maturity, license price and networking performance. ZTE recommends the strategy of hierarchical networking across low-, mid-, and high-band spectrum (sub-1 GHz+C-band+ mmWave). In terms of network architecture, NSA is the cautious investment choice by some operators in the initial phase of 5G deployments whereas SA is the target network architecture. If conditions are allowed, operators can go straight to SA 5G for TCO savings and faster expansion into vertical industries. The pace of deployment is also important in the top-level network design. Operators can follow a phased approach based on an assessment of the future service requirements to balance between investment control and the need for service expansion.

High-Performance Network Planning

As the most critical technology of 5G, Massive MIMO is a decisive factor in realizing a high-performance network. The performance of Massive MIMO depends on core chips, key components and key algorithms. As the leading vendor, ZTE has put 7 nm chips into commercial use, and will launch 5 nm chips in the coming two years. Key components including power amplifier, filter and antenna are moving towards miniaturization, new materials and new processes. Thanks to innovations in algorithms, some new technologies like automatic antenna pattern control (AAPC), 1+X SSB have become available.

The insufficiency of 5G uplink capability is a common concern in the industry. Both consumer services and industrial applications need higher uplink rates in 5G era. Currently, some technology solutions have been released to address it, for example, ZTE's FDD assisted supper TDD (FAST) that uses time-frequency dual aggregation to improve uplink coverage and data rate.

Dynamic spectrum sharing (DSS) is a focus for operators as it improves spectrum efficiency and enables faster 5G rollouts. The normal DSS solution based on 4G+5G dual-mode can't support 2G or 3G voice services. ZTE's SuperDSS solution realizes 2G+4G+5G or 3G+4G+5G dynamic spectrum sharing.

Low TCO Network Planning

In the 5G era, service scenarios are more diversified and differentiated, and thus serialized products are used for different coverage scenarios to achieve the optimal price/performance ratio. Operators can deploy serialized products targeting dense urban areas, suburban and rural areas, indoor and outdoor hotspots and even special coverage scenarios such as high-speed rail and aviation. Moreover, the coexistence of 2G/3G/4G/5G results in an increasingly complicated site. Operators can simplify sites and reduce installation and operational costs through employing dual-band or tri-band UBR, full-mode BBU, all-in-one cabinet, and A+P antenna system.

For an energy-efficient 5G, it is necessary to continuously optimize chips and key components. AI-based intelligent power saving and comprehensive site energy saving are important solutions as well. Operators also need to introduce an intelligent O&M system to improve processes including network planning, construction, maintenance, optimization and operation.

Road of Empowering Digital Transformation Across Industries

Vertical industry is the most important application scenario of 5G and opens new value propositions to the operator. However, compared with the consumer market, the industry customers are more sensitive to the value rather than the price for a service, and the requirements vary from industry to industry. How to provide high-quality services to attract industry customers, how to select high-value customers, and how to achieve better investment returns in the industrial market are big challenges to the operator.

To provide high-quality services, operators need to build core capabilities for 5G empowerment, which include core network capabilities (MEC, slicing, IOT, and cloud-network integration) and core industry service capabilities (video, V2X, unmanned aerial vehicles, and robots). These two capabilities as general services can be integrated into specific industries to build service systems for digital transformation of specific enterprise customers.

Among the core network capabilities, MEC and slicing are the two most important elements. MEC can be compared to warehouses deployed in communities for fast delivery and reception in the logistics industry whereas slicing choosing different transportation modes based on the importance of customers or goods. The combination of MEC and slicing constitutes a highly-guaranteed "delivery system" for industry applications.

Cloud services are essential in the industry market. However, the public cloud has obvious disadvantages in serving enterprises, especially large and medium-sized ones, such as inflexibility, high redundancy costs, and difficulties in assuring

5G

end-to-end SLA. Therefore, it is recommended that operators build a distributed precision cloud system oriented to industry customers, which precisely focus on industry application scenarios to customize cost-effective solutions for customers in different industries.

In selecting high-value industries and enterprise customers, operators can consider factors such as output value from 5G applications, 5G relevance, an industry's digitization level and appeal for digitization, and 5G application maturity. Manufacturing, energy, transportation, media, healthcare, and public safety are generally considered key industries, which, however, will vary across countries and regions. Meanwhile, operators can develop exemplary 5G applications for leading enterprises since their application cases are more replicable.

Road of Value-Oriented Operation Transformation

With the consumer market reaching saturation in the 4G era, it is difficult to realize significant growth in the 5G era through the traditional pipeline operation and traffic operation. In addition, there are great differences between the consumer and business services, and the existing consumer-oriented business model can't be copied to the vertical market. Operation transformation is inevitable. It is advised that operators make a breakthrough in the existing business models, business boundaries, and organizational capabilities to realize value-oriented operation transformation.

In terms of business models, operators need to

move from the single traffic operation model in the 4G era to multi-dimensional pricing model. For the consumer market, operators can design a multi-dimensional tariff system based on the basic feature packages (traffic+rate+latency), value-added feature packages (connection+cloud service), and content service packages (video, game, and music), enabling user segmentation and service differentiation.

In the vertical application field, it is important for operators to break through the existing business boundary and expand their service scope to both the industry chain and business services. According to their own capabilities and the characteristics of the industry customers, operators can play the roles of connection provider, platform provider, integration service provider and end-to-end service provider respectively while flexibly adopting different business models such as B2B, B2B2C and B2B2B.

Operators also need to change their organizational structures and build capabilities oriented to industrial market, including marketing capabilities, delivery and operation capabilities, and higher-level ecological cultivation capabilities.

Conclusion

Network foundation building, industry empowerment and operation transformation are the essential strategies for 5G development in mid- and long-term. They must be executed together to help operators realize long-term, healthy development. **ZTE TECHNOLOGIES**

Unlocking the Full Potential of Fixed Networks

Wang Xinsheng
Chief Engineer of FM product planning, ZTE

F ixed and mobile networks have always been promoting and affecting each other. The development of one network spurs changes to the other, further accelerating technological innovation and network transformation. As 5G matures, fixed networks have also entered the 5G broadband (5GBB) stage. This kick-starts the era of dual-gigabit speeds based on fixed broadband (FBB) and mobile broadband (MBB).

FBB to Meet 5G Challenges

Compared with 4G, 5G enables over 100x faster speeds, seamless connection and handover of a massive number of terminals, and a significantly lower latency (1ms). This imposes high requirements on the capability of a network, which can also be extended to FBB networks. FBB networks need to utilize their inherent advantages to provide higher bandwidth, better QoS and greater reliability. The rise of 5G forces FBB networks to change and innovate (e.g., providing ultra-high bandwidth and connecting low-latency services).

Upgrading to 10G-PON

With the single-service operation model losing steam, many legacy operators are making strategic transformations. Some multi-service operators replace their cable networks with FTTH infrastructure. As latecomers to the game, alternative operators entice customers through innovations.

10G-PON is a powerful tool for operators to attract users. China accounts for more than 70% of the global FTTH market. When large-scale 10G-PON deployment starts in China, the 10G-PON industry chain will be fast improved to offers lower costs, which will in turn drive the 10G-PON deployment worldwide and stimulate the broadband development.

It is expected that the next five years will be the golden period for 10G-PON deployment. Due to the need for constant network upgrades in the future, equipment should be made flexible, for example, one card supports two generations of technologies, or one platform evolution within three technology

generations. This reuses the existing network resources and lowers the cost of upgrades such as from GPON to 10G-PON.

Introducing IT Capabilities into CT Devices

As video becomes a basic broadband service, user attention shifts from bandwidth to experience. To create an efficient and smooth user experience, higher bandwidth, less jitter and smaller packet loss are required, and operators need to find differentiated means while making the most of their legacy network resources. Building IT functions into CT devices is an industry trend, which allows a network to have higher utilization ratio, more powerful functions, and easier scalability, and also allows operators to increase user stickiness and get a competitive edge over OTT players.

ZTE's Innovations in FBB

To achieve the above purposes, FBB networks need to be innovated to adapt to the evolving market situation and the changing application scenarios. ZTE has made a lot of exploration in FBB to improve service/network competitiveness.

10G-PON

Based on a deep understanding of the

FTTx field, ZTE made 10G-PON a development priority for the next 10 years as early as 2012. It has since made many innovations in solutions and products centered on 10G PON and implemented many network deployments and evolutions (Fig. 1).

In 2016, ZTE launched the innovative Combo PON solution to enable large-scale, cost effective deployment of 10G-PON networks. One Combo PON port supports both GPON and XG(S)-PON access, thus allowing a smooth upgrade of bandwidth. At the user side, different optical network units (ONUs) can be deployed on demand, where they can form part of a mesh Wi-Fi network to deliver seamless whole-home gigabit coverage and enhance user experience. In this way, the existing GPON services will not be affected and there is no need to modify the existing optical distribution network (ODN).

More than 30 operators around the world have collaborated with ZTE to test, trial and deploy the Combo PON solution. It has already become a preferred solution for operators to build 10G-PON networks.

Fixed-Mobile Convergence

The construction of a 5G network demands a large amount of optical fibers and supporting facilities, which incurs substantial initial investments. In a residential compound

Fig. 1. Innovations ZTE has made in the field of 10G PON.

Industry's first
10G-PON OLT
(ZXA10 C300)

Industry's first
commercial 10G-EPON trial

Industry's first
NG-PON2-oriented
TWDM-PON prototype
based on 10G-PON

Industry's first
XG-PON solution
for commercial use

First to introduce
the Combo PON
concept and solution

TITAN flagship
optical access platform for
cross-generation evolution

Industry's first
16-port three-rate
Combo PON solution

or office building where FTTH has already been deployed, the equipment room is restricted in space, making it unable to house additional stand-alone devices. There are also other challenges such as pipe laying, which requires the consent of the property owners, worries about the radiation risk posed by the base station, long construction periods and uncontrollable progress. If the FTTH resources including devices, fibers, pipes, equipment rooms and street cabinets can be reused, the 5G network can be built faster at a lower cost.

To reuse fixed network resources and accelerate 5G deployment, ZTE introduced the innovative Combo PON Plus solution based on Combo PON. In the solution, Combo PON Plus cards are inserted into idle slots of OLT, and one Combo PON Plus port carries five wavelength channels via one fiber. There is no need to change existing ODN. Active antenna units (AAUs) or GPON/10G-PON ONUs are deployed at the user side as needed to simultaneously provide FTTx and 5G service access over one fiber.

To exploit the full potential of copper infrastructure, ZTE also released a copper-based enhanced fixed wireless access (FWA) solution targeting at multi-story buildings. It utilizes G.fast technology and in-building copper resources to route 5G signals into homes in a low-cost, stable and reliable fashion.

IT-CT Integration

Some real-time services like online video, online gaming and interactive online teaching require very low latency and small packet loss. In an end-to-end network, there are usually several layers of equipment and bandwidth convergence occurs at every layer, leading to increased latency, uncontrollable jitters and bandwidth bottlenecks. It has become a trend to deploy computing capabilities closer to end users, which minimizes the uplink bandwidth bottlenecks and also meets the requirements of experience-sensitive services such as video.

Moving computing capabilities closer to end users means placing additional devices in the equipment room. This brings more pressure on power supply, heat dissipation and space provision. One workaround for this problem is to add computing capabilities to an existing device such as a PON OLT in the access office closest to end users, which addresses issues such as space occupation, temperature control, improves the resource utilization of the existing PON OLT, and significantly cuts the load on the upper-layer networks.

ZTE innovatively embeds 300 mm deep blade servers in a PON OLT to bring services closer to users, creating a better experience for services such as HDTV, 4K/8K video. For instance, some heavily sought-after video resources can be deployed in the built-in blade servers to reduce the latency and packet loss.

OLT Platform

Platform innovation is the basis of product and solution innovation. The capabilities of a platform determine its technical scalability and expandability. Making continuous efforts in platform innovation, ZTE has launched the ZXA10 C300, the only OLT in the industry that fully supports 10G-PON access in the past decade, and the TITAN, the industry's most powerful optical access platform that is based on a router architecture and fully-distributed forwarding.

Innovation opens up new business opportunities and helps generate new revenue streams. As a technology leader in the FBB field, ZTE has been driving the industry forward with innovations and will tap the full potential of fixed networks in the 5G era. ZTE TECHNOLOGIES

5G E2E Network Planning in the Mid- and Long-Term

Ding Guanghe

Wireless Solution
Architect, ZTE

Building a solid network foundation is a strategy for operators' mid- and long-term 5G development and also one of their traditional strategic directions. Most operators have gone through the network planning and construction from 2G to 4G. Given the more complex networks and more stringent service requirements in the 5G era, the mid- and long-term network planning will be more challenging. With its long-term experience and E2E product delivery capability, ZTE provides a top-level network design and E2E network planning to help operators build a highly cost-effective 5G network.

Starting with a Top-Level Design

Before planning a network, operators first need to define their mid- and long-term vision and goals, including market share, user scale, revenue, and cash flow, as well as their key strategies, for instance, being the first to launch commercial 5G services to preempt high-end users, maximizing the value of the existing networks, and using TCO to increase the operating income. Under the guidance of these strategic goals, operators can make the top-level network design from three aspects: spectrum, architecture, and deployment pace.

- **Spectrum strategy:** Spectrum is the primary consideration in a top-level design. In 5G spectrum planning, industry maturity, spectrum fees, and network performance need to be considered. 3.5 GHz is the mainstream 5G spectrum as it provides a larger capacity with wider bandwidth in most countries. Despite its high licensing fees, it is still the first choice for most operators. Compared with 3.5 GHz, 2.6 GHz is more advantageous in coverage and would be a good choice if sufficient bandwidth can be obtained. In the mid- and long-term, operators need to use a mix of low-band, mid-band, and high-band spectrum to achieve low-cost coverage of the 5G network.
- **Network architecture strategy:** NSA is the initial 5G deployment choice while SA is the ultimate goal. Operators need to make a reasonable choice based on their mid- and long-term development goals. Those with enough investments can select SA at the beginning of 5G deployment since SA reduces the TCO over the mid- and long-term and supports the fast integration of 5G into the vertical industry market. Those who start from the NSA and transition to the SA in the future can consider smooth evolution solutions, such as a converged core network and NSA/SA dual-mode BTS, to avoid or reduce repeated investments and lower the engineering difficulties.
- **Deployment pace:** A demand-driven approach is critical in network deployment. The initial stage of 5G deployment focuses on eMBB services dominated by big video. During this period, a large number of users still stick to 4G with the average traffic per user increased continuously, thus making 4G enhancement still a priority. 5G can be started out in dense urban areas of select cities. In the 5G growth phase, the sub-6 GHz 5G service is gradually extended to most of the cities, towns and suburbs around the country,

and a large number of users migrate to the 5G network. Meanwhile, portions of the 4G FDD spectrum can be refarmed to 5G, making up the 5G coverage layer. In the 5G maturity phase, the sub-6 GHz network covers all towns with the use of small cells and mmWave for in-depth coverage in urban areas.

Wireless Access Network Planning

In wireless access network planning, a deep analysis of the existing network is important in that operators can identify high-value areas, which helps them plan and deploy an enhanced 4G network and precisely address hotspot areas in the early 5G stage, and a reuse of the existing site resources is crucial for accelerating 5G deployment and reducing 5G deployment costs. Based on the analysis of the existing network, the mid- and long-term wireless network planning focuses on full-scenario equipment selection, KPI planning, and key technology applications.

- **Full-scene wireless network planning and model selection:** First, match different coverage scenarios with the most suitable products to improve the cost-performance ratio and then deploy them in phases. For example, in the early stage, 3.5G@64TR AAU is used for general urban coverage and the 32TR solution for expanding coverage into the suburban areas. In the middle and later stages, small cells are used to secure coverage for indoor hotspots and low-cost differentiated equipment for special scenarios such as local hotspots, blind spots, high-speed railway and tunnels.
- **Service KPI planning:** 5G coverage is limited in the uplink, and thus

defining the cell-edge uplink rate is key to determining the site density. Setting a reasonable cell-edge uplink rate meets user experience expectations and also controls the network construction scale. Based on an analysis of the resolutions for smartphone front cameras, the cell-edge uplink rate can be set at 1 Mbps to 2 Mbps for 5G in its initial phase. With the increasingly high service requirements, terminal capabilities, and deepening 5G coverage, the cell-edge uplink rate can be increased to about 10 Mbps in urban areas.

- **Planning and application of key technologies:** Some key technologies are needed in wireless network planning to improve network performance, for example, FDD assisted super TDD (FAST) for enhanced uplink capability, the dynamic spectrum sharing solution SuperDSS, AI-based automatic antenna pattern control (AAPC) and 1+X SSB.

Core Network Planning

The core network needs to be planned from a long-term perspective by taking into account both the current service requirements and the future capability evolution. Therefore, the converged architecture Common Core is deployed at the very beginning, and functions as vEPC in the NSA phase, EPC + 5GC in the NSA+SA hybrid networking phase, enabling smooth evolution. Both software and hardware can be reused to help reduce costs and the impact on user experience. Core network planning and deployment focuses on such aspects as multi-level DCs, 4G and 5G interoperability, voice services, user data platform, policy

platform, network orchestration and management platform. The planning for multi-level DCs is discussed here.

Planning and deploying multi-level DCs is to meet the low-latency and large-bandwidth requirements posed by 5G services. Generally, two to three levels of DCs are planned for 5G networks, including central, regional and edge DCs. The private network UPF and MEC for vertical industry applications are deployed in the edge DC, the public network UPF and the control-plane NEs for vertical industries in the regional DC, and other control-plane NEs, user data platforms, and IMS in the central DC. Multi-level DCs are deployed in phases and on demand. The central DCs are deployed first, and then regional DC, with edge DCs deployed on demand.

Transmission Network Planning

Transmission networks are moving towards high bandwidth, low latency, high-precision synchronization, automation and intelligence. Microwave has been the primary backhaul technology for 2G/3G/4G in most countries. At present, 5G microwave can deliver a throughput of over 10 Gbps, meeting the transmission requirements of most 5G sites. Therefore, transmission network planning needs to take into account both the microwave transmission and the optical fiber transmission for the optimal network construction cost. The increasing use of fiber in wireless access networks and OTN downshifting are also general trends. Considering the requirements for 5G transmission bandwidth, it is recommended to build a 50 Gbps or 100 Gbps platform in the access ring, a 200 Gbps/400 Gbps platform in the aggregation ring, and provide Tbps-level capacity for the
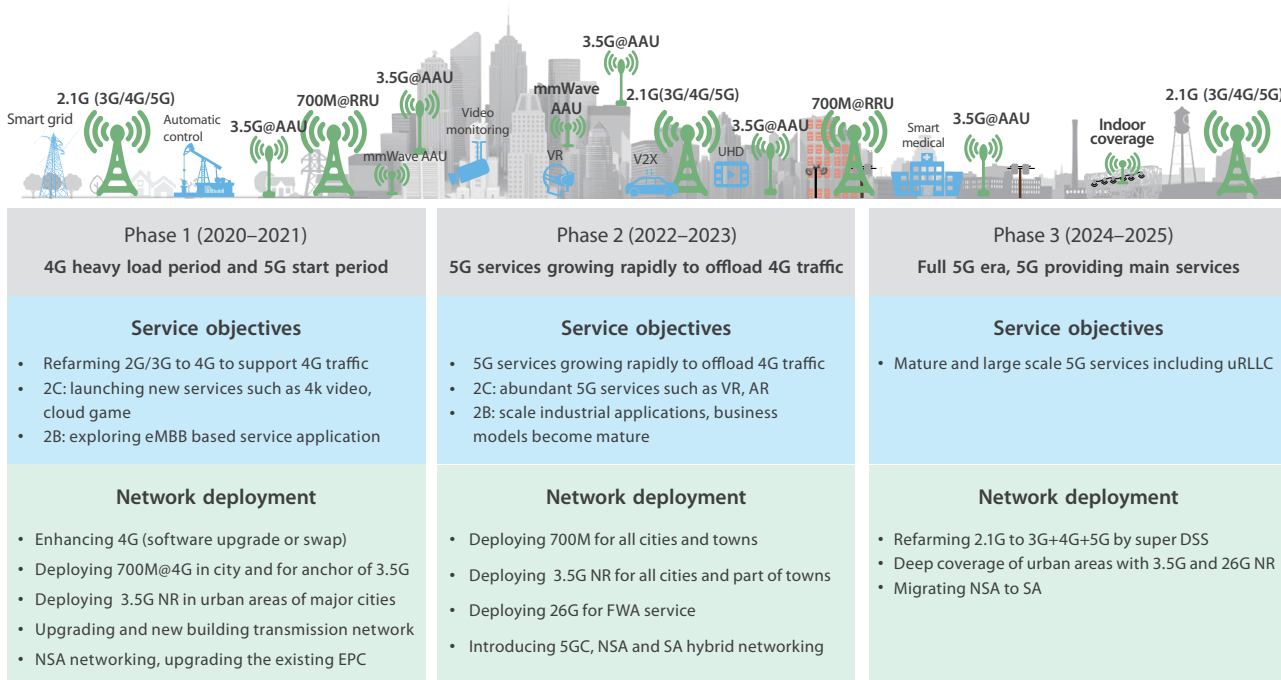
Phase 1 (2020–2021)	Phase 2 (2022–2023)	Phase 3 (2024–2025)
4G heavy load period and 5G start period	**5G services growing rapidly to offload 4G traffic**	**Full 5G era, 5G providing main services**
Service objectives	**Service objectives**	**Service objectives**
• Refarming 2G/3G to 4G to support 4G traffic • 2C: launching new services such as 4k video, cloud game • 2B: exploring eMBB based service application	• 5G services growing rapidly to offload 4G traffic • 2C: abundant 5G services such as VR, AR • 2B: scale industrial applications, business models become mature	• Mature and large scale 5G services including uRLLC
Network deployment	**Network deployment**	**Network deployment**
• Enhancing 4G (software upgrade or swap) • Deploying 700M@4G in city and for anchor of 3.5G • Deploying 3.5G NR in urban areas of major cities • Upgrading and new building transmission network • NSA networking, upgrading the existing EPC	• Deploying 700M for all cities and towns • Deploying 3.5G NR for all cities and part of towns • Deploying 26G for FWA service • Introducing 5GC, NSA and SA hybrid networking	• Refarming 2.1G to 3G+4G+5G by super DSS • Deep coverage of urban areas with 3.5G and 26G NR • Migrating NSA to SA

Fig. 1. A mid- and long-term 5G E2E network planning for an operator in Southeast Asia.

backbone network. In addition to capacity, new technologies need to be gradually introduced to fully meet 5G service requirements, including FlexE, SRv6, SDN, high-precision synchronization and TSN. Meanwhile, if the existing equipment can be upgraded to meet the 5G requirements, reuse it as much as possible; if not, replace it or build a dual-plane transport network to carry 4G and 5G services respectively.

A Planning Case

ZTE has made a mid- and long-term 5G E2E network planning for an operator in Southeast Asia (Fig. 1). In this plan, 3.5 GHz is used as the primary 5G coverage layer, 700 MHz+2.1 GHz as the bottom layer for extensive coverage, 26 GHz for FWA and high-demand hotspots. The first phase of 5G network is NSA, followed by NSA+SA hybrid networking, and a migration to SA. In the first stage of network deployment, to realize a low-cost, fast 5G commercial deployment, 3.5G@64TR AAUs are co-located with 1.8 GHz sites in the proportion of 1:1, and 4G services are deployed on the newly acquired 700 MHz spectrum. In the second stage, the 3.5G@32TR network covers most suburban areas and towns, and new 5G sites are built to ensure a cell-edge uplink rate of 2-5 Mbps. Also at this stage, 26 GHz is used for FWA, and additional 700 MHz sites are deployed for capacity expansion with some sites re-farmed to 5G. In the third stage, the 3.5 GHz network is further expanded with the use of small cells for deep 5G coverage, and 2.1 GHz is used to provide 3G voice, 4G data and 5G URLLC services through dynamic spectrum sharing.

Conclusion

To plan an end-to-end 5G network over the mid- and long-term, operators can adopt a top-down approach, with a focus on a top-level design and coordinated planning between RAN, core network and transmission network, building a solid foundation for 5G development. **ZTE TECHNOLOGIES**

ROI Analysis Essential for Medium and Long Term 5G Planning

Qi Xiaohong

Director of Wireless
Solutions, ZTE

How its rationality is evaluated when the medium and long term 5G planning for an operator is accomplished. The analysis of financial return on investment (ROI) is an important means to test its rationality, and it can also further modify the mid- and long-term 5G planning. The following is a brief introduction to ROI analysis of medium and long term 5G planning designed by ZTE, including basic modeling ideas, data prediction and acquisition, and the application value of ROI analysis results. Finally, this article shares a ROI analysis case of medium and long term 5G planning for an operator.

Building a ROI Analysis Model for Medium and Long Term 5G Planning

In a ROI analysis model for medium and long term 5G planning built by ZTE (Fig. 1), the revenue of operators in the 5G era comes from 2C and 2B, while the proportion of 2B revenue in the 2G/3G/4G era is negligible. CAPEX includes investment in network construction (including equipment and engineering) as well as license cost. OPEX involves network-related operation and maintenance (O&M) costs, and non-network-related marketing costs, general and administrative (G&A) expenses and other expenses such as international

gateway fees and financial expenses, which are often listed in the operators' annual report.

Key Data Acquisition and Prediction

In ROI analysis, data acquisition and prediction are fundamental. Some data comes from the direct output of network planning, some from basic database, and some needs to be obtained through reasonable forecast tools.

The network size is output through E2E network planning. Through network planning tools, new 5G link budget, and service KPI settings, the number of wireless sites deployed at each stage can be generated. For core network planning, the capacity configuration of each network element is generally based on user and service forecasts, combined with the average rates of users and services. The transport network is planned according to the scale of wireless sites, which involves existing site expansion and new site construction.

It is quite important to estimate the cost for a single site, so a typical site model is established in network planning. Through the site model, the number of devices configured at each site and the engineering work can be clearly known, so both equipment and engineering expense of a single site can be calculated.

Some key data such as the number of users,

ARPU value, and vertical industry income, are recommended to be forecasted by an intelligent big data platform.

Application Value of ROI Analysis

The main purpose of ROI analysis is not only to understand the medium and long term return on investment, but also to guide us to carry out targeted strategies for future 5G network and business planning.

First of all, it is necessary to make a CAPEX analysis. According to the ROI analysis of the medium and long term 5G planning of some operators, the investment in RAN accounts for 70–80% of total network CAPEX, in bearer network (BN) about 15%, and in core network (CN) about 5%. Therefore, in terms of cost control, it is critical to reduce TCO of wireless network. The first major strategy to reduce investment in wireless network is to control the number of sites. The main schemes include reasonable spectrum planning, reasonable coverage planning, and reasonable setting of performance indicators, especially the uplink edge rate. Reducing the cost of a single site is also quite important. The extreme simplified site solution is the trend of 5G planning.

The second is OPEX analysis. By the OPEX analysis, we find that network O&M cost, marketing cost and administrative expense account for the same proportion, which constitute the vast majority of OPEX. From the perspective of equipment suppliers, we usually give strategic suggestions on network O&M cost. By further analysis, it is illustrated that electricity cost, site rental cost and network maintenance cost are three major ones, so the solution is reducing energy consumption, simplifying the site, and intelligent O&M.
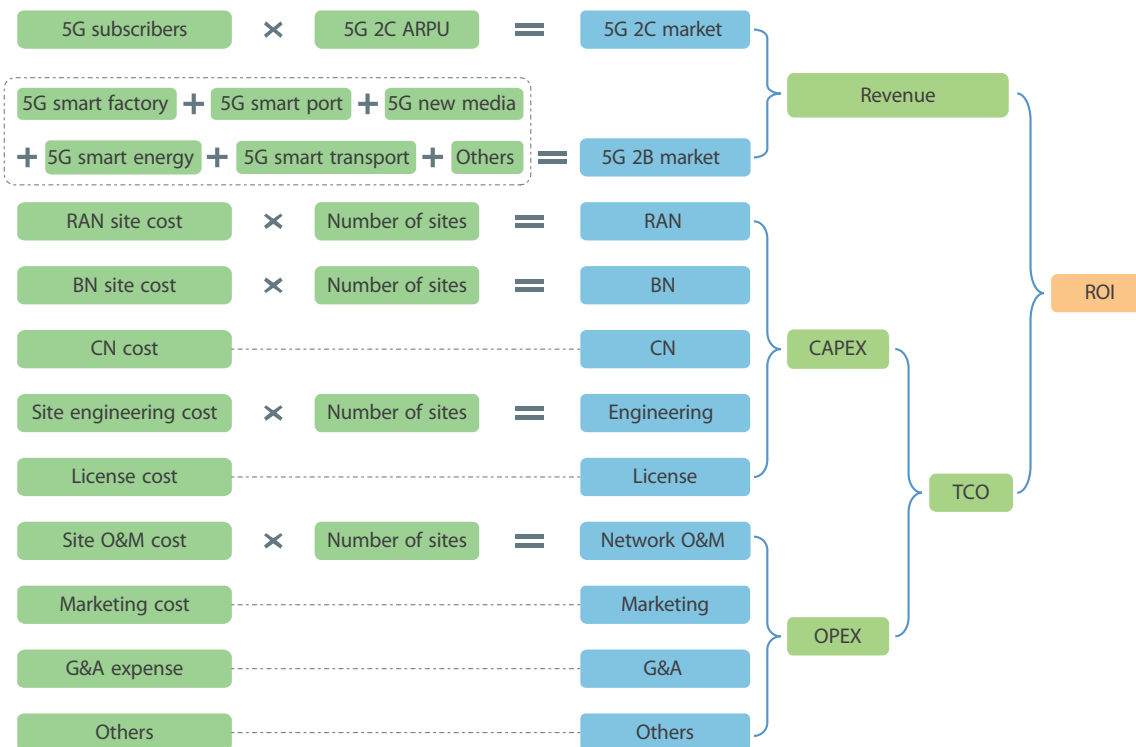

◄ Fig. 1. ROI analysis model for medium and long term 5G planning.

The last part is the analysis of key financial indices, especially focusing on cash flow trends. Due to the large investment in 5G, few individual users in the early stage and the difficulty of industry applications to produce economies of scale, the pressure on cash flow is very high. Operators need to reserve enough funds to deal with it, including using 4G business revenue to feed 5G. If the operators' own financial strength is weak, they need to broaden financing channels or adopt innovative business models in cooperation with suppliers. In the analysis of ROI financial indicators, there are several key indicators to evaluate the rationality of 5G investment.

- Earnings before interest, taxes, depreciation and amortization (EBITDA) above 40% is relatively healthy margin for the telecom industry.
- Net present value (NPV) is the difference between the present value of future capital inflows (income) and the present value of future capital outflows. An investment with a positive NPV will be profitable, while an investment with a negative NPV will result in a net loss.
- Internal rate of return (IRR) refers to a metric used in financial analysis to estimate the profitability of potential investments. IRR is generally higher than the loan interest rate of a local bank.

Case Study

The following is a case study of ROI analysis of the medium and long term (2020-2025) 5G planning for an operator in Southeast Asia, which is analyzed from three aspects.

- **Revenue:** The operator's 5G revenue comes from individual mobile business, FWA and vertical industries. According to the six-year forecast, the revenue from individual mobile business still accounts for more than 80% of total revenue, while 2B income is relatively low in the first three years and will gradually grow to over 20% after the fifth year. It can be predicted that 2B income will account for over one third of the total revenue in the long run. However, the revenue forecast of 2B industries is more uncertain than that of 2C business, which largely depends on the country's macroeconomic development and the operator's strategy.
- **CAPEX:** The operator's existing transmission devices are obsolete and have been put into use for a long time, most of which need to be replaced, so the investment in transmission is relatively high. As for the wireless network, reasonable KPIs are recommended to control the site size and a large number of co-site construction and infrastructure are shared, so the investment in wireless network can be well controlled, accounting for slightly over 70% of the total.
- **Financial indicators:** From the perspective of 5G ROI alone, the pressure of cash flow is relatively high within six years. Cash flow does not turn positive until the fourth year, nor cumulative cash flow positive until the fifth year. However, the revenue from 4G business remains stable and can supplement 5G cash flow. The IRR of this project reaches 16%, and the static return cycle of 5G investment is 5.1 years, with a good overall evaluation.

Conclusion

ROI analysis is indispensable for medium and long term 5G planning. A good ROI analysis must come from professional model building, comprehensive data collection, and scientific prediction and evaluation, and can help operators adjust their business development strategies and optimize their medium- and long-term network planning. ZTE TECHNOLOGIES

Innovation in Business Model to Explore 5G 2B Applications

Enabling the Internet of Everything (IoE), 5G brings infinite imagination to the society. With the help of new technologies such as big data, artificial intelligence (AI), cloud platform and edge computing, 5G has attracted the attention of the whole society. Mobile operators are actively exploring new 5G business opportunities, and 5G applications for vertical industries are a vast blue ocean business for them. According to GSMA, 5G will contribute $2.2 trillion to the global economy from 2019 to 2034, accounting for 5.3% of GDP growth. And Gartner predicts that 5G will bring $619 billion to global operators in vertical industries in 2026, accounting for 36% of their operating revenue.

Exploration of 5G Industry Applications and Business Model

In the early stage of 5G development, some leading operators have started to explore 5G industry applications. Vodafone and Deutsche Telekom have launched applications such as medical services, remote control and video surveillance in Europe, SKT and KT have carried out automatic driving, smart factory and smart grid in South Korea, and China's three major operators have explored more extensive applications in many industries. Based on ZTE's experience, 5G vertical industry exploration needs to focus on

industry selection, business positioning, service framework and solutions, and profit models.

Select Industries Through Multi-Dimensional Evaluation

Selecting the target industry and appropriate application scenarios is the first step for operators to expand the industry market. The China Academy of Information and Communications Technology (CAICT) has proposed five key factors for industry selection: profitability, digitization, rigid demand for 5G, competitive risks, and competitive opportunities. China Telecom has also put forward the PRMCC+A model: Policy, Reform, Market, Customer, Case and Advantage. Furthermore, the selection of target application scenarios chiefly consider the dependence on 5G and the ability to support 5G.

Determine Business Positioning of Operators in Industry Applications

Four basic value positioning are suggested for operators according to their involvement after fully considering their own capabilities, industrial market size, dependence of the industry on 5G, and industrial digitalization level.

- **Connection providers:** Provide 5G end-to-end network connection
- **Platform providers:** Provide MEC basic platform and industry PaaS platform for third parties

Tang Hong

Wireless Solution
Architect, ZTE

- **Service integrators:** Provide end-to-end industry applications integration and have a deep understanding of the industry
- **Service providers:** Provide end-to-end services for industry customers and have deep involvement in the industry as industry experts.

In these four value positioning, connection providers are operators' basic capability, platform providers are their extensible scope, and service integrators and providers can serve as directions they can attempt in the mature stage of their industry businesses.

Provide Service Framework and Solutions for 5G Industry Applications

According to the four value positioning, operators can provide corresponding platform solutions and private network solutions. The platform solutions provide services and service support capabilities for industry customers. According to different value positioning, operators provide the platforms at different levels including IaaS, PaaS and SaaS. The private network solutions guarantee different 5G capability needs of industry customers, including 5G private line, 5G virtual private network, 5G hybrid private network and 5G physical private network.

Innovate the Pricing and Profit Model to Achieve Business Returns

For 5G 2B industry applications, the pricing of products and services is also a main research direction of operators' business model. Unlike 4G 2C traffic-based pricing models, 5G pricing model is more complex. Corresponding to the four value positioning, 5G 2B value-based pricing model is adopted, with the connection as the basic quotation package, and the platforms, services and operations as value-added services. In the basic connection quotation package, differentiated quotations can also be made in accordance with the type of 5G private network and the traffic of industry users.

Case Study of 5G Industry Application Planning

5G industry application practice is the only way for operators to explore 2B market. Only by exploring, practicing, and innovating with industry partners can operators find their own business opportunities in the 2B industry. The following shows key industries of a 5G 2B application planning made by ZTE for an operator in the Asia-Pacific region (Fig. 1). Industrial manufacturing, power grid and ports are the first priority followed by new media, public safety, transportation, medical

	Five key factors					PRMCC + A						Suggestion
	Profitability	Digitalization	Rigid demand for 5G	Competitive risks	Competitive opportunities	Policy	Reform	Market	Customer	Case	Advantage	
Manufacturing	*****	*****	*****	****	*****	*****	*****	*****	*****	*****	*****	★★★★★
Power grid	*****	*****	*****	***	****	*****	*****	*****	*****	****	****	★★★★★
Ports	*****	*****	*****	****	****	*****	*****	*****	*****	****	****	★★★★★
Media	****	****	****	****	****	****	****	***	***	****	*****	★★★★
Transportation	*****	****	****	***	***	****	****	*****	***	****	****	★★★★
Public security	***	***	****	****	***	*****	***	****	***	*****	****	★★★
Medical care	***	***	***	***	***	***	***	***	***	***	***	★★★
Agriculture	**	**	**	**	**	**	*	**	*	**	**	★★

Fig. 1. 5G industry selection for an operator in the Asia-Pacific region.

care and agriculture. Described below are service planning and business models of the three major industries with the first priority.

- **Smart factory:** Manufacturing is the most important pillar industry in the national economy and plays an important role in electronics, automobile, and chemical industry. Digital transformation will greatly boost the development of manufacturing in this country. The 5G application planning in the smart factory can focus on environment monitoring, high-definition video surveillance, industrial camera, AR/VR-assisted guidance, and logistics tracking in the initial term, on cloud AGV, automatic control and automatic driving in the medium term, and on accurate operation and flexible production in the long term. The operator can be positioned as a connection provider or platform provider, and can also be considered as an integrator in mature areas such as video-assisted production monitoring. In terms of private network, 5G private lines, virtual private networks or hybrid private networks can be selected to meet different needs. The operator can charge based on its value positioning and the type of 5G private network it provides.

- **Smart grid:** The power grid is a national livelihood project and also a complex large-scale network involving power plants, power grids and a large number of consumer terminals. The 5G application planning in the smart grid can focus on intelligent drone/robot inspection, VR/AR remote maintenance and training, HD video monitoring, asset management and meter management in the initial term, on electrical load response, precise load control, intelligent distributed power distribution, differential protection of distribution networks, PMU and remote precise control and scheduling in the medium term, and on smart home and electrical appliance control, electricity monitoring and power saving system, and fire monitoring and alarm of home appliances in the long term. The operator can be positioned as a connection provider or platform provider, and it is

recommended to provide guaranteed connections as its target value positioning. In terms of private network, it is recommended to choose a 5G hybrid private network to ensure that the network data meets the strict security needs of grid customers. The operator can charge based on the hybrid private network mode.

- **Smart port:** Port is a relatively closed geographical area compared with other industries. For the operator's early 5G 2B exploration, it can reduce interference to the public network. The 5G application planning in the smart port can focus on HD video monitoring, data collection, logistics tracking, customs inspection and real-time analysis in the initial term, on remote heavy truck driving and remote quay crane control in the medium term, and on automatic driving, automatic inspection and other innovative applications in the industry park in the long term. The operator can be positioned as a connection provider or platform provider, and it is recommended to serve as a platform provider considering that port applications are relatively mature. In terms of private network, 5G hybrid private networks and physical private networks can be selected. For a large port area that is relatively closed and has data security requirements, it is recommended to build a separate physical private network. The operator can charge based on the hybrid private network or physical private network as well as platform services it provides.

Conclusion

The above 5G 2B planning and suggestions given for the operator need further network deployment and commercial practice. At present, Chinese operators have been in the forefront of the world in the exploration of 5G industry applications, and some 5G industries are gradually put into commercial use. ZTE is poised to develop the 5G 2B market with global operators and hopes to share China's successful experience with them. **ZTE TECHNOLOGIES**

Intelligent Big Data: Creating Reasonably Accurate Forecasts for Business Development

Qi Xiaohong

Director of Wireless
Solutions, ZTE

Forecast, as an activity of human cognition, has existed since ancient times. Specifically, it refers to scientific speculation on possible trends and levels of things in the future by using various qualitative and quantitative analysis methods according to the objective process and laws of the past development and changes of things, and the current movement and changes of things. The forecast falls into three types: economic forecast, technical forecast and demand forecast. In time dimension, it can be divided into short-term forecast, medium-term forecast and long-term forecast. From the perspective of forecasting method, it can be divided into qualitative forecast and quantitative forecast. Qualitative forecast belongs to subjective judgment that is based on estimation and evaluation. Quantitative forecast is a method that can be used to predict the future in historical data related to the past on the basis of setting. Historical data may contain factors such as trends, seasons, and cycles.

The advent of the 5G era marks the beginning of a new digital era. The accelerated development of science and technology has brought an endless stream of new things, and there are more uncertainties in the future than in the past. Therefore, it is more important to make a good rolling plan of the business. Data analysis and business forecast are the basis of rolling planning. According to historical data and experience, future business development can be predicted and a quantitative analysis can be provided. The new intelligent big data platform facilitates fast learning iterations in massive data and timely correcting forecast data to improve accuracy. This provides effective data support for operators' strategic development.

The global large-scale 5G deployment is planned for 2020, but the outbreak of Covid-19 has caused great difficulties to global social and economic development and disrupted the existing rhythm for the telecom industry. According to authorities, the number of wireless users worldwide will reach 8.72 billion by 2025, a decrease of 99 million compared with previous forecasts. From 2019 to 2025, the investment curve of 5G will be smoother than that of 4G, and the investment schedule will also be delayed. The first reason is that the revenue growth of 5G is slow, with a compound growth rate of 1.3% during this period, which is lower than the 2% compound growth rate of 4G revenue in the period from 2011 to 2019. Secondly, the high cost of 5G network infrastructure also restricts operators' enthusiasm for investment.

The above is a macro analysis of the telecom field. In specific areas and markets,

how can we make a good forecast to provide strategic support for business development of operators.

Operators accumulate massive data in their daily operation, including operation data, business data, network data, user data and other basic data. In the 5G era, new services emerge one after another, and there are more uncertainties in the future.

In these uncertainties, how can operators forecast and plan future business, develop valuable users, do a good job in daily operation management, and improve their return of investment? It is known that the core value of big data lies in forecast and the core of enterprise operation is to make correct judgments based on the forecast. Big data forecast is based on big data and the forecast model to forecast the probability of something in the future. The biggest difference between big data and traditional data analysis is to shift the analysis from being oriented to the past that has happened to the future that is about to happen. Based on these massive big data, using new artificial intelligence technologies, operators connect existing business domains, management domains and operation domains to build a unified intelligent digital platform for value-centric operation (Fig. 1). With the intelligent big data platform, they can improve their operation level and provide timely and accurate forecast capability for future business development. The gold value of big data is thus highlighted.

Intelligent big data platform can provide tightly coupled AI capabilities such as data analysis, scene recognition, model design training, model/algorithm library, reuse annotation management, and monitoring services. Through the business sharing, the service platform builds a core business center, shares service capabilities of business units, and provides rapid business combination. It achieves accurate forecast of business, capacity, coverage, and revenue, providing strong support for precision marketing of operators.

In practical applications, based on business and user data analysis, accurate user insight is first achieved by abstracting the tagged user model from information such as user social attributes, living habits and consumption behavior. Upon the user insight, users are then classified. Through the user insight and classification, different types of users can be
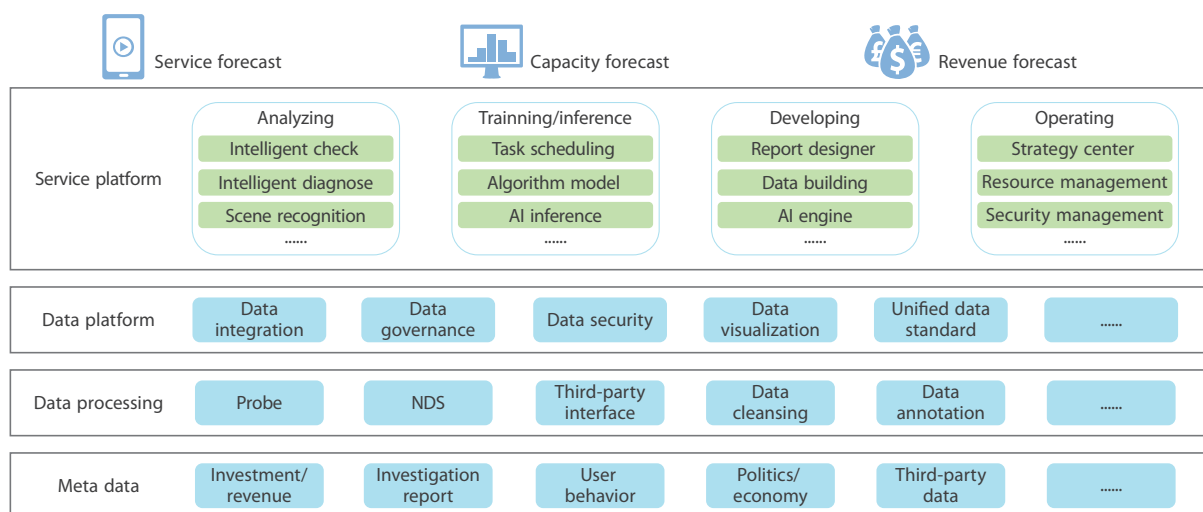
Fig. 1. A unified intelligent digital platform for value-centric operation.

clearly and accurately located. The training model is used to make accurate user forecast, recommend appropriate products, track customer feedback, and complete business closed-loop optimization.

There is a use case to see how to use the intelligent big data platform to complete business analysis and recommendation.

Step 1: User insight. Know the details of users' business usage by analyzing the business type, proportion, time distribution, and geographical location distribution.

Step 2: User analysis. Classify different types of users and find out their consumption habits and preferences through user insight.

Step 3: User forecast. Bring classified users into the model for iterative analysis according to their consumption habits and preferences, analyze and forecast emerging businesses and tariff packages that users may be interested in, and provide business reports that best match users' propensity to consume.

Step 4: Business recommendation and feedback. Make business recommendations according to different types of users, give feedback by regularly tracking users' new business usage, carry out iteration and constantly modify the model, and form a closed loop.

In this case, through user insight and accurate forecast, business sales conversion rate, actual revenue and user satisfaction are all improved to achieve a win-win situation for both users and operators.

Under the guidance of users and business planning, current network operation data can be analyzed to achieve network insight. Accurate network planning is made by accurately forecasting network capacity, coverage, performance and traffic. In network operation, information about network performance and customer experience can be tracked in real time to complete a closed-loop optimization of

network planning. This enables operators to build networks quickly and accurately, seize the golden window period, and deliver accurate services for value areas and customers, thus gaining an advantage in the competition.

There is another use case to see how to use the intelligent big data platform to make accurate 5G network planning.

Step 1: Collect data such as user distribution, traffic distribution, business type distribution, as well as user experience and complaints based on existing 4G network data to form a network operation dashboard.

Step 2: Bring data into the existing model for business, capacity and coverage analysis and forecast as well as user experience analysis and evaluation based on the network operation dashboard.

Step 3: Forecast 5G network service, capacity and coverage, plan hotspot areas and select wireless sites based on the above analysis and evaluation.

Step 4: Carry out data simulation to find out over-coverage and weak coverage areas, and adjust wireless sites (remove redundant sites and add weak-coverage sites) based on the selected sites and forecast data, and also evaluate the site planning base on the results of forecast and simulation.

Step 5: Generate site planning solutions and evaluation reports automatically to complete accurate 5G planning based on the above analysis and evaluation.

The above are the solutions to two scenarios such as business recommendation and 5G network planning using an intelligent big data platform. In practical applications, the intelligent big data platform can play an important role in user forecast, business forecast, revenue forecast, market size forecast and so on. **ZTE TECHNOLOGIES**

Redefining Consumer Services Through Innovation

Consumer services have always been the top strategic priority for operators. In the 5G era, the competition for valuable users is growing rapidly. Operators are striving to ensure steady growth of consumer services and revenues. There are two types of innovation—service innovation and model innovation, which will allows operators to develop consumer 5G services and break the 4G growth ceiling.

Service Innovation to Create 5G Killer Apps

The consumer services in the 5G era mainly focus on the video-based field, and incorporate 5G features to provide a better user experience. They mainly include UHD videos, AR/VR, cloud games, 5G messages, and wireless fixed access.

UHD Video

Video services are the most critical service in the consumer field, and also the basis for service innovation. In addition to the original 4G service mode, the UHD video can provide multi-angle live broadcast (panoramic view, player tracking and special angle) for scenarios such as stadiums and concerts, powered by some new 5G features such as MEC and slicing. In addition, the UHD video also can be combined with 4K/8K live broadcast, VOD and camera array-based video analysis.

AR/VR

AR/VR services attract the highest expectations from consumers. IDC forecasts that shipments of AR/VR head-mounted display (HMD) will increase from 7 million in 2020 to 77 million in 2024. In particular, COVID-19 has increased use of online office and entertainment while some offline activities (e.g. exhibitions, industry summits, and even concerts) have become online pursuits. However, large-scale AR/VR deployment depends on the development of headsets, such as functions, costs, and needs the right contents. Major application scenarios of AR/VR include 4K/8K panoramic VR live broadcast, cloud gaming, sports events, office environment, industry summits and exhibitions.

Cloud Gaming

Cloud gaming allows easier access to high-quality games, and improves the user's willingness to pay more, and on the other hand, the user pays for the services rather than for the expensive hardware. Mobile games have vast potential. Combined with MEC and 5G slicing, cloud rendering creates a more realistic and lower latency gaming experience. In the era of cloud gaming, operators can provide different levels of gaming performance in accordance with different classes of users.

Bai Xiaomei

Wireless Solution Architect, ZTE

5G Messaging

5G messaging is based on the unified GSMA rich communication suite (RCS) standard, and provides a brand-new experience in multimedia messaging, business messaging, intelligent messaging and interactive services. Parties in the 5G messaging industry chain are enriching 5G application scenarios and helping the intelligent and digital transformation of thousands of industries. The first commercial use of 5G messages in China and the continuous maturity of the industry chain build industrial capabilities for subsequent deployment in other countries.

FWA

Fixed wireless access (FWA) has been an important supplement to the wired connection in the last mile since the legacy 3G/4G era. As a solution for fast and low-cost broadband connectivity, it can be used in single-user and multi-user broadband access scenarios. According to GSA, 37 operators have launched 3GPP-compliant FWA, and the number of 5G CPE devices has reached 84. From the perspectives of application scenarios, costs and industrial chain, 5G FWA is a suitable service for early 5G deployments.

It should be noted that operators deploy their 5G services based on the user requirements, network performance, and the status of services-related industry chains. Table 1 shows the mid- and long-term planning for consumer 5G services made by ZTE for a Southeast Asian operator.

Model Innovation to Add Value to Operation

The tariff plans based on voice and texting during both the 2G and 3G eras were phased out with the popularity of mobile Internet applications. The unlimited plans in the 4G era, which have less consideration for the special requirements of users, were phased out due to the scissor gap between data of usage (DOU) and income. In the 5G era, operators need to break the shackle of unlimited plans and meet the differentiated needs of users.

Maximizing Network Value Through Multi-Dimensional Tariffs

Based on the performance features of 5G, it is advised that operators use a value-oriented measurement system in the business models for consumer services. In essence, this system uses different tariff dimensions based on service level differentiation. 5G services can be divided into network connection services with features including data volume, latency, priority, security, and reliability, and platform services such as MEC, capability openness, slicing, and integration. Therefore, operators can implement multi-dimensional tariffs according to the capability requirements of different services (Fig. 1).

Table 1. A Southeast Asian operator's mid- and long-term planning for consumer 5G services. ▶

Phase 1 (2020–2021)	Phase 2 (2022–2023)	Phase 3 (2024–2025)
2K/4K UHD Video	8K UHD Video	XR
FWA	Cloud Game	V2X
	5G Messaging	
	AR/VR	

User subdivision and differentiated tariff package				
Data traffic	**Data rate**		**Latency**	**Connections**	**Cloud service**

◀ *Fig. 1. Multi-dimensional tariff mode based on value-oriented operation.*

Maximizing User Value Through Differentiated User Rights

Differentiated user rights are assigned based on the membership system and the principle of higher price for higher quality. With the in-depth development of O2O, the issue of homogeneity in consumption brought by the surplus supply becomes more pronounced, and consumers are becoming more and more rational and mature. In addition to the network performance rights based on user levels, consumers will pay more attention to the additional rights.

- Connecting 5G commercial value chain horizontally for differentiated value: Operators need to collaborate with players in the value chains related to consumers' daily lives and work, such as players in the entertainment and business travel fields. Users can redeem their points for the services they want, which encourages more purchases, and on the other hand, additional services can be precisely pushed through information such as users' package usage, which further promotes consumption.
- Promotion of rights based on personal service scenarios: Personal service scenarios are divided based on user preferences and user locations. For example, operators can push to users notifications such as a traffic acceleration card or a low-latency card by predicting their preference for movies or

games according to their browsing history. Pushes of location-based rights target scenarios such as central shopping areas or sports venues, and are to deliver timely and relevant contents, such as venues discounts, VIP coach information, which increases consumption opportunities and revenues for operators.

Conclusion

Despite the COVID pandemic, South Korea's SKT and LG Uplus saw their Q3 operating profit rise 19.7.6% and 60.6% respectively year-on-year. They both saw double-digit profit growth for two consecutive quarters as a result of steady 5G subscriber growth. As of September, South Korea had more than 9.25 million 5G users. 5G users consumed two times more data than 4G users, mainly driven by games, VR and media usage. It can be seen that the commercial success of 5G is the main driver of both the revenue and profit growth for operators in South Korea.

Therefore, harnessing the performance benefits of 5G networks, operators can create more innovative services and business models to gradually release themselves from the operation pressure of relying solely on data usage. Meanwhile, innovations in the consumer field will more directly and quickly contribute to revenue growth, which enables operators to expand into new fields in the future. ZTE TECHNOLOGIES

End-to-End 5G Private Network Planning for Precise Industry Empowerment

Tang Hong

Wireless Solution
Architect, ZTE

E very major technological revolution will promote a qualitative leap in human society. Today, the world is entering the era of the fourth industrial revolution, and the internet of things (IoT), digitalization and intelligence have become the characteristics of this era. The existing wired networks, Wi-Fi, 3G, 4G and traditional private enterprise networks have been unable to adapt to the digital change and upgrade of vertical industries in the new era because of their own limitations. However, 5G can better meet the needs of digital upgrade for its high bandwidth, low latency, massive connections, combined with cut-edge technologies like network slicing, AI, big data, edge computing, and cloud computing platform. Compared with individual services, industry applications have special requirements for ultra-low latency, high reliability, and high security, so it is necessary to build 5G private networks to meet the applications of various industries. The end-to-end 5G private network planning is also an important part of mid- and long-term 5G planning.

Flexible 5G Private Networks for Differentiated Industry Applications

A major technological innovation in 5G networks is to achieve end-to-end network slicing, which can divide a 5G physical network into multiple virtual networks to provide special services for thousands of industries. Therefore, 5G private network planning is first of all based on the public network. The following four 5G private network models can be planned to flexibly adapt to application scenarios of different industries and specific customers (Fig. 1).

- **5G private line:** A 5G private line from core network to RAN completely shares the 5G public network and provides private line services for enterprises through QoS and APN. This mode is suitable for small and micro enterprises and can be implemented in both NSA and SA modes.

- **5G virtual private network:** The 5G public network is completely shared by a 5G virtual private network, which provides private network coverage for enterprises through end-to-end slicing. This mode is applicable to small and medium-sized enterprises.

- **5G hybrid private network:** In a 5G hybrid private network, MEC and UPF are separately deployed for the enterprise, so that local data traffic can be offloaded in the enterprise campus. This mode is applied for

large and medium-sized enterprises.

- **5G physical private network:** A separate 5G physical private network is built for a super-large enterprise, which consists of 5GC, MEC, transport and radio wireless base stations. The general application scenarios include large ports and mines.

E2E 5G Private Network Planning Based on Public Network

End-to-end (E2E) 5G private network planning solution consists of service platform, core network, MEC, RAN, transport network, and terminals. The basic idea of 5G private network planning is based on the public network, combined with private application characteristics and special scheme considerations.

- **Service platform:** Compared with the public network only for individual consumer services, the service platform is a new and independent platform

that provides vertical industry services based on network connections, including infrastructure as a service (IaaS), general platform as a service (GPaaS), application platform as a service (APaaS) and software as a service (SaaS).

- **Core network:** From the whole network perspective, whether 2C and 2B core network platforms are co-built or built independently is a key strategy of operators, which needs to be determined based on their strategic positioning of the 2B market and their business development. The use of lightweight 5GC for specific private users can meet the needs of independent deployment of low-cost core networks. The dedicated UPF can also be deployed close to different application nodes according to service needs.

- **MEC:** MEC is an industry-oriented edge cloud solution that can be deployed at network access nodes, aggregation nodes, or even core nodes to meet the flexible
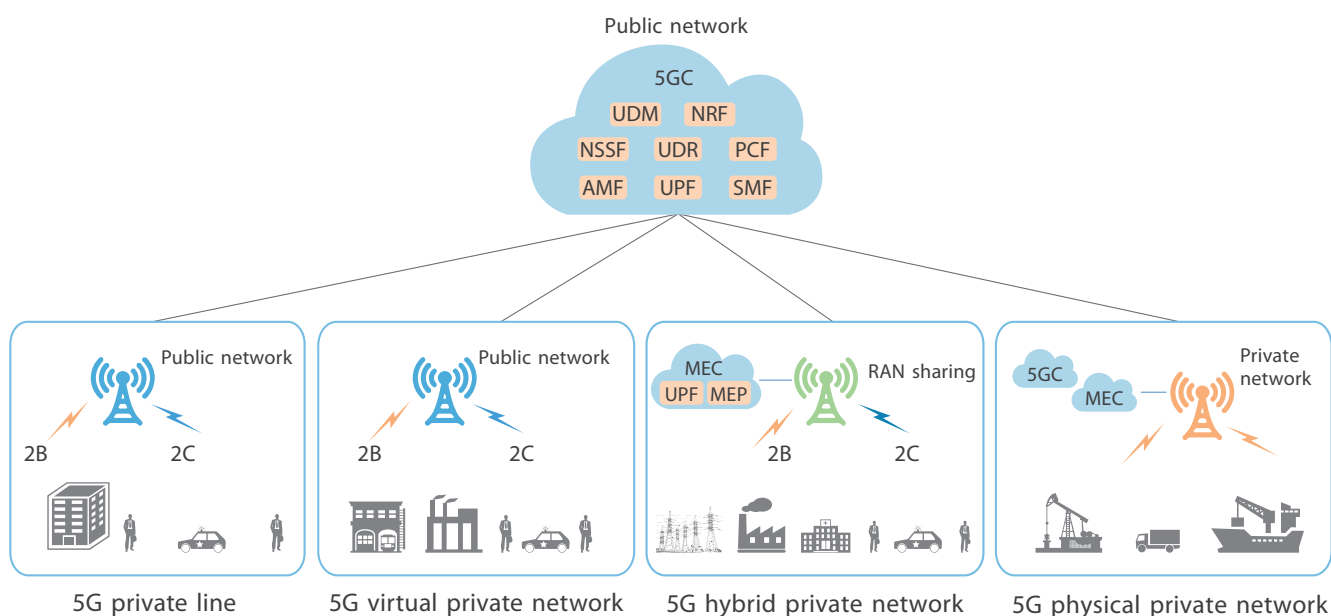

Fig.1. Typical 5G private network models.

needs of industry users for latency, bandwidth and security. It is one of the most important platforms in 5G industry applications.

- **RAN:** In terms of networking, RAN basically shares the public network. It should be noted that private networks often have a large demand for indoor coverage and 5G indoor cell planning is the focus.
- **Transport network:** The private network basically shares transport network with the public network, but provides higher-level services for industry applications through slicing.
- **Terminals:** Industry terminals are also an important factor affecting 5G private network planning. At present, the terminals in line with the industry application are CPEs and some industrial modules, which will be gradually enriched in the future.

Key Technology and Function Planning for Precise Empowerment

Industry applications have higher performance requirements than ordinary individual services. In addition to targeted end-to-end network planning, 5G private networks need to introduce key technologies and functions for industry applications and precise enablement. The following key functions and technical solutions will be introduced on demand in the deployment of 5G private networks.

- **E2E network slicing:** In the management domain, the end-to-end slice orchestration and management system implements slice design, slice establishment, and slice deletion. In the operation domain, end-to-end network resources are guaranteed through the NE slicing technology, such as QoS+5QI at the RAN side, FlexE in the bear network, and micro-service and NFV orchestration in the core network.

- **Bandwidth guarantee and uplink enhancement:** In addition to ultra-broad bandwidth provided by M-MIMO, physical resource blocks (PRBs) are reserved to guarantee the bandwidth for industry applications. The industry applications have high requirements for uplink services. TDD+FDD dual aggregation is an important technology for uplink enhancement.
- **Low latency and low jitter:** 5G private networks reduce end-to-end network latency through MEC architecture and new air interface technologies. FlexE and TSN are also the solutions to reduce latency and jitter.
- **Precise positioning:** High-precision positioning is a common requirement in industry applications. The main technologies to implement high-precision positioning include 3GPP-based AoA+RTT and Multi-RTT, and non-3GPP based Bluetooth5.1 and UWB. 3GPP R16 further enhances high-precision positioning.
- **High reliability:** Link protection is implemented for high reliability, including dual-card terminals, dual connectivity, and dual backhaul. Optimized coding rate and retransmission can also improve reliability.
- **High security:** High security of private networks can be achieved through end-to-end network isolation, local offload in data parks, and access control and management.

5G Private Network Planning for Typical Scenarios

Although the needs of industry users are different, 5G private network planning in the same industry scenario has something in common. The planning for 5G private networks in three typical industry scenarios is recommended as a reference.

- **Smart factory:** 5G hybrid private network is planned for large and medium-sized industrial enterprises, where a dedicated MEC is deployed in the industrial park,

5G AAUs are used for outdoor coverage, and QCells are used for indoor coverage. Main services of the smart factory include cloud AGV, remote control, machine vision, HD video monitoring and automatic driving. These services fall into three types: uRLLC, eMBB and mMTC. Accordingly, three end-to-end network slices are designed, with data offloaded in the park through MEC.

- **Smart grid:** The grid usually involves super-large enterprises, whose services are scattered in space. Therefore, 5G hybrid private network is planned, where multiple MECs are deployed in the regional and headquarters data centers respectively, and 5G RAN and 5GC are shared with the public network. Main services of the smart grid include differential protection of distribution network, phasor measurement unit (PMU), electric load response, precise load control, HD video monitoring and unmanned aerial vehicle (UAV) inspection. As the uRLLC slice of the grid has high requirements for delay and jitter, it is necessary to introduce PRB reservation and TSN solutions to ensure service performance.

- **Smart port:** 5G physical private network is planned for a super-large port that has large-scale independent parks, large needs for digital services, and high requirements for service security. Dedicated 5GC, MEC and wireless sites are deployed for the port. Main services of the smart port include real-time customs inspection, remote crane control, HD video monitoring, automatic driving and personal communications. Slices are planned according to different services in the physical private network. Internal data traffic of the port area is bypassed to the data center through MEC, while its external traffic is connected to the public network through the private 5GC.

Conclusion

Enabling various industries is the greatest value of 5G applications, but it must be implemented based on a powerful network. ZTE has gained a lot of practical experience in 5G industrial applications and can provide operators with tailor-made 5G network planning for the 2B market. ZTE TECHNOLOGIES

Building Low-TCO 5G Network in a Simple and Efficient Manner

Bai Xiaomei

Wireless Solution
Architect, ZTE

Low TCO is a long-term strategy for operators. In the 5G era, great changes in spectrum coverage features and equipment patterns lead to high networking density, high equipment costs, and high power consumption. This increases network investment costs and makes operators face greater pressure on return on investment. Therefore, low TCO is a top priority in 5G network planning. How can low TCO be achieved in 5G medium and long-term planning? First, a TCO calculation model is built to analyze the TCO composition of a 5G network. It is found that controlling network size and reducing single-site costs are the most direct and fundamental means to reduce TCO. Top-level and focus planning are then proposed to achieve low-TCO 5G planning. Top-level planning refers to top-level design of overall network, while focus planning contains simplified sites, energy saving, and AI-based intelligent O&M. Finally, special attention should be paid to low-cost planning of private networks.

Reasonable Top-Level Design Is the Basis of Low TCO

The purpose of top-level design is to reduce network size, simplify network architecture, and thus reduce TCO from the perspective of macro networking. Specifically, it can be divided into the following aspects.

Spectrum Planning

The basic idea is to provide hierarchical coverage by effective combination of high, middle and low frequency bands. Due to the high cost and small coverage of 3.5 GHz and mmWave equipment, it is necessary to focus on high-value areas to control the scale of investment instead of blindly covering the whole network. The 3.5 GHz band provides continuous coverage for urban and suburban areas to ensure service experience of major mid- and high-end users, while the FDD bands such as 700 MHz featuring wide coverage can achieve low-cost 5G coverage and provide the experience of basic 5G services including URLLC and mMTC. The

mmWave bands only provide super-hot and FWA coverage. In the future, existing 4G bands such as 2.1 GHz can be refarmed to 5G NR to supplement the 5G underlying coverage in a low-cost manner.

Service KPI Planning

The 5G network is still limited by uplink coverage, so the uplink edge rate setting is the key to determine the site density. Based on the development trend of front camera resolution of mobile terminals, it is reasonable to set the edge uplink rate at about 1M–2M at 5G initial and development stages. With the improvement of service requirements, terminal capability and in-depth coverage of 5G network, the uplink edge rate can reach about 10M in urban areas. The solutions to improve uplink rates including the FDD assisted super TDD (FAST) solution based on time-frequency carrier-aggregation can be introduced to reduce the number of sites. This is also in line with the idea of spectrum planning through the combination of high and low frequencies.

Network Architecture

The network architecture can start with SA deployment. In the medium and long term, the networking cost is lower than that of starting with NSA and upgrading to SA. Even if it is necessary to start with NSA to control the upfront investment cost, it is also recommended to deploy NSA/SA dual-mode base stations and the core network of converged architecture, so

that a smooth evolution can be achieved in the later stage without wasting investment. The C-RAN architecture with centralized CU/DU is also especially planned for urban coverage areas, where fiber to site costs are low and sites are densely distributed. C-RAN can simplify the deployment of wireless sites, improve the utilization of BBU resources, and reduce the cost of operation and maintenance.

Simplified Site Planning Reduces Single-Site Deployment and Evolution Costs

With the evolution of wireless network access technologies, 3G and 4G radio sites coexist, resulting in limited site space and high rental pressure. The industry continues to optimize wireless site solutions. The early 2G sites dominated by indoor equipment rooms and shelters have been gradually developed into highly integrated outdoor cabinets, which simplifies the sites. The continuous innovation of extended RF units, multi-band integrated units, and multi-band multi-port antennas further simplifies the deployment on tower. Therefore, a simplified site solution has been introduced in the 5G era, especially in the scenario where the antenna space is limited and the rental cost is high. Two- or three-band UBRs are used to replace existing multi-band FDD RRUs, and multi-band multi-port antennas are used to replace existing antennas in all bands, which creates antenna space for the introduction of 5G AAUs.

Although the cost of early site replacement increases, the new equipment reduces site rents and energy consumption, and has the ability to evolve smoothly through software, so TCO is lower in the medium and long term.

Intelligent O&M Reduces 5G Operation Costs

5G high energy consumption is a concern of the whole society. It not only increases the pressure on operation costs for operators, but also makes it more difficult to expand and transform power supply of the site. 5G energy saving involves core chips, key components, site auxiliary, network architecture, and software functions. The chips, components, and software functions are implemented on the equipment layer and are not directly related to network planning, while some energy saving can be achieved through reasonable network planning. For example, multi-band UBRs and integrated outdoor cabinets can be planned as macro cells in urban areas to reduce energy consumption; integrated pole-mounted small cells that has low power but accurate coverage can be used in local hotspots and blind spots to reduce power consumption; and integrated new-energy macro cells can be planned in rural areas to achieve green 5G. In terms of site auxiliary, new-generation efficient power modules and intelligent lithium batteries can be planned to gradually replace existing batteries, thus achieving lower TCO in the medium and long term. In the 5G era, there

may also be a large number of extended RF units that use pad to extend and boost power supply (57 V) to further reduce power loss and save energy.

Intelligent O&M based on AI and big data can run through the whole process of network planning, construction, maintenance and operation. AI and big data tools can implement precise network planning and reduce labor costs. Intelligent fault prediction can be used to reduce O&M costs. AI-based intelligent shutdown can also greatly improve energy saving efficiency. To improve satisfaction, VAP users are identified in advance through user experience assurance in an active mode. User complaints are handled by automatic demarcation and location to improve efficiency. The pipeline visualization capability and user profile technology can also help to identify high-value users and services and promote development.

Precise Cloud Network Expands Industry Applications at Low Cost

Enterprise users generally require fragmented scenarios, heterogeneous synergy and high security. However, public cloud has such disadvantages as weak full-stack cloud customization, high redundancy cost, low data security, and weak E2E SLA guarantee. In fact, to empower industry users, 5G needs to focus more precisely on their scenarios, and find their real pain points and key problems, so as to solve problems with differentiated

> The low TCO effect achieved in the field of operators' networks can also be extended to industries and private networks, making the digitization process of various industries fast, efficient and cost controllable.

solutions and create value through precision services. Therefore, it is recommended to expand the industry market at low cost through precise cloud network.

At the cloud side, one core feature of the distributed precision cloud solution is to build a JAVA-like compatible cloud base that shields hardware differences and provides optional all-scenario hardware. Another core feature is that edge cloud deployment supports ultra-lightweight start. The most basic embedded board only needs to be added on OLT or BBU. This supports the provisioning of basic services, and thus flexibly supports low-cost innovation and reduces trial-and-error costs. At the network side, it is a basic consensus to reduce TCO by sharing public networks with end-to-end slices. Different private network models are also planned to flexibly serve different industry users, including

5G private lines for micro and small enterprises, 5G virtual private networks for small- and medium-sized enterprises, 5G hybrid private networks for medium- and large-sized enterprises, and 5G physical private networks for special large-sized enterprises. At the specific network element side, 5G private networks reduce TCO through compact and lightweight 5GC, integrated UPF and low-cost indoor coverage.

The network and business development in the 5G era is facing more cost pressures, so operators need to take into comprehensive consideration its medium and long-term development goals to reduce costs and increase efficiency. The low TCO effect achieved in the field of operators' networks can also be extended to industries and private networks, making the digitization process of various industries fast, efficient and cost controllable. ZTE TECHNOLOGIES

AIS: Creating a Digital Life Experience with Smart Mesh Networking

Zhou Weiyou

FN Product Planning
Manager, ZTE

Thailand has a population of nearly 70 million, with about 10.36 million fixed-home broadband users and 48% fixed-line penetration. Its average fixed broadband speed is 125 Mbps, slightly lower than that in developed countries such as the United States and France. In terms of both penetration and speed, the development level of fixed broadband in Thailand is close to the first-tier market.

AIS is the largest mobile operator in Thailand, and its mobile services account for about 50% of the Thai market. Guided by a vision of becoming the most respected digital provider in Thailand, AIS is dedicated to offering superior products and services that deliver an optimal experience to boost customer intimacy. To provide users with high-quality services in both mobile and fixed networks, AIS started to build FTTx networks at the end of 2014 and launched its fixed network operation under the brand "AIS Fiber" in 2015. In only five years, AIS has developed more than one million fixed broadband users, rapidly becoming the fourth

largest fixed-line operator in Thailand.

Pain Points in the Last 10 Meters

AIS designed multiple packages, with each enjoying a different service level agreement (SLA). In practice, however, users often reported problems like poor signal, low speed, video stutter, and high gaming latency. A thorough investigation by AIS found that such users usually lived in a villa or large apartment, which could hardly be covered in its entirety by the one Wi-Fi access point (AP) offered by a common service package. Although mesh solutions for this scenarios were available in the market, they are expensive and difficult for ordinary users to install and maintain.

Therefore AIS decided to make a bold attempt at smart mesh networking solutions. Such a move would allow it to do the testing and inspection, ensure the high quality of Wi-Fi APs, and offer professional deployment and after-sales services. With these benefits, AIS could provide users with ultimate experience in the last 10 meters of broadband access.

Smart Mesh Networking Solution

Optical line terminals (OLTs) and optical network units (ONUs) on AIS's network came from mainstream vendors such as ZTE, and the home section of the network was mostly deployed in 1+1 mode (one bridge ONU and one Wi-Fi AP). To implement its smart mesh networking solution, AIS only needed to purchase mesh APs.

AIS enlisted ZTE to build an FTTx network in 2014 after years of deep cooperation in mobile network deployment. When AIS requested proposals to supply its smart mesh networking project in 2019, ZTE provided the ZXHN H198A AP. The product employs an in-house mesh solution to enable superior performance, deep customization and flexible management, helping AIS reduce Capex and Opex through the following features:

- **Low investment cost.** The ZXHN H198A can be used as a master AP or a slave AP. When deploying a network, AIS only needs to add AP without replacing the existing ONU in the user home. This scheme reduces device costs by around 40% compared with replacing the in-service ONU with a new all-in-one unit.
- **Good coverage.** The ZXHN H198A supports both "1+1" and "1+N" application scenarios, which means that the number of APs can be determined according to the area of user home. The APs are intelligently networked to cover every corner of the home, thereby improving user satisfaction and reducing the complaint rate. The good coverage also cuts truck rolls and slashes AIS's cost in network maintenance.
- **Easy operation and maintenance.** All mesh APs of ZTE can be remotely managed through its in-house auto configuration server/session traversal utilities for NAT (ACS/STUN) solution. Configurations and services are automatically delivered to APs without

the need to deploy a new network management platform. With the flexible remote management of APs, AIS can further bring down its Capex.

AIS commercially launched its smart Mesh networking solution in September 2019, becoming the first operator in Thailand to commercialize such products.

Creating a New Digital Life Experience

AIS's smart mesh networking solution, i.e. the "Super Mesh" package, was widely favored by users after its rollout. The flexibility of the solution allows engineers to customize a deployment scheme based on the layout of the home to ensure that the entire residence is blanketed in Wi-Fi. Within half a year of the solution's launch, AIS solved the Wi-Fi coverage problem for tens of thousands of homes in Thailand.

The "Super Mesh" package enables millisecond roaming handover between mesh APs and delivers a 70% improvement in performance over the other solutions on the market. It ensures that voice, video and gaming services are not interrupted in the handover process and are imperceptible to users. It also delivers a concurrent throughput of at least 500 Mbps for both uplink and downlink to meet the high bandwidth needs of ordinary home users while reducing the latency of multiple concurrent service streams, thus providing a superior user experience.

After AIS launched the "Super Mesh" package, other operators in Thailand have followed suit and successively carried out bidding, testing, and commercial use of smart mesh networking solutions.

As a latecomer, AIS is playing an increasingly important role in Thailand's fixed home broadband market. In 2020, it became the first operator in Thailand to make Wi-Fi 6 technology a priority of strategic planning and asked several vendors including ZTE to provide customized prototype for testing. The prototype provided by ZTE supports the Wi-Fi 6 technology and an in-house mesh solution to enhance performance and coverage. With continuous innovation, AIS is poised to bring a better digital life experience to users in Thailand. **ZTE TECHNOLOGIES**

The First mesh AP (ZXHN H198A) rolled out by AIS

To enable connectivity and trust everywhere