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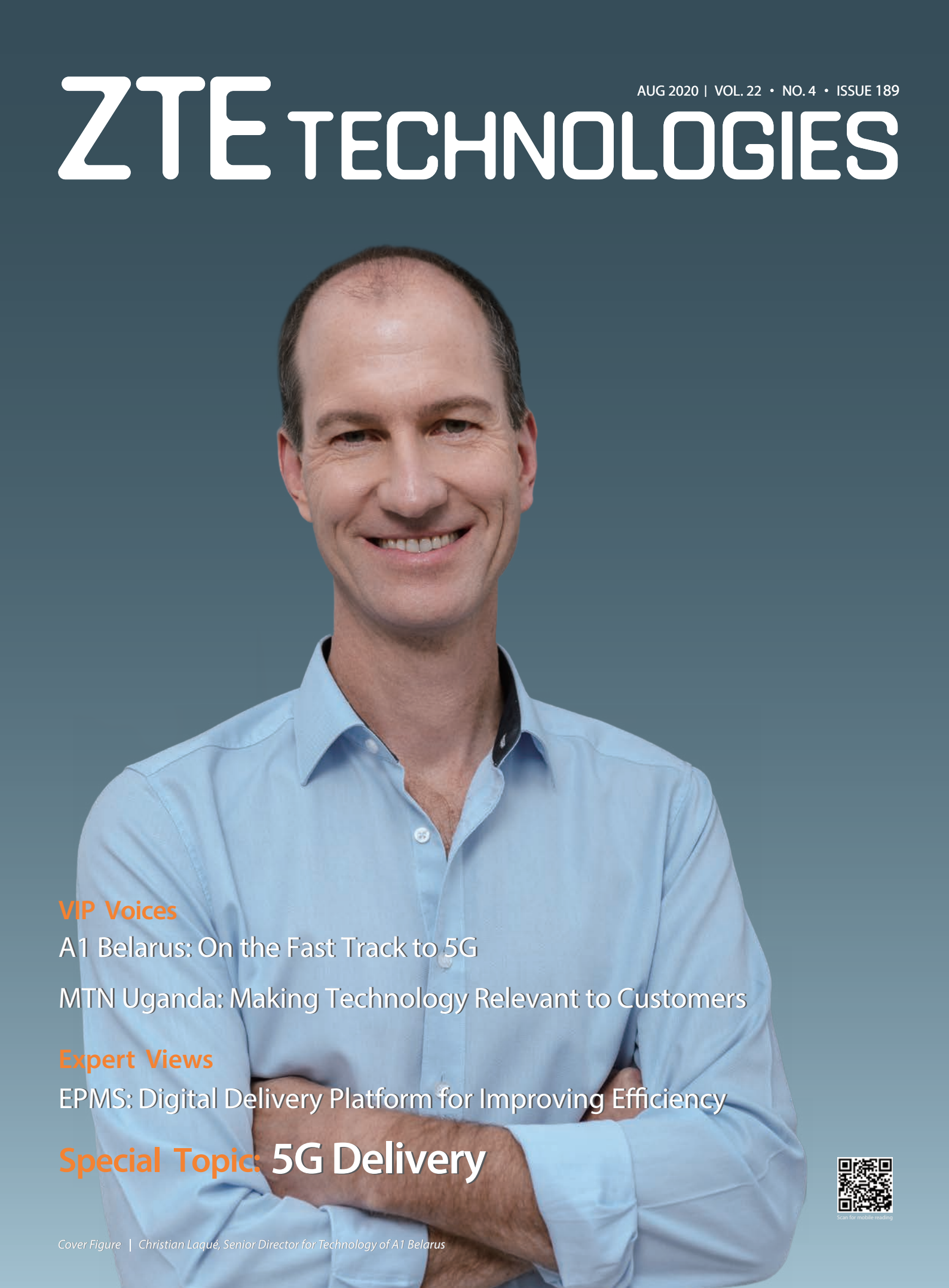

VIP Voices

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Special Topic: 5G Delivery

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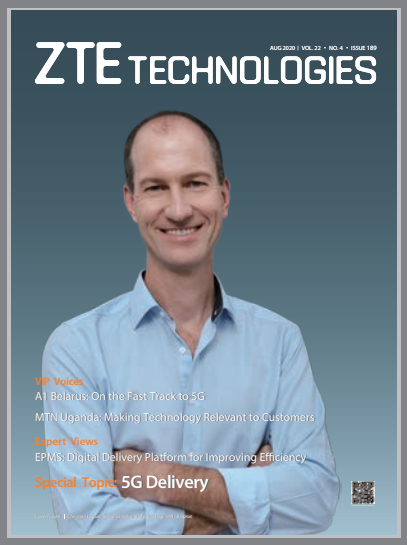
Cover Figure | Christian Laqué, Senior Director for Technology of A1 Belarus



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Edited By Shenzhen Editorial Office

General Editor: Lin Xiaodong

Deputy General Editor: Huang Xinming

Editor-in-Chief: Liu Yang

Executive Editor-in-Chief: Yue Lihua

Circulation Manager: Wang Pingping

Editorial Office

Address: NO. 55, Hi-tech Road South, Shenzhen, P.R.China

Postcode: 518075

Tel: +86-755-26775211

Fax: +86-755-26775217

Website: wwwen.zte.com.cn/en/about/publications

Email: yue.lihua@zte.com.cn

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Success Stories

A1 Belarus: On the Fast Track to 5G

Reporter: Veronica Karliukevich

Christian Laqué, Senior Director for Technology of A1 Belarus

Belarusian telecommunications operator A1 is accelerating its 5G journey with the recent launch of the first 5G SA test network in Belarus. A1's Senior Director for Technology Christian Laqué talked about this "key milestone" as well as the opportunities and challenges ahead.

Where does A1 stand in terms of technology development of networks?

A1, a group of advanced mobile operators (in seven markets), started preparing for the next generation of mobile networks many years ago. The first transformational step (in Belarus) was the switching of our "pre-existing" core network, with a "fully virtualized" core network, which utilizes the "OpenStack" cloud. In 2016, and within 9 months of starting the process, A1 had switched (in collaboration with ZTE) from the "pre-existing" core network to a "fully virtual" setup, making it the first "fully virtual" set-up in the world. This development initiative enabled A1 to ensure its transition towards 5G was extremely efficient, smooth and fast.

On top of these developments, in 2017, A1 tested the core network, slicing and switching to an SDR based RAN. This development allowed A1 to unify the equipment of our base stations (at the software level) for transmitting signals in several different ranges at a time. In 2016 & 2017, the introduction of U900 across the nation, combined with G900, was the first evidence of success. Today this approach, along with the experience A1 has accumulated can be used to deploy 5G networks. To further elaborate, the RAN is ready to be extended to 5G (in the existing frequency bands)—by implementing an SW upgrade and baseband extension. The IP network is the third component in the network, which was fully modernized with the newest technology, including SDN, thus allowing it to be 5G enabled.

A1 launched the 5G SA network. Could you elaborate a little bit more on that and what is your roadmap about then and beyond?

The launching of the autonomous 5G SA network (as a trial) is a key milestone in preparation for a nationwide rollout. As one of the first operators in our region to test end to end, introducing "ultimate 5G technology" is an important step. Working with the most advanced supplier in the market has been a great experience. A1 has already proved that the commercial technology is available, and it works in accordance with our expectations.

In the first phase, A1 is opting to go with the new spectrum of 100 MHz in the 3.5 GHz band (with TDD). A1 has installed outdoor macro and indoor systems and we are currently testing the interworking efficiencies. A1 has also completed the first steps on the road to realizing a fully commercial end-to-end product with VoNR and eSIM. A1 was the first company to conduct testing of the 5G SA technologies in Belarus, as well as undertake the first testing of an e-sports match for mobile games. Mobile gaming is absolutely phenomenal in 5G; it adds another dimension to the whole experience. This can be done using a standard smartphone (from our portfolio) and uses all the features of our mobile services. The next critical steps will be for A1 to manage handover scenarios with the legacy network provider. On top of this A1 will also assess the viability of the existing spectrum, on the existing infrastructure. Currently the 1800 MHz is the first

candidate to be assessed and trialed.

What does that mean for the industry and the future trajectory?

The full ecosystem required to support real 5G in standalone mode is starting to become available—this will be finalized before all the stages are complete in Belarus, which is required prior to the official launch of the new technology. On a consumer level, the full "end to end" process required for enhanced mobile broadband is working. The customers are currently purchasing smartphones from our portfolio, which are fully capable of 5G. With this in mind, these consumers will be able to take full advantage of the new standard communication as soon as it is launched.

5G is not just about high-quality voice calls, high-speed mobile internet and a new level of entertainment services. Yes, these areas of increased functionality and performance will be a major step forward; however, there are some other exciting developments that this technology will open up, such as alignment with smart homes, smart cities and the internet of things (IoT). A1 is of course preparing (in-advance) for these implementations. When it comes to "the IoT," it is critical that work in this exciting field is "fast-tracked." To elaborate—giving access to a broad range of developers in the real field will enable us to move out of pure lab setups.

What monetization opportunities does A1 expect from 5G and why?

The bandwidth demand in the mobile industry is rapidly growing. In Belarus we are in a very special and unique situation. LTE was introduced very late on, and via a single wholesale model. Therefore, for us to "fast-track" to the new technology (of 5G) in the standalone mode will provide mobile bandwidth more efficiently than ever before. The trial case with eSports has already shown how thrilling the new performance could be for consumers. The work associated with "the IoT" has the lowest latency and a massive amount of sensors. We are in a very early phase with this. We are living in exciting times of extremely fast development cycles. The car industry is on a fast-track towards autonomous driving and fully electric vehicles. The collection of data everywhere at any time is key for all digitization. We are not talking about the transformation of access; we are adding a new dimension of capabilities to work with data.

How will A1 balance and prioritize 2G/3G/4G/5G investment in the medium to long term?

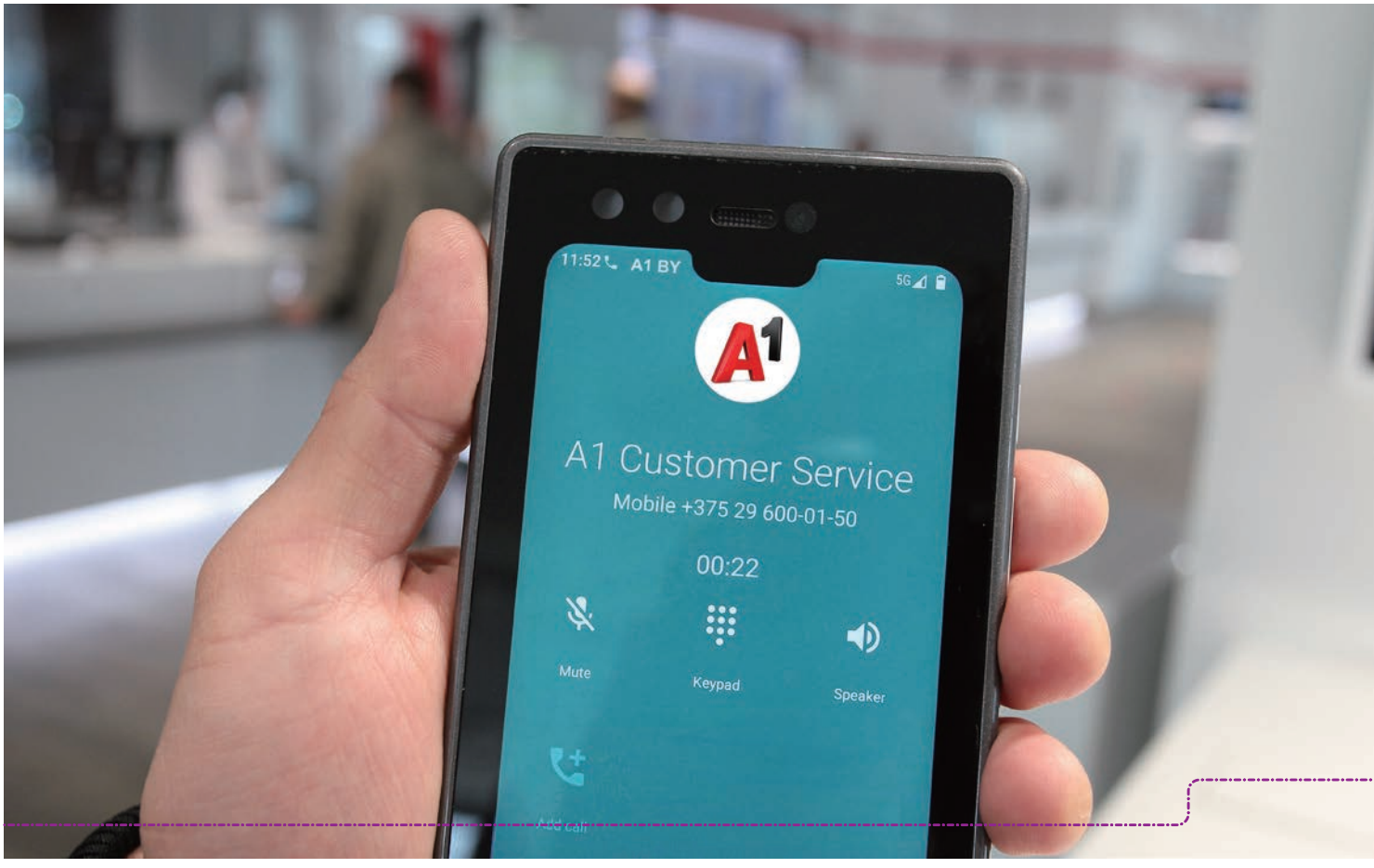
Over two years ago, A1 decided to stop investments into 2G. Given that 3G was the technology that would bring mobile broadband to the masses, this decision was relatively straight forward. In Belarus, 3G coverage has been provided almost everywhere; in fact across 98% of the country. It is now just a case of adding increased capacity and overcoming coverage issues as they arise—this is mainly to overcome accessibility issues in areas of new construction. As for 4G in Belarus—it is provided by a single wholesale company to all mobile operators. This greatly limits the opportunities available to us to develop our own 4G network. We have and will not abandon plans to further search for possible options and ways to work in this direction; however our future sits squarely in our efforts to embrace 5G technology. To further emphasize our focus on 5G, A1 is throwing a lot of preparation into the rolling out of

this new and hugely exciting network. Providing the demand is apparent from our subscribers, and as soon as the license is made available to A1, this will be rolled out.

What are the major challenges in the path towards next-generation 5G networks in Belarus and how these can be addressed?

The current challenge is to get the license. The process of awarding the license has not currently been decided. On top of this, sadly, the timeline is also not entirely clear. A1 in Belarus along with the entire A1 Telekom Austria Group has been doing everything they can to help facilitate constructive dialogue with the Belarusian Government in the sphere of 5G implementation.

A1 Telekom Austria Group has a successful track record of implementing 5G in different countries and regions; and as a Group we are ready to share our experiences to assist as required. But for now, we, like other market players, have to wait for the official decision concerning the issue of licensing and allocation of the frequency range. The mobile industry in Belarus is preparing itself for the launch of this new network technology. The main direction is clearly to go directly to 5G SA and skip the NSA add-on to LTE.



About A1 Belarus

A1 Belarus, part of the A1 Telekom Austria Group, is the largest private telecom, ICT & content service provider in Belarus. The company provides GSM 900/1800, UMTS (WCDMA/HSDPA/HSUPA/HSPA+) and 4G services (via beCloud infrastructure operator). A1 Belarus is the second-largest mobile network operator in Belarus. A1 Belarus also provides ADSL, Ethernet and GPON Internet access services in all regional centers of Belarus, and IPTV digital television services under the VOKA brand. Until August 2019, the company conducted operations under the brand name velcom. In 2019, A1 Belarus reported turnover of EUR 426.1 million and EBITDA of EUR 190.9 million.

Other macro-economic considerations cannot be ignored, such as COVID-19. Luckily, in spite of this global challenge, which has a huge impact on other sectors, such as the oil industry, property, retail (amongst others), the demand for mobile communications, especially mobile data, is resilient and growing further. The crisis is also accelerating digitization in all industries. Belarus with its huge IT development industry should be able to harvest exponential growth with 5G as enabler for digitization.

How has the partnership with ZTE worked out over the past few years and what do you expect for the future?

ZTE and A1 have developed their relationship from one supplier/customer towards being trusted partners. With any partnership, challenges do present themselves. However, overcoming these challenges "together" will strengthen the relationship and prepare you adequately for tough times that lie ahead—this has been the case with ZTE and A1. During the past five years it is worth reflecting on the fact that the partnership has developed from that of supplying several radios to becoming a major network supplier, across mobile and fixed—covering core, transport and access.

There is always pressure on costs and for legacy. A reduction of power consumption is important in order for us to have space for innovation. The road of open platforms is proven and disaggregation based on open standards will be key to keep up with the pace of developments.

There are a lot of opportunities to become more successful. We have to be agile and focus on long-term outperformance. ZTE TECHNOLOGIES

MTN Uganda:
Making Technology Relevant to Customers

Reporter: Song Mingyao

Wim Vanhelleputte, CEO of MTN Uganda

"One of the key first applications that I see for 5G in Uganda will be the wireless fiber connectivity of bringing reliable, high speed and low latency internet into hundreds of millions of homes on the continent," said Wim Vanhelleputte, CEO of MTN Uganda, during an interview at the 5G technology trial ceremony in Kampala, capital of Uganda, who shared his ideas on the key 5G application in Africa, the unique challenges in Uganda and the importance of human resources. On Jan 17, ZTE and MTN Uganda started a 5G trial to be the first to bring the standalone 5G network into reality in East Africa.

Most of the countries in Africa are still in 2G, 3G and 4G eras. We are in a time to transition from 4G to 5G. What made you decide to launch 5G in Uganda?

I am very grateful that you are a trustworthy and reliable technological partner that has enabled us to show off the 5G pilot today. It has been a great success. It proves that we are at the forefront of technology innovation. It also proves in the long term that our commercially viable applications will require 5G and make 5G relevant for Uganda. I strongly believe in the concept of wireless fiber. It is very difficult to get fiber rolled out in this country. There are a lot of restrictions like rebuilding a new road here. The following day we want to dig it up again to put your fiber. There will be a bit of coordination in terms of rolling out fiber infrastructure. So it is going to be a very big challenge in the next three to five years to roll out fiber to every household in Uganda, and that's why one of the key first applications that I see for 5G in Uganda and in Africa in general will be the wireless fiber connectivity of bringing reliable, high-speed and low latency internet into hundreds of millions of homes on the continent. You won't need to dig expensive and slow fiber into all the households. I strongly believe that in the next two to three years we will start seeing serious 5G roll out on the continent.

We still have to deal with the spectrum problem first.

Sure. The spectrum in 3.5 GHz, 700 MHz and all the other frequency bands has not been allocated yet. Spectrum is a scarce commodity at the disposal of a

country. It is up to the regulatory authority to allocate it to the right people who can make the right use of it. We have had the discussions that the spectrum is going to be freed up and it will be available in the next one or two years so that we can start thinking of commercial applications.

MTN is a world-leading company. As the CEO of the company, how do you serve the MTN strategy in Uganda, the second-level country market?

The challenge in developing emerging economies like Uganda is that you need to spread yourself very wide. We have customers that are just discovering 2G voice because of enhanced rural development. Our group CEO Rob Shuter made the commitment to roll out more than 5000 rural sites within MTN's footprint. That means there are still unconnected people who are just discovering what a mobile telephone means. On the other end of the spectrum, we have a very vibrant, young and dynamic population who feels like whatever technology is available in the rest of the world should also be available in Uganda. They are entitled to it. So we have that challenge of deep-down rural connectivity in 2G, and at the same time we have aspirational, young and energetic customers who want 4G and even 5G. That's an exciting challenge we are facing in our market.

In South Korea where there is very advanced 5G, they are switching off 2G and they are probably looking at switching off 3G soon. They are just going to have 4G and 5G. For us, because of the wide spread of challenges, we have to cover the whole spectrum of 2G all the way to 5G. I believe we will go live with 5G before we switch off 2G. For us, it will be a combination of a whole set of technologies that will allow us to deliver services and enable applications relevant for the entire population. We need to be relevant as a mobile operator deep down in rural Uganda just as we have to be relevant for the young urban population in urban Kampala.

MTN is successful in the Ugandan market. How do you achieve this success? Is that the way you implement the Oxygen strategy in this country?

On the guidance and the visionary leadership of our group CTIO Charles Molapisi, we have embarked on the Oxygen program across our footprint in 21 countries. The Oxygen strategy is a beautiful acronym to show that we have to make technology relevant to our customers. Rolling out technology for the sake of technology is meaningless. At the end of the day, it is about what is useful, what applications can change people's lives. If there is one thing where I believe MTN has made a difference—I've been with MTN for more than 10 years—it is that we do listen to our customers and we understand our customers' needs. We are Africans. We develop applications and solutions for African challenges by Africans. I think our African connections make us very relevant to really understand what our customers need and how we can address and find solutions. Problems will always be there. The challenge is how you find relevant solutions to those problems. That's how you make a difference in a customer's life.

Just now you mentioned that MTN has captured Africans' needs. Do you think that the your people here in MTN contribute a lot towards the strategy of digitalization?

Our biggest asset is human resources. It is even more so for a technology company. Everybody can roll out 5G. It is, maybe, a matter of financial resources and technology partners. Technology is just technology on its own. How you make it relevant depends on the kind of people you work with. We have an amazing, dynamic young workforce, passionate about what they are doing. And we have solid technology partners like you. I think the combination of those two really makes a winning team. ZTE has been with us on the ground for many years. You employ a lot of

Ugandans and bring managed services for us. So you know the potential that Ugandan engineers and technicians have. The world is a village. When you look at the VR applications, I can put on the glasses and I can feel as if I am walking on the Great Wall of China. Uganda, China and anywhere else in the world are becoming one village. Tapping into the unique human resources, creativity in this country but also abroad and across is going to take us forward into new territories.

We don't know even today what the applications of 5G will be. It is up to the human brain to think and understand the challenges we are facing and then to see how technology is going to address that. Who knew 20 years ago that because of 2G we would be able to do mobile money, which is a unique application coming out of East Africa to meet the challenge of unbanked? 2G is the enabler that allows smart people in East Africa (e.g. Kenya and Uganda) to develop mobile money technology or application. 2G was not developed to make mobile money happen; mobile money came as a result of finding a solution for a particular challenge. And the same will happen with 5G.

Some African operators are very concerned about the affordability of products. Do you believe that it is your biggest concern in the market right now?

Affordability of devices that enable 5G applications will be a challenge because already on 3G it is a challenge. In Uganda, we have 22 or 23 percent smartphone penetration because the smartphone is still relatively expensive for the Ugandan consumers even at the 30 or 40 dollar price point. Massive usage of 3G or 4G requires the right devices. We are catching up. I believe that the big obstacle we faced on 3G adoption—a smartphone costing a hundred dollars two or three years ago was a massive barrier—will be lowered. Today, technology is getting more and more efficient and the cost of 5G devices will go down much faster than that of 3G or 4G devices. I believe that it will take less time to democratize and make 5G massive market applications than it took for 3G or 4G.

Do you have any expectations on cooperation with ZTE?

My expectation is that we continue our good, healthy and solid relationship. We have just recently confirmed our mutual agreement to continue modernizing the network and rolling out a 5G pilot. There is still a lot of work on 4G. We have done 3G. So the immediate future is to roll out 4G everywhere. We have 4G in all dense urban areas but also need to take 4G countrywide. We count on you as our technology partner with your good collaboration with our staff and our people to take us forward, take yourself forward, take our customers forward and take the country forward! ZTE TECHNOLOGIES

Intelligent Response to Changes of 5G Cloud Core Network Delivery and Operations

Li Pu
Chief Engineer of ZTE CCN Products

In the evolution to 5G core network, the software and hardware architecture of telecom equipment has undergone tremendous changes from traditional to virtual, cloud-based devices. The telecom industry has introduced not only IT software architectures but also new ideas and methods. While bringing a lot of convenience to telecom applications, the decoupling of three layers (cloud platform, core network services and hardware infrastructure) based on the OpenStack open-source technology has also made a great impact on network delivery and operations, and has therefore promoted their intelligent changes.

Automatic One-Click Deployment to Solve Difficulties in Network Delivery

Coexisting with 2G, 3G and 4G networks, 5G networks are commercially deployed on a large scale. To reduce deployment difficulties and improve delivery efficiency under the existing manpower and network conditions, an end-to-end automatic core network delivery solution has become an urgent need. ZTE has developed its NFV auto integration center (AIC) that can fully meet the needs of operators.

By integrating and solidifying the NFV integration process, AIC automates the design and planning, deployment, and acceptance tests of 5G virtual core networks, significantly shortens the network construction time, and achieves "zero distance" between tool functions and customer needs in the whole life cycle of network integration through a friendly user interface.

The AIC platform provides end-to-end one-stop tool support for virtual core network construction involving network planning and design, scheme verification, network deployment and integration tests, and realizes automatic integration of various scenarios such as NFVI, MANO and VNF. With the AIC tools, operators can automate the planning, deployment and test of their virtual networks, which greatly improves the efficiency and quality of NFV integration. The AIC platform can also considerably reduce costs and difficulty in the integration. This helps operators accelerate their NFV

construction and achieve rapid network transformation with simplicity.

Intelligent and Rapid Fault Location to Solve Difficulties in Network Operations

To change the inherent operations mode of traditional equipment including restart, switch-over, and board removal and re-installation, there is an urgent need of automatic and intelligent technical support for network operations. This can make full use of virtual features to liberate people from heavy operations work, rapidly locate problems in the system, and solve them. After the network is delivered and put into formal operation, how can operators rapidly demarcate and locate the problems or failures that will occur? ZTE has developed targeted solutions to deal with them.

First, deploy intelligent monitoring system. When the software automatically detects that the system is not operating properly, it automatically triggers the next step of fault analysis to locate the root cause and fix the fault rapidly.

Intelligent monitoring can be performed in either direct or indirect mode. In a direct mode, the software monitors the indexes of key facilities such as the environment, hardware (compute, storage and network) and cloud OS. Once failure data occurs, it directly alarms and locates the fault. In an indirect mode, the software monitors the KPIs of 5G services and makes a multi-dimensional comparative analysis. Through the analysis, it finds abnormal KPIs and determines whether a fault has occurred, which triggers the further fault correlation analysis and location. The multi-dimensional comparative analysis can be made from several aspects.

Second, introduce automatic operations to analyze the root cause of a fault through the vertical and horizontal correlations. That is, after the monitoring system detects a system failure, it triggers hierarchical alarms and log correlation analysis in the vertical direction, and also correlation analysis of intra-NF and inter-NF micro-services at the horizontal level.

In the vertical architecture, network architecture includes three layers: physical layer, virtual layer, and service layer. When a fault occurs at the bottom layer, upper-layer services will be affected. The key to vertical correlation is to identify where the root cause of the fault is located. Is it at the PIM layer, VIM layer, or VNF service itself?

At the horizontal level, there is service flow correlation and mutual influence among micro-services within a VNF. The horizontal correlation between micro-services can help to find the root cause of a problem. The key to horizontal correlation is to associate one faulty NE with another service-related faulty NE, associate one faulty micro-service with another micro-service that really goes wrong, and identify the really faulty micro-service or component on the same application layer.

In addition to fault monitoring and hierarchical correlation analysis of fault root causes, other key technologies such as fault self-healing, global perspective, cross-domain data collection, network topology management, one-click automatic tests, and one-click automatic service deployment are all mature commercial capabilities for intelligent operations.

Network Slicing to Bring Value-Added Services in Network Operations

Network operations give rise to network slicing, which allows various industries to create more applications based on the 5G network. As a result, abundant vertical industry applications such as automatic driving, industrial control, smart grid, big video, and AR/VR will be widely used in our daily life. Ultra-large bandwidth, ultra-low latency, and massive connections will be ubiquitous in the near future. This is not only a major challenge to 5G core network operations, but also an important opportunity for the prosperity of 5G core networks.

5G core network is essentially a virtual network that has all features of virtualization. Network slicing is an important feature. Through flexible allocation of network resources and flexible combination of capabilities, logical subnets with different features are virtualized based on a physical network to meet the customization needs in different scenarios.

Operations based on network slicing in essence are to provide the whole life-cycle management of slice instances, including their design, commissioning, SLA guarantee, and termination. While bringing great flexibility, network slices also increase the complexity of operation and management. It is an inevitable trend to enhance the automatic slice management capability based on artificial intelligence (AI).

After the introduction of AI, the slice management system can automatically implement management policies according to the decisions output by the AI training platform, and give the network the capabilities of intelligent perception, modeling, commissioning, analysis, judgment and prediction, so as to achieve a perfect balance between slice flexibility and management complexity. Through intelligent slice commissioning, intelligent slice SLA guarantee and intelligent slice closed-loop operations, end-to-end slice delivery and management can be realized. It can be predicted that the combination of AI and 5G slicing networks will promote rapid network development and evolution.

ZTE will reduce the complexity of system maintenance brought about by the 5G cloud native and service-based software architecture through intelligent delivery and operations in the construction of 5G core networks, helping operators worldwide build high-quality 5G networks, focus on 5G services, and create greater value for their customers. ZTE TECHNOLOGIES

EPMS: Digital Delivery Platform for Improving Efficiency

Luo Qiuwen
Director of ZTE Delivery Project Management

Digital transformation has become an important trend in the global science and technology industry. 46% of enterprises around the world will promote digital development as their primary business in the coming year, compared with 69% in China. In the wave of digital transformation, operators place higher requirements on the efficiency, flexibility, and user experience in telecom project delivery.

To improve the delivery speed and help operators seize the opportunity, ZTE keeps pace with the times, embraces changes and puts forward a digital delivery solution—the engineering project management system (EPMS). EPMS is committed to building an anytime, anywhere, collaborative, real-time, intelligent, visual, efficient (ACTIVE) digital delivery platform to make project management more efficient.

Based on years of practical experience in large-scale projects at home and abroad, ZTE's self-developed digital delivery platform EPMS focuses on five functions: progress management, quality management, document management, material management and outsourcing management (Fig. 1).

Progress Management: Intelligent Schedule, Real-Time Report

The most important function of EPMS is to manage project plan and progress, achieving multi-dimensional management from scope, milestone, master plan to implementation plan, as well as project, contract, area, site and task. A typical wireless engineering delivery project may include wireless sites, core network, and microwave products, and the delivery process involves many partners. To fully implement the contract, the plan management and control system needs to integrate and cooperate with sub-plans such as customers, partners, supply chains, and even relevant government departments. EPMS supports intelligent schedule of project plans according to site priority, area, and project implementation phase. A detailed plan, which previously took three days, can now be completed in only half an

hour through the intelligent schedule. According to the detailed plans, EPMS can automatically generate tasks to be assigned to partners, and the partners' construction teams can also report progress or ask for help in real time through mobile applications.

The EPMS report function is to implement data extraction, aggregation, cleaning, modeling and report making through the data center, and visualizes data through the mainstream BI tools. Operators, management staff, and project members can obtain real-time project progress through the screens, PCs, and mobile phones, and track key activities of the sites in detail. The EPMS progress management function can make the plan more intelligent, the process more transparent, and the control easier.

Quality Management: One-Click Report, Closed-Loop Management

EPMS provides an end-to-end online quality management solution that realizes structured quality inspection templates, integration of quality inspection and progress management, self-inspection and rectification, and one-click generation of quality inspection reports. The quality standards and inspection points of an operator can be solidified into the quality inspection templates that are structurally stored in EPMS. The construction team performs online self-inspection in accordance with the solidified quality standards and quality templates to ensure that the quality requirements are completely met and

Fig. 1. Five functions of EPMS.

the quality inspection points are not omitted. Under the permission of relevant laws and regulations, the self-inspection photos will automatically record the longitude, latitude, date, and time data to enhance the credibility of the photos.

The EPMS quality management solution can greatly improve the effectiveness and efficiency of on-site quality inspection. It takes two man-days to complete the quality inspection report of each site by hand, and the period may be as long as seven days. However, if the quality self-inspection is carried out through EPMS, the construction team can complete inspection items according to the quality template and directly submit the generated quality self-inspection report without human intervention.

Document Management: Online Approval, Remote Acceptance

The EPMS online document management solution allows for document interaction among ZTE, an operator, and cooperative partners (Fig. 2), especially helps to improve the efficiency of large projects, and is very popular. During the project initiating period, the project team works with the operator to determine the document template and delivery plan, and integrate the document requirements into the project delivery plan. In this way, site completion documents are bound to the site job progress to ensure that the construction team can output documents on time and with high quality. EPMS integrates a deeply customizable workflow engine that can be customized according to the operator's approval process. By applying the EPMS document module, the approval cycle of a single document in an actual project can be decreased from 20 days offline to 4 days online. In the Italian WT project alone, EPMS has been able to manage millions of engineering documents online.

The EPMS document management module can also be combined with the terminal's EPMS APP, through which data about on-site equipment and installation quality can be collected. The operator performs remote site acceptance based on the highly reliable data, which saves the cost of going to the site and improves the efficiency of network deployment.

Material Management: Daily Accurate Inventory, Consistent Material Bills and Physical Objects

Material management focuses on plan driven scheduling, electronic delivery order (DO), and site acceptance. The plan-driven scheduling ensures that the materials urgently needed on site will be supplied first without affecting the construction period, and those required in the long term are only prepared as planned but not delivered, so as to reduce the pressure of on-site inventory. Although plan driven scheduling cannot compress the supply cycle of materials, it improves the supply efficiency through accurate delivery and fulfills the delivery target required by the operator.

The electronic DO reshapes the site distribution process. After the design manager completes the site design, the bill of site materials is digitally uploaded to EPMS. When rolling and updating the delivery plan, the project manager can arrange the distribution, installation and commissioning plan properly according to the resource constraints in the construction team and local inventory, so as to minimize the loss of goods or

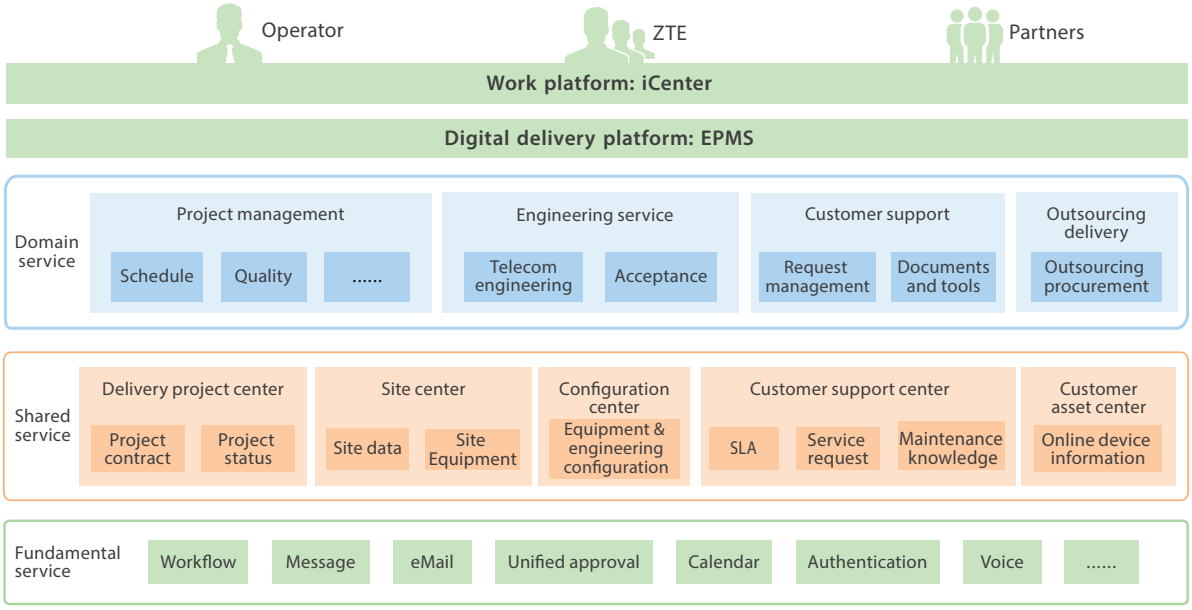


Fig. 2. EPMS architecture.

idle work and ensure the smooth implementation of the site plan. The electronic DO has been fully applied in the Italian WT project. The site acceptance and electronic DO are combined to ensure material bills are consistent with physical objects in both the warehouse and the site.

Outsourcing Management: Accurate Dispatch, Convenient Settlement

Cooperative partners are important delivery resources of ZTE. To improve ZTE's competitiveness in the outsourcing market and allocate better resources to ensure smooth project delivery, the EPMS outsourcing module supports the project management layer to accurately assign workers based on contract configuration data and project plan. After the feedback on progress and submission of quality self-inspection reports through EPMS, cooperative partners can initiate outsourcing settlement online. With the support of system data, the project management layer can quickly approve the outsourcing settlement applications by the partners. For the project that is currently managed online through EPMS, partners can complete the outsourcing settlement only within the 1/4 time of the offline process, and no full-time staff is required to be responsible for the settlement business, which greatly improves the per capita efficiency of the partners.

ZTE's digital delivery platform EPMS has been widely deployed in global projects, which has effectively improved the management efficiency of engineering delivery project. The design concept and operation mode of EPMS have also been fully recognized by operators in practice. ZTE believes that EPMS will help more projects achieve efficient, transparent, and intelligent management. ZTE TECHNOLOGIES

Keys to ZTE 5G Delivery

Yi Weiping

Business Planning Manager of ZTE Engineering Service

Zheng Hong

Branding Planning Director of ZTE Engineering Service

Network delivery is a core task in the telecommunications industry. Excellent and complete network delivery solutions and capabilities are often the keys to vendor success in the industrial competition. In addition to being a leader in global communications technology, ZTE also excels in network delivery. Over the past three decades, ZTE has delivered over 450 medium and large-scale turnkey projects worldwide, built more than 3.5 million sites, and deployed more than 120,000 kilometers of outside plants. The company has provided quality products and efficient services for more than 2 billion users worldwide and obtained their high recognition.

In terms of 5G delivery, ZTE has gained its core competitiveness with decades of rich application experience combined with advanced technologies and its latest achievements.

Intelligent Tools

ZTE has been committed to researching intelligent 5G delivery and providing a complete end-to-end intelligent delivery tools covering network planning, installation and deployment, optimization, acceptance test, and operations to reduce the delivery difficulty and improve efficiency. Automatic integration center (AIC) is the new-generation intelligent end-to-end virtual integration tool platform that helps operators simplify network deployment, automate network operation, and provide excellent user experience.

Intelligent Network Planning

Due to the particularity of 5G Massive MIMO and other technologies, network planning—the first step in network delivery, must be accurate and reliable. ZTE has made significant innovations in

intelligent traffic prediction, intelligent coverage prediction, intelligent antenna feed weight planning, and LTE inventory expansion, and has realized automated PCI and neighborhood planning. This makes network planning much more accurate than expected, and allows ZTE to lead the industry in network planning speed. ZTE can better match operator needs for rapid network construction.

Automated Network Commissioning

In the network deployment, the workload and complexity of commissioning big number of sites are very high, and the complexity of 5G NR makes the commissioning task more difficult. ZTE's innovative solutions for automated installation, commissioning and upgrade can greatly simplify this task and improve the efficiency. ZTE has released BCT and image burning tools that can commission a 5G site in 30 minutes. The UniDeploy tool can achieve minimal deployment involving minimal installation and commissioning. It uses ZTE's self-developed mobile app for easy site commissioning and acceptance. Cloud drive test can also be used for intelligent network optimization.

Intelligent Network Optimization

Network optimization, as the most demanding and difficult task for engineers in network delivery, is the key to a successful delivery project. Relying on revolutionary technological innovation, ZTE has achieved automation in network drive test and single-site optimization, bringing big savings in manpower costs. Through intelligent KPI degradation detection and root cause location, intelligent Massive MIMO antenna feed weight adaptation, intelligent industrial parameter calibration, and automatic capacity parameter optimization, engineers have become "versatile warriors" who can really solve a large number of technical on-site problems with intelligence tools.

Intelligent Operations

Operations run through the whole life cycle of a wireless network, and its operational ability often determines network competitiveness and user satisfaction. ZTE has made epoch-making progress in 5G network operations such as intelligent alarm root location, intelligent load balancing, intelligent optical path fault detection, and intelligent energy saving, which also lays a foundation for rapid delivery of more networks. ZTE's self-developed UniCare—a very simple operations tool has realized unified release of universal functions, customized function development and user self-development, field automation, and intelligent operations.

Fig.1. ZTE won PMI awards.

Intelligent Project Management

Engineering project management system (EPMS), a digital project delivery solution independently developed by ZTE, is committed to creating anytime anywhere, collaborative, real-time, intelligent, visual and efficient (ACTIVE) digital delivery platform that makes project management more efficient.

ZTE has established an end-to-end engineering service capability system worldwide, and has professional teams covering project management, cooperative partners, and expertise in 5G project delivery. As of August 2019, ZTE had set up a team of nearly 2,000 5G delivery experts and formed a mechanism for continuous training and growth of 5G delivery talents, preparing sufficient resources for global 5G delivery.

At present, ZTE has established a three-dimensional network in more than 160 countries around the world, with one global customer support center and three sub-centers in Shanghai, Nanjing and Xi'an, six regional customer support centers (RCSC), 55 local customer support centers (LCSC), and 10,000 after-sales service engineers and 3,000 skill experts. These professionals are the core of ZTE 5G delivery. ZTE has also established a global flexible resource allocation mechanism that can quickly gather resources, establish teams and implement delivery for newly entered markets. The company provides customized technical implementation solutions to ensure smooth project delivery in various complex scenarios. Through years of experience, it has worked out a standard operating procedure (SOP) to ensure the quality and efficiency of project delivery. ZTE has a mature project management system, is a member of the PMI Council, and has won many PMI annual awards (Fig. 1).

The arrival of the 5G era concerned by the whole industry will promote the development of the telecom industry and bring about numerous changes in related vertical industries that are currently unpredictable. 5G delivery will play an important role that cannot be ignored. ZTE will help operators build quality 5G networks efficiently and work with them to move forward steadily in the 5G era. ZTE TECHNOLOGIES

Intelligent Network Delivery Based on Big Data Platform

Qin Tao

Engineer of ZTE Big Data Product Support

In the evolution to 5G, with the enrichment of data services, popularity of intelligent terminals, and gradual implementation of the internet of everything (IoT), the volume of data traffic in communication networks is becoming larger and larger. The huge amount of data cannot be captured or processed by conventional software tools, which brings great challenges to network delivery and operations. A new network management mode that can collect, store, analyze and apply massive communication data becomes an urgent requirement for efficient network delivery. As a result, many big data tools and systems based on the big data platform play a vital role in network delivery, making network delivery more efficient and intelligent.

With rich experience in network delivery, ZTE has applied big data methods in network delivery. By analyzing massive data from core network, wireless side and drive test (DT), ZTE has proposed end-to-end intelligent operations solution, intelligent DT solution, intelligent network optimization solution, and network self-organizing solution for intelligent network delivery. At present, big data tools used in network delivery include value multi-analysis expert (VMAX), wireless network guardian (WNG), network multi-analysis expert (NetMAX) and centralized self-organizing network (CSON), as shown in Fig. 1. These tools play the role of reducing cost, improving efficiency, and simplifying operations in network delivery that involves user complaint analysis, network performance optimization, precise network commissioning, user experience analysis, visual presentation, service/terminal/user analysis, end-to-end automatic fault demarcation, and test data collection and analysis.

VMAX: End-to-End Intelligent Operations Solution

The VMAX system is a petabyte (PB)-sized big data management platform based on the Hadoop technology. It uses end-to-end data correlation in wireless and core networks to rapidly carry out end-to-end fault demarcation analysis, accurately identify wireless, core network, internet, user and terminal faults, and help operators completely improve their operational efficiency and quality and reduce costs. Main functions of the VMAX system include end-to-end one-click complaint, user experience analysis, real-time service guarantee, signaling backtrack, XDR query, session trace, VoLTE media plane demarcation, multi-dimensional report analysis, visual presentation, and precise commissioning.

Starting with real user experience including data experience, voice experience and IoT experience, the VMAX system can help the customer service department quickly confirm user complaints, improve the efficiency of handling the complaints, and automatically transfer the demarcation results of user complaints to the network maintenance department. VMAX has leading service experience modeling capabilities and can quantitatively evaluate the experience of mainstream internet hot applications such as social networking, games, portals, videos, finance and travel, voice services (connection success rate, call drop rate and quality), and IoT services (internet of vehicle, smart transportation and logistics) to meet the system requirements of differentiated network services for operators. The intelligent 5G operations solutions supplied by the VMAX system include network slice analysis, 4G/5G collaborative

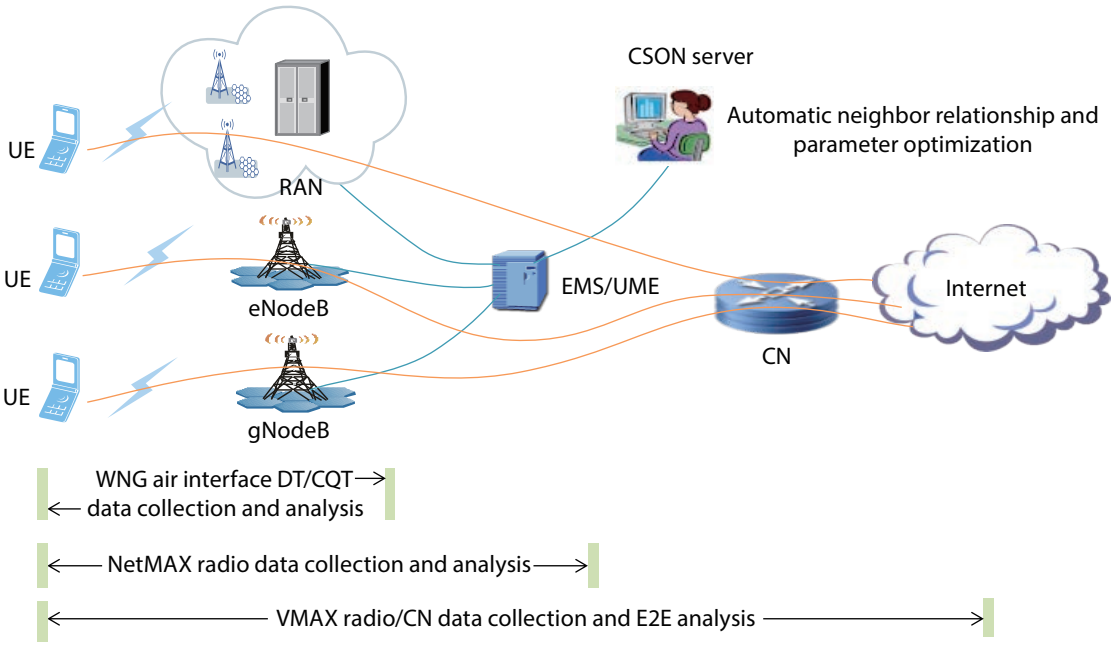


Fig. 1. Intelligent network delivery system.

analysis, 5G monitoring solution, VR service experience, 5G resident experience monitoring and optimization, intelligent network planning, global voice escort, and intelligent factory operations, which can achieve the integration of the whole process of network planning, construction, operations and optimization.

VMAX has been applied in communications networks in many countries. In an overseas project, VMAX played an important role in data processing and improving delivery efficiency through user complaint analysis, inter-operator network comparison, APP time/area domain analysis, user migration analysis, terminal analysis, user profile and poor-quality cell analysis, indoor/outdoor comparison analysis, and 2D electronic map. In less than two months after using VMAX, network operational indicators were improved significantly. Data traffic increased by 78.30% compared with the same period last year, and more than 5000 3G users were migrated to 4G. VMAX was used for the first time in the network guarantee work of Christmas 2019 and New Year 2020. VMAX successfully handled large-capacity data and ensured successful network operations. The operator fully recognizes the help brought by VMAX to the network and plans to expand its capacity.

WNG: Intelligent Drive Test Solution

Drive test is an important method for evaluating performance indicators in wireless network optimization such as network coverage, call hold, and data throughput. Traditional drive test with high cost and low efficiency has always been a challenge to network delivery. ZTE has proposed its WNG solution that can complete drive test with one person and one vehicle. This solution implements simple test, automatic report output through a smart cloud platform, and sharing of cloud resources by many projects, greatly improving efficiency of the test and reducing project costs.

WNG supports four major test scenarios: single site acceptance test, cluster acceptance test, indoor acceptance test, and unattended test. Special test scenarios include MOS test, NB test, and metro test. Unlike traditional test tools, WNG changes the pattern of previous individual test and written report into the test management mode based on platform, modules and packets. It unifies test and report output templates and automates test and report output actions, thus greatly saving costs in network engineering and optimization and improving the pass rate of acceptance tests. The WNG system significantly improves the efficiency of drive test, especially suitable for project delivery of large-scale

networks. This has been verified in many major project delivery at home and abroad. ZTE's self-developed WNG system has been adapted to 5G terminals (ZTE A10 pro) and can meet the requirements of 5G single site and cluster acceptance tests.

NetMAX: Intelligent Network Optimization Solution

NetMAX serves as a wireless network optimization expert system and its data comes from users' measurement reports, call logs and signaling. By collecting user data of the whole network, it rapidly evaluates network coverage and interference and traces back abnormal events in the network, which can greatly improve the efficiency of network operations and optimization. NetMAX can analyze the network from many dimensions such as NE level, user level, terminal level and grid level. Its main functions include coverage analysis, interference analysis, antenna feeder troubleshooting, network performance analysis, VIP user monitoring, in-depth coverage solution, virtual drive test, and terminal capability statistics.

Virtual drive test presents a wireless network coverage analysis solution with the same effect as the traditional drive test by obtaining and analyzing massive measurement reports (MR) with latitude and longitude information in wireless networks, correlating them with call detail trace (CDT), and using the geographic information system (GIS). In the stage of network operations and optimization, virtual drive test partially replaces the traditional one, improves efficiency and reduces costs. Antenna feeder troubleshooting plays an important role in engineering optimization. It helps engineers identify failure sites, reduce the number of visits to the site, avoid repeated drive tests to troubleshoot reverse antenna feeder connections, and improve RF optimization efficiency. The NetMAX system is evolving to network geolocation insight (NGI) to meet the needs of intelligent 5G network optimization. The evolution functions include automatic report of 5G virtual drive test, automatic report of visual coverage, UE capability analysis (SA), competitor analysis, 3D coverage, abnormal event analysis, and anchor rationality check.

CSON: Network Self-Organizing Solution

CSON is a GSM/UMTS/LTE wireless network self-optimization system independently developed by ZTE. The CSON self-optimization flow can provide automatic closed-loop optimization to save manpower and improve efficiency. The main functions of CSON include neighbor cell self-optimization, frequency and scrambling code optimization, high-load scenario optimization, LTE CCO antenna feeder parameter optimization, and initial site commissioning parameter setting.

The neighbor cell self-optimization function includes automatic addition and deletion of intra-RAT, inter-RAT, and inter-frequency neighbor cells, and adjustment of neighbor cell priority, which can reduce dropped calls caused by improper neighbor cell relationships and improve the handover success rate.
The LTE CCO antenna feeder parameter optimization function can give suggestions for adjusting RF parameters, send the RF parameters to EMS, and synchronize them to the base station, so as to automatically solve the coverage problems such as weak coverage, cross-cell coverage and overlapped coverage, and improve the efficiency of operations.
A 5G network requires a self-optimization solution that is fully intelligent and can adjust its policies independently. CSON introduces AI reasoning to implement intelligent policy execution and closed-loop optimization. The intelligent energy-saving solution is evolving to achieve fully adaptive energy saving based on energy-saving objectives and user experience.

With the development of 5G, IoT and AI, the construction of smart factories and smart cities, and more diverse terminal types and service applications in telecom networks, operations and delivery of the networks will face greater challenges. ZTE's intelligent network delivery solution based on big data will continue to upgrade intelligently to help operators accurately plan and build networks and enhance their value. ZTE TECHNOLOGIES

Delivery of Elite Merger Network to Share 5G

Wang Liangbo

Senior Engineer of Network Planning & Optimization, ZTE

Since the beginning of 2020, global 5G networks have been gradually put into commercial use. With the expansion of 5G deployment from large operators in large countries to small and medium-sized operators in small and medium-sized countries, the small and medium-sized operators are facing practical issues of 5G development. These issues involve how to solve the lack of funds for 5G deployment when the cost for deploying 4G has just been recovered, how to deal with too long returns of 5G Capex when there are few terminals supporting 5G at present, and how to ensure 5G first-mover advantage if it is now impossible to invest in large-scale 5G deployment.

To address these issues and achieve low investment and high returns for operators, a new option for merging networks has emerged for 5G deployment. The solution enables two operators to merge their infrastructure 2G, 3G or 4G networks and jointly build and share a 5G network. Due to high spectrum costs and power consumption, 5G network will cause high Capex and Opex for operators. As a result, small and medium-sized operators are easily squeezed out of the market. To seize 5G opportunities, the merger network solution will become a new trend for these operators to deploy their future wireless networks. ZTE has rolled out a delivery solution for elite merger network that can help operators retain existing users and greatly reduce their Capex and Opex in existing infrastructure and new 5G network.

End-to-End Merger Network Solution

Merging different networks of two operators needs an end-to-end technical solution on the network side. The solution involves merging on both the core network part and the radio network part, and the two parts coordinate with each other.

Core network merger is the first step and needs to implement and verify multi-PLMN and new PLMN+EPLMN solutions. The two key solutions ensure that old users of the two operators can be identified and connected to the shared network, and roaming users as well as new SIM users can be rapidly registered to the network.

Radio network merger usually involves many devices from different vendors, and needs tailor-made solutions to meet actual requirements of each operator. The merger solutions focus on three key user experience indicators: user access, service continuity and mobility, and include many key technical solutions such as 2G/3G/4G multi-band interoperability solution, user access solution for merger area, user mobility solution for merger boundary, and multi-vendor equipment compatibility solution for the boundary. These solutions guarantee basic services and normal experience of call access, hold, and handoff for two networks' users during and after the merger process.

Identifying Valuable Areas

Based on multidimensional data from big data tools, MR, traffic, KPI, ACP, customer complaints, and VIP areas, planning of merger network can achieve real network re-planning and re-deployment. With the analysis of multidimensional data on the existing network, it is easy to identify valuable areas and help operators address their pain points. Accurate

planning of merger network in valuable areas are carried out based on the existing network model. After the merger process, site capacity can be re-planned for the valuable areas as required by actual network traffic. This can significantly improve user experience in these areas.

In remote non-valuable areas, planning of merger network really considers operators' needs for cost saving. While ensuring basic coverage, redundant sites are offlined to reduce network maintenance costs.

Accurate planning of merger network will help operators effectively enhance user experience in hot spots and increase market profitability. It can also help operators significantly reduce unnecessary network O&M expenses and improve their return on investment (ROI).

Enhancing Network Value

In a merger network project of two overseas operators, ZTE proposed and verified several technical solutions in the onsite lab environment to meet special needs of the two operators. In merging two different telecom networks, problems of handover, re-selection, paging, and roaming between two networks' users at the merger boundary were solved. Seamless connection between the merger and non-merger areas could be implemented to ensure consistent user experience. However, due to many devices from different vendors as well as inconsistent parameter settings and strategies of the two operators in the merger network, there were some hidden issues that affected user experience and could not be reflected by KPI.

To find out the hidden issues in the network and improve user experience, ZTE collaborated with operators to trace, reproduce, and analyze each suspected one. Through abnormal signaling flow analysis, they located many conflict scenarios between core network and radio network in the merger network, and finally solved these hidden network issues by means of parameter optimization and hot patch optimization. This also helped to enhance user experience.

With the sites properly distributed, capacity increased in hot spots, and hidden network issues solved one by one after the merger, both user experience and satisfaction were significantly improved. ZTE succeeded in the delivery of an elite merger network for two operators, which enhanced their network value and brand reputation.

Looking Forward to 5G Deployment

Following the current global mainstream 5G NSA deployment scenario, the delivery of an elite merger network has laid a good foundation for 5G deployment and can bring many advantages.

While core networks are merged for two operators, the topology of their core network elements are optimized. This will facilitate 5G solution and save the cost of upgrading and deploying 5G core network in the future.

In the process of network merger, the transmission part on the radio side is upgraded and transformed. This will reduce great radio and transmission upgrade costs for subsequent 5G deployment. With the reasonable site planning and redundant site offline, operators can allow users in two networks to access 5G network with relatively little Capex. Moreover, with the increase of site density after the merger process, they can also achieve better network coverage.

For the future 5G NSA network, accurate site planning of merger network in valuable areas can take 4G anchor distribution into account, reduce the difficulty of 4G anchor selection, and save the planning and time cost in new anchor deployment.

After the delivery of an elite merger network, re-optimization for 2G/3G/4G basic networks will be completed to ensure good network quality and significantly improve user experience. This can avoid solving 2G/3G/4G basic network issues in 5G deployment, clearing up obstacles to 5G delivery. ZTE TECHNOLOGIES

Highly-Efficient, Agile Project Management

Zhou Kaixiang

PMO of ZTE Engineering Service Operation Division

Yu Fang

PMO of ZTE Engineering Service Operation Division

In recent years, the rapid growth of user demands for network applications has promoted the internet traffic to grow at a rate of more than 40% per year, which is also a key factor in driving network construction. With the impending large-scale commercial use of 5G, both network operators and service providers are facing the formidable challenge of fast and high-quality project delivery. When volatility, uncertainty, complexity and ambiguity become the new status of the project environment, ZTE's network delivery project management takes an active, agile and insightful approach.

With more than 30 years of experience in large-scale global network project delivery, ZTE has formed a complete operation system, including digital transformation, efficient and agile project management methods, an accurate project delivery operation process, a three-dimensional project management control mechanism, and professional team building. The system ensures highly efficient project delivery, improves operators' satisfaction, and helps operators achieve commercial value.

ZTE's Project Delivery Operation System

Digital Transformation

Digital transformation is a big trend in the global hi-tech industry. ZTE has the vision of digital transformation, that is, enabling higher efficiency of operation and providing better services through digitized operations (Fig.1). It proposes the engineering project management system (EPMS)—a digital delivery solution to build a digital engineering service delivery platform that is "anytime, anywhere, collaborative, real-time, intelligent, visual and efficient". The EPMS provides four main functions: progress management, quality management, document management, and material management.

- **Progress management:** The progress management module has multiple dimensions ranging from scope, milestones, master plans to plan implementation, contracts, areas, sites, and tasks. The project plan is compiled online, and tasks are generated and distributed to partners. The construction team can report the progress in real time or ask for help through mobile applications. The EPMS has powerful report capabilities, and the customer can easily learn the project progress through various report services in the EPMS.

- **Quality management:** The construction team can perform online self-check in accordance with the preset quality standards and quality templates. The self-check photos include longitude, latitude, date, and time information. The back end automatically generates quality reports. The customer and ZTE's project management team can perform remote spot check, acceptance, or issue rectification forms without going to the site.
- **Document management:** Online document management enables document interaction among ZTE, customers, and partners to improve the delivery efficiency of major project documents. In addition, the customizable approval flow is integrated, and the customer can perform remote site acceptance with reference to the on-site equipment information and installation quality information collected by the EPMS APP, thus saving the on-site costs and improving the deployment efficiency.
- **Material management:** Material management focuses on three aspects: large cycle, small cycle, and consistency between the accounts and facts. The big cycle is driven by an engineering plan. According to the material requirements of the site to be executed, the construction team shall submit sets of batch delivery to the headquarters to ensure that the shipments from the headquarters are what is urgently required on-site. The small cycle is to reshape the site distribution process based on the electronic delivery order (DO), thus promoting the consistency between the accounts and facts and digitizing the whole process of material management.

At present, the EPMS has been widely used in thousands of ZTE's projects in more than 100 countries, achieving remarkable results.

Project Management Methods

By summarizing project experiences and referring to the project management body of knowledge (PMBOK) and advanced methodologies in the industry, ZTE has formed a complete best-practice methodology for customer delivery, including process, guide, template and best practice case library.

Based on this methodology, ZTE defines a series of key project management actions.

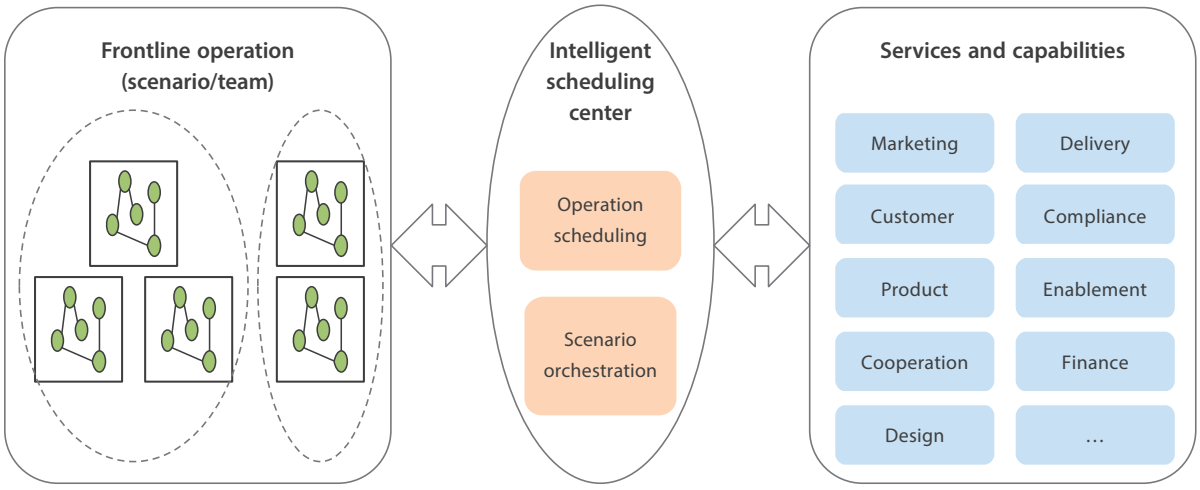


Fig. 1. Digital transformation.

For each of the five major processes (start, plan, execute, monitor, and close), ZTE formulates key management actions focusing on communication among related parties, risk/problem solving, progress and quality monitoring. These actions ensure that all steps of project management are organically and orderly integrated and help the project team advance a project in a more standardized and efficient manner. In addition, ZTE incorporates agile–one of the fastest growing management technologies for early delivery, continuous improvement, and scope flexibility–to establish its own agile practices according to the characteristics of delivering the telecom networks.

Accurate Delivery Project Operation Process

Large-scale telecom network deployment involves multiple products (e.g. wireless, wired, and microwave), multiple services (e.g. civil engineering, network planning and optimization, and equipment installation), and multiple systems and scenarios. If there is no complete end-to-end operation process, project delivery efficiency and quality will be greatly affected.

ZTE plans an end-to-end project delivery process, and formulates a standard operating procedure (SOP) that interconnects with the customer's operation process, while creating a complete set of end-to-end standard operation guides for fast project coordination and accurate implementation.

The SOP has been configured in the project management system electronically. The next task will be triggered when the present task is completed. The SOP has been used in global delivery project management (Fig. 2).

Project Management Control Mechanism

By setting up a multi-level project management office (PMO), ZTE forms a three-dimensional project communication and management control mechanism, including project promotion meeting, project review mechanism and problem/risk escalation mechanism, to help achieve the project objectives.

Professional Team Building

The project delivery team, comparable to an army, needs an excellent general and a group of soldiers.

Based on the project manager competence development framework (PMCDF) of the project management

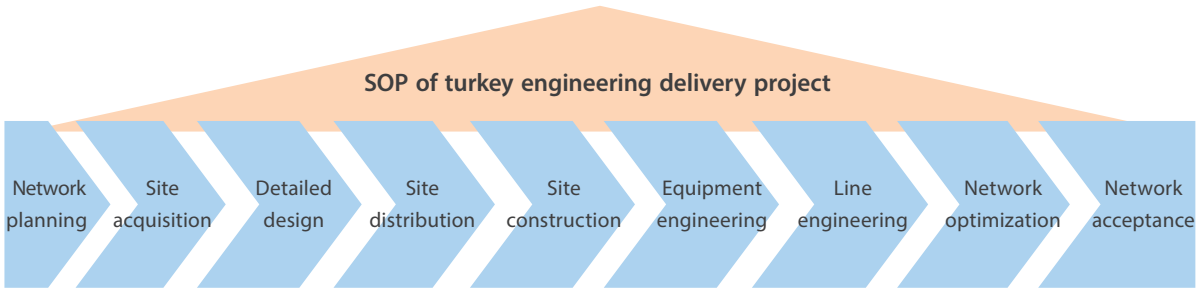


Fig. 2. SOP of a turnkey engineering delivery project.

2019 PMI (China) Project Excellence Award (WT Project in Italy)
Best Enterprise Practice Award for 20 years' development of project management in China

2017 Outstanding PMO Award of PMI China (R&D PMO)
Software Measurement Model Enterprise granted by China Software Industry Association (R&D field)

2016 Achieving the CMMI level-5 certification (R&D field)

2015 Annual PMO Award of PMI China (PMO of the Engineering Service Operation Division)

2013 South Africa's SAICE Award for Project Management and Construction

2012 PMI (China) Project Excellence Award (Beijing Rail Transit Project)

2011 Annual PMO Award of PMI China (PMO of the Company)
PMI (China) Project Excellence Award (Nepal NCELL Phase II Project)
PMI (China) Project Excellence Award (ZXSDR-NodeB Product Package Project)
PMI (China) Project Excellence Award (Cloud Computing Component Platform Project)

Fig. 3. Awards won by ZTE in project management.

association (PMI), ZTE establishes a scientific project manager selection and retention mechanism in terms of knowledge capability, practice capability and personal capability as well as the career development path of the project management personnel, to continuously provide high-quality talents for project delivery.

A qualified project manager can lead a team to carry out a project only after being trained and certified by the capability center.

Awards Won in Project Management

ZTE's project management won the 2019 PMI (China) Project Excellence Award and the Best Enterprise Practice Award for 20 years' development of project management in China, indicating that ZTE's organizational project management capability is leading in China.

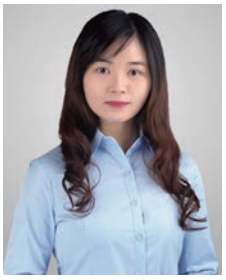
Italy's WT Project, as the winner of project excellence award, sets a good example of project delivery in a high-end market. The WT project department is established through the project organization model innovation, which improves project resources investment and management of responsibilities and rights, project operation and decision-making efficiency, and project management and service integration through completing the project management mechanism. In addition, to enable digital transformation, the EPMS interconnection and interworking platform is built to realize information sharing among customers, subcontractors and ZTE as well as visual management, which greatly improves project management efficiency.

With the development of global 5G standards and pilots, 5G is moving closer to reality. Capitalizing on its global delivery practices, ZTE constantly improves its integrated delivery management capabilities to help operators build more efficient, reliable, and stable networks in the 5G era. ZTE TECHNOLOGIES

ZTE AIVO Solution: Realizing AI-Empowered Value Operation

Li Wenlong

Big Data Planning Manager at ZTE



Lu Chunmei

Big Data Planning Manager at ZTE

Jiang Xianzhong

Big Data Planning Director at ZTE

With the acceleration of 5G networks deployment and rapid growth of traffic, operators face the challenges of huge and complex network systems and difficulties in network management and service operation that are beyond the manual processing capability.

ZTE AI insight value operation (AIVO) solution (Fig. 1) aims at solving the pain points of operators. Based on a unified platform integrating big data and AI, the solution provides the digital operation sand table and support system to help operators improve integrated management of network planning, construction, O&M optimization and service development, and each domain's efficiency.
On the one hand, the solution proactively discovers operational problems through a predictable network, service, and user insight, and rapidly achieves end-to-end optimization. On the other hand, driven by data, it achieves interconnection of planning, construction, O&M optimization and service development, integrates the operators' production requirements into the big data analysis platform, and implements intelligent, closed-up full-process service processing with AI enablement.

One Foundation

The AIVO solution provides intelligent insight into telecom data. It uses big data and AI to integrate full data of all domains, and is capable of collecting 100GE big data, identifying over 10,000 services and assigning over 9,000 tags to user profiles across multiple industries. It provides three-dimensional insight into network, services and users in terms of quality, value and development.

At the network level, the solution can automatically identify the poor quality NEs, poor quality cells and value areas, and intelligently predict the network capacity and performance. At the service level, it can report the status of 2G/3G/4G voice service and various data services in real time, and provide insight into the quality of voice and video services through second-level slices. At the user level, it builds an intelligent perception evaluation system for each service of each user to accurately assess user experience and provides insight into behaviors and preferences of high-value customers based on user profiles to guide personalized smart marketing.

Two Types of Integration

Based on ZTE's intelligent big data platform, the AIVO solution achieves two key types of integration: the integration of big data and AI into an architecture to provide intelligent big data openness capability; and the integration of network O&M and service O&M to provide integrated, intelligent O&M capabilities.

Big Data + AI Integration

The solution builds an integrated system including a big data platform, an AI platform and NM to form a unified data lake and AI capability, and opens data and AI capabilities via OpenAPI to support fast customized development and provide intelligent application data service. It supports intelligent operation combining the homing and hosting modes. The homing mode carries out intelligent training and releases typical AI models to the model market through moving data into a data lake, unified data governance and modelling. In the hosting mode, the on-site system obtains a model from the model market, iteratively preforms optimization based on the existing network data, and realizes intelligent operation.

Network O&M and Service O&M Integration

The solution enables interconnected management of the NE layer, network and service management and control layer, and service operation layer through data connection and sharing. It offers the integrated O&M capability with "unified view, whole domain perception, intelligent closed loop and active O&M". On the one hand, it provides a real-time, customizable unified operation view to support operation decision-making. On the other hand, the system accurately predicts and locates faults by associating all domain perception data, and intelligently solves problems in a closed loop by connecting the alarm and work order systems, thus forming the active O&M capability.

Smart & Simple O&M and Optimization

The solution provides intelligent and automatic capability, and improves O&M and optimization efficiency in complicated networking. In the VoLTE project, the AIVO solution provides O&M guarantee for over 100 million VoLTE subscribers, and promotes the growth of millions of subscribers each month. In the BS energy-saving project, the AIVO solution is implemented in more than 10,000 cells. While keeping the network indexes stable, the intelligent power-saving application time of the BS is increased by 80% compared to the traditional manual power-saving time, and the power consumption is reduced by 10% to achieve the green operation.

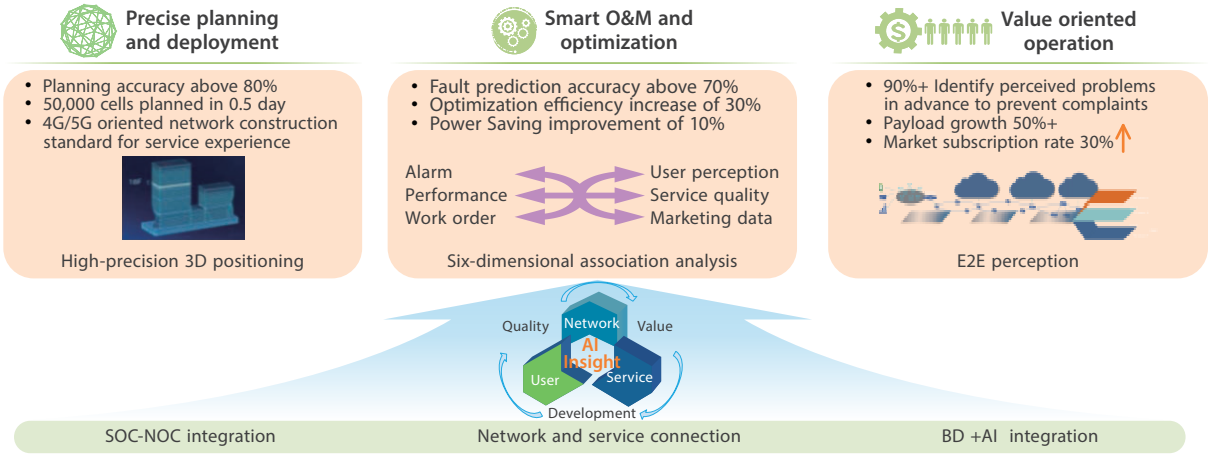


Fig. 1. Panorama of AIVO solution.

Three Major Applications

Based on the big data analysis and AI enablement platform, the AIVO solution continuously creates value for operators through precise planning, intelligent optimization and O&M, and value operation.

Precise Planning and Construction

The solution adopts an accurate 5G planning scheme based on the existing 4G network, makes full use of the existing network and environment information, and outputs agilely the expansion construction scheme through such means as intelligent network prediction, scene-based site selection and value sorting. In actual projects, 50,000 cells can be planned in half a day. Site planning is simplified by 28% than the initial solution, and the coverage excellence rate can reach 95%.

Value Operation

By utilizing big data user profile technology and AI methods, the AIVO solution provides precise marketing, and support for payload improvement and user development. In practical projects, it can identify potential 5G customers, and implement precise service provisioning and package recommendation for 5G users. Through user migration, hot service and regional analysis, and precise marketing of low-traffic users, the solution helps the customer increase the payload by over 50% and increase the marketing subscription conversion rate by 30%.

The ZTE AIVO digital operation solution has been widely applied in over 30 networks around the world, and ZTE has carried out value operation exploration with more than 80 partners. With the deep integration of big data and AI into telecom network operation, the AIVO solution will continue to help operators improve their efficiency and support telecom operators' service innovation and revenue growth in the new 5G network era. ZTE TECHNOLOGIES

Smart Hippo: An Intelligent Platform for Network Planning

Yi Weiping

Business Planning Manager of ZTE Engineering Service

Zhang Baoshu

Product Manager of Intelligence Network Planning Platform, ZTE

In the 5G deployment, operators are faced with new problems such as technological innovation, complexity and high Capex, which makes them pay more attention to the quality of network deployment. To be accurate and avoid detours at the initial stage of 5G deployment, good wireless network planning has become quite important.

Limited by technical conditions such as tools and algorithms, 2G, 3G and early 4G network planning is chiefly based on network simulation and prediction. However, with the introduction of Massive MIMO in 5G, the traditional network planning has been unable to meet the needs of new technologies, and it is imperative to innovate the wireless network planning. To this end, accurate and efficient network planning and deployment so that the network provides not only conventional area coverage but also excellent three-dimensional performance, has become the goal of the industry.

ZTE has independently developed Smart Hippo, an intelligent platform for wireless network planning that can accurately and efficiently solve the problems of 5G network planning and raise the network planning capability to a new level. Even in more complex 5G scenarios, Smart Hippo can have good applications and achieve the goal of accurate, intelligent and efficient network planning.

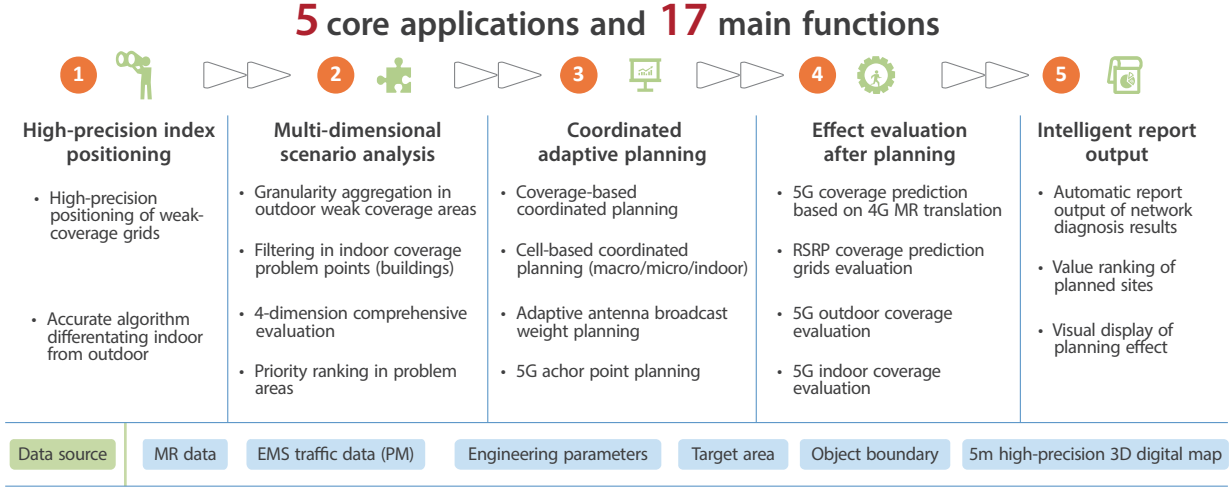


Fig. 1. Applications and functions of Smart Hippo.

Smart Hippo aims at both coverage and capacity, and focuses on planning and analyzing intelligent and accurate multi-site coverage. Based on real measurement report (MR) and network management data, Smart Hippo implements adaptive deployment of macro cells, micro cells and indoor distributed cells through comprehensive coverage and capacity evaluation.
In 5G network planning, it takes the particularity of 5G antenna into full consideration. Based on the completion of accurate site planning, combined with 3D electronic map, using the principle of black and white dots, Smart Hippo accurately carries out antenna weight planning, and creates an integrated design concept of combining site planning and antenna planning. As a dynamic and intelligent platform, Smart Hippo provides full process analysis such as coverage evaluation, site planning, MM weight planning and coverage prediction, which forms a double-edged sword with simulation tools in the field of network planning. They can complement each other and innovate to enrich network planning methods.

The rise of innovative technologies such as big data, cloud computing and AI provides a strong support for Smart Hippo. Big data enables network planning to effectively use real mass data, and makes the basis for network evaluation, planning and design richer and more solid. Cloud computing enables more powerful system support and higher resource allocation and utilization. AI provides deep learning to revolutionize traditional network planning methods.

Smart Hippo innovates in hybrid multi-site planning, coverage pre-evaluation, antenna weight planning and anchor point planning to automate the processes based on 5G sites, new sites, site deployment display, site value ranking, planning report and layer output. Smart Hippo provides 5 core applications and 17 main functions for 5G network planning (Fig. 1).

Smart Hippo can implement 5G coverage planning, antenna weight planning, and anchor point planning, and its main functional modules include high-precision index positioning, multi-dimensional scenario analysis, coordinated adaptive planning, effect evaluation after planning, and intelligent report output.

Future 5G deployment will adopt the mode of “accurate area coverage prediction followed by fine key scenario evaluation”. The innovative technologies of Smart Hippo will become a strong guarantee for building high-quality, high-performance 5G networks. The improvement of cell-based coordinated planning, granularity aggregation in outdoor weak coverage areas, precise weight planning, and 5G anchor point planning can give full play to 5G innovative technologies and maximize the utility of wireless coverage evaluation. 5G coverage prediction based on 4G MR is a featured application that makes full use of huge data in existing networks to support 5G planning and design. A major principle of future 5G deployment is to focus on key areas, especially the existing network defects, evaluate according to the value dimension, and solve the high-value difficulties in the network.

To make wireless network planning efficient while ensuring the quality of planning, Smart Hippo will continue to improve, so as to better meet operator needs of fast network evaluation and deployment. Smart Hippo will become a powerful tool for operators to plan their networks. ZTE TECHNOLOGIES

Wind Tre: Building the Best Network in Italy from Scratch

Li Chenhui

PMO Director of WT Project, ZTE

In September 2016, the European Commission approved the merger of Wind and H3G in Italy to create a new company named Wind Tre. The two separate legacy networks of Wind Tre had problems like poor coverage, insufficient capacity and aging equipment, and could not support the evolution to 4G Pro and even 5G, which will undermine its market competitiveness. Therefore, network reconstruction and upgrade were in an urgent need. With advanced technology and delivery capability, ZTE exclusively won the bid for Wind Tre's national wireless upgrade project in December 2016.

The Wind Tre project was the largest and the most complicated network consolidation project ever undertaken by ZTE. It was the first time for ZTE to deal with the special site permits, all-round EHS requirements, GDPR and CPR regulations. Wind Tre also stated that this project is the most difficult one to complete in Europe in the past decade. ZTE was destined to fight an arduous battle.

Fast Running-in to Pass the Initial Test

The newly-formed Wind Tre had become the largest wireless operator in Italy. Wind Tre expected to complete the network upgrade quickly and reduce the start-up period, so as to drive the digital transformation. The start-up time for multiple services was required to be

one to three months earlier than that required in the contract.

However, ZTE had no delivery experience in the local place at that time. So everything started from scratch. Facing this huge challenge, ZTE established a president-led project steering committee, which carefully selected project management members and senior business experts from around the world, and formed the project department. In the first month, the management team and key members were in place. In the second month, offices for four regions and 15 sub-regions as well as a local team were set up. Tests were finished in the third month, hence site construction was started as scheduled. Both sides established a good communication mechanism to enhance mutual trust. ZTE also worked with the subcontractors to set up a war room to solve problems end to end and build one team with one goal.

ZTE's efforts won recognition from Wind Tre. At the beginning of 2018, Wind Tre's senior management team came to ZTE's Milan-based office for a visit, during which they showed great appreciation of the hard-won achievements made by the ZTE team, and expressed full confidence in the cooperation between both parties.

Efficient Coordination to Create a Miracle of Delivery

The Wind Tre project delivery solution is complex, involving five bands, seven systems, hundreds of site models and thousands of antenna feeder scenarios. The key path of network consolidation reaches 270 days with many risks of uncertainty. Swap, overlay, building new sites, dismantling and other services were implemented concurrently. The number of sites delivered monthly exceeded 1,000, which means extreme difficulty in management. Italy has a very strict electromagnetic field (EMF) exposure limit (6 V/m), resulting in a fairly long period of obtaining permits and constraining the site construction process. In addition, the comprehensive EHS management requirements, together with the new EU and local regulations such as GDPR and CPR, also posed new challenges to ZTE.

ZTE's project team established a fast channel to connect with the company's senior management and headquarters to obtain resource assurance and full authorization, organized project-based global supplier conferences, and built industry chain alliances with customers and downstream partners. As to the delivery bottleneck on site permit, the temporary solution and the final solution were performed in parallel to meet the rapid network construction requirements of Wind Tre while maximizing internal efficiency. To deal with the complex and uncertain environment and numerous constraints, ZTE has formed a "334" project management method. This includes three management methods (precise objective management, efficient process management and delicacy management), three innovations (the organizational model with integrated rights and responsibilities, innovative solutions based on local conditions, and customized system tools), and four guarantees (talent cultivation guarantee, two-level resource pool fund guarantee, extended material end-to-end guarantee, and outsourcing resource guarantee).

After three years of painstaking efforts, ZTE's project team completed the relocation of more than 10,000 sites and network consolidation, and created a delivery miracle. The monthly output of permit files involved over 1,200 sites and the monthly maximum number of swapped sites exceeded 1,300, breaking the local historical records. ZTE has

successfully helped Wind Tre complete spurts of progress several times, winning high praise and a project bonus of millions of euros from Wind Tre.

At the PMI (China) Project Management Conference 2019 held on October 26, 2019, the ZTE Italian Wind Tre project won the Project Excellence Award due to its excellent project management and efficient execution.

Sincere Services to Build a Quality Network

Adhering to the culture of "serving with dedication and being committed to customers", ZTE tries hard to provide high-quality services for customers. Guided by the ISO9001 standard and ZTE's own quality process, ZTE implements quality management to effectively control reversed sector, TMA, SWR and other quality problems while establishing a complete environmental health and safety (EHS) organization and operation mechanism to ensure personnel health and construction safety. At the first quality summit held by ZTE in 2019, Fabio Massimiani, chief architect of Wind Tre, shared some cases and expressed hope to create a new 5G ecosystem with ZTE.

ZTE dispatches R&D and technical experts to the front line to communicate with customers about product solutions and technology evolution to ensure the competitiveness of its solution. In addition, ZTE provides differentiated services based on customer needs, and provides high-quality network guarantee for major events such as Sicily concerts and Champions League. Wind Tre has the network performance greatly improved after consolidating two networks. As reported by the local media, the data volume in the integrated area increases by

ZTE's first quality summit held in 2019

The project celebration meeting held in 2019

270.0%, call drop rates of 2G and 3G calls decrease by 38.2%, the network availability increases by 2.4%, and the LTE DL throughput increases by 18.1%. In the network quality evaluation organized by P3, a well-known third party testing organization in Europe, the Wind Tre network ranked first overall with excellent indexes, making it the best local network.

Innovative Solution to Reduce Cost and Increase Income

Based on ZTE's unique Uni-RAN solution and highly integrated equipment, the Wind Tre network supports integration of 2G, 3G and 4G networks and smooth evolution to 5G, greatly reducing TCO. The number of base stations was reduced from 21,000 to 19,000 with energy savings of 25%. ZTE's self-developed energy & efficiency solutions further reduce energy consumption and improve system efficiency.

Successful project delivery contributes to the success of Wind Tre's business and brings long-term value. After the network consolidation, the operating expense as a percentage of revenue was reduced from 36% to 29%, and the EBITDA margin increased from 18% to 44% in 2018. By stabilizing the average revenue per active customer in 2019, Wind Tre keeps growing steadily in business performance. Wind Tre has achieved corner overtaking in only three years.

Wind Tre CEO Mr. Hedberg highly praised ZTE's capability and acknowledged the strategic importance of the cooperation. Wind Tre CTO Mr. Hanssen said during a media interview that ZTE is technically strong, and has accumulated much valuable experience during China's network construction, making it the best supplier for Wind Tre. At the project celebration meeting held on December 12, 2019, high-level leaders from both parties granted prizes to each other. Wind Tre's top management thanked again ZTE for its efforts in the past three years, and expressed hope that both parties will continue to cooperate faithfully on the 5G project and win the future together. ZTE TECHNOLOGIES

Drei Austria, ZTE and IoT40 Jointly Develop 5G Bee-o-Meter for Biotech

Wu Wenjia

ZTE Brand Manager

Along with the rapid development of the global economy, climatic and environmental problems are becoming increasingly severe, threatening the world's every survival. In recent years, the living environment of bees has deteriorated in Europe and even the whole world. In agroecosystems, pollinators are essential for crops. Pollinators such as bees, birds and bats affect 35 percent of the world's crop production, increasing outputs of 87 of the leading food crops. Due to the immensely valuable contribution from bees, it is imperative to find a solution to improve the living environment of bees and protect the ecology. 5G network, which features large bandwidth, low latency and massive connections, opens a new way for environmental problems.

A Collaborative Effort

ZTE has cooperated with Drei Austria and IoT40 to carry out a 5G Bee-o-Meter research and pilot in Austria since 2019, which allows 5G to improve the living environment of bees via visual analysis and other technologies.

"We are very glad to be the first one to bring 5G together with Drei Austria to Austria", says Christian Woschitz, CEO of ZTE Austria. "We had an idea to do something connected with the environment and local company to really bring value added to the Austrian market. So we achieved to find out our partner IoT40 together with Drei Austria to develop the so-called 5G Bee-o-Meter."

"5G Bee-o-Meter is a good showcase demonstrating what you could do combining real-time video, AI and 5G capabilities", explains Matthias Baldermann, CTO of Drei Austria. "Drei Austria contributed the network planning and connectivity expertise. ZTE provided 5G core, radio network technologies and 5G CPE. And IoT40, our partner, implemented very quickly the beehive hardware and AI training for the 5G Bee-o-Meter prototype."

Christian Inzko, CEO of IoT40 Systems, adds that ZTE is a strong partner to get this beehive more generally to the communities and to other potential customers, and it is an interesting showcase how 5G can work for the public.

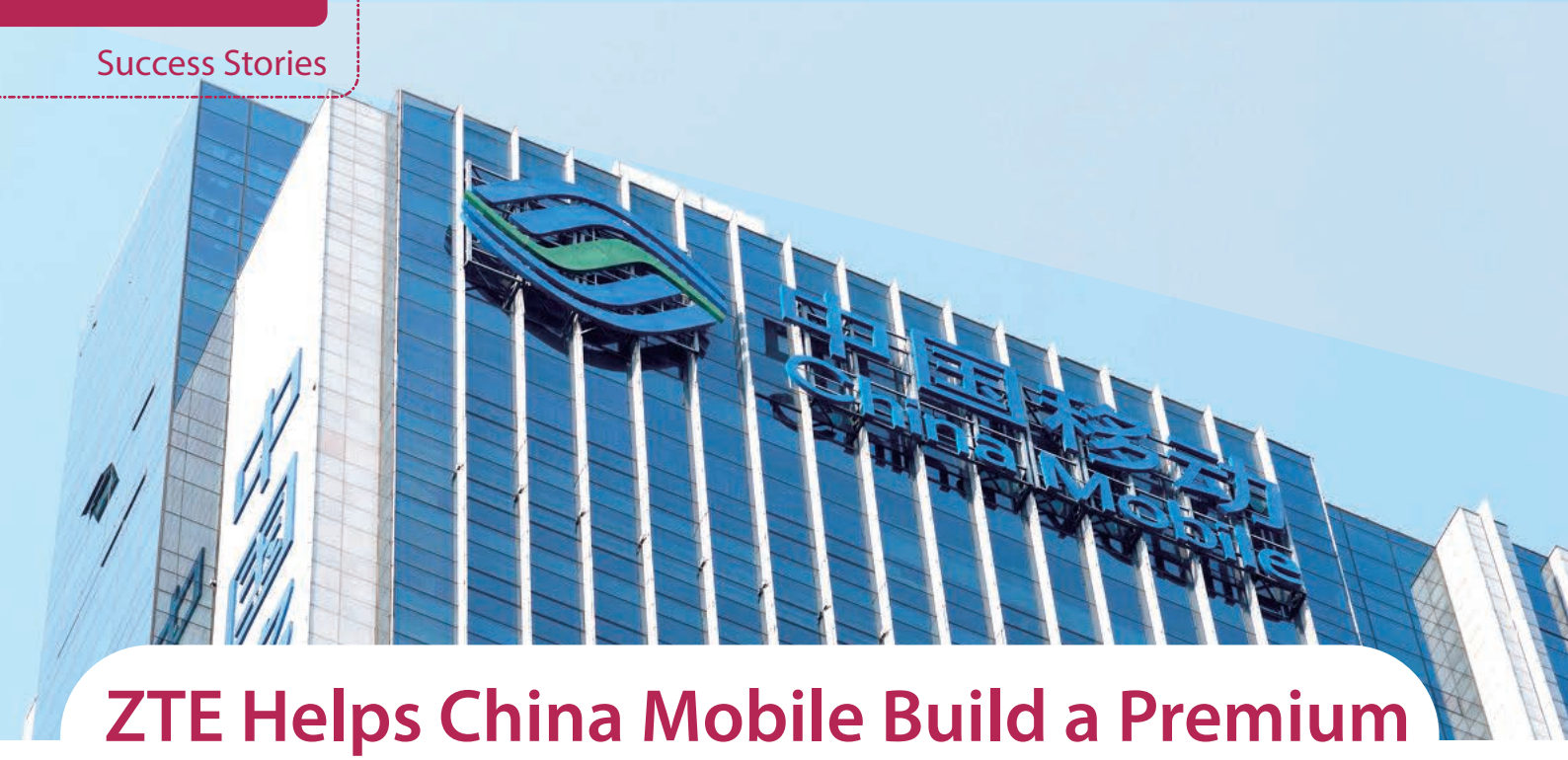
Future Prospect

The 5G Bee-o-Meter offers great benefits. "I think we all agree on the importance of environmental protection," says Matthias Baldermann, CTO of Drei Austria. "We can demonstrate the potential of new technologies, contributing to the actual challenges of these days. Counting bees in real time, detecting specific intruders or bee sicknesses would support the bee-keepers, help the agricultural research industry and provide valuable environmental quality information to regional authorities."

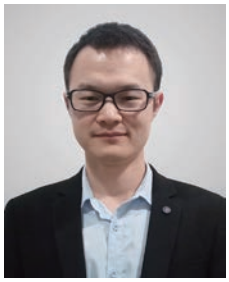
Thomas Schweege, a bee-keeper, acknowledges that 5G Bee-o-Meter gives him around-the-clock, real-time access data to the beehive, "Without that, I would only watch the bees once a week but now I can watch from the office and get alerts."

Albert Schittenhelm, President of Regional Association for bee-keeping in Vienna, pins hopes on the 5G Bee-o-Meter collaboration: " We hope that the collaboration of ZTE, Drei Austria and IoT40 will bring results for us. We would hope to get some backing and inputs on bee sicknesses, robbery, poisoning and so on, which will help us better manage our beekeeping challenges in the future."

With large-scale commercial use of 5G, ZTE will strengthen the cooperation with Drei Austria, IoT40 and industry partners to apply the key technologies to the 5G Bee-o-Meter. In the coming days, the number of 5G Bee-o-Meter hives is expected to increase to 1000 in Austria to cover the biological quality evaluation of the whole Austria. ZTE TECHNOLOGIES



ZTE Helps China Mobile Build a Premium 5G Network with Intelligent Delivery



Jiang Shi

Wireless Project Director at ZTE

China officially launched its commercial use of 5G in 2019. As the operator with the world's largest network scale and largest customer base, China Mobile has deployed over 50,000 5G commercial base stations in 31 provinces and enabled 5G commercial services in 50 cities, greatly contributing to the global end-to-end 5G industry. However, China's vast territory, complicated topography and dense population, when combined with multiple co-existing networks of China Mobile, pose great difficulties for 5G network construction.

ZTE, a strategic partner of China Mobile and a major contractor for its 5G network, has proposed to the operator an end-to-end intelligent delivery solution covering a life cycle's four key phases (planning, construction, maintenance, and optimization). This reduces network delivery difficulties, enhances delivery efficiency, and enables simplified network deployment and ultimate user experience for China Mobile.

Precise Planning

China Mobile faces the problem of achieving a higher input-output ratio under the complicated 5G networking situations. To solve this, ZTE puts forward a 4G/5G coordinated network planning solution that is based on a capacity expansion planning platform with the help of the 4G measurement report (MR) massive data analysis and AI prediction. It identifies valuable areas in terms of such dimensions as coverage and capacity, and matches site locations with suitable products. The platform has been used by China Mobile in eight provinces including Guangdong and Fujian to output the planning reports and complete intelligent preliminary 5G planning involving various valuable scenarios like central urban areas, important scenic spots, and commercial premises. These high-value scenarios quickly won reputation for China Mobile in the early stage of 5G network construction, laying a solid foundation for future service and user development. With this solution, the planning work used to be done by two engineers in one month can now be completed by one engineer in a week, increasing the efficiency by 80%.

Highly-Efficient, Simplified Deployment

Due to the constant upgrades in wireless networks and rapid urbanization in China, the

space for antenna installation is getting more and more constrained in cities. China Mobile is also confronted with difficulties in acquiring new sites and balancing costs in construction. To tackle this, ZTE proposes the UniSite solution, which supports 2G/3G/4G/5G integration and covers all deployment scenarios including macro-site, indoor and hot/blind spot scenarios to maximize the site efficiency. Meanwhile, ZTE releases the UniDeploy simplified deployment solution. It facilitates highly-efficient site deployment for all scenarios with three modes of site commissioning including PnP, data burning, and simplified configuration.

In the PnP mode, with the auto-discovery function, a site can be commissioned automatically through auto-establishment of a transportation link, auto-acquisition of configuration files and software packages right after the site equipment is installed and powered up. This mode has been applied to several provincial branches of China Mobile with the site commissioning efficiency increased by 50%. Besides, ZTE uses the wireless network guardian (WNG) solution to perform single site verification and guarantee "a quality site after commissioning". WNG is based on 5G terminal + cloud architecture, which automates the whole process from data collection to customized report output, i.e. the single site verification test can simply be completed by an engineer with a terminal. WNG is widely used in the provincial projects of China Mobile for single site verification test, which lowers the manpower costs by 60% and increases the efficiency by 55%.

Intelligent Maintenance

As the largest network operator in the world, China Mobile runs multiple networks and the co-existence of different networks will continue for a long time, which makes the maintenance a very tough task. ZTE introduces the intelligent alarm filtering and root cause analysis (RCS) solution to perform correlation analysis and trouble locating from both the vertical direction (Cell-AAU-DU-CU/ Cell-RRU-BBU) and the horizontal direction (inter-site/inter-CU/inter-DC). This solution screens and removes the invalid alarms to get to the root cause of an issue based on AI training of millions of historical alarms combined with algorithms optimized by Pearson's correlation coefficient, frequent itemset, and confidence level. In the pilot tests in provinces like Guangdong, Shandong, and Fujian, the original 17 alarms are reduced to six by using AI algorithms, which allows the maintenance team to focus on the root cause alarms and fast locate and solve the incidents, and hence to protect the value of network resources with lower costs and higher efficiency.

Automatic Optimization

5G macro base stations mainly adopt the Massive MIMO antennas, which have more software-configurable parameters than the traditional ones but increase the difficulties in parameter optimization. China Mobile is thus required to invest more resources on 4G/5G coordinated optimization for an enhanced user experience. ZTE has developed the big data and AI-based automatic antenna pattern control (AAPC) tool to realize the automation of data collection, analysis and parameter optimization. Its application in the pilot tests in China shows that for a single beam the RSRP can be increased by 5 dB and the SINR by 2-3 dB on average, and for multiple beams the RSRP can be increased by 3-4 dB and the SINR by 1.5-2 dB. The construction costs can also be greatly reduced. Meanwhile, ZTE has deployed the SON function in the 5G networks in several provinces to realize automatic optimization of 4G/5G neighbouring cells, X2/Xn as well as PCI, which effectively lowers the parameter optimization frequency.

China Mobile is committed to building the bench-marking 5G scenarios in the first year of 5G construction. In its branding areas such as scenic spots and important stores, the 5G network can reach more than 1.2 Gbps in the downlink and 100 Mbps in the uplink. In the central urban areas in cities like Nanjing and Guangzhou, the downlink speed can reach over 800 Mbps and the uplink 80 Mbps, and the downlink speed can reach over 550 Mbps in less dense urban areas with continuous coverage.

Conclusion

To assist China Mobile in implementing its 5G network and "5G+" plan, ZTE is fully prepared in terms of intelligent solutions and human resource cultivation. It is believed that a new 5G ecology of resource sharing and mutually-beneficial and integrated development will be achieved through sincere cooperation between both sides. ZTE TECHNOLOGIES

To enable connectivity and trust everywhere