

ZTE TECHNOLOGIES

VIP Voices

AIS: Driving Digital Transformation for Thai Businesses

Expert Views

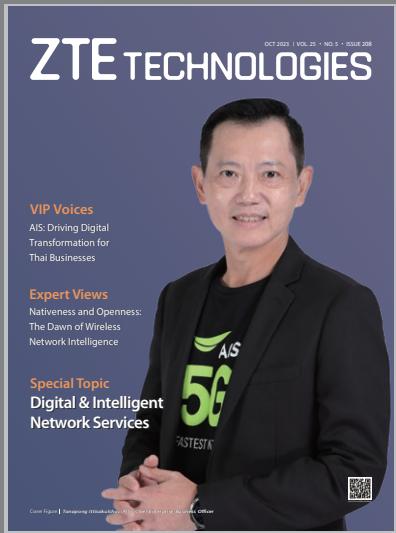
Nativeness and Openness:
The Dawn of Wireless
Network Intelligence

Special Topic

Digital & Intelligent Network Services



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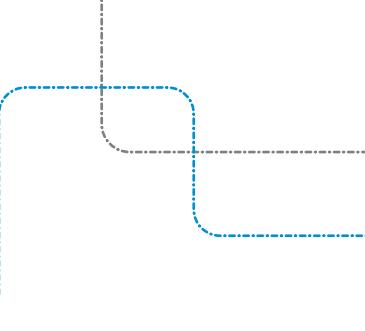
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AIS: Driving Digital Transformation for Thai Businesses

Reporter: Mao Junyong



As the largest operator in Thailand, AIS is committed to unlocking digital technologies, especially 5G, which is regarded as a critical infrastructure for enhancing the country's prowess in the digital economy. In this fast-paced digital world, Tanapong Ittisakulchai, AIS's Chief Enterprise Business Officer, sheds light on AIS's transition from a digital life service provider to a cognitive tech co. In his role as CEBO, he shares how AIS is accelerating digital transformation for Thai businesses and highlights the company's progress in developing 5G use cases.

Tanapong Ittisakulchai, AIS's Chief Enterprise Business Officer

AIS has proposed the digital strategy "cognitive tech-co". What are the key drivers that led AIS to begin its transformation journey from a telco to a tech-co?

In today's rapidly evolving digital landscape, we're witnessing significant changes in how consumers behave and how businesses operate. To remain competitive in this dynamic business environment, AIS has proactively responded to this paradigm shift by embarking on a transformational journey, transitioning from our previous role as a "Digital Life Service Provider" to embracing the identity of a "Cognitive Tech-Co". This transformation represents a fundamental change in how we approach our services and solutions. We've infused innovation and intelligence into every facet of our customer-centric offerings, aligning them with the ever-evolving demands of the digital age.

Our transformation journey encompasses several vital components including:

- **Data Insights and Customer-Centric Approach:** We are leveraging data insights and adopting a customer-centric approach as the key elements to enable us to deliver fresh and valuable experiences to our customers. AIS has conducted many personalized services campaigns in order to meet the customers' service needs, for example, the campaign by age that allows customers to join AIS special activities on the date as per notified age, the campaign by interest that enable the customers who have plan to travel to get the information of SIM that they can use during travelling and by target, service offering will be depending on Nationality or Language, etc.
- **IT Intelligence:** Our IT intelligence plays a crucial role in ensuring that we provide agile, stable, and secure services and solutions, allowing our customers to navigate the digital landscape with confidence. myAIS Application, AIS Personalized Super App, is one of the examples that reflect our effort to offer the new value service for customers.

This application allows customer to view fees, pay bills, register, and monitor packages in one stop.

- **Autonomous Networks:** The Autonomous Network helps AIS reduce 10%+ workload, improve 20%+ network efficiency, optimize 10% customer experience, and enhance network intelligence and automation level. These networks empower us to provide uninterrupted services to our customers, 24/7.

All of these are the key components that support AIS services across different fields including:

- **Mobile:** We've enhanced our 5G technology with AI and advanced data analytics to offer personalized, real-time, and interactive experiences, providing an exceptional mobile service.
- **Fixed Broadband:** AIS's home network solution seamlessly blends innovation with round-the-clock customer support. This ensures uninterrupted online experiences, now reaching 8.8 million Thai households for peace of mind.
- **Enterprise Business:** AIS is committed to driving digital transformation for all types of enterprises. We facilitate this journey and collaborate with top-tier partners to expand our service offerings, enabling organizations to thrive in the digital age.
- **New Digital Services:** We offer personalized, real-time, and interactive solutions like Content and Insurance Services to deliver the best possible experiences across all dimensions for our customers.

And with the partnership concept of an "Ecosystem Economy", the model emphasizes comprehensive cross-sector integration. We generate mutual growth by working with a range of partners to support Digital Transformation in various national industrial sectors by cooperation with a variety of vertical industries and business expert partners to co-create the 5G solution that can enhance the efficiency of industry verticals and businesses and fulfill their differentiation needs.

5 Focused Area of Digital Transformation Strategies



All efforts of AIS aim to deliver the best service to customers. We can overcome the challenges faced by traditional telecom providers, such as slow revenue growth, ARPU pressure, and profit challenges.

As CEBO, what is your mission to help customers enhance their business capability in digital transformation journey?

Our mission is to serve Thailand's sustainable digital economy by accelerating digital transformation for Thai businesses with a comprehensive suite of digital technologies and services delivered by highly competent and trusted professionals. We have rolled out the "Growth, Trust, and Sustainability" program focusing on delivering trusted and resilient digital services and solutions which meet customers' need for sustainable growth through five strategies, which are:

- **Connecting 5G ecosystem to enhance businesses:** AIS is working with partners in both the public and private sectors to create an ecosystem that supports various industries.
- **Enhancing secured network performance with intelligent network:** AIS provides both wireless and fiber optic cable connections to enterprise customers with gateways to both domestic and international connections.
- **Enhancing trusted digital infrastructure and platform of cloud and data center:** We are working with world-class partners extending a

suite of digital platforms encompassing Cloud Solutions, Cyber Security, IoT services, and ICT Solutions.

- **Enhancing digital marketing and data-driven business capability:** AIS is committed to supporting businesses with advanced data analysis tools.
- **Delivering solutions and managed services by trusted professionals:** With our long experience expert, AIS Business can deliver end-to-end managed services which meet business needs accurately, efficiently, and professionally.

Another important part to support my mission is "Growth, Trust, and Sustainability" program. AIS has enabled our customer "Growth" by creating agility for businesses with AIS 5G and Cloud Platforms, Data Insight & Lifestyle as a Service and tailor-made solutions for Business and Verticals. "Trust" with modernizing trusted digital infrastructure enables customer to improve efficiency, agility and security. This is delivered through comprehensive solutions as Sovereign Cloud, SD-WAN and Secured Connectivity. "Sustainability" involves the creation of an ecosystem for developing innovative solutions. AIS, joining with partner, developed various solutions that help create sustainable business, such as energy and carbon emission management solution.

From AIS strategies, how AIS leveraged 5G network capabilities to enable customer business digital transformation journey?

Although AIS is the leading player in the Thai and 5G industries, we keep going to accelerate our network capability, create and design solutions and tailor adjustments for the needs of each industry with maximum efficiency.

With AIS, the efficiency of 5G network infrastructure, both in 5G coverage and the completeness of bandwidth and spectrum, allows us to deliver a vast array of infrastructure solutions and platforms rooted in 5G technology. These encompass fixed wireless access (FWA), network

slicing, multi-access edge computing (MEC), and cutting-edge offerings like the 5G private network, which enables the flexibility to tailor the network to specific customer requirements. Recently, AIS launched "Paragon Platform," a one-stop platform to manage 5G, edge computing, and cloud computing, which will help industry and businesses level up their digital transformation.

You once said in a panel discussion that more value will be created in 5G vertical solutions than in 5G horizontal solutions. How is AIS collaborating with industry players in terms of developing new 5G use cases?

AIS has a comprehensive ecosystem of 5G, which includes the interconnectivity with most of the technology domains, for example, IoT, Edge and Cloud. These enable AIS to create a wide range of solutions and services.

With the new chapter of AIS in vertical sector, could you tell us more about AIS 5G Use Cases?

As I mentioned earlier, AIS has expanded our service portfolio of 5G services to support various industry verticals such as Manufacturing, Transportation and Logistics, Property and Retail. We and our expert vertical partner have co-created 5G solution to help our customer to overcome the obstacle they face in their vertical industry. The examples of AIS 5G use cases are:

- **Smart Manufacturing Use Case with Somboon Advance Technology:** AIS offers a variety of 5G solutions, including 3D Vision-Robot, AS/RS-Warehouse, and unmanned AGV, enabling Somboon Advance Technology to transition into smart manufacturing and overcome the limitations inherent in the manufacturing industry.
- **Smart Green Mining Use Case with SCG (Siam Cement Group):** The 5G Smart Autonomous Vehicle Solutions facilitate sustainable industrial advancement, managing routing for the shipment of materials and equipment within

the industrial zone. This solution ensures continuous mutual connectivity, minimizing downtime and reducing CO2 emissions by over 35% annually compared to traditional methods.

- **5G AI Autonomous Drone System Case with ARV Co., Ltd (part of PTT Exploration and Production):** AIS introduces the latest 5G use case featuring the 5G AI Autonomous Drone System, known as Horrus, marking a pioneering achievement by Thai engineers. Supported by AI to enhance its capabilities, these drones can operate autonomously along predetermined flight paths and schedules. They have the capacity to monitor and detect abnormal activities in real time, promptly alerting the Control Center.

How is AIS's collaboration with ZTE contributing to Thai businesses, 5G adoption?

Our collaboration with ZTE is all about empowering businesses through 5G technology. AIS is the network service provider with the most frequency spectrum and the best network coverage in Thailand, and we give top priority to innovating for the country sustainably. We have strategically partnered with ZTE in three components:

- Upgrading Thailand's 5G network to world-class digital infrastructure, not only in the matter of speed, but also intelligence, controlling itself in real time (5G Smart Autonomous Network).
- Jointly developing solutions for the business sector, for industry and for the wider public, and enhancing competitive capabilities under Thailand 4.0.
- Delivering a vast range of 5G services to improve Thai people's lives sustainably. The first 5G A-Z Center in Thailand is at the crux of working towards this goal. It is a transformative moment to unlock Thailand's potential and take the country to the next level, focusing on business and industry. We have inaugurated Digital Transformation in productivity and management, which will directly power the country's digital economy. **ZTE TECHNOLOGIES**

Globe Telecom: Uplifting the Lives of Filipinos

Reporter: Liu Yang



Yoke Kong Seow, Chief Technical Advisor of Globe Telecom

Globe Telecom, a major provider of telecommunications services in the Philippines, faces the challenge of providing reliable connectivity and enabling the digital lifestyle across the country's vast archipelago of more than 7,100 islands. Yoke Kong Seow, Chief Technical Advisor of Globe Telecom, shares insights into the company's strategic focus areas, digital transformation approach, and connectivity efforts to address this challenge.



You have rich experience in the telecom industry across APAC. What trends have you observed in the APAC region?

I have previously worked in Singapore, Australia, and now in the Philippines. While the focus is slightly different in different markets, the common theme has been on how to do things more efficiently and more effectively. Initially, there was a strong focus on utilizing data and doing analytics. However, over the past year or so, there has been a shift towards leveraging AI to improve the customer experience.

While many people are talking about AI chatbots, our focus on the technical and network sides is centered on using AI to detect issues faster, determine where the issues are in the network, and identify the problems that our customers are facing with their mobile phones or their mobile streaming experience. Given the large amount of data involved, AI is needed to help. Undoubtedly, AI has become a major trend.

Any best practices you would like to apply to the Philippine market?

There are two practices that I would like

to implement in the Philippine market, specifically for Globe. The first practice is focused on our ways of working. This involves making use of tools, dashboards and automation to simplify our operations. The second one is centered on customer experience optimization. This relies a lot on partners like ZTE to deliver to us innovative technologies and radio solutions, so that we can provide better services to our customers.

How do you think the company should technically advance, and what is your strategy for maintaining Globe's leading position in the country?

Today, my first focus is on automation and simplification. This includes how we bring data together, how we use AI to simplify some tasks, and how we use digital technologies to make things simpler.

The second area of focus is our transport network strategy. One of the most important considerations for customers is availability, which is closely related to reliability. They expect to be able to use network anytime, anywhere they need it. Therefore, our challenge lies in delivering a reliable network. To achieve this, one of the things we need to

focus on is our transport network, particularly our optical fiber networks. In countries like the Philippines where there are extensive infrastructure developments, we need to ensure that our transport network—our fiber, IP, Metro Ethernet networks—is resilient and free from any single points of failure.

What are some of the challenges you are facing as you implement your strategy?

When it comes to automation and simplification, the key challenge is getting the right talent or developing the right skills for our people as it requires a different way of thinking and an understanding of how to use data and AI. Therefore, we're focusing on equipping our people with new IT skills while attracting talent to join our group to help us do that.

The second challenge is ensuring the resilience of our network, especially our transport network. We're in the process of re-architecting our transport network to make it robust and resilient. This involves bringing in a party to look at our entire architecture and help us see the things that we cannot see ourselves. Additionally, we are exploring the use of some new optical technologies to help us achieve long-haul optical transmission.

Digital transformation offers endless opportunities and benefits. What elements do you think are going to bring the necessary digital transformation and make an impact on society?

Globe has a very focused purpose: to uplift the lives of Filipinos. Filipinos face many challenges in improving their economy and education. As an enabler, Globe provides reliable connectivity and various tools that allow them to interact digitally and access services such as healthcare and mobile wallets for transactions.

With our connectivity, Filipinos can also engage in the digital economy and sell things

online through social media platforms like TikTok, where they can engage with customers and show what they have. The three key elements for Globe are reliable connection, access to a digital wallet (GCash in Globe's case), and access to services like healthcare and others.

What is your plan to better engage with household customers and boost ROI?

As the No. 1 mobile operator in the Philippines, we also recognize the importance of delivering quality broadband services to the Filipinos. We understand that the social and economic conditions of Filipinos are diverse, and many of our customers are earning their wages on a daily basis.

To address this, we are rolling out a new prepaid fiber service. This service allows customers to have a fiber connection, and when they want to have internet access, they can top up their broadband for a certain time period, such as 7 days or 15 days. Then they can wait until they need to use it again and top up. The introduction of prepaid fiber makes broadband available to the poorer sections of Filipinos, empowering them to uplift themselves and narrowing the digital divide.

How do you see the future of connectivity evolving in the Philippines? What are your expectations for vendors like ZTE in this process?

We have made significant investments in connecting all the islands. As part of this effort, we have been building a lot of submarine cables and exploring the use of microwave and satellite to deliver services to remote areas or islands. This is one area we are partnering with ZTE. We are deploying ZTE microwave technology to enable us to deliver services to remote communities where it's hard to deploy fiber. We'd love to work with ZTE to look at other wireless broadband technologies that can offer cost-effective solutions to Filipinos living in remote areas. **ZTE TECHNOLOGIES**

Nativeness and Openness: The Dawn of Wireless Network Intelligence



Li Xiaotong

Vice President of ZTE and General Manager of RAN Products

As 5G deployment deepens, the continuous emergence of new services and scenarios drives the evolution of networks, providing a high-quality network foundation for the new era of digital and intelligent living, industries, and society. Meanwhile, wireless networks are becoming increasingly complex, facing challenges such as multi-mode multi-band collaborative networking, differentiated QoS guarantee, bit-watt curve optimization, and operational efficiency improvement. To address these challenges, the introduction of artificial intelligence (AI) to enhance the intelligence and automation capabilities of wireless networks has become widely accepted in the industry.

Wireless Networks Evolving Towards Intelligence

Wireless network devices have witnessed a constant enhancement in computing power in recent years. In addition to fulfilling basic network functions, the collaborative computing power among multiple devices can support increasingly efficient AI algorithms. Moreover, wireless networks have access to massive data generated by all users, allowing for nearby AI

model training and near-real-time inference computations, facilitating instant network strategy optimization. Wireless networks now possess the three essential elements of AI, including computing power, algorithms, and data, making them well-prepared for intelligence.

From R15 to R18, 3GPP has defined the RAN intelligence architecture and has been continually pushing for the evolution of native intelligence within RAN. Native intelligence, as one of the core capabilities of 5G-Advanced, supports the intelligent transformation of wireless networks, meeting the requirements for new capabilities, services, and technologies in the future. After years of exploration, wireless network intelligence has evolved from a technical concept to a reality, thanks to the collective efforts of the industry, and is now steadily moving towards commercialization.

ZTE has begun its research on wireless network intelligence and its applications in commercial networks since the pre-research stage of 5G networks. Currently, it has established a comprehensive network intelligence architecture that can support a wide range of intelligent network applications, tailored to different real-time demands, operational frequencies, and complexities.

Intelligent Service Exposure Empowers Multi-Dimensional Applications

ZTE's RAN intelligence architecture consists of three layers: physical network layer, intelligent service layer, and intelligent application layer (Fig. 1). These three layers enable native intelligence within the wireless network and empower operators to achieve cross-domain closed-loop operations, cross-domain collaborative computing, and cross-domain service orchestration.

The physical network layer encompasses all hardware infrastructure and raw data sources that form the basis for native intelligence within RAN. It includes various devices such as base stations, network management systems, intelligent platforms, as well as a diverse range of data resources from terminals or relay nodes such as mobile phones, wearable devices, connected cars, drones, ATG aircraft, and satellites. These resources facilitate interaction with the intelligent service layer through data collection and policy delivery.

The intelligent service layer utilizes the computing and data resources from the physical network layer to model and orchestrate computing capabilities and govern data. It employs various algorithm models to orchestrate intelligent atomic capabilities, and ultimately exposes computing power, data, and algorithms in the form of services to the application layer.

In terms of computing power, the native

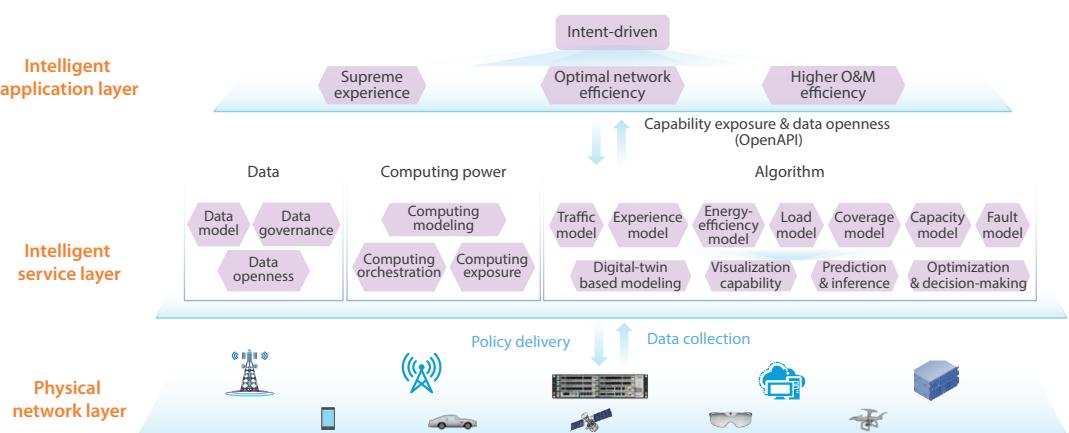
computing resources and enhanced computing resources within multiple base stations can be pooled and aggregated through transmission, enabling dynamic sharing and collaborative orchestration of computing power across base stations. This achieves load balancing and efficient utilization of computing resources. The combination of computing power at the base station level with the computing power of intelligent modules on the network management side and an independent intelligent platform forms the foundation for distributed native computing capabilities.

In the realm of data, standardized data collection processes and a unified data model are employed for data collection, cleansing, correlation, and labeling within the RAN system. This enables the generation and maintenance of modeled data such as user profiles and base station profiles. Model training and inference for native intelligence within the RAN system is efficiently supported by combining distributed data services with domain knowledge as well as model knowledge.

In the dimension of algorithms, the real-time intelligent engine deployed at the base station side supports extremely lightweight model training and near-real-time model inference. It improves network efficiency and user experience through precise prediction and proactive optimization.

On the network management side,

Fig. 1. ZTE's RAN intelligence architecture.



the lightweight intelligent engine supports lightweight model training and non-real-time model inference, facilitating efficient and proactive network operations through capabilities like quality insights and intelligent troubleshooting. Additionally, this architecture also supports the deployment of digital twin systems on independent intelligent platforms. Through data interaction with the physical network, it implements a series of atomic capabilities such as dynamic simulation, predictive optimization, intelligent decision-making, and data derivation.

The intelligent service layer can manage and orchestrate the above-mentioned computing power, data, and algorithm atomic capabilities in a microservice architecture. It exposes these capabilities to operators in the form of AI as a service (AlaaS), empowering the application layer. Operators can efficiently and cost-effectively integrate AI capabilities into their own systems through service calls and low-code development. This allows for flexible and on-demand feature expansion as well as resource scaling.

At the intelligent application layer, operators can leverage AI services to achieve highly automated and intelligent processes for network planning, construction, and maintenance. They can access on-demand capabilities for network visualization, modeling and simulation, precise network planning for multiple scenarios, optimization of network policies and parameters, precise network fault diagnosis, and predictive maintenance. In addition, operators can perform on-demand trial runs and performance evaluations for new services, as well as research and low-cost experimentation for new technologies.

ZTE's Achievements in RAN Intelligence

In 2020, ZTE launched the industry's unique NodeEngine computing base station solution to drive the commercial implementation of native intelligence in RAN. By adding

computing boards to traditional base stations, it enables elastic expansion and capability exposure of edge computing. The NodeEngine solution can be centrally managed and scheduled by the intelligent network brain, providing ubiquitous computing services.

In 2021, ZTE launched a wireless intelligent orchestration solution based on the above-mentioned native intelligence architecture, including user orchestration and network orchestration. User orchestration focuses on delivering the best possible experience and resource efficiency by intelligently guiding users to optimal frequency bands and cells, thereby enhancing user satisfaction. Network orchestration aims to maximize 5G experience while ensuring the fulfillment of 4G network demands, providing operators with a more beneficial resource sharing mode and improving network efficiency.

In 2022, with the successful implementation of computing base stations and wireless intelligent orchestration, ZTE combined a range of achievements in system architecture, technological innovation, and commercial deployment of wireless network intelligence. This led to the official launch of the comprehensive RAN Composer native intelligence solution. Leveraging the computing power, data, and algorithm services at the intelligent service layer, ZTE developed several intelligent applications at the application layer and rapidly advanced their commercial deployment in the field.

The evolution of wireless networks towards intelligence has begun, and ZTE's RAN Composer native intelligence solution has seen multiple intelligent applications deployed both domestically and overseas, showcasing its value in enhancing experience, efficiency, and network maintenance. Moving forward, ZTE will continue to advance the process of wireless network intelligence, guided by the core principles of surpassing, intelligence, and leadership, to build the most superior network. **ZTE TECHNOLOGIES**

Building a Secure Cloud Core Network to Consolidate the Foundation of Digital Society

Chen Xinyu, Vice President and General Manager of Cloud and Core Network Products at ZTE

With the rapid development of information technologies, digital life has become a consensus and inevitable choice for the development of human society. The digital wave is profoundly changing the way we produce and live. Mobile communication serves as the information base for the construction of digital society. Meanwhile, newly emerged mobile communication technologies are driving the development of a digital society. As the cornerstone of the mobile communications network, a secure and stable cloud core network is essential for information communication and transfer in a digital society. ZTE's Cloud Core Network products prioritize security, and aim to build, maintain, and operate a secure and stable core network from three aspects: high reliability, trustworthiness, manageability.

Highly-Reliable Network Ensures Security

A highly-reliable architecture and highly-reliable products are essential for secure network operations. ZTE's Cloud

Core Network offers a highly-reliable and secure network from three aspects: intra-NE, inter-NE, and the network layer.

Intra-NE Reliability

ZTE's Cloud Core Network equipment is built on a stateless architecture that separates services and data, enabling resource elasticity without service loss. During the elasticity process, user status data remains intact, ensuring service continuity. The service components also support N+M full load sharing, meaning that if one component fails, other components take over the services in real time to ensure that services are not affected. VMs or containers of the same type in an NE are deployed in anti-affinity mode, distributed across different physical hosts or bare machines. In the event of a host failure, the VMs or containers can perform local self-healing or remote regeneration to complete self-recovery.

Inter-NE Reliability

The Cloud Core Network offers various backup modes, including inter-NE load

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As the cornerstone of the mobile communications network, a secure and stable cloud core network is essential for information communication and transfer in a digital society.

Chen Xinyu



sharing, 1+1 mutual backup, and 1+1 active/standby. The appropriate disaster recovery mode is determined based on the NE type. If a single NE fails, the system utilizes the NE's disaster recovery mechanism to implement recovery between NEs and ensure fast service recovery. If all the disaster recovery NEs of a certain type fail, the bypass function of the adjacent NE interface is activated. This allows for timely bypassing the faulty NE, ensuring maximum continuity of user services. For example, the AMF and SMF support UDM bypass function, and each NF supports NRF bypass function.

Network-Level Reliability

In order to ensure the overall reliability of the Cloud Core Network, it is important to meet the eight-level disaster recovery requirements during network planning and construction. Additionally, the resource pool should be built according to the remote dual-DC solution. In the event of a resource pool fault or an equipment room fault, services can be quickly switched over to a remote equipment room for quick service takeover. With the deployment

of the hot standby function of NEs such as AMF/MME, SMF/GW-C, and UPF/GW-U, the takeover efficiency of the Cloud Core Network can be further improved, realizing smooth takeover of terminals without the need for reconnection.

Sometimes, during the normal operation of the network, a fault may trigger a signaling storm where a large number of users access the network concurrently within a short period of time, exceeding the NE's ability to process signaling messages in a timely manner. In addition, when terminal access fails, it attempts to access the network repeatedly, resulting in network congestion.

To effectively prevent signaling storms, the core idea is to implement end-to-end flow control based on source control. The system accepts a proper number of users based on the end-to-end capability dynamically perceived by the source end. This ensures that the back-end NE can handle users within its capability range and avoids overload. To achieve this, the data domain AMF/MME and voice domain PSBC are used as the ingress NEs, and end-to-end flow control is jointly deployed based on the capabilities of the back-end



UDM/HSS. This creates a solid barrier to prevent signaling storm.

Trustworthy Technologies Ensure Product Security

Although the Cloud Core Network is located in a trusted domain, it still faces certain information security threats. To address these threats, ZTE uses industry-leading trustworthy security technical standards and integrates trustworthy security into its products. This construction mode provides a stronger shield for the security of the Cloud Core Network, ensuring the trustworthy security of products.

Data Compliance

ZTE attaches great importance to the security of its core network products. Data security is integrated into the product development lifecycle to ensure the provision of secure products and solutions. ZTE strictly adheres to the laws and regulations of each country and industry. In 2020, the company successfully

passed GSMA's Network Equipment Security Assurance Scheme (NESAS) audit for its development and product lifecycle processes. Additionally, ZTE has implemented more than 100 security activities based on the Building Security in Maturity Model (BSIMM). In 2021, ZTE's 5GC passed the BSIMM 11 security assessment and obtained the 27701 privacy protection certification from the British Standard Institution (BSI).

Intrinsic Security

ZTE's Cloud Core Network products are designed to strengthen intrinsic security and provide active autonomous network asset security. These products leverage security capabilities across different layers, including infrastructure, virtualization, service, application, and management, to implement network security autonomy, automatic and intelligent analysis of network policies, and flexible orchestration. The goal is to establish an automated, self-defending, and self-adaptive integrated security protection system.

Quick Response Mechanism

ZTE has established and improved its organizational structure based on three lines of defense to promote product security governance. The product security incident response team (PSIRT) effectively responds to security incidents, and security laboratories are set up to ensure the security, transparency, and trust of products and services.

Manageable Network Maintenance Ensures Reliable Network Operation

The complexity of the Cloud Core Network makes network maintenance challenging. To address this, ZTE provides efficient

maintenance tools to reduce reliance on human intervention. By standardizing processes and tools, ZTE manages the quality of solutions and network changes, making network maintenance more transparent and controllable.

Visualized O&M

The Cloud Core Network utilizes the core network intelligent analysis (CNIA) system, equipped with health analysis and KPI dashboard features, to analyze various data including alarms, performance, logs, preventive maintenance, and dialing tests. By incorporating AI capabilities, the system generates device health report and visualizes the network operation status, helping to identify potential problems in advance and improve maintenance efficiency.

ZTE's NetScope and NetInsight can be flexibly deployed to display the vertical transport network topology for cross-layer monitoring and fault diagnosis. NetScope is an end-to-end delimiting and locating solution for IP network faults in a virtualized core network. NetInsight is a virtual-layer network O&M tool.

ZTE's EMS+ and the MagicEye tools facilitate horizontal service-domain problem delimiting and locating. EMS+ is a data service analysis tool while MagicEye is a voice service analysis tool. These tools bridge the gap between voice and data services, allowing for quick resolution of voice problems.

High-Quality Solution

ZTE guarantees the overall quality of its cloud core network solution through integrated verification. The solution is jointly developed by the product service preparation team, integration team, and R&D team. It is then verified in real

environments to ensure high quality. The integration team participates in the implementation of the solution to ensure network stability throughout its lifecycle and the availability and reliability of the integrated network solution.

ZTE's Network R&D Institute provides full-process management and control for the initial operation of the solution including compilation, testing, review, and operation support. The goal is to ensure the safe implementation of the solution without any negative impact on the existing network.

To avoid manual operation errors, tools are used to automate operations on complex solutions. For high-risk solutions, the solution test team conducts additional testing and verification, providing an extra layer of assurance for the solution's operation.

Automatic Operation

ZTE has established a dedicated team for network change solution automation, using the automatic operation tool integrated in CNIA to encapsulate various operation scenarios and replace manual operations with machines. This approach minimizes risks associated with uncontrollable operation factors caused by different operators and ensures network operation security through automation.

ZTE always prioritizes security, and implements an end-to-end collaborative workflow, both horizontally and vertically, to create a secure Cloud Core Network for users and enterprises. Moving forward, ZTE will continue to advance the cloud core network to be highly reliable, trustworthy, and controllable. This will enable the provision of seamless communications services anytime and anywhere, contributing to the development of a digital society. **ZTE TECHNOLOGIES**

New Practice of Digital and Intelligent Network Deployment



Hong Gongcun

Vice President and General Manager of Technical Delivery of Global Services at ZTE

Communication networks are the foundation of the digital transformation of society. With the rapid development of digital industrialization and industrial digitalization, the construction of communication networks is accelerating. The challenge is to automate network deployment while guaranteeing the quality of communication networks and user experience.

During network deployment, the rapid growth in network scale and complexity of scenarios complicate network planning, solution and data preparation, and network operations. This requires more time and manpower investment, and also increases the risk to communication services. Manual site visits for distributed NEs such as base stations result in low working efficiency and collaboration capabilities. Repeated site visits are a long standing problem. Furthermore, it is crucial to proactively prevent, rapidly identify, and solve user experience problems in complicated networks.

ZTE is committed to incorporating digital, intelligent, and big data

technologies into full-lifecycle network delivery and O&M processes. We continuously promote the scenario-based analysis of network deployment activities to improve efficiency and quality. Our goal is to increase the automation level of network deployment in terms of network planning, network deployment, network quality, and user experience assurance.

Precise Network Planning

Network planning is crucial for successful network deployment. At present, wireless network planning faces many challenges, such as accommodating future service growth, identifying investment areas that maximize value, and selecting the most appropriate planning solution for new site types and scenarios.

ZTE, with its extensive experience in global network planning, adopts the concept





of "value-centric network construction and intelligent planning" to meet the diversified requirements of the global communications industry. ZTE integrates AI technology into its network planning tool to enable intelligent identification of traffic suppression cells, intelligent forecasting of business volume growth with a 90% accuracy rate, and intelligent pre-evaluation of planning effects.

ZTE continuously enhances the planning capability of its tool for specific scenarios. For example, it can generate building profiles intelligently and accurately identify the buildings that lack 5G indoor distribution. The multi-site-type planning function facilitates the reasonable layout and efficient coordination of macro base stations, micro base stations, and indoor distribution base stations. Moreover, ZTE introduces user perception data-driven planning in addition to coverage and capacity-driven planning. This approach

allows for the accurate setting of cell-level capacity expansion thresholds, achieving a win-win situation between investment and user experience.

Digital and Intelligent Deployment of Sites

Site construction, reconstruction, testing, optimization, and acceptance are core activities in network deployment. ZTE utilizes intelligent tools and digital platforms, along with fast and flexible programming and orchestration capabilities, to enable digital and intelligent site delivery.

During the site construction phase, automation in operations, multi-team management, and multi-position coordination are highly demanded to ensure engineering quality and progress. This requires the use of intelligent tools to simplify operations and improve

productivity, as well as digital platforms to provide data management of tools and manual operation management capabilities.

To adapt to multiple scenarios, digital platforms and intelligent tools must be capable of fast on-site combination, programming, and orchestration. ZTE's iTech digital platform is a site deployment platform that integrates digital and intelligent technologies. It consists of the site work platform and the data management platform.

The site work platform provides site engineers with a one-stop solution for their work. It enables process orchestration, interconnection of tools, group coordination, and site navigation. By combining with intelligent tools, it allows for automatic site commissioning and tests, improving work efficiency and quality. The platform improves team collaboration through real-time, open, and visible messages. It also automatically calculates workload and asset changes, and generates site commissioning reports.

The data management platform focuses on the storage and full-process management of key technical data in the site delivery phase. In wireless networks, engineering parameter data such as antenna parameters is crucial in various phases. In the traditional management mode, it is difficult to accurately and timely update data. The data management platform improves the reliability and accuracy of engineering parameter data by implementing online management across the planning, installation, drive test and optimization phases, laying a solid foundation for network quality.

In the planning and configuration phase, ZTE's intelligent product planning and configuration tool automates the generation and delivery of product configuration files for wireless, bearer, and core network products, reducing errors in manual operations. It provides programmable

interfaces, allowing for rapid customization and development for complicated scenarios. Compared to traditional tools, this tool improves the operation efficiency by over 80%, ensures more accurate data, and guarantees network quality.

During the commissioning phase, ZTE's wireless and bearer products support remote commissioning. If a site visit is required for operations, the mobile phone app can be used for one-click site commissioning and tests. This app covers wireless, microwave, and wired products, and reduces operation difficulty. It is interconnected with the iTech platform, enabling automatic data delivery and improving site commissioning and debugging efficiency by more than 30%. The SOP orchestration by site and automatic group building capabilities reduce the communication time by more than 50%.

After completing the commissioning, the on-site engineer can use AI to locate the root causes of alarms that occur and provide solutions. This allows for identification of quality problems and completion of rectification before leaving the site, without the need for cooperation from back-end personnel. As a result, the number of second site visits can be reduced. In addition, the site commissioning report and workload estimate can be generated automatically. The combination of intelligent tools and digital platforms not only improves the efficiency and quality of site construction, commissioning, and debugging, but also greatly improves the working conditions of site operation personnel. This aligns with ZTE's goal of paying attention to the health and safety of employees and partners, and actively fulfilling the corporate social responsibility (CSR).

ZTE has also improved its digital and intelligent testing and optimization

capabilities by leveraging automation, portability, and remote transformation. For wireless network drive tests, ZTE utilizes the WNG solution based on cloud services and automatic test terminals. This solution allows test tasks to be delivered from the cloud, data to be collected via handheld terminal, and reports to be generated with just one click. ZTE is also promoting the application of the virtual drive test mode based on MR in acceptance and optimization. By combining virtual drive tests, KPI, and CQT, ZTE is able to replace the traditional drive test mode in multiple projects around the world, reducing drive test costs in the network optimization test phase.

Core network service test items can be complicated. ZTE's iTest terminal test tool on the AIC platform provides a complete set of easy-to-use test items and functions for different NFV components and VNFs in different scenarios. After major operations such as core network acceptance, version upgrade, and capacity expansion are completed, the iTest tool can automatically perform tests in multiple places simultaneously. This greatly reduces test difficulty and saves test time.

During the acceptance phase, a large amount of data and photos need to be collected for the acceptance report. The traditional manual editing and output process can be prone to human errors and inefficient. ZTE's digital platform and intelligent tools can be used together to automatically collect data, manage data uniformly, and generate customized reports automatically, improving document production efficiency and shortening the acceptance period.

Network Quality and User Experience Assurance System

Establishing a complete network quality and user experience assurance



system is a prerequisite for smooth network deployment. ZTE provides a comprehensive guarantee system for network quality, user experience, and network operations through intelligent network management and the VMAX big data platform.

The key to assuring network quality is timely detecting indicator changes, identifying wireless network changes, and analyzing poor quality. ZTE's system can automatically detect network indicator changes and analyze the root causes through self-learning of past indicators and training of the change detection model. In the past, it was difficult to obtain device degradation trends from the existing information when a fault occurred. Alarms were only handled after the fault threshold was triggered. Additionally, locating the root alarm from a large number of alarms, and diagnosing the root causes were inefficient. ZTE's alarm handling expert function rapidly identifies root alarms and locates root causes after detecting problems, improving troubleshooting efficiency. ZTE's equipment failure prediction function can detect potential problems in advance to reduce the failure loss rate.

User experience assurance and prevention are common challenges faced by operators in complicated network architectures. ZTE's VMAX big data platform addresses this with its real-time intelligent insight and correlation analysis capabilities. The platform uses KPI, KQI and QoE to establish a comprehensive user perception evaluation system, accurately restoring service perception. Based on the perception analysis and processing capabilities of wireless, bearer, and core networks, an end-to-end user perception analysis and optimization system is built. This system helps delimit and locate end-to-end poor quality problems, analyze user perception and network complaints, predict perception problems, and handle problems in a closed loop quickly.

In terms of data services, the VMAX platform uses intelligent probe technology to collect various type of data, such as videos, games, live broadcast, QR scanning, webpage browsing, and OTT. It is capable of identifying encrypted services and offers an industry-leading identification rate of new services. VMAX can rapidly delimit end-to-end data to analyze the poor quality threshold and related wireless indicators.

For voice services, VMAX supports VoNR, EPSFB, and VoLTE service analysis to analyze poor-quality cells and user delimitation. VMAX also supports signaling trace and comprehensive evaluation in each phase. Moreover, it can associate calling and called parties in all scenarios with an end-to-end accuracy rate of over 95%.

In terms of user complaint handling, VMAX offers closed-loop management by integrating with complaint work orders, and supporting end-to-end problem ticket dispatching, optimization, and verification. This significantly improves complaint processing efficiency. Fault delimitation and localization takes into consideration single-domain performance and alarm data, and the platform's root cause

analysis capability is expanded through AI, increasing the device fault localization accuracy rate by 5%.

A large number of network changes occur during network deployment, which poses risks to stable network operation. To address this, ZTE has built an end-to-end operation security guarantee system that covers solution change formulation, implementation control, and result backtracking to ensure network change operation security.

The operation encapsulation tool, through its template library, designer, and executor, implements modular combination of operation scripts such as upgrade, cutover, and expansion. This reduces the difficulty and risk of formulating the operation solution while ensuring security.

The iNet tool is installed on the operator's computer to automatically associate the operation plan, forbid unplanned operations, and automatically identify and intercept high-risk instructions to prevent misoperations. The smart EMS implements hierarchical management of network operations through the vault mode.

For operations that involve a wide range of areas and have high risks, managers need to authorize each operation individually. Real-time visualization through dashboards and large screens during operations ensures the transparency and controllability over the process and its effects.

The combination of digitalization and intelligence presents new opportunities for improving the quality and efficiency of network deployment. In the future, ZTE will continue to adhere to the "ultimate service" concept, actively explore and implement new network deployment modes, stimulate the vitality of digital and intelligent transformation in the communications industry, and work towards a win-win digital and intelligent future. **ZTE TECHNOLOGIES**

Autonomous Network Construction: E2E Automatic Collaboration for Complaint Handling and Hidden Risk Identification

As 5G networks are extensively deployed and the digital economy continues to grow, the construction and operation of communication networks face more requirements and challenges. In particular, the proliferation of multiple frequencies and standards has led to increasingly complex and vast communication network structures. Diverse terminals are heavily connected, accompanied by a rapid surge in different types of service requirements. Traditional O&M methods are no longer adequate to meet customer efficiency and cost expectations, nor can they fulfill the demands for user experience. With automation and intelligence as its core features to improve network quality and efficiency, an autonomous network is becoming a crucial trend in the future of communication networks.

In 2017, ETSI established the first standard organization for network intelligence, and later, ITU/3GPP/CCSA formed intelligent network projects. The development of autonomous networks began to take shape in 2019. Though certain areas have achieved partial automation capabilities, they mainly concentrate on intelligent tools and functionalities for individual domains and scenarios, lacking complete end-to-end automation. As a result, interconnections between different fields rely on manual

efforts, lacking automatic collaboration.

As the industry's leading provider of integrated communications and information technology solutions, ZTE has conducted ongoing research into automation capabilities in areas like wireless, bearer, and core networks. It has achieved industry-leading levels in certain single-domain autonomous functionalities. However, to enhance autonomous capabilities of communication networks and assist operators in their digital transformation, it is necessary to improve end-to-end (E2E) autonomous capabilities. Therefore, ZTE has proposed a full-domain autonomous network solution leveraging its VMAX big data platform. The solution seamlessly integrates diverse single-domain capabilities to achieve end-to-end intelligence. Particularly, two end-to-end scenarios—customer complaint handling and hidden risk identification—have been successfully implemented in multiple projects, thus facilitating operators' network intelligence enhancement and driving digital transformation.

ZTE's uSmartNet full-domain autonomous network solution, built on its big data product VMAX, establishes seamless connectivity between various individual domains through relevant standard interfaces. It retrieves relevant configuration, alarm, and performance data from wireless, bearer, and core networks. Through the



Li Ruiming

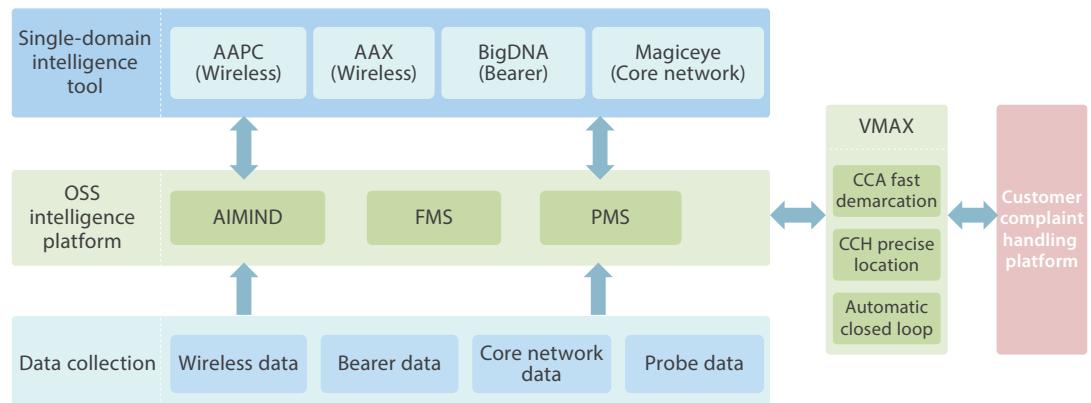
Chief Technical Delivery
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Products

analysis and processing of big data, it intelligently analyzes and precisely locates problems, ranging from individual call detail records to the entire network. Moreover, VMAX extends its capabilities and interconnects intelligent tools from different domains through the OpenAPI interface. Leveraging intelligent core algorithms, this approach addresses the challenge of diverse protocols and characteristics in individual domains, which previously hindered collaborative efforts. By taking a multi-layered approach that encompasses native network elements, single-domain automation, and cross-domain collaboration, it enables automatic closed-loop of full-domain network automation and problem handling (Fig. 1).

In the complaint handling scenario, the typical approach heavily relies on manual intervention with tools from individual domains as auxiliary support. However, this can result in lengthy complaint processing cycles and substantial expenditure of manpower resources. To address these challenges, ZTE leverages its VMAX big data platform that employs cutting-edge data mining algorithms to achieve end-to-end automatic complaint demarcation, covering terminals, transmission, wireless, core

networks, and SPs. The platform also correlates wireless measurement reports (MR), performance data, and alarm data. Through fault tree analysis across various complaint user scenarios, user-level root causes can be drilled, and problems can be located and handled quickly. In some scenarios, automatic closed-loop of complaint handling can be achieved. For example, in the TNR coverage problem analysis, the platform utilizes ZTE's wireless intelligence function—automatic antenna pattern control (AAPC) through an OpenAPI interface. By employing the AAPC weight optimization solution, it automatically distinguishes the scenarios with coverage problems and establishes a relative coordinate system based on the direction of arrival (DOA) data, enabling automatic weight optimization without relying on engineering parameters. This ensures personalized weight deployment and automatic optimization with a "one-station, one-scenario, one-weight" approach, leading to true "zero-touch" fully automated optimization. According to the evaluation criteria of TMF Autonomous Network Whitepaper 4.0, this scenario almost achieves L4 automation capability. Additionally, it interconnects

Fig. 1. Data architecture ▶ of cross-domain collaboration solution for autonomous networks.



the BN intelligence tool BigDNA and the CN intelligent tool Magiceye, enabling automatic demarcation and location of bearer and core network problems. Furthermore, the interconnection with wireless intelligence tool AAX facilitates precise locating of wireless-side alarm problems and software self-healing, ultimately achieving end-to-end automatic handling of complaint problems.

In the hidden risk identification scenario, the industry is still in the early stage of exploration, with most network elements being handled only after faults occur, resulting in fluctuations in network quality that affect user experience. To address this issue, ZTE utilizes its OSS intelligent tool AIMIND, which accesses CM/PM/FM data from wireless, bearer, and core networks, and employs AI algorithms and self-learning capabilities to forecast potential site outages. According to the forecast results, operators can take proactive measures to mitigate the risk of site outages, ensuring the stable operation of communication networks. Moreover, AIMIND provides targeted fault predictions in various individual domains, including wireless-side optical module, RRU/AAU environmental issues, voltage-related problems, as well as bearer hardware and traffic-related faults. Its fault prediction capability stands at the forefront of the industry.

ZTE's full-domain autonomous network construction solution uSmartNet has been implemented in multiple projects. Particularly, in the customer complaint handling scenario, it has achieved true end-to-end automatic network optimization. In some scenarios, the solution accomplishes automatic closed-loop of problem handling without the need for manual intervention. This remarkable approach significantly reduces complaint handling time and minimizes the need for expert involvement, thereby facilitating operators' digital transformation. Moreover, in the hidden



risk identification scenario, the solution automatically identifies hidden risks and gives suggestions. This capability helps operators improve fault handling efficiency by over 30% and effectively reduces the probability of fault occurrence. As a result, it enhances network stability and enables industry-leading intelligent network O&M, empowering operators to stay ahead in the market. In addition to achieving automation capabilities in the above-mentioned scenarios, ZTE has also deployed end-to-end solutions for FNR coverage and wireless interference issues, expanding the scope of operators' autonomous networks.

Full-domain automation is a vital path to the development of communication intelligence. Through intelligent technologies, it enables cross-domain collaborative intelligent network O&M, encompassing wireless networks, bearer networks, and core networks. This advancement leads to improved operational efficiency and enhances network reliability, security, and user experience. **ZTE TECHNOLOGIES**

Building Networks with Ultimate Service and Craftsmanship

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As network technologies develop rapidly, the market competition is becoming increasingly fierce. Telecom operators are confronted with a multitude of challenges from their competitors, spanning technology update, service quality, and operating costs. According to the latest GSA report released in June 2023, a total of 535 operators in 162 countries or regions are investing in 5G networks, and 259 operators in 102 countries and regions have launched or trialed at least one 5G service compliant with the 3GPP standards. As the global expansion of 5G network infrastructure continues, the complexity of networks within each operator deepens. The coexistence of 2G, 3G, 4G and 5G networks further compounds the challenges, resulting in high construction and maintenance costs. To address these challenges, operators must embark on a journey of digital transformation, incorporating emerging technologies like big data and AI. This ongoing effort aims at continually improving their network quality and service competitiveness. Standing out in the fierce competition has become a major concern of every telecom operator.

ZTE has introduced the brand concept of "Ultimate Service" through deep cooperation with operators, aiming to provide global operators and industry customers with ultimate network experience through continuous exploration in critical areas of network

services. This initiative is geared towards enhancing network value and driving the digital transformation and upgrading of operators. With over 38 years of experience in communication network deployment, ZTE's global service team has developed the "Craftsmanship Network" construction solution based on the concept of digital network deployment. Throughout the entire process of network planning, construction, optimization, maintenance, and operation, ZTE adopts innovative ideas. This involves the use of cutting-edge innovative solutions, digital network deployment systems, and intelligent delivery tools to meet the diverse needs of operators, ultimately improving network quality and establishing a robust brand image.

"Leadership" Role of Craftsmanship Network Construction

In the rapidly evolving landscape of communications technologies, telecom operators must maintain technology leadership to secure a competitive edge. In this process, the crucial role played by "Craftsmanship Network" construction in technology leadership is particularly important. Setting network construction goals that exceed industry standards, using state-of-the-art technologies and equipment, and delivering high-quality network services and user experiences to meet diverse needs of different

industries and users are all essential aspects of this role. It is through these efforts that the industry, technology and customer leadership roles can be effectively demonstrated. ZTE has established high-performance craftsmanship networks in over 100 countries and regions, assisting operators in enhancing network quality, user perception, and their network value. In China, ZTE collaborates with operators in prominent cities across the country, including Beijing, Guangzhou, Dalian, and Chengdu. They work together to create "Leading City" with a focus on product leadership, innovation leadership, brand leadership, and autonomous network leadership. This initiative not only builds 5G superb networks but also provides users with ultimate network experience. Moreover, it empowers operators to develop leading 5G applications, thereby facilitating the digital transformation of the economy and society.

- In Thailand, as AIS's network equipment and solution provider in the northeast region, ZTE adheres to the brand philosophy of "Ultimate Service" and is committed to providing top-quality services and solutions to ensure AIS's leading position in network quality and technology in this region. ZTE's wireless AI solution uSmartNet-RNIA is dedicated to offering a variety of automation and intelligent tools that cover the entire process of network planning, construction, maintenance, optimization, and operation. This helps customers improve O&M efficiency while reducing costs. After introducing its VMAX-R precision planning tool into AIS, ZTE has greatly improved the efficiency of AIS network planning, facilitating precision network construction. AIS's existing network comprises seven different network standards, including GSM, UMTS, FDD LTE, TDD LTE, NB-IoT, FDD NR, and TDD NR. The network architecture

is extremely complex, which presents challenges for optimization. Considering the characteristics of network architecture, ZTE has worked with AIS to deploy an intelligent network optimization platform. This platform utilizes functions such as AAX alarm root cause analysis, EFP device health check and prediction, AAPC automatic antenna weight control, NQI automatic interference analysis, and TopN poor quality analysis to significantly boost O&M efficiency in corresponding scenarios. Recently, ZTE has partnered with AIS and Qualcomm to successfully complete a 5G mmWave standalone (SA) test at the AZ Innovation Center in Bangkok. This approach dramatically simplifies the network structure, eliminating the need to deploy anchors in EN-DC or NR-DC, resulting in substantial Capex savings.

- In Beijing, China Mobile Beijing Branch (Beijing Mobile) and ZTE signed a strategic cooperation agreement for intelligent computing innovation in 2023, confirming that both parties would engage in deep collaboration in the fields of computing networks and cutting-edge 5G innovation in the future. Beijing, renowned for its unique charm and vibrant technological innovation, is emerging as a beacon for 5G city development and a model for China's digital economy. So far, Beijing Mobile has built more than 44,000 base stations, accounting for over half of the total number of 5G base stations in Beijing. This achievement marks it as the largest and fastest metro 5G network in the world. Within the urban areas, encompassed by the Fifth Ring Road, the comprehensive coverage rate has soared to 99.6%, with over 15 million 5G users. Utilizing a range of innovative technologies, the network provides a peak rate of 3 Gbps in key areas of Beijing, delivering an excellent user experience.
- In Guangzhou, China Mobile, in collaboration with ZTE and several partners, launched the "5G Leading City" initiative in 2021, aiming to enhance user experience through new 5G infrastructure and facilitate the digital

transformation of various industries. They are committed to building Guangzhou into a "5G Leading City" with the leadership in network, application, and ecosystem. With the common goal of the Leading City initiative, Guangzhou Mobile and ZTE have worked together on 5G commercialization, technological innovation, and industrial applications. Utilizing ZTE's VMAX NM central platform, both parties have made valuable explorations in improving 5G residence ratio, implementing pandemic tracking cards, and ensuring support for major events. By April 2022, Guangzhou Mobile had reached a 5G residence rate of 90.17% and a traffic offloading rate of 32.77%, ranking at the forefront among all provinces in China Mobile nationwide.

- In Dalian, China Unicom and ZTE are collaborating to evolve the PowerPilot energy-saving solution. They have launched the world's first "Green Generation Network" in Dalian, which maximizes energy efficiency while minimizing network infrastructure. This innovation, combined with photovoltaic demonstration sites, significantly reduces mobile network energy consumption, enabling environmentally friendly network operations and paving the way for a sustainable digital

economy. Dalian Unicom and ZTE will continue to jointly build an intelligent, efficient, and eco-friendly 5G network. In addition to energy saving efforts, they have undertaken extensive research on network performance, such as collaborative perception consistency, 4G/5G synergy, and beam scenario strategies, all of which have enriched their experience in enhancing 5G perception in Liaoning province. Moreover, they have run the first trial of NSA/SA dual-mode networking solutions nationwide, and their development of 3G/4G/5G multi-mode equipment and solutions in the 2.1 GHz band has provided a clear roadmap for future network planning and deployment.

- In Chengdu, China Telecom and ZTE have jointly built a "5G Leading City" since 2020, aiming to set up a benchmark 5G network for Chengdu Telecom and create the Chengdu Telecom 5G brand. After years of operation, they have achieved remarkable success in various aspects, including comprehensive performance experience, innovative research projects, intelligent O&M, and refined methodology. Through the collaborative effort, a three-dimensional, high-speed, and intelligent 5G network has been built, allowing the citizens of Chengdu to easily enjoy a wonderful life with indoor and outdoor speeds of up to 3 Gbps, providing large bandwidth for uploads and downloads. With the service-level smarter and more eco-friendly energy-saving solution PowerPilot, they have enhanced the city's reputation as the "Park City Under the Snowy Mountains". Additionally, they provide fast, accurate, stable and flexible 5G private network solutions catering to diverse needs of small and medium-sized enterprises and industry leaders. Their advanced intelligent O&M technology makes the network smarter, stronger, and more reliable. This robust 5G network infrastructure is injecting 5G intelligence to various industries, propelling traditional sectors such as healthcare, culture and tourism, and industry toward digital



transformation, ushering a new era of growth.

Opening the Door of “Intelligence” Through Craftsmanship Network Construction

With the large-scale deployment of 5G networks, communication networks become increasingly complex, demands are fragmented and diversified, and the coexistence of multiple standards and frequency bands has greatly increased the operational difficulty. Coordinating cloud network resources faces many challenges. Therefore, the adoption of AI technologies to accelerate network intelligence has emerged as a prevailing trend and an industry-wide consensus.

ZTE demonstrated its new-generation autonomous network solution uSmartNet 2.0 at MWC Barcelona 2023. The solution aims to help operators accelerate their journey towards level 4 (L4) automation. ZTE’s “Craftsmanship Network” construction solution focuses on ubiquitous connections, intelligent O&M, and agile operation in value-driven scenarios through the uSmartNet 2.0 system. By leveraging the power of big data and AI, it creates an intelligent brain that operates at multiple levels, starting from intrinsic network elements, single-domain automation, to cross-domain collaboration. This solution provides automation capability through layered, domain-based, and hierarchical evolution, achieving a fast service-driven closed loop. By using intelligent O&M tools such as VMAX, RNIA, and CNIA, craftsmanship networks greatly optimize user perception delay and enable alarm root cause diagnosis and potential fault identification. This not only helps operators increase their network automation, but also greatly improves efficiency and quality in network deployment, optimization, and maintenance. Currently, ZTE has cooperated with over 80 partners across more than 100 global sites, maintaining industry leadership in areas such as big data,

AI, and deep packet inspection (DPI).

Achieving the Goal of “Surpassing” in Craftsmanship Network Construction

As the construction of “Craftsmanship Network” continues to progress, ZTE and its customers are working closely, paying keen attention to the latest technology trends and industry standards, and addressing network weaknesses by establishing up innovative topics and sharing research results. In China, ZTE partners with China Mobile, China Telecom, and China Unicom to jointly build “Leading Cities”, and has won the Communication Network Optimization Excellent Project Award from the China Association of Communication Enterprises. Internationally, ZTE understands the unique needs and challenges of operators in different countries, helping them achieve top rankings in multiple internationally recognized benchmarking tests. This has earned them a strong market reputation and driven business growth, fostering win-win cooperation. For example, the Hutchison Drei Austria wireless project has won Ookla's "Fastest 5G Mobile Network Award" for four consecutive times, while the Indonesia TSL wireless project has secured Ookla's "Fastest Mobile Network Award", "Best Mobile Coverage Award", and "Best Mobile Network Award" for three consecutive times.

ZTE has long been committed to serving industry-leading telecom operators. Through the “Craftsmanship Network” construction, it continually deepens its strategic cooperation with operators, strengthens technological innovation collaboration, and upgrades from traditional order-based procurement models to a new cooperative R&D approach. At present, ZTE has built high-performance “Craftsmanship Networks” in more than 100 countries and regions, securing operators’ leading positions in the industry, facilitating their digital transformation, and achieving a win-win situation. **ZTE TECHNOLOGIES**

Intelligent OTN Solution: Enabling Fast and Simplified Deployment of Self-Healing Networks



Chen Sen

Chief Engineer of
Wireline Technology
Support, ZTE

Recent years have witnessed a booming development within the global ICT sector. The deployment of 5G networks on a large scale is in progress, leading to an explosive surge in network traffic from various applications. Additionally, new technologies like intelligent driving, AI, and ChatGPT continue to emerge, imposing higher requirements on the rate and bandwidth of infrastructure networks. Enhancing digital intelligence of OTN foundational network has become a pressing need for network operators. ZTE has been exploring the realm of OTN intelligence and has introduced its collaborative solution integrating network management and control with WDM/OTN automatically switched optical network (WASON). Additionally, new intelligent technologies such as power balancing and flexible grids have also been unveiled. These efforts are aimed at building highly intelligent transmission networks for customers.

Management and Control Integrated Solution for End-to-End Management and Distributed Control

The traditional OTN management and control approach implements dynamic network restoration and control through a centralized mode. This method, when

compared to WASON's operation on the device side, results in a longer interaction process. This, in turn, leads to increased uncertainty factors, including disrupted signaling channels between OTN management and control and the devices. As a result, stability issues emerge, thereby presenting significant risks in engineering applications. Though the WASON function is stable and supports dynamic restoration, it lacks the global route computation capability, which becomes a bottleneck for supporting large networks with more than 300 network elements (NEs). To leverage the advantages of both, ZTE has rolled out a collaborative solution that combines intelligent OTN management and control with WASON, enabling the management and control to have the route computation capability.

As shown in Fig. 1, the management and control integrated solution utilizes the global perspective of the management and control server for end-to-end service allocation. It hands over the services with restoration attribute to the WASON distributed control, and the services with non-restoration attribute to the management and control server. This approach enables end-to-end management and control, promoting coordinated development of the control plane. Additionally, the WASON distributed control function is used to restore services and improve the operational stability of

the control plane. The controller provides centralized route computation to improve the success rate of service restoration.

The management and control integrated solution abstracts the bandwidth supported by each board through the network management system, eliminating the need for manual resource allocation for optical-layer boards. The solution also deploys collaborative services, enabling direct end-to-end cross-layer deployment of OAC services. After deployment, it can generate optical channels (OCHs) while also allowing a one-click removal of services. This simplifies the steps involved in service deployment and removal.

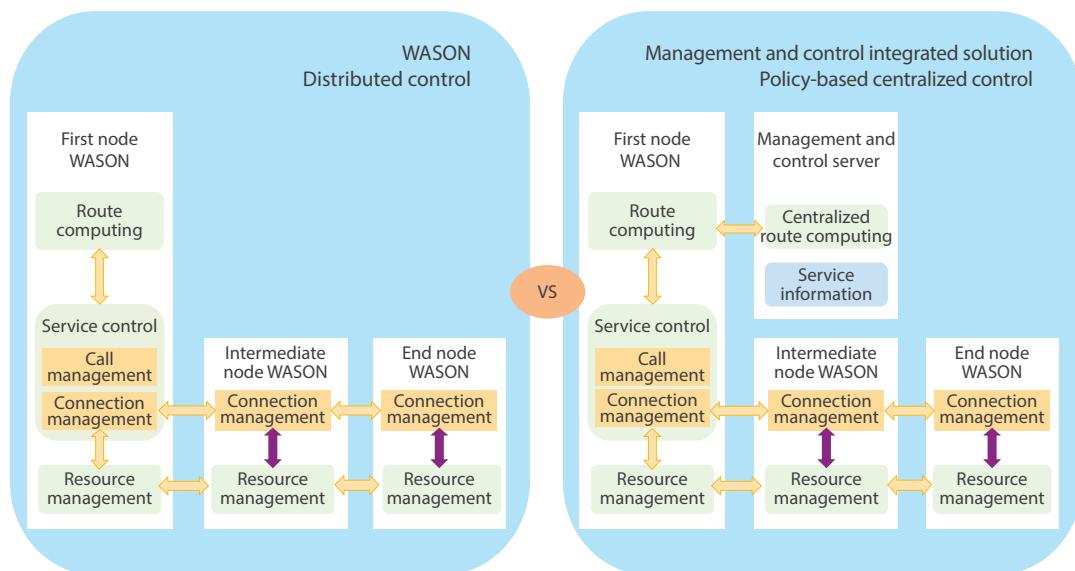
Automated Power Optimization for Cost Reduction and Efficiency Improvement

The optimization of optical power within the optical power system for traditional OTNs is carried out manually during joint debugging and maintenance phases. This is especially challenging in WASON service restoration scenarios, where the number of routes to be restored can be extensive.

Manual operation methods are unable to debug all available paths, demanding a significant amount of human effort. The traditional method of prefabricated paths, due to its inability to cover all possible routes, results in certain risks to network robustness. Furthermore, it is unable to promptly adjust optical power in the event of optical cable degradation, consequently affecting services.

To tackle this challenge, ZTE has implemented an automatic power optimization (APO) solution. Through intelligent algorithms, this solution enables automatic control and optimization of optical power throughout the entire network. Compared with manual calculations and interventions, this approach is closer to optimal values. This not only enhances transmission performance but also reduces the need for extra transmission performance margins, thereby lowering network construction costs.

The APO solution includes a range of functions such as collection and reporting of power detector data, target power preset for the power detector, power parameter setting for the power controller,



◀ Fig. 1. Comparison between the WASON distributed control solution and the management and control integrated solution.

local automatic optimization of controller power parameters, global optimization of controller power parameters, automatic power optimization of the detector, and automatic channel power equalization.

The APO solution implements network-wide power equalization by overlaying the power adjustments at both the optical multiplexing section (OMS) layer and the OCH layer. At the OMS layer, when the actual engineering parameters (such as fiber length) do not match the power budget design during network commissioning, or when fiber link attenuation changes during network maintenance, APO enables the system to automatically adjust the attenuation of optical attenuators or the gain of amplifiers. This allows the system to maintain the intended target power budget as designed. At the OCH layer, when individual wavelength channels experience power fluctuations due to factors like fiber connector losses, APO automatically adjusts the attenuation of boards equipped with channel attenuation adjustment capabilities (such as VMUX). This restores wavelength channels with abnormal power levels to their optimal operating points.

During network commissioning, APO's network-wide power setting and adjustment capabilities can improve the efficiency of new network deployment. Throughout network operation, APO's real-time intelligent monitoring and network-wide power optimization capabilities can reduce the manpower costs of routine operation and maintenance. In addition, APO can rapidly respond to network power changes, reducing network adjustment time, network degradation duration, and even service failure time. This significantly strengthens network reliability and stability, leading to a substantial improvement in the intelligence of network self-healing capabilities.

In the scenario of WASON service

restoration, APO can automatically adjust the optical power of service paths, enabling the WASON network to possess a genuine automatic global exhaustive route computation capability. This greatly enhances network robustness.

Flexible Grids for Self-Intelligence Management

A key concept of a flexible grid is frequency slot, which refers to a spectrum section that meets the definition of a flexible grid as specified in G.694.1. At any given moment, this spectrum segment can be used for only one optical channel and is uniquely defined by its central frequency and slot width. Compared with the traditional fixed grid network, a flexible grid network has the flexibility to select a range of slot widths as required.

In comparison to the traditional fixed-grid network, where all NEs are fixed-grid components, and the spectrum resource management granularity is based on fixed wavelengths, a flexible-grid network offers a different approach. In a flexible-grid network, there's no need for manual grid division in the network management. The network is composed entirely of fully automated flexible-grid NEs. The control plane can dynamically create and remove optical-layer wave channels as required, without human intervention. Resource allocation in a fully automated flexible-grid network is based on fundamental frequency slots, allowing the control plane to efficiently allocate optical-layer resources within its designated spectral range.

- In the 100G+ OTN service scenario, signals with different transmission rates or signals with the same transmission rate but using different modulation modes and coding schemes have different baud rates. This necessitates the use of different channel spacing. The concept of a flexible grid is exceptionally

well-suited for accommodating this mix of various channel spacing requirements in transmission. It can dynamically allocate spectrum as needed, leading to efficient spectrum utilization and conservation of spectral resources.

- In the WASON service restoration scenario, fixed grids need to manually configure all ports of WSS and OPM spectrum analysis boards on the working and restoration routes. When a large number of alarms occur on idle network ports, the typical practice is to suppress these alarms. However, in cases where WASON services need to recover due to factors like optical cable interruptions, the previously idle ports become active for the restoration path. In such situations, it's challenging to manually and promptly remove the alarm suppression from these parts, which can lead to a problem of real network alarms being overlooked. In contrast, flexible grids can automatically enable the ports on the route taken by the service through WSS and OPM spectrum analysis boards. When the service route changes, the system automatically removes these ports, ensuring that network alarms are always visible throughout the process. This feature makes network maintenance more convenient.
- In a fully automated flexible grid scenario, during the optical-layer end-to-end service provisioning phase, the system can automatically identify and adjust parameters related to service boards and the optical channel's spectral width. This eliminates the manual configuration steps for individual network WSS bandwidth and OPM spectral analysis board ports, simplifying network deployment. In the network maintenance phase, WASON services can automatically enable WSS and OPM ports on new recovery routes, and idle ports are automatically removed when

the services are restored. This advanced capability facilitates autonomous network management.

Intelligent Applications

ZTE and a Turkish mobile operator collaborate for the first time to implement a simplified deployment of OTN networks using a combination of intelligent solutions. This deployment encompasses the management and control integrated services, enabling OMS APO and OCH APO functionalities, with all scenarios based on flexible grids.

In the network deployment phase, there's no need for WSS channel setting, EOPM channel setting, or OA board resource allocation, resulting in a workload reduction of over 40% for single-point network configurations. The system automates optical power adjustments, boosting end-to-end service activation efficiency by over 70%.

In the network maintenance phase, APO can automatically adjust the power of the optical system in real time, achieving intelligent network self-healing and greatly reducing the network management and maintenance costs.

In terms of network evolution, the use of flexible grids enables the system to automatically allocate resources when transitioning to different service bandwidths, such as 400G in the future. This facilitates significant network scalability and growth.

ZTE's OTN intelligent applications come with distinct advantages in saving manpower and time costs, improving network maintenance and management efficiency, and promoting network scalability. The intelligent OTN solution is expected to be widely used in future network construction and optimization, helping customers achieve rapid and simplified network deployment, along with intelligent self-healing capabilities. **ZTE TECHNOLOGIES**

Enhancing User Perception with uSmartNet: Achieving a Leap in User Experience



Qian Zhengtie

Deputy Director of ZTE
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With the rise of the metaverse, big data and generative AI are gradually penetrating into diverse sectors, creating new application fields. Meanwhile, the global digital economy is developing rapidly, and the construction of 5G networks is speeding up. Communication networks are becoming more complex, and the number of applications is increasing. People have raised higher requirements for network quality, and user experience has become the key to the success of communication network businesses.

A conventional KPI defined based on an event trigger counter cannot visually reflect actual user experience of a network. As a result, the focus of network quality improvement is gradually shifting from the conventional target of improving network KPIs to the core target of improving user experience. For operators, there is an urgent need to establish a network indicator identification and optimization system based on user perception, and ensure that it provides efficient and accurate functions in daily networks.

Rapidly identifying and solving user perception problems, and achieving predictability and prevention of such problems, is an ongoing goal pursued by the technical team of ZTE Global Services in the digital and intelligent era. Through the

delivery of a large number of commercial network projects around the world in recent years, ZTE has accumulated comprehensive service capabilities in platforms, personnel, knowledge, and processes. The company has developed an end-to-end user perception identification, improvement, and prediction solution based on uSmartNet, with rate and latency perception as its core objectives.

uSmartNet is an autonomous network platform that integrates big data and AI technologies, providing end-to-end coverage for communication networks from single domain to cross-domains (Fig. 1). The platform provides insights into data from multiple domains including users, terminals, services, networks, and operation, supporting the digital and intelligent transformation of operators. In terms of ensuring user experience, uSmartNet uses a comprehensive KPI+KQI+QoE approach to establish a user perception evaluation system to accurately restore service perception. Leveraging the perception analysis and processing capabilities of big data, wireless networks, bearer networks, and core networks, it builds an end-to-end user perception analysis and optimization system to demarcate and locate end-to-end quality problems, analyze user perception and network complaints, predict perception problems, and handle the problems in a closed loop quickly.

uSmartNet Enables Intelligent Identification and Location of User Perception Issues

Identifying user perception problems in the network in a timely manner is key to ensuring user experience. uSmartNet can collect the control-plane and user-plane data from the wireless, bearer, and core networks, and clean, correlate, and integrate the data to form a high-quality perception database. To solve the increasing problem of service identification rates for new applications, AI capabilities are introduced into the probe system at the data collection layer. Through machine learning, new applications can be identified automatically, boosting the overall service identification rate of the system to over 90%. This provides a reliable basis for analyzing perception problems.

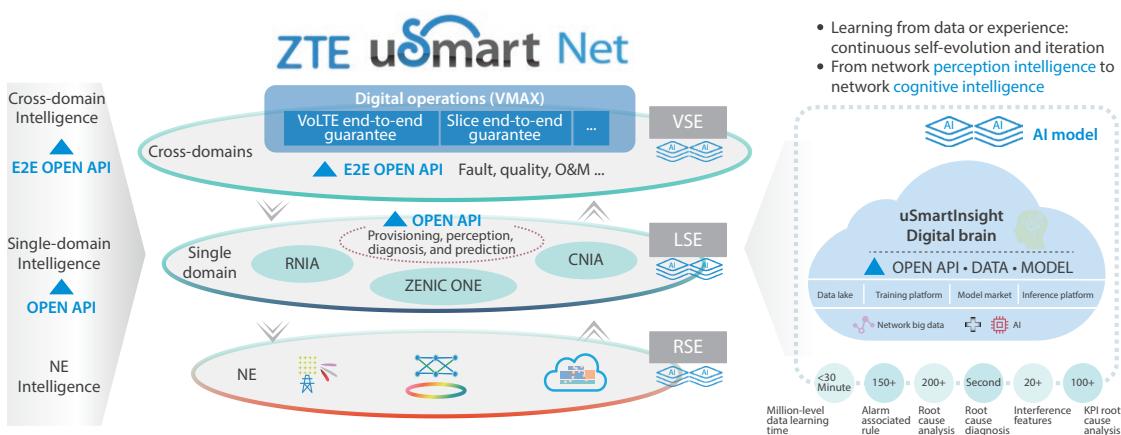
With the support of complete, reliable, and high-quality data, the platform quantifies the user experience for various service categories like network browsing, video streaming, gaming, OTT video, and OTT voice. Using appropriate mathematical models, it comprehensively evaluates the overall user experience of data services. By means of cascading, time sequence, space domain, aggregation, and failure reasons, the platform demarcates problems with

low perception scores to specific network domains.

To locate user perception problems more quickly and accurately, the platform relies on AI capabilities and expert experience to continually explore and expand its ability to delve deeper into the root causes of the problems. On the wireless side, it analyzes and locates the root causes of cell faults, coverage issues, interference, and capacity constraints based on wireless MR, CDT, alarms, and performance data, and provides corresponding solutions. On the bearer side, it locates problems to specific links based on the delay, jitter, and packet loss measurement data of each link, and more accurately identifies and locates the problems that affect user perception in accordance with the single-domain capabilities of radio, bearer, and core networks.

Expertise Combined with uSmartNet's Perception Analysis Capability: Efficiently Resolving User Perception Issues

To solve the perception problems that affect user experience, such as rate, delay, voice quality, and video quality, ZTE has developed comprehensive and practical functions that facilitate the improvement



◀ Fig. 1. ZTE uSmartNet solution.

of end-to-end user perception. In terms of voice services, functions like intelligent pre-scheduling, intelligent resource allocation, and adaptive handover optimization effectively improve MOS and latency indicators. For data services, functions such as intelligent pre-scheduling for web browsing, intelligent AMC, adaptive CFI optimization, intelligent downlink scheduling, user location-based load balancing, and service-based inter-frequency handover all contribute to a notable improvement in perception-related elements like data rates and latency.

Good network quality is the basis for guaranteeing user experience. Based on the concept of self-discovery and self-optimization, ZTE continually advances the autonomous capability of network maintenance to enhance network quality. In a latency perception optimization project for an operator, ZTE performance experts leveraged uSmartNet's big data perception analysis capability to comprehensively analyze the reasons behind variations in user-perceived latency and performed multi-dimensional analysis on the latency indicators for key services like games and videos that customers are concerned about. This approach enabled ZTE to quickly demarcate and locate problems, thereby enhancing network quality in the areas of weaknesses. From the perspectives of time domain, area domain, service, and NE, ZTE formulated a cross-domain end-to-end optimization strategy covering wireless, microwave, IPRAN, core network, IPCORE, international ISP links, and CDNs, and devised detailed latency enhancement plans for each product category. Through measures such as poor-quality service identification and rectification, traffic balance, international link optimization, CDN cross-traffic optimization, transmission link optimization, and air interface scheduling optimization, the user's experience about latency was greatly improved. This propelled

the operator to the top position among many operators in China.

Excellent network service quality can enhance user satisfaction and create brand value. The insights into market competition provided by third-party authoritative communication network testing and analysis organizations play an important role in the competitiveness of service quality that operators focus on. Organizations such as Tutela, Ookla, and Opensignal collaborate with widely-used market apps and secure necessary permissions. When a user opens an app authorized by a crowdsourcing enterprise, the app will track the base station connected to the mobile phone, measure the signal strength, and send this data anonymously back to the dedicated server deployed globally. The crowdsourcing platform can then use this data to analyze the network quality of different operators in the same area and generate a report on network perception quality analysis.

Though crowdsourcing data contains a large amount of third-party network data, it is limited to user terminal data and lacks network device data. As a result, it cannot be directly used to demarcate and locate perception problems. Operator only knows the results, but they cannot identify root causes or provide tailored solutions. In response, ZTE comprehensively explores the impact of users, terminals, NEs, and servers on crowdsourcing test results from multiple dimensions of big data. This approach identifies weaknesses and provides robust support for operators to enhance network evaluation.

In the uSmartNet solution, the "Digital-Intelligent Brain" explores the hidden relationships between crowdsourcing measurements and network performance, uncovering critical network performance and parameters. It deduces optimal parameter configuration models by using algorithms like random forest and decision tree to demarcate and locate related network

problems. It automatically calculates network factors that affect perception, formulates solutions, and provides direct recommendations for adjusting parameters at the cell level. Through the connection with wireless EMS, it issues commands to adjust parameters, achieving a fully automatic closed-loop of the entire process. This application has demonstrated outstanding performance in practical use and has been featured in the 2022 TMF release of the "Autonomous Network White Paper V4.0" thanks to its successful implementation in an Indonesian telecom operator.

uSmartNet Empowers Precise User Satisfaction Prediction

At present, the trend in network operations is gradually changing from passive response to proactive guarantee. When user complaints arise because of perception issues, it means that network problems have escalated to a point where their impact cannot be ignored, often requiring last-minute solutions. To proactively identify, locate, and handle user perception problems, it is necessary to shift the focus towards "preventive treatment" measures. To this end, ZTE has built a customer satisfaction scoring system (CSAT) that combines multi-dimensional indicators such as key quality indicators (KQI), coverage quality, and customer complaints. This system also incorporates AI capabilities to predict future satisfaction trends in different regions, ensuring an average accuracy rate of over 90% when forecasting the trends of various indicators over the next week. Maintenance personnel can then optimize areas with low satisfaction in advance, actively ensuring user experience.

After CSAT was deployed on the uSmartNet platform of an operator in a country, it automatically detected potential drops in satisfaction within a specific region and issued early warnings. After

troubleshooting, it is confirmed that the interference problem existed in this region, with a discernible upward trend. Maintenance personnel optimized the performance, solved the interference problem, resulting in significant improvements in various indicators for that region. Video download rates increased by 3%, regional data traffic grew by 7%, and user satisfaction notably rose. This proactive approach prevented a large number of complaints arising from poor user perception. This system has been embedded in the routine optimization process of operator network maintenance. During the quarterly optimization task planning, the maintenance team devises optimization strategies and solutions based on the satisfaction scores of the top N areas identified by the CSAT function as having poor satisfaction, along with the areas with low satisfaction predicted by AI. The CSAT function is also used for closed-loop verification of optimization results.

Throughout the entire process of network construction and operation, ZTE prioritizes enhancing user perception. It tailors network performance enhancement solutions to match the unique characteristics and requirements of operators. Over the past decade, ZTE has driven the development of high-quality networks. It has now achieved a multitude of leading network quality benchmarks in over 100 countries and regions, providing reliable user perception guarantee for operators worldwide. Drawing upon its rich experience in global network operations as well as its collaborative capabilities driven by digitalization and intelligence, ZTE will continue to help operators accelerate their network automation and intelligence. This effort aims to reduce operational costs, increase efficiency, expand revenue streams, and empower digital transformation of the industry. **ZTE TECHNOLOGIES**



ZTE Supports AIS in Smart Network Construction and Intelligent O&M



Liang Ao

Deputy General Manager of ZTE Thailand Engineering Service Office

AIS is a leading mobile operator in Thailand, with over 46 million subscribers nationwide. In the digital era, the rapid development of the information and communication industry has dramatically changed people's production and life styles. As an industry leader, AIS is committed to providing high-quality mobile communications services for users in Thailand.

ZTE, as the world's leading provider of integrated communications and information technology solutions, has been assisting AIS in building the 3G network since as early as 2010. ZTE also helped AIS in deploying its 4G network on a large scale, which was put into commercial use in 2015. In early 2020, AIS began to build its 5G network, which has basically achieved full 5G coverage in urban areas and is actively promoting the maturity of the end-to-end 5G industry. However, the coexistence of multiple 2/3/4/5G frequency bands in AIS's network has made the

equipment type and network architecture complicated, posing great challenges to 5G network construction and O&M.

As a strategic partner of AIS, ZTE has developed an end-to-end intelligent solution for AIS in network construction and O&M. This solution covers single-domain precision planning, automatic AAPC antenna weight optimization, VDT, NQI, cross-domain complaint handling supported by VMAX-S big data platform, and self-intelligence implementation. It effectively improves network delivery efficiency, reduces network maintenance difficulties, and reduces network O&M costs.

Value-Based Guidance, Precision Planning

In the initial stage of 5G network construction and during the operation phase of in-service networks, operators face the important goal of improving network utilization and obtaining a timely return

on investment. However, traditional network planning is inefficient and inaccurate. To address this, ZTE has launched the precision planning solution, which utilizes the VMAX-R wireless network precision planning platform to identify high-value areas from multiple dimensions, such as coverage and capacity, and multiple space granularities.

In addition, the platform incorporates intelligent identification of weak-coverage areas and the latest functions, including the analysis of 5G inter-frequency weak-coverage in comparison with competitors. This allows more efficient identification of weak-coverage areas and more accurate placement of new sites. The VMAX-R precision planning platform has been deployed in 25 provinces in the northeast and east districts of AIS coverage. It effectively reduces the difficulty of network planning for the customer and quickly and precisely identifies value areas for expansion.

Intelligent Optimization of Antenna Weight for Automatic Adjustment of Antenna Coverage

With the large-scale deployment of 5G, ensuring network quality has become increasingly important in order to maintain service operation and enhance user experience. ZTE's adaptive antenna pattern control (AAPC)

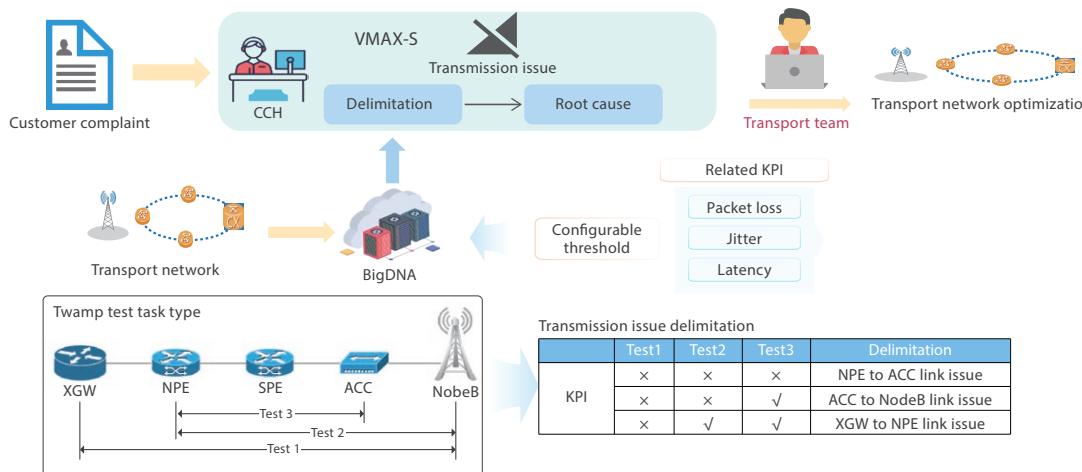
tool automatically calculates the optimal weight of AAU's subbeams based on measurement reports collected from commercial users and ZTE's self-developed AI algorithm. This ensures that the network coverage aligns with the user model to the maximum extent.

The AAPC tool not only automatically adjusts the antenna weight, but also self-adapts the antenna coverage model over different time periods based on the changing user model to meet user requirements. All of these optimization operations are performed at the back end, which significantly reduces network O&M costs. It enables a fully automated process of data collection, analysis, and self-optimization.

Currently, ZTE has deployed periodical AAPC tasks in 25 provinces in AIS coverage in Thailand, optimizing more than 3,000 sites. The optimization results have shown an average increase of 4 dB in RSRP and 2 dB in SINR, effectively improving user experience and reducing optimization costs during the engineering phase.

VMAX-S+BigDNA Accurately Locates Cross-Domain Bearer Problems

When it comes to handling user complaints, on-site teams typically have extensive experience in handling wireless single-domain problems. However, they may find it difficult to



◀ Fig.1. VMAX-S + BigDNA workflow.

solve cross-domain transmission problems, requiring the involvement of a specialized team. In addition, traditional manual analysis is time-consuming and costly, making it difficult to ensure the timely resolution of complaints. Therefore, cross-domain delimiting analysis of transmission problems is a major pain point in improving complaint handling efficiency.

To address this, ZTE has implemented the one-click cross-domain problem delimiting through the customer complaint handling (CCH) function, utilizing the VMAX-S big data platform and the bearer BigDNA cross-domain capability (Fig. 1). The on-site team only needs to click “Query” to obtain the cross-domain root cause analysis results for both wireless and transmission problems. This assists the complaint handling team in quickly locating problems and solving related faults, significantly improving the operator's complaint handling capability.

VMAX-S+AAX Implements Cross-Domain Fault Self-Diagnosis

In the traditional network optimization process, alarm problems have the most direct impact on user perception, and are also common causes for user complaints. However, solving alarm problems can be difficult. For example, when there are a large number of alarms in the network, it is challenging to manually analyze and associate different alarm, as well as accurately locate their root causes. This often leads to a reactive approach of addressing the symptoms rather than the underlying issues. Even if the root cause is located, dealing with the problem in face of the complicated network environment requires a professional team, which is labor and time-consuming. Therefore, improving the efficiency of alarm handling is a major pain point in current network O&M.

ZTE addresses this issue with the CCH function of its VMAX-S big data platform,

along with the single-domain alarm automation eXpert (AAX) capability of the wireless network. With just one click, the customer can quickly delimit and locate user complaints caused by alarm problems and automatically obtain the root cause diagnosis results and alarm handling suggestions. This allows the onsite complaint handling team to respond to alarms quickly and resolve faults quickly in accordance with handling suggestions. There is no longer a need for manual troubleshooting of alarms and analyzing root causes in a single domain, thus greatly improving troubleshooting efficiency and saving O&M manpower. According to the TMF standards for autonomous networks, the VMAX+AAX solution has reached L3 cross-domain capability and is close to L4 autonomous capability, greatly improving operators' complaint handling capability.

Summary

In the digital economy era, the use of digital and intelligent tools provides a more diversified and efficient solution for predicting and analyzing problems in the AIS network. In the 2023 Q1 Network Assessment organized by AIS, ZTE ranked first in cross-region network performance.

As new scenarios and services continue to emerge, efficient, simplified, and intelligent communication networks are required. AIS is committed to building a 5G network benchmark. With the full support of ZTE, AIS has achieved single-domain autonomy across the wireless network, wired network and core network, reaching the L3 capability at the tool side. At the same time, with the deployment of VMAX-S, the single-domain tools can be used to implement cross-domain workflows, laying a solid foundation for the customer's autonomous network. With continuous and in-depth cooperation, ZTE will assist AIS in moving toward a higher-level autonomous network. **ZTE TECHNOLOGIES**



Boosting Digital Economy Development in Wuhan with Ultimate Service

Wuhan, often referred to as the "Gateway to Nine Provinces", holds a significant place in Chinese history. Its glorious past has given rise to the spirit of the new era in Wuhan, characterized by a commitment to innovation and excellence. This spirit not only upholds Wuhan's historical legacy but also reflects the aspirations and ambitions of the people of Wuhan for future development. As the cornerstone of the digital economy, Wuhan's communication networks have witnessed rapid growth. ZTE has been working with operators in Wuhan in various aspects such as network quality enhancement, network expansion, network innovation, and industry applications. This collaborative effort aims to increase network deployment and operation efficiency, improving network quality and user experience.

Ultimate Service Boosts Network Quality

ZTE continues its in-depth cooperation with network operators in the Hubei region of China, centered on the user's perspective, jointly driving network quality improvement. In recent years, it has achieved outstanding results

in tests conducted by the Chinese Ministry of Industry and Information Technology (MIIT) and network evaluations by network operators.

ZTE has assisted Hubei Mobile in prioritizing user experience and leveraging the network profiling system to enhance network quality. In 2022, the number of complaint tickets in ZTE service area decreased by 20% year-on-year, leading to a significant improvement in network quality.

ZTE has worked with Hubei Telecom to launch the VoNR optimization service, introducing its in-house VoNR EMI voice evaluation system. This system enables voice quality evaluation and optimization at the cell, CDR and slice levels on the network geolocation insight (NGI) platform. It facilitates rapid convergence and closed-loop of network problems, aiming to create an ultimate 5G voice experience.

Digital Transformation Accelerates Upgrade to Autonomous Networks

The digitalization of the economy and society, along with the high-quality development of the information and communications industry, is propelling the digital transformation of the



Zhang Dongsheng

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telecom sector. ZTE actively cooperates with telecom operators to jointly promote their transformation to autonomous networks.

- ZTE partners with three major operators in Wuhan to implement precise 5G planning and improve user experience through innovative NGI applications. It makes grid-level or building-level 5G coverage evaluation based on NGI, performs value evaluation based on complaint scenarios of traffic terminals, and obtains multi-dimensional building-level profiles. This approach focuses on residential areas, identifying high-value residential zones and providing guidance for the application of scenario-based solutions.
- ZTE's alarm automation expert/equipment fault protection (AAX/EFP) interfaces with Hubei Mobile's dual-platform production system, facilitating rapid enhancement of its automation capabilities. Leveraging the AAX and EFP intelligent O&M solution, ZTE implements seamless interconnection with Hubei Mobile's centralized fault management system platform and automation platform for alarm root cause diagnosis and identification of base station potential faults. After interconnection, AAX achieves an accuracy of over 90% in locating front-line O&M service outage faults, resulting in a 30% improvement in fault location efficiency. EFP reduces the potential risk screening and handling process workflow by 45%, leading to a 43% increase in the average weekly handling of fault sites.
- ZTE's poor NQI cell analysis and RAIS interference analysis functions help Hubei Mobile improve efficiency and quality in multiple dimensions. The NQI tool is successfully interconnected with Hubei Mobile's production system, and NQI analysis tasks are established to ensure a 100% match of performance tickets. Moreover, the system algorithm is used to improve the efficiency of both poor quality analysis and interference analysis.

Joint Innovation Maximizes Network Value

Considering the specific local network conditions

and customer requirements in Wuhan, ZTE tailored its approach and planned nearly 20 innovative projects for operators in early 2022. Several key projects have been deployed in the production environment and are being continuously utilized.

- In scenic spots such as Donghu Meiyuan and Tan Hualin in Wuhan, ZTE assisted Hubei Mobile in creating an ultimate experience. Utilizing technologies such as 2.6G+4.9G carrier aggregation, it offers impressive speeds of 2 Gbps for downlink and 300 Mbps for uplink.
- ZTE assisted Hubei Mobile in leveraging the automatic AAPC weight optimization function to automate network weight optimization in scenarios involving overlap coverage and out-of-service compensation. Through statistical estimation of cell UE distribution and neighbor cell interference by eNodeB, the solution comprehensively considers network coverage performance to achieve adaptive adjustments. Additionally, it helps eNodeB intelligently estimate optimal broadcast weights, thus achieving optimal coverage.
- In certain university scenarios in Wuhan, ZTE helped Hubei Telecom deploy the tidal AAPC function on a large scale to address a variety of coverage scenarios. This ensures adaptive and flexible adjustment of broadcast weights. Through fast and intelligent network planning and optimization, it minimizes network deployment time and human resources, resulting in optimal coverage and performance gains across different scenarios.
- ZTE helped Hubei Telecom take the lead to launch the innovative 5G AAU automatic start/stop energy-saving solution, minimizing the energy consumption of an inactive AAU to less than 5W in a zero-traffic status. This initiative has been put into commercial use on a large scale in Wuhan, providing full support to Hubei Telecom's efforts to promote low-carbon operation of its communication infrastructure. While guaranteeing network performance and user experience, it maximizes the reduction

of energy consumption and emissions.

5G+ Applications Create a Fresh Engine for Industrial Development

Since 2020, the 5G+ Industrial Internet Conference sponsored by MIIT and the Hubei Provincial Government, has been held consecutively in Wuhan for three years. Hubei is actively promoting the development of 5G+ applications to enhance the modernization of the industrial chain. ZTE is fully cooperating with operators to drive the digitalization upgrade across various industries.

- ZTE partners with Hubei Mobile to build an intelligent 5G+ optical cable manufacturing factory in Wuhan, achieving full 5G coverage throughout the factory campus. Leveraging the functionalities of 5G+ automatic logistics, 5G+ monitoring platforms, and 5G+ energy consumption data collection, while ensuring that all factory data remains within the campus, ZTE implements remote real-time visualization of production, comprehensive monitoring of the entire production process, and intelligent energy-efficient manufacturing. This drives the digital transformation and upgrading of the enterprise.
- ZTE collaborates with Hubei Mobile to empower the pharmaceutical industry in Wuhan by building a 5G fully-connected traditional Chinese medicine (TCM) production line. Through cutting-edge technologies such as 5G, edge computing, and digital twin, ZTE provides an exclusive 5G private network with full coverage for the production campus, creating a virtual factory. It offers industrial internet applications like automated guided vehicles (AGVs), 5G data acquisition systems, and remote integrated control, enabling visualized and intelligent management. As a result, production efficiency has seen a remarkable increase of over 30%.
- ZTE works with Hubei Unicom in Wuhan to commercialize FRER functions extensively based on its edge computing gateway (SmartEdge) and computing base station

ZTE conducts 2.6G+4.9G carrier aggregation test in Donghu Meiyuan



(NodeEngine). This advancement has significantly increased the proportion of data with a latency of less than 20 ms on FRER channels to 99.99%. This represents a two-nines increase in reliability compared to the single-frequency solution, thereby helping enterprises achieve unmanned on-site driving operations.

In China's 14th Five-Year Plan, several crucial directives have been outlined. These include accelerating the large-scale deployment of 5G networks, elevating the standard of telecom equipment, core electronic components, and key software industries, building 5G-based application scenarios and industrial ecosystems, and promoting the efficiency enhancement of emerging sectors like 5G and big data centers. These requirements provide clear guidance for the future of various industries. ZTE will continue to work closely with operators worldwide to build robust networks, explore opportunities for new growth, and contribute to creating a favorable business environment for the booming development of Wuhan's digital economy. **ZTE TECHNOLOGIES**

To enable connectivity and trust everywhere