JUN 2019 | VOL. 21 • NO. 3 • ISSUE 182

ZTE TECHNOLOGIES

VIP Voices

Bangladesh: Moving Towards a Digital Future

Expert Views

Deep Cloud-Network Convergence to Meet Digital Transformation of Enterprises

Special Topic: Cloud-Network Convergence

Scan for mobile reading

Cover Figure | Zunaid Ahmed Palak, State Minister of ICT Division, Bangladesh

ZTE TECHNOLOGIES

JUN 2019 | VOL. 21 • NO. 3 • ISSUE 182

Sponsor: ZTE Corporation

Edited By Shenzhen Editorial Office, Corporate Development Department
Editor-in-Chief: Lin Xiaodong
Deputy Editor-in-Chief: Huang Xinming
Editorial Director: Liu Yang
Executive Editor-in-Chief: Yue Lihua
Circulation Manager: Wang Pingping

Editorial Office

Address: NO. 55, Hi-tech Road South, Shenzhen, P.R.China
Postcode: 518075
Tel: +86-755-26775211
Fax: +86-755-26775217
Website: www.zte.com.cn/global/about/magazine
Email: yue.lihua@zte.com.cn

Statement: This magazine is a free publication for you. If you do not want to receive it in the future, you can send the "TD unsubscribe" mail to magazine@zte.com.cn. We will not send you this magazine again after receiving your email. Thank you for your support.

CONTENTS

VIP Voices

Expert Views

Special Topic: Cloud-Network Convergence

Success Story

Bangladesh: Moving Towards a Digital Future

Reporter: Hua Lei

Zunaid Ahmed Palak, State Minister of ICT Division, Bangladesh

Since the Digital Bangladesh by 2021 vision was proposed in 2008, Bangladesh has been undergoing a digital transformation. At MWC 2019, Zunaid Ahmed Palak, State Minister of ICT Division, Bangladesh, talked to *ZTE Technologies* about the country's recent achievements in digital government and the five targets for achieving Digital Bangladesh in the next five years starting from 2019.

What are the most important elements of Digital Bangladesh?

Our honorable Prime Minister declared her vision to build Digital Bangladesh in 2008. Since then, we have been building four pillars for achieving Digital Bangladesh: human resources development, internet connectivity for all, digital government, and ICT industry promotion. These are the four areas where we are focusing on to build Digital Bangladesh.

What have been the achievements in e-government so far? How do you evaluate the national data center project?

Honorable Prime Minister Sheikh Hasina has taken a very different approach for providing digital government services to the citizens. In 2009, honorable Prime Minister decided to set up digital centers at the village level. Since then, we have set up 5,000 digital delivery centers across the country where 500 different types of digital services are available to the citizens, villagers. Every month six million people are getting digital services from those digital centers. And we have one of the largest government portals in the world where we have 43, 000 websites and 1, 500 different types of

State Minister Zunaid Ahmed Palak at MWC 2019

forums. We have introduced 700 mobile applications to make citizens' lives easier. I would say that 50 percent of government services are now online and setting up the IV Tier national data center supported by ZTE—we are now using two petabytes storage capacity—is going to play a very vital role in digital government.

ZTE has been working in Bangladesh for more than 20 years. How do you evaluate its contribution to the local market? What's your expectations or suggestions for ZTE?

We are really grateful to ZTE for their presence in Bangladesh for the last 20 years. They are working with the private sector and, at the same time, with the government agencies, ministries. Currently, ZTE is implementing two important projects for the government. One is laying down the fiber optical cables across the country; another is IV Tier national data center establishment. I think ZTE has been working for Bangladesh for a long time, and I hope that ZTE will be the most important partner in building Digital Bangladesh. And I also would like to request to ZTE for setting up a center of excellence on frontier technology in Bangladesh. I hope in the future, we will be working together for building Digital Bangladesh.

What does the future hold for Bangladesh's ICT sector in the new session of the Government especially in the next five years starting from 2019?

Bangladesh government has been working hard to achieve Digital Bangladesh under the prudent leadership of honorable Prime Minister Sheikh Hasina and under the proper guidance of the architect of Digital Bangladesh, Sajeeb Wazed Joy. ICT Division has been working to achieve all these targets that are important for achieving Digital Bangladesh. In the next five years, we have five specific targets.

We want to provide modern citizen services and facilities to the villagers, and, to ensure the modern facilities for villagers; we have five targets, like ensuring access to electricity, access to internet connectivity, a modern road connectivity, education and health. These five basic needs we want to provide for the villagers by using ICT definitely.

The second is we want to develop our human resources. Bangladesh is one of the youngest nations in the world. We have 70 percent of our population who are below 35. We have 50 million students who are studying from primary to tertiary level. We want to develop all these human resources according to the global requirements and according to digital world's requirements. That's why we have set up nearly 9000 digital labs across the country and we have a target to set up another 25,000 Sheikh Russell digital computer labs in primary, secondary, higher secondary and tertiary levels. We want to set up specialized labs in the university level. We are setting up IT training and incubation centers at the university level and we are building 28 high-tech parks across the country to develop our human resources.

Third, we want to use ICT for reducing the time, cost, visit and corruption. We want to provide digital services for the government and for the people.

Fourth, we want to create an innovation ecosystem in Bangladesh. We want to develop entrepreneurial supply chain. We want to provide home-grown solutions for the people of Bangladesh and we want to create a start-up culture in Bangladesh because Bangladesh has a huge market size. We have a huge demand of different types of products because we have 50 million middle-income and affluent consumers. To fulfil their requirements and demands, we want to create that supply chain.

Fifth, we want to introduce 5G mobile facilities in the next five years.

These are the five areas we are focusing and we want to achieve all these five targets in five years. ZTE TECHNOLOGIES

Mobitel: Prioritizing Customer-Centricity

Reporter: Liu Yang

Nalin Perera, CEO of Mobitel

Sri Lanka's telecom market is vibrant and competitive. Mobitel, one of the country's largest mobile network operators, has yet again embarked on a large-scale network expansion drive. Nalin Perera, CEO of Mobitel, spoke to *ZTE Technologies* about the company's successful 2018 and what he wants to accomplish in 2019. As a veteran of Sri Lanka's mobile industry, he also shared with us his management philosophy.

Looking back on 2018, what do you think were some of Mobitel's greatest achievements?

If you look at Mobitel's commercial operations for the last 25 years, we have been revolving around many technologies. Initially we were with AMPS, and then we went to TDMA and then into GSM. So from GSM onward, every time when there is a new technological improvement, we have always been ahead.

We crossed the threshold for becoming a strong brand and established ourselves as one of the most popular brands in Sri Lanka. With our commitment to 4G as the de facto standard for mobile communications, we rolled out over 1,000 eNodeBs in 2018. This was the fastest 4G

roll-out in the market. We won the prestigious SLIM service brand of the year award for 2018. We recorded the historically highest revenues and profits in 2018. We also had the highest net additions to our network last year.

How has the telecom landscape evolved in Sri Lanka? What are the key trends?

There were five mobile operators in Sri Lanka. Now we can see the market is consolidating, which I think is good. The market growth has been tremendous within the last few years. With Etisalat and Hutchison merging, the industry landscape has changed from five to four operators. I think in terms of technology and user experience, all the operators face huge challenges to make sure that they meet user expectations. The industry is going through digital transformation aided by intense 4G rollout by the key operators. At least two operators, including Mobitel, have done 5G technology testing.

What are some of the biggest challenges facing Mobitel today?

One of the biggest challenges we have is taxation. In the mobile industry, spectrum is the life blood. There are limitations in terms of technology relating to the spectrum. With the technology advancements happening in the industry, in order to reap the benefits in a timely manner, we should have the most appropriate spectrum portfolio at any point of time.

Another challenge is that increasingly broadband traffic is becoming dominant out of the total investment and effort. As Sri Lanka has the lowest mobile broadband pricing, we need to transform mobile broadband business to yield sustainable profits.

Unlike the voice era, in the mobile broadband era, we cannot depend on the commoditized data revenues. As a mobile company, we need to become the value-added platform connecting various communities in the society, and generate multiple business lines to supplement the MBB infrastructure. For that we need to bring in a culture of innovation where we bring to life many propositions and face out if not successful. For that to happen, this type of products and services should take place with minimum time and cost. Establishing such ecosystem is one of the prime success factors in today's context.

As an industry veteran, could you share with us your management philosophy?

I think you have things that you have no control over. Within what is controllable, one thing we strongly believe in is customer centricity. When you make an investment decision, you need to understand what your customer expectations are. Your customers are the most important in the whole ecosystem, so your management philosophy should revolve around user expectations and market demands.

I believe to achieve any strategic progress there is a window of opportunity, so I urge everybody to act with a sense of urgency and purpose; a series of strategic wins propel you out of the pack, towards success and leadership.

Also I urge everyone to do the best within one's capability at any given task at hand. That requires a number of actions by the individuals such as learning new skills, seeking help for the task or even changing the context if it's adverse to the achievement of the task.

In which market segments do you see short-term and long-term opportunities?

I would say that mission-critical applications, monitoring analytics & big data, high-end premium quality video services, and real-time gaming are some of the promising market segments. Also I believe, as the National Mobile Service Provider, we have a serious obligation to assist through mobile technology and drive the government's digital transformation projects by

providing the thought leadership and implementing national-level platforms. So we believe the government sector would be a focal point in our future business.

Video on demand is going to be the one of the biggest challenges and one of the long-term things you will have. In addition, we may be investing in some smart city projects. But currently, it is difficult to identify an exact business model. In such situations, if government funding or some assistance can be provided, then I think there is some kind of model for the operators to look at in the long term.

What is your strategy on 5G? How do you prepare it in current network deployments and operations?

For an economy like Sri Lanka where scale and cost is a challenge for any industry, the promise of 5G is impressive; to that even 4G/LTE can enable a lot of such critical value addition into the network. So I believe with advanced technologies like 4G/5G, mobile companies become the catalyst for the growth of a host of other industries. Therefore, for the success of the era of new technologies, partnerships are the key. We should have strong backward integration with our technological partners and forward integration with our value chain partners and end-user entities.

Technologically, I understand that with the concepts of network slicing and DevOps we will be able to cater to the specific needs of various industry segments quite effectively in the 5G domain. Our first step is to exploit the 4.5G/LTE Advanced to deploy 5G like services in areas like mission-critical applications.

How do you assess ZTE's solutions and team?

ZTE is one of the biggest telco equipment vendors in the international market. As a challenger to more established vendors I believe ZTE has a high degree of hunger to reach further heights and is also perceived as a dominant challenger in the market.

All in all, we are extremely happy with the local support that we get. It's not just like a vendor who provides some pieces of equipment but who collaborates with our teams and shares its global experience. In that sense, we are very proud and happy that we have made ZTE our partner. You are a part of our total ecosystem.

What do you expect for the future?

I think one of biggest issues that we have in a technology-driven organization like Mobitel is that technology is so dynamic. So we need support from our vendors, mainly to keep the cost low and go for better technology. In that sense, what kind of a roadmap you have for your product is very important for long term planning.

Do you have anything to add in the end?

2019 is going to be a very crucial year for Mobitel because we have just embarked on one of the biggest expansion programs. 90 percent of our network will be 4G/LTE. It's going to be a really hectic exhilarated expansion program. We need every possible resource to complete our project as fast as possible. ZTE TECHNOLOGIES

ZTE CTO Wang Xiyu

ZTE CTO Wang Xiyu:
ZTE Committed to 5G Technological Innovation for Digital Transformation Push

Source: ZTE Press Release

In 2018, the 5G NR specifications were frozen. Many countries moved faster to allocate spectrum. Vendors had network product portfolios ready and started to launch commercial devices. Field trials were booming. Governments, operators, vendors, and vertical market companies were working together to accelerate 5G commercialization. Now, 5G is arriving while 4G is still flourishing. And 2019 will be the first year of 5G commercial deployments.

5G will definitely change all aspects of the world. But what would be the changes? How can ZTE maintain its leading position in 5G? What 5G product and solution portfolios does ZTE offer? In the wave of 5G, operators face many challenges in their digitization. How does ZTE become the best partner of operators? Mr. Wang Xiyu, ZTE CTO shared his insights into key issues of 5G development.

How do you think 5G will impact the society?

The 5G network will be 10 times faster than 4G and connect a massive number of things. Latency will decrease to 1 ms, dozens of

times less than that of 4G. As virtualization, cloudification, and AI technologies are introduced, the whole network will be more flexible and agile based on requirements. With the breakthrough in these capabilities and the adoption of AR, VR, and AI, 5G will advance the development of a comprehensive and intelligent ICT infrastructure that integrates communications, cloud, intelligence, and applications to drive the digitization of the world.

Firstly, there will be unlimited potential in new services like VR and AR, in new markets and applications like IoE and industrial internet, and in new business models. They will bring exciting user experience and encourage operators to refine their operations and create more value. They will also create more industry opportunities and boost related markets, which promote one another to form a positive cycle.

Secondly, 5G will empower the digitization of all industries directly. It will expand the capability boundaries of related industries and increase efficiency significantly, laying a solid foundation for industry upgrading.

In addition, the IoE in the 5G era will converge the virtual and physical worlds. It will enable real-time sensing and interactions of all things in the physical world and extensive AI applications. We will be able to make predictions and intervene before an event occurs rather than knowing about an event after it has happened, like in the internet era.

ZTE has been working with operators and partners to demonstrate how 5G will empower traditional industries in vertical markets like new media, IoT, IoV, industrial internet, smart grids, and smart cities. The demonstrations have shown the new capabilities of 5G. As commercial 5G networks are deployed, more innovative companies will leverage 5G networks to develop new services and models to meet the requirements of different industries.

Though 5G business models are still being explored, the requirements that drive the exploration are real, and the enabling technologies are solid. We believe that we will succeed in achieving the digitization of the whole society based on the 5G infrastructure.

How does ZTE ensure its leading position in 5G development?

The telecom industry has a high technology threshold, and telecommunications technologies have been evolving. To maintain competitiveness in this industry requires long-term accumulation of technologies and core capabilities, precise insights into tech trends, and a good understanding of the market. Over the past 30 years approximately, ZTE has adhered to customer requirements as the traction and to technology leadership. It is how ZTE ensures its leading position in 5G.

Adhering to customer requirements as the traction does not mean to meet any customer requirement. Only when the common pain points behind the requirements are discovered can we develop valuable solutions and lead the industry in innovation and development. In the past decades, ZTE has been focusing on attracting and developing a large number of technology talents. Meanwhile, ZTE has been following with markets closely and working closely with customers. Based on the precise insights on technology trends and customers' common pain points, ZTE has launched many solutions that are leading in terms of innovation. For instance, ZTE's SDR base stations help customers operate three generations of networks and evolve them continuously. ZTE's UBR helps customers solve problems relating to antenna platforms and costs for multi-band base stations. Pre5G helps customers meet increasing data requirements prior to 5G deployment. Common Core helps customers get relieved from investment confusion when they experience 4G-to-5G evolution and virtualization. ZTE is able to support both 5G NSA and SA networks, but we suggest operators to choose SA, as it enables 5G networks to have better performance and service extension. The

5G SA networks feature a lower TCO of network building in the middle term and long term. They are also flexible in selecting suppliers. All of these will bring higher value to operators. Therefore, it is the focus on customer requirements and concerns that helps ZTE create higher value for customers and promote its own development.

Adhering to technology leadership helps ZTE outperform competitors and better meet customer requirements. The technology leadership can be illustrated from the aspects of infrastructural architectures, efficient delivery, core algorithms, and intelligent network O&M. In infrastructural architectures, ZTE's core communications chipsets, including baseband, intermediate frequency, packet, and network processor chipsets, are based on advanced 7 nm process. Their excellent performance facilitates 5G commercial deployment at low cost, low energy consumption, high quality, and large scale. They ensure leading product performance and smooth long-term evolution. In efficient delivery, based on agility and DevOps, internet openness, and efficient process, the software architectures are becoming component-based, microservice based, virtualized, open and programmable. These facilitate rapid product delivery and address operators' demand for cloud-based networks and open network ecosystems. In core algorithms, ZTE has over 30 years of experience in optimization of core algorithms for the physical, link, and network layers. Meanwhile, platform-based development helps grow such core capability and ensures the leading performance of customers' networks. In intelligent network O&M, ZTE network intelligence solutions, based on ubiquitous AI, realize network resource optimization and failure prediction and analysis to increase efficiency and lower costs.

It is adhering to customer requirements as the traction and technology leadership that help ZTE increase its core competency and obtain a leading position in the 5G segment.

In the 5G era, what is ZTE's strategy in product and solution portfolios?

ZTE focuses on end-to-end 5G solutions and has developed a full range of products, solutions, and services that cover five key areas, including 5G devices, RAN, bearer network, core network, and vertical applications. ZTE is a major provider of end-to-end 5G solutions in the industry.

ZTE has been developing technologies that are essential to 5G for many years. These technologies include Massive MIMO, NFV, end-to-end slicing, edge computing, AI, and cloud-network convergence. We have launched commercial end-to-end 5G product portfolios for all bands and scenarios.

In the area of RAN, ZTE has been leading in Massive MIMO technologies. We have over four years of experience in commercial deployments,

with an accumulative number of shipment of over ten thousand sets. ZTE's industry-leading multi-mode IT BBUs and a full range of RRU and AAU products for flexible combination can meet the requirements at different frequencies and in various scenarios.

In the area of 5GC, ZTE will be the first to launch the commercial version of a fully converged core network solution based on SBA. It will support 2G/3G/4G/5G and fixed networks and thus increase network convergence and resource utilization.

In the area of 5G transport network, ZTE was the first to offer a unified solution for 5G fronthaul, mid-haul, and backhaul. It is leading the industry in FWA, ultra-wide pipe, elastic network slicing, lowest latency, ultra-high reliability, and high-precision time synchronization. This solution helps customers build super-fast, intelligent, and converged 5G transport networks. TITAN, ZTE's new-generation flagship optical access platform developed for 5G and network re-architecture, has been commercialized in many countries across the world.

In the area of devices, ZTE will launch its commercial 5G mobile phones in the first half of 2019. ZTE is also developing 5G tablets, in-door/outdoor CPEs, hotspots, data terminals, and other 5G products, to meet different consumers' requirements.

In the area of self-developing chipsets, ZTE has developed and produced at scale over 100 types of chipsets for over two decades, covering transport, access, and terminal areas. Its latest multi-mode chipsets support all of the current 5G specifications and realize the convergence of 2G/3G/4G/5G. To save energy, ZTE adopts advanced processes, new materials, and new architectures of essential chipsets to lower energy consumption and increase power and PA efficiency. In combination with network optimization such as intelligent network shutdown, ZTE's solutions help operators reduce Opex.

In the area of consumer applications, ZTE is working with operators to carry out 5G-based big video service pilot programs. ZTE is also collaborating with operators and partners to demonstrate how 5G will empower traditional industries in vertical markets like new media, IoT, IoV, industrial internet, smart grids, and smart cities.

As operators are undertaking digitization, how can ZTE be their best partner?

Operators have notable advantages in the process of digitization. They have extensive offline service networks to serve households and enterprises. They have high credibility, which is a natural quality for B2B services. Their infrastructures are the first interface with clients.

To better serve clients' digitization, operators need to first increase their network agility, resource scheduling flexibility, and network scalability so as to enable their networks to support diversified and customized services. ZTE provides SDN/NFV products that are based on mainstream technologies and provide telecoms reliability and high performance to help operators make their network agile.

As the operators are in different stages of digitization, some operators have not completed the digital transformation of their own operations, so they are facing challenges in response to the digitization of the society. ZTE has rich experience in its own digitization and provides national data platforms, ICT PaaS, distributed databases, and other fundamental software for large operators. ZTE is able to help operators achieve their own digitization.

When extending business, operators need to accumulate experience and integrate capabilities of partners to offer clients solutions with the best technologies, the lowest costs, and the optimal delivery. As a long-term strategic partner of operators, ZTE has required capabilities relating to video, AI, fundamental software, and device development. ZTE is willing to work closely with global operators to offer the best solutions for customers' digitization. ZTE TECHNOLOGIES

ZTE Is a Reliable Partner for Global Customers

Source: MWC 2019 video

See what our customers say about cooperation with ZTE. ZTE adheres to making technology innovation and creating value for customers and partners to enable connectivity and trust everywhere.

5G is Ready—Let Us Create a Better Future Together

Jan Trionow, Hutchison Drei Austria CEO

ZTE has been our main network partner since 2010. This applies both to the radio network and the core network. Together we have implemented successfully a number of big projects, including the modernization of our 3G network, the consolidation of two networks after merger, and the nationwide rollout of 4G.

To do that, we need a very strong technology partner, but we need also a partner that is very good and trusted in working together in our cooperation. And we found that was ZTE.

In 2019, we expect the first small-scale commercial deployment of 5G. After a couple of years of discussions, it is now the time to deliver. We see that the technology is mature for that step. We have been preparing for that moment for a couple of years together with ZTE in our innovation center in Austria.

We believe that ZTE can be a good partner on this journey.

Benoit Hanssen, Wind Tre CTO

In L'Aquila, with ZTE, we are testing and trying the new 5G technology, that we plan to deploy starting from this year. But, before we do that, we need to understand how it works, and how it is the best way to deploy it. And also we are starting to look at how it can be used. I think that is an important part of what we are doing in L'Aquila with ZTE.

We are working very closely together. I think the partnership with a technology company like ZTE is very important, because while we are a service company, the technology is really provided and developed by ZTE.

Zhang Yunyong, President of China Unicom Research Institute

A group of leading independent innovation enterprises represented by ZTE, have made great contributions to our country's leap-forward development from 2G to 5G. ZTE actively cooperates with operators and third parties to develop industrial applications. It can be said that 5G is indeed the

future trend. If you can say that 4G reconstructed the network, it can be said that 5G will reconstruct the industry and society. We have cooperated with ZTE on 3G, 4G, and 5G. We now have established close and in-depth connection and cooperation with ZTE in 17 provinces and various scenarios.

Yi Zhiling, Chief Scientist of Wireless Technologies at China Mobile Research Institute

As one of important strategic partners on 5G exploration, ZTE has all along participated in all of China Mobile's early-stage key technologies PoC experiments as well as subsequent large-scale field trials.

Following that, we have been jointly exploring many new innovative service application opportunities that 5G would enable. Examples include remote AR session, panoramic VR broadcasting as well as, of course, autonomous driving.

We look forward to continuing our close partnership with ZTE, together to explore and contribute to the great new world that 5G era will bring upon us.

Innovative Cooperation to Facilitate Digital Transformation

Luk Bruynseels, VP of Engineering at Telenet

Working with ZTE is going well. If you see what's the challenge we had together, and if you see what we have done with it, they did an amazing job in upgrading the mobile network for Telenet, and also moving and migrating all customers from our host MVNO that we had at that time to our own network, and that went good.

In 2017, we opened together with them an innovation center in Brussels. There we did some work in Narrow Band IoT, LTE-M and we want to continue that with 5G that is coming.

So we see them as an innovative partner that with all the technologies that are coming, they can help us with.

Joddy Hernady, Senior Vice President of Media and Digital Business at PT Telekomunikasi Indonesia, Tbk

Telkom Indonesia actually has a very long relationship and cooperation with ZTE.

So, I hope with ZTE, we can build a joint innovation center or R&D center, together to find the best application services that can run in a 5G network, specifically for the Indonesia market. So probably a lot of benchmarks or implementations in other countries, especially in China that can be explored together and implemented in Indonesia as a starting point. This kind of cooperation we hope we can have from ZTE.

Muhammad Adeel Israr, Ncell CTO

I think ZTE and Ncell are getting along from 2008 if I am not mistaken. Our cooperation is more than 10 years now in this country.

ZTE being a trusted partner, we find them very professional and supportive, and aligned with the goal of Ncell. What we have seen them as a partner is that in most of these cases, we go hand in hand together to deliver the common goal of a better and connected Nepal.

So I hope they will keep innovating, and they will be still able to support us as a strategic partner for the future needs as well. ZTE TECHNOLOGIES

Future Network Architecture Based on Cloud-Network Convergence

Tao Wenqiang
Chief Engineer of High-End Router Product Planning, ZTE

Major global operators have started their infrastructure network transformation programs centered on cloud services, such as AT&T's Domain2.0, Deutsche Telekom's PAN-EU, China Telecom's CTNet2025, China Unicom's CUBE-Net, and China Mobile's NovoNet. However, their existing networks are vertical chimney-type private networks that are separated from the cloud and unable to meet the agility, flexibility, programmability and openness required for cloud service development. Changing the existing network architecture is a hot topic in the industry.

Network architecture design belongs to the top-level design of the network. It is not only a series of high-level abstract design criteria, evolution goals and technical frameworks, but also the basis of technical decisions. The network architecture is not only a purely network-level technology strategy, but is based on network re-architecture that will drive a series of deep transformations involving organizational structure, production process, management model, and talent reconstruction. ZTE has launched its target architecture for deep cloud-network convergence that can cover full-scenario services, focus on user experience, and connect all things with the cloud to help operators grasp the opportunities of digital transformation.

Basic Principles

Facing the needs for cloud-network convergence, ZTE has proposed to build a future cloud-network converged network based on the following principles.

- **Simple architecture with the separation of infrastructure and services:** Services are decoupled from infrastructure. The service layer is flexible, open, and programmable, while the infrastructure layer focuses on large capacity as well as SLA and QoS guarantee.
- **Flexible expansion:** Learning from the idea of Spine-Leaf data center architecture, service network elements are based on the cloud or pool. Networks are expanded on "stacking" modules rather than upgraded on the original modules (network elements).
- **Experience driven, automatic and intelligent O&M:** The deep SDN management, control and

orchestration of cloud-network convergence enables active care and predictive network adjustment. Through network programmability and automation, an autonomous network can be realized.

Reference Target Architecture

Based on the above-mentioned principles for cloud-network convergence, ZTE has proposed a reference target architecture (Fig. 1).

To achieve simplicity, uniformity, agility and resilience, ZTE has also proposed a layered deployment scheme for underlay and overlay networks. The overlay network corresponds to the service layer that supports cloud-based services and DC-centered flexible expansion to achieve rapid service innovation and make the pipeline stronger. The underlay network is the service transport layer that simplifies networking and device functions and automatically creates tunnels to improve efficiency and meet differentiated transport requirements.

Decoupling between the two layers allows for independent planning. The flexible, agile and rapid deployment on the service layer is achieved through decoupling, and any change to the deployment has no impact on the underlay layer. The underlay layer focuses on fast connection, automatic establishment, and SLA guarantee.

By introducing new technologies and flexibly using SR/EVPN/VxLAN, the underlay layer greatly simplifies network protocols, reduces O&M difficulty, makes more flexible access to the cloud, and enables on-demand network changes. The IP and optical synergy improves transport efficiency and simplies O&M. By decoupling from the resources, IP connectivity only focuses on reachability rather than service attributes, so the IP technology is greatly simplified. Optical networks are no longer just pipes, but has intelligent features that can be dynamically configured. The IP and optical resource pool dynamically matches service requirements, greatly improving resource utilization and reducing transport network costs.

To achieve agility and resilience, the target architecture also needs to support end-to-end network and service slicing as well as hierarchical network slicing solutions with hard isolation and soft isolation capabilities. For some services that have general security requirements, the architecture provides soft slicing based on L2 or L3 logical isolation. Through the packet

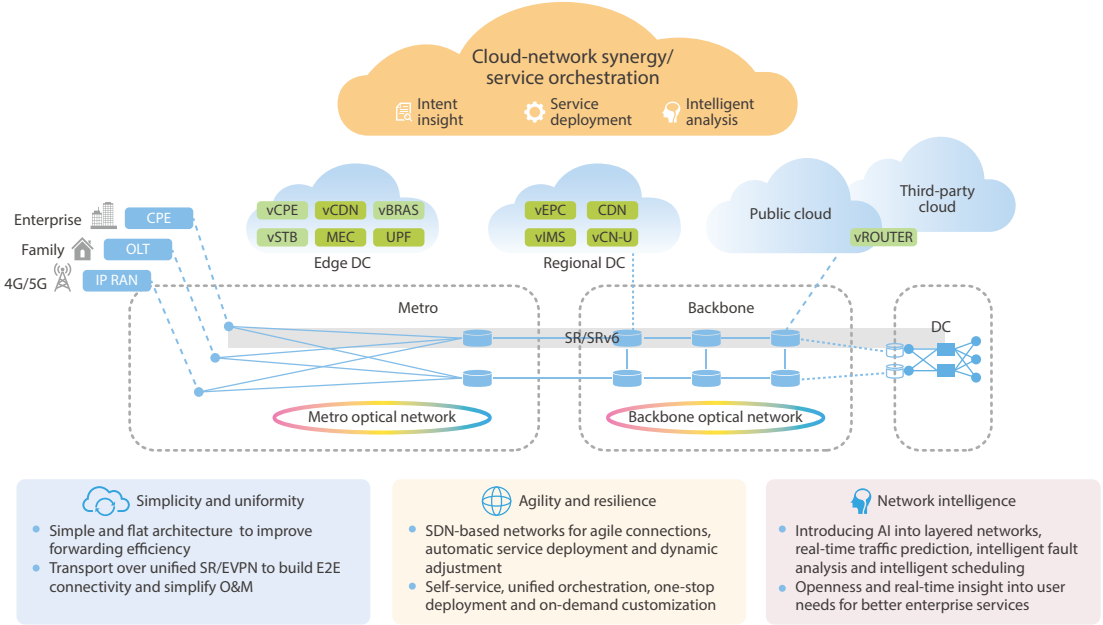


Fig. 1. ZTE's reference target architecture for cloud-network convergence.

Simplicity and uniformity
- Simple and flat architecture to improve forwarding efficiency
- Transport over unified SR/EVPN to build E2E connectivity and simplify O&M

Agility and resilience
- SDN-based networks for agile connections, automatic service deployment and dynamic adjustment
- Self-service, unified orchestration, one-stop deployment and on-demand customization

Network intelligence
- Introducing AI into layered networks, real-time traffic prediction, intelligent fault analysis and intelligent scheduling
- Openness and real-time insight into user needs for better enterprise services

multiplexing, bandwidth utilization can be maximized. For financial and enterprise private line services that require exclusive resources, low latency and high reliability, hard slicing based on FlexE can guarantee the exclusiveness and isolation of network resources.

The end-to-end network slicing architecture supports E2E slice lifecycle management ranging from terminal to core network (Fig. 2).

- **Slicing awareness by terminal:** A 5G terminal can preset or acquire a slice ID, and associate it with a specific APP. When an application session is created, the slice ID is uploaded. According to the user's subscription data, the 5G core (5GC) selects the corresponding slice to establish a session.
- **Wireless slicing:** For shared wireless slice, a user session can select the configuration parameter package according to the slice ID to provide different air interface features. For exclusive wireless slices, physically isolated slices can be provided through the division of different frequency bands.
- **Transport slicing:** SDN-based 5G transport network can be virtualized into multiple virtual networks to differentiate forwarding performance needs. According to the scenario QoS and latency needs, a service-oriented connection tunnel can be established on the corresponding virtual network to form a bearer network (BN) slice.
- **Core network slicing:** 5GC network functions are deployed on demand on the multi-layered DC to form CN slices. The user plane UPF can be flexibly moved down and deployed to meet to the latency requirement in the scenario, and the control plane NFs can be shared between different slices.

Introduction of Network Intelligence

The target architecture for cloud-network convergence needs to be built on network intelligence. ZTE has proposed four levels of network intelligence (Fig. 3).

To gradually introduce artificial intelligence (AI) into the network, ZTE has proposed unified orchestration (thick orchestrator) as well as domain-based controller (thin controller). This helps to build a healthy network intelligence

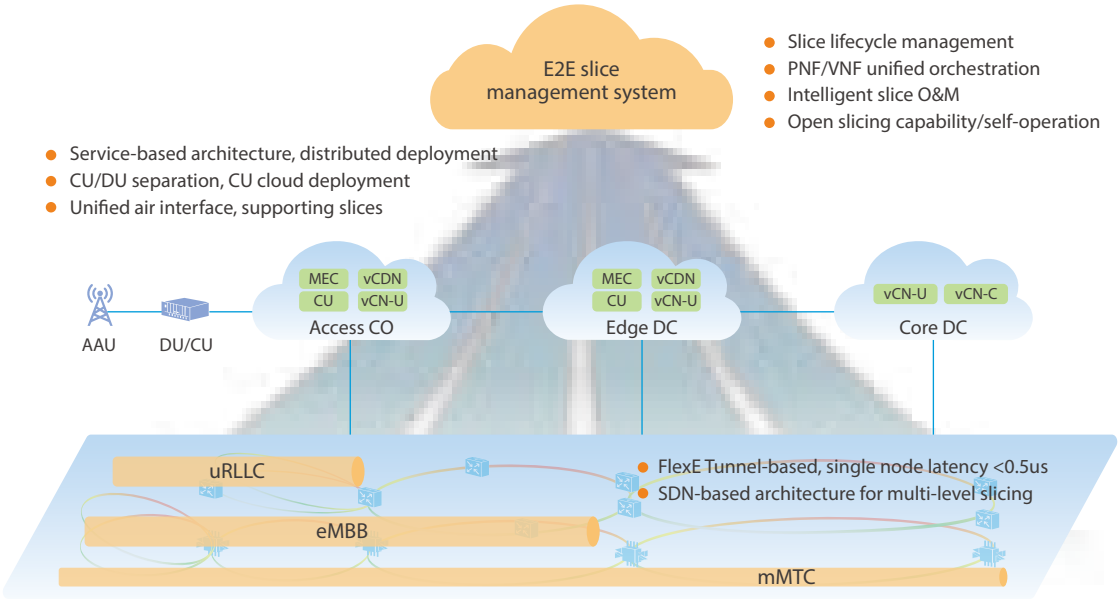
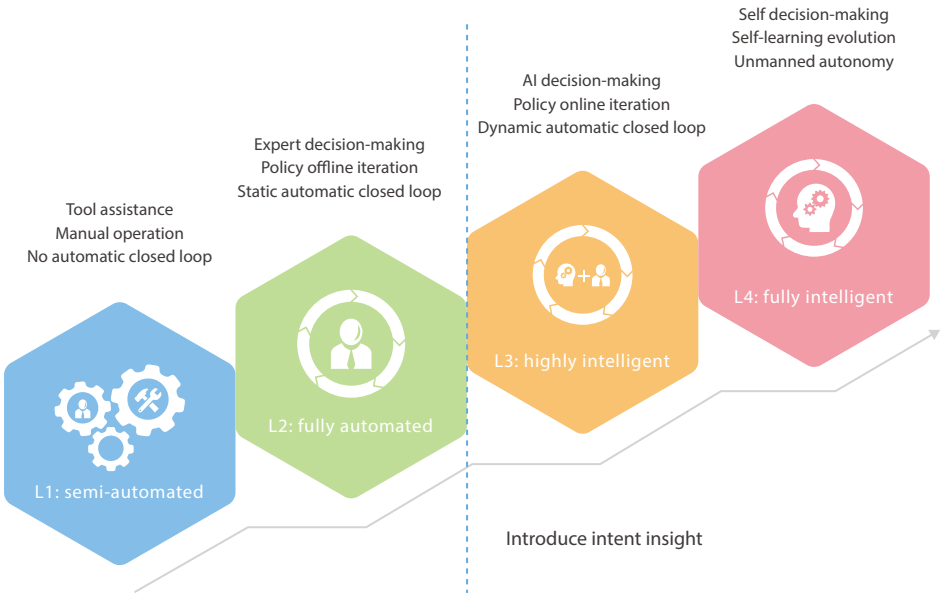


Fig. 2. End-to-end network slicing architecture.



All levels of decision-making support manual intervention,
and manual review conclusions and execution have the highest authority

Fig. 3. Four levels of network intelligence.

ecosystem. The main considerations include the following aspects:

- **Intelligent active data collection:** Telemetry collection + AI
- **Thick orchestrator supports service innovation:** service model + atomic network capability abstraction
- **Standard northbound interface of the controller:** hierarchical decoupling + simplified architecture
- **Hierarchical big data AI analysis:** operational intelligence + network intelligence
- **Strategic hierarchical closed loop automation:** hierarchical closed loop + unified policy

Unified orchestration is the basis for rapid deployment of cloud-network services. The unified orchestration allows for one-click cloud-network service activation, E2E overlay network setup, and E2E service guarantee. The network is based on SDN, controllers are deployed based on different domains and can coordinate with each other for flexible connection, and edge nodes can be flexibly loaded with traffic. In this way, networks can be set up on demand, and unified management can be implemented for the underlay network. To achieve unified orchestration of cloud-network services, it is necessary to strengthen the orchestration management and enhance service innovation. Building the orchestrator for cloud-network convergence involves:

- Atomic network capability for on-demand cascade connectivity
- Component-based service functions for customized APP development
- Compatibility with controller/EMS for combined new and old network configuration
- API-based northbound interface for internet operations

ZTE actively introduces AI into the telecom field. With its uSmartNet solutions, ZTE can provide complete data awareness, intent insight, and intelligent analysis for telecom networks, helping operators adapt to trends, meet challenges and build an AI network capable of autonomous management, future foresight, on-demand change, and smart operation. ZTE TECHNOLOGIES

Deep Cloud-Network Convergence to Meet Digital Transformation of Enterprises

Meng Xiaobin
Chief Engineer of Integrated Solution Planning, ZTE

Enterprise services consist of three basic capabilities: computing, storage, and connection. Traditional applications that provide computing and storage are deployed within the enterprise. Operators provide simple connectivity between enterprise branches and between the enterprise and its customers, as well as private line service between enterprise branches and voice/SMS for their customers. With the deepening of the internet and digital economy, the provision of computing and storage capabilities through low-cost and efficient cloud services is gradually accepted by enterprises. More and more enterprise applications evolve from local deployment to cloud deployment. This promotes rapid development of the cloud service market, and also requires faster, better, and more flexible network connection services. The cloud-network convergence has therefore become the basis for current digital transformation of enterprises.

Challenges from OTT

Internet companies represented by Amazon AWS and Alibaba Cloud have built core cloud capabilities based on their own internet business growth needs and have attracted enterprises to the cloud with rich enterprise applications. They have formed an oligarchic pattern in the public cloud service market and threatened the operator's private line market. At the end of 2017, Alibaba released the "cloud backbone" and built 110+ cloud POPs around the world. In 2018, it launched the edge intelligent access gateway and built a cloud-network convergence system combining network over cloud (Luoshen), intercloud network (Zhinv) and cloud access network (Chang'e). The system can build up a multi-regional global network in minutes and connect with hybrid cloud to create a smart cloud network with enterprise scale and communication capabilities.

IT vendors represented by Aryaka and Cisco have launched their SD-WAN solutions. They work as another OTTs that have impact on the operator's private line market. SD-WAN service providers (SPs) can lease operators' physical private line resources to build a global network. They offer convenient on-demand WAN services through the SDN technology, helping

enterprises achieve complex networking with multi-branch and multi-cloud connectivity. They also offer IT value-added services such as WAN acceleration and firewalls. They can get the connection bonus with cost-effective on-demand flexible SD-WAN services delivered for enterprises.

Enterprise private line is the core of the operator's enterprise market. The strategy for enterprises to access cloud can bring unprecedented opportunities to the enterprise private line market. However, faced by double impact of cloud SPs and SD-WAN SPs, operators need to change their thinking and strengthen the cloud-network convergence. With the SD-WAN concept, they can provide flexible and quality cloud-network converged services for enterprise users.

Key to Challenges of OTT: Leveraging Network Advantages to Promote Cloud-Network Convergence

Pure cloud services delivered by telecom operators can no longer compete with a variety of SaaS services and easy user experience offered by cloud SPs. The operators' core advantage still lies in network connection, so the key for operators to address the challenges of OTT is to leverage network advantages to promote cloud-network convergence. In this way, operators can provide enterprises with one-stop, agile, flexible, on-demand and intelligent cloud-network converged service capabilities.

Building a Unified Cloud-Network Operation System to Deliver Cloud-Network Converged Services

One-stop cloud-network service is the basic need for enterprises to access the cloud. However, in order to concentrate resources and settle accounts independently, operators usually set up independent cloud companies to operate external cloud services separately. This leads to the separation of cloud and network operations, and customers cannot be provided with unified service acceptance and provisioning processes, making fast fault location and recovery impossible. Therefore, the operation system should be transformed to support one-point acceptance, one-stop provisioning, and unified operation and maintenance to enhance user experience and maximize business benefits through the promotion of cloud-network convergence.

Rearchitecting Networks for On-Demand Cloud Private Capabilities

Compared with cloud SPs and SD-WAN SPs, operators have the advantages of last mile access, wide network coverage, and access flexibility that OTT providers cannot replace. The construction mode of MAN and backbone networks also provide the basis for operators to deliver differentiated services. However, the long-term rolling construction of the operator network leads to a wide variety of network devices, complex protocols, and weak auto-provisioning and flexible adjustment capabilities. Moreover, the state of operator infrastructure assets is not clear enough, resulting in a long period of provisioning the enterprise private line. For example, the provisioning of a cross-province VPN private line requires more than 40 manual processes, and the provisioning period is as long as one to two months, resulting in poor user experience.

To provide fast and flexible cloud-network converged services, operators need to re-architect their existing rigid closed networks into cloud networks using the SDN/NFV technology. They can have their networks based on software and their network control functions deployed on cloud infrastructure. In essence, operators can implement deep cloud-network convergence. The cloud-based network rearchitecting achieves the transformation from rigid networks to software-defined elastic

networks, centralized network resource management, and flexible on-demand distribution, so that operators can quickly provide flexible, on-demand cloud access private line capabilities for enterprises.

Leveraging Network Infrastructure to Build a Multi-Cloud Ecosystem

The purpose for enterprises to access the cloud is to use quality SaaS services and on-demand cheap cloud resources on the public cloud to reduce Opex. Enterprises choose quality services of different cloud SPs. Considering security and localization, they may choose to deploy some services on the private cloud, so multi-cloud has become the choice of most enterprises. Telecom operators can leverage their own advantages to connect telecom networks with cloud networks of mainstream cloud SPs, offering flexible multi-cloud connectivity for enterprises. AT&T's NetBond and DT's PLAS are the industry benchmarks for multi-cloud connectivity for enterprises.

OTT cloud services have dominated the cloud market. If telecom operators only provide cloud-network converged services on self-operated clouds, they will lose most of the customer base. Therefore, strengthening cooperation with cloud SPs for one-point access to multi-cloud is the key for operators to maintain their long-term network advantages and grasp the strategic opportunity for enterprises to access the cloud.

Building MEC to Grasp the Key to Digital Transformation

The enterprise access to the cloud involves three stages: web customer service system access to the cloud, enterprise management information system access to the cloud, and core production system access to the cloud. Digital transformation will drive the enterprise

core production system to access the cloud, and put forward relatively high requirements for reliability, latency and security. This will inevitably promote rapid development of edge computing.

Though edge computing is still in the initial stage of development, cloud SPs and operators see edge computing as the next most promising market. By deploying MECs at the network edge, operators can fully utilize their widely distributed infrastructure resources, resident customer services, and efficient collaboration capabilities at the cloud and network edge to take competitive advantages in the edge computing market and to create an intelligent information node that integrates communications, cloud, intelligence and applications. The intelligent information node is also the key entrance for telecom operators to start digital transformation in the industry.

Enabling AI to Provide Intelligent Cloud-Network Convergence Service

Customer experience is where OTT providers is generally superior to operators. It is imperative for operators to introduce AI to enhance automation and intelligence of their cloud-network convergence. Real-time insight into customer scenario needs, on-demand customization, and uninterrupted service are the ultimate goal of cloud-network convergence, which requires long-term continuous evolution. The first and basic step is to strengthen cloud-network data collection, perform real-time awareness of cloud-network operation status, and make cloud-network resources visible. The second step is to build an automatic closed loop and introduce the AI model to achieve dynamic resource allocation, intelligent traffic adjustment, and rapid fault demarcation and self-healing. The final step is to introduce the intent engine based on the automatic closed loop to provide real-time insight into customer scenario needs and fulfill dynamic deployment and optimization of cloud-network convergence. In the end, cloud-network resources and customer scenarios can be seamlessly connected to offer optimal user experience.

The national strategy for enterprises to access the cloud opens up a broader market space for cloud-network convergence. In the face of competition and cooperation with OTT providers, the key to operators is to strength and optimize their networks, deliver smart cloud-network converged services close to customers, and expand the cloud-network convergence ecosystem with their networks as the basis. In this way, operators can firmly grasp the market opportunities brought about by digital transformation of enterprises. ZTE TECHNOLOGIES

Building DC-Centric Networks On Demand with Cloud-Network Convergence

Bian Yingyin
Integrated Solution Architect at ZTE

Enterprise Access to the Cloud Has Become a Trend

As cloud computing matures after the first decade, enterprise access to the cloud has become a trend. China's economy is transitioning from internet-driven transformation to digital transformation driven by cloud computing and AI. Cloud computing is accelerating the integration with traditional industries such as finance, education, and transportation. The rigid demand of digital transformation for enterprises and the strategic support from the government have brought huge market space for cloud services. China's cloud computing market is developing at a high speed, and cloud is replacing traditional networks and gradually becoming the center of services.

Enterprise access to the cloud has several phases. As more and more enterprise systems migrate to the cloud, the quality of network connectivity has gradually become the focus of attention. In the face of competition, operators first need to tap into their network advantages. They provide flexible and diverse private lines for access to the cloud as well as secure and reliable multi-cloud connectivity services and introduce SDN to improve existing networks and achieve rapid service provisioning and network optimization. When combining cloud-network orchestration capabilities, operators can also build an overall cloud-network convergence system to provide end-to-end cloud access services for users.

Building a DC-Centric Network

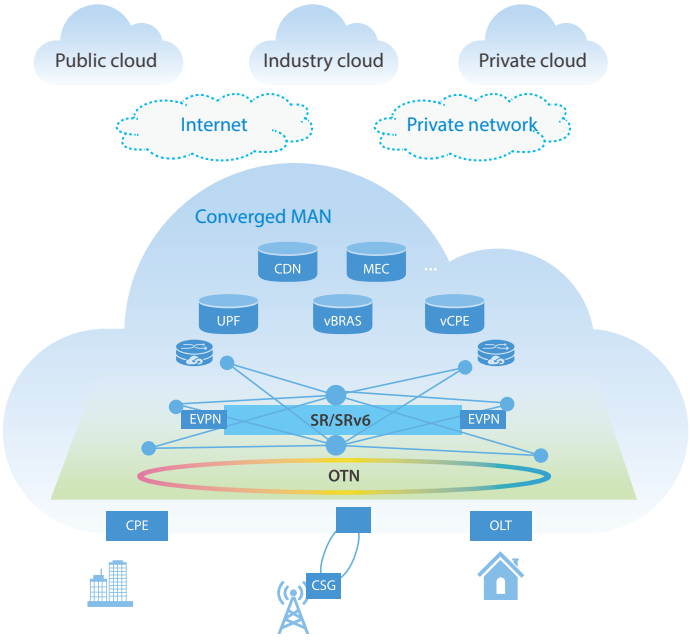
Cloud computing has become richer in its second decade. In addition to public clouds, private clouds, hybrid clouds and industry clouds are also developing rapidly and cloud services are gradually extending to the edge, bringing new market opportunities. The arrival of a more complex multi-cloud era is driving the transformation and upgrade of traditional networks, and clouds and networks are breaking through each other's boundaries and converging

with each other. With the advance of all-cloud concept, a network needs to be built around the cloud and the network architecture is optimized with the concept of cloud computing, so that network resources can be dynamically and flexibly scheduled and allocated according to user needs and a quality network with agility, flexibility and intelligence can be built up.

At present, MAN devices use proprietary hardware, and a business model of optimal bandwidth raises high requirements for device capabilities. The network with tightly coupled software and hardware is not flexible enough, and it is difficult to introduce automation. The rapid innovation model led by internet thinking has brought uncertainty in network service and traffic, and the network architecture is difficult to meet the needs of service growth. Operators need to introduce the design concept of the IT industry. With SDN/NFV as the basic architecture, they can build a simple, automatic, and intelligent cloud network that supports unified transport (Fig. 1). The network can quickly and flexibly adjust resources for service innovation.

The construction of future MAN will be DC-centric and oriented to industries, 5G, HD video and MEC. The new architecture shall make better use of existing network resources and integrate with the cloud to meet the requirements of industry digitization for flexible deployment and ubiquitous access.

Future MAN tends to be a flexible, efficient, and scalable network built with simple-designed devices. Currently, being the core of MAN, CR shall meet the requirement of large-traffic forwarding while satisfying the service need of large routes, which results in high Capex. As traffic grows in MAN, an architecture for the separation of forwarding and service can be introduced to lower the requirements of intermediate forwarding devices. A single router or a large-capacity ASIC device can be used as metro core switching node to forward metro



Simplified network
Transport integrated fixed, mobile, and DC services, simplify network, and reduce Capex

Simplified architecture
Decouple network services, focus on large-capacity forwarding at the transport layer, and simplify forwarding devices

Simplified protocol
Build flexible connection over SR/EVPN and unifiy transport protocols

Simplified O&M
Support network automation, intelligence and flexible deployment and simplify O&M

Fig. 1. DC-centric network architecture.

traffic and offload the traffic passing CR. ASIC devices are characterized by large bandwidth, low power consumption, and higher cost effectiveness. The EVPN protocol is introduced to build a Fabric matrix for rapid metro traffic forwarding, storage and computing resource pooling, flexible resource scheduling, and highly reliable resources based on physical distribution. The access layer provides large-bandwidth access through 10G PON and 5G, meeting large-bandwidth needs of future services such as HD video and VR. As the network extends to 5G, it is necessary to plan uniform transport of fixed-mobile and cloud-network services for better use of network resources.

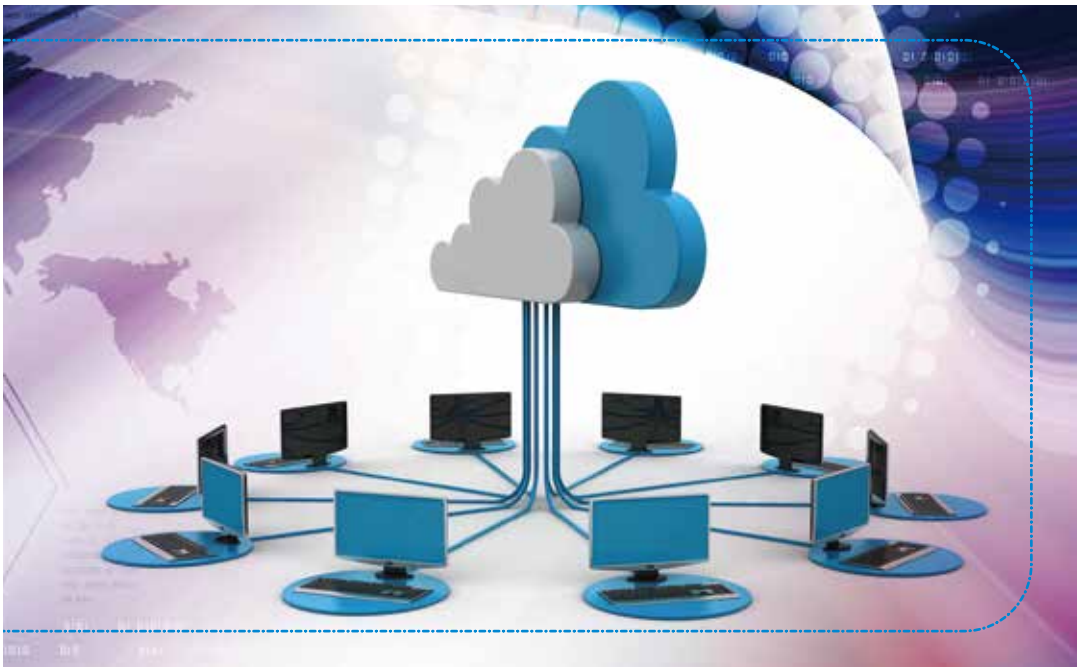
The architecture for the separation of forwarding and service can better improve the efficiency of resource utilization, simplify devices, and allow flexible service deployment, which is the direction of network evolution. The cloud-based service layer is deployed on the physical network to achieve rapid service innovation and flexible expansion capabilities. The forwarding layer is simplified, reduces device requirements, and provides reliable transport and end-to-end automatic deployment to meet differentiated transport requirements. Network transport protocols are also gradually simplified and unified into SR/EVPN, and then evolve to SRv6. The transport protocols based on SR/SRv6 can realize end-to-end small-granularity scheduling, improving network scheduling capability by hundreds of times. SRv6 combines IPv6 and SR to realize the unification of common IP forwarding and tunnel forwarding without using MPLS any longer. This will greatly simplify devices and networks. The programmable characteristics introduced by SRv6 make the network more flexible and easy to implement automation and intelligence. SRv6 has the ability to deploy from the applications, so the network and applications will be deeply integrated, and the network will be more open and provide better support for services.

The key driver for building a DC-centric new MAN is the services in the metropolitan area. At present, most of MAN traffic comes from video and web, most of which is internet content and ends outside the metropolitan area. In the near future, there are three types of services that can be introduced into the metro DC: cloud-based network devices including vBRAS, vCPE and UPF, video services provided by operators and the internet, and local services provided by enterprises. With the development of 5G, the demand for edge computing and industry-oriented AI, especially VR bandwidth will be the main driving force of network re-architecture. VR will bring large-scale gains to the network after 2021. The new MAN can be gradually built according to business needs. When MAN east to west bound traffic accounts for a relatively high proportion, core switching nodes will be added to offload CR traffic and finally implement fixed-mobile converged service transport.

Building a New-Generation O&M System

Changes in network architecture need the support of an O&M system. The focus of improving cloud-network convergence experience is on the optimization of service processes. To deliver cloud-network converged products and services, operators need to build a new-generation O&M system.

Unified cloud-network orchestration is the key to the new-generation O&M system and also the basis for one-point service provisioning and end-to-end service guarantee. Operators should first focus on building the orchestration and collaboration layer, controlling the orchestration layer, and introducing atomic capability and service-based architecture to support rapid service innovation. Due to high complexity of multi-vendor and cross-domain management, it is suggested that controllers should be simplified as far as possible and be deployed in different domains, and the controllers in different domains should coordinate with each other to create connections. Therefore, converged management and control is the



future development trend. Considering the compatibility with existing networks and the diversity of equipment functional interfaces, operators and vendors should have a reasonable division of labor, which will help to promote the rapid commercial use of SDN.

Since dynamic and flexible network architecture brings the O&M complexity, operators first need to have the network ability of closed-loop automation. Data collection is the basis of closed-loop automation. Traditional network management methods such as SNMP and FTP are inefficient, collect few types of data, and have poor scalability. To meet real-time collection requirements, it is necessary to introduce telemetry that can achieve millisecond sampling, improve the collection ability up to 100 times, and support real-time data reporting. Based on real-time collection, corresponding strategies can be introduced into equipment, controller and orchestration layers respectively to realize hierarchical closed-loop network automation.

The introduction of intelligence can further improve the cloud-network collaboration efficiency and give better user experience. Operators need to build an intelligent system and introduce hierarchical big data AI capabilities. Building the intelligent system is a gradual process, which can be applied first in network elements and individual function points to enable point-like network element optimization and intelligent fault analysis. Moreover, intelligent abilities of network elements are connected in series to form end-to-end intelligence capabilities to support end-to-end fault location and demarcation, recovery and self-healing. Finally, network intelligence is introduced throughout the network, entering the intelligent phase of the whole network. At the same time, intentional insights are superimposed on the basis of automation to achieve network autonomy.

New MAN oriented to future services and based on a flexible and scalable architecture can cope with the uncertainty of service development, coordinate operations and process transformation, and build network core capabilities. This will better assist operators in operational transformation and help them seize the opportunity of digital transformation. ZTE TECHNOLOGIES

Unified Orchestration and Distributed Management and Control for Network Automation and Intelligentization

Wang Chengfeng
BN Management and Control Product Planning Manager at ZTE

Developments in cloud computing, AI and 5G are driving cloud-network convergence. Network operation and maintenance (O&M) in the cloud-network convergence era will face the challenges of complicated network forms including multiple network domains and multiple cloud platforms, diversified industrial application services, and management of ultra-large-scale network connections. As a result, the new O&M mode must be automated and intelligent.

A Hierarchical Architecture

ZTE proposes a hierarchical management and control architecture (Fig. 1) after analyzing the complicated cloud-network convergence O&M scenarios while taking into consideration of the overall development trends of the industry.

The business logic layer at the top is the business application layer of cloud-network convergence. Apps at this layer represent specific business application scenarios and can capture and classify business intents of end users.

The service orchestrator layer needs a unified cloud-network convergence orchestrator. The service orchestrator can translate a business intent into specific service logic of cloud-network convergence, and further translate the service logic to network orchestration requests and NFV service chain orchestration requests, which will be finally sent to the network orchestrator. With unified E2E orchestration of networks and clouds, this layer centrally represents cloud-network convergence.

The network orchestrator layer is interconnected with the service orchestrator layer. SDN orchestration refers to orchestrating SDNs across multiple domains to offer E2E connections. The NFV orchestrator (NFVO) performs unified orchestration of VNFs. The unified cloud management system uniformly manages and schedules various cloud platforms.

The distributed management and control layer is the layer for manufacturers' controllers.

It allows the MAN and the backbone network to use different SDN controllers. Multiple SDN controllers can be used in the MAN to realize network decoupling. In the cloud computing scenario, a VIM cloud management platform can be deployed for a telecom cloud and an independent cloud management/scheduling system for a public cloud at the control layer.

Unified Orchestration, Distributed Management and Control

In view of the above-mentioned architecture, ZTE believes that unified orchestration and distributed management and control are the key architecture for the O&M in the new cloud-network convergence era.

Distributed Management and Control for Network Efficiency and Reliability

Distributed management and control means deploying a controller or management system in each management and control domain of the cloud network to control and manage the domain's networks and cloud platforms, which not only guarantees the agility and efficiency of each domain but also ensures high reliability of the whole system.

A WAN spans a large geographic area. If a management and control system is deployed centrally, the system will need to access the widely distributed network devices, which reduces the network reliability between the network devices and the management and control system and hinders efficient network control and scheduling. The current network forwarding plane also has some distributed control functions, which need to cooperate with the centralized control functions of the management and control system.

Each management and control domain is generally built by one equipment manufacturer. With the continuous development of network

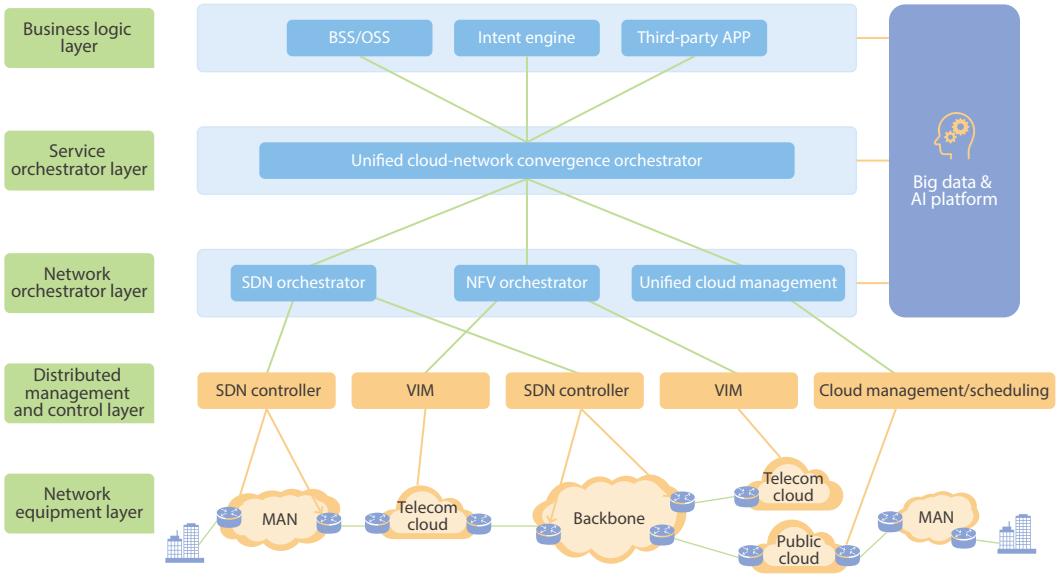


Fig. 1. Hierarchical management and control architecture of cloud-network convergence.

technologies, southbound interfaces are becoming more diversified and complicated. There are at least hundreds of southbound interface-based service models. Only the management and control system provided by the corresponding network equipment manufacturer can provide more efficient and reliable southbound interfaces.

Unified Orchestration for E2E Cloud Network Service Delivery

Unified orchestration refers to connecting the management and control system of each domain at the orchestrator layer and providing unified orchestration interfaces of cloud-network convergence. It has the following advantages:

- Differences among network domains and cloud platforms are hidden. The distributed management and control systems are uniformly connected to the centralized orchestration system, and the system interfaces from different vendors are standardized. This gives full play to the innovative features of different manufacturers' products.
- Service-oriented interfaces are easy to standardize. Different from the management and control system that is oriented to network technology, the interfaces at the orchestrator layer are oriented to services and business intent, and can be abstracted and standardized according to service models.
- The evolution of lower-layer network technologies has much less influence on the upper-layer service system. Through abstraction implemented via the orchestration layer, many technical details of the lower-layer network are hidden, which not only allows lower-layer network vendors to make technology innovations but also improves service system stability.

Therefore, unified orchestration is an inevitable choice of cloud network service E2E delivery.

Hierarchical Automation and Intelligentization of Cloud Network Services

Based on the architecture for unified orchestration and distributed management and control, cloud network services can be automated and intelligentized hierarchically. The distributed management and control layer is closely connected with network devices, and based on innovative technologies of different vendors, it enables intelligentization and local closed-loop automation. The unified orchestration layer performs business logic oriented E2E service orchestration to implement "customer intelligence" and E2E service automation.

Hierarchical automation and intelligentization of cloud network services can be analyzed from the following aspects.

Intelligent Proactive Data Collection

Real-time network perception is the basis of network automation, and real-time collection technology is key to real-time network perception. Traditional minute-level data collection via SNMP or FTP cannot meet the requirement of real-time collection. It is recommended to use telemetry collection. Telemetry supports millisecond-level hardware sampling, thus providing very high collection efficiency. However, it brings 100 times more data than the traditional collection modes while increasing collection frequencies, which makes data storage and analysis much more difficult.

ZTE developed its patented technology of intelligent telemetry collection based on AI technology. This technology builds an optimal learning model through active AI learning to realize low-density collection of steady-state data and high-density collection of bursty data. It also makes scientific predictions based on AI, which greatly reduces the data volume to be collected and stored, and substantially increases the real-time data analysis efficiency.

Hierarchical Big Data Analysis

Big data-based service analysis is the foundation for an intelligent network. The value of hierarchical big data analysis is that it better aligns with the analytical requirements at each level and provides analytical capabilities that are more appropriate to the application requirements.

The distributed management and control system integrating subnet analysis modules in the domain provides subnet-level analysis, and with a focus on real-time analysis in the domain, it drives real-time network protection based on AI policies. It provides real-time analysis policies for intelligent fault diagnosis and performance degradation of networks inside the domain. The analysis capability required at this layer is mainly the real-timeness of analysis responses.

The unified orchestration layer integrating an independent big data platform can identify customers precisely and provide proactive analysis and protection in view of business logic and service quality, which improves customer satisfaction. This layer may have lower requirements for real-time responsiveness but should support mass data storage and analysis, offline history big data analysis, parallel technology and analysis, and AI-based analysis.

Hierachical Closed-Loop Automation

Unified policy management and hierarchical automatic closed loops are the basis of dynamic cloud network service automation.

Policies are the basis of automatic closed-loops. Unified policy management requires centralized policy management, which ensures unified scheduling of network automation polices and also reduces policy repetition and complexity.

Automatic closed loops at the distributed management and control layer support self-healing of services inside the domain and second/millisecond-level service recovery. At the same time, distributed automation policies can prevent adverse chain effects brought by local service interruption that may cause whole network failure.

Automatic closed loops at the unified orchestration layer can employ preventive service protection and provide minute-level service switchover and self-healing.

Automated E2E SR Path Creation

An E2E segment routing (SR) path of the cloud network service generally needs joining multiple manufacturers' SR paths. Hierarchical SR path creation can use the following way:

The unified orchestrator computes the start and end nodes of the E2E SR path and the overall SLA quality requirement for the SR path according to the service requirements. E2E quality detection is performed for the SR path. If the overall quality requirement meets the service requirement, SR segmentation requests (including the path information and the split SLA indicators) will be sent to each distributed management and control system.

The distributed management and control system computes the optimal local SR path inside the domain according to the requirement of the orchestrator and reports the path information to the unified orchestrator.

Hierarchical SR path creation makes full use of the advantages of the unified orchestrator in centralized service logic processing and E2E management as well as the optimal path computation capability of the distributed management and control system.

Cloud-network convergence is the development trend and the core competitiveness of operators. Facing the requirement of unified E2E management and control and orchestration of various domains and cloud platforms, ZTE believes that unified orchestration and distributed management and control are the optimal O&M architecture to realize cloud network service automation and intelligentization. ZTE TECHNOLOGIES

Building Cloud Access Platforms for Efficient and Unified Multi-Cloud Management

Ji Xiaowei
SD-WAN Planning Engineer at ZTE

As cloud computing matures, more and more enterprises are starting to build their own cloud resources on public clouds and use various cloud services. They tend to deploy cloud IT services on multiple public clouds. However, enterprises that choose different cloud services need to apply to the network provider and multiple cloud service providers independently for resources and maintain them independently. As there is neither unified and secure network management platform nor cloud resource management platform supporting multiple tenants, the application efficiency is low and the service deployment and maintenance is complicated. To solve these problems, enterprises are in urgent need for a solution that can manage multiple clouds efficiently and uniformly.

Trend for Operators to Build Cloud Access Platforms

Multi-cloud access has a broad market space. Leveraging their own network advantages to build cloud access platforms, telecom operators can provide better cloud access services for enterprises and facilitate the enterprises to manage multiple clouds more efficiently.

AT&T launched its NetBond early in 2013, providing network management and cloud infrastructure connection models for cloud service providers. Using the MPLS VPN technology, NetBond provides secure, flexible, high-performance connectivity for a customer. It can extend the customer's MPLS network from AT&T to any cloud service provider interconnected with the NetBond cloud system. The customer can also adjust network resources in real time. AT&T builds a complete cloud service provider ecosystem and has deep cooperation with Amazon, Microsoft, Google and Salesforce. Now more than 20 partner members provide cloud solutions.

Equinix Metro Connect deploys multiple international business exchanges (IBXs) in a metropolitan areas, providing highly reliable network connectivity between data centers, and direct access to more than 1800 networks and more than 9800 enterprises as well as cloud, digital content and financing companies. Equinix provides an interconnection platform to access multiple clouds, so that customers can access the Equinix network through physical and virtual connections.

Moreover, some third-party internet service providers (ISPs) offer multi-cloud access through VPN. China's VPN market has expanded from 4 billion RMB in 2010 to tens of billions RMB in 2018, and third-party ISPs occupy more than 50% of market share. Third-party ISPs are interconnected with multiple mainstream cloud service providers through high-speed fiber

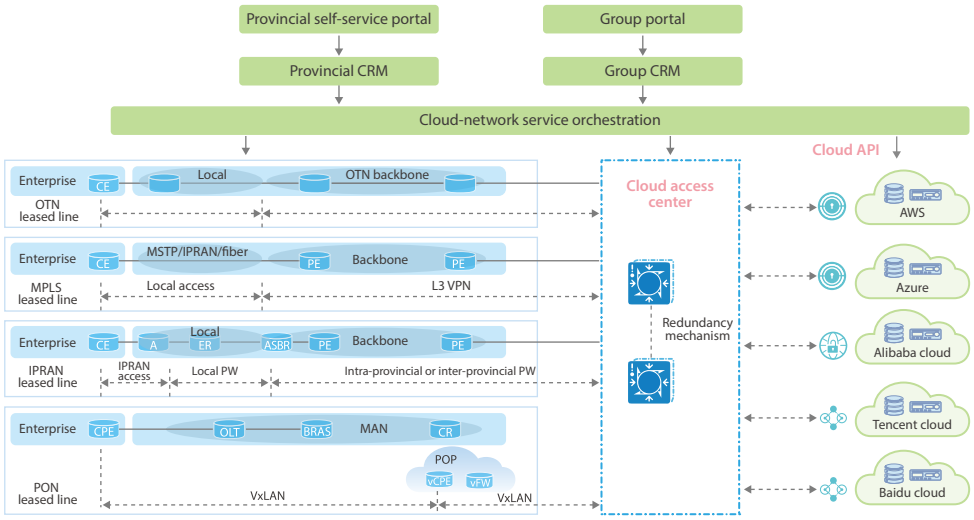


Fig. 1. Cloud access platform architecture.

networks. Enterprise users can access multiple public clouds from any VPN node and deploy their cloud-based IT services.

Analysis of Mainstream Public Cloud Access Modes

At present, mainstream public clouds include AWS VPC, AWS PaaS, Azure VPC, Office365, Baidu cloud VPC, Alibaba cloud VPC, Tencent cloud VPC, and Kingsoft cloud VPC. Based on these mainstream public clouds, the requirements for devices in the cloud access center include:

- Multi-instance: Provide multi-cloud access for multiple enterprises (tenants)
- IPSec: Access Baidu cloud, Alibaba cloud and Tencent cloud by VPN
- BGP: Advertise routes over AWS DirectConnect and AZure ExpressRouter
- VLAN sub-interface: Access AWS and Azure; access Baidu cloud, Alibaba cloud and Tencent cloud by leased lines
- NAT: Provide NAT for user private networks to access the PaaS service and Office365 service in the public cloud
- VxLAN: Interconnect with PON leased line
- L2VPN/L3VPN: Interconnect with IPRAN and MPLS leased lines

Thoughts on Building Cloud Access Platforms for Operators

Telecom operators can build a cloud access platform as shown in Fig. 1. A cloud access center is built, where OTN, MPLS, IPRAN and PON leased lines are terminated. Through the cloud access center, these leased lines are connected to different public clouds, so that the enterprise can reach multiple clouds by accessing the internet from one node. This architecture can reduce the impact of the increasing number of public cloud providers on leased line networks.

By deploying the cloud access center close to public cloud nodes, telecom operators can take advantages of their transport networks, control the network path of enterprises accessing the cloud, and provide differentiated network services for enterprise users. Also they can reduce network security threats and provide secure connectivity for enterprises to access multi-clouds.

Operators need to build a unified cloud-network service orchestration system to manage MAN, IPRAN, backbone network, POP node and cloud access center, and manage enterprise users' network resources on public clouds through the cloud API interfaces opened by public cloud service providers. Opening self-service portals to enterprise users based on the cloud-network service orchestration system enables enterprise users to rapidly and safely implement on-demand interworking between IDC and VPC, obtain PaaS/SaaS services, and perform unified management of multiple clouds, thus helping them complete digital transformation. ZTE TECHNOLOGIES

Intelligent Private Line Solution Enables On-Demand Cloud Services

Zhang Jun
SD WAN Solution Planning Manager at ZTE

Status Quo of Operators

A traditional Chinese network operator provides two types of products for government and enterprise users: internet private lines and site-to-site VPNs. The former offers internet access to middle and small-sized government and enterprise users to satisfy their voice and internet service needs, while the latter enables interoperability among multiple nodes and delivers secure data transport service through multi-protocol label switching (MPLS) or data transport links over the operator's data transport network.

As more and more enterprise users need cloud services, Chinese operators provide them with scalable server computing, storage and internet bandwidth resources through virtualization and cloud computing technologies. However, if the government and enterprise users need a variety of products, they need to apply at different portals and may also need to build multiple physical lines, which leads to poor customer experience and complicated network maintenance and management.

The operator's intelligent private line solution provides not only internet access and site-to-site VPN services but also cloud computing through a unified portal, thus meeting the network and service requirements of middle and small-sized enterprise users in a one-stop manner.

Components of Intelligent Private Line Solution

The intelligent private line solution provided by Chinese operators for middle and small-sized enterprises can substantially reduce internet access costs, improve network QoS, and deliver integrated services including cloud computing and value-added service (VAS).

The intelligent private line solution includes the forwarding layer, the management and control layer, the orchestration layer and the peripheral system (Fig. 1). The forwarding layer includes CPEs and virtual service gateways. The enterprise CPE functions as the enterprise egress device and generally provides basic routing and tunneling functions such as VxLAN, IPSec and VxLAN over IPSec VPN. The CPE can be expanded to support virtual VAS. The virtual

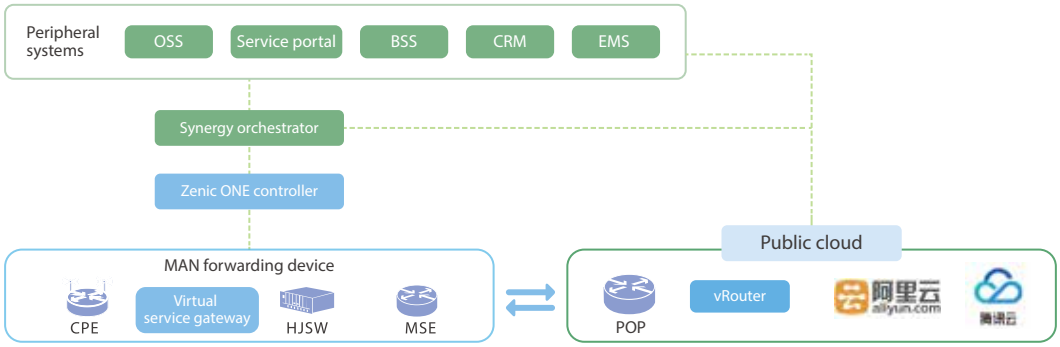


Fig. 1. Architecture of the intelligent private line solution.

service gateway ZXR10 V6000 vRouter needs to support various VPN functions such as VxLAN and IPSec and also needs to support CGN, DHCP Server, EVPN and service chain. The management and control layer includes controllers supplied by vendors or third parties. The controllers are connected to the orchestration layer in the north and to the forwarding layer network elements (NEs) in the south, which can shield service details. The synergy orchestrator supplied by the operator at the orchestration layer is responsible for connecting vendors' controllers and the IT support system. Peripheral systems contain the service portal and the IT system. The self-service portal, generally provided by a third party or the operator, needs to support multiple tenants. It provides E-commerce experience for enterprise users such as bandwidth adjustment, VAS, and cloud resource service. The operator's IT system is responsible for overall business process of cloud services and network activation in various resource pools. The IT system is also responsible for handling, approving, changing and deleting orders as well as billing function.

ZTE's Intelligent Private Line Network Solution

The intelligent private line service uses the operator's MAN to provide transport solutions as required by enterprise users. According to the enterprise CPE's capability, the start point of the tunnel in the intelligent private line solution can be deployed flexibly on different types of devices in the MAN. The networking topology of ZTE's intelligent private line solution is shown in Fig. 2.

The enterprise CPE can act as the device that diverts enterprise service traffic, or the OLT/aggregation switch in the MAN can also be selected as the device for diverting the traffic. The virtual service gateway (GW) deployed in the IDC resource pool is the anchor of enterprise service traffic. The virtual service gateway identifies internet traffic, cloud traffic and site-to-site VPN traffic based on the five tuples. For the internet traffic, the virtual service gateway needs to perform source NAT and forward it to the internet egress. For the cloud traffic, the virtual service gateway needs to complete the splicing of the access layer VPN tunnel and the cloud VPN tunnel and provide an end-to-end VPN tunnel to access the cloud to meet the security requirements of enterprise users. For the site-to-site VPN traffic, the virtual service GW is responsible for aggregating the sites in the local area and exchanging the routing information of enterprise sites with virtual service gateways in other areas as needed.

In the resource pool of IDC, VAS software can also be deployed as required by customers, such as vFW, internet access behavior management, and WAN acceleration software. The software deployed on demand can help operators reduce their deployment costs and create new profit models.

To facilitate the deployment of the above services, ZTE provides Zenic ONE controller and related components. These products support

deployment of virtual service gateways on demand, flexible choice of the start point of enterprise site overlay tunnels, including enterprise CPE, HJSW or SR/BRAS, and networking topology such as Hub-Spoke and Full/Half-mesh. They can also support life cycle management and automatic deployment of virtual service NEs and VAS software, meeting the requirement of automatic network deployment.

To meet the deployment need of an operator's intelligent private line system, Zenic ONE controller and related components open northbound interfaces and support the interoperability with the synergy orchestrator/IT system of the intelligent private line system through the API defined by an enterprise or the operator. In this way, the operator need for cross-domain automatic service deployment can be satisfied.

Zero-Touch Provisioning of Enterprise CPE

In the intelligent private line solution for an enterprise, since there are numerous enterprise CPEs, the zero-touch provisioning solution is quite important. The entire zero-touch provisioning procedure includes three steps:

- **Step 1: underlay network activation**
  After an enterprise user applies for a service, the operator's O&M personnel check the line resource through the BOSS before device delivery and installation, which can also be completed by a third party. The simple device power-on can also be completed by the enterprise user. After the network quality passes the inspection, the operator confirms that the underlay network is activated.
- **Step 2: initial configuration of enterprise CPE**
  After a CPE obtains the WAN interface information from the underlay network SP, initial configuration of the overlay network should be made for the CPE to implement zero-touch provisioning over the underlay network. Currently, the CPE supports Web, U disk and Email initialization solutions.
- **Step 3: CPE management by call home**
  After the initial configuration, the CPE initiates a connection to the controller. After authenticating the CPE, the controller manages the CPE and establishes a management tunnel with the CPE, thus finishing the whole zero-touch CPE provisioning procedure.

VAS Deployment Solution

Through the Zenic ONE controller, ZTE's intelligent private line solution supports flexible deployment of VAS in the DC. Now ZTE can provide vFW and internet access behavior

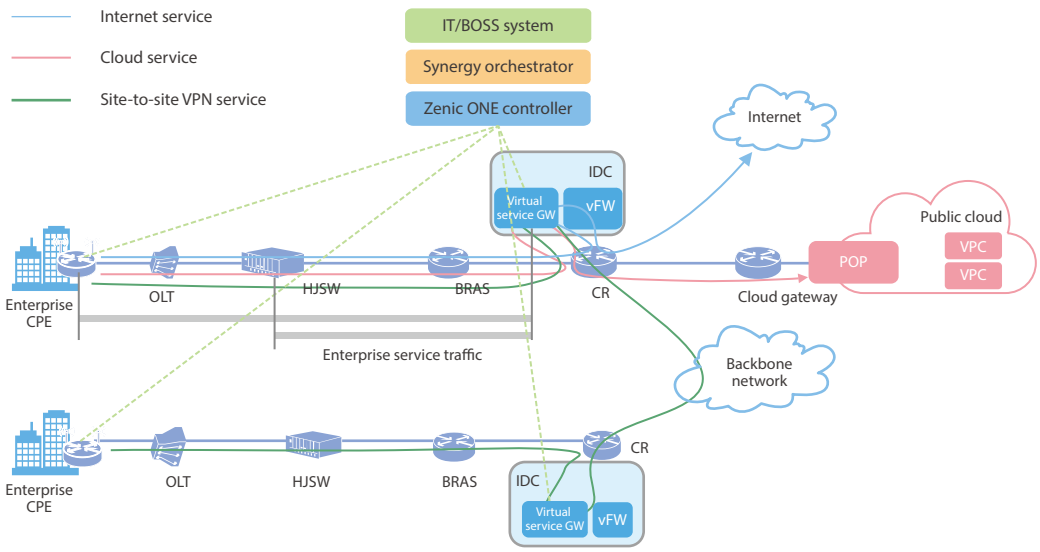


Fig. 2. Network topology of ZTE's intelligent private line solution.

management software, and will continue to add new services. These VAS applications are deployed on a universal server as software and support flexible "pay as you grow" business model, lowering the initial investment cost.

In the DC, the applications are interconnected through virtual physical interfaces. Virtual service gateways acting as the centralized ingress and egress of user traffic are the starting and ending nodes of the whole service chain. The virtual service gateways are interconnected with other virtual applications through virtual physical interfaces. Serving as service classifiers (SC) and service function forwarders (SFF), the virtual service gateways use the traffic redirection policy to concatenate traffic between different virtual applications.

Redundancy of Virtual Service Gateway

ZXR10 V6000 vRouter used as the virtual service gateway supports distributed architecture, in which its forwarding and control planes are deployed on different virtual machines (VMs). The forwarding plane VMs can be expanded to guarantee high reliability of the vRouter.

ZXR10 V6000 vRouter also supports centralized architecture, in which its forwarding and control planes are deployed on the same VM. The vRouter supports the deployment of two VMs at most. It supports 1:1 redundancy on the control plane. The forwarding plane can work in the 1+1 load sharing mode or the 1:1 active/standby mode to improve reliability of the vRouter.

Forwarding plane modules where the interfaces are located can be on the same host or different hosts. When the interfaces are on different hosts, the interface of vRouter1 and that of the vRouter2 will be added to a link aggregation group. The active and standby interfaces are determined according to their priority. The messages are forwarded from the active interface. When a fault (link, network card or host fault) occurs, a new active interface will be selected. The new active interface will send gratuitous ARP packets to the connected device to refresh the MAC table, and the subsequent packets are forwarded from the new active interface.

Advantages and Applications

As a major partner of China's telecom operators, ZTE has participated in a wide range of intelligent private line projects. ZTE's intelligent private line solution has the following advantages:

- ZXR10 V6000 vRouter supports different device specifications, three-layer decoupling deployment, and third-party virtual platforms including VMWare and Redhat.
- Zenic ONE controller can manage enterprise CPE MCG53/51 series, ZXR10 V6000 vRouter series, ZXR10 M6000 series, ZXR10 9900 and ZXR10 8900E series. It supports end-to-end networking capability and zero-touch provisioning of enterprise CPEs through the centralized controller platform.
- Zenic ONE controller opens northbound APIs that can connect to the operation and management platform of the operator, meeting the operator need for automatic service provisioning. Through the unified portal, Zenic ONE controller supports automatic service provisioning and synergy of networks and cloud services, and the service provisioning time is shortened to several minutes. Also, the order is visual and the bandwidth is adjustable.

An operator's intelligent private line business involves "network on the cloud" and "cloud-network synergy" and faces many challenges such as unified display of cloud and network resources, cross-domain orchestration and scheduling, unified APIs between the controller and the orchestrator, and forwarding performance and O&M of virtual NEs. The current intelligent private line projects in China are still in commercial trial phase. ZTE will continue to cooperate with the operators in their plans for cloud-network convergence, helping them transform their networks. ZTE TECHNOLOGIES

Requirements and Solutions for Telecom Cloud Network

Bi Yifeng
vDC/SDN Planning Engineer at ZTE

An Overview

Cloud-network convergence is a deep transformation of network architecture driven by service requirements and technology innovations. It involves both the cloud and the network: the cloud computing services need the support of strong network capabilities; and the network resources need to be optimized based on the concepts of cloud computing. With the increasing adoption of cloud computing services, network infrastructure needs to better accommodate the demands of cloud computing applications to ensure network flexibility, intelligence and maintainability.

Telecom Cloud Network's Requirements

A telecom cloud network has its own features and quite different requirements for cloud-network convergence from an IT network.

Diverse VMs with Different Communication Modes

Telecom cloud needs to support different communication modes simultaneously and has complicated network functions.

A signaling plane NE carries little traffic and consumes little bandwidth; it has strong control function and uses lots of virtual machine (VM) CPU resources. OVS VM ports are recommended for communication, such as vPCRF. A user plane NE handles large traffic, has high bandwidth demands and is latency-sensitive, such as vFW. SR-IOV deployment is recommended. A hybrid NE has both the features of a signaling plane NE and a user plane NE. Multiple different ports need to be deployed on the same VM. That is, SR-IOV ports and OVS ports coexist on one VM, such as vGW (the virtualized form of PGW).

To meet special requirements of operators, some NEs need to be deployed in physical servers. Thus, it needs to support bare-metal server's communication. Some NEs need to be deployed in containers, and therefore container network communication needs to be supported.

High Requirements for Reliability and Disaster Recovery

Unlike IT NEs, telecom NEs have strict requirements for reliability and disaster recovery and need to achieve the carrier-class 99.999% reliability. This requires the telecom cloud

network to provide reliability and disaster recovery protection at all levels, at least 1+1 active/standby redundancy for devices including servers, network cards, switches, switch links and gateways.

In addition, the telecom cloud network needs to provide capabilities for highly efficient backup & recovery and remote disaster recovery. For the virtual layer, it needs to support automated network adjustments for VM rebirth and self-healing.

Strict Requirements for Fault Detection and Switchover

The telecom cloud network has ultra-high requirements for fault detection and device switchover time. For example, the service interruption time caused by network device version upgrades or active/standby switchovers should not exceed 50 ms. The network device is required to enable BFD mechanism to realize fast bidirectional link detection. When a fault occurs, the network can timely switch the service to the standby device and link. These features are not possessed by the IT cloud.

High Network Security Requirements

Ultra-high security requirements of telecom NEs extend from the physical network layer to the virtual network layer.

In general, strict network isolation is applied to a physical network. Some operators require multi-layer isolation. For example, the service network, storage network and management network are isolated at the first layer and firewalls are used to protect inter-network communication.

A service network is further divided into an exposed zone, a DMZ zone and a core zone. Different types of firewalls are used between different zones to implement layered protection. The management domain and storage domain are further divided into different network planes, among which, mutual access is strictly prohibited.

Special Requirements for Traffic Detection

The monitoring requirement of a traditional telecom network has been inherited by a cloudified telecom network. In addition, to

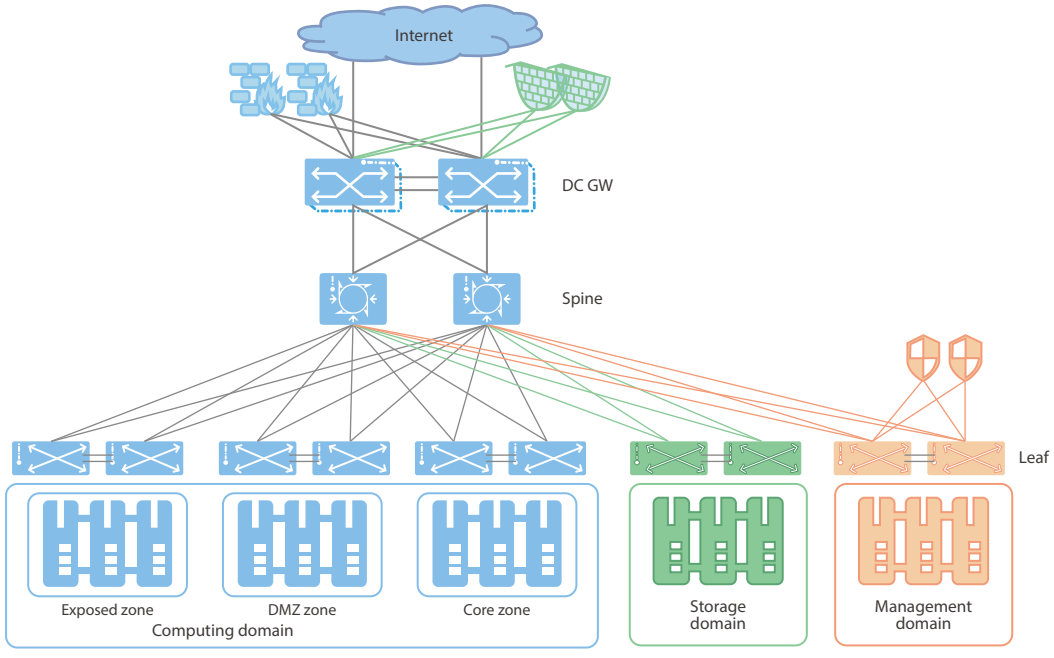


Fig. 1. Physical architecture of a telecom cloud network.

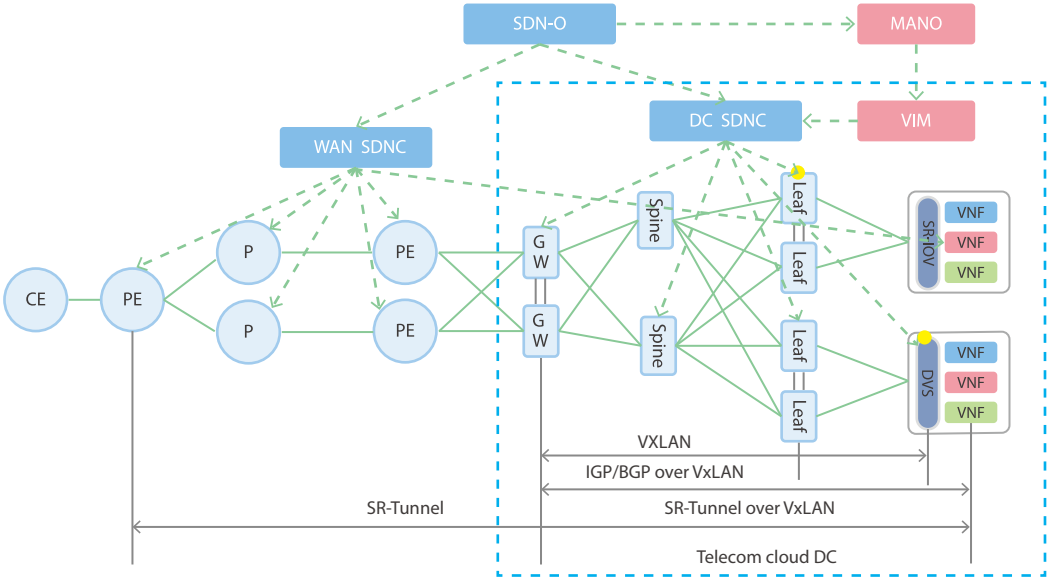


Fig. 2. Logical deployment of a telecom cloud network.

realize automated O&M and network analysis, the telecom cloud requires real-time collection and analysis of signaling and data in the network. Driven by these two requirements, the telecom cloud network should support precise and automated data distribution and collection. In particular, traffic collection policies can be automatically adjusted during migration and rebirth of VM terminals.

High Requirements for Network Service Quality

Various communication modes coexist in the telecom cloud network, and different communication planes have different requirements for network service quality. In general, the signaling plane has higher QoS requirements than the media plane. Moreover, the media plane has different service levels for communication, such as VoIP and internet services. Therefore, the telecom network needs to support the QoS mechanism at the transport layer and assigns different service classes to different QoS levels so that high-priority services will be transported first in case of network congestion.

High Requirements for Bandwidth

The media plane of the telecom cloud has route-type NEs, such as vGW and vBRAS. When the growing 5G services and fiber-to-copper transition bring traffic explosion, the bandwidth requirements of these NEs increase exponentially. Meanwhile, these NEs are deployed on servers, and their traffic is finally transported to the backbone network or the internet by the telecom cloud network. This puts high bandwidth requirements on the telecom cloud network. Especially when there are service function chains, the same traffic will traverse within the DC of the telecom cloud two to six times, which results in multi-fold growth in traffic and brings huge challenges to the forwarding capability of the telecom cloud network.

Recommended Telecom Cloud Network Architecture

As a scenario of cloud-network convergence, the telecom cloud network has the above-mentioned unique features and requirements in addition to general features of a

cloud network. According to the telecom cloud features, we recommend the network architecture as shown in Fig. 1.

The telecom cloud network architecture is vertically divided into Border Leaf (also known as DC GW), Spine and Leaf layers. Firewalls and external networks, as the special network services, are connected to the Border Leaf, and physical servers are connected to the Leaf switches. The switches use virtual switch cluster (VSC) and equal cost multiple path (ECMP) to provide high reliability. The network is horizontally divided into computing, storage and management domains. To meet some special requirements, certain out-of-band management domains are divided from the management domain. To guarantee security, communication between the management, storage and computing domains needs to be filtered and protected by the management firewall.

The computing domain's servers employ VMs, bare-metal servers or containers to install VNFs. Communication among VNFs and that between a VNF and an external network is performed by a SDN-controlled overlay network. VxLAN encapsulation dynamically adjusts the virtual network to meet VNF communication requirements, according to the dynamic creation, destruction, scale up/down, rebirth and self-healing of VMs. Based on the security level of VNFs, the network is divided into an exposed zone, a DMZ zone, and a core zone. VNFs in the exposed zone are mainly route-type NEs for external communication, such as the vGW in a core network. In the DMZ zone, it is recommended to deploy VNFs that are not directly exposed to the outside but need to communicate with VNFs in the exposed zone, such as vMME. In the core zone that has the highest security level, core subscription data NEs (e.g. HSS) get deployed the most. Communication between zones with different security levels needs to be protected by the firewall.

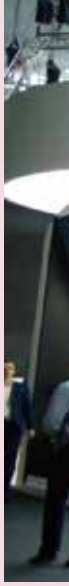
The storage domain is mainly deployed with storage servers or disk arrays to provide cloud storage for VNFs to use on demand. The management domain is mainly installed with cloud control nodes and SDN controllers to implement coordinated control and orchestration for the cloud and the network.

The industry has reached a consensus on using SR as the technology for evolution of P backbone network, mobile backhaul, MAN and DCI underlay network outside the DC. VxLAN technology is implemented within the DC to provide overlay virtual networks. The DC can be considered as an L2 VPN domain, and a VNF a client device of the vDC L2 VPN. In particular, vRouter-type VNFs such as vGW or vBRAS are a part of a WAN, and SR path orchestration for WAN should include these VNFs.

The industry is considering using the same technology to achieve unified evolution of internal and external networks of vDC. ZTE recommends to use SR over VxLAN (Fig. 2) to achieve interconnection and unified orchestration of external and internal overlay networks of DC. This enables unified coordination and control for service networks, minimizes the impact on internal physical networks of DC, and avoids excessive dependence on the underlying network functions.

Due to the telecom cloud network's special architecture and requirements, deployments of NFV/SDN in the network will be varied. Operators and equipment vendors need to develop specialized solutions and functions.

Telecom cloud virtualization technologies keep evolving. Smart NIC offload and container technologies are rapidly maturing and increasingly applied to virtualization. In-band network telemetry, intelligent traffic collection and analysis, and network self-test and self-healing technologies are also developing rapidly, providing operators new ideas for intelligent O&M. On the other hand, we must realize that network cloudification cannot be done at one stroke; instead, it requires more trials and explorations. ZTE TECHNOLOGIES



Viettel: Standing Out from the Competition in Vietnam's Broadband Market

Wang Chengguang
FN Product Marketing Director of Asia-Pacific Region at ZTE

Tang Yuzhe
FN Product Marketing Manager of Asia-Pacific Region at ZTE

Viettel is the biggest integrated telecom operator in Vietnam. Driven by its ambition to become a globally top-tier full-service carrier that spans mobile, fixed and media services, Viettel aggressively seeks to attract new users and launch new services domestically while also expanding the overseas market through its international arm, Viettel Global. Viettel now has operations in nine countries with a combined population of over 175 million. In countries such as Cambodia, Laos and Mozambique, Viettel is already a market leader.

Facing Fierce Competition

At the beginning of 2016, the Vietnamese Prime Minister approved a broadband initiative mandating that the broadband penetration in Vietnam reach at least 40% by 2020. Amid cut-throat competition in Vietnam's fast growing broadband market, mainstream wireline operators are looking for transformation, using the PON technology to offer network access, IPTV, and CATV services.

As early as 2014, Viettel started large-scale GPON FTTH construction and developed IPTV and three-screen (TV, computer and mobile phone OTT) services. Now Viettel has about 1.2 million FTTH users, 600,000 AON users and more than 500,000 DSL users. The core driver of wired broadband is video business. As video evolves from SD to HD to 4K and 8K, the need for broadband construction keeps rising. Therefore, Viettel needs to lay a good foundation for broadband networks and improve network performance. It also needs to develop video business, improve user experience, continue to reduce Capex and Opex, and gain advantages in the fierce market competition.

Improving Customer Experience

Viettel adheres to the business philosophy of "putting customers at the center to pursue harmonious and sustainable development". Accordingly, its brand building is centered around respecting, serving, and listening to customers. Network service quality is directly related to customer satisfaction. In 2015, Viettel pinpointed the top three issues with its network quality. First, the complaint rate of PON and AON users was too high. Second, customer experience management was difficult because Viettel did not have a complete solution to monitor service quality. Third, home Wi-Fi coverage was unsatisfactory. Many households in Vietnam live in independent two- to four-storey dwellings, and it is hard to blanket the entire building with Wi-Fi.

The biggest advantage of Viettel lies in the mobile sector, where the operator accounts for 46% of the domestic market. Viettel was thinking of a way to tap its strength in mobile services to develop fixed-line services through network convergence. The strategy Viettel came up with was offering diverse mobile-fixed combo packages to attract users and addressing the existing network issues to boost user experience. After a meticulous selection process,

Viettel chose ZTE as a partner to help it grow broadband business.

To quickly expand user base and improve customer satisfaction, Viettel developed a range of mobile-fixed combo broadband service packages that could meet different user demands. The packages for low-end users focused on cost-effectiveness to attract new customers and retain old customers. Those for mid- and high-end users offered quality services and often included family-level bundles to boost user loyalty and increase upselling. To help Viettel deliver these differentiated home broadband services, ZTE customized multiple ONUs. The ONUs for low-end users provide FE ports at the user side to allow for basic services including internet access and SD video. The ONUs for mid-end users have GE ports plus VoIP ports to enable HD and 4K video services. Those for high-end users offer dual-band gigabit Wi-Fi functionality as well as GE and VoIP ports to deliver high-bandwidth, HD and 4K video services.

To enhance user experience, Viettel set up a network KPI monitoring mechanism to monitor and evaluate the quality of different vendors' devices in the existing network. ZTE ONUs were always at the forefront in quality assessment. Viettel also introduced a DPI probe-based monitoring system to analyze data and provide multi-layer monitoring for service-level applications such as video, gaming, email, internet access and voice. ZTE ONUs contain customized DPI software to support the DPI probe-based monitoring system, allowing Viettel to improve customer experience through the visual quality of experience (QoE) management system while reducing Opex.

To solve the Wi-Fi coverage issue in the Vietnamese market, ZTE provided Viettel with its NetSphere solution that uses a home gateway and multiple APs to set up a home Wi-Fi network. The home gateway and APs are customized to vastly expand the Wi-Fi range. With its advanced technologies such as auto configuration, mesh networking, intelligent roaming and efficient O&M, NetSphere can bring benefits that go beyond resolving difficulties in extending in-home Wi-Fi coverage. It can also raise service quality, enhance user experience, upgrade home network services, and support remote and local management. Thanks to the solution, Viettel's Capex and Opex can be significantly reduced.

Through the cooperation with ZTE, Viettel has built a stable and efficient network that can reduce Capex and Opex and strengthen its position in Vietnam's fixed network market. Viettel has grown its GPON user base to 4.6 million, accounting for about 50% of Vietnam's GPON market. The bandwidth and service quality of its GPON network have also risen markedly, offering a great support for the deployment and evolution of IPTV services. Viettel is currently collaborating with ZTE in its subsidiaries in the hopes of promoting Vietnam's broadband development and deployment models and bringing its successful experience in Vietnam to more markets to achieve greater success. ZTE TECHNOLOGIES

To enable connectivity and trust everywhere