ZTE TECHNOLOGIES

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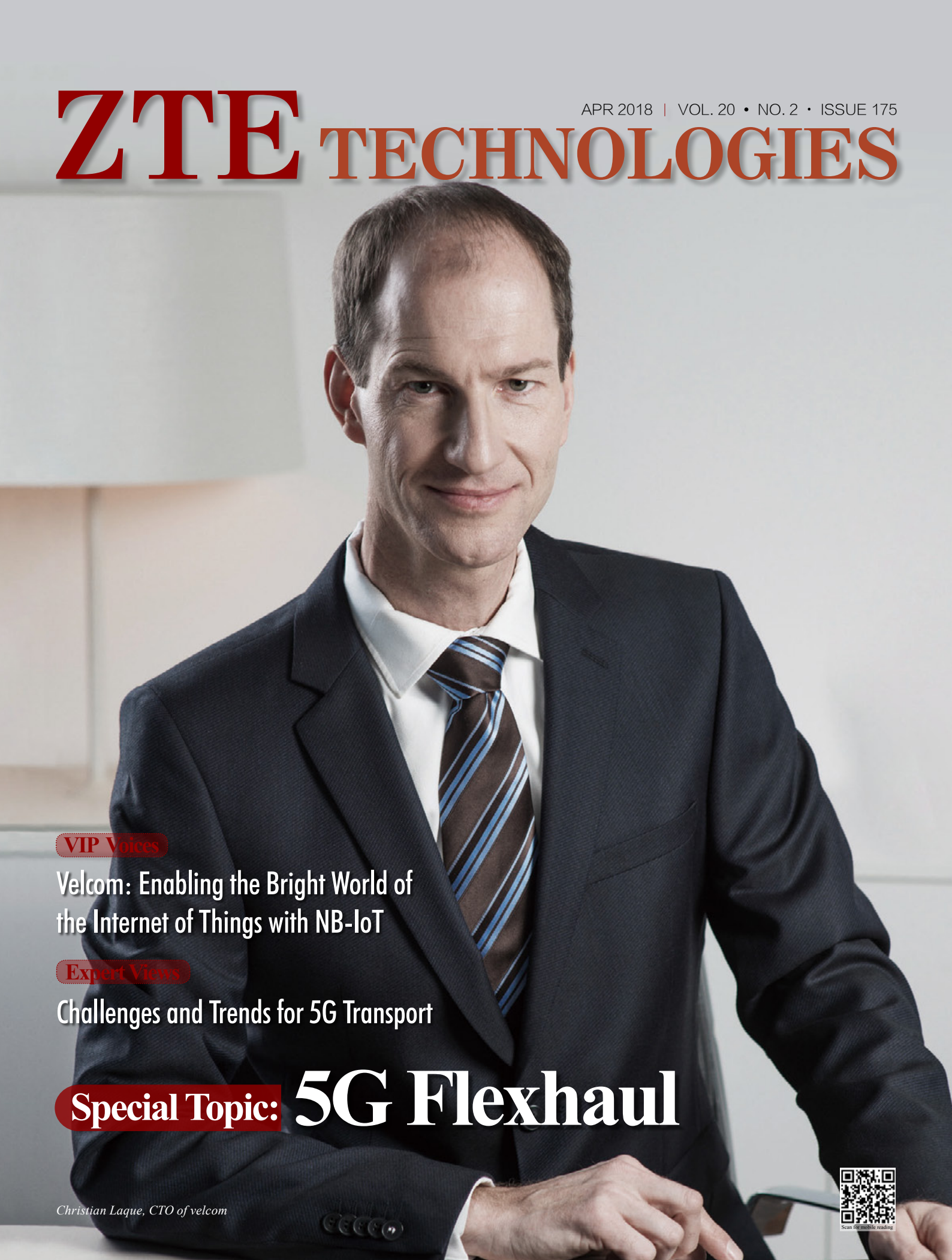

VIP Voices

Velcom: Enabling the Bright World of the Internet of Things with NB-IoT

Expert Views

Challenges and Trends for 5G Transport

Special Topic: 5G Flexhaul

Christian Laque, CTO of velcom

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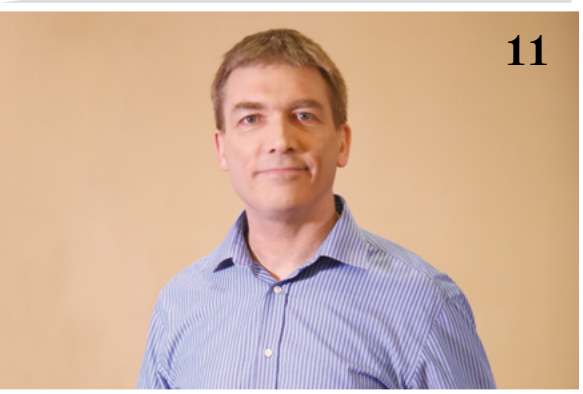
CONTENTS

ZTE TECHNOLOGIES APR 2018



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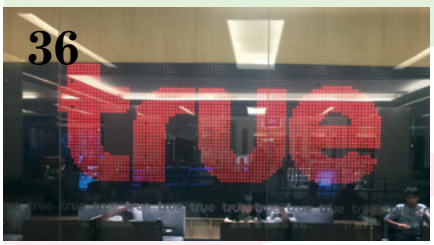

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A technical magazine that keeps up with the latest industry trends, communicates leading technologies and solutions, and shares stories of our customer success

ZTE Leads in Passing China Mobile's R15 SBA Framework IoT Test

1 March 2018, Shenzhen, China — ZTE announced it has successfully passed the 5G core service-based architecture (SBA) IoT test organized by China Mobile Research Institute.

As China Mobile's strategic partner, ZTE participated in the whole process of standard discussing and formulating, and took the lead in completing the test and verification of 5G core.

In the context of interoperability being the essential condition of 5G commercialization, the successful completion of this test attaches positive and great significance to promoting the maturity of the 5G core network and the entire 5G industry chain. In association with China Mobile, the world's leading mobile operator and a leader in SBA architecture, ZTE took the lead in passing the IoT test, which fully testifies ZTE's industry-leading position in recognition of its 5G core solution's openness and compatibility.

To embrace the mobile era of all connections, ZTE takes 5G development as its core strategy and continues to increase its investment in 5G core technology innovation. The company is committed to becoming a trailblazer in 5G and providing better services for operators worldwide to achieve digital transformation.

ZTE Signs Partnership Agreement with VOO Belgium

28 February 2018, Barcelona — ZTE signed the partnership agreement with Nethys (VOO) for the provision of full virtualized mobile core and digital transformation services. VOO is a brand owned by Belgian cable operators Nethys and Brutele and provides communications services to customers in Brussels and Wallonia (French-speaking part in Belgium), including internet, fixed voice services and digital and interactive TV. VOO mobile is operated by Nethys as Light MVNO.

Earlier in December 2017, ZTE announced the exclusive bid with Nethys/VOO for a digital transformation program from Light to Full MVNO. This program will enable VOO to converge its fixed and mobile core networks and develop its business autonomously and flexibly by becoming a Full MVNO.

In this program, ZTE will deliver the first full-fledged virtualization solution that is based on ZTE's self-developed hardware and Ceph storage solutions in the high-end market in Western Europe. It provides nearly 30 + vApps, which is of a full suite of network elements such as vCN and vVAS, including end-to-end virtualization solutions for all components from hardware, NFVI platform, VNF to MANO.

ZTE and velcom Deploy World's First 5G-Ready Network

1 March 2018, Shenzhen, China — ZTE and velcom, the Belarusian telecom operator, deploy the first commericial 5G-ready virtual core network in Belarus. Due to superior technical results, the project is one of the shortlisted nominees for the Best Network Software Breakthrough award of the MWC 2018.

The velcom's 5G-ready virtual core network provided by ZTE is the world's first fully virtual mobile core network. It is based on an open industry standard infrastructure, following Open Stack and Devops mechanism. This state-of-the-art technology allows fast service deployment, both by default and flexible usage for upcoming 5G applications. It is also applicable with legacy networks such as 2G, 3G or 4G. Due to this pioneering accomplishment, new services like massive IoT, autonomous driving, real time VR and ultra-low latency applications will be possible.

ZTE Teams up with Ooredoo Group to Lead 5G Commercialization in MENA

1 March 2018, Shenzhen, China — ZTE reached an agreement on strategic cooperation with leading operator Ooredoo Group. That will enable Ooredoo Group's 164 million customers to experience digital in new and exciting ways and enjoy the internet more.

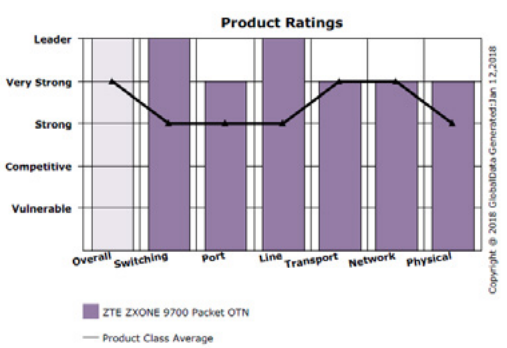
According to the agreement, both parties will jointly conduct a series of technology verification tests and assessments in 5G, to further strengthen Ooredoo's leading position and accelerate the commercialization and roll-out of 5G in MENA. ZTE will provide Ooredoo Group comprehensive technical support including end-to-end networks, applications and terminals. The two parties will complete the joint verification of 5G technology architecture, business model and user experience, expecting to lay a solid foundation for Ooredoo Group to take the lead in 5G deployment in MENA.

"ZTE has always been a long-term strategic partner of Ooredoo Group. We hope that through the strategic cooperation this time, we can strengthen existing cooperation and jointly explore the future direction of network construction and technology evolution, and promote our 5G ecosystem building across our footprint. This will help us achieve our vision of enriching people's digital lives and enable them to enjoy the internet even more," said Sheikh Saud Bin Nasser Al-Thani, CEO of Ooredoo Group.

ZTE E-OTN Product Rated 'Leader' by GlobalData in Core Packet-Optical Platform Class

6 March 2018, Shenzhen, China — ZTE announced that its ultra-large-capacity packet optical transport device ZXONE 9700 was rated as the sole "Leader" in the Core Packet-Optical Platform class by GlobalData, an internationally renowned telecommunications, software and IT service research firm.

Among the same type of devices, ZTE's ZXONE 9700 has been leading the industry in terms of switching capacity and DWDM line card port capacity.



ZTE Launches Commercially Viable Intelligent Optical Cross-Connect Product

6 March 2018, Shenzhen, China — ZTE launched a commercially viable intelligent optical cross-connect product that supports fully-automatic optical cross-connection based on all-optical switching.

Capable of avoiding wrong connections, the product can relief personnels from the deployment and maintenance work, reduce overall network construction costs for operators, and promote the establishment of intelligent and simple E-OTN.

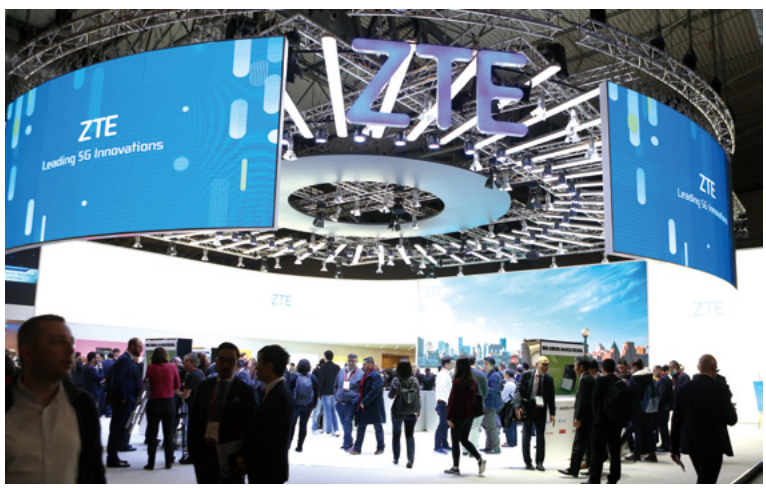
As new services such as 4K, VR, cloud computing and big data emerge in the coming 5G era, network traffic is surging rapidly and the services need to be scheduled more flexibly. Therefore, the ROADM technology is widely used. However, as ROADM site degrees rise, the complexity of optical fiber connections in the site increases geometrically, which brings inconvenience to O&M and difficuty in meeting the requirements of rapid and flexible service scheduling.

ZTE's intelligent optical cross-connect product allows optical-layer service scheduling to reduce end-to-end latency and supports more than 32 optical directions to provide up to 800T+ cross capacity. The new structure design also enables one-to-one correspondence between optical backplane slots and boards to support higher integration, effectively preventing wrong connections and reducing deployment time from days to hours.

ZTE 2017 Full-Year Revenue Rises to RMB 108.82 Billion

Achieved approximately RMB 1.384 billion cash dividend (before tax)

15 March 2018, Shenzhen, China — ZTE reported a full-year revenue of RMB 108.82 billion in 2017, 7.5% higher than a year earlier, benefiting from continuous investments in telecommunications networks by global operators and the company's growth in consumer businesses and government-enterprise markets.



According to the company, its net profit attributable to holders of ordinary shares of the listed company in the whole year 2017 was RMB 4.57 billion, an increase of 293.8% based on the financial statement published by ZTE today. Basic earnings per share was RMB 1.09. The weighted average return on equity accounted for 15.7%, with a year-on-year growth of 24.1 percentage point. The proposal for profit distribution of 2017 was RMB 3.3 in cash (before tax) for every 10 shares. Total amount of cash dividend was RMB 1.384 billion (before tax), accounting for 30.29% of the net profit attributable to holders of ordinary shares of the listed company in 2017, which was the highest in the history of profit distribution of the company.

In 2017, the company strengthened its cash flow and sales revenue collection management. Its net cash flow from operating activities for 2017 is approximately RMB 7.22 billion, about 37.3% year-on-year growth. ZTE's R&D spending increased to RMB 12.96 billion in 2017, covering 11.9 % of revenue.

In 2017, ZTE harvested bumper growth in all its Carrier Networks, Consumer Business and Government-Enterprise Business, with the specific revenues achieved RMB 63.78 billion, RMB 35.21 billion and RMB 9.83 billion respectively.

ZTE reported operating revenue of RMB 61.96 billion from the domestic market. From the overseas market, ZTE reported operating revenue of RMB 46.86 billion during the period.

In 2017, the company focused on 5G end-to-end solution and fully invested in standardization, product development and commercial use verification. To date, ZTE has formed a 5G R&D team with more than 4,500 professionals, covering a full range of connectivity, carrier, service and mobile devices to establish ZTE's threefold leadership in 5G technology, commercial use and economies of scale.

In the aspect of future-oriented 5G commercial use, ZTE has achieved great breakthroughs in 5G technologies. Specifically, ZTE broke several records in Phase 1 and 2 of China's National 5G Tests, and is now getting fully prepared for Phase 3. In collaboration with China Mobile and Qualcomm, ZTE completed the world's first end-to-end 5G New Radio (NR) Interoperability Data Testing (IoDT) system based on the latest 3GPP 5G NR standard. In partnership with Intel, ZTE launched the world's first SDN/NFV virtualization-based 5G RAN solution, largely facilitating 5G commercialization. In addition, ZTE released the 2/3/4/5G fully-integrated Common Core solution to comprehensively realize the 3GPP R15 service-based architecture. By the end of 2017, ZTE had deployed over 320 NFV commercial/trial cases on a global basis, laying a solid foundation for the commercial use and evolution of 5G core network. To date, ZTE has formed strategic partnerships with over 20 operators worldwide to jointly advance the verification and test of 5G technologies, thereby accelerating 5G commercial deployments.

Velcom: Enabling the Bright World of the Internet of Things with NB-IoT

Reporter: Liu Yang

Christian Laque, CTO of velcom

Christian Laque, CTO of velcom sees GSMA standardized technology (NB-IoT) to be the right one to be introduced shaping the market and paving the road to the future. In an interview with *ZTE Technologies* in February, Laque highlighted its NB-IoT commercial network, the first in Belarus, and shed light on its NB-IoT applications and business models, and the challenges ahead. Velcom is the leading mobile operator in Belarus and a branch of Telekom Austria Group.

If there was one recent development in your company that you would like to highlight, what would it be?

After the full migration of the radio network to soft defined version and virtualization of the core network, the launch of NB-IoT was a logical step. It is such a highlight because it is an enabler for the bright world of the internet of things. Velcom is again a leader in technology by implementing NB-IoT as a software upgrade of the network nationwide.

The launch of our new state-of-the-art data center is another huge step. The opportunities in ICT are huge and also for the IoT applications the cloud in our data center will play an important role.

What is the present status of LPWA market? What are the key drivers to NB-IoT development?

This market is relatively new for Belarus as there was no dominant LPWA technology. There were experiments that did not turn into something serious. We see GSMA standardized technology to be the right one to be introduced shaping the market and paving the road to the future.

It is a great opportunity to leverage NB-IoT, a worldwide standard, to enter the amazing world of IoT together with partners, developers and of course our customers.

So far we have used 2G, 3G as connectivity for M2M applications. With the steep increase in the number of sensors, these networks were no longer the suitable ones. The new generation of sensors have quite specific needs which do require a proper LPWA.

Key drivers for a global standard instead of proprietary solution are the number of devices to drive the cost down and to create a universal ecosystem.

What is the significance of your NB-IoT commercial deployment? How can NB-IoT help your business grow?

Launching the NB-IoT network was the logical next step for us when we think about the development of our carrier business. Connecting machines is equally important now as connecting people. We see NB-IoT network as the enabler for our partners and us to explore new vertical applications, which have not been possible before. Definitely, it is a key element for our digital strategy.

We are foreseeing our IoT business growth leveraging on the technology advantages like improved signal strength and battery life. In some cases, battery-powered solutions were simply non-existent. Now we have the tool and we can offer to our solution partners to reach the places they could not think reachable before.

What do you think are the success factors of Belarus' first scaled NB-IoT deployment?

Velcom is well established as the mobile service provider of choice for business customers. With the data center/cloud and NB-IoT we are enlarging our portfolio for the business segment. To be the leader and drive innovation is in our genes.

Belarus has a proven position in application development in the world and a growing community of innovations. The new direction to develop Belarus into an ICT country will also foster the development in IoT.

How do you comment on ZTE's performance during the NB-IoT project?

From the beginning of 2017, velcom and ZTE have combined their forces and built one project team. As a leader, you are facing challenges but together we have been able to solve them all. ZTE has provided its expertise and technical solutions in NB-IoT development. Due to the hard work of the project team, technology deployment was done in a short time frame. This success was based on the common projects in the past years.

What vertical applications are you or will be looking at?

We see utilities sector as one of our key adopters in the first wave. They obviously need NB-IoT based solutions to connect the huge amount of sensors. The focus is on smart city with smart metering solutions including water, power, and gas, and other city utilities.

Another segment that is interested in our solutions is transportation. Whenever a company is looking to monitor goods condition, we are there to find the best solution.

We are collaborating with manufacturing companies. Many of their sensors used to monitor the production cycle conditions have been limited by the connection via wires. We are working on developing technical solution that will help to connect faster and more flexibly much more sensors.

What is your NB-IoT business models to develop new services?

Velcom is offering each customer tailor-made contracts for end-to-end solutions, encompassing sensors, data storage and analytics, as well as the NB-IoT connectivity and data-center services. Velcom is working with local companies from Belarus, Latvia and Lithuania and multinational players, such as Qualcomm, Quectel and ZTE, putting together a tailor-made proposition for each enterprise customer.

We are also working with start-ups in various fields (Med, Logistics to name a few) to get them onboard with the new technology where we see it applicable. We are re-engineering their devices together so they can benefit from NB-IoT.

What are the challenges in the NB-IoT industry at the moment in your view? What needs to be done to ensure its future success?

Number one challenge is the module price. NB-IoT is engineered for mass deployments of cheap devices. The costs must clearly undercut other technologies like 2G or 3G.

Another challenge to be tackled is to foster developer and startup environment around the new technology. Teams we met are already well aware of pros and cons of existing technologies and their ways to use them. We think it should be a common effort of key players to raise the NB-IoT awareness among the developers and startup teams.

5G is gaining momentum. What kinds of activities are you getting involved with in this domain?

We are on track and even have 5G already. I would count NB-IoT as a piece of 5G technology. With the virtualization of the entire core network we have a great base. For network slicing, we have already tested with several use cases successfully. It is only a few steps further to have 5G fully in the core network.

What is your vision for the IoT and 5G sectors?

IoT will become a standard component in everything. It will help to ease processes and our daily life dramatically. Huge opportunities will come up. Of course we have to take care of security.

5G is much more evolution than revolution. The major step is the capability in the core network. The radio is mainly driven by bandwidth demand.

One challenge is to lead the customers to use the new network and free up the existing one faster than any time before. The cycle of developments will get faster and faster, and to keep pace, we have to migrate and close legacy. ZTE TECHNOLOGIES

Long-Term Use and Upgradability Key to Future PON Systems

An interview with Dr. Jun-ichi Kani, FSAN General Chair

Reporter: Liu Yang

Dr. Jun-ichi Kani, FSAN General Chair and Distinguished Researcher at NTT Access Network Service Systems Labs

The Full Service Access Network (FSAN) Group comprising of around 70 telecom service providers, test labs and equipment vendors, is dedicated to studying optical access technology. At the recent FSAN/ITU-T joint meeting hosted by ZTE, Dr. Jun-ichi Kani, FSAN General Chair and Distinguished Researcher at NTT Access Network Service Systems Labs, talked about FSAN's role in the PON industry and the impact of 5G transport on PON.

Could you please give us the big picture of the telecom industry?

The telecom network has now changed from the old-fashioned telephony network to the broadband network based on the internet protocol. Various attractive services have been developed on top of that. This is the current situation. A very important issue now is to further grow the broadband business.

How do the PON technologies fit into this big picture?

PON is the most viable and future-proof solution for providing broadband access. What I mean is that the fiber access can provide abundant bandwidth and PON is a very cost-effective solution to provide that. It is very important.

How does FSAN help the PON industry move forward?

FSAN is an interest group comprising of PON industry members. Here we are studying the requirements for ideal solutions and technologies, for example, to study future PON systems and also to use operators' existing PON systems. We are trying to do the work and guiding the efforts of the industry in the same direction.

How does FSAN align its work with that of the other organizations?

First of all, FSAN has a very good relationship with ITU-T Study Group 15 Question 2. In the past, for example, we developed base specifications for 1G PON, 10G PON and 40 GPON systems. After that, FSAN members jointly proposed those base specifications to ITU-T and they are now standardized as ITU-T recommendations. That is one example. Another example is that we are studying interoperability test plans. That work is done in collaboration with the Broadband Forum. Some results have already been published by the Broadband Forum.

What has been the most exciting achievement within FSAN to date?

Recently, we have developed the base specifications of NG-PON2. They have been standardized as ITU-T G.989 series Recommendation. It's a next-generation PON to cover various applications, including residential, business and mobile backhaul, fronthaul applications. That is one of the biggest achievements.

What does FSAN's roadmap mean to you as the General Chair?

We developed the initial PON roadmap in 2007. It served as a guide for the PON industry and NG-PON2 was developed based on that roadmap. Now that NG-PON2 is completed, we have established a new roadmap to show the future direction after NG-PON2. That is currently available on our website and is a new guideline for the PON industry to further develop the systems.

What are some of the latest industry trends and hot topics that FSAN will (should) be focusing on?

The new FSAN roadmap includes some industrial

trends, such as 5G mobile and software defined network/network function virtualization (SDN/NFV). Those are very important trends we have to consider when developing the future PON systems.

5G wireless transport has been a hot topic recently. What do you think is the role of optical access in the 5G evolution?

5G has various technical aspects. Among these, one topic deeply related to optical access is the massive deployment of small cells. If there are a lot of small cells, we have to think about how to effectively connect these small cells to the Central Office. That segment is called mobile fronthaul and could be the new application for PON. So we are now studying the requirements for future mobile fronthaul.

NTT is the world's largest FTTH operator. What is NTT's view on optical access technologies? What are we going to see in terms of optical access in the APAC region?

NTT has massively deployed Gigabit PON systems since 2004. It has been a long time. One thing I have to say is that it is difficult to frequently change the system in the access. If we think about the future system, it is very important to think about the long-term use and also the upgradability. These are very important points that we are studying in FSAN as well.

You mentioned APAC. In FSAN, we have a lot of APAC members including some Chinese operators. As you know, Chinese operators have deployed a lot of PON systems recently. I think it is a lot more than those deployed in Japan. That is a big accomplishment. In my opinion, many APAC operators will follow the moves in China and Japan.

What do you think of ZTE's contribution to FSAN?

ZTE is one of the very active and stable contributors in FSAN and is very much appreciated. ZTE has presented various technical proposals for discussion, which are very helpful for FSAN to find the best solution amongst the many proposals.

How could ZTE best support FSAN operators' requirements?

It is very important to continue to discuss topics in order to reach a creative consensus. Stable and continuous contribution is very much appreciated.

What are the major challenges for you as chairman of FSAN? How do you overcome them?

As I mentioned, the recent trends include 5G mobile and SDN/NFV. Many trends will affect the PON requirements in the future. In the past, the application requirements were simple. It was just broadband. But recently you have to consider a lot of different aspects. We are planning a workshop in the next meeting to invite some external experts like mobile network experts and SDN/NFV experts. Also, I am promoting collaboration with Broadband Forum where specifications related to SDN/NFV in access are under study. Through such efforts, I believe we will be able to produce good specifications to support various new applications such as 5G. ZTE TECHNOLOGIES

Towards More Bandwidth at Lower Costs

An Interview with Peter Dawes, FSAN NG-PON Task Group Co-chair

Reporter: Liu Yang

Peter Dawes, Co-chair of the NG-PON Task Group at FSAN and Standards Strategist at the Vodafone Group

The proliferation of bandwidth-intensive services brings challenges and opportunities to the PON market. At the FSAN/ITU-T joint meeting hosted by ZTE in Shanghai, Mr. Peter Dawes, Co-chair of the NG-PON Task Group at FSAN and Standards Strategist at the Vodafone Group, chatted with us about the evolution of the PON industry, saying that it should be the aim of this group and the PON industry in general to provide as much bandwidth at the lowest cost as possible.

What's your perception of the current PON market?

If you listen to the FSAN operators at this meeting, I would say that the PON market is very healthy. Everybody seems to be seeing good growth in customer base and data usage. I think especially over the last two years, there's been a realization that copper is not the right solution for many kinds of deployments going forward. Fiber is usually the best answer for access. I think there is a bright future for PON technology. We've even seen some companies like Google get interested in PON and some companies that might have paused their deployments and are now looking to the future with new deployments.

What are the goals of the NG-PON Task Group?

The NG-PON Task Group is a collection of worldwide PON experts. We are lucky to have a concentration of experts from all over the world, including operators, system vendors like ZTE, and component vendors. The goal of the group is to try to produce standards and technologies that will grow the PON market and fit a lot of worldwide applications. We have operator sessions and vendor sessions, which means we do have a good focus on the requirements and a good understanding of how the market is growing and what subscribers are doing.

What topics are being discussed in the Task Group?

The main topics we have been discussing in 2017 and will continue into 2018 include enhancing currently defined technologies and building on what we've done before (enhancing the capacity and peak rate). That's the first thing.

There are some specific areas that we are focused on. For the recently standardized NG-PON2, we are looking at ways to help it become a real product in the market, ways to focus on some of the options and standards so the initial products don't have to support a wide variety of things that aren't going to be used straight away, and also ways to enhance single wavelength capability.

Then some other new application areas have come into focus last year (2016), such as 5G radio. Everybody is thinking that 5G standards will be finished soon. Virtualization is also another topic of interest to operators. The question is how access technology might support operators' programs to virtualize their networks.

Behind all of this, I guess everybody is aware that there are two big PON standard bodies: ITU and IEEE. In the background, the groups are looking for opportunities to converge the two to do things the same way and solve the same problems.

What does FSAN's roadmap mean to you as NG-PON co-chair?

We've probably spent a year discussing the roadmap. Although it is just one page for standards, it is an important symbol of where we're heading and a signal to the industry.

If you look at the main path of the roadmap, it is to enhance the standardized technology. It doesn't mean defining something that's very similar. What it means is working on the same outside deployed networks and the same fiber in the ground, making sure that when you have ways to migrate you still support your old technologies so you don't need to throw them away and completely change what you are doing.

An interview

If you look at the end of the main path, there is a kind of realization that perhaps we should look at radically new ways of doing things in 2021. Maybe just incrementally improving what we've done before doesn't get the step change in performance that we need. So there is a realization that we can look into research on those kinds of things for the far future.

Another part of the roadmap is alternative ODNs. We acknowledge that PON technologies, which were originally thought of as fiber at home and fiber at businesses, can have other applications like radio backhaul for mobile. In those cases, you might not want the same fiber, layout and deployment as you would for homes for example.

Then we have a bar of industry trends that mention virtualization, Internet of Things, and 5G, which you should have in the back of your mind when you plan the enhancements for PON just to give it the widest application as possible.

Is the industry moving fast enough to meet the ever-increasing demands for bandwidth?

Every operator is seeing a big increase in data usage and I think it should be the aim of this group and the PON industry in general to provide as much bandwidth at the lowest cost as possible, because if you provide it, it will get used. We cannot lose focus on continuous improvements. I think once you provide that bandwidth, you will see some big changes in the market and in the ways people behave. I mean I don't know if video streaming like Netflix would have become possible until you provide the broadband capacity. I think it's really up to groups like this to keep the growth going on these broadband products.

What do you think the industry can do to ensure its success?

I think the important thing for FSAN and the industry as a whole is to keep the dialogue going between what the customers are using, what the subscribers need, and what the technologies can provide, and to try to give them the best solution for the future. That really should be the aim of the group.

In terms of meeting future demands, I think everybody realizes that mobile and mobile data is a big source of future growth. We need to make sure that we look at the mobile data part of the market. I think another emerging issue is making the best use of feeder fibers. We have lots of fiber deployed already. As data grows it'll become heavily used, and rather than putting more fiber in the ground, we can focus on ways to maximize the use of what we have and put as much data as we can on each fiber. I think that will help with that problem.

When do you think we will see the tipping point for transition to another generation of PON?

There are two ways of looking at that. One is the tipping point between current technologies we are deploying and one is which has been standardized but hasn't been deployed in volume. So we're looking forward to making NG-PON2 a success in the market. I think probably the tipping point for NG-PON2 will be new high-speed applications. I think it has a place in the residential market, and other opportunities for deployment of that technology include mobile radio and more symmetrical business services. For the next-

generation PON technology, you know that's kind of crystal ball gazing into the future. It's difficult to predict what new services might drive that one. That's hard to say.

As the fastest growing broadband operator in Europe, what is Vodafone's view on optical access technologies?

Vodafone is known as a mobile network operator. We have mobile networks in 23 countries. In 16 of those, we have fixed broadband products. So we're a big fixed broadband provider and in fact it's nearly a quarter of our revenues.

We're doing a lot of new fiber rollouts, and we're focusing on providing what is known as the next-generation access in our broadband markets. We already have an offering of 1 Gbps in several countries (New Zealand, Spain, Italy, Portugal and Ireland). So the next-generation high-speed access service is important to Vodafone.

We also need the access technologies to support the general quality of services from end to end. They are just one link in the chain so we need to look from the customer end through the core network. The fiber access in some cases is running ahead in performance in some of the other parts of the network. So we need to build the whole end-to end experience for the customers.

What are we going to see in terms of optical access in the EMEA region?

Those are the kinds of areas of the world where we operate; in Europe, in Africa, and we have a network in Qatar. Our default plan is to provide fiber where we can. That's our aim—as far as possible and sensible to put fiber to the user and that's what we do in all of those regions. And we have a variety of ways of doing that and a variety of investment styles. We try to be creative to give that kind of capability to as many people as possible. We may do joint ventures like we did in Ireland, Spain and Portugal, do a complete new-build ourselves or do wholesale for the people. But in all cases we are trying to focus on fiber solutions.

How would you describe ZTE as a partner?

As the co-chair of the NG-PON group, it's very good to see that ZTE has a very active participation in FSAN. It's nice to see the same people and the same team turning up to the meeting so you can get to know them and carry the topics over from meeting to meeting. ZTE is one of those companies that does that. ZTE is a very active contributor. The contribution of your company and the focus on answering the call for contribution questions means we always get very focused feedback.

That's also very helpful because it's easy to interpret the answers into what the operators want to know. I would mention that the delegates must have been very good in school exams because they always answer the topics exactly. It's also useful that ZTE is active in the 3GPP world. Your delegates are there as well.

How could ZTE best support FSAN operators' requirements?

Keep doing what you are doing. But stay approachable, keep in touch and keep communicating. I think that's really important. The better understanding that both sides (operators and vendors) have, the better results you get. The operators have good visibility of the customer trends. We know what we are deploying. But the system vendors have much better ideas for what's practical and the new technology ideas coming into the market and they can inform the operators in those directions. So I would say, keep two-way communication going. Let both sides stick to their expertise.

What are some of your most notable experiences at this event?

Since I first came to China in 2006, I've been to Shanghai a few times. Every time I come here I've seen new buildings and new areas. It's been another successful trip. It's great to have these facilities and the meeting organization hosts providing everything. Excellent!

Bitel: Providing Peruvians with More High Quality Data

Reporter: Liu Yang

Huynh Minh The (R), CTO of Bitel, and Nguyen Chi Tuan (L), Director of Business Dept.

On October 15, 2014, Bitel, a branch of the Viettel group, officially launched its telecom services in Peru and became the first mobile operator using a 3G-only network in Peru, with mobile Internet covering 80% of the nation. Peru is the first overseas market of Viettel that has a considerably higher GDP than Vietnam. Hence, the service launching of Bitel marked a new development milestone in the globalization of Viettel. In late 2016, Bitel launched its 4G LTE network and now it is expanding its 4G footprint. Huynh Minh The, CTO of Bitel, and Nguyen Chi Tuan, Director of Business Dept., talked about how the new entrant has grown into a popular mobile brand, having a considerable impact on the market.

What are the differences between the Peruvian and Vietnamese telecom markets? How would you describe the process of adapting to the new environment?

There are many differences including geography, climate, culture, competitors, and language. But we are an international company, and have to adapt to the new environment step-by-step. That is not easy at the beginning, but we know that when we want to, we can do it. When we have the goal before us, we will find the solution. We want to change the market, bring the best services to Peruvians, and give them the opportunity to use data on mobile phones and many other things that people hadn't imagined before we came.

As a new entrant, Bitel has recorded high growth rates. What achievements would you like to highlight from the past several years?

Actually, one year after Bitel launched its telecom services, many Peruvians still did not know about Bitel. But three years later, we have 13% market share and 99% of the people know us and our products. In the minds of most people, Bitel is the best telecom company, which provides them with more high quality data. It's not the market share but the belief of the Peruvian people that is our greatest achievement in the past three years. We will continue to try our best to maintain this belief.

What is Viettel's business strategy to compete in Peru?

To be different. That's our strategy. We want to be different in products, channels, and communication. Of course, everything is based on our customers. Customers are central to what we do—how to make them happy, bring them not only voice/SMS and data but also extra value to make their life more comfortable.

Apart from a good business strategy, what do you think are the other success factors?

To be successful, a good business strategy is not enough. We need also other factors, such as a good network, a good core system, and a good billing system, but I think the most important factor is people. We have a good strategy to recruit people, keep them with us, and promote their ability.

What's your outlook for the Peruvian telecom market?

As Peru's telecom market is a dynamic sector we will focus on the increasing satisfaction of our customers by providing trendy and innovative services that differ from our competitors'. Peruvian people are increasing the average data usage and require more quality in service and we will focus on this. We consider Peru a big opportunity to provide our mobile services to all, even in the farthest areas nationwide. So with this thinking we can deploy our strategy according to market needs and customer requirements. According to this, from this year we will schedule to deploy some special plans for niche markets targeting tourists, kids, taxi drivers, and enterprises.

Zhao Fuchuan
Chief Engineer of 5G Transport Solution, ZTE

Challenges and Trends for 5G Transport

By Zhao Fuchuan

5G, a converged network for multiple application scenarios, will revolutionize the internet of things, bringing unprecedented experience and new business modes. It will enable enhanced mobile broadband (eMBB), ultra-reliable low latency communication (uRLLC) and massive machine-type communications (mMTC) applications. It is predicted that 5G will grow mobile data traffic by 500–1000 fold and typical user data rates by 10–100 fold, increase peak transport rates to 10 Gbps or above, shorten end-to-end latency by 5–10 fold, and improve network efficiency by 1000 fold when compared to 4G. The high performance requirements of 5G are driving reconfiguration and innovation in RAN, core and transport networks.

In the architecture of 5G transport network (Fig. 1), cloud-based core network, C/U separation, and data-plane slicing for distributed deployment will make the

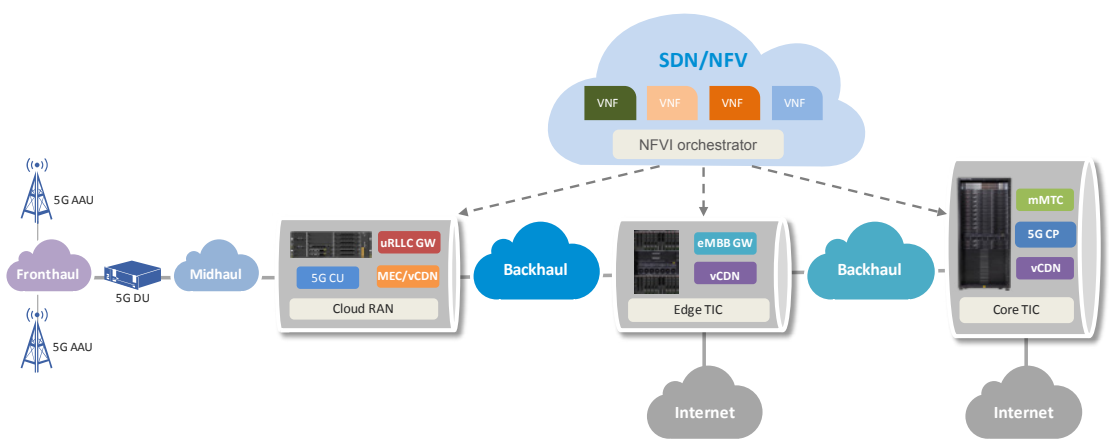


Fig. 1. The architecture of 5G transport network.

network more flat. The RAN architecture will also be reconfigured into into three functional entities: CU, DU and AAU. The transport network is divided into three parts: fronthaul, midhaul and backhaul. 5G will place higher requirements on the transport network in terms of bandwidth, latency, connectivity, reliability and SDN capability openness. The major challenges are:

- Fronthaul and midhaul: 5G fronthaul and midhaul will have high latency requirements for the transport network. Currently, the fronthaul latency budget does not exceed 30 μs, and the midhaul latency budget does not exceed 150 μs. In a traditional packet transport network, the store-and-forward queue scheduling mechanism is adopted and the non-congestion forwarding latency for a single node is 30–100 μs, which can hardly meet the requirements. It is therefore necessary to introduce a new low-latency forwarding technology.
- Backhaul: The bandwidth increases over 10 fold, and the traffic model changes from aggregation into full-mesh. The dual connectivity of 4G and 5G convergence, inter-base station coordination, as well as load balance and multi-homed backup for cloud-based core network deployment make traffic more complicated and dynamic. This requires the transport network provide scalable bandwidth and flexible mesh connection.
- Ultra-high-precision time synchronization: Ultra-short frames, carrier aggregation and coordinated multipoint (CoMP) are introduced in 5G to improve time synchronization accuracy by an order of magnitude from ±1.5 μs in 4G to ±130 ns.
- Network slicing: The core network and RAN adopt SDN/NFV-based cloud slicing architecture. Network slicing is based on different application scenarios, and different functional slices have different requirements for bandwidth, latency, network functions and reliability. The 5G transport network is a part of the 5G end-to-end service path and must meet the needs of different services in multiple scenarios. Moreover, 5G is an open network that can meet application requirements of vertical industries and leasing services. Therefore, the transport network is required to support service separation and independent O&M of sliced 5G networks. Different transport network slices are allocated to different service types, with each transport network slice serving as an independent physical network.

To meet the transport needs, ZTE has innovatively developed Flexhaul—an end-to-end 5G transport solution that integrates L0-to-L3 network functions to provide scalable large bandwidth, low latency and flexible L3-to-edge service addressing. The solution has the following attractions:

- It uses the same equipment for 5G fronthaul, midhaul and backhaul. An end-to-end transport solution can be offered, and the equipment can be flexibly deployed to meet network needs.
- It supports the IP and flat optical network architecture, and also supports FlexE over DWDM to enable multi-wavelength multi-link bandwidth binding for capacity expansion. This can greatly enhance bandwidth scalability and reduce initial network construction costs.
- It adopts innovative FlexE tunnel to expand networking capabilities from the interface level to the network level. FlexE timeslot switching, OAM and fast protection switching are supported for creating virtual slicing networks on the Ethernet. Slicing links are similar to circuit pipes that have ultra-low latency and ultra-low jitter. The bandwidth of slicing links can be flexibly configured according to 5G granularity, and services are strictly separated between different slices.
- It uses segment routing in combination with SDN intelligent traffic engineering to address the needs for ubiquitous flexible connectivity brought by cloud-based 5G core network and base stations and to meet the ubiquitous mesh networking requirement caused by L3 down-shifting to the base station. Segment routing decouples service instances from the network, greatly enhancing network capability and scalability of supporting ubiquitous mesh connectivity. Segment routing can be easily integrated with the SDN technology that can calculate an optimal forwarding

path to meet service needs based on network traffic and topology resource conditions. The routing information can be delivered to the source node without controlling other nodes in the forwarding path or exchanging signaling. This greatly improves network control performance.

- It supports the slicing of forwarding plane, control plane and management plane. The forwarding plane uses FlexE tunnel for slicing, with each slice having its own independent topology. According to service requirements, different L2/L3 network protocols can be selected such as segment routing and MPLS -TP. Different slices have their own control and management planes. Through the coordination of slices in the wireless, bearer, and core networks, an end-to-end 5G slicing solution can be provided to meet the multi-scenario multi-tenant application needs of 5G vertical industries.
- It provides end-to-end high-precision time synchronization technologies, including high-precision time sources based on common mode and common view, transport devices supporting high-precision timestamp and phase detection, and network control technology based on intelligent clock time. These technologies can meet application requirements of 5G base stations for new air interfaces, inter-site coordination, and location-based services.

ZTE has made great progress in the R&D of 5G Flexhaul products. At the MWC Shanghai 2017, ZTE released ZXCTN 609—a 5G Flexhaul pre-commercial product, and offered a live demonstration of the industry's first FlexE tunnel technology. Through the FlexE tunnel, different network slices were created, with services being strictly isolated and having no impact on each other. The minimum forwarding latency for a single node is less than 0.5 μs, and the fast protection switching time is less than 1 ms. These performance indices set new records for Ethernet, meeting the requirements of 5G fronthaul, midhaul and backhaul services for ultra-high-reliability and low-latency transport.

ZTE is promoting the R&D and trials of 5G transport solutions in an all-round manner. As a leader in the 5G era, ZTE will continue to innovate in 5G transport technologies, solutions and equipment development and provide operators with competitive and cost-effective solutions. ZTE has been well prepared for 5G transport innovations. ZTE TECHNOLOGIES

Challenges in 5G Commercial Deployment

Summer Chen
Director of Wireless Solution, ZTE

By Summer Chen

As 5G commercial deployment approaches, studies on 5G standardization, technologies, services, ecosystem, and deployment modes are being deepened. It has been proven that services rather than technologies are the main driving forces of network development. Therefore, the functions and performance required for the implementation of 5G networks need to be analyzed from the perspective of application scenarios and service requirements.

eMBB is a deterministic requirement during early 5G deployment, and is also the core to drive the accelerated growth of the entire 5G industry. All early standard formulation, commercial use, testing, and verification of products are based on such requirement.

This paper analyzes and describes the challenges that operators may face in early 5G deployment, especially the problems encountered in 5G base station (gNB) deployment, the preparation of 5G bearer networks, O&M complexity resulting from network virtualization and slicing, and the impact on operators' organizational architecture. It also proposes the solutions.

Massive MIMO Featured gNB

In eMBB scenarios, the core requirement of 5G networks is for a significant increase in access rates. As rich spectrum resources are available on millimeter-wave bands (26 GHz, 28 GHz or above), it is easy to achieve a cell access rate of over 10 Gbps. However, network coverage and construction cost are big constraints. Considering the industry chain and 5G candidate spectrum around the world, sub-6G bands have gradually become the preferred spectrum resource of mobile operators in their early 5G deployment, and 3.5 GHz is their top-priority choice. According to Ovum, by the second quarter of 2017, there are 15 markets around the globe that have allocated 3.5 GHz band to 5G or have used 3.5 GHz band for 5G testing and verification.

In the fully competitive market, it is difficult for each operator to obtain more than 100 MHz from the 3.5 GHz spectrum. Therefore, utilizing the limited spectrum resources to deliver expected 5G

access rates is the greatest challenge for operators. Moreover, as the early 5G deployment focuses on building macrocell sites, operators are still highly concerned about site density and construction costs. Using the existing 4G infrastructure to achieve decent coverage at the 3.5 GHz band and reduce the number of 5G gNB sites is also a major concern of operators.

Massive MIMO is the most important core 5G technology to improve spectrum efficiency (Fig. 1). With the precise beam forming capability provided by large-scale antenna arrays, Massive MIMO allows multiple users to share the same spectrum resource through space division multiplexing, thus increasing cell throughput several times. In the 5G field test in Guangzhou, ZTE and China Mobile demonstrated over 6 Gbps downlink cell peak throughput by utilizing the MU-MIMO feature of Massive MIMO (using the 100 MHz bandwidth of the 3.5 GHz band). Massive MIMO can significantly improve not only system capacity but also network coverage. This is of great importance in supporting continuous coverage of 5G networks and reducing site density and construction costs.

It is commonly agreed that 3.5 GHz 5G NR provides much poorer coverage than 2.6 GHz LTE due to many factors such as propagation loss, penetration loss, and time-division multiplexing issue. To have the same coverage, more base stations need to be constructed. ZTE has demonstrated through theoretical simulations and field tests that the 3.5 GHz 5G network can be co-sited with the 2.6 GHz LTE network based on Massive MIMO and dual-antenna CPEs. This will help operators greatly reduce investments in their early 5G deployment.

In addition to hardware design, the Massive MIMO deployment also has requirements on its algorithm and performance optimization. With the large-scale commercial deployment of Pre5G Massive MIMO worldwide, ZTE has gained rich experience in channel estimation and multi-user multi-stream algorithm optimization. This has laid a solid foundation for ZTE to reap the first-mover advantages in 5G. Currently, ZTE's 5G products at low frequency bands have distinct advantages in technical maturity and performance. Compared with the traditional deployment mode (antennas + base stations), Massive MIMO base stations will undergo

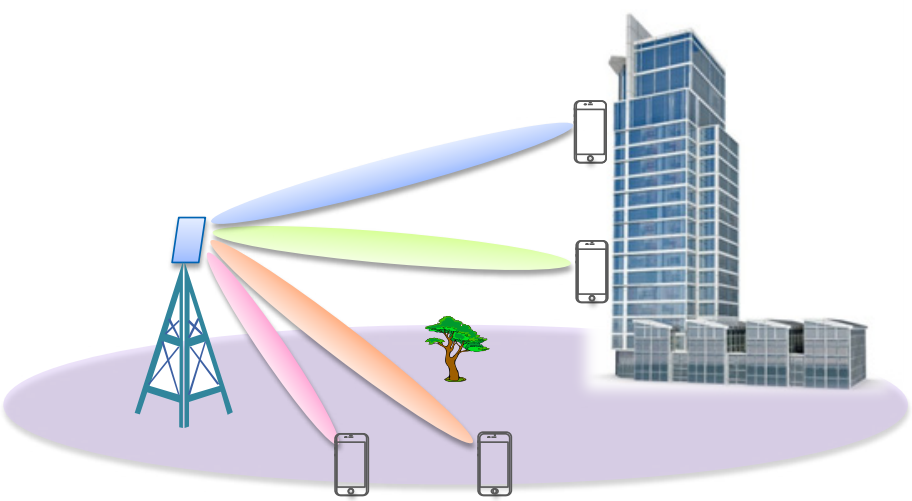


Fig. 1. Massive MIMO enhances user experience.

remarkable changes in installation, debugging, and optimization. The large-scale commercial use of Pre5G Massive MIMO will make ZTE well prepared for the whole 5G deployment process.

Massive MIMO can not only increase several times the spectral efficiency of a 5G network but also enhance coverage capabilities of a 3.5 GHz 5G network. It also supports co-sited 4G networks to help operators reduce initial 5G deployment costs and difficulty.

FlexE-Based 5G Transport

Transport is the first concern for 5G deployment. With the accelerated process of 5G standards and commercial 5G systems and terminals, time is running short for transport network reconstruction and upgrade. Operators will invest a lot in reconstructing existing transport networks before deploying 5G networks. Mobile operators must select the most proper reconstruction plan for their transport networks by fully taking into account the 5G network architecture and gNB deployment modes.

Since 5G uses broader spectrum and Massive MIMO, the CPRI interfaces are no longer applicable and need to be re-split. Considering some baseband functions are centralized and virtualized, the baseband part is also divided into distributed units (DUs) and centralized units (CUs). Their deployment modes are quite flexible, depending on service requirements and transport networks. DUs can be deployed with AAUs on the site side, converged to the convergence node to form a resource pool, or deployed with CUs in the central office (Fig. 2).

Compared with 4G networks, 5G eMBB can achieve over 100-fold increase in access

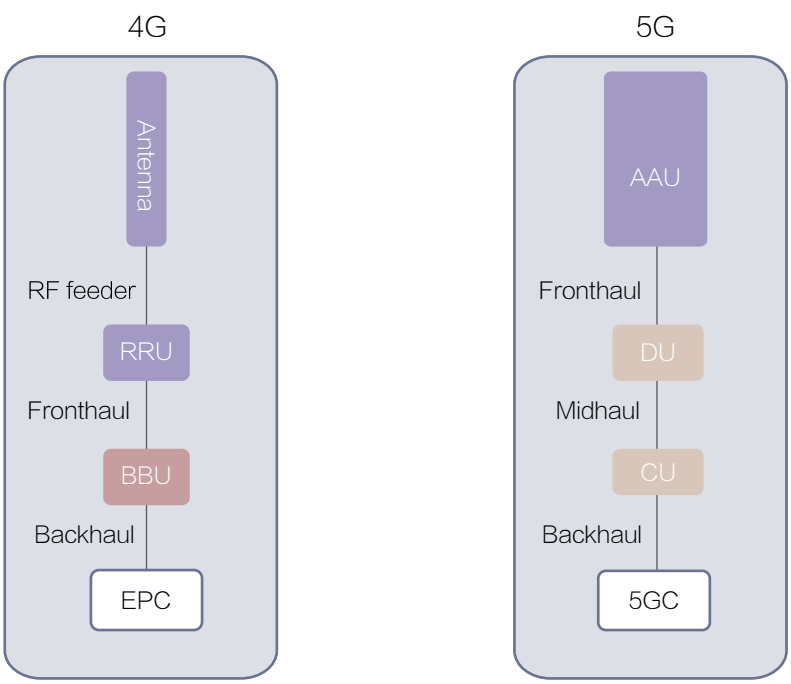


Fig. 2. Difference between 4G and 5G transmission requirements.

capability, which raises higher requirements on transport bandwidth. Due to the flexible deployment requirements of 5G CUs and DUs, transport networks have to deal with fronthaul, midhaul, and backhaul scenarios. In the future, 5G will support massive IoT access, ultra-reliable low-latency communication, and inter-DC on-demand connectivity after network virtualization is completed. It can be anticipated that 5G transport networks will face the challenges of unprecedented complexity and flexibility.

Currently, the standardization of 5G transport is being advanced. ZTE has proposed its FlexE-based 5G transport solution that can flexibly handle hybrid access scenarios involving fronthaul, midhaul, and backhaul and easily deal with inter-DC on-demand connectivity after network virtualization is completed. The solution can also deliver extra-high broadband access capability to eMBB services through flexible slices, and ultra-low-latency forwarding channels to latency-sensitive services. FlexE has therefore become an ideal 5G-oriented transport solution.

Cloud Native-Based 5GC

Virtualization is an inevitable trend of future core networks, while end-to-end network slicing allows operators to easily cope with differentiated requirements in vertical industries and provide customized services for users in different fields in an agile way. After network virtualization, the ratio of software in place of hardware will gradually increase. The operation mode of multi-network coexistence and multi-service concurrency will rely more on intelligent algorithms, and the network O&M team shall gradually transform into the lifecycle management team focusing on new service development and network slicing.

ZTE's 5G core network (5GC) uses cloud native and micro service architecture to meet different needs of high bandwidth, massive MTC, low latency and high reliability as required by different services in the same network. End-to-end network slicing allows for flexible function orchestration, on-demand resource scheduling and diverse service capabilities among the core, transport and access networks. Moreover, ZTE's carrier-grade DevOps system enables operators to develop, test, operate and optimize new services. This greatly shortens time to market for new services and reduces O&M complexity.

The standardization of 5GC is later than the 5G RAN schedule. Some operators may plan to first deploy 5G NR and then introduce 5GC at the second phase. Other operators may consider building a complete 5G network at the beginning. In either mode, the virtualization of core networks does not rely on the progress of 5GC standardization. After core networks are virtualized, both EPC and 5GC will be loaded onto the virtualization platform in the form of software applications. Therefore, 5GC standards can be smoothly supported through software upgrade after they are frozen. The virtualization of core networks at the 4G phase can not only reduce O&M costs of 4G networks, but also be well prepared to introduce 5G networks.

Conclusion

As the process of 5G commercial deployment speeds up, most operators are actively involved in verifying new technologies, developing future-oriented evolution strategies, and exploring innovative ICT business modes. In facing the challenges of 5G deployment at this stage, it is of vital importance to select an appropriate path at a right pace.

5G network deployment will cover access, transport and core networks as well as the network management system. ZTE has taken the lead in pre-commercial 5G end-to-end solutions and system performance, carrying out the world's largest 5G pre-commercial field test. The company has also worked with China Mobile and Qualcomm to complete the world's first R15-compliant end-to-end interoperability test. These advantages will help global leading operators become the first to launch their 5G commercial services and seize the market opportunities in the 5G era. ZTE TECHNOLOGIES

Transport Network Requirements of 5G

By Zhang Yongjian

Zhang Yongjian
Director of Transport Network Solutions, ZTE

The upcoming 5G standard has grabbed the industry spotlight. 3GPP divided 5G in two phases: Phase 1 (Rel-15) and Phase 2 (Rel-16). However, 3GPP agreed an accelerated plan for 5G deployment at the RAN plenary meeting held in March 2017 in Dubrovnik, Croatia. This means that 5G will come earlier than was originally envisaged.

As a multi-scenario integrated network, 5G provides the foundation for the ICT development. It will drive integration and innovation in terminal, wireless, network and service fields. The 5G network focus on user experience and will revolutionize the way people perceive, acquire and control information. Therefore, higher requirements are imposed on the transport network, in terms of bandwidth, connection density, latency, synchronization, cost and efficiency.

Huge Bandwidth Increase

In the ICT era, intelligent mobile terminals and cloud applications will promote the explosive growth of data. The 5G wireless base stations employ Massive MIMO, CoMP and high-order modulation to improve spectrum usage, and with the introduction of new spectrum, the bandwidth of a single base station can increase by tens of times. Take the 5G low-frequency base station (64 antennas, 16 streams, 100 MHz bandwidth and S111 configuration) for an example to calculate bandwidth requirements. As the average bandwidth required by a base station is over 2 Gbps and the peak bandwidth over 6 Gbps, six such base stations connected to a ring need to be configured with 20 Gbps bandwidth (peak bandwidth for one base station and average bandwidth for the remaining five base stations).

However, in practical deployments,

the number of the antennas and streams, spectrum bandwidth, and the base station density may vary. Moreover, 5G high-frequency base stations also generate extra bandwidth demands. Therefore, in addition to providing bigger interface bandwidth, the transport network needs to support smooth bandwidth expansion (for example, link capacity expansion by bonding multiple links or wavelengths) so as to satisfy the ever-increasing bandwidth demands in the future.

Differentiated Latency

The three main 5G usage cases of mMTC, uRLLC, and eMBB cover various applications such as mobile communications, ultra-high-definition videos, cloud office and games, VR/AR, smart wearing, smart home, smart city, industrial automation, automatic driving and highly reliable applications, which have differentiated latency demands. As suggested by NGMN, the one-way E2E latency in uRLLC scenario should be less than 1 ms. 3GPP sets uRLLC wireless air interface latency to 0.5 ms. Besides, there is latency in core network, and the backhaul network latency should be around 100 µs. These requirements present huge challenges to both 5G fronthaul and backhaul networks.

Highly Accurate Synchronization

The new 5G frame structure requires ±390 ns synchronization accuracy for the air interface. 5G inter-site CA and JT technologies requires ±130 ns synchronization accuracy (±5 ns for a single node of the transport network). Moreover, the high-precision positioning service with different positioning accuracy levels also has some special requirements for the synchronization.

Network Slicing

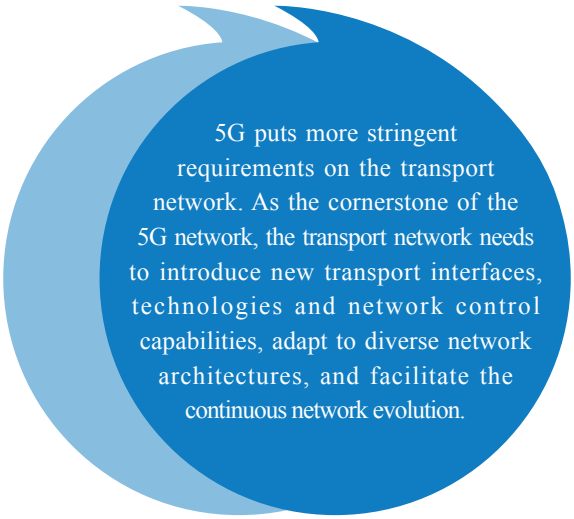
In the 5G era, operators need a network architecture that supports unified deployment and operation. Coordination is needed across different control domains of RAN, backhaul network and core network to realize full service control and operation covering cloud, pipe and terminal layers. SDN/NFV technology is utilized to optimize data flow paths and make service source stay close to the service anchor point. This effectively shortens the network transport latency. Service-oriented

APIs are constructed to meet differentiated service requirements and also make the service deployment more efficient. The network orchestration and management system is used to implement network slicing according to the needs of specific scenarios.

Meanwhile, SDN/NFV enables allocation of network resources to slices based on demand, where each network slice can have different application and control. This helps create an on-demand network architecture to support various application scenarios, opening up network capabilities and bringing new operation mode and potential profit.

Emerging C-RAN

In some 5G dense network scenarios, the cloud-RAN (C-RAN) can provide the flexibility in wireless resource management and function deployment to enable MEC service. It can also achieve decoupling of software and hardware to facilitate softwarization of cellular networks. However, if the CPRI interface is still used for 5G fronthauling, much higher bandwidth and much lower latency would be required. There is consensus that CPRI is not the right fit for 5G fronthaul. A new fronthaul interface is urgently required. Meanwhile, it is commonly believed that the BBU in 5G C-RAN will be split into two functional entities: centralized unit (CU) and distributed unit (DU). The CU mainly processes non-real-time protocols, and also supports the deployment of certain core networks functions in the network edge. The DU mainly handles physical layer functions, real-time HARQ flows and carrier aggregation. Some physical layer functions can also be moved downwards to RRU/AAU to significantly reduce the transmission bandwidth between RRU/AAU and DU and lower transmission costs. The bandwidth requirements between CU and DU are almost the same as those for the backhaul network. The interface between DU and RRU/AAU has not been standardized. Although solutions such as NGFI and eCPRI have already become available, it is estimated the standards will be finalized when the 5G NR protocol stack becomes mature and stable.



Ubiquitous Connections

The evolution towards 5G will require a restructuring of operator networks. The traditional centralized core network is evolving towards a virtualized distributed core that places the user plane close to users. The user plane functions of 5G core network will be moved to the network edge since the deployment of service anchor points is also distributed. The backhaul network not only needs to support dynamic anchor point selection, but also satisfies the inter-cloud traffic requirements after the network is re-architected and cloudified.

Summary

Compared with conventional mobile communications systems, 5G puts more stringent requirements on the transport network. As the cornerstone of the 5G network, the transport network needs to introduce new transport interfaces, technologies and network control capabilities, adapt to diverse network architectures, meet demands for bandwidth, differentiated latency, highly accurate synchronization, network slicing and enhanced network openness and coordination, facilitating the continuous network evolution. ZTE TECHNOLOGIES

Flex-Slicing for 5G Transport

By Chen Jie, Liao Guoqing

5G services will be differentiated and applied in multiple scenarios. For example, mobile internet services demand high bandwidth, automatic driving services require low latency and high availability, and IoT services need to support massive connections. Therefore, 5G radio access network (RAN) and core network (CN) have to be reconfigured. Based on service types, physical deployment locations of device processing units are changed, and independent end-to-end (E2E) logical networks are built for different service types on the same physical network through slicing.

5G is an open network that can meet application needs of the vertical industry and rental services. Since 5G bearer network (BN) is a part of 5G E2E service paths, BN needs to support service isolation and independent O&M for 5G slicing and to allocate different BN slices for different service types.

Implementation of Network slicing

ZTE was the first in the industry to propose to ITU-T an innovative BN slicing solution that comprehensively describes hierarchical BN slicing architecture model and the control plane architecture.

SDN-Based Network Slicing Architecture

BN slicing refers to virtualizing network topology resources such as links, nodes, and ports to form multiple vNets (or slicing networks) as required. In terms of overall architecture, a vNet can be divided into the service layer, slicing network layer, and physical network layer (Fig. 1). With features similar to those of a physical network, a vNet has independent management plane, control plane, and forwarding plane. Each vNet can independently support various services such as L2VPN and L3VPN.

SDN implements decoupling for the control plane and forwarding plane, makes physical networks open and programmable, and supports innovation in future network architecture and services. Through the SDN, the control plane can abstract physical forwarding resources into virtual device nodes and logical connections, perform group-based management of these virtual resources based on policies, and form

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Liao Guoqing
Transport Product Planning Manager, ZTE

independent logical slices vNets.

The vNet hypervisor in Fig. 1 is a special SDN controller for network slicing. It maps virtual vNet resources to physical resources and creates vNet management. The vNet controller on the service layer is the user of vNet resources and can only see vNet resources allocated to itself. It can create various services like L2VPN and L3VPN on the vNet and implement life cycle management for services. Each vNet corresponds to one independent vNet controller and supports the isolation of the control plane from the management plane. The common control function is a main component of the universal SDN controller. When network virtualization is not needed, this component can directly control the physical network. NCO is responsible for slicing orchestration policies of the vNet hypervisor and implements life cycle control for the vNet.

Forwarding-Plane Slicing

The forwarding plane can determine slicing methods based on service needs and use soft slicing solutions, such as the tunneling technology based on VxLAN, MPLS, and SR, and the virtualization technology based on VPN and VLAN. The forwarding plane can also use hard slicing solutions, such as FlexE, OTN, and WDM technologies. A mixture of hard and soft slicing solutions can also be used, with hard slicing ensuring secure service isolation and low latency, and soft slicing supporting bandwidth multiplexing.

Computing resources and storage resources can be sliced to form virtual NEs (also referred to as device slices). With features similar to those of a physical NE, a virtual NE has an independent forwarding plane, control plane, and management plane. Independent topological connections, isolation of CPU and memory resources, isolation of control and configuration channels, and independent deployment and upgrade of slices are supported between virtual NEs.

FlexE-Based Transport Network Slicing Solution

FlexE can forward slices based on the PHY layer,

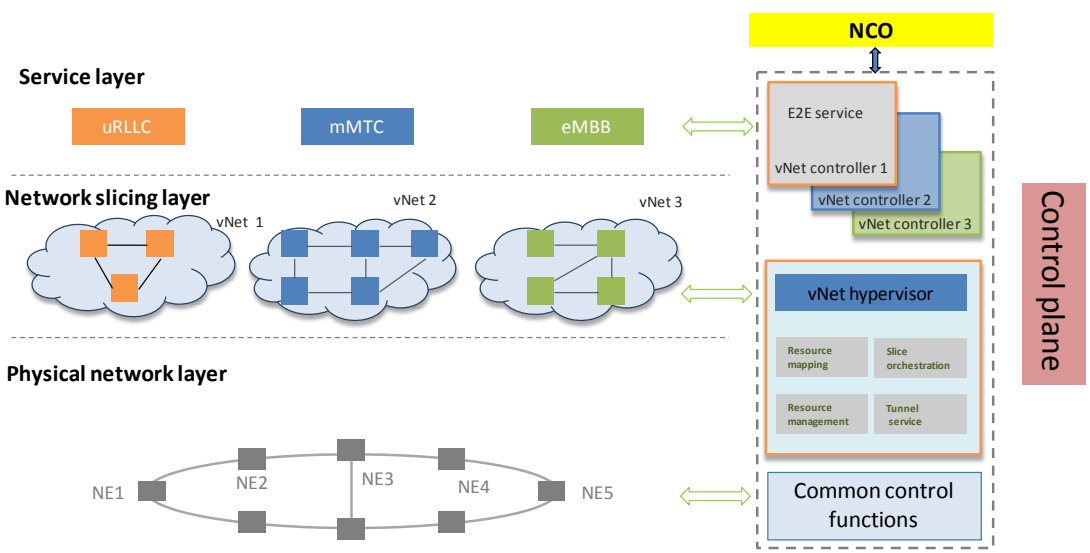

Fig. 1. SDN-based network slicing architecture.

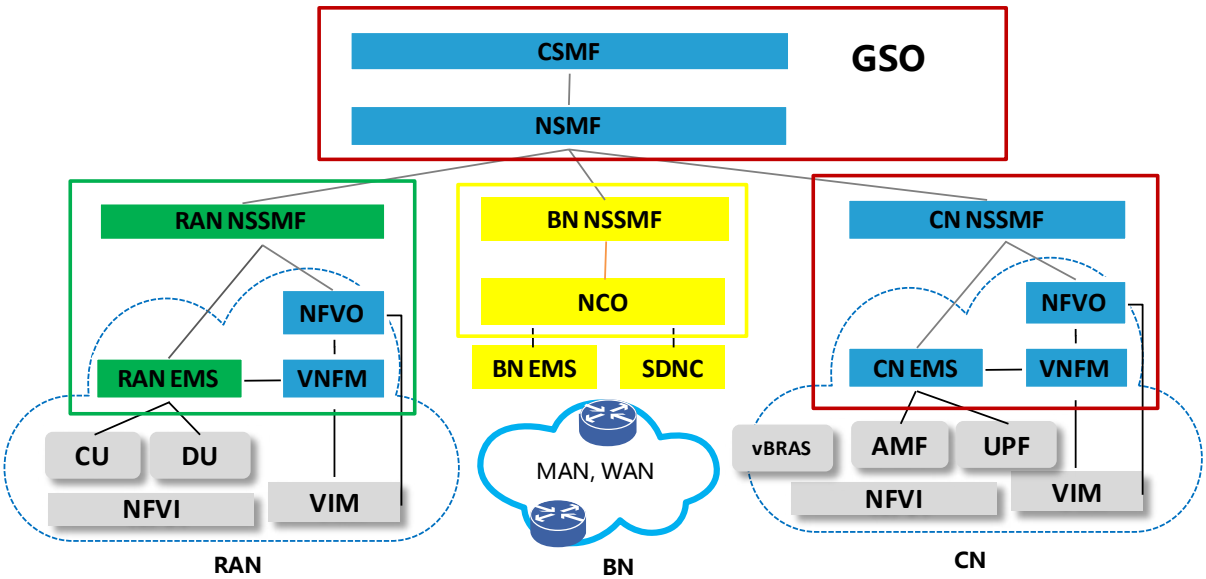

Fig. 2. Synergy among RAN, BN, and CN slices.

isolate hard pipes, and flexibly allocate bandwidth. ZTE has innovatively introduced FlexE switch, OAM, and protection to successfully evolve FlexE to FlexE tunnel, a network-grade technology. FlexE tunnel extends service isolation from port level to network level and can implement E2E subchannel isolation for different services, providing the best forwarding plane support for 5G transport network slicing. Moreover, FlexE tunnel can provide a protection switching within 1 ms, boosting the protection from carrier-grade to industrial-grade. For uRLLC services, FlexE tunnel is used to solve the problems of large service granularity and low bearer efficiency in the wavelength through solution, and the problems of high latency and failure to implement physical isolation in soft slicing.

Synergy Among RAN, BN and CN Slices

Network slicing for E2E 5G services requires synergy among RAN, CN and BN. BN slices can be defined based on the isolation and latency features of wireless services. VNIs of service VLANs and VxLANs as well as DSCPs of IP addresses can be flexibly selected as required to implement mapping between RAN services and BN slices.

The synergy among RAN, CN and BN is implemented through the slice orchestrator based on the SDN/NFV architecture (Fig. 2). NCO is responsible for BN slice orchestration policies, and completes cross-domain transport service orchestration through the hierachical SDN controller (SDNC). Global service orchestrator (GSO) completes cross-domain service coordination and orchestration between RAN and BN and can simultaneously coordinate CN NSSMF, RAN NSSMF, and BN NSSMF to implement E2E 5G service slicing and to meet the needs of differentiated 5G services through different functional attributes of slices.

Through BN slicing, multiple logical network services can be provided based on unified physical network facilities to meet differentiated needs of customers or specific scenarios, to share resources, and to enable rapid services provisioning. Provided that service performance and security isolation are guaranteed, BN slicing allows network resources to be shared and flexibly scheduled, implements independent subnet management, and helps operators reduce their capital expenditure.

Progress of Standardization for 5G Transport

By Zhang Yuanbin, Zhan Zhiguo

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Transport is the first concern for 5G commercial deployment. As further research is done in 5G wireless standards, it is pressing to carry out research into 5G transport standards. At the June 2017 plenary meeting of ITU-T SG15, Chinese enterprises and organizations including China Mobile, ZTE, and CAICT submitted several 5G contributions related to 5G transport, actively promoting the research on 5G transport standards. Experts at the meeting agreed that a transport network meeting 5G requirements was a very important new topic, and at the summary meeting, they officially approved the initiation of a technical report *Transport Network Support of IMT-2020/5G (GSTR-TN5G)*, and the research plan for 5G transport standards. This marked a key step towards 5G transport research in ITU-T and also a major contribution made by Chinese enterprises to the research.

The research on 5G transport technologies and standards involve several standards organizations such as ITU-T, IEEE, OIF, and IETF. ITU-T SG15 focuses on 5G transport requirements and solutions, IEEE 802.1 TSN on 5G time-sensitive network requirements and solutions, IEEE 1914 Working Group on 5G fronthaul requirements, network architecture, and data encapsulation and mapping, OIF on FlexE interfaces and links, and IETF Segment Routing on simplifying MPLS TE signaling protocols for network traffic engineering and rapid protection switching.

FlexE

At the meeting held in January 2015, OIF officially launched the FlexE project, aiming to expand capabilities of standard Ethernet interfaces in three aspects:

- Bonding: Multiple standard Ethernet interfaces are bonded to transport higher-rate traffic.
- Channelization: Multiple Ethernet data streams at any bit rates are multiplexed for transport through a standard Ethernet interface.
- Sub-rate: Sub-rate emphasizes transporting services at rates lower than Ethernet PHY rates.

In November 2016, OIF started research into FlexE 2.0 that involves support of FlexE groups composed of 200 Gb/s and 400 Gb/s Ethernet PHY and transport of frequency or time by the FlexE group. ZTE actively participated in the research of FlexE 2.0 and submitted several contributions at the OIF meetings.

During the OIF meetings, ZTE submitted multiple contributions concerning the requirements of using FlexE technologies for 5G transport. As discussed at the meeting, if these requirements are reasonable, different projects may be started to standardize these technologies.

At the ITU-T SG15 plenary meeting held in June 2017, ZTE was the first in the insustry to submit a contribution *FlexE Layer Network Model*. The contribution creatively extends the FlexE technology from link to network, which includes 66B path layer and 66B section layer. The former implements 66B cross connection, client service OAM insertion and extraction, and protection, while the latter is identical to FlexE 1.0 defined in OIF and provides rate adaption, section-layer OAM insertion and extraction, and multiplexing and demultiplexing.

Ultra-High Accuracy Time Synchronization

For ultra-high accuracy time synchronization, the timing performance of enhanced primary reference time clock (ePRTC, G.8272.1), enhanced reference clock (eEEC, G.811.1), and enhanced synchronous Ethernet equipment slave clock (eEEC, G.8262.1) is carried out, which involves frequency precision, noise generation, noise tolerance (wander and jitter tolerance), noise transfer, transient response and holdon performance, and interface requirements. The development of LTE-A, CoMP, accurate location service for base stations, and future 5G has raised higher requirements for precision synchronization (100 ns for an end-to-end synchronization requirement). In PRTC lock mode, requirements for time error and wander tolerance are even stricter and the time error should be within 30 ns (max|TE|) or smaller. The PRC frequency precision (longer than a week) increases from 10^{-11} to 10^{-13}. More effort will be put in the research on partial timing support, SyncE, new time synchronization architecture definition (including 5G transport and fronthaul networks), and synchronous OAM and management.

NGFI/P.1914.1

IEEE1914.1 was started in February 2016 and will be completed in December 2018. The research focuses on transport architecture for mobile fronthaul services including user services, and management and control plane services. The research also involves fronthaul network definition and requirements including data rates, timing, synchronization, and QoS. The 0.3 draft version has been completed, and the follow-up research will focus on OAM, latency, network management, and convergence requirements.

TSN

Time-sensitive networking (TSN) was originated from the former IEEE802.1 audio/video bridging (AVB) project. The target of TSN TG is to provide determinate services through the Ethernet, for example, to ensure low latency and jitter and very few packet loss.

- Frame preemption: 802.3br and 802.1Qbu are used to divide low-priority data that can be preempted into smaller segments, so that high-priority data can be handled and transmitted before low-priority data. This ensures a faster transmission path.
- Frame replication and elimination: 802.1CB is used to guarantee frame loss rate and ensure that a copy of key traffic can be transported in disjoint paths of the network and two pieces of incoming data can be merged and deleted for seamless redundancy.
- Stream reservation protocol (SRP) enhancement: 802.1Qcc is used to configure TSN traffic, providing more enhanced functions than the original SRP. The TSN traffic can be configured in fully distributed mode, fully centralized mode, network centralized mode, and user distributed mode.

Segment Routing

The IETF Segment Routing working group was established in September 2013, responsible for the research on simplifying MPLS traffic engineering and signaling protocols. Segment IDs are advertised through IGP to construct specified forwarding paths for traffic engineering and fast switching. The Segment Routing data plane uses two formats: MPLS label stack and IPv6, which are compatible with existing MPLS and IPv6 networks. Segment Routing, being studied currently, is regarded as the basic network technology for 5G network transport and slicing.

Standards organizations are carrying out in-depth research on 5G transport standards in terms of low latency, large bandwidth, huge connectivity, physical isolation, network slicing, and high-accuracy time synchronization. The research will definitely provide strong technical guidance and reliable technical guarantee for commercial deployment of future 5G transport networks.

A Discussion on 5G Transport Network Planning

By Pang Ling

Driven by a joint effort from industry players, the 5G industry chain, from technical standards, network researches, to prototypes, has been ready for commercial use. To deliver a variety of services, it is necessary to develop transport networks. As a critical cornerstone of 5G commercialization, 5G transport network planning has become the industry's focus.

5G Transport Network Deployment in SA and NSA Scenarios

There are two ideas for the evolution from 4G to 5G: standalone (SA) mode and non-standalone (NSA) mode. In the SA scenario, existing 4G networks are independent of future 5G networks. The two transport networks can be built separately, depending on service requirements and development. The existing 4G transport networks can be built into high-quality transport networks for delivering 4G, fleet users, and NB-IoT services, while 5G transport networks are specially used for 5G services. The NSA scenario is applicable to the initial stage of 5G networks, where LTE and NR terminals coexist for a long time. Therefore, when 5G networks are deployed initially in some areas, the convergent 4G/5G networks can best meet user experience needs. In this case, UEs can be connected to both 4G and 5G networks, and 4G LTE base stations serve as anchors. Operators can either upgrade existing transport networks to support 4G/5G shared transport, or build new standalone 5G transport networks for 4G/5G dual-plane transport.

Keys to 5G Transport Network Planning

5G transport networks contain MAN, core aggregation, and access layers. Whether existing 4G transport networks are upgraded or new 5G transport networks are built, the focus of network planning varies from layer to layer. The deployment of some new functions also needs to be considered in network planning.

Focusing on Fronthaul Scenario, High Bandwidth, L3 Function, and Ultra-Low Latency at the Access Layer

The biggest impact of 5G on transport networks lies in the access layer. Some 5G-related requirements must be considered at the access layer, including higher bandwidth, fronthaul transport needs brought by DU/CU integration, and other key functions such as L3 scheduling and ultra-low latency for traffic forwarding. The existing 4G transport and access devices can hardly meet these requirements, and

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thus need to be reconfigured or newly built.

Access devices need to provide 10GE and 25GE interfaces for access at the UNI side. 10GE is an interface for 5G NR base stations, and 25GE is an interface between AAU and DU . The line side needs to provide 40/50/100GE interfaces for networking at the NNI side.

Some factors make traffic flows more complicated, such as virtual functions of 5G mobile backhaul RAN and CN, distributed deployment of service anchors, and migration of L3 functions to base stations. In addition to the north-to-south traffic (from base stations to CN), the demand for east-to-west traffic also increases. It is therefore necessary for 5G transport and access devices to move L3 functions to the edge.

In the 5G era, vertical industries such as internet of vehicles and industrial control impose strict requirements on latency. As defined by 3GPP, the air interface latency in uRLLC scenarios is as low as 0.5 ms, and the one-way end-to-end latency is not more than 1 ms. For a backhaul network, the latency is 100 to 150 μs, about one third of the CN latency. Although the media plane of CN can move down in a distributed manner, the requirement for low latency is necessary for transport and access devices. Therefore, 5G transport and access devices need to support FlexE and time-sensitive network (TSN) to achieve ultra-low latency for traffic forwarding.

Focusing on High Bandwidth and Network Flattening at the Core Convergence Layer

In the 4G phase, the bandwidth required on the line side at the core convergence layer is N×10GE and 100GE, while that in the 5G phase will exceed 400G. To meet 5G massive bandwidth needs, transport devices need to provide larger switching capacity and higher bandwidth on the line side.

The existing 4G transport networks use packet OTN overlay networking at the MAN and core convergence layers. Network architecture at the two layers face the challenges of high construction costs, insufficient equipment room space, high power consumption, slow service provisioning, and difficult network protection and O&M. As services evolve to be diverse and differentiated, 5G imposes higher requirements on network functions such as ultra low latency and network slicing. Network architecture has to be optimized to carry multiple services and reduce costs. Therefore, in the 5G phase, legacy packet OTN overlay networking and new integrated equipment networking are likely to become two network setup options for operators.

Introducing SDN for Traffic Engineering and Network Slicing

5G mobile backhaul network will use the architecture of centralized control and separate forwarding and control to make effective and on-demand routing calculation through SDN controllers. Only the routings with connection relationships are calculated and forwarded. This can implement L3 functions of the forwarding equipment at the access layer. While considerably reducing equipment performance pressure, services are effectively forwarded. Moreover, intelligent adjustment capability based on SDN controllers and traffic monitors can optimize networks in real time to meet network dynamic changes and address the issues in the 5G era involving more complicated east-to-west traffic flow between base stations, more complex interactive connection models between the clouds, and more connections.

With deployed SDN controllers and the separation feature based on FlexE, 5G transport networks can provide network slicing to carry services over the same physical network in different scenarios and to virtualize multiple service networks that are managed independently without any interference. SDN-based open networks can achieve rapid cross-domain service provisioning and adjustment and simplify network O&M.

Commercial Progress of 5G Transport Networks

The progress of 5G transport networks depends on the growth of the 5G industry chain and the maturity of the transport industry chain including standards and equipment maturity.

At the plenary meeting of ITU-T SG15 held in Geneva in June 2017, technical report *Transport Network Support of IMT-2020/5G (TRGS-TN5G)* , and research plan for 5G transport standards were formally approved, marking a key step towards 5G transport research in ITU-T.

Mainstream vendors worldwide have released 5G transport solutions and can provide 5G transport equipment for functional verification in small field tests. It is expected that 5G transport products will be qualified for pre-commercial use in 2018 when operators will be able to build small-scale 5G transport network trials. In 2019, 5G transport products will have the commercial capability to satisfy the requirements for large-scale commercial deployment in 2020.

Industry's First 5G Flexhaul Solution:

Verification and Analysis of FlexE Tunnel Technology

By Zhang Runmei

5G services not only have high requirements on network bandwidth, latency, reliability, and security, but also present a huge challenge to transport networks. ZTE has innovatively proposed 5G Flexhaul solution that can provide flexible and super-large capacity transport of fronthaul and backhaul services and achieve ultra-low latency and SDN-based dynamic traffic engineering.

In 2015, several equipment vendors, operators, and internet content providers jointly proposed flexible Ethernet (FlexE) interfaces, aiming to utilize existing 100G PHY resources to meet the needs of transporting large-granularity and some small-granularity services. FlexE has the characteristics of large bandwidth and port isolation. However, only as an interface technology at that time, FlexE failed to meet the 5G needs of low latency and E2E isolation.

Based on FlexE, ZTE has creatively developed three key techniques: FlexE switch, OAM, and protection (Fig. 1). FlexE is thereby extended from a point-to-point interface technology to an E2E networking technology. The FlexE tunnel solution,

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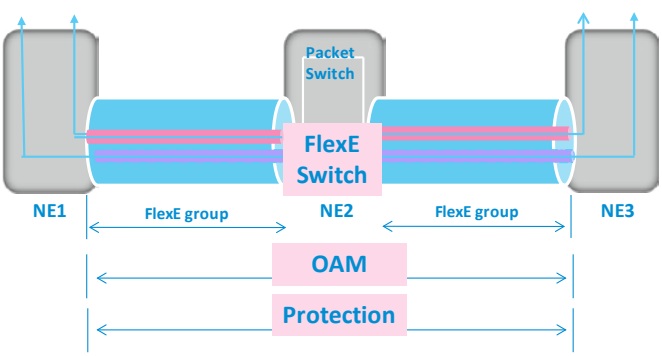

Fig. 1. Composition of FlexE tunnel technology.

Table 1. Comparison of packet switch and FlexE switch.

	Packet switch	FlexE switch
Single node switching latency(L2)	20 ~ 30μs	<0.5μs
Traffic forwarding jitter	>10μs	<0.1μs
As the load for single node increases	Jitter↗ ; Latency↗	Jitter→ ; Latency→

featuring E2E, ultra-low latency, and hardware isolation, is formed, providing vital technical support for 5G transport. This innovation is an important advancement of the 5G Flexhaul solution.

During the MWC Shanghai 2017, ZTE conducted a field test of key FlexE tunnel technologies. In the test, three 5G Flexhaul pre-commercial ZXCTN 609 devices are connected to the test instrument (data tester IXIA XM2) through 100GE links. ZTE demonstrated service isolation, ultra-low latency for traffic forwarding, E2E OAM, and rapid protection switching.

ZXCTN 609, based on packet switch and FlexE innovative technologies, supports integrated fronthaul, midhaul, backhaul transport scenarios, meeting the application need for unified 3G, 4G, and 5G networking. By providing wide bandwidth networking capabilities (100GE, 50GE, and 25GE) and supporting innovative E2E FlexE tunnel, ZXCTN 609 can also realize reliable service isolation, ultra-low latency for traffic forwarding, E2E OAM, and rapid protection switching.

- FlexE hard pipe isolation: In the 100G link, three high-speed bandwidth slices at rates of 5 Gbps are established by using the FlexE technology. Test traffic is injected into the three slices. When the test traffic in the first slice is over 5 Gbps, packet loss occurs. However, the other two slices still work normally. Traffic forwarding between different slices is strictly isolated without affecting each other.
- Industrial-grade rapid protection switching: In the FlexE tunnel solution, a complete OAM system including Flex Group OAM and FlexE Tunnel OAM is defined. Fault management, channel detection, latency measurement, and management channel are also included. Three devices are used to set up working paths and protection paths. The OAM fault detection mechanism at the FlexE level is enabled on the active and standby paths. Through fiber pulling, it can be observed that switching between the active and standby paths takes only milliseconds. Protection switching based on FlexE tunnel can be completed within 1 ms. This upgrades the protection switching from telecom-grade to industrial-grade.
- Ultra-low latency: Based on time slice, FlexE switch uses data block with 66 bits for data switching and forwarding on the shim layer, which is similar to cars passing through the viaduct. One and two P nodes are respectively inserted between two PE devices, and a test instrument is used to test E2E traffic latency in the two networking scenarios respectively. The test results show that the latency of a single P node can be as short as 500 ns and the jitter as short as 0.1 μs (Table 1). The latency and jitter of FlexE switch have no obvious changes as the load for single P node increases. FlexE switch can fully meet the ultra-low latency need of uRLLC traffic in the 5G era.

In the test, traffic forwarding between different network slices are strictly isolated without affecting each other. E2E connectivity detection and latency measurement are provided. The test results show that fault switching time is shorter than 1 ms, and the lowest latency of a single node for traffic forwarding is shorter than 0.5 μs. The test proves that ZTE's 5G transport devices, with the traffic isolation and ultra-low latency features of FlexE tunnel, can fully meet differentiated transport requirements of various 5G services. Moreover, its efficient protection solution can lay a solid foundation for 5G network security in the future.

ZTE has completely carried forward the trials of 5G transport solution. The company has cooperated with several operators to explore the 5G transport field and has actively promoted the development of related standards. As a leader in the 5G era, ZTE will continue to make innovations in terms of device function, traffic forwarding, and network slicing, aiming to offer more competitive solutions for operators.

EMPOWERING TRUE WITH ULTRA-HIGH SPEED OPTICAL TRANSPORT NETWORKS

By Wang Chunyan, Dai Chengming

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Transport Netwrok Product and Solution Manager, ZTE

Founded by Charoen Pokphand Group in 1990, True provides cellular under TrueMobile, fixed-line phone under TrueOnline, and Pay TV services under TrueVision. True is the largest full-service operator and the second largest mobile operator in Thailand. It is also the largest broadband provider in Bangkok. Since 2017, True has been heavily promoting FTTx to support Thailand to step into Industry 4.0.

Challenges and Requirements of True Backbone Networks

With the popularity of 4K UHD video, the introduction of new services like 8K, VR, and AR, and the evolution from 4G to 5G, the access rate per unit area will increase by 1,000 times, and the granularity of government and enterprise private line services is moving to GE and even higher. The rapid growth of all these services brings about huge bandwidth increases and challenges the capacity and reliability of networks.

100G DWDM backbone networks have been widely deployed all over the world, and will evolve into 200 Gbps, 400 Gbps, and even 1 Tbps systems in the future. In an effort to prepare for 5G, big data, big video and also the growing competition, True was in urgent need to introduce new technologies and solutions to upgrade its 10G/100G backbone DWDM systems for higher capacity and performance. The existing backbone DWDM networks after almost 10 years of operation had complex networking environment, and it was risky and highly difficult to reconstruct them. In addition, frequent fiber cuts due to weather made network maintenance difficult. Targeting these problems, True

decided to build a new dual-plane backbone network with increased capacity and performance as well as improved reliability and maintenance.

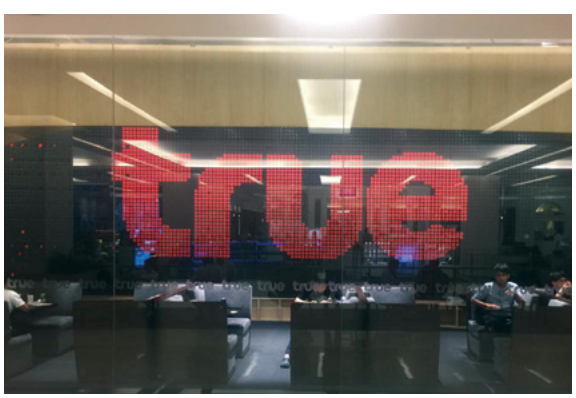
ZTE Helps True Build Backbone DWDM Networks

In August 2016, True announced an open tender for its beyond-100G backbone network project, which attracted four mainstream optical transport equipment providers. After a four-month competition, ZTE, with its industry-leading solutions and products, won the bid for three out of the four networks in the project: Northeast region (100G), East region (200G), and Central West region (200G).

For this project, ZTE adopted the 100G and beyond-100G WASON solution, PM-QPSK/PM-16QAM modulation and coherent reception technology, third-generation SD-FEC, CD-F ROADM and high-performance OTDR&GIS Map to build quality backbone DWDM networks for True and help it adapt to future service development and follow-up evolution.

Ultra-High Capacity

ZTE used advanced 200G PM-16QAM modulation, CD-F ROADM (with CDC-F ROADM to come), and high performance WSS pass-through solution to build the world's first backbone DWDM network with 37.5-GHz spacing in the East and Central West regions. It supports 53 400G wavelengths or 106 200G wavelengths, and the system capacity can reach up to 21.2 Tbps, an increase of 25% over networks with 50-GHz spacing.



While 200G 16QAM ensures increased spectral efficiency, ZTE's outstanding third-generation SD-FEC and 37.5 GHz WSS pass-through solution enhance the performance of 200G transport to the maximum degree. More routes are available for selection without any REGEN, which is very important in the deployment of intelligent WASON. ZTE has both ensured the network reliability and saved costs for True.

High Reliability

ZTE introduced WASON technology in those three networks in the project. This, when coupled with full mesh, makes optical transport more intelligent. Intelligent switching mechanisms can flexibly respond to various network emergencies to effectively reduce the time of service interruptions due to fiber cuts, while speeding up service deployment, increasing service survivability and improving network resource usage and scheduling efficiency

Simplified O&M

The OTDR&GIS Map and automatic power optimization (APO) functions help True simplify O&M, improve O&M efficiency, and reduce OPEX. The high-performance embedded OTDR&GIS Map function enables the real-time monitoring of the fiber parameters and fault points. In the event of a failure, this function through coordinating with ZTE's resource management software QRun can identify failure locations on a GIS map, and inform maintenance staff of this. Network maintainability is increased dramatically, and failure recovery time is reduced greatly. In addition, the OMS-layer APO, OCH-layer APO, and APR functions increase the network reliability and security while reducing the O&M complexity.

The newly-built 100G and 200G DWDM backbone networks allow True to have much higher capacity, and advanced technologies are used for simplified O&M and improved O&M efficiency, supporting True's service growth in areas of 3G/LTE, fixed line and broadband.

HATHWAY: A PIONEER OF INDIA'S OPTICAL BROADBAND DEVELOPMENT

By Wang Jia

Wang Jia
Fixed Network Solution Manager, ZTE

Indian Broadband Market: A Sluggish Mover

India is the world's second most populous country with a population of 1.326 billion. More than half of the Indian population are young people under the age of 26. Although India is experiencing robust economic growth, its fixed broadband development is lackluster. At end of 2016, its fixed broadband user base reached 15 million, and its broadband penetration was about 7%, far lower than the world average. Among the reasons for such low broadband penetration are enormous investment in fixed broadband with a long payback period, fierce competition in the wireless sector, and inadequate support from the government. However, India's multiple system operators (MSOs) who have a different view from traditional telcos find opportunities in the broadband market.

Hathway: An Emerging Broadband Player to Deploy FTTH

MSOs/ISPs are the first in India to pay attention to developing fixed broadband. Unlike other large countries, India's fixed broadband is developed spontaneously by civil players. The latest market data shows that there

are more than 6,000 MSOs in India and 10 of them have over 10 million users each. The 10 MSOs all use GPON and Ethernet to deploy broadband networks. Hathway, in particular, develops at the fastest pace, with the number of FTTH users surging from zero to 100,000 within short 21 months. At this time, the number of FTTH users in the whole country is not more than 500,000. However, it took Bharti, India's largest operator, five years to grow its FTTH customer base to 100,000.

Hard Choice: New Technology vs. Legacy Technology

In 2015, small and medium-sized operators in India were confronted with an existential threat after the country's biggest conglomerate, Reliance Jio, announced that it would enter the fixed broadband market in two to three years. Hathway hoped to increase customer stickiness and improve profitability through pipes while deploying IPTV/OTT services in the future to attract high-value users and enhance competitiveness. In the first half of 2015, Hathway started to consider expanding its broadband network and increasing bandwidth rates. Though FTTH was a future trend, it was difficult for Hathway to deploy it. Hathway had been a cable operator without any experience in deploying and operating optical networks. Also, it was hard for Hathway to choose between DOCSIS and GPON technologies. In this context, Hathway and ZTE had technical exchanges and analyzed two technical paths in terms of cost and network evolution. They had a clear idea of what advantages GPON FTTH can offer. ZTE proposed a broadband strategy for Hathway, in which GPON would be deployed only in new areas because it is relatively easy and cheap to install fiber in these areas.

Hathway lacks experience in the construction, operation and maintenance of an optical network, so it is quite important for Hathway to choose a good cooperative partner. According to research firm IHS, ZTE grabbed the world's No. 1 for 10G PON sales and No. 2 for PON revenue in Q1 2017. The company has built high-quality all-optical networks around the world and gained rich experience in network deployment, operation and maintenance. After three-month network trials and training, Hathway decided to partner with ZTE for its FTTH initiative.

Focusing on Its Own Strengths

Hathway and ZTE worked together to work out a broadband development strategy that focuses on compactness and competitiveness. In September 2017, Hathway decided to deploy FTTH in Chennai, planning to invest $300 million in three years. Hathway rapidly secured the central offices (COs) and increased its new user base to 10,000 every month. Such expansion made Hathway a dominant leader in the Indian fixed broadband arena. Hathway also used a WiFi-capable ONT to replace the original combination of ONT and wireless CPE to reduce capex and maintenance complexity. By offering free ONTs to users, actively promoting 100M broadband and Wi-Fi services, and sweetening its service offerings without extra charge, Hathway quickly attracted more users.

Opening the Road to All-Optical Networks

Currently, the ARPU of CATV users in India is about 164 rupees and declines year by year. However, the ARPU of broadband users is 800 rupees. Hathway sees the potential of broadband business and gradually accepts the FTTH strategy. Through the cooperation with ZTE, Hathway has learned from the experience and achievements other operators have gained in FTTH deployment. By builting up its own capability to operate FTTH services, Hathway has positioned itself accurately in the ever-changing Indian telecom market and developed a growth strategy that determines the first focused sites and then expands to the entire area. As the first MSO in India to resolutely embark on network transformation, Hathway has given a brand-new direction for fixed broadband development in the country. Several other MSOs now follow Hathway's development path to work with ZTE on their FTTH deployments. Though today the broadband market develops still slowly in India, Hathway stands as a beacon of hope to many MSOs. ZTE TECHNOLOGIES

TRAVEL WITH TELEFÓNICA

By Sun Rui

Sun Rui
Microwave Product Brand Director, ZTE

Telefónica is one of the largest telecom operators and mobile network providers in the world, with more than 346 million subscribers in 21 countries. It operates the Movistar mobile phone brand throughout Latin America. ZTE and Telefónica have established strategic partnership in several technological areas of interest to the company, including radio technologies.

ZTE has established relationship with Movistar Venezuela in microwave (MW) transmission since 2013. A contract of 1000 hops of MW was signed by both parties. Considering the highly focus on hybrid access of multiple service and smooth LTE-oriented evolution, ZTE provided NR8000 series microwave products—ZXMW NR8250/NR8120 based on hybrid and packet platform, which would enable smooth evolution from 2G/3G to LTE backhaul. In this project, there is a super long distance MW link up to 92.23 kilometers from Guasdalito to Cerro Azul. It is a big challenge for microwave due to performance decrease by multipath fading and specular reflection. Besides, this is a key link on backbone transmission, where a fair amount of sites would be affected in case of any failure. Hence, high reliability and outstanding transmission performance with high throughput are the most important for this link. ZTE proposed space diversity (SD) technology with 3.7 meters diameter antennas to guarantee transmission reliability. Cross polarization interference canceller (XPIC) technology was also used to achieve high throughput transmission. Finally, the outstanding performance and high reliability of ZXMWNR8000 series products impressed Movistar, which lay a good foundation for the subsequent long and stable cooperation between ZTE and Movistar.

In 2015, Telefónica Group launched

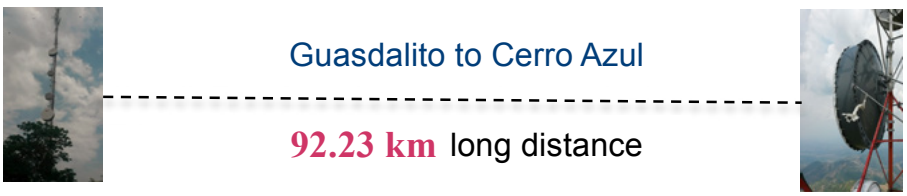


Fig. 1. Long distance MW transmission in Venezuela.

a new Global MW RFP for 2016 deployment. ZTE's new-generation MW products started homologation tests with Telefónica Group in the branches of Ecuador (field trial), Panama (field trial), Venezuela (lab tests only) and Nicaragua (field trial). Based upon the results of these tests, ZTE would be able to participate in the Global MW RFQ bidding process.

In Nicaragua, another long distance MW link of the existing network was facing challenges such as antenna size—the diameter should not be larger than 2 meters, installation space—no indoor space, over lake and long distance (88 kilometers)—severe specular reflection. ZTE proposed NR8000 TR 4+4 XPIC SD with physical layer aggregation (PLA) solution to meet the challenges. The transmitting power of NR8000 increased 2 dB, which lowered the requirement for antenna size. Only 1.8 meters antennas were used to fulfill the requirement. NR8000 could also be installed in an outdoor cabinet—zero footprint. Moreover, PLA with XPIC functionality solved the conflict between throughput and distance, and SD configuration addressed the issue of specular reflection.

In the lab test in Venezuela, the latest software release and full package of license were applied (Fig. 1), including future-proof functions such as 10GE and hierarchical quality of service (HQoS). A total of 291 items were tested covering environmental, power and radio features, as well as system robustness and management. NR8000 family products including ZXMW NR8120D, ZXMW NR8150, ZXMW NR8250 and ZXMW NR8950 were fully conformed to the tests and received high recogniztion from Movistar Venezuela.

Fig. 2. MW transmission in five branches of Telefónica Movistar.

Movistar Panama, the subsidiary of Telefonica, is the second largest mobile operator in Panama. It has established cooperation with ZTE since 2016. ZTE helped Movistar Panama modernize its networks by swapping out existing sites and deploying Uni-RAN solution. In 2016 Q2, Movistar Panama signed contracts with ZTE on MW transmission. With excellent network quality, Movistar saw a significant business growth in H1 2016.

Telefónica Movistar Peru and Mexico also chose ZTE's ZXMW NR8000 products in 2016 Q2. So far, five branches of Telefónica Movistar in Mexico, Venezuela, Nicaragua, Panama and Peru, have all cooperated with ZTE on MW transmission (Fig. 2).

ZTE has been involved in microwave radio system products since 2005. The company set up a microwave product line in April 2008. ZTE's microwave product NR8000 series includes compact NR8120/NR8120A/NR8120D, modular NR8150, nodal NR8250, all outdoor NR8950/NR8961 and trunk radio NR8000 TR. The products provide a unified hybrid and packet transport platform featuring high capacity, high performance, IP oriented, and multiple service access, which can satisfy transmission demands of 4G and 5G.

Up to Q4 2017, more than 130,000 hops of ZTE's microwave products have been deployed in more than 90 countries and areas, providing high-quality transmission services for 200 telecom operators and enterprises. ZTE's microwave products have been successfully deployed for mainstream operators worldwide such as China Mobile, China Unicom, China Telecom, Vodafone, Orange, TeliaSonera, Telefonica, MTN, Etisalat, STC, and Telestra. ZTE TECHNOLOGIES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