VIP Voices

Orange Jordan: Simplify the Lives of Customers

Tech Forum

OEID: A New Tag Technology in Optical Wireless Communications

Special Topic   NG-PON

A Discussion of NG-PON Evolution Trends

Olivier Wicquart, CTO of Orange Jordan

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ZTE

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

Success Stories

Tech Forum

ZTE Wins Best Core Network Product Award at 5G World Summit for Its vCN

30 June 2016, Shenzhen — ZTE announced that its cloud-based virtualized core network vCN won the Best Core Network Product award at the 5G World Summit 2016 in London.

As an important component of the Cloud UniCore solution, the vCN solution adopts a low-coupling, stateless and hierarchical design. Hosted in cloud storage, user data is not bound with service processing. Separated from service logic, public modules become universal components. The service processing control plane is separated from the user plane, achieving flexible deployment. The vCN product has the characteristics of rapid scalability, quick new service importing, low service time delay, and carrier-class reliability.

ZTE's vCN product winning this award demonstrates ZTE's innovation capability and leading position in the mobile CN and cloud-based CN fields.

ZTE Releases SDON White Paper

30 June 2016, Nice, France — ZTE released software-defined optical network (SDON) white paper at the NGON conference. The white paper analyzes existing SDON technology from four aspects: development trends, solutions, application scenarios and technical challenges. ZTE finds that SDON requires up to 50% less operational manpower than that of traditional networks. SDON service provisioning time can also be reduced from days to a matter of hours.

SDON architecture transforms tight coupling of control and transport functions into tight coupling of control and operation functions. SDON also shifts connection-centered closed control into a networking-centered open control model. This new model, which forwards the progress of more intelligent, virtualized and cloud-based networks, represents the future path of development for optical network technologies and applications.

The white paper describes the characteristics of ZTE's SDON solution, which involves four top to bottom layers: the app layer, orchestrator layer, single-domain controller layer and optical network device layer. This architecture can provide bandwidth on demand, optical virtual private network, and IP/optical coordination.

ZTE Gains the Most Share in FTTx PON Market Change According to Ovum

11 July 2016, Shenzhen — ZTE announced that it delivered a stellar performance in 1Q16, exhibiting meaningful positive change in FTTx PON market share by gaining almost 0.8 points in worldwide market share based on a rolling four quarter basis. In addition, ZTE was market share leader in Central and South America for total GPON equipment revenues and also for total ONT/ONU. Moreover, in the wireline access market ZTE held the second biggest market share worldwide and continued to gain market share, strengthening its position. The data comes from research firm Ovum's 1Q16 report on fixed-network titled: *Market Share Report: 1Q16 FTTx, DSL, and CMTS.*

ZTE is the global market share leader of 10G PON OLT according to Ovum's 1Q16 report. In early 2016, ZTE released its Combo PON solution comprising GPON/XG-PON1 all in one optical module. This solution solves the problem of high costs, the need for large room occupancy, as well as complex fibre optic deployment and O&M challenges during network upgrade to GPON XG-PON1.

ZTE President Zhao Xianming: IoT to Spark Fourth Industrial Revolution

ZTE Launches 5G-Oriented Next Generation RAN Solution

30 June 2016, Shenzhen — ZTE President, Dr. Zhao Xianming delivered his keynote speech at MWC Shanghai 2016, sharing ZTE's vision on how the IoT will bring about the Fourth Industrial Revolution and revolutionize the entirety of how societies work and live.

Dr. Zhao's forward looking speech highlighted both the stunning progress made possible through the IoT and the challenges that it must overcome in future. These challenges include difficulties with existing network infrastructure and access modes, the need to accommodate exponential connection growth and the diverse

requirements for delay, bandwidth and reliability. Dr. Zhao also outlined ZTE's plans to help the industry overcome these obstacles through the deployment of innovative solutions including 5G.

Dr. Zhao concluded, "The IoT has created significant progress in intelligent manufacturing, smart cities, intelligent transportation, and smart homes. Various innovative IoT applications will soon emerge. We're at the eve of a powerful new IoT-enabled revolution in business and as a global society. All parties across the industrial chain have a collaborative, cooperative role to play in promoting the healthy development of the IoT industry."

1 July 2016, Shenzhen — ZTE announced the release of its new generation radio access network (RAN) solution—ZTE Cloud RAN. This solution is designed to reconstruct the wireless network based on the cloud processing platform, allowing operators to deploy networks using this new concept and develop new business values; it also helps operators fully meet future performance challenges and versatile service requirements.

Based on the unified M-ICT platform, ZTE Cloud RAN is a fully virtual RAN platform integrating all modes of access including 2G, 3G, 4G, WiFi, IoT and 5G. ZTE Cloud RAN based on PaaS architecture provides open interfaces for third parties, which enables operators to quickly deploy various services in volatile circumstances to build a successful ecosystem.

Despite the ever-present global commercialization of 4G technologies in today's market, this has not stalled the research and development of 5G technologies by ZTE and its partners. 5G presents new challenges for RAN, such as processing performance, coordination capability, and service deployment. RAN is therefore required to continue evolving its architecture for diverse use cases of the future, so as to achieve a seamless transition from 4G to 5G.

ZTE and China Unicom Demonstrate 5G MEC-Based VR Service Solution

29 June 2016, Shenzhen — ZTE and China Unicom announced at a joint MWC Shanghai conference that they have demonstrated a mobile edge computing (MEC) solution basing on 5G architecture. The demonstration showed what the impact of MEC solutions will be on future network evolution. They also displayed VR video applications with

the MEC solutions, offering wireless VR experience to conference visitors.

Orange Jordan:
Simplify the Lives of Customers

Reporter: Zhang Ying

Olivier Wicquart, CTO of Orange Jordan

Orange Jordan is a Jordanian public mobile telephone network operator, and is the operator of the mobile communications license granted to Jordan Telecom. The company aims to build a mobile communications network to serve Jordan, and has launched full public services across the Kingdom in September 2000. Recently, *ZTE Technologies* interviewed Olivier Wicquart, CTO of Orange Jordan. He shared with us Orange Jordan's presence, milestones, networking strategies, SDM project and IMS solution. He also talked about his expectations for ZTE and visions about global telecom trends.

Could you brief us on Orange's presence in Jordan?

Orange Jordan is the sole integrated telecom operator in the Kingdom, providing fixed line, mobile and internet services to B2C and B2B customers, with the most comprehensive portfolio of offers and solutions designed to simplify the lives of our customers.

Orange is also a hub for wholesale activities in the Middle East, thanks to our unmatched international connections and agreements with 60 regional and international operators. Orange has a strong historical presence in the cities beyond the capital Amman. In both the fixed line and mobile domains, Orange is offering Jordanians the telecom services they need and deserve.

What are the major milestones that have marked Orange Jordan's development?

Historically, Jordan Telecom (now Orange Jordan) was responsible for developing telecom infrastructure for Jordan, which is used for fixed line and data communications today.

Since 2006, the commercial brand has been Orange that includes the integrated suite of fixed and mobile

services provided by the operator.

We launched 2G services in 2000 and 3G in 2010. Orange was the first operator to launch 4G in Jordan as part of a discovery phase in October 2014, which also saw us introducing fiber connectivity for B2C customers. We commercially launched 4G in May 2015, delivering nationwide coverage within several months.

Jordan's telecom market has transitioned from traditional voice-oriented to current data-oriented. How did Orange respond to this transformation?

Jordanians have a strong appetite for data consumption, such as social media, browsing the internet, and enjoying videos. Within Orange Group, Orange Jordan has the highest average data consumption per user.

At the same time, Jordanians make plenty of voice calls. To meet those needs and develop the telecom services in the Kingdom, Orange Jordan has adapted both its offers and networks.

In 2013, we launched bundle offers for mobile voice and data in the mass market, which we called Yalla Shabab and Ghair Shekl. In 2015, we proposed some convergent offers, including mobile and fixed broadband services, as part of an all-inclusive family package called Bait El Aileh, offering families a complete solution for

their telecom and infotainment needs.

On the mobile network side, we implemented in 2015 a full modernization of our network, which improved coverage and increased the overall capacity of the network. As a result, Orange Jordan is now offering Jordanians the best mobile network in the Kingdom.

On the fixed network side, we have increased capacity, coverage and the speed that we offer to our customers: within the span of 18 months, our ADSL and Fiber customers went from mainly 1 Mbps offers to 8 Mbps or above.

We also enriched our portfolio of B2B offers to support companies in their own business transformation, providing tailor-made solutions based on our network and infrastructure capacities, like a new data center that opened at the end of 2013.

Could you tell us Orange's overall networking strategy in Jordan?

Networks are a cornerstone of our strategy—Essentials 2020: we want to offer customers the best experience through enriched connectivity. This means to provide solutions that will simplify the daily life and work of our customers and fellow citizens, enabling them to always remain connected to what is essential to them.

This vision is driving our strategy on network: we develop our networks where people and companies need modern and efficient telecom services. Orange is offering the widest range of services and devices in Jordan: by combining fixed and mobile services, and adding solutions like dongles, MiFi, PiCo and WiFi repeaters, we are able to meet all customer needs, whether in mobility for professional or personal usages, or at home where all the family members can enjoy services thanks to high-speed fixed broadband.

What makes Orange Jordan stand out from its competitors?

We have strong assets: our networks and offers, our teams in shops and call centers, our field sales and our technicians. To offer an unmatched customer experience, we want to reach a new level in the availability of our networks and services.

In parallel, we also want to listen and respond more and more efficiently to our customers, especially B2B customers, to support them in their own business

development. This fully matches with His Majesty King Abdullah II to develop the ICT sector in Jordan and international investment.

On the technical side, we are modernizing our IT systems and we are building "customer centric organization" with teams dedicated to each customer's segment.

What is the significance of the successful cutover of SDM project? How will this affect your network evolution?

SDM is a technical requirement for launching 4G. This project has been implemented smoothly on time and without any impact on quality of service and customer experience.

Orange Jordan has mobilized its teams to implement successfully this project and ZTE did the same. It was thanks to the great teamwork between the two companies that we achieved this milestone.

Orange could rely on the quality of ZTE products

A celebration ceremony for Orange Jordan's SDM migration

and on the professionalism and efforts of its teams. ZTE teams have perfectly managed the project and met the requirements outlined by Orange.

What are your main concerns about IMS, IN and VAS solutions? How do you avoid such concerns?

IMS is the next step in our networks transformation. This evolution is of course driven by the obsolescence of our switches, but we also see some business opportunities as we will be able to provide new services. This will be a complete transformation of our fixed network at the core level, at the RLU and DSLAM level and also with regards to CPEs.

For many years, we have been developing value-added services with the support of Orange Group and our Technocenter based in Amman, which also develops solutions geared toward the MENA region. This enables us to bring innovative products and services to the market.

One of the most successful services we brought is a smartphone application called "My Orange," giving our customers essential information such as locations of Orange shops, their Orange account balance, and promotions and special offers.

How would you evaluate ZTE's team and solutions? What are your expectations for ZTE in the future?

ZTE has a wide range of telecom solutions and was selected for SDM after a tendering process involving major suppliers. ZTE was chosen because of the competitiveness of its offer, the high efficiency of its products and its ability to implement this project in due time without impacting customer experience.

As far as the future is concerned, I am expecting ZTE to understand our pain points and our strategy, to be able to provide relevant solutions and customized offers, thus helping Orange Jordan to successfully implement its strategy.

Could you share your vision about global telecom trends, such as internet of things (IOT), big data and 5G?

Customers are using more and more data, and we will continuously adapt our networks to support this major trend.

IOT is already part of the present, and we provide and operate M2M solutions in Jordan. This will grow in the future and our network architecture is ready to support this growth.

We will reach new heights in big data and customer experience management in 2016, thanks to the projects developed by Orange Group worldwide. Orange Jordan's customers permanently benefit from Orange Group's capacity to anticipate those trends and develop solutions to meet them.

What are your goals in 2016?

We want to deliver an unmatched customer experience. This is our ultimate goal in 2016 and beyond, and this drives our daily actions and ambitions.

Currently, our focal points include content-on-demand, security, cloud services and the delivery of convergent offers that cater to the widest spectrum of consumer segments in Jordan. **ZTE TECHNOLOGIES**

Turknet:

An Innovative Challenger with a Differentiation Strategy

Reporter: Zhang Ying

Cem Celebiler, CEO of Turknet

"ZTE's team has done a fantastic job working with Turknet's teams to integrate the solution, complete the proof of concept and commence the rollout," said Cem Celebiler, CEO of Turknet.

Turknet started as one of the first commercial internet service providers (ISPs) in Turkey in 1996. It experienced and influenced the journey from a monopolistic telecommunications industry to a more open and competitive one, which is focusing more on consumer needs. Recently, *ZTE Technologies* interviewed Cem Celebiler, CEO of Turknet. He shared with us his career history; Turknet's achievements, innovative initiatives and challenges; and his thoughts on the LLU project and IPTV sector. He also talked about his expectations for ZTE and visions for Turknet.

How did you get into the industry? Could you tell us a bit about your career?

My first job, in the late 1980s, was as a programmer, while I was still in high school. After studying Electrical Engineering & Computer Science and Mathematics at MIT, I worked in software development.

With the emergence of the commercial internet in the early and mid-1990s, the computer and telecommunications worlds started their convergence, which is still ongoing. The potential of the internet, the introduction of competition in the telecommunications industry, the positive impact of entrepreneurs, and innovative startup culture have motivated me.

What are Turknet's recent achievements?

Turknet is an innovative challenger offering services to residential users, businesses and carriers. Turknet has a clear differentiation strategy: simple and transparent pricing with an emphasis on all-inclusive bundles; superior, friendly and flexible customer experience; and a focus on online sales and customer interactions.

Turknet is the first operator in the consumer space to focus exclusively on bundles, to simplify its product offering, and to move to a no-committment model. In addition, since March of this year, we provided much higher usage quotas as a standard offering than any of our competitors. All of these have significantly impacted the market. Turknet was recently rewarded with the A.L.F.A. Award for best customer experience in the internet service provider category in Turkey.

Turknet is also a leading challenger in the SME segment for fixed line telephony. We will continue to develop and propose innovative communications offerings to the SME segment.

What role does innovation play in Turknet? Could you give us some examples?

Celebrating its 20th anniversary, Turknet has always been an innovator in the industry. Turknet is one of the first firms offering a 7×24 call center. At that time (1996), neither the incumbent operators, nor banks or airlines had such an approach. We are the first operator to negotiate and activate DSL services over bitstream access with the regulator, and the first again for unbundling. We are the only operator offering Ethernet over copper services in a wide footprint (20 cities),

allowing SMEs in areas where fiber is not widespread or prohibitively expensive to get high speed symmetric metro Ethernet access at affordable prices.

As a challenger, Turknet has a culture of innovation and thinking outside of the box. We have the most innovative and industrious engineers and team members, who come up with unique solutions to our customers' and our needs. We have developed our own billing, CRM and OSS/BSS software and systems in house, which give us a lot of flexibility.

Our whole approach, focusing on simplicity, transparency and a friendly customer experience, has allowed us to differentiate ourselves and innovate on our go-to-market strategy. While our competitors have

to balance and manage storefront sales and resellers, our online sales has allowed us to be more innovative and focused on this front through our no-committment offering.

What major challenges do you face in terms of marketing your products and services?

We are competing with legacy and multinational operators who have very large advertising budgets, so getting our message across is a challenge. Competitors are also quick to copy innovations, so our success is based on having a fundamental value proposition and business model that is so unique that it cannot be

easily copied.

In addition, although consumers are increasingly looking to purchase goods and services online, at the moment they are still more accustomed to purchasing internet services in shops than online. Managing and educating the consumers, and giving them a superior experience in purchasing online will help this change.

What is the importance of LLU project? How is this project impacting Turknet's overall networking strategy?

Turknet has built its strategy on the Investment Ladder model: Turknet continues to invest in its own infrastructure while also purchasing services from the incumbent where necessary.

Turknet was the first operator to apply for access to the local loop (2001) and was able to sign the first unbundling agreement in 2007. While initially using unbundling to offer services to SMEs, we are now migrating home users to this infrastructure as well. We are grateful to the ICTA (Turkish industry regulator) for their support in this process, and will continue working with them and the incumbent operators to rollout our LLU footprint to an even wider geography.

At the moment, Turknet is the only Turkish operator pursuing a nationwide unbundling strategy. This project is another sign of our innovative and trail breaking approach.

What made you choose ZTE as a strategic partner and how do you comment on the partnership?

We initially worked on the LLU project with other vendors but did not find the support and approach we needed. ZTE's willingness to help integrate its solution into our existing ecosystem, to work with us to find win-win commercial models, and the flexibility of its rich product line lead us to partner with ZTE.

ZTE's team has done a fantastic job working with Turknet's teams to integrate the solution, complete the

proof of concept and commence the rollout. We are very happy to work with ZTE on this project and hope to broaden our relationship further on this and other projects.

The support of the same MSAN platforms for XPON offerings and the strength of ZTE's XPON product set are also very important for us. We have started rolling out XPON FTTH services using ZTE equipment.

What is your view on the growth potential of IPTV sector?

IPTV and OTT technologies are transforming the TV industry. While TV channels and content providers were previously limited to a small number of cables and satellite PayTV platforms for distribution, they now have many more options in the form of telecommunications operators such as Turknet or directly through the internet.

Internet service providers such as Turknet are obvious partners for channels and content providers as we can provide distribution and monetization. From the consumer point of view, the triple play of fixed telephony, broadband and TV at a single price point has proven value and demand continues to grow.

What are your objectives for the next three years?

Turknet will continue to execute our differentiation strategy and investments. We will continue simplifying our product offering in the SME segment while offering high value managed service solutions.

We will continue to develop our online sales and marketing strategy, and continue our infrastructure investments. We already have extensive fiber metropolitan area networks (MANs) in Istanbul and Izmir, and we are investing in eight more cities this year. We also hope to complete our first intercity link this year and to continue these investments over the next couple of years. **ZTE TECHNOLOGIES**

Uzmobile:
To Achieve a Win-Win Situation with ZTE

Reporter: Zheng Lina

Sergey A. Melnikov, CTO of Uzmobile

Uztelecom is a national fixed network operator belonging to JSC Uzbek Telecom. Uztelecom operates a vast majority of fixed networks, provides CDMA network services in remote and border areas, runs business through its subsidiaries and regional state subsidiaries. Uzmobile, a wholly-owned subsidiary of Uztelecom, is responsible for operating mobile networks. In 2015, Uzbek Telecom and ZTE signed a GU contract covering wireless, power supply, core network, and microwave. The cooperation indicates that ZTE has taken an important step forward in the Uzbek telecom market. ZTE has showed its willingness to help Uzmobile build high-quality networks, and this is significant for Uzmobile. Recently, *ZTE Technologies* interviewed Sergey A. Melnikov, CTO of Uzmobile. He shared with us the main factors for Uzmobile's development, his challenges, and his thoughts on ZTE. He also talked about his expectations for ZTE.

Uztelecom is the largest national operator in Uzbekistan, and Uzmobile is its only subsidiary responsible for wireless networks. What are the main factors for your rapid development?

I think there are three factors for our rapid growth.

First, we understand our customers very well, and respond quickly to customer needs. This is the most important factor for our development. We are always putting our customers in the first place, and offering them top-quality products and excellent services. I believe this is a long-term driving force for Uzmobile.

Second, we have got strong supports from the government. This is essential to us. With the supports, we can explore new market opportunities, and expand the scale of projects. By doing this, we will gain more resources and chances in the future.

Third, from my point of view, master core technologies and purchase advanced equipment are also very important for us. Technology is the base impetus in the telecom industry.

What major challenges do you face in today's telecom sector? How will you tackle these challenges?

We are facing three major challenges now. The first

one is tough competition. In the Uzbekistan's telecom market, the competition is fierce, and operators are competing with each other for more market share. The second challenge is that the penetration of mobile phones is getting close to saturation. The third one is that the need for data traffic continues to grow.

These present both challenges and opportunities to Uzmobile. It is therefore important for us to focus on users needs, examine the prevailing market dynamics, and adapt to the development tendency.

Meanwhile, technological innovation is a key factor to beat the challenges. As the technology evolves, we will renovate our products and services according to user needs. In addition, we will put our emphasis on the long-term relationship with suppliers. This is critical for improving our overall supply chain.

After several years of cooperation, how do you evaluate ZTE? What do you think are the advantages of ZTE?

ZTE is a global telecom equipment provider and a high-quality services supplier. It is taking a leading position in the telecom industry. ZTE has developed in Uzbekistan for more than 10 years, so it really understands the market and customer behaviors of Uzbekistan.

With its advanced technologies, ZTE can meet various requirements of operators with diverse technological solutions. In my opinion, ZTE is the strongest performer in terms of responding to customer requirements. It is committed to delivering superior equipment and services to customers.

What aspects do you think ZTE should improve to provide better services to Uzmobile?

With the development of internet, user demands on network change persistently. In order to meet the evolving needs of users, operators and suppliers are required to cooperate closely and make joint efforts.

I believe that ZTE can take initiatives to implement technology innovations, and improve its delivery management. I think ZTE will continue to maintain strong growth momentum in the future, and I hope that Uzmobile and ZTE can work in close collaboration to achieve a win-win situation. ZTE TECHNOLOGIES

A Discussion of NG−PON Evolution Trends

By Hu Kai

Network-based applications have rapidly emerged in recent years. In particular, high-quality video services such as 3DTV, HDTV, 4KTV, or even 8KTV and virtual reality (VR), are offering customers amazing entertainment experience. The number of devices connecting to the network has dramatically increased. There are a plenty of portable internet devices like mobile phones or tablets available nowadays. This means there are growing needs for bandwidth. Nielsen's Law says that the bandwidth available to users increases by 50% annually. To satisfy such a quick growth, PON needs to be widely deployed.

10G PON: The Mainstream FTTx Technology after 1G PON

1G PON including GPON and EPON usually supports a bandwidth of 20 to 50 Mbps for end users. This is not enough for some applications like 4KTV. Therefore, the 10G PON concept has appeared as an evolution of 1G PON. ITU-T has proposed XG-PON1 with a double upstream rate of 2.5 Gbps and a fourfold downstream rate of 10 Gbps. IEEE has also introduced 10G EPON that can increase downstream rates to 10 Gbps. High upstream bandwidth is critical in certain applications. XGS-PON, a symmetric-bandwidth version of 10G PON has been developed to offer 10 Gbps data rates in both upstream and downstream directions.

The study on 10G PON has completed. A series of standards have been released describing the

Hu Kai

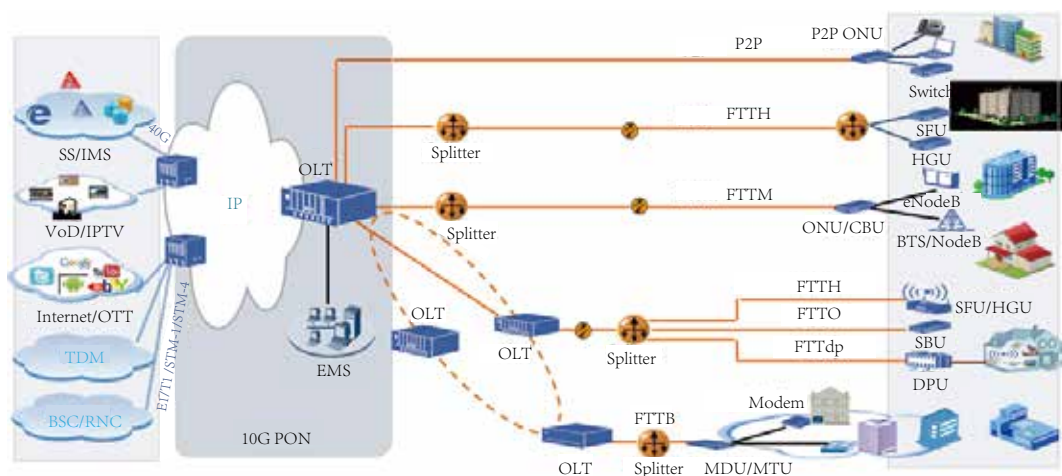FN Product Planning Manager, ZTE Corporation

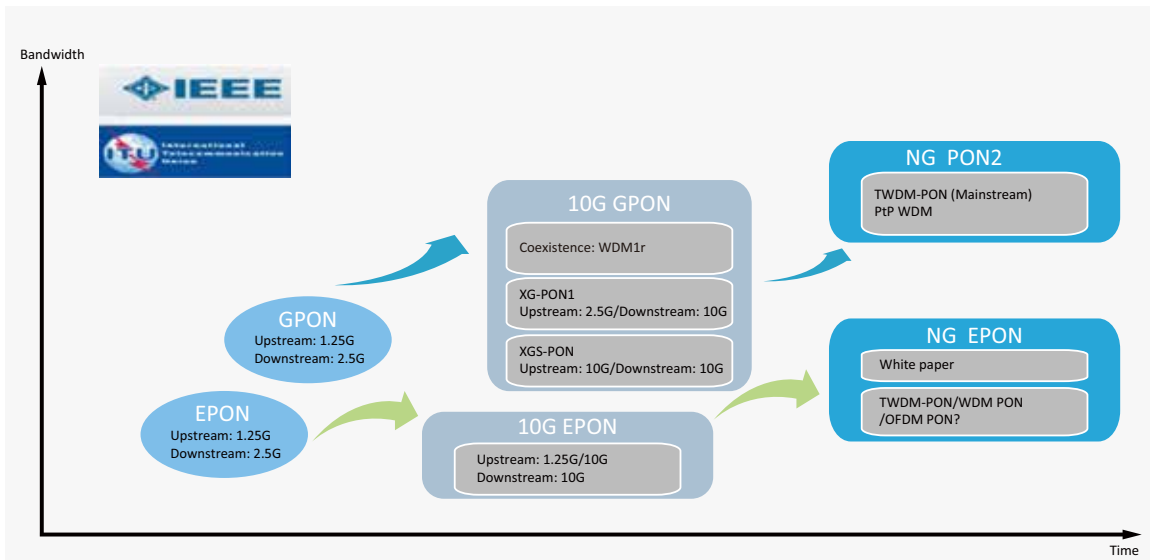Figure 1. 10G PON supports various FTTx scenarios.

Figure 2. The Development of PON technologies.

specifications, including IEEE's 802.3av for 10G EPON and ITU-T's G.987.x series and G.988 for 10G GPON. Based on these standards, mass production of 10G PON devices is possible.

Benefiting from the mature industry chain and good performance, 10G PON has gradually evolved into the mainstream PON technology applicable to multiple scenarios such as buildings and residential districts reconstruction; high-End family, enterprise and campus broadband access; and mobile backhaul. More importantly, through ODN reuse and proper wavelength deployment schemes, 10G PON can perfectly coexist with 1G PON. This also means operators can easily achieve smooth network evolution. Such coexistence helps traditional operators improve user experience, increase user stickiness, and maintain their competitiveness; and provides emerging operators with differentiated ideas to enhance their competitiveness.

10G PON Scenario: Buildings and Residential Districts Reconstruction

In this scenario, the access bandwidth of 10G PON is fully used to provide wide coverage and a high access bandwidth of 100 Mbps or even 1 Gbps. In cost-sensitive scenarios, existing resources such as CAT-5 and twisted-pair cables can also be fully used for fast deployment and service provisioning. This reduces capex. In a copper-to-the-home case, VDSL2 and Vectoring can be used to offer a broadband access experience comparable to that brought by FTTH.

10G PON Scenario: High-End Family, Enterprise, and Campus Broadband Access

10G PON is the best choice for high-end users because its access capacity reaches as high as 1 Gbps or even 10 Gbps. This satisfies the requirements of both enterprise and family users such as high-speed internet access, cloud storage, ultra-HD videos, and 3D/VR online games. In this scenario, 10G PON access is used to help operators increase user satisfaction and thus cement and even raise their revenues.

10G PON Scenario: Mobile Backhaul

In the era of mobile internet, mobile communication occupies a significant share in the telecom market. It is therefore necessary to provide operators with a flexible and low-cost access solution that can carry massive mobile traffic. 10G PON applicable for various indoor and outdoor scenarios is the optimal solution to address the needs. 10G PON and smallcell are perfectly matched in terms of development and bandwidth provision. The existing FTTx and PON resources also greatly facilitate high-density LTE smallcell deployments.

NG-PON2: The Next-Generation PON Technology after 10G PON

Although the current mainstream 10G PON can guarantee a vast majority of telecom services, there are growing needs for higher bandwidth. Ultra-high-
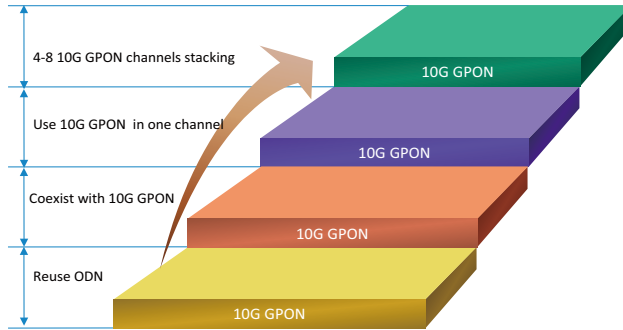
Figure 3. 10G PON is fundamental to NG-PON2.

definition video services such as VR and 8KTV as well as new-generation mobile communication technologies like Pre5G and 5G all need a huge amount of bandwidth and may trigger a bigger burst of traffic in the future. Early in 2009, FSAN began research into next-generation PON (NG-PON2). In 2012, FSAN selected TWDM-PON as the mainstream NG-PON2 technology and PtP WDM PON as a supplement. This was also regarded as a milestone in the NG-PON2 development. By the end of 2015, FSAN had finalized several technical recommendations including G.989.1, G.989.1 Amd1 and G.989.1 Amd2. IEEE is also engaged in researching NG-EPON and considers it as the evolution trend of 10G EPON (Fig.2).

The main idea of TWDM-PON is to combine the WDM mechanism with the existing TDM mechanism in the PON. Several wavelengths or channels of 10G GPON are multiplexed into one channel to bring a bandwidth as high as 10 Gbps. In this way, the tremendous carrier capacity of optical fiber could be fully used.

NG-PON2 is developed upon 10G PON and can be fully compatible with the existing 10G PON (Fig.3). This also means the evolution to NG-PON2 can be easy, smooth, and economical. Usually four, or eight, or even more 10G PON wavelengths are stacked for on-demand network upgrade and fast broadband connection. At the user side, colorless ONUs in NG-PON2 use tunable transmitters and receivers to ensure normal operation on any upstream and downstream wavelength.

Nowadays, the G-989 series of standards for NG-PON2 are under research. NG-PON2 technical indicators and management modes still need to be discussed and specified. Moreover, the progress of NG-PON2 commercialization is highly restricted by the immature industry chain. Most NG-PON2 products are still unveiled as prototypes. There is a great shortage of some key components like optical modules with standard encapsulation. These factors make the cost of NG-PON2 much higher than that of XG-PON1. It is expected NG-PON2 will be widely commercialized in 2020.

ZTE: The Technology Leader in NG-PON

ZTE is a global leader in PON technology. The company keeps pace with cutting-edge technologies and standards and continues to innovate. ZTE has been devoted to offering state-of-the-art and future-proof telecom solutions to customers around the world.

ZTE leads the 10G PON industry. It is the first vendor in the industry to launch the 8-port high-density ASIC 10G PON card that complies with IEEE 802.3av, ITU-T G.987 and G.988 standards. With the ASIC 10G PON portfolios including OLT, MDU, SFU/HGU and CBU/CTU, ZTE's end-to-end 10G PON solutions have widely deployed by operators around the world. These solutions are featured by clock and time synchronization, H-QoS, unified-management platform, and optical link quality diagnosis by built-in OTDR modules. ZTE can also help operators reduce their opex and capex. The PON cards and optical modules are designed to be pluggable for easy switching and upgrade. By introducing energy-saving chipsets, smart speed-adjustable fans, and power-saving management, ZTE's 10G PON products are highly energy efficient.

ZTE also provides smooth evolution to NG-PON2 through its excellent platform. With high switching capacity and unified architecture, NG-PON2 can coexist with 1G/10G PON, helping operators save capex. During the evolution, existing platform features such as carrier-class security and reliability, full-service operation, rich uplink and downlink interfaces, and outstanding service performance can be fully inherited. Successful operations worldwide have proven that ZTE is a reliable partner. The company is poised to partner with operators worldwide in embracing the promising next-generation PON. **ZTE** TECHNOLOGIES

10G PON:

The Best Choice in the 4K Era

By Wang Kun

4K is a video service with 3840 × 2160 pixels. 4K standard has been defined by ITU-R Recommendation BT.2020 (ultra high definition television 4K and ultra high definition television 8K), which has been released by ITU in 2012. The resolution of 4K is fourfold as that of high definition TV (2K). In addition, the images of 4K are more smooth and colorful than that of HD. Therefore, 4K services enable the audience to see every detail of images and enjoy the unparallel visual experience.

4K Brings Huge Opportunities

4K industry has burgeoned in recent years. Now, it is booming in many countries. In the United States, Netflix was the first to launch video-on-demand services based on 4K technology. In Japan, where 4K has been viewed as a basic service of ICT sector, NexTV forum has been set up to promote 4K services. In Europe, Pay-TV operators, telecom operators, and multiple service operators (MSO) are working hard to prepare for 2016 World Cup broadcast with commercial 4K. What's more, as the hardware technology of 4K has developed, mainstream vendors are supporting the 4K technology now, including chip, video interface standards, TV panels and terminal equipment. Obviously, 4K industry chain has already been created and developed.

4K brings huge opportunities for operators. Firstly, as a basic service, especially for families, video service has a massive user base. The development of 4K services drives FTTx network construction. Secondly, video service boasts

a key source of network traffic consumption, and it helps operators gain the high ground of traffic. Finally, 4K services enable operators to build brand, increase revenue, boost appeal and strengthen user loyalty. In short, the operator who grasps 4K technology will stand out in the competitive market.

10G PON: The Best Choice in the 4K Era

4K technology is not only an opportunity but also a challenge for the existing network. The capacity of a 4K video is up to tens of Gigabits, which is dozens of times that of ordinary video. The large-capacity video is challenging the storage and process performance of terminals. It is estimated that the required bandwidth for smooth playback of 4K video is 45M~100M. That means the bandwidth access to home should be upgraded to more than 100M, and the watch model should be transferred from download model to real-time online model, which set higher requirements for performance, delay and reliability of the access network. In addition, as 4K technology is gradually applied to video shooting, security, and online games, the uplink bandwidth will be increased, and the traffic model of upstream and downstream will be changed.

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Table 1. EPON and GPON can't meet the requirements of 4K services.

Scenarios	Bandwidth (M)	Split Ratio	Per PON Interface Users	Concurrent	Bandwidth to Home (M)	Meet 4K Requirements
FTTH@ EPON	1000	1:64	64	50%	31.2	No
FTTH@ GPON	2500	1:64	64	50%	78.12	No
FTTB+LAN @ EPON	1000	1:4	96	50%	20.8	No
FTTB+LAN @ GPON	2500	1:4	96	50%	52.1	No

Therefore, the existing EPON and GPON technologies can't meet the requirements of 4K services (Table 1). Take EPON as an example. As the common split ratio of FTTH@ EPON is 1:64 and the concurrent radio is 50% in the existing network, the bandwidth access to home is 31.2M, which can't realize 100M to home. In the FTTB+LAN@ EPON scenario, there are 96 users per PON interface, and the concurrent radio is still 50%, the bandwidth access to home is about 20.8M, which is far from to meet the needs of 100M to home.

It is the same case with GPON. FTTH@ GPON and FTTB+LAN@GPON are very difficult to implement 100M to home. In order to run 4K services smoothly, increase broadband speeds and upgrade the existing network have become key issues. Meanwhile, a technology with higher bandwidth, such as 10G PON, is required to support 4K services.

Table 2. 10G PON can achieve 100M to home.

Scenarios	Bandwidth (M)	Split Ratio	Per PON Interface Users	Concurrent	Bandwidth to Home (M)	Meet 4K Requirements
FTTH@ 10G PON	10000	1:64	64	50%	312.5	Yes
FTTB+LAN@ 10G PON	10000	1:4	96	50%	208	Yes
		1:8	192	50%	104	Yes

In 2009, IEEE issued IEEE802.3av as 10G EPON standard, which raises the downstream speed to 10 Gbps. In 2010, ITU-T issued XG-PON1 standard for G.987.x. The upstream bandwidth and downstream bandwidth are 2.5 Gbps and 10 Gbps respectively.

To meet the bandwidth requirement of high upstream scenarios, ITU-T issued a symmetric 10G PON (XGS-PON) protocol, which sets 10 Gbps data rates in both upstream and downstream directions. Over many years' attentive efforts, a complete industry chain has been established on the base of 10G PON technology, and 10G PON has entered the commercial stage.

Due to its mature industrial chain and excellent performance, 10G PON has gradually become a mainstream technology of PON network. 10G PON is evolved from EPON/GPON technologies and it can be

upgraded to 100M to home easily. By reusing ODN and deploying appropriate wavelength, 10G PON and 1G PON coexists with each other, which means operators can achieve network evolution smoothly. Moreover, 10G PON greatly reduces the cost for operators to popularize 100M and 1G.

In the FTTH@10G PON scenario, as the split ratios is 1:64 and the concurrent radio is 50%, the bandwidth access to home is up to 312M. In the FTTB+LAN@10G PON scenario, the bandwidth access to home is about 208M~104M. Therefore, 10G PON is the best choice in the 4K era (Table 2).

ZTE: A Pioneer of 4K and 10G PON Technologies

Based on ASIC, ZTE's 10G PON solution boasts the highest density in the industry. It is the first 10G PON solution that has been put into commercial use, and the following characteristics interpret its superiority.

- Eight-port capacity and high density 10G PON cards, including 10G EPON cards and 10G GPON cards. All cards employ pluggable optical transceiver modules for on-demand configuration.
- Complies with G.987 and G.988 standards, transmits 1PPS+ToD signals to implements clock synchronization, and supports H-QoS (hierarchical QoS).
- Full range of ASIC terminal products, such as 10G PON MDUs, SFUs/HGUs and SFP ONUs, to meet

various requirements in different scenarios.
- High-precision OTDR detection. ZTE's build-in OTDR supports link detection without affecting optical lines and service quality.
- Unified network architecture, service distribution, O&M, and access regardless of transmission medium. By operating and managing FTTO, FTTdp and FTTB networks in a unified manner, ZTE's 10G PON solution achieves network flatness and simplifies O&M.
- Eco-friendliness. ZTE's 10G PON solution adopts multiple energy-saving measures, including port management, card electromechanical management, ONU energy-saving control, and smart low-power chips, to reduce overall power consumption.
- The first Combo solution in the industry. It combines GPON and XG-PON1 in an optical module, and reuses the existing ODN network to save space and simplify the complex routing and O&M.
- Evolve to NG-PON2 with low cost through wavelength stacking and bandwidth overlay.

ZTE's 10G PON solution enables operators to transform their business successfully. It helps operators protect investments, enhance competitiveness, and improve brand influence.

4K technology is leading us into a splendid video era. By virtue of profound technology accumulation, ZTE's 10G PON solution guarantees good user experience of 4K services, and contributes to the development of 4K technology. **ZTE** TECHNOLOGIES

Cost–Effective Combo PON for

Bandwidth Increase and Value Creation

By Qin Yewen

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AUG 2016

ZTE

High-bandwidth services including 4KTV, 3D gaming, HD video, live interaction, virtual reality (VR) and augmented reality (AR) have been flourishing in recent years. Faced with fierce competition and driven by national broadband policies, operators are accelerating broadband network deployments. The prevailing GPON is increasingly unable to meet the bandwidth demand of ever-growing high-bandwidth services. To enhance user experience and create new value, operators need new technologies that deliver higher bandwidth and better services. When upgrading GPON to 10G GPON, they have to consider issues concerning resource reuse, fast deployment, and forward and backward compatibility.

The field-proven 10G GPON can meet operator needs by providing high bandwidth to enable service growth. Most operators have begun to develop solutions for upgrading GPON to 10G GPON in a low-cost, flexible and fast manner.

Two solutions are available: the external WDM1r solution that uses external wavelength division multiplexing filters and the Combo PON solution that has integrated optical modules. The external WDM1r solution requires additional accessories including OLT frames, racks, 10G GPON line cards, external WDM1rs, patch cords,

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and ODFs. This results in high construction costs, requires excessive floor space, and causes difficulty for the operation and maintenance of fiber optic cabling. Moreover, optical power loss introduced by external WDM1rs affects the optical power budget of in-service ONUs and thus may adversely impact user experience. However, the Combo PON solution with integrated optical modules combines GPON and 10G GPON wavelengths into dual-channels within one optical module before outputting them through one optical port. To evolve into 10G GPON, operators only need to use Combo PON cards to replace their original GPON cards on the OLT. GPON and 10G GPON can coexist when fibers on the GPON cards are cut over onto the Combo PON cards. Existing ODN and related equipment frames can be reused without adding accessories such as OLT frames and external WDM1rs. Compared with the external WDM1r solution, the Combo PON solution saves floor space and capital investment, makes it easy to upgrade and maintain networks, and supports fast service provisioning without impact on existing services.

Combo PON is a combination of GPON and 10G GPON. GPON and 10G GPON wavelengths are combined in one optical module, and the two optical signals are separately sent and received. The Combo PON solution is compatible with existing GPON services and also provides necessary high-bandwidth services. The existing network devices and ODN are reused. This avoids changing network resources and occupying additional floor space. User-side ONUs can be replaced as required for a fast, smooth upgrade to high-bandwidth services.

The Combo PON line card supports Combo PON optical module. An operator can upgrade its network to
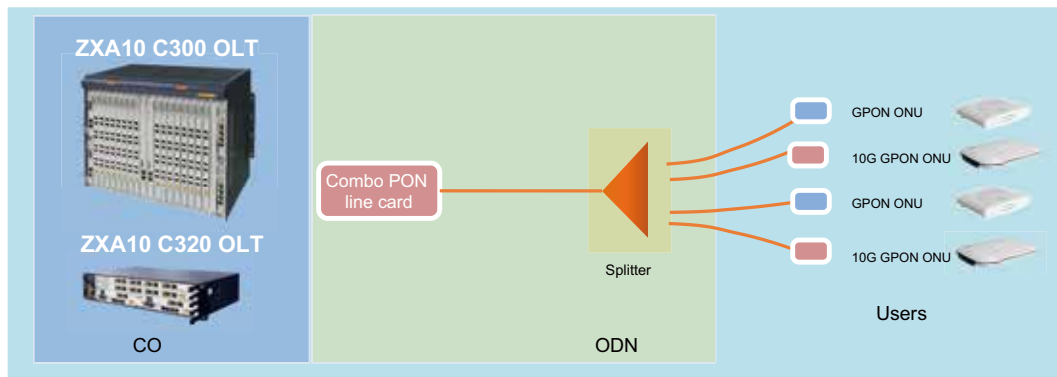
Figure 1. Combo PON networking topology.

10G GPON and fast deploy high-bandwidth 10G GPON services by using Combo PON line cards to replace the line cards on GPON OLT (Fig.1).The Combo PON solution enables a smooth migration to high-bandwidth services simply by replacing line cards. It has distinct advantages over the external WDM1r solution.

- Great site space savings and simple O&M: The Combo PON solution does not require additional external devices and accessories. When GPON is fully configured and upgraded, the solution can greatly save floor space. For a GPON rack that is fully loaded with two GPON OLT frames and is upgraded to 10G GPON, the solution saves more than 60% site space (Fig.2). Moreover, no additional devices are needed. This simplifies O&M and brings capex and opex savings.
- Balancing the return on investment: Currently, 10G GPON ONUs cost much higher than GPON ONUs. With the Combo PON solution, operators

can upgrade ONUs in user homes as needed. This enables an asset-light upgrade to 10G GPON, avoids high investment by directly using 10G GPON ONUs, and rapidly balances the return on investment.
- Smooth network evolution: Widespread deployment of GPON services has led to a tight optical power budget for some regions and users. The external WDM1r solution introduces at least 1.5 dB insertion loss, which may make existing GPON ONUs unable to work properly and thus affect the existing services. The Combo PON solution combines GPON and 10G GPON wavelengths and amplifies their optical power within the optical module to compensate for optical power loss caused by the wavelength combination and keeps their optical power budget unchanged. This ensures that existing services are not affected.

The Combo PON solution can also reduce central-office (CO) deployment costs. A cost comparison made on CO deployment and floor space occupation for SingTel during its five-year operation has shown that the Combo PON solution can cut costs by 24% against the external WDM1r solution.

ZTE has been committed to the innovation of products and solutions to create customer value. Its Combo PON solution can solve problems concerning high upgrade costs, much floor space, complex fiber optic cabling, and O&M difficulties during the evolution from GPON to 10G GPON. The solution has become a preferred choice for operators. They can use the solution to fast and flexibly deliver high-bandwidth services, improve user experience, increase their competitiveness, and thus achieve sustainable profit growth. **ZTE** TECHNOLOGIES
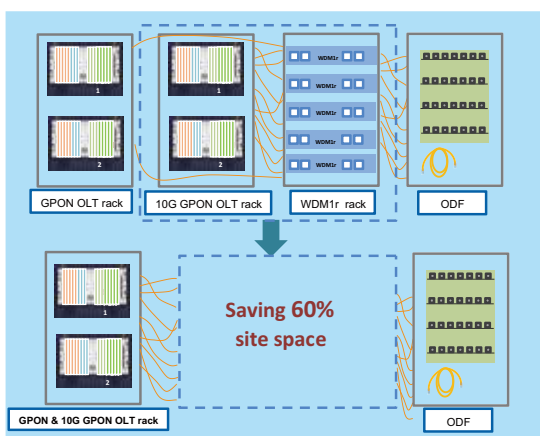

Figure 2. Great site space savings.

Access Network Virtualization

Enables Network Transformation

By Diao Yuanjiong

Virtualization is rapidly transferring the commercial value of networks from services provided by dedicated hardware to that delivered by software. Internet companies are beneficiaries of virtualization. While they traditionally lease physical servers from internet data centers (IDCs) to develop services, their computing, storage and internal networks in data centers are now run through virtual infrastructure as a service (IaaS). Down the road, they will evolve towards the platform as a service (PaaS) model, which features integrated development and operation. With PaaS, services will be iterated and launched faster, and the ecosystem that integrates partners will become stronger.

Challenges Faced by Operators

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Chief FN Product
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Currently, incumbent operators still operate services including voice, IPTV, high speed internet (HSI) and enterprise VPN through private APIs or network management interfaces provided by dedicated equipment. Most of the operators' IT systems, including B/OSSs, still run on physical servers in IDCs in a low intensive level.

The changeable and distinct demands of end users can be customized in the cloud of internet companies. On one hand, taking advantage of their head start in virtualization, internet companies direct massive connections to their cloud to create value. On the other hand, operators' voice and IPTV services are challenged by OTTs. Operators' revenue has no obvious growth as the internet traffic and connections exponentially grow.

The lag in virtualization puts operators at a disadvantage when they try to tap the commercial value of internet services. Even if operators wish to achieve a win-win with internet companies, they must accelerate their response to keep pace with internet companies and end users in providing new services.

Starting CO Reconfiguration to Add Virtualization Capabilities for Operators

To overcome challenges, operators have two choices:
- Descent to dumb pipelines (Fig.1). In this case, operators only reap revenue from ordinary internet connections. They can't predict any changes in user experience or customize networks as required by users. For example, while a best-effort pipe is sufficient for internet access most of the time, bandwidth needs to be increased when users visit video sites. Videos can mostly be pushed to users through unicast transmission, but a customized multicast network ensures good user experience when major sports events are held.
- Be smart channels which satisfy ever-changing demands (Fig.2). Operators need to build PaaS-centric networks that can be fast orchestrated to tackle challenges. Mainstream operators have accepted the network functions virtualization (NFV) concept
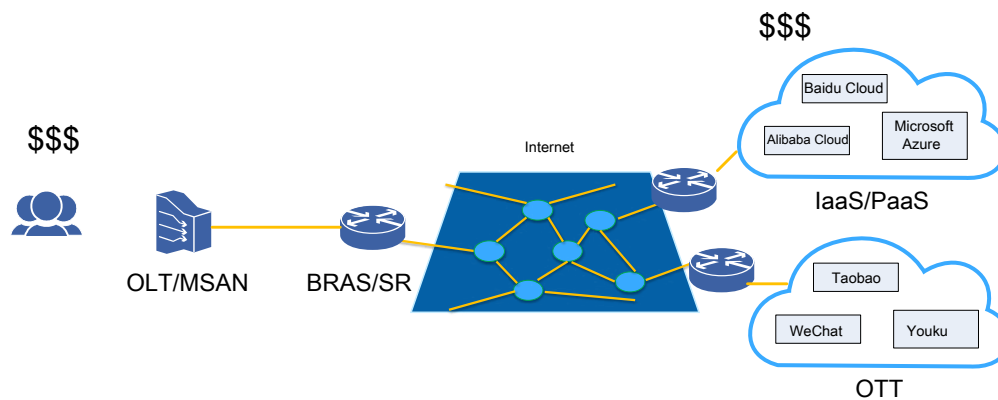
Figure 1. Operators descent to dump pipeline.

proposed by ETSI and are planning to build cloud-based data centers as their NFV infrastructure (NFVI).

Data centers based on PaaS platforms are similar to the service zones set along a highway in that they can readily provide differentiated services for network traffic. A large physical network that includes an access network and an IP WAN is abstracted and virtualized to the PaaS data center. A mirror of the network resources is established in a purely software-based virtual environment, where the network resources and functions can be programmed.

Internet companies and end users don't have any physical WAN networks. In most cases, they can only use ordinary internet connections.

If operators possess capabilities for network virtualization, end users and internet companies can ask for network customization when some valuable connections are about to happen. In this way, they can acquire one-to-many connections, which have shorter delay, higher bandwidth, and lower cost than ordinary internet connections.

SDN Helps Achieve Virtualization

The control, separation and forwarding of SDN enable software functions to separate from dedicated hardware. Through the SDN controller, even physical

network resources outside the data center can be mirrored in a software-based virtual environment to implement the VNF.

It differs from traditional VPNs, which neither support the mirroring function nor have any attached software that can clearly show how to customize VPN networks.

Contents of Access Network Virtualization

Access network virtualization consists of network virtualization and network functions virtualization.
- Network virtualization: the access network is cut into different slices, with each slice serving as a customized virtual network. A virtual network can be preconfigured with a long life cycle. Such virtual access networks can be wholesaled by basic operators to virtual operators. A virtual network can also be dynamically created and deleted to guarantee a good user experience. Such virtual networks can be low-delay and low-bandwidth to meet the requirement of industrial control, or they can be low-jitter and high-bandwidth to enable virtual reality (VR) applications. In this case, a physical access network can be shared by multiple virtual access networks.
- Network functions virtualization: virtualized network function (VNF) is a pure software function
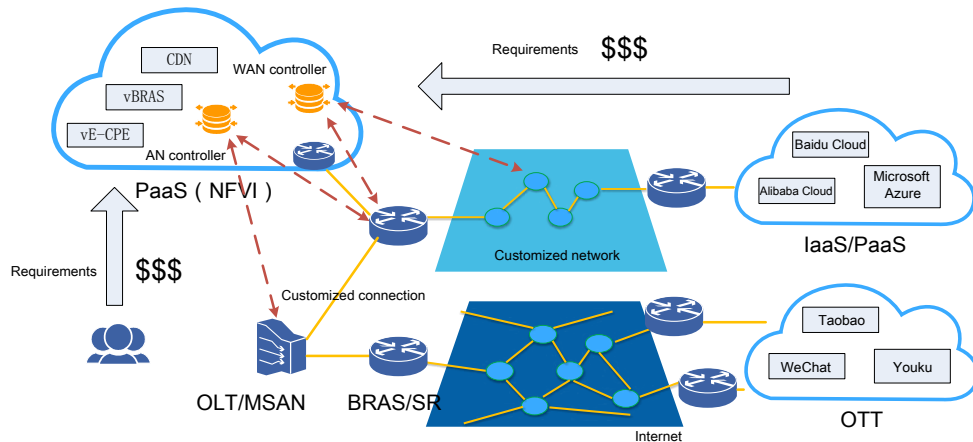
Figure 2. Operators act as smart channels.

module. With the VNF, the development and verification functions are independent of dedicated hardware platforms; the computing and storing resources during actual operation are acquired from virtual platforms like x86, and network resources can be obtained from physical network connections. At this time, network traffic needs to be routed to the VNF for processing. In addition, the network resources obtained by the VNF can also be a mirror of the physical network established through SDN. In this case, the physical network is driven by SDN and the actual user traffic can go beyond the VNF.

Main Components for Access Network Virtualization

There are five main components for access network virtualization as below:

- VFN components used for NFV: The VNF components include vOLTs, vBNGs and vCPEs, which are control- and management-plane software functions separated from the physical OLT, BNG and CPE respectively.
- NFVI platform where VNF runs: The NFVI is an IaaS or PaaS platform that is responsible for virtualizing physical computing, storage and network resources.
- Physical forwarding device controlled by NFVI: It consists of distributed OLTs, centralized NFVI-GW forwarding pools, and overlay networks in data centers.
- SDN controller: It consists at least of vDC

controllers and AN controllers. While computing and storage resources are only centralized in data centers, network resources include both DC networks in data centers, and many network nodes and links that are outside of data centers. The vDC controller virtualizes overlay networks in the data center, and the AN controller virtualizes the access networks that connect users to the NFVI. All the VNFs control the direction of network traffic through SDN controllers.

- EMS: It is used to configure the network elements irrelevant to virtualization, such as physical nodes and links. All configurations are semi-permanent, constant in normal cases, and irrelevant to the orchestration of upper-layer services.

Summary

With SDN and NFV, we are building an agile and demand-driven access network. The wide application of DC technologies is vital to the evolution of access network virtualization. Network control and management can be realized by virtualized computing and storing resources, and are independent from the dedicated hardware devices.

SDN extends network virtualization from data centers to outside. Although more and more traffic will occur horizontally in the data center or between data centers, a controlled access network is still required to dispatch vertical traffic to the respective data centers and traditional internet, and then flexibly process the traffic with diverse software. **ZTE** *TECHNOLOGIES*

NETCOM KASSEL:
DEPLOYING AN END-TO-END IP/MPLS BEARER NETWORK

By Zhang Ting

The reason why German industry always maintains a leading place in the world is that every participant competes in a fair and challenging market. Any enterprise, large or small, keeps its vitality and competitiveness by providing differentiated and cost-effective services for customers with ever-improving technology. The telecom sector of German is an example. It not only boasts the dominant Deutsche Telekom, but also has hundreds of small and medium-sized operators like Netcom Kassel. They are competing with each other for more market share.

As a regional operator, Netcom Kassel is located in Kassel, the capital of Hessen. It used to be a municipal construction department of the Kassel government and has developed by leaps and bounds in telecom services in recent years. After it built DSLAM-based access networks, access convergence networks, and IP networks, Netcom Kassel has launched various services, including HSI, VoIP, BTV, leased line and broadcast wholesale. To date, it has expanded its services to Grebenstein, Hofgeismar, and Immerhausen, and is building a new DSLAM network in Calden.

With the continuous development and expansion of services, the existing network of Netcom Kassel, which is Ethernet, can't meet user needs any more. It encountered insurmountable challenges in terms of IPTV multicast, QoS, protection switching, and IPv6 evolution. Therefore, Netcom Kassel failed to provide cost-effective services

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for customers.

After having successfully built a DSLAM network for Netcom Kassel, ZTE was thinking about how to build a bearer network to help Netcom Kassel meet new service requirements. By analyzing the technical requirements and future plans of Netcom Kassel, ZTE's bearer experts proposed to build an end-to-end IP/MPLS bearer network. Compared with other solutions, ZTE's end-to-end IP/MPLS solution stood out for its distinct advantages. Thus, Netcom Kassel adopted it.

However, there is a large amount of work needed to be done in the

network construction, such as technical solution detailing, migration solution verification, laboratory test, and project implementation.

ZTE's bearer network devices (6120Ss, 9000-3Es, and M6000-8Ss) constitute an end-to-end IP/MPLS bearer network, which is featured by comprehensive functions, excellent performance, and high reliability (Fig. 1). As UPE devices, the 6120Ss access DSLAM services and VIP customer private line services in four cities, and transmit them to Kassel. The 9000-3Es, which are located in Kassel and work as PE-AGG devices, aggregate services and transmit them to the BRASs. The
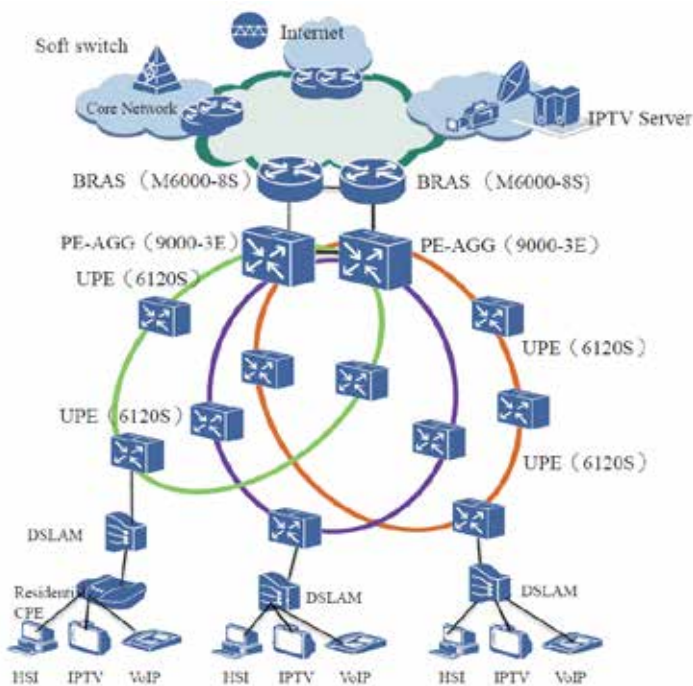
IP/MPLS network consisting of 6120Ss and 9000-3Es is characterized by perfect end-to-end O&M, protection, QoS, and clock synchronization. As broadband remote access servers (BRASs), the M6000-8Ss are equipped with PPPoE, IPoE, and L2TP functions, and provide both hot-standby redundancy and cold-standby redundancy.

Based on an advanced hardware platform, ZTE's end-to-end IP/MPLS solution not only satisfies the current bandwidth requirements of Netcom Kassel, but also upgrades its bandwidth by orders of magnitude. Due to the "end-to-end layer 3 MPLS VPN" function, this solution effectively separates different services and improves security. In addition, this solution is designed with dual stacks of

Figure 1. ZTE bearer network devices.

Technical exchanges between bearer experts from ZTE and Netcom Kassel

existing network.

- Second, access services of the newly constructed DSLAM network in Calden to ZTE's end-to-end IP/MPLS bearer network, in other words, access service at the 6120Ss, aggregate services at the 9000-3Es, and implement PPPoE and IPoE functions of the M6000-8S BRASs.
- Third, move services of Netcom Kassel in all cities to ZTE's end-to-end IP/MPLS bearer network constituted by the 6120Ss, 9000-3Es, and M6000-8S BRASs.

The migration solution has a minimal impact on services in the existing network, ensuring smooth upgrade and practical feasibility.

This project was the debut of ZTE's end-to-end IP/ MPLS bearer network, and the M6000-Ss as BRASs were unveiled in Germany. ZTE's end-to-end IP/MPLS bearer network enables Netcom Kassel to simplify network O&M, reduce OPEX, and improve the accuracy of service provisioning.

National broadband networks are being rolled out around Europe. Germany will complete national broadband network deployment by 2018, and the national plan will be jointly implemented by hundreds of large, medium, and small operators. Therefore, ZTE will delve into the technical requirements and network plans of European operators in order to make a significant contribution to broadband network construction in Europe. **ZTE TECHNOLOGIES**
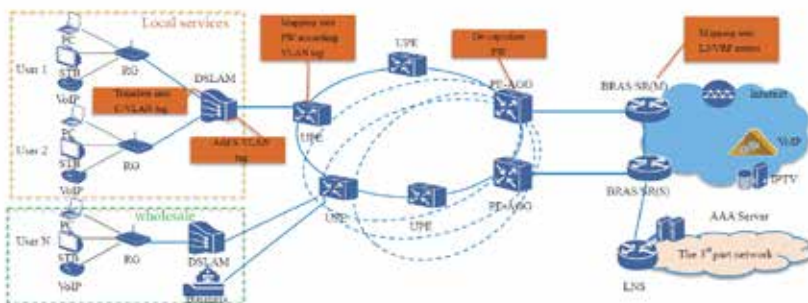
IPv4 and IPv6, which ensures smooth evolution towards IPv6 services for Netcom Kassel.

After the technical solution is determined, the migration solution must be developed. Considering service deployment and network plans of Netcom Kassel, ZTE has formulated a three-step migration plan as below.

- First, move the DSLAM services in Grebenstein, Hofgeismar, and Immerhausen to ZTE's bearer network constituted by the 6120Ss and 9000-3Es. Then, aggregate services at the 9000-3Es in Kassel, and forward them to the core switches and routers of the

Figure 2. ZTE's end-to-end IP/MPLS bearer network architecture.

ETB DEPLOYS GPON NETWORK WITH AN "EASYOPTICAL+OTDR" SOLUTION

By Guan Xiangming

Guan Xiangming
Market Director
of FN Products, ZTE

The Empresa de Telecommunicaciones de Bogota (ETB) is the largest fixed network operator in Bogota, the capital of Columbia. ETB has two million fixed-line subscribers. Among them, 600,000 are broadband subscribers, accounting for 34% of the Bogota broadband market. ETB aims to expand both mobile and fixed businesses. Its strategy on fixed networks is to provide high-speed broadband pipes on which N-Play and other new services can be delivered to boost its revenue.

Challenges Faced by ETB

Based on the high-speed broadband strategy, ETB started to build an FTTH GPON network in the urban area of Bogota in 2012. The project, which involved an optical transformation to ETB's existing access network, was undertaken by ZTE and ALU, with ZTE taking a 70 per cent share.

ETB operated a GPON network that could provide a variety of services. While the GPON network had helped ETB steadily boost market share and operating revenue in recent years, it faced increasing O&M and service issues. For example, it lacked sufficient PON network monitoring and automatic diagnosis mechanisms, leading to low efficiency in fault location and slow response times to user complaints. To improve user satisfaction, ETB urgently needed a complete, end-to-end FTTH GPON O&M assurance system.

EasyOptical+OTDR: Improving GPON O&M Efficiency

Since it first deployed ZTE's GPON

products at the beginning of 2013, ETB has maintained a stable partnership with ZTE. Focusing on cutting O&M cost and enhancing user satisfaction, ETB and ZTE carried out discussions on the issues involving quickly analyzing and locating broadband access faults, predicating broadband performance deterioration, analyzing and managing QoS of the broadband access network, and optimizing broadband service O&M process.

To address these issues, ZTE came up with an "Easyoptical+optical time-domain reflectometer (OTDR)" solution consisting of seven modules: fault diagnosis, real-time monitoring, alarm processing, performance prediction, statistics and analysis, online evaluation, and online optimization. Through the modules, the solution enables the fast handling of FTTx network faults, enhances O&M efficiency, and optimizes service quality. The solution also provided performance prediction and QoS optimization that could change the original FTTx O&M model. As a result, customer complaint processing is turned from passive into active and user

satisfaction is elevated.

ETB commercially deployed the "EasyOptical+OTDR" solution that covered its entire GPON network. This paved the way for ETB to smoothly expand its FTTH business.

EasyOptical+OTDR: Reducing Operating Costs

The "EasyOptical+OTDR" solution can rapidly establish a well-rounded FTTH GPON O&M assurance system that enables all the active equipment, regardless of its vendors, and the open data node (ODN) platform to be monitored in real time. In the test of interoperability with the third-party optical line termination (OLT) as part of the bidding process, the solution delivered a brilliant performance, deeply impressing ETB with its user friendly interface, proactive fault detection and accurate fault location.

With the "EasyOptical+OTDR" solution, ETB can significantly decrease broadband opex, improve its customer satisfaction index (CSI) and quality of experience (QoE). This will

also strengthen ETB's market position in Columbia and boost its profitability as well.

GTB Fixed Network Infrastructure Innovation Award

At the Innovation Awards 2016 held by Global Telecoms Business (GTB), ETB and ZTE were the winners of the Fixed Network Infrastructure Innovation award thanks to their joint implementation of an "Easyoptical+ OTDR" project that produced a visible, manageable and controllable FTTH network. With a real-time network monitoring system and accurate fault location functionality, the network features drastically shortened troubleshooting times, and vastly improved O&M efficiency. The system itself was implemented this year. Similarly, the nomination for this award was also given in 2016. The GTB Innovation Awards are presented by the authoritative telecoms industry publication Global Telecoms Business to recognize innovative telecom projects and services across the world.

ZTE TECHNOLOGIES

OEID: A New Tag Technology in Optical Wireless Communications

By Xu Jidong, Hao Xiangyong

Introduction

Modern society is an information society, and social media like facebook and twitter focus on the connection between people based on the internet. Smart home and appliances are emerging, and the internet of things (IoT) will connect everything on the internet in the future. Tags are important for IoT and most of them are non-contact type, such as barcode and radio-frequency identification (RFID). Barcode tags cannot be edited, but RFID tags can. Therefore, RFID has been widely applied in transportation cards, bank cards and hotel room keys. RFID is based on mature wireless RF communication technologies and can work from low frequency (LF) to ultra high frequency (UHF).

With regard to RFID transmission principles, the magnetic induction coupling can be applied to the near field, while the electromagnetic transmission applied to the far field. However, there are still problems for RFID working in the electromagnetic and metal environments.

The increasing broadband demands have pushed the use of communication frequencies from kHz to GHz, and then to THz, that is, from RF to optical waves. Optical wave including infrared has been used for communications, and visible lights for illumination have also been used for communications. Visible light communication (VLC) based on light emitting diodes (LEDs) has been considered as a promising technology for future wireless communication.
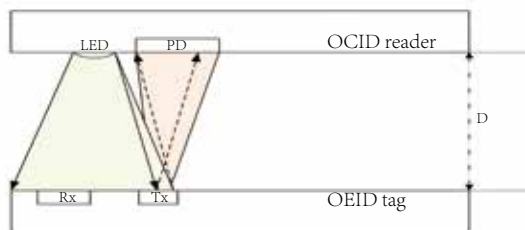

Figure 1. OEID system architecture.

Illumination LEDs captured almost 45% of the lighting market in 2015 and is expected to gain more market share in the future. This is the fundamental base for VLC development. Optoelectronic identification (OEID) based on VLC has therefore attracted much attention.

OEID System Architecture

OEID belongs to a non-contact ID system working at the same optical wireless communication range as VLC. The OEID architecture is shown in Fig. 1.

According to the tag power supply status, OEID can be classified into active OEID, semi-active OEID, and passive OEID.

Active OEID

An active OEID system has an active tag with its own power supply. In this system, there are little difference between the reader and tag. Therefore, the roles of the reader and tag can be exchanged.

An OEID tag can be an external part that is inserted or integrated into a marked device. One of the near field active OEID applications is mobile payment. In this scenario, a POS machine and a cell phone serve as the reader and tag. In the future, any electronic devices may be labeled; if they are marked by OEID, both mobile and fixed devices such as cell phones and LED lamps can

VLC based on light emitting diodes has been considered as a promising technology for future wireless communication. Optoelectronic identification (OEID) based on VLC has attracted much attention.

—**Xu Jidong,** Senior Technical Advisor of FN Product Team, ZTE

be used as OEID reader to collect ID and location information.

If the definition of the active OEID is expanded, the VLC in a home network such as light fidelity (Li-Fi) can also be an example of active OEID system. LED lamps in a LiFi system can communicate with any electronic device inside the room and the communication mode can be point to point (P2P) or point to multiple point (P2MP).

Semi-Active OEID

In a semi-active OEID system, an OEID tag brings its own battery and is independent of a marked object. The OEID tag can be attached on anything. However, its limited battery life affects the application of the semi-active OEID system. Therefore, the battery must be exchangeable or rechargeable to extend its lifetime. The semi-active OEID is suitable for applications with a time limit, such as tickets, visitor cards and hotel room cards.

Passive OEID

A passive OEID system has a passive tag that gets energy from the reader or outside light (Fig. 2).

The passive OEID system is a bi-directional VLC system. The OEID reader has a PD to receive tag data, and the white LED is used as a transmitter
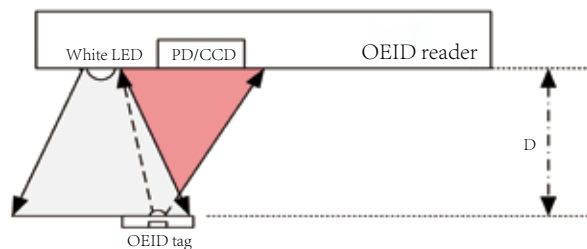

Figure 2. Passive OEID system architecture.

that sends instructions or transfers energy to the OEID tag. The tag converts light into an electronic source for running its chip and driving its LED. The distance D between the reader and tag depends on the tag size. If the tag size is smaller than 10 mm × 10 mm, D should be below 20 mm. When D increases, the OEID tag size need to be increased too. Most passive OEID applications are near field.

A passive OEID tag consists of the solar cell, LED, and OEID chip. PVD is used as the solar cell that converts continuous wave light into direct electronic voltage. It can also be used as a receiver to detect ves as both the energy provider and the receiver in the OEID tag. Silica is typical material for solar cells, and only white LED solar cells with high energy conversion rate and matched spectrum can be chosen. The size of an OEID tag is determined by the size of a solar cell. LED is used as the tag transmitter that consumes most power of the OEID tag. Because the OEID tag is passive, LED operating at very low power such as below 1 mW can be chosen. There are at least five units in an OEID chip. The electronic source management unit manages the offering of electronic sources to the whole chip and transfers downstream data to the control and management (CM) unit. The CM unit deals with downstream data and controls LED for reply. The LED driver unit follows the order from the CM unit to drive the LED by sending upstream data to the reader. The ID memory unit stores ID data of the tag. The OEID chip must be designed with low power consumption (a few mW).

> OEID is more energy efficient than RFID because it transfers information via light. OEID also outperforms RFID inelectromagnetic and metal environments.
>
> —**Hao Xiangyong,** Chief Engineer of Network Product Management, ZTE

OEID Applications

Both OEID and RFID can store information. OEID is more energy efficient than RFID because it transfers information via light. OEID also outperforms RFID in electromagnetic and metal environments. OEID has wide applications that can be classified based on the distance (Fig.3).

OEID can be widely applied in public and business areas such as mobile payment, ID cards, position ID, advertising, anti-counterfeiting label, and information acquisition.

Mobile Payment

Apple Pay is a well-known mobile payment based on the near field communication (NFC)— the 13.56 MHz RFID technology. This application requires special NFC phone and App, special NFC POS machine and related software. However, there are still security problems to be overcome. OEID can also be used for mobile payment called Photon Pay. The flashlight and camera of a cell phone can be used as an OEID tag/reader receiver or transmitter. Photon Pay does not require a special phone. Any cell phone can be used as an OEID phone after installing the OEID App software. The POS machine becomes an OEID
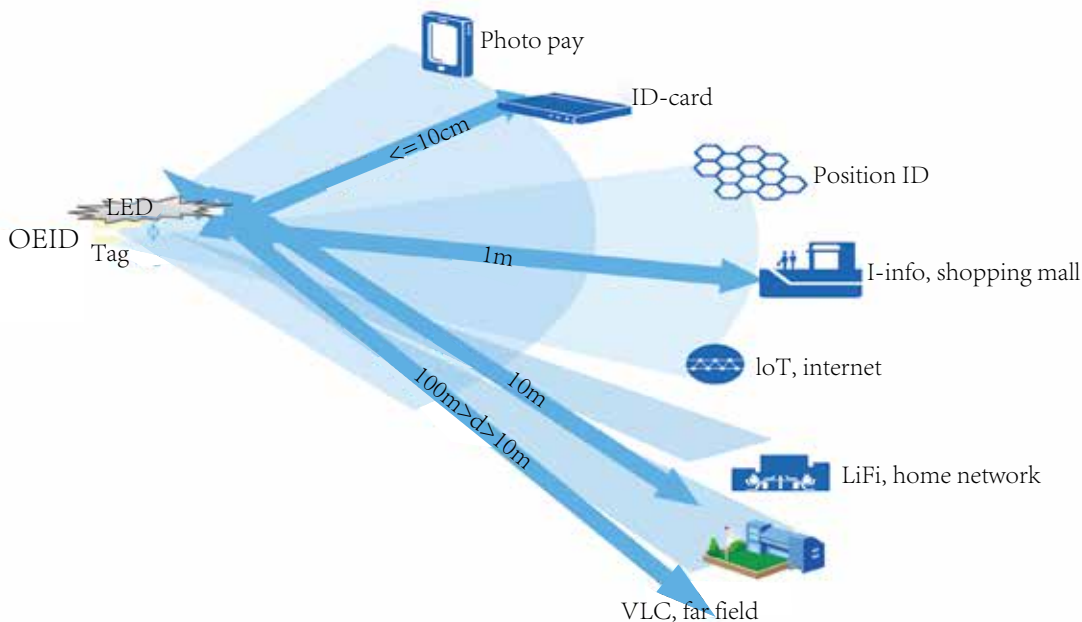

Figure 3. OEID applications based on the distance.

POS after an OEID head is inserted. The OEID phone and POS can work together to implement photon payment.

ID Cards

Passive OEID tags can be used in ID cards such as keys, band-cards, transportation cards, work cards and hotel room cards, and the corresponding OEID reader can be integrated into a POS machine, a lock or a bank machine. The verification process can be identified between the OEID reader and its tag card.

Position ID

Accurate goods location is quite useful for storage and retail stores. OEID outperforms RFID in accurate locating tags within mm range. Each OEID tag on the goods has a LED, and any person or camera can easily locate this tag when the LED flickers. OEID can improve localization accuracy up to the mm range.

Advertising

There is a lot of advertising information in shopping malls or business centers to attract customers. An information centre is often found at a place marked with a big "I" where someone can answer customer questions. If an active OEID tag is added to the "I" lamp, any customer can use its own cell phone to receive the advertising information he wants.

Anti-Counterfeiting Label

An OEID tag cannot be simply copied as a barcode or a QR code, and is hard to forge. Most OEID tags can be read by cell phones but not be edited without a special OEID reader. Therefore, anti-counterfeiting labeling

is a good choice for valuable goods.

Information Acquisition

When an OEID tag is integrated with some sensors, the OEID system can offer electronic source to sensors and also automatically save sensor data. The OEID system is used for monitoring and recording at special places. The recorded data can be even remotely acquired by fixed or mobile OEID readers.

OEID has promising commercial prospects. An OEID tag can be used for resource management in the communications industry; and used for material management in the electric power industry. As many military supplies such as firearms and ammunition have ferromagnetic shells and can be detonated by electromagnetic field, OEID rather than RFID is used. OEID is also applied to the medical industry, because medical devices are often sensitive to the electromagnetic field and the radiation to human body should be avoided at certain cases.

In the IoT, wireless passive OEID will play a similar role as RFID and be widely applied. If connected to a sensor at the monitoring site, OEID can also save data that will be collected and transferred to the central office by the reader.

Both OEID and RFID are wireless tag technologies. RFID is a field-proven technology based on radio frequency communication and has been widely applied. OEID is an emerging technology based on optical wireless communication especially VLC and is also called RFID in the optical domain.

Conclusion

OEID is a new wireless tag technology that has wider applications than traditional optical tags and can be even used in electromagnetic and metal environments where RFID cannot work well. OEID can also communicate without antenna, so OEID tags are smaller in size than traditional RFID tags.

A passive OEID tag consists of the solar cell, LED and OEID chip. With the development of CMOS and silica technologies, it can be expected all components of the OEID tag will be integrated into one chip. This will significantly reduce OEID costs and extend its applications. The active OEID application ranges from near field to far field. A typical near field application is photon pay that can compete against Apple pay or Android pay based on the NFC technology. Another popular home network application is LiFi that can compete against WiFi.   ZTE TECHNOLOGIES

Digital Transformation:
Unleashing the Power of Telco

By Ivan Cairo

Business support systems (BSS) and operational support systems (OSS) are essential for the telecom industry. Their importance has increased in direct relationship with the expansion and sophistication of communication services. Traditionally, OSS is to manage telecom resources to guarantee services are efficiently delivered, while BSS components are oriented to support service commercialization by packaging network capacities and commercial conditions, assuring and improving operator revenue streams, and supporting customer relationship management. With their respective network platforms, both OSS and BSS are largely responsible on how end customers perceive the quality of services delivered by operators. This is commonly known as the customer experience.

Nowadays, digital economy is about constructing disruptive value and providing outstanding experience in the connected world. In such a context, the telecom industry has been heavily disrupted as a result of major technological and social evolution trends:

- Connectivity is perceived as a ubiquitous and affordable commodity. Traditional telco business model is declining.
- Individuals, enterprises as well as public institutions and global organizations are eager to use and produce all types of digital services to support and improve every aspect of human life.
- OTT and other digital services providers have consolidated their relationship with users in the digital world.
- Personal mobile devices with very important and increasing processing power are widely used.
- More and more competitive edge in the business landscape is achieved by a combination of disruptive technologies and business models, empowered by artificial insight into the processing of huge data volumes.
- Network providers are in network dilemma: data eagerness requires huge investments while carrier service providers (CSPs) get a small part of the benefits.

In spite of the current dominance of global OTT players, network services are essential for digital service development. A solution to the network dilemma will bring stability to the whole digital ecosystem. Digital transformation can allow CSPs to regain relevance in the digital arena, reengage in the growth, and provide a solid foundation for vigorous development of digital businesses.

To assure transformation objectives, operators need to address innovation, integration and monetization. Operators need to develop systematic innovation capabilities at three levels: business models, products, and operations. Business model innovation is the source of disruption capabilities as it allows redefining the way operators integrate and create value in the digital ecosystem. The innovation creates new value chains and ways of doing businesses by synthesizing business imperatives with emerging technologies. Product innovation allows operators to extend their market share and diversify their sources of revenue. Operation innovation focuses on doing more with less while creating the environment that facilitates business models and product innovation. In a digital economy, innovation is the engine, and the source of competitive edge relies in implementing systematic innovation. This makes partnership essential for a successful business strategy in the

> After struggling in fierce competition, carrier service providers have the opportunity to strike back and reaffirm their relevance in the digital ecosystem. Deep transformation is essential to achieve this objective.
>
> —**Ivan Cairo**, Business Development Director, ZTE Corporation

digital business. No single party is able to address all capabilities and capacities needed to maintain systematic innovation. Partnership allows service providers to leverage their own strengths and investments to produce massive and systematic innovation with controlled risk. Harnessing this vision requires service providers to provide simplified and automatic platforms that facilitate products and services integration provided by third parties. All this assures end-to-end QoS to an end consumer. It is also essential to develop the capabilities to easily and systematically monetize any participation in the value chain. The monetization capabilities shall support different business and pricing models.

Another important issue to be addressed by digital transformation is to protect scarce and expensive network resources while assuring customer experience. Service providers should develop the capabilities to dynamically optimize network resources, avoid overutilization and guarantee QoS.

Digital Transformation: Pondered Strategy, Rapid Execution

Transformation is happening in the industry at different paces and with different results. The outcome of transformation processes will be the key to their competitive edge as

winners will be those who manage to leverage their own strengths and investments with intensive partnership and innovative business models to provide a right blend of services and experience to their customers. Lean operational organizations and streamlined business processes powered by NG-BOSS architecture will allow CSPs to deliver new services, implement innovative business models, grow revenue, improve customer experience, and optimize resource utilization while lowering overall operational costs.

Digital transformation for CSPs is a complex process involving the orchestration of changes in organizations, business processes and the underlying technologies from a specific state to a target situation in a predefined period of time. The journey will be risky, with multiple dangers jeopardizing the success of the process. Hence the transformation process requires a thoughtful and careful preparation. The preparation should unify the vision of future organization and settle transformation expectations of stakeholders to assure organizational commitment, the right sponsorship, the collaboration of relevant areas, and necessary resources to carry on with the transformation process.

Before launching specific transformation activities, CSPs should focus on defining a clear transformation roadmap and comprehensive governance procedures for managing massive transformation activities, controlling internal and external interdependencies, and mitigating risks. Transformation planning is not about predicting the future with a crystal ball, but rather about defining clear objectives and a consistent process to follow up the progress of transformation initiatives, identify contextual changes and provide a flexible framework for adjustment. The governance procedures should also implement a rigorous decision-making process based on deep understanding of the transformation process, impacts and potential benefits.

However, once transformation strategy, plans and governance procedures have been settled, speed is of the essence to achieve successful transformation. The faster

to yield the foundation, the better to keep transformation momentum, that is, to probe benefits of target architecture, gain support from stakeholders and users, and to mitigate the risks associated to uncontrollable growth of legacy systems and customized product-oriented processes.

Strategic milestones are different from tactical milestones that are mostly driven by quick wins and technical insight to accelerate and secure the transformation process. The following are recommendations for securing and accelerating the transformation process from a tactical perspective:

- Minimize changes and evolution investments in legacy systems.
- Avoid as much as possible the burden and complexity generated by parallel processing.
- Define a single source of truth for data even during tactical stages.
- Use the integration layers of the target architecture to absorb the burden and complexity of temporary interfaces and parallel processing (if any).
- Implement formal communications channels with business areas, ongoing operations and other ongoing projects.

Transformation Approach: A Pathway to Success

Although influenced by the choice of technical solutions, a successful transformation for CSPs has to be driven by business. This helps to fulfill business transformation objectives, provide a consistent decision process, and determine the real relevance of risks and opportunities that will popup during the transformation.

Defining the transformation approach involves settling expectations of stakeholders and unifying the vision of future operations. Clear transformation objectives, strategic roadmap principles and target conceptual architecture should be also defined. Issues to be addressed by the transformation strategy include business organization, business and

operational processes, business products and services, conceptual solution architecture, and cost effectiveness.

The transformation approach needs to provide clear objectives, flexibility and control, and a convenient process to manage work teams, identify their responsibilities and accountabilities, and break down transformation objectives in manageable phases. A controlled process is also necessary to assure the quality and continuous improvement of the delivery process.

Moreover, the transformation approach needs to introduce flexibility in managing transformation roadmap as well as its investment predictability so as to take advantage of changes and opportunities that will occur in the execution.

The transformation approach can be divided in two major phases: platform preparation and project execution. A platform will be used for launching transformation initiatives in a controlled manner. A framework will also be implemented to assure business strategic focus and effective delivery. The framework will establish a link between transformation objectives and functional domains where the transformation is implemented (Fig.1).

The transformation framework is used by a program transformation office (PTO) to assure consistent evolution of all activities within the transformation program, control architectural decisions, and integrate initiatives and projects as a part of the transformation program. The transformation framework works with different elements of the two transformation phases, as illustrated in Fig.2.

Transformation preparation includes three elements: the vision and transformation strategy, conceptual solution architecture, and PTO setup for consolidating governance procedures. During the project execution, PTO
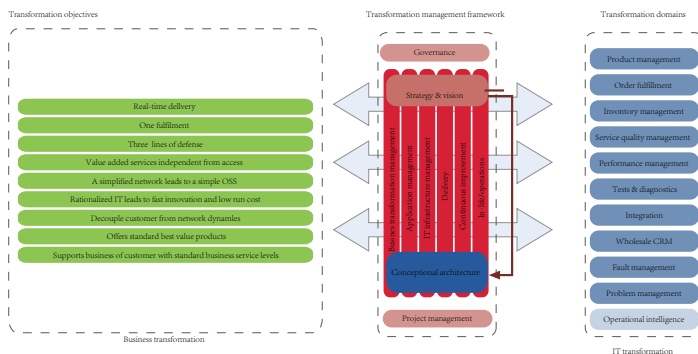

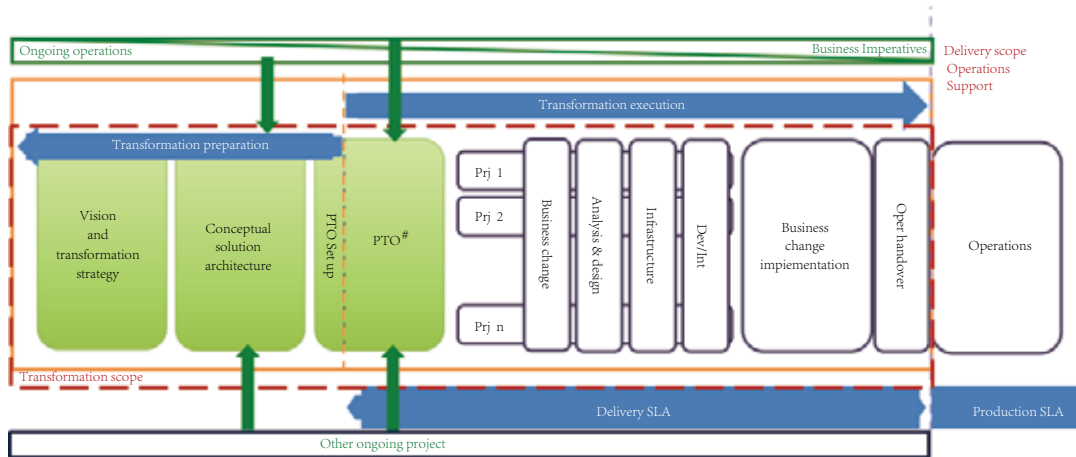Figure 1. Transformation management framework

Figure 2. Operating diagram of the transformation framework.

uses the framework to define the transformation roadmap and launch different projects that will be composed of a different blend of activities such as business change, analysis and design, infrastructure management, and development and integration. The result of all these projects is then handed over to operations. The approach also involves establishing formal channels to communicate with stakeholders about the transformation progress and to integrate inputs and changes coming from business areas in the form of business imperatives, ongoing operations and other ongoing projects outside the transformation program.

The transformation approach also manages the necessary collaboration between three different streams engaged to the same objectives but with different focuses. To assure delivery consistency, these streams should have end-to-end accountability of the transformation process in their respective domains.

- Business transformation stream: They own business transformation objectives and have deep understanding of existing processes and organization. They also have the mandate and resources to make changes across the organization.
- Design to deployment stream: They own the solution and have a solid understanding of business

and operational environments. They also assure solution implementation according to the business transformation objectives.

- Build stream: They own the systems and have a deep knowledge of OOB functionalities and implementation options. They assure consistent functionality implementation based on native functions, and also provide tools and development capabilities to facilitate the implementation process.

ZSmart: Innovation for OSS Transformation

ZSmart is a solution suite covering whole operation process domains for telecom operators. Drawing on ZTESoft's rich industry experience and conforming to technological standards, ZSmart offers the most complete functional component packages that can be assembled and configured flexibly on the unified SOA infrastructure to quickly deliver new services. It can also be integrated with external systems to satisfy various market and customer demands.

ZSmart has been thoroughly designed to support fast implementation and deployment at low costs and risks, helping operators protect their investment and increase their reactivity to the ever-changing market.

ZSmart brings a brand-new architectural approach by providing flexible end-to-end business support through native orchestration and articulation of standard-based federated components and interfaces. With full-fledged business process management, integration, and operational support, the architectural approach guarantees incomparable flexibility and independence for customers and opens a wide new world of transformation and innovation opportunities for CSPs. ZTE TECHNOLOGIES

ZTE

Tomorrow never waits