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VIP Voices

Tunisie Telecom:
Fostering Innovation to Improve Customer Service

Special Topic: Big Data

The Path of Big Data:
Cooperation, Innovation, Win-Win Partnerships

Tech Forum

LTE Network and Backhaul Trends

Nizar Bouguila, CTO of Tunisie Telecom

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05

Tunisie Telecom: Fostering Innovation to Improve Customer Service

Tunisie Telecom is the incumbent telecom operator in Tunisia. It provides GSM, WCDMA/HSPA+, xDSL, FTTH, cloud computing, and enterprise services. Cooperation between Tunisie Telecom and ZTE began in 2004 and extends to DSLAM, SMS, NG-SDH, CWDM, DWDM/OTN, support services, 3G USB modems, and RBT. *ZTE Technologies* interviewed Nizar Bouguila, CTO of Tunisie Telecom, who talked about management philosophy, cloud services, and the compromise between technology ambitions and expenditure.

09

CONTENTS

ZTE TECHNOLOGIES AUG 2014

VIP Voices

Tech Forum

Special Topic: Big Data

Success Stories

Solutions

Editorial Office

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

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

ZTE Wins Wind Telecom Contract to Build First 4G TD-LTE Network in Dominican Republic

24 June 2014, Shenzhen — ZTE announced that the company won a contract from Wind Telecom to build the first 4G TD-LTE network in the Dominican Republic.

ZTE's globally-leading TD-LTE solutions will be implemented to help Wind Telecom deploy a stable high-speed network to provide mobile broadband services for consumers and businesses in the Dominican Republic. ZTE's unified platform EPC and eNodeB solutions, based on ZTE's proprietary Cloud Radio technology, will help Wind Telecom achieve savings in capital expenditure, and operation and maintenance costs, and lay solid foundations for future growth.

Wind Telecom, with a long history of providing comprehensive telecommunication and television services in the Dominican Republic, is renowned as an operator of high-quality and professional broadband access and television services.

ZTE Launches 400G OTN Solution

25 June 2014, Shenzhen — ZTE has launched its 400G OTN solution at the WDM & Next Generation Optical Networking conference in Nice, France.

The 400G OTN solution is designed for operators looking to advance their existing network infrastructure to meet today's business challenges and deliver high speed data. The solution will enable operators to optimize bandwidth and network management and enhance network flexibility.

"Faced with the challenges of rapid traffic growth, high bandwidth data centre applications and cloud computing, carriers have increasingly been considering building large capacity, evolving and 'elastic' networks. The 400G transmission equipment with multiple, adaptive modulations will be a must for all future networks," said Mr. Wei Xiaoqiang, director of ZTE Bearer Network Products.

The 400G solution features multiple modulations including Nyquist QPSK, 16QAM and 8QAM. It is designed to meet carrier requirements for different network scenarios and transmission reaches. The solution also supports software-defined optical networking based on advanced, ZTE-designed low-power chip sets, and photonic components.

ZTE Maintains Strong Growth in the Optical Access Market in Ovum Report

19 June 2014, Shenzhen — ZTE maintained strong growth in the optical access market in the first quarter of 2014, according to data from industry consultant Ovum.

ZTE shipped 1.251 million lines of Ethernet passive optical network (EPON) products in the first quarter, leading the global industry with a market share of 30.9%, according to Ovum's report on the FTTx, DSL, and CMTS markets.

ZTE's global shipments of Gigabit passive optical network (GPON) products increased to 4.781 million lines in the half year from Q4 2013 to Q1 2014, 23.6% higher than the previous two quarters from Q2 to Q3 2013, making ZTE one of the fastest growing GPON vendors over the period, according to Ovum.

In the global market, shipments of GPON products in the half year from Q4 2013 to Q1 2014 were 18.305 million lines, rising 9.4% compared with the period from Q2 to Q3 2013, according to Ovum. Global EPON shipments in Q1 2014 were 4.048 million lines.

ZTE Wins Best LTE Core Network Product Award at LTE World Summit 2014

25 June 2014, Amsterdam — ZTE has been awarded Best LTE Core Network Product for its ZXUN xGW converged multi-access packet gateway.

The LTE World Summit brings together industry leaders from across the world to share progress and innovations in LTE. The LTE awards celebrate and reward those companies that have made significant contributions to the LTE industry.

The ZXUN xGW is designed and developed based on the advanced ZTE T8000 router platform and integrates the functions of multiple network devices. One single cabinet can support network traffic of up to 600 Gbps and 57.6 million EPC user-plane bearers. The ZXUN xGW also supports LTE-A access mode, a feature that enabled Hong Kong-based operator, CSL, to launch the world's first LTE commercial network. The ZXUN xGW has been deployed in 3G and LTE networks including those of China Mobile, China Unicom, China Telecom and KPN.

ZTE has signed 140 LTE/EPC contracts around the world. With leading end-to-end LTE solutions and global partnerships, ZTE has broken into 70% of the countries that have invested in LTE. ZTE has successfully launched commercial LTE services for Bharti, China Mobile, China Telecom, Hutchison, KPN, Telenor, TeliaSonera, VimpelCom and Vodafone.

ZTE Proposes First Pre-5G Concept

2 July 2014, Shenzhen — ZTE, a publicly-listed global provider of telecommunications equipment, network solutions and mobile devices, has introduced its first pre-5G concept.

At the LTE World Summit 2014 in Amsterdam, Netherlands, ZTE announced that under certain conditions some 5G technologies can provide a 5G-like user experience on 4G terminals without changing the air interface standards.

ZTE Signs Expanded Strategic Cooperation Agreement with Portugal's DST Group

1 July 2014, Shenzhen — ZTE is pleased to sign an expanded strategic cooperation agreement with Portugal's Domingos da Silva Teixeira, SA to cover collaborations in enterprise technology and provisioning of information systems for transportation and public utilities.

The agreement between ZTE and DST was signed at a ceremony in the Great Hall of the People in Beijing officiated by President Xi Jinping of the People's Republic of China, President Cavaco Silva of Portugal, José Gonçalves Teixeira, President of the Board at DST, and Shi Lirong, President of ZTE. The wide-ranging agreement will cover multiple projects including the construction and deployment of core networks, wireless broadband networks, data centers and information systems for transportation.

"ZTE is the most professional and friendly partner. We are honored to cooperate with an enterprise that is an established leader in the global telecommunication industry" Mr. Teixeira said.

DST signed an initial cooperation agreement with ZTE in 2012. In 2013, ZTE exclusively signed an agreement with DST for the DST FTTH phase I project, helping DST construct a north-south backbone network across Portugal, deploying ZTE's fixed networks, bearer networks, power and safety control solutions.

Tunisie Telecom:

Fostering Innovation to Improve Customer Service

Reporter: Hassene Akkeri

Tunisie Telecom is the incumbent (and largest) telecommunications operator in Tunisia. Its shareholders include the Tunisian government and Emirates International Telecommunications. Tunisie Telecom has impressive infrastructure, with 15,000 km of optical fiber, 3 million copper lines, and more than 800 outlets. The operator provides GSM, WCDMA/HSPA+, xDSL, FTTH, cloud computing, and enterprise services. Cooperation between Tunisie Telecom and ZTE began in 2004 and extends to DSLAM, SMS, NG-SDH, CWDM, DWDM/OTN, support services, 3G USB modems, and RBT. *ZTE Technologies* interviewed Nizar Bouguila, CTO of Tunisie Telecom, who talked about management philosophy, cloud services, and the compromise between technology ambitions and expenditure.

Q: What is Tunisie Telecom's main focus in 2014?

A: We're mainly focusing on improving customer services, delivering the best customer experience, and creating new and interesting offers for our subscribers. These are the axes of our work. Of course, we try to be cost efficient in order to deliver our services

at competitive prices.

Q: What is your management philosophy?

A: Our philosophy is built around teamwork. We encourage everybody to work together to identify the best strategic technical orientations, and we devise the right action plans to meet our business expectations. It's important to involve everyone in both the strategic direction and day-to-day work of the company. We want our people to adhere to the company's mission and demonstrate a high degree of motivation.

Q: A few years ago, you opened a technical lab to develop sample platforms for different technologies. Do you plan to expand this R&D effort?

A: Actually, the technical lab has been completed, but we haven't expanded it over the past few years. We recreated our network in miniature in the lab so that we can emulate how new products and services will perform before we put them into production. This ensures we provide the best possible operational and service quality. We also have an innovation unit that is working on customer experience benchmarking and introducing best practices and innovative solutions. We consider this as a step towards construction of a state-of-the-art R&D unit.

Q: How do you balance your technology ambitions with the need to minimize costs?

A: As engineers, we're always eager to test and integrate new technologies, but we always have to be realistic from a business and strategic standpoint. We faced such dilemmas in the past when we had to choose between WCDMA and CDMA2000, and then between WCDMA and WiMAX. Despite certain technical temptations, we chose to put aside CDMA2000 and WiMAX and go for GSM/WCDMA/LTE. We can say today that we made the right decision. Going forward, we will use the same methodology to make similar decisions in the future. That is, we will focus on, select, and invest in one technology line per sector, regardless of whether it's wireless or wired. All of our decisions are guided by business cases, so we invest according to the potential business that will arise from the adopted technology. Our passion for pure technology R&D is always there, but it is always twinned with profitability.

Q: Do you think that fixed broadband can still compete with wireless broadband?

A: The future will be a mixture of both. Fixed broadband will be critical especially for the backhaul of small cells and MSANs. It will also continue to be critical for enterprise customers and IPTV. I also believe that wireless broadband will continue gaining in popularity. Yet, this will be thanks of the backhaul delivered by fixed and transmission networks. So the future

Nizar Bouguila, CTO of Tunisie Telecom

will be a mixture of both.

Q: Have you taken any concrete steps to simplify fixed broadband so that it is as attractive as wireless broadband?

A: We're working with the Ministry and regulator to set up a new delivery model so that fixed broadband is smoother and simpler for customers. The target is to have only one entity for fixed broadband service and support; otherwise, customers will migrate en masse to wireless broadband. We also believe that businesses and critical applications require fixed broadband because services can be delivered much quicker and easier and with higher quality. So we need to move in a direction where everyone has a suitable wireless or fixed solution.

Q: Some international operators charge OTT providers for the privilege of allowing their traffic on the network. Does this model solve the problem of not being able to profit from OTT traffic?

A: I can tell you this: Telcos cannot ignore OTTs and vice versa. We must both work together to ensure that the delivery model is stable and balanced. Both of us must achieve our interests while moving forward to deliver innovative solutions to end users. Regardless of whether a pay-for-carry model or some other models is used, what's certain is that both OTTs and telcos have to include each other in the business model. There has to be a common-interest solution that is sustainable in the long term.

Q: Tunisian customers are still satisfied with 2–4 Mbps. Do telecom operators have to get involved in content production, sponsoring and distribution in order to push subscribers towards more bandwidth-hungry applications?

A: I think this is tightly related to content. I believe customers in Tunisia are similar to Europeans; they are eager to consume more (relevant) content. So the content-delivery model is a key factor that affects speed requirements. The current model must be re-worked and revised in terms of the way we deliver TV, the way we protect copyright, and the way we cooperate with content providers.

The average bit rate delivered to customers in Tunisia is the same as that in Europe. We're eager to deliver more and more depending on the evolution. As for content production, we don't have any plans to get involved in this. We think this is a different business entirely and requires different know-how. We are telecom professionals. Perhaps we are helping the production sector indirectly by delivering more of their content, especially local content.

Q: Tunisie Telecom aggressively adopted multicarrier upgrades and HSPA+. Will you shift to LTE?

A: This depends on how the technology for carrying mobile data evolves in terms of efficiency. We have invested in 3G and launched it only three years ago. Financially speaking, we're looking to leverage what we have already done and will continue to upgrade our 3G equipment to meet customer needs. However, we're looking closely at 4G. If this proves to be a better alternative in terms of efficiency and strategic ROI, we'll go for it.

Q: Tunisie Telecom was the first to launch cloud services in Tunisia. Is the Tunisian market welcoming such kind of services? What about security and volatility concerns?

A: We built an operational data center a few years ago, and now we have prepared a brand new Tier III data center that complies with international standards. Our customers are showing huge interest in having cloud services, and we are trying to respond with valuable offers. Tunisie Telecom has hosting and SAAS services that we will enrich this year with IAAS, backup as a service (BaaS), and security as a service (SecaaS).

Q: Tunisie Telecom is far ahead of its competitors in terms of infrastructure. How do you intend to leverage this?

A: Tunisie Telecom leverages its infrastructure to provide better coverage and network performance for customers. Indeed, more than 95% of our node-Bs are connected through

An interview

fiber optics. This means we can handle existing traffic and expected traffic from mobile data growth better than our competitors. We are also leveraging this infrastructure through our wholesale division, which offers services to other operators and utility companies.

Q: The new amendments to the Telecom Law Code allow companies to act as telecom carriers. Several government-owned enterprises are deploying large-scale fiber and communication infrastructure. What do you think about this?

A: The networks of utility companies are designed to fit their own needs and therefore are not very competitive with operator networks. Such companies might complement Tunisie Telecom in some areas such as security and redundancy. This arrangement has worked very well recently.

Q: More and more countries have ambitious national broadband plans designed to guarantee high-speed broadband to all citizens. In Tunisia, the telecom industry is still betting on a purely commercial model. As the incumbent semi-public operator, can you foresee a partnership between Tunisie Telecom and the government in a publicly sponsored NBP? If not, do you think the involvement of STEG and SNCFT might be an alternative that could unbalance the market in the long run?

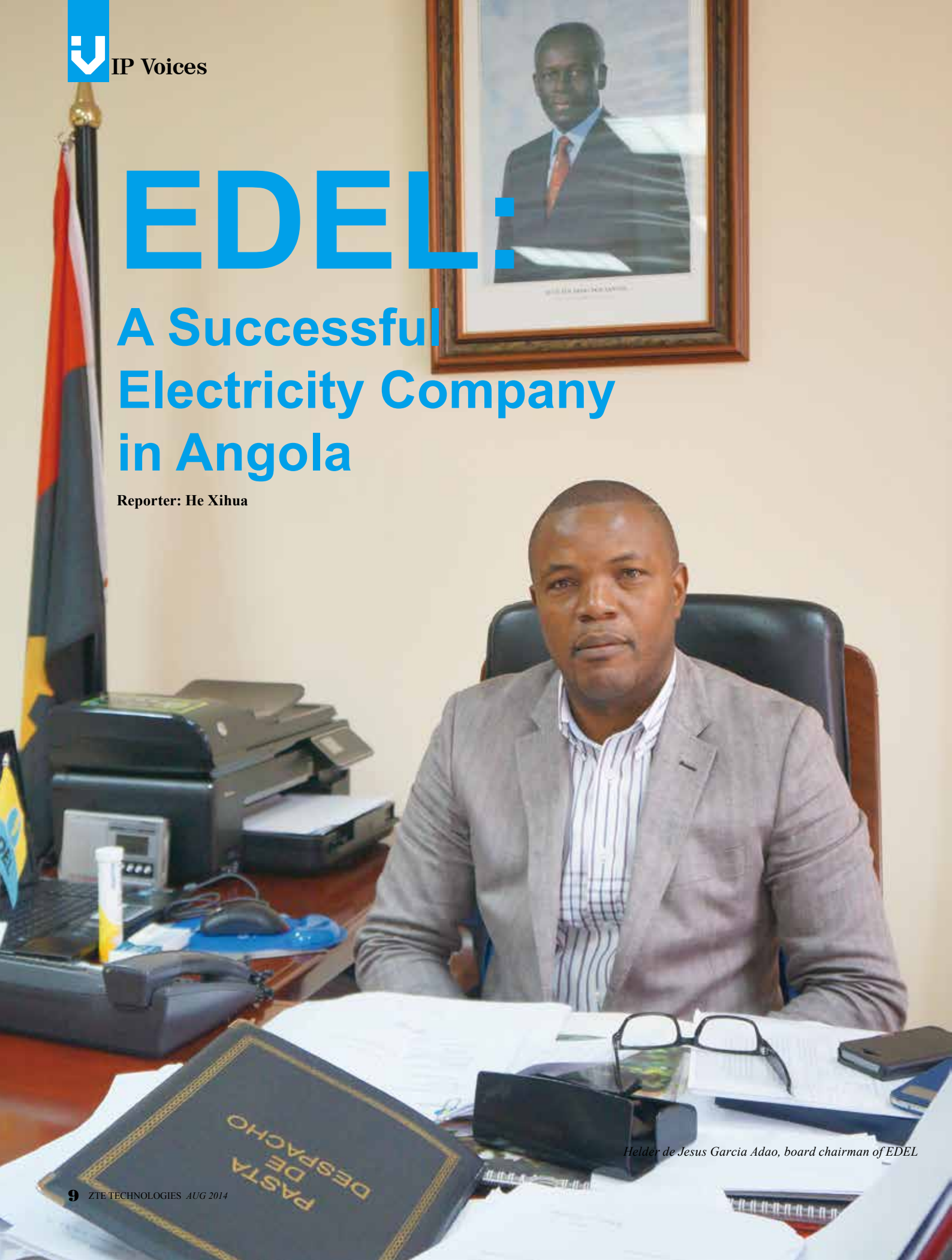
A: Tunisie Telecom welcomes such a plan, and we think that Tunisia has to build a national broadband network that will benefit GDP, employment, etc. Tunisie Telecom is willing to take responsibility and help implement this plan. We're ready to partner with the state and other stakeholders, and we're fully supporting the ministry and the regulator.

Q: Are you outsourcing some of your network OAM and support?

A: I think Tunisie Telecom is quite different in this regard. We have a large number of skilled employees who not only manage our network but also help manage those of other operators, ISPs and xVNOs. In this way, our managed services model is reversed; Tunisie Telecom is a supplier not a consumer. ZTE TECHNOLOGIES

EDEL: A Successful Electricity Company in Angola

Reporter: He Xihua



Helder de Jesus Garcia Adao, board chairman of EDEL

Angola is located in southwest Africa and has the highest potential economic growth of any country on the continent. Angola's electricity is sold and distributed by Empresa de Electricidade de Luanda (EDEL), a state-owned enterprise. As the strategic partner of EDEL, ZTE has contributed to the development of electricity in Angola, and the cooperation between the two companies has been emulated within other government sectors. *ZTE Technologies* interviewed Helder de Jesus Garcia Adao, board chairman of EDEL. He talked about the current state of Angola's electricity sector, the challenges associated with large electricity projects, and the overall objective of EDEL.

Q: Could you introduce EDEL?

A: EDEL is dedicated to electric power distribution and operates in the capital Luanda. EDEL was founded in 1982 and is derived from two former companies: LAI and SEMAIS. The merger of these two companies gave rise to EDEL, which has been growing fast in terms of infrastructure and number of clients in recent years. With the end of the war, Angola has experienced rapid development. Now we live in a time of reform and transformation. This means companies will be reformed and structured, and we are prepared for this new stage. We currently have around 1,215 workers and 550,000 clients. Our greatest challenge is the electrification of areas where we hold a concession (i.e., Luanda and Bengo). In these provinces, there are many virgin, non-electrified areas. The city has recorded large growth in housing over the past 10 years in all directions; so this is a great challenge for our current business. We also have other challenges, such as repairing and rehabilitating the network in areas that already have electricity. We have put a lot into training our technicians to upgrade the network. In recent years, we have undertaken various projects to expand and develop power supplies, and we have extended partnerships with various companies.

Now we live in a time of reform and transformation. This means companies will be reformed and structured, and we are prepared for this new stage.

Q: What is the current state of Angola's power sector?

A: Electricity production is lower than demand. All the equipment we have available is being used to full capacity, and we do not have any equipment in reserve. There is a lot of pent-up demand for electricity, including infrastructure projects that have been defined by the government. The first phase in the government's electricity infrastructure program will run from 2013 to 2017. The large projects will be concluded by 2017, and this will help satisfy the demand. With these infrastructure projects underway, the supply curve is expected to gradually match the demand curve.

Q: What are the challenges associated with large electricity projects in Angola?

A: Training and expertise is a challenge. We need to train our technicians how to operate the new hydroelectric plants, Kaculo and Lauca, as well as the combined cycle plant in Soyo and second plant in Cambambe. Safety is also a big part of the necessary training. Staff will be trained, but we have done this before in past projects, such as construction of the Capanda substation, which was completed successfully and still being operated by our local staff.

Q: ZTE entered Angola in 2003 and started a partnership with EDEL in 2012. At the end of 2012, EDEL and ZTE signed the first contract for supply and installation of prepaid services. What do you think about ZTE's cooperation with EDEL so far?

A: ZTE had no references, so we had

to make a wager that the partnership would turn out ok. The only background we had on ZTE was its partnership with Angola Telecom. The project with ZTE has been going well apart from a few timing issues. In general, we are pleased with the work ZTE has done and this partnership overall. We are almost in the final stages of the projects we have undertaken together, and ZTE has left us with a good impression. This assures us that we can invest in the partnership for new projects. Of course, there are some details that require further attention from ZTE, but in general, we are very satisfied and want ZTE to be a big partner. We can count on ZTE in the near future.

Q: What has been ZTE's contribution to energy development in Angola? Beyond the power sector, what other areas can ZTE contribute in?

A: ZTE has a lot of potential; it is a multinational company with good technology. We can explore what we want in coming years and see how ZTE might be able to help us in different areas, particularly in telecommunication, information, and IT technologies. We are also thinking about maintaining this connection with prepay, and how we can test this partnership in other areas or sectors so we can deepen this relationship between the two companies.

Q: Will the partnership with ZTE be emulated within other corporate or government sectors in Angola?

A: Yes, certainly. ZTE already has a relationship with Angola Telecom and ENE. This means that in the medium-term, other doors could open for ZTE in other sectors of the Angolan economy.

Q: Why is Angola transforming large electricity companies such as EDEL, GAMEK and ENE?

A: The objective is to make these companies as efficient as they can possibly be. Currently, these companies still depend on the state, which is the largest investor in the sector and subsidizes energy. Tariffs need to be adjusted to become closer to real market price. The real overall objective is to make these companies more efficient and less dependent on the government.

Q: Will this transformation affect the relations with ZTE and other companies?

A: The main objective of transforming the sector is to create a company dedicated to each segment within the value chain. That is the main focus of the transformation. Any of these companies that rise within the scope of this transformation will always need partnerships with companies. During the current transformation, companies will need this relationship or partnership with partners. In this respect, a change is also needed in electricity laws so that they permit the participation of many private-sector companies. At present, the tendency is for very restricted relationships with private companies.

Q: What is EDEL's objective for the next five years?

A: The future distribution company has to further the objectives of the whole reform process so that companies within the electricity sector become more efficient. EDEL must also formulate strategic objectives where the challenges remain the same. One of these objectives involves expanding electrification to secure access to energy for the largest number of clients. This is defined in the government program for 2017, including 600,000 new connections or 600,000 new clients in Luanda between 2013 and 2017. We predict that a future distribution company will have more than 1,000,000 clients in the rest of the country by 2017. Electrification is a big challenge, but there are also other important challenges. The most important responsibility of the distribution company is to maintain the sustainability of the sector because the company is in the last segment of the chain that aims to assure stability of the sector. ZTE TECHNOLOGIES

LTE Network and Backhaul Trends

By Phil Marshall

Phil Marshall, *chief research officer, Tolaga Research*

Phil Marshall is the chief research officer of Tolaga, where he leads software architecture and development, and directs Tolaga's thought leadership for the mobile industry. Before founding Tolaga, Dr. Marshall was an executive at Yankee Group for nine years, and most recently led its service provider technology research globally, spanning wireless, wireline, and broadband technologies and telecommunication regulation. He serves on the advisory boards of several startup companies and was a non-executive board member of Antone Wireless, which was acquired by Westell in 2012.

Marshall has 20 years of experience in the wireless communications industry. He spent many years working in various engineering operations, software design, research and strategic planning roles in New Zealand, Mexico, Indonesia and Thailand for Verizon International (previously Bell Atlantic International Wireless) and Telecom New Zealand. In addition, Marshall was an electrical engineer at BHP New Zealand Steel before he attended graduate school. He has a PhD degree in Electrical and Electronic Engineering and is a senior member of the IEEE.

This is a speech by Dr. Phil Marshall, chief research officer, Tolaga Research, at the 2014 LTE & Backhaul Forum at MWC 2014.

> *The real challenge today is the operational inertia of traditional business and the challenges of being able to evolve operational environments in order to take advantage of these new capabilities.*

I want to talk to you today about what's needed within LTE networks and the way in which networks are evolving to support services beyond just being broadband access. I want to talk about embracing certain architectures as well as concepts of the way in which services can be distributed.

If we look at the global deployment of LTE, the rate at which networks have been deployed is staggering. We're heading to about 300 LTE networks, and this trend is going to continue into the future. Even though many networks are deployed, we haven't yet really leveraged them to the full extent in terms of subscriber adoption. So certainly that needs to happen, and indeed I'd say that the major activity with LTE network subscriber growth has been in North America and Asia Pacific. So we're certainly anticipating these other markets to grow.

LTE Implementation Phases

If we look at the phases of evolution, you can really tell where service provider is at in terms of their mobile service ecosystem, how they are positioning their LTE deployments, and the extent to which they're embracing the digital services like those presented earlier in this session by China Mobile and certainly talked about by other operators. We see in the first phase an emphasis on being very network centric, and then an evolution towards how to use LTE for service enhancement. When that occurs, you start to see a lot more devices advertised on the websites of service providers as well as packages that talk about much more than the speeds and feeds associated with LTE. LTE is starting to enable true service evolution when we start to look at what companies like NTT DOCOMO are doing with their data offerings, what Telefonica is talking about with its digital service strategies, and other companies like Telstra who are leveraging some of the advanced features, such as eMBMS broadcast, in LTE as well. These companies are really trying to push the envelope in terms of the service experience that you're trying to create for subscribers and what the next generation of services looks like. Certainly that's an important evolution the industry needs to go through. The real challenge today is the operational inertia of traditional business and the challenges of being able to evolve operational environments in order to take advantage of these new capabilities.

Case Study: Verizon Wireless Traffic Simulation

At Tolaga Research, we do a lot of network simulation work. We simulate several hundred service providers looking

at different traffic profiles and the impact of implementing different types of technologies in their networks. What I want to do is just a very basic analysis of Verizon Wireless in the US, just to demonstrate the importance of a service provider implementing advanced technologies. This particular scenario shows dramatic growth in LTE traffic. This really comes about as Verizon migrates its device base across to LTE and starts to launch more data services. As this occurs, we notice that the macro network essentially requires twice as many cell sites, and this is in conjunction with a small-cell overlay. Obviously, this isn't really an achievable practice when you think of site acquisition issues and so forth. So it's a complicated challenge that the service providers face in the sense that they can't really do this within their network. They need the innovations that were presented earlier today in terms of squeezing more capacity out of the existing sites. They need more radio spectrum etc. to achieve that.

In the same simulation, you can see what we've considered from a small-cell standpoint. There's actually a lag in this particular simulation because we assume there are some operational challenges, particularly around site acquisitions and so forth, to bringing small cells to the market at a meaningful scale. This demonstrates that you're getting to about 120,000 small cells; bearing in mind that you've got about 80,000 macro cells to support that traffic profile, which is quite plausible within the simulation that we are considering. So a lot more is needed than just building more cell sites to support this traffic.

So there's no doubt that mobile operators are going to end up with networks with massive scale. The question is how they're configured and what kinds of innovations do you use to achieve this scale. Small cells will become a reality and when that occurs, the mobile network will start to look more like a broadband network than a traditional macro cell network that we're accustomed to. The backhaul considerations are immense, and what we see already is a variety of innovative alternatives to the conventional point-to-point architectures, such as millimeter wave and point-to-multipoint architectures. Certainly, operational automation is

crucial. There's a lot of talk around implementing SON. When we evaluate the business case for mobile broadband, the way in which network operations are automated is crucial. This will drive in a few key areas; particularly with small-cell deployments and to address other challenges that service providers find as the network becomes more complicated to manage.

Once we've done that, traffic optimization and management solutions are also needed. So you can't underestimate interference management, the role of schedulers and so forth as these networks evolve and the fact that these will change between different types of cell sites that are implemented. We also must consider the way in which traffic is prioritized, considering different traffic flows that are associated with different services, and the way which these services utilize network resources. In terms of media-management technologies, we've already seen some efforts around CDN and pushing content closer to the edge of the network. Particularly when we start to look at network function virtualization, the device itself must become part of the network and part of the virtualized architecture. This is obvious when we start to look at the price memory and the amount of capacity and memory that you can put in mobile devices. We see the media going all the way down to the device, and service discovery functions and content distribution networks extend that far down as well.

LTE Backhaul Strategies

When we look specifically into backhaul, certainly the fixed network is becoming increasingly important as a part of a mobile architecture, and obviously we've seen an aggressive migration towards Ethernet and further innovations in all types of backhaul. Dark fiber is seeing a significant resurgence since many service providers have provisioned inadequate capacity with their existing infrastructure. We also see very high capacity microwave as well as the mainstreaming of some more exotic technologies, like millimeter wave and FSO. So you're starting to see these technologies come to the fore, and indeed there's a lot of interest in them just because of the bandwidth capabilities they can achieve, particularly for small-cell environments and particularly because they can be architected in a way that enables you to manage them effectively. Even with satellite, with HTS satellite capabilities and MEO/LEO solutions for remote rural areas, you start to see business cases where higher bandwidth WiFi and LTE makes sense in rural and remote areas.

When we look at the economics of backhaul solutions specific to small cells, firstly I think with small cells we have to reduce planning and implementation costs. The rule of thumb is to try to get this down to 5000 dollars for an all-in implementation. That is very challenging, and certainly from a backhaul standpoint, it requires a lot of innovation. Beyond the point-to-point, point-to-multipoint, and the types of radio and fiber technology that are implemented, I think you actually start to see SON and automated optimization techniques emerge as well. In other words, you essentially have your backhaul as part of the hierarchy of an access network. We're already starting to see solutions in the backhaul arena and I think is particularly important.

LTE Continues to Fuel Market Change

There's a lot of uncertainty in this market, so I thought I'd trying to put some stakes in the ground in terms of things I think are more likely to happen and what won't. This is almost an arbitrary list, but I just want to illustrate there are some things we can be certain about in this industry, and we should focus on these and build strategies around them while dealing with some things that are a little bit less certain. Policy-based approaches to service delivery make a lot more sense than billing caps. We can start to see changes in the way in which service providers implement their services, recognizing that the bill is actually quite an important component of the overall purchase decision and should not be hindered by usage cap constraints.

Other trends will be the use of TDD spectrum, and certainly listening to China Mobile on that, as well as wider-spread usage of TDD and recognizing ZTE's role in the TDD arena. If you actually look at TDD spectrum in terms of megahertz-POPs, about 30% of the available MHz POPs for mainstream mobile technologies are the TDD band. So there's plenty of spectrum there.

The number of LTE networks continues to expand, and there we expect the challenges will remain within the backhaul arena.

It's unlikely that mobile traffic growth will bankrupt the industry. The industry has to transition, and I think we are starting to see these changes occur.

Also, it's unlikely that we'll see these massive network expansions that are predicted out of rudimentary traffic-modeling tools. This is back on the topic of what I presented earlier: we have to introduce advanced technologies; we have to change the architecture and the way which we deploy and operate the networks. ZTE TECHNOLOGIES

Focusing on User Experience to Build Converged, Innovative 5G Networks

By Wang Xinhui

Wang Xinhui,
director of 5G standards, ZTE Strategy Planning Department

About 5G

In today's ICT industry, physical network elements are continually evolving and merging with each other. Greater consideration of user experience represents an advance in smart terminals and network technologies in the mobile ICT industry. 5G will provide much better user experience and makes further convergence and innovation possible in terms of terminals, wireless network and services. 5G will revolutionize information perception, acquisition, participation, and control. 5G services will expand to include more enterprise users. A 5G network will leverage

the excellent features of a LAN and cellular network; it will become smarter and friendlier and serve a broader range of purposes. It will penetrate all aspects of life and coexist with other successful technologies.

Challenges

5G does not only imply increased bandwidth and meeting the needs of personal users; it also implies a greater focus on user experience and meeting the needs of internet-connected social applications. In achieving these ends, there are three big challenges: providing ubiquitous services, handling massive data connections, and ensuring energy efficiency.

Ubiquitous Services

In the M-ICT era, services will be everywhere. People will require more efficient mobile offices, information sharing, social interaction, e-commerce, internet finance, and other mobile internet services. R&D on 5G will begin with improving user experience and will shift to setting up a user perception model based on meeting service needs. Then, the R&D focus will shift to improving key technical indicators, such as network capacity, bandwidth guarantee, peak rate, network delay, and high-precision indoor positioning.

Massive Data Connections

A 5G network establishes high-speed person-to-person, person-to-machine, and machine-to-machine connections. With information as the link between the physical and digital worlds, a ubiquitous, general-purpose, high-speed interconnected network needs to be built up. 5G provides efficient connections for social life and enterprise applications. These connections are massive and will be a big challenge in terms of network capacity and robustness. Therefore, 5G has to incorporate into the mobile internet industry all the value links and production elements associated with the office, shopping, medical care, education, entertainment, transport, and social life. A physical map is thus set up on the internet, and the physical world is integrated with the digital world.

Energy Efficiency

Energy efficiency is essential in 5G. In the M-ICT era, a big, dense 5G networks with ubiquitous services and massive data connections will consume a huge amount of energy if built with available technologies. Terminals connect man and machine to the entire network and directly affect what the user experiences. There will be many power-related challenges in developing 5G terminals that incorporate all kinds of sensing and new media technologies, materials, and entertainment facilities. It is therefore necessary to change network architecture and restructure NEs and related functions in order to save energy on both the network and terminal side.

Technological Expectations

5G R&D will center on enhancing user experience, orienting applications to the information society, and building an integrated smart network.

Technologies for Super-Heavy Data Traffic

Smart mobile terminals and cloud applications will fuel the explosive growth of data traffic. To support super-heavy

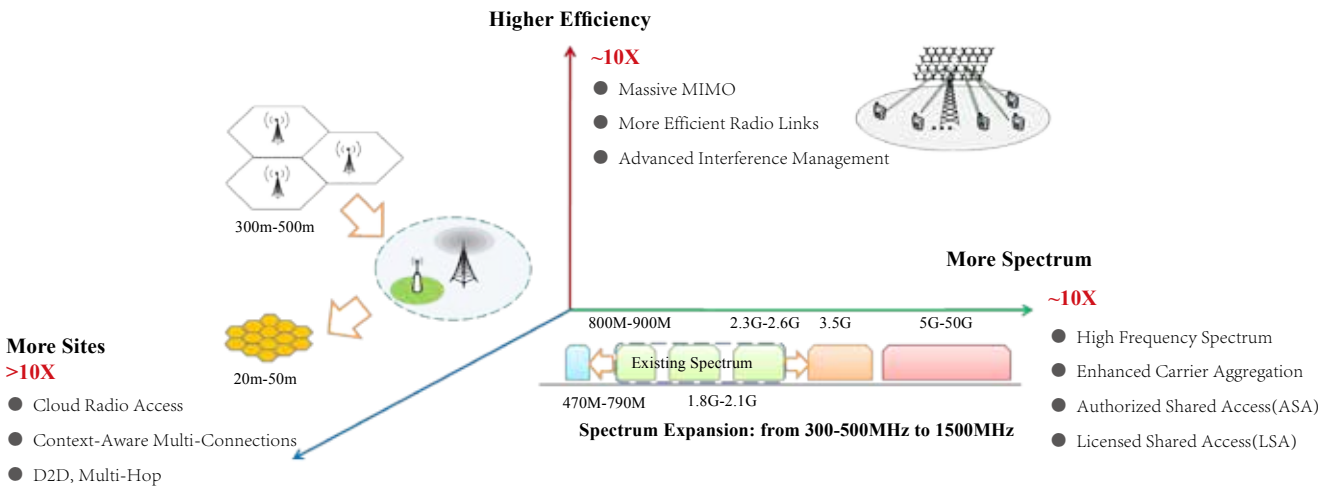


Figure 1. Supporting super-heavy data traffic.

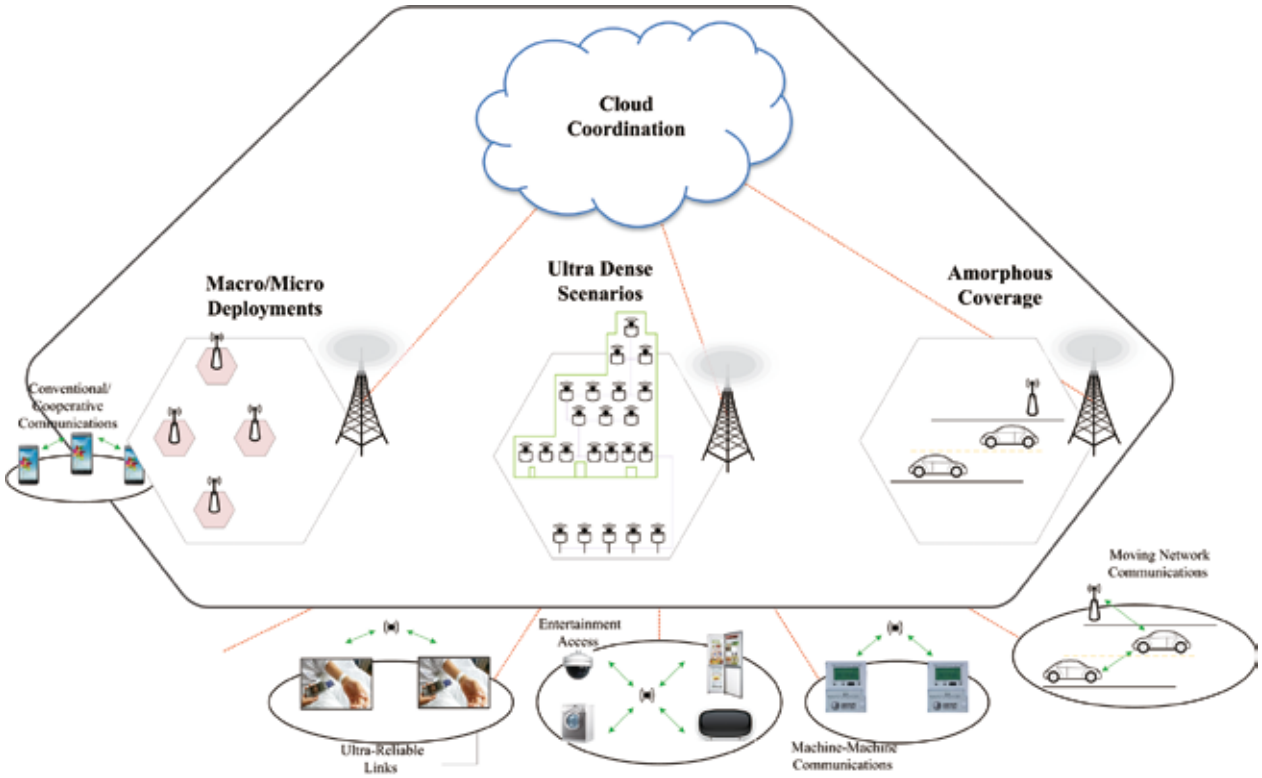


Figure 2. Cloud access network architecture.

data traffic, greater research needs to be done on wireless radio link, spectrum utilization, and networking (Fig. 1).

Radio links can be made more efficient in terms of coding and modulation, multiple access technology, and receivers. Nonlinear multiuser pre-coding, new joint coding and modulation, and network coding can all be explored. Multiple access technology includes non-orthogonal multiple access technology. In terms of receivers, much research has been done on 1) new waveforms that support MIMO and 2) full duplex short radio links. Combining all of these technologies can significantly improve transmission in a wireless network.

5G provides higher bandwidth by adding new operating spectrum that includes frequencies above 3 GHz or even some sub-millimeter wavelengths. These frequencies provide indoor and hotspot data rates similar to that possible with optical fiber level. With these new frequencies, 5G can enable dynamic, intelligent spectrum management so that the network operates on unauthorized or unassigned frequencies.

5G will be important for local hotspots with super-heavy date traffic. Bandwidth capacity per unit space can be improved through dense networking. Combinations of various new high-speed wireless LAN access points and small cells can be densely deployed to form a network with super-high bandwidth capacity.

Intelligent Cloud Networking

5G network architecture needs to be adaptable to fluctuation in data traffic, and this means the network needs to be intelligent and cloud-based. Person-to-person, person-to-machine, and machine-to-machine connections will all need to be seamless. Any individual, enterprise, or even machine could be the consumer or provider of information services. They form a new relational digital ecosystem and drive the rapid growth of data traffic. An intelligent cloud network must be able to cope with related challenges.

5G will be a heterogeneous network based on cloud processing (Fig. 2). While introducing new wireless technologies, the network will provide access control over existing wireless systems. A new control mechanism is needed to coordinate resources in all kinds of wireless systems, frequency bands, and cells. This is necessary to improve user data access capabilities in various scenarios. Cloud-based wireless resource management and scheduling reduces network construction and management costs and facilitates a unified operation of both 5G and existing wireless networks.

A 5G network will also need to have a flat architecture in order to suit M-ICT services. Software-defined networking and virtualization will be used to transform the vertical network architecture into a flat one. RAN functions will be enhanced and gateway functions will be simplified to reduce network complexity. A centralized control plane and universal forwarding plane in the 5G network will make it easy to support value-added services, big data analysis, and open pipes.

In a 5G network, multiple access technologies, including new high-speed wireless LAN and short distance connection, need to be converged into a unified system architecture. Research will be done on multisystem convergence, intelligent management, and universal cloud-based platform construction.

Reducing user response latency is important for improving user experience. This may involve reducing network delay, backhaul delay, access delay, and terminal delay. Related technologies and strategies include preliminary scheduling, local gateway, local caching, fast decoding, and service-oriented QoS control.

Deep Convergence of Services and Network

In the M-ICT era, mobile multimedia services will grow fast. With the current network and service structure, some large-traffic services, such as HD and super HD mobile videos, will flood the entire network. On a 5G network, services that directly affect user experience will be provided by both the network and the cloud end. Therefore, deep convergence of services and network will significantly improve user experience and reduce capex and opex.

Open Network Capabilities

A unified and open platform will be the basis of service provisioning. While providing fundamental services for users, a 5G network can open its interfaces that third-party developers may use and assemble to create new applications.

Cooperation

5G for the M-ICT era will allow ICT applications to penetrate other industries. In the early days of 5G, it will be necessary to listen to the demands of other vertical industries and cooperate closely with them.

It will also be necessary to pay close attention to operator needs in term of network construction and OAM. Cooperation between operators and equipment vendors will lay the foundation for achieving ubiquitous services and perfect user experience.

The big challenges posed by 5G are also opportunities for close cooperation between academia and industry. The ITU, NGMN, 3GPP and IEEE are now determining 5G requirements, researching 5G technologies, and formulating related 5G standards. Both academia and industry can leverage the platform to make their own contributions to 5G development.

Conclusion

5G is the basis of the M-ICT era. 5G will center on user experience for multilevel convergence and innovation. It will provide super-high bandwidth, enable massive connections, and ubiquitous services and perfect user experience for individuals and enterprises. While improving its capacity, 5G will also make the network and terminals consume less energy.

5G will be combined in depth with mobile internet in structure and will evolve to a smart cloud-based network. The deep convergence of services and the network will eventually bring superior experience and services to users. ZTE TECHNOLOGIES

The Path of Big Data: Cooperation, Innovation, Win-Win Partnerships

By Chen Zhiguo and Li Xiaojin

Statistics show that the amount of internet data doubles every two years, and more than 90% of current data has been produced in the last few years. Massive scale is only one aspect of big data; other aspects are speed, variety, and value. The last of these is key to the future of big data.

Necessary Conditions for Big-Data Development

Big data can be developed in terms of data sourcing, data transactions, and creating value out of data. Recent years have seen the rise of social networks, the development of M2M, and the popularity of mobile internet. As a result, many valuable data sources have emerged, and these have laid the foundation for big-data development. There are two important symbols of the advent of the big-data era: 1) the emergence of a large number of specialized data traders, and 2) the emergence of an industry related to data trading that includes data collection, clearing-up, analysis, and application. Central to big-data development is enabling users to create new value from vast amounts of unstructured and semi-structured data. The value of data is the driving force behind data transactions.

IBM, Oracle, and SAP have invested heavily in acquiring data management and analysis companies in recent years. Thanks to the efforts of these internet giants, data-analysis technology has matured. In June 2013, Edward Snowden exposed the U.S. "Prism" plan, which shows how mature big-data technology is being used in the service of national security. However, people are yet to experience the benefits of big-data technology in their everyday lives because there is little value in the data transactions.

The development of big-data technology promotes the deployment of cloud computing which, in turn, increases market expectations about

the value created by data. The market has finally seen the profit potential of big data and cloud computing, and the market for cloud computing seems to have exploded overnight. System integrators are working with local governments to build cloud data centers and smart cities. Industry leaders are establishing hybrid cloud standards for their own industries in order to build up industrial cloud platforms. Public clouds have also come into being. IT giants are trying their best to obtain a public cloud license in China. Because of market expectations of the value of big data, cloud computing has finally been implemented, five years after it first emerged. The concept of smart city has been widely accepted, and cloud computing infrastructure has been prepared as the hardware foundation for big-data applications. Because of the expectations for ROI in cloud computing, big data must produce great value from its applications. Now, the emphasis is on how data can create such value.

Data Integration and Openness

According to a survey of 800 business and IT managers, conducted by Connotate in 2012, 60% of respondents said that it is too early yet to be certain about the ROI in big data. At present, big data is not open enough; that is, big data is in the hands of different sectors and enterprises that are not ready to share data. The inherent laws of big data have to be determined through study of data correlation, and this relies on data authenticity and universality. Data sharing is a major area of concern in big-data development.

Obama's success in the 2012 presidential campaign benefited from data integration. The campaign team employed a data-mining group who helped raise $1 billion through mass data mining. Campaign advertising was also made 14% more efficient through data mining. The data-mining group provided the raw data used to create detailed models of voters in swing states and calculated Obama's chances of success in these states by simulating the elections 66,000 times every night. This means the campaign could channel resources efficiently. Data integration differentiated the Obama campaign from the Romney one.

The data-mining group of the Obama campaign also realized that data was scattered across too many different databases, so in the first 18 months, they created a single data system that could integrate all the information coming from pollsters, donors, on-site staff, consumer databases, and social media as well as information about the main Democrat voters in swing states. This huge database helped the Obama campaign pinpoint potential voters and capture their attention. It also helped the campaign team predict what types of people could be persuaded by

specific stories. Obama's campaign manager, Jim Messina, said that there had been very few hypotheses that were put forward without data support.

In March 2012, the Obama administration announced that it would invest $200 million into big-data research and development. Big data has been defined as a national strategy; mass data and its related applications will become an important part of a country's overall strength. Data sharing is also one of the goals of smart cities in China.

Business Model for Big Data

As cloud computing, big data, and related businesses mature, more software developers will use cross-industry big-data platforms to build applications that create value from this data. This is becoming easier. Data owners are more willing to make this happen so that they can generate extra income for minimal cost. Big-data equipment vendors are also willing to see this happen because they need applications that attract consumers to buy their devices. Vendors generate more profit by entering into in-depth win-win partnerships than by merely focusing on selling devices. Some far-sighted vendors have started supporting software developers by providing funds, technical support, and stock. There is also a growing need for data-analysis applications in the enterprise market, and innovative developers of enterprise data applications will have a central role in the entire big-data industry chain.

In the forthcoming era of big data, enterprises that have mass data, strong data analysis capability, and innovative software developers will dominate the big-data industry chain. Social networks, mobile internet, informatization enterprises, and telecom operators are all creators of mass data. Facebook boasts a user base of 850 million; Taobao has 370 million registered users; and Tencent has 400 million WeChat users. The data produced by these huge user bases may be a source of enormous business opportunities someday. In the near future, owners of mass data will either grow to be data-analysis providers or cooperate with enterprises such as IBM and ZTE in upstream/downstream business relationships. The big-data industry chain will grow surprisingly fast after a certain flashpoint.

Potential Drawbacks of Big Data

Instead of data being randomly sampled, all data can be collected and retained so that analysis of this data is more accurate and inferences do not need to be made for the whole data set. This decision-making model is more accurate because it cuts out interference that might come with personal emotions, psychological motivations, and sampling errors. The accuracy of big data depends on the methods used to collect it. Any problem in the method of collection can lead to flaws in the data. As a consequence, decisions based on this data may also be flawed.

Just as too little information may be useless, too much data whose accuracy and value cannot be determined is also useless and may even be detrimental in scenarios where it is the basis for important judgments. The big-data theory is based on the fact that all data is true. What if a data provider forges data? This can be very harmful because the prejudice and filtering process of data providers are not controllable. Wall Street investment banks and top European and American rating agencies were the first to accept the concept of big data and owned perfect databases; however, they have suffered at times from critical errors of judgment based on erroneous big data. This reveals the limitations of big data. It is necessary to be aware of the potential drawbacks of big data while continuing to develop it.

The economic value of big data has been recognized, and big-data technology is maturing. Big data will reach a critical turning point when data has been integrated and regulated. ZTE TECHNOLOGIES

Developments in Big-Data Hardware

By Xiong Xiankui

There are three important aspects of big data: the huge scale of the data to be handled, multidimensional data analysis, and diverse data processing requirements. Big data is so big that it is usually measured in petabytes whereas data used in traditional online transactions is usually measured in terabytes. Big data is comprehensively analyzed in a dozen dimensions whereas in a traditional relational database, more emphasis is given to the coupling relationship between data and to the NoSQL database, which uses the key-value of hash for storage. Big data also has diverse data processing requirements. Non-real-time business intelligent processing occurs in the background and is used for analysis and mining. However, real-time decision-making, such as that which occurs in a high-frequency financial trading system, is needed to replace traditional online transaction and processing of big data. These factors have driven the development of bottom-layer hardware technologies.

Video-based smart city applications, such as vehicle license plate recognition, facial recognition, or vehicle tracking, create data at the petabyte or even exabyte level and need to be stored economically. Large-capacity, high-density SATA hard disks are usually used to store and analyze such data, and open-source software, such as Hadoop, is used to construct a distributed file system for storage. The POSIX-mode API interface is used to build a big-data processing platform. Recently, there has been much interest in a server that combines computing and storage. A storage server usually has:

- a two-channel Intel XEON processor
- strong computing and storage capabilities
- mid-range memory
- GE and 10GE network adapters
- 12 to 24 local SATA hard disks.

Large internet companies, such as Tencent, use this type of server to build their own big-data processing platforms. ZTE provides the i8350 storage server, which meets the TS6 specifications and has passed rigorous tests. ZTE i8350 is now very popular in the market.

Database platforms, especially those for big-data processing, analysis, and mining are becoming column-oriented rather than row-oriented relational databases. Sybase IQ is a high-performance, highly-scalable, column-oriented database suitable for OLAP

i8350 storage server

applications. The hardware architecture of the database usually comprises high-performance disk arrays and high-density server arrays. ZTE provides the E9000 blade server, which has a height of 10U and supports 16 blades. The server has a built-in high-bandwidth FCoE gigabit switch, supports FCF (which provides FC ports), and can be upgraded smoothly to support 40GE FCoE with a single node. ZTE i8350 can be combined with ZTE's high-performance FC SAN disk array in the KS3200 series to create a PB-level OLAP big-data processing system. Many of ZTE's big-data products are based on a database platform and have been put into large-scale commercial use. ZTE's UBAS user-behavior analysis system is one such product used in the telecom industry.

Because of the wide variety of big-data application models, it is difficult for customers to identify different hardware solutions. A big-data processing platform with integrated software and hardware is needed. Oracle's Exadata and IBM's Netezza are examples of all-in-one hardware platforms in which a minicomputer or high-end servers at the front end are used to resolve and distribute SQL requests, and a server cluster at the back end is used for processing. Both Oracle Exadata and IBM Netezza have solid-state storage, such as PCIE SSD, for accelerated index processing. IBM Netezza also uses FPGA on the blade server cluster to accelerate SQL processing. However, the two platforms have different storage mechanisms. Oracle Exadata uses shelf-mode storage servers for distributed storage whereas IBM Netezza uses the blades to connect external optical fiber disk arrays. The combined state-of-the-art technologies within the two databases make an all-in-one platform and service fees expensive. SAP's HANA is another all-in-one system with customizable hardware. It has a hybrid row-column memory database and sells well. HANA supports multi-node extension and therefore has high requirements in terms of memory and bandwidth.

These all-in-one platforms can support various applications, including OLTP and OLAP applications, if the storage capacity is expanded. They are also suitable for background non-real-time analysis and real-time decision making. ZTE's R8500 four-channel server includes Intel's Brickland platform, which ensures high reliability, availability, and serviceability. Its four CPU sockets support up to 96 hot pluggable memory chips. If one LRDIMM has a capacity of 32 GB, then one R8500 has 3 TB of memory, which is ideal for memory databases. With powerful processing capabilities, R8500 can also be the head of the all-in-one platform. The R8500 can be combined with an i8350 storage server to create a distributed storage system that is used as an all-in-one platform for OLAP applications.

Existing computing-centric technologies are insufficient for big-data applications. At present, big-data processing is usually optimized in traditional memory-disk access mode, and there is always a data I/O bottleneck during processing. New hardware and materials, such as phase-change materials and impedance RAM, will be commercialized, and this will greatly increase processing speed and memory. Then, big-data processing technologies based on memory computing will boom. ZTE is working hard to develop big-data hardware. ZTE TECHNOLOGIES

ZTE's R8500 four-channel server

E9000 front

E9000 rear

The Way Ahead for Virtualization:

Integration of Virtualized Computing, Storage and Network

By Huang Xiang

Virtualization is at the core of cloud computing, and vendors such as ZTE have dedicated many resources to researching and developing virtualization software. ZTE has developed fully virtualized computing products and has taken big strides in

- hyper distribution and dynamic adjustment of computing, storage and networking
- live computing and storage migration
- infrastructure network.

A test of ZTE's virtualization software conducted by a third party revealed that the basic functions of the software are on par with those of ZTE's competitors.

Virtualized computing has developed far more quickly than virtualized storage and networking. In current virtual data centers, traditional SAN or NAS methods are still used to store mass data. This limits scalability, reliability, and performance and creates the risk of failure in individual storage devices. Because traditional networks are still used, virtual machines have shortcomings in terms of cross-data-center migration, multi-tenant support, and network service provision. Trends in storage virtualization are:

- distributed architecture without a central node. Without the risk of single-node failure, storage nodes can be deployed according to required capacity and performance. If storage nodes are added or removed, the stored content can be re-distributed according to policies. This guarantees that load and capacity are balanced on each storage node.
- definable storage reliability. Erasure coding and a number of copies ensure that storage reliability is definable according to tenant needs.
- integrated deployment of computing and storage. Storage virtualization software optimizes computing virtualization and ensures that fewer CPU and memory resources are used than is otherwise the case with common cloud storage software. Storage virtualization software enables computing and storage to be deployed on the same physical host, and both computing and storage systems have distributed architecture. This means that capacity can be more easily expanded and equipment can be more optimally used.
- intelligent storage. Storage virtualization software stores data (image files) intelligently according to computing load, and the virtual storage system can set the size of blocks according to virtualization features. When deployed together with a virtual storage system, virtualization software stores what it reads into the node it serves in order to reduce network traffic.
- tiered storage. To meet high I/O operational requirements and create intelligent tiered storage, storage virtualization software supports SSD,

SAS and SATA hard disks.

- multiple storage interfaces. Storage virtualization provides multiple interfaces for block, file and object storage. This enables tenants to use these types of storage as needed.

Trends in network virtualization are:

- virtual switches controlled by a network-control node and VxLan used for encapsulation. This solution is suitable for a network based on an overlay model. A DPDK framework and SR-IOV-enabled smart NIC (capable of local exchange and overlay encapsulation) are also introduced to improve forwarding. Virtual machines can be migrated from different networks and data centers so that computing resources can be remotely scheduled.
- an SDN controller that controls both virtual switches and physical switches. This is suitable for a network based purely on SDN. The data center is divided into an internal control domain and an interconnected control domain so that network features can be migrated along with virtual machines. The solution also supports flexible network deployment and multitenancy. For greater energy efficiency, network topology can be adjusted, and idle network devices can be disabled according to network traffic.
- virtualized network functions. Conventional routers, load-balancing devices, firewalls, and security groups no longer depend on hardware and can be implemented through software. Multitenancy is also supported. Tenants are created as required and can interact with virtual machines for unified configuration.

ZTE is a leading provider of cloud storage solutions in China. ZTE's CSS2000 products account for two-thirds of the cloud storage market. ZTE has also won a bid to complete China Mobile's cloud storage project in the south of China, where important services, including 139 mailbox and mCloud, are provided.

In response to trends in SDN and NFV networks, ZTE has also rolled out ElasticNet, an elastic network solution that provides customers with a diverse, flat network.

With strong cloud-storage capabilities, latest network research, and rich experience in computing virtualization, ZTE plans to launch complete next-generation virtualization solutions, including virtualization product iECS4.0 and cloud management platform iROS4.0. These solutions bring together computing, storage, and network virtualization to implement unified, cross-domain scheduling and dynamic adjustment of computing, storage, and network resources. ZTE TECHNOLOGIES

Trends in Data-Center Development

By Li Shiliang

The cloud computing model has been significant in creating demand for data centers, which are becoming more modular, standardized, intelligent, and energy efficient. Data centers will be at the locus of the cloud era.

Modularity represents a fundamental change in the way data centers are constructed. An integrated data center now comprises cabinet modules, power-distribution modules, cooling modules, firefighting modules, and management and control modules. An integrated, modular data center enables smooth, elastic expansion; phased construction; and customization for different scenarios. A modular data center can be built in an equipment room or in a shipping container (for outdoor environments), and an integrated resource cabinet can be provided for small users and vendors.

For rapid deployment and simple operation, a data center should be built according to set of standards that encompass civil engineering, power distribution, cooling system, and network. Standardization will greatly promote the deployment of data centers.

A modern data center has intelligent OAM comprising basic OAM and value-added OAM. Basic OAM includes configuration management, topology management, alarm management, performance statistics, authority management, logs, and reports. Value-added OAM services includes PUE calculation, modeling, optimization, energy efficiency analysis, planning and configuration, terminal access, location suggestion, cooling analysis, problem management, event management, change management, and asset management. Of these, problem management, event management, and change management meet ITIL requirements.

Operational management of a data center involves billing management, measurement management, imaging management, order management, contract management, product management, resource management, and bill management.

The inlet air temperature of an IT cabinet is controlled on demand through precision cooling. Cold channels are isolated from hot channels, and efficient water-cooled hosts are used. This helps improve inlet temperature of frozen water. A high-voltage DC power supply is also used to make a green data center with PUE up to 1.3.

After infrastructure has been deployed, IT facilities are managed in full virtualization mode to create a cloud-based data center. OpenStack architecture is used to manage servers, storage, and networks uniformly so that computing, storage, and network are virtualized. Network orchestration is also implemented, and this enables tenants to flexibly access different resources.

Computing Virtualization: iECS

ZTE's computing virtualization product iECS uses industrial mature XEN as its virtualization engine, and it also integrates ZTE's carrier-class server operating system, NewStart CGSL, ZTE's virtualization management suite ZXVManager, and related tool kits. This means that ZTE's cloud computing solution supports full virtualization and para-virtualization. iECS supports a variety of guest operating systems, such as Linux, Windows XP, BSD, and Solaris. It supports CPUs in a different architecture such as X86, ARM, and PowerPC, and provides hardware virtualization for Intel VT and AMD-V.

iECS also provides highly available clustering, live migration, dynamic load balancing, dynamic resource adjustment, and energy-saving management.

Storage Virtualization: ZXCLOUD CSS2000

The hardware resource pool of ZXCLOUD CSS2000 comprises storage gateways, disk arrays, and storage servers. The hard resources can be flexibly expanded to meet specific application scenarios. The software system of ZXCLOUD CSS2000 includes the distributed file system (DFS), distributed database (DHSS), and distributed cache (DCache). The software system is installed in a universal storage server and supports the architecture of universal x86 servers and universal disk arrays. ZXCLOUD CSS2000 has local OAM modules to facilitate local management of the system. ZXCLOUD CSS2000 can be managed by a unified cloud management platform iROS through the Webservice interface.

SDN-Based Virtualization

Software-defined network (SDN) technology enables centralized network management, flexible networking, multipath forwarding, virtual machine deployment, intelligent migration, and multiple virtual tenants. This makes SDN quite applicable in data-center networks. An SDN controller can serve as the control plane of a cloud data center network and is responsible for topology management and routing calculation within the network. Currently, the SDN controller supports OpenFlow 1.0/1.2/1.3 protocols and automatic adaptation and can be interconnected with the upper cloud management platform iROS through the API interface. The Openflow switch, including Vswitch and Openflow physical hardware switch, supports Openflow1.0/1.2/1.3 protocols and is interoperable with standard controllers. The SDN controller also incorporates Vxlan gateways, multitenant NAT, and VPN functions that enable tenants to communicate between their private networks and a sharing network. IP addresses of different tenants may overlap, and real isolation between tenants can be implemented. With SDN technology, network devices in a data center are virtualized into a logical resource pool that allows users to manage their own networks through a unified framework, allocate resources on demand, and ensure their ability to respond to applications.

Openstack-Based Cloud Management Platform: ZXCLOUD iROS

ZTE's cloud management platform ZXCLOUD iROS is based on the OpenStack architecture and can provide a standard OpenStack interface for upper-layer applications. This removes the differences of virtualization software platforms provided by different manufacturers so as to uniformly manage and operate different virtualization software platforms and allow for diverse underlying virtualization technologies. ZXCLOUD iROS also supports flexible expansion of various third-party virtualization software platforms.

> *Data centers are becoming more modular, standardized, intelligent, and energy efficient, and will be at the locus of the cloud era.*

New-Generation PCDC with Automatic Orchestration

ZTE's new-generation PCDC provides automatic orchestration based on the OpenStack APIs. Users may allocate computing, storage, and network resources flexibly to meet their specific application scenarios. The PCDC enables automatic deployment of a virtualized data center.

With these innovative products, users can flexibly arrange and allocate computing, storage, and network resources on their own portals to implement a fully-virtualized data center. In the future, the data center will evolve in terms of both infrastructure and virtualization and will deliver more convenient services to all users. ZTE TECHNOLOGIES

ZTE Assists China CITIC Bank in Building a Data Bank

By Peng Yu, Hai Yongjun and Ye Yuwen

OTT TV Becomes Essential for Operator Development

China CITIC Bank was one of the first commercial banks established during China's reform and opening up. After nearly three decades, the bank is one of the best capitalized in China and is rapidly growing.

Cloud computing and big data have created new opportunities for innovation and service modes in the financial industry. However, in the banking industry, the requirements for security, stability and timeliness put added requirements on cloud computing and big data. In recent years, internet companies and terminal vendors have been changing traditional ways of thinking. WeChat, Weibo, and third-party payment services are already in full swing and are impacting traditional industries, including the financial industry. Combining internet and finance is a growing trend.

China CITIC Bank proposed to rebuild their online banking by launching internet-based financial strategies. CITIC will create new operation and profit models through payment, data mining, and financial management based on big data and other new technologies. CITIC established an IT team to research and discuss the data bank project. They decided to build an internet-oriented big-data platform that could carry major existing and future banking services.

The data bank deployment project was initiated in 2013. The vision of CITIC is to implement a new big-data platform with basic cloud computing architecture that will drive service development. After eight months of technical exchange and proof-of-concept testing for the big-data platform, ZTE won the bid for the project in March 2014.

Sophisticated Architecture for Stable System Running

China CITIC Bank's big-data platform runs on the X86 server and is capable of high performance and mass storage through the software system. The platform is highly reliable, expandable, efficient, and fault-tolerant. It reduces hardware fault rate through redundant, distributed data and services; allocates data between available PC server clusters that can be expanded to thousands of nodes to fulfill computing tasks, and moves rapidly data between nodes while keeping dynamic balance among them. It can also automatically save multiple copies of data and re-allocate failed tasks.

The big-data platform comprises hardware resource layer, Hadoop big-data processing software layer, and service application layer. At the hardware resource layer, unified x86 storage servers are deployed for the cloud storage system. The Hadoop big-data processing software layer comprises software resources used for the cloud storage system, such as the

unstructured data storage engine HDFS, parallel computing engine MapReduce, NoSQL data storage engine HBase, and structured data storage engine HIVE. These engines manage user and data access and provide services through the HDFS, CMD Line, REST, MR, FTP, JDBC/HQL, and NoSQL interfaces. The service application layer stores and processes WAP gateway logs, click-streams, CDRs, and signaling data.

Hadoop and HBase Based Big-Data Platform

In traditional IT deployment modes, each service platform that comprises server, storage, and network resources is constructed independently. Repetitive deployment of these resources on different service platforms leads to high capex. To meet service requirements, different hardware devices are used. This greatly increases opex. Unbalanced load between different servers also leads to low hardware utilization, and many computing, storage, and network devices are idle. This increases equipment room rental, power consumption, and cooling costs. Moreover, a long cycle for deploying new services also leads to high opex.

Internationally recognized, open-source Hadoop and HBase are used to handle mass data. ZTE has built a big-data platform based on Hadoop and HBase that has distinct advantages over traditional platforms.

- **Concurrent Read/Write and High Performance**

The big-data platform has optimized algorithms based on the underlying Hadoop layer. This improves application efficiency and enables balanced computing and storage. The distributed Hadoop architecture is used to provide highly concurrent services through multiple nodes. The platform also has the same features as the NoSQL data platform. These features include mass storage, linear expansion, and highly concurrent read/write. The platform is low cost and can easily exchange data with other components in the Hadoop ecosystem.

- **Efficient and Secure Data Isolation**

The big-data platform has an enhanced Kerbos security mechanism that allows only authorized users to access data and services. Data is also isolated at the server to ensure different users have different data access rights.

- **Load Balance and Data Cache Mechanism**

The big-data platform provides REST services and sends user requests evenly to multiple REST services through the built-in load-balancing service. The load-balancing service provides an effective data cache mechanism that can use the cache to directly return the requests with duplicate content instead of submitting many times the same computing requests to the Hadoop cluster.

- **Dynamic Online Expansion**

The big-data storage platform serves as a centralized data storage platform at the back end and can provide dynamic expandability to meet the requirements of front-end systems for continuous expansion and expandable storage. The platform also supports dynamic online expansion. Storage and CPU capacity can be increased without interrupting existing services. This avoids the risks inherent in traditional expansion, and storage capacity and system throughput increases almost linearly.

- **Rapid Deployment and Easy Expansion**

The big-data platform provides an automatic system installation program that can calculate configuration parameters automatically and is applicable for most scenarios. It also provides efficient OAM with high automation and intelligence. Multiple versions for maintenance are supported, and online capacity expansion can be completed in several minutes.

- **High Availability and Reliability**

The big-data platform is a distributed system that involves several peers processing nodes for computation redundancy. The platform provides high availability and reliability. Multiple copies of data are stored. When a node fails, other nodes can automatically take over its functions without affecting existing services.

- **High Cost-Performance Ratio**

The big-data platform uses low-cost universal storage servers. Full hardware redundancy is implemented through software. This improves system reliability and reduces storage costs. The platform is highly automated and easy to maintain. Mass data on the order of petabytes can be stored. The platform can also reduce computing load according to dynamic traffic load and put idle disks to sleep to reduce power consumption and extend equipment life.

Winning the contract to establish CITIC's big-data platform indicates that ZTE has taken a further step into the financial sector. With its experience in both the IT and financial arenas, ZTE is helping CITIC build a new internet-based strategic financial platform. Both parties will profit from cloud computing and big-data technologies. ZTE TECHNOLOGIES

Nanjing Telecom:
Embracing the LTE Era with IP RAN

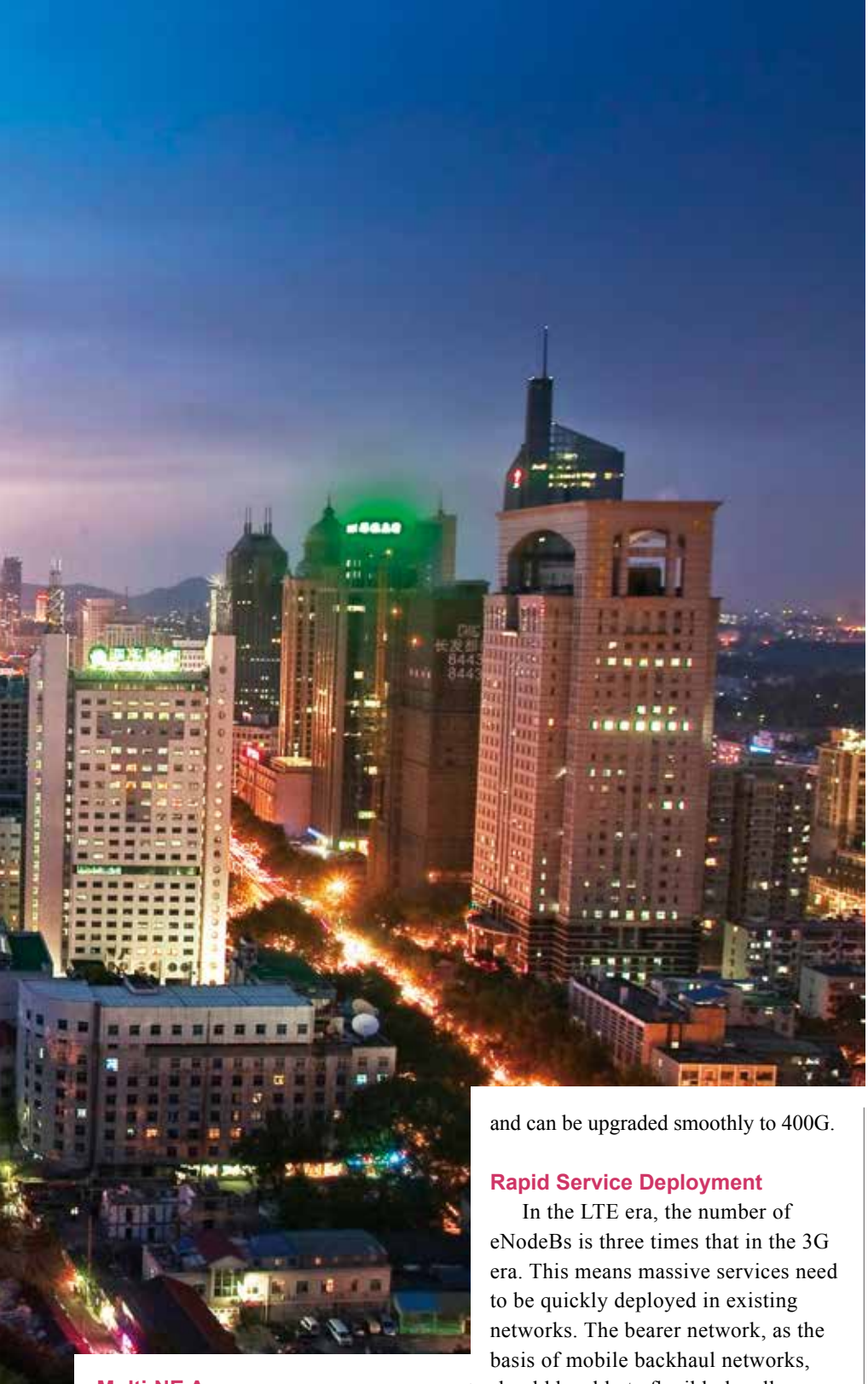
By Hu Junjie

Nanjing is the capital of Jiangsu province, China, and has a population of about eight million people. Located in the lower Yangtze River basin, Nanjing has long been a national transportation and communications hub. It is also an outsourcing and software innovation hub in China.

China Telecom is a traditional fixed-network operator that has had a large number of terminal users since its early days of operation. To increase revenue in the wireless field, the Nanjing branch of China Telecom (Nanjing Telecom) continues to pour money into 3G and LTE networks and has chosen ZTE's high-end bearer product, ZXCTN 9000-E, for its mobile backhaul networks.

After many years of network planning and optimization, Nanjing Telecom has completed its IP transformation on the radio side. However, to protect their investment in equipment and lower capex and opex, Nanjing Telecom has to allow 2G, 3G and 4G networks to exist together. When frequently upgrading, expanding, and cutting over the network, OAM personnel always have to consider long-term mobile network evolution and development.

ZXCTN 9000-E is an IP RAN device with pure IP routing architecture. Combined with China Telecom's L2VPN+L3VPN solution, it plays an important role in the construction of ultra-wideband bearer networks with high routing capacity.



Multi-NE Access

IP interfaces are used for base stations on the radio side; therefore, all base stations can be connected to IP RANs through the interfaces of the equipment at the access layer. The 10/100 Gbps ports of ZXCTN 9000-E are sufficient for the requirements of explosive traffic growth in the LTE era, and can be upgraded smoothly to 400G.

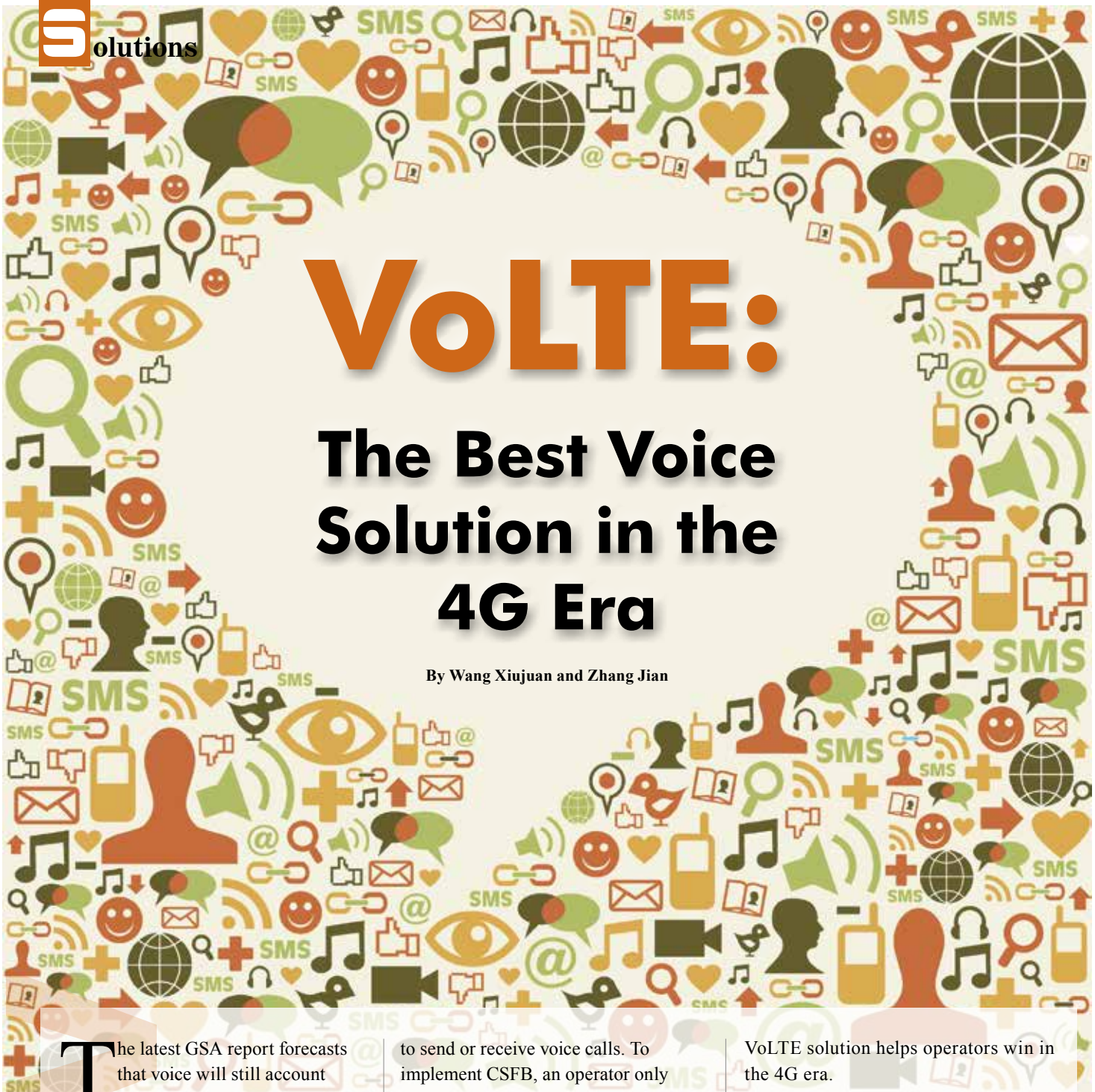
Rapid Service Deployment

In the LTE era, the number of eNodeBs is three times that in the 3G era. This means massive services need to be quickly deployed in existing networks. The bearer network, as the basis of mobile backhaul networks, should be able to flexibly handle changes in traffic transmission. The plug-and-play function in an IP RAN solution should eliminate the need for equipment at the access layer to be debugged and commissioned. This will greatly reduce engineering implementation expenses in IP RAN deployment. During software debugging and commissioning, basic services of all IP RAN devices on the network can be configured automatically by using the SNMP protocol and through collaboration with third-party network-management systems. This further reduces the difficulties in IP RAN service deployment.

High Performance and High Availability

With competition between China Telecom, China Mobile, and China Unicom heating up, both terminal users and OAM personnel expect more in terms of overall network quality. The ZXCTN 9000-E, incorporated with field-proven L2VPN+L3VPN IP RAN solution and high-performance commercial chips, enables carrier-class protection switching in the case of network failure. This greatly improves network stability and guarantees LTE services of Nanjing Telecom.

Through rapid service delivery and smooth, stable operation, ZXCTN 9000-E has laid a solid foundation for Nanjing Telecom's mobile bearer networks. It provides ultra-wideband resources that Nanjing Telecom can use to offer flexible pricing and cope with the impact of heavy traffic on IP RANs. Nanjing City is ready for the LTE era. ZTE TECHNOLOGIES



VoLTE:

The Best Voice Solution in the 4G Era

By Wang Xiujuan and Zhang Jian

The latest GSA report forecasts that voice will still account for 65% of total revenue in the global telecom industry until 2016. In the LTE era, voice solutions still matter a lot to both operators and users.

ZTE provides standard circuited switched fallback (CSFB) as well as single radio voice call continuity (SRVCC) and enhanced single radio voice call continuity (eSRVCC) solutions. With CSFB, an LTE network only provides data service, and wireless devices fall back to the CS domain to send or receive voice calls. To implement CSFB, an operator only needs to upgrade their existing mobile switching centers (MSCs) without deploying an IP multimedia system (IMS). SRVCC and eSRVCC require the operator to deploy an IMS for IP-based voice service in the LTE network. When a user moves outside the LTE coverage area, voice calls are seamlessly handed over to the CS domain.

ZTE's voice over LTE (VoLTE) provides excellent user experience and guarantees service quality. The VoLTE solution helps operators win in the 4G era.

Faster Connection for HD Voice and Video Calls

SRVCC and eSRVCC enable smooth evolution from 2G and 3G to 4G and guarantee seamless voice handover. Compared with legacy CS voice, VoLTE with SRVCC or eSRVCC shortens call set-up time, ensures good handover to 2G and 3G, and provides better user experience. HD voice relies on the adaptive multirate wideband (AMR-

WB) speech compression standard to capture voice between 50 Hz and 7000 Hz (the ordinary voice spectrum is between 300 Hz and 3400 Hz). HD voice also has a mean opinion score (MOS) of 4–4.5 (the MOS for ordinary voice is around 3.5), which indicates a deeper clarity that is almost the same as speaking directly into a person's ear. AMR-WB adds significant depth and nuance to the transmitted voice signal and supports seamless voice-video switching with LTE.

End-to-End QoS Guarantee

VoLTE voice and video calls are sensitive to QoS metrics. To achieve high QoS, IMS requires low latency and low bit error during transmission. IMS voice uses dedicated bearer QoS class identifier (QCI), as defined by 3GPP, for end-to-end QoS guarantee and uses the policy and charging rule function (PCRF) for QoS policy control and resource allocation. ZTE's intelligent QoS perception system enables an operator to monitor QoS metrics in real time and receive alarms in case of failure. In wireless IP environments, ZTE uses enhanced wireless technologies, including transmission time interval (TTI) bundling, robust header compression (RoHC) and semi-persistent scheduling (SPS), to guarantee high-quality voice calls.

Consistent User Experience

Users need not change their phone numbers after migrating to IMS. With one number, a user can enjoy rich VoLTE and multimedia services while continuing to subscribe to 2G and 3G.

In a legacy network, CS and IMS user profiles are stored separately and may have differences. To guarantee consistent service, ZTE provides an intelligent user data convergence (UDC) architecture that ensures consistency between stored data and phone-operation data in both the CS and IMS domains. For SMS interworking between LTE and 2G/3G networks, ZTE uses an IP short message gateway (IP_SM_GW) to guarantee a consistent user experience. ZTE also uses an IP multimedia service switching function (IM-SSF) to inherit 2G/3G services and maintain a consistent user experience.

IMS enables a mobile operator to integrate voice services into enriched applications while keeping legacy voice and SMS services. In this way, a variety of services can be provided.

Innovative and Differentiated Solutions

The coexistence of CS, PS and IMS domains means that user data is distributed. Selecting a terminated domain in VoLTE call flow is a key issue. An improper target domain selection may cause slow call connection and repeated service triggers. This results in bad service experience. To address this issue, ZTE provides the 3GPP-defined terminating access domain selection (T-ADS) solution as well as the dual-trigger solution. A proper domain selection solution helps an operator accurately select a domain and reduce call set-up time in order to provide the best voice service.

With mature VoLTE solutions and rich experience in IMS deployment, ZTE is the vendor of choice for operators wanting to deploy a VoLTE network. ZTE has been recognized by operators worldwide for its VoLTE performance at multiple trial sites.

ZTE's VoLTE Development Milestones

- April 2014: ZTE made the world's first IPv6 VoLTE call.
- February 2014: ZTE demonstrated NFV and voice & video service over LTE on vIMS and vEPC at MWC 2014.
- December 2013: ZTE made the world's first VoTD-LTE call with eSRVCC.
- June 2013: ZTE made the world's first end-to-end VoTD-LTE call.
- February 2013: ZTE made the world's first HD VoLTE call with eSRVCC.
- January 2013: ZTE deployed the world's first multi-tenancy and VoLTE solution based on the IMS and CS convergence.
- November 2012: ZTE trialed the world's first commercial VoLTE call with eSRVCC.
- September 2011: ZTE completed the world's first VoLTE IOT.
- November 2010: ZTE made the world's first VoLTE call.

ZTE is dedicated to offering the best telecom solutions. ZTE has developed WebRTC, NFV and RCS cutting-edge technologies to help operators compete with OTT players, reduce capex and opex, and enhance core competitiveness in the mobile internet age. ZTE TECHNOLOGIES

ZTE Magic Radio: Focusing on Increasing Spectrum Efficiency

By Zhang Yan

Spectrum is the most precious resource for operators. In most countries, it is a chargeable resource, and the license fees are high. Making the best use of limited spectrum and increasing spectrum efficiency are of continual concern to operators. GSM systems have distinct advantages in terms of voice services and global interconnection, but LTE is the trend for mobile networks because it is capable of transmitting at high speed. LTE mainly operates in the 2.3–2.6 GHz frequency bands and costs more to deploy than GSM, which operates in the 900–1800 MHz band. The capex required for LTE indoor coverage is particularly high; therefore, GSM/LTE dual mode 900/1800 MHz can be used. Using existing GSM macro sites is an ideal solution: high-rate data services are supported but existing GSM voice services are not affected. The solution can also accelerate commercial LTE deployment and lower construction and OAM costs.

Although GSM and LTE can be deployed in the same frequency band, a certain guard interval must be left between them. LTE has a coarse bandwidth granularity, generally 5 MHz, and GSM spectrum resources are slowly released. This means a certain part of the spectrum is used inefficiently. ZTE has developed Magic Radio, a breakthrough for improving spectrum efficiency in GSM/LTE refarming and converging multiple networks. Magic Radio enables an operator to use the same frequency spectrum when deploying GSM/LTE networks in 900/1800 MHz. Magic Radio has two sub-solutions: GSM/LTE spectrum overlap and GSM/LTE collaborative spectrum scheduling. The former allows GSM and LTE to simultaneously occupy identical frequencies. This maximizes GSM and LTE capacity. The latter dynamically schedules the amount of spectrum resource used by GSM and LTE. When these two sub-solutions are deployed simultaneously, spectrum efficiency can be improved by up to 50 percent.

GSM/LTE Spectrum Overlap

With the GSM/LTE spectrum overlap solution, GSM and LTE occupy the same frequencies at the same time in order to maximize their capacities. The solution includes dynamic GSM

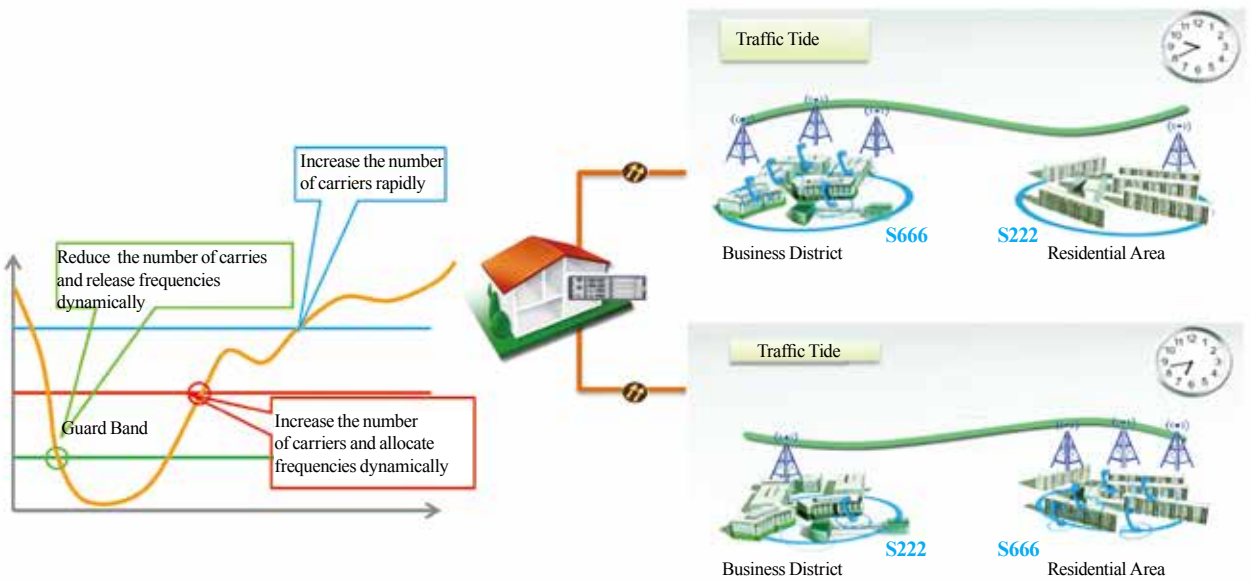


Figure 1. Dynamic frequency allocation based on traffic tide.

frequency sharing and GSM/LTE negative guard bandwidth technologies.

Dynamic GSM frequency sharing is based on the tide of traffic. It is used to dynamically allocate and release carriers according to the carrier on/off status and a measurement of cell traffic. This saves frequency resource, increases spectrum utilization, and reduces interference. Fig. 1 shows two sites with the traffic tidal effect. When traffic is high, each site needs to be configured as S666; when traffic is low, each site is only configured as S222. Traditionally, each site must be configured as S666. Frequencies are dynamically allocated. S666 is configured for a business district during the working hours. At night when traffic lowers to reach the carrier off threshold, the number of carriers is reduced, and frequencies are released. In this case, the S222 configuration is used. In the daytime, when traffic rises to reach the carrier on threshold, a number of carriers are added, frequencies are dynamically allocated, and S666 is configured. The tide of traffic in a residential area moves contrary to that in a business district. Dynamic frequency allocation depends on determining and responding to the tide of traffic. All carriers except BCCH and some high-priority carriers are dynamically allocated and activated according to an interference evaluation. This saves spectrum resources and increases spectrum efficiency without changing system capacity.

A reasonable guard interval is needed to avoid inter-system interference during GSM/LTE refarming. If the guard interval is too small, more interference is generated in both the GSM and LTE systems. If the guard interval is too large, both GSM system capacity and spectrum efficiency will decreases. A guard interval directly affects interference between different systems or channels and thus affects network coverage, capacity, and user experience. In addition, it is also necessary to consider whether there are sufficient frequency resources reserved for GSM after a guard band has been set and whether the C/I of the GSM network deteriorates seriously after the frequency has been adjusted. It is extremely important to set a reasonable GSM/LTE guard interval. The guard bandwidth for GSM/LTE is generally 200 KHz. An LTE bandwidth has two transition bands. If the LTE bandwidth is 20 MHz, only the 18 MHz band in the middle is used by LTE, and there will be one 1 MHz transition band on the

left and right sides (Fig. 2). The signal power near the edge of the 20 MHz band is low. Provided that GSM signals are not affected, GSM frequencies can be configured on the LTE transition bands. ZTE's Magic Radio solution is designed to leverage the LTE transition bands to implement zero and even negative GSM/LTE guard bandwidth and improve spectrum efficiency using its own innovative filtering algorithm.

GSM/LTE Collaborative Spectrum Scheduling

The GSM/LTE collaborative scheduling solution dynamically schedules spectrum resources occupied by GSM and LTE according to traffic conditions. The solution uses dynamic LTE spectrum spreading and GSM/LTE collaborative scheduling technologies to fully utilize spectrum resources at any time.

Dynamic LTE spectrum spreading involves both bandwidth and carrier spreading. Although GSM and LTE can be deployed in the same frequency band, a guard bandwidth must be reserved. It is complex to release existing GSM spectrum resources according to traffic. In the long term, traffic decreases slowly and progressively, but in the short term, traffic changes along with user behavior and fluctuates dramatically. During working hours, voice traffic is high, and GSM requires high bandwidth. At night, data traffic is high, and LTE requires high bandwidth. The traditional spectrum allocation mechanism cannot allocate spectrum according to traffic demands. This results in wasted spectrum resources.

With dynamic LTE spectrum spreading, the spectrum occupied by GSM and LTE can be adjusted according to regional real-time GSM traffic statistics. If GSM traffic decreases, some GSM spectrum resources can be released. When all shared frequencies in the area are released, a specified cell can use these frequencies for LTE. Fig. 3 shows a flexible LTE configuration

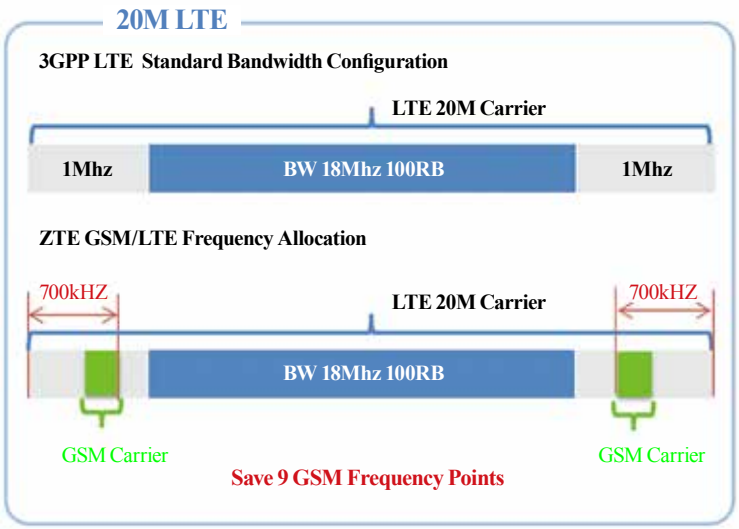


Figure 2. LTE bandwidth compression (negative guard bandwidth).

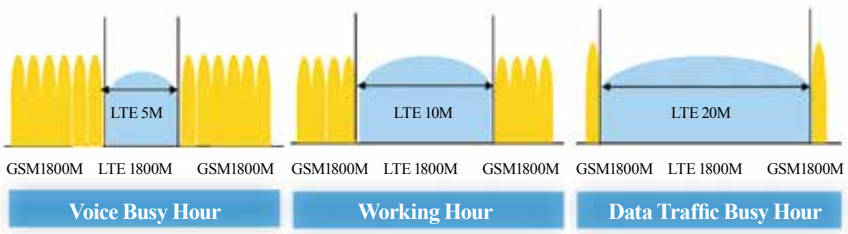


Figure 3. Dynamic LTE bandwidth spreading.

based on standard or compressed bandwidth. Dynamic LTE carrier spreading is more flexible mode for LTE spectrum spreading. Fig. 4 shows a low-bandwidth dual-carrier LTE configuration based on the standard or compressed bandwidth. The two carriers, with frequencies such as 5 MHz and 1.4 MHz or 5 MHz and 3 MHz, can be aggregated or used as two cells for load sharing. Carrier spreading provides more flexible bandwidth combining and higher spectrum utilization than bandwidth spreading.

With GSM/LTE collaborative spectrum scheduling, spectrum resources are dynamically scheduled and allocated to GSM and LTE with 200 KHz granularity, as required by traffic. Because the bandwidth configured for LTE can be higher than the available bandwidth, spectrum released when GSM is idle can be used for LTE. The bandwidth occupied by GSM and LTE are automatically adjusted according to their respective traffic loads. When GSM traffic increases, LTE releases some edge resource blocks to GSM; when GSM traffic decreases, the resource blocks at the frequencies close to LTE are released to LTE at first. Compared with dynamic LTE spectrum spreading, GSM/LTE collaborative spectrum scheduling focuses on sharing resource blocks. This provides higher spectrum efficiency. For a 20 MHz LTE bandwidth with 2 MHz transition bandwidth, when GSM traffic increases, GSM/LTE collaborative spectrum scheduling can occupy the

LTE Dynamic Extension – Carrier Extension (DCE)

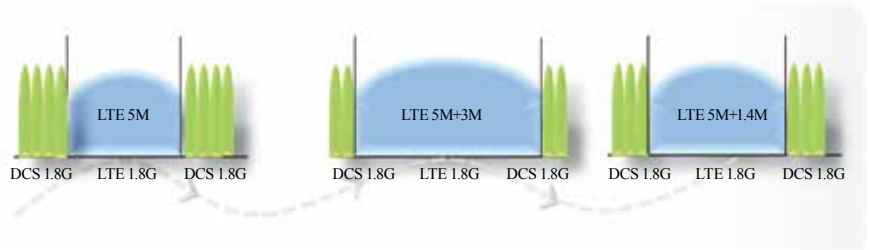


Figure 4. Dynamic LTE carrier spreading.

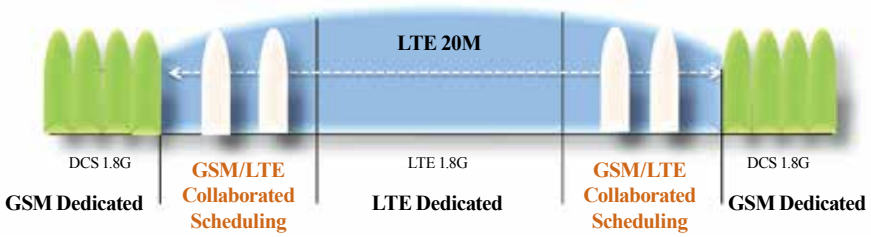


Figure 5. GSM/LTE collaborative scheduling.

LTE operating bandwidth within 18 MHz bandwidth (Fig. 5), and LTE can release some resource blocks to GSM by lowering data rates.

Conclusion

ZTE's Magic Radio solution focuses on increasing spectrum efficiency during GSM/LTE refarming. The solution has its own innovative proprietary technologies and can deploy GSM and LTE in the same frequency band at the same time. In the future, the solution will be widely used as a preferred key technology for GSM/LTE co-frequency deployment. It will make network deployment easier for operators and also reduce their capex. ZTE TECHNOLOGIES

Bringing you Closer

Cloud Radio™ enables optimal radio performance adaptive to a variety of network availability. Through a series of key technologies breakthrough, Cloud Radio™ realizes sophisticated radio coordination empowering higher network performance for operators and better QOE for users. Operators win with Cloud Radio™ two core values: diversity and boundlessness. Cloud Radio™, delivers 4G promise and helps you to excel in 4G era.

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