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TECHNOLOGIES

VIP Voice

Euskaltel: Dreaming Big

Tech Forum

ZTE's Perspective on Top-Ten New
Wireless Technologies for 2015

Special
Topic

Network Virtualization

NFV: Making Networks More Agile

Fernando Ojeda, CEO of Euskaltel

ZTE



Euskaltel: Dreaming Big

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

ZTE Wins Prestigious GSMA Award at MWC 2015



4 March 2015, Barcelona, Spain — ZTE announced that the ZTE Smart Projector (Spro) has been recognized as the ‘Best Mobile Enabled Consumer Electronics Device’ Award at Mobile World Congress 2015. The award was presented by the GSMA during the 20th Global Mobile Awards, held at the Fira Gran Via in Barcelona.

The ZTE Spro is the world’s first all-in-one smart portable projector. Designed to provide up to eight users with anytime Wi-Fi anywhere access at 4G LTE speed, the Android-based smart projector with built-in storage and expandable Micro-SD and USB port can project 120-inch images and videos from a variety of convenient inputs.

On the show floor at MWC (Hall 3 Stand 3F30), ZTE will be demonstrating the second iteration of its award-winning smart projection technology, the SPRO2, which is due to launch in May this year.

ZTE Wins 2014 GTI Excellence Award for Massive MIMO Solution

4 March 2015, Shenzhen — ZTE was awarded a GTI excellence award, recognizing its innovative pre5G massive multiple-input multiple-output (MIMO) solution.

In November 2014, ZTE successfully completed pre-commercial field testing of the world’s first pre5G 3D/massive MIMO base stations in partnership with China Mobile. The testing was based on ZTE’s latest 64-port/128 antenna 3D/massive MIMO base station.

3D/massive MIMO is a key part of 5G technology. Multi-antenna technology improves wireless spectrum efficiency

significantly, which in turn increases network coverage and system capacity, and helps telecom operators maximize the use of existing site locations and spectrum resources. According to the simulation completed by ZTE and China Mobile, the massive MIMO throughput can be four to six times higher than the 4G throughput.

This GTI award highlights ZTE’s achievements in utilizing massive MIMO for commercial deployment, and further activity regarding the commercial concept of pre5G. As a leading provider of 4G, ZTE is committed to continuous innovation and preparing for commercial 5G products.

ZTE and GSMA Host LTE Forum at MWC

3 March 2015, Shenzhen — ZTE and GSMA hosted a forum covering the theme, “Expanding the LTE Boundaries” at Mobile World Congress, Barcelona, on March 3, 2015.

The forum was attended by over 200 senior management representatives from well-known global telecom operators as well as representatives from the terminal chip and communications sectors. Attendees at the forum were encouraged to exchange ideas on the development trends of LTE networks and the latest service applications, and discussed a range of topics including the establishment of a new mobile internet of everything.

The era of M-ICT has seen mobile communication expand from traditional communication between people, to



information exchanges between people and machines and machine to machine (M2M). Mobile smart terminals, cloud applications, and the IoT will promote the explosive growth of data traffic, and drive 5G technologies towards 1000 times the current system capacity, 10 Gbps access speed, 50 billion connections, and diverse scenarios.



ZTE, China Mobile and Qualcomm Jointly Complete Successful Demo of TD-LTE Commercial Three-Carrier Aggregation

5 March 2015, Shenzhen — ZTE has collaborated with China Mobile and Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated, to successfully demonstrate time-division long term evolution (TD-LTE) downlink three-carrier aggregation (3x CA), marking an important step towards TD-LTE CA commercialization.

This demonstration was conducted using ZTE's TD-LTE eNodeB and evolved packet core (EPC) devices, based on terminals powered by the Qualcomm® Snapdragon™ 810 processor with X10 LTE modem. Three 20 MHz carriers in the 2.6 GHz time division duplexing (TDD) frequency band were aggregated, and the downlink data throughput rate reached 330 Mbps. This shows that 3x

CA is mature and can meet commercial deployment requirements.

CA is a core technology used in LTE-Advanced, which allows two or more carriers in the same or different frequency bands to be aggregated into one channel. This helps to increase peak TD-LTE cell rates in a multiple manner, effectively avoiding co-channel interference, improving TD-LTE network performance, more flexibly balancing loads between the primary cell and secondary cells and increasing network capacity. By using the CA technology, operators can provide mobile users with higher speeds and more diverse service experience, better coping with the explosive growth of data traffic, and enhancing TD-LTE network competitiveness.

ZTE and China Mobile Set New Record Exhibiting Precommercial 5G 3D/Massive MIMO Base Stations

4 March 2015, Barcelona, Spain — ZTE has jointly exhibited pre-commercial 5G 3D/massive multiple-input multiple-output (MIMO) base stations with China Mobile at Mobile World Congress in Barcelona.

During the demonstration using massive MIMO technology, the base stations reached a peak value three times as high as that of traditional eight antenna base stations in a joint field test, setting new records in both spectral efficiency and single-carrier capacity.

3D/massive MIMO, which is one of the major 5G technologies, uses the multi-antenna technology to improve radio spectral frequency exponentially, and enhance network coverage and system capacity, helping operators make full use of existing sites and spectrum resources.

The innovative Pre5G 3D/massive MIMO outdoor base station integrates baseband units (BBUs) and radio frequency units (RFUs), and has 64 ports 128 antennas, with an overall frontal area similar to that of an 8-antenna base station. By integrating BBUs, RFUs, and antennas, the innovative Pre5G base station requires only a third of the installation space of traditional mobile base stations, allowing for easier installation and maintenance, and significantly lowering operators' TCO.

ZTE SDN Demo Launched at MWC



5 March 2015, Shenzhen, China — ZTE has launched its IP radio access network (RAN) operation and maintenance (OAM) system based on elastic software defined networking (SDN) technology at Mobile World Congress.

The innovative solution of introducing SDN technology to an IP RAN network OAM to effectively reduce OAM cost has generated widespread attention among the operator community.

ZTE Features Its New M-ICT Strategy and Presents Smart Enterprise Solutions at CeBIT 2015



16 March 2015, Düsseldorf, Germany — ZTE featured its revolutionary and innovative mobile information and communication technology (M-ICT) strategy at CeBIT held from 16 to 20 March 2015 in Hannover, Germany. Under the overall motto “Connecting everything in the mobile world”, ZTE showcased a wide range of industry and enterprise solutions in a new fresh corporate design which reflected the new cool, green and open corporate culture and product spirit.

On stand C12 in hall 13, ZTE presented live demos and showcases on smart ICT solutions as well as new products such as switches, routers, home gateways, WLAN and video conferencing systems. Showcased under ZTE’s mission statement “make companies more efficient, the industry more colorful, and the city more beautiful”, the demonstrations at the expo focused on a large number of industry topics covering:

- ZTE’s communication solution, combining soft multipoint control unit with the mobile office automation platform and hardware video

terminals which are optimized for deployment in small/medium-size enterprise clients

- ZTE enterprise IT O&M solutions including IT system-integrated services for enterprises, providing in-depth services such as professional system software customization, O&M, and managed services
- cloud internet data centre with ZTE’s green and energy-saving micro-module data center (MDC) enabling an extremely efficient deployment and ZTE’s virtual desktop (including a server and thin clients) for safe and highly efficient operation processes
- smart education presenting an interactive ZTE classroom offering new options for an innovative forward thinking, more vivid, interesting, and interactive classroom teaching based on interactive software and multimedia terminal devices
- a comprehensive ZTE smart grid-solution that combines various instruments such as intelligent electric meters
- a clean new-energy system based

on high-power wireless charging technology for new-energy vehicles

- over-the-air internet-access services by providing 4G ZTE technology-based ground-to-air broadband communication, so that users flying at an altitude of 10 km can enjoy the same internet-access speed as while on ground-level
- train-ground wireless communication presenting a management, control, and scheduling system for railway transportation based on 4G
- ZTE traffic information service platform, an overall traffic information service solution enabling providers to offer seamless services to their customers.

“ZTE sees CeBIT as an important platform for interaction with customers and partners. We are very excited to present an impressive range of innovative new products in close cooperation with our channel partners in 2015”, said Li Ming, ZTE’s vice president responsible for operations in Europe.

“With China as this year’s official partner country, ZTE is proud to build a successful role model for Chinese investments in Germany. We have massively enhanced our business in Europe and are looking forward to further establishing the economic relations between our two countries. The success story of ZTE in Germany is very valuable for all our operations, and positively impacts our work in other western markets.”

ZTE held various press events around the expo. One of the press briefings was also dedicated to the announcement of new ZTE mobile devices for the German market. The company has partnered with some major channel distributors and for these channel partners, ZTE has offered a special area at ZTE’s expo-stand with further channel specific presentations and information.

Euskaltel: Dreaming Big

Reporters: Liu Yang and Zhang Ying



Fernando Ojeda, CEO of Euskaltel

Our project this year involves deploying a 4G network that will cover the whole Basque country. We own the 2.6 MHz license, and we want ZTE to do this project. I'm sure ZTE will do a great job.

Euskaltel was founded in 1995 and has its headquarters in Derio, which is in the Basque country of northern Spain. Compared to its competitors, Euskaltel is small; however, it has competed strongly against the giants Vodafone, Orange, and Telefonica and carved out a place for itself. *ZTE Technologies* recently interviewed Fernando Ojeda, CEO of Euskaltel. He shared with us Euskaltel's market presence, main challenges, development strategies, and the partnership with ZTE.

Close to Customers

Q: What kind of market presence do you have in the Basque country?

A: Our main business is our residential customers, small businesses, and large businesses. So we cover all kinds of customers. We have a very good presence in the three main markets: residential, small and medium-sized businesses, but we also have some large corporate, government and institutional

customers. In the three main markets, we compete strongly with Telefonica, and are the market leader. We have been successful because our network covers 95% of Basque population. That has given us the technological advantage. We deliver services in a way that Telefonica has been unable to do. Our highest-level call centers are located in the Basque country. We know our customers and understand what kinds of problems they may have. What's more, we help all kinds of associations and



Guggenheim Museum Bilbao in Spain

Source: Google

sponsor all kinds of local activities and professional sports, including football, surfing, museums, arts and universities. We try to invest a lot in this community.

In the Basque country, I think we have several advantages. First, we are close to our customers. Second, we have a high-quality network and have been very fast to develop and launch services. Third, we deliver residential broadband, fixed broadband, fixed voice and TV services. We are a mobile operator, so we also have 3G mobile services and will be looking into the future of 4G.

Q: Since its beginnings in 1995, Euskaltel has had some very prestigious shareholders from different sectors. How have you benefited from having leading businesses as your shareholders?

A: When we started a new business from scratch, it was very difficult. Telecom was a new business in Spain 70 years ago. In Spain, there was only one operator, Telefonica, and it was owned by the government. The only way to deploy a network was to have solid, powerful investors. It was not only

a matter of money but also a matter of having strong institutional backing. So among our shareholders were leading utility companies. They were important because we needed them to help us deploy our networks. We also had local savings banks as shareholders, and they gave us financial security and support. We benefit from having strong backing because to deploy a network you need to put a lot of money on the ground and you might not initially have a customer base. So that initial investment is very important; it made us creditable and gave us enough time to invest heavily without



looking for short-term benefit. That's the main impact of these shareholders.

Growing Outside the Basque Country

Q: The global telecom market is constantly changing. In a climate of uncertainty, what are the main challenges you are facing?

A: I think the first challenge is expertise. We are the leading operator in the Basque country. With 2.2 million inhabitants, that's our market. We compete against global companies who

have expertise and resources. For them, rolling out new services and continuing to evolve is something natural. While for us, the more the world becomes global, the more difficult it is to remain competitive. So that's our biggest challenge. I don't think our competitors are better than us—we know our customers better than they do.

The second challenge is growth, that is, how to compete in the global world with giants who are maybe twenty, thirty, fifty times bigger than we are. However, we have to face this challenge. We are small, but we are flexible. We are very good at what we do, but we need to be able to grow.

Q: How do you overcome challenges?

A: Well, that's why we have signed the agreement with ZTE. The way to overcome challenges is to benefit from partners that can give us the expertise and allow us to have the technologies that our competitors have. We look for partners who are global, who are leaders, and who can help us deliver services to our customers.

Q: What are your new opportunities?

A: We have been very focused on our network in the Basque country. We want to deliver cloud services, smart cities or whatever independently from our network outside the Basque country. We want to grow in this country, but we also want to grow outside the country to the rest of Spain. For this, we are also looking to ZTE, which was a small company that has grown to be very big. We hope to find partners that have the

vision and ambition to grow and take on bigger companies.

Service Oriented Transformation

Q: Many operators are transitioning from being a product company to a services company. What do you think about this transformation? Do you have any strategies for such transformation?

A: It's a good question. I think that the world is moving from networks to services, but I'm not sure that many telecom companies are capable of this job. In this world, we have telcos and all other kinds of companies that deliver services, but there are few telcos that can deliver services in a competitive way, so the competition is coming more and more from service companies, not from telcos.

For Euskaltel, being a service-focused company is our goal for this year. We are looking at delivering cloud services for small and mid-sized companies. The other area we will focus on is residential. We are delivering all kinds of smart services around the home, including home security. Smart home means to take care of your home. It's a package that gives you security and makes your life much more comfortable. The third area we are exploring is smart city based on big data. In China, there are five to ten million people in a city, which is more than in the entire Basque country. Euskaltel doesn't talk about smart city; we talk about smart country. We will make the Basque country the first smart country in the world.

Q: Euskaltel signed a ten-year network-wide managed services contract with ZTE recently. Why did you choose ZTE? How do you think the partnership will evolve?

A: We signed the contract with ZTE in December 2014. The idea was not only to look for a partner that would give us managed services but would be with us over the long term as we evolve the company. We wanted someone who could provide us with expertise. Two years ago we started looking for a partner who would deliver managed services, rollout a network with our people, and go the distance with us in the coming years. We wanted a partner who had the same mentality and DNA as Euskaltel. Technically, ZTE is as good as the top companies in the world. The main reason we chose ZTE is that in ZTE we saw a company that was ambitious and aggressive, that wanted the contract with us, that wanted to be in the Basque country. Everyone from ZTE came to visit us and was really hungry for the contract. They really wanted to help us grow. We found there were many similarities between us in terms of culture and people—the culture of ZTE was very close to ours. We understand that we are very small, but from day one, ZTE treated us as if we were important. So we believe that we will never have a problem; we will always find new ways of delivering additional services because we have the same interests. We want to grow Euskaltel, but we also want to develop the Basque country. For us, it is very important that ZTE said it was going to make the Basque country the main

service center for southern Europe. That indicates commitment, which we like very much.

The relationship between Euskaltel and ZTE is just beginning. Our project this year involves deploying a 4G network that will cover the whole Basque country. We own the 2.6 MHz license, and we want ZTE to do this project. I'm sure ZTE will do a great job. Actually, the contract is about network cooperation shared services, but for me, it is more than that. It is about having a partner that will work hand in hand with us over the long term to improve our operation in the Basque country.

Q: Euskaltel is always striving to be different. What kind of customer experience would you like to create?

A: I think the best customer experience is the one that allows customers to do what they want, when they want, how they want. By that I mean, if we have customers who don't want to talk to a machine or access a web page or login for help, we have person-to-person services for them. We have hotlines specifically for business customers and hotlines especially for residential customers.

However, we have other customers who just want to go to a web page to solve their problems. If they want to configure their TV, they can use the services of the mobile phone. I think it is important to make our web page clear for them.

In addition, we have sixty-five stores where you can go in person to configure your mobile phone, get help with your

TV, or get advice about what price you should pay for international calls. There are always people who would prefer to get face-to-face help in a store. We try to give all our customers different options and approaches. We spend the necessary time to solve your problems and meet your requirements.

We don't forget customers who want the personal touch. We also provide a very simple digital way. In the Basque country, we have two languages: Spanish and Basque. We have everything in Spanish and Basque. That's also something that differentiates us from Orange, Vodafone and Telefonica. It enables us to be more local.

Q: Who are the main users of your services?

A: We do have a very young customer base. We provide home, TV, fixed broadband, and mobile services. Young people are heavy users of TV and mobile services. Now we are deploying our Wi-Fi network in Basque cities to make our TV available across all devices. You can see young people with their mobiles watching TV or using our services to download or send messages. That's why we also support things like surfing schools, pop concerts and football games. We try to go where young people are.

Consolidation and Convergence Trends

Q: What trends do you foresee in the global telecom market over the next few years? How will these affect your company vision?

A: I suppose that the telecom market



An interview

will consolidate even further. In Europe, there are too many local operators, and there is potential for more consolidation there. In Spain, there will be more consolidation too. We have three major players—Vodafone, Orange and Telefonica—but in northern Spain, there are also three smaller cable operators. The biggest of these is Euskaltel, and the other two are smaller than us. Potentially, there will be consolidation between the big operators.

Globally, I think convergence of mobile and fixed networks will push consolidation of global players, but we are already a much-converged company. Our residential customers have more than three services with us. We have

been very fast to deliver services, and the Spanish market is much converged. The market in Europe also has a high level of convergence. Very few people only have mobile services; in Spain, they buy mobile and fixed together in packages. We will continue pushing convergence. I think the challenge over the next two years is to sell more TV services. Convergence has begun around mobile and fixed, but TV still is not totally part of this trend. I think the challenge with TV (ok, let's call it media) over the next eighteen months is how to make TV a real necessity in Spanish households.

We have launched many TV programs, but only 40% of our customers pay for TV services. For

Euskaltel, that number should be at least double; it should be 80%. I think we just need to push it more. I mean, our customers can watch Euskaltel TV or pay TV at home or on the move. As we know, 80% of our customers have mobile and fixed broadband, and 100% of our customers have fixed voice. How can we push paid TV? I think that the technology (i.e. 4k compression) will help us. We also need our customers to be using these more and more. That's why we're beginning to deploy a Wi-Fi network in the Basque country this year, and it will be completed soon. I believe Wi-Fi will help give our users a better experience when they use our services over 3G. [ZTE TECHNOLOGIES](#)

ZTE's Perspective on Top-Ten New Wireless Technologies for 2015

By Xiang Jiying

Mobile internet and internet of things (IoT) are developing at lightning speed and spurring the growth of mobile data services. More diverse communication, better user experience, and more extensive applications are development trends. To handle mass data traffic, mobile networks need to evolve into wireless networks without limitations. They need to become so-called "big pipes". Breakthroughs are continually being made with wireless technologies as a result of more diverse applications and a renewed focus on user experience.

ZTE is a leading proponent of innovation and research on future-proof technologies, especially in the field of 5G. Here we discuss the top ten wireless technologies that ZTE will be watching with great interest in 2015.

New Multiple Access

5G applications will focus on mobile broadband and IoT, both of which require wider coverage, higher capacity, lower latency, and mass connections. It is therefore imperative to introduce new multiple access (NMA) for 5G. ZTE has proposed multi-user shared access (MUSA) based on the more advanced non-orthogonal multi-user information theory. MUSA is different from various orthogonal and quasi-orthogonal multiple access schemes (TDMA, CDMA, and OFDMA) currently used in mainstream wireless systems.

MUSA has innovative complex-field multielement codes and advanced multi-user detection based on successive interference cancellation (SIC). In the uplink, MUSA enables the system to reliably access several users using the same time-frequency resource



*Xiang Jiying,
CTO of ZTE wireless
products*

and simplifies resource scheduling. This greatly simplifies mass access, shortens access time, and reduces terminal power consumption. In the downlink, MUSA uses innovative enhanced superposition coding and overlapped symbol-extension technologies to provide downlink transmission at higher capacity than mainstream orthogonal multiple-access schemes. This also greatly simplifies access and reduces terminal power consumption.

New Coding Modulation and Link Adaptation

Traditional link-adaptation technology is no longer adequate for 5G. New coding modulation and link-adaptation technologies can significantly

improve system capacity, reduce transmission delay, increase transmission reliability, and allow access to more users. ZTE has proposed soft link adaptation (SLA), physical layer packet coding (PLPC), and Gbps high speed decoder (GHD).

SLA increases the accuracy of channel prediction and feedback, eliminates long-period and burst interference of open-loop link adaptation (OLLA), and satisfies various QoS requirements (e.g., low latency, ultra reliability, high throughput, or high-speed mobility) in new scenarios. PLPC resolves the contradiction between large data packets and small coded blocks. GHD can significantly increase speed for a single user and provide high data rates for 5G.

Massive MIMO

To handle explosive traffic growth, wireless network capacity can be upgraded by increasing spectral efficiency, network density, and system bandwidth and by intelligently offloading services. Large-scale antenna array technology has attracted more and more attention.

With a large-scale antenna array, tens to thousands of arrays at the base station side are configured for more accurate beam control than is traditionally possible with less than eight antenna arrays. A large-scale antenna array uses the same time-frequency resources as a traditional array but also uses space multiplexing to serve more users and improve spectral efficiency. A large-scale antenna array significantly suppresses intra-cell and inter-cell interference and increases system capacity and coverage.

More research is needed on the huge potential gains of large-scale antenna array technology, especially in the areas of channel information acquisition, array design, and codebook design. ZTE has

competitive advantages in wireless technology. In November 2014, ZTE partnered with China Mobile to conduct pre-commercial field tests on the world's first 128-antenna massive MIMO base stations.

HF Communication

The wireless spectrum below 6 GHz is very crowded and available bandwidth is limited. However, there is a large amount of spectrum available between 30 GHz and 300 GHz, which is quite attractive for wireless communications. Compared with carrier frequencies in existing cellular networks, millimeter-wave frequencies result in big transmission loss. Because the wavelength of high frequencies is short, more antennas per unit area can be configured so that transmitters and receivers obtain greater beamforming gains and compensate for extra path loss.

With a high-gain antenna base station, optimal beams cannot be used to cover the receiving end before their weights are obtained. Because the terminal measurement is not accurate, the two parties cannot communicate by means of the weights of optimal beams. It is difficult to identify high-gain narrow beams within a mobile environment. If optimal beams cannot be identified, the terminal will either not reside in the cell or it will reside in the cell but experience poor transmission quality. This is contrary to the high rates expected in 5G networks. Beam identification and tracking is a common problem in high-frequency communication. A beam-discovery process is therefore added to high-frequency communication so that the base station and terminal can find each other and use optimal beams for high-rate data communication.

Wireless Self-Backhaul

Wired backhaul makes the cost of dense base station deployment unacceptable and may make deployment very inflexible. Microwave backhaul requires additional spectrum resources and increases the cost of transmission nodes. When there are obstacles, the quality of the microwave channel is seriously affected. This makes it difficult to select appropriate base station sites and reduces the flexibility of base station deployment.

With self-backhaul, wireless transmission technology and

More diverse communication, better user experience, and more extensive applications are development trends.



frequency resources are shared with an access link and are used to solve problems in the wired or microwave backhaul. However, self-backhaul consumes the available resources of the access link and may limit network capacity expansion. Therefore, increasing self-backhaul capacity is an important research direction in the field of ultra-dense networking.

Increasing self-backhaul capacity involves using multi-antenna technology to

- further increase spatial freedom
- improve receiving capacity through coordination with receivers
- tap the same service requests with content-aware technology and improve resource efficiency through multicasting and broadcasting
- dynamically allocate resources between the backhaul and access links.

Virtual Cell

Virtual cell is the key to solving the cell-edge problem. At its core, virtual cells provide user-centered services. A virtual cell comprises multiple access nodes around a user. A virtual cell updates fast—like a shadow that follows a user's movements and changes with the surrounding environment. This enables a user to access stable data services and have a consistent experience wherever they are.

Virtual cell turns a traditional cell-centered mobile access network into a user-centered mobile access network. Each user has a user-related virtual cell comprising several physical cells around the user. The physical cells coordinate with each other and serve the user together. When the user moves within the network, the physical cells contained in the virtual cell change dynamically, and the virtual cell

ID is unchanged. Because no handover occurs during the movement, the user experiences good signal coverage from surrounding physical cells and the best access service wherever they are. Virtual cell is a revolution in mobile access. Before, the user had to search for a network; now, the network finds the user.

Ultra-Broadband Radio Unit

According to statistics, 83% of operators in 14 countries in Europe have 1.8/2.1 GHz dual-band. Large- and medium-sized operators in Europe have multiple mobile-spectrum licenses. Convergence of operators may greatly increase the sharing of wireless infrastructure, which is gradually evolving from broadband to ultra-broadband.

Ultra-broadband radio (UBR) supporting multiple bands will develop rapidly in 2015. UBR breaks through the constraint of one RF channel supporting only one band. UBR provides ultra-broadband processing for dual-band or multi-band operation. Its core technologies are ultra-broadband transceiver, ultra-broadband amplifier, ultra-broadband DPD, and collaborative

duplexing. In 2014, ZTE launched a UBR unit operating at 1.8 GHz and 2.1 GHz. A single channel with transmission bandwidth of 365 MHz can support dual-band 1.8/2.1 GHz and enable power sharing between the two bands.

Fat NodeB

Fat NodeB is a new network node that can be networked with traditional base stations. It enables flat network architecture and can be used in complex scenarios.

Fat NodeB integrates the control-plane functions of a core network. This significantly shortens the time needed for terminals to access signaling. The core network only needs to focus on core services that are independent of wireless standards, and this makes it easier to provide personalized services. Fat NodeB also integrates gateway functions of a core network. Traffic from the terminal can directly enter a PDN via the fat NodeB without backhauling to a remote core network gateway. This alleviates the forwarding load on the user plane of a core network and reduces transmission cost. Moreover, moving the gateway down to the NodeB also enables content to be localized. Co-siting content servers and fat NodeBs enables terminals to access content nearby. This greatly reduces transmission delay and improves user experience.

ZTE's fat NodeB solution leverages the idea of a flat, user-centered 4G network. It makes services and networks flatter and closer to the end user.

NFV/SDN

Because there are many dedicated devices in circulation, construction and OAM costs of traditional telecom networks are high, and traditional telecom networks provide more close

services than IT networks do. Operators are therefore faced with a dilemma of unbalanced income and expenditure. Network function virtualization (NFV) and software defined networking (SDN) are a new ray of hope for operators.

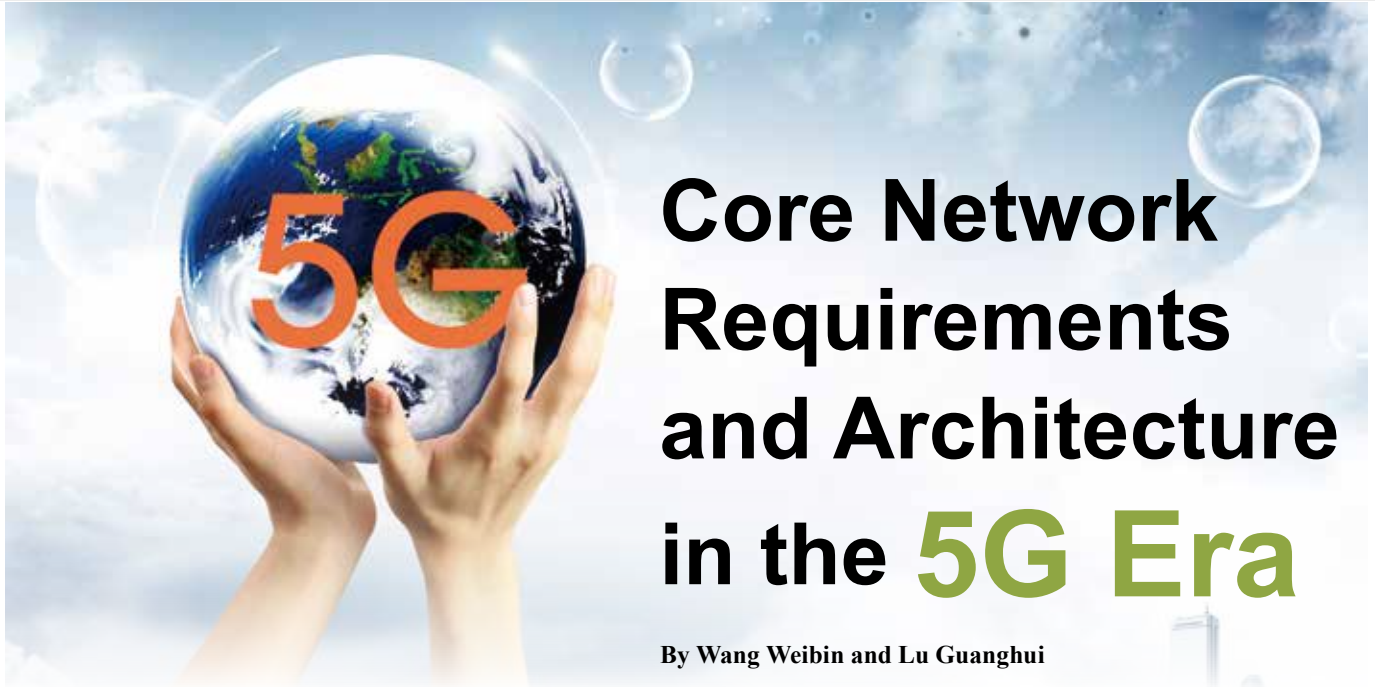
NFV involves virtualizing server-related computing, storage, and networking resources into multiple (different) virtual machines for different users. NFV can be used in a telecom network to share hardware resources, improve resource efficiency, and rapidly introduce new third-party services. Through NFV, the telecom network decouples the dedicated hardware devices and makes it possible to use IT and universal hardware resources in the network. This helps operators reduce hardware purchase costs.

SDN derives from routing control of an IP network. By separating control from forwarding, SDN enables a large amount of complex routing configuration to be centralized via the controller, and this routing configuration is sent to the forwarding plane for execution. This greatly simplifies network routing maintenance. By opening northbound interfaces, SDN also enables third-party apps to easily control service routing in the network. SDN can be used in a telecom network to improve automatic network deployment and flexibly dispatch service-based components. SDN can also be introduced into mobile network nodes, such as SAE GW, to make a flat network and increase packet-forwarding efficiency.

Device-to-Device Communication

Device-to-device (D2D) communication is a candidate technology for 5G. It has received widespread attention in the industry for its potential to improve system performance and user experience and expand cellular communication applications. D2D can be used for

- social applications. With D2D discovery and communication functions, a user can look for another interesting user in the neighboring area for data transmission and sharing.
- network traffic offloading. Cellular communication between adjacent users can be switched to D2D mode. This saves air interface resource and reduces transmission load on the core network.
- IoT enhancement. In the internet of vehicles and smart home, where there are many terminals, the terminals are connected in D2D mode to specific terminals that have already accessed the network. In this way, the congestion caused by mass terminal access can be relieved.
- emergency response. In the event of network damage caused by blind area coverage or disasters, user devices can be connected to the user devices in the coverage area through D2D and finally be connected to the target network. [ZTE TECHNOLOGIES](#)



Core Network Requirements and Architecture in the 5G Era

By Wang Weibin and Lu Guanghui



*Wang Weibin,
ZTE chief architect of
core network products*



*Lu Guanghui,
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PS/EPC products*

New Network, New Requirements

3GPP standards have entered the post-LTE era. The maturation of cloud computing technologies in the IT industry is driving mobile networks to adopt new implementation and business models. The rapid development of software-defined network (SDN) technology is also causing industry to reconsider the deployment of mobile network architecture and services.

The booms in machine-to-machine (M2M) communication, smart terminals, and mobile user base and data traffic have increased the requirement for network capacity. Smart terminals and over-the-top (OTT) providers are gaining prominence, while operators are gradually being marginalized and are becoming pipe providers. Carrier-grade telecom systems are becoming a burden, and the current network architecture cannot be easily transformed. Therefore, there is a pressing need to change system technology.

5G is a brand new wireless communication system that will serve the information society in 2020. The key 5G requirements will involve:

- **requirement for user service.** 5G user experience will interlace and integrate multiple terminals, rich applications,

As a mobile communication system increases its bandwidth and capability, individual and enterprise mobile applications develop rapidly and social informatization accelerates its development, information communication will be the main artery maintaining normal operation of the entire social ecosystem. With ubiquitous usage and convenient access, mobile communication will no longer be confined to man-to-man communication. Instead, it will play an increasingly important role in the future information communication system, and it will be extended to all aspects of human society. Future mobile communication will evolve to be intelligent, user-centered, and elastic network oriented to full-service applications instead of simply seeking higher rate, higher bandwidth, and higher capacity air interface technologies. 5G mobile broadband systems will be full-service, multi-technology convergence network that will use ICT technological evolution and innovation to meet fast-growing requirements of all kinds of services containing a wide range of data and connections and to meet user-centered network requirements.

and high bandwidth. Emerging services need higher bandwidth, lower delay, higher reliability, and greater intelligence. Users need to access a 5G network anytime, anywhere. In an era the web is becoming more socially orientated, massive, high-density terminals will access the 5G network. The access-independent feature will meet 5G requirements for rich applications and terminal access abilities. Moreover, a 5G network must also be secure and reliable.

- **requirement for operation service.** 5G will be a huge multi-network, multi-layer, multi-domain network requiring elastic, automatic, and intelligent network operation and management. The 5G network will have large capacity, high bandwidth, high flexibility, high reliability, and low delay. Network resources will be efficiently and intelligently used in order to save energy, reduce cost, and increase revenue.
- **requirement for business service.** 5G will help people enter a networked society where all aspects of people's lives are closely connected with networks. There will be many more new services and businesses. Conventional services including voice will be inherited, enhanced, and innovated. Feature-rich service patterns such as device to device (D2D), machine type communication (MTC), and virtual operation will be delivered over 5G networks. These new services can be flexibly deployed, and their content can be distributed according to user information and network status and topology. The function, performance, and intelligence for processing user traffic data will be enhanced as well.

From the perspective of industry, network capabilities will also need to be open to different participants in the industry so that they can customize their key 5G capabilities.

New Technologies, New Challenges

To meet all these requirements, ZTE has identified the following key technologies that will be possibly used in future 5G networks.

Network Functions Virtualization

NFV involves decoupling software from hardware. IT is used to reconstruct CT, and the commercial off-the-shelf (COTS) platform can be used to construct a telecom infrastructure environment in order to significantly reduce hardware infrastructure costs. Through NFV, an operator can uniformly purchase or customize NE hardware infrastructure resource and environment. This dramatically increases network agility and flexibility and shortens service deployment time. The new challenge for NFV is to combine the same functions of multiple physical NEs to optimize network architecture and the end-to-end signaling procedure.

Software-Defined Networking

SDN involves controlling networks through software and fully opening network capabilities. SDN is also a new network architecture and technology characterized by separate control and forwarding, centralized logic control, and open APIs. SDN can turn a closed vertical network architecture into a converged, open, elastic, application-focused, and horizontally layered architecture. The new challenge for SDN is to reconstruct network functions and design new interface protocols to optimize network architecture and end-to-end signaling.

Information-Centric Network

ICN is a network that separates content from terminal location and provides named content and name-based content routing. Everything in an ICN is called information that can be interconnected and labeled by name. The role of the network is to manage flowing and caching of all information and respond quickly to requesters with the correct information. ICN is another revolution in the telecom industry. Because ICN makes an end-to-end modification of the entire network, its compatibility with existing networks is a big problem.

Big Data

Big data refers to a massive amount of data that cannot be collected, managed, and processed by simple tools in reasonable time to help enterprises make proper operating decisions. The core of big data is prediction, and its strategic significance is to professionally handle meaningful data. The challenge for big data is how to process and use the data.

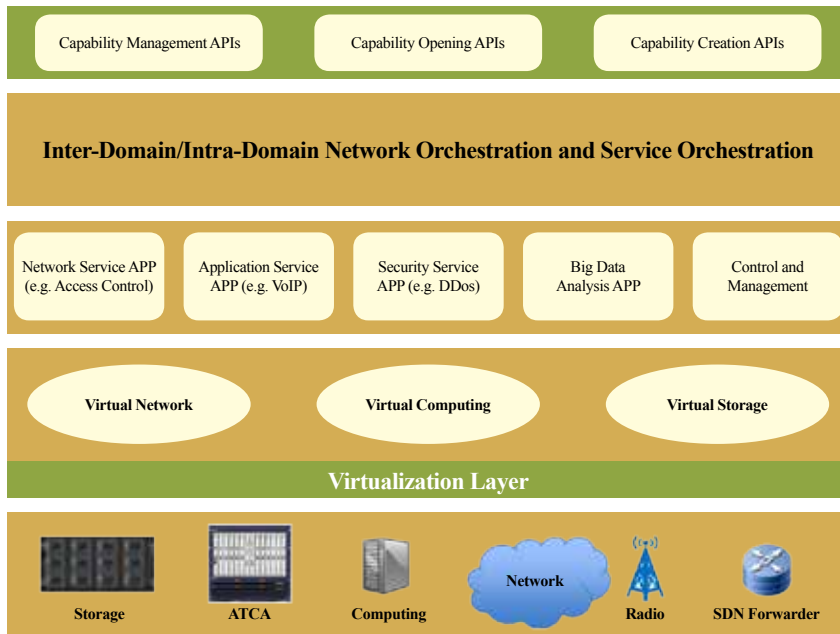


Figure 1. 5G network architecture.

5G Architecture

Considering the above-mentioned 5G requirements and new technologies, ZTE has devised a 5G network architecture that consists of five layers: hardware, virtualization, application, management, and capability opening (Fig. 1).

High-Performance and Reliable Network: Large Capacity, Low Delay, and High Reliability

Because SDN separates the control plane from the user plane, 80% of packets can be directly forwarded via the SDN forwarding layer. This facilitates local offloading, improves forwarding efficiency, shortens delay, and enhances user experience. NFV enables decoupled software and hardware so that all kinds of applications can be deployed on the COTS hardware platform. The market size of COTS devices is larger than that of telecom devices, and their computing cost per unit is far less than that of telecom devices. Moreover, COTS devices reduce costs two to three times faster than telecom devices and have faster update cycle (usually three to four years). Therefore, new IT technologies can be quickly adopted to maintain leading device performance. Hardware resources can be virtualized into multiple virtual machines (VMs), each of which can be migrated and reborn to ensure high network reliability.

Software-Based Intelligent Network: Flexible Resource Scheduling

Using virtualization that enables decoupled software and hardware as well as cloud computing that enables rapid deployment, the period of NE capacity configuration can be shortened from weeks to minutes, thereby greatly increasing flexibility in network expansion and eliminating device bottlenecks. Operators and equipment vendors can shift their focus to service innovation and create more opportunities for profit.

Automatic Distributed Network: Local Offload, Centralized O&M, and Unified Management

ICN and SDN enable data forwarding nodes to be deployed in a distributed mode. This can implement local forwarding or caching and reduce detours. A 5G network can automatically perceive virtual servers and perform the reconfiguration when the network changes its location after virtual servers are migrated and scheduled. Centralized O&M reduces costs. The 5G network also supports real-time operation of telecom NEs so that NEs and NaaS can be integrated for automatic O&M.

Open and Convergent Network: Capability Opening and Rapid Innovation

Network capability opening architecture and available big-data technology are used to completely open up the whole mobile network including hardware, software, network, applications, and data. This facilitates rapid service innovation and significantly reduces deployment time for new services. [ZTE TECHNOLOGIES](#)

NFV

NFV: Making Networks More Agile

By Zhou Yuxiang

With the development of intelligent terminals and mobile internet, telecommunications is no longer confined to traditional voice calling and SMS. People are more connected, and in the future, we can expect more and more inanimate things to be connected also. Operators are challenged by emerging OTT services and new business models. Traditional telecom networks are deployed using private platforms and dedicated devices. This means that it takes a long time to deploy a traditional telecom network and network O&M is complicated. Some operators are learning from ISPs and are reforming their deployment and O&M practices to make their networks agile. In October 2012, AT&T, BT Group, and Deutsche Telekom established the Network Functions Virtualization Industry Specification Group (NFV ISG) at the European Telecommunications Standards Institute (ETSI) to promote network function

virtualization (NFV). The NFV ISG has released NFV white papers and has put forward its objectives and plans.

What Is NFV?

NFV is the migration of telecom

devices from existing dedicated platforms to commercial off-the-shelf (COTS) x86 servers. In existing telecom networks, all devices are deployed on private platforms. All network elements (NEs) are enclosed boxes, and hardware cannot be shared.

Traditional Network Application Deployment



- Private hardware platform.
- Physical devices need to be installed on each site for each application.
- High threshold for hardware R&D hampers the innovation and competition.

NFV Network Application Deployment



Figure 1. Vision of NFV.

Each device requires additional hardware for increased capacity, but this hardware is idle when the system is running below capacity. This is time-consuming, inflexible, and costly. With NFV, however, NEs are independent applications that are flexibly deployed on a unified platform comprising standard servers, storage devices, and switches. In this way, software and hardware are decoupled, and capacity for each application is increased or decreased by adding or reducing virtual resources (Fig. 1).

NFV is based on cloud computing and virtualization technologies. Virtualization technologies are break down general COTS computing, storage, and network hardware into virtual resources and decouple applications from hardware so that upper-layer applications can make full use of these resources. Decoupling reduces the amount of time needed to supply resources from days to minutes. Cloud technologies make it much easier to allocate resources according to service load. This improves resource usage efficiency and ensures system responsiveness.

A virtual 4G EPC system (Fig. 2) comprises four virtual NEs: two PGWs or SGWs, one MME, and one HSS. Each of these virtual NEs is deployed within a data center and provides the functions specified by the EPC network. In their white paper, the NFV ISG states that NFV

- reduces purchase, development, and O&M costs.
- reduces power consumption.
- enables fast service deployment and innovation.
- enables more efficient testing and integration.
- substitutes hardware deployment with software installation.
- enables different applications, users

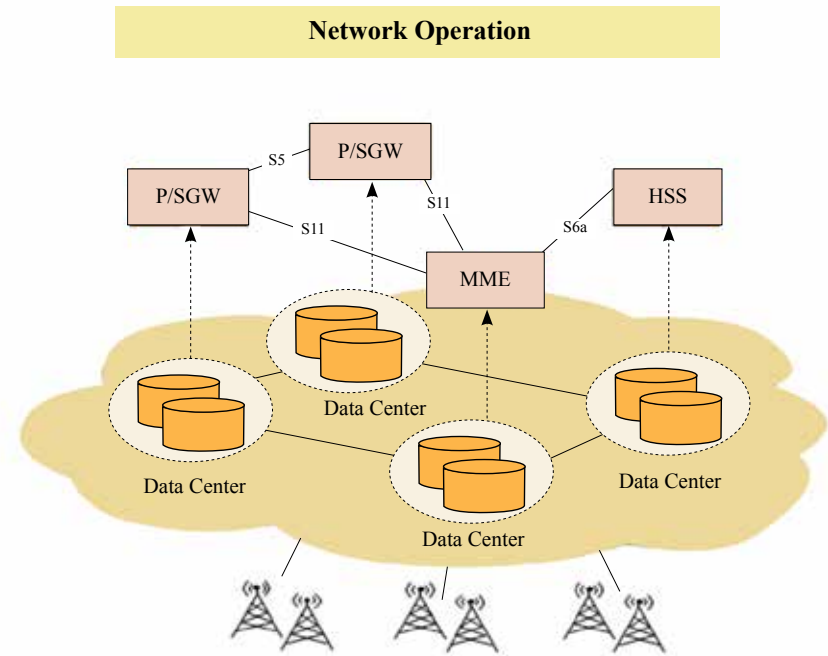


Figure 2. Virtual 4G EPC system deployment.

- and tenants to share the same platform.
- facilitates service customization for different physical areas and user groups.
- enables services to be quickly scaled.
- promotes network openness and service innovation to create new revenue sources.

Current NFV

NFV ISG has developed rapidly since it was established. Six plenary conferences have been held; phase one was completed at the end of 2014; and phase two has begun in 2015.

NFV ISG comprises the Technical Steering Committee as well as work groups for architecture of the virtualization infrastructure, management and

orchestration, software architecture, reliability and availability, performance and portability, and security.

The TSC has formulated four general standards, and other work groups have drafted NFV definitions for their areas. The four general standards encompass use cases, architecture framework, terminology for main NFV concepts, and virtualization requirements. A number of vendors and operators have worked together to complete 18 PoCs that verify NFV technologies.

With existing network architecture, the service network and OSS are independent. However, with NFV network architecture, the network is deconstructed both vertically and horizontally.

Vertically, an NFV network comprises

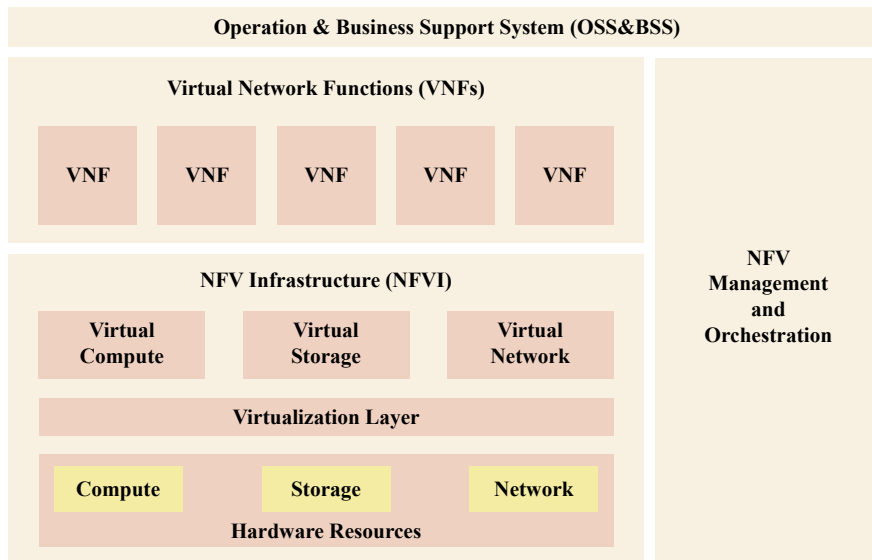


Figure 3. NFV architecture.

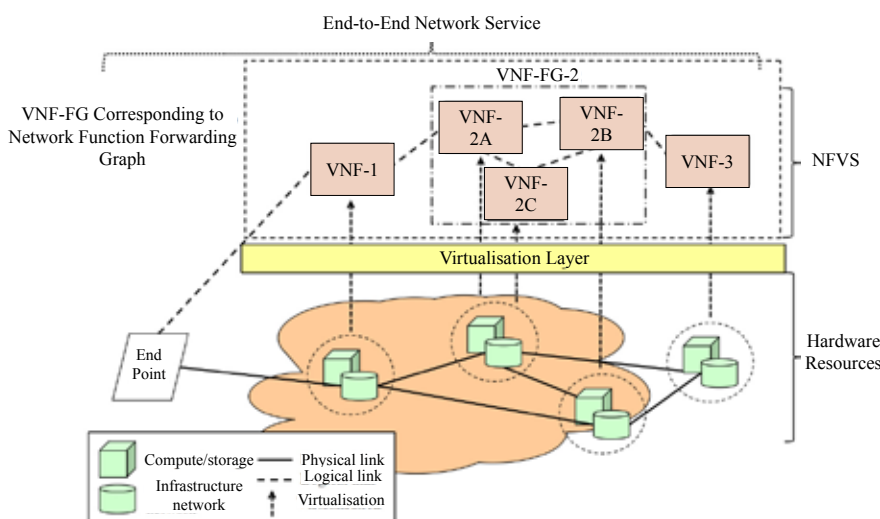


Figure 4. Network service deployed with NFV.

infrastructure, virtual network layer, and operation support layer (Fig. 3).

The NFV infrastructure (NFVI) is a pool of cloud-based resources. It includes multiple geographically separate data centers that are connected by high-speed telecom networks and mapped to the physical infrastructure. NFVI virtualizes

physical computing, storage, and switching and places them into resource pools.

The virtual network layer corresponds to the existing telecom service network. Each physical NE is mapped as a virtualized network function (VNF) or virtual NE. Resources that require VNF need to be broken down into virtual

computing, storage, and switching resources. Traditional 3GPP and ITU-T network interfaces are used to interconnect VNFs as usual, and the VNF service network management system (NMS) still uses the NE-EMS-NMS mechanism.

The operation support layer acts as the existing OSS/BSS and must be altered for virtualization.

Horizontally, the NFV network comprises service network domain and MANO domain.

The service network domain acts as the existing telecom service network.

The MANO domain differentiates the NFV network from traditional networks. It manages and orchestrates all NFVI resources, maps and associates service networks and NFVI resources, and implements OSS service resource procedures.

A service network includes a VNF forwarding graph (VNF-FG) comprising a group of VNFs and VNF links (VNFLs). Each VNF includes a group of VNF components (VNFCs) and internal connection graphs. Each VNFC is mapped as a VM, and each VNFL corresponds to an IP connection for which certain link resources (traffic, QoS, and route parameters) need to be allocated.

A service network can be broken down level by level according to the MANO. Then, NFVI allocates related resources in the same manner as VMs. VNFL resources need to interact with the bearer network NMS and are allocated by the IP bearer network (Fig. 4).

Many vendors have performed PoC tests on the NFV architecture and verified systems such as vIMS, vEPC, vCPE, and vCDN. NFV architecture was demonstrated at the WRC2014 annual conference, where it was shown that NFV technologies are feasible.

Development of NFV Technology

NFV technologies are feasible but are still a long way from being put into commercial use.

The demands on NFV technologies are exacting. At the end of phase one, the TSC had formulated only four general standards, and other working groups had not yet completed their definitions. Many issues have been held over to phase two, which means that existing NFV standards are less mature than expected.

NFV is an extensive architecture and with multiple new interfaces. The role of telecom vendors has been redefined so that they are now not only hardware suppliers but also suppliers of virtualized-management software, virtualized telecom network software, and NFV orchestrator (NFVO) software. Telecom vendors will also be NFV system integrators. Now, multiple vendors are responsible for software and hardware integration during network deployment, which increases complexity. NFV itself defines standards only at the architecture level, and open-source and other third-party technical organizations are needed to define and implement specific interfaces. This weakens technical standards to some extent and increases the likelihood of future incompatibility between devices of different vendors.

In the service network, less advanced self-organization network (SON) technologies reduce network flexibility. In an NFV architecture, the MANO automatically deploys resources required by a new VNF. The O&M architecture of the service network, however, still depends on the traditional EMS/NMS mechanism, and connections and traffic routes between VNFs need to be manually configured. Therefore, plug-and-play is not possible in a VNF. Industry needs

to develop SON technologies for the service network and decouple them from VNF vendors in order to manage the VNFs of multiple vendors.

Reliability of 99.999% needs to be guaranteed for traditional telecom applications as well as NFV. Traditional hardware is designed for high reliability, but COTS devices used for NFV are less reliable. NFV can be made more reliable by improving the reliability of the software.

Dedicated chips are used for user-plane devices. The x86 devices, however, are less cost-effective in terms of packet processing. This hampers device integration after virtualization. SDN and intelligent network card technologies can be used to address this issue. Specifically, SDN technologies are used to separate control and bearer services for user-plane devices and process packet forwarding on SDN switches. The intelligent network cards of servers have packet in-built processors to reduce packet processing loads.

Compared with computing and storage virtualization technologies, network virtualization technologies are less advanced, and SDN is not mature. It remains a significant challenge to integrate various network virtualization technologies into NFVI. In most cases, the service network is distributed and requires many network resources to be configured to carry services. These resources need to be allocated to LANs within data centers, bearer networks between data centers, and bearer networks between service networks and access networks. Allocating bearer network resources may also involve allocating transport network resources. All resource allocation needs to be virtualized and automatic. However, resources are allocated using the NMS of the bearer or transport network and is far from automatic. It is most likely that

SDN technologies will allocate resources automatically by working with NFV.

NFV is designed to resolve automatic deployment issues in the service network. NFV is a large ICT system-integration project within architecture. It encompasses the integration of NFVI, VNFs, and service network and involves many systems, vendors, geographical areas, and interfaces. It involves a higher degree of engineering difficulty than public and private cloud deployment. Automatic deployment includes all the planning, commissioning, upgrading, optimization, and O&M related to a telecom network but increases implementation complexity and is more demanding on the technologies of integrators.

Prospects

NFV will reform traditional network deployment models and will expand the scope of operators in terms of infrastructure. NFV converts data center devices, bearer network devices, virtualization software systems, and MANO systems into infrastructure. It replaces service deployment with software deployment and matches in real time service network resources and loads. This makes resource usage much more efficient. Despite its immaturity and issues, NFV is expected to be commercialized within three to five years through common effort of industry.

When NFV architecture is used, telecom networks will improve markedly in terms of automatic management and agility. The deployment timeframe for a telecom device will be hours rather than months, and the time needed to expand capacity will be measured in minutes rather than weeks. New network services will be deployed in weeks, which will help operators become much more agile. **ZTE TECHNOLOGIES**



Introducing SDN Technology into a Mobile Core Network

By Tao Quanjun

Motivations

During the evolution of the mobile PS domain from 2G/3G to LTE evolved packet core (EPC), the control plane has been separated from the user plane. The mobility management entity (MME) in the EPC has signaling-plane functions, and the signaling gateway (SGW) and packet gateway (PGW) forward data on the user plane. This division of responsibilities is sufficient for meeting demands created by booming mobile data usage.

However, from the perspective of device implementation, the control and forwarding functions in the EPC are not completely separate. EPC gateway devices have route-forwarding modules and signal and service processing modules. These two types of modules

are tightly coupled and communicate with each other. The structures of EPC devices are different from those of both general computational telecom devices, such as ATCA and Blade server, and routers and switching devices, which are widely used in networks. Poor device universality leads to prolonged R&D, testing, network access, and O&M. It also leads to poor scalability of functions and increased costs. Generally, traditional gateways have the following problems:

- User data streams are mainly processed at PDN exit gateway, which resulted in verbose functions and poor scalability.
- The forwarding plane needs to be expanded more frequently than

the control plane. However, a high degree of coupling between the control and forwarding planes causes synchronized expansion, short cycle for device renewal, and high composite costs. Therefore, a high degree coupling is contrary to core network evolution.

- In overlay mode, user data is transmitted from eNodeB to PGW. In the network layer, data can only be forwarded according to QoS from the upper layer, not according to user and service features. On the one hand, oversupply of network resources results in inefficient resource utilization. On the other hand, data flow cannot be controlled



in the network layer without user and service features.

- Many policies require manual configuration and constant optimization, and this increases errors, management complexity, and opex.

Given this, the control function of the PS domain gateway needs to be further separated from the forwarding function. In this way, general forwarding devices can be controlled using standard interfaces to achieve mobility management, QoS, and charging functions of PS domain. Therefore, improvement of functions and performance of the forwarding plane is related to improvement of functions and performance of the mobile PS domain. Convergence and resource sharing between the transport network, mobile PS domain, and IP bearer network can be promoted on the forwarding plane. The general forwarding plane can be used as needed to simplify network deployment.

Separation of Control from Forwarding

Some key issues in separating control from forwarding are:

- tunneling. One of the most basic functions of the mobile PS domain is to construct a GTP tunnel on

the forwarding plane. Separating control from forwarding causes interfaces definition problems. The SGW and PGW use the GTP-U protocol on the user plane, but SDN southbound interface protocols, such as OpenFlow, are cannot process the GTP-U protocol (e.g., cannot establish or terminate GTP-U tunnels) or monitoring data streams within GTP-U tunnels. Regardless of whether dedicated hardware or virtualized software is used for devices on the forwarding plane that supports GTP-U processing, interfaces between the controller and forwarding-plane devices still need to be standardized.

- QoS on the forwarding plane. Traditionally, mobile networks ensure QoS according to the bearer and ensure high-quality services according to dynamic policy control. QoS processing, such as bearer and service flow granularity QoS processing, must be ensured in a mobile soft network architecture. There are two issues that need to be studied in relation to mobile soft-switch networks: 1) routing and forwarding data according to the QoS strategy of the mobile network, and 2) providing user experience equivalent to that of traditional networks for upper layer applications.
- redistributing the gateway function. Traditional EPC gateway devices are capable of IP packet tunnel encapsulation and forwarding as well as session and mobility management (including IP address assignment, triggering and paging on the user plane). In a mobile soft-network architecture, these functions need to be redistributed for optimization.
- selecting gateway devices on

the forwarding plane. After the control plane is separated from the forwarding plane, forwarding plane devices need to be selected according to criteria such as capacity, load, and UE location to forward IP flows. This maximizes the utilization of forwarding devices and makes transferring user traffic more efficient.

- optimizing route flow entry on the general forwarding plane. The GTP protocol the OSI's application layer, where GTP-U encapsulation and decapsulation, TEID maintenance, and tunnel association from different segments are completed. The application layer also maintains lots of forwarding information for GTP tunnels. The underlying route entries are converged according to such standard route protocols as RIP, OSPF, and ISIS. After the control function is separated from the forwarding function, the general forwarding plane needs to support GTP-U tunnel encapsulation and decapsulation, and piecewise tunnel association. The GTP-U tunnel forwarding information is maintained in the flow table of the general forwarding plane devices. Therefore, general forwarding plane NEs are required to optimize the number of flow table entries to improve forwarding performance.

Industry-Related Research

Currently, research is being conducted in the following areas:

- EPC in a cloud computer with OpenFlow data plane. This architecture was patented by Ericsson on in November 2012. It integrates the control plane into the cloud computing system, which

contains a cloud controller and cloud manager. The cloud controller includes multiple control-plane modules that correspond to the original EPC control-plane entities. The cloud manager monitors traffic and resource utilization of control-plane modules. These modules transmit signaling to the data plane through OpenFlow protocol to establish traffic rules and perform corresponding actions.

- EPC extensions that support mobility schemes. The latest version of this architecture was published on January 31, 2013, as part of the MEVICO project. The architecture integrates all functions into a centralized gateway element that is the termination for 3GPP signals. This element also assigns IP addresses, saves UE contexts, and runs route-selection protocols. Although the architecture uses new methods to divide SGW and PGW, it has to comply with original 3GPP interfaces and protocols.
- cloud EPC. The cloud EPC is an SDN-based soft EPC architecture proposed by ZTE (Fig. 1). The SDN-based soft EPC architecture completely separates control from forwarding in mobile core network NEs and strips control from forwarding-plane NEs. In this way, the control plane, not the forwarding plane, is responsible for mobility and session management. The new SDN controller on the mobile core network controls unified forwarding devices and constructs control logic for the mobile application protocol layer and functional layer. This enables basic applications of converged mobile networks. In addition, the APP can provide control functionality and

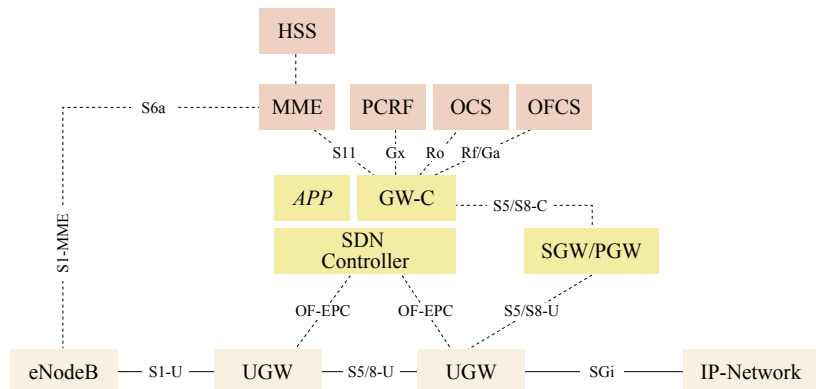


Figure 1. SDN-based soft EPC architecture.

service orchestration functionality (i.e., MME, P-GW-C, S-GW-C, and PCRF) of NEs as well as newly introduced service functionality after interfaces have been opened. The SDN controller connects the APP by using either internal interfaces or NBI interfaces.

To smoothly evolve existing networks, SDN technology can be introduced to gateway devices during the first stage. Traditional PGW and SGW functions can be implemented through cooperation between the GW-C and controller, both of which are on the control plane, and the UGW, which is on the forwarding plane. The GW-C can function as a separate NE, in order to communicate with the controller through NBIs, or it can be located with the controller so that internal interfaces can be used. Internal interfaces should be used in the first stage given the international standardization work on NBI done by ONF and given the performance

overhead created by NE interaction.

The cloud EPC follows 3GPP protocols so that 3GPP protocol-based interfaces remain unchanged. The MME, HSS, PCRF, and OCS on the EPC network can be either traditional NEs or NE functions implemented through virtualization technology. The southbound interfaces between the SDN controller and UGW use the OF protocol based on EPC extensions.

Conclusion

All three architectures mentioned here separate the control plane from the forwarding plane. However, a cloud EPC does this more thoroughly. It splits the PGW and SGW functions, integrates the data plane into UGW, and updates the control plane to controller. The cloud EPC is designed to simplify network deployment and maintenance and expand network functionality. Cloud EPC enables future network requirements to be handled more flexibly and efficiently. [ZTE TECHNOLOGIES](#)

Core Network Virtualization Management Solution

By Zhang Maopeng

Challenges

Increased competition in the telecom industry has meant that traditional telecom operators are facing serious challenges from OTT providers. The growing popularity of multimedia applications has led to slow growth in voice revenue and a decline in operating profit. The surge in mobile data traffic requires large-scale investment into upgrading telecom infrastructure. To address these issues and reduce capex and opex, operators have studied virtualization technology, which has mature IT functions. Virtualization technology creates new issues for the management of a core network system.

A virtual core network system comprises physical devices, virtual devices, and NE applications. These are located on and managed by the physical layer, virtualization layer, and NE application layer, respectively. The management software on each layer may be provided by different vendors. A challenge for the virtual core network system is to coordinate, monitor, and manage different management software offerings and to facilitate network O&M.

Another challenge for the virtual core network system is to orchestrate resources and deploy them onto the cloud platform rapidly and automatically.

A virtual core network system dynamically allocates virtual resources according to the current traffic condition. Therefore, policy and resource

management caused by dynamic resource adjustment is also a challenge.

Solution

Management and network orchestration (MANO) is based on the ETSI NFV architecture and comprises orchestrator, virtual network function manager (VNFM), and virtual infrastructure manager (VIM). MANO is added to the corresponding physical NEs of the core network system. A virtual core network system is managed on four layers: physical, virtualization, NE application, and service management (Fig. 1).

Physical Layer

The physical infrastructure manager (PIM) can be used to manage common hardware, such as COTS servers, network switches, and storage disk arrays, in a virtual environment in order to provide a unified, stable, reliable, efficient physical infrastructure for the virtualization layer.

Virtualization Layer

The virtualization layer supports multiple hypervisors, including KVM, XEN and ESXi, and provides diverse VIM platforms such as OpenStack, VMware, and TECS. The virtualization layer provides a virtual hardware infrastructure for the NE application layer and creates an efficient, reliable, manageable operating environment for applications.

NE Application Layer

The NE application layer supports virtual NEs such as vEPC, vIMS and vEMS. It introduces a VNFM module to manage the lifecycle of each virtual NE. This module is responsible for automatic deployment and elastic capacity expansion. The NE application layer can also work with the orchestrator to orchestrate virtual network services.

Service-Management Layer

The service-management layer contains the OSS/BSS and orchestrator. The new orchestrator module orchestrates virtual

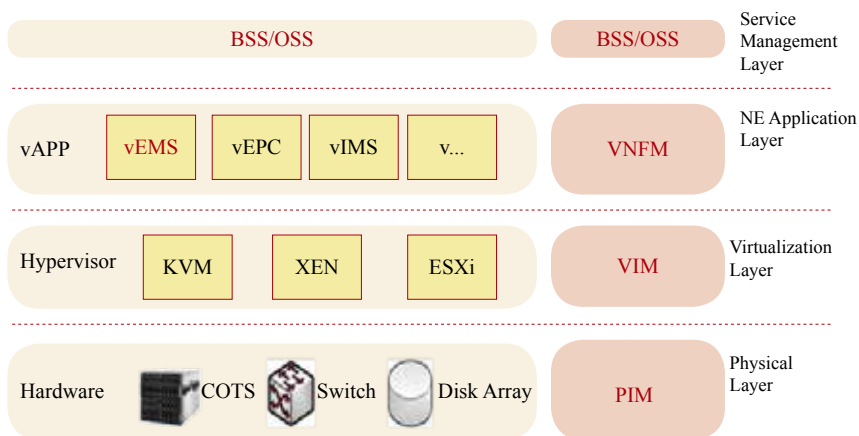


Figure 1. ZTE's core network virtualization management architecture.

network services, which means it manages the lifecycle of core network services and NEs, manages network service policies, and orchestrates global resources.

Each layer of the virtual core network system manages the resources deployed on it. Resources on the physical layer are managed by the PIM, and those on the virtualization layer are managed by the VIM. The orchestrator and VNFM coordinate to orchestrate and deploy core network services. Resources on the NE application layer are managed by the EMS. The OSS/BSS functions as an integrated network manager to globally monitor alarms and performance statistics on the service layer. Alarms on the physical and virtualization layers are reported via the VNFM to the EMS, which performs a correlation analysis of the alarms generated on the virtualization and NE application layers and reports these alarms to the OSS/BSS. In this way, alarms can be located and handled in a unified manner.

Value

ZTE's core network virtualization management solution includes core network NE management, cloud platform management, and hardware management. The solution is

- standardized. At present, more than 50 network operators, telecom equipment vendors, IT equipment providers, and technology suppliers have joined the Network Function Virtualization Industry Specification Group (NFV ISG) since the group was established in ETSI in October 2012. The NFV ISG aims to use standard IT virtualization technologies as well as the industry's standard large-capacity servers, storage devices, and switches to carry network software functions and flexibly load and deploy software on data centers, network nodes, and clients. This can speed up network deployment and adjustment, simplify

service deployment, improve network generalization and adaptability, and eventually lower network capex and opex. ZTE's core network virtualization management architecture complies with the ETSI standards.

- open. The solution has hierarchical management architecture. Physical devices such as COTS blade servers, switches, and disk arrays are used on the physical layer and are independently managed by hardware-management software. The virtualization layer supports OpenStack, VMware and other types of cloud platforms. The NE application layer offers EPC, IMS, EMS, VNFM and other NE applications. NEs can open their capabilities and interact with VNFM, and NE services can be orchestrated. The VNFM provides open REST interfaces for interconnection with a third-party orchestrator. The OSS/BSS functions as an integrated NMS, and the EMS supports interoperability with a third-party OSS/BSS. The orchestrator complies with ETSI specifications and offers open REST interfaces for interconnection with the VNFM. As the capabilities of interfaces between different layers become more open, operators have more choices in operation and hardware purchase. This increases system openness and compatibility.
- automatic. In a virtual core network, services and NEs are managed in an automatic way. The whole process of network service and NE lifecycle management is automatically implemented, and the processing time is shortened from a couple of weeks or even months in the physical NE era to a few minutes in the virtualization era. This makes it much easier for operators to deploy new services and lower their opex.

- intelligent. In a virtual core network, policies on how to use system resources can be specified, and current usage of resources can be viewed dynamically on the orchestrator. Fewer resources can be used in low-traffic cases, and more resources can be occupied in high-traffic cases. In this way, resources can be dynamically allocated and released, and energy and capex can be saved.

Customer Benefits

ZTE's core network virtualization management solution brings the following benefits for operators:

- central monitoring, hierarchical management, and simple O&M. System resources can be monitored in a centralized manner. The orchestrator provides a global resource management view for monitoring allocation, alarm and performance of virtual and physical resources. The OSS/BSS/EMS monitors NE application resources. A standalone maintenance UI is provided on each layer to meet operator needs for independent O&M and hierarchical management.
- one-click network service management and short O&M cycle. Core network service management includes service deployment, capacity expansion and service orchestration and can be implemented with one click on the UI. This greatly simplifies system O&M, shortens system deployment and capacity expansion cycle, and helps operators rapidly roll out new services and cut down O&M costs.
- elastic NE expansion and low equipment capex. While the system is running, resources can be dynamically allocated and occupied according to traffic load. This helps operators improve resource efficiency, consume few energy, reduce carbon emissions and lower equipment capex. [ZTE TECHNOLOGIES](#)

ZTE's iSDN Solution

for a Sustainable Telecom Network

By Wu Se



With the emergence of mobile broadband and new internet services, the world now ushers in a brand new information era. People are benefiting from the convenience engendered by information and services, but operators who provide mobile broadband networks are losing their traditional edge and being seriously challenged by OTT services.

Many dedicated telecom devices and complicated network O&M leads to high TCO. Enclosed telecom services and long service provisioning timeframes make operators less competitive with OTT providers in light of fast-paced innovation. High expenditure and decreasing profits have put operators in the position of having to learn from

failure and comprehensively transform themselves. In this context, building an innovative, efficient, green telecom network is a top priority.

Virtualization technologies offer operators a way out of their predicament. When introduced in a telecom network, network function virtualization (NFV) technology decouples software from hardware, frees telecom devices from dedicated hardware, generalizes IT-based telecom hardware, and greatly reduces the cost of hardware procurement. NFV promotes resource sharing for better hardware use, and generalized IT-based hardware enables new third-party services to be introduced. Operators have wanted these things for a long time.

However, NFV also raises new issues

for operators:

- NFV is now built on the x86 platform, which forwards and processes packets less efficiently than traditional routers and switches. Operators are concerned about this when they try to promote virtualization of user-plane NEs.
- Although numerous virtual components can be created by NFV, organizing them so that network services can be provided flexibly is very complicated.
- NFV enables massive new value-added services to be provided. However, scheduling these services according to user and service flow characteristics to maximize virtualization is still problematic.

The rapid development of SDN in recent years can help operators solve problems. SDN separates the control function of a routing device from its forwarding function and changes the way network routing is managed. Previously, routers were configured separately, but now forwarding policies are generated on the control plane and implemented on each forwarding point. In this way, network routing maintenance becomes simpler, more flexible, and more dynamic. Furthermore, by opening northbound interfaces, SDN allows third-party applications to control service routing.

To assist operators solve problems in network virtualization, ZTE has launched an iSDN solution that incorporates NFV

and SDN technologies (Fig. 1).

The iSDN, which rides on NVF and SDN technologies, separates control from forwarding in a telecom network. Specifically, the components used for O&M, service control, and user-plane complex service processing on the control layer are created using virtualization technologies. The forwarding plane efficiently encapsulates, decapsulates, and forwards packets and collects packet information according to the control-plane strategy. The network is based on the latest ETSI NFV architecture and introduces a big-data platform, strategy platform, and open-capability platform. These work together with the BSS and OSS to enable intelligent network O&M. All components on the control plane can be created according to external requirements, obtained from the open-capability platform, and real-time status, obtained from the big-data platform. SDN is then used to automatically manage and orchestrate the overall network topology and service routing.

In ZTE's iSDN solution, SDN is used in the user-plane NE (GW), for orchestration of network services, and for service chaining for value-added services.

With an SDN-based GW, the control plane and forwarding plane, which are usually integrated in an existing GW, are separated from each other. The control plane GW-C can be virtualized for centralized deployment and the forwarding plane can be deployed in a flat, distributed manner in order to rapidly offload traffic. Furthermore, the forwarding plane of an SDN-based GW is no longer subject to the x86 platform and can be embedded with cost-efficient hardware chips, such as ASIC and MIPS chips. In this way, the packet forwarding of a virtualized user-plane NE is increased.

The orchestrator in the NFV architecture can create required network components, but these are only isolated entities and

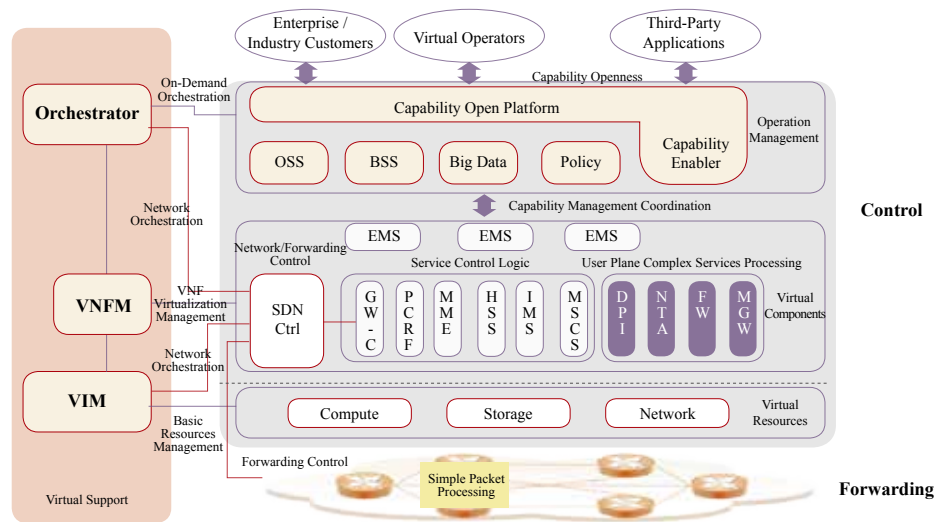


Figure 1. Architecture of ZTE's iSDN solution.

cannot provide complete network services. When SDN is introduced, the orchestrator can use the SDN controller to control the open-flow switch (OFS) on the forwarding plane and automatically orchestrate network components. The orchestrator manages network topology and network component lifecycles in a unified way. It works together with the open-capability platform, which collects external requirements; the big-data platform, which analyzes the current status of the network, users and services; and the strategy platform, which develops strategies. In this way, the orchestrator forms a closed control loop for more flexible, efficient O&M of network services.

In the mobile core network, the components that provide value-added services for users are deployed between the GW and service network. The existing GW can only follow a specified routing policy to forward packets. These packets have to pass all relevant value-added services successively thereby making provision of services much less flexible and decreasing the utilization of components. When SDN is introduced, these components can be mounted on the OFS, and the orchestrator can be used to manage both the lifecycles of the components and service chain selection rules.

Specifically, the orchestrator sends the service chain selection rules to the PCRF, which instructs the GW to label service flows according to user and service flow characteristics. The orchestrator also sends the label routing rules to the OFS through the SDN controller, instructing the OFS to route service packets to the corresponding VAS components according to the service flow labels in a given order. The orchestrator adjusts the service-chain selection rules and synchronizes the changes with the OFS according to the number and statuses of value-added services in the network. Therefore, all the VAS components can be orchestrated in real time, and user flow, service flow, and actual states of these components can be reflected. This allows the VAS components to be scheduled more effectively.

ZTE's iSDN solution combines NFV with SDN so that a telecom network can be adapted by the customer to different network states. This creates an intelligent, efficient, low-consumption network capable of adaptively providing value-added services. ZTE's iSDN solution helps operators rapidly transform themselves and is central to evolving current telecom networks towards 5G. **ZTE TECHNOLOGIES**



A NEW CHAPTER FOR VOLTE

ZTE Enables Commercial Use of VoLTE on the CSL* Network

By Sun Hui

In late August 2014, ZTE enabled voice over LTE (VoLTE) for CSL's customers in Hong Kong, delivering a superior voice and video calls. At the end of 2014, VoLTE had been activated for more than 1 million CSL subscribers so that they can use VoLTE on any compatible device.

Early Mover on VoLTE

Hong Kong's mobile penetration is one of the highest in the world. With a population of more than 7 million, there are a total of 17 million mobile subscribers by July 2014, it pushes the mobile subscriber penetration rate to 236.2%. In addition, there are four

mobile operators in Hong Kong and users may port their numbers to the other operators. This makes Hong Kong's wireless market even more competitive.

CSL is Hong Kong's leading mobile operator and has partnered with ZTE to commercialize the most advanced technologies and launch higher-quality mobile voice services. This helps CSL maintain its competitive edge in the wireless market.

The Way to Commercial VoLTE

ZTE has been engaged in continual discussion, cooperation and innovation with CSL on VoLTE from the beginning of 4G construction and has finally

commercialized VoLTE on CSL's network.

- In 2010, ZTE demonstrated the first VoLTE call based on CSL's commercial LTE network at the GSMA conference.
- In 2011, ZTE's CS fallback (CSFB) solution was successfully commercialized for CSL. CSFB allows wireless terminals to fall back to the CS domain to send and receive voice calls, while the LTE network carries the data service only. ZTE's CSFB helped CSL speed up LTE commercialization.
- In February 2013, ZTE successfully demonstrated a HD voice call using



enhanced single-radio voice call continuity (eSRVCC) on CSL's commercial LTE network. The eSRVCC solution solves the problem of voice handover between 2G, 3G and 4G.

- In August 2014, ZTE enabled end-to-end VoLTE interconnection between the VoLTE networks of CSL and HKT. This gave Hong Kong's mobile operators invaluable experience with interconnection.
- In late August 2014, CSL commercialized their VoLTE service. At the end of 2014, VoLTE had been activated for more than one million of their network subscribers.

Focusing on Customer Experience, Winning the Future of 4G Voice

With the rapid development of the 4G market, network quality is the key to measuring customer experience. ZTE draws on its rich experience with network construction worldwide to bring CSL's end users a new VoLTE experience and helps CSL stay ahead of its competition and build the best brand.

Faster Voice Call Set-up

A call connection on a 3G network currently takes around seven seconds. Now, ZTE's IMS-based VoLTE solution transmits voice packets through the LTE bearer network, which greatly shortens the call set-up time. During testing, call connection between two VoLTE users was as fast as one second. If a VoLTE user calls a 3G network user, the call connection is connected in around four seconds. This solution ensures a superior HD experience for CSL users.

Enhanced Video Call Quality

The HD codec technology in the VoLTE solution increases the sampling rate and reduces background noise to provide the end user with clear, natural, authentic voice. A video call connected using VoLTE has a resolution of up to 640 × 480 pixels. The picture is very clear—high-quality and without any grids. When a voice call is being processed, the user can switch the call to video with the click of a button. The user can switch back from video call to voice call in the same way. It is very convenient. This solution helps CSL differentiate its products and stand out

from the competition.

Instant Switching between Voice and Video Calls

eSRVCC enables seamless handover from VoLTE to CS voice calls. When a user moves outside the LTE coverage area, the ongoing call is not interrupted. The user can enjoy VoLTE service anytime and anywhere.

Smooth Evolution to 4G

ZTE has come up with a creative solution for 3G to VoLTE evolution. The user can enjoy voice and video calls via the 4G network by using a VoLTE-compatible handset, such as Samsung Galaxy Note 3, iPhone 6 or LG G3, without changing phone numbers or cards and subscribing to 4G service. This solution enables CSL to implement VoLTE at maximum speeds and minimum cost and prepare for large-scale migration to VoLTE.

Together Stronger

With innovative, cutting-edge technologies and solutions, mature network deployment and delivery, and a customer-centered philosophy, ZTE will focus on improving network quality and creating the best network in Hong Kong. Meanwhile, ZTE will also begin interworking and roaming tests on VoLTE networks in other countries. CSL and ZTE are moving forward towards the common goal of giving the people of Hong Kong the best mobile voice service.

(*) CSL Mobile Ltd., which was acquired by HKT Ltd. in May 2014 [ZTE TECHNOLOGIES](#)

CHINA MOBILE: BUILDING A FUTURE-PROOF RCS NETWORK

By Zhang Lu and Yang Wei



With the growing popularity of mobile internet, profit from traditional telecom services is in decline. Squeezed by over-the-top (OTT) players, voice and SMS revenue of operators in 2014 decreased by \$US14 billion, a fall of 26% year-on-year.

Tencent, Alibaba and NetEase have invested heavily in WeChat, Laiwang and Credulity respectively, in order to preempt internet communication. SMS is being overshadowed by emerging OTT services. People used to send or receive text messages; now they use rich-text messages that include voice and video. Communication trends have changed. Li Yue, president of China Mobile, released a white paper China Mobile: Next-Generation Converged Communications at the GTI Summit at GSMA Mobile World Congress 2014. This white paper aims to redefine basic communication services, which should provide superior experience in the 4G era. The paper explains that the core component is rich communication services (RCS), which is a service-capability suite planned by GSMA that enhances calls, messaging, and phonebook.

RCS is based on existing communication capabilities, but will converge voice, messaging, video, presence, community networks, and other means of communication and provide users with a more diverse communication experience.

In October 2014, China Mobile

chose ZTE as the exclusive contractor to construct the IP multimedia subsystem (IMS) RCS network.

World’s Largest Commercial IMS-based RCS Network

As originally planned by China Mobile, the capacity of their RCS network in phase one is more than 100 million users, 16 million of whom will be able to use the network simultaneously. The RCS network is China Mobile’s largest network and also the world’s largest commercial IMS-based RCS network.

China Mobile gave full consideration to RCS features and designed the network accordingly. The home subscriber server (HSS) provides storage and fast processing of mass user data. The call-session control function (CSCF) enables intelligent service load sharing. The serving-call session-control function uses policies that encompass message type, application server keep-alive status, user service subscription information, and terminal service capabilities to automatically distribute massive amounts of service traffic to appropriate service NEs.

World’s First Virtualized Commercial RCS Network Based On Standard ETSI NFV Architecture

China Mobile has used ZTE’s virtualization technology to cope with rapid service growth, to deploy their RCS network rapidly, and to reduce network maintenance costs. This technology is based on the ETSI NFV architecture (Fig. 1). China Mobile’s RCS network is the world’s first virtualized commercial RCS network

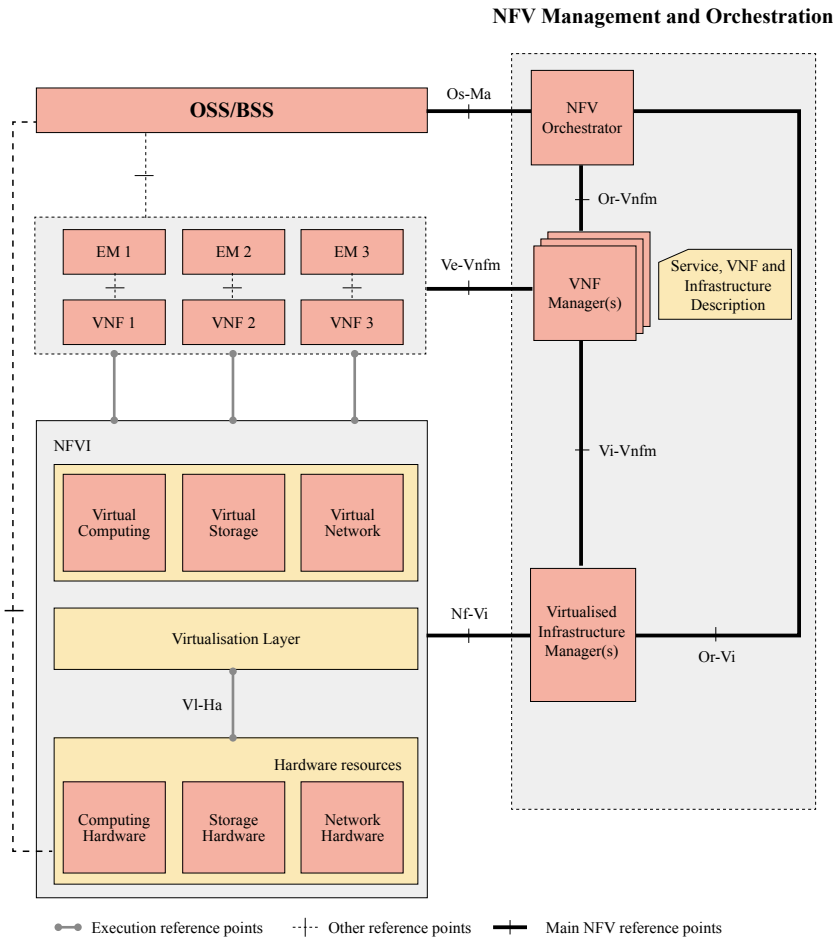


Figure 1. ETSI NFV reference architectural framework.

based on the ETSI NFV architecture.

Any Access, Any UE, Anytime

To enable future communication between various devices, when designing the RCS network, China Mobile used the IMS architecture, defined by 3GPP, and RCS version 5.1, defined by GSMA. All the terminals, 3GPP-compliant or GSMA-compliant, can access the China Mobile RCS network. Smart access and auto-configuration are also included in the China Mobile RCS network. These enable flexible

policy control so that different terminals can access the RCS network at different times and by different means.

Smart access and auto configuration are implemented as follows. Before a terminal accesses a service, the terminal connects the device-management server (DMS) in the RCS network. The DMS checks the terminal app type (web or native), terminal access mode (WLAN, 2G, 3G or 4G), terminal IP address, and request time and then generates a configuration file. This file, which includes address information of various RCS servers

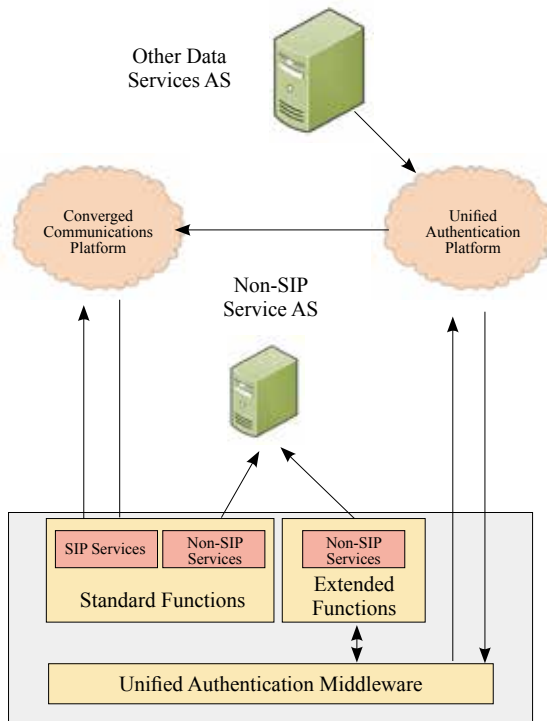


Figure 2. China Mobile's RCS network architecture.

and terminal user ID, is sent to the terminal in HTTPS mode.

Policies are set on session border controllers to provide various means of access. Users in an office can access the RCS network through firewalls of their business. The SBC supports business firewall traversal through tunnels. A home user can access the RCS network through a WLAN. The SBC supports transport layer security connections to ensure information is transmitted securely. An outdoor user can access the RCS network through a 2G, 3G or LTE network. The SBC supports TCP connections to ensure proper service operation and reduce terminal battery consumption.

Varied Services

China Mobile's RCS network (Fig. 2) provides varied services, including one-key multical services and automatic certification.

The former are based on enhanced phonebook. China Mobile's RCS network not only has the basic functions of an existing telecom services but also new functions of the internet. The RCS network allows a user to perform various operations based on the phonebook. You can press a key to make a multi-party call and select multiple contacts from the phonebook to join the call. During the call, you can add new members or remove existing ones. On the screen, you can also observe the number of members in real time. This greatly increases the availability of existing service functions.

China Mobile's RCS network uses a unified certification solution to allow a user to automatically and directly access RCS services after installing a USIM card. The user does not have to enter their user name or password. The unified certification solution enables multiple service NEs to share the

same authentication data.

When a terminal is powered on for the first time and a native app is started, or a mobile app is started for the first time, the DMS in the network determines that the RCS function is not enabled on the terminal. The DMS interacts with unified certification platform deployed in a centralized manner and generates RCS app password for the terminal. The HSS, AS, and ENUM/DNS are involved in RCS account creation. The DMS pushes the app password to the HSS in the RCS network, and after the account has been created, the DMS sends the generated private user identity (PVI) and public user identity (PUI) to the terminal.

After receiving the configuration information, the terminal invokes the embedded unified certification middleware to interact with the unified certification platform. In this way, the terminal obtains the app password generated during account creation and starts the registration flow in the RCS network.

The S-CSCF obtains the corresponding authentication data, including the app password generated during account creation from the HSS. Because all application passwords are generated by the unified certification platform and all password data is the same, the authentication is passed, and the terminal logs in to the RCS network. The user of the terminal is not aware of this process.

This unified certification solution greatly simplifies user operation and improves user experience in a secure manner.

In December 2014, China Mobile's RCS network was demonstrated before 5000 people at the China Mobile Global Partner Conference. Services were interworked between terminals of different manufacturers. This was an important milestone for converged communication of China Mobile and laid a solid foundation for RCS commercialization. **ZTE TECHNOLOGIES**



Opening Network Capability to Lead 5G Network Operation

By Xie Baoguo and Lu Guanghui

In the mobile internet era, increasing network capability is an irreversible trend for operators. With the advent of 4G and 5G, numerous internet applications have turned operators into mere pipe providers. Therefore, building unified and open capability, providing platforms, and opening basic services and information are the key to operators' future competitiveness. Facing keen competition from within the industrial chain, operators can only increase their capacities to build a mobile internet industry ecosystem and seek new development opportunities.

Positioning of Network Capability Opening

The first concern of network capability opening is determining what network capability and information can be opened. Increasing capability maximizes multi-parties' interests and results in win-win situations. After

network capability has been increased, users can subscribe user information services with guarantees, while operators can provide differentiated services and launch rich internet applications rapidly. Increasing network capability also facilitates service promotion in the market. What's more, increasing telecom capability and information motivates operators to better construct, operate, and optimize their networks as well as improve network resource utilization.

Increasing network capability involves increasing the capability of IT hardware and infrastructure, network service processing capability, and network information capability.

IT hardware and infrastructure includes IDC/SDN, CT hardware and infrastructure, including telecom hardware platforms, CPU resources and computing resources, bearer resources with QoS guarantees, and user-based dedicated network resources.

Network service processing capability includes SMS, location services, multi-party conference, rich communication suite (RCS), and billing service.

Network information capability includes the collection and analysis of network information and user information, network policy control, information management, subscription and query, and information security, including user management and authentication, accurate sales, big data consulting, and information security for value-added services. To satisfy customers' short-term demands, operators need to enhance billing capability, location information, user data, SMS capability, and user management and authentication.

ZTE's Capability Opening Architecture

ZTE's capability-opening architecture is an innovative 5G

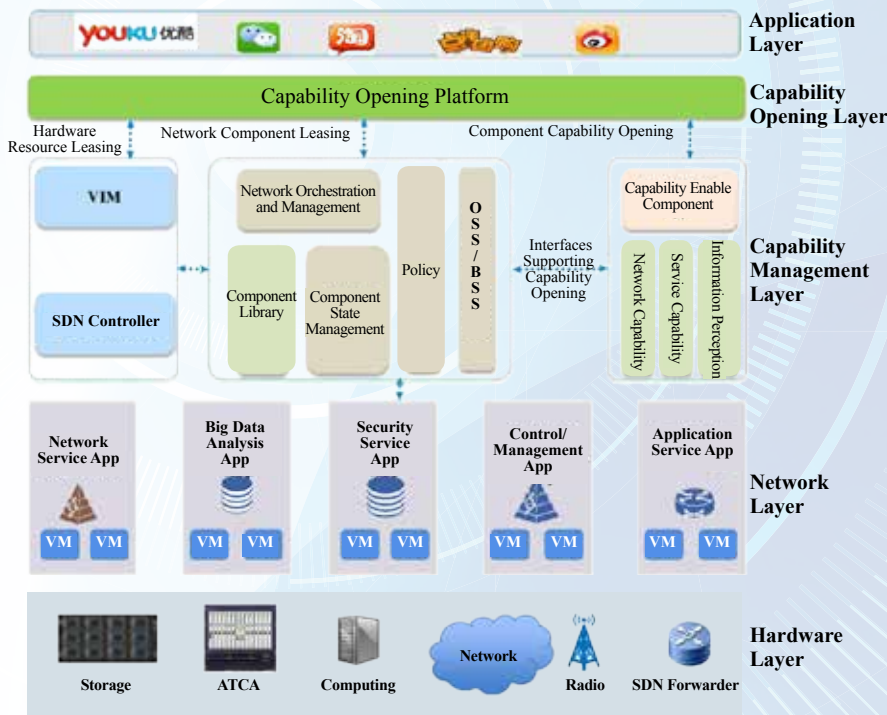


Figure 1. ZTE's 5G capability-opening architecture.

capability opening solution (Fig.1).

ZTE's 5G capability-opening architecture encompasses the capability opening layer and capability management layer. The capability opening layer invokes network capabilities and provides service capability for the application layer. Its northbound interface is connected to the third-party application layer, and its southbound interface is connected to the capability management layer. The capability management layer adapts capabilities and shields network layer topology from the outside. Its northbound interface is connected to the capability opening layer, and its southbound interface is connected to network layer.

Capability Opening Layer

The capability opening layer involves several functional modules, encompassing capability opening security and reliability,

capability resource coordination, pre-billing and post-billing, service platform and environment, and southbound and northbound interface protocol processing. Through this layer, third parties can request the following services from network operators: building a dedicated network environment, leasing proprietary components, opening user and network information, invoking network capability and updating QoS. This layer also has a service platform that can be a self-platform or third-party platform. The service platform is used for accurate sales, games or applications launch and promotion, and content release and subscription. In addition, this layer provides service development environment and test environment in which content providers and individuals can develop and release applications rapidly.

Capability Management Layer

The capability-management layer has several functional modules responsible for service orchestration and modeling based on third-party service requirement, network capability adaptation and encapsulation, network policy generation and execution, information processing, user privacy protection, and northbound and southbound interface protocol processing. This layer adapts and encapsulates capacities according to the capability invocation requirements of the capability opening layer. If any network parameters or user subscription parameter, such as QoS update, are updated this layer generates a corresponding policy and delivers it to the relevant network service APP for execution. If any invocation of user information or network information, this layer converges big data analysis and processing information, network service APP information, and terminal-reported information to presents user and network context information with user privacy protection. In addition, this layer generates different APIs from network capability at the network layer, dedicated network environments or components, infrastructure memory and computing resources in order to increase network capability.

Operation Model Analysis for Increasing Capability

Capability can be increased by network operators or third-party capability operators. Through multiple capability operation models, both operators and CPs/SPs can provide users with better experience and network services.

Package Subscription and Portfolio Charges

One-stop portfolio charges can be

adopted by network operators for both individual and enterprise customers. Users can purchase one-stop network capacities that they need through an integrated e-business platform. Individual users can order different bearer QoS levels for various telecom services, and government and enterprise users can order network multi-party conference resource services according to duration.

Platform Provision and Revenue Sharing

Network operators provide service platforms on which the audiences share various platform services, including content, service development and test, user management, and marketing. With the above, users can release chargeable content, promote services, and develop and test application software. Operators collect charges by platform services.

Capability Integration and Cooperation-Benefit

Network operators can integrate all open network capabilities to build a capability-opening platform. Mobile internet providers can request network capabilities according to their service requirements through the platform, and operators provide them with integrated network capability as APIs (Fig. 2).

Win-Win Cooperation

By increasing network capabilities, both network operators and individual users, CPs/SPs, and government and enterprise users can obtain maximum interests from the ecological chain built through capability opening operation. Therefore, network capability opening is a win-win and feasible operation model.

Individual users can have a better experience by subscribing to network capability services. They can purchase QoS resources, subscribe to content

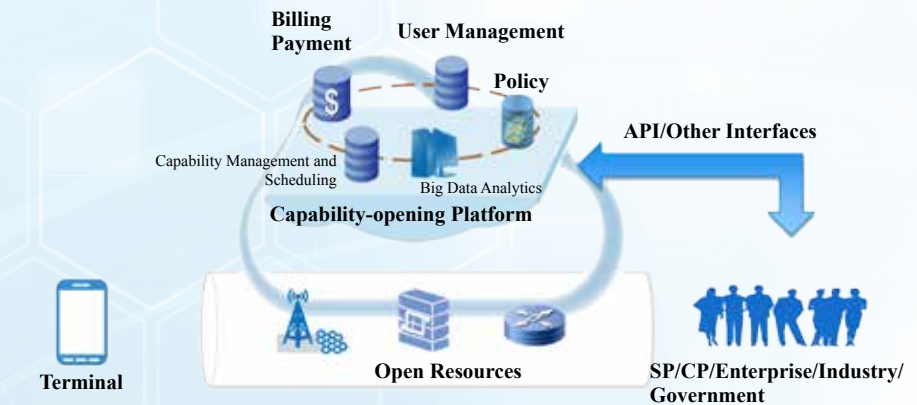


Figure 2. Capability-opening platform.

services and location-based information services (i.e., transportation information, commodity information and restaurant information), but also release applications developed by themselves and content with personal copyright through the service platform and content release platform to gain profits.

For CPs/SPs and government and enterprise network users, increasing network capability can lower the threshold to use telecom service capabilities. Through the capability opening platform, enterprises can directly utilize the operator's telecom resources and platforms to customize required telecom and information services, and efficiently use the operator's infrastructure resources and subscribers and social data to make profits. Moreover, enterprises can achieve service support capabilities such as background billing, user management, and user authorization, which save manpower and operation costs. What's more, enterprises can build small networks such as CDNs and operate these dedicated networks, and subscribe to sales services, such as

game promotion and traffic payment.

Partners work closely with the operator's own ecosystem by increasing network capability in order to build a good ecological chain and increase their value in the mobile internet era. Increasing service capability saves operators from complex service provisioning and approval process so that they can meet customer's requirements and improve customer satisfaction. By providing third parties with paid open platform capability, service capability and context information resources, PCC resources, operators create a new profit growth point. Breaking the pipe operation and closed operation models, operators can explore their large-scale core resources and service potential, and creates business value together with partners. Increasing capability enables operators embedding their capabilities in the services that users concern most to attract more customers. In addition, increasing capability enables operators to optimize their resource configurations and increase their competitiveness. [ZTE TECHNOLOGIES](#)

Technology's Biggest Challenge Is **How to Connect with People**

By Shi Lirong
January 20, 2015
Source: South China Morning Post

The industry needs to make dependence on technology more enjoyable and intuitive as IT is incorporated even further into everyday life.



Shi Lirong, CEO of ZTE Corporation

The word “technology” leaves many people cold, but its pervasive presence in daily life is only going to make it even more important.

Individuals, businesses, governments and countries are dependent on information technology to drive greater productivity and efficiencies.

The challenge for the IT industry is how to make this dependence more enjoyable and intuitive for users to access content and applications.

This is imperative because this year, the emergence of the “internet of thing” (IoT) will extend the sphere of IT even further into everyday life. IoT will allow devices of any nature to be interconnected and used to communicate with each other or with humans in real-time, enabling new possibilities around data, new ways of interacting and new services.

IoT will be big this year, with research firm Gartner predicting 4.9

China is already a source of industry innovation as well as a driver of global trends.

billion “connected things” to be in use, up 30 percent from last year.

Every possible device imaginable is being connected in some way from Bluetooth-enabled toothbrushes to medical devices, cameras, printers and of course the many wearables that are hitting the market. The reality of a hyper-connected world is here today.

In the business world, Gartner predicts IoT will digitize everything and enable any industry to manage, monetize, operate and extend products, services and data.

Researchers at IDC make similar predictions, forecasting rapid expansion of the traditional IT industry into areas not typically viewed as within IT’s universe.

The whole electronics industry, citywide infrastructure, car and transport systems as well as the home, are just a few examples of where IoT is disrupting operations today.

IDC predicts that IoT spending will exceed US\$1.7 trillion this year, up 14 percent from last year, and will hit US\$3 trillion by 2020. A third of spending for intelligent embedded

devices will come from outside the IT and telecommunications industries.

“This amounts to a dramatic expansion of what we would consider IT,” said Frank Gens, chief analyst at IDC.

This implies a fundamental commitment to innovate and explore new applications of technology with the potential to transform how we live and work—whether through the rapid rise of mobile applications, or interactions between machines and human users.

Thinking big is crucial and China is at the forefront of it.

Local governments and municipalities across the country are looking at new energy-powered vehicles as part of smart city metropolitan technology projects. Having carmakers and IT companies work together to roll out wireless charging technology for electric vehicles on a large scale this year could be key to their success.

IoT will be a major enabler for smart city projects as intelligent sensors and networks are required to proliferate across city infrastructure. More than 100 cities in China are working on

programmes to give residents easier access to information and smart applications covering everything from transport, tourism, business, education to health care.

Air China, financial services companies and internet service providers are partnering to roll out the industry-wide Air China Wi-Fi Alliance, giving airline passengers inflight access to broadband internet.

In finance, ground-breaking payments technologies are being pioneered, including phone-based point-of-sales and photonics-based payments, which promise to change poor security perceptions of near-field communications.

These examples demonstrate the new ways that IT is being applied to everyday life and that China is already a source of industry innovation as well as a driver of global trends.

IDC predicts that this year, China will account for 43 percent of all ICT industry growth, a third of all smartphone purchases, and about a third of all online shoppers.

More than 680 million people in China will be online next year, or 2.5 times the number in the United States.

With the world’s largest mobile user base and increased commitment to technology innovation, China will continue to drive much of the development in IoT and the broader global IT market, and this year will only see China’s influence and reach across the global IT landscape grow. [ZTE TECHNOLOGIES](#)



ZTE

Tomorrow never waits