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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



CVTC:

Providing Our Customers
with State-of-the-Art
Communication Services

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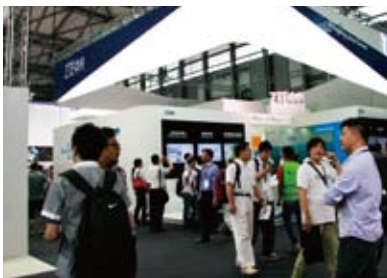


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By Ryan Huang Source: ZDNet

ZTE Transcends 1 Gbps Barrier to Make Industry Breakthrough for LTE-Advanced



26 June 2013, Shenzhen — ZTE achieved wireless data transmission rates of 1 Gigabits per second in a live demonstration for guests at the Mobile Asia Expo conference in Shanghai, delivering a global breakthrough in the development of next-generation LTE-Advanced networks.

In the demonstration, ZTE deployed carrier aggregation technology with four carrier frequencies on the F-band (1.9G band) and D-band (2.6G band). Carrier aggregation is a core technology in the LTE-Advanced (LTE-A) standard, combining two or more carrier frequencies sharing the same or different bands into one channel, increasing the peak transmission speeds of TD-LTE cells by multiple times. ZTE used three carrier frequencies in the 2.6 G band, and on carrier in the 1.9G band to complete the 1 Gbps (F+D CA @ 4×4MIMO) demonstration successfully.

ZTE Attains **No. 2** Position in Worldwide IPTV Market Share

25 June 2013, Shenzhen — ZTE has attained the world's No. 2 ranking in the IPTV market.

According to the Market Leader Report by Product and Region issued by Multimedia Research Group (MRG), ZTE ranked No. 2 in IPTV in six product categories as of March 30.

The report ranked ZTE No. 2 globally for IPTV, video-on-demand (VOD), IPTV middleware and IPTV set-top boxes (STB), three key IPTV equipment and services. ZTE's IPTV VOD and middleware all rank No. 2 globally, with a market share of 11.3%

and 18.3% respectively. ZTE's IPTV STB also ranks No. 2 in the world, moving up from 3rd place in 2012, with a market share of 18.1% as of the end of March this year. The report also stated that the company had robust growth, and excels among Asian IPTV equipment and service vendors.

“ZTE's continued penetration of the IPTV market has enabled it to achieve the No. 2 global ranking in three product categories—STB, VOD and middleware,” said Norm Bogen, vice president of Global Research at MRG.

ZTE Cloud Radio Solution to Usher in New Era of High-Performance LTE Networks

27 June 2013, Shenzhen — ZTE is pleased to showcase the innovative cloud radio solution for 4G network optimization at the Mobile Asia Expo conference in Shanghai.

Comprised of the cloud scheduling and cloud coordination modules, ZTE's cloud radio solution enables operators to build high-performance LTE networks and deliver improved user-experience to consumers, resolving key engineering challenges in 4G network deployment. China Mobile is utilizing ZTE's cloud radio solution to optimize trial TD-LTE networks in Guangzhou.

As operators transition from 2G and

3G networks to LTE, they are likely to find signal interference to be a far more severe engineering challenge. ZTE's cloud scheduling module utilizes a central scheduler to manage network resources on a real-time basis and achieve unified network scheduling. The cloud coordination module enables seamless and borderless coordination for the whole network to improve user experience. Cloud scheduling realizes coordination at the cell level from a macro perspective, while cloud coordination realizes coordination at the user level from a micro perspective. The two-level coordination helps operators build smooth LTE networks.



ZTE Awarded Most New Contracts in China Telecom CDMA Procurement Program

4 July 2013, Shenzhen — ZTE is pleased to be awarded the most new contracts in phase 1 of China Telecom Group's 2013 CDMA network procurement program, the sixth successive year in which ZTE had been entrusted as the leading CDMA vendor in the China market.

ZTE, the global leader in CDMA wireless technology, is proud to support China Telecom in network expansion and optimization by providing innovative and leading-edge solutions. As more consumers access mobile internet services on smartphones, operators globally face more stringent demands on network capacity and quality. With the 2013 network procurement program,

China Telecom is strongly-positioned to grasp the new opportunities in CDMA services and meet the increasingly sophisticated needs of subscribers.

To meet the requirements of China Telecom, ZTE was the first company to launch the SDR-based distributed base stations in the China market. SDR technology helps operators migrate from a network architecture based on macro stations in metropolitan areas, to a more distributed architecture that effectively enhances indoor and rural area coverage. With zero equipment room footprint, low power consumption, and convenient installation, SDR technology has earned the trust of China Telecom across all provincial and organizational levels.

E-Plus and ZTE

Expand Relationship

8 July 2013, Shenzhen — ZTE is broadening its strategic partnership with the E-Plus Group. In future ZTE will operate and maintain the E-Plus network. ZTE has extensive international experience in the field of managed services. For several years it has served as a key partner during E-Plus' efforts to comprehensively expand its network.

The E-Plus Group is delivering greater efficiency, flexibility and effectiveness as part of the broad-based evolution of its network infrastructure to high-speed 4G. Along with a growing need to build out and maintain its network, customers are also calling for consistent high network quality. To help meet these challenges, E-Plus has signed an agreement with ZTE as managed service partner in Germany. Under the five-year contract, ZTE will be responsible for building, operating and maintaining the E-Plus network. The E-Plus Group will retain ownership over the network and maintain control over strategic network planning and development.

“We can take advantage of the synergies available as ZTE not only supplies the equipment but also builds and operates the E-Plus network,” says Andreas Pfisterer, CTO at the E-Plus Group. “ZTE is a perfect partner for successfully implementing our network strategy and with the transfer of network operation we take our partnership to the next level.”

ZTE Wins Best Optical Product—100G Award

20 June 2013, Shenzhen — ZTE has received the award for ‘Best Optical Product—100G’ at the 15th Annual WDM & Next Generation Optical Networking Forum, held in Monaco.

The award was presented to ZTE in acknowledgement of the capabilities of its 100G DWDM/OTN solutions ZXONE 8000 and ZXWM M920. It follows a number of honors recently bestowed on ZTE for its OTN products including the Infovision Award from BBWF and the Innovation Award from GTB.





CVTC:

Providing Our Customers with State-of-the-Art Communication Services

Reporters: Zhao Rujing and Kun Su

Copper Valley

access is required. We have a dedicated group of employees that understand our mission to be the telecommunications provider of choice and to provide our customers with state-of-the-art communications. Being a small rural carrier, CVTC has the flexibility to make strategic decisions quickly.

Q: Someone said that capacity, speed and devices are the keys to success in the telecom industry. What is CVTC's perspective?

A: Over the past decade, CVTC has been deploying fiber and microwave in our network. We have more than 360 miles of fiber and two major microwave links. This network allows us to provide high-speed, high-capacity backhaul from our cell sites and from other wireless providers in our region. Our network can also be scaled to increase capacity in line with usage. Devices are another issue. As a small carrier, we are at the whim of manufactures and larger carriers. However, we are seeing some progress in small rural carriers being able to access devices.

Q: You are also president of the board at RTG. Tell us more about RTG.

ZTE Technologies recently interviewed Dave Dengel, CEO of CVTC. He talked about cooperation with ZTE, CVTC's strategy, and the synergy between fixed and wireless networks.

Q: CVTC provides services in remote areas with low population densities. How can you succeed in such areas?

A: CVTC has been in business for more than 50 years. We know about remote regions, and we know who our customers are. It is challenging to provide both wireline and wireless voice and data services in regional areas. The distances between exchanges and cell sites are great, and sometimes helicopter

Copper Valley Telephone Cooperative (CVTC) has proudly served the Valdez and Copper River Basin areas for more than 50 years. The company provides high-quality communication services, including residential and business landlines, call features, long-distance calling, high-speed internet, and wireless voice and data. CVTC also provides high-capacity special-access businesses and carrier services over a robust fiber and microwave network.

■ VIP Voice



A: The Rural Telecommunications Group (RTG) is the only national trade association representing rural wireless carriers that serve less than 100,000 subscribers. The mission of RTG is to promote wireless opportunities for rural telecommunications companies through advocacy and education. We strive to regularly update our members on regulatory and legislative issues. RTG staff are extremely active at the Federal Communications Commission and in Washington. We have a highly engaged membership base, and this is critical to RTG's ability to direct policymaking towards rural wireless telecommunications.

Q: Last year you announced that CVTC would provide LTE by the fall of 2013. Could you update us on your 4G LTE deployment?

A: We are still on schedule to launch LTE in the fourth quarter of this year. We will begin to deploy the cell sites once the snow has melted later this spring. CVTC is already planning to expand the LTE network in 2014.

Q: What have been your concerns in the transition from 3G to 4G? How have you dealt with them?

A: Our biggest concern has been operating and maintaining two separate networks while transitioning to a full 4G network. We have been able to do this; however, our extra power and backhaul requirements have been expensive. The other concern has been access to devices. This has required dual-mode 3G/4G.

Q: How will you synergize your fixed and wireless networks?

A: CVTC's wireline and wireless businesses support each other by offering bundled services. By bundling, we can provide our customers with lower DSL internet prices. Many of our cell sites are co-located with our wireline sites. This allows us to reduce operating costs for both networks.

Q: How has ZTE contributed to CVTC's development? In which areas do you think we can strengthen our collaboration?

A: ZTE enabled CVTC to enter the digital wireless arena in 2007. The support we received from ZTE has helped us grow network and increase the number of services we offer to our customers. Collaboration could be improved if ZTE were to increase its R&D presence in the United States. At times, it has been difficult for CVTC to troubleshoot issues because of the cultural and time barriers in dealing with China. We would also like to see a greater offering of fully tested small-cell equipment that CVTC could use to improve coverage without deploying a full cell site.

Q: What is CVTC's strategy?

A: Our long-term strategy is to continue providing choice to our retail customers. We also intend to continue using fiber and microwave for our own backhaul and to provide backhaul to other wireless carriers in our region. This will allow CVTC to continue providing affordable state-of-the-art telecommunications to customers in our region. **ZTE TECHNOLOGIES**



Christian Daigneault, CTO of CSL

Smart Expansion of LTE at 1800/2600 MHz in Hong Kong

By Christian Daigneault

At the MWC 2013 LTE Forum, Christian Daigneault, CTO of CSL, talked about CSL's LTE deployment. In November 2010, CSL launched the world's first LTE/DC-HSPA+ network in partnership with ZTE.

It's a pleasure for me to be here to introduce CSL and the experience that we had with LTE over the past two years. Back in 2010, we were the first company to launch a dual band LTE network in Asia.

CSL: Hong Kong's Mobile Broadband Leader

CSL was established in 1983 and is owned by Telstra Australia. CSL has been leading on the technology front not only in Hong Kong but in the world. Some recent technology milestones are: CSL launched the first All IP HSPA 21 Mbps network in Asia in early 2009. CSL LTE network was launched in 2010, and

offered commercially to the mass market in August 2011. In July 2012, we signed the world's first LTE roaming agreement with SK Telecom and we have signed another LTE roaming agreement with Telstra as well.

Why LTE so Early?

You could ask why we were so early to launch LTE in Hong Kong. The population density and high GDP means that smartphone penetration is very high. Typically, in Mongkok and Causeway Bay, everybody owns one or two mobile devices. Mobile penetration is more than 200%. Hong Kong is the world's fastest broadband service for both fixed and

mobile. Therefore, customers in Hong Kong are used to the best service, and they expect the same level of service for their mobile devices as they experience with their fixed network.

Several studies have confirmed that Hong Kong has the world's fastest mobile and fixed broadband. One that I often refer to is Ookla's Speedtest.net, a popular test for all smartphone applications and fixed internet that shows Hong Kong as the fastest. Rankings from Akamai State of the Internet and ITU reports also show that Hong Kong is number one. Hong Kong is even ahead of other "very fast" Asian countries such as Korea, Japan, and Singapore.

There is an application called OpenSignal that is available for Android phones and will come to iPhone very soon. Millions of people have already downloaded the application to test speed; this is crowd-sourcing. In terms of LTE speed, Hong Kong is number two in the world, just behind Sweden. The reason that Sweden is faster is likely to be the wider bandwidth. In Hong Kong, we are using 15 MHz at 2600 MHz and 10 MHz at 1800 MHz. In Sweden, there are many markets with 20 MHz. So the bandwidth available could make the difference.

The Mobile Data Explosion

In our two years of experience with LTE, you can see the growth in traffic. Over the past six to eight months, the LTE growth has been tremendous. Before that time, we mainly sold dongles and a few handsets. Popular devices from Apple, Samsung, HTC and Sony devices have entered the market, and so many other new devices are now available. Everything we sell is LTE; we don't promote 3G anymore so LTE traffic is picking up very fast. Now we carry 25 percent of the traffic on LTE, and we predict that by the end of the year 2013, the volume of LTE traffic will be equivalent to that of 3G traffic. From that point, LTE will be dominant in Hong Kong.

There was 200% traffic growth in Hong Kong last year. We are seeing this is slowing down though, mostly because the driver of growth over the past few years has been the conversion to smartphones. 70% of our customers have now converted to smartphones, and once everyone has converted, growth slows.

2+ Years of 4G LTE Maturity

Over the past two years, we have learned a lot. Many features have improved, and we are now improving customer experience, handover reliability and "stickiness" to 4G so that users do not return to 3G too often.

There were some important milestones achieved. In November 2010, we launched the HD-Voice at the same time as we launched LTE, bringing a much better voice quality through 3G fallback. In April 2012, we launched our first smartphone. Just last week, we teamed up with ZTE to demonstrate VoLTE and e-SRVCC using HD-Voice. We are doing that in our lab using our model network. In the next few months, we plan to bring that to the live network in a larger scale proof of concept.

Innovative 4G LTE Plans

It took some time, but we now have a variety of very good LTE devices. LTE is not all about technology; it is also about our market offers. We want to aggressively move our customers to

LTE so they can enjoy the enhanced experience but also to offload the 3G layer. We have not charged a premium to move customers to LTE though. We have several innovative offers that we introduced to the market. We have various offers for our two brands (1010, one2free, high-end, mass-market-end) as well as a multi-user and multi-device plan. The wireless penetration is more than 200% in Hong Kong, therefore many people own several devices; so we combine all the SIMs together into one volume plan so that users can share the data with friends and family. With multi-device, a single person can have several SIMs. These plans are all based on the volume of data used. In Hong Kong, we still have unlimited data plans for a single SIM but we have gradually moved to volume-based pricing over the past two years. Most of our customers now prefer volume-based plans to unlimited plans and we plan to remove all unlimited plans soon.

World's First Roaming Pacts

We introduced the first LTE roaming agreement with SK Telecom in the summer of 2012. Earlier this year, we launched 4G roaming with Telstra. There are some challenges because it is a new roaming protocol using IPX and Diameter. We have gone through the hurdle successfully, and we are now in discussions with several operators across



the world to introduce LTE roaming.

LTE Performance Today

About 20 to 25 percent of traffic is now LTE. Early adopters (I don't think this is representative of long-term users) consume almost double the traffic as those on 3G. At the very beginning, we had many dongles, which typically consume more traffic. We initially introduced the iPhone 5 on 3G and after a few weeks enabled it over to LTE. We found that a user consumes about 30% more traffic on the same device when it is moved to LTE, just because of the technology shift and faster speed of LTE.

We have also learnt that circuit switched fallback (CSFB) is very good, and it is transparent to users. In typical situation, it introduces about one to two seconds additional set-up time, but customers have not been complaining about this. This is the least of their concern I would say. Everyone is concerned about the data throughput for internet pages, and they are also concerned about not getting any dropped calls. So the call set-up time has not really had a negative impact, and CSFB

is very acceptable. The average speed experienced by the customer now is about 15 Mbps in typical situations, which is 5 Mbps faster than 3G average.

LTE Network Expansion

We started two years ago with a minimum deployment that was leveraging the 3G DC-HSPA+ network. Our LTE 2600 MHz coverage was not very dense initially, having introduced LTE for every four sites. In the last year, we have expanded with LTE 1800 MHz at all sites. 1800 MHz is the coverage layer, and on top of that, we will also add 2600 MHz to every site in the summer of 2013. So we have 2×15 MHz at 2600 MHz and 2×10 MHz at 1800 MHz overlaid. We have tremendous LTE capacity already, and we target to fully re-farm our 1800 MHz spectrum in 2014 to have a full 2×20 MHz, which will give 70 MHz of LTE spectrum. We are in a very good position to sustain capacity for the next few years. This is why we focus very much on LTE. We think with this additional bandwidth, we can guarantee much better customer experience and throughput.

ZTE's New SDR Solution

We have leveraged ZTE's software-defined radio to very quickly deploy LTE at 1800/2600 MHz at all of our sites. We were the first user of ZTE's dual band SDR, so we were certainly the motivation for them to develop it. Access to LTE in the 1800 and 2600 MHz is very common for many operators, so I figured that there would be demand to incentivate vendors such as ZTE to develop. The new RRU 8884 is four radios in one package. It supports 1800/2600 MHz, MIMO, 2G and LTE in the same footprint. It was very important for cities like Hong Kong. We have 900 MHz, 1800 MHz, 2100 MHz and 2600 MHz bands. So you can imagine the antenna sites: they are mostly rooftops loaded with these types of RRU boxes. A very small footprint was key to deploy two frequency bands at the same time.

Fostering Innovation with ZTE

There are a few innovations that we are working on and that are critical to meeting our future capacity requirement. We have signed a joint innovation agreement with ZTE in 2012, and I think

that Hong Kong is a great real life lab for ZTE. Hong Kong is complex environment in terms of customer demand, density of traffic and challenging radio environment with water, mountains, and high buildings; if you can design something to work there, it will very likely work anywhere in the world. Right now we are experimenting and developing VoLTE together with ZTE. We are preparing the network, and we believe that VoLTE is mostly needed in our case to meet the increased capacity requirement that will come from offloading 3G traffic onto the 4G network. It also allows us to re-farm the 3G spectrum to LTE over the next few years.

We are also working with ZTE on a radio optimization tool called Netmax. It is a very important tool for our future because optimizing a multiband, multilayer network is becoming unmanageable with current tools. Other innovations include small cells, carrier aggregation, active antennas, and E-MBMS. We are ready for carrier aggregation in terms of having the radio at 1800/2600 MHz already installed, only a software upgrade will be required. We are working on this. For sure, we need to have devices that support all frequency bands; we'd like to encourage vendors to develop carrier aggregation at 1800/2600 MHz with full 20 MHz bandwidth. Especially in Asia and Europe, there will be large demand for these bands since several LTE networks have been deployed at 1800/2600 MHz.

New multibeam antenna technology also needs to be developed, and it's critical in a high-density city like Hong Kong. We need to build several layers of coverage, from the top of buildings

down to the street. We need antenna beamwidth of 5 to 10 degree dedicated to different buildings, in the horizontal plane but also in the vertical plane. Antennas are key to increased capacity in the future.

I also see some opportunity for E-MBMS. In some locations in Hong Kong like our MTR, customers are watching the same content at the same time and I think that MBMS could provide substantial capacity gain.

Those are the projects we are working on currently in our joint innovation center with ZTE.

Managing Customer Experience End-to-End

I'd like to say it's not all about building an LTE network. We are also focused on end-to-end customer experience and how to define and monitor this experience. Like many other operators, we are investing in new tools to do this; but we are doing it at the customer level. Voice service is very traditional, and we have been managing the experience with the same tools and processes for many years. For data experience, new tools are required. With our traditional tools, we may see KPI at the BTS level looks good, that the average delivered speed is good and everything looks all right, but the user may not be having a good experience at all. We are now looking at KPIs from the customer angle, for each customer. It is not just something we are talking about; we are doing it on our network now. This is where we can start differentiating with better customer experience management;

since everyone in Hong Kong has deployed LTE, everyone is equal in terms of technology. However, there is a big difference between how operators can optimize the customer experience and handle each customer issue with wireless broadband internet.

In Closing

In closing, I would like to summarize in three points:

- The network experience is the main driver of customer satisfaction. Customer experience is not only about speed; it is not 100 Mbps or 1 Gbps. It's being able to deliver perhaps 1 Mbps or 2 Mbps necessary for HD video on smartphone anytime, everywhere, with no buffering. We have now implemented the net promoter system (NPS) and any network problem is immediately reflected in the customer feedback. If we have capacity congestion in the network, we will immediately see a difference in our NPS. Everyone in our organization realizes that network experience is a main driver of customer satisfaction.
- Expanding capacity with LTE 1800/2600 MHz is a smart way to enhance customer experience. We were fortunate to have very good spectrum position, and we leverage it using the right technology for more cost efficient deployment.
- We are now at the turning point in investing in 4G expansion over 3G. All our customer growth is in 4G while 3G traffic remains stable. Most of our investment is going into LTE because it is the future. **ZTE TECHNOLOGIES**

TD-LTE: A Driving Force for Mobile Broadband

By Bill Huang



Bill Huang, general manager of China Mobile Research Institute

At the LTE Forum at MWC 2013, Bill Huang, general manager of China Mobile Research Institute, shared with us China Mobile's views in TD-LTE deployment. China Mobile has been actively promoting the use of TD-LTE technology.

Today, I will share with you China Mobile's experience in deploying, trialing, and testing a TD-LTE network. We have been doing testing for the past two years, and we are pushing for large-scale rollout this year. So I want to take this opportunity to share with you some of the stuff we've found out.

TD-LTE Deployment Update

We are all aware that LTE now is a phenomenon. It is now probably the most rapidly developing technology with the shortest introduction cycle in the history of mobile communication.

Why? Because it provides the lowest possible technology to get bandwidth to users. Today, we have more than 150 LTE networks, 35 of which are TD-LTE networks. We started trialing TD-LTE in China in 2009 and put it into service in more than 7 cities in 2011. By the end of 2012, we had 20,000 base stations covering 13 cities.

It's fair to say today that TD-LTE and FDD-LTE network infrastructure technology are basically equal. Not only that, there are perhaps more vendors providing TD equipment as a result of legacy WiMAX. Many of you may be aware that TD-LTE and FDD LTE

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is highly integrated today. The only difference between them is the radio front end. The baseband and core network is the same, and in some cases, antennas are shared.

Performance Designed for Mobile Broadband

Let's talk a little about performance. Using 3GPP methodology, NGMN guidelines, and GCF test methodologies that we have developed over the years, we are testing the network in application situations that closely approximate those in real life. In the required specifications, I want to address the issue of asymmetric uplink and downlink configuration for TD-LTE.

Internet key performance comparison: Throughput

By configuring three downlink timeslots and one uplink timeslot, we are able to validate TD-LTE networks. In terms of spectrum utilization, TD-LTE is about 1.5 times better than FDD. In other words, you could generate 1.5 times more revenue using the same spectrum allocated for LTE. That is very important for operators that are data-centric because LTE is not necessarily made for providing voice communications; it is made to provide internet connection. If you allocate 20 MHz to deliver LTE service, with FDD-LTE, you have to divide this by ten and add ten. So, the peak speed will only be 75 Mbps. But in reality, this may be somewhere around 20 Mbps. In our testing, we

found that by asymmetrically allocating bandwidth, you can achieve much higher speed because, in this case, the carrier bandwidth is 20 MHz for TDD. Theoretically, you could achieve more than 110 Mbps, but in testing, we achieved 41 Mbps on average. TDD technology is very promising when it comes to LTE.

Internet key performance comparison: Latency

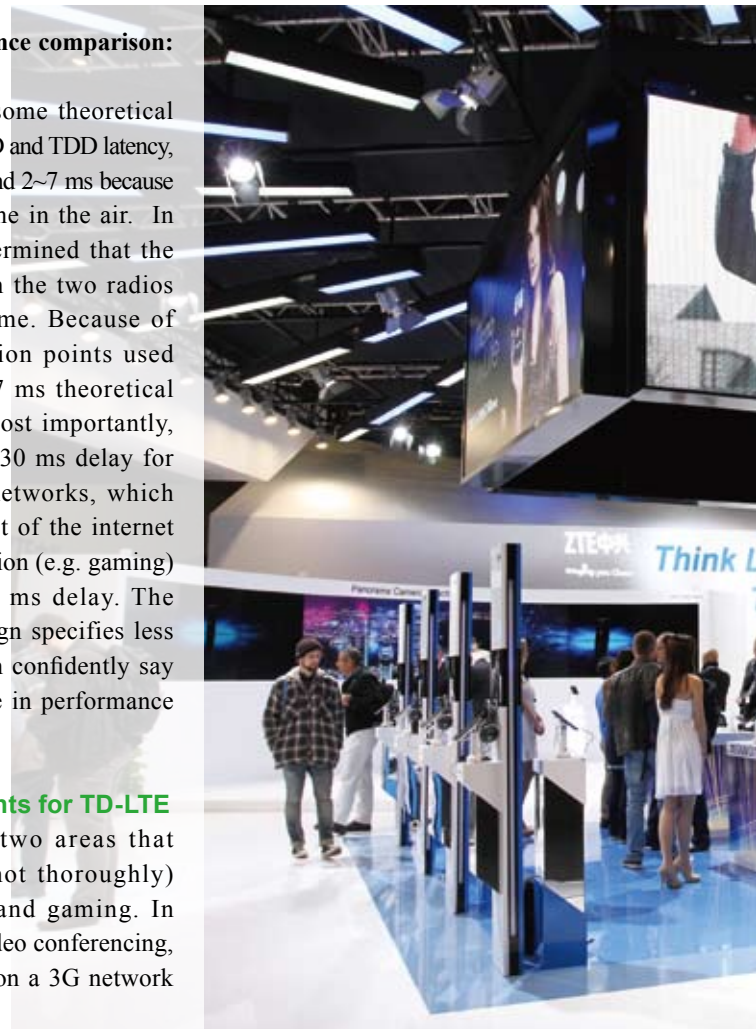
Second, there are some theoretical comparisons between FDD and TDD latency, which is somewhere around 2~7 ms because of the frame switch time in the air. In actual testing, we determined that the average delay between the two radios is pretty much the same. Because of the various optimization points used in the system, the 2~7 ms theoretical delay is eliminated. Most importantly, we achieved less than 30 ms delay for both TDD and FDD networks, which is critical because most of the internet applications for interaction (e.g. gaming) require less than 100 ms delay. The guideline for LTE design specifies less than 50 ms delay. I can confidently say that LTE is comparable in performance to fixed broadband.

Network Requirements for TD-LTE

In 3G networks, two areas that are reasonably (but not thoroughly) addressed are video and gaming. In addition, there's also video conferencing, which is very difficult on a 3G network because of latency.

LTE supports diverse mobile internet services

We have not only tried real conferencing on LTE networks, we have also tried live high-definition video broadcasting. We put a broadcast camera in a stadium or along a marathon



route and used LTE as the only uplink mechanism during the live broadcast. In this scenario, LTE performed extremely well. In fact, we optimized the network so that we could provide real coverage along the side of the sports stadium or along the marathon route. It is very



likely that you will be able to achieve broadcast-quality coverage for a sports event. This further proves that LTE is ready for prime time.

We are not just using an LTE network to provide internet access. We are also exploring the use of LTE to deploy private IP services. To deploy future carrier-class public IP services, we believe in the E2E QoS guarantee provided by LTE. We should be able to provide leased-line-quality services to future users over LTE infrastructure. This is very important for generating additional revenue for the LTE network.

Optical backhaul requirement

LTE deployment requires a reasonable overhaul of the transmission network. For those of you who have been contemplating network migration, packet transport network (PTN) technology is very important. We are now doing a massive overhaul of our transmission network, migrating from SDH to PTN. We are also massively deploying passive optical network (PON), especially in the high bit rate (10 Gbit area) in order to backhaul our signals for C-RAN. This will be the foundation for deployment of a good LTE network. It's very important to make our operator friends here aware that investment in LTE involves investment not only in radio equipment but also in the optical backhaul.

More and more capex of ours is now invested in optical backhaul for the LTE

network. There is a dramatic difference in bandwidth between the present backhaul and traditional backhaul. Backhaul bandwidth for GSM is very small, and for 3G is reasonably big (but not very big). However, larger backhaul bandwidth for LTE, especially when moving to C-RAN, is something that we need to be prepared for. Of course, the long-term saving of capex and opex in an LTE network with C-RAN technology is significant. So investment in this area is definitely called for.

Nanocell: Ideal technology for integrating LTE and Wi-Fi

Nanocell is another new technology we are moving into. We have conducted some studies of traffic patterns and have noticed that 1% of the area covered by the network perhaps accounts for more than 50% of traffic flow. This is the reason Wi-Fi has become such an important alternative mechanism for traffic offloading. In the LTE area, this technology is not only providing LTE coverage for indoor and hot zones but is also providing integration with Wi-Fi. This is so-called nanocell technology. It's not a picocell or a femtocell but somewhere in between which carrier is going to deploy. So we call it nanocell. It further flattens the network architecture and allows an operator to collaborate with enterprises or fixed-line broadband service providers by integrating LTE cell and Wi-Fi AP into the same backhaul. Both local breakout and centralized EPC routing work

*Now we are in the era where new technology is introduced in both the semiconductor and unified protocol stack. We are entering the era where **mobile phones are becoming global.***

together at the same time. This nacocell technology will become significant over the next three to five years.

How to build an E2E IPv6 LTE network

I know many of you are contemplating IPv6, but due to the lack of compatibility between IPv4 applications and IPv6 applications, either you settle for a dual-stack network running both IPv4 and IPv6 or you settle for IPv4 networks. Very few operators have really tried to move forward with an E2E IPv6 network. However, since LTE services have been introduced to the field, it becomes more important to have more and more IP addresses to reach end devices. So how do we do that? New technologies are now available to solve these problems. These technologies may be BIH or newly emerged dual translation. What will these technologies do? They will embed the ability to provide backhaul compatibility for IPv4 applications. In other words, IPv4 IP stack will be compatible in an E2E IPv6 network. These technologies are becoming very important, and without them, it's very difficult to deploy an E2E IPv6 network.

Carrier IP public service (CIPS)

Let me talk a little bit about carrier-class IP public services. What is carrier-class IP public service? To start with, we know that the internet is a public IP service, but there is no QoS guarantee, and you cannot use it to provide SLA to any subscriber. Today, we deploy leased line; we deploy virtual private networks, but it's for enterprises that use VPNs or leased lines communicate with each other. This is where carrier-class public IP services come in. In this new network, we provide customers with public IP services but not internet access. It's a public IP services with QoS and SLA. We need to have operators to work together to provide interconnection of such a network. Inside our own carrier network, we can provide the service, but to provide the service across the carrier boundary, we have to build a new IP network that will serve as a public IP network extension. This is the best guarantee to continue to maintain the internet transparency.

Terminal Recommendations

Last, I will talk a little bit about terminals. If you look at the technology

today, we are at the verge of breaking out, just like in the 1980s, when all the different types of PCs finally became IBM PC compatibles. Today, we have many different spectrums, technologies, and countries with different radio requirements. Mobile phones, although they look exactly the same, are actually customized for every different country. Now we are in the era where new technology is introduced in both the semiconductor and unified protocol stack. We are entering the era where mobile phones are becoming global.

At the TD-LTE GTI Summit, we will introduce eight new types of devices that have global roaming. We will introduce five modes and ten different bands. We hope to promote this technology to make sure that operators, big or small, enjoy a unified device market and low-cost mass market LTE terminals. This is the future. I hope that all operators issue similar requirements, and we have white papers available for our device manufactures. Maybe in the next two to three years, these types of devices will not just be for the high-end market but also for the prevailing mid-end and perhaps even the entry-level segments. **ZTE TECHNOLOGIES**

The Evolution of Smart OTN

By Hong Yu

Technological Evolution

Smart optical transport networks have evolved because of new optical networking applications and demands. Compared with a traditional transport network, a smart OTN has an independent control plane for dynamic connections that involve routing, signal processing, auto discovery, connection control, and protective restoration. The control plane also supports a variety of new services, and bandwidth is allocated in real time according to actual needs. This makes traffic engineering easier in optical channels and also makes it easier to quickly introduce value-added services.

OTN control plane

An OTN control plane is

developed on the basis of an automatically switched optical network. A traditional wavelength-switched optical network schedules only single wavelengths whereas an optoelectronic hybrid OTN schedules both the optical and electronic layers in a unified way. As OTN evolves, the control plane needs to schedule large-granularity services that have the capacity for widespread interconnection. The OTN control plane also needs to dynamically adjust the bandwidth in order to manage and control switching devices at multiple layers. Increasingly, the role of the control plane in the OTN is becoming important.

Unified control plane

Convergence is an inevitable trend

in bearer networks. The control plane, therefore, is developing towards multilayer and multidomain resource control. Vertically, the control plane supports IP/MPLS, SDH/PTN, and WDM/OTN switching technologies and VC, STM, and ODUk switching granularities. Horizontally, the control plane allows interoperability between different operators and manufacturers. The control range has been extended from SDH to WDM/OTN and PTN/CE. This means that the control planes of different switching technologies are interoperable or form a unified plane to control different switching technologies. This requirement has become the focus of attention of standards organizations and operators. Leading telecom vendors have put forward their own solutions and

■ Special Topic: Smart OTN

demonstration systems. Generalized multiprotocol label switching (GMPLS) allows control of PSC, L2SC, TDM, LSC, and FSC switching and all types of devices in a bearer network. GMPLS allows the control plane to be easily extended so that it can control networks and devices with different switching technologies and granularities.

The control plane does not yet support all PSC, L2SC, TDM, LSC, and FSC switching granularities. However, the topology for dual-layer device scheduling (i.e. ROADM + OTN and PTN + OTN) has been widely accepted in the industry and will evolve to support multilayer device scheduling.

A unified control plane can control switching devices or networking at multiple layers, but it has issues in terms of protocol extension and standardization. GMPLS is currently the only protocol suite that can control devices at all PSC, L2SC, TDM, and LSC layers. GMPLS has therefore become the preferred protocol suite for a unified control plane.

In an environment with multiple operators and vendors, issues with interoperability often hinder network development. Each operator requires services to be quickly assigned, connection paths to be optimized, and privacy to be protected. To implement large-scale networking, overlay, peer, and border peer networking models can be used. UNI, E-NNI, and I-NNI interfaces can also be used.

Development of Programmable OTN

Unlike traditional optical networks, future software-defined

networks (SDNs) will be highly programmable. In an SDN, resources and operations at the transport layer can be opened to APPs and can be controlled at the network control layer in a centralized and personalized way.

Programmability implies the capacity to alter a command as needed. The programmability of the transport layer is based on the programmability of its components so that node devices are more programmable and capability resources and information can be abstracted in the controller. In this way, the SDN transport layer is highly programmable and capable of optimizing resource scheduling. A controller provides unified traffic flow control for optical, electrical, and packet-switching devices of different granularities. This helps converge the network and unify resource scheduling.

A software-defined network can

- satisfy user demand for network

programming. This improves user experience; provides flexibility in device usage, operation and sales; shortens the service-development period; cuts hardware costs; and helps operators reduce opex and create new profit models.

- virtualize network resources. This makes all OTN products manageable.
- leverage centralized computing. This helps operators uniformly optimize and schedule resources and obtain information about resources in a timely manner.
- provide openness and flexibility. This helps operators build an efficient, flexible, open OTN in the cloud era.

Component programmability

With a software-defined optical module (Fig. 1), spectrum efficiency and compensation algorithms can be selected according to link state.

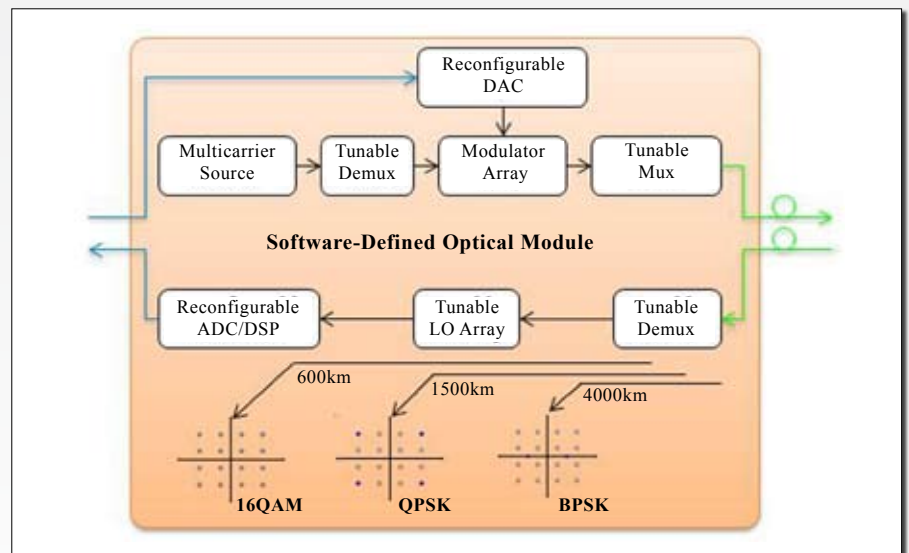


Figure 1. Programmable optical module.

Such algorithms are programmable: Impairment compensation algorithms and forward error correction, types and formats can be changed.

With tunable mux, demux, and WSS, grid width and filter shapes can be selected according to the signal spectrum width and number of cascades. Grid width and spectral shapes are programmable.

Node programmability

FLEX OTN allows rate adaptation and multiplexing, and the size of a flexible ODU/OTUC container is programmable (Fig. 2). In a TDM/packet hybrid scheduling scenario, the electrical switching granularity is programmable.

FLEX ROADM allows optical switching based on spectrum resources.

In the grid, the optical switching granularity is programmable, and in the transport channel, spectrum combination/separation is also programmable.

Nodes can be virtualized and combined, and the scale of nodes is programmable. A single physical node may be virtualized into multiple logical nodes, or multiple physical nodes may be virtualized into one logical node.

Network programmability

Network programmability allows resources in the network to be abstracted and changed as required during service scheduling. Network programmability involves bandwidth on demand and technology as a service. With bandwidth on demand, a connection can be selected according to actual needs. Bandwidth type (TDM/packet), size, latency, and QoS can be changed. With technology as a service, different logical subnets are virtualized for different users so that different bearing requirements are met. Network type (packet, subwavelength or wavelength switching) is changeable, and the number of ports, nodes, fibers, and connections are also changeable.

Conclusion

In the evolution of smart OTN, the transport plane and control technologies have developed. The transport plane includes open interfaces and decoupled software/hardware functionality and is evolving towards programmability. Control technologies are evolving from distributed, single-domain network control to centralized, multilayer, multidomain network collaboration. **ZTE TECHNOLOGIES**

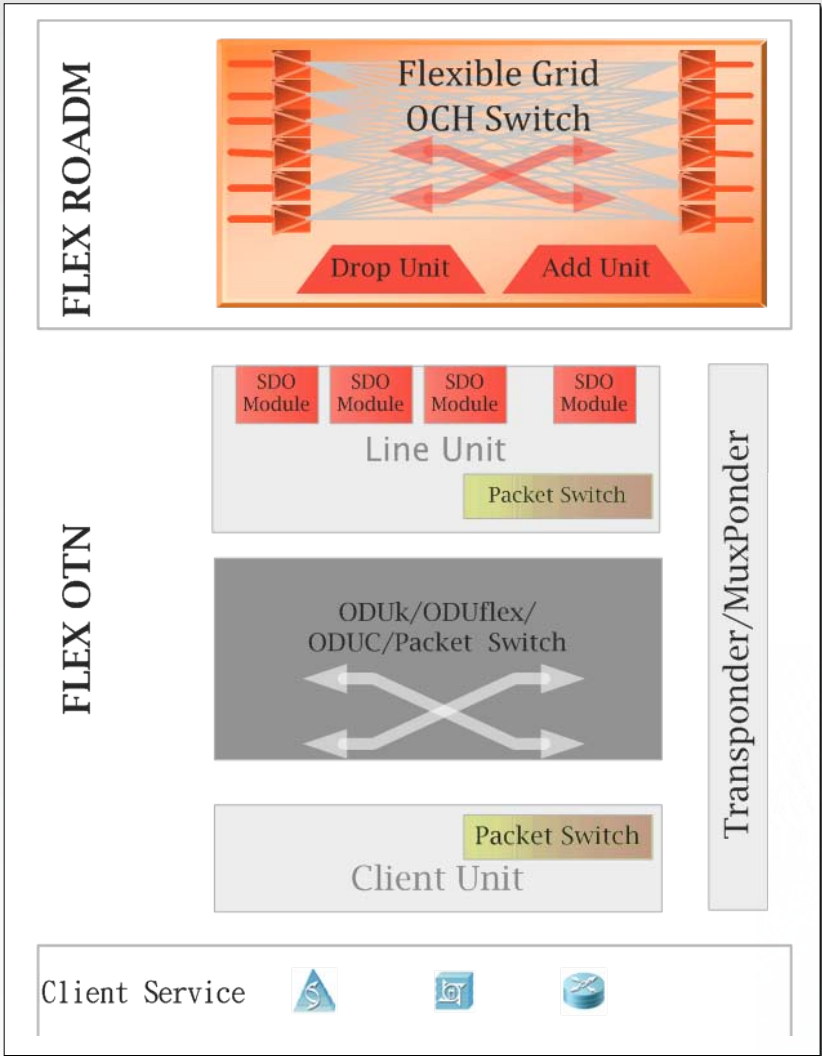


Figure 2. Programmable nodes.

OTN in the Metro Access and Convergence Layer: Development Trends

By Ma Guangpei

With the development of all-service operation, services transported in the metro access and convergence (MAC) layer have changed tremendously. Access services require high-bandwidth LTE base stations, optical line terminals with 10G uplink, and lines dedicated

to gigabyte (or higher) Ethernet verification IP. Earlier networks in the MAC layer did not meet service requirements, so constructing networks in this layer has become a priority for operators.

An optical transport network (OTN) has the advantages of synchronous digital hierarchy and wavelength-division multiplexing and is a unified bearer platform for

backbone networks and metropolitan area networks. OTNs provide unified, end-to-end monitoring; high bandwidth; and highly reliable transmission. Little by little, the requirements for highly efficient transmission in the trunk and metro layers are being met. This is a result of large-scale construction of unified OTN bearer platforms. Extending OTN from the backbone to the edge and metro access and convergence layer is desirable when there are insufficient optical resources and

inefficiency occurs as a result of using traditional methods to expand bandwidth. OTN allows for a high degree of integration and saves money and power.

Technical Characteristics of OTN

OTN is defined by ITU-T recommendations G.872, G.709, and G.798. Although an OTN is based on WDM, it does not have the problems of a traditional WDM network. These problems include poor wavelength and subwavelength dispatching, and weak networking and protection.

In the all-service era, every telecom operator will need to become integrated ICT service providers. Greater diversity in services means higher demand for network bandwidth, capacity, and transmission performance. An OTN meets all these requirements, and optical networking is the main trend in transport networks.

Service Bearing: From Cities to Suburbs and Towns

In recent times, OLT equipment rooms have been moved from urban areas to suburban and regional areas. This has been the driving force behind building the OTN in the MAC layer. As service requirements change, suburban transmission networks are insufficient in terms of bandwidth and transmission distance.

In the small-bandwidth era, the network between the OLT/DSLAM and BRAS has used fiber connections. However, as speed increases, a GE uplink port is insufficient for OLT/DSLAM. Two to four GE ports are bound together to provide more

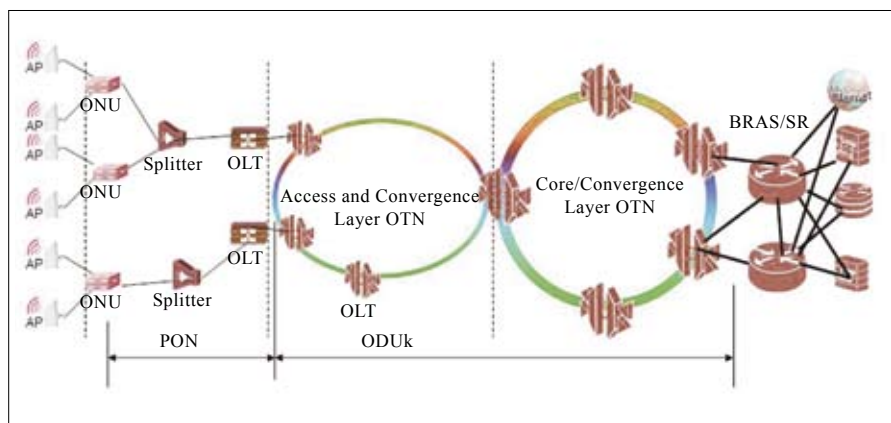


Figure 1. An OTN in the MAC layer.

bandwidth, and this means that more fibers are required. Meanwhile, new services, such as IPTV, SDI, and HTV, have emerged and promoted the deployment of multi-edge gateways. This also means that more optical fibers are needed in the OLT/DSLAM uplink. All of these factors increase the burden on fiber cables. Therefore, the OTN needs to be deployed in the MAC layer for transmission between OLT/DSLAMs and BRAS/SRs. This will ease the burden on fibers, provide optical-layer network protection, improve network security, and give users a better experience.

The distance from an urban area to a suburb or town can be a hundred kilometers, and the distance covered by a ring network (used for transmission) can be even greater. If the transmission distance between two nodes is too great, relay stations must be added, and this increases network

cost and may even affect networking. An OTN has high bandwidth and supports long-distance transmission.

During city-to-county bandwidth upgrades, the OTN can reduce the rapid consumption of optical fiber resources caused by fiber connection. It can also protect services and better manage bandwidth resources in the MAN MAC layer (Fig. 1).

VIP Line Access

VIP line service has become an important part of an operator's all-service strategy. Dedicated lines are fast and provide flexible access (Fig. 2).

In most transmission networks, many devices are located in the MAC layer, and network resources need to be coordinated in order to provide services. If there is no end-to-end solution between the MAC and core layers, services cannot be properly dispatched and provided.

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An OTN greatly improves network transparency, channel performance, and fault monitoring. It also helps with end-to-end physical transport and the creation of a management layer.

The OTN network supports electrical cross-connection and tributary/line separation on OTU boards in order to quickly provide services.

LTE Bearer

In recent years, services such as email, flight and weather updates,

banking, shopping, and video have become available for smartphones. On the one hand, smartphones have brought convenience to daily life; on the other hand, they demand higher bandwidth and transmission rates. As Wi-Fi, LTE and LTE-A advance, wireless transmission rates are pushed higher and higher. All of these factors weigh heavily on the architecture and bandwidth of the base station network.

As they move to all-service operation, operators are using PTN/IP RAN for mobile backhaul. LTE

deployment continues to increase the load on the MAN; therefore, the ability to dispatch different services must be strengthened. Combined with PTN, MSTP and PON technologies, OTN lightens the bearing pressure.

In MAC-layer applications, small OTN devices are extensively deployed. These devices are deployed on access and convergence nodes to carry services transported from the GE ports on OLTs. These devices also have a large capacity and can accommodate an LTE uplink rate of 300 Mbps to 500 Mbps. Furthermore, they can alleviate the need for greater capacity in 10 GE rings comprising PTN/IP RAN equipment.

The OTN can transform a daisy-chain network into a flat tree network and optimize the PTN/IP RAN network architecture (Fig. 3). Services are processed on the access and convergence nodes and then transported to the metro core and convergence layer through the OTN network. This creates a flat PTN/IP RAN network, increases bandwidth capacity, and improves QoS.

Conclusion

As the bandwidth requirements of fixed, mobile, and dedicated networks increases, operators are choosing to deploy OTN at the MAC layer. This increases the speed of fixed and mobile broadband networks and provides an end-to-end platform so that high-end VIP services can be rapidly provided.

An OTN in the MAC layer is a unified bearer platform that integrates fixed line, dedicated line, and mobile services. An OTN allows operators to provide all types of services, create a more competitive network, and improve customer satisfaction. **ZTE TECHNOLOGIES**

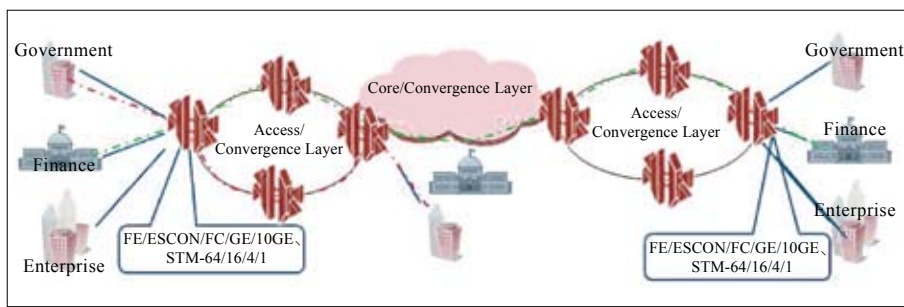


Figure 2. A VIP line.

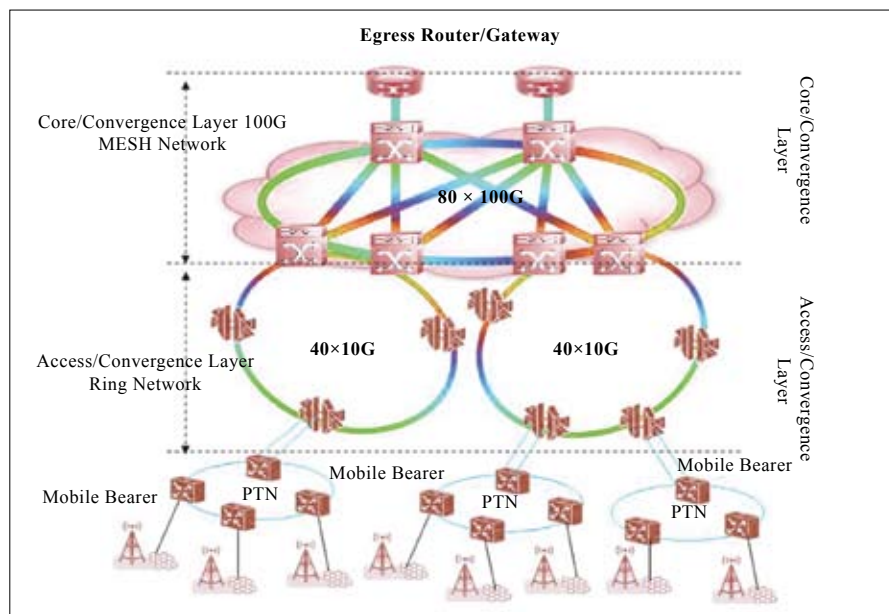


Figure 3. Network architecture.

OTN Deployment in the Convergence and Access Layers

By Luo Lairong and Wang Linfeng

Mobile internet is developing fast and is changing the way people work. HD videos and other services that require large bandwidth are pushing mobile networks to evolve to LTE. Limited capacity of the metro bearer network is a challenge for LTE development. OTN is a large-capacity, multi-service bearer platform that has been widely deployed in metro core networks and is used in the convergence layer of MANs. We discuss the bandwidth requirements of LTE services propose deploying OTNs in the convergence and access layers so that LTE services can be efficiently carried.

LTE Bandwidth Requirement of a Metro Transport Network

In a 3G network, base stations and bearer network equipment in the access layer mainly connect through FE/E1 ports. In an LTE

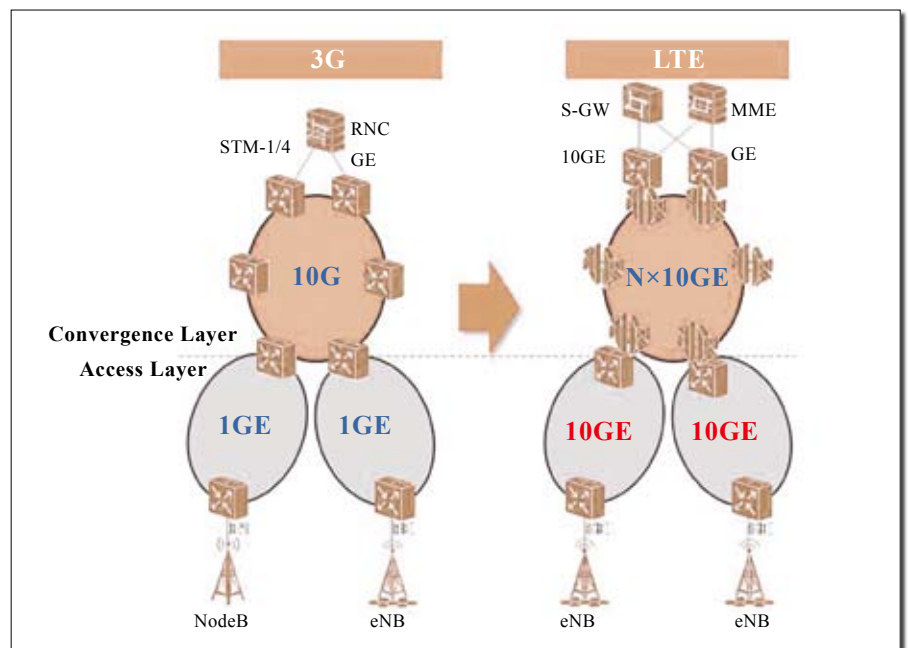


Figure 1. Bandwidth requirements of 3G and LTE networks.

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network, GE optical ports are used for connection (Fig. 1). The typical bandwidth requirement of a single base station in an LTE network is about 100 Mbps, and the peak bandwidth is 300 Mbps. The number of GE optical ports is greatly increased in an LTE network. A PTN/IP-RAN network, which is the access layer of an LTE backhaul network, usually has 10GE networking. In a typical wireless backhaul network, an access loop has about six to eight access nodes, a convergence loop has about four to six convergence nodes, and each convergence node has two access loops. The bandwidth of a single convergence layer is about 20–30 Gbps. In a moderately developed city, there are multiple convergence planes, so the total bandwidth of the convergence layers is multiplied. The bandwidth of the current 10GE PTN/IP-RAN networks cannot meet the LTE requirements, and network upgrades are required.

Bearing PTN/IP-RAN Traffic by Deploying OTN in the Convergence Layer

OTN leverages the bandwidth of optical fibers through WDM and transparently carries 10GE PTN/IP-RAN traffic from 3G networks. OTN also carries PTN/IP-RAN traffic of services that require a higher rate. OTN is an important bearer technology for the convergence layer of LTE networks.

An alternative solution to bearing RTN/IP-RAN traffic is 40G PTN/IP-RAN. The two solutions have their own advantages and can be selected as required.

Table 1. Features of 10G PTN/IP-RAN over OTN and 40G PTN/IP-RAN for the LTE convergence layer.

Index	40G PTN/IP-RAN	10G PTN/IP-RAN over OTN
Technology maturity and industrial chain development	Bearer networks for IP services have evolved from 10GE to 100GE. 100G transport has been widely applied, and 40G will be superseded. 40G standards are no longer at the cutting edge, and many manufacturers have turned to 100G to reduce their investment in 40G equipment. Therefore, limited supply and high cost of 40G products are big issues. 40G PTN/IP-RAN equipment is still new, and the performance of this equipment has not been fully determined.	10G PTN/IP-RAN and 10G OTN equipment has been widely used. They are cost-effective products and perform steadily.
Full-service bearer capacity	The total bandwidth of a 40GE PTN is limited, which means that 40GE PTN is inappropriate for bearing broadband services.	OTNs can bear a full range of fixed and wireless traffic, including 10G PTN traffic at the convergence layer, MSTP convergence loop traffic, and GE/10GE uplink traffic from OLTs.
Scalability	10GE convergence loops in current 3G networks cannot be directly upgraded to 40GE convergence loops, and new equipment is needed.	10GE ports can be added easily to increase the value of the investment.
Investment	The cost of 40G optical modules is high.	10G optical modules are cheap and widely used. However, total investment into OTN equipment is only slightly higher than that for 40G PTN/IP-RAN equipment.
Competition	40G PTN/IP-RAN is a single-layer network, so it does not create serious competition in the market.	An OTN and an original 10G PTN/IP-RAN can be deployed by different manufacturers, so there may be serious competition, which would reduce networking costs.

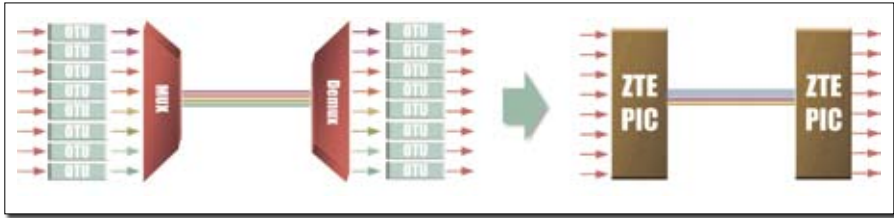


Figure 2. PIC solution.

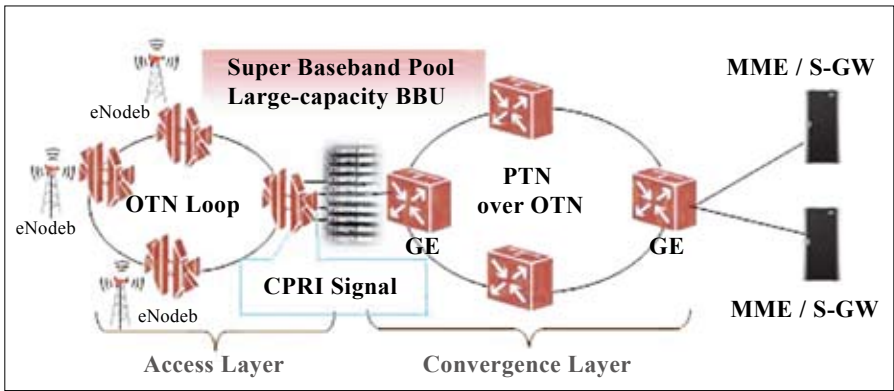


Figure 3. OTN in a network with centralized BBUs.

**OTN in the Convergence Layer:
A PIC Solution**

OTN equipment with integrated PIC modules has large bandwidth and is easy to maintain. A single PIC module can bear 80–120G traffic and is suitable for converged loops in LTE networks.

The PIC solution supports 8/10/12 EA modulated lasers and optical receivers (Fig. 2). This greatly reduces the size and power consumption of optical components. EA modulated lasers are sensitive and OSNR tolerant. When applied in the MAN convergence layer of LTE networks, the PIC solution has the following advantages:

- The number of fiber pigtails and

ODFs are reduced, and this is helpful in maintenance.

- Lower network investment is required, and carbon emissions are reduced because the PIC modules consume little power.
- PIC modules are well designed and can be easily replaced and maintained.

C-RAN in the Access Layer

A C-RAN is a centralized/collaborative/cloud radio-access network. In a cutting-edge architecture oriented towards 4G, C-RAN can reduce system capex and opex. In C-RAN, centralized BBUs are separated from multiple RRUs. The volume of IQ data transmitted between BBUs and RRUs is a multiple of that

transferred between BBUs and RRUs in traditional macro base stations. Because of IQ latency and clock synchronization requirements, a packet solution is not feasible. Current bearer solutions use fiber connection. As more and more BBUs are deployed, each RRU has to use a pair of optical fibers, and many optical fiber resources need to be used. Moreover, fiber-connected link security cannot be ensured, and it is difficult to maintain fiber jumpers at BBUs. With the OTN WDM solution, additional optical fibers are not required. Security is guaranteed, and C-RAN maintenance is simplified.

The flat transport structure is suitable for future LTE requirements, and the super baseband pool is connected directly to the convergence layer (Fig. 3). This reduces the number of router hops. The access layer uses compact OTN equipment to provide a multiservice bearer platform that can bear the traffic of CPRI services, big customer services, and even future services.

Conclusion

LTE services require more bandwidth in the bearer network. Operators have therefore chosen to deploy OTN in the convergence layer. In this way, PTN/IP-RAN resources of 3G networks can be used to reduce the need for additional investment. OTN equipment in the convergence layer is necessary to efficiently bear broadband services and transparently carry traffic well into the post-LTE era. **ZTE TECHNOLOGIES**

Software-Defined OTN

By Zhu Xuetao

Challenges for Traditional OTN

In recent years, new IP-based services have continuously emerged and the volume of global internet traffic has grown rapidly. According to Cisco's annual visual networking index forecast, the compound annual growth rate of network traffic will reach 29 % by 2016, and global internet bandwidth will enter the Zettabyte era.

Operators have to face the challenges created by this surge in traffic, even though their revenues are not keeping pace. It is not realistic to meet traffic needs by

linearly expanding the bandwidth of OTNs. Because of technology limitations, the bandwidth capacity of OTNs is limited for some time. It is therefore necessary turn to other resources to improve spectrum efficiency, reduce invalid traffic handling, and optimize networks.

Traditional OTN has a rigid-bandwidth pipe, fixed interface speeds, and fixed spectrum intervals. Operators are also faced with bursty traffic caused by new real-time services. OTN is simply not flexible enough for dynamic traffic. A more flexible, open network architecture is needed.

Software-Defined OTN

SDN concept

In a software-defined network, software controls the network and fully opens up network capabilities. This allows the network to change rapidly and easily through software upgrades. The key features of SDN are the separation of control and forwarding, centralized logic control, and open APIs (Fig. 1).

Architecture and function of software-defined OTN

A software-defined OTN has similar features to a software-defined network. Through flexible, programmable hardware, optical transport resources can be adjusted.

ZTE's software-defined OTN architecture has FLEX ROADM, FELX OTN, and a cloud scheduler (Fig. 2).

FLEX ROADM supports colorless, directionless, contentionless and gridless (CDCG) features. It can switch between carriers of any granularity, between channels at any level, and between wavelengths or subcarriers with any spectral width. This provides great flexibility for efficient service bearing.

FLEX OTN provides flexible ODU/OTU encapsulation at variable rates. It supports any link rate with a granularity of 100G and also supports flexible

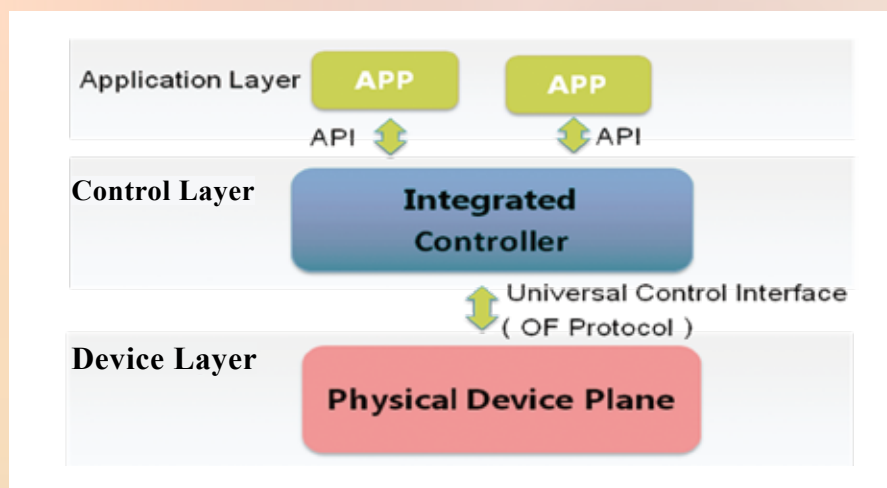


Figure 1. SDN architecture.

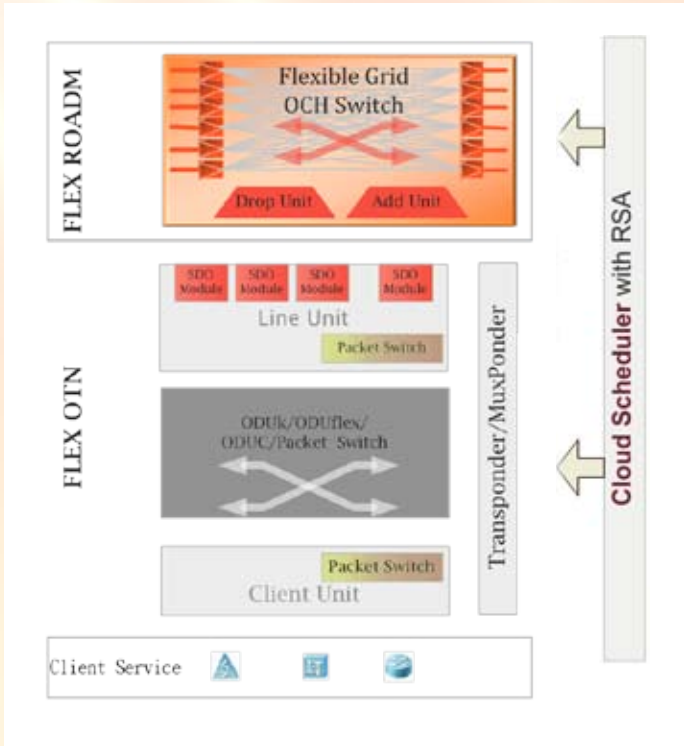


Figure 2. ZTE's software-defined OTN architecture.

modulation formats. The software-defined optical module allows for these variable rates and modulation formats. If traffic is not heavy, the system can be configured with lower rates. As traffic increases, the configuration can be altered through software. This allows the system to adapt to changes in traffic and application scenarios and the high cost of replacing functional boards is avoided.

Photonic integration and efficient DSP are key features of an SDO module. By balancing bandwidth, distance, and complexity, the SDO module achieves optimal spectrum efficiency.

The SDO module also provides cloud resource scheduling between line boards. Unused slots (optical modules)

on one board can be used by another board, and multiple boards can form a line path. This allows resources to be flexibly used.

The cloud scheduler allows users to control all network resources and manage virtual devices and networks through SDN interfaces. With the routing and spectrum assignment algorithm, the cloud scheduler can schedule channels and subcarriers of any granularity, establish flexible end-to-end communication pipes, and adjust bandwidth according to real-time changes in traffic. These capabilities all improve network efficiency.

The value of software-defined OTN

Software-defined OTN can provide

access to any service; it can switch services of any granularity; and it can transport on any bandwidth. It has a view of the whole network and can controls and optimize network resources in a centralized way. This helps maximize equipment use and reduce network construction costs.

Because software-defined OTN has universal hardware architecture that can be configured flexibly through software, the number of different boards and spare parts is reduced and this reduces OAM costs. The technical requirements in engineering and maintenance are lowered, and this allows services to be rapidly commissioned and deployed and hardware to be more easily maintained.

Software-defined OTN can also virtualize transport resources for multiplane multiuser virtual operation. Application providers can apply for and control appropriate network resources in order to offer applications with better quality guarantee.

Summary

Traffic storms, traffic bursts, and complex flows have put huge bandwidth pressure on traditional OTNs, which cannot meet dynamic service needs because of their rigid bandwidth characteristics. Software-defined OTN has been introduced to improve network efficiency. With open interfaces and the flexibility to optimize the whole network, software-defined OTN is an important development trend in the telecommunications industry. **ZTE TECHNOLOGIES**



CERNET: Education Informatization with OTN

By Sun Wei

The China Education and Research Network (CERNET) is a national academic computer network. It is funded by the state, managed by the State Ministry of Education, and operated by Tsinghua University in collaboration with other universities. CERNET is China's largest nonprofit interconnected network that serves the educational and scientific research organizations. In 1996, CERNET was recognized by the State Council as one of the four backbone networks in China. In the 12th Five Year Plan, the State Ministry of Education detailed the upgrading of the existing education computer networks and the development of an education informatization

platform. CERNET is a next-generation education network that will become the foundation of education informatization. The Asian Education Network is the first cloud-based education platform in China. It integrates the internet, telecommunications networks, and radio and television networks.

Project Background

CERNET Phase III is an important part of the public service system in the Higher Education 211 Project and is being jointly completed by Chinese universities. The objective of the project is to make CERNET into an advanced national education infrastructure by improving its technologies and services, expanding coverage and capacity, improving access in the backbone network, and improving the performance of core nodes. Objectives also include building a reliable network OAM and security system, improving the information resource service system of key disciplines, and

helping strengthen key disciplines in universities throughout China.

ZTE's 100G solution was rigorously tested by the CERNET project team and was found to be better than solutions offered by competitors. The solution provides excellent transmission, strong access capability, and extraordinary interconnection. ZTE's 100G solution has back-to-back OSNR that is 0.5 dB lower than the industry average, and increases transmission distance by 10% without the need for electric relays. Moreover, the solution supports both 100G and 10G transmission and smooth upgrade from 10G to 100G.

Fierce Competition

Huawei and Alcatel-Lucent jointly completed CERNET Phases I and II, and previous experience on these projects helped them with further opportunities. To secure market share, Huawei and Alcatel-Lucent also bid for CERNET



Phase III. Early on, they determined customer demand and expectations for CERNET. They also suggested technical indexes in the hope of shutting other vendors out. ZTE also talked extensively with customers to determine their real needs and to better understand the true positions of other bidders.

Tailored Solution

CERNET Phase III involves construction of a large network with a lot of end-to-end service scheduling, large-capacity access at the core nodes, and increased traffic cross-connection capacity. The needs necessitate the construction of an OTN.

The new network should

- accommodate growing service needs and be easily scalable
- be future-proof yet still make use of current equipment rooms
- have full-service access capabilities
- have fast and efficient protection mechanisms
- allow for flexible network

management and maintenance.

ZTE took all these considerations into account and figured out a perfect solution for the CERNET network construction. The solution

- takes into account space, power supply, and other limitations of existing equipment rooms so that the network can be optimally expanded and upgraded
- uses multiple protection mechanisms to guarantee network and service security
- provides open protocols and abundant client interfaces so that the network can support STM-N (N = 1, 4, 16, 64), GE, and 10GE services, all of which are expected in a typical regional backbone network
- a reasonable wavelength plan in which the shortest wavelengths are used to transport existing services and construction cost is minimized
- provides a simple, clear NMS interface so that the network can be easily maintained. This saves money, improves efficiency, and speeds up launch of new services.

Advanced Devices

A cost-effective solution requires reliable, advanced devices. ZTE's ZXONE 8000 series devices guarantee safe, efficient, energy-efficient network operation. These devices support

- ODUk electrical-layer cross connection. This implies ODU0/1/2/2e/3/3e2/4 multi-granularity, non-blocking cross connection and overhead detection (with capacity reaching one terabyte).
- optical-layer wavelength cross connection. This is needed to meet

existing and future scheduling needs for services of different types and granularities.

- various access modes. These modes include STM-N, GE/10GE, DVB, ESCON and FC.
- multiple service protection modes. A cross-connection unit uses state-of-the-art cubic protection to ensure normal network operation, even if two such units are damaged at the same time.
- bearing of large-granularity services when there is shortage of optical fiber resources. This greatly reduces network construction costs and shortens the project cycle.
- energy-efficient product designs. This helps decrease overall energy consumption in the OTN. Fewer boards and parts make maintenance much easier and cheaper.

Customer Benefits

ZTE won the bid for CERNET Phase III. ZTE will provide a coherent 100G solution and ZXONE 8000 series OTN products to build the backbone bearer network. This network will cover a distance of more than 10,000 km and will cover major cities in China, including Beijing, Shenyang, Dalian, Shanghai, Hangzhou, Guangzhou, Shenzhen, Xi'an, Wuhan, and Chongqing. ZXONE 8000 series products are customized for the CERNET Phase III project and provide outstanding performance. With ZXONE 8000 products, CERNET will bear services in a way that satisfies customer expectations. ZTE is expected to further its cooperation with the CERNET team and make even greater contributions in the future. **ZTE TECHNOLOGIES**



BT and ZTE Are the First to Deploy XG-PON in a Live Customer Environment

By Dr. Ranulf Scarbrough, programme director for Superfast Cornwall Group

A component manufacturer in Cornwall is the first company to achieve hyperfast broadband download speeds of up to 10 Gbps over a real fibre network. That's 100 times faster than 100 Mbps.

Just five months ago, electronic component manufacturer Arcol struggled to achieve 1.5 Mbps, but it was one of the first subscribers to BT's fibre to the premises (FTTP) service. The export-driven company soon achieved 330 Mbps. Not content with this big upgrade, they were more than happy to be involved in part of the XG-PON proof-of-concept trial. XG-PON is the ITU's next-generation standard for passive optical networks. It is capable of a startling

10 Gbps over standard fibre. BT first demonstrated hyperfast broadband in Cornwall and used ZTE equipment as part of the fibre broadband roll-out across the United Kingdom.

BT is rolling out superfast broadband to Cornwall in a £132 million program funded by the EU, BT and Cornwall Council. The program is being managed by Superfast Cornwall. The project was initially designed to provide superfast fibre-optic broadband to at least 80% of Cornwall by the end of 2014. However, in the spirit of progress, this coverage target has been increased to 95%, and BT has recently announced that it will also be taking superfast broadband to the Isles of Scilly, 28 miles across the Atlantic Ocean

from the mainland.

Arcol's offices in Threemilestone Industrial Estate in Truro are connected by a 5 km direct fibre link to BT's exchange in Truro. The trial involved running G- and XG-PON in tandem at the customer's premises. The XG-PON technology was jointly developed by ZTE and BT and is designed to show that such high speeds can be achieved using the current infrastructure. BT added that the speeds accessible using the new XG-PON technology are only hampered by current computing and networking devices.

Ranulf Scarbrough, programme director for Superfast Cornwall Group said, "What is exciting about this trial is that these hyperfast speeds have been

“What is exciting about this trial is that these hyperfast speeds have been obtained over the exactly the same fibre that carries BT’s fibre broadband services today. All we are doing is changing the electronics at either end,” said Ranulf Scarbrough, programme director for Superfast Cornwall Group.

obtained over the exactly the same fibre that carries BT’s fibre broadband services today. All we are doing is changing the electronics at either end.”

BT engineers took one day to install the system in Arcol’s offices. BT ran in and connected the fibre optic cable and used a splitter to divide the line between the XG-PON 10 Gbps line and Arcol’s existing Superfast Cornwall 330 Mbps connection. An initial 300 MB test returned results of higher than 376 Mbps over G-PON. This result excited the Arcol team, but the BT engineers knew that this was just the tip of the iceberg. XG-PON was then switched on, and an ultrahigh definition (UHD) video was streamed direct from the Truro exchange at 850 Mbps. However, even this remarkable feat wasn’t even close to the potential of the system, with the full bandwidth being allocated to the firm being greater than was consumed at the peak times of traffic on the London Olympics media network.

BT hopes that the demonstration will show that existing cables can be used to provide far greater speeds than are currently available. Upgrading exchanges and user equipment can make a major difference.

Demand for network speed continues to grow, so newer and faster technologies are needed over and above existing

standards. XG-PON, also known as 10G-PON, provides next-generation ultrafast capability for G-PON providers. It is designed to coexist with G-PON equipment on the same network. Triple play video, data, and voice services over IP are often cited as driving user demand for heavier usage of broadband that requires PON investment. While RF overlay has been popular in some countries and minimises congestion caused by video services, the convergence of HDTV and IPTV will create demand for bandwidth that exceeds the capacity of gigabit services in future. Teleworking and video conferencing are other applications that sometimes demand such triple play capabilities.

Other bandwidth-intensive applications include video-conferencing, interactive video, online interactive gaming, peer-to-peer networking, karaoke-on-demand, IP video surveillance, and cloud applications, where remote storage and computing resources provide online service on-demand to users with thin-client local systems. Cloud applications could take advantage of local content hosting, but 10 GPON may encourage explosive development of services that become feasible as users connect at faster speeds.

Business continuity systems may

also include XG-PON for cost-effective real-time backup or replication of critical business systems. These systems may themselves be centralized services that support multiple sites. Other businesses may only need to connect several sites as a virtual private network (effectively a virtual office) or may have e-commerce services that require business partners to have sufficient connectivity for constant database access.

Many of these applications already become more popular for bandwidth leading to the formulation of Nielsen’s Law predicting demand for data downloads to double every year.

Jeremy Steventon-Barnes, Network Director, Superfast Cornwall said, “This trial shows we are thinking and ready for the future even though there are no current plans to deploy this technology. A lot of this project is about future proofing—making sure that it’s not just the fastest speeds today but that we can continue to be at the cutting edge for five, ten, twenty years”. Dr Scarborough added, “There are no plans to make this into a product at the moment, because there is nothing you can do on the internet at that speed right now, but when the need arrives we’re ready. We’ve thought about the future, we know and have tested the technology to do it”. **ZTE TECHNOLOGIES**

Deutsche Telekom Partners with ZTE for Ultra 100G Trial

By Ren Zhiliang



Background

Deutsche Telekom AG is the largest telecommunications carrier in Europe and the fourth largest telecommunications carrier in the world. In June 2010, DT established the world's first commercial 100 Gbit/s optical network connecting a high-performance data center at Technische Universität Dresden to another at Technische Universität Bergakademie, Freiberg. As the internet and terminal data services evolve, DT expects that increased backbone network bandwidth will create strong demand for ultra 100G technologies after 2014.

DT is eager to obtain research and experimental data about ultra 100G technologies. This will allow them to determine the development direction of transmission technologies and to deploy ultra 100G systems by using appropriate technologies. The company will be able to cement its leadership of the industry.

For years, ZTE has been committed to researching and developing 100 Gbit/s, 400 Gbit/s, and 1 Tbit/s technologies and has made important breakthroughs in these technologies. ZTE has achieved a single-channel transmission rate of 11.2 Tbit/s, which eclipsed the previous world record of 1 Tbit/s for single-

channel transmission. The optical signals were transmitted over 640 km standard single-mode fiber (SSMF). ZTE also achieved a signal transmission rate of 24 Tbit/s (24×1.3 Tbit/s) using wavelength-division multiplexing.

In February 2012, a team of experts from ZTE and DT conducted an ultra 100G trial.

Process and Results

The trial was based on standard single-mode fibers (G.652 SSMF) that already connected eight densely populated cities—including Darmstadt, Stuttgart, and Nuremberg—in the

south of Germany. To test the long-haul transmission capabilities of different technologies, laboratory SSMF was also used to extend the optical transmission distance.

The lowest fiber span loss was 20 dB, and the highest fiber span loss was 24.1 dB (Fig. 1). Eight 100 km G.652 fiber spans were added in Stuttgart, extending the total transmission distance to 1750 km. A commercial flat-gain in-line erbium-doped fiber amplifier (EDFA) was used to compensate for the fiber span loss, and no other gain equalizers were used. The average fiber loss for all 22 spans was 21.6 dB. Transmitters and receivers were installed at the test center, which was

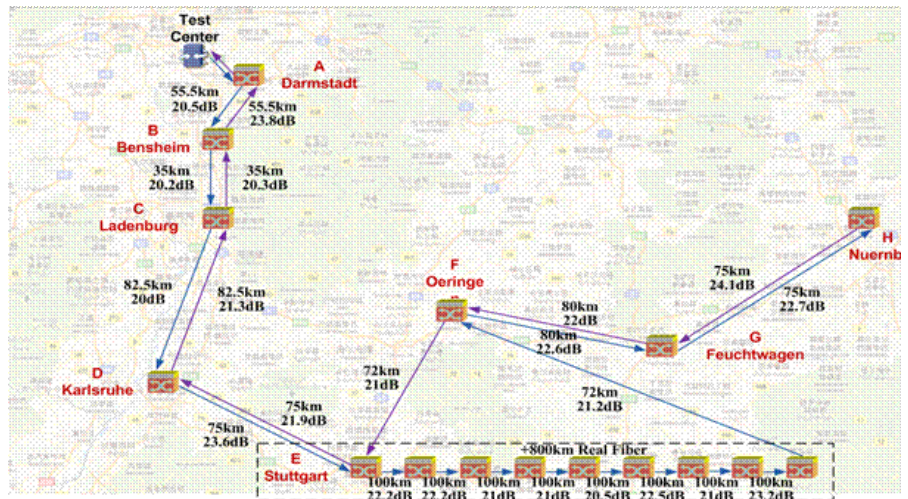


Figure 1. The trial network.

located in DT's Darmstadt R&D center.

ZTE conducted two experiments on the trial network.

The first experiment was designed to test long-haul transmission of eight 216.8 Gbit/s PDM-CSRZ-QPSK signals with 50 GHz spacing (Fig. 2).

In the signal system, eight tunable lasers were used as light sources. The eight lasers were divided into two groups of four: odd and even. The lasers in each group were spaced at 50 GHz, and the spacing between the groups was 100 GHz. Optical signals generated by the lasers in each group were coupled by an optical coupler before being modulated by an I/Q polarization-multiplexed modulator. The modulator was driven by two 54.2 Gbit/s binary signals. Then, the optical signals underwent carrier-suppressed return-to-zero (CSRZ) modulation before being sent to the polarization multiplexer and EDFA. Finally, the optical signals of the two groups met in the WSS for coupling and filtering before being transmitted to the line.

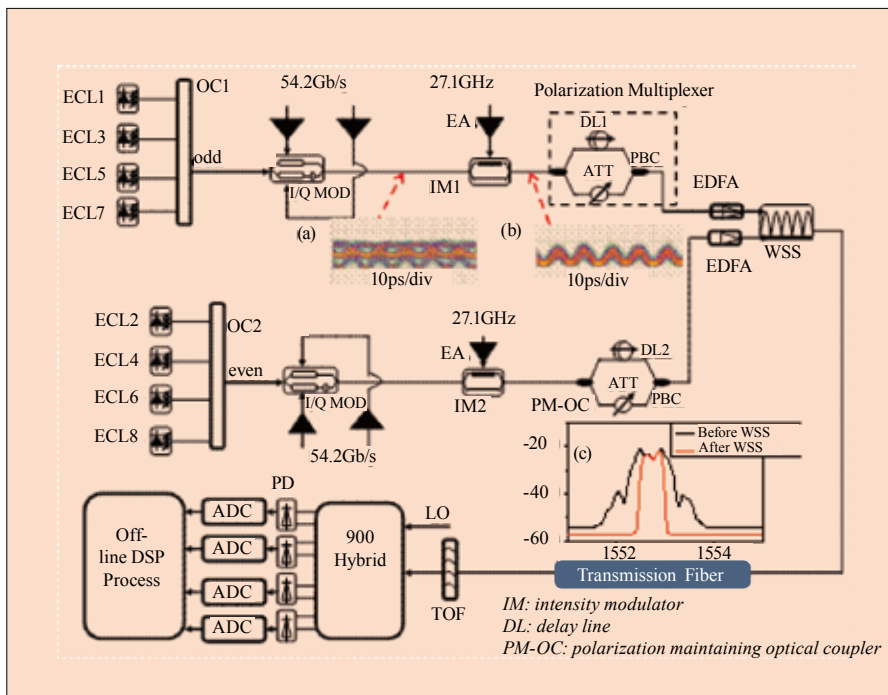


Figure 2. Transmission of eight 216.8 Gbit/s PDM-CSRZ-QPSK signals. (a) PDM-CSRZ-QPSK eye diagram before CSRZ modulation; (b) PDM-CSRZ-QPSK eye diagram after CSRZ modulation; (c) spectrogram before and after wavelength selective switch (WSS).

■ Success Stories



A digital post-filter was introduced into digital signal processing (DSP) at the receiver in order to convert binary signals into duobinary signals. This was necessary to reduce noise and crosstalk between channels and to enhance the performance of 1 bit maximum likelihood sequence estimation (MLSE) DSP.

The signals had a record spectrum efficiency of 4 bit/s/Hz. After they were transmitted across more than 22 SSMF spans over 1750 km, the bit error rates (BERs) of all signals was less than 3.8×10^{-3} , which is lower than the forward error correction (FEC) threshold. This experiment proved that baud rate and channel capacity can be doubled and ultralong-haul transmission

can be achieved by using polarization-multiplexed quadrature phase-shift keying (QPSK) with 50 GHz spacing.

The second experiment was designed to test hybrid transmission at 100 Gbit/s, 400 Gbit/s, and 1 Tbit/s and to demonstrate ZTE's 400G and 1T transmission capability in the DT laboratory.

In this experiment, Nyquist-WDM was used to generate a 400 Gbit/s super channel using four 112 Gbit/s PDM-QPSK signals that were multiplexed after filtering. A 1 Tbit/s channel with more than 13 subchannels was created using optical orthogonal frequency division multiplexing (OFDM). Each subchannel occupied 25 GHz, and the total signal bandwidth was 325 GHz.

Using these two superchannels and ZTE's two commercial 100G line cards, hybrid transmission was possible. After the signals were transmitted over 1750 km, the BERs of all signals was less than 2×10^{-3} . When the length of an optical fiber was extended to 2450 km using a commercial 100G line card, the BER was 1.1×10^{-3} . This indicated that there was still considerable room for improvement.

This experiment proved that SD-FEC 100G technology can be used in ultralong-haul transmission, and Nyquist-WDM is feasible for strengthening ultra 100G channel capacity in long-haul transmission. In addition, ZTE's 400G and 1T technologies are compatible with the original commercial 100G technologies.

Significance of the Field Trial

This trial was a significant milestone in the development of 400G and 1T transmission technologies. It demonstrated ZTE's ability to design 100G, 400G, and 1T transmission systems. Because these technologies are compatible and scalable, they can help expand network capacity, reduce the cost per bit, and reduce difficulties in implementation. The field trial also showed ZTE's strength in helping network carriers address exponential increase in backbone network traffic that has arisen as a result of a boom in data services.

ZTE and DT have cooperated closely on the implementation and development of ultra 100G technologies and have laid a solid foundation for future exchanges. **ZTE TECHNOLOGIES**

SingTel Uses ZTE

GPON FTTH to Build an NBN

By Shi Ying

Singapore Telecommunications Limited (SingTel) is the largest telecom operator in Singapore and has 133 years of experience in public telecommunications. SingTel has operations and investments in many countries and provides voice and data services via fixed lines, wireless, and internet.

SingTel has an operation center in Singapore and an operation center in Australia, which is run by Optus, a wholly-owned subsidiary of SingTel. SingTel has offices in China, United States, Britain, Japan, South Korea, Malaysia, Indonesia, Vietnam, Hong Kong, and Taiwan. Through these offices, SingTel delivers reliable and superior network solutions, either independently or by working with local partners.

SingTel has made strategic investments in India, Indonesia, Philippines, Bangladesh, Pakistan, and Thailand. Collaboration with regional partners has helped SingTel grow into the biggest multimarket communications operator in Asia Pacific and a top global carrier that serves more than 434 million customers and 5000 enterprises across the world.

Communications Wisdom of an “Intelligent Nation”

Singapore is a small country with an area of 700 square kilometers and a population of five million. It has world-leading broadband penetration and relatively low tariffs for fixed line, mobile, and broadband internet services. In 2006, Singapore launched the “Intelligent Nation 2015” (iN2015) initiative to promote information and communications technologies in various sectors.

The Info-communications Development Authority of Singapore (IDA) reported that, in 2008, revenue for the infocomm industry in Singapore grew by 12.4%; export revenue accounted for 61% of total infocomm revenue; and the number of people employed in the infocomm sector increased by 6.6%. Also, 90% of Singaporean enterprises with more than 200 employees had a website, and all of them used the internet in their work. Ninety four percent of households with children had at least one computer at home.

The next-generation nationwide broadband network (NGNBN) is the infrastructure for iN2015 and will carry Singapore’s existing and future infocomm services, including voice, high-speed internet access, IPTV, VOD, enterprise leased lines, and mobile broadband. The government plans to

invest one billion Singapore dollars to bring the fiber-based information highway to every household and to provide each user with 1GB bandwidth.

GPON FTTH: A Wise Choice for SingTel

With the launch of the NGNBN project in 2009, Singapore began large-scale GPON FTTH deployment. After losing the NGNBN OpCo contract to Nucleus Connect, a subsidiary of the second largest operator in Singapore, SingTel chose GPON FTTH as the main technology for its future network deployments.

Collaboration and customization helps SingTel deploy GPON FTTH

SingTel had been looking for a trustworthy partner to help deploy the FTTH network. In March 2010, ZTE and SingTel had a high-level meeting to lay the foundation for future cooperation. In April 2010, ZTE began a three-month demonstration for SingTel. In July 2010, ZTE’s GPON equipment was put into SingTel labs, where it was stringently tested according to SingTel’s GPON specifications. In November 2010, ZTE passed SingTel’s lab testing and obtained certification for a commercial trial.

In March 2011, SingTel put out its GPON tender, attracting bids from Huawei, ZTE, Ericsson, ALU, and ECI. After three weeks of receiving bids, SingTel selected three vendors from

■ Success Stories

the shortlist for the first stage of POC testing. ZTE eventually passed this test. In December 2011, SingTel signed a framework agreement with ZTE on GPON collaboration.

Singapore's NGNBN is the world's first NBN with open-access architecture, and ZTE's solutions and products had to support this architecture. ZTE's GPON system supports QinQ and retail service provider (RSP) service differentiation. Each user interface of ZTE's optical network terminal (ONT) corresponds to an RSP. The ONT also supports multiple customer VLANs (CVLANs) and native Ethernet. The same RSP can deliver multiple types of service streams through one or several ONT user interfaces. In addition, ZTE provides a VPORT-based GPON HQoS solution. These solutions allow SingTel to handle various application scenarios in an open access architecture.

During GPON FTTH deployment, SingTel wanted to customize the appearance, hardware architecture, and software of home terminals.

ZTE custom-made a unique and elegant terminal that is fit for households or business users who do not need TDM service. The shape of the ONT is inspired by piano keys, and there are indicators on the front of the case (Fig. 1).



Figure 1. SingTel optical network terminal custom-made by ZTE.



SingTel also specified that the ONT should integrate some RG functions. ZTE's R&D and testing team swiftly responded with the customized PON terminal ZXA10 F660 (Fig. 2). The terminal supports flexible logical grouping at the WAN side. Different GE interfaces at the LAN side can connect residential gateways of different RSPs or act as user interfaces of the RSPs.

In December 2011 and April 2012, SingTel requested a full-load test of systems and terminals, the largest of its kind in the world. The final result was that SingTel was amazed by perfect performance of both system and terminal products supplied by ZTE.

Large-capacity products with low power consumption help SingTel build a green GPON FTTH network

SingTel considers environmental protection its top social responsibility.

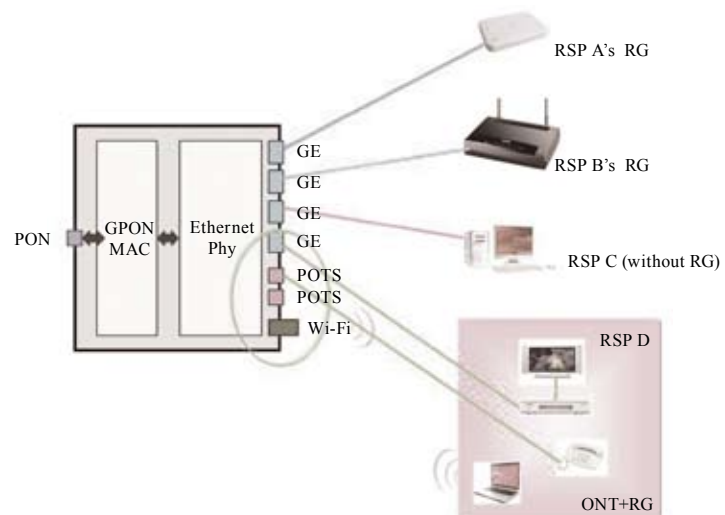


Figure 2. ZTE ZXA10 F660 ONT with RG functions.



Its GPON FTTH network must consume minimal energy, be cheap to build, occupy minimal space, and require low labor cost. ZTE helped SingTel build a green broadband by

- **reducing energy consumption.** Innovative ASIC and PCB components, highly-integrated cards, and fans with adjustable

speeds enable ZTE's GPON equipment to consume minimal power, and this ultimately helps SingTel reduce opex. The power consumption of each GPON port of ZXA10 C300 is 40% lower than the industry average (Fig. 3). F660 and F620 strictly comply with the IEEE 802.3az standard and reduce power consumption by 70%. They also support idle and doze modes, which provides a further 5% energy saving.

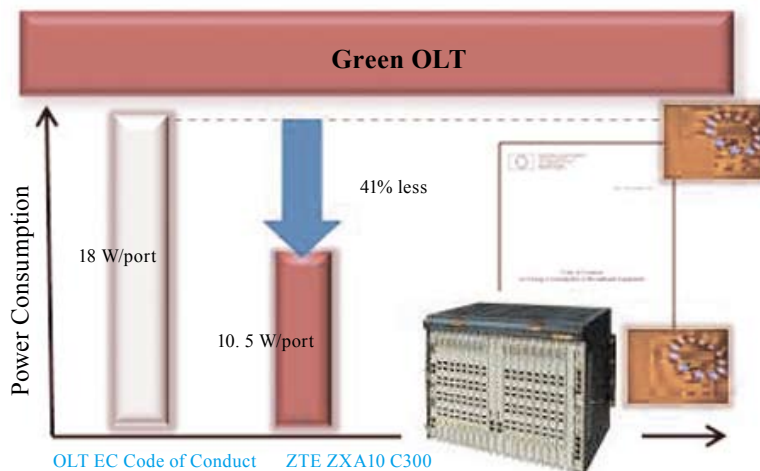


Figure 3. ZTE ZXA10 C300 with less power consumption.

- **using harmless materials.** ZTE's GPON system has a lead-free design. The materials used in construction meet international standards, including RoHS and WEEE.
- **prolonging the lifecycle of equipment.** ZXA10 C300 is a unified xPON platform and supports smooth evolution to 10G EPON, 10G EPON, and WDM PON. Because equipment can be smoothly migrated to future technologies, the lifecycle of equipment can be extended.
- **saving space.** ZXA10 C300 is a high-density PON OLT. The whole system provides up to 128 GPON ports and enables access for 6,384 GPON ONUs. Such a high-density ensures equipment occupies minimal space, and the cost of constructing equipment rooms.
- **saving labor costs.** ZTE's GPON solution incorporates an end-to-end OAM scheme that includes zero-configuration of ONTs, automatic diagnosis of lines and equipment, and remote diagnosis and management of equipment. This saves the labor costs associated with system maintenance.

The Singapore government has a vision of using telecommunications to advance the economy, benefit citizens, and boost Singapore's status as a hub in the Asia-Pacific region. This vision is being turned into reality with the iN2015. Building an NGNBN is a test of an operator's overall strength. ZTE helped SingTel design its business model and worked out customized solutions and products. With ZTE's GPON FTTH technology, SingTel will soar even higher in the telecommunications arena. **ZTE TECHNOLOGIES**

ZTE Optimistic Over Pickup in LTE, Cloud Opportunities

By Ryan Huang

April 24, 2013

Source: ZDNet

The Chinese telecoms gear maker is looking to leverage an expected growth in demand driven by network upgrades and cloud computing solutions, as it looks to return to profit this year.

Chinese telecoms equipment maker ZTE is eyeing growth opportunities from network upgrades especially in China, and a rising demand for cloud computing products driven by mobile devices.

According to David An, CTO of ZTE's Singapore-based Asia-Pacific marketing center, network infrastructure spending is expected to grow in momentum this year as carriers across the region invest more in 4G LTE capabilities to cope with demand.

For example, the company is optimistic of getting more business once China starts building out 4G networks, An said in an interview with ZDNet. China is set to issue 4G licenses this year.

The country's largest carrier China

Mobile had last month announced it would invest almost US\$7 billion in 2013 in the construction of its new 4G network. The telco has been experiencing slowing growth as its proprietary third-generation network standard is not commonly used outside the country and has prevented it from supporting popular handsets like Apple's iPhone.

The CTO pointed out Singapore also presented more business opportunities for the company to sell more backhaul transmission gear with the latest government mandate over buildings which comes into effect next month. Under revised laws, building owners must provide rent-free areas for deployment of infrastructure such as base stations—a key obstacle often cited

by telcos in improving mobile coverage.

“We don't sell wireless equipment yet in Singapore but there could be an opportunity in small cell solutions,” said An.

Cloud Push Driven by 4G LTE

A key trend which is happening is the convergence of cloud and LTE, noted the ZTE executive.

“For the past five years, operators have been focusing on introducing smartphones. This year they have been talking more about cloud and smartphones, especially now with LTE,” he said.

An said the company has been developing more cloud computing offerings especially in software-as-a-service (SaaS), on top of infrastructure-



David An (L), CTO of Asia-Pacific marketing center at ZTE and Ryan Huang (R), the correspondent at ZDNet

as-a-service (IaaS) and platform-as-a-service (PaaS).

Its push to tap the space includes the launch in February of its cloud radio solution—a combination of 20 of the company’s technologies for network optimization. The ZTE executive explained cloud radio helps operators solve key problems in their transition to 4G, such as unbalanced load in 2G, 3G and LTE networks, and interference

between cells. Current customers include Softbank subsidiary WCP in Japan, Bharti Airtel in India, and CSL in Hong Kong.

ZTE is looking to revive its fortunes after posting the company’s first annual loss last year 2.84 billion yuan (US\$456 million), reversing a net profit of 2.06 billion yuan (US\$333 million) in 2011. It has also been facing challenges expanding to some western markets

amid national security concerns over Chinese firms due to their alleged links to the military.

Part of its plans to do so has included a bigger push into the consumer space with handsets carrying its own branding. On Wednesday, ZTE also signed a deal with Microsoft for access to its patents for use in its various Android and Chrome OS devices such as tablets, PCs and phones. **ZTE TECHNOLOGIES**