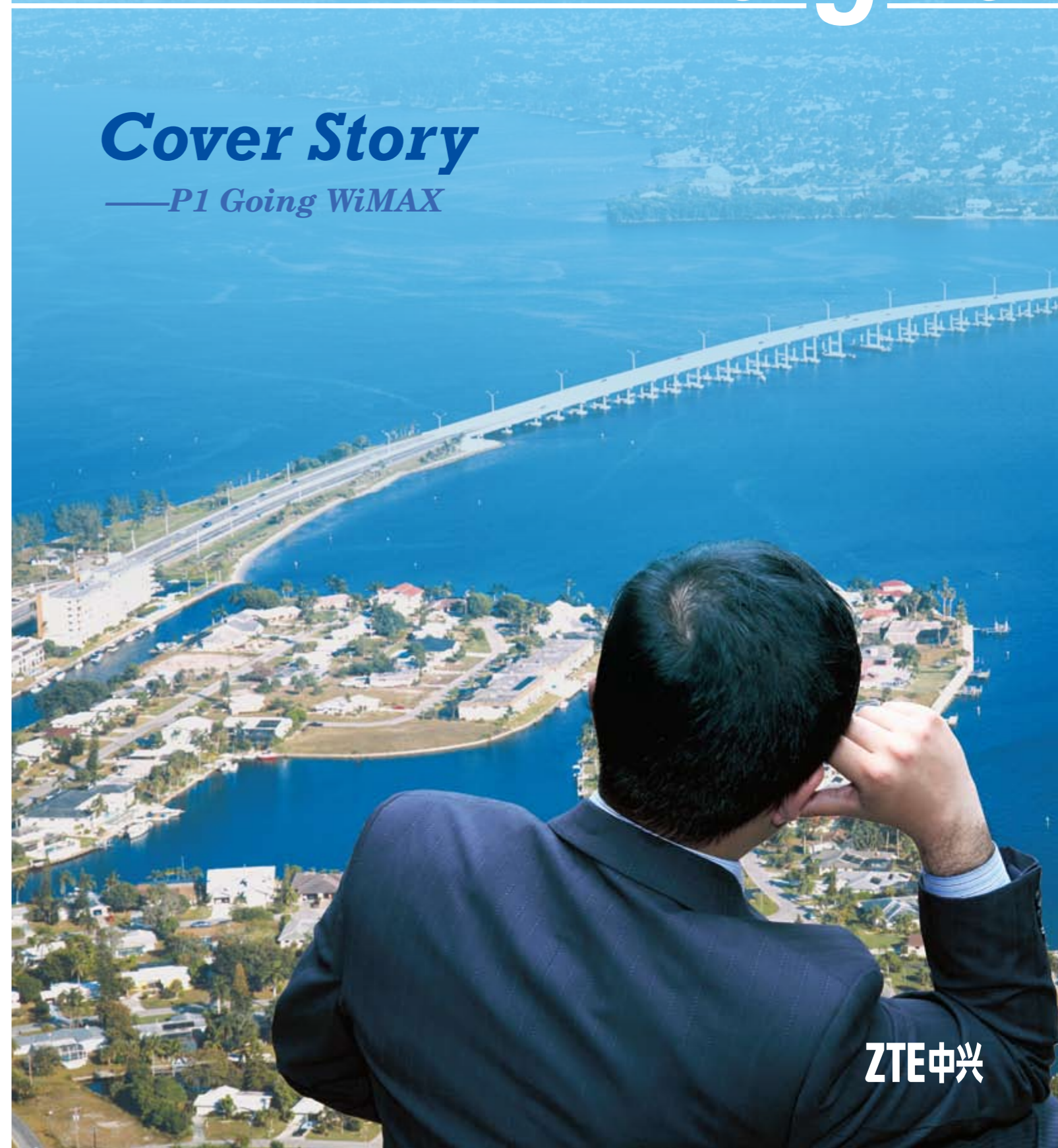# WiMAX Insight

Cover Story

——P1 Going WiMAX

ZTE中兴

ZTE WiMAX

ZTE WiMAX

Broaden Your Way

Innovative——ZTE WiMAX products are developed on the basis of the unified SDR platform and ensure low power consumption and green solution.

Customized——ZTE provides customized solutions which can cater for all kinds of scenarios ranging from dense urban area, urban area, suburban area, rural area and blind spot.

Reliable——ZTE WiMAX products have successfully entered America and Japan.By Q2 of 2009, ZTE had deployed more than 46 WiMAX commercial networks and field trials in 31 countries around the world. ZTE is the strategic partner of Intel. By now, ZTE has conducted IOT tests with more than 30 terminal device suppliers.

ZTE中兴

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WiMAX Insight

ZTE中兴 ZTE CORPORATION

ZTE Profile
ZTE is a leading global provider of telecommunications equipment and network solutions. ZTE's product range is the most complete in the world—covering virtually every sector of the wireline, wireless, service and terminals markets. The company delivers innovative, custom-made products and services to customers in more than 135 countries, helping them achieve continued revenue growth, while shaping the future of the world's communications.

Packet One to form new WiMAX tech partnership

KUALA LUMPUR: Packet One Networks (M) Sdn Bhd is appointing a second WiMAX technology partner in ZTE Corporation, a leading global provider of telecommunication equipments and network solutions to telecom operators all over the world, in addition to its existing partner Alcatel-Lucent.

WiMAX is scheduled to formalise the new partnership at a signing ceremony here on March 19.

In a statement on March 13, Packet One said it was part of its ongoing efforts to accelerate the expansion of the country's largest WiMAX network. It said ZTE, as one of the 15 WiMAX Forum Board members, had been a strong promoter and a critical player of WiMAX ecosystem.

ZTE *WiMAX Insight*

WiMAX will be Wi-Fi's big brother, says Intel

The introduction of WiMAX this year, with a theoretical distance for high-speed broadband over 5km, will be vital in cities, towns and the countryside where DSL has been a failure.

At a demo of the WiMAX platform that will be rolled out in Ireland in the coming months by Imagine, Colin MacHale, a spokesman for Intel said that WiMAX – "effectively the bigger brother to Wi-Fi" – will take Ireland a step closer to universal broadband coverage.

ZTE *WiMAX Insight*

1.45 million

"Total BWA/WiMAX revenues for 2008 totaled US$1.82 billion, compared US$898.78 million in 2007 - a 102% annual revenue increase despite the economic downturn that began affecting operator revenues in Q3 2008," noted Maravedis CEO and founder Adlane Fellah.

"2008 was a difficult year for most WiMAX vendors, which accelerated both market consolidation and niche specialization in order to survive the downturn," said Cintia Garza, co-author of the report and 4GCounts team leader. "Because many operators are planning to deploy mobile WiMAX equipment, devices based on 802.16-2004 experienced a slow down," she added.

June 10, 2009 (FPRC) -- Green Packet, a leading developer of next generation mobile broadband and networking solutions and Beceem Communications, a leading developer of Mobile WiMAX chips, are forming a strategic partnership to introduce a portfolio of high-performance WiMAX USB dongles for the global WiMAX market.

Steadfast in its commitment to enhance its products and services while providing better end-user experiences, Green Packet has based its UM350 USB dongle on Beceem BCSM250 single chip solution. Beceem is a leading contributor to the rapid growth of the WiMAX ecosystem, and has set themselves as the enabler of high quality chipsets at very reasonable price points.

ZTE *WiMAX Insight*

$275 million and 120%

By the research report of Infonetics, The overall WiMAX equipment and device market held steady in 4Q08 over 3Q08 at $275 million, as the 802.16e mobile WiMAX segment increased 5% to counter a slight dip in the 802.16d fixed WiMAX segment. Year-over-year, worldwide sales of 802.16e mobile WiMAX equipment (ASN gateways, BTS, CPE) grew 188% in 2008

Worldwide sales of 802.16e mobile WiMAX devices (Ultra Mobile PCs, phones, and external data cards) grew 121% in 2008, though the range of devices is still very limited

While WiMAX infrastructure revenue is subdued by the current global economic climate, strong CPE sales will drive overall mobile WiMAX market growth in 2009, as more services launch and new subscribers adopt WiMAX services for the first time.

ZTE *WiMAX Insight*

Cisco Joins WiMAX Forum® Board of Directors

The WiMAX Forum® announced the addition of Cisco as a new member of its board of directors. Sai Subramanian, director of marketing for the broadband wireless business unit of Cisco, will serve as Cisco's representative on the WiMAX Forum board. Last week, the WiMAX Forum also announced that it had added Tata Communications' COO Prateek Pashine to its board.

Other members of the WiMAX Forum Board include: Airspan Networks, Alcatel-Lucent, Alvarion, Aperto Networks, British Telecom, Clearwire Corporation, Comcast Cable, Fujitsu, Huawei Technologies, Information and Communications Research Laboratories at Taiwan's Industrial Technology Research Institute (ITRI), Intel Corporation, KDDI, KT, Motorola, Nokia, Samsung, Sprint and ZTE.

ZTE *WiMAX Insight*

UQ Communications, Intel to Promote Fast, Widespread Deployment of WiMAX Services in Japan

UQ Communications Inc. and Intel Corporation today announced their extended collaboration to promote and expand "UQ WiMAX" the commercially available WiMAX service from UQ Communications in Japan. Scheduled to launch on July 1, UQ Communications will offer new services to meet the diverse consumer demands for mobile Internet broadband use. Working closely with OEMs, Intel is providing embedded WiMAX laptops based on Intel® Centrino® 2 processor technology to enable mobile WiMAX broadband Internet access. The two companies will also work with PC vendors and MVNOs to deliver a range of initiatives and promotional activities driving the adoption of WiMAX technology and creating greater awareness for the global WiMAX ecosystem.

WiMAX is the only solution available today that is meeting the demand for the mobile Internet. With WiMAX, users can enjoy rich, interactive content outdoors and on the go as mobile broadband Internet access traditionally requires a fixed broadband connection. Together, Intel and UQ are helping to enable wireless Internet connectivity with WiMAX, forming alliances with a number of companies in the industry and offering a range of new digital equipment and services designed to enhance user experience.

ZTE *WiMAX Insight*

Clearwire's WiMAX Services Already Available in Las Vegas

According to the latest news, Clearwire's WiMAX services are already available for purchase for those who live in Las Vegas, even though the company plans to officially launch them only during the summer. Clearwire already confirmed the fact that it started selling its services in the area, while also announcing that the actual launch would take place later during the following months.

"In advance of our full commercial launch of Las Vegas scheduled for this summer, we are now selling Clear service as part of our operational readiness activities," Clearwire spokeswoman Jennifer Morgan says. "Store openings, advertising, and other market activities will be a part of our full commercial launch, but residents of Las Vegas can now go to Clear.com and order services."

According to some reports on the Internet, the fact that the Kirkland,

Wash.-based mobile broadband operator has had only a soft launch of its services in Las Vegas resembles a lot the move it made back in May when it started deploying its "Clear" service in Atlanta. It seems that this launch covers the third major market in which Clearwire makes its own services available, while the Sprint Nextel's XOHM-branded Baltimore network should also become a part of Clear during the ongoing year.

The Clear brand is expected to cover a number of nine commercial mobile WiMAX markets during 2009, while five of them should be new markets, including Chicago, Philadelphia, and Dallas/Ft. Worth. In addition, major Clearwire fixed-wireless markets should be converted to mobile WiMAX, and the process will include Seattle, Honolulu, and Charlotte, N.C.

For the time being, there are no details regarding the vendors that Clearwire will use for the rollouts in Las Vegas, though there are some rumors pointing towards Huawei Technologies Co. Ltd., yet it seems that Clearwire refrained from commenting on the vendor choice it has made.

ZTE *WiMAX Insight*

LTE Crushing WiMAX? Not So, Report Says

If you think WiMAX is being crushed by LTE, think again, says ABI Research.

Nortel left the mobile WiMAX market, and Alcatel-Lucent has "backed off" from WiMAX, supposedly dealing a blow to Clearwire, which has not chosen either company as an infrastructure vendor, ABI points out.

But Nortel is still in the fixed WiMAX market, and Alcatel-Lucent is actually involved with mobile WiMAX, says ABI Research

principal analyst Philip Solis. Alcatel-Lucent has had its 3.5 GHz products certified by the WiMAX Forum; its ng Connect program includes mobile WiMAX; and it is working with Intel on an interoperability program for mobile WiMAX devices, he states. "In addition, Alcatel-Lucent ranks first in 2008 market share for mobile WiMAX base station deployments, followed by Alvarion, Motorola and Samsung." WiMAX has many growth opportunities beyond traditional mobile operator networks, including data-

centric deployments in both developed and developing regions, ABI says. "To ignore a growth market in a down economy would be a mistake," adds Solis. Growth will be more modest for WiMAX base stations by themselves for 2009, but 2010 will see healthy expansion.

U.S. WiMAX service provider Clearwire reports its fourth-quarter results later today.

ZTE *WiMAX Insight*

Intel Capital Invests $43 Million in UQ Communications

Intel Corporation's global investment organization, invested $43 million (JP ¥4.15 billion) in Japan-based UQ Communications, a provider of WiMAX mobile services. UQ Communications will utilize the funding to continue the nationwide expansion of UQ WiMAX service in Japan, with the commitment to provide WiMAX coverage to 90 percent of the country by 2012.

Intel has played a large role in the proliferation of the WiMAX global standard. The company has worked closely with computing and communications manufacturers to

embed WiMAX-enabled chipsets in devices, and has made significant capital investments worldwide to help service providers build and deploy networks as well as address spectrum and regulatory needs. To date, nearly 460 WiMAX networks have been deployed in 135 countries.

UQ Communications recently launched trial service of its UQ WiMAX in Tokyo's 23 wards, Yokohama and Kawasaki, and the Haneda Airport (Tokyo International Airport). UQ Communications will formally launch UQ WiMAX service on July 1.

UQ Communications to Launch "UQ WiMAX" Commercial Service

UQ Communications Inc. announced it will launch a new global standard future broadband service called "UQ WiMAX" in July. This launch follows the free trial WiMAX service UQ has been providing customers since

February 26 of this year.

With commercial service on track to start July 1, UQ will expand WiMAX service areas around metropolitan Tokyo, Yokohama, Osaka, Kyoto, Kobe and Nagoya.

Clearwire Launches WiMAX Service in Atlanta City

US WiMAX operator, Clearwire Communications has expanded its network coverage to include Atlanta City. The city is now home to the largest 4G WiMAX wireless broadband network in the United States with CLEAR service available to nearly three million people across approximately 1,200 square miles.

As part of a multi-year network build-out plan, Clearwire's WiMAX network will be available in major metropolitan areas across the United States. In addition to Atlanta, mobile WiMAX is already available in

Baltimore, Maryland, and Portland, Oregon. Clearwire also plans to launch CLEAR in Las Vegas later this summer.

The company plans to bring CLEAR to 80 markets and up to 120 million people by the end of 2010. Some of the additional markets planned to launch in 2009 include Chicago, Charlotte, Dallas/Ft. Worth, Honolulu, Philadelphia, and Seattle. Some of the additional markets planned to launch in 2010 include New York, Boston, Washington, D.C., Houston and the San Francisco Bay Area.

BSNL will invest $300 Million in FY09-10

Bangalore: The public sector telecom company, Bharat Sanchar Nigam Limited (BSNL) is planning to invest a sum of $300 million (Rs.15, 000 crore) in the fiscal year 2009-2010. The money will be used for the mobile expansion and services like wireless broadband, 3G, IPTV, WiMAX and mobile commerce. It will also be used in enterprise resource planning and value-added landline, the Business Standard reported.

"We will offer wireless broadband through WiMAX technology in 1,000 blocks of the country out of the total 6,000 blocks. The state-run telecom operator will roll out franchisee-based WiMAX service in the country, starting with Gujarat, Maharashtra and Andhra Pradesh. We have floated tenders for offering similar a WiMAX service in other states as well, we are also working on improving our quality of service and have engaged AC Nielson to test the quality of our mobile service," Goyal added.

ZTE Helps Etihad Atheeb Telecom Build a Nationwide WiMAX Network in Saudi Arabia

17 June 2009, Shenzhen, China – ZTE announced that it has partnered with Etihad Atheeb Telecom (Atheeb), the largest WiMAX operator in Saudi Arabia, to build the Kingdom's first nationwide WiMAX network. Upon completion in 2010 Q1, the WiMAX network will help Atheeb fully meet the demands from the local market by providing subscribers with an unparalleled experience through its high-speed broadband network services.

Under the contract agreement, ZTE will help Atheeb construct a high-speed WiMAX network covering five major cities in Saudi Arabia, including Dammam and Khobar. In addition to about 300 WiMAX base stations, ZTE will also supply related equipment including IMS (IP Multimedia Subsystems) and MPLS (Multiprotocol Label Switching) to Atheeb, thus becoming the largest equipment supplier of Atheeb.

ZTE *WiMAX Insight*

The Export-Import Bank of China Provides ZTE US$10 Billion Credit Line

ZTE announced that it has entered into a strategic partnership with The Export-Import Bank of China (China Exim Bank) by signing a "Strategic Cooperation Agreement" for a US$10 billion credit line. This agreement further helps strengthen the leading edge of both China Exim Bank in the financing area, as well as ZTE's leading position in the telecom technology industry.

Under the cooperation agreement, ZTE and China Exim Bank will join together to establish a financing platform to support ZTE and its holding subsidiaries in overseas market activities including export seller's credit, export buyer's credit, import credit, preferential foreign loans, transferred loans of foreign governments and trade financing, as well as other premium financial services. ZTE agrees to deal with China

Exim Bank as a principal banker and handle loans and relevant businesses thereunder through China Exim Bank. China Exim Bank shall provide the Company with a USD10 billion facility for cooperation, comprising the Company's overseas project financing, consulting services, financial services (other than financing) and innovative ventures.

ZTE *WiMAX Insight*

ZTE SDR Base Station Records over 100,000 Volume Shipment

ZTE announced that its SDR base station recorded a total volume shipment of 107,000 units in less than one year: since its latest product advancement in October 2008 through April 2009. ZTE attributes this business achievement to its strong R&D and the growing popularity of SDR (Soft Defined Radio) technology favored by global operators, including those in fast developing mobile markets such as China and India.

ZTE *WiMAX Insight*

ZTE has again achieved another corporate milestone by becoming the first in the industry to offer Wave2-based 2.3GHz Pico base station 9200. This feat is expected to further enhance and expand the WiMAX equipment supply chain for the industry.

The E9200 base station has a compact size of 260mm×200mm×65mm, the same size as an ordinary telephone, which makes installation much easier. It allows high-speed transmission with downstream rate at 30Mbps. In high density regions, it can flexibly overcome coverage hurdles, offering a reliable all-scenario solution. The deployment of ZTE's 2.3GHz Pico base station will further help operators to effectively improve signal coverage, accelerate network deployment and reduce network building costs by about 20%.

ZTE *WiMAX Insight*

China Development Bank Provides ZTE US$15 Billion Credit Line

ZTE announced that it has entered into a strategic partnership with China Development Bank by signing a "Development of Financial Cooperation Agreement". This partnership further strengthens the solid relationship the two organizations have previously developed.

Under the agreement, both parties will closely work together to establish an investment and financing platform, including expansion to overseas markets. According to a 5-year cooperation framework agreement, China Development Bank will provide ZTE a US$15 billion credit line, including ZTE's overseas project financing and ZTE's credit limits. The two companies are currently in discussion to develop specific terms and procedures on financing project and how to effectively execute the business cooperation.

ZTE *WiMAX Insight*

ZTE Achieves Another Industry First to Offer Most Comprehensive WiMAX Equipment

ZTE Unveils World's First WiMAX Mobile Video Surveillance Terminal

ZTE announced its latest Mi100 device, the world's first WiMAX Mobile Video Surveillance Terminal. The new device is the result of ZTE's relentless R&D efforts and expertise in developing state-of-the-art WiMAX equipment and solutions.

Integrated with highly advanced WiMAX 16e chipset, the Mi100 smoothly enables automatic access and connection to WiMAX wireless network. It supports high-speed mobile remote surveillance of up to a maximum speed of 100km/h. With a compact and portable size of only 115x62x50mm, the Mi100 terminal is easy to install and does not require additional modulated decoder compared with traditional mobile video surveillance terminals. It can also be deployed in public areas such as airports, highways, hospitals and railways, facilitating mass WiMAX applications in transportation, utilities, irrigation works, oil fields, as well as government departments.

ZTE *WiMAX Insight*

ZTE Launches Industry's Smallest WiMAX 16e RRU Device

ZTE has officially launched the industry's most powerful WiMAX 16e RRU (Remote Radio Unit) product, the R9110 that helps reduce the number of base stations by 50%, hence enabling telecom operators to maximize their return on investment (ROI). The company has exhibited the new device at the Mobile World Congress Barcelona 2009 from February 16 – 19 to demonstrate its continuous R&D efforts and expertise in WiMAX field.

ZTE RRU R9110 is based on BF4*8 Multi-Antenna technology, which effectively improves signal quality from a single base station, allowing extensive network coverage and enhanced network performance. Compared with traditional devices using MIMO technology, RRU R9110 further minimizes the number of base stations from 35%-50%, helping telecom operators reduce network construction and maintenance costs.

In addition, the latest RRU device supports dual carrier discontinuous spectrum, enabling a maximum speed of 100MHz expansion between uplink and downlink. By leveraging on this advantage, telecom carriers using traditional FDD spectrum can save cost and investment on RRU, antenna and wireless tower required in network expansion by up to 50%.

ZTE *WiMAX Insight*

P1 Going WiMAX

Liu Yang

Malaysia is the "tropical heaven" on earth. The country with a large population and numerous tourists has a prosperous telecom market. The Malaysian government encourages the development of the telecom industry, especially broadband service; and has a national broadband target of 50% household penetration by 2010.

Packet One Networks (Malaysia) Sdn. Bhd. (P1), Malaysia's first and leading WiMAX Telco provider with the widest network coverage, is not only committed to providing quality broadband services to users but also to building itself into one of the world's leaders in WiMAX deployment and business success. P1 commercially launched its Phase 1 WiMAX network in August 2008, covering several major cities in Malaysia including Kuala Lumpur, Kedah, Johor and Penang. Why did P1 choose WiMAX as technology for broadband wireless access? What are its target customers? What are its requirements on suppliers? Bearing these questions in mind, the reporter of ZTE Technologies interviewed Michael Lai, CEO of P1, on 29 March, 2009.

Journalist: Firstly, why WiMAX in Malaysia – why not other technologies? What gives WiMAX the edge in Malaysia, compared to other technologies?

Michael Lai: Firstly, Malaysia is grateful to her government for having the foresight to be one of the earliest governments in the world to issue WiMAX licenses in the country. Today, the broadband Internet penetration in Malaysia is hovering just above 21% and the government has set a national goal to achieve 50% household broadband penetration by 2010. In an effort to help the Malaysian government realize this ambitious goal, P1 launched its P1 W1MAX high-speed wireless broadband service in August 2008.

Broadband Internet access through P1 W1MAX will benefit Malaysians in many ways. It will increase industrial efficiency; stimulate e-business and create new jobs and e-businesses; improve Malaysia's global competitiveness and raise GDP. For individuals, they will be able to work effectively beyond their office space, which will open new opportunities for them. Ultimately, increased broadband penetration will improve the quality of life for all Malaysians.

Compared with other broadband solutions, P1 W1MAX offers several advantages as follows:

Firstly, WiMAX is wireless with a range far superior to any other wireless technology of its kind and so it can be rapidly deployed across vast areas cost effectively without the need to lay expensive cabling.

Secondly, WiMAX is as secure if not even more secure than existing wireless technologies available today. Hence WiMAX technology can be used to convey sensitive information like business plans and banking information with confidence.

Thirdly, WiMAX can be configured to deliver dedicated bandwidth to each user so that the quality of service is very high even during times of high network traffic.

Lastly, the expertise needed to evolve the WiMAX ecosystem is already well developed and in place. WiMAX is a mature, well-supported technology that is currently seeing over 350 deployments around the world. Major devices and chipsets manufacturers are investing in the development of chipsets, devices and other fundamental components to support

the steady growth of the adoption of WiMAX technology.

The inherent advantages and growing acceptance of WiMAX as the true standard of 4G communications is driving the cost of WiMAX components down making the technology even more accessible to consumers. In addition to this, embedded WiMAX devices or better known as Mobile Internet Devices (MID) are being introduced at a growing rate and will see adoption by an even larger number of device manufacturers.

One more beauty of WiMAX compared with other technologies is that it delivers data and speeds capable of meeting the demands of next generation mobile users who are looking for high-performance, reliable connectivity to keep up with rapidly advancing mobile applications used in mobile devices today.

J: Who are your target customers?

Michael Lai: Our mission is to provide broadband for all. Hence, our target is the largely under-served Malaysian population who want and have the need for broadband but are not yet able to have access to it due to supply not being sufficient.

In addition to this we are also aggressively marketing the benefits of P1 W1MAX to existing broadband subscribers who want better performance and flexibility with very good value for money.

P1 also has its sights on business and corporate clients who completely understand the benefits of providing quality broadband to its workforce, be it in the office or out on assignments.

J: What is P1's key selling strategy now?

Michael Lai: Our strategy is to provide quality, broadband access to as many areas and customers as possible.

Initially at our launch, we offered fixed packages but in less than eight months, our product offering now includes a portable WiMAX package as well. This portable service in the form of Malaysia's most advanced USB WiMAX modem is called WIGGY.

Generally speaking, in Malaysia, there is an overwhelming demand for broadband across all walks of life and one of the major issues is that there is just simply not enough supply to meet the demand in terms of availability, affordability and quality.

Hence, P1 will look into meeting this demand on all levels as we are committed to make quality, high-speed broadband a very powerful value proposition.

We will support this with one of the country's most aggressive network rollout and deployment plans ever. As it stands, the P1 W1MAX network is growing almost every day, as I speak.

J: Who were the P1 network vendors and why they were chosen?

Michael Lai: Alcatel – Lucent is the network vendor for P1 Phase 1 rollout and just recently, we have appointed ZTE as the network vendor for our Phase 2 rollout. Alcatel – Lucent was chosen due to the full turnkey technology and their experience worldwide in deploying WiMAX. P1's appointment of ZTE is another step in crystallising our commitment by accelerating the deployment of P1 W1MAX networks in more areas to meet the overwhelming consumer demand for high-quality, high-performance wireless broadband.

Our multi-vendor strategy is the proof of our commitment to provide broadband for all and meet our set coverage targets. For 2009, we aim to cover 35% of Peninsular Malaysia with P1 W1MAX and 65% of the nation by 2012.

J: How is the progress of the network

set-up in terms of trials, vendor selection, deployment timescales and budget going? Pleases share with us your target timelines for WiMAX deployment.

Michael Lai: We are slightly delayed in our earlier timelines but still very aggressive in our rollout. We plan to cover 35% of population by 2009, 40-45% by 2010 and 60-65% by 2012. The delay is normal as we are the first to market, and technology depends on scalability and stability. Every two weeks, there is a new software upgrade. We are also facing challenges in site acquisition, obtaining permits from selected locations, and seeking official approvals from local councils. The budget for the first phase investment is US$100 million that includes backend systems, AAA, billings, storage, etc.

J: What about the voice market? Is P1 exploring additional areas beyond WiMAX – if yes, what are they?

Michael Lai: There is no denying that WiMAX is capable of delivering next generation voice service but our focus is currently on increasing coverage and growing our broadband customer base and there is much room for this market to grow in Malaysia.

With regards to voice, it is something that we will definitely consider when we have all the support mechanisms in place to ensure that we can deliver a truly high-level of quality in voice services.

J: How much is P1 investing in WiMAX?

Michael Lai: Our total investment in WiMAX for the next 5 years is expected to be RM 1 billion(about US$287 million).

WiMAX Boosts Mobile Internet for Advancement

Ye Weichen

With the advancement of technologies, traditional Internet and mobile communication are being converged, boosting the rapid development of mobile Internet. The popularity of Wi-Fi represents the first wave of broadband wireless access (BWA), and now WiMAX is pushing BWA to a new stage. Particularly, with the maturing of mobile WiMAX (based on IEEE 802.16e standard) ecosystem, many leading manufacturers in the industry treat it as a typical new generation broadband wireless access (NGBWA) technology.

Today, including commercial in

over 136 countries across the world. The WiMAX networks in over 50 counties will be expanded into nationwide networks, and many WiMAX network operators are leaders in their domestic markets. Operators' confidence in WiMAX comes from reliable technology and mature ecosystem: Over 20 enterprises are involved in the development of chips, terminals, base stations and other products for WiMAX, and the most flagship enterprises in the industry are involved. WiMAX Forum, initiated in 2001, has 522 member companies. Under its leadership, the interoperability certification of the members' WiMAX products has made remarkable progress, expediting product commercialization and network deployment, allowing WiMAX technology to be reasonably competitive while rapidly achieve scale economy. It is notable that Chinese enterprises play an important role in boosting the development of WiMAX industry. ZTE is one of the pioneer Board members of WiMAX Forum, and is the first company winning a terminal contract valuing 100 million USD for Sprint's WiMAX network (now merged into Clearwire) deployment. Currently ZTE has achieved WiMAX networks for over 40 operators in 26 countries.

A WiMAX technology advocate and an ecosystem booster, Intel supports WiMAX in an all-round way: in terms of technological standard, it supports mobile WiMAX to evolve towards next generation technology (802.16m); in terms of product development, it develops chips for devices and boosts device interoperability and certification test; in terms of industrial ecology, it provides strategic investment for chip manufacturers, equipment manufacturers and operators in the ecosystem, boosting the optimization and maturity of ecosystem; and in terms of intellectual property rights, it creates open patent pool and reduce patent barrier.

Operators are an important factor for the promotion of WiMAX technology. To expedite the activation of commercial operation, Intel has provided a total strategic investment of over 2 billion USD for WiMAX operators in 12 countries and regions around the world, including Clearwire In US, UQ in Japan, Comstar in Russia, and VMAX in Taiwan, China. Currently these operators' network deployment progress has become an indicator of the global WiMAX industry.

Intel's steadfast support to WiMAX results from its confidence in the future application of mobile Internet. Internet development is ultimately driven by subscribers' IT application needs, which evolve from text, through picture to video, and in the future, rich media based subscriber creation and application will prevail. These application needs pose increasingly higher requirements on Internet access anywhere anytime, especially those from young subscribers. In terms of corresponding technologies, the technological upgrading of broadband radio access from Wi-Fi to WiMAX meets the growing mobile Internet application needs of subscribers.

Different application needs have different terminal forms to match them. Mobile Internet application terminals in the future will include extensive product types ranging from traditional notebook computer and netbook to MID and intelligent mobile phone and other handsets, as well as terminal devices for car, medical, insurance and other special purposes. The screens of these terminals range from around 14 to 3 inch. Intel's strategy for this is, based on a unified Intel architecture (IA), to provide corresponding processors and chipsets for different types of terminals, including Intel® Centrino® 2 processor technology and Intel® Atom™ processor, thus properly extending subscribers' application experience on traditional Internet to mobile Internet.

In terms of WiMAX products, Intel launched the world's first WiMAX/Wi-Fi Dual-mode module (Echo Peak) in the second half of 2008, serving as a radio module option with Intel® Centrino® 2 processor technology. Immediately after that, almost all major computer manufacturers launched their notebook computers with built-in Echo Peak module. Clearwire's subscribers have begun to use these products. It is foreseeable that with the established support of PC ecosystem to WiMAX, subscriber needs will greatly boost WiMAX network deployment.

The PC industry features open industrial standards. Therefore, notebook computers, being the first among terminal devices, achieved the support of WiMAX, representing the openness of WiMAX ecosystem, which relies on low barrier intellectual property admission strategy. For the WiMAX ecosystem, the establishment of Open Patent Alliance (OPA) and its patent tool secures an open environment for WiMAX ecosystem. WiMAX industry hope stimulate more innovation and new entrants into the WiMAX ecosystem via the simple, predictable and fair intellectual property rights frameworks that OPA set up.

Looking forward, mobile WiMAX network deployment in US, Japan, Russia, India and China Taiwan will be carried out this year, triggering a new round of WiMAX commercial deployment tide across the world. A typical technology for new generation broadband radio access, WiMAX, boasting its outstanding performance and cost-effective, is leading the world's mobile Internet technology. Meanwhile, emerging powers from China, including ZTE, Huawei and the members of WiMAX Ecosystem in Taiwan, are playing increasingly important roles on the global arena of mobile Internet.

ZTE *WiMAX Insight*

WiMAX™: The 4G Era is Here

Ron Resnick

WiMAX™ Today

In January 2008, the telecommunications industry proclaimed 2008 to be the year of WiMAX™. As the first 4G technology to hit the market, WiMAX provides a clear advantage for operators who have been quick to adopt and deploy the technology. WiMAX delivers mobile broadband service in both developed and developing market segments on a wide array of devices. These networks are commercially active today, providing WiMAX operators and device suppliers the opportunity to reach more than four billion people around the world. As of January 2009 the WiMAX ecosystem boasts more than 450 commercial WiMAX network deployments in 135 countries, and the number of WiMAX network deployments is still growing with the availability of approximately 1,700 spectrum licenses across 140 countries. According to recent WiMAX Forum research, today's deployed networks cover over 430 million POPs. Hundreds of devices are already commercially available or under development by several dozen ecosystem vendors. While the embedded WiMAX devices are the fastest growing products, multi-mode mobile devices such as CDMA/WiMAX and GSM/WiMAX are already available from device manufactures.

WiMAX technology supports a broad range of applications and usage models, from connecting remote villages in India to providing cost-effective mobile internet access in downtown Baltimore, Maryland. According to recent WiMAX Forum market projections, there will be over 130 million WiMAX users by 2012.

Testing to Ensure Superior Performance

WiMAX products undergo WiMAX Forum Certification at designated labs around the world to ensure interoperability and conformance to the WiMAX standard. Our objective is to continue to grow our capability to deliver consumer satisfaction and facilitate new service models. Particularly we view WiMAX Certification as an important ingredient so that consumers can purchase products in retail outlets and then select

an operator for the WiMAX service. The retail model is an excellent way to deliver a greater selection of innovative and low cost products into the market. Today, the WiMAX Forum has six established certification labs (see map below). The WiMAX Forum continues to seek additional labs in key markets to handle the anticipated certification demand.

Mobile WiMAX Certification Labs

Mobile WiMAX™ Roadmap

In early 2009, we will see Mobile WiMAX expanding to 20 MHz channel bandwidths with peak download rates exceeding 144 mbps per sector. With support for closed loop (4x2) MIMO, multi-hop relays and Femto cells, reduced link-layer latency and higher VoIP capacity, Mobile WiMAX will meet all of the Next Generation Mobile Network Alliance (NGMN) requirements.

WiMAX Fast Forward

In 2010, the WiMAX industry is expected to transition to its next release, which is based on IEEE 802.16m, mirroring IMT-Advanced performance goals. Features will include higher channel and VoIP capacity, higher user data rates with advanced MIMO configurations at the mobile station including: (1x4), (2x2), and (2x4) MIMO. This next release will offer mobility for up to 500 km/hr, improved link budget and cell edge throughput, link layer latency less than 10 ms and hand-off at about

30 ms. There will be a fractional frequency reuse with inter-base station coordination, enhancements to location-based (LBS) and multi-cast broadcast services (MCBCS).

Meeting consumer demand

As the demand for increasing high-speed Internet access on the go grows among consumers worldwide, WiMAX technology provides a clear solution to meet the mobile broadband needs of consumers everywhere. Consumers, accustomed to their home connections' upload and download speeds, are continuing to have their patience tested by today's slower wireless devices, and now demand access to their higher speeds wherever they roam. WiMAX is the first 4G wireless technology available to meet the pent-up demand for mobile Internet. As a 4G technology, WiMAX can provide three times the performance of today's 3G solutions, with the ability to scale to 10 times the performance with 802.16m.

Backwards compatible and satisfy the demand today

Most importantly, Mobile WiMAX

backwards compatible migration path is in place. This will continue to protect operators and consumers as they deploy WiMAX today so that their products will work for many years into the future. Mobile WiMAX offers operators a time-to-market advantage over other similar OFDMA-based technologies that will not arrive for years. We are living in an era of unprecedented change – and WiMAX is a change for the better. And it's here now.

About WiMAX Forum®

The WiMAX Forum® is an industry-led, not-for-profit organization formed to certify and promote the compatibility and interoperability of broadband wireless products based upon the harmonized IEEE 802.16e/ETSI HiperMAN standard. A WiMAX Forum goal is to accelerate the introduction of these systems into the marketplace. The WiMAX Forum currently has more than 500 members globally, including operators, component and equipment manufacturers, and many others in the communication ecosystem.

WiMAX Forum Certified products are interoperable and support broadband fixed, nomadic, portable and mobile services. Along these lines, the WiMAX Forum works closely with service providers and regulators to ensure that WiMAX Forum Certified™ products meet customer and government requirements.

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ZTE **WiMAX Insight**

Opportunities Outweigh Risks
——An interview with Zhao Songpu, General Manager of ZTE's WiMAX products

Zhao Songpu joined ZTE in 1998 and now serves as General Manager of the company's WiMAX products. Formerly, he worked as Deputy General Manager of ZTE's CDMA products. With over 10 years of experience in wireless communications, he has gained a deep insight into the wireless market, playing a key role in helping ZTE grow from a standard follower to a standard leader in the WiMAX field.

As the WiMAX standard and its industry chain get more and more mature, the WiMAX technology has been gradually changing our life. The WiMAX applications, for example in the United States, Saudi Arabia and Libya, offer users exciting experience. What new WiMAX technologies will be used this year to decrease the Total Cost of Ownership (TCO)? What measures will be taken in the field to enable future technical evolution? What impacts will the global financial crisis have on the WiMAX industry? With these questions in mind, ZTE TECHNOLOGIES interviewed Zhao Songpu, General Manager of ZTE's WiMAX product line.

Journalist: Can you introduce the global development of WiMAX in 2008? What market achievements did ZTE make?

Zhao: In the year 2008, WiMAX reached the eve of the explosive development: more than 100 mobile WiMAX networks were deployed and commercialized; 80 WiMAX vendors dedicated themselves to the R&D and production of WiMAX equipment; over 480 terminals and system equipment were launched; the WiMAX industry chain became stronger and more mature. It is expected that there will be explosive growth of WiMAX this year. ZTE made big achievements in the WiMAX field last year. By November 2008, ZTE had deployed 30 WiMAX networks in more than 20 countries including developing countries in Asia Pacific and Africa, and high-end markets in Europe, Japan and North America.

As we know, long-term partnership can not be established by one-time communication. In 2008, ZTE also cultivated many potential markets,

and had deep communication with many operators. For example, we have passed the Global MSF Interoperability (GMI) test at BT's site and won acknowledgement of BT. In 2009, we hope that more operators will recognize and trust ZTE's products.

J: What's ZTE's viewpoint concerning the impact of the financial crisis on the WiMAX this year?

Zhao: In late 2008, we read some news about WiMAX given up by some Western vendors. We regard this as the result of severe market competitions. While many mainstream vendors have been losing profits in the telecom market, ZTE has witnessed continuous growth. Many traditional vendors had to give up new, competitive markets and retain existing, profitable fields. The global financial crisis that broke out last year further accelerated the decline of these vendors. The effects of financial crisis on the market and the weakening of our competitors coexist. For ZTE, we expect both opportunities and challenges this year, and we believe opportunities outweigh challenges.

A question is: how will the financial crisis influence the demands of end users, as it has caused a decrease of requirements in the marketplace? We can refer to the "potato theory", which has recently become popular in the economy field. According to this theory, consumers will cut back on luxury consumption during this financial crisis; however, they cannot cut back on basic consumption, as they must eat potatoes every day. In the telecom field, mobile voice service is a basic need, and broadband Internet, in both wireless and wireline options, is also a necessity. As the demand for broadband Internet, the "potato", keeps increasing, we believe there will be growing market demands

and opportunities, despite the economic recession resulted from the financial storm.

J: The WiMAX technology was at first oriented to mobile broadband networks. Is there any change in this orientation, since the WiMAX standard and industry have become more mature?

Zhao: Nowadays, the WiMAX industry is developing very fast, the industry chain is gradually getting mature. The initial orientation of the WiMAX was based on the characteristics of the technology, and little consideration was given to terminals and user experience. As time goes by, many people realized that WiMAX can do more. It can be used as a fixed service to replace the traditional DSL mode, saving network construction costs.

An operator can construct a WiMAX network in three phases. In the first phase, the operator deploys WiMAX for fixed access and hotspot coverage, to compete for the wireless broadband market and major customers. The second phase is the nomadic phase when the network covers target enterprises and residential areas apart from hotspot areas. In the third phase, the operator offers full mobile service and seamless converge, helping users experience uninterrupted WiMAX network services.

J: What significant features of WiMAX can effectively decrease the TCO?

Zhao: WiMAX adopts many advanced technologies to increase network capacity and enhance coverage. For example, it makes use of technologies like Multiple-Input Multiple-Output (MIMO), Beamforming (BF), and Fractional Frequency Reuse (FFR) to tackle

network interference. ZTE has recently launched the industry's first WiMAX 16e Remote Radio Unit (RRU) based on BF4*8 Multi-Antenna technology. The RRU device supports dual carrier discontinuous spectrum, enabling a maximum bandwidth of 100MHz expansion between uplink and downlink. It is a cost-effective solution for operators using FDD spectrum.

In fact, decreasing the TCO is only one aspect. It is of greater importance to offer operators reasonable networking plan and proper combinations of equipment. For example, we supply integrated outdoor Base Transceiver Station (BS), which is applicable to hotspots and CBD areas in cities. For suburban and mountainous areas, where equipment room facilities are not available, we offer outdoor cabinets, which integrate transmission, power and air-conditioning resources, and it is only necessary to place the BS equipment in the cabinet. ZTE has always been promoting customized solutions. For different networking conditions and demands of different operators, we recommend customized, low-cost solutions.

J: Nowadays, many operators are making efforts to improve the spectrum utilization. What features of WiMAX can improve the spectrum utilization?

Zhao: Firstly, WiMAX has a range of channel bandwidths, like 5MHz, 7MHz and 10MHz. Our WiMAX equipment, which has just received WiMAX Forum 3.5GHz Wave2 certification, supports flexible configurations of these bandwidths. We are also the first vendor that has completed 5MHz, 7MHz and 10MHz bandwidths testing procedures and we will support 3.5MHz and 20MHz this year.

Secondly, WiMAX supports flexible networking, including Full Usage of Subchannels (FUSC), Partial Usage of Subchannels (PUSC) and Adaptive Modulation and Coding (AMC). Through different sub-carrier allocation modes, the WiMAX equipment can improve link quality and throughput. We also adopt other advanced technologies, such as the Cyclic Delay Diversity (CDD) and FFR, to effectively enhance coverage and decrease interference.

J: We have seen constant evolution and development of mobile communications systems. What about the WiMAX's support for smooth network evolution?

Zhao: WiMAX has adopted many key technologies, which are actually future mobile technologies, for example, Orthogonal Frequency Division

Multiplexing (OFDMA), MIMO and BF. Therefore, WiMAX stands in an advantageous position in terms of future technical evolution.

We have recommended many solutions for operators to choose. As our equipment is based on the Software Defined Radio (SDR) platform, 2G/3G network operators can upgrade the existing networks to 4G simply through replacing a channel board and software upgrade.

At present, we are developing the 16m technology, which takes into account network convergence and aims to be a candidate of IMT-advanced standards. We believe that WiMAX will have a brighter future.

The Optimistic Growth of WiMAX Terminal Industry

Zhang Yong

As an important part of the WiMAX industry, terminals have become increasingly mature in terms of their equipment manufacturers, chip manufacturers, terminal manufacturers and operators, in recent years.

In most commercial cases, it is the WiMAX equipment manufacturers who provide end-to-end solutions. Terminals, whether self-owned brand or OEM, are provided to the operators together. Therefore, the equipment manufacturers have contributed a lot to the development of the terminal industry. Some system vendors mainly rely on terminal products based on self-research, such as ZTE, Motorola, Samsung, Alvarion, etc; others usually adopt the terminals through cooperation with terminal manufactures, such as Alcatel-lucent, Huawei, etc. On Mobile World Congress Barcelona 2009, these equipment manufacturers showcased diversified terminals.

In recent years, WiMAX terminal chip manufacturers have grown at a remarkable pace. Two pacemakers, Sequans and Beceem, have seen increasing shipment. Terminal chips such as Sequans SQN1130 and Beceem BCS200 have become mature enough to withstand large scale commercial network. With great achievements in first generation chips in the market, chip manufacturers are launching their second generation chips, such as BCSM250 and BCS5200 launched by Beceem, SQN1210 and SQN1220 launched by Sequans, Nelson Peak by Intel, GDM7205(2.5G) and GDM7213 (3.5G) by GCT, and WiMAX mobile phone chip MT7108 by MTK. These second generation chips are highly integrated, with remarkably reduced power consumption, supporting full-band frequency, applicable to data card, USB Dongle, CPE, MID, embedded notebook and WiMAX mobile phone, etc.further facilitating the development by terminal manufacturers and terminal diversification.

WiMAX terminal manufacturers have undergone their development more and more smoothly with the deployment of a large number of commercial networks in 2008 and 2009. With government support to WiMAX, a dozen of WiMAX terminal manufacturers have appeared in

Figure 1 Some terminals showcased on Mobile World Congress Barcelona 2009

Figure 2 Beceem launched BSCM250

Zyxel, Gemtek, Jstream, AWB, USI, Asus, Tecom and Alpha, which have distributed their products across the world.

WiMAX operators, due to different service types, have different needs for WiMAX terminal types, primarily including card, USB and CPE. However, in North America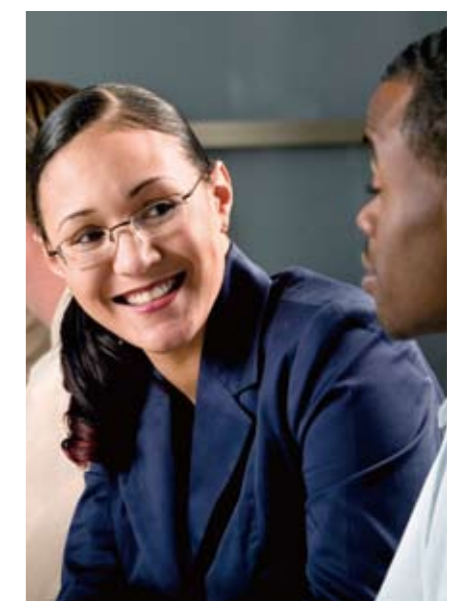, Japan, West Europe and other high-end Taiwan, Quanda, including markets, there are different needs for embedded notebook, handset, multimodal card, MID and UMPC, etc.

As a leader in WiMAX industry, ZTE is one of the few manufacturers capable of providing end-to-end solutions. Through self-research and cooperation, ZTE has launched diversified terminals that can satisfy the requirement of different operators.

Currently ZTE has established 5 independent IOT laboratories and offers the IOT test platform to WiMAX terminal manufactures and awards test certificates to them, providing operators with more terminal choices for large-scale commercial use. By now, ZTE has conducted IOT tests with more than 30 terminal device suppliers.

ZTE, as a member of the WiMAX Forum, is proactively pushing the industry for more healthy development.

Operator need	ZTE's terminal type	Picture
Fixed data service	Indoor CPE	
	Outdoor CPE	
Mobile data service	Card	
	Embedded notebook	
Fixed voice service	WiMAX IAD	
Mobile voice service	WiMAX mobile phone	
Supplement to existing network	Multimode card WiMAX + HSPA	
	Multimode card WiMAX + EV-DO	
Monitoring	Mi100	
Low cost	Windwo antenna + CPE	

Table 1 ZTE's different terminals for operators with different requirement

Experiencing a Tour of Extreme-Speed Broadband in Malaysia

——*ZTE helps P1 to make the largest WiMAX network in Southeast Asia*

Tao Xiaomin, Li Lanqing

Customer evaluation

P1 CEO Michael Lai: Our goal is simple – to make broadband a right choice for all Malaysians. To deliver this commitment, the rapid and prime-quality deployment of the P1 W1MAX network is crucial. P1's appointment with ZTE is another step in crystallizing our commitment by accelerating the deployment of P1 W1MAX networks in more areas to meet the overwhelming consumer demands for high-quality and high-performance wireless broadband.

Background

In 2007, broadband penetration in Malaysia was merely 5%. In order to promote the development of broadband communication, Malaysian government and Malaysian Communications & Multimedia Commission (MCMC) issued four 2.3G WiMAX licenses simultaneously in 2007. This has brought operators more opportunities and challenges. What's more, fierce competition in Malaysia broadband communication market has been triggered.

Packet One Networks (Malaysia) Sdn. Bhd. (P1) is a subsidiary of Malaysian Group "Green Packet". It specializes in WiMAX/WiFi telecommunication service. In 2008, P1 was the first operator in Malaysia to launch WiMAX service and the first operator in Southeast Asia to have realized commercial WiMAX 802.16e.

ZTE - a long-term strategic partner

Facing this fierce market competition, there raises two questions: how to construct a competitive network? How to realize rapid development of user? P1 has put high requirements on network: Firstly, as a new operator, site resource is not sufficient; it is necessary to effectively control the investment on initial network construction and the long-term operation & maintenance cost. Secondly, it is very important to build the network rapidly to develop new users as fast as possible, which requires extremely strong capability of project deployment. Last but not least, exquisite broadband network will attract excellent customers; the stability of the high-throughput network should be guaranteed. Therefore, selecting a partner is the key factor for the success of P1.

In July 2008, ZTE was short-listed by P1 for its Phase II project, a trial network. ZTE did an excellent job in the testing and was highly recognized and praised by P1. ZTE adopted new-generation distributed BS to construct the network rapidly; functionality tests and KPI tests of the whole network were passed; the pre-commercial network was running normally. All these helped ZTE to smoothly pass the strict tests given by P1 and strengthened P1's determination to build WiMAX network. After comprehensive consideration and evaluation on technique, business and market development strategy, etc, P1 finally selected ZTE as the long-term strategic partner in March 2009.

Clinging to customer requirements and quality network

The distributed BS architecture makes networking flexible and efficient. ZTE distributed BTS is flexible to deploy, offers a green solution, and ensures easy installation and use; meanwhile it is fully compatible with the advanced functions of Wave 2 such as MIMO and HARQ. This totally helps to reduce the networking cost, accelerate the network deployment, and enhance the operator's investment value to the maximum extent.

Excellent product performance guarantees user experience. In order to ensure the users in the commercial network to enjoy high-bandwidth data service, P1 required service test in the trial network of 150 users per sector. The test result showed that ZTE performed best among the three vendors that had participated in the test in terms of system performance, total sector traffic, single user download traffic and download stability.

3D coverage solution makes an exquisite network. Besides the large-scale macro BTS coverage solution, ZTE's mature indoor coverage solutions provides with even more convenient and efficient WiMAX broadband access in different scenarios. These solutions help to realize fast and cost-effective network deployment in dense and key areas.

Professional network planning & optimization guarantees a high-quality network. Networking with 3*10M makes full use of bandwidth, but it will easily cause inter-sector interference. The reasonable solution is to minimize the interference through professional network planning & optimization provided that the high-speed broadband network is guaranteed. ZTE did well in the KPI tests and its capability of network planning & optimization was highly recognized by P1.

Creating a better future together

P1 always adheres to "Customer First" concept, providing premium quality broadband services, and establishing the brand image of future industry leader. It attaches great importance to high-quality network construction, insists on principle of early market penetration, and chooses mature products, solutions and extraordinary engineering implementation to enhance user experience.

ZTE inherits P1's concept, building up goals of "Simple, Premium-Quality, Efficient", solely constructs Phase II network for P1. Meanwhile, the IOT test center in Malaysia constructed by P1, Intel and ZTE has been completed, giving a new impetus to development of WiMAX industry worldwide. ZTE, together with P1, will accomplish network deployment in 31 cities of Malaysia, constructing the largest, fastest and best user-experience commercial mobile WiMAX network in Southeast Asia.

Broadband Oasis in the Sahara Desert

——LTT selected ZTE to build the first mobile WiMAX network in Africa

Li Lanqing

Customer Comments

LTT CTO Abdul Nasir A. Al-Tubuly, "ZTE is a reliable partner. ZTE WiMAX products can provide wireless coverage in all kinds of scenarios and satisfy our network construction requirements."

Project Background

Libya is located in the northwestern corner of the African continent and borders the Mediterranean Sea to the north. It lies across some of European countries such as Greece, Italy, France and Spain. Libya is famous for its vast territory and a long Mediterranean coastline. It has rich oil and natural gas, which are the main economic pillars and have created huge enormous wealth.

Libya Telecom & Technology (LTT) is a subsidiary of GPTC. It is specialized in providing data services such as Internet. It was only providing dial-up Internet access, VSAT, DSL, WiFi and E-mail services. In August 2007, LTT was determined to develop wireless broadband service and carry out tender and bid activities in the WiMAX field. After careful survey, LTT selected ZTE as its strategic partner to build the first WiMAX network in Africa.

Opportunity or Challenge

The mobile voice service in Libya was offered by Libyana and Al-Madar. As the telecom market grows, the mobile penetration soars to 110% and reaches close to saturation. The Internet becomes ubiquitous in the globe and influences people's communication habits. Because the broadband data in Libya is comparatively backward and the existing wired broadband data resource cannot meet the increasing market demands, the development of wireless broadband has become a key issue for Libya to construct a broadband data network.

Libya is surrounded by the Mediterranean Sea on the north and extends deep in the Sahara Desert. Except the green coastal areas (also densely populated areas), more than 90 percent of the country is desert or half-desert dry plateaus where the population is sparse. The different types of landform result in different climates. For example, the coastal lowland in the north of Libya features sub-tropical climate. It is hot and dry in summer, but warm and rainy in winter. The inland in the south of Libya features tropical desert climate. It is cold in winter and hot in summer. The seasonal temperature difference and the temperature difference between day and night are very big. The landform, climate and population distribution features put strict requirements to network construction. By virtue of outstanding WiMAX strength and good understanding of the local environment, ZTE offered WiMAX end-to-end solution to fully satisfy LTT's requirements.

By cooperating with GPTC, LTT and Libyana since 2005, ZTE has accumulated rich experience in building local networks. Following the previous successful cooperation, ZTE was selected by LTT to build the first mobile WiMAX network in Africa.

Best Solution Selection

WiMAX - new wireless broadband access technology, has obvious technical advantages. It features high access rate and large throughput. It can obtain 17.85 Mbps DL and 3.74 Mbps UL peak rates (MIMO 2*2) at 5M spectrum bandwidth. Compared with other 3G technologies, WiMAX can obtain higher broadband rate at the same spectrum. Due to good mobility, high capacity and rate, QoS guarantee, perfect coverage solution and rich multimedia and broadband data services, WiMAX will help operators to rapidly explore the market.

The complicated geographic and climate environment in the north of Libya rose to the challenge of equipment performance and engineering execution. ZTE WiMAX end-to-end solution adopts key technologies such as MIMO, OFDMA and efficient power amplification. With the BS supporting large coverage, a large number of BSs can be saved. The large-capacity outdoor distributed BS cabinet integrates BBU, transmission equipment, environment monitoring equipment, ACD/DC conversion equipment and backup power supply. This cabinet can save the equipment room space and allow rapid network construction. Moreover, this cabinet can protect against high and low temperature. It is able to stand 50℃ in the Sahara Desert.

During product design, ZTE focused on low-TCO, green network and convenient installation. ZTE made every effort to satisfy the operator's demands and maximize value for the operator.

Firstly, ZTE adopted the structure of the Universal IP Platform, greatly reducing expansion, evolution and convergence costs. ZTE's unique SDR technology based on Micro TCA supports technical upgrade and evolution through software/hardware upgrade, thus reducing investment in network upgrade. In addition, ZTE BBU supports at most 12 carrier-sectors, allowing network expansion in the future.

Secondly, ZTE WiMAX technology leads the industry. The multi-antenna technology supports 4T8R. With the same coverage area, by using 8-antenna BSs, more than 12% BSs are saved as compared with using 2-antenna BSs. The unique ultra long-distance coverage solution helped the operator to build networks in rural or remote areas, for example, the big areas in the middle and south of Libya. It can achieve a coverage radius of 19 kilometers.

Thirdly, ZTE's diversified indoor solutions provide convenient and efficient WiMAX broadband access. ZTE's mature Pico/Femto BS for indoor equipment features small size, convenient installation and wide coverage area. It can be deployed rapidly in densely populated or important areas. For the indoor environments where cable layout is not convenient, ZTE offers indoor Pico solution based on power line transmission.

ZTE has committed to R & D of WiMAX and owned more than 600 WiMAX-related patents. It is always leading the industry in standard pre-research, industry standard and equipment certification. ZTE is the first company to win the 3.5 GHz equipment certification in the world and also the first company to acquire Wave II 2.5GHz/3.5GHz equipment certification and 2.5GHz terminal certification. ZTE's commitment to R & D ensures advanced technology, high compatibility and reliability of ZTE WiMAX products.

With abundant experience in engineering execution, ZTE offered all-round network planning & optimization, site acquisition, infrastructure, equipment installation and network operation & maintenance service. Through regulated project management model, uniform deployment and rapid action, ZTE built a high-quality and cost-effective wireless broadband network for LTT.

Confidence in Future

ZTE provided customized terminals for LTT to rapidly explore the market and promote WiMAX brand. ZTE customized a series of terminals, designed personalized user interface, and found new functions catering for the user demand on the client end.

After put into commercial operation, LTT WiMAX network is running normally with good performance. The market promotion quickly spreads. WiMAX network is attracting new users. A lot of users have subscribed to the WiMAX service and purchased WiMAX terminals. The high user growth has raised LTT's confidence in the prospect of WiMAX.

Analysis on the Operating Strategy of WiMAX in High-end Market

Zhang Sihong, Ling Min

How shall we operate WiMAX, and what is the appropriate business model for WiMAX operation? To get the answer to these questions, we have to refer to the operators from the high-end market who will provide us with some information and lessons for us to count and learn.

As an operator incorporated by Intel and other local financial groups with joint investment to specialize in WiMAX business service and a global largest WiMAX operator going ahead of mobile operator A in Japan, operator B began to provide WiMAX wireless broadband service on February 26, 2009 and is expected to set up 20000 base stations covering 93% of the population within the territory of Japan by 2012. Then, what shall we learn from such a leading operator?

I. What positioning should be made to step into a potential market?

It is critical for a WiMAX operator to seek an appropriate market opportunity to develop its operation because the market positioning plays an important role to determine the development strategy for an operator. There are three recognized application models of WiMAX, namely wireless DSL, mobile broadband and handset multimedia.

Unlike most of the emerging market, the high-end market in Japan is rich in copper wire and even optical fiber resources as the vast majority of areas are covered by DSL and even optical fiber. It is obvious that the positioning of wireless DSL is not appropriate for this market. Having recognized this problem, operator B took two steps to implement its business operation. The first step is the development of mobile broadband, or that is, to support the full internet application of PC, Laptop and net-books by means of USB Dongle or built-in WiMAX chip. The second step is the application of handset multimedia, or that is, to develop handset based multimedia and voice service along with the maturity of WiMAX based multimode terminal and the completion of WiMAX network coverage.

With respect to the mobile broadband business which is to be conducted in the first step of the development strategy, operator B shall focus on the targeted markets described as follows:

(1) The new broadband users. Athough the penetration rate of the broadband business is high in the market of Japan, there are still some potential users to be covered by the mobile broadband which is more attractive than the wired broadband for its prompt and easy installation.

(2)The existing mobile data card users. The users shall be attracted to change their network by the offer of more rational and competitive price package.

(3) The existing PHS data card users. To attract the users who are more concerned about user experience with the higher Mbps of WiMAX.

(4) The wireless broadband in public areas. To attract customers with the mobility feature of WiMAX, Operator B expects to develop five million mobile broadband users in these markets by 2012.

II. The Market Strategy

Operators	Speed (downlink)	Monthly charge (JPY)	Technology
Operator B	40 Mbps	4480	WiMAX
Emobile	7.2 Mbps	4980	HSDPA
Docomo	7.2 Mbps	13000	HSDPA
KDDI	3.1 Mbps	4410	EVDO
Softbank	7.2 Mbps	5985	HSDPA

Through the comparative analysis of the flat price of operator B and other operators, we have found that the price of operator B is obviously lower than those of the leading operators such as Docomo and Softbank, and even lower than that of Emobile, a radical new operator who provides HSPA, but at a higher price than that of KDDI. Such price shall not bring any impact on the existing business of KDDI because, on one hand, KDDI does not need to compete for the market share with low price as it uses EVDO technology which provides wider bandwidth by WiMAX, and on the other, KDDI is also the major shareholder of operator B. We can conclude by the price comparison that operator B selected low price strategy but also took into account other factors such as technologies to avoid the cutthroat competition caused merely by price war.

As the market positioning is the first step in the process of market development, it is necessary to make an appropriate market strategy to attract customers. Then, what is the market strategy made by operator B ?

Services and Pricing Strategy

Operator B released the trial business service in February and offered free service for the users from 23 districts of Tokyo, Kanagawa Yokohama and Kawasaki who joined this promotion campaign for a period ending at the end of June. A flat price package of 4480.00 Yen per month was released after June 1 when the formal business operation began. The new operator selected the simplest flat price strategy instead of complicated price model in order to establish its brand name and develop trust of the customers to its products in the early stage of market entry because the price of 4480 Yen per month without limitation of traffic can be an attraction to the high-end users. It is estimated that the double flat and the double flat light tariffs which are fairly popular in the market of Japan shall be gradually released along with the development of the business to gradually cover the customers from the high-end users to middle and lower end ones.

Terminal Development Strategy

In order to support the business development, operator B has also made complete terminal development plan, which is to be implemented in two steps. Firstly, to release its own-brand data card in the stage of trial for commercial use, and in the stage of commercial use, to release the Laptop and the net-book with built-in WiMAX. The handset mobile on-line terminal shall be released in fall. Secondly, to release the dual-mode inner gateway of WiMAX and WiFi to improve the indoor coverage capacity.

In the stage of trial for commercial use at present, operator B has released four types of data cards including USB, PCMCIA and Express cards, the three data card application models which are typically used today, in cooperation with Shinsei Corporation, the indigenous manufacturer in Japan. The four types of data cards are all the own-brand of operator B and each type has its unique advantage. For example, UD01SS is claimed to be the lightest USB dongle in the industry and UD01NA has a USB interface that can rotate 180 degrees.

Network Coverage Strategy

Operator B plans to establish its network in three steps. Firstly, to set up 4000 base stations covering 50% of the population in the key metropolis like

Tokyo, Kanagawa, Yokohama, etc. from 2008 to 2009. Secondly, to set up 14000 base stations covering 85% of the population in all the major cities of the country from 2010 to 2011. Thirdly, to set up 18500 base stations covering 90% of the population of the country form 2012 to 2013.

Apart from the outdoor network coverage, supplementary method of Pico BS shall be used to improve the coverage in some hot spots (such as subway stations, airport and busy indoor areas). In the first stage of the network development, the operator worked with JR East Japan Corporation to set up 44 base stations along JR railway to cover the subway line. It also set up indoor base stations in Haneda airport, the busiest airport in Japan and operates the WiMAX service at the first tower and second tower at Haneda airport in April 2009. The operator will use mobile repeater as a supplementary method to improve the coverage of JR subway line. In addition, operator B is also making efforts on the R&D of low cost improvement and the expansion of the 802. 16j product covered by the network with an aim to consequently bring down the cost of the base station and expand its communication capacity.

III. Development of Mobile Broadband NVNO, a New Business Model

The Japanese government required the licensed WiMAX operators to open MVNO service to other operators when it granted the licenses to them in order to promote the development of broadband market and improve the competition mechanism. This is not only a limitation of competition but also a provision of opportunity for operator B to release another business model. By MVNO mode, operator B can not only obtain users by retail but also provide wholesale service by resale to increase revenue.
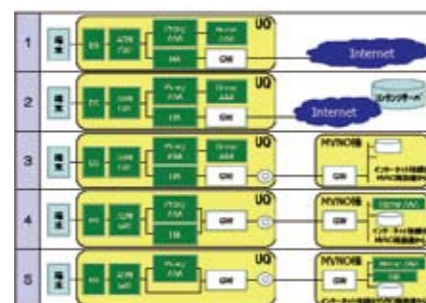

Figure 1 The five MVNO scenario models provided by operator B

As indicated in Figure 1, operator B has designed five types of MVNO models, each of which is determined by the amount of the network resources rented by MVNO. The two models of type 1 and type 2 are suitable for the operators who have no experience in network maintenance but are capable of market operation and who have no network resources of their own but rent the network from operator B to focus on the promotion of brand name products and the expansion of market. The third scenario is suitable for the operators who have certain network operation experience and resources and rent the base network of operator B but get access to internet by self-owned internet gateway. In the fourth scenario, MVNO rents the base network from operator B but build its own internet gateway and user authentication billing system (AAA). In the fifth scenario, the operator shall set up its own home agenda in addition to building its own internet GW and AAA. We can conclude that the requirement for network capacity of MVNO intensified from scenario 1 to scenario 5. Therefore, the operator may select appropriate model in accordance with the requirement for MVNO.

The price model varies with different scenarios. Generally speaking, the MVNO that rents more network resources shall pay more rentals to operator B. In the first and the second scenario, each user shall pay 3300 Yen per month, the highest of all. Compared to the retail price of 4480 Yen per month set by operator B itself, we can conclude that there is an actual difference of 1180 Yen between the two prices. Therefore, the MVNO must be strong enough in marketing capacity and cost control to maintain profit after payment of cost for market operation, etc.. Each of the other three scenarios has two price models named price A and price B respectively. Like model 1 and model 2, price A is charged per month on each user, but the monthly rental is less than that in scenario 1 and scenario 2. In mode B, certain basic rental is charged per month on each user and the rest shall be charged based on the traffic. This mode is suitable for MVNO which does not have too much traffic.

In addition to the rental for the basic network, the MVNO of type 3, type 4 and type 5 shall charge rental based on the interface mode classified into electricity connection and optical fiber connection. For electricity connection the price is 200 thousand Yen per interface per month and, for optical fiber connection, the price is 300 thousand Yen per interface per month. In addition, another 100 thousand Yen is charged per month for equipment configuration because the network gateway of operator B that is connected with that of MVNO needs operational maintenance for data configuration.

We can conclude from the above analysis that operator B, the leader of WiMAX suppliers in the high-end market, has made great efforts on the research and exploration of market positioning, market development strategy and the innovation of MVNO business model, which is a good example for many perplexed WiMAX operators to follow.

ZTE WiMAX Insight

ZTE Built a Quality WiMAX Network in North Africa

Luo Yong, Shao Yan

A high quality WiMAX network requires professional and meticulous network planning. Meanwhile, special key technologies and application needs of WiMAX network bring new challenges to network planning.

Challenges for WiMAX network planning include:

- the way to maximally use the spectrum resources obtained by the operator to improve system capacity within limited bandwidth;

- to minimize the number of base stations without compromising capacity and service quality so as to reduce construction and maintenance costs;

- to maximally reduce intersystem interference to achieve required service quality and provide maximum capacity;

- and to achieve radio coverage with maximum time and places in the service area.

ZTE has applied its sophisticated 2G/3G radio network planning experience to WiMAX network planning, particularly achieving innovations one after another in frequency planning, multi-antenna technology, interference control and network planning tools, etc. Currently, taking into account the characteristics of WiMAX network planning, a series of planning optimization tools (ZXPOS) have been developed, primarily including CNP, CNS, CNT, CNA and CNO, which are respectively used in each stage of network construction. Currently this series of solutions have been successfully used for global major operators, including STC in Saudi Arabia, TATA and BSNL in India, China Telecom, China Mobile and China Unicom.

Up to January 2009, ZTE had discussed with over 100 operators across the world on WiMAX standard, network planning and construction. In Asia-Pacific region, Middle East, Europe, Russia, USA and Latin America, test systems are built, and

some WiMAX commercial contracts are won. In particular, the great success in WiMAX commercial network in Libya, North Africa is significant, creating a classic WiMAX network. Refined WiMAX network planning begins with demand analysis. Libya is located in the north of Africa, covering an area of 1750,000 sq m, 94% of which is desert or half desert. ZTE's network planning team, according to the geography, distribution of urban buildings and the customer's coverage requirement, rationally determined the borders and features of coverage. Meanwhile, according to the existing frequency bandwidth, estimated number of subscribers, traffic model, MIMO configuration, edge uplink rate requirement, building penetration loss, edge coverage, area coverage, standard deviation and other parameters acquired by the customer, also taking into account existing base station height or estimated antenna mounting height, terminal type, terminal mounting height and feeder loss, an accurate link budget sheet is prepared.

In terms of radio environment analysis, spectrum scanning is carried out for the planned area to ensure the availability of the spectrum resources acquired by the customer. In the Libya project, to provide the customer with a high precision network planning solution, ZTE's WiMAX network planning team did a lot of work in field strength test, obtaining the forecast model accurately describing the local radio transmission environment, thus greatly improving the creditability of planning emulation and being highly praised by the customer. Meanwhile, in the field strength test, it was found that serious interference existed outside the system in the service area. Therefore, the customer needed to refer this problem to the local radio authority with sufficient data support. ZTE's network planning team proactively coordinated with the customer in

spectrum scanning and interference analysis, providing the customer with rich analytical documentation and removing interference upon base station activation, winning time for network commercialization.

In terms of topology, based on radio propagation model, comprehensive planning and design tools are used to generate network topology. Effective network planning tools are one of the key factors to ensure network quality. ZTE has developed a series of planning optimization tools (ZXPOS) for WiMAX network, primarily including CNP, CNS, CNT, CNA and CNO. CNP, CNS, CNO are primarily used in the network planning stage of the Libya project.

In the site survey stage, ZTE's network planning team, by site survey and discussion with the customer, helped the customer to solve problems in land requisition and construction, etc., both reducing engineering cost, expediting project progress, and being highly recognized by the customer.

In the emulation verification stage, based on the emulation result, the best scheme was selected out of optional schemes. ZTE's network planning team, by times of emulation, found the system's radio parameters best securing high network quality, further guaranteeing network construction and coverage quality.

With the completion of more interoperability certifications and the decreasing of terminal prices, the commercial deployment of WiMAX network will be expanded rapidly around the globe. ZTE will continue to focus on customer needs, and create more classic WiMAX commercial networks for operators through refined WiMAX network planning.

ZTE *WiMAX Insight*

Out to Win
——Analysis on Low-TCO Network Strategy of WiMAX

Hu Yumin, Chen Min

Over the recent years, competition in the telecom industry has been intensified. Despite the richer and richer services provided, telecom operators have seen slow increase, or even decrease, of the Average Revenue Per User (ARPU). They are pay increasing attention on how to decrease the network's Total Cost of Ownership (TCO) through saving the Capital Expenditures (CAPEX) and Operation Expenditures (OPEX).

Analysis of WiMAX Network TCO

For an operator, the TCO includes CAPEX and OPEX. In constructing and operating a WiMAX network, CAPEX mainly consists of purchase and construction expenditures. Purchase expenditures cover the purchases of WiMAX and supplementary equipment as well as upgrade and expansion equipment in the later phase. Construction expenditures cover site acquisition, civil works, and equipment installation. OPEX is indirect costs related with routine network operation and maintenance. Operational expenditures cover the expenses on site rental, transmission rental and power consumption.

According to the process of network development, we can divide the lifecycle of wireless network into three stages, namely network construction and deployment stage, operation and maintenance stage and upgrade and evolution stage. The key factors that influence TCO are different in each stage of the network lifecycle. Through the analysis of the key factors that influence TCO in each stage of the network lifecycle, we can help the operators better manage the value generated by their investment and the total cost in each phase of the network lifecycle to continue maximizing such value by reducing and protecting their

investment.

Network Construction and Deployment Stage
— How to Reduce the Total Cost of Site

In the network construction and deployment stage, the key factors that influence TCO is no other than the total cost of site.

It is noticeable that the cost of major wireless equipment makes up only 30% of CAPEX, because the costs of the site acquisition, civil works, and equipment installation are higher and even more than 50% of the total cost. Therefore, the cost of the supplementary equipment and the expenditures on site installation and deployment are more concerned about by the operators.

It is obvious that the most effective way to reduce the total cost of site is to reduce the number of sites, bring down the cost for the construction of the major equipment and minimize the expenditures on the installation and rental of the equipment incurred by their occupied space. Less number of sites means the corresponding supplementary equipment will also be saved. This can significantly decrease the operators' CAPEX and OPEX.

As a pioneer of WiMAX Industry, ZTE has made every effort to reduce the total cost of site in the early stage of product design to help operators reduce the expenditure on equipment and operating maintenance,to meet operators' needs to build the network site at lower cost.

Supported by a most complete series of base stations in the industry including distributed base station, low-cost integrated base station and low-cost indoor/ outdoor Pico base stations, ZTE is trying to reduce operators' capital expenditure by providing

the appropriate product portfolios according to the different scenarios. These products are supported with various flexible and efficient solutions for indoor and outdoor installation and deployment to meet the requirements of the operators.

ZTE's base station equipment adopts the Software Defined Radio (SDR) technology, it enables the WiMAX and the 2G/3G equipment to share the same site, the same cabinet and the same transmission to save the site room and to reduce the construction cost and rental expenses.

The most effective way to reduce the number of the station is to increase the coverage of each station. By using MIMO, Beamforming, CDD and other industrially leading coverage enhancement technologies, ZTE can effectively enhance single station coverage by 20-40%. The use of MIMO 2T4R, against the normally used 2T2R, can achieve a coverage gain of above 4 dB and reduce the number of stations by over 45%. Beamforming 4T8R, against 4T4R, can get a coverage gain of above 2-3 dB and reduce the number of stations by above 30%.

Network Operation and Maintenance Stage
— How to Reduce the Expenditures on Operating and Maintenance

During the network operation and maintenance stage, the energy consumption, transmission cost and equipment maintenance and management cost, which form the cost of operations and maintenance, are the three key factors that will reduce profit of the network operation.

It is all known, not to mention the evidence of startling data, that the operators have spent so much on energy that both they and the earth on

which we are living are suffering the pain incurred by such a heavy burden. It is the duty of every one of us to save energy and reduce emission. Through energy saving and emission reduction, we can not only effectively reduce energy consumption and save operation cost but also make contributions to natural conservation by recovering the eco-system of the earth.

In the areas where there is limited resources of the traditional transmission like microwave and optical fiber, the operators have paid high transmission cost no matter they have built or rented them. If various transmission resources are suitably and flexibly used by the base station equipment, this problem can be easily solved.

In order to reduce the high cost of labor and equipment maintenance, the operators are eager to seek the highly reliable and maintainable and cost-effective base station equipment.

ZTE WiMAX products use board design featuring improved power amplifier efficiency, high integrity and low power consumption, as well as RRU natural cooling, BBU intelligent temperature control technology, intelligent power saving algorithm and other methods. All these help the customer to reduce energy consumption in an all-round way and create a truly green, energy saving and environmentally friendly network.

ZTE provides a variety of flexible and innovative solutions to meet the operators' requirements, which can make full use of the indoor Ethernet and power line to realize transmission and transmit clock signal through IEEE1588 technology, and the unique WiMAX self-transmission solution can even provide the operators who are short of transmission resources with an approach to the reduction of the transmission rental.

In addition, Owing to the IP65 level of protection, extremely wide range of temperature, the back-up mechanism of the key board and modularization design, which enable high reliability and easy-maintenance of the equipment, can minimize the maintenance cost.

Network Upgrade and Evolution Stage
— How to Reduce the Cost of Upgrade and Evolution

During the network upgrade and evolution stage, the key factors that influence TCO are the cost of upgrade and evolution.

Because of the uncertainty of the network evolution and frequent change of standard evolution brought about by the diversity of wireless systems, the new technology and standard often enter the market when or before the network established by the operators based on the former technology begin to gain profit. The operators shall not be able to afford the high cost of the technology upgrade incurred by the failure to smoothly upgrade their established network to meet the new technology and standard.

How to best protect the investment and reduce the cost of upgrade and evolution? Operators have to select the products which can best satisfy the needs for radio network evolution, superimposition and convergence. Expand flexibly to support multi-frequency, multi-system, and multi-network overlay; Upgrade smoothly to best utilize the existing equipment and protect the existing investment to smoothly upgrade into LTE/16m in the future.

The unified SDR based platform innovated by ZTE is applicable to all kinds of wireless network.. It had been deployed massively in commercial

network all over the world, won the awards granted by BBWF and GSMA.

The ZTE WiMAX product based on the unified SDR platform can support multi-frequency, multi-wireless systems including 2G, 3G, 16m and LTE and can support smooth evolution to LTE/16m. It has met the operators' needs for network upgrade and evolution, extended the lifetime of the system equipment, evaded the investment risk and minimized the cost of network upgrade and evolution.
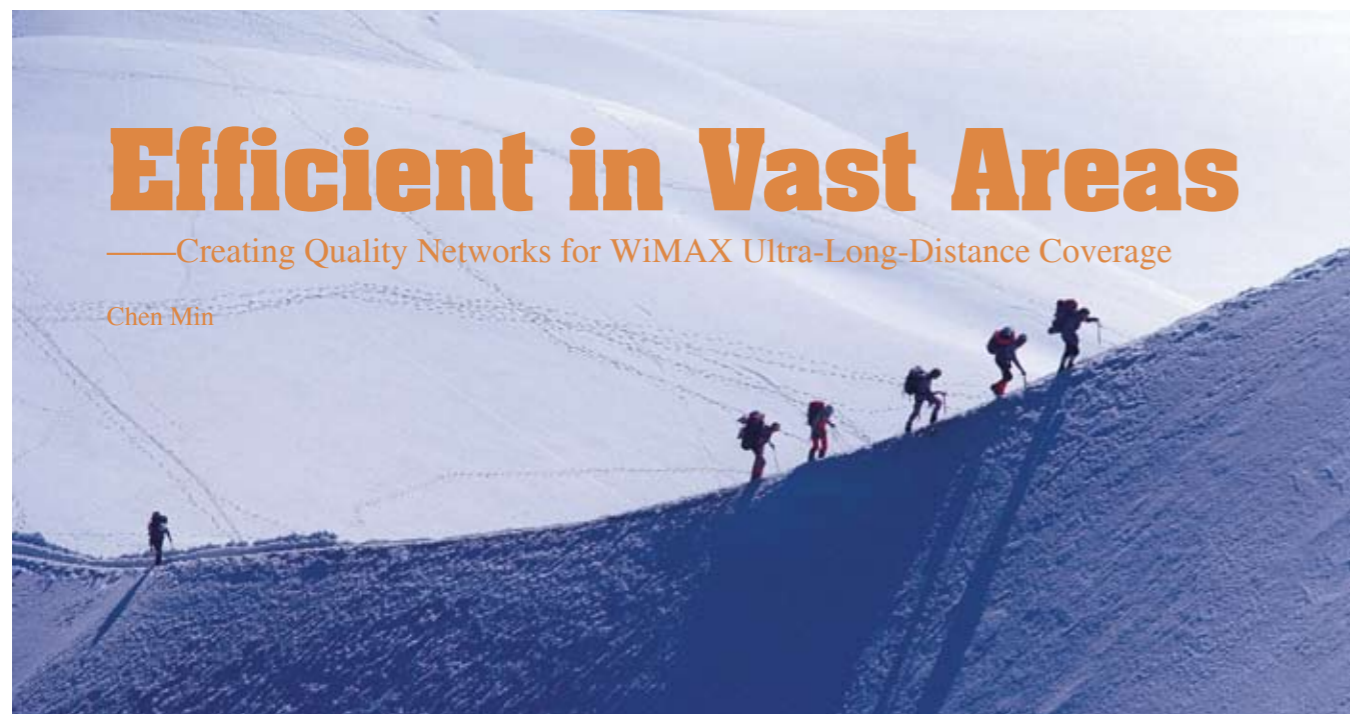
Conclusion

Under the circumstances of the global financial tsunami and facing the ever intensifying competition in telecommunication Industry, you can only win over the competitors by applicable low TCO strategy which take into account the key factors that influence TCO in the stages of network construction and deployment, operation and maintenance and upgrade and evolution to maximize the value with limited investment.

Supported by the extensive R&D experience in GSM, UMTS, CDMA and TD-SCDMA systems in wireless communication industry, ZTE has been focusing on the study of minimizing operaor's TCO based on the analysis of TCO model and framework when designing and developing WiMAX products. It has embodied its low TCO concept in its product design, system network development and network evolution by taking into account the characteristics in each stage of wireless network lifecycle to save and protect the operators' investment and keep on maximizing the value for the operators.

Efficient in Vast Areas

——Creating Quality Networks for WiMAX Ultra-Long-Distance Coverage

Chen Min

In today's increasingly competitive world, an urgent issue faced by telecom operators is, for areas under ultra-long-distance coverage, how to use less equipment to achieve long distance or even ultra long distance coverage, and how to use less base stations, fewer investment and more flexible network construction and maintenance mode to meet the growing voice and data service needs of subscribers distributed in special areas and improve ARPU.

Difficulties in WiMAX wide area networking

Ultra-long-distance coverage refers to the coverage of vast areas other than dense urban area, normal urban area, suburb and township, mainly including plain, mountainous area, desert, adjacent sea, lake, grassland and rural area. With economic and social development, these areas under ultra-long-distance coverage are generating growing needs for mobile communication, especially economically developed adjacent sea, lake and plain areas.

The communication in these areas features low subscriber density, small capacity and growing needs for data service, with a distance for coverage of dozens of kilometers, and radio signal propagation primarily of line-of-sight.

For wide area coverage in these areas, if normal macro cell or micro cell base stations are used, a large number of base stations are required to achieve satisfactory effects while the capacity is unlikely to be effectively used, remarkably increasing network construction and operation costs; and normal base stations have stringent requirement on site conditions, thus increasing operation cost and leading to the failure of many distant areas to meet site installation requirement.

Creating classic network for WiMAX ultra-long-distance coverage

With the deployment of WiMAX network construction, the way to address these challenges and achieve network deployment and operation in areas under ultra-long-distance coverage with low cost and high quality has become a big concern of operators.

If we can find a technical solution that remarkably improve base station coverage, and meet network needs for ultra-long-distance coverage with the deployment of less base stations and less investment; if we can find a base station that is small with low power consumption, and flexibly mountable outdoors without being required to meet strict requirement for equipment room installation; if we can carry out diversified services according to the characteristics of these ultra-long-distance coverage areas to rapidly improve ARPU; then all challenges will be readily solved and the classic network for ultra-long-distance coverage will be built.

As a leader in WiMAX industry, ZTE has been committed to such research and proposed an innovative solution for WiMAX ultra-long-distance coverage.

Outstanding technology serving as safeguard

Ranging test algorithm

What is the most difficult to achieve ultra-long-distance coverage in the WiMAX system is how to determine and calibrate the distance between base station and terminal, and distinguish between all terminals within the covered cell. ZTE WiMAX proposed industrially leading Ranging test algorithm that overcomes ambiguous test phase upon excessively long distance between terminal and base station. Combined with highly sensitive receiver and flexible measurement and adjustment technology, it can properly meet ultra-long-distance coverage needs.

Multi-antenna coverage enhancement technology

ZTE WiMAX ultra-long-distance coverage solution uses MIMO, Beamforming, CDD and other industrially leading coverage enhancement technologies to effectively enhance single base station coverage by 20-40%. Currently in the industry, only ZTE can support 4T8R Beamforming solution.

Array of high gain antenna

ZTE WiMAX ultra-long-distance coverage solution uses a series of high gain antennae respectively on base station and terminal sides to further enhance coverage. The use of high gain antenna on base station side can acheive a gain of 17.5dBi. High gain antenna is also used on the terminal (for example, panel antenna gain can reach over 12dBi), and by hanging outdoor terminal antenna higher, the signal transmission distance between base station and terminal is further increased, thus expanding coverage.

Flexible cost-effective networking solution serving as a foundation

Reducing cost of investment

ZTE WiMAX ultra-long-distance coverage solution, by using abovementioned technologies, greatly enhances single base station coverage. The use of MIMO 2T4R, against the normally used 2T2R, can get a coverage gain of above 4dB and reduce the number of base stations by over 45%. Beamforming 4T8R, against 4T4R, can get a coverage gain of above 2-3dB and reduce the number of base stations by above 30%. This helps the customer to heavily reduce the investment in equipment as well as operation and maintenance costs.

Rapid and flexible installation

The base station for ZTE WiMAX ultra-long-distance coverage is small, with low power consumption, for outdoor application and featuring flexible installation, can help you to rapidly deploy the network, remarkably save space and reduce base station installation and renting costs.

Green, energy saving and environmentally friendly

ZTE WiMAX ultra-long-distance coverage solution uses board design featuring improved power amplifier efficiency, high integrity and low power consumption, as well as RRU natural cooling, BBU intelligent temperature control technology, intelligent power saving algorithm and other methods. To address the difficulty in power supply in some ultra-long-distance coverage applications, remote power supply mode for base station equipment can be provided. All these help the customer to reduce energy consumption in an all-round way and create a truly green, energy saving and environmentally friendly network.

Professional services acting as backing

Professional network planning and engineering services

ZTE has rich experience in network planning, network optimization and engineering, provides technical support services for wide area coverage oriented network planning, network optimization and project implementation, and can prepare feasible solutions for different radio propagation environment and complicated topography.
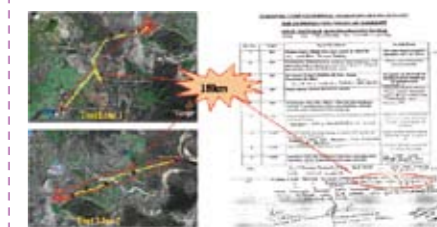
Customized services

According to the development of areas under ultra-long-distance coverage, ZTE also provides tourism information, video surveillance, positioning and navigation and other customized solutions to help operators to better meet customer needs, provide diversified services to improve ARPU value.

Application case

ZTE WiMAX ultra-long-distance coverage solution has been tested and commercialized with China Unicom, BSNL, KCell and other operators, achieving favorable effects and obtaining rich experience.

In the trial of BSNL in India, ZTE WiMAX ultra-long-distance coverage solution achieved a coverage of over 18km. In the KCell trial, a coverage of over 19.8km was achieved.

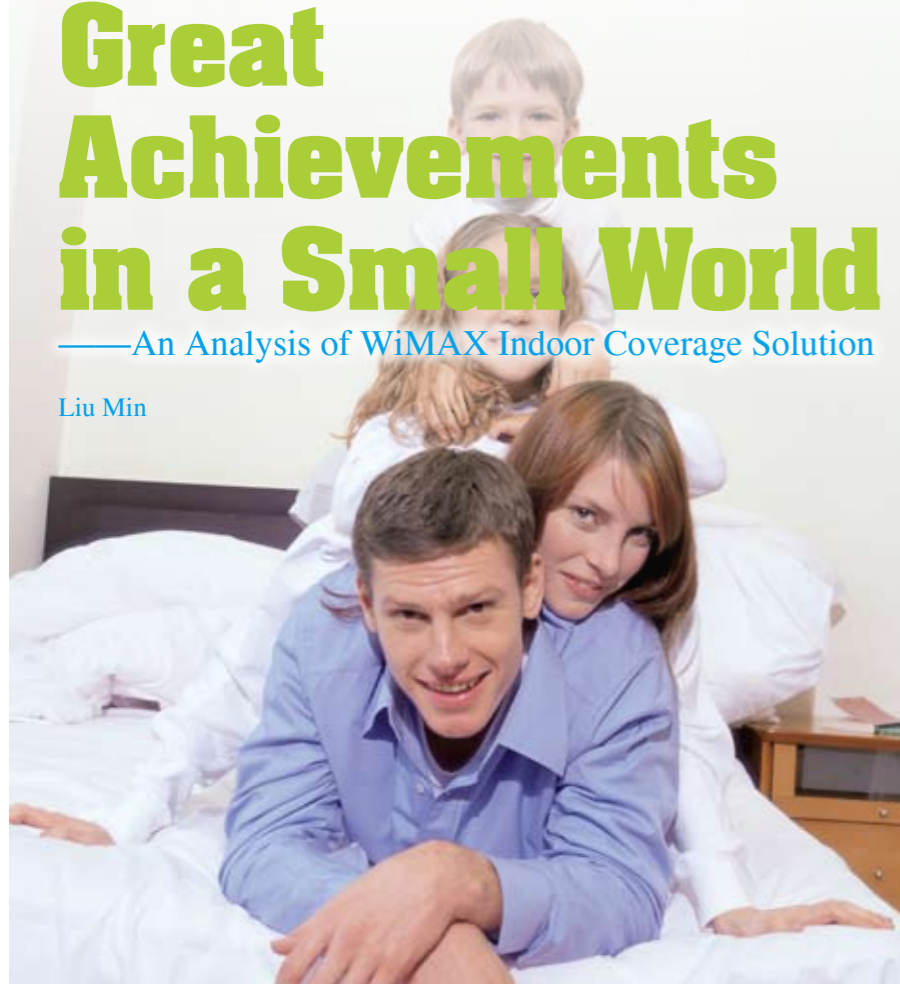*ZTE WiMAX achieved ultra-long-distance coverage of 18 km in the trial of BSNL in India*

Conclusion

As a leading equipment and solution provider in WiMAX industry, ZTE, while boasting its leading technologies, professional services and customized solutions, is committed to creating classic networks of ultra-long-distance coverage for operators.

Great Achievements in a Small World

——An Analysis of WiMAX Indoor Coverage Solution

Liu Min

Indoor coverage is the main battlefield for high density and differentiation among operators, especially for WiMAX. On the one hand, because of the spectrum characteristics of WiMAX, where currently in the world, major spectrums of WiMAX include 2.3G , 2.5G and 3.5G, and the fact that the higher the frequency band, the greater the propagation loss and penetration loss of radio wave in the free space, so as compared with 2G/3G network, WiMAX outdoor base stations have greater difficulty in solving indoor coverage. On the other hand, according to the statistics of NTT DoCoMo, although indoor coverage accounts for only 20% of all covered area, over 70% of data service, especially high speed data service, occurs indoor, so indoor coverage is decisive to network quality.

As seen from the experience of mobile operators' 3G indoor station construction, time synchronization, backhaul transmission and network deployment will be major challenges faced by post-3G system in indoor coverage. How shall operators face up to the challenges and survive indoor coverage competition with technological innovation and feasible solutions, and finally maximize the return on investment? The following is ZTE's ideas about WiMAX networking based on our experience in radio network construction.

I. Technological innovation tackling the traditional difficulty

WiMAX is a TDD system. For indoor coverage, the first step is to acquire time synchronization. Traditional GPS solution, due to the restriction and high cost of telecom construction, as well as the difficulty in GPS antenna feeder layout, has very limited applications.

Facing the difficulty to acquire time synchronization, ZTE creatively proposed two solutions, namely, using ToP technology or high sensitivity GPS, for indoor Pico BS/Femto.

Based on IEEE1588 protocol, ToP technology can solve indoor GPS antenna installation and indoor coverage problems through packet network transmission and clock synchronization recovery. Besides, ZTE ToP server can also intelligently adjust the parameters of ToP algorithm according to the characteristics of different transmission mediums, so as to better satisfy WiMAX network synchronizations requirements. ZTE is the first vendor supporting IEEE1588 time synchronization solution on commercial base stations. ToP server can support GPS signal provision and distribution upon regional coverage.
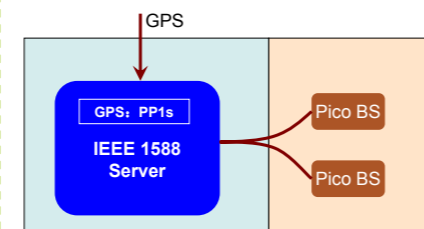

Figure 1 Working mode of IEEE1588 server

In case of the sporadic deployment of Pico BS/Femto, high precision indoor GPS scheme can be used for time synchronization. The receiving sensitivity of high sensitivity GPS receiver can reach -160dBm. Therefore, using indoor GPS antenna can ensure that the synchronized signals outputted from GPS can meet WiMAX system requirements, while a normal GPS receiver has a receiving sensitivity of only -143dBm, requiring outdoor GPS antenna to secure its performance.

In addition, ZTE's Pico BS for indoor coverage can support flexible subcarrier distribution and networking mode, FFR technology, adjacent signal measurement as well as frequency justification and optimization to minimize the interference in indoor coverage. These enhanced technologies effectively remedy the inherent deficiency of indoor conditions and bring great gain to coverage performance.

II. Adjustable solutions, rapid profit-making

The second difficulty faced by indoor coverage is how to solve the backhaul problem of R6 interface, and provide a cost-effective and fast deployment solution. Existing indoor transmission resources have two features: diversity and limitedness. Different operators have different indoor transmission resources, but to a specific application, the resource is mostly limited. For a fixed network operator, Ethernet or optical fiber resources are normally available in the building; for a cable operator, normally only cable resources are available in the building; for an emerging operator, wired resources are largely unavailable within the last mile, so as in the building; for a traditional

2G/3G mobile operator, it depends: in a better condition, some transmission resources such as FE and E1/T1 may be available, while in a worse condition, the transmission resources may be far from meeting WiMAX data transmission requirement.

For the difficulties mentioned above, ZTE has given a flexible and fast solution. For fixed network and cable operators, they can make the most of existing DSL, Ethernet, optical fiber and cable resources, with equipment directly integrating corresponding transmission interfaces thus achieving flexible deployment and capacity expansion. For some historical buildings or those that do not allow wall penetrating and rewiring, ZTE uses broadband power line (BPL) technology where ubiquitous power lines are used as plug-and-play transmission media, remarkably shortening network construction period, reducing construction cost, and allowing the operator to make profit rapidly. Besides the reduction of OPEX in the initial networking period, ZTE also helps the WiMAX operator to effectively reduce CAPEX through unified network management and charging.

III. Success stories in the high-end market

KT in South Korea, Sprint-Clearwire in USA and KDDI (UQC) in Japan are three major pioneers in WiMAX industry. Their development modes and successes serve as models for and are decisive to the whole WiMAX industry. From 2007, ZTE has successively entered Sprint in USA and UQC in Japan, starting its success stories in the high-end market.

The world's first WiMAX commercial

network by Sprint-Clearwire, a top operator in USA, will greatly influence global WiMAX industry. ZTE WiMAX's indoor coverage system equipment have successfully entered into Sprint-Clearwire and is now working together with U.S. biggest enterprise solution pioneer to form the WiMAX enterprise solution industry model. On the Christmas eve of 2008, all test items of Pico BS were passed at Sprint Pico trial.

UQC, a major WiMAX operator in Japan, has put lots of attention in indoor coverage with planning more than 9000 Pico BSs in 2009 and 19000 Pico BSs in 2010 to enhance coverage not only for outdoor scenario but also indoor scenario. ZTE, as a leader in this field, has started coorporation with UQ since 2008 and its advancement has won high credit from customers by successfully gaining the LOI lately.

Conclusion

Due to the characteristics of WiMAX technology and service, WiMAX network is totally different from 2G/3G network using outdoor first and then indoor deployment mode. WiMAX can realize indoor and outdoor deployment simultaneously, or first starts from hotspot and indoor coverage then to the whole metropolitan area network, wide area network and even the nationwide network. In all, for WiMAX, indoor coverage is more important.

ZTE is willing to work with operators to technically break the restriction of traditional indoor deployment, and use feasible engineering deployment schemes to reduce indoor coverage cost, expedite networking and help operators to get 'maximum' success in 'small' indoor coverage world.

Broaden Your Horizon by Wireless Network

——A Solution to Video Surveillance

Zhang Jun

No.	Name	Advantage	Disadvantage
1	Microwave transmission	Proven technology and large coverage	High cost for point-to-point transmission, only capable of transmitting in line of sight, not movable, high cost for each transmission link and future upgrade
2	LMDS/MMDS	Capable of point-to-multi-point transmission.	Not movable, incomplete system architecture, high cost since before the industrial chain has not been formed
3	WiFi	Easy installation, high throughput and inexpensive equipment.	Short transmission distance of less than 300 ft., use unlicensed frequency band, not movable, incomplete QoS framework and billing mechanism
4	2.5G/3G	Large network coverage and mobile	Low throughput and incapable to support the transmission of HD monitoring images

Table 1 Deficiencies of existing wireless monitoring methods

I. WiMAX – a technology more suitable for wireless video surveillance

According to the requirement for transmission media in video surveillance, the bandwidth is the most important bottleneck. Other factors include coverage, cost and capability of point-to-multi-point communication.

With further analysis, the transmission technologies mentioned previously have more or less deficiencies in bandwidth, coverage, multi-point transmission capabilities and cost. Therefore it is impossible to carry out large-scale video surveillance business with wireless video surveillance system that adopts these technologies as transmission media.

However, we can see in Table 2 that WiMAX can offer a throughput of tens of mega-bits per second with similar coverage as that of 3G. The mechanism that assures five QoS guarantees more reliable performance of video surveillance service. Its capabilities to provide mobility and multi-user access make a perfect technical foundation to develop video surveillance business.

Technical Analysis	Analysis on Cost Advantage
Throughput	In OFDMA, can reach 45 Mbps with 10MHz of bandwidth
Coverage	The ZTE WiMAX system can cover an ultra long distance of more than 19 km. The enhancement of coverage can further reduce the cost of the construction of video surveillance system.
Multipoint Access	Single sector is capable of supporing more users to reduce the investment in equipment and benefit from the reuse of resources and the benefit of large scale.
Cost	WiMAX is a technology with international standard, has incubated a large-scale industrial chain to operate under low cost.

Table 2 Analysis of the advantages of WiMAX technology to video surveillance business

A long with the intensifying competition in the market, the telecom operators are trying to extend their businesses into other derivative services from traditional voice and data services, in order to expand the scope of business and strengthen their competitive edge. The video surveillance service gradually becomes a key business to compete with for operators because it is widely used in different scenarios like education, government administration, water conservancy and power supply, oilfield exploration, military affairs, family affairs, urban traffic, community security, hotel management, sports and tourism as a solution of security, management and monitoring.

The deployment of traditional wired video surveillance system has many difficulties. For example, it costs a lot and takes a long time to lay cables in the traditional way as the points to be monitored are scattered and located far away from the master control center. Also it is hard to perform cabling work in the areas where mountains or rivers stand in the way. These problems have greatly impeded the development of video surveillance business.

The wireless transmission is bound to become a major transmission mode in the future. In wireless monitoring system, the wireless network generally acts as a data transmission link between monitoring points and the master control center that allows devices at remote monitoring points to transmit video signal through. As the video surveillance system requires high quality video images, how to ensure the transmission of high quality video in a stable manner in the wireless network becomes one of the key points for wireless monitoring system.

Currently the technologies such as microwave transmission, WiFi and CDMA-based 3G technologies (WCDMA, CDMA2000 and TD-SCDMA) are playing a leading role in the monitoring system. However, WiFi is apparently inefficient in wireless coverage of a large area though it has significant throughput. The microwave transmission has limited capacity because it can only be used in point-to-point control. Other 3G technologies are notably incapable to ensure the transmission of HD monitoring images which demands high throughput. For the details of comparison between different technologies, see Table 1 (deficiencies of existing wireless monitoring methods).

We can conclude by a general comparative analysis that the use of WiMAX as access method can reduce the cost of the construction of wired transmission system. User can perform video surveillance in a mobile vehicle. The soloution is scalable and easy to adjust. It can save the time, labor and engineering costs related to the deployment of the network cables.

The microwave transmission is more complicated than other traditional wireless monitoring technologies. It can only support point-to-point transmission in line of sight and it has to be fixed. WiFi transmits signals in a short distance. It is fixed and lack of a complete QoS mechanism. CDMA/WCDMA are inefficient in performing large scale HD monitoring because they are short in frequency spectrum effectiveness and data throughput. Therefore, WiMAX is more suitable for mobile video surveillance than the aforesaid wireless technologies.

II. Cost-effective Highly Integrated Terminal

The most workload is on the civil works of the monitoring points in the project of video surveillance. Also most of the investment is spent on the front-end equipments of the monitoring system. Usually the WiMAX wireless monitoring system consists of camera, encoder and WiMAX CPE at the monitoring point and base station at the master control center. The camera, encoder and CPE together constitute the front-end equipment in the monitoring system as indicated in Figure 1.
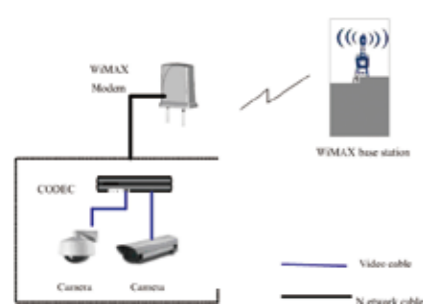
Figure 1 Diagram of the traditional WiMAX wireless monitoring system

The front-end equipment of this monitoring mode consists of camera, encoder and wireless transmission devices. They need to be installed separately at monitoring points, which will generate high cost for engineering works. Furthermore, the system is unreliable. It is complicated to maintain and the diagnosis is difficult when the system failure happens.

Therefore, the trend is to adopt integrated monitoring terminals in wireless monitoring system. The separated monitoring front-end equipment is considered only in some rare circumstances. The integrated monitoring terminal consists of the camera, encoder and transmission devices together. Its reduced size helps to save room and labor cost, and facilitates centralized management. Furthermore, the highly integrated equipment can be very cheap.

The integrated WiMAX monitoring camera MI100 of ZTE is shown in Figure 2. As an advanced monitoring terminal in the industry it is highly integrated, handy and extremely cost-effective.

Figure 2 ZTE WiMAX MI100 integrated video surveillance terminal

III. Complete Accreditation Billing Platform, a guarantee for scale operation

A powerful operation platform is the key to promote the civilian use of video surveillance and extend its application from specialized networks to public networks. ZTE has merged the operation and management platforms of video surveillance and WiMAX systems in order to realize unified management, billing and network administration.

The powerful business management system can facilitate massive user access, service access, user and service authentication management, tariff management, access control and alarm management. The system is also versatile in data collection and statistics to satisfy the needs of various applications that run on the platform. This can help to avoid double investment on management platforms in traditional solutions. The system also has interface to support various types of operational supporting system. The accounting module supports full functionality of pre-payment, post-payment and payment by card and can interface well with the billing system. A unified network management platform provides support to automated process management. It supports not only the protocols like SNMP but also the latest terminal management protocol TR069 to enable unified network management of the streaming media server, the disk storage system, the PU device and CU device that are involved in the video surveillance operation. The system can be integrated into the existing unified network management platform of telecommunication operators to achieve unified management. The PU/CU devices of the video surveillance system have intelligence and their

configuration and control are complex. Installed scattered with large quantity at the outdoor monitoring points or next to the users, an efficient method is necessary in order to facilitate the management of terminals. The network management system "Network Video" can manage and maintain efficiently and promptly PU/CU with the network management protocol TR069. Extensive management measures help to transform from pure equipment management to business management.

IV. Extensible Scalable Network Structure Topology to Facilitate Flexible Network Deployment

Since the front-end monitoring points are always expanding, we have to install the front-end devices whenever a new monitoring point is added. But the master control center expands only when the number of monitoring points reaches certain threshold. For example, a master control center does not need to be expanded until another 8 or 16 monitoring points are added. Therefore, it is necessary to take the network layer into consideration. The expansion of each network layer needs to be modularized.

Operatable network structure

The system design of ZTE WiMAX based on end-to-end video surveillance solution follows the philosophy described previously. As shown in Figure 3, the whole network is divided into supporting layer, media exchange layer and user device layer (front-end and user-side).
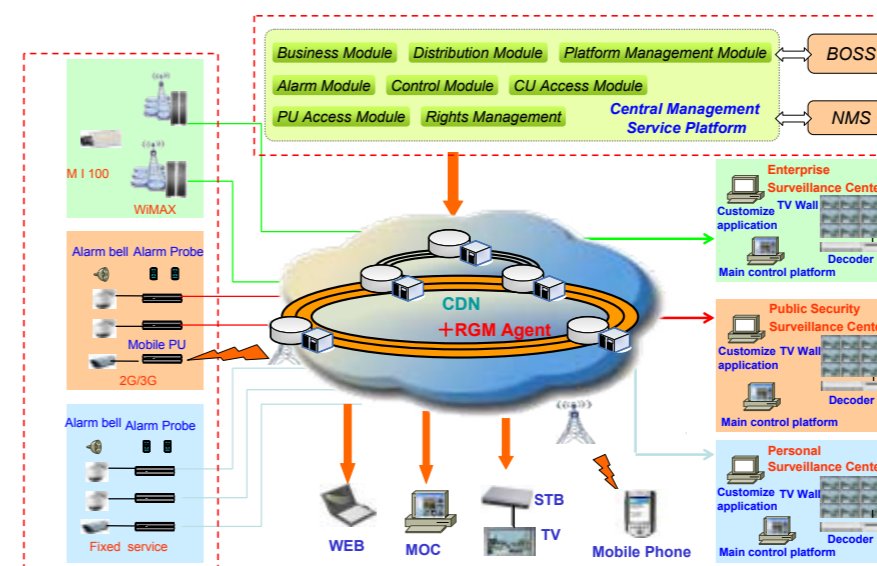

Figure 3 ZTE WiMAX video surveillance system

The supporting layer can be set up all at once and its service can not be opened to the public until it gets powerful operation management capabilities. The supporting layer of Wi-Eye system is composed of the management platform of video surveillance service and operation supporting system. The major modules include operation platform and equipment management platform that performs equipment management and control, alarm, dispatch, access authentication and network management.

The media exchange layer consists of media distribution network. It works as a media distributor and network storage manager. The ZTE wireless video surveillance solution has distributed architecture. The solution provides the forwarding, distribution and storage of the monitoring media, the processing and control of monitoring video, and it support access-on-need of different users. The quantity of network elements in media exchange layer can be expanded at certain scale and the modification will not affect the operation support layer and the user equipment layer.

The user equipment layer is composed of PU front-end and CU client equipments which are located at the monitoring point of the user and the master control center respectively. The user can realize the image upload from the monitoring points by PU front-end equipment and real time monitoring and background control of every monitoring point by CU client.

Layered expansion method

The ZTE Wi-Eye video surveillance system can be deployed in a distributed way. The system expansion and upgrade are smooth. The design of distribution network is hierarchical and distributed. It builds a forwarding network by deploying the streaming media servers in different layers. Followed by the expansion of monitoring application, two methods are supported

■ Increase the stream capability of individual node, increase the capability to support more concurrent streams by adding extra stream media servers.

■ Increase the number of nodes to expand the stream concurrent capacity

of the whole system, for areas where the number of the users increase rapidly, increase the number of node at edge to achieve linear increase of various demands

The distributed configuration of business operation platform can realize smooth expansion of registered management modules in response to the growth of the system size and applications.

In both expansion methods, the stream service, the storage equipment, the PU front-end and the CU client can each expand its capacity in every possible way without restructuring the original system to ensure the smooth progress of the business.

The wireless network monitoring system adopting WiMAX wireless transmission technology can better share the transmission line in order to combine adequately the special and public networks. It can generate great business opportunities to operators by introducing video surveillance to civilian applications while bringing down the application cost of the special networks.

Conclusion

The WiMAX-based end-to-end wireless video surveillance solution of ZTE combines the advantages of the monitoring system (including different aspects of the platform) and that of WiMAX technology. Four advantages of the solution are cost-effective, high quality, easy to operate and manage. Without sacrificing the monitoring performance the solution can reduce the operation cost and make the system easier to operate at the same time.

Recent Progress of WiMAX Standards

Liu Yang, Chu Li

Nowadays, there are two WiMAX-related standardization organizations: IEEE 802.16 Working Group and WiMAX Forum. The IEEE802.16 Working Group aims to create standards for broadband wireless access, while the WiMAX Forum is an industry-led non-profitable organization committed to promoting and certifying interoperable WiMAX products.

As the first company to put forward the concept of carrier-grade WiMAX network, ZTE has always been devoting itself to the development of WiMAX standards. The company has already submitted more than 400 proposals to the IEEE 802.16 Working Group covering control channel, frame structure, multi-hop relay, Femto Base Station (BS), mobility management, etc. Additionally, as one of 15 board members of the WiMAX Forum, ZTE has submitted over 200 proposals to the forum involving hot topics such as MultiCast BroadCast Service (MCBCS), Emergency Service (ES), IP Multi-media Subsystem (IMS), Policy and Charge Control (PCC), and Simple IP.

Due to their outstanding contribution to the setting of WiMAX standards, many experts from ZTE are honored to lead the standardization process. Among them, Tricci So is elected as Chairman of the MCBCS Working Group in the WiMAX Forum; Jerry Chow is invited to be Chairman of the IEEE 802.16m E-MBS Rapporteur Group; Mary Chion is appointed as Chairman of the IEEE 802.16m Handoff E-MBS Rapporteur Group.

MCBCS

The unicast network offers personalized contents to end users on a one-to-one basis, with each user occupying independent spectrum and network resource. However, this resource could be shared by all users when the same content is delivered. MCBCS can effectively utilize the limited resources to broadcast the same content to multiple users. Mobile TV is a typical application of MCBCS. As the spectrum resource is limited, and most of the users' requirements can be classified, MCBCS is receiving increasing attention in the industry.

At present, a MCBCS subgroup has been established in the Network Working Group (NGW) Release 1.5 of the WiMAX Forum and it plans to finish the related standardization work in two phases. Broadcast and static multicast service will be provided in the first phase and dynamic multicast service will be supported in the second phase. The basic technical documents of the first phase have been finished, which specifies the MCBCS network architecture, service initiation, service setup/release procedures, mobility management, power saving support, data transmission, and data synchronization. They are in the Verification and Validation (V&V) comments resolution process and will be released in the Q1 of 2009.

Being the leader of the MCBCS subgroup, ZTE has been undertaking great responsibilities and has submitted proposals covering almost all key technical points. Despite of the fierce arguments and a wide divergence of views from different operators and equipment vendors, ZTE managed to bring different opinions into agreement and keep the standardization work on schedule.

Multi-Hop Relay

All BSs of current wireless communications system need the support of fixed lines, and their coverage is relatively fixed. Because of the barriers on the transmission routes or long distance transmission, blind areas or edge areas with serious signal attenuation are formed. To expand the coverage and improve the service quality for the edge users, the IEEE 802.16 Working Group proposes the multi-hop relay technology, in which one or more wireless Relay Stations (RSs) are added into the system to decode or demodulate the received signals into source signals for storage and processing. After being coded and modulated, the source signals are sent to the receiver.

The IEEE 802.16 Working Group has two subgroups related to multi-hop relay: Relay Task Group (RTG) and IEEE 802.16m Task Group (TGm). RTG aims to develop IEEE 802.16j standards, hoping to introduce the multi-hop relay technology based on IEEE 802.16e standards. The IEEE 802.16j D8 is currently under sponsor ballot and the IEEE 802.16j D9, which will be finished in February 2009, will integrate the IEEE 802.16e to form a complete IEEE 802.16 Rev2 standard. The objective of TGm is to provide higher mobility and transmission rate to fulfill the IMT-Advanced requirements. A Relay Rapporteur Group is established in TGm to draft system description related to the IEEE 802.16m multi-hop relay.

The system topology will be changed due to the adding of wireless RSs. Therefore, it is necessary to intelligently adjust the topological

relation and configuration between the RSs and BSs. Specifically, the impact on the system from connection, release and handoff of the RSs should be taken into consideration, and full use of the RSs should be made to improve data transmission efficiency. For example, when a RS performs handoff from the serving BS to a target BS, it must allow its connected RSs or mobile terminals to be handoffed first to the target BS. Another case is that the BS must inform the RS to transmit the corresponding data delay so that it can transmit MCBCS data synchronously with the BS. One more example is that the RS can directly forward data for transmission between its connected two mobile terminals without transmitting them to the BS, which improves data transmission efficiency.

ZTE has submitted more than 20 relay-related proposals to RTG and TGm, with content covering data transmission methods, MCBCS, relay data format, as well as connection, release and handoff of the RSs.

Femto BS

Beside the above-mentioned wireless RSs, Femto BS with a coverage radius of tens of meters can be installed indoors to enjoy high speed access and seamless coverage. The introduction of Femto improves system capacity based on the existing spectrum resource.

The IEEE 802.16m Task Group has also set up a Femto BS Rapporteur Group to specify the related system description including definition, handoff, paging, power saving and Ad hoc of the Femto BS.

Because there is a large number of Femto BSs used, it is unnecessary or impossible for users to access each Femto BS. Therefore, the Femo BSs must be quickly identified by users for accessibility. The Task Group agrees that the Femto BSs could be categorized into two different types. One type is accessible only to authorized users and the other type is accessible to all users.

Accordingly, technologies related to the BSs should be changed based on the Femto BS features. For example, when a user performs handoff from an ordinary Macro BS to a Femto BS, it is necessary to adopt a customized neighbor BS list including accessible BSs for scanning. In the IEEE802.16e standards, if an idle user needs to be awakened, it is necessary to send paging commands to all Macro BSs related to the user; however, if the idle user is in the Femto BS, the paging commands can be sent inside the Femto BS to save the overhead by using the feature of slow speed of user movement. Moreover, as there are few Femto BS users, Femto BS may work in a power saving status when no user is accessed or activated, which reduces the transmission power and hence reduces system interference.

ZTE has submitted more than 10 proposals to the Femto BS Rapporteur Group, covering definition, handoff, paging, and power saving of Femto BS.

Frame Structure

The format for a resource allocation unit is defined by frame structure, which is one of the most basic technical features in telecommunications system. In specifying the frame structure, the IEEE 802.16m Task Group should take into consideration the backward compatibility of 16m and 16e, the decrease of signaling overhead and transmission delay, and the coexistence with other TDD systems. Three things have been preliminarily determined: the TDD mode is adopted for backward compatibility of 16m and 16e; the concept of Superframe or Miniframe combined with new control channel and synchronous sequence is adopted to reduce signaling overhead; and the rapid feedback and the additional uplink/downlink switch points are adopted to reduce transmission delay.

For the issues concerning low spectrum efficiency in the present 16e system and poor compatibility and scalability between different bandwidths, ZTE put forward its innovative design of frame structure that allows backward compatibility with existing systems while improving spectrum efficiency and ensuring system scalability. Moreover, the frame structure can maximally reduce interference when coexisting with other TDD systems.

Conclusion

Technical standards are of great importance for product commercialization. Higher speed and mobility are the development trends of WiMAX standards. ZTE has always been committed to promoting WiMAX standardization work from the perspective of industry chain, and will certainly make greater contribution to the progress of WiMAX products and standards.

E9230, A New Orientation for WiMAX Base Stations

Chen Min and Li Lilin

O perator A is deploying a 2.3G WiMAX network with the plan to conduct supplemental coverage for hotspot and blind spot areas in dense urban areas. If traditional base stations are used, it is difficult to select sites in a city with high land price. Progress of network deployment will be slow and high rent further increases the network operation cost.

Operator B has long been operating GSM network and recently got the license for 2.5G WiMAX. The operator wants to share the existing infrastructure as much as possible, such as stations, power supplies and transmission, in order to save the network cost while accelerating the network deployment.

Operator C plans to build rural network with WiMAX technology. If the network is built in the way as traditional network did, start with the proper selection of station sites,

then the construction of standard machine rooms/iron towers, followed by conditioning/storage battery and other supporting facilities, the long duration of network construction and high deployment cost will remarkably extend the investment recovery period. Plus, many remote areas cannot afford to satisfy the strict requirements for site installation.

Operator D is deploying a 3.5G wireless broadband network and conducting discontinuous coverage for key areas. Cost is the major concern in this case compared with 802.16d network.

At this moment, a compact WiMAX base station E9230, the latest base station released by ZTE, attracts their eyeballs.

Networking Difficulty Readily Solved

To promote WiMAX technology in an increasingly competitive wireless communication market, the rapid network deployment with low dependency to the environmental is the key that leads to the success. A flexible and light outdoor integrated station is a perfect choice. However, the adoption of MIMO and other multi-antenna technologies in WiMAX system brings high transmission power and complex baseband processing. To satisfy the same capacity requirement, the equipment size and power consumption become inevitable challenges to the design of an integrated and compact outdoor WiMAX base station.

As the leader in WiMAX industry ZTE has rich wireless communication R&D experiences in GSM, UMTS, CDMA, TD-SCDMA and other systems. By taking into account the customers' needs in service, capacity, coverage, transmission, power supply,

installation and maintenance, etc., ZTE overcomes the difficulties launched customized E9230 compact base station which include various advanced technologies such as the improvement of power amplifier efficiency, highly integrated lower power consumption board design and natural cooling design.

E9230's overall dimensions are 370×320×165mm (H×W×D), with a volume of only 18.5 liter and a weight of less than 15 kg. The outdoor installation of the station can be on pole, on tower or wall mounted. A single station can support 2C1S configuration with a maximum transmission power of 2*10W. It is cooled naturally with an overall power consumption of less than 210W. These absolute advantages make E9230 to be the focus of the industry after its release.

E9230 is the smallest and the lightest among other products in its category without sacrifysing its capacity, transmission power and overall power consumption. With integrated design, flexible installation mode and natural cooling the headaches of Operators A, B, C and D can be releaved easily by. E9230 starts a new era of site construction with zero-footprint. It helps operators to build networks rapidly, operate and maintain them easily.

Customized Design Brings Surprises

Customized design has brought E9230 operators a lot of surprises:

Flexible networking

Each E9230 supports three electrical interfaces and one optical interface configuration, satisfying both the requirements for short distance

electrical interface transmission media and low cost, and over-100m long distance applications through optical interface. Through the cascade configuration of R6 interface, it can support star or daisy chain networking, thus reducing switch configuration, configuration cost and installation space.

Clock concatenation supported

It is applicable that 3 E9230's share one GPS receiver to reduce deployment and installation costs, and save installation time.

Adaptation to diversified harsh environment

It supports IP65 level of protection, adapts to harsh weather and electromagnetic environment, securing cost-effective and efficient networking.

Green base station

E9230 uses highly integrated configuration mode, has ultra low power consumption, saves energy and is environmentally friendly, being a truly green base station. Under 2C3S configuration, it reduces power consumption by over 40% as compared with other WiMAX products.

Conclusion

ZTE E9230 compact base station can be flexibly and easily used for total network coverage, supplemental coverage for hotspots and blind spots, rural network, radio broadband network and other scenarios, started a new era of WiMAX network featuring zero footprint and the absence of site. E9230 will surely become a new orientation for WiMAX base stations, allowing operators to achieve rapid deployment, reduce networking cost, and achieve easy operation and maintenance and maximum value.

ZTE WiMAX Insight

R9110, A Sharp Problem-Solver for Operators

Su Guojun

A telecom operator in CIS (Commonwealth of Independent States) currently has two bands of spectrum resources, 3400-3415 MHz and 3500-3515MHz. The operator plans to build WiMAX network to provide wireless broadband access service. The initial plan is to cover some rural areas and a 20km² area in the center of its capital. The networking idea is to make the most of its spectrum resources and maximize spectrum use while minimizing the number of base stations so as to reduce entire TCO.

The way how to make the most of

spectrum efficiency and minimize the number of base stations has become a big concern for this operator. The two frequency bands they owned, 3400-3415MHz and 3500-3515MHz, are typical 3.5G bands with an interval of 100 MHz between them. The way to use this 30MHz spectrum resource simultaneously is one of this operator's puzzles. On the other hand, since its coverage includes some rural areas and a 20km² downtown area, the way to minimize the number of stations while fulfilling the coverage is another issue faced by the operator.

spectrum resources

3400-3415MHz and 3500-3515MHz, the two bands of spectrum resources owned by the operator, have a bandwidth interval of 100MHz between them, having the characteristics of typical 3.5G FDD spectrum, as shown in Figure 1.

Figure 1 Spectrum resources owned by the operator

How to make the most of

To make the most of spectrum resources, these two bands of discontinuous spectrum shall be used simultaneously upon networking. In a specific networking scenario, if the RRU chosen by the operator can only support single carrier configuration or continuous multi-carrier configuration, then 2 RRUs are required to use combined cabinet mode to make the most of these two bands of spectrum resources; on the contrary, if the RRU chosen by the operator can support discontinuous multi-carrier configuration, using just one RRU can make the most of these two bands of spectrum resources, thus reducing the number of RRUs and remarkably reducing the operator's TCO.

ZTE WiMAX R9110 can support discontinuous multi-carrier 2T4R MIMO configuration, allow the operator to make the most of existing frequency resources at minimum cost, successfully maximizing its spectrum use.

How to reduce the number of base stations

To reduce the number of base stations, in terms of link budget, uplink/downlink channel quality shall be maximally improved to maximally improve uplink/downlink coverage and expand the covered distance of base stations, so as to reduce the number of base stations.

In the WiMAX system, normally uplink coverage is restricted. By using multiple antenna for reception on base station, uplink channel quality can be remarkably improved, so as to improve uplink coverage. As the link emulation result shows, an improvement by a gain of 3-4dB can be seen between 4-antenna receiving diversity and 2-antenna receiving diversity, while between 8-antenna receiving diversity and 4-antenna receiving diversity,

there is an improvement by at least a gain of over 2dB. Meanwhile, using Beamforming technology on the downlink, base stations can aim lobe at target subscribers, and nulls at other subscribers, thus remarkably improving the link quality of subscribers at the edge of a cell. As compared against 2-antenna MIMO technology, 4-antenna BF technology can improve downlink gain by over 2-3 dB, and the radius of base single station coverage can be expanded by about 30%, thus remarkably reducing the number of base stations in the whole network.

In terms of the operator's expectation to reduce the number of stations, we have the following comparative analysis: To cover an area of 20 sq km

	DL Traffic	UL Traffic	DL MAP	Sites Number	Sites Number Saving(based on 2T2R-3 sec)	Sites Number Saving(based on 2T4R-3 sec)
2T2R-RRU	139.03	132.52	140.97	59	0.00%	/
2T4R-RRU	139.03	137.32	140.97	30	49.20%	0.00%
4T8R-RRU	141.48	141.02	141.92	18	69.50%	40.00%

Table 1 Analysis of 4T8R BF@RRU, 2T2R MIMO@RRU and 2T4R MIMO@RRU

Figure 2 Numbers of stations required for 4T8R BF, 2T2R MIMO and 2T4R MIMO configuration

ZTE WiMAX R9110 can support single carrier and continuous multi-carrier 4T8R BF configuration, and remarkably reduce the number of base stations, so as to heavily reduce the operator's networking and maintenance cost and save its TCO.

Conclusion

R9110 launched by ZTE WiMAX

in the center of the capital, if the RRU chosen by the operator can support 4T8R BF configuration, then only 18 base stations are required to meet the coverage requirement. Comparatively, if the RRU chosen by the operator can only support 2T2R MIMO configuration, then the number of required base stations is 59; and if the RRU chosen by the operator can only support 2T4R MIMO configuration, then the number is 30. Therefore, to cover the same area, the number of stations required for the RRU supporting 4T8R BF configuration is 69.5% less than that required for the RRU supporting 2T2R MIMO configuration, and 40% less than that required for the RRU supporting 2T4R MIMO configuration.

product line is the first intelligent multi-antenna RRU in the industry, supporting both 4T8R BF featuring single carrier and continuous multi-carrier, and 2T4R MIMO configuration featuring discontinuous multi-carrier. It is applicable to large capacity and macro coverage areas, featuring long coverage distance, adaptation to diversified frequency ranges, easy and flexible networking. It can help the operator to make the most of existing frequency resources, maximize the use of frequency resources, and remarkably reduce the number of base stations for cost-effective operation.

ZTE WiMAX Insight

I. Overview

According to WiMAX Forum, there are 455 WiMAX networks put into business operation in 135 countries around the world, and many countries will issue the licenses of WiMAX. As the bandwidth of the license for WiMAX issued by each country is different, some licenses comprise broad bandwidth resources. For example, Sweden issued TDD frequency points of 50 MHz in the frequency band of 2.5

Han Gang

Analysis of WiMAX FFR

GHz and Japan issued the licenses for the bandwidth of 30MHz, but some licenses issued by some countries contain limited bandwidth resources. For example, the license issued by India contains a bandwidth of 20MHz and an operator of Singapore has only a bandwidth of 12MHz. As the narrow bandwidth resource of WiMAX is limited, the operators expect ZTE to provide a solution which can best utilize the frequency resources and provide mobile cellular network with best capacity and coverage.

The limited frequencies resources will result in inter cell interference (ICI) which is an inherent problem of mobile cellular telecommunication system and an inevitable outcome of frequency reuse. Like other cellular telecommunication systems, the frequency reuse mode and frequency of mobile WiMAX has to be determined in the stage of network plan.

In mobile cellular system, the frequency reuse mode is defined as (C×N×S), of which C stands for the number of the base sites, N stands for total number of the channels (or channel group) where the frequency is reused and S stands for the number of the sector of each base site. When the operators have rich resources of WiMAX, their major frequency reuse mode is 3 (1×3×3) or 6 (2×6×3) . When there is limited resource of frequency, i.e. only one of 10 MHz, the cellular networks are formed in the following ways:
- *Co-channel network deployment, 1×1×3*
- *PUSC 3 Segment, 1×3Segment×3*
- *Fractional Frequency Reuse (FFR)*

In 1×1×3 mode networking, it has too much interference at the boundary of the cell. In PUSC 3 Segment mode networking, it is hard to ensure a certain throughput because it is inefficient in using the frequency

spectrum.

However, FFR can meet the requirement for both coverage and capacity. The following is the analysis of the WiMAX FFR of ZTE.

II. Fractional Frequency Reuse (FFR)

Fractional Frequency Reuse (FFR) is a technology that adopts different frequency reuse coefficient in different reuse groups. If the terminal is suitable to work in the condition where the reuse coefficient is 3, the reuse factor with coefficient 3 is provided for such terminal. If the terminal is suitable to work in the condition where the reuse coefficient is 1, the reuse factor with coefficient 1 is provided for such terminal. More flexible approach is to control all the sub-carrier groups with different transmission power to coordinate different cells radius. FFR can be realized in static mode and dynamic mode. In static mode, the frequency coefficient used by the terminal, which is associated with the terminal location, is relatively regular. When the terminal measures the interference in the adjacent downlink cell (sector) and reports the result to the base site, the base station shall allocate appropriate frequency coefficient to such terminal in response to the interference. The problem with the static mode approach is that it is not capable of dealing with different conditions in various deployment sites and business flow distribution because each reuse group has definite number of sub-carriers. In this case, the dynamic mode of FFR shall be used. That is to say the reuse group where the terminal locates is Continuously updated. Such dynamic dispatch gives general considerations to the QoS requirement of the clients, the avoidance of inter cell interference and the principle of equity. Dynamic FFR

is rather a complicated technology because it requires that the base station obtain the channel quality information of each reuse group in a timely manner.
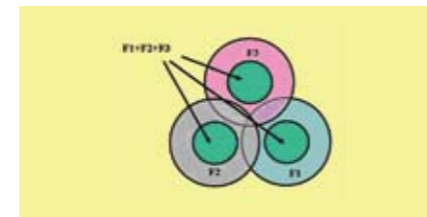

Figure 1 Fractional Frequency Reuse

The figure above is a typical FFR mode, in which F1, F2 and F3 stands for the subsets of different sub-channels respectively in the same frequency. In such frequency configuration, the users at the center of the sector adopt the reuse factor 1 to maximize the spectrum efficiency and the users at the boundary of the sector adopt the reuse factor 3 to ensure the quality of service and throughput. The system that uses FFR aims at achieving a better overall spectrum efficiency than that of reuse coefficient 1 and reuse coefficient 3.

FFR aims at reducing interference and improve the SNR of the signal by effectively allocating the system resources and reduce the time and frequency interference of the resources used at the boundary between adjacent cells so as to improve the service at the boundary of the cells in the system and even the service of the whole system.

III. Solution of ZTE WiMAX FFR

Solution of ZTE WiMAX FFR is focused on two approaches, namely frequency division FFR and time division FFR, as described below:

■ *Frequency division FFR*

In frequency division FFR, the

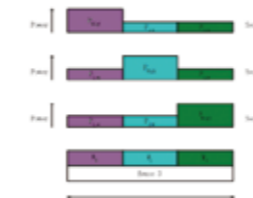frequency resources are divided as follows:

Figure 2 Division of Frequency Resources of frequency division FFR

In frequency division FFR, the frequency resources are divided into a reuse set named reuse 3 including sub-band W1, W2 and W3. The adjacent sector 1, sector 2 and sector 3 respectively select W1,W2 and W3 in reuse 3 and are transmitted with high power Phigh, and the other two sub-bands are transmitted with lower power Plow .

Figure 3 The frequency resources allocation

The frequency resources allocation in adjacent sectors in frequency division FFR is indicated in the figure above, in which each sector is divided into inner ring section and outer ring section before allocating the sub-band resources corresponding to Phigh in Reuse 3 to the outer ring section and finally allocating the sub-band resources corresponding to Plow in Reuse 3 to the outer ring section. In frequency division FFR, the base station shall distinguish the users of the inner ring section from those of the outer ring section by the SINR value reported by the users.

■ *The time division FFR*

The time-frequency resources division in the time division FFR is indicated in the figure below, in which the down-link sub-frame supports two Zones. One is PUSC 1/3 and the other

is PUSC all. The users at the center of the cell are dispatched at PUSC all and the users at the boundary of the cell are dispatched at PUSC 1/3. Therefore, the network deployment of single frequency point can be used to improve the frequency spectrum efficiency to some extent.
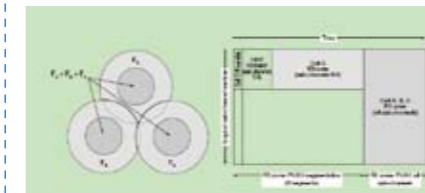

Figure 4 The time frequency resources allocation in the time division FFR

In the time division FFR, the time frequency resources are divided into Reuse3Zone and Reuse1Zone. Reuse1Zone uses the mode of PUSC all sub-channels and the adjacent Cell A, Cell B and Cell C and use Reuse1Zone, while Reuse3Zone uses segment network deployment of PUSC, where the frequency resources of Reuse1Zone allocated by the adjacent Cell A, Cell B and Cell C are orthogonal to each other.

The transmission power of the sub-carrier of Reuse3Zone shall be notably higher than that of Reuse1Zone. Like frequency division FFR, the base station shall distinguish the users of the inner ring section from those of the outer ring section by the SINR value reported by the users.

IV. Analysis of FFR Performance

The FFR achieved the network deployment with frequency coefficient 1. The result of emulation and test has showed that the solution of ZTE WiMAX FFR is better than the network deployment of 1×1×3 and 1×3Segment×3 in the following ways:

- *The time division FFR has the same coverage as that of 1×3Segment×3.*
- *The frequency division FFR is better than the network deployment of 1×1×3 in coverage, but not as good as the network deployment of 1×3Segment×3. As the transmission power of the inner ring significantly decreases, the coverage of frequency division FFR will be the same as that of the network deployment of 1×3Segment×3.*
- *In the mode of the time division FFR and the frequency division FFR, the overall frequency spectrum efficiency is higher than that of the network deployment of 1×3Segment×3 and similar to that of the network deployment of 1×1×3.*

In conclusion, considering coverage and throughput, the performance of FFR is better than that of the mode of 1×3Segment×3 and 1×1×3.

Conclusion

By enabling the users of inner and outer rings to reuse different frequencies, ZTE WiMAX FFR has avoided interference, improved the performance at the boundary of the cell, achieved the network deployment of frequency reuse coefficient 1 and helped the operators improve the coverage and throughput in the conditions of limited frequency resources.

By supplying the products of high performance, ZTE WiMAX has established its position as a leader in the Industry. By 2009, ZTE has established more than 40 commercial and experimental offices for mobile WiMAX in the global market covering America, Africa, Asia and Europe. ZTE E2E WiMAX solution is the best choice of the operators.