VIP Voice

Asteo Red Neutra:
Bringing Fiber Connectivity
to Rural Spain

Executive Insights

ZTE CEO Xu Ziyang: Convergence
and Innovation—Build Phygital
DNA for Faster Growth

Special Topic
New Video Ecosystem

Cover Figure | *Pedro Abad, founder and CEO of Asteo Red Neutra*

Scan for mobile reading

CONTENTS

VIP Voice

Executive Insights

Special Topic: New Video Ecosystem

10

02

06

Success Stories

Press Clipping

35

Asteo Red Neutra:
Bringing Fiber Connectivity to Rural Spain

Reporter: José Luis Ortiz Grande

Pedro Abad, founder and CEO of Asteo Red Neutra

S pain, one of the leading pioneers of fiber-to-the-home (FTTH) in Europe, has achieved a high fiber optic penetration. However, the rural areas in Spain still have inadequate broadband connectivity, which hampers their further development. "Asteo has been born specially to support this," stated Pedro Abad, founder and CEO of Asteo Red Neutra, when discussing his company's efforts in bringing connectivity to rural Spain through FTTH services in an interview. Asteo Red Neutra is a wholesale FTTH operator that is focused on building ultra-modern FTTH and backhaul networks in rural environments.

Spain leads in FTTH deployments in Europe. What factors do you think have contributed to this significant growth?

Spain was one of the first countries that started deploying FTTH in Europe with a firm commitment to develop these networks by the main telecommunication companies and the government. This has allowed Spain to be in a quite privileged place and ranked 2nd in Europe in terms of fiber optic penetration level (73.5%) according to FTTH Council, but ranking as No. 1 country in both metrics, HP (home passed) and HC (home connected), for many years. Supportive regulation for FTTH roll outs and the flexibility that the different Public Administrations are developing, is also a key factor to speed up this technology adoption.

Another key singularity of the Spanish market is the number of registered local ISPs.

In Spain there are more than 3,500 ISP licenses registered at CNMC (Spanish regulator), around 1,500 of them are already active. Most of these 1,500 are local ones, and have performed a key role in the proximity and customer centric strategy, specially in rural environments, where these companies focus their activity and business, bringing a high quality service by all means to those communities, based on their own local fiber roll outs.

Spanish people have full confidence in fiber optic and, as soon as it is available in their homes, they do not hesitate to contract it because of all the advantages over other technologies.

From your perspective, what are the major challenges for the Spanish FTTH market, and how is Asteo addressing some of those issues?

Our market is a worldwide reference in terms of effective execution of FTTH deployments, based on the reasons explained above, and as a consequence of this, the FTTH estimated coverage at national level reaches 90%. But, if we consider just rural coverage, the data decreases down to nearly 65% (FTTH Council sourcing). So, our main challenge is to connect any municipality by fiber to secure a proper connectivity that guarantees the needed foundation for the digitalization of this rural community, a strategic pillar for its future development.

Asteo has been born specially to support this, in our phase 1 we are connecting 500 municipalities with less than 1,000 inhabitants, and for connecting them we are building more than 1,900 km of backhaul (regional fiber to interconnect all these municipalities).

And to fully support this, there is also a big challenge at the Public Administration side to optimize the current administrative processes in order to speed up the civil works permits and licenses.

At Asteo we fully believe that innovation is not just about technology, it is also about the process and way of working. We have implemented a very agile and flexible working model, where we involve any Public Administration that could affect our roll-out activities, with the aim to openly collaborate in a common goal of bringing an ultra fast broadband technology to our ultra rural municipalities areas of influence.

As a new entrant, what distinguishes you from other wholesale FTTH operators on the market?

We are the first wholesale FTTH rural operator totally focused on bringing connectivity to ultra-rural areas with a population of less than 1,000 people. In addition to providing service to citizens and businesses in the rural areas, we have another relevant feature: our 2,000 km of fiber optic backhaul that connects each of the municipalities among them. This backhaul has enough capacity to provide services to the mobile phone antennas that are deployed in these territories and that in the future will begin to offer 5G connectivity.

As mentioned before, our vision regarding innovation also includes our business model as a neutral operator that allows any telco or digital company to offer its services in these rural locations based on Asteo's state-of-the-art network based on XGSPON technology.

In a market as dynamic as the Spanish one, what is the objective of Asteo?

We are currently deploying our network in Castilla y León, specifically in Burgos, Salamanca and Segovia, and in Extremadura, specifically in Cáceres and Badajoz. The first phase of our development plan includes bringing connectivity to nearly 500 rural municipalities and 170,000 houses. We have already completed 50% of our plan and we will keep working on connecting these rural areas. In parallel we are working to incentivise the creation of new local operators in rural areas and expanding our network of authorized operators that can use our fiber optic network.

Focusing on rural environments, what difficulties have you met during your deployments and how do you solve them?

Rural deployment is clearly conditioned by the big number of different permits to execute the roll out. We are working very closely with the Administrations to speed up this process.

Also, the execution on the ground became a challenge, in particular in some areas given the orography and physical limitations. In this case, Asteo has performed a very well adapted methodology to this civil work environment that secures we can reach any of 500 planned municipalities as part of our network topology.

In a world hungry for ever-richer digital experiences, how do you support the rising expectations of operators and their customers?

When we started project planning at Asteo, we were considering the pros and cons of the different available technologies. At the end our conclusion was to focus on bringing the latest available technology to the rural and secure a future-proof network that can accommodate the increasing demand profile from the consumers without any technical risk. According to the study conducted by the "Observatorio Asteo" when a town is connected to fiber, their residents use it with high frequency everyday and this will keep growing,

Cuellar (Segovia) in Castilla y León region, where Asteo Red Neutra has deployed fiber in more than 60 small municipalities.

for example: 89% browse the Internet, 83% use e-mail, 79% use it for social networks/messaging, 68% for bank transactions, and 52% enjoy films, series or watch sports. To a lesser extent, but with significant percentages of use, are shopping online (50%), administrative procedures (40%) and listening to podcasts or radio (34%).

Also we have designed our network to be able to provide any connectivity based on high technical specs and capacities, like 5G services which mainly demand a very low latency metric and can only be supported by networks like Asteo's.

What do you think of ZTE as a partner and what's your expectations for it?

Asteo's vision is to work everyday to connect the rural to the world, and our contribution to the society is to secure that digitalization will not be limited due to digital infrastructure shortage.

The role of this network is crucial for the future development of these rural regions so we request our suppliers to be very solid, consistent, efficient and future-proof validated.

Our network must be solid, resilient and capable of guaranteeing the needs of this society today and in the future, and for this, the way in which it is built and the elements that are used are key. ZTE is a company committed to support

this mission of connecting the rural with its latest generation equipment, with XGSPON technology, and always willing to participate in any improvement initiative that we implement at Asteo.

What do you think the industry will look like in Spain in the coming years, and how will Asteo make a big difference in its growth?

Spain is on the right path in terms of increasing the fiber optic network. An important task ahead is to connect the rural areas to fiber and allow them to have the same services as in urban areas. But the focus cannot only be to develop the fiber networks. It is important to contribute to the adoption of the technology by the residents of small towns, the digitalisation of the companies and services available in these areas.

Also, the 5G roll out is the next European challenge. Based on the lessons learned from the deployment of FTTH, we cannot allow that, once again, a part of society is excluded from accessing the advances that this technology and its added services will bring.

Therefore, Asteo's backhaul network will make a key contribution to ensure that the mobile antennas distributed in the rural areas we cover have adequate connectivity capable of supporting the bandwidth needs, but especially low latency needs, which are essential for guaranteeing 5G. **ZTE TECHNOLOGIES**

ZTE CEO Xu Ziyang:

Convergence and Innovation—Build Phygital DNA for Faster Growth

Editor's Note: ZTE CEO Xu Ziyang delivered keynote speeches at the "Digital First Networks" session and the GTI Summit Shanghai. During his speeches, Mr. Xu shared ZTE's insights and practices in this digital era.

C urrently, the digital infrastructure in China, especially dual-gigabit networks and computing power, has developed into a mature phase. Consumers are shifting from voice and data communications to intelligent and integrated information services tailored to specific scenarios, such as fiber to the room (FTTR), intelligent cockpits, virtual-real fusion, and low-altitude economy. In addition, industrial digitalization has entered a crucial stage, with problems emerging from both the demand and supply sides. For example, on the demand side, there are difficulties in service integration, high management costs, and barriers to service innovations. On the supply side, how can we strike a balance between high requirements and low costs, fragmented scenarios and large-scale application, as well as heavy investments and slow monetization? The good news is, driven by such problems, we are finding a way out with technological breakthroughs and collaboration. ICT is iterating at a fast pace, with significant technological innovations occurring frequently, such as 5G-Advanced, 6G, FTTR, 400G OTN, heterogeneous computing, and modern data centers.

This is an era of data explosion, with ubiquitous but distinct requirements for data processing and circulation. As you know, ChatGPT is a heated product that has triggered the AIGC boom globally. Also, challenges are posed in addressing the slowdown of Moore's Law, closing the gap to the Shannon Limit, pursuing green and sustainable growth, and guaranteeing digital security. Against this backdrop, ZTE focuses on key underlying technologies, infrastructure, and applications, and promotes physical-digital integration, computing and network convergence (CNC), and higher efficiency of production and transaction. By doing so, we aim to build phygital DNA for faster iteration and innovation, ultimately reshaping the entire society.

As for key underlying technologies, the top priority is to achieve breakthroughs in terms of chipset, component and material, and algorithm and architecture. They are the foundation of innovation, and decide how far we can go in capability and efficiency improvement, as well as boundary extension and technology integration. In this respect, ZTE is taking firm steps and making consistent efforts, to pursue excellence even when tackling the hardest challenges.

Just like the brain of a human being or the

Xu Ziyang, Executive Director and CEO at ZTE

engine of a car, chipsets are one of the most essential underlying technologies, which directly affect the performance, integration, and power usage effectiveness (PUE) of a product. In other major fields such as computing facilities, 5G, data center switches, and terminals, there are higher expectations and requirements. Hence, we have made innovations and breakthroughs by taking various measures. For instance, advanced processes are adopted, and innovations are made in domain-specific architecture (DSA), packaging, and systemic design, to prolong the Moore's Law. Also, we introduce heterogeneous computing to match different scenarios, and therefore enhance performance and efficiency. Moreover, we achieve hardware acceleration based on DPUs and smart NICs, to constantly promote the co-optimization of software and hardware.

Innovations in components and materials, such as new power amplifiers, filters, antenna elements, and heat dissipation design, can also create huge value. Take power amplifiers as an example. Based on ETSI's standard for measuring power consumption, with a 1% increase in power amplifier efficiency, the overall energy efficiency of equipment will rise by 1–2%, which will make possible larger

bandwidth and greater transmit power of base stations. With continuous efforts in this field, ZTE has achieved a power amplifier efficiency 8% higher than the industry average. Also, we use flexible, optical backplanes for 32-dimensional optical cross-connects (OXCs) to simplify equipment architecture while greatly enhancing network capacity and performance. To extend the range and reduce the penetration loss of millimeter wave, ZTE has used reconfigurable intelligent surface (RIS), to significantly improve coverage, user experience, and deployment efficiency.

Regarding algorithm and architecture, ZTE's 5G PowerPilot solution enables the energy saving of wireless networks by 35%, and this will reduce the power consumption of a single site to as low as 5 watts in sleep mode. Based on the algorithm for dynamic collaboration between base stations and RIS, our Dynamic RIS solution increases the millimeter wave coverage by 30% and the average downlink rate by six times. What's more, our distributed database solution, GoldenDB, can raise the performance and capacity of databases tenfold, and save 70% of investments via the decoupling of hardware and software.

For infrastructure and capability enhancement, the key lies in the network,

computing power, and the convergence of computing and network.

To enhance network performance, ZTE is dedicated to providing groundbreaking products and solutions.

The upgraded UniSite solution integrates lightweight devices such as the UBR series, A+P series, and broadband antennas, making it easy to deploy multi-mode and multi-band sites.

The 5G TSN solution provides deterministic connectivity with "five 9s" availability, guaranteeing a latency of less than 5 milliseconds and a jitter within microseconds in industrial scenarios.

Our SBFD system has increased the uplink throughput to over 1.4 Gbps while reducing the end-to-end latency to 4 milliseconds for a single carrier.

Integrated sensing and communication (ISAC) base stations have boosted low-altitude economy and made smart transportation a reality.

Our RedCap technology fulfills the needs of medium- and high-speed IoT scenarios at a lower cost, greatly broadening the application scope of 5G.

The 400G OTN solution enables ultra-long-haul transmission, building the optical infrastructure for China's East-to-West Computing Resource Transfer Project.

The FTTR solution provides a whole-home gigabit-plus broadband experience for every household.

On the way to level-4 autonomous networks, we are using digital twins to create mixed reality experiences and building intent-based networks for human-machine coordination, achieving end-to-end processing within seconds and closed-loop O&M across domains with self-X capabilities.

As for computing power infrastructure, ZTE provides a full range of server and storage products, including general-purpose servers, GPU servers/intelligent computing clusters, liquid-cooled servers, and all-flash and hybrid flash storage products. Cold plate liquid cooling is applied to further reduce power consumption. Indirect evaporative cooling, extreme liquid cooling, and AI-driven management reduce the PUE of our modern data centers to 1.13. With TECS Cloud Foundation (TCF), the distributed precision cloud, computing resources are pulled from cloud, edge, and terminal levels to enable multi-service deployment and on-demand scheduling.

In terms of CNC and CPN, ZTE has developed a one-stop ICT solution integrating edge cloud. It features an IaaS/PaaS cloud technology stack, and supports heterogeneous computing as well as the unified planning, building, and O&M of ICT infrastructure. As such, this solution has provided practical guidance for the evolution from edge computing to computing power networks.

Also, we actively explore computing and network synergy to build a bridge between the application layer and the network layer, so that the network can sense service demands and computing power resources, implement computing power routing, and realize on-demand scheduling across multiple resource pools.

In addition, ZTE is building an orchestration center featuring unified and open APIs. It enables flexible management in multi-vendor and multi-cloud environments, and ensures quality services that integrate "connectivity, computing, and digital capabilities". In this way, we not only unlock new opportunities, but also empower the digital transformation of various industries in an agile and cost-effective manner.

As industrial digitalization accelerates, we see higher production and transaction efficiency.

ZTE keeps working to improve production efficiency for its partners.

In the smart steelmaking plant of Ansteel, our URLLC technology for remote control of machinery has been adopted on overhead cranes, achieving "five 9s" availability, a 100% increase in production efficiency, and a 20% reduction in labor costs.

In the smart factory of Benxi Tool, we have provided AI-powered machine vision, improving quality inspection precision to two microns, and reducing costs by 15%.

AGV-based warehousing and logistics have made flexibility and lean management a reality. For example, we have helped Gree improve the warehouse automation rate to 60%, and shortened the changeover time to less than two days. In the smart factory of JA Solar, AGVs are deployed for the automated distribution of silicon around the clock.

With situational awareness based on digital twins, we have improved the management of onsite personnel and security for Wonfull Petrochemical.

To improve transaction efficiency and convert it into market value, we empower full-process operation with digital technology, that is, to remove information silos, and enable end-to-end data interconnection and intelligent analysis and matching.

Working with China Telecom Sichuan, ZTE has launched the 5G+ intelligent supply chain demonstration project. By integrating the technologies such as automatic sorting, AGVs, and RFID labels, we customized a digital distribution system, which features one-stop purchase, direct-to-store service, industry collaboration, and a streamlined structure. With this system, the delivery efficiency is increased by 50%, and inventory is reduced by 1/3.

At Tianjin Port, we have enabled remote quay control, automated driving of container trucks, 5G intelligent tallying as well as intelligent on-demand stacking, quality grading, and real-time sorting of goods. Through such efforts, the overall operation efficiency is increased by 20%.

Working with China Southern Power Grid, we have connected grid control and detection nodes on a large-scale 5G network and realized high-frequency collection of power consumption data over broadband networks in real time. This solution has not only enabled smart power consumption and electrical safety, but also increased power distribution efficiency by 2.7 times and accelerated access to green energy.

To better adapt to more diversified and fast-evolving scenarios, we have recently released ZTE Digital Nebula 2.0. With a unified architecture and scalable design, this solution can improve adaptability to multiple industries, unlocking greater potential and further enhancing production and transaction efficiency. Finally, it will help various industries achieve data-driven efficiency improvement, build flexibility through cross-domain collaboration, and boost trust based on openness and transparency.

Phygital DNA will ultimately contribute to a more prosperous human society. With a scientific mindset and human-centric spirit, ZTE leverages digital infrastructure and AI to catalyze and boost sustainable growth for good. Specifically,

- By promoting digital inclusion, we help close the digital divide across the globe and ensure a fair distribution of social resources.
- With digital capabilities, we strive to build knowledge graphs for the entire human society, so as to make our cultures stay alive.
- With innovative technologies, we are committed to achieving more balanced, green, and low-carbon development together with global partners.

We firmly believe that human civilization and technology will complement each other and lead us to a better tomorrow.

In such an unprecedented era, we are all witnessing and enabling historic changes. As a digital native company, ZTE is dedicated to full-stack, all-domain, and full-cycle DICT innovations. As a driver of digital economy, we will always adhere to the business philosophy of "Simplicity, Agility, and Openness for Win-Win". Together with operators as well as industry and ecosystem partners, we aim to build a digital and intelligent ecosystem for shared success, and will always play our part in promoting sustainable development. **ZTE TECHNOLOGIES**

Ways to Break Through TV Multimedia Service Bottlenecks

You Hongtao

Chief Engineer of ZTE
DHome Product Planning

Since its launch in 2005, IPTV service in China has enjoyed significant growth with a user base reaching 380 million in 2023. However, while IPTV subscribers continue to increase, the user base has reached its peak in terms of both growth rate and potential. Furthermore, despite the huge user base, the revenue of the IPTV value-added services has not been maximized for operators, and the basic video services are facing problems like fierce competition from OTT and the increase of an older audience, leading to a bottleneck in development.

To define a second growth trajectory, IPTV needs to explore something new. There are two key aspects to consider: boosting retention of the existing audience, especially senior audience, and attracting young people who are vital in shaping trends.

Currently, IPTV, similar to cable TV, mainly attracts older generations. To enhance retention among this existing audience, IPTV providers are exploring new services that offer convenience for viewers, for instance, making an outpatient appointment or offering health consultation online. In China, there is a growing consensus within the industry to develop services tailored to the elderly. However, there is a need to further improve service capabilities and quality to empower the eldercare industry.

To attract young generations, IPTV needs to address three challenges.

The first significant challenge is the lack of interaction. Young people, growing up in an online world, are accustomed to sharing their thoughts and experiences on the internet. OTT services have gained popularity among young viewers due to their interactive features, such as comments, bullet comments and sharing options. However, such functions remain rudimentary or even absent on TV platforms due to limitations on interaction models and security concerns. To attract young

audiences, IPTV services need to align with their viewing habits.

The second challenge is the unattractive UI design of IPTV platforms. TV interaction is not user-friendly, and linear TV leads to poor operability, making young audiences less inclined to use IPTV.

The third challenge lies in the inferior processing capabilities of current IPTV set-top boxes (STBs) compared to mobile phones. This leads to less smooth UI control, insufficient support for new services, and an inability to install popular apps on the internet. Consequently, young audiences, accustomed to high-end mobile phones, have little interest in watching TV.

It takes time and collaborative efforts to address these challenges. With increasingly diverse entertainment options and rapidly changing user habits, there is not much time

for TV to adapt. Here are some discussions on how to take IPTV services to the next level.

Optimize Basic Video Services

Actually, young people's reluctance to watch TV is often due to the content offered rather than the TV itself. However, if a popular TV show or a sports event is available on both TV and OTT platform simultaneously, viewers may prefer to watch it on TV for a better viewing experience. As a must-have for most households, TV sets still hold great potential. To seize these opportunities, it is essential to optimize the video services offered on TV platforms.

Optimize Viewing Experience

It is crucial to cater to the needs of the

elderly and kids. This can be achieved through simplifying the UI and introducing voice control. Furthermore, introducing popular contents like sporting events, esports and live webcasts can attract young audiences.

Introduce Short-Form Videos

The success of TikTok shows short-form videos can effectively engage users and enhance customer stickiness. Recent statistics show that people are spending more time watching short-form videos on mobile phones. Notably, the elderly shows an increasing interest in short-form videos, which poses a threat to the IPTV service that focuses on long-form content. Therefore, it is urgent to introduce short-form videos to IPTV services.

The introduction of short-form videos can drive traffic to long-form video services, maximizing monetization opportunities. By using algorithms, short-form videos can be recommended to users based on their preferences, increasing exposures and subscriptions to the relevant long-form videos.

Looking ahead, model tuning can be leveraged to target different audiences within households with relevant content, such as education content for kids or healthcare content for the elderly. This can help form accurate recommendation algorithms for TV services. Considering the higher compliance standards for TV content and the important position of TV sets in households, there is an opportunity to build an ecosystem that is different from that of mobile devices, creating a new business model specifically tailored for the TV screen.

Innovate Video Experience

It is also important to accelerate the launch of new video services for TV screen, such as 360-degree VR, free-viewpoint video, multi-view mode, and multi-viewpoint video. These services are suitable for scenarios like cultural tourism, sporting events, live concerts, and live esports. By combining these new video services with compelling content, we can attract young people to spend more time watching TV. This business model has already been developed and needs to be promoted for large-scale deployment.

In addition, exploring the application of metaverse technology on TV screen can provide users with a brand-new TV viewing experience. For example, MIGU of China Mobile held a "Metaverse World Cup Music Festival", creating a virtual interactive space. Viewers could access this metaverse world though their TV sets and use avatars to enjoy a 360-degree view of the singers' performances while watching the interaction between real persons and avatars. This approach was very popular among young people.

Upgrade TV Services

As technology, especially AI technology, develops rapidly, traditional TV services like IPTV need to keep pace with changing consumer needs. We need to think about how to introduce the industry's latest technology to make TV devices and services smarter, enable continuous service upgrade, and add new impetus to the industry growth.

Smart Voice Control

Voice control technology has matured and is widely used in IPTV services. For example, by configuring far-field voice modules or Bluetooth voice remote control, users can search for and play programs via natural language dialogues, enjoying a true hands-free experience. This significantly increases the activation rate of video programs, showing the positive effect of

new technology on services.

Introduction of AI Capabilities

ChatGPT has gained great popularity as an AI application, reaching 100 million monthly active users in only two months after its launch. This success shows the potential of AI technology to drive traffic. Currently, many Chinese companies are stepping up efforts to launch similar AI systems. We should seize this opportunity to introduce AI to IPTV services and optimize application scenarios for home users. Here are some areas where AI can be integrated into IPTV services.

- **Smart elderly care:** AI can play a crucial role in addressing the needs of senior citizens who live alone or having difficulty in getting medical care. By guiding them in identifying their health priorities, enabling online interaction with doctors via TV sets, and reminding them to take medicine, AI makes it much easier for senior citizens to access medical care, greatly increasing the service value for them.
- **Digital humans:** Digital humans have become increasingly popular. When combined with conversational models like ChatGPT, they can become smarter and more human-like, enabling new services like elder care, child companion and emotional guidance. They can also be utilized as virtual idols, virtual spokespersons of a company or a brand, or customer service robots, interacting with customers in a more immersive way and expanding business models.
- **AI-powered education and entertainment:** Generative AI technology experienced explosive growth in 2022. For education and entertainment, applications such as AI avatars, AI painting and AI video products, can greatly enhance user interaction and

revitalize traditional value-added services.

Upgrade Hardware of Terminal Devices

The growth of services reply heavily on hardware development. In order to support the future IPTV service development, upgrading the hardware of terminal devices should be the top priority. The next-generation terminal hardware needs improvement in the following aspects:

- **Gigabit network access:** Enabling Gigabit wired access and Wi-Fi 6 wireless access can guarantee high bandwidth and low latency for video services like XR.
- **Video processing capabilities:** Enhancing video processing capabilities is essential to support multi-channel 4K decoding, binocular 4K VR display, UHD multi-view mode, or even 8K decoding and display, allowing users to experience more and better new video services.
- **AI processing capability:** Integrating an AI processor, such as a neural processing unit (NPU), is becoming increasingly important for IPTV terminals. To effectively support AI-powered services, the NPU should deliver a processing performance of at least 3 trillion operations per second (TOPS).

The development of mobile phones has shown that advancements in hardware processing capabilities can facilitate the proliferation of new services. Similarly, for IPTV to overcome current challenges, it needs to accelerate hardware configuration upgrades to optimize its processing capabilities. This will enable IPTV services to attract more attention and investment within the industry, thus entering a new development stage. **ZTE TECHNOLOGIES**

Thriving Video Business Creates New Opportunities

Xu Yanmin

Director of Partnerships,
ZTE DHome Products

In recent years, the rapid growth of global broadband services has fueled an increasing demand for video services. While focusing on expanding their user base, operators are also seeking to continually create more value from video services. On the one hand, consumer behavior is becoming increasingly personalized and fine-grained, resulting in a growing demand for TV advertising and gaming services. On the other hand, the growing number of set-top box (STB) models and vendors poses challenges for operators in managing the launch of new services. The network management (NM) functions of STBs have also become crucial requirements for many operators. This article will discuss the new opportunities in the development of the video business by introducing video advertising, gaming and the terminal management system (TMS).

Video Advertising

According to eMarketer, global spending on digital advertising surpassed $600 billion for the first time in 2022. This figure is expected to grow and exceed $800 billion by 2025. TV operators can benefit from TV advertising matched precisely with user preferences. In everyday video


Fig. 1. Targeted advertisements.
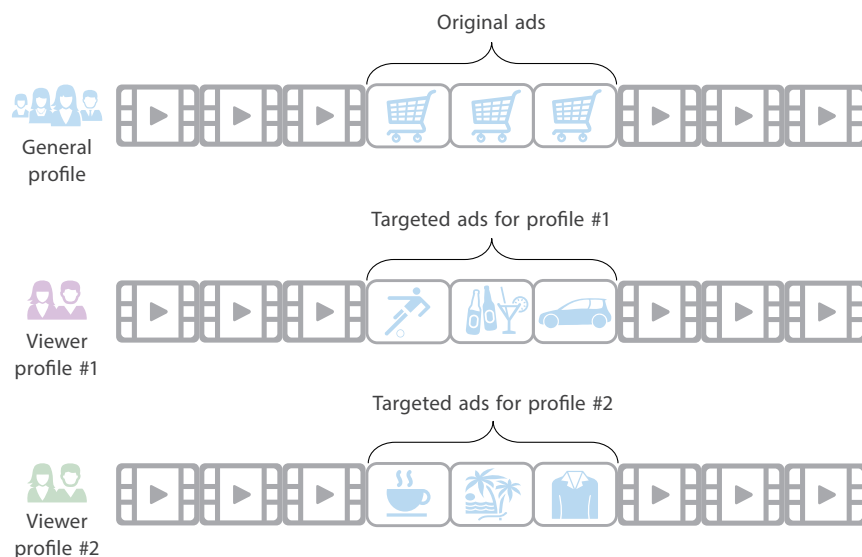
services, user viewing behavior and basic information are collected to create user profiles. With a focus on maintaining data security, precise advertisements are accurately delivered to users (Fig. 1). Using "digital prompts" in live broadcast signals, terminal devices seamlessly replace ads in the original video with personalized ads. These "addressable ads" can extend the time viewers spend on watching ads while minimizing the impact on user experience.

TV ads can bring more business revenue and enhanced experience:

- Improve the relevance of ads to viewers. Targeted TV ads can be tailored to the interests, behaviors and demographics of individual viewers, offering them a more attractive experience. With the relevance improved, users may be more interested in these ads and are willing to spend more time watching them.
- Provide better control over ads delivery. Targeted advertising can have a better control over the broadcast timing and duration of ads, creating a better advertising effect. It can choose to broadcast ads on specific programs, at a certain time of a day, or on specific channels.
- Improve ads inventory management for TV operators. With targeted TV ads, TV operators can optimize their ads inventory to provide viewers with more relevant ads. This enables increased viewer engagement rates and delivers a better viewing experience.
- Bring a higher return on investment (ROI). Compared with ordinary ads, targeted TV ads can effectively drive conversion and bring a higher ROI for advertisers. In addition, advertisers can save costs by avoiding wasting money on irrelevant ads.
- Create a larger share of revenue. With ads matched precisely with user
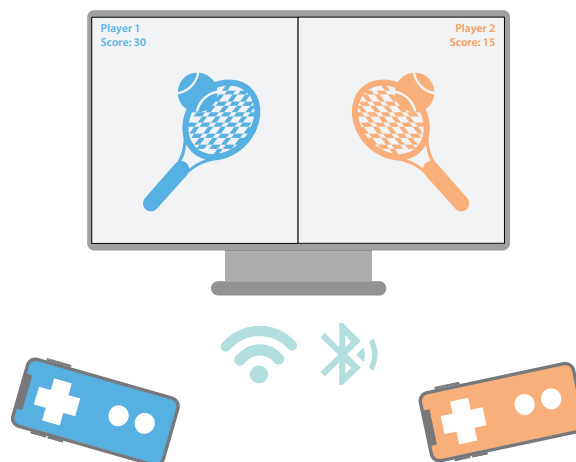
Fig. 2. Gaming on TV with smartphones as gamepads.

preferences, viewers spend more time watching these ads, enabling TV operators to gain a larger share of revenue from advertising.

Gaming

The rapid growth of video services has also brought new innovations and opportunities for online games. Compared with conventional game consoles and computers, ordinary home video terminals or set-top boxes fall short in performance and operability when used for game playing. Usually, they cannot effectively support complex computing and gaming operations, and purchasing an extra handle or joystick is an additional expense.

To deal with these difficulties, game developers have designed some new models to improve user experience. Users can pair their smartphones with STBs or smart TVs via Bluetooth and Wi-Fi, and instantly convert the smartphones into remote controls (Fig. 2). The games are designed mainly for home users for entertainment and intelligence, using simple operations to deliver a single-player or multiplayer gaming experience.

This new gaming experience provides many opportunities for operators.

- **Game incorporation as a service:** Pay-TV operators can add games as a service to enable viewers to play games on TV. This can add value to subscription and attract more users.
- **Cross-promotion with other services:** Pay-TV operators can cross-promote gaming services with their other offerings such as on-demand videos or sports packages. This strategy can incentivize existing customers to explore gaming options and vice versa.
- **Cooperation with game developers:** Pay-TV operators can partner with game developers to offer exclusive access to new games or content, or even co-develop games tailored to their specific customer base.
- **Enhancing interactivity:** Pay-TV operators can use games to enhance interactivity within their programming. For example, they can develop games based on popular TV shows or movies, or provide interactive quizzes or polls at live events.
- **Increasing revenue:** Pay-TV operators

can add games as a service to generate additional revenue. They can charge for access to certain games or offer microtransactions within the game, allowing players to buy additional content.

- **Integration into existing STBs for cost reduction:** Pay-TV operators can integrate games into their existing STBs, allowing customers to access games without the need to purchase additional hardware, which reduces the cost of customer experience.
- **Competitive edge:** Pay-TV operators offering gaming services can gain a competitive edge over those who do not. As more and more consumers play online games for entertainment, the ability to provide a comprehensive entertainment experience including gaming will present these operators with more opportunities.

TV operators can capitalize on these opportunities to improve their offerings, attract new customers, and increase

Running Status

87%
CPU usage
Temperature: 41
0%   100%

50%
Memory usage
Used: 1024 MB
0%   100%

WiFi signal
-57 dbm
0%   100%
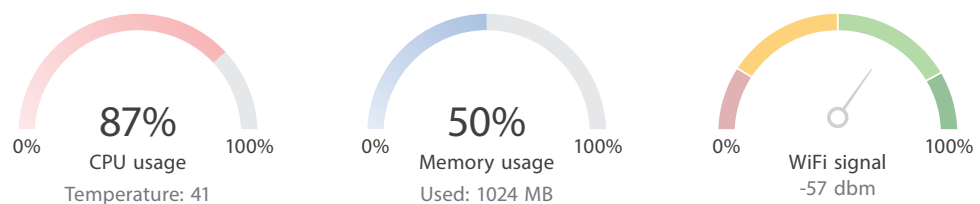
Fig. 3. Dashboard of ▶ terminal management system.

Storage

System: 2.32 GB   Application: 1.58 GB   Other: 0.17 GB   Uswd: 4.07 GB / Total: 5GB
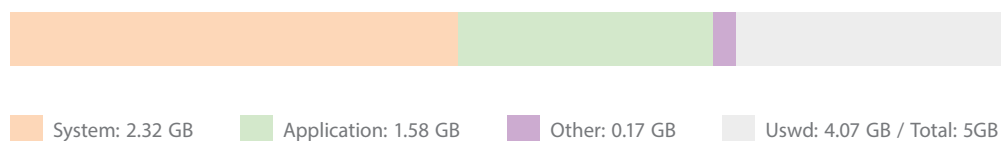
revenue. They can also utilize gaming to create a more engaging and immersive user experience, establishing themselves as leaders in the evolving multimedia and entertainment market.

Terminal Management System

As TV operators' business continues to grow, the diversity of terminal devices and services presents management challenges. However, TMS can offer video service providers better analysis and help them learn their user viewing habits and preferred content. Through a user-friendly graphical interface, TMS presents the collected data to operators, enabling them to tailor their services to meet customer needs and deliver a better user experience (Fig. 3).

- **More accurate positioning:** The booming video streaming service increases the risks of security vulnerabilities and cyber attacks. TMS can strengthen the security of video streaming service by providing secure communication channels and monitoring network traffic to prevent any signs of intrusion. It can also predict potential faults or problems in video streaming service through data analysis, helping the after-sales service team proactively solve these problems before they grow into major ones. In this way, it improves the overall customer experience while reducing downtime.

- **More flexible deployment:** TMS can be deployed in public or private cloud to provide greater scalability and flexibility. This means that video streaming service can be easily scaled or downsized to meet changing needs without having to invest heavily in hardware and long-term maintenance.

- **More effective support:** TMS can enable remote diagnosis and support for video services, and provide detailed

customer feedback and analysis. While reducing the need for on-site after-sales service and hotline calls, it also helps to quickly identify and solve problems. In addition, TMS provides customers with self-service options such as resetting password, changing billing information, and managing preferences. While improving customer satisfaction, it reduces the workload of after-sales service personnel.

By introducing TMS, operators can improve equipment management efficiency, enhance user experience, support business growth and improve security, thereby increasing their competitiveness and profitability.

Conclusion

With the fast growth of their business, operators face the need for more fine-grained device and operational management. As user expectations for seamless experiences increase, there is a growing demand for greater service diversity and customer satisfaction. Leveraging the data generated from their operations to support existing and innovative business models will create tremendous opportunities for the development of operator video services. **ZTE TECHNOLOGIES**

Online Upgrade and Switching Scheme for Set-Top Box Ecosystem
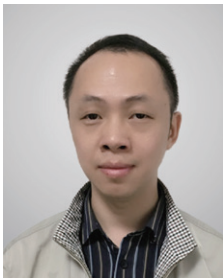
Liu Chenggang

Chief R&D Engineer of
ZTE DHome Products

Amid the fierce competition landscape of the set-top box (STB) industry, various ecosystem manufacturers, including Google, operators, content providers, CA/DRM vendors, and middleware vendors, engage in a dynamic game of cooperation and competition. They form multiple ecosystem factions, each relying on different software operating systems to capture their respective market share. Operators, driven by their individual circumstances and commercial interests, continually adapt their ecosystem choices. Therefore, there is a growing need for STBs to support online upgrade and switching between different ecosystems, which has become a crucial requirement for operators.

Requirement

The STB ecosystem is categorized based on operating systems, primarily including AndroidTV, AOSP, RDK-V, and Linux/Ecos. From the operator's perspective, a comparison of the advantages and disadvantages of each ecosystem is given in Table 1.

Operators make dynamic choices for the ecosystem based on their own circumstances and business interests. For example, some operators initially choose AOSP but later opt for AndroidTV to incorporate premium content and service from Google. They hope that existing

Table 1. A comparison of the advantages and disadvantages of each ecosystem.

Ecosystem	Advantages	Disadvantages
AndroidTV	Built on the Google ecosystem, it inherently provides users with a wide range of content options, including YouTube and Netflix.	Google dominates the ecosystem, while operators have little control. Frequent system updates lead to higher maintenance costs.
AOSP	Based on the open Android system, it provides users with a rich choice of content. Operators have strong control over the ecosystem.	Unable to introduce Google's premium applications and content, such as YouTube, Google Assistant, and Google App Store.
RDK-V	The ecosystem matures rapidly and can provide users with a wealth of content choices such as YouTube and Netflix. Operators have strong control over the ecosystem.	Compared with Android TV, it falls short in content diversity and industry influence.
Linux/Ecos	It has obvious cost advantage. Operators have strong control over the ecosystem.	Due to the low hardware configuration and the lack of ecological content and service, it can only provide basic live TV and video on demand (VOD).

RPMB		Save keys (such as attestation key and widevine key)
Bootloader		Uboot
Reserved		
Env		Save the uboot environment variable
Misc		Save the system boot identifier
Conf		Save the key configuration
Cache		Save the upgrade package
Boot	Boot	Linux kernel partition
System	Super	System partition
Data	Data	User data partition

◀ *Fig. 1. The imaging partition of old and new systems.*

AOSP STBs can be online upgraded and switched to the AndriodTV system. Similarly, when bidding for new products, some operators repeatedly weigh the choices between RDK-V and AndroidTV, expecting STBs to support seamless online upgrade and switching between the two ecosystems. The ability of STBs to support online ecosystem upgrade and switching has gradually become an important requirement for operators.

Solution

The process of online ecosystem upgrade and switching goes through the following three steps.
- **System version upgrade and switching:** Upgrade from AOSP to AndroidTV, or switching between RDK and AndroidTV.
- **Key data update and switching:** Due to varying storage partition and formatting requirements for key management (such as attestation key and widevine key) in different systems like AOSP, AndroidTV and RDK-V, keys cannot be reused across systems. Therefore, it is essential to download and set new keys online based on the new system.
- **System version and key upgrade and switching completed:** After the new system starts up, users can follow the on-screen setup wizard and enter the Launcher to use the system.

To enable ecosystem upgrade and switching, STB hardware configuration needs to fulfill certain requirements. For example, a 4K STB powered by AndroidTV requires a minimum memory of 2GB. Therefore, when upgrading a 4K STB from AOSP to AndroidTV, it is necessary to ensure that its memory is equal to or greater than 2GB.

The following is a step-by-step explanation of online upgrade and switching from AOSP to AndroidTV.

System Version Upgrade and Switching

The imaging partition of old and new systems needs to be planned and designed. As shown in Fig. 1, the front shared partitions (green) need to be offset and size consistent, while non-shared partitions (blue and orange) do not require offset and size consistency.

The upgrade program of the old system is responsible for downloading and saving the new system upgrade package to the cache partition. It also performs signature and integrity verification on the upgrade package. If the verification is successful, it triggers the old system to enter recovery
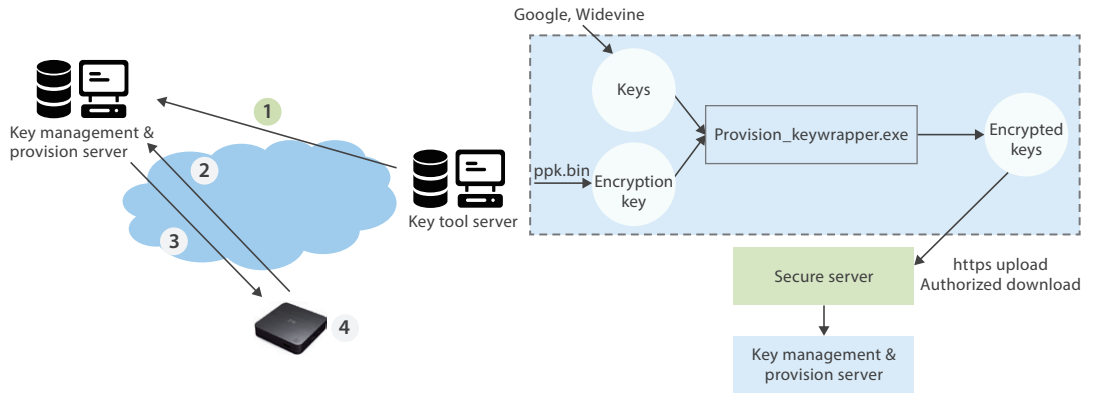
or bootloader mode to overwrite the image data for upgrade to the new system. The apps and data formats vary greatly between the old system and the new one. Therefore, when upgrading to the new system, the user data partition will be automatically formatted. This means that any apps and data downloaded and installed by the user in the old system will be cleared. When the new system starts up, it will automatically guide the user through the setup wizard.

Key Data Update and Switching

After Google approves the project

of upgrading AOSP to AndroidTV, the new keys (such as attestation key and widevine key) provided by Google are downloaded online and written into existing commercial STBs. The specific steps are as follows:

● **Step 1:** Import the new keys provided by Google to the secured key tool server, encrypt these keys on that server, and generate encrypted key files with the corresponding encryption device identifiers of STBs as the file names (Fig. 2). Upload the encrypted key files to the key management & provision server in a secure channel. This task needs to be completed before
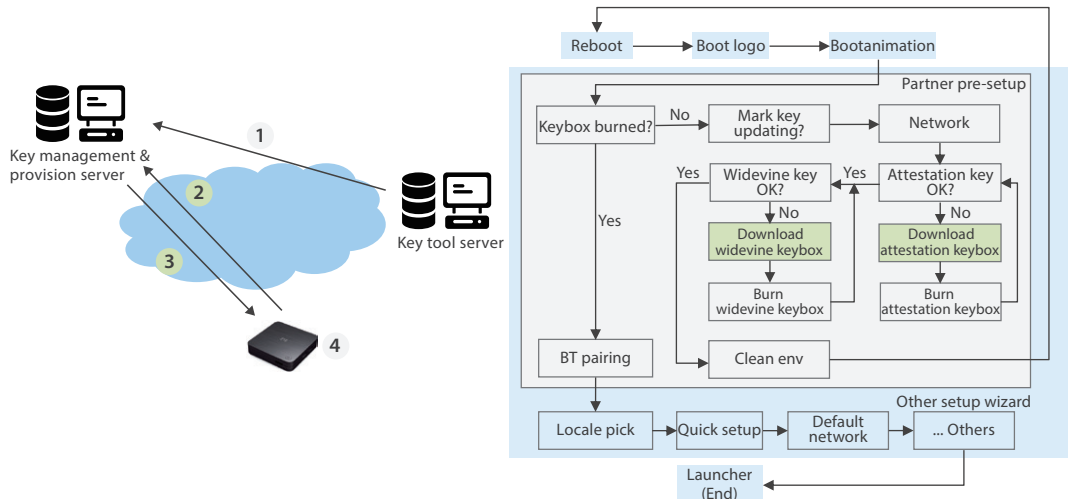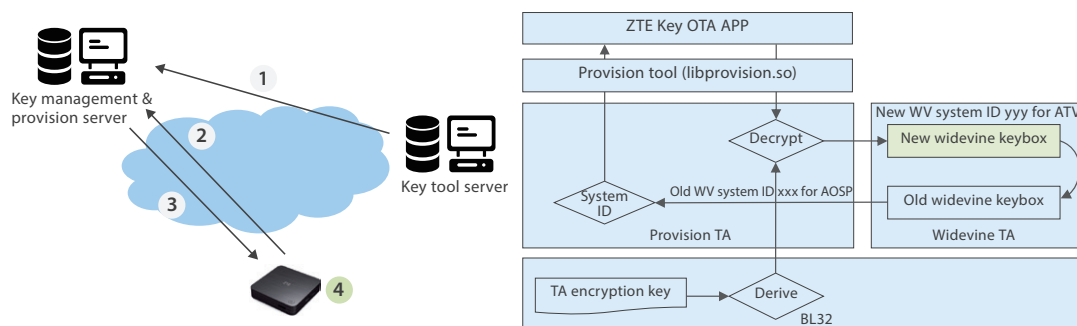
starting the system upgrade.

- **Step 2:** The STB carries the encrypted device identifier and requests the key management & provision server to download the corresponding key file (Fig. 3).
- **Step 3:** The key management & provision server processes the STB request. After successful verification, it locates the corresponding key file based on the device identifier and returns it to the STB (Fig. 3).
- **Step 4:** The STB utilizes a secure application to write obtained new keys into TEE with the expected level of security, and then triggers a system reboot (Fig. 4).

New System Setup Wizard

The new system will automatically enter the setup wizard after it starts up. When the user finishes the relevant setup wizard, the new system will enter the Launcher normally, and the whole process of online upgrade and switching between the old and new systems has been completed.

To ensure the safety and reliability of online key updates during the ecosystem upgrade and switching process, the following design requirements are of great importance.

- Use a secure TEE configuration mechanism to replace the keys in the old system and configure new system keys.
- Establish a reliable mechanism for uploading and downloading keys.
- Build a retry mechanism for reliable key configuration.
- Develop an interactive user interface (UI) for end users, helping them understand and complete the upgrade process.
- Ensure uninterrupted usage of critical applications like Launcher, YouTube, Netflix, and Amazon Prime in the new system.

Value

With the support of STBs for online ecosystem upgrade and switching, operators have the flexibility to choose desired ecosystems while maximizing their ROI on fixed assets. This not only drives the rapid growth and prosperity of ecosystems such as Google and RDK-V but also empowers operators to navigate ecosystem choices with confidence. ZTE, as a pioneer in the industry, has adopted this advanced technical scheme and successfully facilitated the upgrade and switching from AOSP to AndroidTV for millions of STB devices in the existing network of the AMX project in Mexico. This achievement signifies a win-win outcome for all parties involved. ZTE TECHNOLOGIES

Smart STB Management Platform
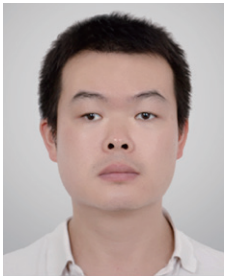
Ouyang Yonghui

Senior Engineer of ZTE
Wireline R&D Planning

Drawing upon years of experience in device and business management system development and utilization, ZTE has launched a high-performance and open set-top box (STB) management platform tailored for smart Android STBs. The platform primarily utilizes the TR069 protocol family to interact with STBs, enabling remote parameter configuration, data collection and fault diagnosis. Additionally, it incorporates protocols like HTTP to support the upload and download of STB version files and log files. It also provides interfaces for integration with customers or third-party systems to enable corresponding service functionalities.

The software architecture of the STB management system consists of three layers: the equipment management layer (including FS and ACS), the business management layer (APP), and the service management layer (NIM), as shown in Fig. 1.

The application server (APP) is a system portal that provides users with operation interface and entrance. The auto configuration server (ACS) is responsible for interacting with STBs and accessing database resources. The file server (FS) stores, upgrades and downloads version files. The database (DB) centrally stores all system data. The northbound interface management (NIM) module receives instructions from external systems and delivers its processing results back to them. The interface can be customized.

The STB management platform brings value primarily in the areas of equipment management, operation, and maintenance. Once authenticated by the platform, STBs can be remotely configured, modified and queried for parameters, supporting both individual and batch operations. Individual and batch restarts as well as factory settings restoration can be performed on STBs as required. The

*Fig. 1. Software architecture of the STB management system.*
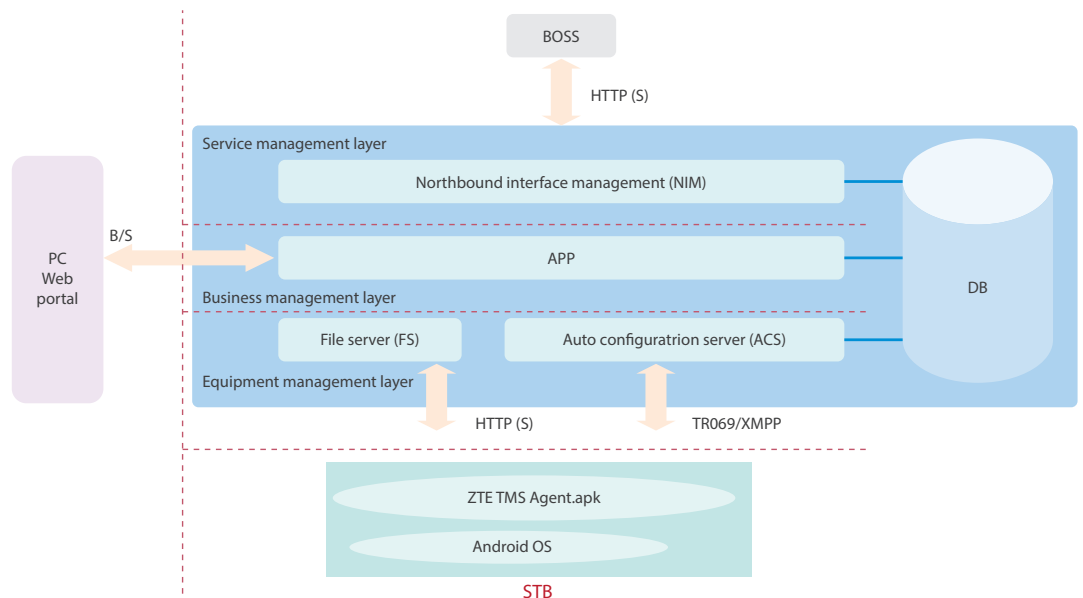
platform enables firmware upgrades for STBs either triggered by the platform itself or initiated by STBs. Additionally, various operations such as app installation, update, uninstallation, and cache clearing are supported for APK files.

When system, service or network faults occur in the STB, the STB management platform can remotely diagnose and troubleshoot the faults. The supported diagnostic processes include ping diagnosis, traceroute diagnosis, speed testing and log reporting. The platform can initiate automatic diagnosis on the STB and report the results. It also supports intelligent analysis of logs. With user authorization, it can provide remote desktop and remote console for deep diagnosis. Remote desktop allows users to view the STB interface and operate it using a virtual remote control, similar to on-site operation. Remote console enables logging into the STB for ADB debugging.

The STB management platform can also generate a variety of statistical reports, providing valuable support for customer operations. By collecting STB parameters, obtaining running information, as well as analyzing user behavior, the platform can generate reports across multiple dimensions. These reports include geographical distribution of STBs, trends in new user acquisition, online user rates, popular programs and applications, as well as information about the brands and models of TV sets and remote controllers connected to STBs. In the future, with the integration of a business intelligence (BI) analysis engine, there will be an increase in data mining capabilities and improved data presentation.

The STB management platform supports the integration of third-party STBs. There are two main integration methods available. The first method involves third-party STBs in two ways. The third-party STB vendors develop their own integration using interfaces and protocols. The second method encompasses direct integration with ZTE's STB management agent, as illustrated in Fig. 1. The second method is recommended as it can significantly reduces the integration period and accelerate
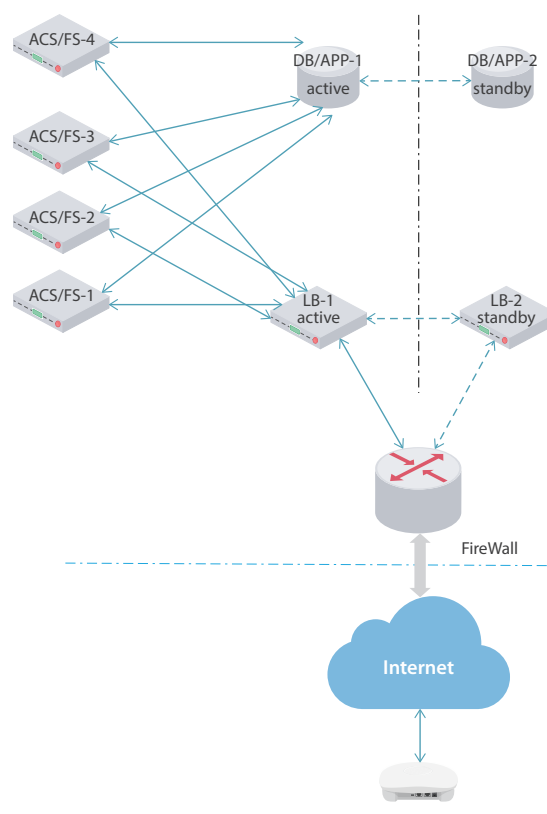
◀ *Fig. 2. Deployment diagram of the STB management platform.*

the deployment of functionalities.

The STB management platform can be deployed on the local physical server or in the cloud, giving customers the flexibility to choose. Figure 2 depicts a schematic diagram where load balancer (LB) ensures load balancing by distributing STBs to various ACS/FS instances. To ensure security and reliability, LB and DB/APP are configured with backups in active/standby mode. Additionally, if needed, geographic disaster recovery solutions can also be provided.

ZTE supports customers in building their own STB management system. For customers with specific needs, it can also provide software-as-a service (SaaS) solutions in a tenant model, reducing their investment costs.

The STB management platform can enhance user viewing experience, increase user satisfaction, reduce after-sales costs and improve the efficiency for customers. Looking ahead, the platform will keep evolving to be more user-centric and intelligent, aiming to deliver even greater value to customers. ZTE TECHNOLOGIES

Going Greener with Energy Efficient STB Solution

Bian Ling

Wireline Product Planning Manager, ZTE

Accordingto the Paris Agreement, global carbon emissions need to be reduced by 45% by 2030. To achieve this goal, governments and organizations worldwide have introduced various eco-friendly policies and regulations. The telecom industry should play a significant role in this effort by prioritizing energy conservation through enhanced efficiency and minimizing technology-related emissions. It is crucial for enterprises to realize that sustainable development is not only an act of public welfare, but also closely related to their long-term survival.

ZTE's Journey Towards Green Business

Environmental conservation and reducing carbon emissions have emerged as shared responsibilities among countries and enterprises around the globe. ZTE, throughout the entire process spanning from ideation and planning to development, validation, production and operational management, has consistently prioritized environmental protection and carbon emission reduction, with clear implementation measures in place.

ZTE's set-top box (STB) products are fully compliant with international environmental standards such as CE, REACH and RoHS to ensure quality control. According to CE certification, ZTE needs to provide environmental test reports or assessment reports for its products, and add product recycling manuals to the product development output, while meeting customers' environmental certification requirements such as ULE certification. ZTE has been complying with relevant laws and regulations and environmental standards, taking into account customer needs and recyclable designs. In the operation and management sector, it develops recycling manuals, transforms network infrastructure, and implements reverse logistics processes including product returns, material substitution, reuse, waste disposal, repair, and remanufacturing to enhance the environmental efficiency of enterprises.

Through continuous efforts over the past fifteen years, ZTE has significantly enhanced its capabilities in environmentally friendly production, earning recognition and certification in the field of environmental protection. Each STB product is separately tested according to specific requirements to ensure that its commitment meets and exceeds the relevant standards.

ZTE's Pursuit of Ultimate Green Production

ZTE believes that the adoption of environmentally friendly materials is essential to its sustainable development. From product design to material selection, and throughout the entire lifecycle, ZTE always sticks to the principle of sustainable development. By opting for innovative recyclable materials, the company reduces carbon emissions and achieves sustainable utilization of resources.

95% PCR Plastic Casing

The utilization of 95% polymerase chain reaction (PCR) plastic is a predominant practice in the industry. However, increasing the proportion of recycled plastic may result in degraded material performance, affecting aspects such as infrared light projection. Compared to new materials, the mechanical properties of PCR materials exhibit minimal differences, including lower impact strength and elongation at break. From a product structural perspective, excessive PCR content can

decrease impact strength and elongation at break, thereby increasing the risk of reduced performance. Additionally, in terms of appearance, it is not recommended to use high-gloss products with a high proportion of PCR material.

100% Recyclable and FSC MIX Paper

ZTE evaluates the materials it utilizes based on two criteria: their environmental impact and their technical practicality. Materials that not only have the least impact on the environment, but also meet customer quality requirements in terms of technical performance are given priority. This dual assurance of quality and environmental friendliness is essential. The benefits of recycled paper include low energy consumption, low waste disposal costs and low unit raw material costs, saving more than 50% of paper-making energy and reducing water pollution by 35%. As cost considerations and environmental awareness continue to gain prominence, recycled paper has become an indispensable raw material for the paper-making industry.

ZTE demonstrates its commitment to protecting forest ecosystems by utilizing green packaging materials that are FSC-certified. The FSC MIX certification indicates that at least 70% of the wood used in the product is sourced from FSC-certified or recycled materials, with the remaining 30% derived from controlled wood. Although choosing such paper materials increases the cost, it significantly enhances environmental friendliness.

Plant-Based Ink and Plastic-Free Packaging Design

ZTE keeps improving its printing techniques and packaging materials to achieve sustainable innovations. Its product packaging incorporates various environmentally friendly approaches, making continuous breakthroughs on the path of sustainable innovation. It uses 100% biodegradable and eco-friendly plant-based ink in packaging, replacing petroleum-based inks that affect degradation rates. Compared to traditional petroleum-based inks, plant-based inks are not only safe and eco-friendly but

also deliver excellent printing results.

Halogen-Free STB Device

Halogens are harmful. Organic halogen compounds can cause cancer in the human body, and their low bio-degradation rates can lead to accumulation in ecosystem. Some volatile organic halides also have a significant destructive effect on the ozone layer, resulting in severe impacts on the the environment and human health. Therefore, halogen compounds are classified as harmful chemicals to both humans and the environment, and their use is prohibited or limited. ZTE uses halogen-free ABS materials for structural components, and its primary suppliers also adhere to halogen-free standards for cable wires, cable jackets, and cable connectors.

ZTE's Proactive Approach to Green Recycling

ZTE provides disassembly guidelines for recycling workers, encouraging the recycling of old products for maximum resource utilization.

- **Plastic material:** All components weighing over 50 grams with recycling labels and all the pure thermoplastic components can be recycled.
- **Metal material**: Iron, steel, aluminum, and copper are all recyclable.
- **Electrical and electronic devices:** Metals such as copper are recyclable.

ZTE's Commitment to Green Development

In the future, green practice will be a strategic approach for enterprises to attain sustainable development, and low-carbon and energy efficiency will become essential choices for their transformation and growth. ZTE will continue to adhere to the principles of sustainable development, continuously enhance the green attributes of its products, and optimize the environmental friendliness of its production processes. It strives to make contributions to global low-carbon initiatives and environmental protection efforts. ZTE TECHNOLOGIES

8K UHD Video Services Boost Gigabit Growth

Sha Junjie

Planning Manager, ZTE DHome Products

With the advancement to implement the national strategy of building a cyber power and a digital leader, China has constructed the world's largest information and communication network. Its expansion of fiber broadband and construction of gigabit cities have established the capacity to reach over 500 million households. With the booming gigabit broadband, the fiber-to-the-room (FTTR) solution proposed in the industry is effectively addressing the connectivity bottleneck within households. The advent of 8K technology has also opened up new changes and possibilities for the development of ultra HD (UHD) video services. Leveraging its abundant resources, ZTE has capitalized on its own strengths to facilitate the mutual promotion of gigabit networks and services, thereby assisting operators in their gigabit operations.

Gigabit UHD Video Service: Building a Solid Pipeline Foundation for Operators

The concept of "Gigabit" for operators goes beyond the capabilities like 5G, Gigabit broadband, and Wi-Fi 6. It also encompasses the drive to promote content towards UHD and embrace new video services such as multi-viewpoint video (MVV), free-viewpoint video (FVV), and virtual reality (VR). With the development of the Internet over the years, video is the fastest growing and bandwidth-consuming service. As China continues the widespread deployment of "Three-Gigabit" commercial services, UHD video has emerged as a leading application and is rapidly implemented.

This marks a golden era for UHD video business, positioning China as the largest UHD market and paving the way for ongoing evolution towards 8K and higher resolutions.

On the one hand, UHD video service offers a rich and diverse landscape. 8K UHD video has been widely applied in live sports broadcasting, artistic performances, and cultural tourism live streaming. Users can experience the finest detail of live events on the large screen, with more realistic visuals, stunning effects, immersive scenes, and impressive performances. 8K UHD films and TV shows deliver an immersive viewing experience, allowing viewers to enjoy videos in amazing new ways. Leveraging its ultra-high resolution and lifelike imagery, 8K UHD video is poised to empower more industries such as industrial manufacturing and telemedicine.

On the other hand, VR has become an important form of UHD video and a significant addition to the era of "Three-Gigabit" connectivity. VR offers its greatest value through immersive viewing experience. With the continuous advancements in technology, VR has matured considerably. VR headsets now offer separate decoding, and VR display terminals have become lightweight. The performance of terminal chips has improved significantly, greatly reducing dizziness in VR viewing. Leveraging the 8K field of view (FOV) technology, even with just 4K decoding capabilities, it is possible to play 8K VR videos, resulting in enhanced clarity of VR content. VR can simulate 360-degree surround sound effects. The 2D-to-3D conversion technology enables the transformation of a vast amount of 2D content into VR, thereby enriching

| 8K@60fps decoding for UHD display | AI super-resolution to enhance image quality | Free-viewpoint video to deliver immersive experience | Metaverse to combine digital and real worlds |

Fig. 1. ZTE end-to-end UHD video solution.

| Content collection | Video processing | Content transmission | Display' |

5G · Cloud production and broadcasting · Service platform · CDN · 10G PON · 5G/Wi-Fi6 · 8K STB

AVS3.0, 8K@60fps decoding, 4K@60fps encoding

3.2 TOPS AI computing

B980V2

Dual-gigabit for fast connection
HDMI2.1 for high-speed transmission

4G/16G storage

the availability of VR content sources.

The advancements in 8K and AI technology drive the development of more immersive and interactive UHD video services. Innovations like AI-enabled image enhancement, MVV, AI virtual trials, FVV, and bullet time viewing are gradually gaining industry recognition and undergoing trial promotions. ZTE, as a leading provider of multimedia video solutions, has launched end-to-end UHD multi-dimensional video products and 4K/8K UHD terminal devices (Fig. 1). These products integrate new technologies such as UHD, strong interactivity, and AI enhancement, and have been commercially deployed in sectors including education, healthcare, sports, tourism, and home entertainment.

Combination of FTTR and 8K: Unleashing the Potential of Operator's Pipelines

One of the key strengths of operators is their strong network pipeline connectivity, particularly their control over the home network portal. With this network portal, operators can offer true gigabit experience and leverage smart networking technologies to create a competitive edge. As a leader in FTTR solutions, ZTE has played a pivotal role in the development of FTTR standards, product definition, commercial models, and interconnectivity. It has developed comprehensive whole-home networking solutions and product systems for both residential and enterprise scenarios. These solutions have been widely deployed in 15 provinces in China, including Guangdong, Shandong and Henan. ZTE continues to empower operators in upgrading Wi-Fi quality, overcoming the final bottleneck of gigabit connectivity, and delivering a seamless user experience.

Furthermore, operators leverage their powerful network pipeline advantage, enabling them to boast a user base reaching hundreds of millions. With the vast user scale in mind, operators built on the foundation of new gigabit broadband need to explore inventive gigabit value-added services to increase ARPU and enhance user stickiness. By complementing the "smart networking connectivity" capability with UHD video services, operators can tap into diverse needs of users in the video sector. This will in turn drive network optimization and improve connectivity to better support video services, thereby achieving a collaborative development of gigabit networks and services. **ZTE TECHNOLOGIES**

Beyond Visuals: A New Experience of UHD Video

Xu Huoshun

Chief Engineer of Big Video Product Planning, ZTE

Mao Liangui

Director of Multimedia Innovative Product Planning, ZTE

V ideo is undergoing a transformation driven by technology in the 21st century. With the rapid progress of 5G, Wi-Fi 6, and FTTH networks, capable of delivering gigabit speeds, along with advancements in video production, distribution, and the integration of AI, edge cloud and CDN, video is evolving towards ultra-high definition (UHD), multi-dimensional, immersive, and highly interactive experiences.

New UHD scenario is a collective term for various types of UHD scenarios. It encompasses a wide range of immersive service forms such as 4K (and above) UHD video, VR video, multi-viewpoint video (MVV), free-viewpoint video (FVV), flexible scaling, and 2D-to-3D video conversion. The new UHD scenarios can be categorized into three types based on their features.

The first type is the video featuring image quality enhancement, such as 4K and 8K UHD videos. Leveraging existing video services as a foundation, these videos undergo advancements in resolution, dynamic range, color gamut, frame rate and sampling.

The second type is the UHD video featuring dimensional enhancement and interaction, such as VR video, MVV based on frame synchronization, and 360-degree FVV. These videos enable multidimensional experiences and offer strong interactivity.

The third type is the AI-enhanced UHD video, which uses technologies like 5G, cloud, and AI to provide enhanced user experience. Examples include AI-enabled image quality enhancement, AI-enabled 2D-to-3D video conversion, and AI virtual viewpoints.

8K UHD Video

8K video refers to ultra-high-definition video with an image resolution of 7680×4320 pixels, characterized by high resolution, high frame rate, high color depth, wide color gamut, and high-dynamic range.

- **High resolution:** The dense arrangement of 7680×4320 pixels enhances the level of detail and sharpness in the visuals.
- **High frame rate:** The true 8K video usually requires a frame rate of 120 fps at least. This ultra high frame rate improves the smoothness and fluidity of the images, especially for fast-moving images.
- **High color depth and wide color gamut:** These features enable smoother color gradients, and richer and more lifelike colors.
- **High dynamic range:** This feature enhances the contrast of the image, adding depth and a sense of 3D to the visuals, resulting in a more immersive and layered viewing experience.

8K UHD video has been widely used in live sports broadcasting, arts shows, and cultural and tourism live streaming. Users

can enjoy an immersive experience of these live events on a big screen, with more realistic images, amazing special effects, richer scenarios, and finer performances. 8K UHD films and TV shows revolutionize the visual experience, making viewers feel as if they were physically present at the scene. In addition, leveraging the ultra-high resolution and realistic images, 8K UHD video can empower the industries like industrial manufacturing and remote healthcare.

Interactive Video

Frame-Synchronized MVV

MVV refers to the simultaneous broadcasting of multiple independent video streams from different viewpoints to users during events such as sports broadcasts. This allows users to choose their preferred viewing point or even watch multiple viewpoints at the same time. By breaking the traditional rules of TV broadcasting, this function gives users the freedom to personalize their viewing experience.

As multi-viewpoint videos are transmitted independently, various synchronization issues may arise during camera capture, encoding, transmission, relay, buffering, decoding, and rendering. To address these issues, multi-channel frame synchronization technology is adopted to guarantee the consistency of the multi-viewpoint video feeds, allowing users to experience a seamless and synchronized viewing experience.

The core technology, multi-channel frame synchronization, utilizes a synchronization signal generator at the camera side to achieve signal synchronization. During video encoding, synchronization tags are embedded, and when playing back at the client side, the frame synchronization information from multiple video streams is decoded. This enables frame alignment

during the final presentation, allowing users to seamlessly switch between different viewpoints while maintaining a high level of temporal consistency across all frames.

360-Degree FVV

FVV refers to a business model centered around events and activities, where multiple or surround cameras are used to capture video information from multiple viewpoints. Through stages such as production, transmission, distribution, and playback, users have the ability to freely rotate their view of the captured objects or scenes from any viewpoint by manipulating the user interface.

FVV fully leverages the advantages of multiple viewpoints, detailed capture, and freedom of viewing. It allows users to enjoy videos from different viewpoints and interactively rotate the view, enhancing their sense of participation and interactivity while getting rid of the dependency on traditional director viewpoints.

FVV can also be applied in the production of special effect scenes, creating effects like bullet time and freeze-frame surround. With enhanced technologies like virtual viewpoints and AI recognition, FVV delivers an exceptional user experience, offering superior immersion and engagement.

8K VR FOV

Due to restrictions in terminal decoding capabilities and network bandwidth, current VR videos are mostly in 4K resolution. As a result, the actual image quality experienced by users is relatively low, significantly affecting their viewing experience. The adoption of 8K VR poses higher requirements for both transmission bandwidth and terminal decoding capabilities, which are not yet widely available in terminal devices. Therefore, there exists a contradiction between the clarity and resource

requirements of VR content. However, the use of field of view (FOV) can effectively balance this contradiction.

The principle of FOV is to set a dedicated encoding server at the system end and encode UHD VR videos in a layered and segmented manner. For example, in the case of 8K VR videos, a 2K 360° video is used as the base, supplemented by multiple UHD video fragments encoded for specific regions. During terminal decoding and presentation, the process begins by presenting the base 2K video, and then, based on the current FOV position, the corresponding UHD segmented videos are dynamically retrieved and rendered, ensuring high-quality video presentation within the field of view. This approach can greatly save transmission bandwidth expense while lowering the demands on terminal decoding. As a result, it enables 4K terminals to deliver an 8K VR video quality experience, achieving bandwidth savings of over 70% and reducing head movement latency to less than 150 ms.

AI-Powered UHD Video

AI-Enabled Image Enhancement

As display devices continue to improve in size and performance, people's expectations for video quality are also increasing. However, there is a significant demand for the restoration and enhancement of low-quality videos and images that suffer from issues such as outdated content, low resolution, noise and compression artifacts, as they fail to fulfill users' viewing needs. The AI-enabled image enhancement technology adopts AI algorithms such as super-resolution, frame interpolation, color enhancement, and image denoising to repair and enhance the quality of low-quality videos and images. For example, it can improve old standard-definition (SD) movies to high-definition (HD) or even 4K quality.

AI-Enabled 2D-to-3D Video Conversion

3D services are an innovative video business model that emerged earlier. However, due to the scarcity of 3D content and high production costs, these service have mostly remained concentrated in professional scenarios like cinemas, failing to reach a wider audience in their homes. To address this challenge, the AI-enabled 2D-to-3D technology can be utilized to automatically convert traditional 2D content into 3D, offering a potential solution to enhance the availability of 3D content.

By utilizing a 2D-to-3D conversion engine powered by AI, it is possible to generate 3D videos from 2D content, thereby addressing the scarcity of 3D video resources. Furthermore, this technology supports real-time conversion of live broadcast signals into 3D video signals, facilitating the delivery of 3D live streaming services.

AI-Enabled Virtual Viewpoint

In FVV scenarios, the number of cameras

Fig. 1. Networking for smart spectator experience at the World University Games.

The venue of the 31st FISU Summer World University Games.

placed around the venue is limited due to place or cost constraints. As a result, users may experience visual jitters caused by large disparities between adjacent camera positions during viewpoint transitions. To solve this problem, AI synthesis technology can be applied between adjacent frames to generate N virtual viewpoints, effectively filling in the missing viewpoints and ensuring smoother and more fluid transitions in FVV and bullet time effects.

Smart Spectator Experience at World University Games

ZTE's multidimensional video products integrate the features of ultra-high definition, interactive, and AI-enhanced video capabilities to provide users with a brand-new experience. These products have been commercially deployed in various industries such as education, healthcare, sports, and tourism. One notable service is the smart spectator live broadcasting that supports MVV, FVV, and UHD VR content, catering to both on-site viewers using small screens and off-site viewers on large screens. In July 2023, the 31st FISU Summer World University Games was held in Chengdu, China, and ZTE's multi-dimensional video products played a crucial role in enhancing the smart spectator experience, providing innovative features like MVV, FVV, VR and virtual viewpoints.

As shown in Fig. 1, the smart spectator system consists of four main parts: video capture and streaming adjustment, smart media processing system, UHD CDN, and terminal video playback.

- **Video capture and streaming adjustment:** It involves deploying cameras at the venue to capture real-time video and encode it. The encoded video streams are then transmitted to the system through dedicated lines or reliable networks.

- **Smart media processing system:** It is deployed in the central access office, responsible for enhanced processing on received videos, including protocol conversion, identification, aggregation, transformation, and enhancement. These processes aim to generate scenario-oriented video media streams.
- **UHD CDN:** It is also deployed in the central access office. Its main responsibilities include distributing and storing media content. It ensures that videos are distributed to the required locations and stored or cached based on demand.
- **Terminal video playback:** It involves integrating the multi-dimensional video SDK into the terminal app. The terminal app connects to the video distribution network, decodes the media streams, and renders them according to the scenario for seamless playback.

The smart spectator business scenario primarily includes innovative videos such as frame-synchronized MVV, VR, FVV, and virtual viewpoint. It relies on advanced technologies such as full Gigabit network, video capture, encoding, broadcasting, storage and transmission, as well as terminal decoding and rendering techniques, to deliver a higher-definition, multi-dimensional, and interactive viewing experience. By leveraging cutting-edge video technologies, it adds vitality to large-scale events and activities, increasing the viewers' sense of immersion and engagement. ZTE TECHNOLOGIES

Secure CDN: Achieving Managable, Controllable and Centralized Management

Zhang Yu

Chief Engineer of CDN
Product Planning, ZTE

As many countries place great importance on security, specific laws and regulations have been developed to standardize and supervise product safety. In China, laws and regulations such as the "Cybersecurity Law", "Basic Requirements for Information System Security Protection", "Data Security Law", and "Personal Information Protection Law" have been implemented. In the European Union, regulations such as the "General Data Protection Regulation" and "European Cyber Resilience Act" have been introduced, covering various areas including host security, data security, personal information, and network security. Moreover, national-level cybersecurity initiatives like network protection campaigns and National Cybersecurity Awareness Weeks continue to expand, demonstrating the significant attention given to security by the respective countries. At the same time, cyberattackers are becoming more sophisticated in their techniques, diversifying their attack methods and aiming at lower-level targets. These observations reveal that content delivery network (CDN) customers face three key security pressures: external attack pressure, compliance governance pressure, and security operation and maintenance (O&M) pressure.

To address the security demands mentioned above, ZTE has developed its secure CDN solution that incorporates security as a significant component of CDN. Secure CDN builds a CDN system that is founded on host security and targets business security. It achieves a comprehensive protection from the inside out by detecting, analyzing, blocking and tracing security incidents at the host and business levels. Through the professional service security operation center (SSOC), secure CDN also achieves manageable, controllable and centralized management, allowing for rapid respond to various security incidents.

ZTE Secure CDN Solution

ZTE secure CDN solution consists of two major components: the management center and the client program. The management center adopts a B/S architecture, allowing administrators to manage the host devices effectively. This includes managing device login accounts, process management, log auditing, security policy configuration, host security, and anti-tampering module settings, creating an integrated security system. The client program is an independent program running on the local host. It executes tasks and policies issued by the management center, and collects and reports behavior data necessary for security auditing and detection. The functional modules of ZTE secure CDN solution are shown in Fig. 1.

- **Host security:** By utilizing log analysis and event tracing technologies, combined with functions such as asset management, vulnerability scanning, risk detection, and baseline check, ZTE secure CDN solution promptly identifies potential security risks in servers. These risks include security vulnerabilities, weak passwords, file upload risks, and fileless attacks. The solution offers comprehensive protection and early warning against malicious scanning, brute-force

attacks, abnormal login, reverse shell, and local privilege escalation.

- **Service security:** By utilizing the operating system kernel protection technology, ZTE secure CDN solution monitors and protects the content in CDN servers in real time to prevent unauthorized tampering. The solution incorporates remote disaster recovery and anti-hotlink protection technologies to safeguard service security within CDN servers. Additionally, the data masking technology is also used to prevent the disclosure of sensitive data stored in CDN servers.

Content Security

The CDN host server primarily consists of VOD content, live streaming content, TSTV and TVOD, and database. ZTE secure CDN solution protects the security of the content within CDN from the three aspects:
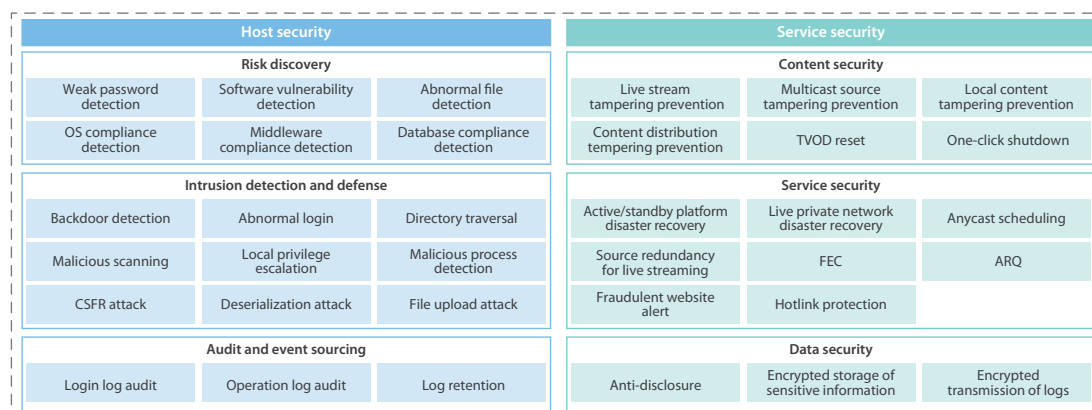
- **Local content tampering prevention:** Using the operating system kernel event-triggering technology, the solution protects the security of the content stored in CDN host servers.
- **Content distribution tempering prevention:** Comparing feature values of the files, the solution safeguards the security of VOD content distributed between CDN nodes.
- **Live streaming tempering prevention:** Implementing tamper-proofing for streaming media based on I-frame and for HLS content based on TS file feature values, the solution ensures the security of live content distributed between CDN nodes.

In addition, in emergency scenarios, the solution offers a one-click shutdown feature to quickly take content offline, minimizing the negative impact of unauthorized content. It also provides a one-click reset function for TVOD to reset any on-compliant content, ensuring compliance and security.

Service Security

To ensure the security of CDN services, ZTE secure CDN solution offers security protection in terms of user service, service quality, source legitimacy, and node disaster recovery. These security measures provide reliable protection and support for CDN services.

- **User service anti-hotlink protection:** User requests are encrypted using algorithms such as AES or MD5 to prevent unauthorized access or hotlinking.
- **Service quality protection:** By utilizing forward error correction (FEC) for live streaming, the solution ensures user viewing quality even in scenarios with a 2% packet loss, without introducing any additional latency. Additionally, the automatic repeat-request (ARQ) technology for VOD enables automatic retransmission of lost packets, ensuring optimal user experience even in situations with a 5% packet loss.
- **Fraudulent website alert:** The system for detecting fraudulent websites leverages big data resources and advanced technologies to build a precise and efficient system for technical blocking and countermeasures.

Host security			Service security		
Risk discovery			**Content security**		
Weak password detection	Software vulnerability detection	Abnormal file detection	Live stream tampering prevention	Multicast source tampering prevention	Local content tampering prevention
OS compliance detection	Middleware compliance detection	Database compliance detection	Content distribution tempering prevention	TVOD reset	One-click shutdown
Intrusion detection and defense			**Service security**		
Backdoor detection	Abnormal login	Directory traversal	Active/standby platform disaster recovery	Live private network disaster recovery	Anycast scheduling
Malicious scanning	Local privilege escalation	Malicious process detection	Source redundancy for live streaming	FEC	ARQ
CSFR attack	Deserialization attack	File upload attack	Fraudulent website alert	Hotlink protection	
Audit and event sourcing			**Data security**		
Login log audit	Operation log audit	Log retention	Anti-disclosure	Encrypted storage of sensitive information	Encrypted transmission of logs

◄ *Fig. 1. Functional modules of ZTE secure CDN solution.*

Its goal is to prevent fraudulent calls, block fraudulent messages, restrict access to fraudulent websites, and prevent fraudulent money transfers.

- **Node disaster recovery:** By utilizing various disaster recovery technologies including Anycast scheduling, private network redundancy for live streaming, source redundancy for live streaming, and active/standby platform, the solution ensures uninterrupted service of CDN nodes even in abnormal scenarios.

Data Security

Sensitive data such as IP addresses, user names, passwords, and email addresses are stored in CDN. To prevent the disclosure of sensitive user data, secure CDN provides a visual management interface for data masking configuration. It adopts AES256 reversible encryption algorithm and SHA256+ SALT irreversible algorithm to mask sensitive data, effectively preventing data disclosure within the CDN.

Host Security

To ensure the security of the CDN host, a comprehensive approach is implemented. Initially, a thorough assessment of CDN hardware and software assets is conducted to identify potential vulnerabilities and ensure compliance. Subsequently, proactive measures are taken for attack defense and detection. Finally, a traceability analysis is performed to establish an integrated host security defense system.

- **Asset management:** This involves managing server basic information, processes, accounts, ports, network connections, and operating system.
- **Risk detection:** This involves detecting risks within the host, such as backdoors, vulnerabilities, weak passwords, trojans, and abnormal files. By identifying these abnormal risks in the host, the system triggers alerts to initiate further inspection.
- **Intrusion detection and defense:** This involves detecting and alerting on threats such as abnormal login, backdoors, local privilege escalation, malicious scanning, malicious processes, and brute-force attacks. It also includes proactive defense against CSRF attacks, deserialization attacks, file upload attacks, SQL injection attacks, and other attack behaviors.
- **Security O&M:** The host security O&M subsystem monitors various security states on CDN host devices, including abnormal processes, operations, account activities, and other exceptional conditions.

Future Product Planning

To improve the security and governance capabilities of CDN, it is recommended to adopt systematic defense and digital operations for product planning. This involves building a layered defense system through capability stacking and using digital metrics to drive security operations, thereby enhancing the practical effectiveness of CDN's security protection. The future secure CDN planning will focus on the following three aspects:

- **Building a unified security platform to simplify management:** Integrating CDN security products with a unified design concept, including platform integration, functional integration, and management integration. This can significantly simplify the complexity of CDN system construction, operation and expansion.
- **Implementing a layered defense system for manageable security risks:** Optimizing closed-loop defense strategies against security threats, and planning based on prevention, protection, detection and response. This enables effective defense against both known and unknown security threats, significantly reducing security risks.
- **Providing security operation tools to improve CDN security intelligence:** Providing methods and tools for security operations to present CDN security effects in real time. This enables targeted analysis of current weaknesses and facilitates the improvement of CDN security management maturity and intelligence level as needed. **ZTE TECHNOLOGIES**

ZTE Brings New Home Video Services to Türk Telekom Subscribers

Turkey, officially known as the Republic of Türkiye, is a transcontinental Eurasian country with a unique geographic position and a rich culture. The country has a total population of 80 million, with a significant proportion of young people. Türk Telekom, the largest integrated telecom operator, dominates the fixed-line market in Turkey, possessing 90% of the country's fiber resources and growing fast in digital services.

In 2020, ZTE began to build a customized end-to-end TV platform for Türk Telekom, and efficiently completed the migration of one million subscribers to the live network within only a year. This migration resulted in a 9.5% increase of the average revenue per user (ARPU) of Türk Telekom's TV bundles. Türk Telekom speaks highly of ZTE's video products.

Türk Telekom and ZTE Collaborate to Enhance TV Experience

ZTE and Türk Telekom have been collaborating since 2011 in sectors such as fixed network and core network. In 2017, ZTE recognized that Türk Telekom's TV services were lagging in service experience and had high costs of operation, maintenance and customization, impacting the competitiveness of the service in the local market. After several meetings and visits, ZTE identified several key issues with Türk Telekom's TV services, including unstable time-shifted TV functions, slow live channel switching, and a slow response of the electronic program guide (EPG). These problems seriously affected the end-user experience and hindered Türk Telekom's ability to launch innovative video solutions and increase ARPU.

To tackle these problems, ZTE quickly offered Türk Telekom an end-to-end solution based on its Big Video products. However, in 2018, due to the financial market fluctuations in Turkey, Türk Telekom did not make a decision on the project at that time.

In 2019, Türk Telekom re-launched the TV project and issued an invitation to tender. ZTE promptly held a video product

Lei Li

Technical Manager of Big Video International Marketing

workshop specifically for the operator, and formed a team comprising experts from various fields to cater to the requirements in the tender.

Compared to the old platform, ZTE's solution has introduced new features in five aspects: a private cloud container solution architecture; over 1,000 customized functions and interconnection with over 10 third parties; customized migration solution to release operator BOSS development workload; brand-new operation solution with a sales promotion system and targeted advertising solution to improve the operator's revenue; and B2B wholesale functions to explore new business models for the operator.

Despite the impact of the pandemic, in May 2020, ZTE's TV project team successfully performed a proof of concept (POC) with approximately 1,000 items. The team set a testing center in Nanjing and held a video conference with Türk Telekom's team. Experts in Turkey, Spain and Serbia participated online in the testing and provided explanations. Through seven days of joint efforts, ZTE successfully completed the testing and convincingly demonstrated its client design, platform service management, and operation and maintenance (O&M) capabilities to the customer. The efficient testing arrangement also showcased ZTE's project management capability. Türk Telekom highly recognized ZTE's solution, and in the autumn of 2020, ZTE was selected for the video project.

The Success of Project Delivery and Migration

Türk Telekom has high requirements for project delivery and customization. As a world-leading provider of video solutions, ZTE provided an advanced video solution — Premium Video Platform (PVP) 2.0 — tailored to Türk Telekom's specific needs. With this solution, Türk Telekom's project achieved the fastest delivery among platform replacement projects of similar scale in the global IPTV sector.

During the solution design phase, ZTE designed a system capable of supporting 2 million IPTV subscribers and 5 million OTT subscribers, based on Turkey's subscriber growth potential. This solution provided access to over 10 types of terminals, including mobile phones, PCs, and smart TVs.

ZTE successfully conducted the research on platform deployment, developed a migration solution, cut over data from the original platform, and migrated the STBs and OTT clients to the new platform. By June 2022, all 1.75 million subscribers on Türk Telekom's TV platform were able to enjoy the new services, which included an elegant UI interaction, personalized content service, and smooth synchronization across different terminals.

Throughout the project delivery process, ZTE collaborated closely with Türk Telekom, establishing four teams focusing on different aspects of the project including client, CDN, service platform, and big data. The project had a delivery staff of over 100, with more than 20 located in Turkey. Each sub-module team had its own project manager, engineering group, R&D group, and testing group, creating a stable team structure.

To accelerate project progress, ZTE implemented a full project delivery procedure, involving collecting customer needs, initiating reviews, solution review, testing, task assignment review, staging platform testing, and ultimately delivering
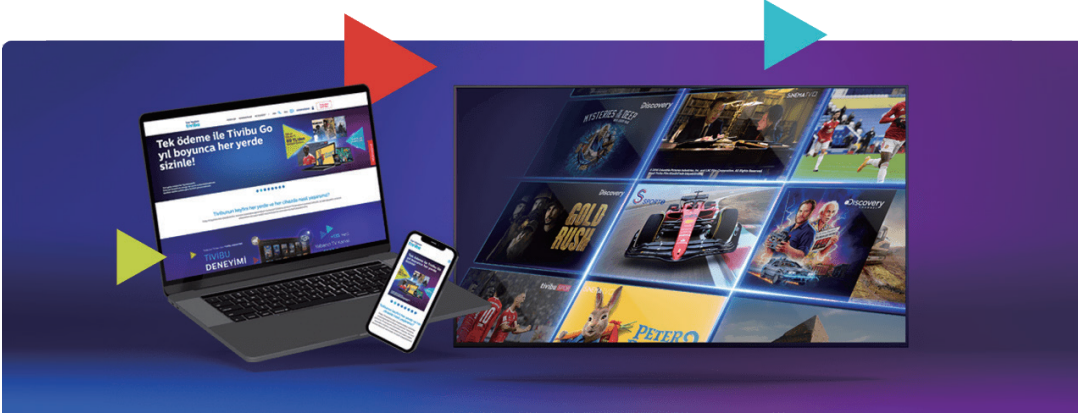
the production platform. By employing efficient project management solutions, ZTE aligned closely with Türk Telekom's requirements. The sub-module teams held meetings two or three times a week with the customer's technical leaders to clarify requirements and provide progress reports. This allowed for prompt detection of any problems or missing information, facilitating resources allocation for problem solving. The project staff in Turkey and ZTE's R&D headquarters arranged daily meetings both respectively and jointly to improve project transparency and address any bottlenecks efficiently. ZTE maintained comprehensive project archives including meeting records, discussions and technical documents to ensure traceability.

ZTE addressed Türk Telekom's requirements for CDN, client, service platform, big data, and migration from signing the project to its delivery by providing suitable solutions. ZTE also introduced services like big data analysis and processing, marketing strategy generation and release (including sales promotion and discounts), and advertising management, while actively embracing Google ecosystem to enable ARPU uplift for the operator. In terms of maintenance, ZTE provided customized migration tools, in-service software upgrades, CDN management platforms, and content multi-DRM encryption to facilitate smooth O&M for the operator.

The migration was difficult as the operator chose to keep existing set-top boxes (STBs) from four different vendors. ZTE designed different migration solutions based on the performance and brands of STBs. To reduce the extra BOSS interconnection workload for the operator during video platform migration, ZTE developed custom migration tools to synchronize and migrate user data, content data, and call detail record (CDR) data between the old and new platforms. ZTE also implemented customized rollback and backup redundancy mechanism to maximize data security and guarantee customer experience. With the help of these migration tools, all the subscribers were successfully migrated to ZTE's new platform.

Conclusion

In November 2022, ZTE's video platform passed the pre-acceptance test (PAC) by Türk Telekom. The two parties celebrated this success together and confirmed video services as a key strategic service for further development.

With the successful commercial deployment of TV services, ZTE will support Türk Telekom in the refined operation of content services. By deploying a new video platform, ZTE will collaborate with Türk Telekom to explore innovative services such as smart venue and VR. Moreover, ZTE will help Türk Telekom further implement wholesale and B2B CDN solutions, enabling them to explore new business models in more industries. ZTE TECHNOLOGIES

América Móvil Strengthens Its Presence in Latin American Pay- TV Market
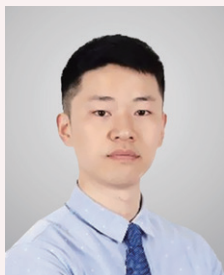
Tu Dezhi

Wireline Product Planning Manager, ZTE

Market Position of AMX in Latin America

América Móvil (AMX), headquartered in Mexico City, is the largest telecom operator in Latin America and one of the world's leading wireless operators. AMX has cultivated its presence in the Pay-TV field over the years, gradually establishing a comprehensive business ecosystem that encompasses various services such as cable TV and satellite TV. Currently, AMX has 21.9 million subscribers, including 14 million TV subscribers. Its major TV services are cable TV and satellite TV, covering multiple countries including Mexico, Brazil, Chile, Peru, Colombia, and five Central American countries. AMX holds a dominant position in the Pay-TV market in Latin America, making it a leading player in the industry.

Pay TV Background

The traditional digital TV market in Latin America has reached its saturation point, with limited room for additional growth. However, there is still a significant number of users who rely on standard definition (SD) set-top boxes (STBs). Therefore, the conversion from SD to high definition (HD) will become a crucial turning point for the traditional digital TV business, especially in countries with relatively low HD penetration, such as Colombia, Chile, and Central America.

The traditional digital TV market is highly competitive, with a narrow range of content offerings. The average revenue per user (ARPU) has been declining year by year, imposing considerable operational cost pressures on operators. Therefore, reducing operational costs is a pressing issue for these operators.

Meanwhile, the widespread availability of broadband has fueled the explosive growth of OTT TV services. Compared to traditional TV services, OTT services offer lower fees and more flexible, personalized customizable options. Mainstream content-rich ecosystems such as YouTube, Netflix and Amazon Prime Video have gained widespread popularity in the Americas, posing huge challenges for traditional operators. Consequently, traditional operators must embrace OTT services and invest heavily in developing IP-based services and a hybrid model of DVB+OTT, as this has become the prevailing trend.

Key Marketing Strategies

ZTE has assisted AMX in attracting subscribers seeking SD to HD conversion at minimal costs. Taking into consideration the challenges faced by AMX, ZTE has introduced cost-effective STBs: B710S2-A10, B710C-A14, B710S2-A16, and B866V2. These devices support MPEG-2/MPEG-4/H.264 HD video decoding, live TV, personal video recorder (PVR), advertising, and UI customization, delivering differentiated video experiences to users.

By supporting both cable and satellite TV services, ZTE's differentiated product solutions cater to a wide range of TV scenarios within AMX. This enhances AMX's product offerings, satisfies user needs, and helps to maintain its competitive edge in the market. Additionally, ZTE maintains close collaboration and interaction with various vendors in the industry chain. Through continuous optimization of solutions, ZTE has successfully helped AMX alleviate cost

pressures and contributed to the future market expansion of AMX.

Constantly Creating Value for Customers

In November 2018, after nearly two years of joint efforts, AMX selected ZTE to provide STB services for its five subsidiaries within six months. AMX's decision has firmly established its presence in the traditional TV market, while also driving the expansion of its new video services. This strategic move has resulted in increased ARPU and an enhanced user experience, making it highly significant.

In 2020, AMX effectively implemented ZTE's end-to-end video solution, bolstering its presence in the high-end market. AMX also adopted ZTE's AOSP-based STB (B866V2) to better meet its market demands. This STB not only supports HEVC/1.2654K video decoding, live TV, VOD and advertising, but also integrates rich content from Google applications and the Google ecosystem. It offers users an immersive 4K video experience, attracting the attention of a large number of high-end users.

In 2022, as the Android TV (ATV) market gradually matured and became a development trend for STBs, AMX sought to maintain its competitiveness in the market by venturing into the ATV business. However, AMX also aimed to save manpower and capital costs while retaining the existing AOSP STBs, with a desire to enhance the user experience. To address these needs, ZTE introduced Google's brand-new variant build approval (VBA) solution. As the world's first operator to deploy ATV with a unified hardware platform for multiple subsidiaries, AMX succeeded in upgrading existing STBs from AOSP to ATV. This upgrade greatly reduced hardware replacement costs, shortened the certification period, and accelerated time-to-market. In addition, mainstream content providers such as Netflix, YouTube and Amazon Prime Video were also incorporated to greatly enrich the ecosystem and enhance customer stickiness. During the early stage of the AOSP project, ZTE worked closely with
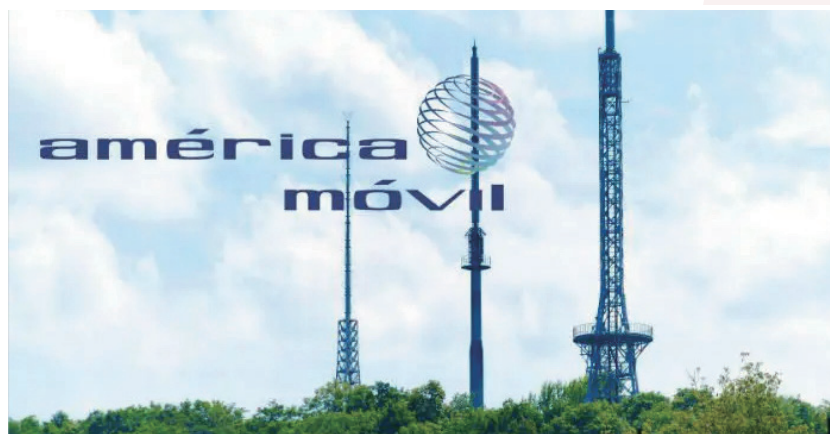
Amco, a platform vendor, the Globalhitss technical team, and UEI, a remote control vendor, laying a solid foundation for the rapid development of the ATV project.

Through its reliable products and services, ZTE has established efficient technical partnerships with third-party vendors and maintained in-depth and effective communication with AMX. With the help of ZTE, AMX has become the world's first operator to successfully deploy the VBA solution. The achievements AMX has made include:

- Migrating existing STBs from AOSP to Android TV
- Saving hardware replacement costs
- Addressing difficult issues of management, certification and deployment in ten countries
- Deploying commercial ATV rapidly in its ten subsidiaries for soaring subscriber growth
- Enriching mainstream OTT video content to enhance user experience and increase ARPU.

The Argentine branch of AMX has become a new end office with millions of STB subscribers, setting a good benchmark for other branches. Moving forward, AMX will continue to work with ZTE to expand its footprint in the high-end market and contribute to the development of Pay TV services in the Mexican and Brazilian branches. Additionally, AMX will consistently prioritize customer value and introduce ZTE's cutting-edge 4K STB solutions to expand its video business, create new revenue streams, and strengthen its market position. **ZTE TECHNOLOGIES**

Concerned About Internet Growth? Get 400G Backbone

Source: CCS Insight

The backbone is the part of the human body that provides strength and stability, holding the skeleton together. We often refer to people with reliable, resilient characters as "having backbone". It's the same in telecom networks, with the backbone providing shape, sturdiness and dependability to the overall system.

Without its backbone, connectivity would not be possible. And as Internet usage grows in volume and complexity, backbone networks must become more robust and capable of carrying the applications of tomorrow. However, there are significant challenges in scaling up backbone capabilities, primarily capacity, distance and energy usage.

The next phase of capacity expansion needed is 400G from metro to backbone networks. The term 400G refers to an optical transport network with capacity of 400 Gbps, a considerable jump in data-transfer speeds. This is driven by the demands of the digital and cloud era, in particular:

Massive traffic volumes generated by 5G, 5G Advanced, fibre-based broadband and emerging service environments such as machine-type communications and ultralow-latency services. 5G needs edge computing architecture, which brings cloud resources—computing, storage and networking—closer to applications, devices and users. However, edge computing demands higher bandwidth.

High-quality cloud interconnection and connectivity with the demands of service-level agreements, driven by standalone 5G and enterprise demand for services such as data centre interconnection. Research suggests that cloud-based data centres will take over 92% of data centre activity.

Fibre resources are relatively scarce in metropolitan area networks (MANs) and data centre interconnection environments, where short transmission distance and higher bandwidth are necessary. Typically, single-wavelength 400G is used. This combines the largest transmission bandwidth and the highest spectral efficiency with the simplest configuration, which effectively reduces transmission costs. Because of its smaller size and simple structure, single-carrier 400G can provide easy network management and low power usage.

However, in the backbone and some more complex MANs, requirements for transmission performance are more stringent because the transmission distance is longer with more network nodes. Here, 400G optical technology can extend the distance to several thousands of kilometres, helping operators deploy 400G backbone networks using as little bandwidth as possible.

400G optical capability has been evolving for the past six years for specific application environments, shown in the timeline below (Fig. 1).
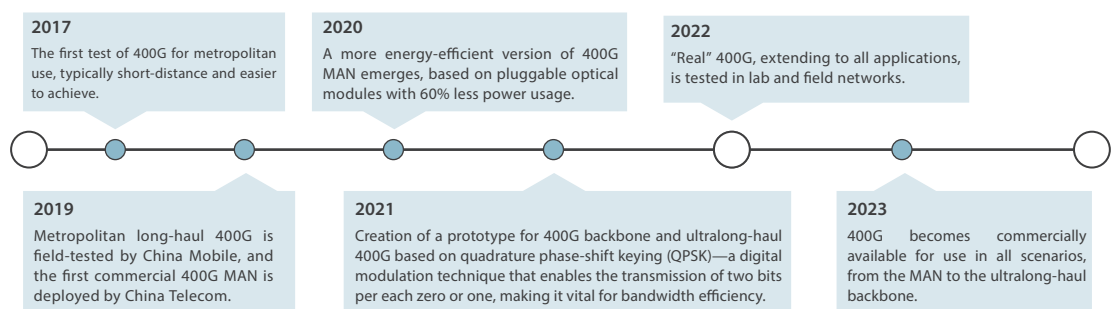
2017
The first test of 400G for metropolitan use, typically short-distance and easier to achieve.

2020
A more energy-efficient version of 400G MAN emerges, based on pluggable optical modules with 60% less power usage.

2022
"Real" 400G, extending to all applications, is tested in lab and field networks.

Fig. 1. The evolution of 400G optical capability for the past six years. ▶

2019
Metropolitan long-haul 400G is field-tested by China Mobile, and the first commercial 400G MAN is deployed by China Telecom.

2021
Creation of a prototype for 400G backbone and ultralong-haul 400G based on quadrature phase-shift keying (QPSK)—a digital modulation technique that enables the transmission of two bits per each zero or one, making it vital for bandwidth efficiency.

2023
400G becomes commercially available for use in all scenarios, from the MAN to the ultralong-haul backbone.

So, what are the criteria for building a 400G backbone? If we think of the backbone network as the highway of Internet connectivity, not only must it be ultrawide in terms of bandwidth, but also ultralong in terms of reach and more energy-efficient than previous iterations.

Ultrawide Capacity

Optical fibre can be divided into several bands, with each being an independent channel to transmit a predetermined wavelength. According to ITU-T standards, single-mode fibre in the range over 1,260 nanometres is divided into six bands.

C-band, known as the conventional band, shows the lowest signal loss and offers advantages in long-distance transmission systems. As transmission distance increases, fibre optic amplifiers are used instead of optical-to-electronic-to-optical repeaters, so the C-band becomes more and more important. With the advent of dense wavelength division multiplexing, which allows multiple signals to share a single fibre, the use of C-band has been expanded. It's typically deployed in urban areas, as well as long-distance and submarine optical transmission systems.

L-band, known as the long-wavelength band, has the second-lowest wavelength loss, so can be used when C-band doesn't meet the bandwidth needs. To deliver ultrawide 400G capacity, the backbone of the future will require the combination of C-band and L-band. Network solution provider ZTE claims that it's the first to complete a network test of this combination to accommodate 400G backbone capacity.

Ultralong Distance

As a transmission technology, optical fibre has many benefits, but it's prone to attenuation or loss as the light signal travels along the cabling. There are various factors that cause this, for example: intrinsic loss, owing to the characteristics of the fibre, such as material absorption; light dispersion loss or structural defects; and extrinsic loss, based on operating conditions like connector loss or cable bending, as light prefers to travel in a straight line.

With longer fibre, these losses can accumulate, so

achieving the ultralong distance required by backbone networks—many thousands of kilometres—becomes highly challenging. This is especially true at higher capacity, as it's also diminished by attenuation. And, as with capacity, new thinking is required so that backbone reach can continue expanding to meet growing Internet usage demands.

Various techniques can be deployed to yield moderate gains in achievable distance, but ZTE proposes that it's only possible to increase the distance capability of 400G networks by up to 60% by combining three technology innovations:

- A new module in 400G QPSK capable of handling 1.2 terabits per second and is able to support up to 130G baud rates
- A 3D fusion package—a modelling tool that unifies design, engineering, electronics and manufacturing into a single software platform. This reduces internal connection distance and improves high-speed signal performance
- ZTE's new Flex Shaping 2.0 algorithm.

This solution was tested by China Mobile in a backbone connection simulation, following a route from Zhejiang to Guizhou. According to the companies, a distance of 2,808 km was achieved, and in an extreme verification scenario the backbone achieved a reach of 5,616 km.

Energy Efficiency

Backbone capacity and distance improvements must not be delivered at the cost of higher energy usage per bit. Here also, ZTE claims that some new capabilities are coming into play: new optical modules can reduce gigabit energy in the backbone by 35%, from 0.275 W to 0.175 W per gigabit—not a bad start.

Accommodating the rapidly rising traffic from Internet usage, and doing so with a phased-in approach to performance enhancement and cost, isn't a trivial task for network operators. 400G backbone represents the next horizon to reach if they're to stay ahead of demand. It won't be the last development in the field, but it does mean that the backbone can continue to provide shape, sturdiness and dependability to the overall network for some time to come. **ZTE** **TECHNOLOGIES**

To enable connectivity and trust everywhere