

ZTE TECHNOLOGIES

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VIP Voice

Bharti Airtel: To Become an 'Open Telco'

Expert Views

A Look into Key Technologies for 8K Services

Special Topic: 5G Video



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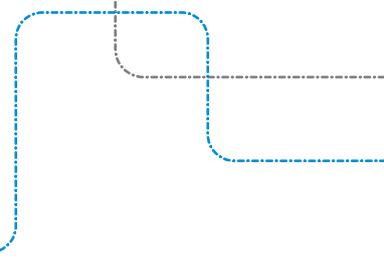
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ZTE Announces a New 5G Axon Smartphone Compatible with SA/NSA Modes

16 December 2019, Shenzhen, China — ZTE announced the latest flagship smartphone ZTE Axon 10s Pro, which is compatible with both 5G SA and NSA modes. This device will be commercially available in China in Q1 2020. Based on Android 10, ZTE Axon 10s Pro is empowered by the new flagship Qualcomm® Snapdragon™ 865 5G Mobile Platform, the world's most advanced 5G mobile platform.

ZTE Axon 10s Pro features the latest Wi-Fi 6 technology that provides users with incredible speeds of up to 1.2 Gbps (laboratory test data) and low latency, especially in crowded environments where many devices share limited network resources. It also supports multiple network connections, allowing users to connect this device to two wireless networks, such as 2.4 GHz and 5 GHz, simultaneously for higher stability and faster speed.

ZTE Axon 10s Pro has a unique advantage of seamless switching from Wi-Fi signals to LTE or 5G networks, due to the link-booster network enhancement solution, which enables an intelligent response to the complicated signal environments through the self-developed high-speed algorithm and smart perception.



ZTE and China Mobile Win 2019 GLOTEL Awards for He-Fetion Project

13 November 2019, Shenzhen, China — ZTE announced that it has been presented with the Project Delivery Perfection award for its ground-breaking contributions to China Mobile's He-Fetion project at the Global Telecom (GLOTEL) Awards 2019 ceremony in London. This award demonstrates ZTE's innovative capabilities and leading position in the rich communication services (RCS) and converged communications field.

The successful delivery of the project marks the commercial use of the world's largest RCS office, which is a significant step for the development of the global converged communications industry.

As a strong supporter of China Mobile, ZTE has witnessed and participated in the full process of China Mobile He-Fetion project.

In addition to the Project Delivery Perfection award, ZTE also won the Highly Commended Award in the categories of Telecoms Transformation award and the Industrial IoT Initiative of the Year, as a result of its 5G E2E Slice Solution and NB-IoT Massive-connection & multi-service Virtual-verification Platform Solution (NMVP) respectively. These awards recognize ZTE's industry-leading approaches to 5G business models and IoT.

ZTE and China Telecom Launch World's First Commercial 5G Magnetic Levitation High-Speed Network Test

29 November 2019, Shenzhen, China — ZTE and China Telecom have jointly launched the world's first commercial 5G magnetic levitation (maglev) high-speed network test in Shanghai, China. The test measured communications within a train travelling at a

maximum speed of 500 KM/h. During the test, the 5G commercial terminal was stable and easy to support various high performance mobile broadband services, demonstrating that the 5G network can provide high-speed maglev trains with ideal broadband communications.





Airtel CTO Randeep Sekhon

Bharti Airtel: To Become an 'Open Telco'

Reporter: Liu Yang

With customer centricity central to its strategy, Bharti Airtel (also known as Airtel) is trying to turn itself into an open telco. "Open network was only for the network; and open telco encompasses the entire company—right from customer care, product, brand, network and IT," said Airtel CTO Randeep Sekhon, who talked about the company's strategies, opportunities as well as emerging technologies like 5G and AI in an interview with ZTE Technologies. Airtel is a leading global telecommunications company with operations in 18 countries across Asia and Africa. Headquartered in New Delhi, India, the company is the world's third largest mobile service provider globally in terms of subscribers.



"Customer centricity is the focus of any service in the industry, but more so for us"

What kind of role is Airtel playing in the telecom sector in India?

Telecom sector has a big impact on a country's economy. It provides the essential connectivity that has a direct impact on—businesses and people. We are moving towards a digital economy where the backbone is seamless connectivity. Airtel does its part in connecting

businesses, workers, farmers, in urban as well as rural areas. Airtel has been the No. 1 operator for a long time. We have always maintained the need to provide good quality and experience for voice and data for both retail and enterprise customers. We support the Digital India initiative with an aim to empower more and more Indians and Indian businesses.

China is a successful example where companies like Baidu, Alibaba and Tencent are successful because they have transformed into digital companies. These companies are supported by companies like China Mobile and China Telecom

to connect their data centers to run their businesses and support users to use their services. I think the same thing is what Airtel is doing for Indian consumers and industries.

Airtel is very customer-centric and has already launched Open Network Initiative and Project Next. How do you improve and differentiate your customer experience?

Customer centricity is the focus of any service industry, but more so for us. If I speak from the technology side, we need to be able to provide a good experience to our customers in the form—quality data, quality voice and quality customer service. We are working towards being entirely transparent to our customers and towards becoming an ‘Open Telco’.

Open network was only about the network but open telco encompasses the entire company—right from customer care, product, brand, network to IT. Our intention is to share information that affects the customer and ensure that we are totally transparent with them. We don’t think good experience is about giving the top speed. It is about giving them a good experience whether they are watching a video, playing a game, or doing any online transaction. We analyze customer level data and strive to solve issues that are hindering a great experience that we intend to provide.

We want to be where we can predict that the user experience is going to go bad, and we fix it before that. We have to move from being reactive to pro-active.

So you are evolving to meet the increasingly sophisticated demands of customers.

Absolutely. Customers are very demanding. They consume a lot of services now. Mobile is central to a customer’s universe whether it is a journalist, banker, taxi driver or from any

walk of life. Each have their own specific demands which need to be met.

Traditionally, legacy networks weren’t so sophisticated but now to deploy our network we work with partners like ZTE for improving network experience, handset manufacturers because handsets play a big role in the customers’ experience, and content providers like Amazon, Netflix and YouTube for delivering faster and seamless service. We also work with gaming providers so that we have minimal latency on our network.

There is a lot of collaboration required and dependency on external entities to provide top quality customer experience unlike before when it was just the network that needed to be streamlined.

“Once technologies like 5G come in, we can do much more in the enterprise business”

The ARPU is going down as a result of price wars in India. Where do you think the new revenue opportunities come from?

It did go down from earlier times but now it has been stable for one year. In fact, Airtel has started seeing mobile ARPU go up. But there are many opportunities for telcos like us to get more revenue. I think one big opportunity is enterprise business. We have a very strong enterprise business, which is purely connectivity, IPLC, leased line and internet. We do have data center, security, SD-WAN, and things like that. But I think once technologies like 5G come in, we can do much more in the enterprise business. As enterprises start to use more automation, more digitization, they will need telcos to support them. That’s one place where we can go.

Home broadband is another place where we can go. We have not seen in India so much ARPU drop in broadband. We still feel fiber to home business has a huge potential.

We also have DTH business where we give



digital TV to consumers. I think that's another business which is growing. More people are moving from cable to digital TV.

Overall, Airtel has the primary mobile business, which is stable now and growing, enterprise business, which is growing well, broadband business and DTH, which has a lot of potential and is growing.

5G and AI are expected to enable intelligent networks and change industries. What do you think of the transformational potential of this combination?

I think AI and machine learning technologies are two tools which are helping us manage this complex business. Looking inward (within Airtel)—we have such a complex network, which cannot run purely by traditional methods, so we have realized the need to automate processes, such as in our NOC where we do the RCAs, correlate alarms, generate auto tickets, and predict customer experience. These things allow us to be proactive. But I think it is a journey that has just begun. Once 5G comes in, we would be able to process the data faster and move to the

edge. I think that will enable a lot of theoretical use cases to become functional.

In China, Shenzhen is one city that has been successful in making the city secure using AI and high-speed connectivity. I think once the connectivity in India improves further possibly with 5G coming—and you have laid out AI use cases—there are a lot of opportunities to do.

If you take it outward—for enterprises, using AI tools, I think enterprises can become more efficient and competitive in the global landscape. This would mean higher chances of being successful.

Which areas will 5G and AI get applied first?

5G would enable the network to move to the edge. Airtel itself can become proactive and efficient internally by using AI & 5G and provide eMBB and fixed wireless experience to our customers.

Like China, India has many OTT companies like digital banks, OTTs for content, gaming, food delivery etc. I think these companies can become excellent beneficiaries of it. Marketing companies can use them to target better

propositions for their customers. AI has the potential to disrupt any industry. I think this is where a lot of legacy industries can progress very fast if they start using it.

“We need all stakeholders to come together”

In a telecom market as dynamic and challenging as India, what are your strategies going forward?

Customer centricity is our only strategy if you ask me. Everything for the customer whether it is the network experience, the billing and payment experience, the product experience or the experience at the Airtel stores. For doing that, we want to do simplification, automation and standardization. We want to produce the lowest cost per GB so that we can compete in a two dollar ARPU market.

We also want to work with our people. All leaders need to develop a digital mindset and get used to this technological shift. I think this new DNA in our workforce and our leadership will help us compete better.

Last is our win-win relationship with our partners like I have explained to you about customer experience. We cannot do it alone so we need our OEM partners like ZTE, handset partners, content partners and infrastructure partners. So we need all stakeholders to come together.

How do you view the future? And what's your expectations from ZTE?

We depend a lot on partners like ZTE to innovate and bring new use cases relevant to India market. And we also want them to help us in digitization and automation because we feel this whole complex network should do away from manual processes and strive to become completely automated. To go along this automation path, a partner like ZTE is a boon to have.

There is also a need to have tailor-made solutions for different needs across India.

For example, rural India cannot be dealt with the same way as urban India hence it needs a different solution to establish a win-win situation for customers as well as Airtel.

Another thing we need from our OEM partners is to be future-ready. I want every investment we are making now should make its way to new technologies. We should reuse our investment as much as possible. Let's say, if I buy a BBU for 4G, tomorrow I have to bring 5G in the same site; then I should be able to add 5G services on this BBU and probably bring radio for sub-6 GHz or another 5G frequency. Since it is an investment-heavy business, our capital expenditures need to be future-ready and serve for a longer period of time.

How do you evaluate ZTE's innovation capability in the 5G arena?

I think ZTE really has really bridged the gap. They are the top supplier as far as the 5G is concerned, especially with their experience in the China market. Now China has taken a big leap in front of the world in 5G. China has had big city launches and are adopting 5G and bringing a lot of B2B use cases along with eMBB. I think ZTE has a dominant role to play with Chinese operators. We can learn a lot from that and use those experiences in India as India gets ready to deploy 5G.

I see technologies like Massive MIMO where ZTE has done a lot of research, in hardware, which are sporting different technologies, in core & transport network. I think ZTE has now the full portfolio, especially as the dependence on external suppliers is less. Being vertically integrated, that is, having your own chip, your own data base allows ZTE to maintain a strong business continuity. This strategy has served ZTE really well. I think this allows ZTE to gain good business traction in the 5G market. **ZTE TECHNOLOGIES**

A Look into Key Technologies for 8K Services



Wang Jindong

Chief Engineer of FM Product Line, ZTE

8K Development

With video information and UHD becoming the dominant trends, 8K UHD technology has showed remarkable improvements in resolution, frame rate, color depth, color gamut, high dynamic range (HDR) and multi-channel audio, delivering a more striking and immersive user experience.

8K is mainly used in the entertainment industry such as live event streaming, digital signs, movie theaters and VR videos/gaming, as well as in vertical industries such as video surveillance, video conferencing, remote health care and industrial inspection. At present, the development of 8K technology can be divided into the plane, VR and holographic stages.

- **The plane stage:** The 8K display approaching the limit of the human eye mainly improves the user experience from the color gamut, frame rate and contrast. The 8K end-to-end industry chain is basically available, but 8K content is still scarce due to limited production time and costs.
- **The VR stage:** When moving from the

plane stage to the immersion stage, 8K resolution is just the beginning. 8K VR delivers a similar viewing experience as that of 480p TV. To achieve the same experience as that of a 4K TV, 24K VR is required. To cope with the pressure on transmission bandwidth caused by massive concurrent data streams and to keep the service latency less than 20 ms, content delivery networks (CDNs) need to move closer to the network edge. In addition, VR projection mapping and rendering impose extremely high requirements on computing capability, so cloud VR becomes the best choice for VR.

- **Holographic display:** Currently, VR content is only displayed on the spherical surface, which easily

causes visual fatigue. In the future, holographic display will be the ultimate display technology that reproduces realistic 3D images. The emerging light field technology is considered as the ideal solution for a holographic display.

8K Technology

The above-mentioned development trends show that 8K imposes higher requirements on video production, distribution, and display.

Video Production

8K video production involve key technologies such as projection mapping and encoding & transcoding.

- **Projection mapping:** The current 8K VR content usually adopts equirectangular projection (ERP) or cubemap projection (CMP), both of which have seriously uneven projection saturation. This causes the waste of pixels in some regions and insufficient pixel density in some other regions, which degrades the video quality. Therefore, to enhance video quality, the non-uniform mapping technology, such as equi-angular cubemap (EAC) projection, is preferred, which helps distribute pixels evenly over a sphere.
- **Encoding & transcoding algorithm:** H.265 as the video compression standard is used for 8K video. However, the high bitrates between 80 and 150 Mbps required by 8K video are not beneficial for storage and transmission. AV1 has not been put into large-scale commercial use yet. The H.266

and AVS3 algorithms, with standards still being formulated, are far from mature commercialization. Therefore, ZTE has optimized the mainstream H.265 algorithm and developed the H.265S video encoding solution based on the intelligent analysis framework. Compared to H.265, H.265S can reduce bitrate by more than 30% while offering the same user experience. It is fully compatible with H.265 and is transparent to downstream products such as CDN and terminals. With superior encoding performance, it won Video Compression Great Challenge at the IEEE International Conference on Image Processing (ICIP) recently.

Distribution

8K distribution involves key technologies such as CDN sinking, low-latency transmission, and transmission bandwidth optimization.

- **CDN sinking:** To avoid congestion of backbone network and guarantee VR service latency, CDN must be deployed at the edge of the metropolitan area network (MAN) close to the users. Given different network types and sinking locations, the sinking CDNs can be divided into three types: MEC-vCDN, BRAS-CDN, and OLT-CDN. MEC-based vCDN deployment is mainly used for 5G and fixed-mobile converged networks, and it provides services close to users based on technologies such as containerization, edge scheduling, scheduling and orchestration synergy, QoS assurance, hotspot



distribution optimization algorithm, and open capabilities. BRAS-CDN refers to the CDN embedded in the BRAS of the fixed network to save space. OLT-CDN refers to the CDN deployed at OLT with no extra space and power required while supporting IPoE and PPPoE user services.

ZTE is the only vendor in the industry that provides BRAS-CDN and OLT-CDN products.

- **Low latency transmission:** Due to defects in the adaptive bitrate (ABR) implementation mechanism and TCP protocol, the end-to-end transmission latency is relatively high, resulting in a poor user experience. The mainstream low-latency technologies being studied include common media application format (CMAF), quick

UDP internet connection (QUIC), and low-latency HTTP live streaming (LL-HLS).

- **Transmission bandwidth optimization:** The transmission bandwidth optimization technology reduces the transmission bandwidth for a single user or a group of users. For single-user VR transmission, the main development trends are field of view (FOV) and FOV+. FOV transmission overlaps a low quality background stream with a FOV stream to ensure high quality within the FOV while reducing the quality outside the FOV to reduce the transmission bitrate and performance requirements on the server and client. In 2018, the MPEG has released the omnidirectional media

application format (OMAF) v1.0 specification, which includes FOV. FOV+ transmits images with a slightly larger angle than FOV to cope with the network and processing latency. Compared to FOV, this technology consumes less transmission bandwidth. However, when a user turns the head very quickly, there will be blank areas in an image. The FOV prediction technology is required to predict the user's head movements so as to transmit images in advance.

The technology to reduce multi-user transmission bandwidth is moving towards mABR+M-FOV. The mABR technology converts the unicast ABR protocol into the multicast protocol for multicast transmission. M-FOV is the multicast transmission technology for VR FOV. It transmits the background stream for users watching the same channel via multicast and FOV stream for each user via unicast.

Video Server

For 8K videos, the ultra-high performance video server is essential to make content distribution more economical. At present, the throughput of a general server is usually 20 Gbps, while the bandwidth required by an 8K user is 150-200 Mbps. For massive concurrent users, this is not economical in terms of construction costs, space of access office, and energy consumption. This year, ZTE is about to launch its ultra-high performance video server specifically developed for 8K/VR, which can provide the industry

leading throughput of 200 Gbps.

Display

Besides the above-mentioned key technologies, 8K display also involves image enhancement. This new technology uses frame interpolation and super-resolution to enhance video quality. At this stage when 8K content is limited, terminals can use AI technologies to improve the frame rate and resolution of 4K or even HD videos to bring a better viewing experience.

Conclusion

Based on years of experience in the video field, ZTE has provided domestic and foreign customers with highly competitive Big Video solutions for individuals and vertical industries. These solutions have been widely used in the industry. At the 2018 World Conference on VR Industry, ZTE and China Telecom teamed for live broadcast of the beautiful scenery of Lake Baiyangdian in Xiong'an New Area with 5G+8K VR. In March 2019, ZTE and the Shanghai Branch of China Telecom broadcast the 26th Music Festival in China live with 5G+4K and 8K+VR. In August 2019, ZTE and the Shanxi Branch of China Mobile have collaborated to deliver China's first 5G sporting event with the broadcast of the country's second National Youth Games.

The continuous success of 8K trials will bring about not only a brand new video experience but also more and more business models, thereby promoting the rapid development of 8K services. [ZTE TECHNOLOGIES](#)

Accelerating the Deployment of CDN



Zhang Yu

Chief Engineer of CDN Product Line, ZTE

While video service is moving towards UHD and immersive experiences, 5G will be used to handle bandwidth-hungry and latency-sensitive services, such as AR, VR, and 4K/8K, which helps promote the further development of UHD live broadcasting and VoD. By 2022, UHD-based IP VoD is believed to account for 22% of the global IP video traffic and UHD 35% of the global VoD IP traffic. To meet the ever-growing demand for user experience, operators are accelerating the deployment of CDN in the following aspects to achieve the distribution of UHD videos and new services.

CDN Nodes Closer to Users

For dense places with large video traffic, such as college campus, business center, metro, railway station, airport, residential district, and island, CDN edge nodes can be introduced to offer indiscriminate service to both internet content and video content for fixed and mobile users. This increases utilization of the CDN server, reduces pressure on network backhaul, and improves user experience. As HD and UHD video traffic surges, it is difficult to deploy CDNs in a centralized manner due to limited conditions of some BRAS offices. In this case, the built-in blade mode is preferred for CDN deployment.

ZTE's CDN sinking solution integrates CDN boards into the OLT/BRAS to move CDNs closer to the network edge. For example, video contents are pushed to the mobile network edge of traffic-heavy areas such as college campus, enabling a better user

experience with large bandwidth and low latency. This also saves 10%–15% of transmission resources and reduces operator Capex. In the future, the built-in blades of OLT can be used as the NFVI infrastructure to be deployed in the access office.

The storage of a built-in CDN is usually limited. To improve the hit rate of edge nodes, ZTE adopts a decision support system to predict and analyze popular content of each area and each node. This enables intelligent distribution of popular content, reduced traffic load on backbone networks, and faster response times. The stuttering rate is reduced from 3.5% to 0.8%, the average latency of the first packet shortened from 109 ms to 20 ms and the byte hit rate increased from 70% to 93%.

Improving Performance of Streaming Devices

With a large-scale introduction of 4K, 8K, and VR

services, the construction capacity of CDN will grow by 4–8 times, which significantly increases the construction costs of the CDN and bearer networks. Since costs will be huge if additional hardware is added to meet the growing service requirements, it becomes critical to develop a new CDN device with high throughput, low power consumption, and large storage.

This year, ZTE will launch its high-performance and high-throughput CDN streaming server VS3000T. The throughput of a single CDN server can reach 200 Gbps, capable of serving various new services in the 5G scenarios. For example, it can fulfill the distribution and service requirements of 8K UHD videos, 4K UHD broadcasting and 8K VR, saving investments for operators.

Optimizing Experience with Technologies

To continuously improve 5G video experience, the video transmission and service stages adopt optimization technologies like fast loading, fast first-frame delivery, FCC, FEC, M-ABR, and JITX. In addition, ZTE's industry-leading OTT low-latency multicast technology reduces the end-to-end latency to less than 1s by virtue of the CMAF and Chunk low-latency transmission technologies. Based on this, ZTE has launched the 5G Smart Stadium Live Broadcasting solution, aiming at large events such as sporting games. Harnessing 5G, this solution integrates multi-angle UHD live broadcast, MEC, 360-degree video stitching and rendering and AI recognition, delivering an innovative, multi-angle viewing experience to users.

Coordination of CDN and MEC in the Future

Operators have rich basic network resources, unique capabilities in edge connection and cloud-network integration, and well-reserved facilities such as access offices and hardware. With the improvement of edge computing in the 5G age, operators are accelerating the deployment of MEC CDN, considering the similarity between edge cloud and CDN in terms of service and deployment location.

ZTE and China Mobile have started to coordinate the layouts for edge cloud and CDN resources in a phased manner, in order to deploy the CDN on the network edge and use it as the MEC basic resource platform. Their coordinated development can be achieved through the following aspects.

- **Equipment room:** Both the CDN and the edge cloud provide services for nearby users and have similar deployment locations; thus, they can be co-located to reuse the equipment room of the CDN service in the early phase.
- **Basic resources:** The CDN and the edge cloud occupy different types of resources. Research shows it is feasible to use idle resources of the existing CDN, and the plan is to use the edge cloud to carry multiple types of services.
- **Capabilities:** The CDN can open up functional modules/components of video applications (e.g. codec, content stitching, and transcoding) to the edge cloud platform. The edge cloud can provide CDN services with rich open capabilities and services, such as QoS, positioning, image recognition capability, and video quality enhancement, to meet new CDN service requirements.
- **Network:** With the rapid growth of 5G traffic in the future, the CDN serving mobile users will move closer to users as required. Since fixed-mobile convergence will be the trend for the edge cloud, the CDN will be capable of providing video services for both fixed and mobile users.

In these ways, ZTE deeply integrates the 5G network and the MEC CDN platform, and optimizes user experience with industry-leading technology.

The future of CDN will focus on providing more real and immersive video service experiences for more diverse scenarios. By virtue of cutting-edge technologies and MEC, the CDN will develop in a more intelligent and highly integrated manner, providing home and enterprise users with a better experience of 5G video. **ZTE TECHNOLOGIES**



Big Video Innovation Is Moving Forward in 5G Era



Yin Qin

General Manager of
Multimedia Video
Conferencing
Products, ZTE

5G networks have the characteristics of high speed, large capacity, low latency and low energy consumption, which will lead to great changes in all industries of the society, especially the video industry. As a mature 5G application scenario, video will embrace more promising prospects in the future. With 5G networks, high-quality video content such as UHD, 4K, 8K, and 120-frame videos will become popular for consumers, and VR, AR, interactive video, and AI-based video content will be their next hot videos. Paid video content will also change in intelligent distribution mode such as advertising, and the use of big data and AI can make video content target the right audience, which will improve video revenues.

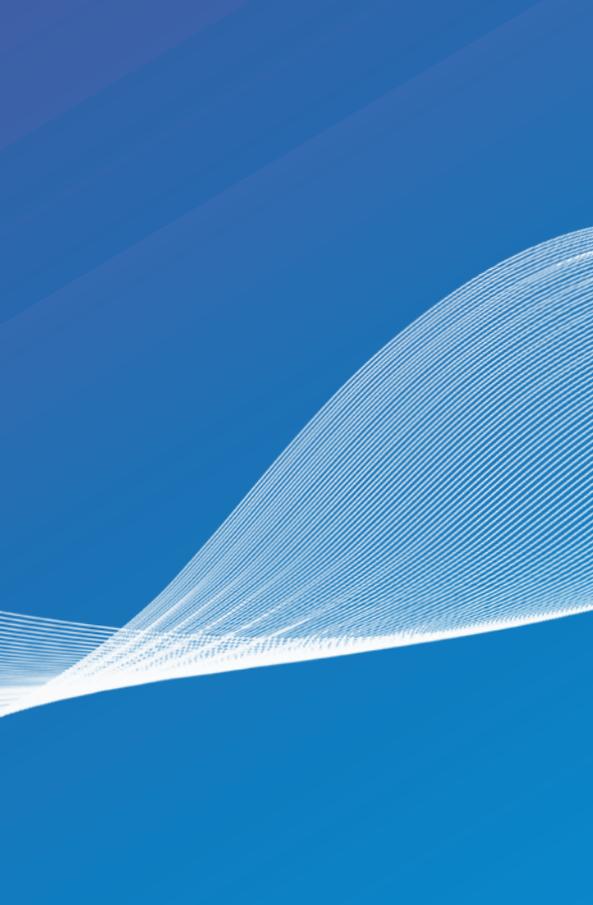
5G Video Features

More Video Applications

As 5G is widely adopted, there will be more video applications such as 4K/8K videos, VR immersive experience, AR, ultra-low latency live broadcast, high-speed mobile video communication, mobile communication in a crowded environment, as well as multimedia and IoV. In the 5G era, UHD video and ultra-high speed will greatly meet people's daily video viewing needs.

More Content Generated at Network Edge

More video content will be generated at the network edge, completely changing the traditional 4G architecture where content is generated and distributed from the center to



the edge. Live TV, live press conference, live broadcast and other user-generated content (UGC) are all typical scenarios in which the content is produced at the edge.

Fast Collection of Multi-Channel Video News Materials

5G networks enable faster collection of multi-channel video news materials for scenarios such as live streaming from smartphones and interactive video connection.

Gradually Enriched Multi-Form Content

Mature 5G networks will allow various terminal users to easily experience UHD services and gradually enrich UHD content in various forms, thereby enabling users to pose higher requirements on HD video services.

Development Trends

5G networks provide more development opportunities for the video industry. Continuous technical explorations have been made in the

fields of high-quality video experience (4K, 8K, and VR), diverse video services (long videos such as movies and TV series, social videos, and live webcast), content security (storage, transmission, and copyright), video user profile and operation, and CDN (MEC-CDN, P2P-CDN, VCDN, and MESH-CDN). Cutting-edge technologies such as cloud VR, virtual set-top box (vSTB), MEC CDN, and automatic multicast tunneling (AMT) are also constantly being explored and innovated.

Video Experience

There is still a long way to go from video technology to video service. Beside the video technology itself, the service platform also needs to be built. Video attaches great importance to a complete end-to-end procedure. During the live broadcast of a sporting event, videos captured by on-site cameras are transmitted through the network, stored and transcoded in the cloud, then transferred to the platform layer for content delivery and media resource management, and finally played at the terminals. The CDN-related work involves network resource scheduling, node management, route planning, route node tuning, and even million-level concurrent balancing and P2P content distribution and transmission. Only when a complete chain is formed from capture to terminal playback, can the video content be broadcast smoothly and with high quality.

Copyright Protection

4K UHD content has high market value due to its scarcity. Its production cost is twice that of HD content, and its production cycle is 1.5–2 times that of HD programs. This brings huge challenges to the copyright protection of 4K content, which requires an end-to-end DRM protection solution.

The consumption scenario of 4K UHD content involves content provider (CP), service provider (SP), and content consumption (CC), which belongs to a complex many-to-many scenario. Therefore, 4K copyright content requires an end-to-end digital copyright protection system that takes into

consideration the interests of all parties. To meet the requirements of future network copyright protection, the new-generation DRM requires unified content encryption implemented at the front end and unified content encryption pre-deployment supported at the terminal side.

Performance Enhancement

At present, the average 4K content bitrate of internet videos is about 18 Mbps, which basically follows the lowest standard of 4K content production. Actually, the bitrate for standard 4K content production is 36 Mbps. After 4K content prevails, internet video traffic will be 4–6 times that of existing traffic. As 8K content enters the market, the traffic of VR content (3 times as much as common videos) will increase considerably with service exploration. Due to the huge cost of stacking hardware to meet service needs and the non-linear growth of construction increment and growth rate, a new CDN device is needed that provides high throughput, low power consumption and large storage. Now the high-performance device with a throughput of 90G has entered the market, and the concurrent throughput of a single commercial CDN device is expected to exceed 200G in 2020.

Smart CDN Delivery

Smart distribution and scheduling are implemented based on big data (video quality and hot content distribution). Big data can be fully used to mine edge nodes to implement log access, apply the best indicators of AI algorithm, and realize accurate scheduling of CDN transmission based on quality dimensions such as service success rate and back-to-source rate.

5G Video Innovations

Cloud VR

According to IDC's *China Quarterly Augmented and Virtual Reality Headset*

Tracker released in the first quarter of 2019, strong growth was expected to continue in China in 2018 as the shipments for VR headsets climbed to 1.168 million units. IDC forecasts shipments for VR headsets to reach 10.501 million units and shipments for AR headsets to reach 8.214 million units in China in 2023.

The existing VR will coexist for a long time with 5G VR. Existing VR users, especially professional ones, need local rendering and control, which poses higher requirements on VR devices but delivers an ordinary user experience. However, in the 5G Cloud VR mode, the data is transmitted to the cloud through a 5G network, and then the processed data is sent to a VR headset. In this process, the VR headset becomes a terminal that receives and sends signals and displays content. It only needs little edge computing capability to drive the operation of the entire system. With less power consumed as a result of lower requirement for chip performance, the VR headset will have a better battery life. Moreover, the 5G network has a more powerful geo-location ability, which also improves VR user experience to a certain extent.

5G Live TV

UHD videos and VR live broadcast of sporting events impose higher requirements on network bandwidth and latency. MEC can move video sources and relevant IT apps down to the vicinity of the stadium to create a network environment with high performance and low latency. Using MEC and low-latency encoding technologies, the end-to-end latency of live broadcast can be reduced to less than one second, which greatly improves the spectators' experience of watching the event.

By using AI and other application capabilities deployed on the MEC cloud platform, videos can be analyzed and processed to offer value-added services such as scene capture and action recognition. In a traditional large sporting event, on-site spectators cannot see

the details of the game due to the restrictions of viewing distance and seat position. However, with the 5G Live TV solution, spectators can use their smartphones to make the cameras lock on a certain player or a specific angle, zoom in or out views on the screen to see the details, and can also rotate views 360 degrees to enjoy a personalized game-watching experience.

Short Video

The application and popularity of 5G technologies will promote rapid development of the short video industry. 5G technologies will bring a new visual, full HD, and ultra smooth viewing experience. Videos will have more saturated, bright and natural colors. Moreover, with the help of multi-screen display, multi-scene, multi-space adaptive rich media technology as well as cool technologies such as AI intelligent editing and full-terminal edge computing, short video is becoming the next-generation immersive media ecosystem.

5G technologies will upgrade short video experience and expand its application scenarios. Download HD and upload bandwidth guarantee all greatly improve the quality of short videos. Besides the basic content, 5G will also penetrate into application scenarios such as video social networking service (SNS) and distance education.

The most extensive applications of AI in short videos are personalized recommendation and targeted advertising, which makes full use of data and value brought by users. With the continuous development, AI has also made achievements in assisting users in content production and smart operation. Smart covers and subtitles, real-time beautifying and reshaping, and even face exchange and action generation all appear in the creation of short videos.

The number of short video users in China reached 249 million in 2019. In the 5G era, the biggest traffic problem in video SNS will be solved. SNS is the most fundamental value in the video era. It is expected to build a user-centered

SNS to promote in-depth social interaction and the boom in short video SNS. In the e-commerce field, short video has also shown its product selling capability, highlighting its future business value.

Interactive Video

Interactive video refers to a technique used to blend interaction and linear video. As the broadband access speed increases and the multimedia broadcast technologies mature, more and more interactive videos emerge. At the beginning, most of these short videos are advertising videos sponsored by advertisers, using a variety of amazing interactive ways to attract people to click and watch their products and make them more exposed. Now there are all kinds of companies specializing in the design and production of interactive videos. Individuals can also easily create interactive videos on YouTube.

There are three types of interactive videos: customizable, conversational, and exploratory. The exploratory interactive video is relatively new and generally provides few tips or even no tips, allowing users to explore interactive points and ways in the video. This type of videos usually adopts real-life scenes to make viewers feel more immersive. Before a user operates, the video is played in a cyclic manner until the user finds the interactive point.

Prospects

In China, there are more than 700 million online video users, and the number of consumers who are willing to pay for video services is still growing. As 5G networks are widely deployed, viewers will pose higher requirements on online videos. In the future, more and more breakthroughs and innovations will be achieved for online videos, which involve improving video quality, providing a clearer, faster and more diverse audio-visual enjoyment, and bringing a new experience to users in the fields of 4K, 8K, VR, holography and short video. **ZTE TECHNOLOGIES**

Creating New Video Experience in 5G



You Hongtao

Chief Planning Engineer
of ZTE's DHome Products

Video service, the focus of users' attention, has become an indispensable way of life for people to obtain information, leisure and entertainment. Both long and short videos are in a stage of rapid development. As 5G network develops, its high reliability, high bandwidth, and low latency features will promote the rapid development and continuous innovation of video terminals in terms of shape, control mode and service mode, and deliver a brand-new experience to users.

New Video Terminals Bring High-Quality Experience

4K video can meet the high-quality requirements of home users for video definition, but there is still room for improvement in sound quality. Due to the limitations of equipment configuration, the combination of a common video terminal and a conventional TV set is difficult to offer high-quality sound effects like Dolby 5.1 surround sound. However, the cost of configuring external devices

such as power amplifiers and high-quality speakers is relatively high.

To meet the above needs, ZTE has developed SoundBar terminals that integrate media players and high-quality audio devices. The SoundBar terminals can play UHD videos with high-quality sound effects, allowing users to enjoy a superior viewing experience at a reasonable price.

New Technologies Bring Changes to Terminal Control

The far-field natural voice interaction technology at a distance of three to five meters enables the control of terminals through natural voice interaction. This technology has matured, and has been gradually applied on terminals.

The process of converting natural voice into device control commands requires the cooperation between the local terminal and the remote system. The local terminal collects voice information and uploads it to the remote voice processing system for speech semantic analysis and control command conversion. After the

completion of the processing, the remote system feeds back to the terminal. The whole process requires at least two network interactions. The reliability and timeliness of an access network are the basic guarantee for a better voice interaction experience. Mobile 5G networks featuring high bandwidth, high reliability and low latency can provide reliable service guarantee for real-time voice interaction and meet the growing demand for voice services.

Integrating AI and IoT technologies will make man-machine interaction more intelligent and easy to operate. The new control mode will be extended to all smart home devices.

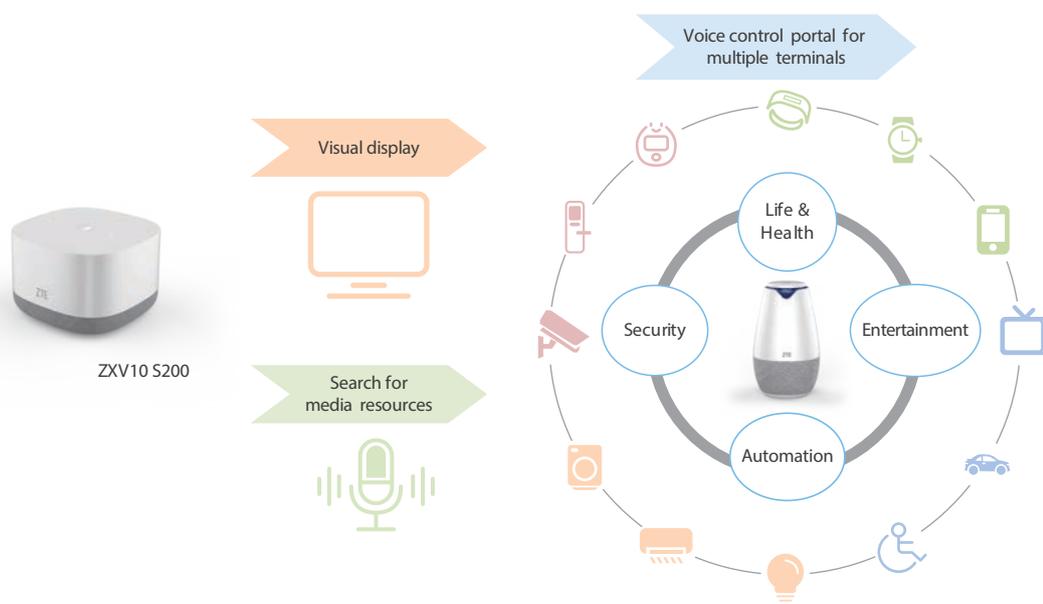
- **5G + AI + far-field voice:** The far-field voice technology allows users to use their voice for operations such as content searching, video control, information input and device configuration, which completely changes the terminal control mode by offering a true hands-free user experience. The integration of 5G MEC and AI enables intelligent voice interaction. Multimedia terminals can be upgraded to smart terminals providing new services that involve accompanying the elderly and educating children.
- **5G + IoT + far-field voice:** By integrating IoT and far-field voice technologies, video

terminals can control smart home devices through natural voice interaction. The traditional complex button and panel control can be simplified to voice commands for device control, and thus video terminals evolve into the control center of smart home.

ZTE has launched a series of smart voice terminals that integrate far-field voice, AI, and IoT technologies. With these smart voice terminals and the video system, ZTE is actively developing scenario-oriented and intelligent far-field voice control services, thus evolving video services towards intelligent voice control (Fig. 1). This allows users to enjoy a brand-new viewing experience and helps operators enhance customer stickiness while expanding new service opportunities.

5G-Enabled 8K and VR/AR Bring New Video Experience

8K video has a resolution of 33.18 million (7,680 × 4,320) pixels, four times the pixels of 4K video. 8K UHD will become the mainstream of the industry in the next two to three years. The gigabit access bandwidth, millisecond low latency and high reliability of a 5G network are naturally integrated with 8K UHD video



◀ Fig. 1. Application scenarios of far-field voice technology integrating AI.

Fig. 2. 8K STB and VR glasses.



services and complement each other. The commercialization of 5G will promote the rapid development of the 8K industry, and the evolution of the video industry to 8K will also drive the commercial 5G deployment.

VR/AR can be applied in many scenarios, such as VR movie theater, VR live broadcast, VR healthcare, VR education, and VR design, bringing opportunities for change in VR video viewing and application. However, its development is hindered by several basic weaknesses.

- **Low resolution:** VR/AR uses near-eye displays that require much higher video resolution than a TV screen. If the resolution is insufficient, the image granularity may affect user experience and also results in the failure of using VR/AR in the industries that have higher requirements for video quality. It is generally accepted in the industry that 8K (4Kp60 on both eyes) can meet the entry-level requirements of VR/AR service experience.
- **Weaknesses in network support:** VR/AR imposes higher requirements on network stability, network bandwidth and transmission latency than ordinary video services. At present, there is no reliable Wi-Fi solution to guarantee network QoS. The wired network needs cabling and is not easy to use.
- **High processing capabilities required for terminals:** VR/AR needs to do a lot of video processing to achieve a good display effect. All the processing implemented on the terminal side will lead to the complexity, heavy and high cost of the equipment, which seriously restricts the service promotion.

The combination of 5G and 8K provides a perfect solution to the above weaknesses. 8K improves the resolution of 4K video by four times. 5G fulfills 8K's network requirements for high bandwidth, high stability and low latency. 5G mobility removes the restriction on network access, making portable VR/AR possible. Moreover, 5G architecture fully supports enhanced multi-access edge computing (MEC). The deep integration of 5G and MEC moves computing capabilities from a terminal to the cloud, reducing the capability requirements for the terminal. Therefore, the terminal can be lightweight, and its cost is more reasonable. It will also trigger the transformation from the traditional VR headsets to glasses, delivering a more natural user experience. The high-quality viewing experience everywhere at any time will give new impetus to VR/AR services.

Relying on its distinct technical advantages in MEC, cloud computing and video terminals, ZTE has launched a 5G and MEC integrated Cloud VR solution and 8K terminal devices at the system side, and will soon roll out VR glasses, aiming to provide customers with lightweight VR/AR solution and create new business opportunities (Fig. 2).

4G changes life, and 5G will change society. In the 5G era, a variety of unimaginable new services will emerge, and video terminals will be more diversified. With the help of 5G networks, AI voice recognition and VR/AR terminals will accelerate the development and commercialization, bringing more new video experience to users. [ZTE TECHNOLOGIES](#)

5G Empowers

ZTE RTB Advertising Platform

Real-time bidding (RTB) derived from big data in the internet era has become the main trend of the advertising industry. RTB has significantly changed online advertising, evolving from the traditional pattern of media buying to target-audience buying. The RTB concept gives rise to many platforms such as demand-side platform (DSP), supply-side platform (SSP), AD exchange (RTB exchange), and data management platform (DMP), considerably changing the ecological chain of online advertising.

Each generation of mobile communication technologies has profoundly changed the way people use media. 5G will also change consumer behavior, increase the amount of accessible data, create new advertising inventory, and change media planning, bringing new operational experience to RTB.

RTB Features

RTB is not a new revolutionary marketing mode, but an online advertising that is driven by modern internet technologies and based on massive data analysis, and focuses on target-audience buying. Compared with traditional online advertising modes, RTB has the following features.

Accurate Advertising: Changing From Media Buying to Target-Audience Buying

RTB was born to meet the accurate market requirements. It has changed the conventional media-centered selling pattern of network advertisements, and has directly pushed the target-audience to advertisers. In this new transaction mode, the media and advertisement space that used to be highlighted by media companies are no longer the most important issue for both parties of the transaction. The concept of accuracy in advertising has changed subtly with the birth of RTB.

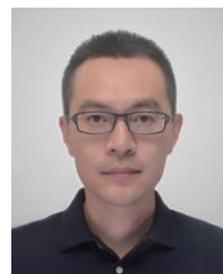
Big Data: Enabling Scientific RTB Operation

RTB relies on big data on the internet. Each data unit comes from a real case, and the characteristics summed up from massive data are representative and universal. Therefore, the data-based reference indicators provided by RTB are more scientific, and have greater advantages over traditional media and online advertisements in terms of comprehensiveness, timeliness and availability.



He Yanfeng

Chief Engineer for Big Video Analytics, ZTE



Zhu Dan

Senior System Engineer for Big Video Analytics, ZTE

Four Core Platforms: Reconstructing the Ecological Chain of Online Advertising

RTB has significantly changed the transaction mode of online advertising. An ecological chain serving this new transaction system is being formed. It is generally agreed that the RTB ecological chain comprises four core platforms (DSP, SSP, AD exchange, DMP) and several auxiliary platforms.

RTB Operation

Fast Data Collection

5G is characterized by low latency and high speeds (10 to 1000 times faster than 4G). These allow sales personnel to collect, analyze, and activate data in real time, which is rarely done by most suppliers today.

Easy to Solve User ID Problems

20.4 billion devices will be connected to 5G networks by 2020. With the massive connected devices, biometric data, gesture action data, environment data, and even more geographical location data will appear, and there will be more abundant data associated with user ID. Based on these, it will be easier to accurately identify the user ID through the user profile model algorithm.

New Changes in Advertising

In the 5G era, digital video advertising and dynamic video ideas will become more mature, and their amount will grow exponentially as downloads and uploads speed up. In particular, the application of AR/VR video technologies will bring about new changes in the current advertising mode.

Updated Infrastructure

The shift from 3G to 4G makes real-time bidding possible, while in the 5G era, advertising companies need to update their infrastructure and make it more flexible for faster advertising services, faster

target-audience coordination, and more programmatic transactions.

Emerging Content Platforms

The 5G network slicing technology enables operators to connect third-party content platforms to their networks, that is, to allocate a small part of the network to third-party content platforms. These platforms will greatly enrich the operators' content networks and bring a large number of advertisers and end-users to their advertising platforms. Their big video RTB ecosystem will also be considerably improved, and its value will be maximized.

ZTE RTB Advertising Platform

ZTE has launched a new Big Video RTB advertising platform for operators. Its architecture is illustrated in Fig. 1.

SSP

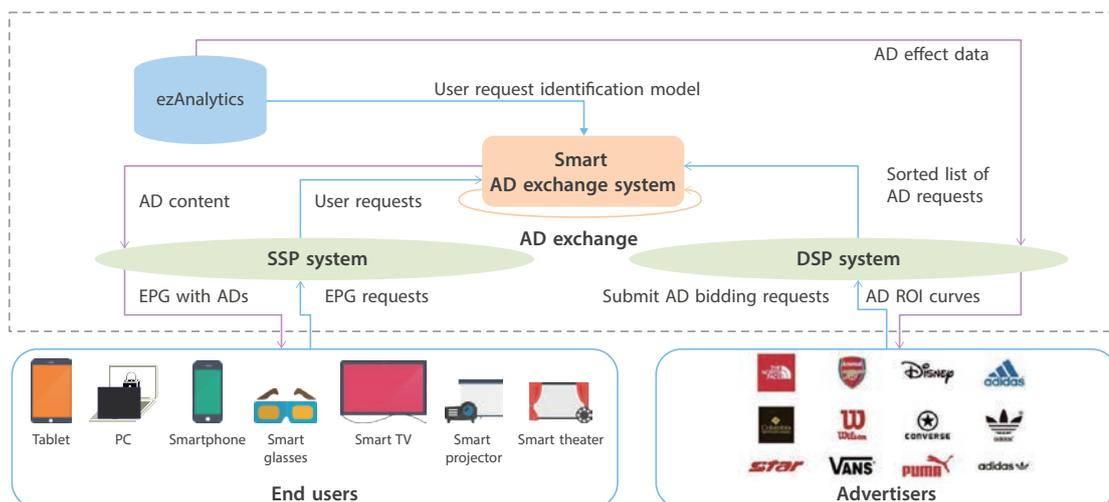
The SSP system sends ads from advertisers to different 5G terminal devices of end users. Based on user profiles provided by ZTE's AI data analysis platform (ezAnalytics), it can carry out multi-dimensional slice advertising in different periods, types and regions, so as to maximize the utilization of advertising resources.

DSP

The DSP system is responsible for the access of advertisers. Through the DSP system, advertisers can learn about the current status of advertising resources and provide relevant tools for advertisement production. This can help advertisers quickly and accurately reach the target users and maximize return on investment (ROI).

AD Exchange

The AD exchange system involves exchanging the advertisers' bids and video advertising resources. This exchange needs to maximize the



◀ Fig. 1. ZTE Big Video RTB advertising platform.

value of advertising resources while targeting the right audience, that is, to maximize the ROI for advertisers. The whole exchange model consists of the bidding model and user profiles. The models are generated from the big data system called ezAnalytics, which is the core of ZTE's Big Video RTB advertising system.

ezAnalytics

ZTE's AI data analysis platform (ezAnalytics) acts as the "brain" of the entire RTB advertising system. It monitors the effect of advertising through the probe deployed on the terminal side, and also creates ad-oriented user profiles. Based on these data, ezAnalytics builds and keeps updating the exchange model to maximize the value of all parties in the entire advertising platform.

Key RTB Technologies

Multi-access edge computing (MEC) based on the content delivery network (CDN) will be widely used to deliver an immersive user experience in the 5G era. It is crucial to use the MEC technology to implement high-quality RTB advertising. Leveraging its technical advantages in the CDN sector, ZTE combines video advertising with CDN to improve the effect of RTB advertising in the 5G network. Through the deployment of CDN cache on the network edge and in combination with 5G high bandwidth and

low latency features, the 5G-oriented CDN video advertising technology can improve user experience with RTB that involves timeliness and accuracy.

Timeliness is improved in two aspects: one is to exchange user requests and advertisements on the CDN cache side and make full use of the CDN cache edge computing advantage for real-time user profile matching and bid response filtering, and the other is to shorten the network distance between users and advertising content to improve the timeliness and response speed of video advertising.

Accuracy is also improved in two aspects. On the one hand, the data of users and advertiser features in the area covered by the cache on the edge is generated based on the AI algorithm training and delivered through the specific interface of ezAnalytics. This model is generated in a specific area, so advertisements, especially those for the O2O service, will target the right audience. On the other hand, 5G networks, featuring high bandwidth and low latency, can improve the bit rate and definition of video advertising. This can vividly show details and personalization of the advertisement and accurately match the potential needs of users.

While providing end users with new service experience, 5G also creates new business models for operators, especially in RTB advertising. ZTE's RTB advertising platform will help operators leverage the advantages of 5G network and CDN to enhance the experience and effect of RTB advertising, change their weak position in the online advertising field, and truly make advertising their next cash cow. **ZTE TECHNOLOGIES**

AI-Based Voice Recognition Enables 5G Smart Home



Gu Yongfei

Product Manager of ZTE Smart Home

As 5G mobile and internet technologies develop, requirements for human-machine interaction are growing. Regarding personalized, convenient, rapid, and user-friendly operation, neither keyboard nor touchscreen is comparable to voice control. Voice is the most natural and convenient way for people to communicate and get information. The control over home devices has developed from ordinary button remote control to Bluetooth voice remote control and then to intelligent voice control that supports sound pick-up. The voice technology will liberate human eyes and hands and become the best human-machine interactive mode for a variety of service business scenarios.

Information Integration

Through smart speakers, users can check real-time traffic conditions. Before going out, they can inquire traffic and road

information by voice to find out the conditions of the road they are going to pass. Through smart home control panels, users can also check real-time weather conditions, so that they can know information about temperature, wind, and rainfall probability of the day through voice query before going out. They can quickly and easily make video calls with their families through the far-field AI set-top boxes (STBs). Just say “video call and the name of the called person” to the STB, and the STB will turn on the TV, call out the video call client, select the called number in the phone book, and make a video call.

HD Video and Audio Entertainment

If users want to watch Jackie Chan’s movies, they only need to say “Jackie Chan’s movies” to the far-field AI STB, and then they can quickly search the list of “movies starring Jackie Chan” for them to choose from. If they want to switch

TV channels, they can just say the name of the channel. If they want to watch a program they missed before, it is easy to do it now. For example, if they miss CCTV News on July 20, they just say, "I want to watch CCTV News on July 20".

Life Reminder

If users want to get up early to catch the train, they just say "set the alarm clock at 7 o'clock in the morning", and the smart voice alarm clock at the bedside can turn on the alarm clock at 7 o'clock the next day. Users can also set multiple reminders, such as the date of paying water, electricity and gas bills and the date of repayment of credit cards.

Smart Home Control

Users can use the voice control panel to control TV and smart home devices such as lights and curtains in time by voice, or set the time or conditions to enable these devices by voice.

To implement these applications in 5G smart home scenarios, the AI voice recognition technology must support key technologies such as far-field sound pick-up, instant-on, multi-turn dialogue interaction, and voiceprint recognition.

Far-Field Sound Pick-Up

Far-field sound pick-up adopts a microphone array that contains several microphones operating in tandem and used to sample and process spatial features of the

sound field. The purpose of using the microphone array instead of a single microphone is to ensure voice commands can be properly received when the user is far away from the smart voice terminal.

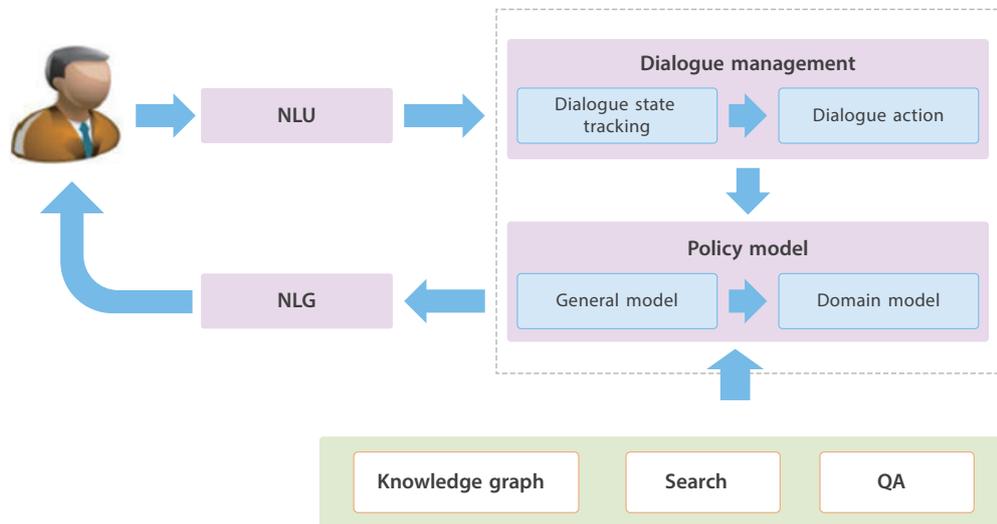
The microphone array is always in the sound pick-up state when it starts to work. It continuously samples and quantifies sound signals, and processes the basic signals. After the collected voice signals are processed by a more complex voice signal algorithm, clean voice signals are obtained and transmitted to the remote voice cloud platform for a real voice interaction.

There are linear, circular, and spherical microphone arrays. A circular or linear microphone array is usually used. At present, the mainstream solution is 6-Mic array, and there are also 2-Mic and 4-Mic products. The microphone array matches front-end sound processing technologies such as beamforming, noise suppression, echo cancellation, reverberation cancellation, automatic gain, and sound source localization.

Instant-on

The wake-up module is a small voice recognition engine. As wake-up words are a single target recognition, only small acoustic and language models are required, which occupy little algorithm space and can be locally implemented. The wake-up words usually contain three to five Chinese characters. It is recommended to choose the words that are not commonly used and have open accents and many syllables.

Fig. 1. Multi-turn dialogue interaction.



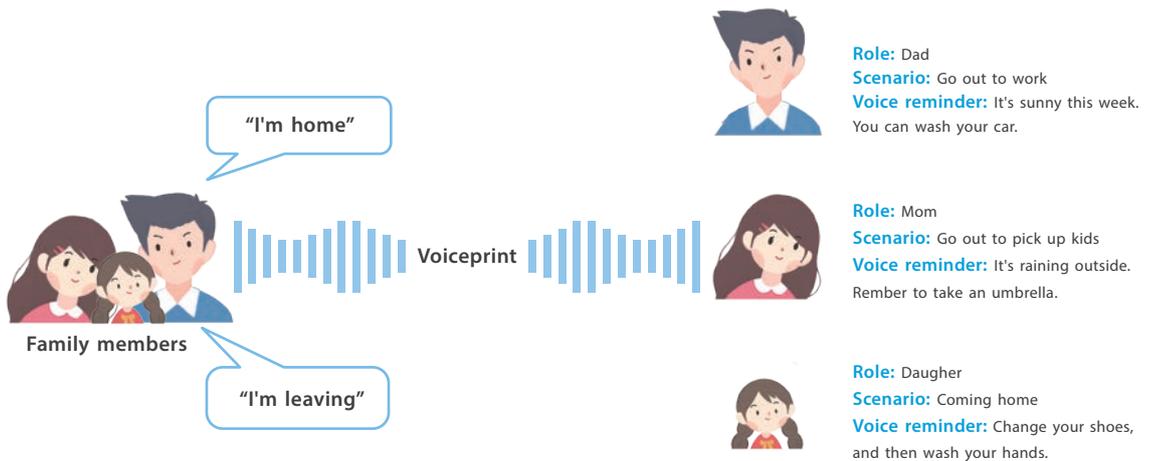
Multi-Turn Dialogue Interaction

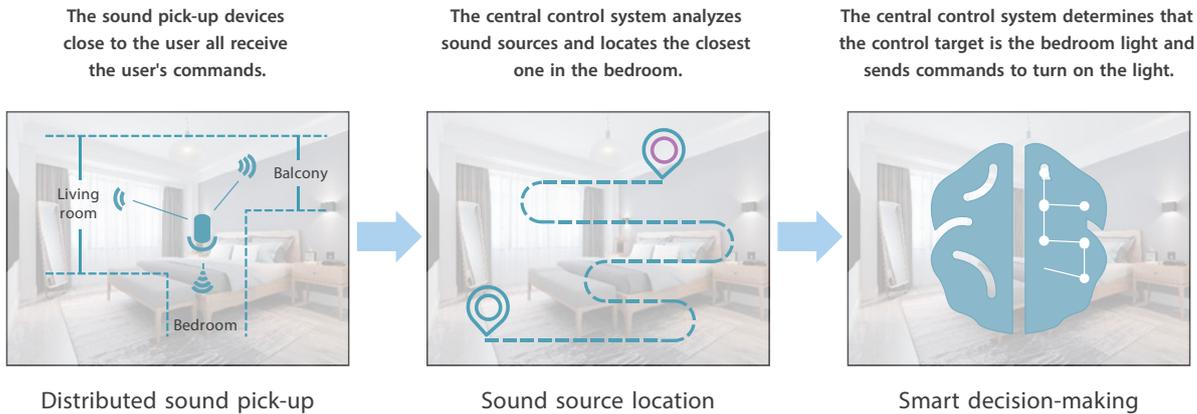
Continuous interaction means that a user can trigger the intelligent voice by saying wake-up words and interact with it for many times without saying the wake-up words any more. If the voice interaction exceeds the specified time, the user needs to say the wake-up words again.

The user's input goes through

the natural language understanding (NLU) module and enters the dialogue management system that identifies the current dialogue state and determines the next dialogue action. The next dialogue action includes general model and domain model. The former deals with general interaction logic, while the latter deals with domain-specific interaction logic.

Fig. 2. Voiceprint recognition.





◀ Fig. 3. Principle of distributed sound pick-up.

The dialogue state includes all kinds of information required for continuous dialogue, and is updated in accordance with the latest system and user actions. The intention parsed by the previous dialogue is used as a global variable and carried to the next dialogue.

Multi-turn dialogue is very important for natural artificial interaction, and people expect to apply the man-to-man dialogue mode to the man-to-machine dialogue (Fig. 1).

Voiceprint Recognition

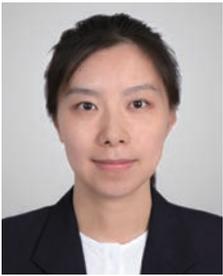
The security of home voice control is quite important in the voice interaction era. Voiceprint recognition falls into two categories: speaker identification and speaker verification. Voiceprint recognition in a home scenario is the process of identifying the speaker. First of all, it is necessary to model the speaker's voiceprint, and then match the voiceprint features during the voice interaction to provide personalized service experience based on the speaker's role (Fig. 2).

Distributed Sound Pick-Up

As sound pick-up devices are distributed in every room in the home, they need to support the distributed sound pick-up capability to coordinate their work with each other. Each sound pick-up device discovers and networks each other. When multiple devices are activated, based on the distribution and location of sound sources, the central control system determines that the user responds to the nearest device to prevent multiple devices from being triggered at the same time, determines the control target, and sends execution instructions (Fig. 3).

In the 5G smart home era, a variety of AI-based voice terminals will emerge, such as embedded smart switch panels, smart speakers, smart alarm clocks, STBs, TVs, and home appliances. More terminals will have the far-field AI voice and home networking capabilities. 5G smart home will adapt to different home scenarios through full-scenario voice coverage and whole-home coordinated voice control, meeting the growing needs of smart life in the future. **ZTE TECHNOLOGIES**

5G Boosts Innovation in Video Applications



Lu Wei

Chief Technology
Innovation Officer,
Head of 5G Video at ZTE

With the development of 5G networks, video serving as the most representative 5G eMBB service will bring about great changes. More innovative service applications have emerged, bringing brand-new visual experience and business value to individual and industry users. With the continuous development, video will be the first to be commercially promoted on large scale in the 5G era.

5G Live TV

Live broadcast in a stadium refers to a scenario where live sports videos are distributed to on-site audience. At present, most live activities such as sports events are only broadcast to the audience outside the venue, and most of them are presented synchronously on large electronic screens in the venue. Japan took the lead to trial live broadcast to on-site audience at baseball games based on 3G networks, while the United States and Belgium had the live broadcast attempts at the Super Bowl and road cycling races based on 4G/LTE networks respectively.

Because of limitations on network conditions, video latency and business model, the video distribution solutions inside the venue were not really mature for commercial use. But now, with the construction of 5G networks, the technological development in the wireless and video fields, and the approach of the Tokyo 2020 Olympic Games and the Beijing 2022 Winter Olympic Games, innovative 5G live broadcast inside and outside the venues has once again attracted attention. Whether 5G venues create a new B2B2C business model has also become a hot topic.

ZTE's 5G Live TV solution provides the on-site audience with a live event APP on mobile clients such as smartphones or PADs, so that they can watch the live broadcast of the game from any angle of view. Also, by simply zooming or dragging the playback window, they can zoom in or out any part of the video or view the panoramic or wide-angle video in all directions (Fig. 1).

The multi-view live broadcast of sports events for the audience needs to collect and distribute live content through the 5G network, and call the capabilities of the multi-access edge computing (MEC) platform to process, store and distribute the content

in real time at the network edge. The solution also needs to achieve low end-to-end latency to ensure best viewing experience for the on-site audience. If such service uses the traditional solution that involves core network, the real-time requirement cannot be fulfilled due to high latency. However, MEC can effectively reduce backhaul bandwidth consumption and service access latency, which greatly improves user experience.

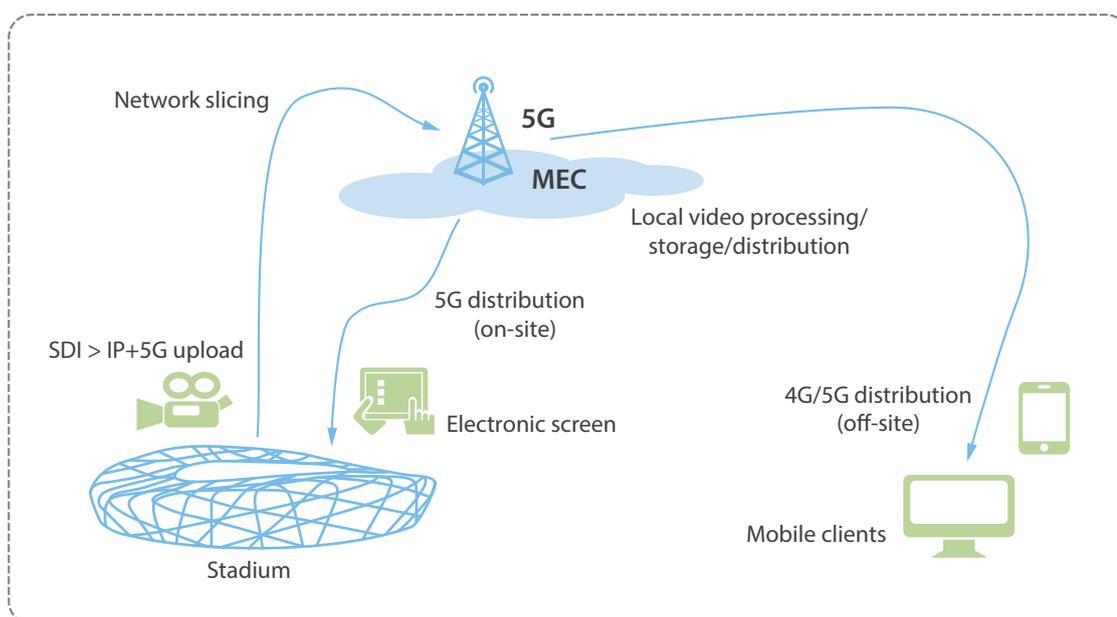
MEC collects and analyzes information about the wireless network in real time, and rapidly and dynamically optimizes services based on the information. In addition to live video broadcast, the stadium can also use this infrastructure to run security sensors and cameras. With the solution to offload video traffic locally, video data from the monitoring devices can be directly transmitted to the data center for local analysis and higher-level decision making.

Cloud VR

VR is recognized as a killer service in the 5G era, so operators in South Korea have

launched a large number of VR service applications for 5G commercial use. However, the traditional implementation of VR services restricts its popularity, such as the high cost of purchasing host and terminal hardware, the lack of rich content distributed on various platforms, and the limitation of device mobility.

The large-scale commercialization of 5G networks gives rise to the emergence of Cloud VR architecture. Cloud VR introduces the concepts and technologies of cloud computing and cloud rendering into VR applications. Through a stable network, audios and videos on the cloud are coded, compressed and GPU rendered, and then output to user terminals. In addition to aggregating multi-party contents and rapidly distributing them to user terminals, the cloud platform also reduces the configuration requirements for terminal devices. While the terminals are lightweight and cost-optimized, the platform improves user experience and provides diverse interactive applications such as VR education, VR gaming and VR social networking.



◀ Fig. 1. The application of 5G Live TV.



The 15th World Wushu Championships

5G significantly improves the development of Cloud VR. For example, a panoramic 8K VR video requires at least the transmission rate of 100 Mbps without using the slicing encoding technology. The application of 6DoF, spatial and optical field technologies will also considerably increase VR video traffic and storage space. To reduce the pressure on transmission bandwidth, VR video will inevitably move towards more efficient transmission that involves efficient compression algorithm, polyhedral projection, non-uniform encoding, and FOV display mode.

Cloud VR does not mean to reduce latency. Compared with the traditional VR, its rendering process adds three extra steps: image compression and encoding,

network transmission, and image decompression. With the 5G network, the overall latency of Cloud VR is much lower than that in the 4G era, reaching a range that can be accepted by users. Although the latency of service procedure is increased compared to the traditional VR, Cloud VR enables VR applications that require complicated rendering on portable mobile VR terminals at any time, bringing more convenience to users.

5G and Cloud VR also bring a variety of lightweight terminals. At present, the popular HMD separates computing/rendering from display. The computing/rendering part can be completed either in the cloud or on terminal devices such as smartphones, servers or set-top boxes, while VR glasses only need to have the

display function and weigh about 100g.

8K UHD

Japan's NHK launched the world's first 8K ultra high-definition (UHD) TV channel "NHK BS8K" in December 2018. UHD Forum fully demonstrated the 8K-based UHD technology at the IBC 2019 in Amsterdam, the Netherlands. China is also making great efforts to develop the UHD industry. For example, Shenzhen Municipal Government has taken the lead in making the action plan for the development of 8K UHD industry from 2019 to 2022.

For the big video industry, 8K is a revolutionary technical innovation that affects the entire video industry chain from content production to terminal playback. At present, HDMI 1.4 is the most-used standard for TVs at home. HDMI 2.0 for 4K has not been widely used, not to mention the HDMI 2.1 standard for 8K which was just released in 2018. The HDMI 2.1 cables available for public sale are extremely rare. With the arrival of 8K, even a TV interface needs to be updated. Therefore, it can be seen that 8K will affect the whole process and the whole industry chain that involves content capture, program production, codecs, interface standards for audio and video devices, content storage and distribution, chips, display, and wireless, wired and transport technologies, or even greatly promote the development and application of AI technologies.

8K and 4K both belong to the UHD field and have the same basic technology. 8K includes resolution, wide color gamut, HDR, high color depth, high frame rate, and surround sound (5.1) or three-dimensional sound (7.1+4). Both 8K and 4K adopt PQ and HLG curves to define HDR. There are two solutions for

PQ-based HDR curves: static metadata and dynamic metadata. Dolby Vision is the industry-leading solution that combines both static and dynamic metadata. In terms of high color depth, 4K still uses little 8-bit color depth, while 8K widely uses 10-bit color depth and continues to explore 12-bit color depth. As for wide color gamut, the signal output mode used to be RGB or YCbCr. On this basis, BT2100 adds ICtCp, which can deliver a better display on the big screen.

Although audio seems to have no connection with vision, it is still an indispensable element in UHD. Looking forward to the next generation audio (NGA), the use of AC-4, MPEG-H and 3D Audio will bring the audience an immersive audio experience.

In the 5G Live TV scenario, the application of 8K will deliver more event details to on-site and off-site audiences, and the free viewpoint and VR services based on 8K will also bring better immersive experience. ZTE's Big Video and STB teams are creating the 8K home media center, with the aim to bring home users a viewing experience comparable to that of the venue.

In the 5G era, operators and industries have great expectations for the development of innovative video services and actively drive them to commercialization. ZTE's 5G Live TV solution has been commercially used at the 2nd National Youth Games of China and the 15th World Wushu Championships, where free viewpoint (360-degree view), as the highlight of the solution, is officially commercialized on the client of MIGU Video for consumers. Cloud VR applications have been gradually trialed in some provinces in China, and 8K set-top boxes are expected to be commercially available in 2020. As 5G develops, more and more innovations in video applications will emerge and become mature for commercial use. [ZTE TECHNOLOGIES](#)

Building a 5G Video Industry Ecosystem



Chai Zuopeng

Manager of ZTE
DVB Products

5G is a revolutionary technology that will bring about the fourth industrial revolution and have a far-reaching impact on all industries. Verizon, the largest mobile operator in the United States, launched its Verizon 5G Home broadband internet service in 2018. The first commercial cities included Houston, Indianapolis, Los Angeles and Sacramento. China Mobile, as a 5G pioneer, also trialed 5G in 2018 and officially put it into commercial use in 2019. Starting from 2020, some mainstream operators will commercialize 5G on a large scale.

In the 5G era, 5G, AI and 8K technologies will enable vertical industries to meet their service requirements. With the advantages of high speed, high reliability and low latency, 5G is entering our lives and changing our way of life. Its future development will inspire people's imagination and enable services such as smart home, smart community, smart car, smart health, smart wearable devices, smart transportation, smart agriculture, and smart industry. 5G will also drive rapid development of the video industry ecosystem.

Since its inception in 2007, Netflix has developed 150 million paying subscribers, with a stock price increase of 6493%, making it a model for the OTT industry. YouTube, Amazon, iQIYI, Tencent Video, 4K Garden, and Hunan TV are also developing rapidly. Content is king. Besides content operation, these OTT players also value

content production to avoid restrictions on content sources. 5G provides a guarantee for 8K video content delivery, and its development will make those companies that produce high-quality video content more and more valuable.

The content security industry is created to protect the copyright of content providers and the business operation of operators. Conditional access system (CAS) is used to protect broadcast data, while digital rights management (DRM) is designed to protect the OTT content, such as Irdeto, Verimatrix, Nagra, Synamedia, PlayReady, and Widewine. In the 5G era, content authentication will be easier, and bidirectional authentication works for both broadcast and OTT content. Google is expected to offer free Widewine CAS in 2020 after the launch of Widewine DRM. Although there is still a long way to go before formal commercial use, it will be more and more difficult for companies that rely heavily on content protection services.

Before 5G arrives, 8K content is transmitted through satellite or cable. Japan's NHK launched 8K UHD channels on December 1, 2018 and planned a live broadcast of 2020 Tokyo Olympics in 8K resolution. In the 5G era, 8K or higher resolution content can be transmitted through 5G networks, which facilitates home access.

The 8K UHD Video Industry Conference themed "leading 8K era" was held in Shenzhen in November 2019. 8K is the new-generation UHD video technology and key innovation of visual



◀ Fig. 1. The 5G video industry ecosystem.

experience that will bring about profound changes in the entire video industry chain. Integrating and interacting with AI and 5G, 8K will give birth to a great many new products, new industries and new business models, and become a new engine to lead economic and social changes. These changes include 5G network transmission, core components R&D (video capture, editing, transmission, decoding, and display), device capability upgrade (TV set, set-top box, panel, and AR/VR), service platform upgrade, and auxiliary industrial applications.

While delivering a superior UHD audio and video experience, 8K also promotes the development of new technologies. The terrestrial transmission of 8K data through HEVC has been restricted by the bandwidth. Standardization organizations such as MPEG and ITU-T have started research into versatile video coding (VVC), the next-generation codec that is 30 to 50% more efficient than HEVC. Core chip technologies are also being developed, such as high-end COMS image sensor chips, video data compression chips, and transmission chips. The chip packaging process is moving towards 12 nm or higher, and CPU has built-in multi-core processor with powerful processing capability. The display technology tends to be a large-size, high-performance P120 smart panel that supports high dynamic range (HDR) image specifications.

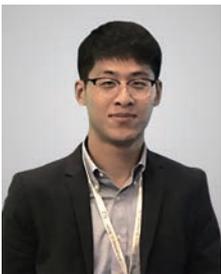
ZTE will launch the 8K smart set-top box

(STB) with built-in 5G and DVB receiving module in 2020. The STB equipped with a built-in data encryption module can receive 5G or broadcast data (audio/video), and adopts the high-performance codec processing chip solution. With the Google Android operating system, it can output high-quality audios and videos after descrambling and decoding. The STB itself has intelligent learning and management functions capable of intelligent classification of content, image beautifying, far-field voice, and video adaptive processing for best video effects. It can be connected to home devices such as mobile phones, air conditioners and refrigerators to implement smart control.

The significance of the 5G era lies in integration. Various industries in the video industry ecosystem tend to be more integrated, gathering the power and intelligence of integration to provide users with innovative experience. ZTE's 5G+AI+8K STB solution is an example of such integration. ZTE has always taken an open mind to build the 5G video industry ecosystem (Fig. 1), aiming to promote the healthy development of smart home ecosystem. As a major international provider of smart home solutions, ZTE will continue the collaboration with industry-leading companies such as Google, Amlogic, Netflix, Irdeto, Verimatrix, and Nagra in many fields to meet the opportunities and challenges in the 5G era. **ZTE TECHNOLOGIES**



A TV Revolution Sweeps Latin America



Zhao Jie

Marketing Manager of
ZTE Home Terminal

Latin America has a population of 650 million, accounting for 15% of the world's population. As the economy develops in Latin America in recent years, more and more Latin American countries have a per capita GDP of over 10,000 US dollars, such as Brazil, Chile, Mexico, Peru, and Ecuador. The improvement in economy also stimulates people's interest in entertainment, leading to a surge in demand for TV services. Consumers are no longer satisfied with the original SD video, and are looking for richer content resources and better broadcast modes. Low ARPU also restricts the income of operators in Pay TV business. A TV revolution is therefore inevitable.

Android TV: Helping Izzi Telecom Build a Dual-Ecosystem

Izzi Telecom, the largest Pay TV operator and the second largest fixed-line operator in Mexico, has 4 million cable subscribers and 9 million satellite TV subscribers, providing TV services for many cities in the country. In recent years, the popularity of broadband has driven the explosive growth of OTT TV services. Compared with traditional TV services, OTT services have the characteristics of lower tariff and more flexible customization. As third-party content providers such as YouTube and Netflix are widely popular in Latin America, more and more traditional users begin to abandon operators' networks and embrace OTT services. This has brought huge

challenges to traditional DVB operators such as Izzi Telecom.

To cope with the impact of OTT, Izzi Telecom chose ZTE's DVB-C+Android TV dual-ecosystem solution for its transformation of TV services. The solution adopts the most popular Android TV operating system and supports both DVB-C and OTT modes. It adds rich video on-demand (VOD) services to traditional live TV services of operators, and also integrates the Google ecosystem as well as content-rich third-party services such as Netflix, Amazon and HBO, which are popular with users.

Based on the solution, Izzi Telecom built a content platform with dual-ecosystem and multiple services, laying a solid foundation for fast deployment of HFC and FTTx, fast launch of new services, diverse user services, and ARPU improvement. With its leading technologies,

rich content, and reliable products, Izzi Telecom will continue to lead the Pay TV market in Mexico.

DTH STB: Helping Claro Colombia Develop Satellite Services

Claro Colombia is an important branch of the AMX Group in South America, with over 3 million TV subscribers. With the growth in TV penetration in Colombia, the number of TV subscribers has exploded. However, most of these subscribers have low ARPU and are less interested in new services. Claro Colombia's major concern is how to complete annual service transformation for existing subscribers and attract new subscribers with a minimum Capex.

Against this background, Claro Colombia worked with ZTE to launch the DTH STB to achieve fast growth in subscriber base. ZTE's DTH

STB can provide a wide range of functions such as MPEG-2/MPEG-4/H.264 HD video decoding, live broadcast, PVR, advertising, and UI customization, delivering a differentiated video experience to users.

Claro Colombia rapidly launched the DTH TV service. Each year, the total number of new DTH TV subscribers and existing subscribers who have completed the transformation of DTH TV reaches one million, and the ARPU value is also increasing. The TV penetration in Colombia will continue to increase in the next few years. With the DTH STB solution, Claro Colombia can help more new subscribers get TV services and help more incumbent subscribers complete service transformation. Claro Colombia will continue to maintain its leading position in the Pay TV market.

Looking to the future, operators in Latin America will accelerate the TV revolution, keep close cooperation with ZTE in the industry chain, and adopt innovative product solutions to continually provide subscribers with more superior, professional, and secure TV services. **ZTE TECHNOLOGIES**

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5G Live TV Creates a New Game- Watching Experience



Zhang Yidi

Assistant Manager of Wired
Product Planning, ZTE



The 2nd National Youth Games of China

As true 4K content is widely available, the traffic of 8K and VR content will increase exponentially. The application and popularity of 5G technologies will certainly bring disruptive changes to the HD video industry. Services like live broadcast of sporting events, live news, and user-generated content (UGC) are characterized by timeliness and large amount of data, so it is quite appropriate to adopt the edge delivery architecture on a 5G network. ZTE's 5G Live TV solution that integrates 5G and UHD live sports broadcast to enable diversity of content has become the focus of attention of major operators.

Shanxi Mobile Delivers Innovative User Experience at NYG

Since the issuance of commercial 5G license in 2019, China has officially entered the first year of 5G. The Shanxi Branch of China Mobile (Shanxi Mobile) has been looking for new business opportunities to deliver high-quality services,

enhance customer stickiness, and achieve growth in profits.

Shanxi Mobile and ZTE jointly achieved the first application of an innovative 5G Live TV solution at the 2nd National Youth Games of China (2nd NYG) in August 2019. Based on the 5G network and IPTV platform, the 5G Live TV solution provided a new experience for watching the opening ceremony, horse riding competition, and wrestling match for both on-site audience and off-site IPTV users. After entering the stadium and downloading the relevant client APP developed by Shanxi Mobile and ZTE on their 5G mobile phones, the audience enjoyed an innovative game-watching experience in three distinctive 5G scenarios: multi-angle views, flexible zooming, and 360-degree viewing, with the end-to-end live broadcast latency reduced to less than one second. The key technology of this solution is multi-access edge computing (MEC) that can call the edge capability to offload live videos locally to achieve ultra-low latency for switching between different views on the 5G network.

Shanxi Mobile not only provides rich game-watching experience for mobile phone users, but also allows IPTV users to access the real-time multi-angle UHD live games on the IPTV platform. With ZTE's Big Video 3.0S UHD AI STB, the off-site audience can watch the high-definition games from four different viewing angles, enjoying a customized game watching experience.

Using the 5G Live TV solution, ZTE and Shanxi Mobile successfully turned the 2nd NYG into China's first 5G sporting event. It was also the first time for 4K and multiple views to make their debut on live TV. These new business attempts have enhanced both delay-sensitive service experience and user stickiness.

China Telecom Enhances Personalized Experience at WWC

E-Surfing Video is an online video operation platform under China Telecom, with more than 220 million users. The huge user base provides

strong support for its successful operation. In the 5G era, China Telecom is seeking to develop innovative and personalized video services to retain existing users and attract new users.

The 15th World Wushu Championship (WWC) was held in Shanghai in October 2019. China Telecom took this opportunity to join hands with ZTE in using its 5G Live TV solution to deliver an innovative viewing experience to on-site audience in three distinctive scenarios that include multi-angle views, 4K flexible zooming, and 360-degree free viewpoint. With the corresponding UHD APP based on 5G, the audience could freely zoom in or out 4K UHD videos in real time when watching the games. Moreover, the image stitching function also created an immersive game-watching experience.

At the WWC, the 360-degree free viewpoint function was used for live broadcast. Its live broadcast latency was reduced to less than 10 seconds, the rotation of views was very smooth, and there was no latency for rotating to a new view. China Telecom adopted ZTE's innovative technologies such as 4K UHD video real-time transcoding, fast CDN media distribution, and instant video playing on terminal APK to achieve the industry-leading low latency for multi-angle views and 360-degree free viewpoint. This was also the first time to use the 360-degree free viewpoint function on a large-screen TV. People watching games at home could use the remote control to rotate views freely to capture highlights of games, enjoying a brand-new, diverse and personalized viewing experience.

Through the live broadcast of this international event, China Telecom provides users with a new video service with new applications and new experience, attracting more users to enjoy a better life brought by E-Surfing Video on a 5G network.

With the large-scale deployment of 5G networks, the 5G Live TV solution will get more attention from operators. The solution will also be more widely used in all kinds of large sports and recreational events and continue to innovate in the applications, bringing users a superior game-watching experience. **ZTE TECHNOLOGIES**

5G Brings Smart Stadium Live Broadcasting to Life

Source: Lightreading

With network operators seeking ways to offer enhanced services that meet real customer needs using 5G solutions, ZTE has been showcasing its 5G Smart Stadium Live Broadcasting Solution, which has already demonstrated the innovative power that cutting edge technology deployments can enable in the most demanding service delivery environments.

Here, Dr. Lu Wei, Chief Technology Innovation Officer, Head of 5G Video at ZTE Corporation, answers some of the key questions about the solution and how it can benefit communications service providers and their customers.



Dr. Lu Wei, Chief Technology Innovation Officer, Head of 5G Video at ZTE

What are the key end-to-end technology elements that comprise ZTE's Smart Stadium Live Broadcasting Solution?

ZTE's 5G Live TV solution features three key technologies: 5G eMBB ultra-high bandwidth, MEC vCDN, and real-time transcoding for multi-channel UHD videos. By virtue of ultra-low latency and free viewpoint (360-degree view), it delivers a unique user experience.

Video services are provided through 5G networks in dense places. ZTE's leading 5G QCELL solution is adopted for network coverage, deeply optimizing and testing the network. The high bandwidth of 5G eMBB slices is fully reflected. As for video capture, high-quality 4K live broadcast signals are sent back via 5G CPE, showing the high bandwidth feature of 5G. As for user experience, services are distributed through the 5G network and displayed on 5G smartphones.

Backed up with MEC, the content generated on the network edge is processed locally and distributed. During live broadcast

of games, the source-end device directly uploads the captured multi-angle content to the MEC server on the network edge. The MEC server responds to the users' requests for watching HD live videos from different angles, and then offloads the video traffic to the local network. The MEC service can effectively reduce the backhaul bandwidth consumption and service access latency, improve service experience, and achieve on-site end-to-end latency less than one second.

Real-time stitching integrating with frame alignment can achieve fast stitching and encoding. Together with the speedy response of MEC CDN and 5G technologies, the end-to-end latency from video capture to video playing on terminals is greatly optimized. In addition, by virtue of ZTE Player, which restores images by resolving stitched model, as well as frame-level synchronization of multiple live channels, a smooth viewing experience is delivered with no delay for view switching.

Could this same service be delivered without using 5G technology? What is the importance of the 5G elements?

For large events such as sporting events and live concerts, the traditional method is to collect signals through cables. The network deployment is difficult, camera positioning is not flexible, and costs are relatively high. When a 4G network is deployed, the user plane is deployed centralized from an architectural point of view. The MEC deployed with the core network is usually located in the capital city of a province—If the MEC is too far away from the stadium, there will be too many network hops, causing poor experience.

However, the adoption of 5G technology can solve all the above-mentioned problems. Geographic location is not restricted, camera deployment is flexible, high uplink bandwidth and low latency can be guaranteed, and the audience can watch games from more perspectives. Meanwhile, the user plane has become decentralized and moved to the edge together with MEC so that data can be processed locally and latency can be reduced greatly.

As network and video technologies develop in the future, some sporting events will prefer to adopt multi-angle live broadcast to provide the audience with more choices of viewing perspectives. In addition, exploration of AI-enabled video recognition and new applications,

such as panoramic view and VR views, continues and some will become available. 5G networks, featuring high bandwidth and low latency, will further promote the development of such innovative services to achieve higher definition, higher concurrency, and a more diversified and immersive experience.

What advantages will this bring to broadcasters and stadium owners? And how does this impact the end user/viewer experience?

ZTE's solution can bring more traffic to broadcasters and stadium owners, and this traffic can be monetized in many ways. We set up an interactive advertising zone to deliver diversified ads and help improve the conversion rate. We also provide VIP users with personalized viewing angles and use drones to track superstars to improve people's willingness to pay for a VIP subscription. In addition, we cooperate with business owners located near stadiums to promote related goods and boost the fan economy. 5G Live TV solution creates a brand new game-watching experience, achieving customization and personalization. Users can select different viewing angles on the app to see multi-angle views, and swipe on the screen to zoom in or out of a view in real time so as to capture details. For professional fans, we customize the free viewpoint (360-degree view) function for them to get a full view of games.

5G Live TV solution creates a

win-win situation. Operators, broadcasters and stadium owners can find new revenue growth drivers. The audience can enjoy a new and immersive game-watching experience.

Has this solution been used in a commercial environment?

The 5G Live TV solution has been commercially used at the 2nd National Youth Games of China in August 2019. ZTE's leading 5G QCELL solution was adopted for network coverage of the main stadium. Deep network optimization and testing were implemented. The high bandwidth, low latency, and massive connectivity features of 5G were fully reflected. We deployed many cameras to send back high-quality 4K live broadcast signals through 5G CPE, showing the high bandwidth feature of 5G. As for user experience, services are distributed through the 5G network and displayed on 5G smartphones.

The application of 5G Live TV solution in the 2nd National Youth Games sets a great example for the future live broadcast of such events. For the first time in the industry, ZTE provides services based on MEC through the 5G network to build end-to-end ultra-HD video production and broadcast capabilities. Focusing on sporting events, ZTE provides end users with plug-and-play services, delivering a new, ultra-HD and immersive viewing experience. **ZTE TECHNOLOGIES**

Live a Smart Life with All-In-One Home Media Terminal

Source: Mobile World Live

As Moore's Law predicts the future of technologies, the performance of processors improves exponentially at regular intervals without changing the price, thus reducing the popularization threshold and cost of various new technologies. This also happens to AI technologies. With the improvement of NPU computing capability and reduction of costs, AI empowers the vertical industry and promotes the emergence of various smart devices from smartphones, smart home to industrial robots, driving industries into the AI era.

Natural language processing (NLP) is the most mature technology in the AI field, showing that voice communication is the most direct interaction mode. Since the smart speaker can cover various scenarios of home life, it is the ideal carrier of voice

interaction in the home, and then the controller of the smart home as the portal to search, e-commerce, content and social media. According to Ovum's latest research, over 30 brands of smart speakers are equipped with various voice assistants. By 2023, the total revenue from sales and service of smart home devices is expected to reach USD 154 billion. The annual sales of smart speakers is expected to increase from 61 million units in 2018 to 133 million in 2023. Smart speaker, which is indispensable for the development of online music subscribers and smart home, has undoubtedly become a must-have consumer electronic item.

As smart speakers become a member of more and more families, the following common problems occur.

- **Voice recognition is poor.** The smart speaker cannot be triggered by the wake word or

can be wrongly triggered by other words.

- **Functions are lack of diversity.** Applications cannot meet the growing subscriber demand for entertainment, except for music and language programs.
- **Privacy and security are under threat.** The microphone is always active and monitors the surrounding in real time, causing widespread concern about product security in the industry.

To address these problems, ZTE, with more than 20 years of experience in multimedia terminals, launches the All-In-One home media terminal integrating the smart speaker and 4K UHD STB functions (Fig. 1). This terminal effectively solves the pain points of the traditional smart speakers, delivering a better user experience and creating a perfect smart life.



Fig. 1. ZTE's All-In-One home media terminal.

Brand-New Interactive Mode

The traditional interactive mode of remote control, which has dominated STBs for a long time, has some intrinsic defects such as complicated operations and low efficiency. However, the All-In-One home media terminal is equipped with built-in microphone array and adopts the patented technologies of noise reduction and echo cancellation developed by ZTE. It offers a hands-free experience by adopting the natural language for interaction, and presents the accurate information and content searched from massive content and services, greatly improving the user experience and providing users with more choices.

Complete Ecosystem

The All-In-One home media terminal is equipped with the mature operating system and supports UHD 4K+HDR

technology. By virtue of cooperation with many content providers, this terminal can bear many video services such as OTT/IPTV, providing operators with complete service customization and extension capabilities.

Portal to Smart Home

The All-In-One home media terminal integrates the smart speaker and 4K STB, providing users with convenient human-machine interaction. By means of extension, it is able to control the smart home devices through IoT protocols including Bluetooth, Wi-Fi, Zigbee, and Zwave, and bring convenience to life.

Ultimate User Experience

The All-In-One home media terminal adopts the advanced 64-bit quad-core processor with built-in AI engine, providing a performance boost when

performing mathematical operations. The built-in TEE security processing engine effectively protects users' data and privacy.

This product has been commercially available in China Telecom and will be widely promoted in its market. Featuring diversified services, it provides users with a wider range of professional services from operators.

In addition, as the demand for voice-enabled smart home and video services surges, the All-In-One home media terminal shows a huge potential in the global market. Integrating core services such as IPTV, smart home and IMS voice, this product can help operators build a smart home ecosystem with voice AI as the portal, smart home products as the bearer, and smart operations as traffic monetization methods, creating a win-win outcome for industrial partners. **ZTE TECHNOLOGIES**

