Alibaba Cloud

Olympic Winter Games Beijing 2022 on the Cloud

Guangliang Zhang

I.   Background Information

Emerging technologies such as cloud computing made Beijing 2022 an unprecedented digital Olympic Winter Games, with over 6,000 hours of 4k video content broadcasted through Alibaba Cloud, reaching over 2.7 billion people worldwide. This marks an important technological milestone since the Olympics were first broadcasted by satellite TV in 1964. Today, broadcasting the Olympics is no longer solely dependent on satellite TV. Instead, the Olympic Broadcasting Services (OBS) supported by Alibaba Cloud brings the Olympics to billions of audiences around the world. Viewers can now enjoy faster and more direct access to the games and immerse themselves in the rich culture surrounding the games. OBS has also become a model in energy saving and environmental protection, and contributed to carbon peaking and carbon neutrality goals. Empowered by cloud technologies, the high-tech, green Beijing 2022 is an innovative representation of the Olympic Spirit in the new era.

II.   Technologies Behind the Olympics

Beijing 2022 is the first Olympic Games that use cloud computing instead of traditional IT infrastructure to support its organization and operation. The core IT systems such as systems of competition results, event broadcasting, information updates, and athletes services were all run on Alibaba Cloud. In the past, these services required dedicated on-site data centers, which were set up and removed each time the Olympic Games were held. Cloud migration largely reduced the IT infrastructure cost and shortened the time required for application development and deployment. Migrating the Olympics to the cloud was the key to making Beijing 2022 digital and green. Compared with traditional data centers, the Cloud Data Center for Beijing 2022 in Zhangbei county reduced energy consumption by over 70%, utilizing state-of-the-art cooling technologies such as natural air cooling, liquid immersion cooling, and intelligent temperature control. These technologies completely replaced traditional, power-consuming mechanical cooling methods.

Starting from Beijing 2022, all videos produced during the Olympics, including both existing and future videos, will be stored on Alibaba Cloud. A tiered storage method is implemented based on popularity. Videos that are frequently viewed, such as those of widely discussed athletes and events, will be stored as hot data, while the videos that have not been viewed for a long time will be automatically archived as cold data to reduce resource consumption.

Online broadcasting technologies played an important role in Beijing 2022. Back in 2018, Olympic Broadcasting Services (OBS) and Alibaba Cloud launched OBS Cloud that made its debut in Tokyo 2020. The platform then underwent a major upgrade for Beijing 2022, delivering both satellite TV broadcasting and Internet livestreaming at the same time. During Beijing 2022, more than 6,000 hours of thrilling events were delivered live to audiences around the world, and for the first time in history, 4K broadcasting was implemented for all the events. OBS Cloud's low latency, high throughput, and high elasticity allowed it to smoothly handle traffic spikes during high viewership periods such as the opening ceremony and popular events and to deliver live broadcasting with 4K or 8K video quality. Compared with satellite broadcasting that can support only Mbps-scale throughput, OBS Cloud supports Gbps-scale throughput. Under extreme circumstances, OBS Cloud is capable of delivering Tbps-scale throughput, at which 500 HD feature movies can be transmitted within a second, and the entirety of Beijing 2022's video content can be transmitted within half an hour. Alibaba Cloud provides Olympic broadcasting services over the Secure Reliable Transport (SRT) protocol. Compared with streaming over other protocols, SRT streaming provides data recovery, forward error correction (FEC), and better network optimization capabilities. SRT streaming is the optimal choice for delivering ultra-high-definition 4K and 8K videos, or live broadcasting. Alibaba Cloud also deploys dedicated cloud networks for rights-holding broadcasters (RHBs) in countries and regions that are geographically distant from China, such as television stations in Brazil and Mexico. This further shortens the streaming latency by 30%.

AI technologies are widely used in the cloud broadcasting of Beijing 2022. OBS Cloud Content+ is a media processing platform for short videos. Content+ allows RHBs to share raw video materials and processed content such as videos of theme reports or interviews, and video clip collections. RHBs can easily identify the content that they need, edit videos in the cloud, and then share the processed content to their colleagues. Content+ provides an AI-powered intelligent video editing tool that runs on the cloud. This video editing tool can automatically analyze game videos in real time and evaluate the humanistic and aesthetic elements of the content. Then, the video editing tool categorizes raw video materials based on athlete motions, incidents at the venue, and camera shots or angles, and automatically generates video clip collections of various themes. The AI-powered intelligent video editing tool starts to analyze video files immediately after game videos are generated. Video clip collections can be produced and broadcasted within two to three minutes. During Beijing 2022, this tool has produced 39,878 video clips of over 200 games.

Beijing 2022 was the first time that the free-viewpoint video (FVV) technology was used, which greatly improved the audiences' experience. In the previous Olympic Games, images were captured by dozens of high-speed cameras set around the arena and then were transmitted to TV stations through satellites. Then, the TV stations switched signal channels to broadcast different images of the competition to audiences. However, at Beijing 2022, the 4K high-definition video shot by dozens of cameras was synchronously transmitted to the edge servers deployed in the arena and then to the remote cloud servers. The edge servers collect and synthesize the high-definition video, producing multi-angle FVV content in just 50 seconds. The FVV content is then transmitted to the broadcasting center and TV stations. Breathtaking moments such as when the winning curling stone is thrown or when the athletes enter the final sprint in speed skating competitions can all be recreated and rendered as panoramic shots for audiences around the world. At the same time, dozens of channels of signals were transmitted to the cloud, and intelligent algorithms were used to quickly build scenario-based models, providing smoother watching experience to audiences. In the previous Olympic Games, even with 50 cameras deployed in an arena, producing a video that pans in a 360° circle around the athlete is a complicated feat. When synthesizing the images captured by dozens of cameras, drop frames may occur, resulting in choppy video quality. At Beijing 2022, cloud-based 3D modeling leveraged advanced algorithms to reconstruct the 3D models of the competition arena from multi-viewpoint images. The models are generated based on the understanding of image data, including scenarios, depth of field, and scenes. This solves frame rate issues and delivers a stereoscopic viewing experience. Alibaba Cloud provides technical support for data computing and transmission based on the cloud-edge-device synergy. The technical support includes algorithm services, cloud networks with high bandwidth and low latency, and cloud computing services in high-performance computing scenarios and high concurrency scenarios.

Against the backdrop of the COVID-19 pandemic, athletes' loved ones could not join them as they competed for glory. To shorten the distance between athletes and their loved ones, Beijing 2022 provided interactive screens in the 12 venues for athletes to share their precious Olympic moments with their closest family and friends, which is called the Athlete Moment project. Alibaba Cloud provides technical support for this project to ensure the low latency of data transmission and high definition of videos. Viewers all over the world could also participate in this event by uploading videos of themselves to the official website of the Olympics to cheer on their favorite athletes.