A New Era of Video Transmission Using Open Transport System: Challenges in 2020 Sporting Events

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Abstract: We developed new ultra-low-latency uncompressed video transmission technology using open transport system. The Real-time Remote-cheering Project was successfully implemented using this system by connecting the marathon course in Sapporo with the cheering venue in Tokyo.

1. Introduction

The Covid-19 pandemic has changed the way we communicate and work. It has become common for people to connect with remote locations using video to work and communicate privately.

In the video and broadcasting industry, there is a growing desire for remote production of live programs such as sports broadcasts, where production is done without dispatching a broadcasting van to the venue. Efforts are also being made to deliver cheers to the players without the need for spectators to gather at the venue. However, in order to realize these use cases, conventional network and video transmission technologies are unable to meet the requirements.

Regarding remote spectator experience, delay time is the largest challenge in transmitting cheering from remote venues to the competition venue. For marathons, in particular, even a small delay can have a significant effect on the ability to transmit cheering to athletes running at 5 m/s. The total delay in watching a sporting event remotely had been several seconds each way, which includes not only the propagation delay of light but also media-processing delay such as transmission-processing delay and compression delay for video information; as a result, it has been impossible to transmit cheering to players, athletes, etc. without a delay.

To complete these requirements, it is desirable to transmit high-definition video in an uncompressed format, however, it has been extremely difficult to achieve this using conventional IP network services and transport systems. Using our ultra-low-latency communication technology, we have addressed these challenges in a remote cheering project for a 2020 sporting event and demonstrated that real-time cheering can be transmitted to marathon runners in remote areas.

2. Device Configuration of the Project

The overall device configuration of the project is shown in Fig. 1. We aimed to create a space in which remote spectators could feel as if they were cheering along the roadside as the runners were running by. Therefore, we

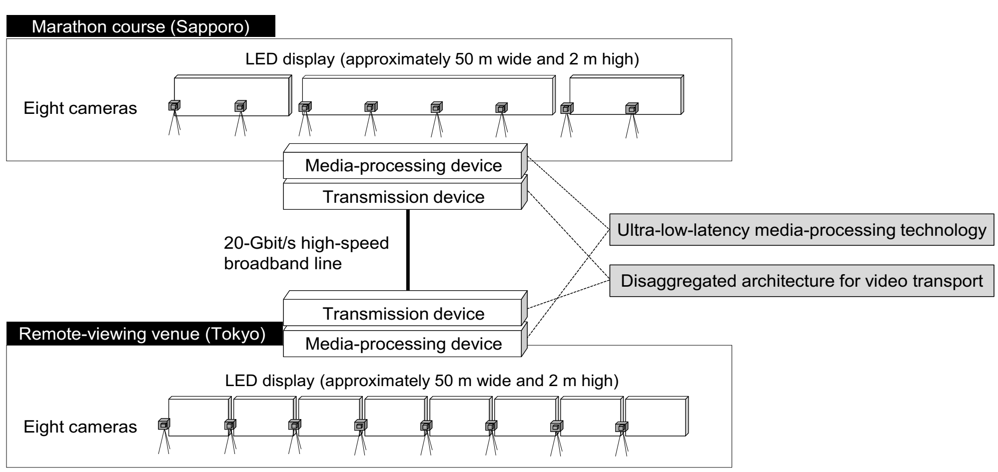

Fig. 1. Device configuration of the remote cheering project

(a) The display installed at the Tokyo venue (b) The display installed at the Sapporo marathon course

Fig. 2 The setup of the both venues

installed light-emitting diode (LED) displays at both the Sapporo marathon course (in front of Sapporo Sosei Square) and Tokyo remote-viewing venue. The displays enabled the runners and spectators to see each other in actual size. The total width of the LED displays at both sites was approximately 50 m, but the location and spacing of the displays varied in accordance with the conditions at the installation site (Figs. 2(a) and (b)). Eight cameras were set up in front of the LED displays at both sites to capture images of spectators and runners. The 4K images from each of the two sites were transmitted to the other site via a 20-Gbit/s high-speed broadband line via a media-processing device using ultra-low-latency media-processing technology and a transmission device with disaggregated architecture for video transmission.

3. Video Transmission Using Open Transport System

Transmission equipment for optical-transport purposes had been provided in a form that integrated optical modules and various functions. In contrast, there is also equipment that adopts technology that enables flexible configuration changes, the addition of new functions, cost reductions, etc. by separating the various functions of the transmission equipment and controlling them by standardized interfaces in a disaggregated architecture. We used an open transport system with such a disaggregated architecture to implement a new approach to video transmission.

We developed a plug-in unit (video PIU) in which a direct serial digital interface (SDI)-signal acquisition function is added to an open transport system with an optical transponder for long-distance transmission. The new video PIU enables direct transmission of uncompressed video and audio in SMPTE ST 2110 format over optical long-distance transmission lines. SMPTE ST 2110 is a standard developed by the society of motion picture and television engineers (SMPTE) for transmitting video over Internet Protocol (IP) networks for the professional media industries. We also implemented a set of functions for video transmission control to achieve integrated operation of network and video devices, and xKD client function, which enables secure transport by coupling the encryption function of the open transport system with next-generation cryptographic key distribution scheme [1] (Fig. 3).

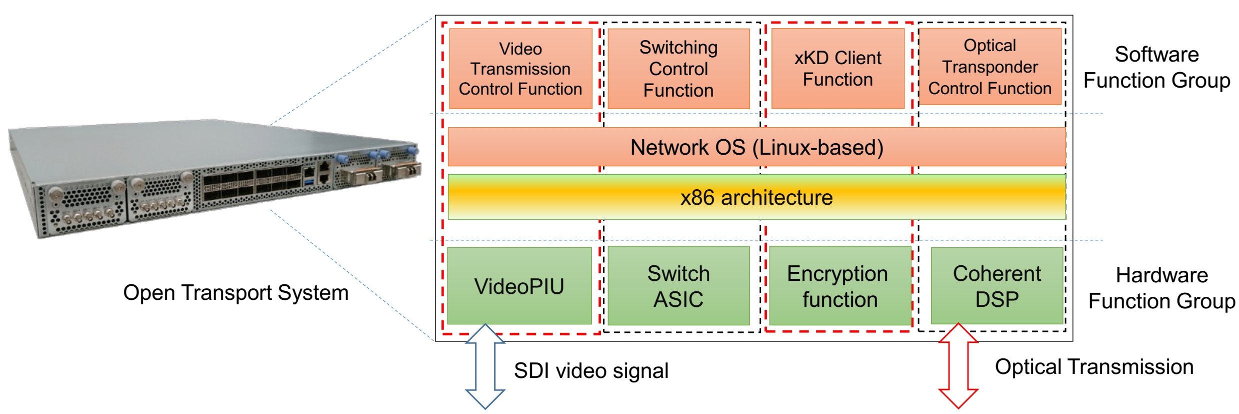

Fig. 3. Disaggregated architecture of open transport system

4. The Results and Future Prospects

The delay between the video input on the transmitter end and video output on the receiver end was reduced to about 1 ms, and the one-way delay (including the distance delay between Tokyo and Sapporo) was reduced to about 20 ms. Furthermore, ultra-low-latency media-processing technology was able to reduce the processing delay in aggregating or disaggregating video from multiple cameras into or from a single 4K SDI. As a result, the delay time for the transmission process was kept to 100 ms each way [2].

The results of this sporting event have convinced us of a new era in video transmission. That is, the arrival of an era of uncompressed transmission using an open transport system for professional use, including remote production. The video PIU has the capability of uncompressed video transmission up to 8K120p with over 100 Gbps transponder fully utilizing the disaggregated architecture of the open transport system.

NTT has announced the IOWN concept as the communication infrastructure that will support the smart world of the near future and is conducting research and development with the aim of realizing it around 2030 [3]. All photonics network (APN) is one of IOWN's three key technology areas. With this technology and IOWN APN, ultra-high-resolution video can be sent and received with ultra-low latency through an end-to-end optical path, enabling distance-aware video communication. As a result, it is expected to be applied to a wide range of use cases such as remote production, telemedicine, and remote monitoring.

5. References

[1] T. Okuda, K. Chida, D. Shirai, et al., “Secure Optical Transport Network,” in NTT Technical Review, Vol. 20 No. 1 Jan. 2022, pp.32-39.

[2] S. Usui, S. Fukatsu, E. Matsumoto, M. Imoto, D. Shirai and S. Kinoshita, “Marathon × Ultra-low-latency Communication Technology,” in NTT Technical Review, Vol. 19 No. 12 Dec. 2021, pp. 78-84

[3] Website of NTT R&D, IOWN, https://www.rd.ntt/e/iown/