White Paper

5G Broadcasting

Enabling Live Sports Broadcast Over Ultra Low Latency 5G Network at the Olympic Winter Games Beijing 2022

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Compared to traditional live-event broadcasts, the Intel-powered 5G broadcast solution offers several key benefits:

Simpler, lower-cost deployments

- Setup and teardown take less time and are less costly, with reduced personnel requirements

Freedom from limiting and expensive cabling

- 5G-enabled content-capture devices provide flexibility and capacity to capture live action from new angles at challenging outdoor sites

Live-media adoption opportunities

- The solution unlocks new possibilities for near-real-time streaming across a variety of use cases

Intel Corporation and the Olympics Broadcasting Services conducted 5G broadcast pilots at the Olympic Games Tokyo 2020 and the Olympic Winter Games Beijing 2022. The Tokyo 2020 pilot included ENG (Electronics News Gathering) event capture, while the Beijing 2022 pilot included both ENG and live event coverage. This 5G platform solution and architecture have demonstrated the potential to reduce costs and complexity of live event video production while also improving flexibility and scalability.

Broadcasters face multiple challenges while covering, capturing, processing, and transmitting live and remote events, such as:

- Cameras requiring extensive cabling have limited mobility and can pose safety risks for the crew, spectators, and even athletes. Multi-camera setups further exacerbate mobility and safety issues.
- Outdoor events like alpine and cross-country skiing require deploying fiber across mountains and large outdoor areas to the media processing venues thus adding complexity, extensive cost, and burden.

During the Beijing 2022 pilot, live sport event streams were transmitted over a commercial 5G network and included the following:

- Encoding/transmitting modules were attached to either standard HD or UHD cameras.
- The module encoded the live stream captured by the camera.
- The encoded stream was then transmitted over a sliced 5G network (or 5G public network for ENG use cases) to an on-premises Intel® Xeon® processor-based server running decoding software.
- The software decoded the live stream and delivered it to production teams for further distribution.

In the Beijing pilot, Intel's COTS hardware components such as Intel® Celeron® processors and Intel® Arria®10 Field Programmable Gate Arrays (FPGAs) were used in the encoder/transmitter module, and 3rd generation Intel Xeon Scalable processors were used for decoding and video processing.

Figure 1 shows an end-to-end flow of data, e.g., data capture, encoding, transmission, and decoding architecture. Encoder/transmitter modules containing Intel Celeron and Arria 10 FPGA are connected to HD or 4K cameras. These field units encode HD or 4K live streams in real-time to optimize available bandwidth and transmit the encoded stream over a 5G network. Quality, bitrate, and security are maintained during transmission and retransmission. It also aggregates multiple networks dynamically in order to improve network capacity.

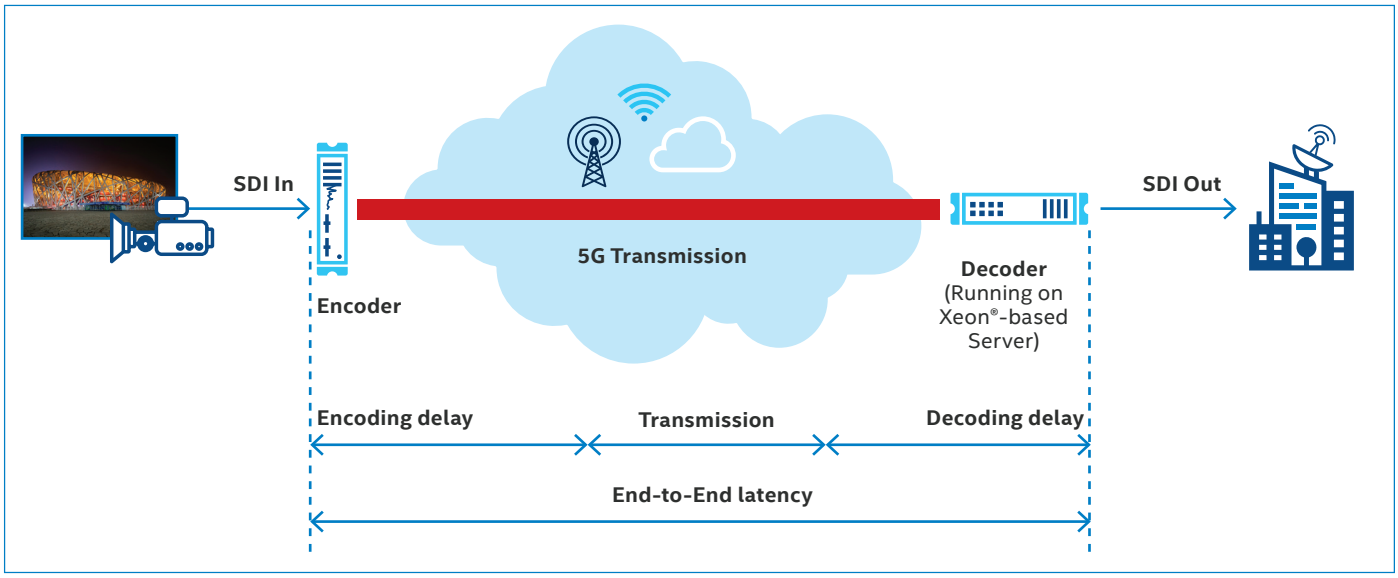

Figure 1. End-to-End Data Flow

The encoded stream is received by a decoder/transceiver module running on 3rd generation Intel Xeon Scalable processors servers at the venue. The decoder appliance is a high-performance transceiver designed to meet the demanding requirements of broadcasting live video over unmanaged IP networks. The decoder appliance supports all major IP video formats (including SRT, NDI, RTMP, HLS, RTMP, SST, etc.). The decoder appliance could be located on-premises to achieve ultra-low latency or could be located at IBC for ENG use cases.

Figure 2 shows the ENG setup at Tokyo 2020. A module encoded and sent the stream over a public 5G network to the decoding servers located at the International Broadcast Center (IBC) for further processing.

Beijing 2022 ENG and Live Broadcast

After the success of the Tokyo 2020 ENG broadcast over 5G network pilot, the Olympic Broadcasting Services requested to extend the architecture to include live broadcast use cases at the Olympic Winter Games Beijing 2022. One of the primary requirements for a live broadcast over 5G network use case was to achieve an end-to-end latency of less than 200 milliseconds. Multiple optimizations and improvements were implemented at each stage of the 5G platform solution and architecture to meet this latency requirement.

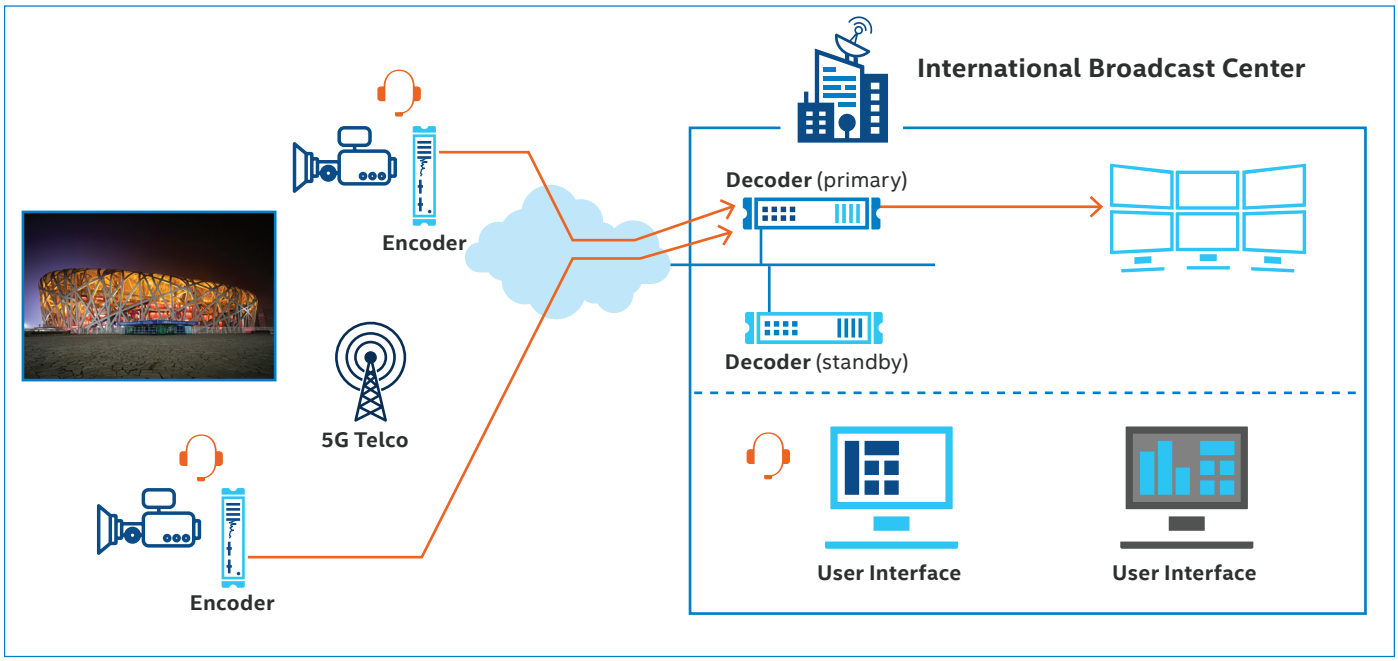

Figure 2. 5G ENG Setup for Tokyo 2020

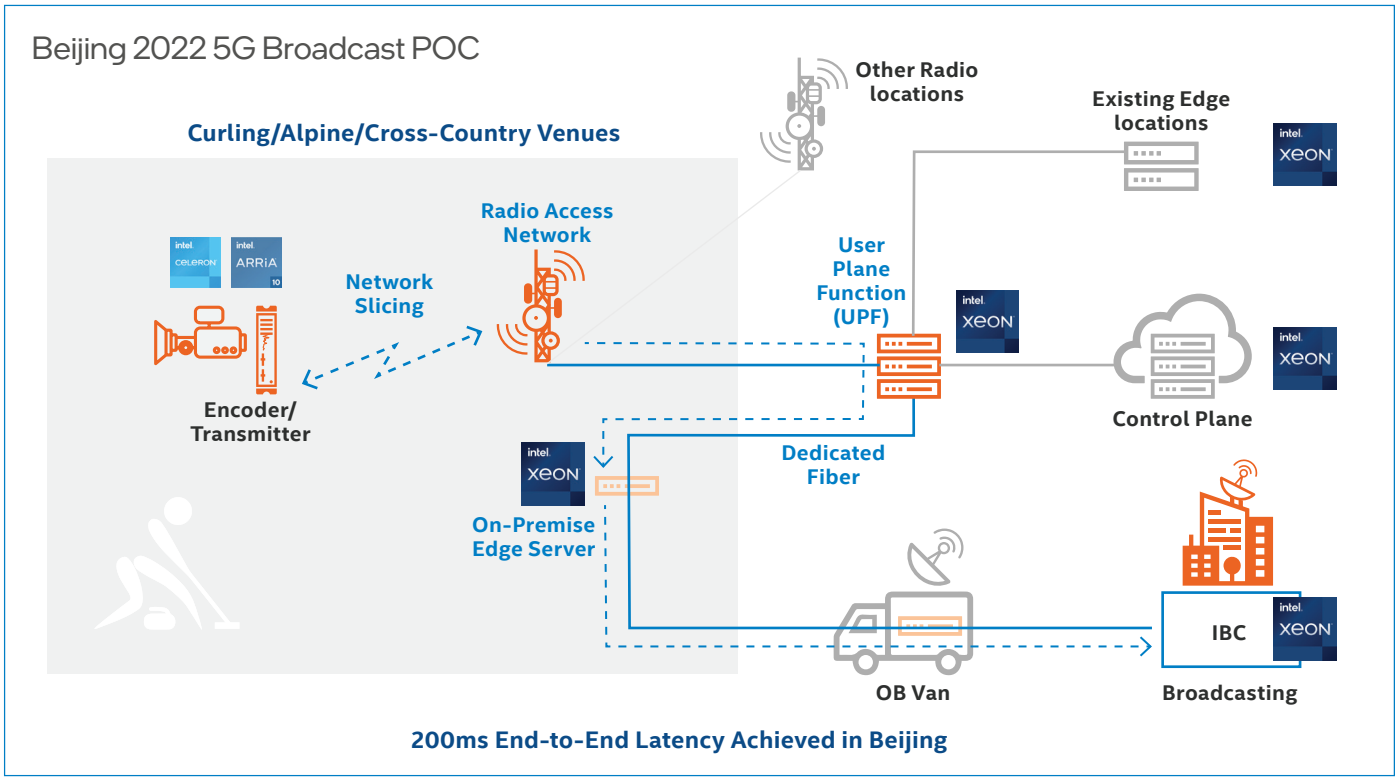

Figure 3. Beijing 2022 Live Broadcast Architecture

Figure 3 shows an end-to-end solution architecture of the Beijing deployment. One of the optimizations and key features is the availability of an ultra-fast, low latency 5G network slice from the local telco service provider for the live event broadcast. In this case, after encoding the live stream, the encoder/transmitter module used a 5G network slice to reliably transmit the encoded feed to the decoding server located at the venue thus achieving about 200 ms end-to-end latency. This solution provides the performance comparable to RF broadcasting solutions and is an attractive alternative for live media broadcast.

Conclusion

Intel conducted 5G broadcast pilots at Olympic Games Tokyo 2020 and Olympic Winter Games Beijing 2022. These pilots used the right combination of technologies—Intel FPGA, Intel Xeon processors, and AVIWEST 4K/UHD encoding/ transmitting modules—that enabled broadcasters to deliver high quality live sport events over a commercial 5G network while reducing complexity and cost, thus improving total cost of ownership (TCO).

The solution is scalable beyond sporting events, e.g., news broadcasters can also benefit from this ultra-low latency, cost-effective solution. Intel and its partners will continue to optimize this technology to further improve latency and quality for live broadcast use cases and deploy at the Olympic Games Paris 2024.

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