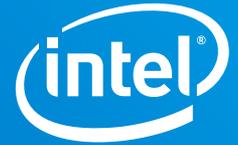


CASE STUDY

Communications Service Providers
Streaming 8K Television



Harmonic VOS® Cloud-Native Software Powers 8K over 5G Trial

Harmonic and Intel were selected by France Televisions to help stream 100 hours of French Open tennis coverage in 8K over 5G wireless networks. Harmonic VOS cloud-native software provides cloud-based media processing using servers powered by Intel® Xeon® Scalable processors.

Demo at a Glance

- Demo network vendors: 18
- Number of 8K cameras: 2
- Number of 8K television sets: 2
- Number of pixels/s: 2 billion
- Encoded bitrate: Live (85 M/s), CAE VOD (32 M/s)
- Hours of 8K video: 100
- Length of tournament: 15 days



Challenge

8K TV and 5G wireless networking are two technologies that will have a significant impact on the future of television. 8K TV has been called the “ultimate”¹ television technology because it is so lifelike. 5G wireless has the bandwidth to be a transport network for 8K TV signals from remote locations like sporting events, but also is the only wireless technology able to carry 8K. France Televisions designed this demonstration as a proof of concept that a working 8K TV service could be built using wireless 5G services.

Solution

The demonstration was a significant undertaking involving the local Orange 5G network designed by Nokia and more than 18 technical partners selected by France Televisions, 8K Sharp broadcast cameras, transmission and processing equipment and software, 8K television sets, and 5G Oppo Reno mobile phones. This use case focuses on media processing using VOS® cloud-native software from Harmonic on servers powered by Intel® Xeon® Scalable processors.

Results

Intel and France Televisions built the network and streamed 100 hours of live tennis to two 8K Sharp 65” television sets. The project gave a better understanding of how to deploy the technologies in the future.

Bringing 8K TV to Life

The next iteration of television is 8K TV. It’s a technology that transmits video at a resolution of 7,680 pixels x 4,320 pixels x 60 frames/s, which is four times higher resolution than 4K TV and 16 times higher resolution than 1080p HDTV. 8K TV provides the ultimate technology¹ for realistic television because the pixels are so small and dense that viewers cannot visualize scanlines that are viewable even in 4K TV technology. It also enables high-quality immersive experiences like VR and personalized streaming on legacy devices. It is a technology already commercially deployed by NHK in Japan.²

Live sports is expected to be a key driver for the adoption of the 8K technology. Yet there are many questions to be answered in terms of media processing performance, transport networks, and the end user technology being TV or mobile devices. The French Open tennis tournament demonstration was designed to provide some of the answers to those questions.



Figure 1. Scene from 8K TV streaming at the 2019 French Open tennis tournament.³

Streaming the 2019 French Open in 8K TV

France Televisions initiated the demonstration of 8K TV streaming system to test how well the video streams could be transported across 5G networks. The goal was to demonstrate the use of this new 5G wireless technology for a video streaming network and also deliver content in anticipation of increased mobile viewing of sports. The video encoding included 8K distributed over 5G to both TVs and 5G phones.

The system was designed to stream 100 hours of tennis to 8K televisions set up in showrooms within the tennis center hosted by France Televisions for professionals. The signal produced was also distributed to the consumer-facing Orange booth.

To capture the action, two 8K TV cameras were set up on the Philippe Chatrier court. The video feeds were transferred via a 4 x 12 Gbps SDI link to an optical converter within the production area and then converted to a 48 Gbps optical link to be transmitted to the France Televisions compound before being converted back to SDI and sent to the video switcher that fed the three encoders used in the demo.

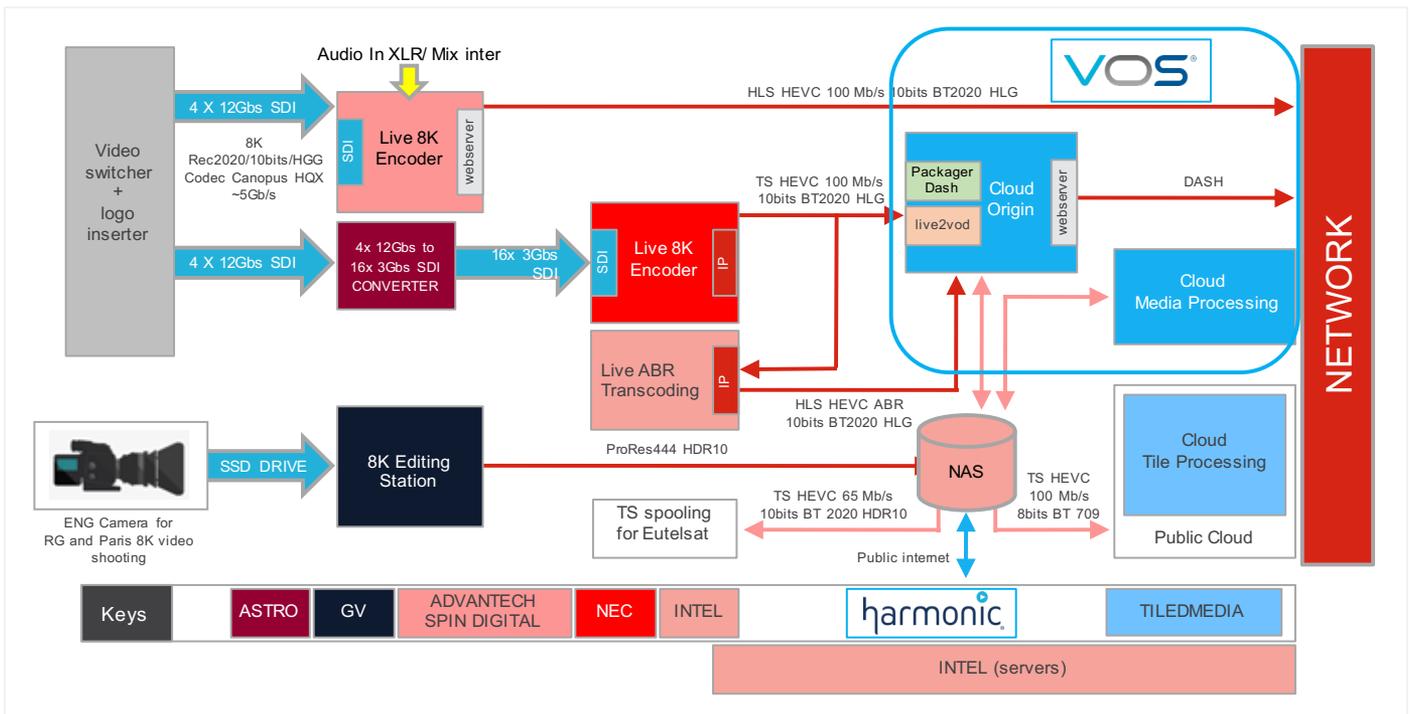


Figure 2. Content preparation and workflow.⁴

Several live encoders were used in the system to support the trial, for benchmarking and also for redundancy purposes. One of benchmark encoders was a Scalable Video Technology for HEVC Encoder (SVT-HEVC Encoder) prototype designed for this 8K TV project. The encoder is a High Efficiency Video Coding (HEVC)-compliant encoder library core that is highly optimized for Intel Xeon Scalable processors and Intel Xeon D processors. The encoder takes an IP input and produces a live, adaptive streaming output in HTTP Live Streaming (HLS) format; the server used for the encoder was based on dual Intel Xeon Platinum 8180 processors.

The second live encoder was a hardware-based encoder from Advantech that was directly outputting live HEVC Main 10 packaged in HLS.

The third live encoder was an NEC Live 8K encoder that was outputting TS to the Harmonic VOS cloud-native software.

Harmonic's VOS Cloud-Native Software

Harmonic's VOS cloud-native software unifies the media processing chain, in this case, after the live encoding is completed externally by the NEC encoder. The VOS cloud-native software provides all of the essential media processing

functions, such as ingest, playout, graphics, transcoding, encryption, and delivery. With VOS cloud-native software, broadcasters need only to define their sources, upload the assets, and set regional or global distribution policies to start engaging with their audience. The solution used for the French Open tennis coverage in 8K over a 5G wireless network is a prototype of the future of Harmonic's VOS offering.

Media Processing in the Cloud

In the demo, the VOS cloud-native software ran on hardware powered by dual Intel Xeon Gold 6152 CPUs, and provided live packaging of the 8K live feed to support Dynamic Adaptive Streaming over HTTP (DASH) format for streaming to 8K TVs, video on demand (VOD) extraction from live (catch up) as well as pure VOD from post-produced 8K content. While the DASH feed is sent directly to the network for TV consumption, one of the demo's objectives was to provide content to mobile devices using adaptive streaming that might not yet support either HDR or 8K resolution.

The catchup content becomes a VOD asset for further encoding to provide video streams suitable for the mobile devices in the demo. The VOS solution converts this feed from 8K hybrid gamma log (HLG) single bitrate (SBR) to adaptive bitrate (ABR) supporting either high dynamic range version 10 (HDR10) for television sets or standard dynamic range (SDR) for mobile devices. The same workflow was also applied to VOD post-produced assets.

Once the video streams hit the network, they ultimately get transmitted across two 250 Mbps 5G wireless links via two dedicated base stations provided by Orange.

Intel® SSD Data Center Family for NVMe for Video Asset Storage

The setup required a high performance and capacity network storage attached to the cloud origin server to manage the mezzanine, catch-up TV, VOD, and other video assets. Intel built a 96 TB network attached storage (NAS) system built on two servers powered by dual Intel Xeon Gold 6152 server processors. The servers featured Intel® SSDs for non-volatile memory express (NVMe). Intel SSDs for NVMe are designed for data intensive workloads with very fast input/output operations per second (IOPS) performance.

Normally, the 5G signal would be terminated by an IP-connected television, but these TVs weren't available for the demo. The workaround involved two 5G-connected Intel® Core™ i7 and Intel Core i9 processor-based PCs that decoded the video streams at 60 frames/s in real time, using VLC (DASH) and Spin Digital (HLS) players. The PCs were connected to 8K televisions via four HDMI 2.0 cables.

Bit Budget

During the demonstration, the encoded bitrate for live was 85 M/s for video and offline encoding using VOS cloud-native software for adaptive streaming was done according the table below.

PROFILE	RESOLUTION	BIT DEPTH	CODEC	FRAME RATE	COLOR SPACE	PURE CBR (M/S)	EYEQ™ (M/S)
1	7680x4320	10	HEVC Main 10	60	BT 2020	65	33
2	5120x2880	10	HEVC Main 10	60	BT 2020	39	20
3	3840x2160	10	HEVC Main 10	60	BT 2020	16	8
4	2560x1440	10	HEVC Main 10	60	BT 2020	9	5
5	1920x1080	10	HEVC Main 10	60	BT 2020	5	3
6	1280x720	10	HEVC Main 10	60	BT 2020	3	1

First, we see that ABR technology can help to adapt to the network variation from 65/3 M/s for constant bit rate (CBR) encoding. Harmonic's VOS cloud-native software includes EyeQ™ content-aware encoding. EyeQ adapts the encoding bitrate to the content complexity. This provides 50% transmission bandwidth savings compared to CBR. These results show that HEVC is an effective technology when streaming 8K over 5G.

Conclusion

The significance of this demonstration is that it proved possible to leverage two technologies—8K video and 5G—to deliver video with outstanding resolution during a major sporting event. The demo was set up only two months before the first matches of the French Open. The result of collaboration between Intel and the partners has created a platform able to support multiple services, including live streaming, catchup, and VOD across television sets and mobile devices. It demonstrates the feasibility of streaming 8K with amazing image quality and immersive services.

Learn More

Visual Cloud Computing with Intel® technology:
www.intel.com/visualcloud

Harmonic VOS Cloud-Native Software for Media Processing & Delivery: www.harmonicinc.com/saas-for-video



¹ The Coming Age of 8K SUPER Hi-Vision: https://www.meiji.ac.jp/cip/english/research/opinion/yoshiaki_shishikui.html.

² "NHK, other TV stations begin broadcasting 4K, 8K ultra-high-definition programs," *Japan Times*, December 1, 2018. View online at <https://www.japantimes.co.jp/news/2018/12/01/national/nhk-tv-stations-begin-broadcasting-4k-8k-ultra-high-definition-programs>.

³ Image provided courtesy of France Televisions.

⁴ Image provided courtesy of Harmonic.

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