

NTT Develops World's First Real-time 4K High Frame Rate HEVC Codec—Enabling Live Transmission of High Frame Rate Video, Resulting in Smoother and Sharper Video Quality

1. Introduction

NTT has developed a real-time 4K^{*1} high frame rate (HFR) High Efficiency Video Coding (HEVC)^{*2} codec that enables live transmission of HFR video. HFR enhances video smoothness and sharpness by doubling the frame rate^{*3} of the standard video frame rate (SFR) from 50/60 p to 100/120 p. HFR video is especially effective for fast-moving video content such as sports.

By developing this codec, NTT will contribute to enhancing the quality of broadcasts and public viewing of sporting events. NTT will also develop opportunities to use HFR transmission in virtual reality and surveillance applications.

2. Background

Ultra-high-definition (UHD) services have been launched recently by many satellite operators and OTT (over-the-top) platforms throughout the world. In March 2015, NTT announced a real-time 4K/60 p HEVC video encoder LSI (large-scale integrated circuit) called NARA (Next-generation Encoder Architecture for Real-time HEVC Applications) [1], which has contributed to the rapid acceptance of UHD services.

Live sports programs are the main drivers of UHD services, so HFR video technology, which is especially beneficial for sports content, has attracted strong interest from UHD service providers. NTT's

real-time 4K HFR HEVC codec enables UHD service operators to conduct live broadcasts of HFR sports content.

3. Technical overview

Both the 4K HFR HEVC encoder appliance and the 4K HFR HEVC decoder appliance, key components of the real-time 4K HFR HEVC codec, are a compact 1U (1 rack unit: 44.45 mm height) size (**Fig. 1**). The 4K HFR HEVC encoder appliance provides backward compatibility by supporting temporal scalable coding^{*4}, meaning the output stream can be decoded by a conventional SFR decoder to yield 4K SFR video.

*1 4K video: A video format that has approximately 4000 horizontal lines and 2000 vertical lines. There are some variations. The television industry uses 3840 × 2160 (UHD-4K) resolution, while the cinema industry uses 4096 × 2160 (DCI-4K) as the standard format.

*2 HEVC: The latest video compression standard developed through the joint collaboration of international standardization bodies, ITU-T (International Telecommunication Union - Telecommunication Standardization Sector) and the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC).

*3 Frame rate: The number of frames per second. 60 p indicates that the video comprises 60 frames per second in progressive scanning.

*4 Temporal scalable coding: An output stream of temporal scalable coding contains one or more subset streams. Different frame rate video can be decoded from one video stream by the combined use of subset streams in decoding.



Fig. 1. Real-time 4K HFR HEVC codec.

Moreover, our codec supports the MPEG Media Transport (MMT) protocol^{*5} which enables hierarchical transmission. Two independent transmission routes can be used to transfer the base-layer data, which is used for decoding 4K SFR video, and the enhancement-layer data, which is used together with base-layer data for decoding 4K HFR video.

4. Technical features

(1) Multichip encoding

The encoder uses two NARA chips in parallel to achieve the high-speed processing demanded by HFR encoding, while maintaining visual quality by carrying out mutual data transfers between the chips.

(2) Hierarchical transmission by MMT protocol

The MMT protocol enables the base-layer data and

enhancement-layer data to be transmitted over different IP (Internet protocol) streams. Using two different transmission routes creates a timing offset in the arrival of the data streams. MMT can reconfigure the order of data by using timestamps based on UTC (coordinated universal time).

Reference

- [1] Y. Omori, T. Onishi, H. Iwasaki, and A. Shimizu, "A 120 fps High Frame Rate Real-time Video Encoder," NTT Technical Review, Vol. 15, No. 12, 2017.
<https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201712fa3.html>

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*5 MMT protocol: MMT (MPEG Media Transport) is the digital container standard developed by MPEG (Moving Picture Experts Group), a working group of international standardization organization ISO/IEC. MMT is designed to distribute media via various transmission routes such as broadcasting and IP networks.