|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  13th Meeting: Incheon, KR, 18–26 Apr. 2013 | Document: JCTVC-M0172 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **Use cases and requirements for lossless and screen content coding** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Information | | |
| *Author(s) or Contact(s):* | Thijs Vermeir | Tel: Email: | +32 56 26 2379 thijs.vermeir@barco.com |
| *Source:* | Barco | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Abstract

This contribution provides input for two ad-hoc groups: JCT-VC AhG8 and MPEG-AhG-SLSCC. The mandates of these AhGs are the activities related to Screen Content Coding. Based on the experience and market insights of Barco as a visualization company, 3 applications are presented as use cases for (perceptually lossless) screen content coding: control rooms, the digital operating room and a collaboration use case. Out of these use cases a set of requirements is proposed. For the mixed-content test sequences (both screen content and natural video) a suggestion is made on the test methodology to group pixels spatially based on the content.

# Applications for screen content coding

In this section the use for screen content coding in Barco will be explained based on three use cases, i.e., a control room equipped with very high-resolution video walls, a Digital Operating Room (DiOR) requiring lossless quality, and a collaboration use case with limited (wireless) bandwidth. Although the use of screen content coding is not limited to these use cases, they provide a good overview of the requirements and problems encountered with screen content coding for professional use.



Figure 1: Large video wall with screen content in Bangalore Metro Rail Corporation

Control rooms are used in multiple areas in the industry (e.g., process control, energy, traffic & surveillance), gathering and visualizing all information to facilitate decision-making and or handling crisis situations. One important part of the control room is the video wall, which visualizes the most important information at each moment. Typically, the content on this video wall is positioned and scaled depending on the target operators’ viewing angle and position, e.g., providing detailed information for an operator sitting close to the wall, while an overview or schematic provides a shared / longer-distance view. An example of a control room is the large video wall with screen content in Bangalore Metro Rail Corporation (Figure 1).

Technically, a video wall is a combination of displays or projection systems combined seamlessly into a display wall. A single display can have a resolution typically ranging from HD to 4K, and so the total resolution of the video wall can go far beyond the capabilities of a single HEVC codec. As a result, a setup of multiple parallel encoders and decoders is common practice. Within the control room a 10 Gbit/s network connection is typically available to transport the video from the application server to the display wall. However, there is often need for transporting the video stream to other control rooms at remote locations, for example for cross-checking in a second control room to improve reliability. In addition to streaming, recording the video for legal or training purposes is often required. Due to the massive amount of video data, compression is essential to make the solution technically feasible as well as financially affordable.



Figure 2: Digital Operating Room (DiOR) with multiple screen content sources

In a DiOR use case (Figure 2), natural video content (e.g. visuals from a small camera inserted in the body) as well as screen content (e.g. showing heart rate, blood pressure) should be visualized, both inside and outside the operating room. Outside the operating room the video streams could be used for diagnostics, clinical review, or educational purposes. For diagnostics, very strict and legally defined constraints are imposed regarding video quality, in practice typically implying end-to-end lossless video. To minimize latency within the operating room, video is often sent uncompressed over high speed networks (e.g. 10 Gbit/s). However, these uncompressed streams cannot be sent on a corporate hospital network or be streamed over the Internet. In the review case (e.g. for training purposes), lossless compression is not a requirement and lossy screen content coding can help reducing the required disk space for recording or reducing the amount of bandwidth for streaming.



Figure 3: Desktop sharing with a wireless connection in a meeting room.

A third use case involves collaboration of people in a meeting. In such a context, the screen of multiple devices could be shared on a large common display or projection system. Although the content to be visualized is often “typical screen content” (e.g., presentations, spread sheets), users also expect the system to work seamlessly as well for non screen content. Hence, the system should both support screen content as well as natural content. A wireless connection is typically used as communication network between the client (connected to the laptop) and the base station connected to the display. Since the network is prone to errors and all available bandwidth is used, the encoded stream should have a high compression ratio. This system can both be used in smaller meeting rooms but also in larger conference rooms with much larger screens. It is expected from this solution that the quality is equal or comparable to a wired connection (e.g. through a VGA/DVI/... cable).

With the increasing interest for streaming video and the use of mobile devices to view streaming video, the consumer is getting used to use its consumer electronics inside a professional environment. The use of standard codecs allows integrating well with these devices. However, as is the case with H.264/AVC, consumer electronics will probably only support the most common profiles of HEVC (without extensions). This means that the decoding process has only hardware acceleration for the building blocks from these profiles. This should be taken into account when new coding techniques are proposed. They should have low complexity in software or be available as a scalability layer on top of an HEVC main profile stream.

# Requirements for subjectively lossless screen content coding

Previous contributions, like JCTVC-L0302 [1], have already reported that new coding tools for screen content coding could improve compression ratios for this type of content. From the use cases described in the previous section a set of requirements can be concluded that are specific for screen content coding:

* Colorspace subsampling gives unacceptable artifacts (like reported in JCTVC-I0272). Therefore YUV 4:4:4 colorspace should be supported; RGB may be supported for lossless coding.
* Screen scraping is the most important use case, so desktop screen specifications should be supported: resolutions up to WUXGA (1920x1600), 8bits per color component and up to 60 fps.
* Consumer electronics will be equipped with hardware acceleration for HEVC video compression. For mobile devices this will increase the battery lifetime. However like with H.264/AVC, it is expected that these devices will only support Main profile (or a limited set of profiles). To support a screen content extension on these devices, the extension should have low complexity or should reuse building blocks provided in main profile. Another option is to provide the screen content extension in a scalability layer.
* An encoded stream is only decoded on a limited number of decoders, unlike in the broadcast market where a single encoder is providing a stream to possibly millions of decoders. Therefore the extra cost to implement this extension should be low (compared to HEVC Main profile) to keep the solution affordable.

# Test conditions and test methodology for subjective lossless quality

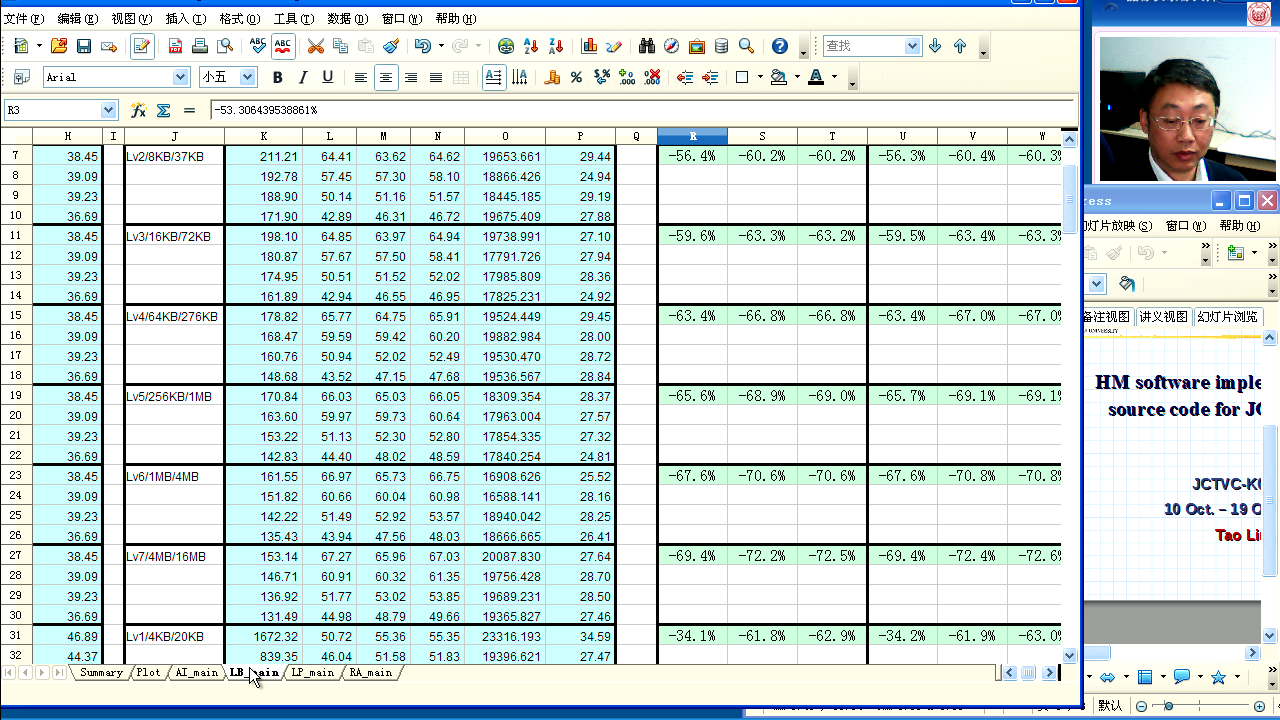


Figure 4: Example of both natural content and screen content in a mixed content test sequence (sc\_video\_conferencing\_doc\_sharing)

In the use cases presented above, the quality expectations for screen content and especially mixed content (both screen content and natural content) are different. An example is already in the test sequences: sc\_video\_conferencing\_doc\_sharing. A screenshot of this sequence is provided in Figure 4. Whereas visually lossless quality is expected for screen content (document sharing), this is not expected for the video in the sequence. In most cases these areas will already present pre-compressed video streams (such as video conferencing data, recorded movie clips, ...) and already incorporate compression artefacts. Therefore taking this area into account to evaluate the global PSNR could have a negative effect on the subjective quality.

It is proposed that based on the content of the sequence the pixels in a frame are grouped in two areas, one for screen content and one area for natural content. PSNR changes in both areas could then be evaluated between different proposals.

# References

[1] H. Yu, W. Gao, J. Ye, Y. Cao, and X. Wang, “AHG8: Results from lossless coding the 4:4:4 screen content sequences”, JCT-VC Document, JCTVC-L0302, Geneva, Switzerland, Jan. 2013.

[2] T. Lin, P. Zhang, S. Wang and K. Zhou, “4:4:4 Screen Content Coding using Dual-coder Mixed Chroma-sampling-rate (DMC) Techniques”, JCT-VC Document, JCTVC-I0272, Geneva, Switzerland, Apr. 2012.

# Patent rights declaration(s)

**Barco does not have any current or pending patent rights relating to the technology described in this contribution.**