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Improvement of Image Sensor Performance through Implementation of JPEG2000 H/W for Optimal DWT Decomposition Level

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Abstract

In this paper, a particular application of digital photos, remote sensing, remote shooting air moving, high-resolution and high compression of medical images required by remote shooting of JPEG2000 standard applied in the field of hardware design, production was implemented. JPEG2000 standard for image compression using the software implementation of the processing speed is very slow compared to conventional JPEG disadvantages, and also the standard of JPEG2000 DWT (Discrete wavelet transform) to improve the level of compression for image data if processing speed is a phenomenon that has degraded. In order to solve these JPEG2000 compression / decompression groups were designed and applied. In this paper, the optimal JPEG2000 compression / reservoir hardware by changing the level for still image compression, faster computation speed and quality has shown improvement.

Keywords: *JPEG, JPEG2000, Image Processing, Decomposition level, Discrete Wavelet Transform.*

1. Introduction

As far as the standard JPEG still image screen in high frequency and medium frequency is shown great performance, while it is impossible to perform specific applications (high resolution and compression, digital photography, remote sensing, remote shooting, medical imaging, etc.) of the area in

low frequency. It is impossible to perform the remote shooting in high resolution and compression

covered by this paper [1]. Therefore, in the environment low-bit-rate (0.25 bps lower) in order to solve the problem of the deterioration by the noise, the image quality of the distortion and specific field rather than the existing standard is leveled up, it was also significantly better video encoding efficiency to still image which is a new standard of JPEG2000 was born [1]. JPEG 2000 maintains a good video quality than conventional JPEG to provide better compression while maintaining at the same time low bit rate and showed an improved

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compression ratio, a single system is provided many more skills loss and lossless encoding, bit error robustness, gradual transfer. However, JPEG 2000 is implemented with the software when it has the disadvantage of being very slow processing speed compared to conventional JPEG. Therefore, this paper is applicable to JPEG 2000 hardware which is the air remote imaging shooting to implement a better compression ratio and faster computing speeds and quality improvement, Additionally, JPEG 2000 compression is one of the most critical technology DWT(Discrete wavelet transform) is compressed images process using the multi-resolution decomposition and band it makes decision to optimal level through analysis of JPEG2000 hardware experiment in making itself [2][6].

2. Body

2.1. JPEG2000 Standard

JPEG 2000 is a complement to disadvantage of existing image compression and at the same time it seems high compression performance than existing ones. As well as, JPEG 2000 is provided several new features, such as did not provide you with the region of interest (ROI) is encoded in JPEG. The image picture is compressed by JPEG 2000 using a former process, Discrete Wavelet transform (DWT) and the arithmetic encode by EBCOT (Embedded Block Coding with Optimized Truncation) [1]. The full image is tiled and each of the tiles is transferred to discrete Wavelet transformation by JEPG 2000. Each block of code is independently encoded in binary arithmetic after sub band values to be quantized by Wavelet coefficients configuration is divided to a block of code (Code block) of a given size.

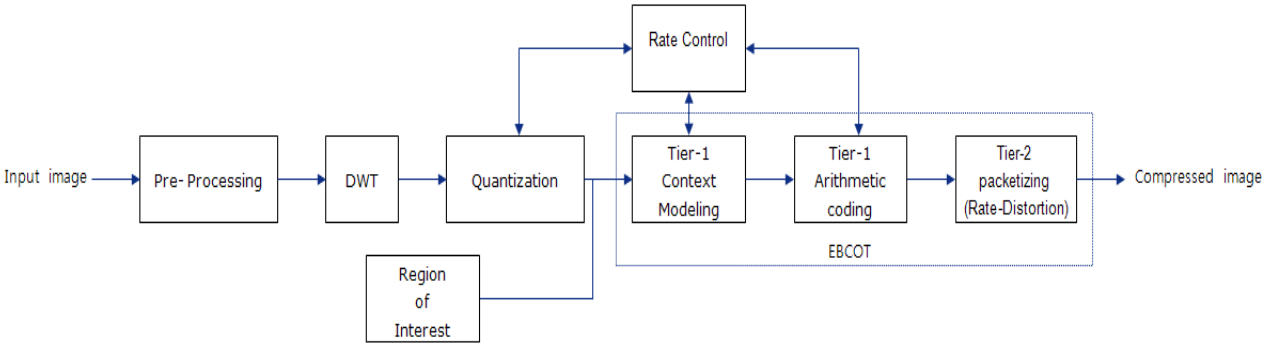

Figure 1. Encoding Diagram of JPEG2000

Currently there is proposed more appropriate Wavelet for signal analysis in many applications. Particularly the image compression field is researched to a way to implement a serial configuration of QMF (Quadrature mirror filter) Bank and to be able to interpret a filter Bank (Filter bank) form having the structure of a binary tree (Dyadic tree) by Discrete Wavelet transformation image compression.

2.1.1 2D Image Wavelet Transform

The Wavelet transforms of image can be obtained by QMF, after then it is consisted of several images of multi-resolution sub-band. Figure 2 shows the video n-level decomposition process using a 2-dimensional Discrete Wavelet transform. The image decomposition process of the 2-dimensional Discrete Wavelet transform is down sampling after translating the origin image to the horizontal direction using H (low-pass filter) and G (high-pass filter). One of the decomposition process is coming up with four images and each band has 1/4 size of origin image. These four parts is divided to the most of the energy concentrated in the

low-frequency image (LL) and the image (HL) having directional horizontal component and the image (LH) of vertical component, and each component image (HH). Figure 3 is shown to be divided to three-level parts of the Lena image which is applied to a 2-dimensional Discrete Wavelet transformation. [5]

2.1.2 ROI(Region of Interest)

Image of a specific region of interest (ROI) is more importance than in other region which provides the functionality of the application. The function is useful of priority to transfer the application before you decode the entire image on the interest of a particular area or the image area of user side as ensuring excellent image quality. JPEG2000 ROI coding in Part 1 of JPEG2000 is using adopted as standard of the Maxshift method, which is scaling up the coefficients of ROI area to be located in higher bit-plane than coefficients having the largest value of non-ROI area. These coefficients in ROI is able to transmit progressively MSB (Most significant bit-plane) to LSB (Least significant bit-plane) according to user requirements as being formed the MSB during the embedded encoding process.

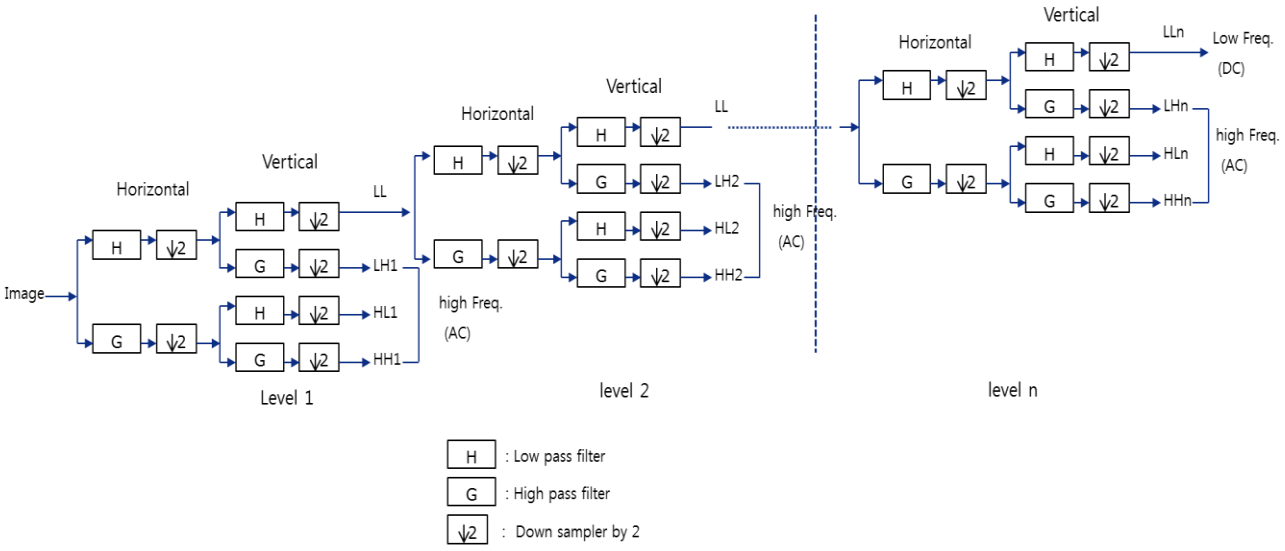

Figure 2. Wavelet n-level resolution of 2D image

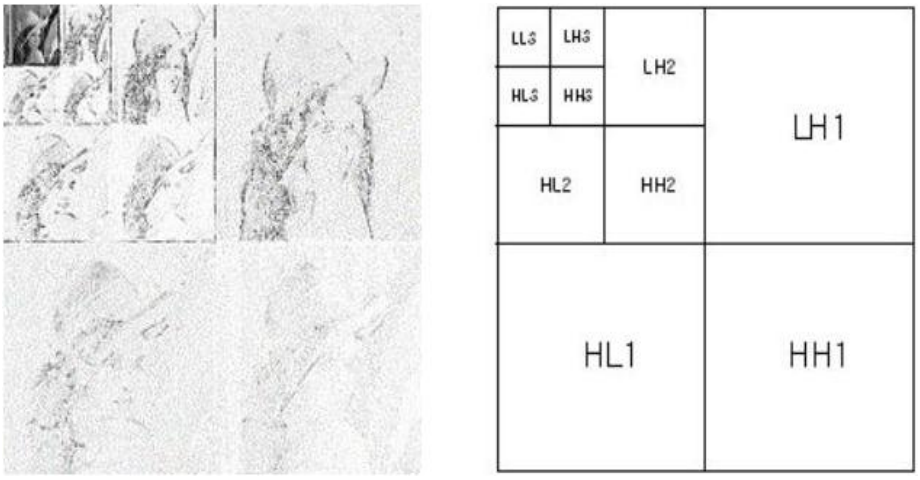

Figure 3. 3-level resolution of Lena image and resolution diagram

2.2 Suggested Algorithm

Electro-optical (Electro optic) image data processor performs the processing and acquisition of the captured images from the EO video camera. The image data processing and compression function for the image data processing is designed to JPEG2000 compression card's hardware meet the criteria as shown in Figure 4.

JPEG2000 compression hardware is consists of the JPEG2000 hardware engine and PMC, PCI/I/F, CPLD. The main control board, PowerPC Embedded Board was applied to PCI interface in order to control the JPEG2000 compression card, and the PCI interface function of the main control board transmits and receives datum to PCI 32bit data bus through the PMC connector as shown in Figure 5. In addition, PCI Bridge device is the standard communication interfaces of data provided the main Control Board, and the JPEG2000 hardware of the transmitted data through PCI mode is the role of the data Bridge of local Bus which consists of the inside data path of the compression card. The main function of the compression board in JPEG 2000 is designed by using the engine of specific hardware built in ADV212. JPEG2000 hardware engine receives the command of the main Control Board through the PCI Bridge, which is designed the control logic for the hardware engine chipset and synchronization of access and real-time control function.

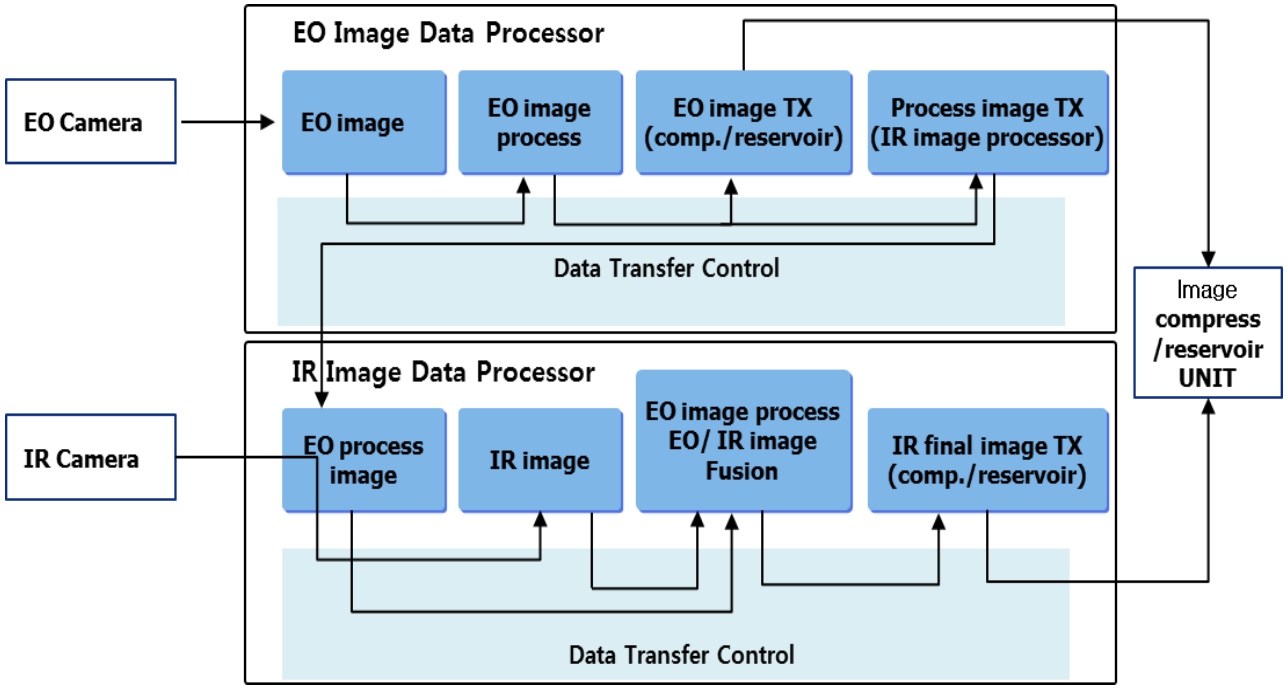

Figure 4. Process of image data

The image source of JPEG2000 compression processes a still image having 1024 x 1024 resolution in JPEG2000 hardware engine with the ADV212. It can process independently the EO (Electro optic) image/IR (Infrared) image within ADV212 two cards at the same time It is designed and made to the embedded board based on CPU of PowerPC which is applied to JPEG2000 compression. The hardware is also able to add PMC (PCI Mezzanine card – PMC) card. Above board is responsible for the main control functions of JPEG2000 compression, and which writing a program to be operated in VX works real-time operating system

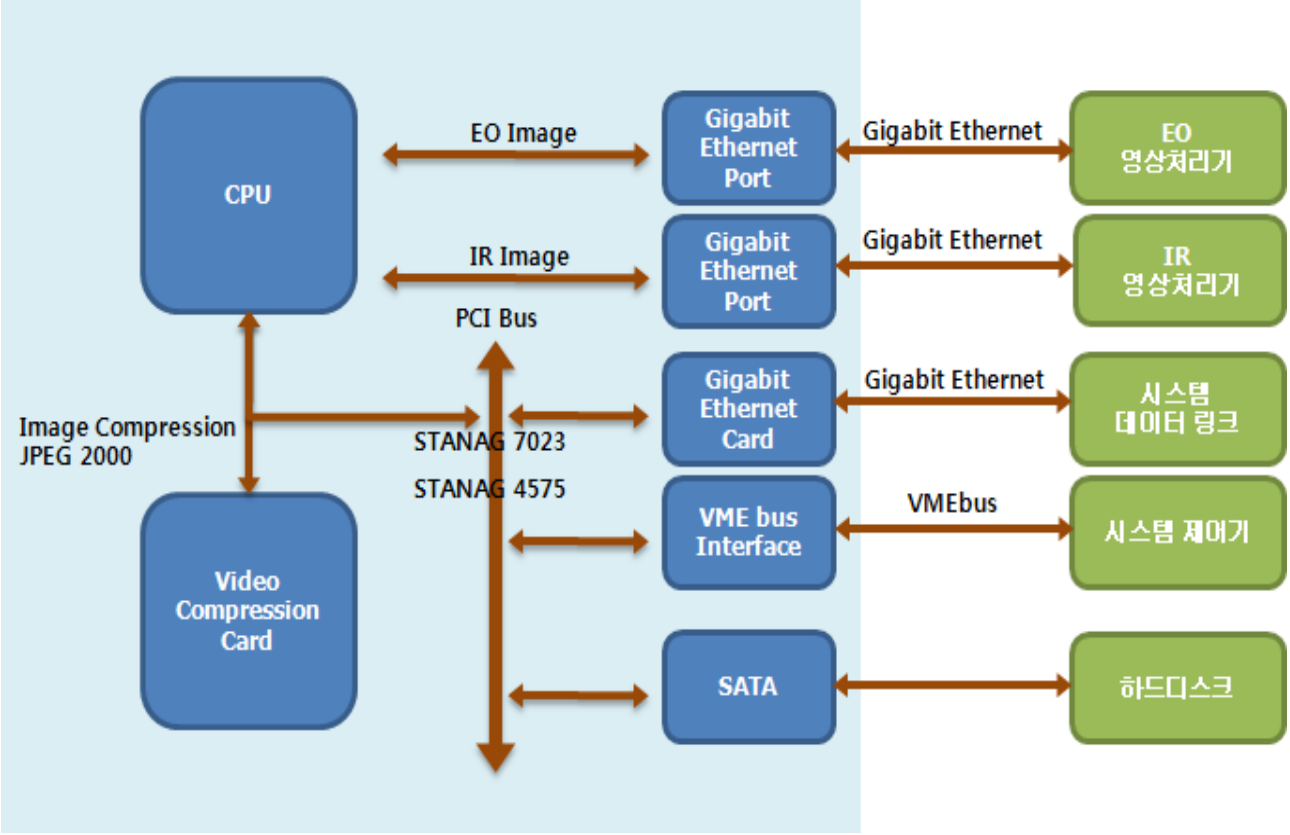

Figure 5. Structure of JPEG2000 compression-coding & storage

2.3 Hardware configuration of implementation board and experimental environment

In order to carry out image data management process, the image data management and compression process are planned for JPEG2000compression·encoding received condition. The implemented hardware board in this study, PMC, PCI I/F, CPLD and ADV212(JPEG2000 CDDEC) of JPEG2000hardware engine. Moreover, the PCI interface is applied to JPEG2000compression card in main control board Power PC Embedded Board.

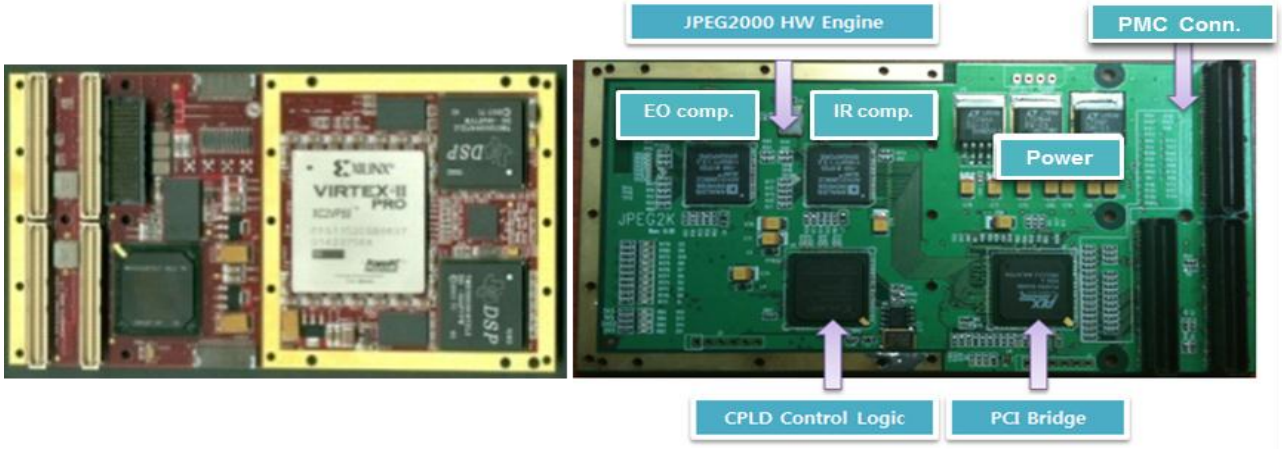

Figure 6. The Shape of JPEG2000 H/W Board

The basic parameter environment of a test board is as follows.

- Image: Lena
- Tile size: 256 x 256
- Compress rate: 2:1, 4:1, 9:1, 20:1
- Number of wavelet transform level: level5, level3
- Code block dimensions: 128 x 32
- Wavelet kernel irreversible: 9 x 5
- JPEG2000 progression style: LRCP(Layer-Resolution-Component-Positon)
- Quantization factor: 256/256 factor (1 x)
- Output code stream format: JPEG2000 format Gray Scale

2.4 The experiment result and analysis

The test result data through the implementation of JPEG 2000 is analyzed and compared to decoding image on the still image through DWT level changes as you can see the resulting data as in table 1. Comparison of the DWT level is shown on the improvement of the PSNR and compression rate which is expressed to the image quality at the processing 5 level regarding the basic level of the level 3 and level 5 proposed in this paper. Even the compression x 20 rate of original video is shown without any improvement of the image quality through experimentation. In the context of the original video compression rate x 20 did not see an improvement of the quality of the video x10 this compression algorithm is useful in proving through experimentation. Analysis of the performance of the proposed algorithm is shown in Figure 8 to the Lena image in 256 x 256 sizes as a test image. The image (a) is x4 compression image compared to the DWT level 5 and 3 video as being decoded and compressed the original image to (b) and (c). As shown in Figure 8 (b) and (c), part (b) of the high frequency component image is showed more improvement than (c). AS shown graph at Figure 7, the PSNR in this compressed x10 is shown to be improved this 3dB or so, as expressing the resulting data values.

Table 1. The Data of Measurement Result

Image	Compression rate	Wavelet Transform Level = 3		Wavelet Transform Level = 5	
		Quantization Step Size = auto		Quantization Step Size = auto	
		PSNR (dB)	Real Compression	PSNR (dB)	Real Compression
Lens	X2	46.85841	5.6	49.8789	5.61
	X4	46.85841	5.6	48.9959	5.61
	X9	40.08143	8.94	42.5106	8.94
	X20	33.56792	19.69	33.7970	19.69

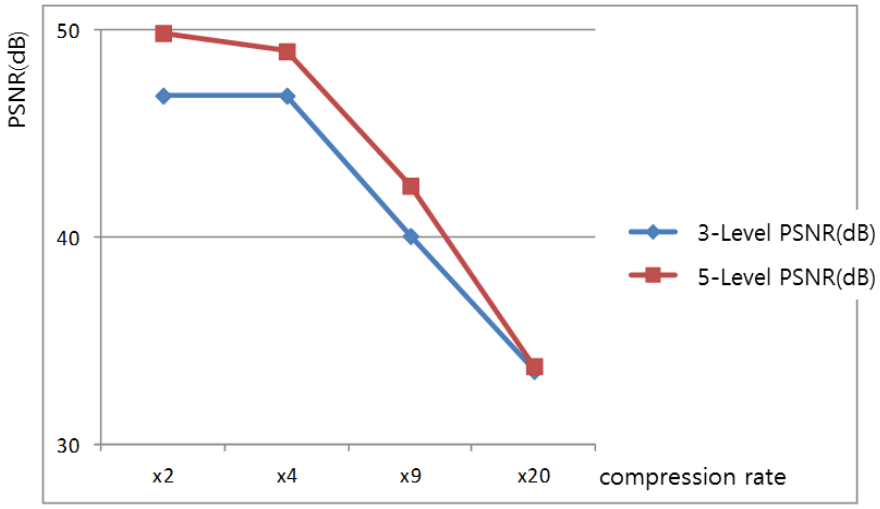

Figure 7. Comparison to Compression rate of 5/3 Level

(a) **(b)** **(c)**

Figure 8. (a) Origin Image, (b) 5 Level Image, (c) 3 Level Image

3. Conclusion

In this paper, the existing Discrete Wavelet transforms (Discrete wavelet transform) software is designed as a hardware development, Image compression processing has improved image quality as changing the levels of the appropriate level of Discrete Wavelet transform in consideration of the amount of the operation and the changes in factors such as compression ratio (Factor) using the developed JPEG2000 compression/save. JPEG2000 compression/encoding is compensated with the processing delay of the image compression and the encoding and decoding. In particular, the compression ratio and the amount of processing time on the image operation showed an improvement in quality through the level increase of Discrete Wavelet transformation which is difficult to apply due to the time delay. And the image quality improvements is carried out the aim to get better image in the remote aerial shooting as a special applied system, also the developed system is expected to the availability of high quality in the field of medical image at below x10 compression rate through general imaging experiments

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