



**Title:** Performance report of TMuC for Super Hi-Vision

**Status:** Input Document to JCT-VC

**Purpose:** Information

**Author(s) or** Kazuhisa Iguchi

**Tel:** +81-3-5494-3354

**Contact(s):** Atsuro Ichigaya

**Email:** iguchi.k-eq@nhk.or.jp

Yoshiaki Shishikui

ichigaya.a-go@nhk.or.jp

NHK

shishikui.y-hw@nhk.or.jp

Science & Technology Research

Laboratories

1-10-11, Kinuta, Setagaya-ku, Tokyo,

JAPAN

Shun-ichi Sekiguchi

**Tel:** +81-467-41-2463

Akira Minezawa

**Email:** Sekiguchi.Shunichi@eb.Mitsubi

Information Technology R&D Center,

shiElectric.co.jp

Mitsubishi Electric Corporation

Minezawa.Akira@ds.Mitsubishi

5-1-1, Ofuna, Kamakura, JAPAN

Electric.co.jp

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## Abstract

This contribution reports the performance of TMuC 0.7.0 for Super Hi-Vision (SHV) sequences. While TMuC achieves substantial coding gain relative to H.264 CFP anchor, it took from ■ to ■ times encoding time than JM encoding with CFP anchor condition.

## 1 Introduction

HEVC is required to support wide variety of picture size ranging at least from QVGA to 8Kx4K [1]. This contribution reports the performance of TMuC software [2] for Super Hi-Vision (SHV) sequences those have been donated for HEVC standardization [3]. As a result of our simulation, while TMuC achieved significant improvement from JM for SHV sequences, its encoding took from ■ to ■ times computation time than JM.

## 2 Simulation results

Figure 1 and 2 illustrate simulation results of SHV sequences "steam locomotive train (SL)" and "nebula festival (nebula)" [3], respectively. Both sequences have 7680x4320 pixels in a frame and 300 frames (60 frames per second). The results of TMuC are obtained by TMuC 0.7.0 with random access condition described in JCTVC-B300 [4]. The results of AVC/H.264 are produced using JM16.1 with CFP Constraint Set 1 condition. Additionally, we also plot the experimental data of A107 codec [5] for the same SHV sequences [6] in the both figures .

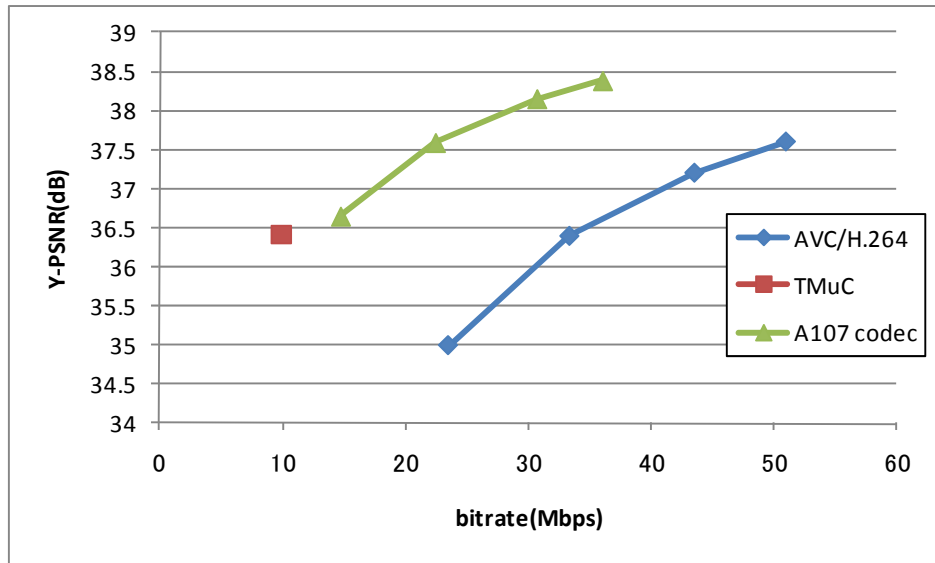


Figure 1 "SL" Luma R-D performance

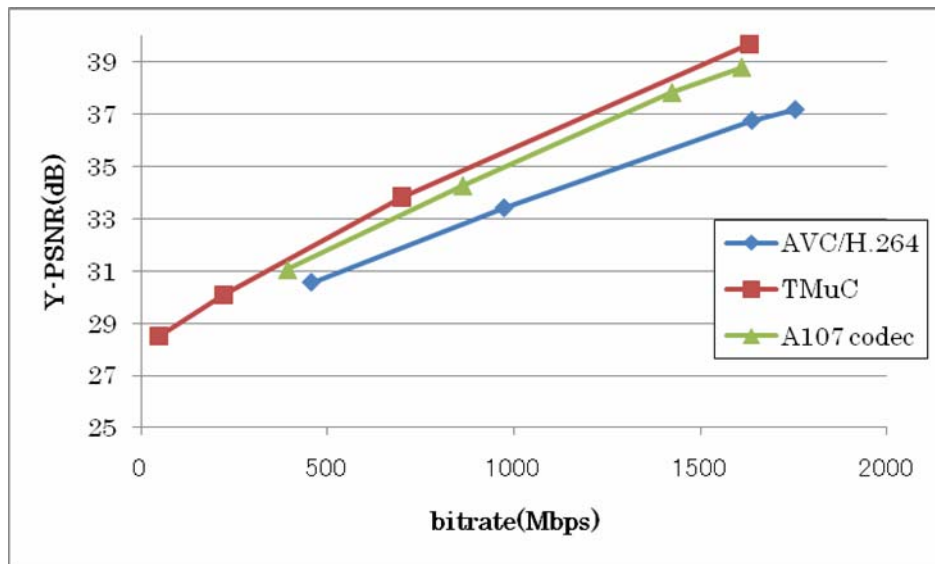


Figure 2 "nebuta" Luma R-D performance

While TMuC achieved significant improvements from AVC/H.264, it took about from 15 days to XX days to complete encoding. Table 1 and 2 shows the simulation environments and encoding time.

Table 1 Simulation Environments

	PC type A	PC type B	PC type C
CPU	Xeon X5680 3.33GHz	Xeon W5590 3.33GHz	Xeon X5482 3.20GHz
Memory	24GB	48GB	32GB
OS	Windows XP Professional x64 Edition 2003 SP2		

**Table 2 Encoding Time**

Sequence	QP	time(seconds)	time(days)	PC type
SL	37			B
	32			C
	27			B
	22			A
nebula	37	1337954.781	15.5	A
	32	1586497.906	18.4	A
	27	2137862.016	24.7	A
	22	2608223	30.2	A

We also used JM16.1 (modified to deal with SHV resolution) to encode “nebula” sequence at QP=22 (the most complex condition). It took 4.6 days to encode for whole sequence. As JCTVC-B066[6] reported that JM encoding required 5 days, the simulation environment of this contribution should be faster than that used for JCTVC-B066. B066 also reported A107 codec required 8days for its encoding. Considering the performance and encoding time trade-off that can be seen in Figure 1, 2 and Table 2, the current TMuC software should careful be assessed on both tool configuration including encoding method and implementation efficiency.

### 3 Simulation results for cropped sequences

As discussed in the previous section, the current status of the TMuC software makes it difficult to evaluate and optimize coding tools for SHV sequences. To make simulation time to be practical length to conduct various performance evaluations, we also encoded SHV sequences cropped into Class A size. It took between 2.7 days and 3.8 days to encode whole frames using the same TMuC 0.7.0 software. The results are illustrated in the column named as "Crop before encode" in Table 3. The "Crop after encode" is calculated from the results in section 2. Before calculating PSNR, the decoded frames were cropped into Class A size. Both columns are the same for all color components and it is observed that the subjective coding quality is also the same. From the results, it can be said that cropped SHV sequences to Class A size shows the similar ability to evaluate codec and coding tools.

**Table 3 PSNR of SHV and cropped SHV**

Sequence	QP	crop after encode			crop before encode		
		Y(dB)	U(dB)	V(dB)	Y(dB)	U(dB)	V(dB)
SL	37	37.1727	43.6988	43.8107	37.1851	43.9070	44.1289
	32				38.8536	44.4956	44.4812
	27				40.0931	45.1099	44.9196
	22				41.5049	45.8045	45.5059
nebula	37	28.0020	35.2387	34.0070	27.9985	35.2871	34.0637
	32	29.7843	36.5096	35.2117	29.8025	36.5201	35.2535
	27	33.6135	37.6487	36.2584	33.7015	37.6566	36.3041
	22				39.5277	38.8480	37.5510

### 4 Conclusion

The results of encoding SHV sequences using TMuC 0.70 are reported. It has been confirmed that TMuC achieves significant coding efficiency compared with JM for SHV sequences but, it takes from 15 days to 30 days while JM required 5 days using up-to-date computing environment.

This high coding complexity of TMuC encoder should be a practical issue for optimizing HEVC standard to UHD TV sources, which should also affect quality of standard compliant UHD TV codec. We recommend to pay attention to encoding complexity, as well as decoding complexity, of the current TMuC tools in the evaluating process of TMuC such as TE12 for defining Test Model.

We also note that SHV sequences cropped into Class A size have the same coding degradation as that of full-resolution SHV sequences in the cropped area.

## References

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