

**INTERNATIONAL ORGANISATION FOR STANDARDISATION  
ORGANISATION INTERNATIONALE DE NORMALISATION  
ISO/IEC JTC1/SC29/WG11  
CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC1/SC29/WG11  
MPEG2006/M13295  
April 2006, Montreux, Switzerland**

**Title**            **Extended Scalability Performance of Wavelet Video Coding**  
**Status**            Input document  
**Authors**        **Riccardo Leonardi, Michele Brescianini, Hassan Khalil**  
                      Contacts: [riccardo.leonardi@ing.unibs.it](mailto:riccardo.leonardi@ing.unibs.it), [michele.brescianini@ing.unibs.it](mailto:michele.brescianini@ing.unibs.it),  
[hassan.khalil@ing.unibs.it](mailto:hassan.khalil@ing.unibs.it)

In this document PSNR curves produced using the Exploration Wavelet Video Coding system are provided according to “extended scalability” test conditions. Such testing conditions was proposed during the last meeting [1] and have been further explored here.

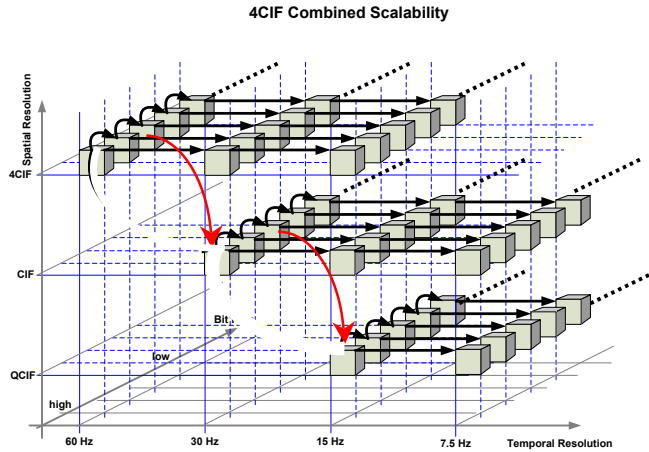
Additionally, a higher resolution sequence (cropped to 4CIF dimension) has been considered and PSNR results are reported according to operating points and extraction path discussed between the last and this meeting.

## **1 Extended Scalability Performance (EXT)**

As stated in [1], in a combined extended scalability scenario, extraction from an upper spatial resolution higher temporal rate to the next lower temporal /spatial resolution is performed from  $\sim 2/3$  more than the CIF spatial resolution max rate point (as indicated in table 1 and figure 1). This is motivated in an application scenario where a provider could be interested in delivering content at various resolutions (4CIF, CIF, QCIF) by buying it at a max predefined rate.

### **Extraction Paths (proposed in [1])**

The applicable extraction paths are depicted below. The main extraction path is along the spatial layers. Temporal scalability is achieved by extraction from the rate points of the highest temporal resolution for each spatial layer.



**Figure 1: 4CIF extraction paths for extended combined scalability.**

The extraction paths for extended combined scalability are shown in Figure 1. To preserve the embeddedness of the bit stream the following rule is defined. For each extraction point in the spatio-temporal-quality cube, it is required to allow the extraction of extraction points of lower or equal spatial or temporal resolution and equal or lower rate point index.

### Rate Points (proposed in [1])

Rate points are shown in table 1. In this extended combined scalability testing scenario, the extracted streams are required not to exceed the target rate points.

**Table 1: Operating points for extended combined scalability**

Sequence	Format	Bit rates (kbit/sec)						
		64	80	96	120	144	168	192
City	QCIF 15Hz	64	80	96	120	144	168	192
	CIF 30Hz	256	320	384	480	576	672	768
	4CIF 60Hz	672	848	1024	1280	1536	1792	2048
Harbour, Soccer	QCIF 15Hz	96	120	144	180	216	252	288
	CIF 30Hz	384	480	576	720	864	1008	1152
	4CIF 60Hz	1024	1280	1536	1920	2304	2688	3072
Crew	QCIF 15 Hz	120	180	240	270	300	330	360
	CIF 30 Hz	480	600	720	900	1080	1260	1440
	4CIF 60 Hz	1280	1650	1920	2400	2880	3360	3840

The rate points marked in red indicate the extraction points for the lower spatial/temporal resolution max points (e.g., for City 1280kbit/s represents the 4CIF 60Hz rate from which to extract a 768 kbit/s max CIF 30Hz stream). The green background shows the test points at which visual testing should be performed.

PSNR values and curves have been plotted for Harbour and Soccer sequences and are reported in the file M13295\_extended.xls attached to this document.

## Modified Extraction Paths and Operating Points

Another set of operating points and related extraction paths has been tested: the bit-rate extremes (first and last column of table 1) have been deleted, while the extraction paths from middle rated to the new extremes have been preserved. The resulting scenario could be more realistic from an application point of view and is less critical for bit-stream encapsulation. Also in this case, PSNR values and curves have been plotted for Harbour and Soccer sequences and are reported in the file M13295\_extended.xls attached to this document.

## 2 Higher resolution tests on “Vintage Car” sequence

A preliminary test has been conducted on the HDTV 1080p (1920x1080) resolution sequence “Vintage Car” that has been cropped, from the top-left position (500,200), to 4CIF dimensions.

Sequence	Format	Point number - Bit rate (kbit/sec)				
Vintage Car	4CIF 30Hz	2048	1792	1536	1280	1024
	CIF 30Hz	640	512	448	384	320
	QCIF 15Hz	160	128	112	96	80

Extraction paths follows a spatial encapsulation on the higher bit-rates (first column) and a SNR encapsulation within each spatial layer (along the table raw). PSNR values and curves are reported in the file M13295\_vintagecar.xls attached to this document.

## 3 References

[1] “Description of Testing in Wavelet Video Coding”, ISO/IEC JTC1/SC29/WG11 MPEG2006/N7823, Bangkok, Thailand, Jan. 2006.