# Adaptive Bitrate Selection for Video Encoding with Reduced Block Artifacts

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# ABSTRACT

Blocking artifacts, commonly introduced during video encoding, are one of the major causes of reduced perceptual video quality. The trade-off between these artifacts and bitrate can be improved by adaptively selecting frames from a set of video copies encoded at different bitrates, prior to actual video encoding. We propose a new direction of constructing mixed bitrate video based on content-based image analysis on each video frame, which was posed as a problem of pre-analysis for the final video encoding step.

The proposed method consists of the following steps: First, we define a simple and fast impact metric in order to identify the blocking artifacts in each frame of multiple videos, encoded at different bitrates. Based on the impact metric, we generate a blocking artifact density functions for the available bitrates, on the whole video. Finally, we define and optimize our objective function from the blocking artifact density functions in order to select a bitrate with minimum perceptual blockiness and file size for each frame.

We validated our method throughout multiple types of videos, showing improved visual quality for the same file size based on commonly used quality assessment measures, such as MSU blocking, MSU blurring, SSIM, 3SSIM, and stSSIM. The reduction rates of average file size and average blocking artifact were about 4.9% and 8.3% over maximum bitrate encoding, respectively.

#### Keywords

Adaptive bitrate selection; video encoding; video quality measurement (VQM); blocking artifact

## 1. INTRODUCTION

Encoding is an essential process in the provision of video streaming services, and there has been a variety of approaches to improve efficiency and visual quality. Many new encoding tools and content-based metrics have been introduced

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Figure 1: Overview of the proposed adaptive bitrate selection method.

to improve the compactness of video coding standards. Recently, the High Efficiency Video Coding (HEVC) [14] shows a significant improvement in compression over previous standards [12]. Another approach to improve the compactness of video coding is adaptive bitrate control, which also facilitates dynamic power control in embedded systems, network bandwidth adjustment, and video quality optimization. Initial work on adaptive bitrate control was mostly concerned with the support of network bandwidth renegotiation [13, 17]. For example, Javdtalab et al. [6] developed an algorithm that measures network bandwidth, frame size, PSNR and SSIM for rate-control under H.264 HEVC. Adaptive bitrate control has recently escaped from the network environment, and been used to improve the efficiency of video encoding and transcoding, and to reduce the power consumption of devices. Feghali et al. [4] proposed the variation of frame-rate and quantization parameters to achieve adaptive bitrate control in mobile video broadcasting, subject to a perceived-quality metric.

Closely related to our research, another lines of method to enhance encoding efficiency have been proposed to re-

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duce blocking artifact. Li et al. presented blocking artifact measurement metric with no reference information using Tchebichef moments [9]. They used an observation of multiple orders of the Tchebichef kernels which have varying abilities to capture blockiness. On the other hands, Yoo et al. developed discrete cosine transform (DCT) based interblock correlation for block artifact reduction algorithm[18].

We introduce a new approach of video quality optimization prior to actual video encoding. In specific, we propose a framework of constructing a multi-bitrate video based on content-based image analysis on each video frame, which is posed as a problem of pre-processing step before the actual video encoding step, as summarized in Figure 1. The proposed method has the following main differences from a multi-pass VBR: VBR is based on the motion changes, which does not necessarily reflect blocking artifacts, but the proposed method uses the pre-computed measures of blocking artifacts to select the video frames with optimal bitrates from the decoded videos that have been already encoded in different bitrates. Therefore, our method can measure/predict them before encoding the final video, whereas VBR cannot measure structural similarity before actually encoding the final video. It means that we can fine-tune the video to generate one with allowable levels of blocking artifacts associated with structural similarity, with budgeting file size. Since the proposed technique is an independent process of typical video quality enhancement techniques, that are typically applied after decoding process, our technique can still be applied as a standalone or along with other post processing techniques such as [7].

Although many different techniques can be applied for frame quality analysis problem, generally, blocking artifacts are known to be caused by quantization errors at the boundary location between adjacent macroblocks where there is a large difference in quantization levels, and to have a serious impact on the visual quality of videos [10]. First, we identify the blocking artifacts in each frame of the video, encoded at different bitrates, and quantify them using an impact metric. Then, we generate an artifact map for the whole video, consisting of blocking artifact density functions for the available bitrates. Finally, we construct an objective function from the blocking artifact density functions, and select a bitrate for each frame by  $L_1$  and  $L_2$  optimization of this objective function. Since we need to encode an input video into multiple bitrates before reconstructing a multibitrate video, note that the proposed method is intended for archived video contents, e.g., video-on-demand service, rather than real-time encoding, e.g., web casting. However, the proposed method is practical in real world application since once the videos in multiple bitrates are created, which is the most time consuming process, frame selection and reconstruction can be processed relatively in small amount of time. Furthermore, differently reconstructed videos can be generated in nominal amount of time.

The main contribution of the proposed method is twofold: First, we explored a new concept of optimizing visual video quality as a pre-processing step. The proposed method was validated throughout multiple types of videos in our experiments, showing improved visual quality for the same file size based on commonly used assessment measures, such as MSU blocking, MSU blurring, SSIM, 3SSIM, and stSSIM. Second, we introduced an optimization method with blocking artifact density function by incorporating a fast and effective blocking artifact detection method. By adjusting parameters, it is also possible to adjust detecting sensitivities according to different displaying environments. We tested multi-rate encoding on a well- known video dataset for testing MPEG-4 and mobile high-definition (HD) video. Our encoding method shows promising reduction rates in file size and decoding time, while improving visual quality when measured by standard video quality metrics (VQMs) .

## 2. BLOCKING ARTIFACTS

We search for blocking artifacts in multiple encodings of an input videos. After encoding at different bitrates, blocking artifacts are identified by examining the horizontal and vertical variations in one-dimensional derivative of pixel intensity in each frame. A cumulative map is then constructed from these candidate pixels, which is then used to locate the blocking artifacts in each frame. We will use  $\mathbf{V} = (f^{(1)}, f^{(2)}, ..., f^{(k)})$  to denote an input video with k frames. By encoding  $\mathbf{V}$  at h different bitrates, we obtain a set of h videos  $\mathcal{V} = {\mathbf{V}_1, \mathbf{V}_2, ..., \mathbf{V}_h}.$ 

Artifacts Identification. Blocking artifacts typically occur where are large differences in quantization level between neighboring macroblocks, and the artifacts appear at the edges of each macroblock in the encoded frame. We calculate the one-dimensional derivatives of pixel intensity, in both horizontal and vertical directions  $(f_x^{(i)}, f_y^{(i)})$ , in the  $i^{\text{th}}$  frame  $f^{(i)} \in \mathbb{N}^{m \times n}$  of a video where m and n are the width and height of a frame. The frame  $f^{(i)}$  belongs to the  $j^{\text{th}}$  encoded video  $\mathbf{V}_j$ , and the derivatives  $(f_x^{(i)}, f_y^{(i)})$  are defined as  $f_x^{(i)}(u, v) = f^{(i)}(u, v) - f^{(i)}(u + 1, v)$  and  $f_y^{(i)}(u, v) = f^{(i)}(u, v) - f^{(i)}(u, v)$  is the intensity of the pixel at location (u, v) in the  $i^{\text{th}}$  video frame.

A one-dimensional horizontal vector  $\mathbf{v}_x(u, v) = [\Delta_x^1, \Delta_x^2, ..., \Delta_x^s]^T$  is constructed for the pixel at (u, v), and  $\mathbf{v}_x(u, v)$  is the variation in intensity from  $f_x^{(i)}(u, v)$  to  $f_x^{(i)}(u, v + s)$ , where s is the number of consecutive pixels with the same intensity which form the boundary of a visible block that has been detected. A second vector  $\mathbf{v}_y$  is constructed in the vertical direction from  $f_y^{(i)}(u, v)$  to  $f_y^{(i)}(u + s, v)$ . This process can be regarded as mapping  $f_x^{(i)} \to \mathbf{W}_x^{(i)}$ , where  $\mathbf{W}_x^{(i)} \in \mathbb{N}^{m \times n \times s}$  is a 3D array. A matrix  $\mathbf{D}^{(i)}$  can then be defined given as a constraint on  $\mathbf{W}_x^{(i)}(u, v)$ :  $\mathbf{D}_x^{(i)}(u, v) = \{\begin{array}{c} 1, & \text{if } \Delta_x^1 = \Delta_x^2 = ... = \Delta_x^s \\ 0, & \text{otherwise} \end{array}$ , such that,  $\mathbf{v}_x(u, v) \neq \mathbf{0}$ .

 $\mathbf{D}^{(i)}(u,v) = \mathbf{D}^{(i)}_x(u,v) \vee \mathbf{D}^{(i)}_y(u,v) \text{ is a binary matrix of the same size as } f^{(i)}, \text{ which indicates the likelihood of a pixel contributing to a blocking artifact.}$ 

Blocking Artifact Map.  $\mathbf{C}_j$  is the blocking artifact map for the  $j^{\text{th}}$  encoded video  $\mathbf{V}_j$  in  $\mathcal{V}$ . The map  $\mathbf{C}_j$  is constructed from  $\mathcal{D}_j = {\mathbf{D}_j^{(1)}, \mathbf{D}_j^{(2)}, ..., \mathbf{D}_j^{(k)}}$  for all the pixel locations (u, v) on all the video frames, where  $\mathcal{D}_j$  is a set of matrices of artifact pixels and k is the number of frames in  $\mathbf{V}_j$ :  $\mathbf{C}_j(u, v) = \sum_{i=1}^k \mathbf{D}_j^{(i)}(u, v)$ . We normalize this map to  $\tilde{\mathbf{C}}_j = \mathbf{C}_j / || \mathbf{C}_j ||$ . By processing all the videos in  $\mathcal{V}$ , we obtain a set of blocking artifact maps  $\mathcal{C} = {\tilde{\mathbf{C}}_1, \tilde{\mathbf{C}}_2, ..., \tilde{\mathbf{C}}_h}$ , where the  $j^{\text{th}}$  element in  $\mathcal{C}$  corresponds to the encoded video  $\mathbf{V}_j$ . If the value at pixel location (u, v) in a normalized blocking artifact map  $\tilde{\mathbf{C}}_j$  is greater than a threshold  $\rho$  then



Figure 2: (a) An example blocking artifact density functions for 80 frames of a video encoded at four different bitrates (s = 8). (b) Scaled blocking artifact density functions  $\mathcal{L}'$  (h = 4, p = 2). The block artifact functions with different bitrate are scaled by  $\lambda$ .

a visible blocking artifact can appear at (u, v). We consider  $\tilde{\mathbf{C}}_j(u, v)$  to be the candidate location of a blocking artifact if it satisfies the constraint:  $\mathbf{R}_j(u, v) = \{ \begin{array}{ll} 1, & \text{if } \tilde{\mathbf{C}}_j > \rho \\ 0, & \text{otherwise} \end{array} \}$ . We call  $\mathbf{R}_j \in \mathbb{N}^{m \times n}$  the region matrices corresponding to  $\mathbf{V}_j$ : we construct a set of region matrices  $\mathcal{R} = \{\mathbf{R}_1, ..., \mathbf{R}_h\}$ . We now obtain  $\mathbf{A}^{(i)} \in \mathbb{N}^{m \times n}$  corresponding to the *i*<sup>th</sup> input video frame  $f^{(i)}$  in  $\mathbf{V}_j$  by intersecting  $\mathbf{D}_j^{(i)}$  with the region matrix  $\mathbf{R}_j$ :  $\mathbf{A}_j^{(i)}(u, v) = \mathbf{D}_j^{(i)}(u, v) \wedge \mathbf{R}_j(u, v)$ . The set  $\mathcal{A} = \{\mathbf{A}_1, ..., \mathbf{A}_h\}$  is later used to generate blocking artifact density functions, allowing us to select frames from  $\mathcal{V}$ with the required visual quality.

## 3. BITRATE SELECTION

We now show how to generate blocking artifact density functions using the set of blocking artifact matrices  $\mathcal{A}$ , and how to choose the best bitrate for each frame optimizing an objective function.

Blocking Artifact Density Function. The outcome  $l_i$  is the visual impact of all the blocking artifacts occurring in the *i*<sup>th</sup> frame  $f^{(i)}$ , and can be expressed as  $l_i = \sum_{u=1}^{m} \sum_{v=1}^{n} \mathbf{A}^{(i)}(u, v)$ . After repeatedly applying this process, we assemble a density function  $\mathbf{l}_j = [l_{1j}, l_{2j}, ..., l_{kj}]^T$ , where k is the number of frames in  $\mathbf{V}_j$ . We also obtain a set of h vectors  $\mathcal{L} = \{\mathbf{l}_1, \mathbf{l}_2, ..., \mathbf{l}_h\}$  from the set  $\mathcal{V}$ , and then generate h blocking artifact density functions. Figure 2 (a) shows an example of these functions when a video is encoded at four different bitrates (h = 4).

**Objective Function Optimization.** To select the best bitrate in each frame for an input video, we define an objective function that expresses the difference between the blocking artifact density functions at the lower bitrates and the same function at the highest bitrate:

$$\underset{\Lambda}{\operatorname{argmin}} \sum_{j=1}^{h-1} \| \mathbf{l}_h - \lambda_j \mathbf{l}_j \|_p . \tag{1}$$

where  $\mathbf{l}_h$  is the blocking artifact density function for the highest bitrate in the set of density functions  $\mathcal{L}$ , and  $\lambda_j$  is a weight applied to the  $j^{\text{th}}$  density function. We minimize this function using  $L_p$  distance to obtain a vector of weight coefficients  $\Lambda = [\lambda_1, \lambda_2, ..., \lambda_{h-1}]^T$ . The exponent of the *p*-norm is set to 1 or 2 in our experiments. Minimization produces a set  $\mathcal{L}'$  of scaled density functions, as follows:

$$\mathcal{L}' = \{ \mathbf{l}'_1, \mathbf{l}'_2, ..., \mathbf{l}'_{h-1} \}, \quad \mathbf{l}'_j = \lambda_j \mathbf{l}_j,$$
(2)

where the  $j^{\text{th}}$  density function  $\mathbf{l}'_j$  is the scaled density function from  $\mathbf{l}_j$  by  $\lambda_j$ , and  $1 \leq j \leq h-1$ . Figure 2 (b) shows an example of  $\mathcal{L}'$  with  $\mathbf{l}_h$  when h is 4 and p is 2. Since  $\mathbf{l}'_j$  is a column vector with k elements, we obtain a  $k \times h$  matrix  $Q \in \mathbb{N}^{k \times h}$  from  $\mathcal{L}'$  as follows:

$$\mathbf{Q} = \begin{bmatrix} l'_{11} & l'_{12} & \cdots & l'_{1h-1} & l'_{1h} \\ l'_{21} & l'_{22} & \cdots & l'_{2h-1} & l'_{2h} \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ l'_{k1} & l'_{k2} & \cdots & l'_{kh-1} & l'_{kh} \end{bmatrix}.$$
 (3)

Now, we select the best bitrates from the matrix  ${\bf Q}$  as follows:

$$\hat{\mathbf{l}} = [\hat{l}_1, \hat{l}_2, ..., \hat{l}_k]^T, \quad \hat{l}_i = \min(l'_{i1}, l'_{i2}, \cdots, l'_{ih})$$
(4)

where the elements of  $\hat{\mathbf{l}}$  are the selected bitrates for all the frames in a video. Finally, we apply a one-dimensional median filter to  $\hat{\mathbf{l}}$  in order to prevent sudden changes of bitrate between two consecutive frames.

Video Generation with Variable Bitrates. Using the selected frame information vector  $\hat{\mathbf{l}}$ , we generate a new video  $\hat{\mathbf{V}}$  from the *h* videos in  $\mathcal{V}$ . The new video  $\hat{\mathbf{V}}$  has *k* frames, just like the original video  $\mathbf{V}$ : each frame  $\hat{f}$  in  $\hat{\mathbf{V}}$  is selected from the *h* available encoded frames based on the information vector  $\hat{\mathbf{l}}$ . The quality of the encoded video  $\hat{\mathbf{V}}$  depends on the minimum and maximum bitrates of the encoded videos in  $\mathcal{V}$  and the number of videos *h* with different bitrates in that range. The results of varying these two parameters are described in next section. Finally, the final video can be generated using a standard encoding technique either one-pass or two-pass VBR encoding approach.

#### 4. EXPERIMENTAL RESULTS

To the best of our knowledge, there exists no other video pre-processing technique that can be directly compared with the proposed technique. The closest application may be MPEG-DASH (Dynamic Adaptive Streaming over HTTP), mainly used by Netflix, but it is still uncomparable since they change the bitrate depending on the network bandwidth, not to maintain the QoE. Our scheme aims at minimizing blocking artifact subject to the file size, which allows users in the DASH environment to receive higher-quality video segments, compared with simple VBR transcoding under the same network condition.

In our experiments, we compared our technique with the test videos encoded in multiple bitrates with H.264/AVC codec as baselines. We show the experimental results from our proposed technique applied to MPEG-4 [3] and mobile HD test datasets. The MPEG-4 dataset contains several types of video clip where each consists of frames at  $352 \times 288$  standard definition (SD) resolution, with a frame-rate of 60fps. The mobile HD test dataset contains six videos with about 30 shots; their spatial resolution is  $800 \times 480$ , and there are 9,000 frames at 30fps. This dataset is included to determine whether our method is applicable to rather



Figure 3: Parameter selection for the threshold  $\rho$  with all videos. Black dot indicates lowest MSU blocking values in each video.

long and high-resolution sequences. All the videos in both dataset are encoded using the standard H.264/AVC codec with the H.264/AVC JM reference software [15][2] after applying our preprocessing technique.

Parameter Selection. We set the number of bitrate levels h to 8, with the same interval between each bitrate. We created the *h* transcoded videos in  $\mathcal{V}$  using the FFmpeg encoder [1]. The minimum bitrates for the videos in the MPEG-4 test dataset were selected between 40kb/s to 275kb/s, and the maximum bitrates between 110kb/s to 625kb/s, depending on the amount of data in the video. We encoded these mobile HD dataset videos at bitrates between 900kb/s and 1600kb/s. The calculation of one-dimensional variation in intensity is controlled by the length s of the vectors  $\mathbf{v}_x$  and  $\mathbf{v}_{y}$  used to detect artifacts, and the distance metric p in the optimization. We tuned the parameters s and p to account for the average of blocky noise and file sizes, using the three videos in the mobile HD dataset with h = 8. As a result of this tuning exercise, we selected s to 8 and p to 2. Threshold  $\rho$  is a parameter to impose constraint to the normalized blocking artifact map in C. We selected  $\rho = 0.6791$  by considering average reduction amount of blocky noises in every video as shown in Figure 3.

Video Quality Measurement Results. We used five video quality metrics (VQMs) provided by the MSU quality measurement [5] for quantitative assessment of our technique: structural similarity (SSIM) [16], 3-component structural similarity (3SSIM) [8], spatio-temporal structural similarity (stSSIM) [11], MSU blurring, and MSU blocking [5]. The structural similarity metric compares the videos with a reference video (in this case an unencoded video) in terms of luminance, contrast and the structural properties of each frame. The 3SSIM augments the results from SSIM with edge, texture, and smoothness information; and stSSIM provides temporal information. All these similarity metrics have a value range of 0 to 1.0, with higher values corresponding to better perceptual quality. MSU blurring estimates sharpness, and again higher values are better. MSU blocking metric is particularly significant for our experiments, because our aim is to reduce the numbers of blocking artifacts. Higher values of this metric correspond to higher levels of blocking artifact noise.

Our result shows that the proposed method generated a video with comparable file size to the video encoded in the minimum bitrate, while achieving less or equal blocky noise than the video encoded the maximum bitrate. The structural similarity values are also comparable to the videos with maximum bitrate with meaningful reduction in file size. Table 1 shows the average file sizes and the VQMs for all the MPEG-4 test and mobile HD datasets, and Table 2 shows the average file size and blocking artifact reduction results depending on different categories and types of video clips. Proposed method achieves about 4.9% and 8.7% reduction in the average file size and the blocking artifacts in all video clips, respectively. It is also observable that the reduction rates are especially increased for videos with large movements in a video. The examples of visual results are available in the supplementary material.

Reduction rate(%)	MPEG-4	Mobile HD	Active	Inactive	Avg.
File size	5.103	4.752	4.711	5.144	4.927
MSU blocking	5.266	11.277	11.985	4.559	8.271

Table 1: The average file size and blocking artifact reduction rates in different categories of video clips. For example, the best reduction in blocking artifact was achieved in "active" video clips.

## 5. CONCLUSIONS

We proposed a novel video pre-processing framework for efficient video encoding with improved visual quality and reduced file size through the analysis of visible blocking artifacts. As well as reduced blocky noise, processed videos are compact and achieved good measures in multiple VQMs. Especially, the proposed method is practical for off-line video service, e.g., video-on-demand, since multiple versions of video reconstruction can be created relatively in small amount of time, once the videos in multiple bitrates are created. In order to apply the proposed method, multiple-encoded videos should be prepared by off-line processing. In spite of this prerequisite, our method can be used for many lines of real world applications on video encoding frameworks, such as video on demand and video achieving.

Since our technique does not directly modify any video encoding scheme, it is applicable to any recent encoding codecs such as H.265/MPEG-H HEVC. Other analysis metrics and optimization schemes might potentially improve our results, in terms of the estimation of visual quality and computational efficiency. It may also be possible to extract features reflecting different aspects of visual quality from the spatial and temporal domains of an encoded video in future work.

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Alrivo	File gize	MSIT	MSII			
AKIYO	File size	MSU	MSU	SSIM	3SSIM	stSSIM
(kb/s)	(bytes)	Blocking	blurring		0.0.0	
40	43,361	14.078	9.2623	0.9776	0.9711	0.7697
50	45 340	14.025	0.33/12	0.0833	0.9803	0.8280
	40,040	14.020	9.0042	0.9000	0.9803	0.8280
60	46,648	13.936	9.4557	0.9868	0.9859	0.8645
70	47.801	14.112	9.4763	0.9888	0.9890	0.8882
00	40,490	14 101	0.5100	0.0007	0.0010	0.0070
80	48,430	14.181	9.5196	0.9907	0.9916	0.9078
90	48,826	13.996	9.5557	0.9919	0.9932	0.9218
100	/8 808	13.880	9 5762	0.0028	0.9942	0.9324
100	40,000	10.000	0.0102	0.0020	0.3342	0.3324
110	49,131	13.656	9.6113	0.9937	0.9952	0.9409
Proposed	46.668	12.941	9.5110	0.9850	0.9870	0.8646
F		MOU	MOU	0.0000	0.001.0	0.00.20
Coastguard	File size	MSU	MSU	SSIM	3SSIM	stSSIM
(kb/s)	(bytes)	Blocking	blurring	551111	0001111	3000111
275	425 407	16.338	24 849	0.9319	0.9508	0.5248
210	425,005	15,200	05.150	0.0010	0.0000	0.0210
320	435,965	15.382	25.152	0.9436	0.9601	0.5868
375	443,989	15.371	25.417	0.9525	0.9669	0.6376
425	450 475	15 120	25.614	0.9596	0.9724	0.6820
420	400,470	10.129	20.014	0.5550	0.9124	0.0820
475	455,520	14.927	25.770	0.9658	0.9773	0.7213
525	457.271	14.986	25.871	0.9708	0.9807	0.7568
520	450,000	11.000	25.0.19	0.0747	0.0000	0.7000
575	458,036	14.689	25.942	0.9747	0.9836	0.7861
625	459,262	14.643	26.020	0.9779	0.9858	0.8114
Proposed	426 723	14.671	25 202	0.0630	0.0771	0.7384
rioposed	420,723	14.071	20.295	0.9059	0.9771	0.1364
Container	File size	MSU	MSU	COTA C	accont	- CODV
(kh/e)	(hytee)	Blocking	blurring	SSIM	3SSIM	stSSIM
(AD/S) 50	70 791	1.C. ACC	onuring 00.040	0.0969	0.0400	0.4751
50	72,731	16.468	20.042	0.9362	0.9408	0.4751
75	79.566	18.152	20.667	0.9567	0.9665	0.6138
100	86,080	16.052	21.144	0.0686	0.0700	0.7110
100	80,080	10.052	21.144	0.9080	0.9790	0.7119
125	91,046	15.910	21.328	0.9765	0.9858	0.7792
150	93,809	15.827	21 456	0.9817	0.9898	0.8297
100	00,000	10.021	21.400	0.0017	0.0000	0.0251
175	95,620	15.091	21.560	0.9852	0.9922	0.8654
200	96,704	15.520	21.673	0.9881	0.9941	0.8960
225	07 797	15.004	91 790	0.0001	0.0054	0.0156
220	91,121	15.094	21.789	0.9901	0.9954	0.9150
Proposed	89.042	14.667	20.452	0.9627	0 9702	0 6699
	~~,~			0.002.	0.0.0-	0.0000
Foroman	Filo sizo	MSU	MSU	0.0021	0.0102	0.0000
Foreman	File size	MSU	MSU	SSIM	3SSIM	stSSIM
Foreman (kb/s)	File size (bytes)	MSU Blocking	MSU blurring	SSIM	3SSIM	stSSIM
Foreman (kb/s) 200	File size (bytes) 259,070	MSU Blocking 11.693	MSU blurring 15.613	SSIM 0.9605	3SSIM 0.9678	stSSIM 0.7130
Foreman (kb/s) 200	File size (bytes) 259,070 263,581	MSU Blocking 11.693	MSU blurring 15.613	SSIM 0.9605	3SSIM 0.9678	stSSIM 0.7130
Foreman (kb/s) 200 225	File size (bytes) 259,070 263,581	MSU Blocking 11.693 11.508	MSU blurring 15.613 15.787	SSIM 0.9605 0.9661	3SSIM 0.9678 0.9728	stSSIM 0.7130 0.7527
Foreman (kb/s) 200 225 250	File size (bytes) 259,070 263,581 264,158	MSU Blocking 11.693 11.508 11.390	MSU blurring 15.613 15.787 15.916	SSIM 0.9605 0.9661 0.9706	3SSIM 0.9678 0.9728 0.9772	stSSIM 0.7130 0.7527 0.7858
Foreman (kb/s) 200 225 250 275	File size (bytes) 259,070 263,581 264,158 266,008	MSU Blocking 11.693 11.508 11.390 11.354	MSU blurring 15.613 15.787 15.916 16.005	SSIM 0.9605 0.9661 0.9706 0.9738	3SSIM 0.9678 0.9728 0.9772 0.9803	stSSIM 0.7130 0.7527 0.7858 0.8090
	File size (bytes) 259,070 263,581 264,158 266,008 266,270	MSU Blocking 11.693 11.508 11.390 11.354	MSU blurring 15.613 15.787 15.916 16.005 16.112	SSIM 0.9605 0.9661 0.9706 0.9738	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9822	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8222
Foreman   (kb/s)   200   225   250   275   300	File size (bytes) 259,070 263,581 264,158 266,008 266,379	MSU Blocking 11.693 11.508 11.390 11.354 11.234	MSU blurring 15.613 15.787 15.916 16.005 16.112	SSIM 0.9605 0.9661 0.9706 0.9738 0.9770	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833	stSSIM   0.7130   0.7527   0.7858   0.8090   0.8332
Foreman (kb/s) 200 225 250 275 300 325	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193	SSIM 0.9605 0.9661 0.9706 0.9738 0.9770 0.9797	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533
Foreman (kb/s) 200 225 250 275 300 325 350	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254	SSIM 0.9605 0.9661 0.9706 0.9738 0.9770 0.9797 0.9816	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859 0.9876	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680
Foreman (kb/s) 200 225 250 275 300 325 350 275	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 266,037	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019	Image: 1000000000000000000000000000000000000	SSIM 0.9605 0.9661 0.9706 0.9738 0.9770 0.9797 0.9816 0.9257	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859 0.9859	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8680
Foreman (kb/s) 200 225 250 275 300 325 350 375	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037 267,453	MSU   Blocking   11.693   11.508   11.390   11.354   11.234   11.156   11.019   10.992	Image: Normal State   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317	SSIM   0.9605   0.9661   0.9706   0.9738   0.9770   0.9797   0.9816   0.9837	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859 0.9876 0.9894	stSSIM   0.7130   0.7527   0.7858   0.8090   0.8332   0.8533   0.8680   0.8836
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037 267,453 261,235	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254 16.317 16.242	SSIM 0.9605 0.9661 0.9706 0.9738 0.9770 0.9797 0.9816 0.9837 0.9779	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8836 0.8836 0.8546
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037 267,453 261,235 Eile size	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254 16.317 16.242 MSU	SSIM   0.9605   0.9661   0.9706   0.9738   0.9770   0.9797   0.9816   0.9779   0.9837   0.9779	3SSIM   0.9678   0.9728   0.9772   0.9803   0.9833   0.9859   0.9876   0.9852	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8836 0.8546
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037 267,453 261,235 File size	MSU Blocking 11.693 11.508 11.390 11.354 11.156 11.019 10.992 10.274 MSU	Image: 100 minipage   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU	SSIM 0.9605 0.9661 0.9706 0.9738 0.9770 0.9797 0.9816 0.9837 0.9779 SSIM	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3SSIM	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8836 0.8836 0.8546 stSSIM
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037 267,453 261,235 File size (bytes)	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking	Image: MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.254   16.317   16.242   MSU   blurring	SSIM   0.9605   0.9661   0.9706   0.9738   0.9770   0.9816   0.9837   0.9779   SSIM	3SSIM 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859 0.9859 0.9894 0.9852 3SSIM	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8836 0.8546 stSSIM
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110	File size (bytes) 259,070 263,581 266,008 266,379 266,445 267,037 267,453 261,235 File size (bytes) 135,748	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199	Image: MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.254   16.317   16.242   MSU   blurring   17.843	SIM   0.9605   0.9661   0.9706   0.9738   0.9770   0.9837   0.9779   SSIM   0.9779	35514 0.9678 0.9728 0.9772 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8836 0.8836 0.8546 stSSIM 0.7651
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,453 267,453 261,235 File size (bytes) 135,748 139,612	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.630	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254 16.317 16.242 MSU blurring 17.843 17.938	SSIM   0.9605   0.9661   0.9706   0.9770   0.9777   0.9816   0.9837   0.9779   SSIM   0.9779   0.9816   0.9837   0.9779   SSIM   0.9792   0.9832	3551M 0.9678 0.9728 0.9728 0.9803 0.9853 0.9859 0.9876 0.9876 0.9894 0.9852 3551M 0.9804 0.9844	stSSIM 0.7130 0.7527 0.7558 0.8090 0.8332 0.8533 0.8680 0.8680 0.8836 0.8836 0.8546 stSSIM 0.7651 0.7050
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110 125	Sile Sile   File size (bytes)   259,070 263,581   264,158 266,008   266,379 266,445   267,037 267,453   261,235 File size   (bytes) 135,748   139,613 149,613	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   15.002	SSIM 0.9605 0.9661 0.9706 0.9770 0.9770 0.9777 0.9816 0.9837 0.9779 SSIM 0.9792 0.9823 0.9823	35514 35514 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 35514 0.9808 0.9808 0.9844 0.9624	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8836 0.8836 0.8546 stSSIM 0.7651 0.7979 0.7979
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037 267,453 261,235 File size (bytes) 135,748 139,613 142,811	MSU Blocking 11.693 11.508 11.390 11.354 11.354 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.938   17.996	SSIM   0.9605   0.9661   0.9706   0.9777   0.9816   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852	35514 0.9678 0.9728 0.9728 0.9803 0.9859 0.9859 0.9859 0.9854 0.9852 3551M 0.9808 0.9808 0.9844 0.9875	stSSIM 0.7130 0.7527 0.7558 0.8090 0.8332 0.8533 0.8533 0.8680 0.8836 0.8836 0.8546 stSSIM 0.7651 0.7979 0.8323
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254 16.317 16.242 MSU blurring 17.843 17.938 17.996 18.037	SSIM 0.9605 0.9661 0.9706 0.9736 0.9770 0.9770 0.9816 0.9837 0.9779 SSIM 0.9792 0.9823 0.9852 0.9852	35514 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9874	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7799 0.8323 0.8541
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News   (kb/s)   110   125   140   155   170	File size (bytes) 259,070 263,581 266,158 266,008 266,379 266,445 267,037 267,453 261,235 File size (bytes) 135,748 139,613 142,811 144,531	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.672	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037	SSIM   0.9605   0.9661   0.9776   0.9778   0.9779   9.816   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852   0.9871   0.9871	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9844 0.9875	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8332 0.8533 0.8680 0.8336 0.8836 0.8836 0.8836 0.8546 5tSSIM 0.7651 0.7979 0.8323 0.85241 0.08702
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110 125 140 155 170	File size   (bytes)   259,070   263,581   264,158   266,08   266,379   266,445   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696	MSU Blocking 11.693 11.508 11.354 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254 16.317 16.242 MSU blurring 17.843 17.938 17.996 18.037 18.084	SSIM   0.9605   0.9661   0.9706   0.9738   0.9770   0.9837   0.9779   SSIM   0.9779   SSIM   0.9772   0.9837   0.9779   SSIM   0.9722   0.9852   0.9871   0.9890	3551M 0.9678 0.9728 0.9723 0.9803 0.9859 0.9859 0.9859 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9894 0.9875	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8586 0.8536 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8541 0.8592
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185	Sile Sile   File size (bytes)   259,070 263,581   264,158 266,008   266,445 267,037   267,453 261,235   File size (bytes)   135,748 139,613   142,811 144,531   146,696 147,696	MSU   Blocking   11.693   11.508   11.390   11.354   11.234   11.156   11.019   10.992   10.274   MSU   Blocking   16.199   15.639   15.672   16.168   15.676   15.859	MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.126	SSIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9816   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852   0.9852   0.9852   0.9803   0.9803	35514 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 35514 0.9808 0.9844 0.9808 0.9844 0.9875 0.9894 0.9815 0.9895 0.9894 0.9915	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8536 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8972
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110 125 140 155 170 185 200	File size (bytes) 259,070 263,581 266,008 266,379 266,445 267,037 267,453 261,235 File size (bytes) 135,748 139,613 142,811 144,531 146,696 147,696	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652	Imsubal   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.126   18.158	SSIM 0.9605 0.9661 0.9706 0.9770 0.9777 0.9816 0.9837 0.9779 SSIM 0.9779 SSIM 0.9792 0.9823 0.9852 0.9871 0.9890 0.9906	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9894 0.9875 0.9894 0.9875	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8836 0.8836 0.8836 0.8836 0.8836 0.8836 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8541 0.8592 0.8972 0.9914
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110 125 140 155 170 185 200 215	Tile size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   147,696   147,696	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652	Image: Non-Section 2   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.158   19.164	SSIM   0.9605   0.9661   0.9708   0.9770   0.9781   0.9779   SSIM   0.9779   SSIM   0.9792   0.9823   0.9823   0.9852   0.9871   0.9890   0.9903	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9808 0.9844 0.9875 0.9895 0.98940 0.9929 0.9940	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7651 0.7799 0.8323 0.8544 0.8541 0.8792 0.8972 0.9114 0.0014
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   147,913   148,046	MSU   Blocking   11.693   11.508   11.354   11.354   11.354   11.234   11.156   11.019   10.992   10.274   MSU   Blocking   16.199   15.639   15.672   16.168   15.676   15.859   15.652   15.539	Imsubal   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.126   18.158   18.194	SSIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852   0.9871   0.9803   0.9903   0.9916   0.9924	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9894 0.9915 0.9929 0.9940 0.9948	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8336 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8972 0.8972 0.9114 0.9212
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110 125 140 155 170 185 200 215 Proposed	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   147,696   144,312	MSU Blocking 11.693 11.508 11.354 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652 15.539	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254 16.317 16.242 MSU blurring 17.843 17.938 17.996 18.037 18.084 18.126 18.158 18.194 17.772	SSIM   0.9605   0.9661   0.9706   0.9738   0.9770   0.9816   0.9797   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852   0.9871   0.9890   0.9903   0.9924   0.9924   0.9924   0.9851	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9848 0.9844 0.9875 0.9894 0.9915 0.9929 0.9940 0.9916	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8583 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8524 0.8323 0.8541 0.8323 0.8321 0.8372 0.8972
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Slast	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   147,913   148,046   144,312	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652 15.539 15.652 15.539	MSU   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.126   18.158   18.194   17.772   MSU	SIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9816   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852   0.9852   0.9852   0.9890   0.9903   0.9924   0.9924	35514 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 35514 0.9808 0.9844 0.9808 0.9844 0.9875 0.9808 0.9844 0.9915 0.9929 0.9940 0.9948 0.9916	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8536 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8722 0.8972 0.9114 0.9212 0.9212 0.9212
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   1700   185   200   215   Proposed	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,913   148,046   144,312   File size	MSU Blocking 11.693 11.508 11.354 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.672 16.168 15.652 15.539 15.244 MSU Blocking 15.652	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.943   17.938   17.996   18.037   18.084   18.158   18.194   17.772   MSU	SSIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852   0.9871   0.9906   0.9916   0.9924   0.9881   SSIM	3SSIM 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3SSIM 0.9808 0.9844 0.9875 0.9894 0.9844 0.9875 0.9894 0.9915 0.9940 0.9948 0.9916 3SSIM	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8336 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8972 0.8972 0.9114 0.9212 0.8870 stSSIM
Image: region of the system   Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News   (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent   (kb/s)	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   144,696   147,696   147,696   144,312   File size   (bytes)	MSU   Blocking   11.693   11.508   11.390   11.354   11.354   11.234   11.156   11.019   10.992   10.274   MSU   Blocking   16.199   15.639   15.672   16.168   15.652   15.539   15.652   15.539   15.244   MSU   Blocking	MSU   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   18.037   18.084   18.158   18.194   17.772   MSU	SSIM   0.9605   0.9706   0.9770   0.9770   0.9738   0.9770   0.9816   0.9837   0.9779   SSIM   0.9732   0.9823   0.9852   0.9871   0.9890   0.9903   0.9916   0.9924   0.9881   SSIM	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9859 0.9852 3551M 0.9808 0.9808 0.9844 0.9808 0.9844 0.9875 0.98944 0.9915 0.9929 0.9940 0.9948 0.9916 3551M	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7651 0.7651 0.7651 0.7651 0.8323 0.8541 0.8323 0.8541 0.8792 0.8372 0.9114 0.9212 0.8870 stSSIM
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent (kb/s)   130	File size (bytes) 259,070 263,581 266,008 266,379 266,445 267,037 267,453 261,235 File size (bytes) 135,748 139,613 142,811 144,531 146,696 147,696 147,913 148,046 144,312 File size (bytes) 144,012	MSU   MSU   Blocking   11.693   11.508   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.234   11.156   11.019   10.992   10.274   MSU   Blocking   16.199   15.639   15.672   16.168   15.672   15.652   15.539   15.244   MSU   Blocking   11.306	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.996   18.037   18.084   18.126   18.158   18.194   17.772   MSU   blurring   15.865	SIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9837   0.9779   SSIM   0.9792   0.9823   0.9852   0.9871   0.9803   0.9916   0.9924   0.9881   SSIM   0.9666	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9894 0.9929 0.9940 0.9929 0.9940 0.9928 0.9926 3551M	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8336 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8972 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8753 0.8754 0.8752 0.87544 0.87544 0.87544 0.87544 0.87544 0.87544 0.87544 0.87544 0
Foreman (kb/s) 200 225 250 275 300 325 350 375 Proposed News (kb/s) 110 125 140 155 170 185 200 215 Proposed Silent (kb/s) 130	Tile size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   147,696   144,312   File size   (bytes)   144,012   File size   (bytes)   144,012	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.672 16.168 15.672 15.652 15.539 15.244 MSU Blocking 11.306 11.562	MSU blurring 15.613 15.787 15.916 16.005 16.112 16.193 16.254 16.317 16.242 MSU blurring 17.843 17.938 17.996 18.037 18.084 18.126 18.158 18.194 17.772 MSU blurring 15.865 16.009	SIM   0.9605   0.9661   0.9708   0.9773   0.9770   0.9816   0.9777   0.9837   0.9779   SSIM   0.9792   0.9823   0.9851   0.9890   0.9903   0.9916   0.9924   0.9851   SSIM   0.9666	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9808 0.9804 0.9808 0.9894 0.9915 0.9894 0.9929 0.9940 0.9929 0.9940 0.9948 0.9915	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8541 0.8792 0.8972 0.8972 0.9114 0.9212 0.8870 stSSIM 0.7850 0.8870 0.8972 0.8872 0.8872 0.8872 0.9914 0.9914 0.9921 0.9921 0.9920 0.8870 0.8921 0.9921 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.9920000000000
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent   (kb/s)   130   145	Sile   File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   148,046   147,993   148,046   144,012   144,012   144,012	MSU   MSU   Blocking   11.693   11.508   11.390   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.366   11.019   10.992   10.274   MSU   Blocking   15.639   15.672   15.539   15.652   15.539   15.244   MSU   Blocking   11.306   11.563	MSU   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.938   17.938   17.936   18.037   18.084   18.158   18.194   17.772   MSU   blurring   15.865   16.009	SIM   0.9605   0.9661   0.9706   0.9770   0.9738   0.9770   0.9837   0.9779   SSIM   0.9779   SSIM   0.9792   0.9823   0.9852   0.9852   0.9890   0.9903   0.9924   0.9881   SSIM   0.9666   0.9726	35514 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 35514 0.9808 0.9844 0.9808 0.9844 0.9808 0.9844 0.9875 0.9894 0.9915 0.9929 0.9940 0.9916 3551M 0.9916 3551M	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8536 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.7799 0.8323 0.8541 0.8792 0.8972 0.9114 0.9212 0.8870 stSSIM 0.7385 0.7385 0.7385
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   200   215   Proposed   Silent (kb/s)   130   145   160	File size   (bytes)   259,070   263,581   264,158   266,08   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   144,312   File size   (bytes)   144,046   144,312   File size   (bytes)   144,046   144,312   File size   (bytes)   144,012   File size   (bytes)   144,012   147,470   149,305	MSU Blocking 11.693 11.508 11.354 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.672 16.168 15.672 16.168 15.672 15.539 15.244 MSU Blocking 11.306 11.563 11.263	MSU   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.046	SSIM   0.9605   0.9661   0.9708   0.9770   0.9816   0.9797   0.9816   0.9779   SSIM   0.9779   SSIM   0.9779   0.9837   0.9779   0.9822   0.9823   0.9824   0.9803   0.9916   0.9924   0.9881   SSIM   0.9726   0.9726   0.9726	3551M 0.9678 0.9728 0.9728 0.9803 0.9803 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9845 0.9894 0.9875 0.9894 0.9875 0.9994 0.9915 0.9929 0.9940 0.9945 3551M	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8580 0.8536 0.8546 stSSIM 0.7651 0.7979 0.8232 0.8541 0.8792 0.8972 0.8972 0.9114 0.9212 0.8870 stSSIM 0.7385 0.7820 0.8113
Image: region of the system   Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent (kb/s)   130   145   160   175	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,696   147,696   147,696   144,312   File size   (bytes)   144,612   144,012   144,012   144,012   144,012   144,012   144,0305	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652 15.539 15.652 15.539 15.244 MSU Blocking 11.306 11.563 11.236	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.938   18.084   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.046	SIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9816   0.9737   0.9837   0.9779   SSIM   0.9732   0.9833   0.9792   0.9823   0.9852   0.9871   0.9890   0.9903   0.9916   0.9924   0.9881   SSIM   0.9666   0.9726   0.9763   0.9763	3551M 0.9678 0.9728 0.9728 0.9803 0.9803 0.9859 0.9859 0.9859 0.9852 3551M 0.9808 0.9844 0.9808 0.9844 0.9808 0.9844 0.9915 0.9929 0.9940 0.9915 0.9929 0.9940 0.9948 0.9916 3551M 0.9916	stSSIM 0.7130 0.7527 0.7858 0.8030 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8541 0.8792 0.8972 0.9114 0.9212 0.8870 stSSIM 0.7385 0.7820 0.8131 0.8374
Image: region of the system   Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News   (kb/s)   110   125   140   155   1700   185   200   215   Proposed   Silent   (kb/s)   130   145   160   175	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,913   148,046   144,312   File size   (bytes)   144,012   147,470   149,305   151,144	MSU Blocking 11.693 11.508 11.354 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.672 16.168 15.672 16.168 15.652 15.539 15.244 MSU Blocking 11.306 11.563 11.236 11.236	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.126   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.466   16.105	SIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9738   0.9770   0.9837   0.9779   SSIM   0.9738   0.9739   SSIM   0.9792   0.9833   0.9852   0.9871   0.9903   0.9916   0.9924   0.9881   SSIM   0.9666   0.9726   0.9763   0.9763   0.9763	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9894 0.9915 0.9929 0.9940 0.9929 0.9940 0.9925 0.9940 0.9925 0.9940 0.9925 0.9946 0.9916	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8336 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8722 0.8712 0.8972 0.8712 0.8702 stSSIM 0.7385 0.7820 0.8113 0.8374
Image: region of the system   Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News   (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent   (kb/s)   130   145   160   175   190	Tile size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   146,696   147,696   147,696   144,312   File size   (bytes)   144,012   144,012   144,012   144,012   147,470   149,305   151,144   152,906	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652 15.539 15.652 15.539 15.244 MSU Blocking 11.306 11.563 11.236 11.056 11.005	MSU   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.158   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.046   16.105   16.046	SSIM   0.9605   0.9661   0.9708   0.9770   0.9816   0.9773   0.9773   SSIM   0.9779   SSIM   0.9792   0.9823   0.9852   0.9871   0.9890   0.9916   0.9924   0.9726   0.9766   0.9766   0.9766   0.9766	3551M 0.9678 0.9728 0.9728 0.9803 0.9803 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9808 0.9844 0.9808 0.9844 0.9875 0.9894 0.9915 0.9929 0.9940 0.9940 0.9948 0.9916 3551M 0.9766 0.9817 0.9845 0.9872 0.9845 0.9872 0.9845	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7651 0.7651 0.7651 0.8544 0.8323 0.8544 0.8542 0.8541 0.8972 0.8972 0.8972 0.8972 0.8972 0.8870 stSSIM 0.7385 0.7385 0.7385 0.8374 0.8374 0.8374
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent   (kb/s)   130   145   160   175   190   205	File size (bytes) 259,070 263,581 264,158 266,008 266,379 266,445 267,037 267,453 261,235 File size (bytes) 135,748 139,613 142,811 144,531 144,531 144,696 147,913 148,046 147,913 148,046 144,312 File size (bytes) 144,012 File size (bytes) 144,012 147,470 149,305 151,144 152,906	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652 15.539 15.244 MSU Blocking 11.306 11.563 11.236 11.055 10.792	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   bluring   17.843   17.938   17.996   18.084   18.126   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.046   16.170   16.254	SIM   0.9605   0.9661   0.9706   0.9770   0.9770   0.9837   0.9779   SSIM   0.9738   0.9739   SSIM   0.9730   0.9837   0.9792   0.9823   0.9852   0.9871   0.9890   0.9903   0.9916   0.9924   0.9881   SSIM   0.9666   0.9726   0.9763   0.9763   0.9764   0.9842	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9894 0.9945 0.9940 0.9948 0.9916 3551M 0.9966 0.9817 0.9845 0.9872 0.9905	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8336 0.8546 stSSIM 0.7651 0.7979 0.8523 0.8541 0.8792 0.8572 0.8972 0.9114 0.9212 0.8870 stSSIM 0.7385 0.7820 0.8113 0.8374 0.8565
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent (kb/s)   130   145   160   175   190   205   220	Size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   147,696   144,312   File size   (bytes)   144,012   File size   (bytes)   144,012   File size   (bytes)   144,012   File size   (bytes)   144,012   147,470   149,305   151,144   152,906   153,158   152,527	MSU Blocking 11.693 11.508 11.354 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.642 15.539 15.244 MSU Blocking 11.306 11.563 11.236 11.056 11.056 11.005 10.792 10.450	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.126   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.046   16.105   16.170   16.254	SIM   0.9605   0.9661   0.9708   0.9770   0.9816   0.9777   0.9816   0.9779   SSIM   0.9779   SSIM   0.9779   SSIM   0.9792   0.9852   0.9852   0.9871   0.9880   0.9903   0.9916   0.99281   SSIM   0.9763   0.9763   0.9763   0.9763   0.9764   0.9842   0.9842	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9876 0.9894 0.9852 3551M 0.9808 0.9844 0.9875 0.9894 0.9915 0.9929 0.9940 0.9915 0.9929 0.9940 0.9946 0.9915 0.9940 0.9946 0.9915 0.9940 0.9948 0.9915 0.9847 0.9901 0.9847 0.9847 0.9847 0.9847 0.9847 0.9901 0.9905 0.9905 0.9005 0.000500000000	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8533 0.8546 stSSIM 0.7651 0.7979 0.8524 0.8524 0.8523 0.8541 0.8792 0.8972 0.8972 0.8972 0.8972 0.8972 0.8870 stSSIM 0.7855 0.7820 0.8811 0.8874 0.8374 0.
Image: region of the system   Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent (kb/s)   130   145   160   175   190   205   220	Sile Sile   File size (bytes)   259,070 263,581   264,158 266,008   266,379 266,445   267,037 267,453   261,235 File size   (bytes) 135,748   139,613 142,811   144,531 144,636   147,696 147,696   144,312 File size   (bytes) 144,012   144,012 147,470   149,305 151,144   152,906 153,158   153,527 153,527	MSU   Blocking   11.693   11.300   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.354   11.234   11.156   11.019   10.992   10.274   MSU   Blocking   16.168   15.676   15.859   15.652   15.539   15.652   15.539   15.652   15.539   15.652   15.633   11.306   11.306   11.056   11.005   10.792   10.450	MSU   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.938   17.938   17.938   17.938   17.938   17.938   17.938   17.938   17.938   17.938   17.938   17.936   18.084   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.046   16.105   16.170   16.254   16.267	SIM   0.9605   0.9661   0.9706   0.9770   0.9816   0.9737   0.9837   0.9779   SSIM   0.9732   0.9837   0.9738   0.9792   0.9823   0.9852   0.9871   0.9881   SSIM   0.9924   0.9881   SSIM   0.9766   0.9726   0.9763   0.9820   0.9821   0.9822   0.9842   0.9842	3551M 0.9678 0.9728 0.9728 0.9803 0.9833 0.9859 0.9859 0.9859 0.9852 3551M 0.9808 0.9844 0.9808 0.9844 0.9808 0.9844 0.9915 0.9929 0.9940 0.9915 0.9929 0.9940 0.9916 3551M 0.9916 3551M 0.9817 0.9845 0.9817 0.9845 0.9817 0.9845 0.9905 0.9901 0.9905 0.9901	stSSIM 0.7130 0.7527 0.7858 0.8030 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7979 0.8323 0.8541 0.8792 0.8541 0.8792 0.8972 0.9114 0.9212 0.8870 stSSIM 0.7385 0.7820 0.8374 0.8564 0.8572
Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent (kb/s)   130   145   160   175   190   205   220   235	File size   (bytes)   259,070   263,581   264,158   266,08   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,531   146,696   147,696   144,312   File size   (bytes)   144,012   147,470   149,305   151,144   152,906   153,158	MSU Blocking 11.693 11.508 11.354 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.672 16.168 15.672 16.168 15.676 15.859 15.652 15.539 15.244 MSU Blocking 11.306 11.563 11.236 11.055 11.005 10.792 10.792	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.93   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.996   18.037   18.084   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.046   16.170   16.254   16.267   16.267   16.267	SSIM   0.9605   0.9661   0.9708   0.9770   0.9837   0.9797   0.9816   0.9738   0.9770   0.9816   0.9738   0.9779   SSIM   0.9779   0.9837   0.9792   0.9823   0.9823   0.9823   0.9914   0.9924   0.9924   0.9924   0.9763   0.9763   0.9763   0.9763   0.9763   0.9820   0.9842   0.9813	3551M 0.9678 0.9728 0.9728 0.9803 0.9859 0.9859 0.9859 0.9854 0.9854 0.9854 0.9854 0.9854 0.9855 0.9894 0.9875 0.9894 0.9915 0.9929 0.9940 0.9945 0.9940 0.9916 3551M 0.9916 3551M 0.9817 0.9845 0.9817 0.9845 0.9817 0.9845 0.9817	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8583 0.8586 0.8546 0.8546 0.7979 0.8232 0.8541 0.7979 0.8232 0.8541 0.8792 0.8372 0.8114 0.7385 0.7385 0.7385 0.7385 0.7385 0.7385 0.7385 0.7385 0.7385 0.83744 0
Image: region of the system   Foreman (kb/s)   200   225   250   275   300   325   350   375   Proposed   News (kb/s)   110   125   140   155   170   185   200   215   Proposed   Silent (kb/s)   130   145   160   175   190   205   220   235   Proposed	File size   (bytes)   259,070   263,581   264,158   266,008   266,379   266,445   267,037   267,453   261,235   File size   (bytes)   135,748   139,613   142,811   144,696   147,696   147,696   144,012   144,012   144,012   144,012   144,012   144,012   144,012   144,0305   151,144   152,906   153,158   153,257   154,487	MSU Blocking 11.693 11.508 11.390 11.354 11.234 11.156 11.019 10.992 10.274 MSU Blocking 16.199 15.639 15.672 16.168 15.676 15.859 15.652 15.539 15.244 MSU Blocking 11.306 11.563 11.236 11.056 11.005 11.055 10.792 10.450 10.591 9.873	Image   MSU   blurring   15.613   15.787   15.916   16.005   16.112   16.193   16.254   16.317   16.242   MSU   blurring   17.843   17.938   17.938   18.037   18.084   18.158   18.194   17.772   MSU   blurring   15.865   16.009   16.254   16.105   16.105   16.1070   16.254   16.267   16.267   16.227	SIM   0.9605   0.9661   0.9706   0.9770   0.9737   0.9816   0.9737   SSIM   0.9738   0.9779   SSIM   0.9732   0.9831   0.9852   0.9871   0.9881   SSIM   0.9903   0.9916   0.9924   0.9666   0.9726   0.9763   0.9763   0.97842   0.9816   0.9820   0.9821   0.9821	3551M 0.9678 0.9728 0.9728 0.9803 0.9803 0.9859 0.9859 0.9859 0.9859 0.9852 3551M 0.9808 0.9844 0.9805 0.9844 0.9875 0.9804 0.9915 0.9929 0.9940 0.9940 0.9948 0.9916 0.9817 0.9845 0.9872 0.9871 0.9875 0.9817 0.9845 0.9872 0.9901 0.9905 0.9901 0.9905	stSSIM 0.7130 0.7527 0.7858 0.8090 0.8332 0.8533 0.8680 0.8546 stSSIM 0.7651 0.7651 0.7651 0.7651 0.7651 0.8323 0.8541 0.8372 0.8372 0.8972 0.9114 0.9212 0.8870 stSSIM 0.7385 0.7385 0.7385 0.8374 0.8374 0.8373 0.8374 0.8373 0.8374 0.8373 0.8374 0.8373 0.8374 0.8373 0.8374 0.8375 0.8373 0.8374 0.8375 0.8373 0.8374 0.8375 0.8373 0.8374 0.8375 0.8373 0.8375 0.8373 0.8375 0.8373 0.8375 0.8373 0.8375 0.8375 0.8373 0.8375 0.

Table 2: Encoded file sizes and VQMs for the MPEG-4 dataset. Shaded entries are the closest values to the proposed method in each column. It can be interpreted that the file size and quality of the proposed method are comparable to the video encoded with the bitrate specified in the same row.

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