

# Algorithm for Multimedia Compression

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**Abstract:** *In this paper multimedia compression is proposed for multimedia application to fit the available bandwidth. This leads to reduction of the bandwidth problem in multimedia network. This compression algorithm is efficient When the traffic load is high in this study a 45 E and 90E load are used. The algorithm was modeled using MATLAB program .The simulation model was build based on a mathematical model .The simulation result shows a good performance of the algorithm during high traffic load.*

**Keyword:** bandwidth, multimedia, traffic load

## 1. Introduction

**Multimedia** refers to content that uses a combination of different content forms. This contrasts with media that use only rudimentary computer displays such as text-only or traditional forms of printed or hand-produced material. Multimedia includes a combination of text, audio, still images, animation, video, or interactive content forms.

Multimedia can be recorded and played, displayed, dynamic, interacted with or accessed by information content processing devices, such as computerized and electronic devices, but can also be part of a live performance. Multimedia devices are electronic media devices used to store and experience multimedia content. Multimedia is distinguished from mixed media in fine art; by including audio, for example, it has a broader scope. The term "rich media" is synonymous for interactive multimedia. Hypermedia scales up the amount of media content in multimedia application.

Since media is the plural of medium, the term "multimedia" is used to describe multiple occurrences of only one form of media such as a collection of audio CDs. This is why it's important that the word "multimedia" is used exclusively to describe **multiple forms** of media and content. Multimedia involves multiple modalities of text, audio, images, drawings, animation, and video.

## 2. Multimedia Compression

When talking about compression, we often mean "lossy compression" while "lossless compression" is often termed as coding. However, not all coding algorithm do actually lead to lossless compression, e.g. error correction codes. Like in every other field in computer science or engineering, the dominating language in compression technologies is English of course. There are hardly any comprehensive and up-to-date German books available, and there do NOT exist any German journals in the field. Codec denotes a complete system

capable of encoding and decoding data which consists of an Encoder and a Decoder, transcoding is a conversion from one encoded digital representation into another one. A fundamental term in the area is compression rate (or compression ratio) which denotes the relation between the size of the original data before compression and the size of the compressed data. Compression ratio therefore rates the effectivity of a compression system in terms of data reduction capability. This must not be confused with other measures of compressed data size like bit per pixel (bpp) or bit per sample (bps).

During the last years three important trends have contributed to the fact that nowadays compression technology is as important as it has never been before – this development has already changed the way we work with multimedial data like text, speech, audio, images, and video which will lead to new products and applications:

- The availability of highly effective methods for compressing various types of data.
- The availability of fast and cheap hardware components to conduct compression on single-chip systems, microprocessors, DSPs and VLSI systems.
- Convergence of computer, communication, consumer electronics, publishing, and entertainment industries.

Compression is enabled by statistical and other properties of most data types, however, data types exist

a) Classification of Techniques:

- Lossless: recover the original representation
- Lossy: recover a representation similar to the original one
  - high compression ratios
  - more practical use
- Hybrid: JPEG, MPEG, px64 combine several approaches

**Table 1:** Multimedia compression

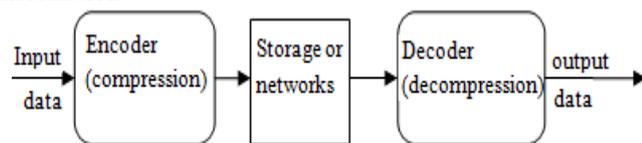
Short Name	Official Name	Standards Group	Compression Ratios
JPEG	Digital compression and coding of continuous-tone still images	Joint photographic Experts Group	15:1 Full color still-frame applications
H.261 or Px64	Video encoder/ decoder for audio-visual services at px64 Kbps	Specialist Group on coding for visual telephony	100:1 to 2000:1 Video –based tele- communications
MPEG	Coding of moving pictures an associated audio	Moving pictures Experts Group	200:1 Motion-intensive applications

### 3. Multimedia Compression Efficiency

The compression efficiency indicate the strength of the compression algorithm and it can be computed using equation (1). In multimedia it can be represented by the cumulative sum of the various media.

### 4. Multimedia compression Algorithm

Compression: the process of coding that will effectively reduce the total number of bits needed to represent certain information.



**Figure 1:** General Data Compression Scheme

#### 1) Classification

##### a) Lossless Compression

- lossless compression for legal and medical documents, computer programs
- exploit only data redundancy
- **Variable-Length Coding (VLC):** the more frequently-appearing symbols are coded with fewer bits per symbol, and vice versa.
- **Shannon-Fano Algorithm :**
  - Sort symbols according to the frequency of occurrences.
  - Recursively divide symbols into two parts, each with approximately same counts, until all parts contain only one symbol.

##### b) Huffman Coding

- Initialization: Put all symbols on a list sorted according to frequency.
- Repeat until the list has only one symbol left:
  - From the list pick two symbols with the lowest frequency counts. Form a Huffman subtree that has these two symbols as child nodes and create a parent node.
  - Assign the sum of the children's frequency counts to the parent and insert it into the list such that the order is maintained.
  - Delete the children from the list.
- Assign a codeword for each leaf based on the path from the root.
- statistics are gathered and updated dynamically as data increments the frequency counts for the symbols.

##### c) Lossless Image Compression

- Approaches of Differential Coding of Images:
- Given an original image  $I(x, y)$ , using a simple difference operator we can define a difference image  $d(x, y)$  as follows:

$$d(x, y) = I(x, y) - I(x - 1, y)$$

##### d) Lossless JPEG

The Predictive method:  $\frac{\text{file size before} - \text{file size after}}{\text{file size before}} * 100\%$

- Forming a differential prediction: A predictor combines the values of up to three neighboring pixels as the predicted value for the current pixel, indicated by 'X' in Figure. The predictor can use any one of the seven schemes listed in the below Table.
- Encoding: The encoder compares the prediction with the actual pixel value at the position 'X' and encodes the difference using one of the lossless compression techniques, e.g., the Human coding scheme

#### 2) Lossy Compression

- digital audio, image, video where some errors or loss can be tolerated
- exploit both data redundancy and human perception properties
- Compressed data is not the same as the original data, but a close approximation of it.
- Yields a much higher compression ratio than that of lossless compression.

#### 3) Distortion Measures :

- **mean square error (MSE)**  $\sigma^2$  .  $\sigma^2 = \frac{1}{N} \sum_{n=1}^N (x_n - y_n)^2$

where  $x_n$ ,  $y_n$ , and  $N$  are the input data sequence, reconstructed data sequence, and length of the data sequence respectively.

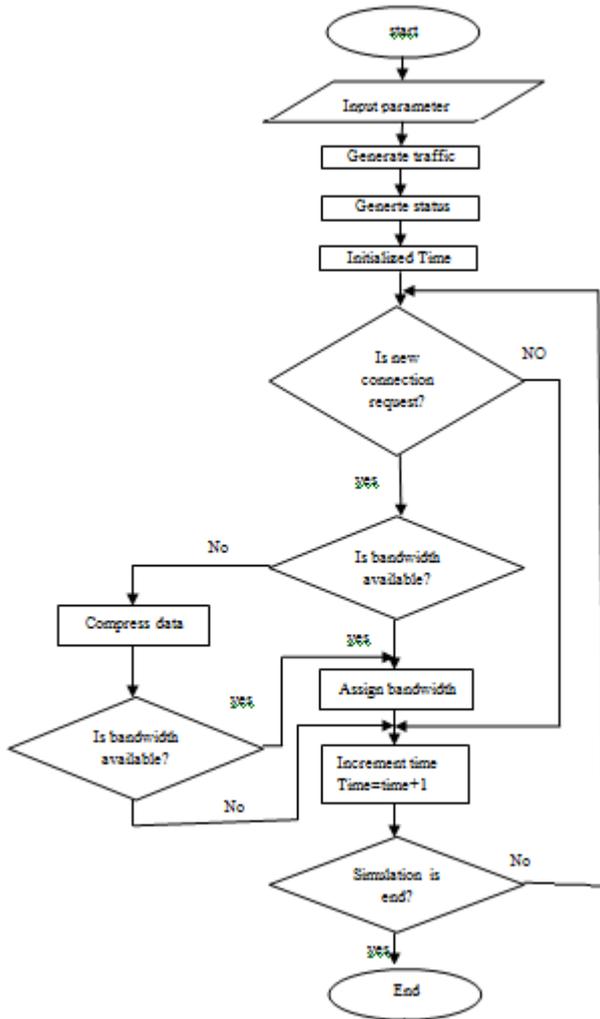
- **signal to noise ratio (SNR).**  $SNR = 10 \log 10 \frac{\sigma_x^2}{\sigma_d^2}$   
 $\sigma_x^2$  is the average square value of the original data sequence and  $\sigma_d^2$  is the MSE.

- **peak signal to noise ratio (PSNR)** . $PSNR = 10 \log 10 \frac{\sigma_{peak}^2}{\sigma_d^2}$

Which measures the size of the error relative to the peak value of the signal  $X_{peak}$

### 5. Simulation Scenario

Figure 1 shows the block diagram for the simulation program. This program is written using MATLAB instruction.



## 6. Result and Discussion

Figure 3 shows that simulation windows and it represented the random distribution of user inside the building as defined previously, the X axis represent window length and Y axis represented width equal 4km both of them.

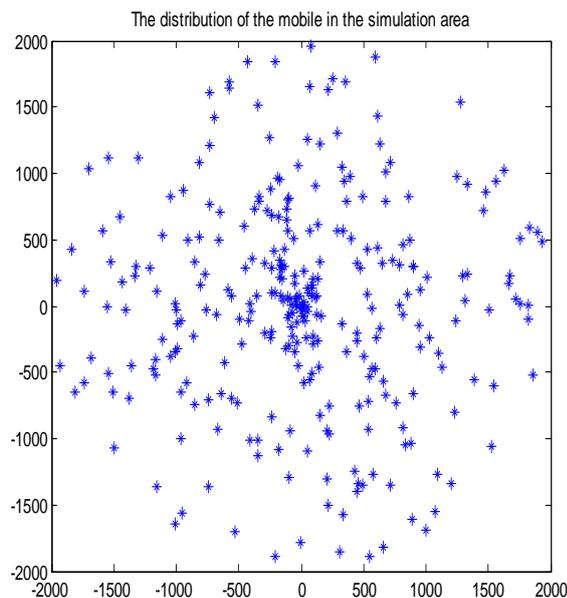


Figure 3: simulation model window

Figure 4 shows the histogram where X axis is the interarrival time [s] and Y axis represented frequency .

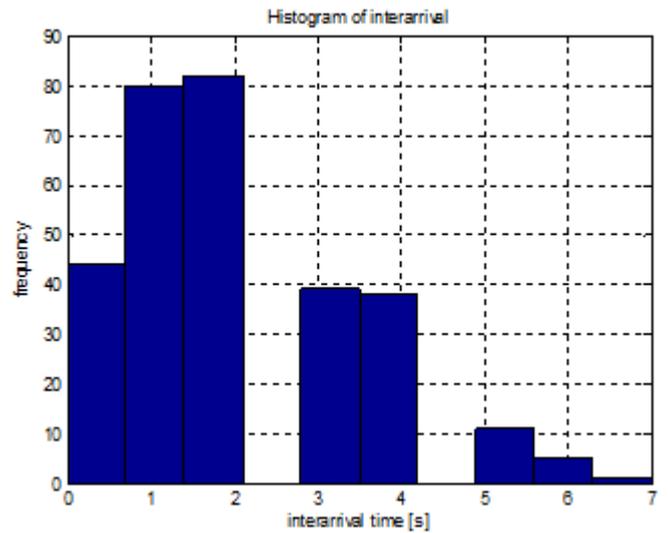


Figure 4: Histogram of interarrival

Figure 5 shows the The distribution of call arrival time where X axis is User ID and Y axis represented arrival time [s]

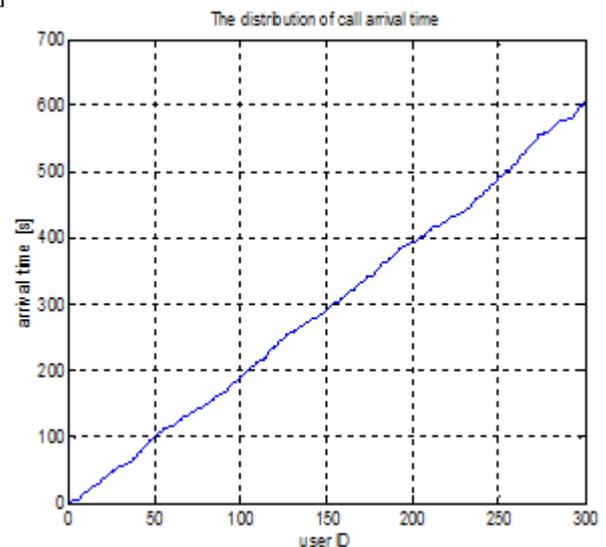
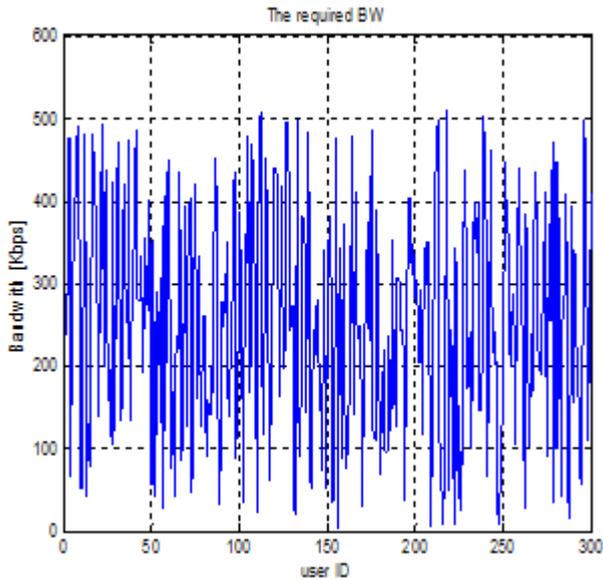


Figure 5: The distribution of call arrival time

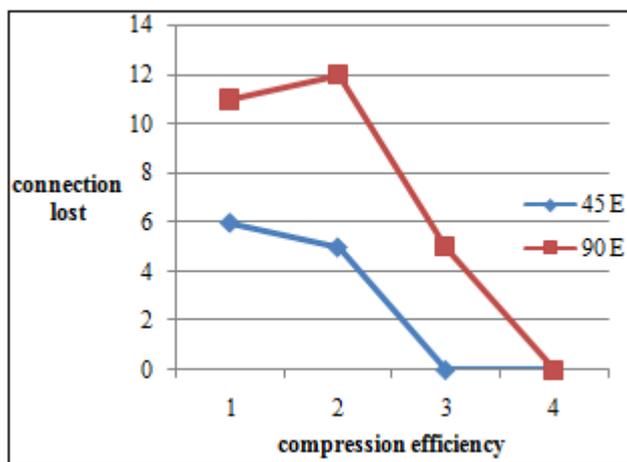
Figure 6 shows the The required bandwidth where X axis is User ID and Y axis represented Bandwidth[Kbps]. Table (1) show the compression efficiency.



**Figure 6:** The required BW

**Table 1:** The Compression Efficiency

CE	45 E	90 E
0	1	16
10	5	12
40	0	5
80	0	0



**Figure 7:** The compression efficiency

## 7. Conclusion

The results indicate reduction in the connection failure due to the increase in the compression efficiency. The amount of the reduction can be observed during the high traffic load. The amount of the connection loss is higher in the heavy traffic load.

## References

[1] C.-P. Wu and C.-C. J. Kuo, "Efficient multimedia encryption via entropy codec design," in Proc. SPIE Int. Symp. Electronic Imaging 2001, vol. 4314, Jan. 2001, p. 128.

[2] W. Zeng and S. Lei, "Efficient frequency domain selective scrambling of digital video," IEEE Trans. Multimedia, vol. 5, no. 1, p. 118, Mar. 2003.

[3] "Security for real-time MPEG compressed video in distributed multimedia applications," in Proc. 15th IEEE Int. Phoenix Conf. Comput. Commun., Mar. 1996.

[4] H. Cheng and X. Li, "Partial encryption of compressed images and videos," IEEE Trans. Signal Process., vol. 48, no. 8, p. 2439, Aug. 2000.

[5] C.-P. Wu and C.-C. J. Kuo, "Fast encryption methods for audio-visual data confidentiality," in SPIE Int. Symp. Information Technologies 2000, vol. 4209, Nov. 2000, p. 284.

[6] A. Barbir, "A methodology for performing secure data compression," in Proc. 29th Southeastern Symp. System Theory, Mar. 1997, p. 266.

[7] H. Bergen and J. Hogan, "A chosen plaintext attack on an adaptive arithmetic coding compression algorithm," Comput. Secur., vol. 12, p. 157, 1993.

[8] D. Gillman, M. Mohtashemi, and R. Rivest, "On breaking a Huffman code," IEEE Trans. Inform. Theory, vol. 42, no. 3, p. 972, May 1996.

[9] W. B. Pennebaker and J. L. Mitchell, JPEG Still Image Data Compression Standard. New York: Van Nostrand Reinhold, 1993.

[10] Fox, E.A (1991) Adanced in interactive digital multimedia systems. IEEE computer , 24 : 9-21 .

[11] Furht, B. (1994) multimedia systems: an overview. IEEE multimedia, 1:47-59.

[12] Ao.Univ.-Prof. Dr. Andreas Uhl , Compression Technologies and Multimedia Data Formats .

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