# Compare Music File Formats

## Introduction

No doubt a lot of people surf the Internet to find music. Many sites the Net surfers visit contain links to music or other listening material samples. Unfortunately it is highly likely that the unwary surfers click a music file to find a very large music file downloading and the computer frozen due to the gigantic music file size.

There exist a variety of sound file formats among which an mp3 enjoys its high popularity. MP3 files are ubiquitous on the Net and it is no exaggeration to say that the MP3 is now a household name in the world. People, however, enjoy an mp3 music file without knowing what it is and its strengths and weaknesses in comparison other popular music file formats.

In this regard, I would like to provide background information and guidance about the most commonly used sound formats for music clips available on the Net and to offer usability pointers for an improved Web audiophile experience.

## Everything about MP3

The most popular sound file format these days is **.MP3** for both Mac and PCs. Other file formats include **.AIFF** (for Mac); **.AU** for Mac and UNIX; **.WAV** for the PC; and **.RA** for Real Audio, a proprietary system for delivering and playing streaming audio on the Web.

The MP3 format is a compression system for music. The MP3 format helps reduce the number of bytes in a song without hurting the quality of the song's sound. The goal of the MP3 format is to compress a CD-quality song by a factor of 10 to 14 without losing the CD quality ofthe sound. With MP3, a 32 megabyte song on a CD compresses down to 3 megabytes or so. This lets you download a song in minutes rather than hours, and it lets you store hundreds of songs on your computer's hard disk without taking up that much space.

To make a good compression algorithm for sound a technique called **perceptual noise shaping** is used. The "perceptual" part in the name means that the MP3 format uses characteristics of the human ear to design the compression algorithm. For example:

- There are certain sounds that the human ear cannot hear
- There are certain sounds that the human ear hears much better than others
- If there are two sounds playing simultaneously we hear the louder one but cannot hear the softer one.

Using facts like these about the human ear, certain parts of a song can be eliminated without significantly hurting the quality of the song for the listener. Compressing the rest of the song with well-known compression techniques shrinks the song considerably -- a factor of 10 at least.[If you would like to learn more about the specific compression algorithms, see the links at the bottom of this article.] When you are done creating an MP3 file, what you have is "near

CD" quality. The MP3 version of the song will not sound exactly thesame as the original CD because some of the song has been removed, but it will be close.

MP3 is a widely accepted format (  ) of downloading music today, and it offers exceptional quality at 1:12 compression. This format is best played with Winamp, although RealAudio Quicktime, and the new Windows Media Player, and many others also support the format. MPEG is the acronym for Moving Picture Experts Group. It is an encoded format for small efficient files true to the instruments and studio conditions that produced the sound. MPEG supports both analog and digital recording formats.

The size of the MP3 file depends on which compression routine was used, near-CD or CD quality. As a very general rule, for CD quality you can assume 1MB = 1 minute of music in an MP3 file. For near-CD quality, a one-minute song takes up only .6 MB of disk space, compared to 10 MB or more for an uncompressed .WAV file.

The sound quality difference of analog recording compared with digital should be minimal. The number of conversion errors you hear are primarily dependent on your PC system. Factors that affect the sound quality are the sound card and the required level of multimedia real time (or streaming) performance.

**Strengths:**

It can be broken up into pieces, and each piece is still playable. The feature that makes this possible (headerless file format) also means that MP3 files can be made to stream across the net real-time.

Best of all we can now easily transmit a song over the internet (a compressed 4 minute song is smaller than 4MB, while uncompressed would be over 40MB!) Because of the high compression, it's possible to download full-quality CD tracks over the Internet in a reasonable time.

**Remember**, downloading or streaming music from the internet *is illegal* unless the copyright owner explicitly allows free downloads. Please respect Intellectual Property Rights.

**Weaknesses:**

Lots of processor power is required to encode and play files, also a sound-card is required (16-bit sound card). And the main disadvantage of the MP3 format is that it needs to be decompressed when played.

## Other Preferred Music File Formats

### WAV

The Microsoft .WAV file format is a technique for storing analog audio data in a digital format. It is capable of storing waveform data in many different formats and an array of compression types.

A *.WAV file is a digital recording of the sounds made by any instrument or human voice. It basically cannot be modified. When a PC plays back a WAV

file, it converts numbers in the file into audio signals for the PC's speakers. A complete tune recorded in .WAV format is always very large.

A .WAV file is always true to the original instruments that produced the music.

**Strengths:**

WAV files are simple and widely used, especially on PCs. Many applications have been developed to play WAV files and it is the native sound format for Windows. Later versions of Netscape Navigator (3+) and Microsoft Internet Explorer (2+) support the WAV format.

**Weaknesses:**

WAV is seen as a proprietary Windows format, although conversion tools are available to play WAV files on other platforms. WAV files are not highly compressed.

**Related resources:**

Tucows/Hensa: Miscellaneous Audio Applications for Windows 95

### .au (AU)

AU is short for AUdio, a common digital sound file format used on Unix machines and the standard audio file format for the Java programming language. The file has a very simple structure: the file header specifies the basic parameters of the sound - sampling rate, sample size, number of

channels and type of encoding - followed by the sound data. AU files usually employ the 8000 hertz u-Law encoding method.

**Strengths:**

A simple, well-established sound format which is the most commonly supported browser sound file format.

**Weaknesses:**

AU files are relatively low quality and are not highly compressed. The format is widely associated with Unix platforms, although they can be played on other platforms without the need for browser plug-ins or helper applications.

Related resources:

Tucows/Hensa: Audio Editors for Windows NT

### rm/ ram (RealAudio)

A mainstay of internet audio for many years, and a standard for streaming audio and video. RealAudio has many quality settings. The RealAudio files are still smaller than 128kb/s MP3 files, but the quality is also less. RealPlayer is the best (and only official) choice for RealAudio files.


### MID (MIDI)

Standing for Musical Instrument Digital Interface, it is an even older format ( 1  ), the standard by which many desktop musicians compose. These files are tiny, and make quick downloads. Most multimedia audio players will support the MIDI format. MIDI information tells a synthesizer when to start and stop playing a specific note, and may include the volume and modulation of the note. For the purposes of this discussion, the synthesizer comprises your PC's sound card and device driver.

Many tunes are available in MIDI format, and you can listen to these tunes using the free players that are installed with your computer's operating system. The two common ones are Microsoft Windows Media Player for Windows (the newest of which is for Windows 98, ME, and 2000) and the Apple QuickTime player for Apple OS computers.

A*.MID file contains what the composer (or the person who played a tune) did at his/her music keyboard. It keeps track of which note (key) was pressed, when it was pressed, for how long, and at what pressure. Playing back a MIDI file requires a device (sound card) that can generate the sounds of common instruments (for example, Piano, Violin, Drum) on its own. The note data is sent to the device, which then generates the sounds that were intended (or sometimes not intended). A MIDI file is comparatively very small and can be edited (including changing the instruments altogether).

The quality of the sound is dependent upon the quality of the synthesizer on a PC's sound card.

Because MIDI files are *synthesized* audio and not *sampled* audio, they play back in audio quality only as good as your PC's sound card. MIDI files sound different on different computers.

**Strengths:**

The MIDI standard allows for musical pieces to exchanged and edited by different computers on different platforms in a way that conventional digitised sound (actual waveforms) cannot. MIDI produces much smaller file sizes for musical events, compared to other sound formats.

**Weaknesses:**

Browsers require separate plug-ins or helper applications to play MIDI files.

**Related resources:**

- The Unofficial MIDI Home Page
- Tucows/Hensa: MIDI Players for Windows 95
- MIDI Tips for Webmeisters
- An Introduction into MIDI

### AIFF (Macintosh Apple QuickTime format)

The AIFF format is associated with Apple QuickTime Player on Mac and Windows computers.  Even if you run under Windows, you will have no problem

playing these files so long as you have Apple QuickTime installed. The encoding is similar to WAV and quality is true to instrumentation.


## Brief explanation of utilities for Playing Sound Files

### Microsoft Windows Media Player

Windows Media Player is included with the Windows operating system. Microsoft updates its player frequently and adds *codecs* (compressor/ depressor) for new or updated media standards.

Windows Media Player does not support RealMedia audio and video streaming. Windows Media Player won't work on the UNIX platform (yet).

### RealPlayer for Playing .RM and .RAM Files

This is a popular utility, especially for artists who want to provide samples of their work and for streaming media in real time.

These utilities support formats other than .RM and .RAM.

**Download at www.real.com,**

### Winamp

Winamp is freeware by Nullsoft and supports MP3, CDA, and other audio formats. One of the best features about Winamp is that it has no ads. does not auto magically support .WAV.

**Down load at www.winamp.com**

### Macintosh Players

A music player for Macintosh is MacAMP. MacAmp is an MPEG Layer 3 (a.k.a. MPEG-3 or MP3) audio player for the Macintosh. Find more information on this player at www.mac.org/audio-video/.

## Conclusion

This research paper dealt with most commonly used sound file formats and their strengths and weaknesses. Each audio file format has its own strengths and weaknesses. However, among these audio file formats, the most popular sound file format these days is **.MP3** mainly because of its high levels of audio quality, its small file size, the Internet, ever-improving technology.

Digital music formats such as MP3 hold a bright future. In addition, MP3 will continue to evolve along with industry support for the format, and provide a viable music format for the next decade and beyond with the love of the Net surfers.

## References


http://www.learnthenet.com/english/html/34filext.htm

http://www.foothill.fhda.edu/music/commercial/mp3.html

http://www.mpeg.org/MPEG/#news

http://www.mpeg.org/MPEG/#faqs

http://www.oddmusic.com/whatismp3.html

http://www.mp3.com/news/

http://www.mp3.com/070.html

http://www.mp3.com/dummies/

http://www.mac.org/audio-video/macamp/

http://www.iis.fhg.de/amm/techinf/layer3/index.html

http://www.eskimo.com/~miyaguch/mp3info.html

http://www.ccewest.org/music_file_formats.htm

http://www.iocon.com/das/faq.shtml

http://dio.cdlr.strath.ac.uk/file_formats.html#7.Sound formats

http://www.ace.net.nz/tech/TechFileFormat.html

http://www.mgermani.net/files.html

http://www.howstuffworks.com/mp3.htm

## Related Links

MP3 Technical Resources

- MPEG Audio Layer 3 at Fraunhofer Institut

  The reference on MPEG Layer 3 and other audio compression technologies.

- MP3'Tech by Gabriel Bouvigne

  One of the best sites to find technical informations on the MPEG audio standards (MP3, AAC). Check out the Overview of the MP3 standard, a short overview of the techniques used in MPEG Layer 3 audio compression.

- MPEG Layer 3 Sounds by Stede Bonnett

  This site contains many technical resources and infos about MP3 encoders and lots of practical informations on how to produce MP3 files using various software tools.

- The ID3 standards group by Martin Nilsson

  ID3v2 is a tagging mechanism commonly used with MP3 files. See also this article on MP3.com.

- MPEG Audio headers guide by Predrag Supurovic

  A description of MPEG audio frame headers.

- The use of multirate filter banks for coding of high quality digital audio by Th. Sporer, K. Brandenburg, and B. Edler (postscript)

  Describes the filterbank used in MP3 and gives an algorithm for a fast implementation of the MDCT (modified discrete cosine transform).

- MPEG Resources by The Realm of Soft Delusions

  Access to MP3 Encoders and players for various platforms.

- A DSP-based MP3 player high-fidelity MPEG-Audio over TCP/IP networks by Björn Wesén

- Snom AG

  A compliant (fully accurate) VHDL implementation of MP3 to make custom MP3 DSP.

- Brett's MP3 Decoder Review by Brett Bennett

  A comprehensive review of MPEG audio Decoder Chips and related chips such as Audio DACs and Micro-controllers.

## MP3 Format Details

- MP3 FAQ - a very nice intro to MP3
- Lots of MP3 Information
- Layer-3 FAQ
- MPEG audio and video FAQ
- http://www.dolby.com/tech/highqual.html - nice technical description of how psychoacoustic models help compress sound.
- A free audio compression format? - lists a number of patents having to do with MP3 audio compression, including:
  - US5285498: Method and apparatus for coding audio signals based on perceptual model
  - US5481614: Method and apparatus for coding audio signals based on perceptual model
  - US5579430: Digital encoding process
  - US5040217: Perceptual coding of audio signals
  - CD-Recordable FAQ

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