# Voice Recording and Digital Audio Podcast Script

*By: Julia Warner, Fatemah Dhirani, Katrina Booth (207784903)*

*Intro:*

Hi, our names are Julia, Fatemah and Katrina and welcome to our podcast!

Our topic focuses on voice recordings and digital audio.

More specifically, the mathematics behind these useful tools – such as the podcast you are listening to right now.

Listen carefully because there will be exercises which follow our podcast!!

*Outline 1:*

Before digital audio, many other recording devices had been invented.

Voice and sound recordings stored as digital files on your computer are an evolution of devices which date as far back as the phonographic cylinder which was invented by Thomas Edison in 1877[Footnote].

But don't worry! Our podcast will not try to explain all which came before, but more so how digital audio works today.

*Outline 2*:

Now, let's get started!

When a sound - such as your voice or a song - is recorded through a computer's microphone, the microphone captures an electrical impression of the sound's vibration waveform and transforms it into an electrical wave.

*Outline 3*:

Let's break this down.

The wave signal is received by the sound card in your computer, and its hardware converters change the analog signal into digital code that can be read by the computer.

This converter takes 'snapshots' of the ever changing electric wave patterns at regular intervals using a process called sample and hold[Footnote].

This means that a sample of the voltage is taken at regularly spaced moments in time and held until the next sample is taken.

The amount of times per second that the sound is sampled is called the *sample rate*.

For example, a CD is recorded at 44.1 KHz (which means the sound is sampled just over 44 000 times per second).

The more samples per second, the 'truer' the recording will be – meaning it will sound less distorted and more closely resemble the original sound.

It is necessary to take twice as many samples as the highest frequency you wish to record.

The frequency of a sound is also known as its pitch - and it is measured in Hertz, or cycles per second.

The higher the frequency is, the higher the pitch and the shorter its wavelength.

So, for example, if we want to record frequencies as high as 20,000Hz then we need to sample the sound at least 40,000 times per second.

Again, the more samples per second, the closer the digital copy will sound to the original.

*Outline 4:*

Each sample is converted into binary code, units of information the computer can interpret.

The 'units of information' which make up each digital sound sample are called bits.

By increasing the number of bits contained in each sample, the amount of detail in each sample is also increased.

It's like the difference between saying "the cat has white fur" and "the purebred Siamese feline has ivory fur with charcoal roots".

The number of bits used to create the sample is called the bit depth.

The higher the bit depth, the greater the sound detail becomes.

*Outline 5:*

Digital music files are measured in the amount of information they play per second, and in most cases, its measured in Kbps (kilo bits per second).

This is the amount of sound information that is presented to the listener every second and is commonly referred to as the bit rate.

The standard bit rate for CD-quality files is 128 Kbps and some even go up to 320 Kbps.

Files played over the internet are 56 or 64 Kbps, to allow for faster transport over networks – such as your dial-up or broadband internet connection.

Extra detail & better sound quality mean more space will be taken up on your hard drive or memory card.

To put this into perspective, consider song quality.

For those of you who have ever used music downloading software such as Limewire, consider that some songs did not sound good in comparison to other versions of the same song.

That is usually because the sound was sampled using a smaller bit rate in order to take up less file space and be more easily sent over the internet.

*Outline 6:*

In fact, the sample rate, bit rate, length or duration of the recorded sound and the number of channels the sound is recorded on (ie. stereo sound requires two channels, with sound recorded individually on each one) all play a role in determining how much space a digital audio file will take up on your hard drive.

By multiplying these factors together you can determine the size of the audio file in bits.

The more you raise the sample and bit rates, the more detail the sound will have and the closer it will sound to the original, though it will take up more space.

The more you lower the sample and bit rates, you will see that the file size is much smaller - but you may pay the price in terms of sound quality.

As you will see in the exercises, with some simple math it is not difficult to figure out just how much space a digital audio file will occupy on your computer, based on the factors we have discussed.

*Conclusion:*

We hope you have enjoyed our podcast and that you have learned something new about digital audio!!

**Digital Audio Exercises:**

In computer processing, a sound is represented by several parameters:

- The sampling rate in Hertz
- The number of channels (1 for mono, 2 for stereo, and 4 for quadraphonic sound)
- The duration of the sound in seconds
- The resolution (or bit depth) in bits

The bit rate is also an important parameter; to determine the bit rate, you need to know the sample rate (the number of samples per second) the bit depth (8 bit, 16 bit, or 24 bit) and the number of channels the sound has been recorded on.

The formula is:

Sample rate **x** Bit depth x Number of channels = Bit rate (in bits per second, or bps)

*Example: For a recording with a 44.1 kHz sampling rate, a 16 bit depth, and 2 channels (stereo):*

*44100 x 16 x 2 = 1411200 bits per second, or 1411.2 kbit/s*

EXERCISE 1:

a) Given that a sound has a sampling rate of 44kHz, an 8 bit depth and is recorded in stereo, what would its bit rate be?

b) Calculate the sampling rate of a sound which has a 24 bit depth, a bit rate of 8400Kbps, and is recorded on one channel.

EXERCISE 2:

The formula for calculating file size of a digital audio file is:

*Bit rate in bps x duration of sound in seconds = file size (bits)*

Using the formula for calculating file size, and the information provided, determine the file sizes of the following sound files:

1. 43,340 Hz sample rate, 3 minutes 23 seconds long, 8 bit coding, recorded on a single channel

2. 22, 475 Hz sample rate, 2 minutes and 12 seconds long, 16 bit coding, recorded in quadraphonic sound
3. Convert your answers from question 1 into bytes. *Note: 1 byte is equal to 8 bits*.
4. You are given a song that is 5 minutes long, with a file size of 24 600 000 bytes, and recorded with a sample rate of 41 000 Hz and 8 bit coding - determine how many channels it was recorded on.