How do I get the best audio quality from streaming music services?

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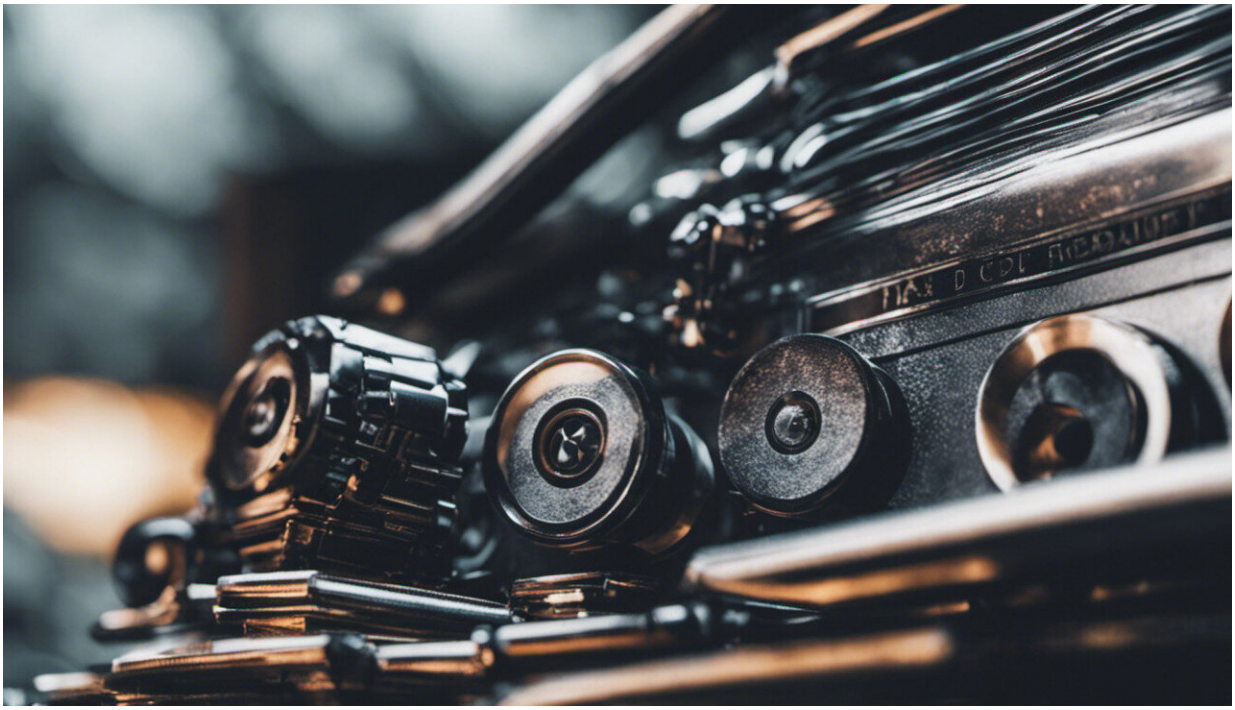

Credit: AI-generated image (disclaimer)

When it came to the way people listened to music at home, vinyl ruled until the 1970s. But technology doesn't stand still. Cassettes, which had poorer sound quality but were much more convenient, gave records a run for their money. In the '80s, CDs, with their improved audio quality and robustness, took over the market, and things were once again stable for a

couple of decades.

Then MP3s showed up and downloads from the internet eroded CDs' hegemony—again, convenience won out over quality. Once consumers' internet connections got fast enough, streaming became the norm, and since 2017 more people have been getting their music from streaming services than from any other source; last year, streaming's share of the sales of recorded music was 84%.

But we've all noticed that there are differences among the streaming services in terms of sound quality. Some of them are excellent, and some leave a lot to be desired. Several companies offer "tiered" services, which give you better audio fidelity in exchange for a higher monthly fee.

What's compression?

Streaming services—and downloading services, too—use what's known as "compressed audio". This is not the same type of compression that's used in a recording studio to limit the dynamic range of a track, like on a singer or a drum set. It's a form of data compression, and it can be "lossless" or "lossy."

Lossless compression is similar to using a .ZIP archive, in that what comes out when you uncompress the file is an exact copy of what went in—thus full fidelity ("CD quality") is maintained. Lossy compression is like the compression that you use when you turn a RAW or TIFF image into a jpeg: some data is permanently taken out of the original file.

An algorithm or "codec" (for compressor/decompressor) determines what data can be removed from an audio file to shrink its size. How does a lossy codec determine what data is removable?

Lossy compression algorithms are very complex, and take into consideration such factors as dynamics (louder signals need more data), stereo separation (sounds that are in the center of the stereo image only need to be transmitted once), and psychoacoustic masking, a phenomenon that, put simply, means that if two sounds of unequal loudness occur simultaneously, the softer sound will not be heard.

The aggressiveness of the codec, and thus the amount of data that is taken away, is expressed as the data rate or bit rate, and that's one of the major factors to consider when choosing a streaming service. This is to be distinguished from the sample rate, which is the number of times per second the original waveform is measured by the analog-to-digital converter at the front of the recording chain.

Understanding formats

Data rates range from 32 kbps (32,000 bits per second) up to 1,411 kbps—if you see the higher number, it means there is no compression at all. Lower data rates are OK for podcasts and other types of speech, and are useful in situations where an internet connection is slow, like when you're on your phone with a weak signal, but music quality suffers.

The compromise in quality can be heard as poorer stereo imaging and reduced separation between left and right channels, a lack of "air" as higher frequencies are filtered out, a reduction in the feeling of presence as transients—the beginning of sounds like drums—are softened, low-level noise, and a general "muddiness" to the sound.

The second major factor is the type of codec the streamer is using. MP3 (whose true name is MPEG-1 Audio Layer 3) is the best known of the lossy codecs, and was the first to get widespread use. The MP3 codec is private property: it was developed in 1994 and is still owned by the German research firm Fraunhofer-Gesellschaft, and any service that

generates content using the codec is supposed to pay a royalty to Fraunhofer.

AAC, or Advanced Audio Coding, came out a few years later as part of the MPEG-4 compression algorithm. It was adopted by Apple, which used it on its instantly popular iTunes platform. AAC is more efficient than MP3, meaning that sound quality at a given bit rate is better with AAC, and content providers don't need to pay a royalty to use it.

Besides these two dominant formats, there are two more lossy compression codecs in use by streaming services, both of which are free and open-source, and offer higher efficiency than MP3: OGG Vorbis, which is used in many video games and by Wikipedia; and Opus, used by Vimeo. As for lossless codecs, the best known are FLAC (for Free Lossless Audio Codec), and ALAC (Apple Lossless Audio Codec), which Apple now uses for all its streams. Windows Media also has a lossless version.

All streaming services are not created equal

Some services, like Tidal, offer super high-resolution lossless audio streaming, with data rates as high as 9,216 kbps, which can enhance the experience if you want to listen to multichannel or spatial audio formats, like Dolby Atmos or Sony 360 Reality Audio. For ordinary stereo listening, however, it's highly debatable whether the extra data adds anything to the audio quality.

Here are the bit rates and codecs for some popular streaming services:

- Amazon Music: 256 kbps AAC, Unlimited tier is FLAC
- Apple Music: ALAC
- Bandcamp: 128 kbps MP3 (but downloads are lossless)
- Deezer: 128 and 320 kbps MP3, FLAC

- Pandora: free tier is 64 kbps AAC, paid tier is 192 kbps AAC
- Qobuz: FLAC
- SoundCloud: 128 kbps MP3, higher tier is 256 kbps AAC
- Spotify: Free tier is 128 kbps OGG Vorbis, paid tier is 320 kpbs MP3 and OGG Vorbis, and a lossless tier is reportedly in the works
- Tidal: the free service is 160 kbps AAC, the paid tier is lossless.
- YouTube Music: 256 kbps AAC

So if you're looking for the highest quality in a streaming service, one that uses a lossless codec is your best bet, but lossy codecs can sound pretty good if the bit rate is high enough. Some studies have concluded that the vast majority of listeners can't tell the difference between an MP3 at 320 kbps and an uncompressed CD.

If you're listening mainly on your phone through ordinary earbuds, or the speakers on your laptop, or in a noisy environment like a car, even a lower-quality stream can sound perfectly OK. But if you're a true music lover with a high-quality audio system or headphones, the more advanced the codec and the higher the bitrate, the better your listening experience will be.

Provided by Tufts University

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