SOUND STORIES

The Beginner's Guide to Hi-Res Audio

Category +

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Sonos now supports high-resolution audio from Amazon Music Unlimited. In this post, we break down what "hi-res" means and help you decide if you want to be streaming hi-res music.

As more and more streaming music services offer tiers of higher-resolution audio, a lot of numbers, terms, and abbreviations are tossed around. You may be wondering, Is hi-res the same as HiFi or HD? What's the difference between 16-bit and 24-bit? Does the number of kHz matter? And is lossless better than lossy? If you're confused, you're not alone. While some aspects of what constitutes hi-res audio are clearly defined, some are not. And as the industry evolves, streaming services are applying their own terms to brand their higher-resolution tiers.

With this blog post, we're going to walk you through the basics so that by the end, you'll have a solid understanding of what hi-res actually means, setting you up with the knowledge to make an informed decision on what kind of audio you want to stream.

What makes a song "hi-res"?

Whenever you're discussing hi-res audio, you're ultimately trying to answer one central question: How accurately does the audio track I'm listening to reflect what the song sounded like when it was recorded in the studio? The best way to determine that is to evaluate a digital audio track using two different measurements: bit depth (which is expressed in "bits") and sample rate (expressed in kilohertz, or "kHz").

Bit Depth (or: Can you hear the really loud elements and the really quiet elements?)

To begin, we need to state something obvious: There are some sounds too quiet for humans to hear, like a wispy feather drawn across a pane of glass. It makes a sound, but we can't hear it. And conversely, there are sounds that are so loud that listening to them would do damage to our ears. (Probably why you never want to stand next to a jet engine.) Between those two extremes is a range of sound that humans can hear and enjoy.

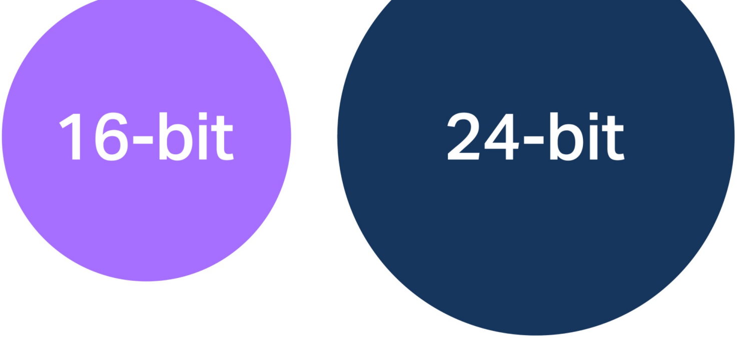
Bit depth is the measurement that tells us whether we can hear the quietest sound in a song, all the way up to the very loudest sound—from the faintest whisper to the loudest cymbal crash.

When you're listening to music, there are two different bit-depths that matter: the bit depth at which the original song was recorded in the studio and the bit depth of the actual music file you're listening to, which is either streamed, downloaded, or played from a CD.

The two most common bit depths that you'll hear about are 24-bit and 16-bit.

24-bit: This is the bit depth at which digital music is recorded in the studio. It is also the bit depth at which a music file you're listening to is considered "hi-res."

16-bit: This bit depth is often referred to as "CD-quality." If you're listening to a song on a CD, you're listening to a 16-bit song. At this bit depth, we should be able to hear the absolute quietest sound in a track, as well as the absolute loudest. Why would a song be recorded at a bit depth higher than 16-bit then, if 16-bit covers the full range of loudness that we would want to hear in music? We'll get to that in a moment.



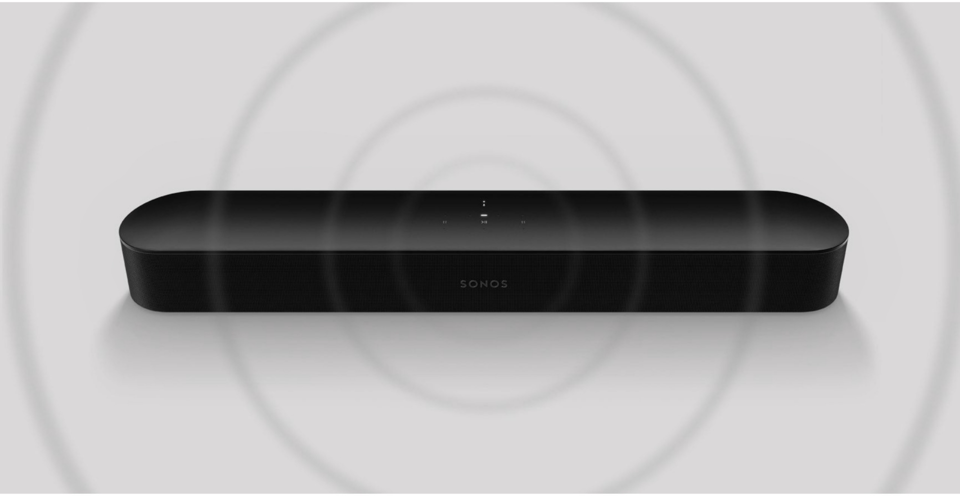
Sample Rate (or: Can you hear the really high elements and the really low elements?)

First off, a quick refresher on frequencies. Our ears can only hear within a certain range of frequencies. You're probably familiar with a dog whistle, which produces a sound at such a high frequency that we as humans cannot hear it, while dogs can.

As with the range of quiet-to-loud sounds that a human can hear (discussed above), there is also a finite range of frequencies we can hear. For a human with absolutely perfect hearing, that range is from 20 Hz to 20,000 Hz (or 20 kHz).

So, at the same time that 16-bit was chosen as the standard bit depth for CDs, 44.1kHz was chosen as the standard sample rate because it includes the full range of frequencies that humans can hear.

Now, you may have heard of sample rates higher than 44.1 kHz (from 48 kHz all the way up to 192 kHz). In contrast to the agreement that a song be considered "hi-res" if it has a bit depth of 24-bit, there is less agreement among the professional audio community around what sample rate constitutes a song being "hi-res." However, because 44.1 kHz covers the entire range of frequencies humans can hear, you can be confident that you're hearing all the frequencies in a song if you're listening at that sample rate and above.



Why haven't we always listened in hi-res?

If we want to listen to music that sounds exactly like it did in the studio when it was recorded, why don't we always just listen to the original files themselves—the 24-bit digital files recorded in studios? The short answer is: because those files are huge. And the process of getting such large files from the studio to our ears has been (and continues to be) somewhat of a challenge. To explain how that process works, we have to talk about audio files. And that story begins, as most good stories do, in the early 80s.

When the CD was first introduced, it could not fit an entire album of 24-bit songs. So, when making a CD, the original 24-bit tracks from the studio had to be converted into smaller, 16-bit files. This bit depth was chosen because, in addition to being smaller than a 24-bit file, with 16-bit you can still hear the full range of quiet-to-loud sounds in a song (as described above). Because of that, CD-quality music has, rightfully, been associated with high-quality audio for decades.

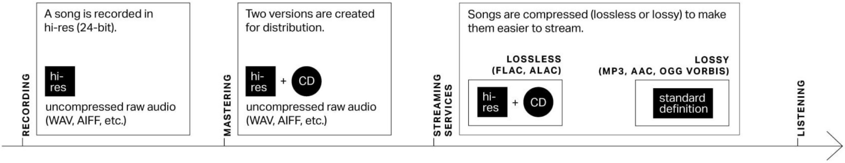
And then the internet came along, changing the way we share virtually everything. Letters became emails. Brochures became webpages. Conversations became chats. But while words can be transferred electronically quite easily through very small files, even 16-bit files were too large to transfer online, much less the original 24-bit music files. (In case you don't remember, the internet was really, really slow in the beginning.) So in order to transfer music online efficiently, music files had to be made even smaller. And to do this, the original audio files were compressed.

There are two methods of compressing a file: lossy and lossless.

Lossy (Examples: mp3, AAC, WMA, OGG): With this method, small parts of a song are completely discarded from the original, uncompressed track in order to make it smaller. The parts that are discarded are chosen based on how unlikely someone is to miss them. For example, let's say that in a song, the sound from a very faint percussion shaker occurs immediately after the loud crash from a hi-hat. Your ears will most likely not be able to hear the sound made by the shaker under the much louder, brasher sound made by the hi-hat. So in this example, the sound of the shaker is something that could be removed from the original audio file without most people noticing or missing it. However, it's a slippery slope. In order to make a lossy file smaller and smaller, the more sounds need to be removed. The more sounds removed, the more likely the listener will notice there are elements missing. And the more sounds the listener notices missing, the more they perceive the song as low quality.

One additional note here: the quality of lossy audio tracks is not evaluated in the same way as uncompressed and lossless tracks. Instead, the quality is measured in kilobits per second (kbps), also known as bitrate (not to be confused with bit depth). However, since the focus of this blog post is on the highest tiers of audio resolution, we're keeping our emphasis on the measurements used to evaluate hi-res and CD-quality audio: bit depth and sample rate.

Lossless (Examples: FLAC, ALAC): The best way to compress a file without degrading the quality of the music is through "lossless" compression. Similar to the concept of a ZIP file, compressing a song into a lossless file means that when you open that file up again in order to listen to the song (or "uncompress" it), nothing has been lost. You're hearing the song exactly as it was before it was compressed into a lossless file. Today, streaming services that offer hi-res audio do so with lossless files.


RECORDING
A song is recorded in hi-res (24-bit).
hi-res
uncompressed raw audio (WAV, AIFF, etc.)
MASTERING
Two versions are created for distribution.
hi-res
+
CD
uncompressed raw audio (WAV, AIFF, etc.)
STREAMING SERVICES
Songs are compressed (lossless or lossy) to make them easier to stream.
LOSSLESS (FLAC, ALAC)
hi-res
+
CD
LOSSY (MP3, AAC, OGG VORBIS)
standard definition
LISTENING

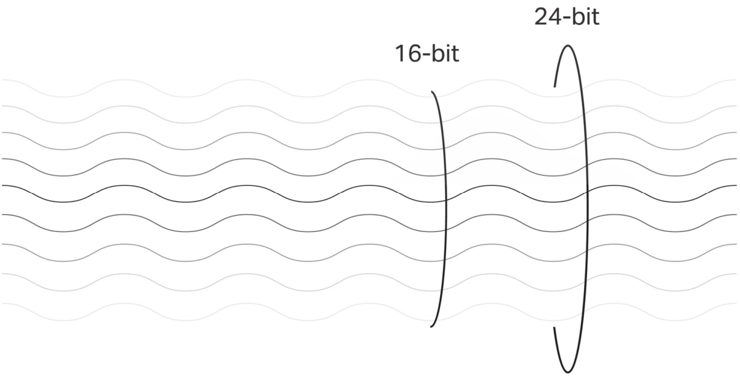
Why might we want to listen in hi-res?

You now know three important things: 1) Uncompressed and lossless audio tracks are evaluated using two measurements: bit depth and sample rate. 2) Listening to a song at 16-bit and 44.1 kHz (or "CD quality") covers the full range of loudness and frequencies humans would want to hear from music. 3) In the studio, songs are recorded with a bit depth of 24-bit.

With that knowledge, you may be wondering two things: 1) Why are songs recorded at a higher bit depth than CD quality in the first place? and 2) Why might I want to listen to hi-res instead of just CD-quality music?

In the Studio

Greg McAllister, Senior Sound Experience Manager at Sonos explains why sound engineers record music at 24-bit with a simple analogy. "Let's say you're trying to catch a small fish with a small net," he said. "Because the rim of your net is slightly larger than the fish, you *should* be able to catch the fish with the net you have. However, if you have a larger net with a much wider rim, it is going to be a lot easier to catch that same fish." He then extends the analogy into the studio: "Recording at 16-bit is like capturing the audio with a small net, while capturing the audio at 24-bit is the big net. You're giving yourself a larger margin of error and making the process a lot easier by using the big net."



From Your Speakers

For years, the highest bit depth and sampling rate you've been able to stream on Sonos has been CD-quality. And because 16-bit and 44.1 kHz audio files include the full spectrum of loudness and frequencies in a song, that quality of audio sounds fantastic.

And, as of today, you can now listen to hi-res (24-bit, 48 kHz) audio on most Sonos products by streaming from Amazon Music Unlimited. Why would you want to listen to music in hi-res? Again, McAllister explains. "The benefit of listening to hi-res music is that you're listening to the actual file from the studio," he said. "No conversion had to take place to change the 24-bit track into a 16-bit track. Listening to a track at 24-bit is a guarantee that you're hearing the audio exactly as it sounded in the studio. To get a bit technical for a moment, if all digital files are made up of just ones and zeros, the file you're listening to in 24-bit is made up of the exact same ones and zeroes that came out of the studio."

So, let's circle back to our original question: How accurately does the audio track I'm listening to reflect what the song sounded like when it was recorded in the studio? Answering this question depends on two things: the track you're listening to and the device with which you're listening. Naturally, the speakers in your cell phone are not going to do a hi-res audio track justice. However, if you're listening to a hi-res track with quality headphones or a Sonos speaker, you're setting yourself up with the best possible circumstances to experience that track as it sounded in the recording studio.

How to listen to hi-res on Sonos

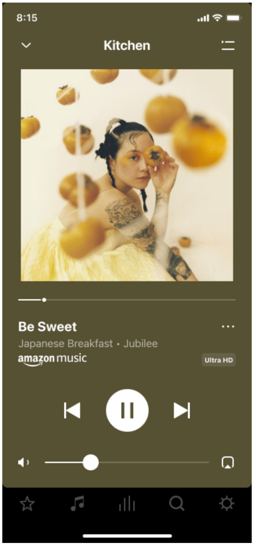
As of this post's publish date, the following Sonos products are capable of playing 24-bit music at 48 kHz: Roam, Arc, Beam (both generations), Five, Sub (all generations), Move, One, One SL, Port, Amp, SYMFONISK Bookshelf, SYMFONISK Table Lamp, Play:5 (Gen 2), Connect (Gen 2), and Connect:Amp (Gen 2).

Sonos currently supports streaming hi-res audio from Amazon Music Unlimited (which streams up to 24-bit, 192 kHz). In order to listen to hi-res audio from Amazon Music on Sonos (which Amazon calls "Ultra HD"), you'll need to sign up for Amazon Music Unlimited. (Note: when streaming on Sonos, the maximum sample rate is 48 kHz.)

If you prefer another streaming service that offers hi-res audio not currently available on Sonos, know that we look forward to introducing more high-resolution experiences in the future. Make sure to keep your Sonos system software updated and follow us on Instagram, Twitter, Facebook, and LinkedIn to keep up to date on our newest features.+

What about HiFi and HD?

You'll note that we've exclusively focused on hi-res, rather than "HiFi" (high fidelity) or "HD" (high definition) audio. Here's why: While the professional audio community is in agreement on what constitutes hi-res audio (24-bit), there isn't a solid, agreed upon definition for HiFi and HD. If you see those terms, they might be used to refer to CD-quality (16-bit), hi-res (24-bit), or something else. Just remember, when you're evaluating a higher-resolution audio track, the bit depth and sample rate are the most consistent ways to determine the quality of that track.



Experiment and decide

Ultimately, the only person who can decide if hi-res audio is for you is you. So give it a try! Amazon Music Unlimited offers a free trial. Choose a song you're familiar with, listen to it the way you currently do, and then listen again in hi-res and see if you notice a difference. Or, you may already know that you want a guarantee that you're streaming the best quality audio on your system. Once you've subscribed, take a look at the Now Playing screen in the Sonos app, where we've added a badge that clearly indicates when you're listening to hi-res audio from Amazon Music.

Your options for listening to hi-res audio will continue to evolve. And so will we. We are constantly evaluating the state of audio and updating our products so that you can be sure you're getting the best quality audio experience with the simplicity, ease, and reliability you expect from Sonos. We'll continue to update this post with new information, including when we introduce new hi-res offerings from other streaming partners. And we want to hear from you. What else do you want to know about listening to hi-res audio on Sonos? Just tag @sonos or send us a DM.

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