

Vorbis

Vorbis is a free and open-source software project headed by the Xiph.Org Foundation. The project produces an audio coding format and software reference encoder/decoder (codec) for lossy audio compression. Vorbis is most commonly used in conjunction with the Ogg container format^[9] and it is therefore often referred to as **Ogg Vorbis**.

Vorbis is a continuation of audio compression development started in 1993 by Chris Montgomery.^{[10][11]} Intensive development began following a September 1998 letter from the Fraunhofer Society announcing plans to charge licensing fees for the MP3 audio format.^{[12][13]} The Vorbis project started as part of the Xiphophorus company's Ogg project (also known as OggSquish multimedia project).^{[14][15]} Chris Montgomery began work on the project and was assisted by a growing number of other developers. They continued refining the source code until the Vorbis file format was frozen for 1.0 in May 2000.^{[2][3][16]} Originally licensed as LGPL, in 2001 the Vorbis license was changed to the BSD license to encourage adoption with endorsement of Richard Stallman.^{[17][18]} A stable version (1.0) of the reference software was released on July 19, 2002.^{[19][20][21]}

The Xiph.Org Foundation maintains a reference implementation, **libvorbis**.^[22] There are also some fine-tuned forks, most notably **aoTuV**, that offer better audio quality, particularly at low bitrates. These improvements are periodically merged back into the reference codebase.

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<u>Filename extension</u>	<u>.ogg</u> ^[1]
<u>Internet media type</u>	application/ogg, audio/ogg, audio/vorbis, audio/vorbis-config
<u>Developed by</u>	Xiph.Org Foundation
<u>Initial release</u>	May 8, 2000 ^{[2][3]}
<u>Latest release</u>	Vorbis I (July 4, 2020 ^[4])
<u>Type of format</u>	<u>Audio compression format</u>
<u>Contained by</u>	<u>Ogg</u> , <u>Matroska</u> , <u>WebM</u>
<u>Standard</u>	<u>Specification</u> (<u>http://xiph.org/vorbis/doc/Vorbis_I_spec.html</u>)
<u>Open format?</u>	Yes ^[5]
<u>Website</u>	<u>http://xiph.org/vorbis/</u>

libvorbis

<u>Developer(s)</u>	<u>Xiph.Org Foundation</u>
<u>Initial release</u>	July 19, 2002
<u>Stable release</u>	1.3.7 / July 4, 2020 ^[6]
<u>Written in</u>	<u>C</u>
<u>Type</u>	<u>Audio codec</u> , <u>reference implementation</u>
<u>License</u>	<u>BSD-style license</u> ^{[7][8]}
<u>Website</u>	<u>Xiph.org downloads</u> (<u>http://www.xiph.org/downloads/</u>)

[Hardware](#)

[Application software](#)

[See also](#)

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Name

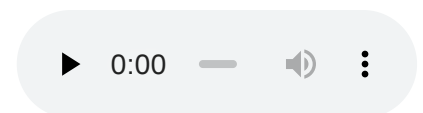
Vorbis is named after a *Discworld* character Exquisitor Vorbis in *Small Gods* by Sir Terry Pratchett. The Ogg format, however, is *not* named after Nanny Ogg, another Discworld character; the name is in fact derived from *ogging*, [jargon](#) that arose in the computer game [Netrek](#).^[11]

Usage

Vorbis faces competition from other audio formats, such as MP3. Though Vorbis is technically superior (addressing many of the limitations inherent to the MP3 design), MP3 has a far higher public profile.^[23] Because Vorbis does not have financial support from large organisations, support for the format is not as widespread, though programs such as [Audacity](#) can convert to more popular formats,^[24] and support in games has gradually improved.^[25]

The Vorbis format has proven popular among supporters of [free software](#).^[26] They argue that its higher fidelity and completely free nature, unencumbered by patents, make it a well-suited replacement for patented and restricted formats.

Vorbis has different uses for consumer products. Many [video games](#) store in-game audio as Vorbis, including *Amnesia: The Dark Descent*, *Grand Theft Auto: San Andreas*, *Halo: Combat Evolved*, *Minecraft*, and *World of Warcraft*, among others. Popular software players support Vorbis playback either natively or through an external plugin. A number of websites, including [Wikipedia](#), use it.^{[27][28][29][30]} Others include [Jamendo](#) and [Mindawn](#), as well as several national radio stations^[27] like [JazzRadio](#), [Absolute Radio](#), [NPR](#), [Radio New Zealand](#)^[31] and [Deutschlandradio](#).^[32] The [Spotify](#) audio streaming service uses Vorbis for its audio streams.^{[33][34]} Also, the French music site [Qobuz](#) offers its customers the possibility to download their purchased songs in Vorbis format, as does the American music site [Bandcamp](#).^[35]



Low-bitrate Vorbis example

Quality

Listening tests conducted through 2014 showed Vorbis performed significantly better than many other [lossy audio formats](#) in that it produced smaller files at equivalent or higher quality while retaining computational complexity comparable to other [MDCT](#) formats such as [AAC](#) and [Windows Media Audio](#).^{[36][37]}

Listening tests have attempted to find the best-quality lossy audio codecs at particular [bitrates](#). Some conclusions made by listening tests:

- Low bitrate (less than 64 kbit/s): the most recent (2007) public multiformat test at 48 kbit/s showed that aoTuV Vorbis had a better quality than [WMA](#) and [LC-AAC](#), the same quality as

WMA Professional, and a lower quality than HE-AAC.^[38]

- Mid to low bitrates (less than 128 kbit/s down to 64 kbit/s): private tests in 2005 at 80 kbit/s and 96 kbit/s showed that aoTuV Vorbis had a better quality than other lossy audio formats (LC-AAC, HE-AAC, MP3, MPC, WMA).^{[39][40]}
- High bitrates (greater than 128 kbit/s): most people do not hear significant differences. However, trained listeners can often hear significant differences between codecs at identical bitrates, and aoTuV Vorbis performed better than LC-AAC, MP3, and MPC.^[41]

Due to the ever-evolving nature of audio codecs, the results of many of these tests have become outdated.

Listening tests

Listening tests are normally carried out as ABX tests, i.e., the listener has to identify an unknown sample X as being A or B, with A (the original) and B (the encoded version) available for reference. The outcome of a test must be statistically significant. This setup ensures that the listener is not biased by their expectations and that the outcome is very unlikely to be the result of chance. If sample X can be identified reliably, the listener can assign a score as a subjective judgment of the quality. Otherwise, the encoded version is considered to be *transparent*. Below are links to several listening test results.

2005, July comparison

AAC vs MP3 vs Vorbis vs WMA at 80 kbit/s. States that Vorbis aoTuV beta 4 is the best encoder for either classical or various music in this bitrate, and that its quality is comparable to the LAME ABR MP3 at 128 kbit/s.^[39]

2005, August comparison

AAC vs MP3 vs Vorbis vs WMA at 96 kbit/s. States that Vorbis aoTuV beta 4 and AAC are tied as the best encoders for classical music in this bitrate, while aoTuV beta 4 is the best encoder for pop music, even better than LAME at 128 kbit/s.^[40]

2005, August comparison

MPC vs Vorbis vs MP3 vs AAC at 180 kbit/s. An audiophile listening test, which states that, for classical music, Vorbis aoTuV beta 4 has 93% percent probability of being the best encoder, tied with MPC. MPC is tied with both Vorbis, in the first place, and LAME in the second.^[41]

2011, April comparison by Hydrogenaudio

Vorbis vs HE-AAC vs Opus at 64 kbit/s. Vorbis was on average between the LC-AAC low anchor and Nero HE-AAC, while the upcoming Opus (by Xiph) was best.^[42]

Characteristic artifacts

As with most modern formats, the most consistently cited problem with Vorbis is pre-echo, a faint copy of a sharp attack that occurs just before the actual sound (this artifact is most obvious when reproducing the sound of castanets).

When the bitrate is too low to encode the audio without perceptible loss, Vorbis exhibits an analog noise-like failure mode, which can be described as reverberations in a room or amphitheater. Vorbis's behavior is due to the noise floor approach to encoding; see technical details.

Technical details

Vorbis is intended for sample rates from 8 kHz telephony to 192 kHz digital masters and a range of channel representations (monaural, polyphonic, stereo, quadraphonic, 5.1, ambisonic, or up to 255 discrete channels).^[43] Given 44.1 kHz (standard CD audio sampling frequency) stereo input, the encoder will produce output from roughly 45 to 500 kbit/s (32 to 500 kbit/s for aoTuV tunings) depending on the specified quality setting. Quality setting goes from -0.1 to 1.0 for the Xiph library and -0.2 to 1.0 for aoTuV. Encoding front-ends map these values to an integer-based quality setting that goes from -1 to 10 for the Xiph library and -2 to 10 for aoTuV. Files encoded with a given quality setting should have the same quality of sound in all versions of the encoder, but newer versions should be able to achieve that quality with a lower bitrate. The bit rates mentioned above are only approximate; Vorbis is inherently variable-bitrate (VBR), so bitrate may vary considerably from sample to sample. (It is a free-form variable-bitrate codec and packets have no minimum size, maximum size, or fixed/expected size.^[4])

Vorbis aims to be more efficient than MP3, with data compression transparency being available at lower bitrates.

Outline of coder algorithm

Vorbis I is a forward-adaptive monolithic transform codec based on the modified discrete cosine transform (MDCT).^[44] Vorbis uses the modified discrete cosine transform for converting sound data from the time domain to the frequency domain. The resulting frequency-domain data is broken into noise floor and residue components, and then quantized and entropy coded using a codebook-based vector quantization algorithm. The decompression algorithm reverses these stages. The noise-floor approach gives Vorbis its characteristic analog noise-like failure mode when the bitrate is too low to encode the audio without perceptible loss. The sound of compression artifacts at low bitrates can be perhaps described as reverberations in an amphitheater or a room.

Tuned versions

Various tuned versions of the encoder (Garf, aoTuV or MegaMix) attempt to provide better sound at a specified quality setting, usually by dealing with certain problematic waveforms by temporarily increasing the bitrate. Most of the tuned versions of Vorbis attempt to correct the pre-echo problem and to increase the sound quality of lower quality settings (-q-2 through -q4). Some tuning suggestions created by the Vorbis user community (especially the aoTuV beta 2 tunings) have been incorporated into the 1.1.0 release.^[45]

Bitrate peeling

The Vorbis *format* supports bitrate peeling for reducing the bitrate of already encoded files without re-encoding, and several experimental implementations exist.^{[46][47]} However, the quality is "unusable"^[46] and markedly inferior to decoding and re-encoding.

Vorbis nominal bitrate at quality levels for 44.1 kHz stereo input. The new libvorbis v1.2 usually compresses better than these values (effective bitrate may vary).

Quality	Nominal bitrate	
	Official Xiph.Org Foundation Vorbis	aoTuV beta 3 and later
-q-2	not available	32 kbit/s
-q-1	45 kbit/s	48 kbit/s
-q0	64 kbit/s	
-q1	80 kbit/s	
-q2	96 kbit/s	
-q3	112 kbit/s	
-q4	128 kbit/s	
-q5	160 kbit/s	
-q6	192 kbit/s	
-q7	224 kbit/s	
-q8	256 kbit/s	
-q9	320 kbit/s	
-q10	500 kbit/s	

The reason that peeling programs degrade quality so severely is that the format does not specify the relative importance of signal data, and existing encoders do not order the data in order of importance. Hence peelers cannot easily determine whether data is important or not.

Container formats

Vorbis streams can be encapsulated in other media container formats besides Ogg.^[48] A commonly used alternative is Matroska. It is also used in WebM, a container format based on a subset of Matroska.^{[49][50][51]} Vorbis streams can also be encapsulated in an RTP payload format.^[52]

Metadata

Vorbis metadata, called Vorbis comments, supports metadata tags similar to those implemented in the ID3 standard for MP3. The metadata is stored in a vector of byte strings of arbitrary length and size. The size of the vector and the size of each string in bytes is limited to $2^{32} - 1$ (about 4.3 billion, or any positive integer that can be expressed in 32 bits). This vector is stored in the second header packet that begins a Vorbis bitstream.^[53]

The strings are assumed to be encoded as UTF-8. Music tags are typically implemented as strings of the form "[TAG]=[VALUE]", for instance, "ARTIST=The John Smith Band". The tag names are case-insensitive, thus typing "ARTIST=The John Smith Band" would be the same as "artist=The John Smith Band". Like the current version of ID3, users and encoding software are free to use whichever tags are appropriate for the content. For example, an encoder could use localized tag labels, live music tracks might contain a "Venue=" tag or files could have multiple genre definitions. Most applications also support common de-facto standards such as discnumber and ReplayGain information.

Licensing

Knowledge of Vorbis' specifications is in the public domain.^[7] Concerning the specification itself, the Xiph.Org Foundation reserves the right to set the Vorbis specification and certify compliance. Its libraries are released under the revised 3-clause BSD license and its tools are released under the GNU General Public License. The libraries were originally released under the GNU Lesser General Public Licence, but a BSD license was later chosen with the endorsement of Richard Stallman.^[54] The Xiph.Org Foundation states that Vorbis, like all its developments, is completely free from the licensing or patent issues raised by proprietary formats. Although the Xiph.Org Foundation states it has conducted a patent search that supports its claims, outside parties (notably engineers working on rival formats) have expressed doubt that Vorbis is free of patented technology.^[55]

The Xiph.Org Foundation has not released an official statement on the patent status of Vorbis, pointing out that such a statement is technically impossible due to the number and scope of patents in existence and the questionable validity of many of them. Such issues can only be resolved by a court of law.

Vorbis is supported by several large digital audio player manufacturers such as Samsung, SanDisk, Rio, Neuros Technology, Cowon, and iriver.

Support

Hardware

Tremor, a version of the Vorbis decoder which uses fixed-point arithmetic (rather than floating point), was made available to the public on September 2, 2002 (also under a BSD-style license).^[56] Tremor, or platform-specific versions based on it, is more suited to implementation on the limited facilities available in commercial portable players. A number of versions that make adjustments for specific platforms and include customized optimizations for given embedded microprocessors have been produced. Several hardware manufacturers have expressed intentions to produce Vorbis-compliant devices and new Vorbis devices seem to be appearing at a steady rate.

- Sailfish OS devices
- Tizen devices
- Openmoko Neo 1973 and Neo Freerunner
- Devices based on Google's Android platform support Ogg Vorbis media files.^{[57][58]}
- Digital audio players such as Cowon's D2 and iAudio X5 ship with Ogg Vorbis support.
- Samsung YP series of digital audio players^[59] ships with Ogg Vorbis support.
- The majority of iriver devices provide Ogg Vorbis support up to Q10 bitrates.^{[60][61][62]} (as July 2008)
- Cowon C2 (Ogg and FLAC support)
- Sandisk added Vorbis capability to the 1.01.29 firmware (<https://web.archive.org/web/20080528155314/http://forums.sandisk.com/sansa/board/message?board.id=clip&thread.id=6720>) for the Sansa Clip player. (added in May 2008)
- Sandisk added Vorbis capability for the Sansa Fuze player in the 1.01.15 (<https://web.archive.org/web/20081005185513/http://forums.sandisk.com/sansa/board/message?board.id=sansafuse&thread.id=4880>) firmware update. (added October 3, 2008)
- Sandisk Sansa Clip+
- Sandisk Sansa Fuze+
- Meizu's M6 and M3 Digital Audio Players
- Elta 8844 MPEG4 DVD/DivX player can play music files in both MP3 or Ogg Vorbis format
- Vedia A10 plays Ogg Vorbis and FLAC in addition to MP3, AAC and other formats
- S1 MP3 Players also supports Ogg Vorbis since at least 2006, though this is not typically listed on the player's packaging.
- GamePark Holding's Linux based portable gaming consoles (GP32, GP2X F100-F200, GP2X Wiz) officially support Ogg Vorbis.
- RIM BlackBerry 9800 "Torch" and 9670 "Style"
- VDO Dayton CD1737X (http://www.vdodayton.com/default2_and_fz_menu=product_documents_and_dataid=523093.aspx) car radio supports 8-192kbit/s Ogg Vorbis files
- HP TouchPad was given support for Ogg Vorbis with the webOS 3.0.4 update
- Denon SC5000 Prime media player
- Ultra HD Blu-ray players support decoding of 4K resolution VP8/VP9 video with Ogg Vorbis audio.

Apple's iPod does not natively support Vorbis but through the use of Rockbox, an open-source firmware project, is capable of decoding Vorbis files on certain models. Similar statements apply to other devices capable of running Rockbox, as well. The Xiph.Org Foundation wiki has an up-to-date list of Vorbis-supporting hardware, such as portables, PDAs, and microchips.^[63] Also see Internet radio device for an overview.

Application software

Software supporting Vorbis exists for many platforms. The multi-platform open-source VLC media player and MPlayer can play Ogg Vorbis files, as can Winamp and foobar2000. Windows Media Player also does not natively support Vorbis; however, DirectShow filters exist^[64] to decode Vorbis in Windows Media Player and other Windows multimedia players that support DirectShow. Vorbis is also supported in the multi-platform audio editing software Audacity, in the multi-platform multimedia frameworks FFmpeg, GStreamer and Helix DNA. Vorbis is well-supported on the Linux platform in programs like XMMS, xine, Amarok and many more. A list of Vorbis-supporting software can be found at the Xiph.Org Foundation wiki and Vorbis.com website.^{[65][66]} For more information about support in software media players look at comparison of media players. Users can test these programs using the list of Vorbis audio streams available on the same wiki.^[67]

Some newer Ubisoft games use Vorbis files renamed with the filename extension **.sb0**. It can therefore be played using a compatible player, although sometimes one must force a different sampling rate to hear it correctly. A number of tools are available for extracting sound from archived files such as the .m4b of Myst IV: Revelation.

As originally recommended by HTML 5, these web browsers natively support Vorbis audio (without a plugin) using the `<audio>` element: Mozilla Firefox 3.5 (and later versions),^{[68][69]} Google Chrome (from version 3.0.182.2),^[70] SeaMonkey (from version 2.0).^[71] Opera 9.5 experimental video builds released in 2007 and 2008 have only `<video>` support and play back Vorbis audio included in Ogg video files.^{[72][73]} Opera 10.5 browser has support for Vorbis audio, WAVE PCM audio and Theora video.^{[74][75]}

The game design software RPG Maker MV, released in October 2015, is the first version of that program to drop MP3 support in favor of Ogg Vorbis.

In October 2017, Microsoft released support for Ogg media container, and Theora and Vorbis media formats as an optional add-on to Windows 10 and Xbox One, available for free in the Microsoft Store.^[76]

Vorbis support by different operating systems

	<u>Microsoft Windows</u>	<u>macOS</u>	<u>Linux</u>	<u>Android</u>	<u>iOS</u>
Codec support	Yes ^[76]	Via third-party applications	Yes	Yes	Via third-party apps
Container support	<p>On Windows 10 Fall Creators Update (1709) with Web Media Extensions add-on: <u>Ogg</u> (.ogg is not recognised; requires pseudo extension)^[a] <u>Matroska</u> (.mka, .mkv)</p> <p>On Windows 10 October 2018 Update (1809): <u>WebM</u> (.webm is recognised officially)</p> <p>On Windows 10 May 2019 Update (1903): <u>Ogg</u> (.opus is recognised officially)</p>	<i>depends on application</i>	<u>Ogg</u> (.ogg) <u>Matroska</u> (.mka, .mkv) <u>WebM</u> (.webm)	<u>Ogg</u> (.ogg) <u>Matroska</u> (.mka, .mkv) <u>WebM</u> (.webm)	<i>depends on application</i>
Notes	<p>On Windows 10: - Requires <u>Fall Creators Update</u> (1709) and installation of <u>Web Media Extensions</u> (https://www.microsoft.com/store/productId/9N5TDP8VCMHS) package. - On <u>April 2018 Update</u> (1803) with <u>Web Media Extensions</u> preinstalled, <u>Microsoft Edge</u> (EdgeHTML 17) supports <u>Vorbis</u> audio embedded in <audio> tags. - Supported on <u>Universal Windows Platform</u> apps (<u>Groove Music</u>, <u>Microsoft Movies & TV</u>). <u>Unsupported</u> on <u>Windows Media Player</u>. - Up till <u>October 2018 update</u> (1809), the filename extension .ogg was not recognised. (substitute with a pseudo file extension such as .m4a)^[77]</p> <p>On Windows 8.1 and older: - Requires installation of a third-party multimedia framework, <u>LAV Filters</u>.</p>	<p>No native support in the macOS native multimedia framework. In versions of Mac OS X prior to 10.11 El Capitan, Vorbis support could be added to <u>QuickTime</u> using the <u>Xiph QuickTime Components</u>.^[78]</p>	-	-	No native support in the iOS native multimedia framework.

See also

- Comparison of audio coding formats
- FreeCast, peer-to-peer Vorbis streaming
- Icecast, streaming media server which currently supports Ogg (Vorbis and Theora), Opus and WebM streams.
- JUCE, cross-platform C++ toolkit with embedded Vorbis support

- Ogg bitstream format
- Opus, a new audio format by Xiph that may replace Vorbis
- Vorbis comment, metadata format used by Vorbis
- XSPF, playlist format
- Xiph QuickTime Components, official QuickTime implementation

Notes

- The `.ogg` filename extension is not recognised by Universal Windows Platform apps Groove Music and Microsoft Movies & TV, hence a pseudo extension of another audio format (such as `.m4a`) is required instead.^[77]

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"With the Beta 4 release, the Ogg Vorbis libraries have moved to the BSD license. The change from LGPL to BSD was made to enable the use of Ogg Vorbis in all forms of software and hardware. Jack Moffitt says, "We are changing the license in response to feedback from many parties. It has become clear to us that adoption of Ogg Vorbis will be accelerated even further by the use of a less restrictive license that is friendlier toward proprietary software and hardware systems. We want everyone to be able to use Ogg Vorbis.""
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External links

- [Vorbis site \(http://www.vorbis.com/\)](http://www.vorbis.com/) - Xiph reference implementation
- [Vorbis reference implementation \(http://xiph.org/vorbis/\)](http://xiph.org/vorbis/) by Xiph.Org Foundation

- [Players \(https://wiki.xiph.org/Vorbis_Software_Players\)](https://wiki.xiph.org/Vorbis_Software_Players)
 - [Christopher "Monty" Montgomery \(main developer\) interview, slashdot.org \(http://slashdot.org/article.pl?sid=00/08/14/1034209\)](http://slashdot.org/article.pl?sid=00/08/14/1034209)
 - [RFC 5215](#) - RTP Payload Format for Vorbis Encoded Audio (audio/vorbis, audio/vorbis-config)
 - [RFC 5334](#) - Ogg Media Types
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