

Ligos Corporation

Indeo® Video and Audio Codecs Technical Documentation

Updated April 5, 2007

Introduction

In this revision, Ligos is pleased to introduce Ligos Indeo Codecs for Windows (including Indeo Video 5.2). This documentation describes the features of the Indeo codecs available through Ligos Corporation.

Indeo for Windows Update

With the September 2002 update to Windows XP (known as Service Pack 1), Microsoft suspended distribution of the Indeo codecs as a base part of its operating system. This only affects users with new PCs that are shipping with Windows XP Service Pack 1, or clean installs of Windows XP SP1 on an older system. Unfortunately, a number of game and multimedia titles require Indeo to be installed on the OS in order to function.

In the 2004 update to Windows XP (known as Service Pack 2), Microsoft has made changes to the OS and Windows Media Player 9 and 10 that prohibit the playback of Indeo content online. Users will find that they will no longer be able to automatically play video files posted on the web if they were encoded with the Indeo codec. Windows Media Player will only play Indeo files if they are local (on your hard drive).

In order to meet the needs of those who use Windows XP and Windows Vista and required Indeo codecs, Ligos created a special version of Indeo Video 5 called Ligos Indeo Codecs for Windows (also known as Indeo Video version 5.2). Although Ligos Indeo Codecs for Windows was previously only available for Windows XP, it has now been made available for all Windows OSes from Windows 95 to Windows Vista, and is the only version available through Ligos.

Performance enhancements

Ligos Indeo Codecs for Windows includes the enhancements of Indeo Video 5, and some new optimizations exclusively for Windows XP and Vista and/or fast systems:

- Optimization of the Indeo Video 5 scalability feature
- A wavelet compression algorithm that improves visual quality over previous versions of Indeo
- Better compression at all levels of video quality than previous generation codecs
- Playback performance enhancements including smoother, interpolated "zoom by 2" playback

Features of Ligos Indeo Codecs for Windows

Ligos Indeo Codecs for Windows includes the Indeo Video 5.2 codec, as well legacy codecs Indeo Video 4.5, and Indeo Audio 2.5. Specific features of each are outlined below:

Features of Indeo Video 5.2

The Indeo Video 5 codec release includes most of the features in previous releases of Indeo video, as well as:

Video access protection

Many multimedia developers are concerned about the illegal distribution of their copyrighted material. The Indeo Video 5 codec helps prevent misuse of video clips by using access keys (numeric passwords that can be inserted into a video clip during compression). Applications need the password to play video clips encoded with an access key.

Key frame flexibility

The Indeo Video 5 codec offers control and flexibility over the use of key frames. The key frame interval is unrestricted, allowing a variety of values:

- 0 Only the first frame in the file is a keyframe. No other key frames occur in the file.
- 1 Every frame in the file is a key frame.
- 2, 3, ... n Every nth frame in the file is a key. The value of n has no upper limit.

Along with this flexibility in key frame intervals, Indeo Video 5 allows for non-periodic key frames. This means that during editing, the encoding application can tell the Indeo Video 5 codec to place a key frame at any location. Video producers can then specify access points anywhere within a video sequence, or better control video quality by placing key frames on scene-change boundaries.

Application interactivity

Indeo Video 5 incorporates features that make it possible to include video in interactive multimedia applications and games, challenging the traditional notion of video as having a fixed size and rectangular shape.

Transparency

For years, the movie and television industries have used the technique of chroma-keying (sometimes called blue-screening) to place foreground objects over synthesized backgrounds. One example of chroma-keying is when TV meteorologists appear to be standing in front of a wall-sized map, when in fact, they are standing in front of a blue wall. Chroma-key circuitry electronically separates the foreground pixels representing the meteorologist from the blue background pixels and overlays the meteorologist on an electronically-generated weather map. The Indeo video codec supports this type of transparency. During encoding, a compression application can send information to the codec describing a color or range of colors that represent a transparent background (such as the blue wall in the meteorologist example). Indeo video then analyzes each frame, separates the background pixels from the foreground, and makes the background pixels transparent, encoding only the foreground objects as compressed video.

Indeo Video 5's transparency encoding is flexible, allowing for arbitrarily-shaped multiple foreground objects. Foreground objects can also move from frame to frame, allowing you to create what might be called video sprites. Video sprites are transparent video objects that can be overlaid onto other video or bitmap backgrounds. During playback, foreground objects can be composited dynamically over different backgrounds. For example, the meteorologist can appear over different weather maps on PCs with sufficiently powerful Pentium processors. A foreground object can even appear over another video stream, as in the case of a tornado.

Local decode

Sometimes an application needs to display only part of a decoded video image. For example, in a game, you might look through the periscope of a submarine where your view is limited to a small

subset of the entire image. This subset changes as the video plays, depending on where the periscope is rotated.

In this case, much of the source image does not need to be displayed, and it's preferable not to waste processor resources decoding it. Indeo Video 5 provides this capability through a feature called local decode.

The playback application can tell Indeo Video 5 to decode only a rectangular subregion, called the view port, from the source video image. The minimum possible size of the local decode viewport is defined during compression, but the display size and location of the viewport can be changed dynamically during playback.

Real-time video effects

The brightness, contrast, and color saturation of Indeo Video 5 files can be modified interactively during play back. This makes it possible to simulate different lighting conditions, or to tailor the appearance of the video playback to particular graphics environments and preferences.

Features of Indeo Video 4.x

Indeo Video 4.x introduced a number of benefits including performance improvements, quality enhancements, and interactive features:

Performance Improvements

- The codec was optimized for MMX™ technology. This enhancement included 57 new instructions that allow Indeo to deliver better performance for multimedia and communications computation.
- The codec uses less memory. The actual amount of memory used by the codec when playing a given file will vary depending on how that file was compressed, but the codec will use anywhere from 25% to 40% less memory to open and play a file than the previous version.
- Files load and start playing faster. The actual time it takes to open and begin playing a file on a given PC will vary based on system performance features such as CPU speed, RAM, L2 cache, etc., but on average the new codec will open and start playing files 20% to 40% faster than the previous version.
- Playback performance was improved. A number of optimizations have been made to speed up playback of video files, especially in 16-bit (65,000-color) or greater display mode.

Compression Enhancements

- Enhancements were made to the offline encoder, and a compression mode called the Quick Compressor was added to make compressing video files much faster and easier.
- Improvements were made to the offline encoder that will allow compressed video clips to display better quality at lower data rates. This is especially noticeable in clips compressed at single-speed CD-ROM data rates (~ 100-135 Kbytes/second) and lower, and in clips compressed at 30 frames/second at double-speed CD-ROM data rates (~ 200-250 Kbytes/second) and below.
- The Quick Compress option allows Indeo video to encode video many times faster than it otherwise would. Exactly how much faster depends on the specific content of the source video and the other encoder options you've selected. The compression speed improvement, however, is significant: compression jobs that once took hours may now compress in just minutes.

Playback Quality Improvements

Changes were made to the decoder to improve the playback quality of both new and existing video clips:

- A problem that caused a pinkish color shift in both 16-bit (65,000-color) and 24-bit (16.7-million color) display modes was eliminated.
- Zoom-by-two quality was improved in 16-bit (65,000-color) display mode. A problem that caused an excessive dither pattern was eliminated.
- Indeo Video 4 introduced alternate line zoom-by-two, a feature that doubles the video window size by horizontal pixel doubling and then drawing a row of black pixels in between each row of image data. This can help reduce some of the "jaggies" caused by vertical pixel doubling.

Features of Indeo Audio 2.5

Indeo Audio 2.5 is the primary audio compression codec used in conjunction with the Indeo Video 5 codec. This release includes the following features:

- 8:1 audio compression
- Indeo audio compresses 16-bit raw PCM audio by a factor of eight. For example, a one-second CD-quality audio (16-bit PCM, 44.1 kHz sample rate, stereo) clip requires 176,400 bytes of storage. After compression, it requires 22,050 bytes of storage.
- Support for Standard Multimedia Sample Rates. Sample rates of 8,000 Hz, 11025 Hz, 22050 Hz, and 44,100 Hz are supported. It is possible to convert to a lower sample rate while compressing an audio clip with Indeo audio. For example, the one-second CD-quality audio clip mentioned above could be converted to 8,000 Hz sample rate during compression. In this case the compressed clip would require 4,000 bytes of storage. Note, however, that decreasing the sample rate can dramatically reduce the audio quality.
- Support for Stereo and Mono. Both stereo (two channel) and mono (one channel) compression and playback are supported. Mono requires half the storage space of stereo. For example, if the one-second CD-quality stereo audio clip mentioned above is compressed as mono at 8,000 Hz sample rate, the resulting compressed audio clip would require only 2,000 bytes of storage. Note, however, that compressing stereo audio as mono can dramatically reduce the audio quality.

Installation Notes

Once you have downloaded the file "IndeoSetup.exe", double click on it to run the Ligos Indeo Codecs for Windows Codec Package installer, and follow the simple instructions. If you receive an installation error, you may have a corrupted file from an incomplete download, or you may not have administration rights on the computer:

- You can verify the file was downloaded correctly by right clicking on the file in Windows Explorer and checking the size, which should be 2.04 MB (2,142,208 bytes). If this is not the correct size the file will need to be downloaded again.
- Windows XP and Vista will generate an error if you try to install any application, but are not logged in with Administrator rights. You will need to either log off and log on as Administrator or set your current rights with Administrator privileges that will allow the installation routine to run correctly.

If installation went smoothly without errors, but you want to confirm that Indeo is installed on your system, check for the installed video codecs in the device manager. A quick and easy way to do this is to go to the Windows Control Panel (in My Computer), and open "Sounds and Audio Devices". Select the Hardware tab, and select Video Codecs in the Devices listbox. Click on the Properties button, and a new dialog will open. Click on the Properties tab, and you should see a list of Video Compression Codecs, including the following:

- Indeo® 5.2 Codecs
- Indeo® 4.5 Codecs
- Indeo® 2.5 Audio Decoder

If you see these listed, Indeo has installed correctly.

Another way to confirm that the codecs have installed correctly is to simply try playing an Indeo encoded AVI file in Windows Media Player. As it is difficult to tell what codec has been used in a particular AVI file, Ligos has made a test video clip available online for testing at http://ligos.com/videoclips/lions/lion_sif_ind5.zip . Type this (or copy and paste) into the address bar of your browser and download it to your local PC. The file is a 7 MB zipped file, so you'll need to unzip it once you have downloaded it. Double click on the AVI, or open it with Windows Media Player. If the file plays, this is another confirmation that Indeo has installed correctly on your system.

If these files play, but other AVI files do not, you should confirm whether those files are actually Indeo encoded AVI files at all. If the file doesn't play correctly, it usually means the file was compressed using a format that is not installed on your computer. Some other possible third party compression formats are Windows Media, Cinepak, M-JPEG, and DivX. Many video files being distributed over the Internet use the DivX AVI format, which is not supported by Windows without an additional codec, and has nothing to do with Indeo. Please refer to <http://www.divx.com/> for information on DivX, or <http://www.videohelp.com/play> for information on codecs in general.

If you are still having difficulties, they may be specific to the other hardware or software you are using, and not related to Indeo. Please refer to the technical documentation and support options for those products. If you have confirmed that you are definitely having a problem directly related to Indeo, please check our Indeo Support web page and follow the instructions for additional support options.

Uninstall

To Uninstall Indeo software:

1. Go to Control Panel and select the "Add/Remove Programs" icon.
2. Highlight Indeo Software and then select the Add/Remove button.
3. Select "Yes" when prompted to confirm your Uninstall selection.
4. All of the components installed onto your system will be removed. Files that were previously on your system will not be removed.

Known Limitations

There are a few limitations associated with Ligos Indeo Codecs for Windows:

- The Indeo video compression in Microsoft ActiveMovie* 1.0 is not supported.
- Indeo compressions under some circumstances can result in slightly higher data rates than requested when using bitrate control.

- The scalability feature of previous versions on Indeo Video should not be used with Indeo XP, as it causes performance problems on faster (greater than 1 GHz) XP enabled systems.
- Microsoft has made changes to the OS and Windows Media Player 9 and 10 that prohibit the playback of Indeo content online. Users will find that they will no longer be able to automatically play video files posted on the web if they were encoded with the Indeo codec. Windows Media Player will only play Indeo files if they are local (on your hard drive).

Creating Indeo Video Files (for End-Users)

With the Indeo codec, you can compress digital video files, distribute them by CD or the Internet, and then play those compressed files on the destination PC.

This document describes how to compress video effectively using Indeo. Read it if you plan to use Indeo to produce multimedia applications for CD-ROM, or videos to be distributed from a Web site.

NOTE: This paper assumes that you have installed the latest Indeo video drivers, software for video capture and editing (such as Adobe Premiere*), and a supported video playback environment (such as Microsoft's Video for Windows* or ActiveMovie* or Windows Media Player).

Choosing Compression Settings in Your Video Editing Application

Most video editing applications have one or more menus/dialogs in which you set important video compression options, including the target data rate for the compressed file, the video compressor to use, the audio/video interleaving, the key frame interval, and CD-ROM playback preparation.

These are the steps for choosing compression setting. Each step is discussed in detail below.

1. Select the video compressor.
2. Set the target data rate or quality level.
3. Choose an appropriate Audio/Video Interleave ratio.
4. Set the key frame interval
5. Disable CD-ROM padding.

Selecting the Video Compression Method

Choose which video encoder compresses the video data (usually under Compression Method). Make sure you have the latest version of Indeo on your system.

Setting the Target Data Rate or Quality

Most editing applications provide a selector box called Data Rate, and a numerical entry box into which you enter the average data rate you want in kilobytes (K) per second.

Another control called the **Quality** slider (typically expressed as a percentage) is usually present, as well. If you enter a nonzero value into the **Data Rate** box, the **Quality** slider is ignored. Setting the **Data Rate** instead of the **Quality** control results in compressed video files with a nearly constant average data rate from beginning to end, but with varying quality, as the video content becomes easier or harder to compress. Using this setting is appropriate any time you want a specific data rate or file size, as you would for playing from a CD-ROM or streaming over a network of a certain speed.

To use the **Data Rate** control, select the box and enter a target data rate, expressed in kilobytes-per-second. The encoder attempts to output compressed data at an average data rate as close to the target value as possible. It usually isn't exact, because video files typically vary in compressibility from beginning to end, and the encoder must change quality as needed.

If you do not select the **Data Rate**, or if you enter a value of zero, the **Quality** slider is enabled. The higher you set it, the higher the overall data rate and the better the visual quality of the resulting file. Using the **Quality** slider results in a video file of constant quality from beginning to end. However, with variable data rates, the video content becomes easier or harder to compress. Another benefit of using the **Quality** slider is speed. The Indeo encoder runs approximately twice as fast when using the **Quality** slider. Use this setting any time strict control of the average data rate is not as important (for downloaded video, or other video played from a hard disk). Also use it when you don't want to vary the quality of a video during playback (to maintain a fixed data rate).

You can obtain a file of approximately the size you want using the **Quality** slider. It just requires a bit of trial and error. Obtaining a file with the quality level you want is much simpler using the **Quality** slider. To use the quality slider, position the control at the quality percentage you want (100% is maximum quality, and 0% is minimum quality).

The file size or data rate required to compress a video to some acceptable level of quality varies depending on the content. For example, computer-generated animation sequences consisting of simple backgrounds, low detail, and little motion, usually compress extremely well. However, some video sequences like live sporting events featuring complex backgrounds and lots of motion, require a much higher data rate. The audio data also requires space in the file. This is particularly important to remember when using the Data Rate control, because the required data rate for audio is subtracted directly from the value you enter into the box. Because uncompressed high-quality audio can be quite large (even compared to compressed video), consider using compressed audio when a low data rate is particularly important.

Setting the data rate for maximum CD-ROM performance

Selecting an appropriate data rate is an art that depends on a combination of factors relating to the system performance of the target playback environment. The most important of these is CD-ROM performance. In the past, PC CD-ROM drives were typically 1X drives, theoretically capable of sustained data-transfer rates of only 150 kilobytes-per-second. Fortunately, most PCs today are equipped with CD-ROM drives capable of at least 2X (300 kilobytes-per-second) performance. Most Pentium® processor-based PCs have drives much faster than that. This means that it is no longer critical to maintain a precisely controlled average data rate that is comfortably below 150 kilobytes-per-second. Data rate control is still important for videos with frame sizes larger than 320x240. However, most videos compressed to a reasonable size with Indeo XP stream successfully from the CD-ROM drive of any machine with sufficient CPU power to decode the video. This means that usually the CD-ROM drive is no longer the limiting factor. Many developers still use the **Data Rate** control for CD-ROM applications, but the main reason today is for convenience in achieving a certain file size to save space on the CD-ROM. However, using the **Quality** slider is becoming more prevalent due to the consistent video quality and faster encoding speed.

Editing Compressed Video

It's best to avoid editing compressed material, but if you must edit a compressed file, use an application like Adobe Premiere, which supports recompression. It recompresses only the part of the file that has been modified.

For example, suppose you'd like to extract a sequence in which the first frame is a delta frame. The application must decompress the first frame and recompress it as a key frame, using the previous key frame from the source file as a reference. All subsequent delta frames until the next key frame must also be decompressed and recompressed as new delta frames, using the newly-created key frame as a reference. But as soon as the next key frame is encountered, no further frames need to be recompressed, and applications that support limited recompression avoid doing so.

NOTE: Certain editing applications, like Adobe Premiere do not have an explicit **No Recompression** option in the **Compression** dialog box. To avoid recompressing Indeo video source files, for example, select the same Indeo video codec when saving those files back to disk. The application compares the format of the compressed input files to the selected output format and automatically refrains from recompressing the data, or recompresses only when necessary.

Finally, it's a good idea to avoid joining files compressed in different formats into one clip. For example, if you join a file compressed using Indeo video with a file compressed using Microsoft's RLE* compressor, and select Indeo video as the save format, the RLE data must be decompressed and recompressed as Indeo video. Avoiding recompression is impossible under these circumstances.

CD-ROM Videos

- Set a target data rate low enough to allow the playback device to decompress the data as well as move it from the drive into system memory. For a 2X CD-ROM drive, a target data rate of about 200 kilobytes-per-second is safe; however, PCs based on faster Pentium processors and with faster CD-ROMs may be able to drive this rate much higher. Do not use the quality slider unless the targeted CD-ROM drives have an ample transfer rate for the video being compressed.
- Interleave the audio with the video at 1:1, unless it is compressed. If compressed, interleave it correctly for the type of compressed audio you are using.
- Never use CD-ROM padding,
- Use a key frame interval of one second (equal to the frame rate).
- Enable scalability to minimize dropping frames if the video is targeted at a range of machines, including those with insufficient processing power. If all target platforms have sufficient power, then do not use scalability.