Windows Media Technology Explained

Introduction

In this white paper, you can read how Quadrox uses the Windows Media technology in its WebCCTV product range.

Windows Media is not just a Windows Media Player. The following three parts of the Windows Media technology are extremely important for WebCCTV:

- Windows Media Software Infrastructure.
- Windows Media Video Container Format.
- Windows Media Compression Algorithm or Codec.

It is important that you understand the difference between those three parts before you can understand how they benefit the WebCCTV product. That is why this white paper starts with a short general introduction on video technology. If you are familiar with digital video, feel free to skip the next section.

You should read this document if you are thinking about integrating WebCCTV in your application, if you can offer interesting add-ons to WebCCTV, if you have special feature requests or if you just want to know more about your WebCCTV system.

WebCCTV is a product from Quadrox NV. Windows, Windows Media and DirectShow are trademarks from Microsoft.

Video basics

Uncompressed digital video consists of a series of digital images that, if displayed in quick succession on a computer screen, give the impression of a moving image. Each digital image is an array of image points, called pixels, which are just numbers representing the brightness and color of that particular point.

Time
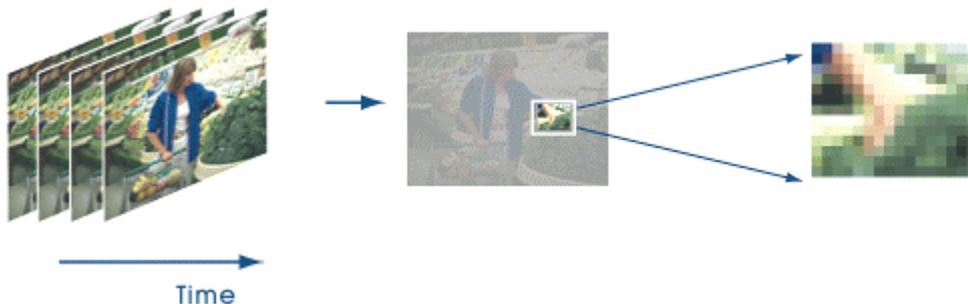
You will understand that with more than 300,000 pixels per image (depending on the resolution), a couple of bytes per pixel and 25 images per second, digital video constitutes a huge amount of data that needs to be stored or transmitted over the network. In fact, video is one of the most data-intensive applications in modern computing. That is why it is important to have a good

compression algorithm and a good infrastructure to support such data flows. Windows Media provides both, as you will find out in this document.

Luckily, digital video can be represented with fewer bits by using a mathematical compression algorithm. This algorithm is often referred to as a codec – short for compressor/decompressor. It works by representing the video data in a different way and retaining only that information that is relevant to the human eye. The result is a complex data structure, which can only be visualized after decompressing it to its original form.
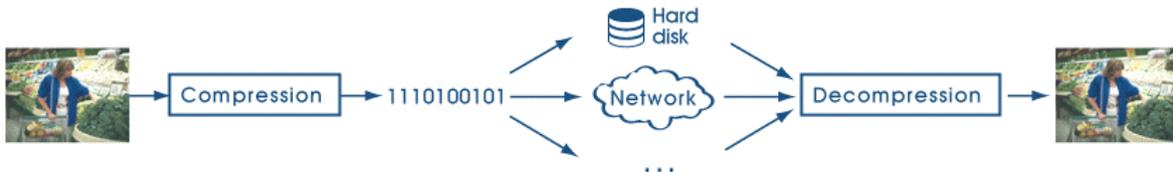
Not every codec is the same. Some algorithms manage to select the most relevant information better than others, resulting in a better visual quality for the same data size. Also different implementations of the same algorithm differ greatly in quality, speed and performance. For instance, many implementations of the popular MPEG-4 algorithm exist, but only a few of them will give you the quality that matches the hype.

After applying a codec to digital video, you end up with raw compressed data. This data is stored in a special file format, called video container that takes into account its special properties. It is crucial that you understand that the container – or file format – is not the same as the video data itself. Consider it as the map in which you store your paperwork.
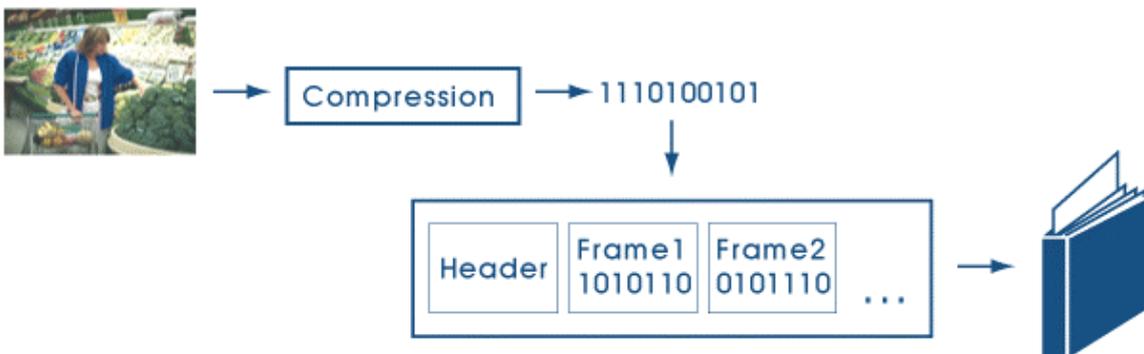
The choice of container does not affect the visual quality of the video. However it provides facilities for handling the video data more easily. (It is easier to find your papers in neat file dividers with pages than in a shoebox).

As another analogy, we can consider text files. Although the content of the text in a .txt file and in a .doc file can be exactly the same, in the .doc file (generated in Microsoft Word) you will be able to store layouts, tables, etc, which will make your text easier to read and navigate and just nicer to look at.

Similarly, the different video containers offer different facilities to the application that works with them. Video file formats differ in popularity (which influences the amount of players that support

it), quick random access to the data and robustness against failure and file corruption. It is important that you choose the file format that best suites your needs, especially in the security industry.

Apart from a good compression codec and a nice file format to store the data in, you also need a good application to work with video. Returning to our analogy with text, Microsoft Word offers more tools for editing your text than Notepad does, so it is much easier to work with.

If you are working with video, you also need good tools. Any video application – from the simplest player to the most complex video recorder – benefits greatly from using a good framework that takes care of handling the file format (storing, transmitting and retrieving the data), the compression algorithms and the data that results from it. Windows Media offers such a framework, as you will find out in the next paragraph.

Windows Media Infrastructure

Microsoft has developed an extensive framework to work with digital video. Developers can use this software infrastructure to produce cost efficient video applications quickly and reliably. Although Microsoft offers its own media formats (codec and file format) with Windows Media, the architecture is not limited to those. It can handle any format of streaming data, including any video or audio format that you will ever encounter.

The video infrastructure in the Microsoft products can be divided into two distinct parts: the **Windows Media Format SDK** (Software Development Kit) and **the DirectShow** (streaming media architecture), which is a part of the DirectX development platform.

The **Windows Media** F**ormat SDK** helps developers to work with Windows Media content: the files (you will read about ASF in the next section), the codecs (the Windows Media codec is discussed in the section after that), etc.
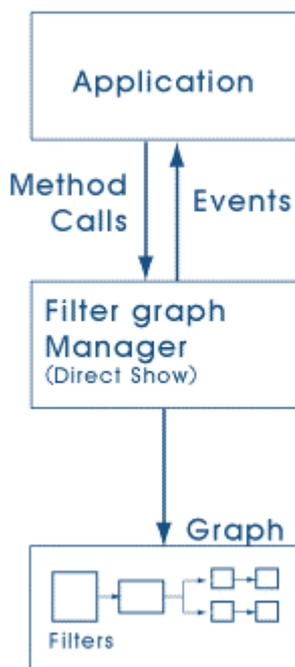
DirectShow is not technically a part of Windows Media, but both are closely related. Direct Show is the basis of the software architecture. It provides a general infrastructure to work with streaming data like audio and video. DirectShow uses the Windows Media Format SDK for some of its lower-level functions, and some DirectShow filters are included in the Windows Media Format SDK rather than in DirectShow itself.

The building block of DirectShow is a software component called a filter. A filter is a software component that performs some operation on a multimedia stream. For example, DirectShow filters can read files, get video from a video capture device, decode various stream formats, such as video encoded with Windows Media or pass data to the video card for visualization.

In DirectShow, an application performs any task by connecting chains of filters together. A set of connected filters is called a filter graph.

DirectShow also offers high-level software components that allow the developer to manipulate the graph (e.g. stop or start the video stream).

This graph-filter structure simplifies the software program by isolating applications from the complexities of data transports (e.g. memory management), hardware differences, and synchronization between different streams. You can simply describe the total functionality as a flow of images through the different filters, like a car moving through a factory assembly line. This makes functionality easy to implement and maintain. Since working with the DirectShow architecture is not difficult, plug-ins can be made and added to the software without problems or delays.

In the WebCCTV products, we have different graphs for live streaming, recording, etc. As an example of the power of DirectShow, we can look at the recording graph pictured below. It basically contains three filters. The source of the video is the capture filter, which abstracts the real source of the video, whether it is a network camera, a capture board for analog video or a network video server. At the other end, we have the writer filter, which takes care of writing the video into ASF files in such a way that they can be easily managed and retrieved afterwards. In the middle, there is a plug-in: the activity detection filter. The video runs through it unaltered, but the filter processes it to calculate activity in the image. The activity detection filter then effectively controls the recording process, so that only meaningful video is recorded.

As you can see, DirectShow helps us to keep the program simple and easy to handle. At the same time the activity detection filter can be easily replaced with a different filter or another functionality altogether in a matter of minutes.
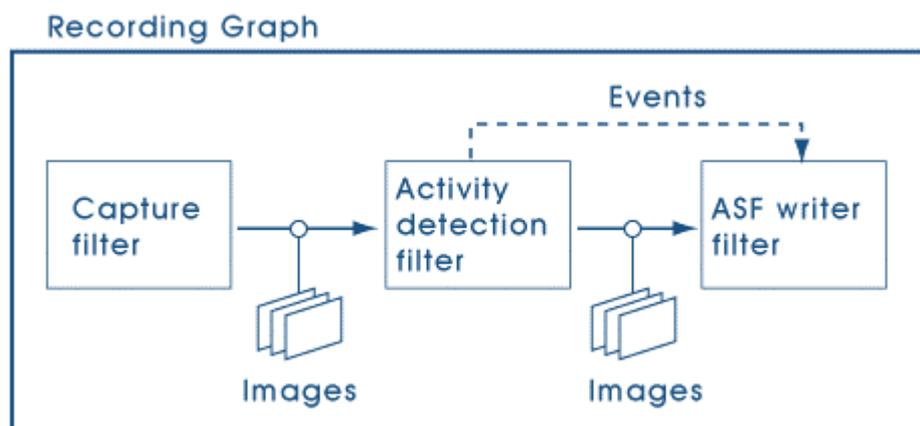
Windows Media container: ASF

The file format – or video container – used by Windows Media is the Advanced Systems Format, or ASF. Microsoft defines it as "an extensible file format designed to store synchronized multimedia data". It supports data delivery over a wide variety of networks and protocols while still proving suitable for local playback. For all practical applications, it can be considered as the successor of the AVI, the well-known previous video container from Microsoft.

In fact, Microsoft provides three file formats for multimedia data, which are all very similar to each other: ASF, WMV and WMA. The latter two are limited to containing only data that is compressed using the Windows Media codecs. Additionally WMA can contain only audio data.

ASF however can contain all types of multimedia data, no matter its form or origin. For example, popular compression formats like (motion) JPEG and MPEG-4 can be stored in ASF files without a problem. This makes it a very versatile and flexible container format.

ASF is an open format. Not only did Microsoft publish an SDK to work with it, but also the specification of the format is freely available on the Microsoft website[1]. Any software developer can use the SDK and specification to make an application that uses this format, on any platform or operating system. As a result, most popular video players on the market today support ASF files.

Another advantage of using an open format is that you can not only play the WebCCTV recorded files anywhere, but also process them without knowledge of the internal working or protocols of WebCCTV. You do not need an SDK from Quadrox to work with our files. This is useful if you want to extract information (e.g. a still picture from part of the image), enhance the images, do calculations on them or any other form of processing, whether you are a software integrator, a developer of video algorithms or a forensic expert of the police department.

ASF is designed for video streaming over networks, as well as local playback on a computer. This is a major improvement over its predecessor, AVI. An AVI file needs to be fully available (e.g. downloaded) before you can play it. This means that if the transmission – over a network or to a hard disk – is interrupted for any reason, the file will be corrupted and you will not be able to play it back.

Because an ASF file or stream does not need to be complete before you start to play it, any corruption that may occur will not affect the entire file. This is a great advancement in robustness against slow and unreliable networks like the Internet, but also against e.g. sudden power interruptions at the video recorder side. It also reduces the delay before you can see video.

Additionally, ASF has provisions for advanced streaming features that provide you with the highest quality of service (QoS), like multi-bit-rate video for instance. It also has the ability to store metadata, index and script commands, and other types of information. The file container supports files as large as 17 million terabytes.

All of this gives Quadrox the opportunity to provide you with robust recording, easily usable video and advanced features in the WebCCTV recording software.

Windows Media codec: WMV

Finally, Windows Media also provides its own compression algorithm (codec): the Windows Media Video Codec, or WMV. The current codec version is WMV-9

Although many video recorders in the marketplace focus on the codec, it is in fact the least important of the three aspects you can read about in this white paper.

1. http://www.microsoft.com/windows/windowsmedia/format/asfspec.aspx

At Quadrox, we try to avoid (re-)compression of digital video coming from network cameras, since this can only lead to a degradation of quality as it affects the overall performance of the system due to the CPU-intensive nature of video processing. As you will see, in some circumstances the selection of a good video codec can provide higher quality results.

WMV codec is delivered by default with every Windows Media Player. And as you know, Windows Media Player is available on every machine with the Windows operating system, which comprise over 90% of all desktop computers in the market. As a result, movies that are exported in WMV are playable on virtually any machine in the field. Also many standalone video players like DVD players nowadays allow WMV video to be played on televisions and other home or office devices.

WMV codec offers high quality video at moderate bit rates (file size). In independent tests it compares very well against the top codecs on the market (e.g. DivX MPEG-4) – it depends on the tester as to which codec is considered to yield the better quality - and it outclasses older codecs by far.

Conclusion

Quadrox WebCCTV product range uses the framework that Microsoft provides extensively for working with digital video: the Windows Media suite and the DirectShow architecture. This benefit provides you with a sound, reliable solution with a clean, effective and open architecture, built for flexibility and the ability to extend the system easily.

Although WebCCTV uses the current technology provided by Microsoft to its maximum potential, it theoretically does not depend on either the video codec or the video file format. WebCCTV supports all popular codecs available on the market today, including (motion) JPEG and MPEG-4. Quadrox is ready for any new video technology that might arrive, from new compression techniques like H.264 over new file formats to exiting new intelligent video processing algorithms. Your investment in a Quadrox product is futureproof.

Because we use the open Windows Media formats and architectures, it is easy for you to integrate WebCCTV in your Windows application. WebCCTV is built as a middleware, ready to be used in any way you see fit.

Windows Media allows both Quadrox and any third party to easily and efficiently integrate different technologies. It is as easy for Quadrox to incorporate a new filter in WebCCTV, as it is for anyone else to integrate WebCCTV in your application.

If you are only interested in post-processing video, you don't even need a WebCCTV SDK. Since we use ASF as a file format, any third party can handle video files (e.g. the police department forensic experts) without knowledge of the internal working and protocols of WebCCTV.

Unlike many of our competitors that offer proprietary solutions, WebCCTV is based on technology developed by a true technology leader: Microsoft. This company – one of the biggest technology providers on the planet – has made entertainment one of its core businesses and Windows Media is at its basis. Windows Media is a safe technology bet for anyone involved.

Another consequence is that Windows Media now has the highest market penetration of any video system. Windows Media Player is installed on more than 90% of all PCs both at home and in the office. A similar evolution is taking place in the mobile device market. As a result, you can play a video produced by WebCCTV almost anywhere.

At the bottom line, Windows Media provides a strong foundation for such easy to implement (which leads to cost effective), easy to integrate, high quality, open video applications as WebCCTV.