

ARBOUR'S NON TECHNICAL GUIDE TO INTERNET VIDEO

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Preface

Most of Arbour Media's web video clients want to get video on the web without having to worry about the technical details and the costs associated with assembling the needed production resources—in fact, it's the major reason they hire us.

To make clear communication and appropriate choices possible, however, we've found it's helpful to offer clients an overview of video production for the web and some basic information on the problems and challenges of delivering video via the internet.

A lot of online information on web video is provided by companies that have stake in selling specific products and services, and so that information sometimes has a commercial bias.

At Arbour Media we are devoted to finding solutions that best suit our client's needs, not selling third-party software or services.

Generally, we look for the lowest-cost, highest-quality, and most easily maintained web broadcast solution capable of doing what a client requires. The information provided in this guide reflects that perspective.

This guide is intended for those who need a non-technical overview of issues related to distributing video on the web. Our guide to video production, available separately, provides addresses more general issues that are common to all motion picture production no matter how the finished programme will be distributed.

My hope is that once you've read this guide, you'll be able to ask good questions of any vendor you might approach about providing video via the internet.

Each section of this guide is followed by a set of questions any potential web video producer or production company should be able to answer. Key terms or buzzwords you are apt to hear bandied about appear in **bold**.

If you have questions or comments, please don't hesitate to contact me at Arbour Media.

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Video Via the Internet

The video files that are produced by the digital video cameras generally used to produce web video are large, so large that there is no way to distribute them via the internet in full, original quality form so that they can be played on demand.

In order to be delivered on demand via the web, the video files that result from the **production** and **postproduction** processes must be **compressed** to make them small enough that on-demand viewing is practical. Video file compression is accomplished by using a computer application to reduce the size of original video files. Compression software encodes the files so they can be decoded or by a video player capable of interpreting the code used.

The codes used used to compress video are referred to as **codecs** (short for **compression** and **decompression**). Some codecs are propriety and require the payment of a license fee (often included in the purchase price compression software) for their use and others are free or open source.

It is the way in which video will ultimately be delivered via the internet that determines the degree and kind of compression used. There are three basic ways to distribute video via the internet: **streaming**, **download**, and **progressive download**.

Streaming Video

When the streaming method is employed, an audience member is connected to a dedicated video sever via a stand-alone video player application or a video player that is **embedded** in a web page. Examples of stand-alone video

players are Microsoft's Windows Media Player and Apple's QuickTime Player both of which can also be embedded in web pages.

Using the streaming method allows users to begin watching almost as soon as they make a connection to a video server. Video data is sent to the user in a more or less constant stream and is played as it arrives. No video data is downloaded to be stored permanently on a user's computer. A nice feature of streaming is that the user can move through the video as it is playing ahead or backwards to skip over or repeat portions of the program fairly quickly. The streaming method can also be used to broadcast live events.

Because it requires a dedicated server with sufficient **bandwidth** to support many video-sized internet connections, the streaming method can be an expensive option. It requires that you either manage your own streaming server or subscribe to a streaming server hosting plan.

Video Download

When the download method is used, an audience member accesses a video file by clicking on a direct link to it on a web page. The browser then initiates a download of the file to user's storage device via standard web file-transfer protocols. Once the file is downloaded, the user can open the video with a stand-alone player and watch the video.

The major disadvantage of the download method is that a user has to wait for the file download to complete in order to view the video. Once the file is downloaded the user has a copy of it, a circumstance that opens the door to piracy and reuse of the video. Advantages of the download method are that it requires no special server and can be used to provide very

high quality videos because files delivered this way can have comparatively high playback data rates.

Progressive Download

If video is properly compressed, the progressive download method provides a good simulation of video streaming without the need for maintaining a dedicated streaming server. It's the method used by YouTube and by which the bulk of web video is now delivered.

During a progressive download, an audience member accesses a video using a browser-based media player that initiates the download of a video file from a web server. When enough of the file is downloaded, the player automatically begins to play the video. As long as the user's internet connection allows the download of data just a bit faster than the rate at which the video is played, the video will play through to the end without interruption.

As with the download method, the major advantage of using progressive download to deliver video is that no special video server is required. Your video files can be hosted on the same server as your web files which helps reduce hosting costs.

Because the video is cached on the computer, being used to play it, however, it is possible for a user to retain a copy of the file. Users can only move forward or backward through the portion of the program that has been downloaded.

Questions to Ask Vendors About Video Distribution Via the Internet

1. How will video be provided to users? Will streaming or progressive download be used?
2. Will my web server be used to host my video?
3. Who will have responsibility for uploading and maintaining finished video files? My web group or your firm?
4. Who will work with me to design and develop the pages that will host video on my existing web site? If some doesn't work, who do I call?

Image, Audio & Playback Quality

If you've spent much time looking at video on YouTube, Vimeo, or similar web video sites, you will have noticed that there is a wide variation of image and audio quality. Some seem fuzzy with audio that sounds like it's originating from the bottom of a bottle, while others are in sharp focus with audio of CD-like crispness.

The overall image and audio quality of web video depends primarily on two factors: the quality of the original video and audio, and the way in which the original video was compressed for use on the web.

Compressing digital video files always removes some information from them, including image and audio information. A compressed video file will never look any better than the original. If the initial quality of the video and audio are poor the compressed versions will be poorer, sometimes markedly so.

The higher the quality the original video and audio recording the higher the quality of a compressed video can be.

A lot of the fuzzy video on YouTube is a result of the fact the original footage was shot on a low-resolution camcorder. The images produced by camcorders have gotten to be so good lately, however, that camera image quality is less of a problem than it used to be.

Of course video files don't have to come from a camcorder. Some are captured from broadcast by a VCR, **DVR** (digital video recorder) or similar device. Some are captured with a computer via a TV-tuner video card, a web cam, or on-board camera. Some start life on a cell phone or other portable device. Some are "ripped" from DVDs with software applications like DVDSHrink or Handbrake.

When video originates from one of these sources, it is often in an significantly compressed format that does not re-compress very well. Consequently, when such files are used to create a program intended for viewing via the internet, image and audio quality may suffer. In some circumstances it is possible to **transcode** one compressed digital video format into another, a process that can add time and expense to a internet video project.

If the only source for a video you have is an analogue Beta, VHS, VHS-C, or VHS-S tape made years ago, it can be **digitized**, but that process will not improve the overall quality of the images without significant post-production work which is not part of the normal compression process.

i & p

Before the development of digital video, all video was analogue. A detailed discussion of the differences between analogue and digital video is outside the scope of this guide, but there is an aspect of the difference that often has an impact on online video quality.

Analogue video was displayed on a **cathode ray tube**, or **CRT**, in which a beam of electrons was shot at a phosphorescent surface—the TV screen—to create a distinctive glowing image. The beam drew a line from left to

right across the screen 480 times (in the US), each new line drawn below the last from the upper left corner of the screen to the bottom right corner of the screen.

The American inventor of TV, Philo T. Farnsworth, grew up doing farm work, and perhaps got the idea for scanning electrons across a screen by watching plowing tractors move back and forth across fields from one corner to the next.

Owing to certain early technical limitations, it was necessary to draw the TV image in two passes across the screen. In the first pass the 240 odd-numbered rows were drawn. The 240 even-numbered rows were drawn in the second pass. The two passes, or **fields**, together made up a full **frame** of video. The system of drawing a full frame of video in two passes is called **interlaced** video. **480i** refers to 480 lines of video information interlaced.

By the time personal computers were developed in the late 1970s, it had become possible to draw the lines of video information one after the other in what's called **progressive** video. **720p**, for example, refers to 720 lines displayed one after the other. Video displayed on a typical personal computer is progressive video.

The difference between interlaced and progressive video has an impact on online video quality because the the display on interlaced video on a progressive screen results in various image defects, often called **artifacts**, that appear as lines in the image.

Such artifacts can be eliminated for the the most part by properly de-interlacing video during compression for the internet.

SD & HD

Technically, high definition, or HD, video is any video with a resolution greater than 480i which was standard definition, or SD video in the United States.

Video can be presented online in HD. YouTube and Vimeo have been offering users the capacity to display HD video for some time and YouTube says it's how their preferred format for video uploads. HD video online is generally 720p.

The best way to get good quality HD video online is to start with files in HD format. While transcoding SD to HD is possible it can be an expensive and time-consuming process.

Video Originating from Film

If you have motion pictures in some kind of film format—8mm, Super8mm, 16mm, 35mm or any one of a number of wide screen formats—they can be transferred to video in a process known as **telecine** which requires special equipment. It is a process that also requires significant technical expertise to do well, and is not considered part of the normal internet video production process. A project that requires telecine will take longer and will be more expensive.

To get the best results when compressing video created from a telecine process, one needs the highest quality video possible.

It is important to keep in mind that the telecine process, in and of itself, will not improve the quality of the original film images. Over-exposed Super8mm of a 1960s birthday party will still look over exposed on video and any defects resulting from film

stock decay, or dust or scratches on or in the film will be present.

However, once one has film in a digital format it is possible to have it undergo a frame-by-frame **digital restoration**. This is a process that requires technical expertise and aesthetic judgement and, depending on the length of the film, a great deal of time to complete.

The Impact of Data Rate On Image and Audio Quality

When video is compressed, a playback **data rate** must be set. The data rate is the expected rate at which video data will be fed to the media player during playback. Faster internet connections allow high data rates, slower connections require slow data rates. Video files with high data rates are generally larger than files with lower data rates.

If a user attempts to play a video with high data rate over a slow internet connection, the quality of playback is affected—the video player will have to stop playing as it waits for more data.

High quality on-demand video playback via progressive download has become practical only as people have gained access to high-speed (also called **broadband**) connections to the internet that allow high data rates, a comparatively recent development in the developed world including the United States.

The choice of data rate is made based on assumptions about the speed of the internet connection viewers will be using. Generally, and especially for video intended for progressive

download, the best data rate is the slowest data rate that will preserve the image quality desired.

If the data rate is set too low during compression, the quality of the image is affected. Low data rate video has a characteristic chunky/fuzzy look. Poor choices about compression are the major cause of poor image quality in web video.

Finding the data rate that's just right for a specific video and web host can require some experimentation. Because it takes time, such experimentation can add to production costs.

Major web video services like YouTube and Video provide specific guidance about how video should be compressed for optimal playback quality which helps to take some of the guesswork out of the compression process.

What's been said about video quality also applies to audio quality. Audio data rates are set separately from video data rates during compression. Bottom-of-the-bottle audio quality is often the result of audio data rates being set low.

Viewers will tolerate poor image quality more than poor audio quality, so if a choice has to be made between the two, it's generally better to optimize audio over video quality.

Codecs and Compression Software

The quality of a video also depends on the **codec** used to compress it. There are dozens of different video and audio compression codecs, and a complete discussion of them is outside the scope of this guide. What's important to know is that different codecs produce different videos of differing quality and some are more suited than others for certain kinds

of videos and specific applications or specific platforms and operating systems.

One big difference between codecs is how well they handle compressing videos that contain lots of motion, like sports events, versus videos that don't, such as extended interviews with "talking heads." For best quality, compression settings do sometimes need to be tailored to subject matter.

Some inexpensive or free consumer-oriented compression software limits control of data rates and other compression variables. Higher-end compression software allows more control over the compression process and overall video and audio quality. Some codecs are proprietary and require licensing to use them—for compression and/or broadcast—and that's one factor in the cost of compression software.

Much of the chunky/fuzzy bad audio videos you see on sites like YouTube, Vimeo, or Facebook is due to poor choices about compression, or compression done with consumer-level software that does not allow changing settings in a way that would produce the best quality.

Internet Connection Speed

Regardless of what internet service providers promise their customers, there can be a great deal of variation in viewers' internet connection speeds (in fact, few ISPs will absolutely guarantee their customers any specific connection speed 27/4).

Variations in connection speed means that for some number of viewers there will be times when the data rate of a video they want to watch will be mis-matched to their connection and the quality of video playback affected.

Some media players have the capacity to automatically detect a user's internet connection speed and show a version of a video that's been compressed with an appropriate data rate. As long as the users' internet connection speed does not change drastically once the video begins playing, auto detection can help ensure that viewers will see your video at the best quality possible.

Another way to cope with the effects varying connection speeds is to allow users to choose the version of a video that works best for them. YouTube currently lets viewers select from available data rates with a popup menu in the lower right corner of the YouTube video player.

Offering different versions of a video to match different ranges of internet connection speeds can add to production costs because it takes more time to create them than it takes to create one version. Using multiple versions of one video requires more storage space and it can be a chore to keep track of many versions of the same video. Your web host may also charge you extra for the storage of many large files.

The Viewer's Computer Matters Too

Issues with internet video quality may have nothing at all to do with the way a file has been compressed or internet connection speed.

Sometimes the processing power of the computer being used to view the video may be the problem. Older, slower computers may not be capable of playing back web video as intended.

Compressing Video Properly Takes Time

One thing that's important to understand about compressing video for the internet is that it takes time and computing power to do. Alas, there is no magic shrink ray for video.

For example, depending on the amount of movement in the video and the speed of the computer used to do the compression, compressing a 7 minute video originated in HDV can take 2 hours to compress for online use. While the compression is going on the computer is difficult to use for other purposes. For this reason, many video production companies have to maintain fast computers and servers dedicated to compression tasks, and of course there is an associated overhead cost.

A potential stumbling block for smaller businesses considering in-house production of lots of online video are workflow issues related to the time required to regularly do compression while maintaining desired video quality and maintaining necessary staff expertise.

Questions to Ask Vendors About Image & Audio Quality

1. How do you intend to compress the video that will appear on my site?
2. Will you or can you provide different versions of my videos suit to different user internet connection speeds?
3. Will the finished videos you provide play properly on the average user's computer?
4. Are the codecs you'll be using to compress my video compatible with all web browsers and platforms?
5. Are you capable of transcoding one format to another?
6. Can you support an HD workflow?
7. I have video on Beta/VHS-S/VHS/VHS-C I'd like to get online? Can you digitize those tapes? What extra charges would that service incur?

Video in Web Browsers

People who view video on a website are using a media player running as a browser extension or plug-in which allows the player and video to be **embedded** in a web page.

Commonly used embedded media players are Microsoft's Windows Media Player, Apple's QuickTime Media Player, and players created using **Adobe Flash** or Java. Of these Flash-based players are by far the most commonly used.

There are a number of reasons why Flash players came to dominate web video. A full enumeration of those reasons is outside the scope of this guide, but a couple are important to mention.

First, because Flash works across different operating systems and platforms and is installed by many, video players created with Flash will work for the majority of web users, greatly simplifying problems related to video compression.

Second, Flash supports a number of good video compression codecs including one called **.H264** used applications from cell phones to HDTV broadcast and which works well at many data rates.

Third, video players created with Flash can be developed to interact with web pages in a variety of ways which provide web designers with wide range of design choices for supporting video.

Until fairly recently, YouTube used only its own Flash-based player, as did Vimeo.

Open Source Flash Video Players

One major potential drawback to the using of Flash-based players is that developing a player requires Flash programming expertise. Building a custom Flash-based player from scratch can be an expensive proposition.

Fortunately, there are very good **open source** Flash players available which greatly simplify the task of embedding video in web pages. Examples of such open source players are **JW Player** and **Flowplayer**.

Its makers claim that JW Player is “the Internet's most popular and flexible media player.” JW is very widely used and has been well tested. There are a variety plug-ins available which extend the player’s functionality and it can be used with Javascript to make the player interact with webpages. Flowplayer is a competing open source that offers the same features as JW Player.

Both JW Player and Flowplayer are free for non-commercial use, but require payment of a license fee if either is used on a website designed to generate revenue. The fees are modest compared with the full development cost of a proprietary Flash-based video player.

Both JW Player and Flowplayer are compatible with software that allows the delivery of **pre-roll**, **mid-roll**, and **post-roll** ads from ad servers, and the delivery of **overlay ads**.

iPhones, iTouches, iPads & Flash

Apple Computer’s widely used iPhone, iTouch, and iPad do not support Flash. Websites that need to provide video on these

devices must do so via the QuickTime Media Player or HTML 5 video.

On the Horizon: HTML 5 Video

HTML stands for Hypertext Markup Language which is the code which is interpreted by web browsers to render web pages. Since it first came into use, HTML has been through several revisions which have expanded what it can be used to do. HTML 5 is the latest proposed version.

HTML 5 includes means for video playback within a web page independent of any media player plug-in, and promises, in time, to greatly simplify the task of using video on web pages.

Currently (circa May 2011) HTML 5 video is supported by the latest browsers, including Internet Explorer 9.0+, Apple’s Safari 3.0+, Firefox 3.5+, Chrome 3.0+, Opera 10.5+. It can also be used with Apple’s iOS that runs on iPhones and iPads, and the Android operating system.

Unfortunately, there is no single video codec that works in all HTML 5 video-capable browsers. This means that to make video available via HTML 5 to most possible viewers, web pages need to be coded to provide a compatible video file for browser being used as well an alternative “fallback” player for browsers that don’t support HTML 5 video. So, for now, using HTML 5 requires creating multiple compressed versions of the same video.

Both YouTube and Vimeo are currently offering their users a choice between viewing video via an HTML 5-based media player and viewing video with a Flash-based player.

There are a number potential advantages to using HTML5 video.

HTML 5 video does not require a user to download and install proprietary plug-ins, an issue for some. Using Javascript and HTML 5 alone it is possible to create a video player that looks and behaves like any other media player. Indeed, web designers can easily develop players to closely match the look and feel of a site—no Flash coding expertise needed.

Until recently, an argument against adopting HTML 5 has been that there are no well-developed advertising servers that will work with it. In recent months, however, that situation has changed. A number of online ad service companies now offer ways to integrate ads into HTML 5 video players.

Questions to Ask Vendors About Video and Web Browsers

1. What kind of video player will be used to play my finished videos? Will its use require payment of any licensing fees? What period do the fees cover?
2. Will the video player you recommend play properly in all browsers and computer platforms?
3. Will my finished videos playback on iPhones and iPads?
4. Does the player you are recommending require display of ads before, during, or after the video plays?
5. Does the player you are recommending support display of advertising? Will the player lock me into specific ad serving technology, or a specific ad server platform?

Serving Web Video

When you type a web address into your web browser, it sends a request to another computer to serve up the data you want. Not surprisingly the computer handling your request is called a **server**. The computer program that allows the server/computer to respond to your request is also often called a server.

As noted above, when using the download or progressive download method of providing video, video files can be provided from a basic HTTP (Hypertext Transfer Protocol) server—the same type server that provides web page data. Full streaming video requires a specialized video server.

For organizations that have just a few videos to provide to a relatively small audience, serving video files from their existing web server via progressive download is a good choice.

For organizations that have many videos to reliably serve to large audiences, streaming videos from a dedicated streaming server may be a better choice than progressive download.

Video Bandwidth

You will have perhaps observed that when there are just a few cars on the road, traffic moves efficiently. As traffic picks up, it moves less efficiently, ultimately slowing. If traffic gets really bad it slows to a crawl, forming a traffic jam. How quickly traffic starts to slow depends on the size of the road and vehicles as well as on the number of vehicles traveling.

To greatly oversimplify a complex subject, one can say that data traffic on the web behaves like road traffic. Just as the

total capacity of a road can be measured as cars passing a point over time, the size of an internet connection is measured in **bandwidth**—the amount of data that pass through it over time.

Video files are large, and because they are large they can require a large amount of bandwidth. If you have a video file that is 15MB viewed once in its entirety it uses 15MB of bandwidth. If the video is viewed 10 times in a day, it takes up 150MB a day. If it's viewed 10 times a day for a month, it takes up about 4.5GB of bandwidth a month. If you have 10 such files, your site would be using 45GB of bandwidth a month.

If your web host provides web hosting from shared servers, as many do, the bandwidth demands may effect the availability of your video at certain times. A **shared server** is a web server that simultaneously hosts a number of web sites from the same computer. This means that the server will share available bandwidth among several websites. High traffic on those other sites can limit the availability of bandwidth for yours and video playback via progressive download.

Because they can cause a decline in the performance of servers, high bandwidth sites—like those hosting video—can cause headaches for web hosting providers. For this reason, many ISPs charge more for hosting sites that require more bandwidth. (even web hosts that promise “unlimited bandwidth” warn their customers the promise really means “reasonably” unlimited).

Some web hosts may place a limit on monthly bandwidth and either charge an overage fee for sites exceeding it or restrict access to the site.

Before making decisions about whether to host video and number and size of video to host at any one time, it's important to consider issues related to server bandwidth.

Video Storage

Because video files are large, they also require more server storage space than typical web files. If you only need to host single versions of a few video files, storage is not likely to be an issue.

If you need store many versions of many different videos, your site may require a great deal of storage for which some web hosts may charge extra fees.

Video Server Shared Hosting

If you want to ensure nearly instantaneous 24/7 availability of your videos in high quality, if you have many videos that are expected to have large audiences, or if you want to provide live video you will have to use a dedicated video server.

Just as there are firms that provide shared web hosting, there are a number of firms that provide shared video hosting. There are dozens of such companies that you can find by search for "streaming video hosts."

Some of these firms just provide a media server to which you upload your video files and connect to them with an appropriate media player of your choice.

Other firms go a bit further and provide what they call a complete video platform which includes customizable proprietary media players you can use on your website, video

encoding services and/or software, and video file management services. Examples of such firms are Brightcove, BitGravity, thePlatform, and SublimeVideo HTML5 Video Player Service. The services such firms offer are aimed at large companies with lots of video to host for large audiences and they are not inexpensive by small business standards.

The YouTube Option

Because YouTube allows you to post any number of videos makes those videos available to a global audience without the hassle of managing video on your server, you might wonder why you shouldn't just upload your video to YouTube and allow your audience to view it from there.

Given the fact that YouTube is nearly synonymous with web video, allows users to easily embed videos in their own websites, makes it easy to find video with an excellent search capacity, and permits the creation of customized user channels, it isn't a bad option for hosting web video. It's certainly hard to be the price. Vimeo provides many of the same services for little or no cost, as do a handful of other video sharing sites.

There are, however, some limitations to using YouTube as your video host that you should consider.

First, YouTube imposes length and size restrictions on video uploads. Currently (circa May 2011) YouTube requires that videos be 15 minutes or less in length and under 2GB in size. These limits are not draconian. It's possible to produce video that will be a very high quality within these limits.

One issue that is important to understand when creating video for YouTube is that YouTube automatically re-compresses uploaded videos to create versions suitable for different

internet connection speeds. The way in which video is re-compressed by YouTube is solely under its control. This means that when you upload video to YouTube you give up some control over the quality of the finished video for some viewers.

YouTube does provide good guidelines about how to compress video for its service, but these may not produce a quality of audio and video you want to present.

A second limitation is that uploading a video to YouTube requires you or your business to be bound by their terms of service and these might not be consistent with your business objectives. Some commercial uses are specifically prohibited by YouTube's user agreement.

Third, your video will appear with advertising that you will have no control over.

Fourth, when embedding your videos on your website with YouTube's player, you have to accept the player as is. You cannot modify it to suit your needs.

Fifth, when you upload your content to YouTube, you agree, according to its terms of service, to

grant YouTube a worldwide, non-exclusive, royalty-free, sub-licensable and transferable license to use, reproduce, distribute, prepare derivative works of, display, and perform the Content in connection with the Service and YouTube's (and its successors' and affiliates') business, including without limitation for promoting and redistributing part or all of the Service (and derivative works thereof) in any media formats and through any media channels. You also hereby grant each user of the Service a non-exclusive license to access your Content through the Service, and to use, reproduce, distribute, display and perform such Content as

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if these terms are incompatible with your business objectives, you should not upload video content to YouTube.

Questions to Ask Vendors About Serving Web Video

1. Can you tell me how much bandwidth my videos will require in an average month based on a given number of views?
2. What kind of video host would you recommend? Why?
3. Which video host would you recommend? Why?