

Delivering Digital Media: Forms and Formats.

A guide to size, format, dimensions, codecs and technical specifications associated with common delivery forms for digital media.

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Intro

Understanding file formats, codec, compression and digital media delivery is a very complex topic. The first key element to understand is the distinction between 'File Formats' and 'CODECS'. They are very often confused or treated as one and the same and this will invariably lead to video creation and delivery problems.

A CODEC (short for COMpressor/DECompressor) is an algorithm that dictates the manner in which video and audio data will be compressed to save data space whilst maintaining as much quality as possible. The choice of codec will depend on how you wish to deliver your project – the internet, TV, mobile phone, computer or any number of other devices. Examples of common codecs include 'DV', 'H264', 'SORENSEN' and 'DIVX'.

A File Format is the 'wrapper' that houses a codec, controls how the information will be read by the computer and gives the file its suffix that directs such things as what application should be used to open the file. The two most common file formats are AVI and MOV.

For example a QuickTime MOV file might house any one of more than a dozen different codecs; it might be a MOV file using the DV codec for high quality TV video or it might be a MOV file using the SORENSON codec for low quality web-video.

This guide will detail both production and delivery specifications using a range of file formats and codecs for different delivery mechanisms and devices.

It should be noted that whilst all the formats described here are

commonly used not all the formats listed will be available as rendering options from every editing system. Many codecs require specific plug-ins or separate applications to your editing system – most notably QuickTime, which will provide all the codecs housed in the MOV file format and Windows Media Player which will provide WMV and WMA formats. MP3, MP4 and MPEG2 codecs very often come supplied with your editing software package. There are also a number of free software utilities for converting file formats such as SUPER and VirtualDub. You will need to ensure you have software tools that have the ability to create the file formats you require for delivering your product.

Deliver content on TV via DVD.

Delivery of video projects on TV requires the highest quality media as the large screen size will make any compression artefacts or pixilation highly noticeable. TV delivery also has some specific traits that make it distinctly different from computer or digital devices.

Delivery media summary:

Video frame size: 720x576

Frame Rate: 25fps

Codec: MPEG2

File format: MPG or M2T

Audio: Uncompressed 48khz 16bit Stereo or Mpeg layer 2 Audio

Production:

PAL TV has a specific and unchangeable frame size, uses rectangular pixels (meaning the individual pixels are wider than they are high rather than square as they are on a computer) and has an interlaced image where the complete image frame is created by two sets of horizontal lines (known as fields) alternately displayed.

Project settings in the video editing system should be set to in accordance with these. Generally this will simply involve choosing a preset PAL DV template with a frame of 720x576, a frame rate of 25fps, interlaced fields (lower field first) and a pixel aspect ratio of 1.093. For widescreen PAL video the resolution is the same but the pixel aspect ratio changes to 1.457.

Video footage to be used for a project destined for TV delivery should be in standard PAL DV either as AVI or MOV file format using the standard DV codec. Video from non-DV sources such as mobile phones

and video captured from digital still cameras is unsuited to PAL TV delivery as the frame size is generally much smaller and the video heavily compressed from these devices.

DV format audio is a standard specification of 48,000hz (48k) 16bit Stereo. This exceeds CD quality (44.1k 16bit stereo). For PAL TV projects the audio should remain at this spec. If using MP3 audio files in your project ensure that they are recorded at a high bit-rate, (128kbps or better)

Digital photos and specially created images need special consideration in PAL TV projects. Because the PAL format for TV uses rectangular pixels and digital photos use square ones there can be stretching of the image when brought into the editing system and a PAL project. To avoid this digital photos and images can be made to a square pixel size of 768x576 which is equal to 720x576 rectangular pixels. If you need to zoom in on stills or use pan & scan techniques you will need your images to be larger than this to allow room to scale. Avoid having the digital photos too much larger in frame size than necessary as computer performance will be greatly decreased and render times significantly longer.

Digital stills for PAL TV delivery can be in a wide variety of formats depending on the software being used but JPEG and PNG are the best choice as they will be most efficient. PSD and TIFF depending on the system being used may also be used if transparency alpha channel is required but are far more system intensive.

Delivery: Video for PAL TV has to conform to a specific set of specifications matching the delivery medium, DVD. The DVD format uses just one type of compression, MPEG2. Video should be rendered as PAL 720x576 MPEG2 files. (note MPEG2 files can have either a MPG suffix or an M2T suffix depending on the process and application used. Both will function within a DVD authoring application.)

Depending on your editing software your audio may need to be rendered separately before importing into the DVD authoring application. Whilst the exact audio format for DVD is "Mpeg Layer2 Audio", for best convenience audio can most often be rendered as WAV or AIFF with any final conforming taken care of by your DVD Authoring application.

Delivery on Computer screen

There are a wide range of ways to prepare digital content for viewing on a computer screen. The focus in this case will look at delivering high quality video played back locally from the computer's hard drive (rather than web-based streaming video). This type of delivery can also include videos as part of PowerPoint and other presentations

Delivery media summary:

Video frame size: 640x480

Frame rate: 25fps

Format: MP4 / WMV / MOV

Codec: AVC\H264 / Windows media video

Audio: Uncompressed. 44.1khz 16bit Stereo.

Production:

All video projects look best when the source footage is higher quality and larger frame size (or equal) than the delivery format. In this case for delivering on computer at what is known as VGA size (640x480) best results will be obtained from DV specification footage (720x576).

Many digital still cameras can shoot video clips at 640x480 (known as VGA) which can also work well for this type of delivery, although the image quality and clarity will not be as good as DV. The codec and file format for VGA video can vary widely and some files may not be read by your editing software. However, most commonly VGA video from digital still cameras uses mpeg4 compression in either an AVI format or a QuickTime MOV format. Both these in most cases should be functional in a good editing system.

Sources Audio for projects delivered on computer screen should be in WAV format at CD quality or better (44.1khz 16bit) or MP3 format at a high bitrate (128kbps or better); this will ensure good sound even after final compression for delivery.

It is very often useful to use still images with frame dimensions larger than final image size of delivery. This will allow for room to Zoom in or 'Pan & Scan' animate your still images. Zooming in on images that are not big enough to accommodate the enlargement will result in severely pixelated images. For example in standard definition PAL DV where the frame size is 720x576 your still images should be 800x600 or 1024x768 to accommodate zooming. Be careful however not to make the images too much larger than what is required as this will drain computer power and make render times much longer.

Delivery:

The format options for computer delivery are enormously wide as the computer is the most flexible playback device. However some formats are more common and give better quality than others.

Three of the best choices for computer screen delivery are Windows Media Video, WMV, format using a high bitrate (1mbps or 3mbps) which, as it plays natively in Windows Media Player, is one of the most universal formats available. AVC (advanced video codec) which is also known as H264, which can be output as an MP4 file format or inside QuickTime as MOV.

All three of these formats will produce excellent quality video for playback locally on a computer. It should be noted however that the files sizes will generally be much too large to email, play from a website or even play from a CD – they will generally need to be present on the local hard drive.

If your video is destined to be embedded in a PowerPoint slide show you have two options – create a WMV file which, because it is a native windows file, can be embedded in the slide; or a MP4 file which you can hyperlink to from the PowerPoint slide.

Delivery on Video I-Pod

I-pod requires a particular form of compression and file format to be playable but the screen size of the project can vary greatly from 320x240 to near TV res of 640x480. That said, for efficiency of delivery and download I-Pod video projects should be developed for a smaller than PAL frame size.

Delivery media summary :

Video frame size: 320x20

Frame rate: 30fps

Format: MP4 / MOV

Codec: AVC (H264)

Audio: AAC 96,000bps, 44.1kh, Stereo or Mono.

Production:

Because the screen frame size of the Video I-Pod is much smaller than a TV there is a much greater degree of flexibility and quality latitude in

source material that can be used. Even heavily compressed and/or low quality video can potentially work well rendered out for I-Pod video small screen. That said it is always advisable to use the best quality source material available.

Project settings in your editing software should be set to 320x240, thus working in the same project size that will be delivered. At that size your editing system will be able to show a 1:1 size preview of your project so you see exactly what the viewer will see.

DV footage is your best source and VGA (640x480) will work very. Any video clip 320x240 can potentially be used so long as it is in an editable codec usable in your system employing either the AVI or MOV format. MPEG files (*.MP2, *.MT2 and *.MPEG) may also be useable.

Audio should be as high in quality as possible; WAV or MP3 at 96kbps or better.

Images can be from any format your system will read but JPEG and PNG files are preferable and should not be larger than 640x480 to avoid overly long render times. Be careful of overly complex Pan & Scan animating of still images as the compression and small screen size can detract from image detail.

Delivery:

I-Pod video will require either QuickTime Pro in order to render MOV files using the AVC/H264 codec or an editing system capable of rendering MP4 files using the same AVC/H264 codec. Alternatively you can use the free video rendering software SUPER (www.erightssoft.net) which can convert finished video projects to a wide array of formats including I-pod ready Mp4 using a specific I-Pod template. Similarly QuickTime Pro will provide a direct export template for I-Pod video with only default settings.

If using an editing system that can export MP4 files then the file should be rendered using 'Variable Bitrate' with the 'Average Bitrate' of the video set to 480kbps along with a frame rate of 25fps. These files can be rendered with a frame rate of 30fps but the extra five frames per second adds significant file size without visually improving motion smoothness.

Audio for I-Pod video uses the audio codec version of AVC called AAC and for good quality the setting should be a bitrate of 96kbps or better. Using mono instead of stereo can substantially decrease the file

sizes (and so download time) and for voice-over and dialogue based audio will not seriously diminish viewing experience.

Delivery on the Internet

As with delivery on computer, website delivery offers a wide range of format and codec options but careful attention must be paid to the balance between quality and file size to facilitate easy downloading or streaming. Specs will be detailed here for the creation of web video in two levels of quality/size – Hi and Lo, using the two most common web-video formats.

Delivery media summary :

Video frame size: 320x240 (or widescreen 400x225)

Frame rate: Hi – 30fps. Lo – 15fps

Format: WMV, MP4

Codec: WMV, h.264/AVC (Hi – 768kbps, Lo – 256kbps)

Audio: AAC = Hi – 44.1k 128kbps, Lo – 32k 64kbps / WMV= Lo – 22khz, 16bit mono, Hi – 22khz, 16bit Stereo

Production:

As with all types of heavily compressed video the quality of the final image of web-video will be drastically reduced from the original material. In this regard there are several things to consider in selecting material to use. Firstly, the better quality your original footage is the better quality the output will be so in many ways it is more important to have really good, hi-quality source footage for web video than it is for TV video. Video that is already heavily compressed, such as that from digital still cameras or phone cameras, is already missing a great deal of image data and so when the video is heavily compressed again for the web this miniscule amount of colour and motion information suffers a second time.

The way compression works is to average and groups frames together in what's called a Group Of Pictures (GOP) rather than read each frame individually. Because of this video of subjects that don't move very much and don't have a lot of fast action hold up much better under heavy compression than fast moving images. This is something to keep in mind when producing heavily compressed web-video.

Compression also has a dramatic effect on audio quality and too much compression can make your audio sound like it is playing underwater. Many webvideo producers sacrifice video quality in favour of

maintaining audio quality as being able to hear voice-over and dialogue is often more important than the images themselves.

Images can be from any format your system will read but JPEG and PNG files are preferable and should not be larger than 640x480 to avoid overly long render times. Be careful of overly complex Pan & Scan animating of still images as the compression and small screen size can detract from image detail.

Delivery:

Two of the most common web video formats are Windows Media Video (WMV) and MP4 using the h.264/AVC codec.

For low-bandwidth web-video a frame size of 320x240 can be very effective with a frame rate of 15fps that still looks fairly smooth. For higher-bandwidth 320x240 with up to 30fps can be very functional for broadband connections.

Both h.264/AVC and WMV give a variety of options for bitrate that will dictate quality and file size. h.264/AVC at 256kbps, 15fps and audio using 64kbps will give very skinny video for dial-up connections. For higher quality h.264/AVC at 768kbps, 320x240, 30fps and AAC audio at 96kbps will give good quality at a reasonable download.

With WMV the settings are near identical.

Delivering Audio as Podcast

Audio only projects (or audio only versions) can be delivered as a podcast utilising the compression efficiency of the MP3 format that allows audio files to be up to 1/3 the original file size without a significant loss of audio quality.

Delivery media summary :

Format: MP3

Codec: Mpeg Layer 3 audio. 64kbps Mono or 96kbps mono.

Production:

As with all compressed formats begin with the best quality audio files you have; WAV and AIFF are uncompressed and represent the best quality possible. Sources in *.mp3 can be used but should be of a sample rate of 128kbps or above.

If your podcast project uses a lot of music you may wish to produce the project in stereo but since most podcasts feature human voice, dialogue and voice over, mono is usually sufficient and will greatly reduce the file size.

Delivery:

The longer the project the more compression that will need to be applied to keep the file size reasonable and as such the more the audio quality will be degraded. In light of this many podcasts are produced in sperate parts that users can download individually.

The *.mp3 file format allows for meta-data to be attached to the file that embeds information about the project into the file itself. Known as ID3 tags this information includes the Title, Artists, Album, Copyright information and any comments the creator wants to make about the work; perhaps where it was recorded or how the project was made. Any good audio production software that allows for the creation of *.mp3's will allow you to add and edit ID3 tags.

When rendering *.mp3 files you have a choice of compression schemes that will dictate the balance between quality and file size. The baseline for Podcasts is usually referred to as 'FM Radio Quality' and is 64kbps. 'Near CD quality' is 96kbps and 'CD quality' is 128kbps. All three of these are suitable for Podcasts but for download efficiency 64kbps or 96kbps is the most functional.

Delivery on Mobile Phone

Video capable mobile phones represent one of the most exciting new delivery platforms for digital media. Whilst the screen size is very restricted and file sizes must be kept as small as possible the ubiquitousness of mobile phone usage among the general public means there is a ready and viable delivery platform waiting to be exploited.

Delivery media summary :

Video frame size: 176x144

Frame rate: 15fps

Format: 3gp

Codec: Mpeg4

Audio: 8khz, 12kbps, mono

Production:

Many of the issues associated with compressed web-video are similarly applicable to Mobile Phones; fast moving action will neither compress well nor look effective on very small phone screens. More static imagery and smooth movements between shots will fare much better. Likewise, whilst the 176x144 screen size means the pool of source media you can draw upon is very wide you should always try and use the best source footage possible. PAL DV or even HDV footage shrunk down to 176x144 will look relatively superb.

What will suffer much more than the image on mobiles is audio quality. The recommended 8khz mono is very, very low specification for sound and in producing content for mobiles careful attention must be paid to how much you will use or focus on sound. The tiny audio sample rate and the tinny speaker of a phone means that the dynamic range of the sound (the distance between the softest and loudest sounds) is severely reduced. If your audio track varies greatly between soft and loud parts you may find whole parts of your soundtrack can't be heard at all when compressed to 3GP format. In this regard audio for mobile phone delivery should be produced to be as even and smooth in volume level right the way through the project. Similarly, because of this heavy data compression any noise in the source recordings will be made all the more noticeable and problematic after compression to 3GP, so be sure and use the best quality audio source recordings available.

In making video for phone delivery it is also important to be aware of limitations in the reproduction of text and type elements. Type that works on larger screens will very likely be lost and unreadable on the phone. Simple Sans Serif fonts such as Arial and Tahoma will be clearer and easier to read than Serif fonts like Times New Roman or script-like fonts and the proportion/ratio of the font to screen area should be much greater than would otherwise be used on other delivery devices. Keep fonts larger and clean.

Delivery:

To create files useable on 3G phones you will need an application capable of rendering the appropriate 3G formats, namely 3GPP (3GP). The most common of these is QuickTime Pro, an inexpensive application that is an upgrade to the free QuickTime Player and can be purchased online for all major operating systems. The free alternative is SUPER (www.erightssoft.net) which is a superb tool able to convert video files to a huge range of different formats including mobile phone

ready 3g.

There are a number of different variations on the 3G format, namely 3GP and 3G2. The two systems are nearly identical, each being originally developed respectively for the two major international mobile network standards – GSM and CDMA. 3GP is the appropriate choice for mobile networks in Australia. 3GP uses MPEG4 compression for the video stream and allows for embedded audio at low sample rates. The frame rate of the video can vary but 15fps will provide relatively smooth playback.

Delivery on PSP

One of the most advanced mobile devices for video playback is the Play Station Portable (PSP). The PSP provides one of the brightest and sharpest small screen viewing devices available and the widescreen aspect ratio makes it highly appealing to mobile filmmakers.

Delivery media summary :

Video frame size: 320x240

Frame rate: 25fps

Format: MP4

Codec: AVC/H264 -768kbps (hi quality) 192kbps (lo quality)

Audio: 48k, 128kbps Stereo

(note: specific name protocol and file structure)

Production:

The PSP represents a great balance for production of mobile device movies; on one hand the quality of the screen and the local media playback of the movie allows for a true mobile cinematic experience – on the other, the size of the screen and small amount of compression required allows for source media to be drawn from a wide range of devices -from HDV, through DV, VGA and even smaller; pretty much anything 320x240 and up will look good on PSP. Similarly PSP movies accommodate a much wider latitude for motion and action in video footage than other mobile devices due to the lower rates of compression, higher frame rates and crisp vibrant screen.

It might also be argued that one of the PSP's great strengths is the quality of the audio derived both from the small amount of compression required and from good speakers on the device or headphones. In this regard it is well worth the time creating a quality stereo audio track for a PSP movie.

Project settings in your editing system should be set to match the resolution of your best footage (usually DV 720x576); then when the project is complete it can be conformed to PSP settings. The PSP screen is also natively widescreen so DV Widescreen footage (16:9) or HDV footage translates perfectly to the wide PSP screen which has an aspect ratio of 16:10.

The PSP is primarily a portable game console and as such the screen has particular strengths related to reproducing game graphics. One of these is that text, titles, typeface and fonts can look superbly crisp and vibrant on the PSP, much more so on other similar size mobile devices. This is quality that is well worth exploiting on the PSP.

Delivery:

The PSP delivers a small-screen image of the highest quality and as such you'll want to take advantage of these capabilities with a small amount of video and audio compression to maintain image quality and clarity, this will be dictated by the bitrate. As a trade off however data size of PSP-ready video files can be quite large and most electronic delivery of PSP movies is done by downloading the video in a Zip file package or by direct delivery to the PSP on memory stick. This of course makes delivery of PSP media more problematic than other forms as downloads can be large and direct delivery requires physical transportation of the file to the device.

The other difficulty with PSP video is that the files themselves require a very specific naming protocol and file structure in order to function on the PSP. There are a number of software applications that can do this encoding for you automatically and some which will also directly transfer to a PSP device: 'Sony Vegas' professional editing system has a direct export function to PSP, likewise Sony 'PSP Media Manager' software can provide this functionality. The free alternative is SUPER (www.erightsoft.net) which is can convert to PSP-ready render templates. You can however also make and name the files in the right format manually as well.

The PSP uses AVC\H264 codec in an MP4 file format. Once you have created this file via one of the methods above you will need to rename it to match the PSP's file structure. The file must be named "M4V..." followed by five digit number then the MP4 suffix. For example a video originally called "mymovie.mp4" could be renamed "M4V00010.mp4" to play on PSP. Despite the file being identical except for the name the PSP device won't read the file if its name

doesn't follow this convention.

For transfer to the PSP device itself the MP4 file must be copied into a specific folder on the PSP's formatted memory stick. The folder "MP_ROOT" has a subfolder inside called "100MNV01" and the *.mp4 file must be copied into this location.

Creating Lossless and Master files

The great majority of digital formats for delivery of video content involve lossy compression meaning that image data is thrown away to reduce file size. As result these delivery formats are not really suited for use as a master copy of your project. Formats that do not significantly dispense with image information through compression are known as 'Lossless'.

Delivery media summary:

Video frame size: Same as maximum input resolution

Frame rate: 25fps

Format: MOV, AVI

Codec: QT Component Video, AVI Uncompressed

Audio: 48k 16bit Stereo

Production:

The golden rule when it comes to working with digital video formats and the creation of master lossless files is that your best resolution is that which is the same as your source footage. So if your source was DV then your final project's best quality spec is DV. You cant improve on the source, what you are aiming to do is preserve all the information of the source.

The other reason for creating Lossless master versions, aside from archiving, is when you wish to work across different video applications. For example if you make your title sequence in one program but want to do the main editing in another program. This will involve rendering the title sequence out as a complete file then importing into the editing system where it may be edited again. In this case you run the risk of double compressing the video data and losing quality. When sequences have to be partly finished in one application before being moved to another (or where you have multiple editors working on different parts that then need to be assembled) you need to render out in a Lossless format.

Delivery:

There are a number Lossless format options. For many general users the standard DV codec serves just fine. This means rendering your project using the DV codec and specification in either an AVI or MOV file format. DV is technically a lossy compression but the compression is relatively light and most people would never be able to tell with their eyes the difference between the copy and the source.

However, for preserving maximum quality (particularly when needing to move a project from one production phase to another in an intermediate format avoiding double compression) there are better options than DV so long as hard drive space is not scarce. Both AVI and MOV provide a variety of options for Lossless formats. In QuickTime the most commonly used codec for master Lossless files is and 'Component Video'.

Component Video is a lossless format but one that exploits deficiencies in the human eye. Scientific study has shown that the eye is less sensitive to changes in colour than it is to changes in brightness; the Component Video codec (and other YUV codecs like it) record all the brightness information but less colour information. The result is a file significantly smaller than an uncompressed file but which is visibly identical. These files make a good choice for archive Master files.

In the AVI file format there are likewise a large number of options but the simplest is to use no compression at all and save an Uncompressed AVI. The file size will be huge – upwards of 1gb/minute at standard definition (720x576). But, on the upside, you will retain all possible quality in your video with no recompression or altering of the data. Alternatively the freely available HuffYUV codec provides the same small amount of lossless compression as Quicktime Component Video.
