

# Introduction to Digital Video Concepts



## Introduction to Digital Video Concepts

### **Description:**

This informational workshop will cover the basics of:

- Video Concepts
- Principles of Shooting
- Principles of Editing

Topics addressed include: when to use video, understanding video cameras, shooting, sound, equipment,

locations, editing, software, digital vs. analog, formats, and considerations for the web.

### **Prerequisites:**

Familiarity and proficiency using a PC.

### **Objectives:**

1. Explore academic uses of digital video.
2. Explore concepts of shooting, equipment, and locations.
3. Explore and discuss digital versus analog, and types of digital video formats.
4. Explore and discuss considerations for the web.

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## Overview

This overview provides a practical example of the transformation of traditional analog video production services at a U.S. university into a program to diffuse digital multimedia services into the teaching and learning of the institution. In one sense, this process was simply a de-emphasis of analog video production services that had fallen into disuse and a new focus on popular forms of digital video and digital multimedia based on use of the World Wide Web. The actual transformation, however, was not merely a shift from a less popular to a more popular form of video technology, but rather a series of changes in the policies and organization of the university that allowed video technology to enter the mainstream curricular life of the institution.

Traditional analog video has been used in educational settings for decades. In fact, a recent comprehensive review of research on educational uses of analog video found over 20,000 research articles on learning from television.[1] Nearly all of this previous research has focused on the educational uses of program-length analog video, similar to the programming we see on our TV screens at home. Many such research studies tried to show that video technology itself was responsible for better teaching and learning. Schram pointed out in 1972, however, that the “superior production techniques [of analog broadcast video] are not also superior for teaching purposes and that the higher budgets required for embellished programs are not reflected in the learning results.[2] Little evidence has come forward to alter Schram’s basic conclusion of nearly three decades ago that what matters most is not the quality or type of the video images, but rather how the use of the video materials fits the learning goals.[3] That is, the effectiveness of video (or any other technology) is not determined by the technology itself, but rather by how effectively the capabilities of that teaching technology are matched with the goals of teachers and the needs and capabilities of learners.

[1] Seels, B., Berry, L.H., Fullerton, K., & Horn, L.J. (1996). Research on learning from television, in D. Jonassen (Ed.), *Handbook of Research on Educational Communications and Technology*, (p. 360). New York: Simon and Schuster MacMillan

[2] Schram, W. (1972). *Quality in Instructional Television*, (p. 56), Honolulu: University Press of Hawaii.

[3] *Ibid*, p. 50

Although simply providing digital video capability can increase use of video by students and faculty, experience supports the theory that such technological innovation must be accompanied by social and organizational changes that support the transformation of video into a curricular tool. When these organizational changes occur, experience indicates that universities can indeed bring about a transformation in the use of video technology that will result in true curricular innovation.

## ***The Use of Digital Video for Education***

Given this highly established research base for analog video, there should be little expectation that the mere advent of a new form of video (i.e. digital video) should inherently improve either teaching or learning. Nevertheless, digital video does present educators with new characteristics that provide the potential to at least encourage faculty and students to increase their use of video technology. The following characteristics of digital video tend to encourage broader use in educational settings:

- The compact size and low cost of high-quality, full-featured digital cameras make the acquisition of instructional video accessible to most students and faculty.
- Features such as inherent low-light recording capability, built-in titling, and electronic image stabilization largely eliminate the necessity for large camera crews typical of analog video production.
- Relatively inexpensive non-linear editing systems built into common computer platforms with powerful editing software allow much of the post-production process to be controlled by faculty and students themselves.
- More importantly, digital video has the following characteristics that allow more flexible use of video for instruction:
  - The ability to produce, edit, and display video in non-sequential form.
  - Tools that allow for relatively easy distribution of limited forms of video over the internet for training and instruction (e.g. Real Video, Quicktime).
  - The ability to interactively combine video with other forms of digital media, such as creation of a single web site with text, graphics, audio, and video.
  - The current inability to send full-length broadcast quality video over the internet encourages use of shorter program lengths of lesser quality. Ironically, these limitations in digital video quality and length seem to encourage *greater* use of video in instructional materials.

## ***“Fair Use”***

### **Section 107 of the Copyright Act of 1976. Limitations on exclusive rights: Fair use**

Notwithstanding the provisions of sections 106 and 106A, the fair use of a copyrighted work, including such use by reproduction in copies or phonorecords or by any other means specified in that section, for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright.

In determining whether the use made of a work in any particular case is a fair use the factors to be considered shall include --

1. the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;
2. the nature of the copyrighted work;
3. the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and
4. the effect of the use upon the potential market for or value of the copyrighted work.

The fact that a work is unpublished shall not itself bar a finding of fair use if such finding is made upon consideration of all the above factors.



**Pre-Production Worksheet**

1. What are your objectives?

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2. Is video the best way to meet these objectives?

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3. How will you present the necessary information to most effectively meet these objectives?

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4. Write a script.

5. Do a script analysis:

a. What does the viewer need to see?

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b. When do they need to see it?

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c. What are the actions (camera or subject)?

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d. Is there anywhere that it might help the viewer to see more than one angle?

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e. Where would you use closeups?

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f. Where would you use wide shots?

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6. Storyboard each shot in the video. (*see storyboard worksheet*)

7. Where will this be shot?

a. Do you need/have permission? From who?

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b. What will the sound be like at the location? What microphones will you need?

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c. Will you have enough space to set up the shots you want?

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d. What will the light be like? Where will the sun be? Will you need to bring additional lighting?

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e. Will the location have electricity easily available?

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8. Find competent actors.

9. Rehearse with your actors.

a. Try to visualize your camera positions. Use the actual camera if possible.

b. Did you learn anything? Do you need to make changes?

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c. Will the location still accommodate your shoot?

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10. What is the most logical order to shoot in?

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11. What is your schedule?

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12. What equipment will you need? (*see equipment worksheet*)

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13. Provide cast and crew a copy of the schedule, script and storyboards.

14. You're ready for production. (*see production checklist*)

## ***Production Checklist***

- Arrive before the cast.
- Bring the necessary equipment. (*See Equipment Checklist*)
- Make sure cast and crew will have snacks/entertainment during downtime.
- Set up furniture, props, etc.
- Set up the tripod, mount the camera.
- Adjust the camera for framing, depth of field.
- Add or adjust lighting to accentuate subjects and eliminate overexposure.
- Assess the sound (check for clarity, hum, and distortion).
- Make adjustments to the sound as needed.
- When all cast and crew have arrived, update them and go over the storyboard/script.
- Shoot a rehearsal.
- Check test for lighting, framing, sound.
- Make final adjustments.
- Shoot the scene.
- Record at least five seconds before and after the content of the shot.
- Review the playback for lighting, framing, sound, and acting.
  - Do not break the timecode.
  - Do not record over previous takes.
- If necessary, make appropriate adjustments and shoot another take.
- Repeat process as necessary.*
- Talk with cast and crew about what is working and what isn't.
- Gather and inventory equipment. (*See Equipment Checklist*)
- Leave location exactly as you found it.
- Thank cast and crew profusely.
- Thank anyone else who helped (e.g. staff/owner of the location)
- Discuss positive and negative aspects of the shoot with cast and crew in a more relaxed setting.
- Get feedback.
- Check footage on a monitor as soon as possible.

## ***Story boarding***

A storyboard is simply a planning device used to visually “sketch out” the actions of a story that will be told in a visual medium like animation, multi-media, a web page or video. Storyboards are linear because they tell a story that runs along a straight line from beginning to end. Storyboards for a video need to include not just the action of characters in a scene but placement of lights and camera as well.

<b>Illustration</b>	<b>Notes</b>
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## ***Ten Tips for Capturing Great Video***

### **1. Be Prepared**

- Go to the filming location the day before to check out the lighting and setting.
- Make a complete shot list.
- Pack DV tapes, extension cords, a tripod, a lens cloth, your camera manual, and an extra set of charged batteries.

### **2. Get great sound**

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- Keep your subject close to the camera.
- Eliminate background noise as much as possible.
- Use an external microphone if available.
- Make sure the microphone is out of the camera's view.
- Use headphones to monitor the sound quality.

### **3. Get the lighting right**

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- Before shooting, determine where the light is coming from (front, side, or back).
- If backlit, add more light so the front of your subject is lit, or move to another location.
- Use a bounce card to reflect light on your subject instead of shining it directly on them.
- If necessary, set your camera mode to match your shooting conditions.
- Avoid bright sunlight (making sure your shadow isn't in the shot).
- If you're filming inside, turn on all of the lights.

### **4. Get clear, steady footage**

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- Use your camera's image stabilization feature, if it has one.
- Use a tripod whenever possible.
- If no tripod is available, hold your bent arm tight against your body or lean against a solid surface to stabilize the shot.
- Use your camera's auto focus mode unless it's having trouble focusing on your subject.
- Hold your camera still and instead have the subject provide motion.

### **5. Capture the complete story**

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- Remember to press "Record" several seconds before you cue action to begin.
- Capture an establishing shot at the beginning of each scene.
- Get shots that tell the beginning, middle, and end of your story.
- Change locations and take shots from different angles and perspectives.
- Look for details in the scene that will help tell your story.
- Make sure your footage answers the questions, who, what, when, where, and why.

### **6. Think about composition**

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- Be sure all parts of the shot work together; the subject, background, color, and

lighting.

- Position your subject off center for a more interesting shot.
- Make sure there is no unnecessary space around the subject.

## **7. Don't forget the background**

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- Keep the background simple.
- Include a few props that will make the shot more interesting, but not distract from the subject.
- Make sure there are no distracting objects in the camera's view.
- Check that objects don't look like they're growing out of your subject.

## **8. Get great shots**

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- Only use your zoom to quickly switch between close-up and wide shots. You can edit out the abrupt zoom in your final movie.
- Try to get at least two types of camera shots for each scene you film: close-up, medium, or wide.
- Use extra video cameras so you can capture the same shot from different points of view.
- Anticipate the action so you get the shots you need.
- Record a few seconds before and after a scene so it will be easier to edit.

## **9. Capture candid shots**

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- Make your subjects feel comfortable and relaxed by talking and interacting with them.
- Try to be discreet.
- Bring along a digital still camera so you can incorporate still photos into your movie.

## **10. Make sure you've got all the shots you need**

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- When you're finished filming, take the tape out of the camera and put it in "safe" mode.
- Review your footage to ensure you have all the shots you need.
- If you have to reshoot later, do so at the same time of day so the lighting matches your earlier footage.

## **Video Formats**

Today there are many different formats available to shoot your video on. This list will provide you with how one is different from the other and some advantages and disadvantages. This list is divided into the two types - analog and digital.

### **Analog**

Analog recorders record video and audio signals as an analog track on video tape. A major disadvantage is that each time you make a copy of a tape; it loses some image and audio quality. The main difference between the available analog formats is what kind of video tapes the recorder uses and the resolution.

### **VHS**

Standard VHS cameras use the same type of video tapes as a regular VCR. One advantage of this is that after you've recorded something, you easily play it on most VCRs. Because of their widespread use, VHS tapes are a lot less expensive than the tapes used in other formats. Another advantage is that they give you a longer recording time than the tapes used in other formats.

### **VHS-C**

VHS-C camcorders record on standard VHS tape that is in a more compact cassette. You can play VHS-C cassettes in a standard VCR with an adaptor that runs the tape through a full-size cassette. Basically, VHS-C format offers the same compatibility as standard VHS format. The smaller tape size allows for more compact designs, making VHS-C camcorders more portable. But the reduced tape size means VHS-C tapes have a shorter running time than standard VHS cameras. In short play mode; the tapes can hold 30 to 45 minutes of video. They can hold 60 to 90 minutes of material if you record in extended play mode (EP), but this sacrifices image and sound quality considerably.

### **Super VHS**

Super VHS camcorders are generally the same size as standard VHS cameras. The main difference between the two formats is that S-VHS tape records an image with 380 to 400 horizontal lines, a much higher resolution image than standard VHS tape. You cannot play super VHS tapes on a standard VCR, but, as with all formats, the camcorder itself is a VCR and can be hooked up directly to your television or to your VCR to dub standard VHS copies. However, you can record on an S-VHS tape in a VHS recorder, but, the signal on the S-VHS tape will be only VHS quality. Yes, this can get confusing.

### **8 mm**

These camcorders use small 8-millimeter tapes (about the size of an audio cassette). One advantage of this format is manufacturers can produce more compact camcorders (similar design to VHS-C). The format offers about the same resolution as standard VHS, with slightly better sound quality. Like standard VHS tapes, 8 mm tapes hold about two hours of footage, but they are more expensive. To watch 8 mm tapes on your television, you have to attach your camcorder and use it as a VCR. 8 mm player/recorders are available but are expensive.

### **Hi-8**

Hi-8 camcorders are very similar to 8 mm camcorders, but they have a much higher resolution (about 400 lines). Hi-8 tapes are more expensive than ordinary 8 mm tapes.

## ***Digital***

The increasingly popular format is digital. Consumer prices have continued to drop which has created a larger number of digital camcorder sales. Digital camcorders differ from analog camcorders in a few very important ways. They record information digitally, as bytes (you've heard - 1's and 0's), which means that the image can be reproduced without losing any image or audio quality. Digital video can also be downloaded to a computer, where you can edit it or post it on the Web. Another distinction is that digital video has a much better resolution than analog video, typically 500 lines.

### **Digital Video (DV)**

DV camcorders can record on compact mini-DV cassettes, which hold 60 to 90 minutes of footage. The video has up to 500 lines of resolution and can be easily transferred to a personal computer. DV camcorders can be extremely lightweight and compact -- many are about the size of a small book. Another interesting feature is the ability to capture still pictures, just as digital cameras do.

If you've already been recording analog video (VHS, S-VHS), a digital camcorder can help you finally edit it into something you'll want to watch. Your original camcorder and a digital camcorder with audio-video input jacks give you everything you need to convert analog footage to digital. All you need to do is connect a VCR or your old camcorder to your new camcorder, using standard audio-video cables (commonly called RCA cables). Hit Play on the analog VCR and Record on the digital camcorder, and you'll have a digital copy in no time. Consequently, you'll lose one generation in the conversion process, of course, but after that the footage is in digital form and so won't degrade any further. You can then edit it just as you would any other digital footage.

The other main advantage of digital video is that once you download it to your computer, it is stored as a basic computer file. This means you can e-mail your movies, post them on the internet or simply store them on your hard drive. However, keep in mind that digital video files are quite large, and that you'll probably need to upload small portions of your footage at a time and then upload your finished movies back to tape for permanent storage.

### ***Analog vs. Digital***

Create the media you want to place on the web. This means that you must either:

- Transfer pre-record media to a computer, for example, music from a CD or cassette tape, video from a VHS tape or captured from a television show.
- Record your own media from scratch, for example, videotape yourself with a camcorder or record yourself speaking into a microphone.

Your source recording will either be in digital or analog format. If analog, like a VHS video tape or sound recorded on a cassette tape, it must be converted to a digital format before it can be placed on the web. Special hardware is required to make this conversion. In the case of audio files, the sound card already installed in your computer is probably capable of doing the job. In the case of video, a special video capture card is required.

In addition to hardware, software is also needed to convert analog to digital. With audio files, there is a good, free alternative, but with video, the software required will usually come with your video capture card, or can be purchased separately.

On the other hand, if your media is recorded digitally in the first place, like from a digital camcorder or audio spoken into a media recorder on your computer, it is not necessary to convert it further, though it may be necessary to use software to edit it. In the case of audio, an original digital recording will yield far better results, and generally be much easier to work with, than a recording converted from analog to digital. With video this is also true, but to a lesser extent.

The idea with capturing or recording media files is to get them into an uncompressed, or raw, digital file format, which can then be compressed--in order to reduce their size--for the web. For video files, this will either be an AVI or MOV format; for audio files, either a WAV or AIFF format. This discussion will concentrate on the PC world, so it will discuss Microsoft AVI and WAV formats. Remember, AVI files store uncompressed video data (usually comprised of both video and audio tracks), and WAV files store uncompressed audio data. These files can be enormous, especially in the case of video files.

Creating these initial files is by far the most difficult part of the process, especially if editing is required and you are combining multiple files into a single file. There is no substitute for practice with your software of choice when doing this. The question to keep in mind when picking a video editing program is: can the program read and write uncompressed AVI files? If so, you won't have any trouble preparing files for the web. You will also need a large hard drive to work with video. Uncompressed video files are very, very large.

### ***File formats for digital video***

**.MOV** signifies Quicktime, an Apple standard. It is playable on Macintosh and Windows machines.

**.AVI** is a Microsoft standard that is playable on Windows and Macintosh machines.

**.MPEG (.MPG)** is playable on Unix and Windows machines. Macintoshes can play MPEG, but may have trouble with the audio track.

**.RM** files are used by RealNetworks streaming. They are playable on Windows, MacOS, and Unix computers.

**.ASF** files are a Microsoft streaming format, and play on Windows, MacOS, and Solaris

### ***Compressors/decompressors***

A note is needed about compressors because all of the above technologies use them and the first three technologies in the list can use several. Some compressors are good at keeping picture quality high, while others are good at reducing the data rate needed for playback. But a trade off is always needed--the compressor that produces low data rates and high picture quality doesn't exist yet.

**.RM** and **.ASF** compression is intended to produce a low data rate, and may discard data as well as compress it. This is appropriate for streaming purposes, but these formats should be used for distribution only. Archive copies of the digital file need to be maintained using other formats in order to keep the quality high enough.

The first three technologies support several compressors, and may overlap in the ones that they use. When a movie is compressed, the viewer must have that same compressor on their computer in order to play it back.

### ***Playing video files***

Most of the movie-playing applications and web plug-ins overlap in the files that they can play. A tug-of-war is currently going on with one technology hijacking another's file type and vice-versa. So even though a movie uses a certain technology, another technology's player or plug-in may play it back

## *Digitizing video: definitions and quality considerations*

Moving pictures are an illusion. Motion pictures are a filmstrip whose individual frames are flashed on the projection screen at the rate of 24 per second. Television does the same thing electronically at the rate of 30 still images a second.

The basic idea in digitizing motion footage is to digitize each image and show them to the viewer at a quick enough rate to simulate motion. Generally, at least 12 to 15 frames per second are needed for smooth motion.

This approach quickly runs into problems because of the huge amount of data that results. If each full frame image is about 1 MB in size:

$1,000,000 \text{ bytes/frame} * 30 \text{ frames/second} * 8 \text{ bits/byte} = 240,000,000 \text{ bits/second}$

At this stage of desktop computer technology, only specialized hardware can deal with this data rate.

Compression helps reduce the data, but it by itself is not enough. So the task of digitizing video requires making decisions about how to reduce the data rate.

Three factors determine the data rate:

- **the size of the video window.**  
320 x 240 pixels (1/4 screen) is usually the largest window commonly used. The smaller the window, the lower the data rate needed.
- **the frame rate of the digital movie.**  
The majority of movies on the Web are either 10 fps or 15 fps. Choose a frame rate that is an even multiple of the frame rate of the source footage.
- **the picture quality**  
[\(how much compression is used\)](#)

The data rate that one aims for is determined by [how the movie is stored and delivered](#). For example, a hard disk can deliver data quicker than the Web can, so better quality, or a faster frame rate, or a larger window might be possible if the movie is played from it.

## *QuickTime Compression Quality Comparison*



Frame size 240 x 180  
File size: 375K

Data rate: 125K/second



Frame size 240 x 180  
File size: 10.5MB

Data rate: 3.5MB/second

The same source footage was digitized at the lowest compression quality and the highest compression quality. Then a still was grabbed of the same frame. The low quality frame (left) trades off picture quality for small file size and low data rate. The picture quality of the high quality compression is obviously better, but the data rate makes it unplayable.

### **Web page presentation**

Media are often linked from web pages; the user clicks a link and the file starts playing. There are two ways to link to a media file: linking and embedding.

Linking is the simplest.

Use a web page editor or write an <A HREF> tag to link to the file as you would any other web page. The media file will open in a blank page.

Embedding

Embedding allows the media file to appear to sit on a web page. This allows you to put the file within a web interface, and to add instructions for using it or comments about what it presents.

The problem with embedding is that the media file has to load before the page is fully functional. This may take time, and is a disservice to the user who is not interested in this file. If the file is small, this may not be an issue, but if it is large, there is a trick that can be used for Quicktime files, called poster movies. Instead of downloading the large media file when the web page opens, poster movies embed a small graphic image. (The image might be of the first frame of the movie so that it looks like the movie has loaded.)

To get it to play, the user clicks the movie. When clicked, the poster movie goes out and gets the media file, so the wait associated with downloading this data is moved from when the page first loads to when the user clicks to see the movie. Users that request something are willing to wait longer than those that aren't sure of what's happening, and those that don't want to see or hear the movie never have to wait for it to download.

### *DVD Player Region Codes*

About DVD Region codes: Because DVD is subject to the same issues of piracy and market sharing that govern the entire video industry, DVD region encoding was introduced to set geopolitical boundaries for compatibility of DVDs and players. For instance, a DVD encoded for Region 1 can only be played on a Region 1 (U.S. and Canada) DVD player.

Currently there are six global DVD regions, and DVD manufacturers can encode their product to play in any combination of regions. The vast majority of DVDs are Region 1 or 2 compatible, and many DVDs are "all-region"--suitable for playback on any player, anywhere.

DVDs are protected with a system called Macrovision, however devices are available that disable this protection of any DVD player and enable the copying of DVDs to video in high quality.

While numerous methods have emerged to illegally bypass DVD region encoding with "hacked" DVD players capable of playing DVDs from any region, movie studios have also increased their efforts to protect their regional copyrights with advanced DVD security coding. **Regional Coding Enhancement (RCE)** is added to some Warner Bros, New Line, Columbia DVDs to stop region 1 (R1) DVDs from playing on Region-free DVD players.

### **DVD Region 0**

Any player and any country compatible

DVD Region 1: Canada, U.S. and its Territories 

Puerto Rico, American Samoa, U.S. Virgin Islands, Guam, Palau, Micronesia, Mariana Islands, Marshall Islands, Canada

### **DVD Region 2**

Albania, Andorra, Austria, Bahrain, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Gibraltar, Greece, Greenland, Hungary,

Iceland, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kuwait, Lebanon, Liechtenstein, Luxembourg, Macedonia, Malta, Moldova, Monaco, Netherlands, Norway, Oman, Poland, Portugal, Qatar, Romania, San Marino, Saudi Arabia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Syria, United Arab Emirates, **United Kingdom**, Vatican City, Yemen, Yugoslavia.

### DVD Region 3

Cambodia, Hong Kong, Indonesia, Laos, Malaysia, Myanmar, Philippines, South Korea, Taiwan, Thailand, Vietnam

### DVD Region 4

Antigua and Barbuda, Argentina, Aruba, **Australia**, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Falkland Islands, French Guiana, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, New Guinea, New Zealand, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, Uruguay, Venezuela

### DVD Region 5

Afghanistan, Algeria, Angola, Bangladesh, Belarus, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Djibouti, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Gabon, Gambia, Georgia, Ghana, Guinea, Guinea-Bissau, India, Ivory Coast, Kazakhstan, Kenya, Latvia, Lesotho, Liberia, Libya, Lithuania, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mongolia, Morocco, Mozambique, Namibia, Niger, Nigeria, North Korea, Pakistan, Russia, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, Sri Lanka, St. Helena, Sudan, Tanzania, Togo, Tunisia, Turkmenistan, Uganda, Ukraine, Uzbekistan, Zambia, Zimbabwe

### DVD Region 6

China

### *VHS Encoding*

There are 2 forms of VHS encoding: NTSC and PAL

<b>NTSC</b> National Television System Committee	
Lines/Field	525/60
Horizontal Frequency	15.734 kHz
Vertical Frequency	60 Hz
Color Subcarrier Frequency	3.579545 MHz
Video Bandwidth	4.2 MHz
Sound Carrier	4.5 MHz

The following countries use the **NTSC** system

Antigua	El Salvador	Philippines	Canada	Midway Islands	Taiwan
Bahamas	Ecuador	Puerto Rico	Cayman Islands	Netherland Antilles	Tobago
Barbados	Guam	Saipan	Chile	Nicaragua	Trinidad
Barbuda	Guatemala	Samoa	Colombia	North Mariana Island	United States
Belize	Haiti	South Korea	Costa Rica	Panama	Venezuela
Bermuda	Honduras	Saint Kitts	Cuba	Peru	Virgin Islands
Bolivia	Jamaica	Saint Lucia	Cambodia	Mexico	Surinam
Burma	Japan	Saint Vincent	Canada	Midway Islands	Taiwan
Cambodia	Mexico	Surinam			

<h1 style="text-align: center;">PAL</h1> <h2 style="text-align: center;">Phase Alternating Line</h2>			
SYSTEM	PAL	PAL N	PAL M
Line/Field	625/50	625/50	525/60
Horizontal Freq.	15.625 kHz	15.625 kHz	15.750 kHz
Vertical Freq.	50 Hz	50 Hz	60 Hz
Color Sub Carrier	4.433618 MHz	3.582056 MHz	3.575611 MHz
Video Bandwidth	5.0 MHz	4.2 MHz	4.2 MHz
Sound Carrier	5.5 MHz	4.5 MHz	4.5 MHz

The following countries use the **P A L** system

Afghanistan	Holland	Portugal	Canary Islands	Malta	Turkey
Albania	Hong Kong	Qatar	Cyprus	Mozambique	Uganda
Algeria	Iceland	Romania	Denmark	Nepal	United Arab Emirates
Angola	India	Singapore	Dubai	New Guinea	United Kingdom
Argentina **	Indonesia	Somalia	England	New Zealand	Uruguay **
Australia	Ireland	South Africa	Ethiopia	Nigeria	West Germany
Austria	Israel	S.W. Africa	Faeroe Islands	North Korea	Yemen
Azores	Italy	Spain	Finland	Norway	Yugoslavia
Baharain	Jordan	Sri Lanka	Ghana	Oman	Zambia
Bangladesh	Kenya	Sudan	Gibraltar	Pakistan	Zimbabwe
Belgium	Kuwait	Swaziland	Guinea	Paraguay **	* = PAL- M
Botswana	Laos	Sweden	Greenland	Poland	** = PAL- N
Brazil *	Liberia	Switzerland			

## *Linklist*

American Memory at the Library of Congress  
**[memory.loc.gov/ammem](http://memory.loc.gov/ammem)**

The Audio and Video Archive Tool  
**[forums.itc.virginia.edu/tibet/ndrp/mediaflowcat/home.cfm](http://forums.itc.virginia.edu/tibet/ndrp/mediaflowcat/home.cfm)**

Films for the Humanities & Sciences®  
**[www.films.com](http://www.films.com)**

Internet Archive  
**[www.archive.org/movies](http://www.archive.org/movies)**

MPEG7  
**[ipsi.fraunhofer.de/delite/Projects/MPEG7](http://ipsi.fraunhofer.de/delite/Projects/MPEG7)**

The Robertson Media Center  
**[www.lib.virginia.edu/clemons/RMC](http://www.lib.virginia.edu/clemons/RMC)**

Tibetan and Himalayan Digital Library  
**[thdl.org](http://thdl.org)**

Association of Moving Image Archivists  
**[www.amianet.org](http://www.amianet.org)**

Faulkner at Virginia  
**[rtsp://qss.itc.virginia.edu/medialab/Faulkner/faulkner-va.mp4](http://rtsp://qss.itc.virginia.edu/medialab/Faulkner/faulkner-va.mp4)**

Informedia  
**[www.informedia.cs.cmu.edu](http://www.informedia.cs.cmu.edu)**

Movielink  
**[www.movielink.com](http://www.movielink.com)**

Ricoh MovieTool  
**[www.ricoh.co.jp/src/multimedia/MovieTool](http://www.ricoh.co.jp/src/multimedia/MovieTool)**

Television News of the Civil Rights Era 1950–1970  
**[www.vcdh.virginia.edu/civilrightstv](http://www.vcdh.virginia.edu/civilrightstv)**

University of Virginia Library Digital Initiatives  
**[www.lib.virginia.edu/digital](http://www.lib.virginia.edu/digital)**

American Museum of the Moving Image  
**[ammi.org](http://ammi.org)**

IBM MPEG-7 Annotation Tool  
**[www.alphaworks.ibm.com/tech/videoannex](http://www.alphaworks.ibm.com/tech/videoannex)**

Journal for Multimedia History  
[www.albany.edu/jmmh](http://www.albany.edu/jmmh)

Postmodern Culture  
**[www.iath.virginia.edu/pmc](http://www.iath.virginia.edu/pmc)**

Television Archive  
[tvnews3.televisionarchive.org/tvarchive/html](http://tvnews3.televisionarchive.org/tvarchive/html)

