Integrating Computer-Based Media in A Broadcast Environment

by Laurence Tietz
StudioSoftware Multimedia Inc.

Sponsored by Apple Computer, Inc.
Apple Developer Connection

media

Integrating Computer-Based Media In A Broadcast Environment

by Laurence Tietz

Are you an expert graphic designer working in the desktop publishing market and want to expand your work into the exciting area of broadcast design? What special concerns do you need to understand in order to succeed in this field? In this paper we will look at the requirements of the broadcast environment and explain how to use your Macintosh system to create broadcast-ready graphics.

Introduction

I remember the excitement I felt when the Mac II was released in 1986. More than with the introduction of the original Mac in 1984 I felt that this color multi-monitor based computer would change the world and the way we work. The original Mac had a nine inch black and white (one bit) graphic display. Cute and revolutionary from the user interface stand point but far from a useful tool for the graphic designer. The Mac II changed all that. Over night graphic designers began the journey to becoming savvy pixel pushers as they ushered in the era of Desktop Publishing (DTP). As the Macintosh grew and became more powerful and with the introduction of CD-ROM drives the DTP revolution was quickly followed by the Multimedia revolution. Designs incorporating compelling moving graphics, animation and 3D molding and video. Around this same time broadcast designers were making use of specialized systems from Quantel such as the Harry and PaintBox. These systems were designed to provide a specific set of tools for the creation and editing of broadcast graphics. Today Quantel (www.quantel.com) remains the leader in providing high-end broadcast graphics creation and editing systems. These systems serve as the industry standard. But unless you work in a broadcast production / post-production studio you probably don't have access to one of these systems. If you work in large media-industry city such as Los Angeles or New York you can find production studios where you can rent time in an edit-bay and make use of one of these systems. But you will still need to be familiar with the tools in order to make good use of them and the costs involved are not trivial. As a graphic designer you have mastered your skills using your Macintosh. The logical question is can I leverage my talents and equipment to address the motion graphics and broadcast market? The answer is a resounding YES! Macs are increasingly used in film and broadcast design. You can expand your market and explore the area of motion graphics and broadcast design using your Macintosh computer systems, but like all special markets you will need to understand the special requirements of an image destine d for the video market. What do you need to know in order to create graphics for this market? The answer to this question is a bit complex. Lets take a look at some basics so that we can generate an understanding of the unique medium.

Broadcast TV Technology – The Basics

Computers and television monitor technology is quite different. TV was invented in the 1950's and is based upon analog signals and systems. Modern computer monitor technology is 10 to 15 years old and is based upon a combination of digital and analog systems. Standard Television or STV utilizes a different color-space, resolution and scanning systems than computer graphic monitors. The differences between STV and Computer technology make it necessary that we “create and process” our computer graphics in order to make them STV-Ready. Lets examine each of these differences and learn how to control our graphics so as to achieve the highest possible quality when our work is converted to STV.

The first color TV broadcast system was implemented in the United States in 1953. This was based upon the NTSC (National Television Systems Committee) standard. The NTSC standard is used by many countries on the American continent, as well as many Asian countries including Japan. The PAL (Phase Alternating Line) standard was introduced in the early 1960's and is implemented in most of European countries. The SECAM (Sequential Couleur Avec Memoire or Sequential Colour with Memory) standard was introduced in the early 1960's and implemented in France. All of these systems use an analog system to "paint" the image on the screen. This analog system encodes the image on an electronic continuous wave. A STV picture is not flashed all at once to the screen. Instead it is painted line by line until the picture is completed. This process is called "scanning". The lines are scanned so quickly that we do not notice the build-up of the image on the screen. The actual time for the complete image scan is one-thirtieth of a second. But at this speed some flicker can be noticed by the human eye. This is eliminated by the use of *interlaced scanning*. Interlaced scanning is illustrated in Diagram 1. The scanning starts at the upper left, point a, and proceeds to point b. The beam then retraces very rapidly to point c and scans to point d. Notice the slight downward slant of each line. The process is repeated to the bottom of the screen, where only a half-line is scanned. At this point, a total of 262.5 lines have been scanned. This is called a field. From point f the beam retraces rapidly upward until it reaches the top center at g. This is the vertical retrace. Next the beam repeats the downward motion while scanning from left to right. Notice that it scans from g to h, retraces rapidly to i, scans to j, etc., until it reaches the bottom right of the screen on scan k to l. This second field of 262.5 lines is now completed. The two fields, combined to form a complete *frame* of 525 lines. The time it takes to scan a complete frame is still one-thirtieth of a second, but each field has been scanned at twice this rate which eliminates the flicker. This interlace scanning is referred to as the raster and the scan lines are called raster lines. The overall size of the image is dependent upon the size of the picture tube. However, it is necessary that the relative dimensions of width to height be the same for all TV transmitters and receivers. This ratio is known as aspect ratio and is standardized at 4:3.

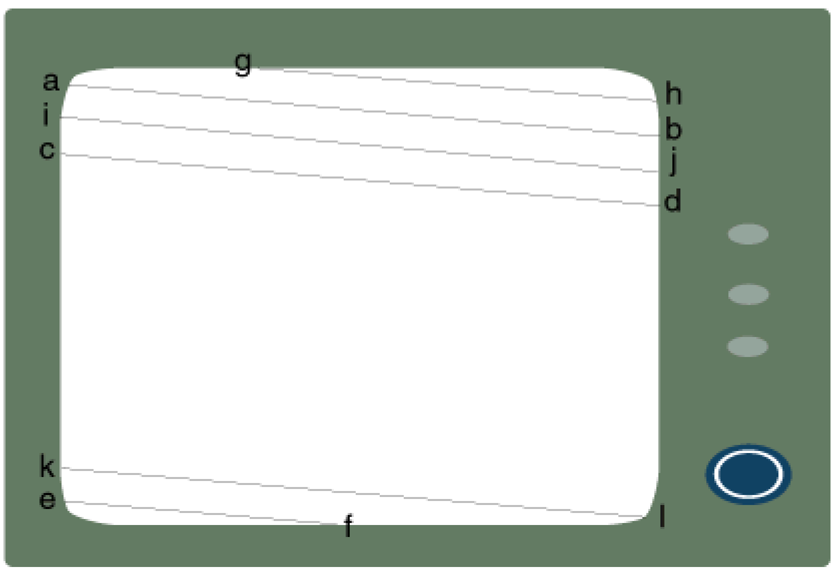


Diagram 1, Interlaced Scanning

Computers Paint the Image in PIXELS

If you are a graphic designer you are very aware of the concept of a pixel. Pixels are the dots on your computer monitor that make up the image. They are unique individual little dots, each with its own location running from the upper left hand corner across your screen to the upper right-hand corner as they form the top most line of your screen. And then again just below the first line there is a second line of pixels. And then another and another until we get to the bottom of the screen. All of these pixels forming line after line column after column create image on your screen. The graphics you create are all made up of thousands of tiny dots of color. The pixels on your computer screen are square (see Diagram 2). As we have seen a STV monitor does not work this way. It paints it's pictures in alternating, downward slanting lines This difference is important to understand and does present us with a hand-full of serious issue for us to address in the creation of our graphics.

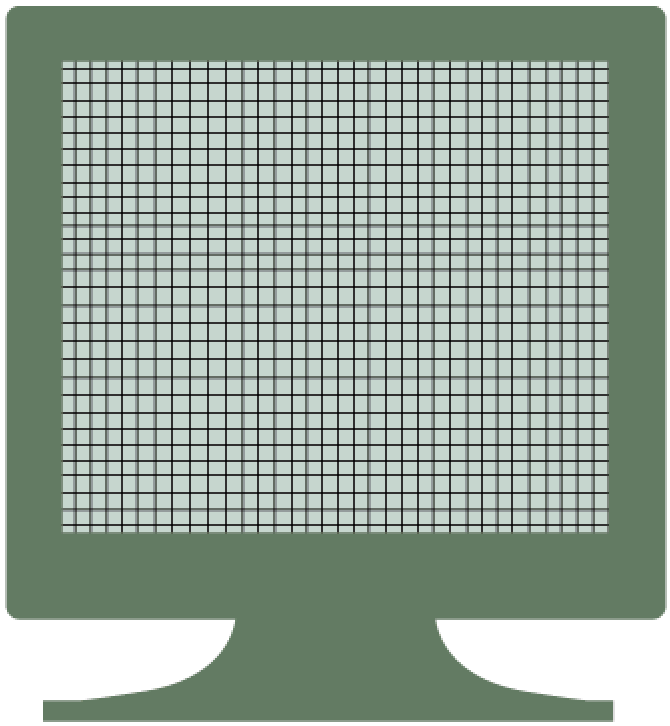


Diagram 2, Pixes on your computer screen.

STV and Graphic Line Width

Imagine a simple graphic image. A one pixel-width non anti aliased white straight vertical line on a black background. Imagine this image displayed on an STV monitor. Imagine the scan lines of an STV monitor painted in alternate frames: odd lines from left to right top starting at the top and continuing to the bottom followed by the even lines from left to right, top to bottom at a slight downward slant. Now imagine that the starting point for each scan line on the left is not very accurate and that the lines can "jitter" from left to right. Your one pixel wide straight line is almost impossible to see. And if you can see it it does not look like a straight vertical line but rather a very thin zig-zag line. Because of this horizontal and vertical "jitter" we must always make all of our lines no smaller than 4 pixels and I prefer to make them no thinner than 6 pixels in width for a graphic that has a width of 640 pixels. Your computer monitor is capable of displaying only so many pixels along the horizontal and vertical rows and columns. This is the "resolution" of the monitor. Modern monitors / graphic hardware will let you "change" the resolution of your monitor. Its common to have the same monitor / graphics hardware display either 640 pixels by 480 pixels or 800 pixels by 600 pixels. If you design an image so that has a 640 by 480 pixel dimension and you display it on a monitor that is set to 640 x 480 pixels, your image will fill the screen. If the same image is displayed on a monitor set to 800 x 600 pixels, the image will no longer fill the screen. Rather it will be centered in the screen with an 80 x 60 pixel frame around it. Typically we think of our screen resolution as 72 pixels per inch. When we change the monitor pixel dimensions we are really changing the screen resolution. When we change from 640 x 480 pixels to 800 x 600 pixels we are increasing our screen resolution. If we are working in a higher screen resolution we will need to make our minimum line proportional to the increase in total screen width. In the case of an 800 x 600 pixel image my minimum width suggestion is 6 to 8 pixels.

Safe Action / Safe Title

A second difference between our computer monitor and STV monitor is that on your computer monitor the image does not "bleed" to the edge of the tube. Rather it falls short of the edge of the monitor by a large amount – as much as 20 to 30 pixels. There are several reasons for this. Your computer monitor is a high performance optical display device that attempts to provide the same image quality at the edges of the screen as it does in the center of the screen. This is no easy task and to make the job easier for manufactures of computer monitors we "stop" the image short of the edge. One of the consequences of this is that we can always guarantee that the complete image will be displayed on the computer screen. This is not true for STV monitors which "bleed" the image to the edge. Couple this with the "jitter" aspect and you immediately realize that any graphic detail presented at the edges of your image may not be visible once this graphic is converted for broadcast. Therefore there are two rules that you need to use when designing your graphics. Safe-Title and Safe-Action. To create an image that is Safe-Title you need to insure that all of your on-screen text is within a region that leaves a 20 % boarder. If you are working with a 640 x 480 image your text should be no closer to the left or right edge than 64 pixels and no closer to the top or bottom edge than 48 pixels (10 % for each boarder for a total 20 % boarder).. This will guarantee that all of your on-screen text will be in a range that will be visible regardless of the "jitter" or other errors associated with centering an image that is bled to the edge. To be Safe-Action we mean that all parts of the image that contain important graphic information (but not text) should be within a 10 % boarder.

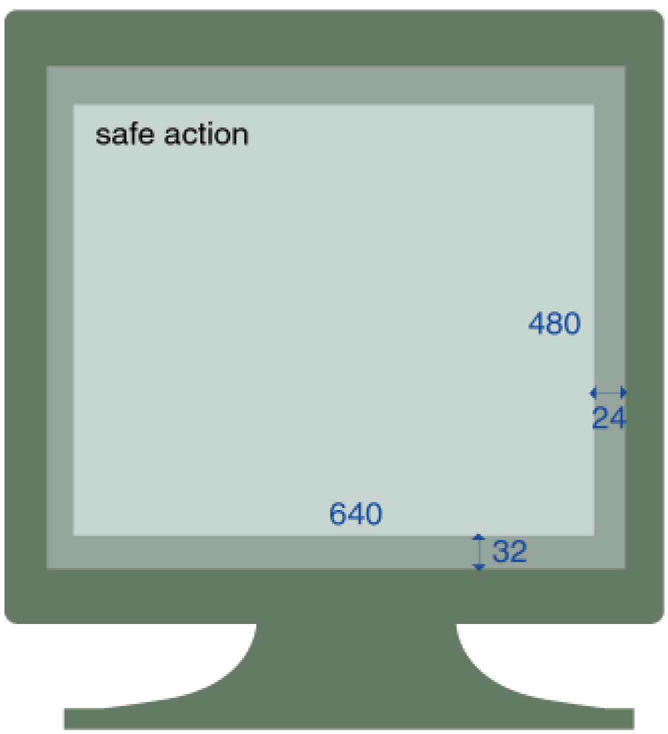


Diagram: Safe Action

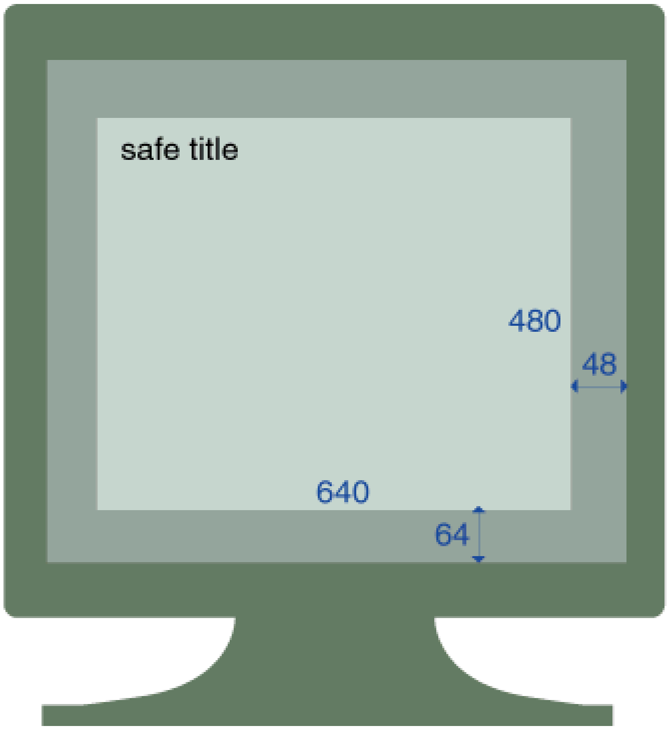
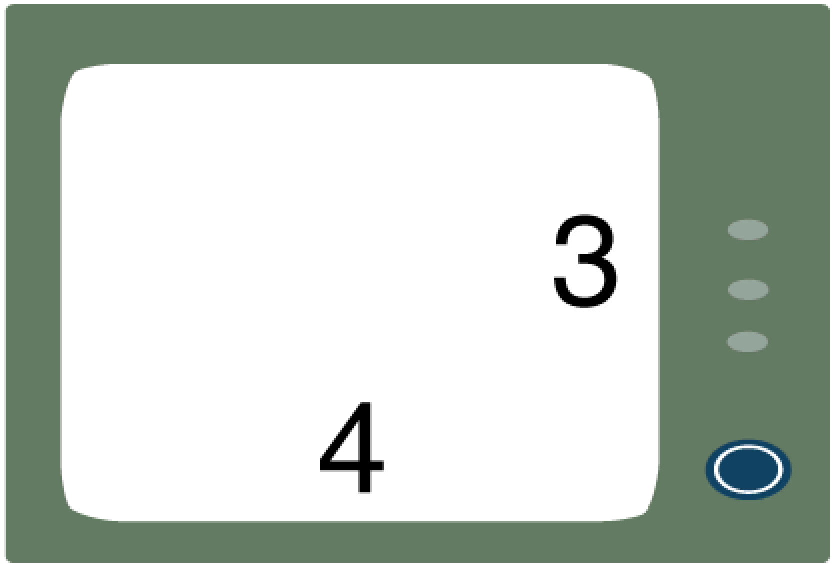


Diagram: Safe Title

Screen Size and Aspect Ratio

We typically set our Macintosh monitor resolution to 640 x 480 or 800 x 600 pixels. If we divide the horizontal pixels by the vertical pixels, 640 / 480, we get the aspect ratio of the image. Notice that 640 / 480 = 800 / 600 = 4:3. If we were to set our monitor resolution to 1280 x 960 we would still have a 4:3 aspect ratio. The aspect ratio of the STV signal is also 4:3. Therefore, it would seem that we would wish to create our broad-cast graphics with a 4:3 ratio so that there is a one to one relationship between our computer image and the image and the STV image. Therefore we want to work in a 4:3 aspect ratio on our computers. Unfortunately this is not the end of the issue. Depending upon target system to receive your graphic and the processing steps needed to convert your graphic to the final format we may need to work in a different aspect ratio. Each target system may require that you deliver your graphics in an aspect ratio different than the standard 4:3 ratio. One reason for this is that the computer screen pixels are not identical to the "pixels" of a STV monitor. As we have observed the STV monitor does not have pixels but rather it has scan lines. Yet this is not the complete story. There is a screening technique that creates individual dots on your STV monitor from the scan lines. These dots can be referred to as pixels. The problem is that they are not the same as the pixels on our computer screen. Where computer-based pixels are square the STV "pixels" are rectangles. To compensate for this difference we must modify our working dimensions to adjust for the target system.



Color Space

When working on a computer monitor we are working in a color space known as RGB. The television camera starts out "seeing" the color image as a RGB color space but the transmission / modulation system converts this to a color space specific to NTSC. The basic reason for this difference is related to bandwidth considerations (the FCC allocates a limited bandwidth to each broadcaster) and the need to be backwards compatible with 40 years of previous television technology. Including black and white TV Sets. The NTSC color space is much more restrictive than the RGB space. What this means to the designer is that we must create our images with the NTSC palette to insure the best possible image when converted to STV. There are some rules-of-thumb that you can follow. The "Christmas Effect" is a computer image created by an artist that really likes to create contrast with color combinations like green and red. Nothing looks worse on a STV. Avoid saturated or "hot" colors. I like to use "DeBabelizer " (fwww.Equilibrium.com) to help me filter the colors for NTSC. Within DeBabelizer, look under the "Tools" menu for the "NTSC / PAL Hot Pixel Fixer". This tool will correct any pixels that will not be able to be viewed successfully on a NTSC system. This is not a solution for a bad design. It is best to avoid bad color combinations and colors that don't reproduce well on a STV. In the world of video, black and white and all the shades of grey are not considered "colors". TVs and VCRs process these shades of grays with a minimum of distortion. When creating an image on your computer, try to use different shades of gray instead of color. (For an indepth look at Equilibrium's DeBabelizer check out DeBabelizer 3.0—The Swiss Army Knife of Multimedia Graphics at ftp://dev.apple.com/devworld/Interactive_Media_Resources/DeBabelizer_3.0).

Viewing Your Work

It is important to view your work on a STV system throughout the project starting with the first comps to the finished product. In this way you will be able spot problems early and will not have any unpleasant surprises. There are several ways to accomplish this. If you have a Macintosh system that has internal video capture hardware (the AV Mac Series) or if you have a video capture workstation set up with specialized video hardware you can view your work on a STV / NTSC monitor hooked up to the analog video output of the system. Using your video editing software you will be able to import the graphic and print to video to view the image. There are also specialized hardware solutions called a "Scan Converter". Scan converters are used to convert the computer's progressive scan to an analog NTSC interlace scan available as a composite or component video. The monitor output of the computer connects to the scan converter. The scan converter provides a connection to the computer monitor (the progressive scan signal is passed through) and one or more NTSC signals (either analog video, or serial digital). The NTSC signal connects to your STV monitor. The scan converter will give you expert control over the output including a flicker filter. In this way you will be able to get a clear view of the way your graphics will look when converted to video.

Some Hints and Tips From DVD and Broadcast Designers Who Use A Macintosh Computer System

Provided by:
Mark Waldrep of AIX Media Group, Los Angeles, (http://www.aixentertainment.com)
AIX is a leader in the development of DVD disks.

Q1: "What aspect ratio or pixel dimensions should I work in when I'm creating an image for the broadcast environment?"

A1: The size of a source graphic file is dependent on what your destination format is going to be. For example, DVD-Video work in NTSC is 720 x 486 (aka D-1 resolution). To create motion graphics for DVD-Video menus and guarantee that sub-pictures will match in the authoring environment, we start with 720 x 540 and resize to D-1 resolution. Stills for DVD-Video menus can be created using 720x480.

Q2: "Do I use different dimensions for images that will be loaded into different STV (Standard Television Broadcast Equipment) devices such as a chyron or an image server?"

A2: The dimensions for broadcast TV are the same as listed above.

Q3: "Would the dimensions be different for an image that is to be loaded in to a non-linear digital video editing system (media 100, avid) vs. a on-line analog editing system?" "If I'm creating a set of DVD interface graphics what pixel dimensions and aspect ratio should I use?"

A3: A non-linear editing system must be able to handle D-1 resolution (720x486) in order to accommodate DVD-Video work. This means that a 640x480 CD-ROM screen resolution is insufficient. A DVD interface graphic for this systems would need to be 720x486 pixels.

Q4: "If I'm creating a graphic for HDTV (16/9 aspect ratio) what dimensions should I work in?"

A4: 16/9 is the ratio for wide screen format movies. These would require 960x540 pixels and then be sized down to 960x486 for the actual video presentation. Remember that computers use square pixels and televisions use rectangular pixels requiring the added vertical dimension.

Q5: "Do you have any general Tips about creating graphics for broadcast? Colors that work best / worst on STV? I know that working in a high DPI is important in the print world, what DPI should I be working in for STV?"

A5: The DPI for television graphics is 72 with color depths of 24 bit. Make sure you restrict your color palette to NTSC safe colors (there is filter in Photoshop 5.1 that can do this automatically). Another good idea is to stay away from small text especially text with serifs. Narrow horizontal lines are also problematic by causing "vibrations" in certain line thickness or width.

Provided by:
Carol Roy and Jim Hoitsma of Bronson Hill Design, Los Angeles
Bronson Hill Design designs DVD interfaces and Motion Graphics for the broadcast industry.

Tips:
We design our broadcast graphics at 72 dpi and in a RGB color space. This resolution makes it easy and fast to try many effects and techniques. Once we have a design that we like, we view the image on a NTSC monitor to check for color problems prior to submission. Two color tips: Some reds have a tendency to bleed. Identify these colors and avoid them. Pure white is too bright. Use a 244/244/244 RGB value (slightly gray-white) instead.

Provided by:
DVCC Los Angeles. http://www.dvcc.com

For your reference here is a quick summary of the art issues as relates to the issue of creating graphic interfaces for DVD.

The main problem is that computers have square pixels, but DVD video (CCIR-601) has rectangular pixels that are tall and skinny. So you must scale the art to look "short and fat" prior to placing it on the DVD disc. Also any pictures that come from a (Rec. - 601) source (720x480) must be readjusted to 720x540 and then proportionally scaled before being used in a menu. You can tell because an image that came directly from a 601 source will look short and fat. If you use a DDR or other similar 601 equipment only pad or crop your images between 486 and 480 as needed.

The following tips should aid you in creating graphic interfaces art for DVD.

1.) Create all menu pages using a image size of 720x540, 16x9 menus use 960x540

2.) Make sure all imported pictures are properly proportioned. Scanner pictures are good, Frame grabbed pictures can be good or bad depending on the frame grabber. Just make sure everything looks sized correctly on your computer at with the square pixel image size of 720x540 or 960x540.

3.) Flatten, resize, and save as .TIF the final image to 720x480 (601 format). This is the tiff we need for the menus.

4.) Create the overlay file using **ONLY** the colors Red (255,0,0), Green (0,255,0), Blue (0,0,255), Black (0,0,0). This overlay file will have all the buttons. It's difficult to preserve the 3 colors when re-sizing a file so create the overlay file only at 720x480 and never re-size and save it. Also you have to be careful to keep aliasing off when making this file. We'll use this overlay file for the button highlighting. If you are making 16x9 menus we will use this overlay for the 16x9 playback mode.

 Secondly, if they are 16x9 menus crop out the center 720x540 from the 960x540 file, image size it to 720x480 and create a second overlay file. We will use this overlay for the 4x3 playback mode of the menus. We don't need the 720x480 "standard" menu extracted to make these overlays. The DVD player creates it from the one you give us from step #3.

5.) Make a table describing the color callouts of how you want the highlighted buttons to appear. Here is a totally contrived sample to get you started. Basically you need to decide and specify to use the color and transparency of each color. You can simulate it by making layers at the top of the Photoshop file in the actual colors and transparency. When you read the colors from Photoshop be careful to get the color for only the highlight layer not the total mixture. Each color can be written as (Red value, Green value, Blue value, transparency) where 0% is clear.

	Overlay File	Unselected Color/Contrast	Selected Color/Contrast	Activate Flash Color/Contrast
Foreground - 1	Red (255,0,0)	Clear	200, 200, 200, 90%	0, 0 150, 90%

Foreground - 2	Green (0,255,0)	Clear	145, 15, 153 50%	50, 15, 75 25%
Foreground - 3	Blue (0,0,255)	Clear	Unused	Unused
Background	Black (0,0,0)	Clear	Clear	Clear

Conclusion

Creating powerful graphic design for the broadcast industry is not very different than DTP or multimedia design. The important issues to remember are that you need to be aware of the technical requirements of the target systems and make your design conform to these requirements. Aspect ratio, pixel dimensions, line-widths, color choices and font choices are important in developing a successful design. Remember that all designs need to conform to the safe-title / safe-action guidelines to insure that all important information within your design will be visible on the STV display. Always take a production meeting prior to starting work to discover any special requirements that the target system will impose upon your design. If you keep these simple design rules in mind there is nothing you and your Macintosh can't accomplish in the exciting field of broadcast design. Let the revolution begin!

Resources

http://www.quantel.com/
http://www.dvcc.com/
http://www.aixmediagroup.com/new/
http://autotv.co.uk/simple/facts/safeareas.html
http://www.chyron.com/
http://www.dvcc.com/

About the Author

Laurence Tietz is co-founder and Director of StudioSoftware Multimedia Inc., a Los Angeles multimedia design and production studio. Laurence earned his BS. degree in engineering form Pratt Institute (NYC) and his MFA from the San Francisco Art Institute. Laurence began his career as a software designer for Hewlett Packard. Combining his strong interest in design and software he served as senior programmer for Amazing Media, one of the early developer of consumer entertainment and educational CD-ROM. With Leslie Safarik, he founded StudioSoftware in order to pursue their vision for interactive media. Laurence has positioned StudioSoftware as one of the industries leading multimedia studios. He was honored by Multimedia Producer Magazine as one of the top 100 multimedia producers for 1995.

Laurence Tietz is co-founder and Director of StudioSoftware Multimedia Inc. Laurence earned his BS in engineering form Pratt Institute (NYC) and his MFA from the San Francisco Art Institute. Laurence began his career as a software designer for Hewlett Packard. Combining his strong interest in design and software he served as Senior Programmer for Amazing Media, one of the early developers of consumer entertainment and educational CD-ROM titles. He was one of the early champions of object oriented programming techniques for multimedia. He founded StudioSoftware Multimedia with partner Leslie Safarik in 1994. After hundreds of projects and countless awards, Laurence quickly earned a reputation in the entertainment industry for high quality, attractive and easy to use custom software. Clients include Imergy ("Star Trek Starship Creator" CD-ROM), Jonathan Goodson Productions (New York, Illinois and Iowa Lottery on-air broadcast systems), KCET (The KCET web site), Smithsonian Institute (The Geosphere Project), The Eames Office ("Powers of Ten" CD-ROM) as well as many network and cable television, motion picture and music related projects.

StudioSoftware Multimedia Inc. is a multi-platform, full service multimedia design and production studio located in Los Angeles, California. StudioSoftware provides complete multimedia design and production services including content development, creative direction, interface, graphic design and software development to clients in the entertainment, advertising and publishing industries. From CD-ROMs to the World Wide Web, StudioSoftware has been a pioneer in interactive design and innovative content - while pushing the boundairies of production value.

StudioSoftware Multimedia Inc.
548 South Main Street
Los Angeles CA 90013, Suite 602
PH 213 430 0335
FAX 213 430 0345
URL: http://www.studiosoftware.com
Email: laurence@studiosoftware.com

.