CHOOSING A VIDEO PROJECTOR

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Introduction

Video projectors come in a variety of flavours, from a compact unit slightly larger than a notebook computer to a 500Kg behemoth. The one you choose depends on your application. *It is critical that the projector type and specifications be matched to your source(s) and your use(s) - present and future*.

We will cover the pros and cons of different projector technologies later in this article. Initially all you need to know is that there are two broad types: multiscan projectors that will lock to any input signal within their range of resolutions (generally, CRT-based); and fixed resolution projectors that convert all input signals to a single fixed display resolution (LCD or DLP-based).

Match Those Scanning Frequencies!

Video: Virtually all projectors will handle a video signal (e.g.: from laserdisc, a tape, etc.). Be aware, however, that if you use a scan doubler or quadrupler to improve the video image quality, the projector must have a higher horizontal scan frequency to be able to project this signal. Most fixed-resolution projectors do not currently have sufficiently high resolution to support a scan quadrupler. There are special scan multipliers now being made that output video at exactly 800 x 600 for these (i.e.: somewhere between a scan doubled and a scan quadrupled signal).

Graphics: If you want to project computer graphics, you must ensure that the projector is capable of handling both the horizontal and vertical scan frequencies generated by your graphics card. For fixed-resolution displays, ensure that the native resolution of the display matches the graphics resolution you most commonly use. If you try to project graphics at a higher resolution than the fixed display will allow, the projector will down-convert the graphics to this native resolution. Some projectors will simply leave out every nth line, while others will use intelligent processing - either way, you will lose resolution.

How much resolution do I need?

The simple answer is: as much as you can afford. The trend in computer graphics is towards higher and higher resolution. What may be high resolution today, may be considered standard in two years.

The more complicated answer is that you need to consider the type of presentation you are making and the desired image quality. If you are doing a bulleted text list of several points on a coloured background, then 640 x 480 resolution will do just fine. If you are showing graphics or photographic images: the higher the needed image quality, the greater the required resolution of the source and the entire signal processing chain. Currently, 800 x 600 is considered to be a standard graphics resolution; 1024 x 768 is considered high resolution; and 1280 x 1024 is very high resolution (high-end graphic workstation quality). Scan-quadrupled video also requires a system capable of about 1280 x 1024 resolution. As a comparison, a 35mm slide or film frame has a resolution of about 10,000 lines.

NOTE: As the resolution of the source and projector increase, so do the demands on the rest of the video system. This is a frequently overlooked area. Your substantial investment in a high resolution projection system will be completely wasted if the interface units, switchers, and even the video cables are not capable of handling the higher bandwidth required of these displays. A common bandwidth specification for graphics systems today is 200MHz. This will continue to rise as the graphics resolution requirements go up.

Be sure to anticipate your future needs! Saving $5,000.00 on the initial purchase of a projector is false economy if six months down the road you decide you want to display high resolution graphics, and the projector won't do it.

Is It Bright Enough?

It is important that the image be bright enough for the application and the venue. For example, if you are in a lecture or seminar situation, the ambient light in the room will be much higher than in a theatre - should be about 54 lux (5 fc) for notetaking. There are ANSI/SMPTE standards for screen luminance level. A detailed calculation should be done to determine the required projector brightness based on this luminance requirement, the size of the screen, the gain of the screen, the reflectivity of the screen, and the ambient light level. Once you have done this, you will have a projector brightness target in ANSI lumens. If a calculation is not done, your choice of a projector is a pure guess.

Unfortunately, brightness specifications for video projectors can be confusing. The ANSI standard is helping considerably, but you will still see different manufacturers quoting any one of ANSI lumens, peak lumens, or just lumens. Trying to compare these can be a little daunting.

For LCD and DLP projectors, three-element units will generally be brighter than a single-element unit - colour saturation also suffers in a single-element unit. Be wary of a

projector that claims higher light output than its closest competitors in the same class. Observe this projector carefully to ensure that whites do not have a greenish tinge. The green portion of the spectrum is brighter than the red or blue. Some manufacturers will increase the green ratio to achieve a higher lumen rating (at the expense of pure whites).

Note that LCD projectors will generally drop in brightness as the graphics resolution increases - the opposite is true for DLP projectors. Any projector that relies on an incandescent light source (i.e.: LCD, DLP, and light valve) will lose brightness, and will likely experience a colour shift, as the lamp ages.

Contrast Ratio

Contrast ratio is as important as brightness, and is often misunderstood or totally ignored. Contrast ratio is a system-wide problem, and the final perceived image quality will be affected by the element in the chain that is weakest. In an ideal projection situation we try for between a 400:1 and a 600:1 ANSI screen contrast ratio. This is achieved by a combination of the projector brightness, the screen construction, and the ambient lighting - we are assuming, of course, that the source material has a decent contrast ratio.

While these contrast ratios are easily achievable with film or slides, video projectors do not normally come close to this level of contrast ratio - typical video contrast ratios range between 100:1 ANSI and 200:1 ANSI. To compound the problem, it is very difficult to get accurate figures from the manufacturers - figures are either quoted as "contrast ratio," with no indication of the measurement method, or "full white," or "ANSI" (this is the only useable figure), or nothing at all. Thus, it is critical that the screen and the ambient lighting be designed so as not to degrade the situation further.

Remember: a projector cannot actually project "black" - in an ideal world, it would simply project nothing (no light) when required to show black. To quickly evaluate your screen's contrast ratio, therefore, set up the lighting conditions as they will be when viewing the presentation, turn off the projector, and look at your screen. What you are looking at is the blackest black you will ever see - if you are seeing a white screen, you obviously have a problem.

The Players

Video projectors can be loosely grouped into three categories. Here is a brief overview of each:

Multiscan CRT Projectors

The "traditional" video projector. Uses three CRT's (Cathode Ray Tubes) and three lenses. Different lenses are not normally available (i.e.: the projection distance is fixed for a given image size). Not considered portable - usually weigh over 100 lbs. (45 Kg). Can range from about $8,000.00 to $50,000.00 US - a typical price is about $20,000.00 US.

Brightness is generally between 150 and 250 ANSI lumens, with 220 being average. Contrast ratio is, on average, about 100:1. Support video plus graphics. Graphics resolution is normally quite high (from a minimum of 800 x 600 to over 2000 x 2000) - have a multi-sync capability that can lock to any resolution within their range. Require technical set-up, as the individual images from each tube must be converged - some units are available with auto convergence. Can adjust for keystoning, skew, bow, etc.

These are often our recommended choice for a fixed installation in a boardroom, small theatre, and some exhibit situations.

Fixed-Resolution Projectors

LCD: Use three Liquid Crystal Display elements - one for each of red, green, and blue. Usually quite compact and portable. Standard units can range from about $4,500.00 to $14,000.00 US.

DLP: Digital Light Processing is a relatively new projection technology. Uses a semiconductor imaging chip developed by Texas Instruments called a DMD (Digital Micromirror Device). Very compact and portable. Standard units can range from about $5,000.00 to $15,000.00 US. We only recommend three-chip units, as the flicker and rainbow artifacts from single-chip projectors are, in our view, objectionable.

These use an incandescent lamp source and a single lens - often different lenses (i.e.: various focal lengths), including zoom lenses, are available. Brightness is generally between 200 and 800 ANSI lumens, with 400 being average. High power units for large displays are also available (see Large Venue category below). Contrast ratio is, on average, about 150:1. Support video plus graphics. The LCD element or DMD chip are fixed resolution devices - lower and higher resolutions are internally converted to this fixed resolution. Minimal set-up is required - these require no convergence. Unlike a CRT projector, however, compensation for keystoning, skew, and bow is impossible - making this an unsuitable choice for a difficult projection geometry or a curved screen.

Because the display resolution is fixed, ensure that the graphics resolution of the LCD elements or DMD is sufficient for your intended purpose - some units are only 640 x 480; 800 x 600 is becoming standard; and higher resolutions are available in LCD and coming in DLP. One advantage of DLP over LCD is that the space between the mirrors is much smaller than the space between LCD pixel elements. This results in a much less noticeable "pixel grid" effect.

We usually recommend these projectors when compact size or high brightness are required. For video-only, some low-end units are also suitable for exhibit and small theatre use. They will generally give acceptable performance for less money than a CRT-based projector. If being used for special effect projection in a themed attraction or planetarium, test the proposed units under simulated conditions - the combination of high brightness and low contrast ratio may be a problem if the image needs to meld seamlessly into a "black box" background.

Large Venue Projectors

This class of projector is intended for high-brightness, large-screen projection (e.g.: a theatre). They achieve their very high level of brightness by modulating a high-intensity incandescent light source (such as Xenon) with the video signal. It is possible to achieve up to 50 times the light output of a CRT projector! At the time of writing, there are three available technologies: light-valve, DLP, and LCD. They usually, but not always, have a single lens, and different lenses are usually available. High-power LCD or DLP units can range from about $20,000.00 to $120,000.00 US - a typical price is about $60,000.00 US. Light-valve projectors can range from about $50,000.00 to $250,000.00 US - a typical price is about $70,000.00 US.

Brightness is generally between 1,000 and 12,000 ANSI lumens, with 2,000 being average. Contrast ratio is, on average, about 200:1. Support video plus graphics. Light-valve projectors use CRT's to create the image, and have the same high resolution and multiscan capabilities as a CRT projector. LCD and DLP projectors are fixed resolution devices, limited by the resolution of the LCD display or DMD chip (see the resolution limitations above).

These are recommended for very large screens and/or high ambient light levels and for high-impact situations such as a world's fair, theme park, or museum. Pay particular attention to the modulation method vs. your application. Contrast ratio is an important consideration for entertainment use. Test the proposed units under simulated conditions - the inability to go completely black may be a problem for planetarium or special effect use.

Evaluating Projectors

The most important piece of advice we can give is this:

> Look at several prospective projectors in an environment that most closely simulates your intended use.

Ensure that you are comparing the various projectors under as similar conditions as possible - the ambient lighting should be at the same level, the screen material and gain should be similar, etc. If you are planning to use rear projection, observe the various contenders on a rear projection screen. This is especially important if the application is unusual (e.g.: a planetarium or a special effect in a themed environment). Characteristics that may not normally be a problem may show up under these special circumstances (for example, some high-quality CRT-based video projectors we know of have a white overscan line at the top of the image - not a problem under normal circumstances, but in a "black box" environment it jumps out and spoils the effect). Here's what to look for:

> First, observe the overall image quality. Do the colours seem realistic? Are the colours bright and saturated, or washed out? Are blacks truly black, or are they grey? Are whites truly white, or yellowy or greenish? Is the overall image crisp and sharp, or does it look as if it were behind a dull film? If the projector uses a fixed resolution device (such as LCD or DMD) does the image look obviously "pixelated"?
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> Next, look at the mechanics of the image. Are the sides of the image parallel? Do the corners form a 90° angle? Does a single colour change in hue as it moves across the screen? Are the edges of objects (and transitions from one bold colour to another) crisp and sharp, without crawling dots? Is the focus uniform across the screen? Is the brightness uniform across the screen, or are there "hot spots"? NOTE: this last problem may also be the result of a poorly specified screen.

All of the above observations should be carried out separately with each type of source material you intend to project (e.g.: video, VGA, and SVGA). Bring your own source material with which you are familiar. This should be representative of the type of material you will project.

Operating Costs

Bear in mind that non-CRT projectors use incandescent lamps that require replacement. Halogen lamps used in LCD projectors are typically rated at 40 hours, and replacement cost is about $25 US. Metal-halide lamps used in some DLP projectors are rated for 250 to 400 hours, and replacement cost is up to $300 US. Some projectors have metal-halide lamps rated from 1,000 to 6,000 hours, and replacement cost can range from $300 to $1,000 US. Some projectors use Xenon lamps with a 1,000 to 2,000 hour rating and a replacement cost of around $1,000 US. Some of these lamps are not user-changeable, requiring dealer service.

You should be aware that you may not get the full rated lamp life. As a halogen or metal-halide lamp ages, its brightness and colour temperature change. This results in a projected image that is dimmer and more yellowish than when the lamp was new. Some 1,000 hour metal-halide lamps may be at half original brightness by 250 hours!

Is It Supported Locally?

An important, but often overlooked element is the dealer or manufacturer's level of local service. Video projectors require initial set-up, ongoing maintenance, and periodic repair. Ensure that your contractor/supplier can provide this service locally for at least three years. Also consider the service response time vs. your allowable down time (e.g.: a boardroom can probably be down for a few days, an expo exhibit cannot).

Summary

The type of projection technology you choose should be carefully matched to the intended use - with an eye to the future. It is important to ensure that the resolution and vertical and horizontal scan frequencies of the projector match any graphics or scan doubler/quadrupler you are intending to use. The brightness and contrast ratio must be selected for the intended application and environment. Different projectors should be compared under as similar conditions as practical - and one which emulates your intended use as closely as possible. A critical eye is needed to compare units properly. Operating costs are an important, but often overlooked, factor. Local support must be available for ongoing service and to reduce down time.