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B2C Technology Story

Web Summary:

A Symphony of Projected Images

by Leon A. Enriquez

Reading Time:
7 minutes

Reader Benefit:
♦Understanding projectors and the different approaches;
♦Discover what you can expect from these image projectors;
♦Insights into the CRT, LCD and DLP projector technologies.

When it comes to image projection, there is often a need to compromise between the amount you are willing to spend, and the quality you expect. What are the issues you must address before you decide what's available at the budget you can afford, and the selection of a decent projector.

Yes, projectors come in all shapes and sizes, and in different technology platforms, from CRT to LCD to DLP. What do these terms mean to you?

Obviously, the latest technology buzz does not always mean the best results. Let's explore the benefits of these technologies. From this know-how, you can then draw your own conclusions.

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John Ng, Asst. Division Manager at NEC Solutions Asia Pacific noted: "Current projector technology are focusing on LCD and DLP. The reason is simple: the use of such chips allow for light weight, small size projectors. Also they do not have the conveyance problem associated with CRT."

"CRT is primarily used for computer monitors. And LCD is the preferred choice because it gives off a better image quality than DLP which tends to give "softer" images," said Lynette Low, Corporate Communications Manager at Canon Marketing Services.

CRT (Cathode Ray Tube):
The front of the CRT is the screen, which is coated with tiny dots of phosphor material. Each dot consists of a red, a green, and a blue phosphor, and the three dots combine to make up each pixel. For the present, CRT technology dominates the projector industry.

However, as threatened by more advanced projector technologies, CRT technology is quickly becoming obsolete, plunging down the bottom end of the product market life-cycle curve. To make matters worse, CRT product's heavy weight is against the market trend, which is heading towards compact size and lightweight.

LCD (Liquid Crystal Display):
By definition, LCD is a device containing three tiny liquid crystal displays with a series of mirrors and lenses. LCD is an analogue-based display technology used in video projectors, employing three fixed panels of pixels – one panel each for the "Red, Green, and Blue" components of a video image.

The pixels on these panels are subject to charges representing the changing video signal, the pixels orient themselves so that light striking them is either passed to a degree, or completely blocked in that area of the panel. Thus, the panels become either transparent or completely solid; corresponding to the light and dark areas of the video image.

A single light source – bulb – illuminates all three panels where the monochromatic images are then converged internally using a prism. Thus, the resulting full colour image is projected via a lens onto a screen. Therefore, the smaller the size of the pixels, the better the image.

For instance, on LCD spec sheets, you will notice that the number of pixels available are quoted as "nearly a million, or 1.5 million, or more." To find the pixel count on a single panel, you will need to divide the total number of pixels by three – because there are three LCD panels. LCD projectors also use line-doubling technology to minimise the visible structure.

LCD projectors are very lightweight, small, relatively bright, simple to set up and operate. These are relatively inexpensive due to the proliferation and usage of LCD technology in many areas.

However, the contrast range, i.e., the ratio between the whitest "White" and darkest "Black" of LCD projectors suffer in comparison to other technologies. This is because there is light present – even when no light is passed by the panels. LCDs use such a bright light source that light leaks between the individual pixels, thus creating blacks that appear more like shades of grey. Additionally, projector bulb life is a constant investment.

DLP (Digital Light Processing):
DLP uses a silicon chip to replace the three LCDs. DLP technology was developed by Dr. Larry Hornbeck of Texas Instruments. – employing 1 to 3 DMDs (Digital Micromirror Devices) or chips, one each for the Red, Green, and Blue components of an NTSC video image. At the heart of a DLP projector is a DMD chip with thousands of tiny reflectors that open and close, acting as light valves.

Each chip contains approximately 750,000 or more microscopic mirrors or pixels. Via digital input representing the changing video signal, these mirrors rapidly orient themselves so that light striking them is either reflected towards or away from a lens. Thus, areas of the chip correspond to the light and dark areas of the video image.

A single light source or "bulb" drives all DMDs where the monochromatic images are converged internally using a prism system, and the resulting full colour image is projected via a lens onto a screen.

DLP projectors are lightweight, relatively brighter, simple to set up and operate. They provide a much better contrast range, i.e., the ratio between the whitest "White" and darkest "Black" with higher resolution than LCD projectors. This is mainly because there are more surface area per mirror, and less space between adjacent mirrors. The space between each mirror is approximately 1 micrometre.

Despite the advantages, projector bulb life is a consideration with DLP as well as LCD. Presently, although prices are affordable, DLP technology is still more expensive than LCD.

Canon's Ms Low confirmed that "LCD gives you more value for money whereas DLP is slightly more expensive and costs a few hundred dollars more."

"We are seeing a slow commercial market that is forcing a very aggressive price war in the low-end market. For the first time, projectors pricing are dropping to below the S$2,000 mark. Due to the cheaper price, we see a pick up in home and SOHO users. Prices are now affordable to this segment which is currently the growing market," highlighted Canon's Ms Low. "And depending on the specific user requirement, both LCD and DLP offer value for money."

Other considerations

Even the best LCD or DLP units have a relatively low contrast ratio – which is the difference between pure white and pure black. LCD or DLP units are not able to produce a pure black. This seriously affects the final image as black is never black, and more of an inky dark grey. As such, LCD or DLP have less accurate grey scale tracking, which affects all colours and often results in poor colour accuracy. As an illustration, this may be most noticeable with flesh tones which are not reproduced correctly.

Beware of making direct comparisons of brightness specifications between CRT and LCD or DLP units. CRT projectors have a much greater difference between black and white parts of an image and the perceived brightness will be higher than figures might suggest.

LCD or DLP units run at extreme temperatures due to their ultra high output lamps. Most units actually cook themselves over time. Thus, lamps cost substantial amounts and last for relatively short numbers of hours, and the running costs can be higher than expected.

Noise is also generally a problem simply because the use of 150-400 watt lamps in small plastic cases require serious cooling fans which create noise. Most CRT projectors also have cooling fans but these are thermostatic and provide air movement in the case. There is no high output lamp burning at a constant temperature producing constant heat. LCD or DLP projectors have their specific uses because they are very portable for mobile display.

A January 2003 report from research firm Decision Tree Consulting revealed the following points:

1. In Asia Pacific, the sales volume of projectors increased by 2 times within two years from 2000 to 2002, with Japan recording the highest sales, taking up about 30 percent of total volume.
2. In the Asean region, Singapore posted the highest projector sales, followed by Malaysia. Singapore sold about 18,000 projectors last year, compared to 16,200 in 2001.
3. LCD projectors are immensely popular – comprising more than 80 percent of the sales in Asia Pacific. This is probably due to the affordable price range.
4. The most popular and widely accepted quality of projectors were the XGA, which is about 1000 to 1,100 ANSI Lumens, and costing between S$3,000 to S$4,000.

As for market trends of usage patterns, Canon's Ms Lynette Low said that "projectors are increasingly used for mobile presentations and wireless applications where wired connectivity presents severe constraints. Another interesting observation is that between 1Q2000 until 3Q2002, the average weight of projectors was 3 to 5 kg. Since 4Q2002, the bulk of projectors sold weighed less than 3 kg."

NEC's Mr John Ng concurred that "projectors have been getting smaller and lighter but believes that it would reach a stage where it would not be practical. Smaller and lighter mean hotter projectors too. Once the heat ratio is not bearable, it does not make sense to continue in this direction."

All things considered, LCD and DLP technology are rapidly displacing CRT as the display technology of choice for projectors – in many instances, e.g., for home theatres and game consoles.

Box Story 1:

The Rainbow Effect

The "Rainbow Effect" is a strobing effect caused by an interaction of the colour wheel with eye movements. This effect is the separation of red, green, and blue that can appear along the edge of objects in motion on the screen. It is caused by the spinning colour wheel's inability to refresh pixel data on the screen fast enough to keep up with rapid motion in the image.

What does it look like? If you move your eyes on certain scenes you will see instantaneous flashes of rainbow-striped colours. They come and go so fast that your first reaction will be "What's that?" They occur most commonly in high-contrast areas of the picture such as white titles on a black background. Another example, which is less obvious, is in bright scenes.

Rainbows appear to be most prevalent on projectors using three-segment colour wheels of red, green, and blue. This dreaded rainbow effect is an artifact that afflicts some, but not all, one-chip DLP (Digital Light Processing) projectors.

Some people can see rainbows repeatedly in ordinary program material. Try a simple experiment to experience whether you can see the rainbows. Simply dart your eyes from left to right across the screen at different speeds. You can avoid the rainbows by simply staring straight ahead and never moving your eyes. Did you ever try to just look straight ahead and never move your eyes while watching a movie? Yes, you're right. That's almost impossible!

Yet, it's also quite possible that you won't see the rainbows. There is "anecdotal evidence" that individual persons vary in their sensitivity to this so-called rainbow effect artifact. But for the individuals whose eyes detect these rainbows, it can be a major irritation – and especially for those who are very sensitive to these distractions.

The most common technical solution to mitigating the rainbow effect – in the latest crop of DLP projectors – is to accelerate the colour wheel, and thus the refresh rate, thereby reducing the error. For those unlucky few that are still bothered by DLP's rainbow effect on these accelerated colour wheel machines, you will need to opt for a non-DLP projector such as the LCD or CRT machine.

Box Story 2:

Choosing a Projector?

When choosing a projector, you must carefully consider how your projector is most likely to be used. Consideration to the following characteristics will help you make the most of your investment.

Portability: Does Weight Matter?

Projectors come in all shapes and sizes. The average weight ranges from 1.5 kg to 8 kg. Note that the ultra-portables (below 2.5 kg) are lightweight but sacrifice such features as ruggedness, brightness and resolution.

Brightness: How bright is bright enough?
Projector brightness is measured in ANSI Lumens (American National Standard Institute). Thus, the brighter the projector, the higher the ANSI Lumen rating.

- ***Less than or equal to 1000 ANSI Lumens:*** As the lowest light output projectors, this category is generally the least expensive. If you are budget conscious, this is the group you should focus on. This is best suited to small and medium room use, with reduced lighting required for optimal viewing.
- ***1000-2000 ANSI Lumens:*** With Lumens increase comes an increase in price. Most manufacturers offer a variety of machines in this output range. Projectors with this output capacity are ideal for standard conference or classroom applications. For optimal screen clarity, especially for the top-end of this spectrum, reduction in room lighting may not be necessary.
- ***2000-3000 ANSI Lumens:*** This class of projectors represents the pinnacle of light output performance for the portable projector, and are suitable for large conference or classroom applications. As these powerful projectors are less likely to be affected by ambient room light, they offer greater flexibility in terms of room lighting. This projector calibre is also able to project to larger screens without loss of image clarity.
- ***Greater than or equal to 3000 ANSI Lumens:*** These are the "ultra-brights" of the projector world! Often sub-categorised within their own genre, there's a range of 3000 to 15,000+ ANSI Lumens. Used exclusively in large venue applications such as churches, auditoriums, concert halls, boardrooms, etc., these projectors carry price tags that match their wonderful capacities.

Resolution: What is clarity?
Resolution is a major contributor to the quality of your projector output. The fast and simple way to answer the question: "Which resolution is for me?" – is to match your projector's native or uncompressed output resolution to the resolution of your input device such as your PC. Clarity means how clear the projected images appear on the screen.

Other important considerations?
For example, your applications may typically use a higher resolution. If you find that a projector with a matching resolution is too expensive, then, the alternative is to consider a projector that is one step down in resolution. Usually, this will give you an acceptable picture while saving money on the purchase.

Also, remember that PCs double in performance every 18 months or so. So, be sure that your projector will be able to match the performance of present as well as future PC purchases.

Box Story 3:

LCD or DLP vs CRT Projectors

Here are the pros and cons of deploying either LCD or DLP technology versus the proven CRT technology.

LCD or DLP vs CRT Technology?

LCD or DLP Digital Advantages:

1. Bright colours
2. Bright display output;
3. Fixed pixel-based geometry;
4. Easy to set up, calibrate and use;
5. Light weight; and
6. Great for PC presentations and video games.

LCD or DLP Digital Disadvantages:

1. Unproven technology compared to CRT;
2. Poor black level performance, many times dark pictures look washed out like the deep blacks. These are difficult to produce because the mirrors only deflect light; they don't shut light out. The resulting leakage creates blacks that are closer to dark greys. Flesh tones are not true for those who like blue.
3. Always require active cooling, some kind of fan is needed, most brands are still noisy;
4. Prone to its mirror structure being visible onscreen; and
5. More expensive and consistent bulb replacement.

CRT Technology?

CRT Advantages:
1. Image quality is good;
2. Infinite resolution;
3. Clearer, sharper and true-to-life images;
4. True black levels, can meet calibration standards;
5. Runs completely quiet, no active cooling needed;
6. Proven technology for the last 50 years; and
7. Lifespan is long, can last for 5 to 10 years.

CRT Disadvantages:
1. Physical size and weight;
2. Calibration required for the best picture;
3. Flexible geometry and not fixed like digital displays;
4. Light level is not as bright as many digital displays; and
5. Not recommended for still displays like computer graphics or video games.

About the Author

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