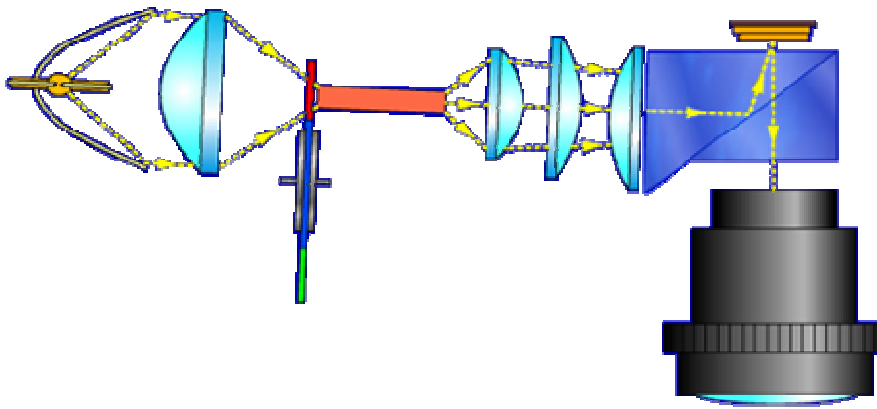


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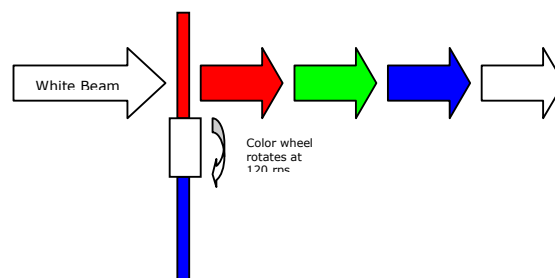
Technology comparison between 1-gle chip DLP (iD R600) and 3-chip LCD projection (iQ R500)

1. Basic Technology comparison

1-gle chip DLP projection uses 1 light modulator, namely a **DMD**. The colors of the projection are generated by using a color wheel, which is chopping up a white light beam into a colored light beam, where the colors are separated in the **temporal field**, which means that the beam now consists of a Red beam following a Green beam following a Blue beam (sometimes following a white beam). There a basically 2 types of color wheels, namely the RGBW wheel and the RGBRGB wheel.

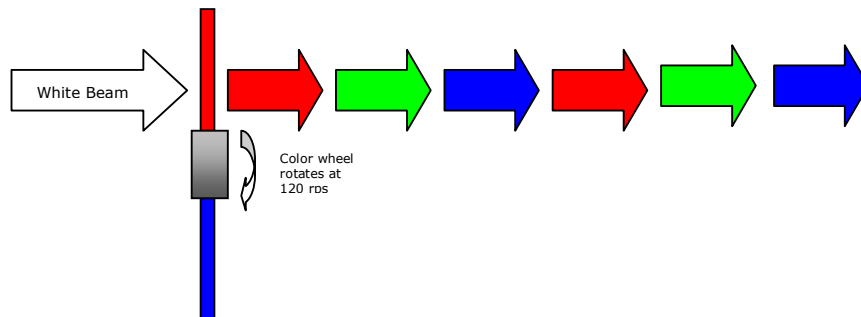


The RGBW color wheel chops up the white light in a Red, Green, Blue and White beam following one another. This color wheel is mainly used for Presentation applications where light output is very important. The white segment is contributing heavily to the brightness of areas in the image that are white, but not to areas in the image that are colored, in other words, **the more color the less light**. This type of color wheel is **used in the iD R600**.

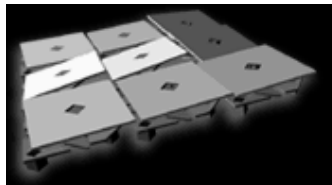


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The RGBRGB wheel chops up the white light in a Red, Green and a Blue beam following one another. This color wheel is mainly used for Home Theatre applications where color saturation and content is very important. **The brightness is less good** because in order to make color, the color wheel is **reflecting** a big part of the light back to the lamp and this light is **lost** for the system.



The DMD is a purely digital device that consists of a flat plane with a number of mirrors mounted on it. There is basically 1 mirror per pixel, so and SXGA+ DMD has 1400 x 1050 mirrors.



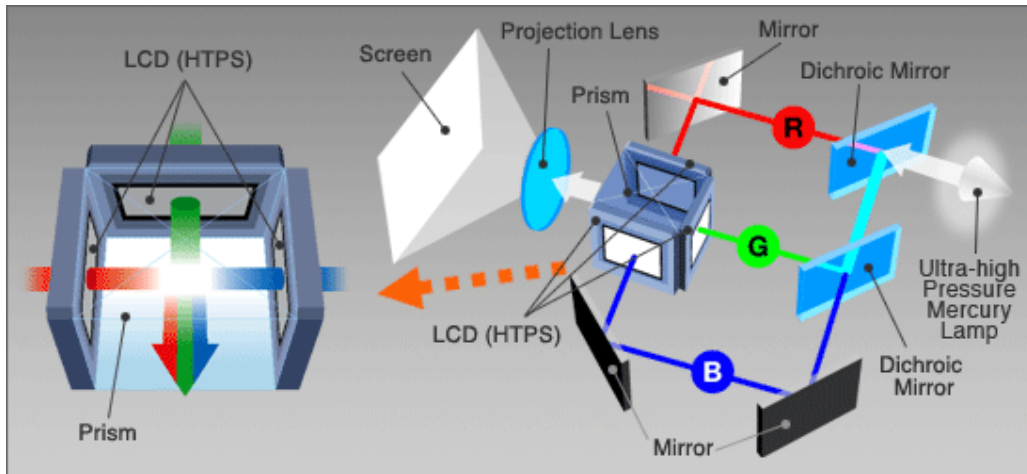
Because the DMD is a **purely digital device** which is working with mirrors, it is **very good** from the point of **uniformity**. Also the **stability** of the image **over time** is **very good** as the individual mirrors on the DMD are very insensitive to degradation. Typically, the DMD will not show degradation before 20.000 hrs operation and so the 1-chip DLP projector has a better TCO than the 3-chip LCD projector.

3-Chip LCD projection uses 3 LCDs. In this type of projection, the white beam is divided into **3 separate color beams** that are spatially separated and each of the beams is hitting then a dedicated LCD. There is virtually **no light lost** because all components of the white beam are used and no light is reflected back to the lamp, hence this technology is **very good** for **brightness** and for **color reproduction**, as the light output is independent of the color content of the image.

Because LCDs are analog devices which are working with Liquid Crystals in tiny cell gaps, there is some tolerance on all the aspects, which is resulting in

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a less good uniformity. At Barco, we do a very intensive color uniformity adjustment, which consists of uniformity adjustment on several grey levels and the white level, in order to compensate for this, but the overall **uniformity performance** is still **less good** than that of a DLP system, which is virtually perfect.



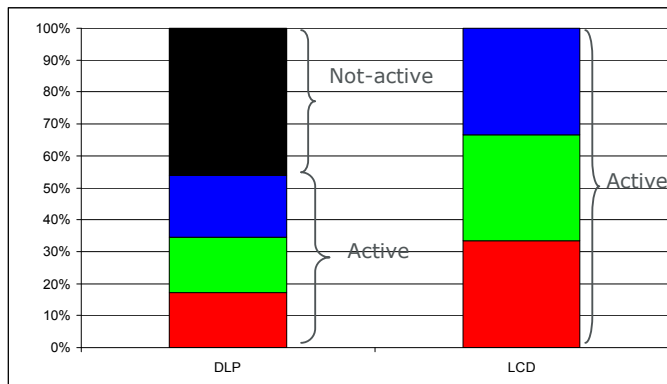
LCD devices exist in many different sizes. The sizes range from 0.5" over 0.7" and 1.0" to 1.4" and 1.65" for the diagonal of the LCD. Some components in the LCD are **sensitive to degradation** over lifetime caused by light intensity on the display. The smaller the LCD area, the bigger the light intensity, so **0.5" and 0.7" LCDs are very sensitive** to degradation which can occur already after 1000-1500 hrs depending upon the brightness of the projector. Depending upon the brightness of the projection system, a 1.0" will show degradation after 2000 to 3000 hrs. **1.4", 1.65" and 1.8" LCDs are less sensitive** to degradation and degradation here will start occurring between 5000 to 12000 hrs operation depending upon the brightness of the projection device. (Polarisers and Analyzers that are used together with the LCDs show similar degradation effect, but may degrade slower or faster depending upon the content of the projected image.) The iQ R500 is using 1.4" LCDs.

2. Comparison on performance of image quality

In this paragraph, we focus more on the comparison in image quality between a 3-chip LCD projector (e.g. iQ R500) and a 1-chip DLP projector with an RGBW color wheel (e.g. iD R600).

For **data images with a high white content** such as e.g. Excel sheets, Word documents... the 1-chip DLP projector is performing best as its white uniformity is very good and very stable over time. Also the brightness of the single chip DLP projector is fully used because the light of the white segment

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For **Video images** such as e.g. DVDs, TV ... the **3-chip LCD** projector is performing **better** as its color content is very good and its brightness is fully used over the different colors. Also **the color saturation** of the individual colors is better on the 3-chip LCD projector. The brightness of the single chip DLP projector is not fully used because the light of the white segment of the color wheel will not contribute to the projected image as this light can not be used in colorful images and so the **overall brightness impression** of the single chip DLP projector will be much **lower** (up to 40% lower) and the color saturation of the colors will be worse. On the other hand, the black level performance of the 1-gle chip DLP projector is better as it is more uniform and stable over time than that of the 3-chip LCD projector and also the **Contrast Ratio of the 1-gle chip DLP projector** is better. For fast moving images, there is an additional consideration to be taken into account for the **1-gle chip DLP projectors as these can generate visible color break up effects** on fast moving images, which are caused by the fact that the different colors are generated sequentially and not simultaneously in a 1-gle chip DLP projector. **Overall the 3-chip LCD projector will display the better image on video images.** Below, you can find a comparison between a video image of a 3-chip LCD and a 1-gle chip DLP projector.



3 Chip LCD image



1-gle Chip DLP image

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3. Executive Summary

Application	data images with high white content	data images with a high color content	Video images	Intensive Use Applications	Multiple Screen Applications
1-gle chip DLP Projection	++ (high White content)	0 (No contribution of the white segment)	0 (No contribution of the white segment + color break-up)	++ (Very good TCO)**	+ (very good uniformity)*
3 chip LCD Projection	+ (Uniformity inferior to 1-gle chip DLP)	++ (High color content)**	++ (High color content + no color break up)**	+ (TCO dependent upon brightness)	0 (Uniformity inferior to 1-gle chip DLP)

* Special features for multiple screen applications are implemented in Sim 5+ series
 ** 3-chip DLP projectors also provide good performance for these specifications

Relative brightness	3-chip LCD	1-gle chip DLP with RGBW color wheel	1-gle chip DLP with RGBRGB color wheel
Images with a high white content	90%	100%	55%
Images with a high color content	90%	50%	55%

4. Abbreviations

- DLP: Digital Light Processing
- DMD: Digital Micromirror Device
- LCD: Liquid Crystal Device
- RGBRGB: Red Green Blue Red Green Blue
- RGBW: Red Green Blue White
- TCO: Total Cost of Ownership