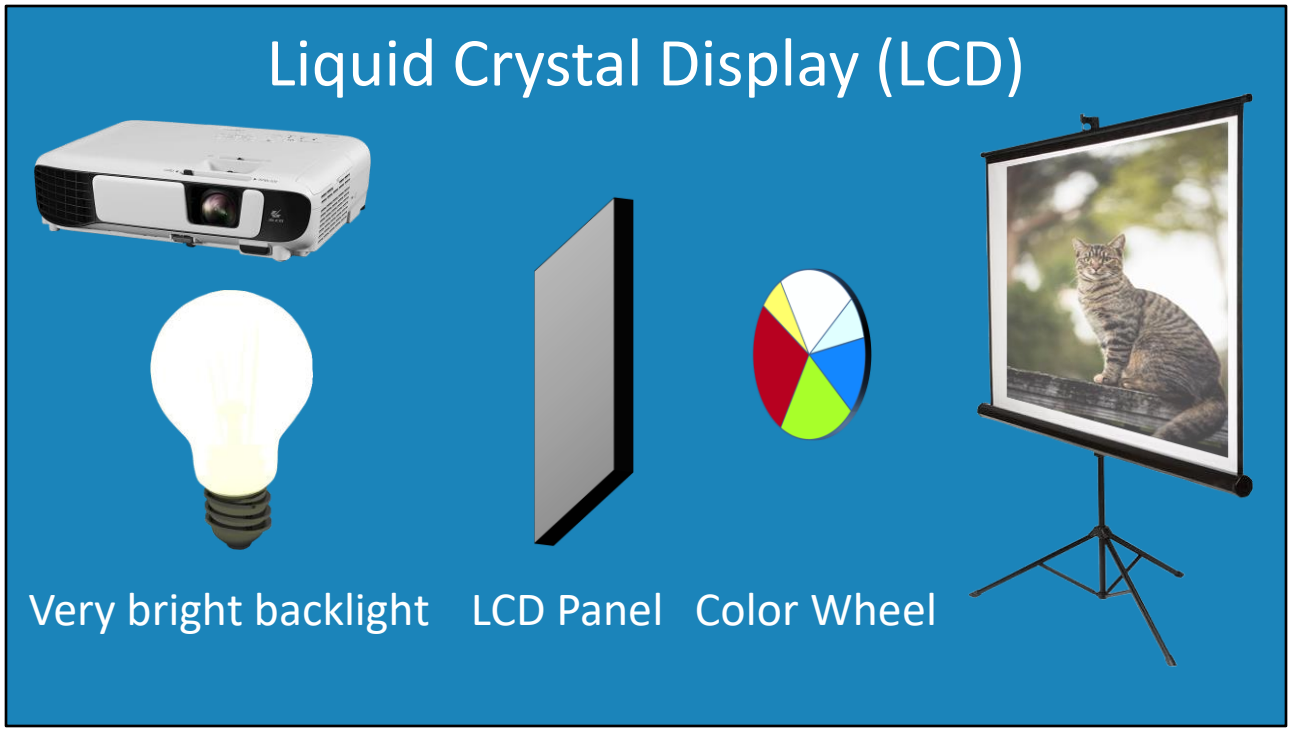
In this video from ITFreeTraining, I will look at projectors. Projectors are found in most meeting rooms. A projector's basic purpose is to project an image onto a flat screen or a wall for viewing.

CRT Projector

- Each color has its own Cathode Ray Tube
- Expensive/big/heavy and obsolete

0:11 The first generation of projectors used CRT. Essentially these projectors contained three very bright CRTs that projected the image outwards. These units were very big, heavy and nowadays obsolete. There were some advantages to them like having good response times, a good display of black and a descent resolution, although newer technology can do a lot better.

CRT projectors were often seen mounted to a ceiling. These required some setup to get them to work correctly, so once installed, it was not a simple matter to move them somewhere else. Their size and difficulty to move is probably the main reason they are no longer sold today.



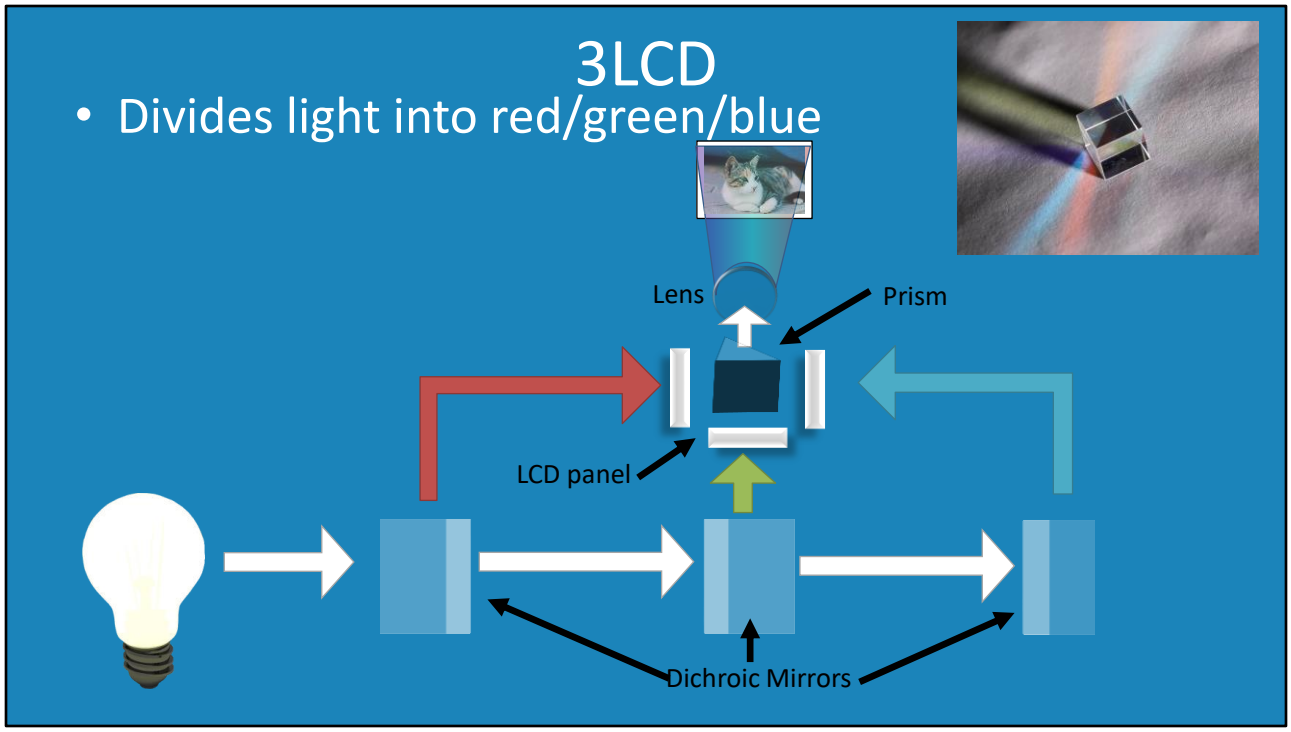
0:54 The next advancement in projectors was Liquid Crystal Displays or LCD. These significantly reduced the size of the projector. It also meant you could move it around quite easily. If you have watched our videos on monitors, you will understand the process is similar to how an LCD screen works.

The process is essentially that the projector has a very bright backlight. This is significantly brighter than what you would have in an LCD screen. This is to be expected because the projector must project light a much greater distance then an LCD monitor would have to. In order to control what light is seen, the light travels through an LCD panel which blocks or allows light to pass through.

So far, we have light, but we don't have any color. In order to get color, a color wheel is added. The color wheel spins and changes the color of the light as it goes through. Different LCD projectors will have different colors on their color wheel and different amounts of color allocated to different parts of the wheel. Don't be surprised if you find the color wheel is not red, green and blue. Once the light goes through the color wheel it will be projected to a surface, for example a screen or even a white wall, where you will be able to see an image.

This are the basics of how an LCD projector works. Similar to an LCD screen but with the addition of a color wheel to change the light to a different color rather than a filter. Like an LCD screen, projectors have a native resolution that they should run at. If you run the projector at a lower resolution, the image will be scaled and won't look as good, so when possible run the projector at its native resolution.

The problem with this approach is that the LCD panel will need to be timed with the color wheel. Essentially the LCD panel will need to change fast enough to match the speed of the color wheel. This makes it difficult to reproduce certain colors. For example, a bright blue will be almost all blue with very little red and green. The LCD panel must essentially max out and then go to the opposite extreme to match the spinning wheel. So, you can imagine, this has an effect on color reproduction. In order to improve color reproduction, there is a different method that is used that divides the light into red, green and blue to give a better result.



3:21 To divide the light into three different colors, a technology called 3LCD is used. 3LCD works like this: as before, you have a light source. The light shines through a series of dichroic mirrors. A dichroic mirror will reflect one wavelength in one direction while allowing the other wavelengths to pass through.

In this example, the first mirror the red wavelength is removed. This is then directed to an LCD panel. As with the previous projector and LCD monitors, the LCD panel determines what light goes through it. In this case, the only light going through is red light. To make the diagram simple, the red light is making a 90 degree turn. Clearly light goes in straight lines and does not make turns like this. In your projector the mirrors may be placed in varying different positions so the light can be bounced around to where it needs to be.

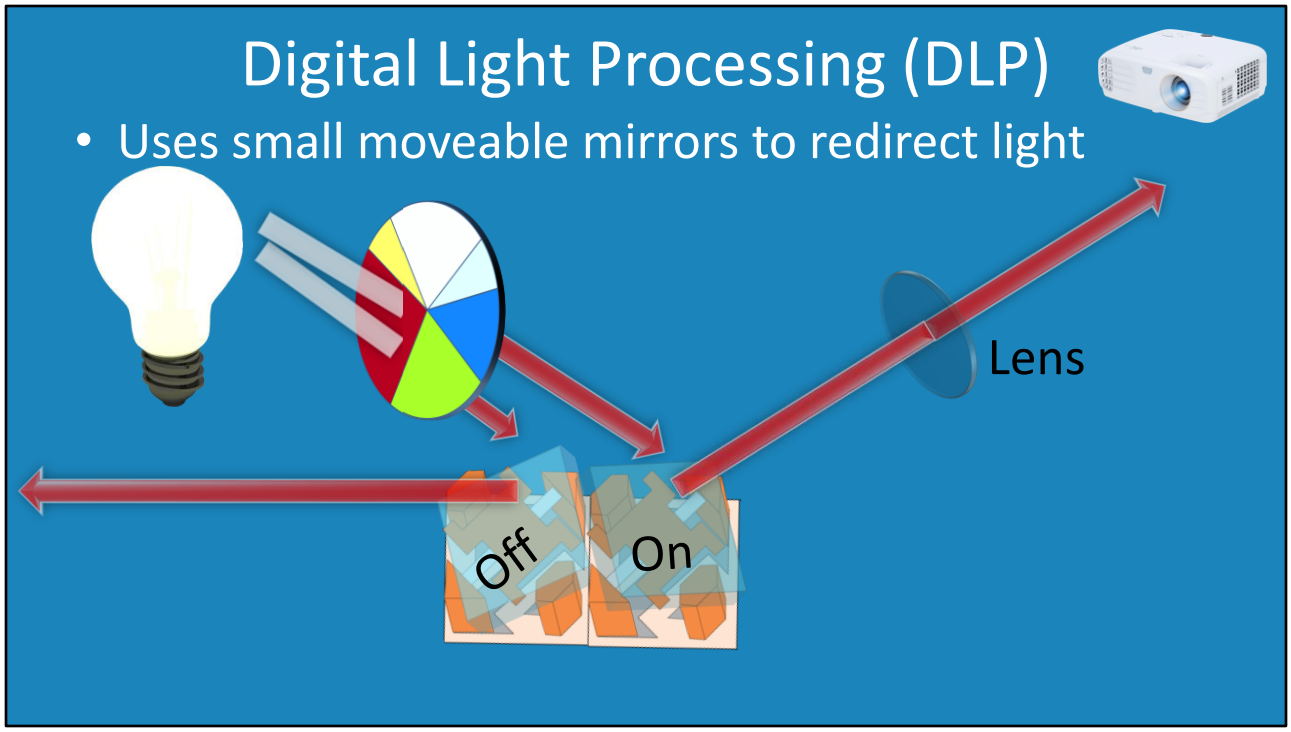
If you have not guessed already, the other two mirrors extract the green and blue light. As before, there are two LCD panels which determine what light is allowed through. So far we have separated the light into three different colors and controlled what light is allowed through. The next step is to combine the red, green and blue light back together.

To do this, a prism is used. The prism is a glass structure that divides light up into the visual spectrum, however if you use it in reverse, it combines the light back together. The light is then shone through a lens onto a screen.

This method gives better picture quality compared with using a color wheel. This is because the light is sent constantly rather than having to be timed with a color wheel. Also, each LCD panel

only needs to worry about one color, so this reduces how much each cell in the LCD panel has to change to show an image.

I have a prism that I have shone a white light on. You can see that, as the light goes through the prism, it gets split into different colors. 3LCD works by essentially sending red, green and blue light into a prism at right angles. This will reverse the process and the light will come out of the prism as white light, essentially combining red, green and blue back together.



5:46 The next projector technology that I will look at is Digital Light Processing or DLP. This technology uses tiny moveable mirrors to redirect light. Unlike LCD technology where you are blocking or allowing the light through, the light is reflected giving better results since it is easier to redirect light than block it. This gives better color reproduction than what is found with LCD. Let's have a look at how it works.

As before, you start with a light source. The light is projected through a rotating color wheel as was used in earlier LCD projectors. This is how a basic DLP projector works, however light could also be divided up into red, green and blue just like the 3LCD projector. This would give you better image quality, but as with the 3LCD, since there are 3DLP panels rather than one, it is going to cost more money.

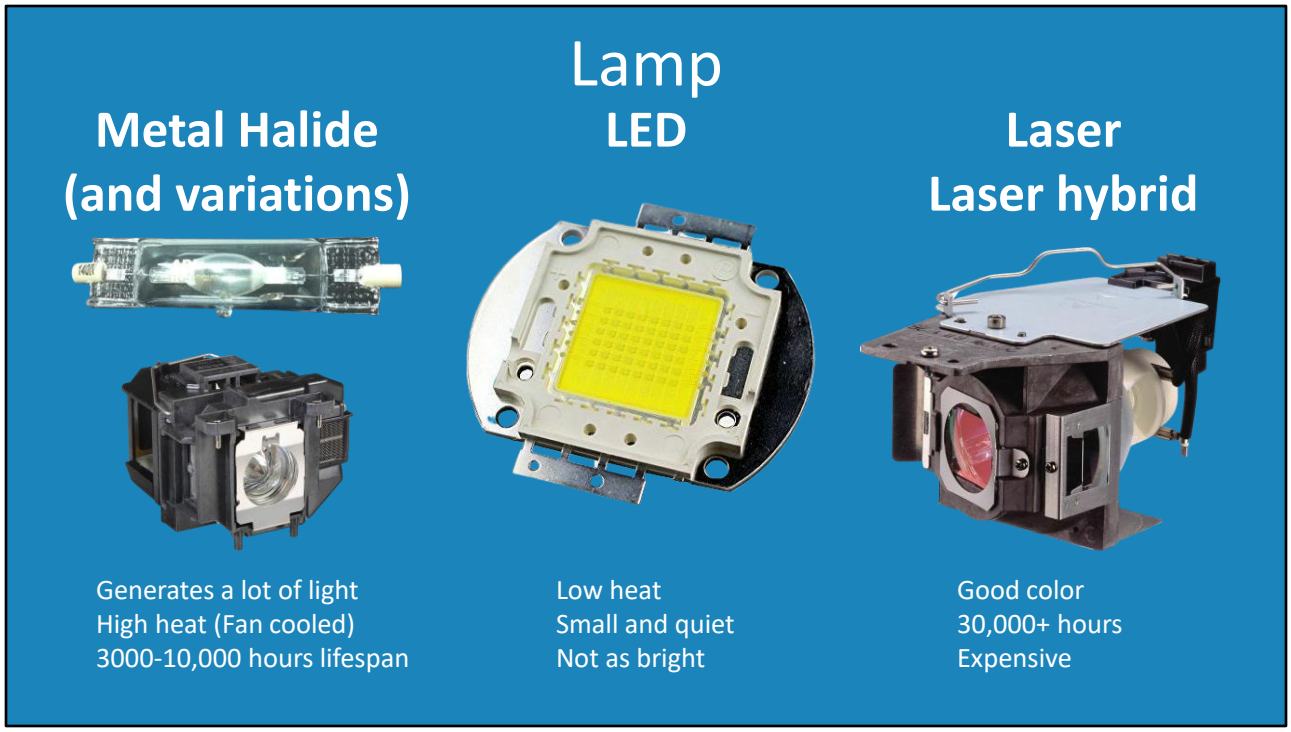
The light then hits the micromirror. For each pixel on the screen there is one micromirror. So, like LCD projectors, a DLP projector has a native resolution. You should, when possible, use the native resolution.

The tiny mirror can essentially be moved so it is either in the 'off' or the 'on' position. In the off position, the light will be reflected away so it is not part of the image. In the on position, the light is reflected to the lens and out of the projector to whatever it is being projected onto.

In order to produce different shades, the mirrors will oscillate from off to on. What shade is required will determine how quickly the mirrors will oscillate. To create little tiny mirrors (one for each pixel) plus the circuits to do this, is difficult. Thus, you can understand why this costs

more to make than LCD. Nowadays, DLP is used in most movie cinemas to project onto the big screen.

As LCD technology has improved, its quality has started to get closer to what can be achieved with DLP. An old DLP projector may not give as good results as a new LCD projector. If all things are considered equal, a DLP projector should be better than an LCD projector, but there are some other things you should look at when purchasing a projector.



8:11 The next thing to consider is the lamp that is used in the projector. The vast majority of projectors will use one of three types of basic lamps or a variation of them. When looking at a projector, it is nice to know what is inside the projector, but sometimes this can be difficult depending on what details the manufacturers provide. Later in the video I will look at what else you can look at to get any idea of what to buy.

The first is Metal Halide. This is one of the more common methods used in projectors. It is essentially a light bulb that can produce a lot of light. There have been a number of different variations like Ultra-high-performance bulbs. Essentially, they use the same principles as metal halide; however, some of the materials used to make the bulb are changed.

The advantage of these is they generate a lot of light. The disadvantage of them is that they generate a lot of heat. For this reason, they must be fan cooled. You will, however, find that all projectors are fan cooled, but metal halide ones generally generate more heat than the others. This is why you will often find that after you switch off a projector the fans will keep running in the projector for a while; this is done to cool down the bulb. This is why when you switch off a projector and the fan is still running, don't worry, as it will switch itself off after a while. Don't unplug the projector as this will affect its ability to cool the bulb down.

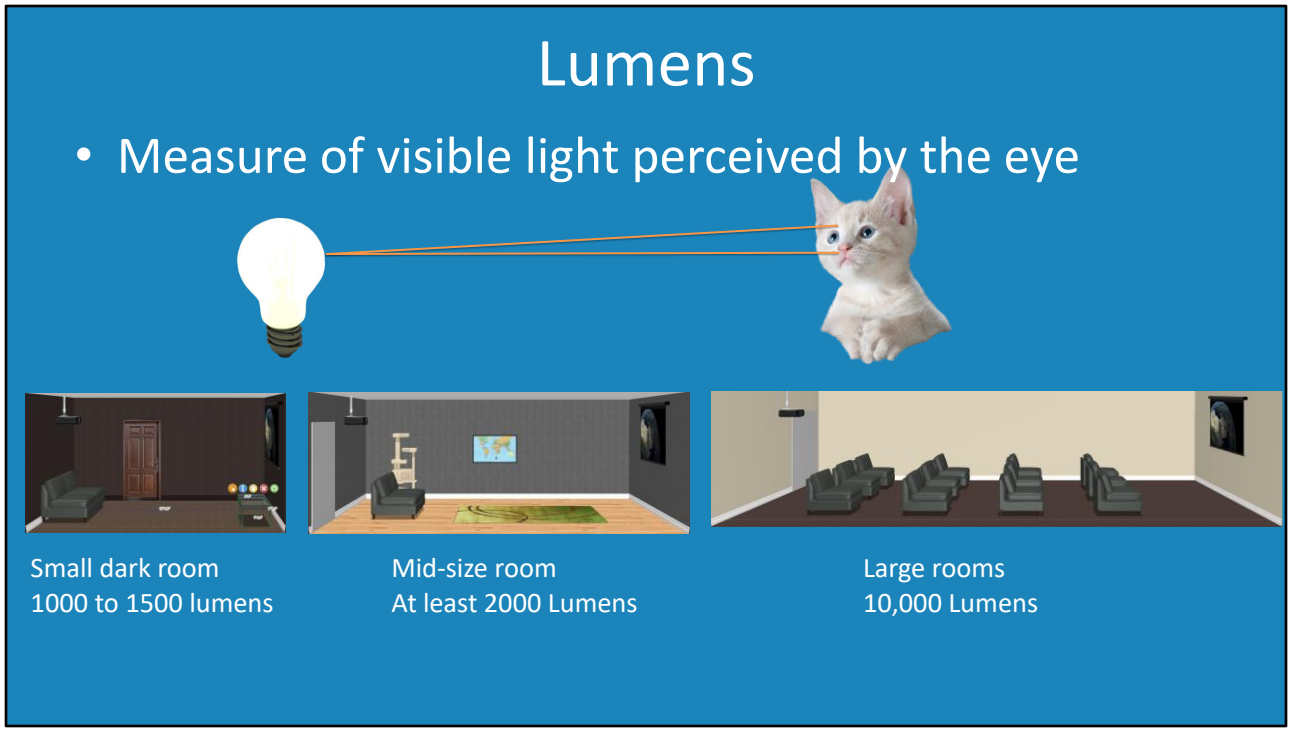
Depending on what the bulb is made of, the bulb will have anywhere from 3000 to 10,000 hours life span. This is an important thing to know, because the bulbs can be very expensive to replace. The light created by this lamp creates a smooth image rather than a sharp image.

The next type of lamp is LED. This uses an LED light rather than a bulb to generate the light. LED lights create a lot less heat than a bulb and are also smaller. The downside is that they are not as bright. LED lighting creates a sharper image and used to be a lot more expensive than metal halide. However, improvements in LED manufacturing have meant that prices have come down a lot from what they once were, meaning that they are only a little more expensive than metal halide.

The last type of lamp is Laser. This creates good color and good brightness. Lasers also last for 30,000 hours plus before they need to be replaced. Lasers however are more expensive than the other bulbs, although the price has been coming down. In some cases, the projector may use a hybrid design. For example, it may have a laser and LED combined to generate the light.

Keep in mind that the lamp in the projector can get very hot. If the lamp is hot, take care when handling it. It is advised to wait for the projector to cool down before moving it to reduce the chance of breaking the lamp. A replacement lamp can be quite expensive. In some projectors, there may be multiple lamps, one for each color.

It is sometimes difficult to determine what lamp is used in the projector. Some manufacturers will list it in in their specifications, others will just give you some specifications for the lamp but not tell you what it is. You may have to do some digging to figure out what it is. However, you can often look at some of the other specifications to help guide you towards what projector you should buy.



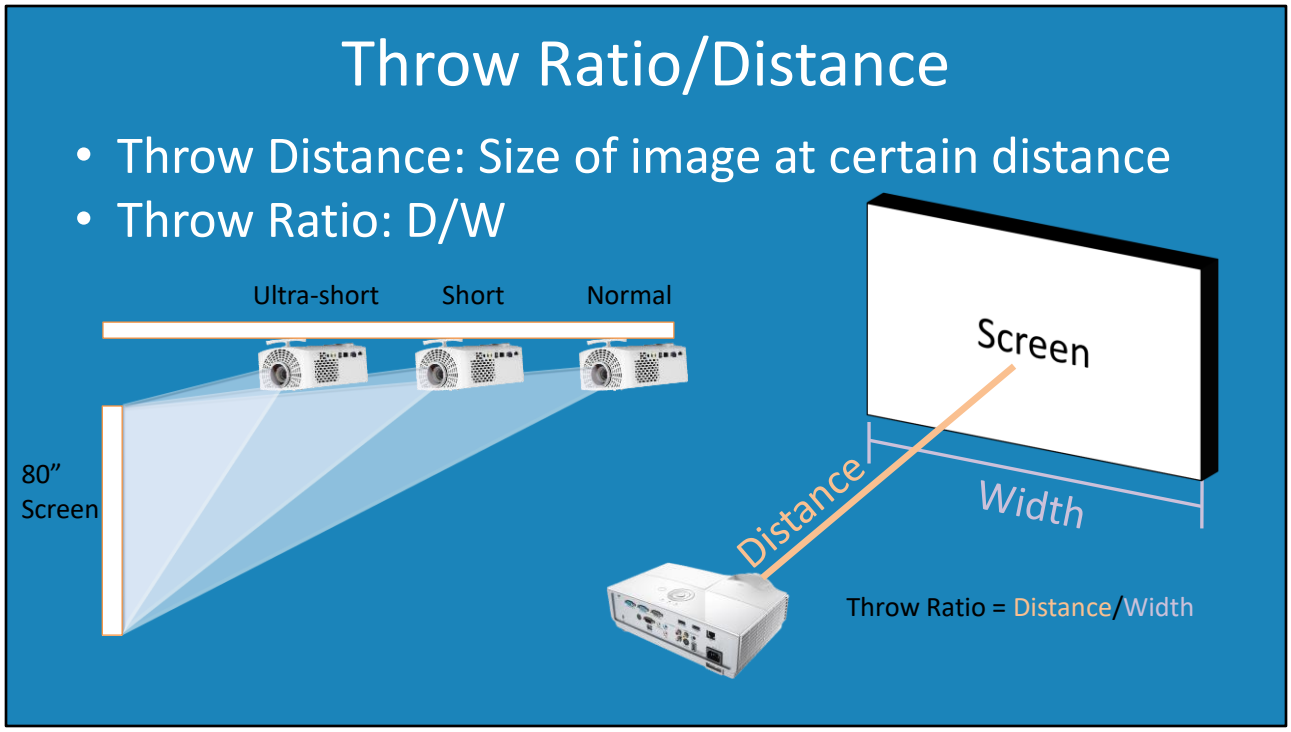
11:46 In the projector's specification there will be the brightness of the projector measured in lumens. A lumen is a measurement of the visible light that can be perceived by the eye. Lumens are quite a good way of measuring, as it does not consider light that humans can't see. For example, you could have a very bright bulb, but if it outputs mostly a wavelength that we can't see then it does not matter how bright it is. Essentially more lumens means a brighter projector which is better; however, more lumens also generally means more cost.

Room sizes vary and the brightness or darkness of the room will also affect how bright the projector will need to be. Mike Myers, in his CompTIA A+ Certification All-in-one exam guide, was nice enough to give a rough guide. As it is a rough guide, keep this in mind when selecting a projector.

For small dark rooms, 1000 to 1500 lumens will hopefully be enough. If you have windows that let the sunlight in, this will affect how well you can see the image. Hopefully, if this is a problem, your windows will have some blinds.

For a mid-size room, look at a projector that is at least 2000 lumens. Remember this is a rough guide, as one person's idea of a small room and a mid-size room may be different. For large rooms, you may be looking at about 10,000 lumens. A projector like this is going to cost a lot of money. Essentially the further the light has to travel, the brighter the projector will need to be.

In this example the projector is at one side of the room and the screen at the other. However, this may not always be the case. There is also another specification that you need to consider before purchasing a projector.



13:35 The last consideration I will look at when purchasing a projector is the ‘throw’. This is given as two different specifications, the first being throw distance, which is the size of an image at a certain distance. This specification will generally give a size of an image at the minimum and maximum distance that image can be projected and still give a good result.

When purchasing a projector, consider where you are going to place the screen and the projector. You want to place the projector within the throw distance to the screen. Also consider if the screen is too big or too small, the image will either be too big for the screen or too small.

The lens and brightness of the projector will determine the throw distance. You may see projectors such as an ultra-short throw projector. These projectors are designed to project at a very short distance; however, the price of the lens for these projectors is quite high.

Projectors can also come in short throws. These projectors can project a 100-inch image from four feet away. A normal throw for a projector will generally be about 12 feet or about 3.5 meters. It is important to consider the throw distance before purchasing a projector.

The next specification that I will look at is the ‘throw ratio’. This is the ratio between the distance from the lens to the screen and the size of the image. Essentially this will give you an idea of how far you need to place the projector from the screen. For example, a throw ratio of 2:1 would mean that, in order to display a one-foot image, you would need to be two feet away. Keep in mind that you need to consider how far the projector can project. This will

ultimately depend on the brightness of the projector and how dark the room is.

This concludes this video on projectors. I hope you have found this video informative and hope it assists you if you decide to purchase a projector. Until the next video from us, I would like to thank you for watching.

References
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