

How to Choose Between HD, 1080p and 4K When Buying a New Television

There are many options to choose from when purchasing a new television. In fact, there can be so many that it can be difficult to decipher. This document will clarify part of the confusing terminology you may encounter.

You may have heard of 1080p, HD, or 4K. But which should you choose? Is the bigger number always better, and is it worth the extra expense? There is a lot of jargon surrounding televisions. The ads, the store displays, everywhere you look you will see several bits of information. But what do all these terms mean, and how do you decipher which is better? And what factors should you consider when making your selection?

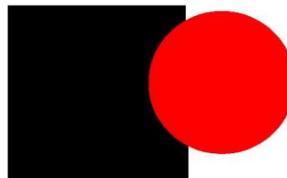
Before you continue, you should know that the terms HD, 1080p, FHD, High Definition, and Full HD are all referring to the same thing. HD and High Definition are also sometimes used for lower resolution, 720p screens, so read carefully when you see those terms. Otherwise, they are all the same. Likewise, 4K is also known as 4K UHD, UHD, or Ultra High Definition.

Confusing, right? Just know that from here on out you will see 1080p and 4K used, but everything applies to those other terms as well. Below you will find an explanation of some of the other jargon you may see, and what it means to you.

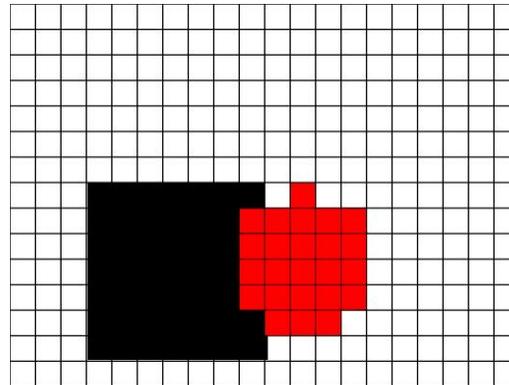
Resolution

When you see the terms 1080p or 4K, what they are referring to is the resolution of the screen. Resolution is the number of dots that make up the full image you see. Your television picture is made up of thousands of tiny dots, which are called pixels. Below is a simplified example of how this works.

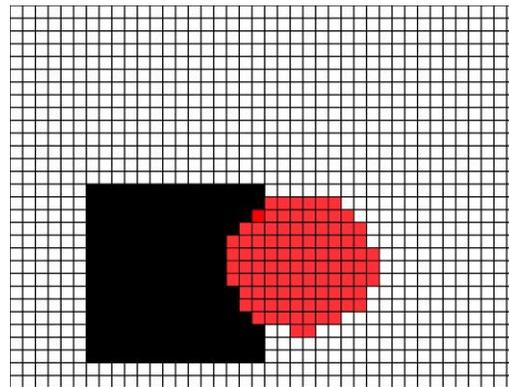
The original image that is recorded for broadcast might look like this:



With a 1080p screen it may look like this:
(Enlarged for illustration purposes, with a grid overlay to represent each pixel.)



With a 4K screen it may look like this:
(Enlarged for illustration purposes, with a grid overlay to represent each pixel.)



This is an exaggeration, but you can see that a 4K television, with a higher-resolution than 1080p, more accurately represents the original image. It's not perfect, but this correctly presents the difference between the two. The 4K has four times the number of pixels, meaning shapes on-screen are more accurately represented.

Of course, the higher-resolution makes little difference if the image it is given to show is not high-resolution. For the most part, a blocky image will display as a blocky image on even the highest resolution screens. There is something called upscaling, which can improve the look of a low resolution image on a higher-resolution screen. That will be briefly explained below, but for now just know that a low resolution *can* be displayed on a high-resolution screen, but a low resolution screen will never show a higher-resolution image at its full detail.

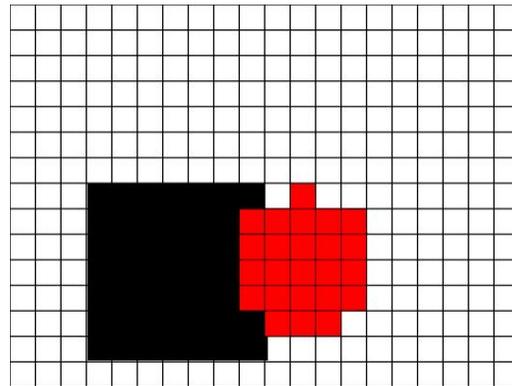
One thing to consider, when deciding what resolution to get, is the size of the screen. With a smaller television, you may not notice the difference between 1080p and 4K as much, but the larger your screen gets the more obvious it becomes, as the pixel size increases along with the screen size. You may get a

good enough picture quality with 1080p on a 24" television, but you will notice the jagged line effect more on a 55" television.

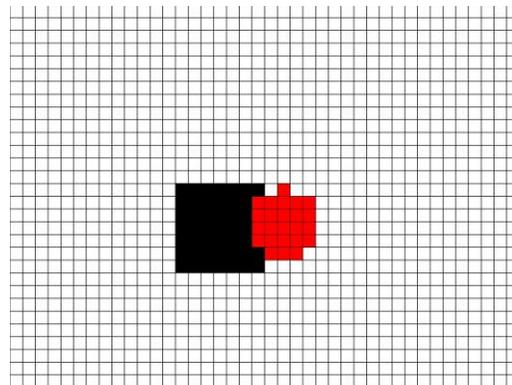
Upscaling

Related to resolution is upscaling. Upscaling is a process by which a television takes a lower resolution image and scales it up to fit the higher-resolution screen.

Let's say you get this image, designed for a 1080p screen.



If you did nothing except show the exact same image on a higher-resolution screen, such as a 4K, you'd get this image. The reason is that each pixel (represented by cells in the grid) is still only being presented once.



Basically, the image is presented in a small form, right in the middle of your screen when this happens. Instead of that, what higher-resolution television do is upscale the image. Using internal logic, they scale the image to the correct size for what it was supposed to be on the screen. Different manufacturers use different processes to accomplish this, and some are more effective than others.

Some televisions are able to not only make the image larger, but actually improve the image a certain amount. It does this using algorithms to smooth out the bumpy picture above, giving something much closer to what a native picture would have on that television. Different televisions use different processes to accomplish this, and the results vary.

Refresh Rate

Refresh rate, which may be shown as 60hz, 120hz, 240hz, or something similar, is simply the rate at which the television redraws the screen. A television that is 60hz will redraw the screen 60 times per second, a 120hz television will redraw it 120 times per second. If a refresh rate is too slow, the image may appear to blur or jump when showing motion. This is especially true if viewing something like a DVD or Blu-ray movie.

A standard television show may be broadcast at 30 or 60 frames per second (fps), and this can be shown with no problems at all on 60hz, 120hz, or even 240hz televisions. The way this is handled is this: if there are less frames per second than the refresh rate (number of redraws per second), then it duplicates, triples, etc., each image to fill the gaps. Both 30 and 60 divide evenly into 60, 120, or 240, so televisions with any of these refresh rates will handle 30 or 60fps content without issue.

Most movies, however, are filmed at 24fps. If you are viewing 24fps content on a screen that is 60hz, that means the television will need to somehow adapt that 24 frames into 60 images, since it redraws the screen 60 times per second. How this is done can differ from one television to the next, but most use something called a 3:2 pulldown.

A 3:2 pulldown is when a 60hz television inserts an uneven number of extra copies of the image shown in one frame between each actual frame. This is done in an alternating pattern, insert 2 one time, 1 the next. This allows 24 frames to be shown over the 60 redraws an even number of times.

In this example, the dark gray are the original images, the light are the duplicated images the television inserts between those to fill the remaining gaps during redraws.



You can see this will create an effect where frames are not shown at a steady rate. One frame will be displayed $3/60^{\text{th}}$ of a second (the image in the frame, with 2 duplicates to fill the time), the next $2/60^{\text{th}}$ (the image in the frame, then 1 duplicate to fill the time), the next $3/60^{\text{th}}$, etc. This is a tiny difference, but it may be noticeable at times.

A 120hz television will handle that same 24fps movie differently. Again, dark gray are the original images, light gray are the duplicated images the television draws in the time between frames.



As you can see, this creates a smoother image transition. Instead of seeing the same image for varying amounts of times, as is done in 60hz, you will always see the image $6/120^{\text{th}}$ of a second. This creates a smoother, more even transition from one frame to the next.

Motion Smoothing

Motion smoothing is a process some televisions implement to smooth out the transition from one frame to the next even more. To smooth out the movements, some televisions create a new intermediary image or images between the existing frames. Instead of repeating the image of a frame in a movie for $6/120^{\text{th}}$ of a second, as previously explained, they would insert an image that they generate, using complex algorithms to make a best guess at where things would be between one frame and the next. Through this process, they may limit the blur that can occur between frames in a standard broadcast.

The way this is done can vary. Different manufacturers have different ways of doing this. Some have varying levels of smoothing, which can be adjusted in the settings on the television.

But some people find motion smoothing distracting. Some feel it creates an experience that feels false, or too polished. It can be distracting and unpleasant to some. Generally speaking, it seems to work well where fast motion is expected, such as when watching sporting events, but can be more jarring when watching a typical television program. What one person finds jarring because it is too smooth, another person may like. Before you commit to a purchase, it is best to view a television to see if the motion smoothing that is used looks ok to you.

Final Thoughts

When it comes to selecting your television, you will now know a little more about what some of those numbers and jargon mean. The very best thing to do is to try to view a demonstration of each model you are considering, then weigh your viewing needs against the cost. Check online reviews to see if others have had any problems. Then make your selection, feeling confident that you know and understand what you are getting.