

4K vs HD TVs

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What is 4K TV?

- Standard HD TV is 1920 x 1080 pixels (= 2073600 Pixels and 16:9 aspect ratio – 1.777).
- 4K TV is either UHDTV - 3840 x 2160 = 8294400 pixels (exactly 4 times HD pixel count and still 16:9) or DCI 4096 x 2160 (slightly more than 16:9 aspect ratio at 1.896 or 17:9).
- 4096 x 2160 format is DCI (Digital Cinema Initiatives) standard for cinema projection.
- 3840 x 2160 pixels is more accurately called QFHD, or Quad Full HD.
- The term 4K is somewhat confusing as it is not 4K total pixels – only 4K horizontal pixels – Total pixel count is at least 8K pixels.

What is 8K Video?

- 8K Video is an experimental movie shooting and cinema projection system having 7680×4320 resolution (16 times that of 1080p HD) – an astonishing 33Mpixels/frame!
- 8K Digital Cinema projection is approximately equivalent to 70mm IMAX film.
- 4K Digital Cinema projection is approximately equivalent to standard 35mm cinema film. 4K Prosumer cameras are around \$7,000.
- Very few cameras can shoot in 8K (likely USD\$100,000+). There is some advantage to shooting movies in 8K since post-production for 4K cinema can use digital pan and zoom without significant video loss.

Digital Cinema Initiatives (DCI)

- Digital Cinema Initiatives, LLC (DCI) is a joint venture of major motion picture studios, formed to establish a standard architecture for digital cinema systems.
- The organization was formed in March 2002 by Metro-Goldwyn-Mayer, Paramount Pictures, Sony Pictures Entertainment, 20th Century Fox, Universal Studios, The Walt Disney Company, Warner Bros. and Lionsgate.
- The purpose of DCI is to establish specifications for an open architecture for digital cinema that ensures a uniform and high level of technical performance, reliability and quality.
- By establishing a common set of content requirements, distributors, studios, exhibitors, d-cinema manufacturers and vendors can be assured of interoperability and compatibility. Conformance to DCI's specifications is considered a requirement of software developers or equipment manufacturers targeting the digital cinema market.

Why Movie Makers Like 8K Video

- Currently, very few cameras can shoot in 8K. There is some advantage to shooting movies in 8K since post-production for 4K cinema can use digital pan and zoom without significant video loss.
- A major reason movie makers are pushing for 8K cameras is to get better 4K footage. Through the process of downsampling, using a higher resolution 8K image downsampled to 4K could create a sharper picture with richer colors than a 4K camera would be able to achieve on its own with a lower resolution sensor.

UHD – Ultra High Definition

- UHD – Ultra High Definition is a term defined in August 2012, by the Consumer Electronics Association (CEA) partly defined as resolutions of "at least 3,840 x 2,160 pixels".
- The idea was to replace the term 4K. The CEA's name lasted less than a day, as Sony then announced it was going to call the technology "4K Ultra High Definition". This is the term now used by most other TV manufacturers too.
- In practice, you will often see UHD used interchangeably with 4K, whether describing TVs, source devices, accessories or content.

Human Eye Limitations and Pixel Size

- The average person with 20/20 vision can resolve 1 arcminute. One arcminute is 1/60th of one degree.
- Consider viewing your TV at 9ft away.
One degree of arc at 108" = $2 \times \text{PI} \times 108" / 360 = 1.885"$
One minute of arc = $1.885" / 60 = 0.0314"$
- Consider 46" diaonal 16:9 TV = 39.68" W x 22.32" H
 $22.32" / 1080\text{p} = 0.0207"$ or $22.32" / 720\text{p} = 0.031"$
- So at 9ft away from a 50" TV, someone with 20/20 vision can just about resolve a 720p pixel, BUT NOT 1080p pixels!

There's Resolution and then There's Resolution!

- The basic resolution figures assume a single white (or black) line against a black (or white) background.
- What about adjacent multiple lines of maybe different colours? It becomes even more difficult for the eye to resolve that one minute arc.
- And if your vision is even slightly impaired, then you're totally out of luck resolving that one minute arc!

So is 4K for You?

- If your eye can't tell the difference between 720p and 1080p on nearly all modern televisions, what's the need for 4K?
- Excellent question. There isn't a need! Not as far as TVs go, anyway. You'd need a 2,160p TV over 154 inches diagonal before you'd be able to see the pixels. On a 4K 50-inch TV, the pixels would be roughly 0.011 inch wide!!
- Where's the crossover where 1080p and 4K become noticeable? It's not exact but suffice it to say at 10 feet, it's somewhere well above 77 inches.

4K Projectors

- The 4K standard is already here in the home projector space.
- Sony makes a \$25K projector that's native 4K, while JVC has several models with the "e-Shift" pixel up-converter that puts 3,840 x 2,160 pixels on screen even though the LCOS chips are 1,920 x 1,080 pixels.
- A case can be made for 4K with larger screens at home. At the moment, though, light output limits screen size far more than resolution. For home projectors, let's just shrug and ask, "OK, why not?"

4K Source Material

- Currently very few movies or any other material are available in 4K.
- Today's physical delivery media e.g. Blu-Ray discs cannot accommodate 4K video of any significant length.
- Likely delivery media is on-line streaming – but you are going to need unlimited Internet bandwidth from your ISP!
- There are a very few Netflix movies available in 4K.

4K TV Summary

- While 4K resolution makes perfect sense for huge theatrical screens, its benefits are less visible on TVs at home, watched from normal seating distances.
- "There was a huge, noticeable leap from standard definition to HD, but the difference between 1080p and 4K is not as marked," said researcher Dave Lamb of 3M Laboratories.
- He added that "4K is at the point of diminishing returns," but said there could be some benefits for screens over 55 inches.
- Currently very limited source material.