

# What is Ultra High Definition and Why Does it Matter?

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## Introduction

The term “high definition” is a now-ubiquitous phrase which took the consumer electronics world by storm in the late ‘90s and early ‘2000s when the digital transition began and televisions moved away from analog and towards digital. These days, a new term is emerging: “Ultra High Definition” or “Ultra HD.” But for many home viewers who have only recently adopted HDTV and grown accustomed to the superior picture quality, the features and advantages of Ultra HD might still be a mystery.

To begin with, this paper will first address the terminology associated with this technology. There have been many terms used and can cause some confusion even for the technology enthusiast. Terms such as “ultra high definition,” “UHD,” “UHDTV” and “4K” are all flooding the market. CEA recently determined that “Ultra HD” should be the term used by the industry when referring to 4K and 8K resolution and will be used in this whitepaper.

In order to understand Ultra HD, it is important to first understand what came before it – as well as some of the basics of video images. Simply put, video images are an array of a bunch of dots (think of the famous artist Georges Seurat and his style of art, called pointillism). These dots are called pixels (short for picture element), and the more pixels per square inch – which is to say, the higher the resolution – the sharper the image.

High Resolution Image



Low Resolution Image



For many years, the total number of pixels in a television image (no matter the size) was just over 300,000 [this was known as “standard definition television”]. For a small television, the image wasn’t bad. However, the larger the screen, the further back you had to stand to clearly see the picture. Thus, television engineers began working on how to get a clearer image, particularly on bigger screens. Enter high definition, which, at just over 2 million total pixels, has a resolution that is about 6.5 times that of a standard-definition picture.

The resolution most often referred to is 1080p (which is 1920 vertical lines x 1080 horizontal lines), and is currently the best available picture for consumer television. For comparison's sake, this is approximately equivalent to the resolution of photos taken by a 2-megapixel camera.

Therefore, engineers have been working on a new standard for viewing, called Ultra High Definition (Ultra HD), which has four times the resolution of a 1080p display (3840 x 2160) and is equivalent to an 8-megapixel image. What this means for the TV viewer is that the image will be extremely sharp even when one is viewing from a very close distance. On a 1080p display, viewers who sit too close to the screen will see little squares which are actually the spaces between the pixels. On an Ultra HD display, the pixels are so small that it would take a magnifying glass to view the space between them at normal viewing distances. Simply viewing on an Ultra HD display does not automatically guarantee a better image, because there are many other variables, such as transmission quality and the actual content, but it certainly improves the possibilities.



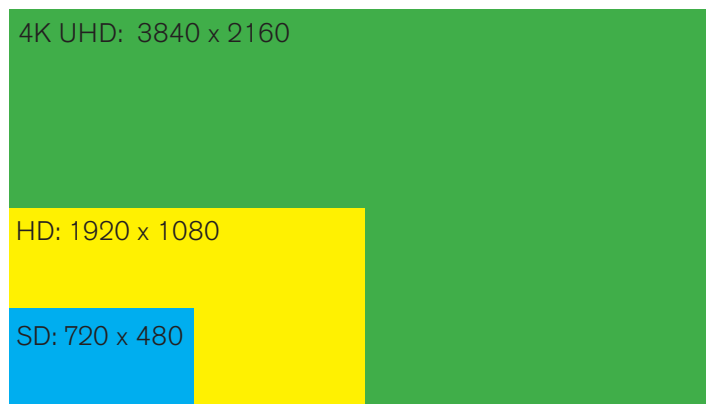
## Is there a noticeable difference between 1080p and Ultra HD?

There are some variables which affect the visual experience, but if set up correctly, the benefits of the superior resolution are plainly apparent. The major benefit of advanced Ultra HD resolution is being able to enjoy a much larger TV in a consumer's current room - consumer's rooms that were best suited for a 42" in HD will easily accommodate 65", 70" or even the 84" or 85" Ultra HD TV. The biggest factor in achieving this benefit is choosing the correct size screen based on the seating distance in the room. If planned properly, an Ultra HD system can offer a cinematic experience that is similar to the viewing experience IMAX offers in movie theaters.

As with IMAX, the Ultra HD experience is all about enabling viewers to sit closer to larger screens than would be possible if they were viewing the average 1080p picture. At a viewing distance of five feet or more, the viewer may not notice a difference between 1080p and Ultra HD on an 80-inch display but at closer viewing distances, the difference becomes clearer.

For the average consumer with a 1080p display, the seating distance should be three times the height of the display. This equation places the viewer far enough from the display that the spaces between the pixels are not visible. For an Ultra HD screen, the minimum seating distance reduces to an estimated one-and-a-half times the screen height. With such a close seating distance, the consumer can achieve a truly immersive viewing experience with a very large field of view, all without sacrificing image quality.

For more on the relationship between screen size and seating distance, see CEDIA's "Selecting Display Size based on Room Size and Seating" white paper, which examines how visual acuity and viewing angles determine how much detail an individual can see on the screen.



## What kind of Ultra HD products are available?

Ultra HD-capable televisions are now available from a wide variety of brands, and in a wide range of sizes from 55" to 84" and larger. For those wanting even larger screens, 4K front screen projectors are also available to literally bring the quality of size of the cinema experience right in to your home. . These sets not only support native Ultra HD content, but virtually all of them upscale 2D and 3D HD content and contain "Smart TV" features as well as digital streaming services.

### 4K Content Production

According to Tom Cosgrove, CEO of the 3Net network, consumer adoption of Ultra HD will depend on "a combination of education, demonstration, price, and believing that there's something compelling to watch" (1). There are currently several different native Ultra HD productions being developed, such as 3Net's Space, and some 4K Hollywood productions have already been released, such as The Hobbit. Additionally, more than 75 new or remastered films have been released thus far by the major studios in Ultra HD, for digital cinema exhibition and are already becoming available in the consumer market as well (2).

There is also progress in building the systems that will bring Ultra HD content into your home. Netflix has stated that they would begin offering Ultra HD streaming in the next year or so. In addition, DirecTV and other service providers are also entering the Ultra HD-4K arena with plans to deliver Ultra HD in 2016.

Another advantage to the Ultra HD format is that it will be the first digital format on the consumer market that can fully capture and convey all the tiny nuances and bits of information from original 35mm negatives. Classic films such as Lawrence of Arabia and new releases like About Last Night are being converted and enhanced to be shown in Ultra HD. Companies such as Sony Pictures, Warner Brothers, and Legendary Pictures are all working to expand their library of 4K content and to provide systems to deliver it to the home.

## Are There Special Considerations to Ultra HD Displays and Content?

One of the issues yet to be solved is how to deliver the significantly higher data required to deliver Ultra HD to the home. Content providers, such as cable/satellite companies and streaming services such as Netflix, as well as manufacturers of optical disc formats like Blu-ray discs and DVDs, and others in the industry are hard at work on developing and standardizing the best and most efficient way to get content to Ultra HD displays. For example, the Blu-ray Disc Association (BDA) recently established a task force to study possible format extensions and new Ultra HD standards. This may take some time, but consumers can look for the results of this work to be available in the marketplace within the next 18 to 24 months, if not sooner.

## The Benefits of Ultra HD

Besides being able to deliver images that look better on larger screens than their smaller 1080P HD counterparts, Ultra HD has the capability to offer increased frame rates and wider color gamut possibilities so that all forms of video content such as sports, live events, and even digital photos will create a more immersive and realistic image than ever before. Increased frame rates allow for the smoother appearance of fast moving objects, which helps make sports and games more enjoyable. The wider color gamut and increased color depth found in many new Ultra HD displays will more accurately reproduce an increased color palate making it possible to present more vibrant and realistic colors than conventional high definition displays. By increasing the number of pixels and allowing a greater range of colors for each pixel, the images seen on an Ultra HD display will be deeper, brighter and sharper than ever before.

Additionally, Ultra HD capable systems with the appropriate external switchers can display up to four HD images at once. This means that a viewer can watch four different games, news stations, or other media sources on the same screen when their system is properly installed and configured.

## Common questions:

### Can I enjoy Ultra HD now even though there is not a lot of 4K content available to the consumer?

This is a valid question, and one that revolves around early adopters and technology. While it is true that there is a limited amount of Ultra HD content available today, the amount is growing at a steady rate. The good news is that many studios have been recording content in Ultra HD type formats for quite some time and once Ultra HD takes off, they will be able to quickly and moderately easily distribute their content across the globe. More importantly, the ability of a Ultra HD display to upscale HD content to Ultra HD means that almost anything you watch will look better on an Ultra HD set.

### What about obsolescence?

Another question that is often asked is what is the next step beyond Ultra HD? Will my television become obsolete in a matter of a few years? While it is impossible to predict, it appears that nothing beyond Ultra HD will be available to consumers until 2020. There are prototype "8K" displays which display 4 times more pixels than their Ultra HD counterparts, but on a practical and affordable level it will be close to a decade out before those will become mainstream adoption.

### Can I keep my existing home entertainment system when I upgrade to Ultra HD?

This answer is a little tricky because each entertainment system varies based on the parts and materials that comprise the system. Your existing AV receiver, if you have one, may or may not be able to pass Ultra HD signals. The peripheral devices may or may not connect directly to the television. As for your cables, according to HDMI.org, the HDMI 2.0 specification which defines support Ultra HD signals, states that current HDMI cables marked “High-Speed” should be able to support Ultra HD. See the “What are my next steps?” section for more information.

### What about new audio standards?

While this paper will focus on the video portion of televisions, it is worth stating that there are new audio formats that are coming out that will enhance the auditory experience as much as Ultra HD will improve the visual experience. Look for future CEDIA whitepapers which discuss the next generation of audio formats.

## What are my next steps?

Switching over to Ultra HD will require some expertise from a professional but the benefits are there and getting better. Determining the right screen size, the proper placement, and transport of content to the display require greater consideration and expertise than a typical 1080p display. Your best bet is to contact your local CEDIA member home technology professional, which you can find at <http://www.cedia.org/find-a-edia-professional>.

## Resources

1. Digital Entertainment Group. DEG Quarterly. Winter 2013. <http://www.degonline.org/>
2. 4K Digital Cinema Titles. October 14, 2013. <http://pro.sony.com/bbsc/ssr/mkt-digitalcinema/resource.latest.bbsscms-assets-mkt-digicinema-latest-Sony4KDigitalCinemaTitles.shtml#2013>

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