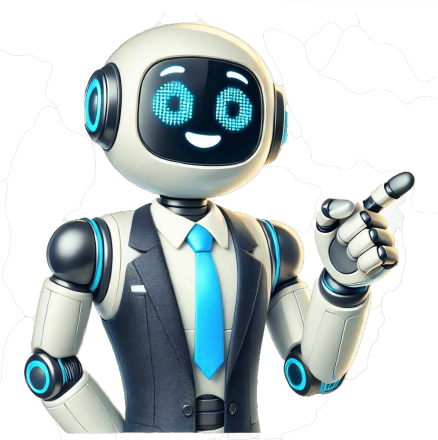


I'm not a bot



[illegible]

a 2718x1528 pixel structure. The amount of data these projectors process is twice 4K, but they overlap the pixels, which is what pixel shifting is. In fact, each of those pixels is far larger. In fact, each one has 50% more area than true 4K. Pixel shifting projectors. This way, they project a pixel and shift it up to the right by a half diameter and project it again with modified data—second pixel overlaid on the first. This would result in adjacent red and green pixels effectively forming yellow, with a fringe on one side of red on the other of green—except that the fringe takes on another color as the next line of pixels overlaps too. 4K UHD or 1080p pixel shifting cannot reveal the fine detail on a true 4K projector such as those Sony ships in the business, education, and home markets. JVC has one true 4K at \$35,000 (in mid-2017) and another for \$120,000.[citation needed] While projecting UHD, it might look as though the pixel structures would have 1/4 the area of 1080p; it just doesn't happen with pixel shifting. That much resolution is only carried by a true 4K projector. This is why "true" 4K costs so much more than 4K UHD projectors that have more or less similar feature sets. They produce smaller pixels, finer resolution—no loss of detail or color from the overlapping pixels. This is in stark contrast to the small variation in the aspect ratio difference, which would be capable of being noticeable in a few companies, such as Kaleidescape, offering media servers that enable 4K UHD Blu-ray movies with a wide dynamic range in a home theater.[95] In November 2014, American satellite provider DirecTV (owned by AT&T) became the first pay-TV provider to offer access to 4K content, although limited to selected video-on-demand films.[96] In August 2015, British sports network BT Sport launched a 4K feed, with its first broadcast being the 2015 FA Community Shield football match. Two production units were used, producing the traditional broadcast in high-definition, and a separate 4K broadcast. As the network did not want to mix 4K footage with upconverted HD footage, this telecast did not feature traditional studio segments at pre-game or half-time, but those hosted from the stadium by the match commentators using a 4K camera. BT envisioned that if viewers wanted to watch studio analysis, they would switch to the HD broadcast and then back for the game. Footage was compressed using H.264 encoders and transmitted to BT Tower, where it was then transmitted back to BT Sport studios and decompressed for distribution, via 4K-compatible BT TV set-top boxes on an eligible BT Infinity internet plan with at least a 25 Mbit/s connection.[97][98] In late 2015 and January 2016, three of Canada's television providers – including Quebec-based Vidéotron, Ontario-based Rogers Cable, and Bell Fibe TV, announced that they would begin to offer 4K compatible set-top boxes that can stream 4K content to subscribers over gigabit internet service.[99][100] On October 5, 2015, alongside the announcement of its 4K set-top box and gigabit internet, Canadian media conglomerate Rogers Communications announced that it planned to produce 101 sports telecasts in 4K in 2016 via its Sportsnet division, including all Toronto Blue Jays home games, and "marquee" National Hockey League games beginning in January 2016. Bell Media announced via its TSN division a slate of 4K telecasts to begin on January 20, 2016, including selected Toronto Raptors games and regional NHL games.[101][102][103] On January 14, 2016, in cooperation with BT Sport, Sportsnet broadcast the first ever NBA game produced in 4K – a Toronto Raptors/Orlando Magic game at O2 Arena in London, England. On January 20, also during a Raptors game, TSN presented the first live 4K telecast produced in North America. [99][101][104] Three days later, Sportsnet presented the first NHL game in 4K.[105] Dome Productions, a joint venture of Bell Media and Rogers Media (the respective owners of TSN and Sportsnet), constructed a "side-by-side" 4K mobile production unit shared by Sportsnet and TSN's first 4K telecasts; it was designed to operate alongside a separate HD truck and utilize cameras capable of output in both formats.[106] For the opening game of the 2016 Toronto Blue Jays season, Dome constructed "Trillium" – a production truck integrating both 4K and 1080i high-definition units.[107] Bell Media's CTV also broadcast the 2016 Juno Awards in 4K as the first awards show presented in the format. [108] In February 2016, Spanish-language Univision trailed 4K by producing a closed-circuit TV broadcast of a football friendly between the national teams of Mexico and Senegal from Miami (America) in the format. The broadcast was streamed privately to several special viewing locations. Univision aimed to develop a 4K streaming app to publicly televise the final of Copa América Centenario in 4K.[109][110][111] In March 2016, DirecTV and CBS Sports announced that they would produce the "Amen Corner" supplemental coverage from the Masters golf tournament in 4K.[112][113] In late 2016, Telus TV announced that they would begin to offer 4K compatible set-top boxes.[114] After having trialed the technology in limited matches at the 2013 FIFA Confederations Cup.[115] and the 2014 FIFA World Cup (via private tests and public viewings in the host city of Rio de Janeiro).[116] the 2018 FIFA World Cup was the first FIFA World Cup in which all matches were produced in 4K. Host Broadcasting Services stated that at least 75% of the broadcast cut on each match would come from 4K cameras (covering the majority of main angles), with instant replays and some camera angles being upconverted from 1080p sources. These broadcasts were made available from selected rightsholders, such as the BBC in the UK, and selected television providers in the United States.[117][118][119] Technical limitations in distributing 4K broadcasts (including the increased cost of 4K-compatible production equipment)[120] have led to some broadcasters deciding against the format in favour of emphasizing 1080p/HDR broadcasts instead. After having broadcast UEFA Euro and the Champions League final in the format, UEFA discontinued 4K coverage for both in 2024, as broadcasters elected to put resources behind HDR and other on-air features instead.[121] Some U.S. broadcasters, such as CBS Sports,[122][123] Fox Sports,[124] and USA Network[125] have broadcast events promoted as having "4K" feeds, but are actually 1080p/HDR broadcasts upconverted to 4K. For the 2024 Summer Olympics, USA Network's "4K" coverage was sourced from host broadcaster Olympic Broadcasting Services (OBS) in 4K, but downconverted to 1080p when received by NBC Sports' studios, and then upconverted to 4K for distribution.[125] Examples of some 4K resolutions used in displays and media Format Resolution Aspect Pixels - 4096 × 3072 1.33 4:3 12,582,912 - 4096 × 2560 1.6 16:10 10,485,760 - 4096 × 2304 1.77 16:9 9,437,184 DCI 4K (full frame) 4096 × 2160 ≈1.90 256:135 8,847,360 DCI 4K (CinemaScope cropped) 4096 × 1716 ≈2.39 1024:429 7,020,544 DCI 4K (flat cropped) 3996 × 2160 1.85 37:20 8,631,360 WQUXGA 3840 × 2400 1.6 16:10 9,216,000 4K UHD 3840 × 2160 1.77 16:9 8,294,400 - 3840 × 1920 2.0 21:7 7,372,800 - 3840 × 1600 2.4 12:5 6,144,000 DFHD 3840 × 1080 3.55 32:9 4,147,200 The resolution of 3840 × 2160 is the dominant 4K resolution in the consumer media and display industries. This is the resolution of the UHDTV1 format defined in SMPTE ST 2036-1. [15] as well as the 4K UHDTV format defined by ITU-R in Dec. 2020 [16] and is also the minimum of Ultra HD displays and projectors.[21] The transition from 3840 × 2160 was also chosen by the DVB project for their 4K broadcasting standard, UHD-1.[56] This resolution has an aspect ratio of 16:9, with 8,294,400 total pixels. It is exactly double the horizontal and vertical resolution of 1080p (1920 × 1080) for a total of 4 times as many pixels, and triple the horizontal and vertical resolution of 720p (1280 × 720) for a total of 9 times as many pixels. It is sometimes referred to as "2160p", based on the naming patterns established by the previous 720p and 1080p HDTV standards. In 2013, televisions capable of displaying UHD resolutions were seen by consumer electronics companies as the next trigger for an upgrade cycle after a lack of consumer interest in 3D television.[126] This resolution is used mainly in digital cinema production, and has a total of 8,847,360 pixels with an aspect ratio of 256:135 (≈19:10). It was standardized as the resolution of the 4K container format defined by Digital Cinema Initiatives in the Digital Cinema System specification, and is the native resolution of all DCI-compliant 4K digital projectors and monitors.[6] The DCI specification allows several different resolutions for the content inside the container, depending on the desired aspect ratio. The allowed resolutions are defined in SMPTE 428-1:[6]:\$3.2.1[7]-p. 6 4096 × 2160 (full frame, 256:135 or ≈1.90:1 aspect ratio) 3996 × 2160 (flat crop, 1.85:1 aspect ratio) 4096 × 1716 (CinemaScope crop, ≈2.39:1 aspect ratio) The DCI 4K standard has twice the horizontal and vertical resolution of DCI 2K (2048 × 1080), with four times as many pixels overall. Digital movies made in 4K may be produced, scanned, or stored in a number of other resolutions depending on what storage aspect ratio is used.[127][128] In the digital cinema production chain, a resolution of 4096 × 3112 is often used for acquiring "open gate" or anamorphic input material, a resolution based on the historical resolution of scanned Super 35 mm film.[129] Various other non-standardized 4K resolutions have been used in displays, including: 4096 × 2560 (1.60:1 or 16:10); this resolution was used in the Canon DP-V3010, a 30-inch (76 cm) 4K reference monitor designed for reviewing cinema footage in post-production, released in 2013.[130] 4096 × 2304 (1.77:1 or 16:9); this resolution was used in the 21.5-inch (55 cm) LG UltraFine 22MD4KA 4K monitor, jointly announced by LG and Apple in 2016[131] and used in the 21.5" 4K Retina iMac computer. 3840 × 2400 (1.60:1 or 16:10); this resolution was used in the 22.2-inch (56 cm) IBM T220 and T221 monitors, released in 2001 and 2002 respectively. This resolution is also referred to as "WOUXGA", and is four times the resolution of WUXGA (1920 × 1080).[132] More recently, this resolution has returned in the Dell XPS Laptop series, under the name "UHD+".[133] 3840 × 1920 (2:1 or 16:8); this resolution is largely used by 360° videos[134] as they largely use a 2:1 aspect ratio. The reason is to represent a 360° on the horizontal axis and a 180° on the vertical. 3840 × 1600 (2.40:1 or 12:5); a number of computer monitors with this resolution have been produced, the first being the 37.5-inch (95 cm) LG 38UC99-W released in 2016. This resolution is equivalent to WQXGA (2560 × 1600) extended in width by 50%, or 3840 × 2160 reduced in height by ≈26%.[135] LG refers to this resolution as "WOHD+" (Wide Quad HD+).[136] while Acer uses the term "UW-QHD+" (Ultra-wide Quad HD+)[137] and some media outlets have used the term "UW4K" (Ultra-wide 4K).[138][139] 3840 × 1080 (3.55:1 or 32:9); this resolution was first used in the Samsung C49HG70, a 49-inch (120 cm) curved gaming monitor released in 2017. This resolution is equivalent to dual 1080p displays (1920 × 1080) side-by-side, but with no border interrupting the image. It is also exactly one half of a 4K UHD (3840 × 2160) display. Samsung refers to this resolution as "DFHD" (Dual Full HD).[140] Sony Handycam FDR-AX1 See also: List of 4K video recording devices The main advantage of recording video at the 4K standard is that fine spatial detail is resolved well.[141] Individual still frames extracted from 3840x2160-pixel video footage can act as 8.3 megapixel still photographs, while only 2.1 megapixels at 1080p and 0.9 megapixels at 720p. If the final video resolution is reduced to 2K from a 4K recording, more detail is apparent than would have been achieved from a native 2K recording.[141] Increased fineness and contrast is then possible with output to DVD and Blu-ray.[142] Some cinematographers record at 4K with the Super 35 film format to offset any resolution loss that may occur during video processing.[143] In full size, this image is trialed the technology in limited matches at the 2013 FIFA Confederations Cup.[115] and the 2014 FIFA World Cup (via private tests and public viewings in the host city of Rio de Janeiro).[116] the 2018 FIFA World Cup was the first FIFA World Cup in which all matches were produced in 4K. Host Broadcasting Services stated that at least 75% of the brightness information.[144] For 3840 × 2160 video, this means that the color information is only stored at 1920 × 1080.[145] Consumer cameras and mobile phones record 2160p footage at much higher bit rates (usually 50 to 100 Mbit/s) than 1080p (usually 10 to 30 Mbit/s). This higher bit rate reduces the visibility of compression artifacts, even if viewed on monitors with a lower resolution than 2160p. Film portalTelevision portal 1080p Full HD - digital video format with a resolution of 1920 × 1080, with vertical resolution of 1080 lines 1440p (WOHD) - vertical resolution of 1440 lines List of 4K video recording devices 2K resolution - digital video formats with a horizontal resolution of around 2,000 pixels 5K resolution - digital video formats with a horizontal resolution of around 5,000 pixels, aimed at non-television computer monitor usage 8K resolution - digital video formats with a horizontal resolution of around 8,000 pixels 10K resolution - digital video formats with a horizontal resolution of around 10,000 pixels 16K resolution - experimental VR format 32K resolution Aspect ratio (image) - proportional relationship between an image's width and height Digital cinema Display resolution standards High Efficiency Video Coding (HEVC) - video standard that supports 4K & 8K UHDTV and resolutions up to 8192 × 4320 Rec. 2020 - ITU-R recommendation for UHDTV, defining formats with resolutions of 4K (3840 × 2160) and 8K (7680 × 4320) Ultrawide formats ~ Goulekas, Karen (2001). 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