

Technological innovation in modern digital television image

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Abstract:

The television image has become one of the most important tools of visual communication and self-expression in contemporary cultures, and has entered the modern video production techniques in various fields. With the development of digital systems for the production of television image, technological innovation has become an essential part in the production of modern television image. The research covers the latest technology in the television image industry from the production stage, and even the display on different screens.

The research problem stems from how to obtain the highest possible quality of television image in various stages and even display on the screen? and how to choose devices and tools and modern methods to ensure that?

The research aims mainly to identify the latest equipment and modern technology in the manufacture of television cameras as well as the development in the broadcasters and television.

The research is presented to the high dynamic range video technology, which is going to be the biggest qualitative change in TV quality since color, offering the better contrast, greater brightness levels, a wider color palette and the maximum depth possible, which increases the creative space of the various television productions.

The research has displayed the technology of modern television screens and their ability to display the high-quality television image in full detail (Light Field capture system) and the emergence of a new generation of television screens in a new technology different from the previous one, that carries high degrees of quality, high color accuracy, high contrast and ability to deal with modern television systems.

The study recommends the need to follow the latest global technology in the TV image to be applied at the local level and the consequent fundamental changes in the broadcasting, transmission and reception systems to keep abreast of the fundamental changes in the television image industry. It is also recommended that symposia, conferences and external missions should be conducted to increase the awareness, in order to achieve the highest possible creative space in the fields of television production.

Keywords:

Resolution – 8k – HDR – QLED – TV technology

Introduction

Video production has become one of the most important tools of communication and self-expression in contemporary culture, video production technologies are now found in various environments, including educational institutions, government agencies, corporate environments and individual homes. With the development of digital systems for the TV image industry, and due to the constant competition between different media, technological

innovation has become an essential part of the modern digital TV image production system. The TV industry goes through many devices and many steps before watching it on the screen, the research will address the latest developments of this technology to develop the form of television image presented through its various stages.

Research problem

The problem of the research is how to get the best TV picture with the highest possible quality, and what are the modern technology and devices that can achieve this, until the television picture appears in its final form.

Research goals

The research aims at many points including:

- 1- Recognition of the latest high quality television cameras that are being used in modern digital TV production.
- 2- Learn about the new technology of television broadcasting and transmitting to send TV signals to ensure their quality.
- 3- Introducing the new technology in TV screens, create an awareness of the differences between them and determining the most suitable for the methods of broadcasting and receiving television signals.
- 4- To identify the modern non-traditional methods and devices that has entered the field of modern image television production and its effect on the process of television creativity

Research hypotheses and questions

- 1- Modern digital Television cameras are evolving basically due to the development of their own sensors.
- 2- Current TV broadcasting and transmitting technology is unable to deliver television image in their full quality.
- 3- Current TV screens and receivers must be changed to allow reception and display of the high quality picture of the TV image.
- 4- The highest quality TV image can be applied to non-TV screens such as tablets, IPad and smart phones.
- 5- What is the highest quality of current digital TV image? And what measures and changes should be made to see the TV picture in its full quality closer to reality?
- 6- Does the development of modern TV technology increase the creative space in the TV production process?

Research Methodology

The research followed the descriptive analytical method, based on the definition, description and analysis of the television image technology and its used devices, and the latest technology in this field.

Research Results

- 1- The development in image quality is due to the development of camera technology processing, sensors and lenses.
- 2- Until now, the highest possible quality of the TV image 8k has not been broadcasting, but a 4k image quality is currently being broadcasted.

3- In view of the great development of the TV screens technology and the emergence of new systems, most of the current screens must be changed in order to be able to display the modern television picture more clearly, or at least add some special converters to the screens that are matching the new technology.

4- Thanks to TV technology and the Internet, it is possible to see the TV image on modern devices such as tablets, iPad and smart phones with high quality.

5- The highest quality of current digital TV image is 8k, but the highest possible quality that can be displayed in our homes is 4k, and with the technological advances TV image will be closer to reality.

6- The development of modern TV image technology has increased the creative space in the TV production process.

Research recommendations

1- The research recommended that TV broadcasting systems should be developed in order to achieve the high quality television image.

2- The need to modernize and develop the TV reception equipment to be able to receive the TV image at the highest possible quality.

3- Increase the awareness of the TV screens to find out what suits the image quality and find out what suits the future of TV image technology development.

4- The need to update the cultural background of the TV image makers to increase the creative space to be in line with the great technological revolution in the TV image.

Previous studies

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- V. Barannik, O. Yudin, Y. Boiko, "Video Data Compression Methods in the Decision Support Systems", Springer, Cham, Online ISBN978-3-319-91008-6, 12 May 2018.

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Television image resolution

One of the most important factor of television production is picture quality, or the resolution which is measured by the size and the total number of pixels (p) in the aspect ratio, while a 720p resolution is considered high definition, the highest available applied quality is 4K or Ultra HDTV, Whereas traditional HD is limited to 1920 vertical columns and 1080 horizontal rows of pixels, Ultra HD has a total resolution of 3840 x 2160 p, a slightly smaller resolution than the 4,096 x 2,160 resolution is seen on cinema screens but it has enough pixels to fill four Full HD 1080p screens .

4K means 8,294,400 pixels on the screen at once that creates images capable of showing more details than standard HD, More pixels mean more information, sharper pictures, more attraction and more enjoyment⁽¹⁾ .

4K is the standard resolution for modern television now, and effectively for TVs larger than 40 inches, but when taking a look at the next step which was created by Japanese broadcasters NHK it was 8K or super Hi Vision TV, it is a higher resolution standard than 4K, quadrupling the total number of pixels just like 4K did with 1080p, 8K is 7,680 x 4,320 p, or approximately 8,000 horizontal pixels, there are also twice as many vertical pixels, this means each step quadruples the number of pixels, and that 8K has 16 times the number of pixels as 1080p.

The design concept is that it has higher quality than the human eye so no pixels are visible, it also has a frame rate of 120 fps so movement is very smooth and realistic in order ,to show this quality a minimum screen size to be around should be 84 inches⁽²⁾ .

The massive progress in the quality of the television image is mainly due to the major progress in the technology of TV camera processing, lenses and their sensors, which we will be addressed in the next factor.

Television cameras

TV cameras manufacturers are working hard to produce the latest cameras that produce the highest possible quality of the television image and we will review the latest television cameras that have been produced recently.

Ikegami UHK- 435 camera

Ikegami introduced the new Ultra high definition camera 4K HDR called UHK-435, It provides 4K images via three 2/3-inch 4K (3840×2160) CMOS sensors with RGB prism optics, for “Real 4K” resolution.

The UHK-435 provides 8 million pixels per sensor, totaling 24 million pixels and delivers wide dynamic range and Wide color gradient, fully supporting HLG (Hybrid Log-Gamma) and conforming to HDR International Standard ITU-R BT.2100.

The UHK-435 is compatible with Ikegami UNICAM XE series peripherals, such as the CCU-430 camera control unit⁽¹⁾.



Ikegami UHK-435 camera

It captures the extended depth of field which is required for studio and outdoor production and can be used with B4 bayonet-mount large studio or OB lenses⁽²⁾.

SONY UHC-8300 8K CAMERA

Vatican Media and Sony Professional Solutions Europe once again on December 24th 2017 to produce Sony UHC-8300 broadcast camera with three newly-developed 1.25-inch sensors , It has been designed to cover all the features necessary for premium productions including live broadcasts, entertainment and factual high end documentaries.

It produce 8K (7680 x 4320) pixels with the ability to record at up to 120 frames per second capturing format delivers well balanced high-resolution footage with an impressive deep depth of field and wide dynamic range, supporting ITU-R BT.2020 color space making it suitable for HDR footage for both S-Log3 and Hybrid Log Gamma (HLG).

The UHC-8300 camera can be used for 8K HDR, 4K HDR and HD, SDR signals is also possible and the effect will be even more pronounced, real time cut outs from an 8K picture to a 4K image provides flexible framing when capturing large shots, facilitating creative enhancing features leading to better production ⁽³⁾.

The original lens mount is a 1.25-inch lens mount, but the UHC-8300 can also accommodate B4 mount 4K lenses with a lens adaptor¹. Media companies are able to choose applicable 4K lenses to ensure they are capturing every drop of action, particularly for live sports production which requires high power zoom lenses.

The 8K signal is transmitted via SDI, however the UHC-8300 also supports IP connectivity, ready for today's IP-enabled live production system.



SONY UHC-8300 8K CAMERA

Most 8K cameras have large sensors, which make the focus difficult in exactly the sort of situations where this sort of technology is intended to be deployed. Putting that many pixels on a single chip requires that the single chip involved be fairly large, otherwise the individual elements will barely be big enough to catch any photons and the resulting images risk is being noisy, but the UHC-8300 is a three-chip camera in the traditional sense, using three monochrome imagers mounted on an optical color splitter block. This means that each sensor only needs to record the light for one of the red, green or blue channels, the pixels can be larger and as a result the camera is more sensitive and enjoys higher dynamic range, while keeping the sensors small enough for manageable depth of field⁽¹⁾.

Sharp 8C-B60A 8K camcorder

The 8C-B60A 8K is a camcorder, because the amount of shooting functions that are built into the camera is designed to offer ease of use in shooting and recording, it's image pickup device

is a large, Super 35-mm-equivalent CMOS image sensor with 33 million pixels, the same one on the Red Helium Weapon 8K, while allowing footage to be recorded at 60fps, Sharp explains the Grass Valley HQX Codec utilizes a coding method that is easier on the cameras CPU enabling efficient 8K (60p) image capture with approximately 40 minutes of continuous recording when using the bundled 2-TB SSD pack.in 7680×4320 4:2:2 at 10-bit that is said to be highly efficient, during Inter BEE this was demonstrated on an Edius editing system ⁽²⁾.



Sharp 8C-B60A 8K camcorder

The 8C-B60A camcorder will most definitely be one of the 8K units used at the Tokyo Olympics in 2020. And it's already equipped for broadcast use as it can transmit 8K uncompressed images while recording.

Sharp's 8K camera comes with a PL mount, so it can take lenses from Zeiss, Leica, and others. With such a lens selection, the camera can be used for other purposes other than broadcasting. An 8K resolution would lend an interesting aspect to sports coverage and current events, camera makers such as RED and Sony have their own versions of 8K cameras, but the 8C-B60A from Sharp looks aimed at broadcasters. Since Sharp also makes 8K television sets

8K resolution won't be within the price range of all TV production. However, the \$77,000 price tag will definitely be a more manageable amount for some broadcasters and producers because having that extra resolution is always helpful in broadcast and production⁽¹⁾.

Panavision Dxl2 8k Camera

When we are talking about the latest digital cameras, we cannot forget one of the most important digital cameras which was announced in London (February 1, 2018). Panavision introduced the new Millennium DXL2 8K camera at BSC Expo 2018.

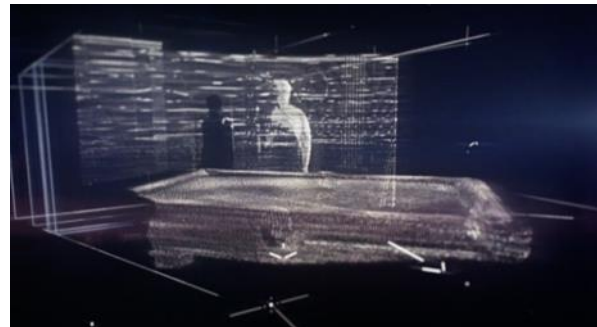
The large-format camera DXL2 is the heart of a complete imaging ecosystem designed from filmmakers' perspectives, built by Panavision based on the input of cinematographers whose feedback contributed to give the DXL2's many significant advances, the DXL2 features a RED MONSTRO 8K VV sensor with 16-plus stops of dynamic range, improvements in image quality and shadow detail, a native ISO setting of 1600, and Pro Res 4K up to 60 fps ⁽²⁾. Images are presented on the camera in log format using new Light Iron Color 2 science (LiColor2), which streamlines the 8K pipeline and provides quick access to high-quality RAW images. Additional features to the DXL2 include a custom-made, integrated PX-Pro color spectrum filter offering a significant increase in color separation and dramatically higher color precision to the image, 24v power, a built-in Preston MDR, and expanded direct-to-edit features, The Millennium DXL2 8K camera system was conceived with the goal of maximum creative control from the moment of capture through delivery and display⁽³⁾.



PANAVISION DXL2 8K CAMERA

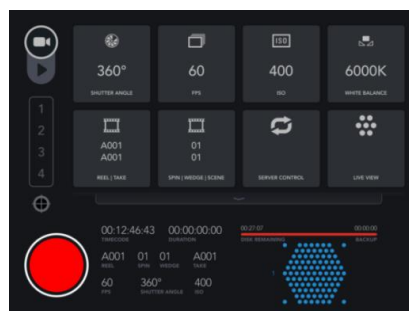
Lytro light field Camera

When we are talking about modern technology in cameras, we must mention the latest technological applications that have entered it which is called Lytro light field camera, Lytro is one of the first practical applications of the light field capture system to be developed for film and television, Light field imaging involves capturing both angular and spatial distribution of light, the optical systems of light field capture devices are optimized so as to improve captured light field image data, Light field capture devices may capture light field image data in the form of highly modulated 4D data that can then be processed to generate 2D and/or 3D output images which can be viewed by a user. It can make that by using any suitable method for doing so, one example of such a method includes, using a micro lens array on top of an image sensor (CCD or CMOS sensor) ⁽¹⁾.



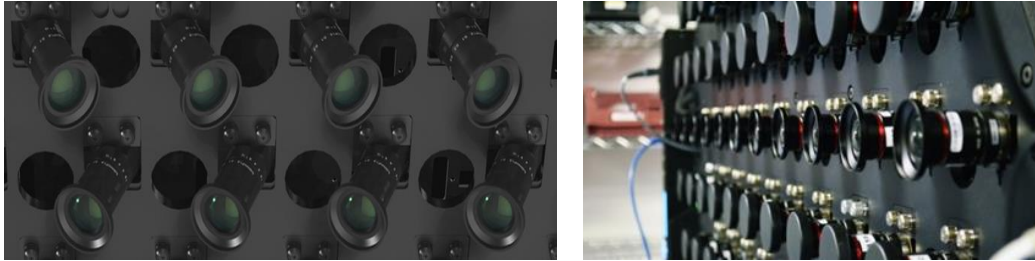
Lytro light field Camera

Lytro announced a new light-field camera called Immerge 2.0, supposedly a major update to its existing cameras resulting in faster production times and improved quality, Immerge 2.0 is a huge Light Field camera rig consisted of 95 light field cameras, which recorded the geometry of the light striking the image sensor instead of just capturing it straight on, this allowed it to capture lots of individual viewpoints in the scene that seamlessly blends live action and computer graphics (CG) using Light Field data, it was designed with alternating rows of cameras that are pointed at the opposite directions ⁽²⁾.



Lytro's Immerge 2.0

The design enables to capture 120-degrees of content rather than the previous 90-degrees, reducing the number of camera rotations from five to three when capturing 360-degree content, and operators of the original Immerge will be thrilled to know that the calibration process is now automated, this tech essentially uses data on all of the available light in a photo to separate objects by depth and store them in a three-dimensional grid ⁽¹⁾.



Lytro's Immerge 2.0

The [Lytro Cinema](#) camera gathers a truly staggering amount of information on the world around it, at 755 megapixels of RAW 40K resolution and 300fps, the camera boasts the highest resolution video sensor ever designed and captures as much as 400 gigabytes of data per second from the world around it ⁽¹⁾.

With Using Lytro output, every frame of a live action scene becomes a 3D model, each pixel of which has recorded color and direction and depth of properties, this visual knowledge gives filmmakers the freedom to make a number of creative decisions in post-production like changing the depth of field, focus position, shutter speed or dynamic range ⁽²⁾.

A big portion of films today rely heavily on green screen technology to turn studio backlit environments into magical worlds, Lytro tech includes different methods of integrating live action footage and visual effects with functionality like Light Field Camera. Tracking and Lytro Depth Screen , the ability to accurately key green screens for every object and space in the scene without using a green screen which allows filmmakers to capture green screen shots without actually having to place actors in green screen environments ⁽³⁾ .



key green screens

Light field technology feels depth accurately, the Lytro camera can just capture the world out to a certain distance and is essentially able to leave the rest of the shot transparent, to put an actor on the surface of the moon when they're actually standing in a room surrounded by camera equipment.

Lytro is the most "mainstream" effort yet from the company to introduce their light field technology to filmmakers, they've already presented their tech to filmmakers looking to make the most of stereoscopic 360-degree virtual reality filmmaking with their Immerge system, but with Cinema, Lytro is specifically seeking out more traditional television and film producers to taste the benefits of light field technology in as rich way as possible.

In the future; such technology will allow the simple creation of VR-ready navigable 3D spaces, but right now it's enabling filmmakers to have the ability to achieve a level of detail and flexibility in gathering shots and making post-production edits that wasn't previously possible⁽¹⁾.

TV Broadcasting technology

Television system transmits both audio and video signals to millions of households through electromagnetic waves with the never ending technological breakthroughs and continuously increasing demands of audio and video services, the TV system has evolved over generations with several important developmental periods in less than a century.

After the television technology has reached the highest possible quality in cameras, it has developed the research and technology of transmitting and receiving this quality, and you'll soon be hearing a lot about a new television broadcast technology called "Next Gen TV" that promises better picture quality, a signal more resistant to interference, interactive features, and localized emergency alerts⁽²⁾, and when we are talking about TV broadcasting we have to know there are three types of TV broadcasting network:

1-**Terrestrial broadcasting system** which uses transmitting stations to send radio waves over the air to cover certain services areas.

2-**Cable TV broadcasting** uses the coaxial cable to deliver information to houses, with an emphasis on serving densely populated areas.

3-**Satellite TV broadcasting** which provides coverage of a large area.

Next Gen TV is an evolution of the current ATSC over-the-air broadcast standard that has been used in North America, ATSC stands for Advanced Television Systems Committee, a nonprofit organization in Washington, D.C., that develops voluntary technical standards for digital television.

It should be noted that the United States is one of the countries that initiated the development of Digital TV broadcast and has successfully completed the analog to digital switchover on June 2009, the advantages of Digital TV broadcast over the traditional analog TV are:

- 1- Better anti interference ability, no noise accumulation and quality signals.
- 2- Higher transmission efficiency and more flexibility in multiplexing.
- 3- Easy to encrypt and support interactive services.
- 5- Easy to store, process and distribute under network environment.

The ATSC standards were developed for HDTV after that it has announced for the new broadcast ATSC 3.0 which uses a more modern compression system to support high-bandwidth streams, which means broadcasters will be able to send 4K UHD signals⁽¹⁾.

ATSC 3.0 is a major version of the ATSC standards it was designed to offer support for newer technologies, including HEVC for video channels of up to 2160p 4K resolution at 120 fps, and the Rec. 2020 color space which make wide color gamut, Dolby AC-4 and MPEG-H 3D Audio, data casting capabilities and more robust mobile television support, ATSC 3.0 supports three video formats: Legacy SD Video, Interlaced HD Video, and Progressive Video which support HDR using Hybrid Log-Gamma (HLG) and Perceptual Quantizer (PQ).

The new technology based on an IP (Internet Protocol) backbone and attempts to merge broadcast TV with content from the internet by embracing IP. Next Generation TV enables broadcasters to transmit information in packets rather than waves. The IP data will offer

broadcasters a treasure of information that can be crunched for in-depth sales, ratings, and other analysis ⁽²⁾.

With ATSC 3.0 broadcasters will be able to provide customers with access to live programming anytime and anywhere, and on multiple devices, they will also offer interactivity as well as better sound and picture quality, it makes the first IP-based broadcast standard, allowing broadcasting companies to simultaneously transmit content over the airwaves and the Internet.

South Korea has already adopted the standards, taking advantage of many of their features, during this year's Winter Olympics in Pyeongchang, where there are already ATSC 3.0-compatible televisions and receivers.

In the United States, televisions do not yet comply with ATSC 3.0, but converters gateway devices that can be incorporated in the existing home entertainment systems to receive ATSC 3.0 broadcasts are expected to be available soon.

ATSC 3.0 offers broadcasters the sort of flexibility that viewers have grown accustomed to with streaming services including Amazon Prime and Netflix. Soon, for example, viewers will be able to catch a major sports event by tuning in on their tablet, or mobile TV ⁽³⁾.

Interactive TV applications will be coming because the standard is IP-based, broadcasters could offer apps to go along with TV shows, making the experience more interactive. Certain programs might come with an app that launches a trivia game about characters in a sitcom, for example, or provides in-depth information about the subject of a documentary.

Many modern televisions have a high dynamic range (HDR), which extends the number of shades of black, white, and gray that can be transmitted and displayed, as well as improve the contrast ratio according to CNET. HDR also offers extended colors, allowing a much broader palette to be transmitted⁽¹⁾.

High Dynamic Range video technology

one of the technological innovation factors in the modern TV image and the newest [TV](#) feature is HDR TV which is going to be the biggest qualitative change in TV quality since color, this technology depends on the contrast performance and the number of colors they can display, it means better contrast, greater brightness levels and a wider color palette, it also supports new transfer functions, greater bit depth, and static and/or dynamic metadata ⁽²⁾.



The difference between SDR and HDR image

Dynamic range describes the difference between bright and dark point in the scene , and how much detail can be shown in between Essentially, HDR content preserves details in the darkest and brightest areas of a picture that are lost using old standards.

Most of video formats, like broadcast television and Blu-ray discs, are limited according to standards that are provided by previous techniques, black is set to only so black, and white could only get so bright within the limitations of display technology ⁽³⁾.

HDR video technology comes to remove the limitations presented by older video signals and provides information about brightness and color across a much wider range, HDR-capable displays can read that information and show an image built from

a wider gamut of color and brightness and recreating image realism from camera through postproduction to distribution and display, the idea is that your eyes can perceive brighter whites and darker blacks than traditional TVs which have been able to display, and HDR aims to improve that.

When we see HDR content on HDR-compatible TVs we can get brighter and darker image at the same time, the difference between the peak brightness and black level is known as the contrast ratio. HDR TVs have to meet specific standards for peak brightness and black level which helps give them the dynamic appearance.

Color is the second of the most important aspects of HDR, When it comes to color a TV must be able to process what's known as 10-bit or deep color, 10-bit color equates to a signal that includes over a billion individual colors. In comparison, Blu-ray uses 8-bit color, which amounts to around 16 million different colors. With 10-bit color, HDR TVs will be able to produce a vastly expanded range of color shades, reducing overtly obvious gradations between shades. Subtle shading helps to make a scene look far more realistic⁽¹⁾.



It can produce deeper and more vivid reds, greens, and blues, and show more shades in between, this requires much more data, and like ultra-high-definition video, current optical media can't handle it. Online streaming can also offer 4K and HDR video, but Ultra HD Blu-ray provides a physical and broadly accessible way to get it.



To watching HDR content you have two options: buy a new Ultra HD Blu-ray player or stream HDR video from the likes of Netflix and Amazon, your TV must also comply with the HDMI 2.0a standard, though any TV with the Ultra HD Premium label will do so by default. Some of streaming services like Netflix and Vudu can work with HDR content like any other 4K content, HDR depends on having a very fast, reliable Internet connection, if your stream can't support it, you won't be able to watch your desired movie or show in HDR even if it is available.

There are no less than four different HDR technologies: Dolby Vision, HLG, HDR10 and HDR10+

Dolby Vision; it was developed for the silver screen ,with 10 to 12bit color encoding—versus 8-bit encoding for standard 4K and HD videos (SDR)—Dolby vision offers a more nuanced image. It also features higher theoretical brightness designed to support up to 10,000 units of peak brightness ,it is currently used for certain UHD Blu-ray discs and by iTunes.

HLG (Hybrid Log Gamma) is a technology developed by the BBC and NHK. Most HDR displays are currently HLG compatible, even though this technology is not yet implemented. It was designed for television broadcasts; it should be implemented in the future by DTTV networks.

HDR10 is the standard form of HDR, HDR10 it is currently the most popular format supported by a wide swath of TV makers. It is used by UHD Blu-ray discs, Netflix, Amazon Prime Video and iTunes. The number 10 indicates that each pixel is composed of 10 bits of data per primary color (3×10 bits).

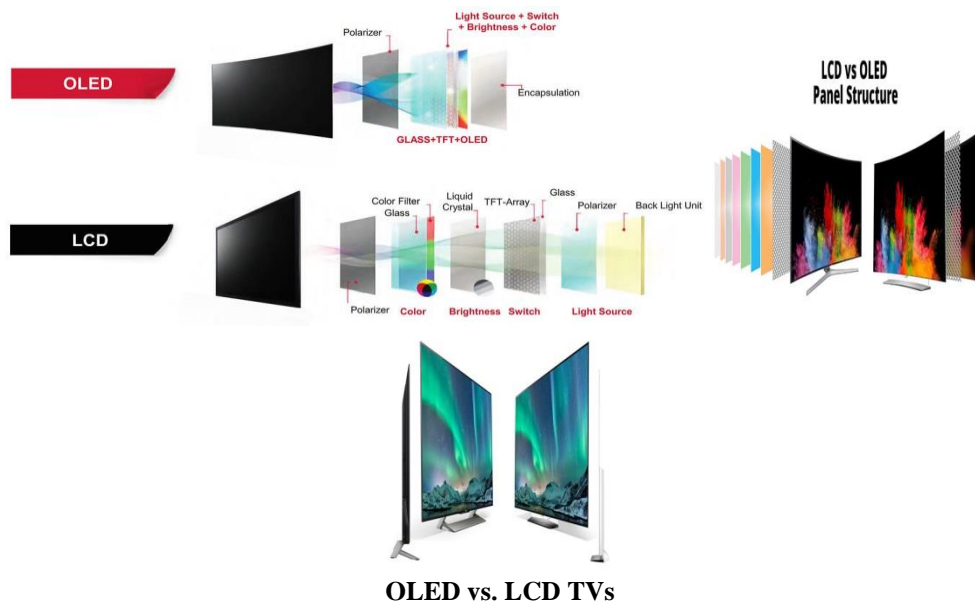
HDR10+ is an open standard, Samsung and Amazon announced it in April 2017, it improves on HDR10 by using dynamic metadata instead of the static metadata used by HDR10. That means it can dynamically alter the brightness of individual scenes and even individual frames throughout a particular TV show HDR10+ is now also available on Panasonic's 2018 4K OLED line, which was unveiled at CES 2018 ⁽¹⁾.

OLED TV and QLED Quantum dot display

The latest technology of TV screen is OLED TV which uses a display that consists of Organic Light Emitting Diode that makes it possible to reach dark black levels from ultra-thin screens because each self-emissive pixel is its own light source therefore, no backlighting is required to create a vivid and bright image and don't need an additional layer of fluorescent or LED backlighting to make images appear, OLED also includes an additional white pixel alongside the usual red, green and blue sub-pixels, with the aim of delivering more varied and accurate colors ⁽²⁾.

OLED technology has several advantages over LED-lit LCD TVs. First OLED designs are lighter and thinner than LCDs, as they don't require a separate backlight.

OLED TVs deliver absolute black and stronger contrast ratio because each pixel can be turned off individually, we've seen this striking contrast and depth time and time again on OLED TVs.



OLED is extremely expensive to produce and consequently OLED TVs are expensive to buy. It is enough to know that the first OLED set LG's, 55EM970V, 55in [cost £10,000 when it was launched in 2013](#) but in 2017 Sony launched their OLED [Sony KD-55A1](#) at a lower cost of £3500 although it's now available for around £2500 ⁽¹⁾.

Another problems of OLED's concerns the annoying blue pixel, the organic material used to create blue light deteriorates more quickly than red and green, which means its lifespan is shorter and over time the color balance could conceivably be affected.

There are two types of OLED technology: Passive-Matrix (PMOLED) and Active-Matrix (AMOLED). Active-Matrix requires electronics to switch each pixel on or off individually, which is better for displaying deep blacks, and therefore the type used in the OLED TVs we see today.

With the advent of 4K Ultra-HD resolution, the two cutting-edge technologies combined LG have introduced the first 4K OLED TV in 2015, and since then it's become an incredibly impressive pairing, LG says you'd have to watch its OLED TVs five hours per day for 54 years before they fell to 50 percent brightness ⁽²⁾.

These efficient OLED televisions made by LG and Sony but Other makers such as Samsung announcing the first QLED TVs at CES 2017 powered by "quantum dot" technology which is the biggest rival to OLED screens called QLED (Quantum-dot Light-Emitting Diode) uses tiny semiconductor particles only a few nanometers in size which emit their own light, It's based on existing quantum dot technology, where the bigger particles emit red light and the smaller ones emit blue light and can almost match the "infinite" contrast ratio of OLED, QLED TVs are just LED TVs that use quantum dots to enhance performance in key picture quality areas.

The luminance between the brightest whites and the darkest blacks. Quantum dots are teeny "Nano" crystals, microscopic dots as small as one billionth of a meter, Quantum dot TVs also deliver a wide, more true-to-life color palette especially reds, greens and cyan, to rival the quality of pricier OLED-based displays, Quantum dots act almost like a filter that produces purer light than LEDs alone can provide TCL now has a QLED line of TVs ⁽³⁾.



QLED – OLED – LED TVs

In order to create TV screens that can offer a deeper and more cinematic view of the action, some television manufacturers, such as Samsung and LG, offer curved TVs whose edges are slightly bent toward the user. Samsung was the first to [curve an OLED](#), while there was a brief flirtation with curved TV screens in 2016.

In curving TV screens the image warps to encapsulate more of your vision. Especially if you sit directly in the center. When curved TVs are big and wide enough, the curve can become enough to the point where the image almost seems 3D, even when the source is only 2D. This is because curving the edges of the image towards the viewer enhances the visual perception of depth in what you're watching and there is a large variation between points on the TV⁽¹⁾.



Curve OLED screen

Many curved TVs also apply a contrast enhancement feature to different parts of the screen, which helps to add clarity and color to image enhancing depth, and the curved screen's image appears to stretch further across the wall than the flat TV image, despite that screen sizes are involved but they are being ostensibly the same, add this to the fact that there is a light which is being directed all over the screen, so you end up with an image that can be easily viewed from almost anywhere in the room.

It can strengthen the light directed at a particular area, and focus the light coming from the screen more directly at your eyes– in much the same way satellite dishes strengthen signals by focusing them onto an LNB and so can deliver between 1.5x and 1.8x higher contrast than flat screens⁽²⁾.

Ultra HD 4K Blu-ray discs

With the advent of OLED and [quantum dots](#) technology they'll need expanded color gamut *content* for this feature to be useful, that's where 4K Blu-ray discs come in, it was revealed at CES 2015.

Ultra HD 4K Blue-rays is the latest video disc format that have the best picture quality possible for 4K TV, this format uses the same size discs as Blu-ray, but are constructed so that they can fit more information, it offers about 8.3 million pixels even better than streaming 4K from Netflix or Amazon ⁽³⁾, it supports a resolution of 3840 x 2160, higher frame rates of up to 60fps and [high dynamic range](#), which is a new standard designed to deliver a wider

range of color, brightness and contrast ,that majority of 4K discs come with the standard HDR10 ,they will not use region coding and will have a capacity of 66GB and 100GB of data on dual and triple layered discs .Most 4K Blue-rays have HDR data which means brighter highlights and expanded contrast ratios.

The new discs also support an optional digital bridge feature, which will allow you to copy Ultra HD Blu-ray content to an external hard disk drive, and to portable devices such as smartphones and tablets, any 4K TV should deliver a 4K picture, but only TVs with the latest spec will be able to take full advantage of what Ultra HD Blue-rays can offer. This includes HDR, which is increasingly seen as one of the key factors for getting the best possible picture⁽¹⁾ .

To watch Ultra HD Blu-ray discs you need three things: an Ultra HD Blu-ray player, an Ultra HD TV and some discs, obviously, there are a few important caveats, though .First , you'll need to make sure your TV supports at least the HDMI 2.0 standard, Most TVs from the last year or so will, but very cheap models and some models from 2014 or earlier might not.

It is worth to be mentioned you cannot play an Ultra HD Blu-ray Disc on a standard Blu-ray Disc player, but Ultra HD Blu-ray Disc players can play standard Blu-ray, DVD, and CD discs, and most can stream content from the internet.

Where DVD utilizes Red Laser technology, the Blu-ray Disc format utilizes Blue Laser technology and sophisticated video compression to achieve high definition video playback on the same size disc as a standard DVD.

A blue laser light beam is narrower than a red laser, which means it can be focused more precisely on a disc surface. Taking advantage of this, the "pits" on the disc where information is stored can be made much smaller. This means more "pits" can be placed onto a Blu-ray disc than a DVD. Increasing the number of pits creates more storage capacity on the disc, which is needed for the additional space required for high definition video⁽²⁾.



Ultra HD 4K Blu-ray player

The future of TV image technology

The future revolution in television image technology as planned by television scientists is what the TV picture will offer in Tokyo 2020 Olympics, which will be broadcasted by NHK (Japan Broadcasting Corporation) Which will provide a 4K/8K image called “NHK Super Hi-Vision”, to do that it started the test of satellite broadcasting of 4K/8K in 2016, and accelerated to develop and install the 4K/8K producing equipment for more programs toward the regular service in 2018.

The beginning was with 8K/HLG camera system with 3 CMOS imagers such as mentioned before ,then with 8K/120 Hz Production Equipment such as ultra-high-definition interface

,"U-SDI", that can transmit full-specification 8K video signals (approx. 144 Gbps) previously required a lot of effort, including connecting about 100 coaxial cables which have about 100 times the data volume of Hi-Vision, over a single cable, the TV images will be recorded on 8K Super Hi-Vision compression recorders for 8K program production at a 120-Hz frame rate, this exhibit displays a compression recorder that can input/output an 8K signal over a single optical cable and record the data in a removable memory package.

NHK will use a TICO codec for 8K ultrahigh-definition, it was designed to be used instead of uncompressed video in many applications, because the bitrate of an 8K uncompressed stream can reach 48 Gb/s, and interfaces consisting of 16 bundled 3G-SDI cables have been used for its transmission, it works at a compression rate of 1/4, and the resulting 8K code stream can be transmitted with a single 12G-SDI cable.

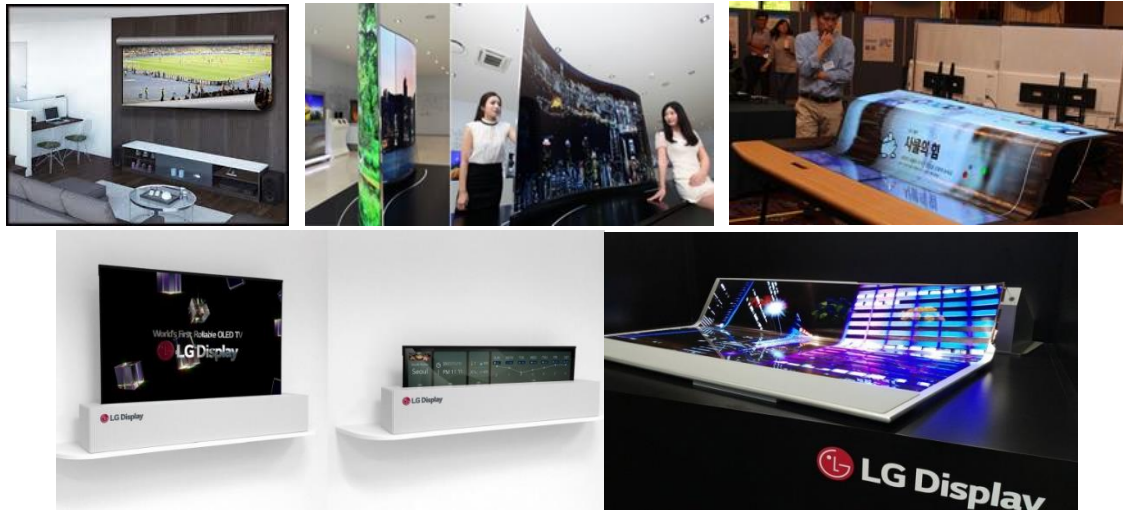
TICO has a lossless video quality, very low latency, and characterized by a quality degradation that is almost independent from the number of successive encoding/decoding operations, which makes it suitable for production systems.

With the proposed application framework from NHK "Hybrid cast Connect X" we can increase the number of touch points of broadcast content like TVs, smartphones, and IoT-enabled devices, IoT means The **Internet of Things** which is the network of physical devices, vehicles, home appliances, and other items embedded with [electronics](#), [software](#), [sensors](#), [actuators](#), and [connectivity](#) which enables these things to connect and exchange [data](#) ⁽¹⁾.



The future of TV image technology

In order to realize more progressive and efficient viewing system that enables viewers to enjoy the broadcast services of 8k Super Hi-Vision at home, LG Electronics is bringing its new OLED TV to CES 2018 in Las Vegas, it demonstrate a 88-inch ultra-thin 8K OLED display at the trade show, It has 33 million individual pixels (7680x4320). However the most exciting display will probably be LGD's newest prototype - a 65" rollable OLED TV that comes with a base that holds the TV when it is rolled away, this is a prototype display, and LGD aims to start producing rollable large-area (55 to 75 inch) OLED TVs to market by 2020 ⁽¹⁾.



Flexible and rollable OLED TV

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