

Postprint: Analysis of Current Status and Innovative Development Approaches for 4K Television Technology

Authors: Sun Jiaqi

Date: 2023-10-08T00:00:00+00:00

Abstract

As living standards continue to improve, an increasing number of high-tech products have entered public view, giving rise to 4K television, which is gradually replacing traditional high-definition television and enhancing the quality of life for the general public. 4K television incorporates numerous advanced scientific and technological innovations, providing convenient living conditions while ensuring quality; however, it has encountered technical bottlenecks in its popularization and promotion. Therefore, this paper examines the current state of 4K television technology, proposes innovative development strategies, and aims to facilitate its widespread application and adoption.

Full Text

Abstract

With the continuous improvement of living standards, an increasing number of high-tech products have entered public view, leading to the emergence of 4K television that gradually replaces traditional high-definition television and enhances quality of life. 4K television integrates numerous advanced scientific technologies, providing convenient living conditions while ensuring quality, yet encounters technical bottlenecks in its popularization and promotion. Therefore, this paper examines the current status of 4K television technology and proposes innovative development strategies to facilitate its widespread application and adoption.

Keywords: 4K television; television technology; innovative development

The emergence of 4K television aims to satisfy user experience demands, offering ultra-high clarity and more precise detail representation that compensates for the deficiencies of traditional digital television. Simultaneously, 4K television

reduces viewing distance, expands screen field of view, and optimizes visual enjoyment for audiences, delivering a more perfect user experience. However, due to the lack of unified technical standards for 4K television, both content sources and programming face restrictions, and current network broadband is limited with insufficient independent innovation, resulting in slow popularization of 4K television that urgently requires improvement and strengthening to achieve innovative development. Therefore, analyzing the current status of 4K television technology and proposing innovative development strategies holds significant importance.

1. Status of 4K TV Technology

According to the definition provided by the International Telecommunication Union, 4K television refers to ultra-high-definition television with a display resolution of 3840×2160 or higher, which is eight times that of high-definition and four times that of full-high-definition [1]. With such high resolution, viewers can clearly see every close-up and detail in television images. Through the adoption of new-generation high-definition technology, 4K television has received unanimous praise since its launch. Presently, 4K television technology has successfully entered the Chinese market. Although it remains a high-end consumer product, numerous domestic television manufacturers have begun producing 4K televisions, and the pace of popularizing and applying 4K television technology in the market is accelerating.

For the home appliance industry, television development has advanced by leaps and bounds. In the second half of 2012, 4K television gradually emerged as the preferred high-end television product for the public. It employs ultra-high-definition IPS hard-screen technology, providing viewers with viewing angles exceeding 178 degrees—significantly wider than conventional screens—and presenting perfect, realistic image quality from all perspectives, even at the edges of the screen without any color distortion. IPS hard screens possess a relatively stable physical structure that avoids the afterimages unavoidable with conventional screens when touched, and they do not flicker, comparable to the masterful color grading abilities of professional colorists, faithfully presenting every image. Additionally, 4K television utilizes flicker-free 3D technology, offering audiences a more comfortable and healthier viewing experience for 3D content, with particularly outstanding advantages and remarkable effects when applied to large-screen televisions.

2. Analysis of 4K TV Technology Innovation

4K television features powerful intelligent systems that incorporate cloud photo albums, multi-screen interaction, and facial recognition capabilities, representing a more advanced and intelligent technology that constitutes a key innovation in 4K television. Simultaneously, 4K television can monitor human body weight, fat percentage, and other health indicators, comparing them with historical data

to provide users with value-added services such as healthy exercise recommendations and dietary advice. When watching films, users can enjoy Hollywood-level visual effects and control the television through voice commands, obtaining a personalized, tailor-made experience that surpasses what traditional television can offer [2]. For instance, “Direct Access to Hollywood” represents one of the value-added services available on 4K television, serving as a content platform that integrates over thirty top domestic and international film and television companies including Hollywood, providing users with more, better, more economical, and faster access to legitimate high-definition blockbusters, enabling people to watch world-class films. Through desktop systems, 4K television users can also log into intelligent systems via voice recognition and facial recognition to access family member desktop profiles, where any household member can customize their interface to receive personalized elements, enjoy film and television recommendation services, application services, and obtain entirely new control and visual experiences offered by 4K television.

Moreover, advanced software infrastructure represents another innovative aspect of 4K television technology. 4K television employs ultra-high-definition chips with $4K \times 2K$ decoding sources, enabling lossless decoding that allows users to experience ultra-high-definition audio-visual effects at home. The commonly used software system for 4K television is the 1080P/1080I intelligent system, which is compatible with various high-definition video formats while tracking and compensating images to achieve ideal information restoration effects. Compared with traditional television, 4K television delivers more vibrant and distinct colors, utilizing new technologies in its LCD panels that not only display high-definition images but also play files obtained through USB interfaces. Details such as LED tubes and brightness enhancement films are also more sophisticated, providing users with superior video experience effects.

3. Suggestions for Innovative Development of 4K TV Technology

3.1 Establishing Healthy Viewing Concepts and Securing Policy Support

Health-conscious concepts are increasingly entering everyday life, and as an emerging healthy television technology, 4K television technology and the 4K televisions produced with it are gaining greater public favor. Establishing healthy viewing concepts represents the primary thinking and direction for the development of the television industry. 4K television, with its ultra-clear, interference-free, flicker-free, and realistic sound quality, provides users with an entirely new viewing experience that significantly reduces harm to human eyes and ears from watching television, particularly for children and the elderly. 4K television technology embodies the comfortable and healthy lifestyle advocated by the government, and efforts should be made to secure policy guidance and support. There is good reason to believe that healthy, green, positive, authentic,

natural, clear, and fashionable 4K television technology products can gradually enter every household through the combined efforts of government, enterprises, and users, bringing people a healthy lifestyle concept that embraces fashion and pursues excellence.

3.2 Establishing a Prudent Development Attitude and Unifying Technical Standards

It is noteworthy that developing new business represents a systematic engineering endeavor. To promote innovative development of 4K television technology, establishing a prudent development attitude and focusing on market cultivation is essential [3]. Given that 4K television requires substantial initial investment and faces uncertain development prospects, a dialectical and rational perspective should be applied to 4K television technology. When necessary, proactive measures should be taken to test signal transmission methods including source coding, channel coding, terrestrial and satellite transmission, and to formulate comprehensive supporting standards to ensure preparedness. In other words, unified 4K television technical standards must be established promptly to effectively eliminate industry barriers.

At present, 4K television faces diverse video formats in acquisition, encoding, decoding, editing, production, and output that lack mutual compatibility, directly preventing captured video from being input, edited, and output for transmission. Relevant authorities must combine the current development status and market realities of 4K television technology to formulate unified standard formats based on open platforms, requiring manufacturers to voluntarily adopt these technical standards and integrate them into their respective technology platforms for producing 4K televisions and related equipment while developing ancillary businesses. 4K television products entering the market should also strictly implement technical parameter standards to continuously normalize the situation of inconsistent technical parameters.

Ensuring full cooperation between upstream and downstream entities in the 4K television industrial chain will further enhance the 4K television viewing experience, enable China's color television industry to firmly grasp development opportunities in 4K television technology, successfully seize discourse power in the high-end television market, and form a complete ecological system for the 4K television industry with independent intellectual property rights.

On one hand, it is imperative to intensify independent research and development efforts for 4K television technology to achieve new breakthroughs in key technologies and meet the requirements of 4K television in video acquisition, encoding/decoding, editing, production, and compression/transmission. Referencing foreign 4K television technology models and based on domestic industry and sector realities, a set of technical standards should be developed to satisfy the rapid development needs of 4K television. Particular attention must be paid to eliminating fake 4K television technology products from the mar-

ket and standardizing the innovative development of 4K television technology. To purify the market, the China Electronics Standardization Institute has already collaborated with several major audio professional institutions to launch the “Ultra-High-Definition Display Certification Technical Specification.” Currently, multiple 4K television products on the market have passed 4K testing and certification, which users can reference when making informed purchases to avoid buying fake 4K television technology products and programs. On the other hand, centered around 4K television technology, the industry should extend to develop 4K television program resource industries as well as intelligent care, intelligent security, intelligent medical, and intelligent education industries. Based on the advantages of ultra-high-definition audio and video, continuously expand cutting-edge scientific research industries to build a healthy, scientific, and complete industrial chain, enabling 4K television technology to achieve sustainable development in the new era and securing a bright future for 4K television.

3.3 Increasing Program Sources and Content, Accelerating Broadband Speed Implementation

Currently, 4K content is in a state of severe scarcity, preventing 4K television terminals from stimulating consumer desire to purchase 4K televisions and limiting market capacity expansion. Under such circumstances, only by striving to produce more 4K ultra-high-definition television programs, increasing the program sources and content for 4K television, and promoting innovative development in 4K television shooting, production, and broadcasting technologies can the market be supplied with rich 4K television video content services that alleviate the current shortage of 4K program sources and satisfy consumer demand. Simultaneously, feasibility studies for launching dedicated 4K television channels should be conducted, as the viewing experience of 4K television programs is significantly impacted by broadband speed. If network broadband speed is too low, stable transmission of 4K television programs cannot be ensured. Therefore, the state should implement the Broadband China Strategy action plan issued by the State Council, striving to achieve broadband price reductions and speed increases within a few years to advance 4K television into the popularization and application stage, diversify its application services, and optimize the innovative development environment for 4K television technology.

Particularly in the post-production of 4K television programs, both system bandwidth and excessively long rendering times significantly impact production scheduling control [4]. At present, domestic networks use traditional gigabit network architecture, which wastes considerable time in material transmission. Necessary improvements and upgrades should be made to network architecture by adopting 10-gigabit networks or constructing high-speed SANs for material exchange, or even building online 4K production SANs. For 3D rendering, where single-machine rendering times are excessively long, consideration should be given to constructing render farms that can handle rendering tasks, thereby

allowing more energy to be devoted to content production and increasing program sources.

3.4 Strengthening Technical Independent Innovation and Building a Healthy Industrial Chain

In the future development field of information technology, ultra-high-definition display technology represents an important branch. As domestic enterprises manufacturing 4K television products, they should rapidly improve and enhance the technical level of 4K television products, increase investment in production and broadcasting fields, ensure full cooperation between upstream and downstream entities in the 4K television industrial chain, thereby further improving the 4K television viewing experience, enabling China's color television industry to firmly grasp development opportunities in 4K television technology, successfully seize discourse power in the high-end television market, and form a complete ecological system for the 4K television industry with independent intellectual property rights.

With continuous scientific and technological progress, innovative technologies pursuing ultimate display effects are constantly evolving, with 4K television technology being the most significant representative. Users can obtain perfect experiences through the realistic, high-definition visual enjoyment provided by 4K television technology, and popularizing 4K television represents the general trend. In actual development, we should fully understand the current status of 4K television technology, analyze its innovative development, actively establish healthy viewing concepts, unify 4K television technical standards, simultaneously increase program sources and content, accelerate network broadband speed implementation, build a healthy industrial chain through independent innovation, allow the public to obtain wonderful healthy life experiences, and lead the continuous, stable, and healthy development of high-definition television industry by relying on 4K television technology.

References

- [1] Tu Chenting. A Discussion on 4K Television Development [J]. Radio & TV Broadcast, 2018(6): 245-246.
- [2] Xu Xun. Research on the Application and Development of 4K Television Technology [J]. Electronics World, 2017(14): 95.
- [3] Li Jianhua, Wang Yun. 4K Television: The Next Tipping Point for the Digital Home Industry [J]. Cable Television Technology, 2017(11): 9-11.
- [4] Wei Anming, Ning Jinhui, Zhang Qian, et al. A Brief Analysis of 4K Ultra-High-Definition Television System Testing [J]. Radio & Television Technology, 2015(8): 26-33.

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.