5G Applications in Broadcasting and Television Technology: Postprint

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Abstract

Currently, the broadcasting and television industry is committed to the in-depth development and application of 5G communication technology. Amid social modernization development, 5G technology can enhance the application value of broadcasting and television technology. This paper focuses on analyzing current broadcasting and television technology, discusses the key aspects and value of 5G technology, and emphasizes improving the modernization and intelligentization level of broadcasting and television technology.

Full Text

5G Applications in Broadcasting and Television Technology

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Abstract

The broadcasting and television industry is currently dedicated to the deep development and application of 5G communication technology. In the context of modern societal development, 5G technology can significantly enhance the application value of broadcasting and television technologies. This paper focuses on analyzing current broadcasting and television technologies, discussing the key points and value of 5G technology, with particular emphasis on improving the modernization and intelligentization levels of broadcasting and television technology.

Keywords: 5G technology; broadcasting and television technology; application key points; application forms; application practice

Introduction

With the continuous development of communication technology, the scale of internet users continues to expand, imposing increasingly stringent requirements on information transmission speeds. The research and development of 5G technology helps increase the penetration rate of mobile network devices and improve mobile information transmission rates. Centered on customers, it constructs a diversified technical system, particularly through user perception optimization systems that can meet actual user needs. It transforms social production and lifestyles, enhances experiences with modern technology, promotes deep reform of network systems, and exerts significant influence on other industry sectors. Data shows that as of December 2020, the number of online news users in China reached 743 million, an increase of 12.03 million compared to March 2020, accounting for 75.1% of all internet users [1]. The innovative development of 5G technology has driven the advancement of mobile media technology. Throughout its development, 5G technology constructs network architectures and reduces network latency. Whether in terms of transmission speed or connectivity capability, 5G technology demonstrates significant innovation in content delivery.

1. Overview and Characteristics of 5G Technology

5G technology represents the fifth-generation mobile communication technology and marks a new development in modern wireless access technology. It integrates newly added complementary wireless access technologies and serves as a general term for comprehensive solutions. Figure 1 [Figure 1: see original paper] illustrates the 5G technology framework. As a convergence of multiple technologies, 5G provides free and secure connectivity channels for both person-to-person and person-to-thing communication. It enhances users' internet application experience, with a focus on the Internet of Things, strengthens the quality of IoT services and business, thereby achieving interconnectivity for all things.

The International Telecommunication Union launched 5G standard research in 2015, dividing the work into different phases. Throughout 2015, the focus was on researching 5G international standards; in 2016, it analyzed 5G technical requirements and evaluation methods [2]; in 2017, it solicited 5G technical proposals; and in 2020, it formulated 5G technical standards. In 2018, Huawei' s R&D department advanced China' s 5G technology development with a 100% pass rate, testing business processes in accordance with core network system network functions. In 5G technology R&D testing, 5G non-standalone network testing constituted an important component that could accelerate 5G commercial deployment.

The evolution of 5G technology can effectively support virtual reality, 4K transmission, and augmented reality technology, while simultaneously improving the penetration rate of 4K transmission and accelerating the development of 8K

transmission. Virtual reality technology has strict requirements for image quality [3]; augmented reality technology demands large data volumes, and 5G technology can enhance the application experience of both virtual reality and augmented reality technologies. For ordinary users, 5G technology can increase network speeds. The maximum transmission rate of 4G technology is 100 Mb/s, while that of 5G technology reaches 10 Gb/s. From a professional perspective, 5G not only meets high-speed transmission requirements but also satisfies demands for large bandwidth, ultra-high capacity, and ultra-dense sites. The communication field considers 5G to be a converged, intelligent, and broadband-oriented network.

2. Impact Relationship Between 5G and Broadcasting/Television Technology

With the support of new technologies, mobile communication network speeds have increased, enabling the loading and dissemination of massive audio and video resources and establishing information network transmission architectures. This technological support has impacted the broadcasting and television industry, and the integrated development of 5G technology and broadcasting can accelerate the development of the broadcasting industry. Analyzing industry prospects reveals that expanding the application scope of 5G technology can lay the foundation for new media business and broadcasting development, extending the development domains of broadcasting and television.

5G technology has gradually demonstrated its technical advantages, capable of optimizing the structure of ultra-high-definition video, virtual reality video, and augmented reality video while providing technical guarantees. However, 5G technology development faces numerous issues, and audio, video, and image businesses are developing rapidly, exhibiting exponential traffic growth. Due to the substantial increase in traffic volume, mobile communication network services are under intensified pressure, and simply increasing bandwidth cannot resolve existing problems. Many experts believe that focusing on broadcasting business development is essential to address these inherent issues.

In the broadcasting technology field, the rational application of multicast technology, point-to-point technology, and point-to-multipoint technology offers significant advantages. Integrating broadcasting technology with communication technology can drive mobile communication technology forward. Under the 4G technology system, eMBMS technology was integrated into broadcasting services, yet this service could not be realized through 4G technology [4]. Figure 2 [Figure 2: see original paper] shows the eMBMS technical framework. Although eMBMS technology was not applied in broadcasting services, in the 5G era context, there is sufficient confidence in service convergence, and proposals have been made for high-efficiency media transmission services, LTE enhancement technology, broadcasting business enhancement solutions, and mobile broadband media distribution technology to achieve the integration of broadcasting/television and 5G technology.

3. 5G Technology Broadcasting Services

In the 5G environment, broadcasting and television operations involve device-to-device communication, mobile broadband, and enhanced broadband low-latency communication. Through wireless communication technology, 5G technology application scenarios are realized. During technology application, broadcasting and television are regarded as information transmission carriers to expand business scope. For instance, both 5G multicast services and broadcast services can be implemented through broadcasting methods. High-definition video, virtual reality, augmented reality, and multi-angle video can all adapt to information broadcasting business requirements.

Under the 5G system, global mobile communications have developed a new system: the digital television broadcasting system. For content distribution, broadcasting and television apply point-to-point methods through cellular mobile networks, focusing on mobile video content distribution [5]. With 5G technology support, digital broadcasting systems can satisfy content distribution for fixed terminals and achieve video content transmission through point-to-multipoint broadcasting modes. Following the point-to-multipoint broadcasting approach, digital broadcasting systems can promote new network operators through mobile technology to transmit and distribute broadband information. Additionally, for video terminals, appropriately increasing video viewing demand can alleviate transmission pressure when transmitting network information.

Based on the 5G environment, the development direction of broadcasting and television business is clarified, along with its business advantages. The development goals for broadcasting and television are as follows: With 5G technology support, focus on developing television hybrid services to enhance broadcasting interactivity, optimize resource channels, strengthen broadcasting functionality, and satisfy broadcasting business requirements. In technology integration development, 5G technology presents new requirements for broadcasting development, including the rational application of channel technology and reverse channel technology to allocate quality resources to users [6]. In the development of the broadcasting industry, integration of voice control technology and intelligent operation technology is emphasized, enabling users to effectively allocate network resources through voice commands. In office applications, voice operation functions can efficiently meet user needs.

4. Application Forms of 5G in Broadcasting/Television Technology

4.1 Broadcasting Convergence

Leveraging 5G technology can fully exploit the advantages of broadcasting and television technology, optimize broadcast content and service forms, and provide media content to audiences, including non-real-time audio-visual and real-time access services. In the 5G era, media information transmission methods have

increased, enabling batch transmission of data, text, and content. Compared to the 3G and 4G eras, the 5G era eliminates concurrent user limitations. Audiences can access converged networks even across multiple base stations. It can integrate and disseminate media text and audio information for different access networks. With 5G technology support, broadcasting and television technology has established information transmission methods, particularly evident in entertainment information [7]. In broadcast convergence, multiple transmission technologies are employed to achieve network conversion, while providing audiences with quality audio-visual enjoyment and ensuring superior network experience services.

4.2 Remote Production and Broadcasting

Remote production and broadcasting involves numerous audience groups with significantly different access methods and content. Therefore, during production and broadcasting operations, appropriate technical methods are selected, and 5G technology is rationally applied to utilize multiple data links to send program information to production and broadcasting platforms. Through platform mechanisms, content is transmitted to users to fully satisfy their needs. With 5G technology support, broadcasting program quality is enhanced, video resolution is improved, and superior playback effects are achieved.

4.3 Virtual Reality and Augmented Reality Broadcasting

Virtual reality broadcasting uses virtual simulation technology and computer equipment to simulate real scenes and environments. In these simulated environments, audiences can obtain highly realistic experiences. When applying 5G technology, virtual reality technology can enhance program attractiveness and bring new sensations and experiences to viewers. Emphasizing 5G technology application, augmented reality broadcasting connects the real world with the virtual world. Through augmented reality technology, high integration can be achieved, and with computer equipment and augmented reality broadcasting technology, realistic scenes are constructed to ensure users obtain quality experiences. When applying augmented reality broadcasting technology, relevant equipment is configured for audiences to access different broadcast information content. With 5G technology support, broadcast information transmission quality is improved. The transmission speed of virtual reality and augmented reality broadcast information can reach 10 Mb/s.

4.4 Emergency Broadcasting

When facing emergency situations, emergency broadcasting is required to send warning information to the public. During long-term development, broadcasting technology has had fast information transmission speeds but could not deliver broadcast content to users. After emergency events occur, involving substantial network data volumes, channel service loads increase, leading to communication paralysis accidents. Emphasizing 5G technology application can elim-

inate broadcasting technology limitations, ensuring that during emergencies, emergency broadcasts can be sent to media, and through broadcasting methods, users can promptly grasp emergency information and prepare accordingly. Emergency broadcast data and information transmission involves audio-video, text information, multimedia data, etc.

5. Application Practice of 5G in Broadcasting/Television Technology

5.1 Displaying Traffic Broadcast Information

In broadcasting and television technology, the rational application of 5G technology helps improve information convenience. Traffic broadcast information dissemination constitutes an important form of emergency broadcasting. With the increase in car ownership, the automotive industry is accelerating its development. Based on the 5G technology environment, television broadcasting can provide traffic broadcast information and road safety information. For road traffic systems, in information early warning, when congestion occurs ahead, timely warning information can be sent to drivers, combined with road sign data information to provide optimal routes [8]. When 5G technology is applied, dynamic display of road maps and provision of driving routes can be realized. In broadcasting and television technology, emphasizing 5G technology application ensures accurate object location description while providing quality traffic guidance services.

5.2 Building Broadcasting IoT

Compared to the 4G era, broadcasting and television under 5G technology have fewer limitations and can lay a solid foundation for broadcast data transmission. Building a smart broadcasting IoT system has become a network development trend. In broadcasting network deployment, the rational application of 5G technology can provide a foundation for smart broadcasting networks and smart city construction. The Internet of Things belongs to integrated device networks that merge with broadcasting and television networks, eliminating network defects and deficiencies while enhancing the intelligence level of broadcasting business.

When building broadcasting IoT, comprehensive technical investigation and research work should be implemented. Combined with broadcasting business, appropriate networking methods should be rationally selected. Currently, self-built networks and cooperative network models are common. Self-built networks refer to broadcasting networks utilizing LPWAN technology to scientifically construct gateways and maintain local IoT deployment effectiveness. Simultaneously, emphasis is placed on leveraging broadcasting network advantages as an information transmission platform to rationally optimize business processes. For cooperative networking, cooperation mechanisms can be provided for broadcasting networks and operators while accessing IoT. Operators expand network coverage through NB-IoT, and enterprises use LoRa technology for coverage

supplementation [9]. Through both proprietary networks, information data is backhauled, and data is connected with internet platforms, emphasizing business process optimization.

5.3 Digital Broadcasting System

Currently, digital broadcasting system R&D has become a focus. For example, mobile cellular networks use point-to-point mechanisms for video transmission modules, with primarily unidirectional transmission methods. Emphasizing 5G broadcasting technology application, broadcasting forms are adopted to send video information to mobile and fixed terminals. When mobile communication network broadband data traffic is substantial, digital broadcasting systems need to be applied to provide convenience for operators. The rational application of digital broadcasting systems to publish multimedia information and process terminal video viewing methods can resolve the problem of multiplying cellular mobile data.

6. Future Development of 5G in Broadcasting/Television Technology

With the development of mobile communication services and technology, traditional broadcasting and television technology is undergoing innovation and reform. It mainly applies diversified open technologies, including audio coding, intelligent operation, dynamic HDR, and data technology. In the integration of internet and broadcasting, following ATSC 3.0, pilot signals are optimized, particularly broadband signals with consistent bandwidth, to guide trailing data signal types. When 5G technology is applied, emphasis is placed on broadcast spectrum time-sharing application. Subsequently, 5G broadband standard reform enters its second phase. When optimizing digital television system design, combined with 3GPP and 5G standards, structural optimization is performed, along with mobile enhanced broadband compatibility. Since this concept was proposed, it quickly gained recognition from most integrated circuit enterprises. In the 5G era, mobile phone products have become demodulation modules in digital television program transmission, greatly influencing the formulation of digital television transmission standards.

In the development of broadcasting and television technology, reverse channel methods are rationally applied. Based on business requirements, reverse bandwidth demand is low. Emphasis is placed on reverse bandwidth application to implement video-on-demand and information feedback services. It should be noted that business information is a type of asymmetric data. China Telecom, China Unicom, and China Mobile operators face fierce competition in broadband services. The competition primarily focuses on wide-area IoT, low consumption, and low-power indicators, with narrowband standards as the core technology. Attention is given to bandwidth low-power consumption control to promote long-distance transmission. The technology offers numerous application advantages,

satisfying frequency band and coverage area requirements. Research focuses on terrestrial digital access, multi-user MAC, and single-carrier frequency multiplexing [10]. In the 5G era, broadcasting and television technology standardization levels have improved. For example, CCTV has established cooperative relationships with communication operators, emphasizing 5G media laboratory construction. When transmitting and testing 4K television programs, 5G technology application is emphasized. Integrating 5G technology with virtual reality, 4K, and 8K technologies enables the collection and arrangement of broadcasting programs while revolutionizing the playback process. For instance, in variety entertainment performances, sports event live broadcasts, and large-scale event live broadcasts, 5G technology can enhance audience on-site participation and expand event audience reach and influence.

Through wireless communication technology, wiring-free aerial connections are realized. For director rooms, studios, interview rooms, etc., program production equipment positions are scientifically adapted and processed while providing network support for devices and terminals. Front-end signal source input can not only satisfy 4K ultra-high-definition transmission requirements but also publish multiple IP streams. Audiences can watch multi-camera footage in real-time through smart mobile devices. Off-site audiences can observe different perspective images, enhancing the live broadcast experience.

In summary, with the rapid development of 5G technology, emphasis on integrating technology with broadcasting and television technology expands the application space of broadcasting systems. During 5G technology development, broadcasting and television' s exploration and practice facilitate the integration of 5G technology and broadcast media. Through 5G technology, the operability of broadcasting and television can be improved, and the media dissemination system can be expanded. In the new era context, the broadcasting industry must attach great importance to the integration and innovation of 5G technology and broadcasting technology.

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