Postprint: A Study on Convergence Applications of Broadcast Media in the 5G Era

Authors: Zhao Jun, Xie Haiou

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

Abstract

Currently, 5G testing and applications have been successively launched on a global scale, with commercial deployment plans gradually being put on the agenda. Compared with 4G, 5G offers advantages such as high bandwidth, low latency, and high network capacity, which exhibit a high degree of compatibility with the mobility, real-time, and interactive characteristics required by broadcast media. The application of 5G technology in broadcast media will usher in more revolutionary transformations in application scenarios.

Full Text

Exploration of Broadcast Media Convergence Applications in the 5G Context

Abstract: 5G technology has been undergoing testing and deployment worldwide, with commercialization plans steadily progressing. Compared to 4G, 5G offers significantly higher bandwidth, lower latency, and greater network capacity—characteristics that align well with the mobile, real-time, and interactive requirements of broadcast media. The integration of 5G technology into broadcast media will enable revolutionary transformations in application scenarios.

Keywords: 5G technology; media convergence; broadcast media; 4K video

1. Current Limitations of 4G Mobile Networks in Broadcast Media Applications

1.1 Limited Network Speed

Since China' s commercial deployment of 4G networks began in 2013, user penetration has reached 70% after six years of development. While 4G has facilitated

the growth of mobile internet and transformed the media landscape, its theoretical downlink bandwidth of 150 Mbps (or 300 Mbps for 4G+ with carrier aggregation) falls far short in practical applications. As audiences increasingly demand high-quality content, broadcast media has progressively upgraded video resolution from HD and Full HD to ultra-high-definition 4K and 8K. Streaming 4K video typically requires 40–60 Mb/s, yet actual 4G network speeds range from only 8–60 Mb/s, clearly insufficient for reliable UHD video support.

1.2 High Transmission Latency

Broadcast media applications demand low transmission latency, but 4G' s high delays often compromise real-time services. For instance, seamless real-time video interaction—particularly remote high-definition video connections—remains difficult to achieve under 4G, as the technology cannot meet the stringent speed and latency requirements for truly instantaneous communication.

1.3 Low Network Capacity

4G network base stations are relatively sparsely distributed, with performance heavily affected by environmental conditions and limited connections per base station. Congestion and unstable speeds frequently occur in dense user areas or during handovers—precisely the fast-moving, crowded environments where broadcast media most commonly operates. While "4G backpacks" have been used to address transmission challenges, their bulky size and high cost create additional burdens.

---

2. How 5G Better Satisfies and Expands Broadcast Media Application Scenarios

5G, the fifth-generation mobile communication technology, represents an evolution from 4G with substantially enhanced performance. Building upon 4G foundations, 5G employs numerous key technologies to dramatically improve network capabilities. Massive MIMO technology boosts spectral efficiency and supports system capacity and speed. Ultra-dense networking improves coverage while increasing capacity and stability. Sparse Code Multiple Access (SCMA) introduces sparse codebooks to enable multi-user code-domain access and enhance wireless spectrum utilization. Millimeter-wave technology at ultra-high frequencies further improves network stability and security.

These advances enable 5G to support user experience rates of 0.1–1 Gbps, connection densities of one million per square kilometer, end-to-end latency in milliseconds, traffic densities of tens of Tbps per square kilometer, mobile access at speeds exceeding 500 km/h, and peak rates of tens of Gbps. The industry widely recognizes 5G as a truly converged network that provides high-speed, secure, and seamless connectivity between people, people and things, and things

themselves using unified standards.

2.1 Large Bandwidth

According to ITU-R specifications, 5G downlink peak data rates reach 20 Gbit/s with uplink peaks of 10 Gbit/s, while 3GPP TR 22.863 defines eMBB user experience rates as 1 Gbit/s downlink and 500 Mbit/s uplink. The China Communications Standards Association specifies that 4K UHD video requires end-to-end bandwidth exceeding 50 Mbit/s, while 8K video needs over 135 Mbit/s. Theoretically, 5G can readily support 4K and 8K video transmission, making it crucial for popularizing ultra-high-definition content and providing the foundation for immersive AR/VR scenarios—representing a significant opportunity for broadcast media video convergence.

2.2 Low Latency

Current mobile communication latency comprises air interface, bearer network, core network, and PDN network components. 5G reduces overall network latency to 1 millisecond through flattened architecture, content 下沉 (edge caching), air interface reconstruction, and edge computing—a 50-fold improvement over 4G' s 50-millisecond latency. This enables previously challenging real-time applications like seamless video connections and live interactive broadcasting, substantially enhancing broadcast media' s real-time interactive service capabilities.

2.3 High Connection Density

5G employs massive MIMO to achieve higher base station density and spectral efficiency, increasing wireless mobile broadband capacity by 1000-fold compared to 4G LTE and supporting at least one million connections per square kilometer. Using Device-to-Device (D2D) technology, 5G enables direct terminal-to-terminal communication, providing critical capabilities for IoT development. Future broadcast media can leverage these connections to interconnect with audience smart devices, creating novel information exchange patterns between media and terminals that will unlock new possibilities for converged media development.

2.4 5G Broadcast/Multicast Service Applications

ITU-R has identified three major 5G application scenarios: Enhanced Mobile Broadband (eMBB), massive Machine-Type Communications (mMTC), and Ultra-Reliable Low-Latency Communications (uRLLC). Many services can utilize 5G broadcast technology, collectively termed 5G Broadcast-like Services or 5G Broadcast Multicast Services (BMS), characterized by three main features:

First, large data packages—supporting data rates up to 300 Mbps (e.g., 15 broadcast channels of 4K/8K ultra-high-definition audio-video content at 20 Mbps per

channel).

Second, content distribution via broadcast/multicast mechanisms.

Third, low latency—achieving round-trip delays of 10–12 milliseconds when transmitting 8K stereoscopic video content at 250 Mbps.

These characteristics create substantial opportunities for broadcast media and 5G integration. Positioned as a "general-purpose" technology benefiting all industries, 5G has made broadcasting a key vertical market for major operators in Europe, America, and China. For broadcast networks seeking to deliver personalized and interactive services, 5G convergence will enable revolutionary offerings:

(1) Hybrid Television Broadcasting Services Based on 5G: Hybrid broadcast television represents a crucial global development direction. The EU is already researching wireless hybrid broadcast television transmission via 5G networks, creating "seamless" integration with terrestrial digital TV broadcast and wireless broadband networks to deliver broadcast content more effectively while offering new service forms. Users can access ubiquitous media content via 5G broadcast in various environments—indoor or outdoor, fixed or mobile.

(2) AR/VR Broadcasting Based on 5G: With ongoing nationwide 5G testing, the AR/VR industry—previously constrained by bandwidth and latency—is poised for resurgence. Major hardware manufacturers have announced 5G+AR/VR plans, including Huawei' s Balong 5G commercial chip (2018) and Qualcomm' s XR1 platform for AR/VR. Independent AR/VR terminals are projected to reach 186 million units by 2023, with VR recognized as a true 5G driver. Each 5G base station can support nearly 1,000 simultaneous AR/VR content consumers, representing a market with enormous potential. Broadcast media content production and distribution will gradually expand into this emerging market, providing immersive experiences.

(3) Vehicle Networking and IoT Services Based on 5G Broadcasting: Beyond human social connectivity, 5G enables communication between people and things, and between things themselves. For vehicle networking, 5G broadcast technology will revolutionize in-car broadcasting by enabling personalized, location-aware, and weather-responsive content delivery—achieving "thousand-people-thousand-faces" program customization. Additionally, IoT expands information dissemination boundaries, as every smart device can become an information collector and distributor, embodying the concept of "everything is media, everything is a platform." Through 5G IoT, intelligent media terminals and broadcast media form bidirectional intelligent connections, with all interaction data becoming valuable resources for improving user experience.

(4) Emergency Broadcasting Services Based on 5G: 5G broadcast/multicast will revitalize emergency broadcasting, delivering "ubiquitous" emergency content to large-screen TVs, mobile smart terminals, and vehicle displays in various formats (text, audio, video), including accessibility features for

visually and hearing-impaired populations, maximizing the value of emergency information.

---

3. Current 5G Application Cases in Broadcast Media

While large-scale 5G deployment remains in testing, early broadcast media applications have begun, primarily as transmission tools. Realizing the full potential of 5G-media convergence requires continued exploration.

3.1 China' s First National-Level "5G New Media Platform" at China Central Television

On December 28, 2018, China Central Television (CCTV) announced a partnership with China Telecom, China Mobile, China Unicom, and Huawei to build China' s first national-level 5G-based new media platform. Through the "5G Media Application Laboratory," they will conduct video application and product innovation in 5G environments. The laboratory will select 10 5G pilot cities with corresponding test sites to establish end-to-end application trials.

3.2 CCTV's First 5G-Powered 4K Live Broadcast of the "Two Sessions"

During the 2019 Two Sessions coverage, CCTV became the first broadcaster internationally to continuously transmit 4K ultra-high-definition signals via 5G technology, live-streaming press conferences on its 4K channel. Leveraging its 5G new media platform with big data and AI technologies, CCTV integrated and distributed multiple 4K and VR video signals. This technological demonstration showcased the innovation and convenience of 4K program production in 5G environments, delivering ultra-high-definition visual experiences to audiences.

3.3 Qinghai TV' s 5G Network + 4K HD Technology for Simultaneous Han-Tibetan Live Broadcast

Qinghai TV live-streamed the premiere ceremony of the documentary "Gesar' s Heroic Grasslands"using 5G network and 4K HD technology. This live broadcast leveraged 5G' s advantages to achieve full-platform simultaneous Han-Tibetan streaming through a converged media live matrix, marking an important step in building new mainstream media through bold technology adoption and accelerated integration. This demonstration also provided a model for 5G applications in converged media.

---

4. Challenges in 5G Technology Popularization and Application

5G networks remain in small-scale testing, with considerable time needed before commercial deployment and widespread adoption. 5G applications in broadcast media cannot be achieved overnight. Recall that 4G networks required six years from commercial launch in 2013 to reach over 70% penetration. As an emerging frontier technology, 5G faces numerous challenges:

(1) High Costs: As a cutting-edge technology with substantial R&D investment, 5G equipment and network costs will be extremely high initially. Priority access requires significant financial commitment.

(2) Workflow Integration: While 5G offers exceptional transmission performance, leveraging it to improve operational efficiency requires upgrading business processes, supporting equipment, and content formats to achieve true technology-business fusion.

(3) Content Explosion and Regulation: 5G will trigger explosive growth in video content, lowering production barriers, accelerating dissemination, and enhancing interactivity. This makes content review and regulation increasingly difficult, posing greater challenges for intellectual property protection and personal privacy.

The 5G era represents more than quantitative improvements over 4G. The convergence of 5G technology with industries will unlock enormous potential across sectors. For broadcast media, 5G integration will reshape the entire industry, drive business transformation, change content consumption patterns, and enhance audience experiences—providing unprecedented opportunities to revitalize broadcast media.

References

[1] Xiao Li. Discussion on New Media Development in the 5G Era [J]. Radio & Television Information, 2016(10).

[2] Lu Ping, Li Jianhua, Zhao Weiduo. 5G Applications in Vertical Industries [J]. ZTE Technology Journal, 2019(1).

[3] 5G Broadcast Key Technologies. http://info.broadcast.hc360.com/2018/03/280930773414.shtml.

[4] Tang Tiantian, Li Rao Wen' na. Opportunities and Challenges for Video Development in the 5G Era [J]. Video World, 2019(1).

[5] Wang Yongli, Cheng Hong, Guo Yuzhe, et al. 5G and Future Television Broadcasting Technology Applications [J]. Modern Television Technology, 2018(10).

[6] Hu Jinquan. Key Technologies of 5G Systems and Their Development Status at Home and Abroad [J]. Telecom Express: Network and Communication, 2017(1).

(Author Affiliation: Technical Information Department, Foshan People' s Radio Station)

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