Postprint: Evolution of Media Communication Patterns Based on Converged Communication Technology Development

Authors: Li Pingshi

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Abstract

【Purpose】 To investigate the development of 6G technology and its innovative applications in the integrated media domain. 【Method】 This paper centers on the key milestones in the evolution of integrated communication technology (5G, 5.5G, 6G), a critical enabling technology for 6G, and adopts a three-dimensional analytical framework encompassing "integrated communication + communication innovation" and "technology generation + communication characteristics + user participation." Through case studies including short-form video news dissemination, marketing strategies for scientific journals, innovation in ideological education, and new technology applications in television programs, it compares the transmission rates, latency, and application scenario performance across different communication technologies, and analyzes the innovative applications and evolutionary patterns of communication models for integrated communication technology in media dissemination at various stages. 【Results/Conclusion】 It is projected that integrated communication technology in the 5.5G and 6G eras will usher in revolutionary transformations for the integrated media industry.

Full Text

Evolution of Media Communication Models Based on Converged Communication Technology Development

Tiandi Sunshine Communication Technology (Beijing) Co., Ltd., Beijing 100095

Abstract

Purpose: This study investigates the development of 6G technology and its innovative applications in the integrated media field. **Methods:** Focusing on

converged communication technology as a key 6G technology, we examine its evolution through major developmental milestones (5G, 5.5G, and 6G). Using a three-dimensional analytical framework of "Converged Communication + Communication Innovation" and "Technology Generation + Communication Characteristics + User Participation," we analyze case studies including short-form video news dissemination, science journal marketing strategies, ideological education innovation, and new technology applications in television programs. We compare the transmission rates, latency, and application scenario performance of different communication technologies to assess the innovative applications and evolutionary patterns of converged communication technology in media communication across different stages. **Results/Conclusion:** Converged communication technology in the 5.5G and 6G eras is poised to bring revolutionary transformations to the integrated media industry.

Keywords: converged communication technology; 5.5G; 6G; media communication models; evolution; innovation

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Converged communication technology integrates multiple communication modalities—including voice, data, and video—while combining modern information technology and internet technologies to provide users with comprehensive, three-dimensional, and seamlessly connected communication services [1]. Based on the synergistic effects of 5G networks, IoT, cloud computing, and big data technologies, converged communication has become an indispensable driving force for both traditional and emerging media. It accelerates the digital transformation of the media industry, enhances the immediacy, diversity, and interactivity of information dissemination, and ushers in a new era of media communication model innovation.

This article systematically analyzes the innovative applications of converged communication technology across different developmental stages in the integrated media field.

1. The Role and Case Studies of Converged Communication Technology in Media Communication Under 5G

1.1 Role Analysis

Converged communication technology will be a key 6G technology, characterized by: first, extensive coverage and deep integration that will make it a ubiquitous technology present in various environments and scenarios, enabling omnipresent

and continuous communication connections to meet people's communication needs in all aspects of life and work, thereby bringing more convenient and efficient communication experiences and driving digital transformation and innovative development across industries. Second, data transmission rates may reach 50 times that of 5G, with latency reduced to one-tenth of 5G levels, far surpassing 5G in peak rates, traffic density, connection density, mobility, spectrum efficiency, and positioning capabilities [3][4], enabling more efficient and extensive communication coverage and connectivity. Third, 6G networks will achieve seamless global coverage, with network signals reaching even the most remote villages [5], allowing converged communication technology to fully leverage its cross-platform and cross-network characteristics to achieve seamless integration and interoperability among various communication methods, providing users with richer and more convenient communication experiences. Fourth, converged communication technology will evolve from software-defined heterogeneous convergence to dedicated chips, enabling deep customization and optimization for critical aspects such as communication protocols and data processing, thereby enhancing overall communication system performance. Fifth, as a key 6G technology, it will continuously generate new all-media, all-platform, and all-scenario media communication models [2].

The primary functions of converged communication technology in media applications include: first, using IP intercom or soft intercom terminals to provide real-time audio guidance for specific audiences; second, achieving multimedia interaction with users through video calls or VoIP; third, pushing various information to users via MMS, email, or more advanced rich media messaging services; fourth, implementing multimedia monitoring of specific areas or targets through video or network monitoring; fifth, broadcasting multimedia content to global or partial personnel through IP broadcasting or network broadcasting; and sixth, providing integrated messaging interfaces to enable message interaction and group communication [2].

This study employs a three-dimensional analytical framework of "Converged Communication + Communication Innovation" and "Technology Generation + Communication Characteristics + User Participation" to examine the current state of converged communication technology in media communication. The details, performance parameters, and application examples of each technology are comprehensively compared and summarized in Table 1 , which contrasts the transmission rates, latency, and performance across specific application scenarios of different communication technologies. In mobile reporting scenarios, 3G/4G technology serves as a key factor in enhancing on-site reporting speed and quality due to its high-speed wireless access capabilities. 5G technology demonstrates advantages of extremely low latency and rapid processing of large data volumes in fast information dissemination due to its ultra-high-speed broadband and edge computing capabilities. In news data center applications, fiber optic communication using WDM multi-wavelength multiplexing technology to achieve 1Tbps transmission rates and latency as low as 5ms plays a decisive role in high-speed stable data access. In media content distribution applications,

network protocols such as HTTP/2 and QUIC significantly improve information distribution efficiency. In media resource scheduling, emerging technologies like Software-Defined Networking (SDN) achieve optimized resource allocation through the separation of control and data planes, while Network Function Virtualization (NFV) enhances network function flexibility through virtualized network functions, both positively impacting news cloud storage and processing services. In on-site news gathering, IoT technology enhances collection efficiency and news quality through sensor networks and Low-Power Wide-Area Networks (LPWAN). In news recommendation and personalization, machine learning/AI improves user satisfaction and reading rates through deep learning algorithms. In summary, the hallmark of media communication models in the 5G era is "ultra-high-definition streaming (4K/8K), shallow interaction (bullet comments/likes)."

1.2 Case Studies

1.2.1 Short-Form Video News Dissemination Based on converged communication technology, mainstream media's use of short-form video for news dissemination has become an important strategy. This communication method not only transforms traditional news production and distribution models but also significantly enhances audience engagement and interactivity. For example, CCTV's year-end "Anchor's Broadcast" program in 2023 adopted an innovative communication model—using short-form video to simplify complex news events into easily understandable content—while leveraging social media platforms for widespread dissemination, greatly expanding news coverage and influence. This optimized communication model enhanced news timeliness and interactivity, enabling viewers to obtain key information within short timeframes and interact with content through comments, likes, and other means. This interactivity not only strengthens audience engagement but also provides valuable user feedback for mainstream media and serves as a reference for other media outlets [6]. Currently, short-form video platforms such as WeChat Channels, Douyin, Xiaohongshu, and international platforms like Facebook and TikTok have profoundly influenced online/offline education models, product sales models, news dissemination and public opinion control patterns worldwide, even impacting global political landscapes.

1.2.2 Science Journal Marketing Strategies Science journals currently face challenges in publishing and distribution as well as bottlenecks in marketing methods. Through converged communication technology, science journals can more precisely target reader groups and provide personalized content and services. For instance, using big data analytics, science journals can gain deep insights into readers' reading habits and interest preferences to formulate more targeted marketing strategies. Additionally, converged communication provides diversified marketing channels such as social media and mobile applications, transforming users from passive content consumers to co-creators of content and establishing "content co-creation" and "value co-creation" relation-

ships with users to obtain more user feedback and creativity, thereby further enhancing user stickiness and loyalty. Of course, quality control of user-generated content and copyright issues require continuous optimization and improvement in practice.

1.2.3 Ideological Education Innovation Converged communication technology provides diversified communication pathways for ideological education by constructing a multi-carrier support system including cultural guidance systems supported by spiritual carriers, education systems supported by curriculum carriers, converged media discourse communication systems, and matrix education platforms to address discourse communication and education challenges in converged media environments. Specifically, it can enhance mainstream ideological identification by deeply 挖掘 content to build converged media cultural guidance systems. Through diversified formats such as cases, videos, fragmented content, stories, graphics, and "micro" formats, abstract theories can be transformed into attractive content, shifting students' learning attitudes from passive acceptance to active identification in converged media environments.

1.2.4 New Technology Applications in Television Programs Based on the aforementioned converged communication technology, significant changes in communication forms have emerged in television program production and broadcasting [7]. For example, the "5G+Ultra-HD Return" technology debuted at the 2019 Spring Festival Gala and "My People, My Country" launch event, bringing unprecedented viewing experiences to audiences. Henan TV's "Chinese Festivals" series successfully presented traditional culture to audiences in entirely new ways under the support of 5G, 4K/8K, and AI technologies [8]. The 2022 Spring Festival Gala's 720-degree dome screen integrated XR, AR, holographic scanning, 8K, and glasses-free 3D technologies to create panoramic stage effects. The dance program "Only This Green" enabled dancers to appear as if immersed in the "A Thousand Miles of Rivers and Mountains" painting, achieving visual stage effects [8][9]. The sixth season of "Chinese Poetry Conference" adopted XR screen construction methods, integrating three LED screens to create a fully immersive, infinitely extendable three-dimensional space, bringing entirely new viewing experiences to audiences. "National Treasure" employed nine movable column screens, a large background screen, and 360-degree holographic projection to provide audiences with richly layered visual stage experiences [8]. Hunan TV's "Hello Saturday" achieved interaction between virtual scenes and real people through camera tracking real-time shooting and 3D engine virtual camera positions, bringing new interactive experiences to audiences [10]. The Beijing Winter Olympics figure skating and short track speed skating broadcasts adopted three-dimensional sound technology to restore the sound field to a three-dimensional space, creating an immersive audio experience for viewers. "Chinese Good Poetry" and "National Treasure" achieved interaction between small and large screens through QR codes in the lower right corner of the screen, making historical artifacts easily understandable [8][11].

2. 5.5G-Era Converged Communication Technology Driving Innovation in Media Communication Models

5.5G networks (officially 5G-Advanced) represent a critical evolution from 5G to 6G. Compared with 5G, 5.5G achieves tenfold improvements in speed, latency, and connection scale [12]. 5.5G networks feature: first, faster speeds with network access rates reaching 10Gbps while ensuring millisecond-level latency; second, better services with hierarchical and graded key business guarantees to meet communication service needs for specific business forms and customer groups; third, superior products that accelerate real-time 3D rendering, game content loading, and cloud collaboration, greatly improving functionalities and experiences of 5G new calling, cloud phones, and cloud computers; fourth, more accurate perception with integrated communication and sensing technology advancing communication networks from single data transmission to comprehensive multi-dimensional sensing to efficiently meet user demands for water, land, and air all-scenario sensing services; fifth, broader connections integrating new wireless IoT networking technologies to achieve transformation from single-point communication to "ultra-long distance, ultra-large scale passive IoT" to meet modern asset management efficiency needs; sixth, more stable control through deterministic networks ensuring high reliability and low latency for key data transmission to meet user demands for precise control and collaborative operations in extreme network scenarios.

Based on these capabilities, 5.5G networks enable real-time generation, distribution, and interaction of media content through high-speed, low-latency connectivity, driving transformation and upgrading of the media industry. The hallmark of this era is "Extended Reality (XR) converged communication, mid-band IoT device linkage" [13], specifically including:

(1) Virtual Reality and Augmented Reality. 5.5G technology's high-speed data transmission and negligible latency provide powerful support for Virtual Reality (VR) and Augmented Reality (AR), making experiences in news reporting, educational content, and gaming entertainment more immersive and realistic. Imagine watching a football match through VR headsets as if physically present, or visiting distant museums through AR technology at home to experience the weight of history.

(2) Personalized Recommendations. Under 5.5G networks' high-speed data processing capabilities, media platforms can real-time analyze users' browsing habits, preferences, and behavior patterns to provide more precise and personalized recommendations. Users no longer need to spend considerable time searching through massive content; instead, intelligent algorithms tailor content for them, making reading and viewing more efficient and enjoyable.

(3) Real-Time Live Broadcasting. 5.5G's low-latency characteristics make real-time live broadcasting exceptionally smooth. Whether capturing exciting moments in sports events or on-site reporting of breaking news,

audiences can enjoy nearly delay-free viewing experiences. This technological advancement greatly enhances media timeliness, allowing audiences to synchronously experience every exciting moment with events.

(4) IoT Device Integration. 5.5G technology's extensive connectivity capabilities enable seamless integration of media content into various IoT devices. From smart homes to wearable devices, from in-vehicle entertainment systems to smart city infrastructure, media content is ubiquitous, providing users with more convenient and diversified information access methods. For example, when preparing dinner in the kitchen, smart refrigerators can recommend recipes and play cooking video tutorials through built-in screens.

(5) Distributed Content Production. 5.5G technology-supported edge computing enables more decentralized content production. This means users can create and share content using devices around them, whether in bustling cities or remote villages. This decentralized production model not only lowers creation barriers but also promotes content diversity and innovation, giving everyone the opportunity to become content creators and disseminators. It also enables online interactive activities to increase user stickiness.

(6) Cross-Industry Collaboration. Collaboration with other industries expands the diversity of interactive content.

3. 6G-Era Converged Communication Technology Driving Innovation in Media Communication Models

The 6G era will bring significant performance improvements through signature technologies such as terahertz communication and space-air-ground integrated networks: peak transmission rates reaching 100Gbps to 1Tbps, network latency as low as 0.1ms, connection density supporting millions to hundreds of millions of devices per square kilometer, global coverage exceeding 99.9%, positioning accuracy reaching 1cm, and overall performance improving fivefold over 5.5G [14]. Currently, Academician Zhang Ping's team at Beijing University of Posts and Telecommunications has successfully built the world's first 6G test network integrating communication and intelligence [15]. This achievement verifies the feasibility of 4G and 5G links possessing 6G transmission capabilities and achieves comprehensive improvement in communication performance under major 6G scenarios. This test network not only provides an important platform for 6G technology research but also lays the foundation for exploring future integrated media applications.

Preliminary analysis indicates that in the 6G era, converged communication technology combining terahertz communication and space-air-ground integrated networks will enhance integrated media performance primarily by constructing multi-dimensional sensing and information fusion networks and integrating artificial intelligence and big data technologies. The hallmark is "full-sensory digital

twin, distributed cognitive co-creation," manifested in the following aspects:

(1) Supporting Higher Quality Content Production, Transmission, and Distribution. First, based on 6G's extremely high transmission rates and low latency, users can enjoy smoother, higher-definition audio-visual content. Second, 6G's high connection density and global coverage will enable integrated media content to reach users more extensively, ensuring consistent high-quality experiences whether in urban or remote areas. Finally, 6G's high-speed transmission and low latency will make remote collaboration and real-time editing possible, greatly improving content creation efficiency and flexibility.

(2) Providing Multiple Innovation Focal Points for Integrated Media. First, 6G technology's ultra-massive connection capability can support massive device access and data transmission, enabling integrated media to connect more information sources and users for broader information collection and dissemination. For example, in smart city and smart agriculture scenarios, 6G technology can support large-scale sensor access and data transmission, providing rich information materials and reporting perspectives for integrated media. Second, 6G technology's integrated sensing and communication characteristics can provide more precise and diversified information acquisition methods for integrated media. For example, in news reporting, integrating sensing and communication functions enables real-time monitoring and data collection of news scenes, providing more accurate and comprehensive information support for reporting. Finally, sensing-communication integration can also support high-precision positioning, environmental reconstruction, and other functions, providing richer reporting forms and means for integrated media [16][17][18].

(3) Innovative Immersive Communication Models. First, 6G technology can connect the physical and digital worlds through multi-dimensional sensing technologies including visual, auditory, tactile, and olfactory perception, enabling more comprehensive and in-depth information acquisition and providing richer materials and content for integrated media [17]. Second, higher-fidelity immersive communication such as AR/VR/XR and holographic communication can create immersive experiences for users, providing a series of high-fidelity business experiences. For example, in news reporting, holographic projection allows audiences to see three-dimensional news scenes as if physically present, obtaining more intuitive and realistic reporting experiences that further enhance integrated media's appeal and influence [7][18][19]. Finally, breakthrough applications in multiple media fields. For example, in short-form video, holographic imaging transmission combined with haptic feedback technology can bring immersive news experiences; in science journal marketing, digital twin technology can be combined to build three-dimensional virtual laboratories for dynamic demonstration of paper results; in ideological education, brain-computer interfaces and affective computing technology can bring breakthroughs in

cognitive communication paradigms.

(4) Comprehensive Realization of Personalized Customization. Through integration with cutting-edge technologies such as artificial intelligence, big data, and IoT, 6G will drive integrated media toward intelligent and personalized development. For example, using 6G and AI technologies can enable intelligent content recommendation and personalized customization, improving user satisfaction and participation.

(5) Integration with Smart Connected Vehicles. An innovative application of 6G technology in the integrated media field. With the development of connected vehicle technology, integrated media can utilize 6G technology to achieve seamless connection between vehicles and media platforms, not only providing users with real-time traffic information and road condition reporting but also delivering personalized news, entertainment, and other content through in-vehicle screens, and even supporting remote operation driving and other intelligent transportation systems to create new business growth points for the integrated media field [16].

Converged communication technology plays a key role in media communication innovation. With further development of converged communication technology, media communication models will continuously innovate and evolve. Through the "Converged Communication + Communication Innovation" framework, research shows that different communication technologies and their transmission rates and latency are suitable for different specific application scenarios. From perspectives including media education, mainstream media communication, traditional media transformation, and science journal marketing, converged communication technology significantly improves information dissemination efficiency and coverage by integrating multiple communication methods and platforms, driving profound transformation in the media industry. Specifically, in mainstream media's short-form video news dissemination, converged communication technology brings innovation in communication forms and channels, enhances audience participation and interactivity, and improves content production efficiency and dissemination effectiveness. It enables science journals to achieve precision marketing and innovation based on big data analysis and diversified channels, enhances students' identification with mainstream ideology through diversified educational methods, and demonstrates numerous highlights and significant effects in multi-directional television applications. Moreover, as a key technology for 5.5G and 6G, it will further drive innovation in media communication models, promote real-time generation, distribution, and interaction of media content, and give rise to innovative applications and cross-industry collaborations including VR/AR live broadcasting, immersive real-time communication, comprehensive personalized customization, and IoT device integration (such as integration with smart connected vehicles). Of course, challenges brought by high-speed transmission in the 5.5G and 6G eras, such as content verification challenges (e.g., real-time identification of deepfake videos), electromagnetic radiation safety thresholds, and privacy data protection mechanisms,

are ethical issues requiring high attention and resolution in the future. In conclusion, with the continuous development and maturation of converged communication technology based on 6G, more integrated media application cases will emerge, bringing further revolutionary transformations to the integrated media industry.

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Author Biography: Li Pingshi (1969–), male, Han ethnicity, from Xia County, Shanxi Province, senior engineer, bachelor's degree. He serves as Chairman of Tiandi Sunshine Communication Technology (Beijing) Co., Ltd. and Deputy Director of the Public Safety Branch of the China Institute of Communications. His research focuses on audio-video communication, converged communication technologies, and product design for deep application in command and dispatch systems. He presided over the design of the "Software-Defined Heterogeneous Convergence Model," which achieves the integration of communication, data, and algorithms, representing a domestically leading level.

(Responsible Editor: Li Jing)

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