Exploration of "Turnkey Project" Implementation Plans for Converged Media in the 5G Era: Post-print

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Abstract

This paper explores, within the context of the 5G era, the transformation of emerging business models driven by cutting-edge technological innovations, closely aligns with the developmental trajectory of radio and television broadcasting, integrates the specific municipal circumstances of Xinyang City and the current operational status of Xinyang Radio and Television Station (hereinafter referred to as "our station"), proposes the feasibility of technical integration between 5G and broadcasting systems, investigates the novel architecture and system composition for broadcasting in the 5G era, presents a process design for user reception services, and provides implementation schemes and technical references for the strategic deployment of broadcasting systems under the 5G paradigm, both for our station and the industry at large, as well as for related research topics.

Full Text

Preamble

Exploring a Turnkey Project Implementation Plan for Converged Media in the 5G Era

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Abstract: This paper explores the transformation of business formats driven by cutting-edge technological changes in the 5G era, closely following the development trajectory of radio and television broadcasting. Combining the specific circumstances of Xinyang City and the current situation of Xinyang Radio and Television Station (hereinafter referred to as "our station"), we examine the feasibility of integrating 5G technology with radio and television systems, propose

a new architecture and system composition for broadcasting in the 5G era, and present a workflow design for user service reception. This provides an implementation plan and technical reference for our station and the broader industry in planning broadcasting systems under the 5G prospect.

Keywords: 5G; radio and television technology; broadcasting services; converged media; broadcasting App; spectrum

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1. Background

Media formats are undergoing profound transformation. In March 2019, President Xi Jinping published an article in *Qiushi* journal titled "Accelerating Media Convergence to Build an All-Media Communication Landscape," which stated: "We must adhere to a mobile-first strategy, enabling mainstream media to firmly occupy the commanding heights of public opinion guidance, thought leadership, cultural inheritance, and people-oriented communication through mobile dissemination." According to the 45th Statistical Report on China' s Internet Development released in April 2020, by March 2020, China had 904 million internet users, with an internet penetration rate of 64.5%, and 897 million mobile internet users. Mobile networks, with smartphones as the primary carrier, are showing vigorous development momentum, with social networks and self-media becoming integral to daily life [**?**]. It is projected that by the end of 2025, 5G will cover 65% of the global population and carry 45% of global mobile data traffic.

In recent years, due to evolving communication methods, shifting viewing habits driven by screen-size transitions, and changes in lifestyle and work pace, audience attention and ratings for traditional radio and television have plummeted, causing advertising revenues for ordinary municipal and county-level stations to evaporate rapidly and threatening their survival. Actively leveraging cutting-edge technologies to address audience needs, seeking survival and development through transformation, and pursuing media convergence has become an inevitable choice for the era. Currently, our station has established a converged media center and high-definition broadcasting systems. However, to "break through the encirclement," we must prioritize building a new converged media platform with strong influence and competitiveness. By seizing development opportunities brought by 5G, boldly applying new technologies, mechanisms,

and models, and accelerating the pace of media convergence, we can identify our direction in fierce communication competition and explore a path for breakthrough development.

Based on two-way communication services, we will focus on developing 5G radio and television broadcasting services to achieve differentiated development. Through the "dual-core" driving force of communication and broadcasting, we can fully revitalize existing resources and form a new radio and television transmission and coverage network supported by 5G technology.

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2. Goals and Pathways

By integrating 5G communication technology with radio and television broadcasting technology and utilizing the resources of our station' s directly-affiliated Xinyang Television Relay Station and Xinyang Huangchuan Relay Station' s large wireless transmission towers, we aim to achieve comprehensive coverage of radio and television signals to 5G mobile phones. This approach will support both traditional fixed-reception large-screen televisions and mobile small-screen terminals (such as smartphones), fully realizing universal access to radio and television services across all devices and users. We strive to build a Xinyang digital cultural communication main channel adapted to the new era of interconnectivity, cross-network, cross-screen, and cross-terminal capabilities, achieving the goal of convenient dissemination and viewing.

2.1 Business Aspects

At present, smartphones have become indispensable tools in people' s lives and work. The scale of 5G production, its breadth of applications, and its high technological content exceed any previous communication technology. Traditional radio and television technology must integrate with cutting-edge 5G technology to adapt to new social development demands. Our objectives are to strengthen Xinyang Radio and Television as mainstream media, fully demonstrate institutional advantages, meet the needs of Xinyang citizens to watch radio and television programs anytime and anywhere, and ensure that Xinyang Radio and Television' s audio and video content is omnipresent and always available. Simultaneously, we will expand business areas, develop new service types, and promote the transformation and upgrading of radio and television media to enhance sustainable development and large-scale monetization capabilities.

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2.2 Network Aspects

We will revitalize the resources of our station' s two directly-affiliated relay stations' large transmission towers by upgrading them with 5G technology to achieve comprehensive coverage of radio and television signals to mobile terminals. Small towers will provide personalized 5G interactive services, while coordination between large and small towers will enable resource sharing and collaborative coverage between broadcasting and mobile networks, improving overall network transmission efficiency and delivering converged media services. By adopting two independent operational models—open reception of 5G broadcasting for all users and exclusive 5G broadcasting for in-network users—we can open up program signals from provincial, municipal, and county-level stations (stations) to achieve value-added revenue growth.

2.3 Service Aspects

Through new technology upgrades and emerging business applications, we will elevate the status of the radio and television industry, enhance social influence, attract mobile terminal users, and achieve good economic benefits.

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3. System Architecture and Technical Implementation

3.1 Four System Layers

The 5G radio and television broadcasting system comprises four layers: the business front-end, core bearer network, wireless transmission system, user terminals, and an intelligent monitoring and management platform.

At the business layer, it includes a media convergence platform, service fusion platform, and intelligent engine operation and maintenance system. The all-media convergence platform, all-media fusion management platform, and communication core network can fully utilize existing infrastructure [**?**].

At the core network layer, it must include both the 5G core network for mobile communication and a broadcasting core network for operating radio and television audio-visual content. Currently, only the broadcasting core network and BOSS (Business & Operation Support System) management platform need to be newly constructed.

At the transmission layer, we must achieve bearer network sharing and joint coverage of wireless communication and broadcasting. The intelligent engine platform and intelligent operation and maintenance platform can be networked to support these functions.

At the terminal layer, the 5G radio and television system focuses on developing terminals with both 5G broadcasting reception and 5G communication capabilities, supporting not only broadcasting-owned users but also third-party users

[**?**].

5G radio and television terminals are primarily smartphones and tablets—the user presentation units for 5G broadcasting services. They can directly receive one-way broadcast signals and also enable two-way internet access or interactive applications. User experience differences when receiving services through the 5G radio and television App mainly depend on whether broadcasting-related auxiliary data or value-added services are delivered via intranet or internet OTT methods, and whether the system architecture supports third-party telecom operator mobile phone users.

For third-party mobile phone users, the process involves App registration and login, followed by loading user configurations to display a customized App interface. Users can then select audio/video playback or data display. If audio/video playback is chosen, they enter a customized minimal audio/video architecture to initiate 5G broadcasting services, focusing only on large-tower services. Depending on whether they are within 5G broadcasting coverage, they enter either the "outside large-tower coverage" or "inside large-tower coverage" branch flow. If data display is selected, they enter a customized data interface to receive pushed data and display it.

For emergency broadcasting services, mobile phones as new media terminals can receive emergency broadcast messages pushed by the new media platform according to standard requirements, promptly alerting users through information display and sound reminders [**?**].

3.3 Spectrum Usage

Spectrum usage will be based on the final 5G radio and television frequency allocation scheme issued by the National Radio and Television Administration. Currently, the main tendency is to place 5G two-way services in both the 4.9 GHz band and the 700 MHz band, while placing 5G broadcasting in the 600 MHz band. This ensures good 5G two-way network coverage, though the issue of 5G broadcasting encroaching on existing DTMB spectrum resources must be resolved.

The configuration of 5G broadcasting bitrates is achieved through Modulation and Coding Scheme (MCS) index values. Each MCS index corresponds to a physical transmission bitrate under a set of parameters. According to the 3GPP Rel14 standard definition, MCS 0-9 uses QPSK modulation, MCS 10-16 uses 16QAM modulation, MCS 17-27 uses 64QAM modulation, and MCS 28-34 uses 256QAM modulation. Calculations show that MCS 9 offers the highest spectral efficiency among all QPSK-modulated MCS indices at 0.78 bits/s/Hz, making it suitable for mobile reception [**?**].

Based on AVS+ or H.265 encoding formats, with estimated bitrates of 0.48/1.92 Mbps per SD/HD program, our station can adapt to two modes: an MSC27 bearer mode that can carry 96 SD programs or 24 HD programs, and an MSC9

mobile mode that can carry 24 SD programs or 6 HD programs.

4. Upgrading Existing Converged Media Equipment

In 2016, our station officially launched the central radio and television program wireless digital coverage project. This project achieved citywide DTMB wireless coverage of 12 central radio and television programs, Henan provincial programs, and our station' s 4 radio and television programs. The program transmission system consists primarily of AVS+ encoders, multiplexers, program monitoring systems, and network management and monitoring systems. After multiplexing 12 CCTV programs, two transmission streams are generated—one scrambled and encrypted, then adapted into DS3 signals for satellite transmission links, and another transmitted via ground networks without scrambling or encryption. Local programs combined with 4 other programs form another transmission stream, transmitted via ground networks without scrambling or encryption.

To develop 5G services, our station must comprehensively transform the current DTMB front-end. Depending on the chosen architecture, we need to construct subsystems such as an all-media content convergence platform, all-service fusion management platform, intelligent indexing platform, and intelligent broadcasting control platform to support the 5G large-tower broadcasting format and OTT services.

Our station' s ground digital television transmitters use all-solid-state transmitters with dual-exciter primary-backup switching. The transmitter consists mainly of exciters, power amplifiers, passive components (including distributors, combiners, bandpass filters, etc.), air-cooling systems, and computer monitoring systems [**?**]. Since 5G broadcasting bandwidths are 5 MHz, 10 MHz, 15 MHz, etc., inconsistent with DTMB' s 8 MHz, the original exciters and combiners require replacement and modification to achieve large-tower coverage.

The 700 MHz band has long been considered a golden frequency band for mobile communications, characterized by low signal propagation loss, wide coverage, strong penetration, and low networking costs. As a 5G underlying network for large-area coverage, it is highly suitable. Furthermore, in terms of 5G content resources, radio and television have strong content production capabilities. Current research reports indicate that 4K video and cloud gaming all require robust content support.

Given the low frequency, large coverage area, and strong deep-coverage capabilities of 700 MHz, it is suitable for large-area network coverage with low networking costs, earning it the industry label of "digital dividend." First, 700 MHz' s extensive coverage can significantly reduce network construction and operational costs. Taking rural areas as an example, under the same technical conditions, the number of 2.6 GHz sites required is nearly 5 times that of 700 MHz, 3.5 GHz is nearly 6 times, and 4.9 GHz is nearly 9 times. Second, 700

MHz has strong diffraction capabilities and indoor coverage performance. Third, the low signal transmission loss of 700 MHz improves transmission efficiency.

In November 2020, relevant national authorities released the ITU (ITM2020Z) formal standard, supporting the construction of mobile terminal devices for broadcasting services and developing 5G broadcasting terminals. Based on our own resources, we will select suitable 5G radio and television system operation models and architecture to achieve a new converged media landscape where large towers and small towers complement each other and various modes operate synergistically.

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5. Expected Outcomes and Benefits of Our Station' s 5G Integration

5.1 Layout Expectations

Upholding the mission as the Party' s mouthpiece, we will promote comprehensive integration of radio and television with 5G technology to build a mainstream public opinion communication network with converged media, achieving the goal of "holding television in one' s hands" and firmly maintaining the initiative in ideological work. We will construct a national public service and safety emergency dedicated network, achieving comprehensive coverage, manageable and controllable, green and secure emergency networks to safeguard national information security. By fully integrating 5G technology with radio and television technology and focusing on innovation to build a converged media platform, we will provide audiences with richer and more convenient comprehensive information services.

In the era of intelligent networks, as 5G, IoT, and artificial intelligence technologies become widely applied, the window of opportunity for media convergence is fleeting. Media organizations that have not yet built all-media capabilities will find it difficult to press the convergence button again. We must firmly grasp two key aspects: deepening institutional mechanism reform and comprehensively cultivating all-media talent and allocating resources. Simultaneously, we must accelerate two priorities: optimizing all-media workflows and business layout, and reconstructing all-media platforms, vigorously enhancing the value-added capability where 1+1>2.

5.3 Economic Benefits

5.3.1 Subscription Fees As a new radio and television network operation institution, we will attract users through emerging 5G services and achieve good economic benefits. Based on user interests, we will select a batch of distinctive programs to create paid content offerings.

5.3.2 Interactive Value-Added Fees Leveraging users' fragmented time, they can receive high-volume live audio and video at extremely low cost through mobile phones, televisions, and handheld tablets. With both broadcasting and on-demand services, more flexible and intelligent businesses can be derived.

5.3.3 Advertising Revenue Through business highlights such as live broadcasting and interactive services, we will attract users, increase user stickiness, and then collaborate with manufacturers to invest commercial advertisements through the 5G radio and television operation platform.

5.4 Ecological Benefits

Cooperating with communication departments, small towers operating in 5G mid-low frequency bands will provide basic coverage, while small towers in mid-frequency bands will provide hotspot coverage. This collaborative approach will yield significant ecological benefits through optimized spectrum utilization and infrastructure sharing.

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