Innovative Practices in Television Live Broadcasting Technology in the Era of Media Convergence (Postprint)

Authors: Jiangnan

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

Abstract

With the continuous advancement of China' s science and technology, computer and internet technologies have permeated all spheres of production and daily life, fundamentally transforming production modes and lifestyles, and catalyzing shifts in both the methods and scope of information dissemination, thereby heralding China' s entry into an era of media convergence. In the era of media convergence, television live broadcasting technology has undergone considerable innovation and enhancement relative to previous periods, as various advanced scientific and technological methods are continuously applied throughout the television live broadcasting process, thereby improving broadcast quality, timeliness, and interactivity.

Full Text

Research on Innovative Practices of TV Live Broadcasting Technology in the Media Convergence Era

Author: Jiang Nan (Hubei Radio and Television Station, Wuhan, Hubei 430070)

Abstract: With the continuous improvement of China' s scientific and technological capabilities, computer internet technology has permeated all aspects of production and daily life, fundamentally transforming how people work and live while reshaping information dissemination patterns and scope. China has entered the media convergence era, during which TV live broadcasting technology has undergone significant innovation and advancement. Various cutting-edge technologies have been integrated into TV live broadcasting processes, substantially improving broadcast quality, timeliness, and interactivity. This paper analyzes the pathways for technological innovation in TV live broadcasting within

the media convergence era and proposes strategies for enhancing these innovations, aiming to provide references for future research.

Keywords: media convergence era; TV live broadcasting; unidirectional live broadcasting; application protocols; interactive live broadcasting

CLC Number: TN919.8
Document Code: A
Article ID: 1671-0134(2022)05-102-03
DOI: 10.19483/j.cnki.11-4653/n.2022.05.031
Citation Format: Jiang Nan. Research on Innovative Practices of TV Live Broadcasting Technology in the Media Convergence Era [J]. China Media Technology, 2022(05): 102-104.

Traditional TV broadcasting has been constrained by technological limitations, featuring relatively monolithic broadcast formats, weak timeliness, and insufficient audience interaction, which hinders the enhancement of core competitiveness in the field. However, as scientific and technological levels continue to advance, various sophisticated technologies have been continuously applied to TV live broadcasting processes, greatly enriching broadcast formats and effectively improving TV program ratings. Unlike traditional broadcast models that require complete download before playback, live streaming technology enables rapid file playback by compressing audio and video resources for immediate playback after buffering, fundamentally transforming conventional broadcasting limitations. This paper analyzes the pathways for technological innovation in TV live broadcasting within the media convergence era and proposes corresponding strategies to provide references for future research.

1. Innovation Strategies for TV Live Broadcasting Technology in the Media Convergence Era

In TV program broadcasting, streaming media plays a critical role. To enhance broadcast quality, it is essential to achieve high-speed transmission of video and audio files across networks, delivering content to users' smart terminals without delay to improve audience experience. Traditional TV broadcasting primarily relied on hard disk playback or pre-recorded programs, where content was edited in advance and stored on videotapes for scheduled broadcast. While hard disk playback offers high automation and intelligence that reduces human error and allows flexible program adjustment, the emergence of self-media platforms and the demand for information timeliness have prompted the TV industry to adopt live streaming technology. In the media convergence era, TV live broadcasting technology typically comprises several key components.

1.1 Unidirectional Live Broadcasting

Unidirectional live broadcasting refers to the process of pushing designated video and audio content to a CDN, which audiences access through streaming pull methods. Widely popular applications such as live commerce and game streaming currently rely on this model. Unidirectional live broadcasting enables one-to-many transmission with latency tolerance at the second level. The technical workflow involves several stages: first, capturing audio and video files at the output end and transcoding them into H.264 and ACC formats suitable for live broadcasting; second, pushing the captured data to system servers using relevant technologies; third, after transcoding, transmitting the files to CDN to generate M3U8, TS, and FLV streams; and finally, enabling terminal pull streaming by converting processed data into HLS and RTMP protocol formats for smooth playback on smart terminals.

When implementing unidirectional live broadcasting, several aspects require attention. The process must follow established workflows sequentially. For video and audio capture, microphones and cameras are used to acquire signals that require digital processing. During transcoding, signals must be compressed and encapsulated to reduce data transmission volume while ensuring format compatibility to meet diverse user needs. It is crucial to distinguish between push streaming (uploading captured data to servers) and pull streaming (extracting encapsulated data from servers). During playback, streaming data must be decoded, encapsulated, rendered, and displayed to enhance broadcast quality.

1.1.1 Application Protocols The primary protocols involved in push and pull streaming are RTMP and HLS.

RTMP Protocol. RTMP is an application-layer protocol that requires reliable underlying transport-layer protocols to ensure transmission reliability. As a real-time message transmission protocol implemented through TCP, it mandates H.264 video format and ACC audio format with FLV encapsulation to guarantee real-time message delivery. This application-layer protocol is increasingly popular due to its convenience and broad support range. However, it has limitations, including incompatibility with certain browsers and potential impacts on live services since Adobe ceased updates.

HLS Protocol. HLS is a streaming media transmission protocol that splits complete file streams for segmented download, which are then sequentially broadcast through server ports and integrated into the complete live content. This protocol primarily operates in on-demand mode, and the segmentation reduces file duration, enabling faster client conversion and accommodating various network conditions to improve push efficiency and broadcast quality. However, HLS has significant limitations, including higher latency requirements and strict content specifications—files must be TS or M3U8 formats, video must be H.264, and audio must be ACC format for smooth broadcasting.

1.1.2 Application Methods Unidirectional live broadcasting is widely applied beyond live commerce to game streaming and news releases, enabling TV program content to be pushed to online platforms for on-demand download. Sports event broadcasting particularly benefits from this approach. In remote news interviews, push devices installed on data collection equipment transmit captured data via 5G networks to studios, where the data is pulled, decoded, and converted to SDI to form video and audio signals for delivery to video switchers and audio mixing consoles, enabling anchor-interview connections. As smart terminals continue improving in performance, unidirectional live broadcasting applications have expanded, gradually replacing traditional satellite and fiber-optic transmission. This not only simplifies operational workflows and reduces costs but also enhances broadcast quality. However, this model has limitations, such as the lack of video and images during information transmission, resulting in relatively monotonous communication forms that hinder interaction between journalists and audiences. To address these limitations, interactive live broadcasting technology must be continuously innovated to enhance audience engagement.

1.2 Interactive Live Broadcasting

Interactive live broadcasting has become increasingly popular, enabling hosts to connect with audiences (either single or multiple viewers) during broadcasts, with other audience members able to watch these interactions. Compared with unidirectional live broadcasting, this connectivity enhances audience participation and accelerates mobile live streaming development. Applying interactive live broadcasting in TV interviews effectively improves broadcast quality and audience enthusiasm while driving economic benefits. To optimize interactive live broadcasting, enhanced understanding and mastery of WebRTC technology is essential for future development.

1.2.1 WebRTC Technology WebRTC technology operates based on browsers, enabling peer-to-peer connections between multiple devices to facilitate real-time audio and video data interaction without requiring users to install third-party software. WebRTC implementation requires classification based on browser adaptability and performance differences. Browsers supporting NAT traversal can transmit information directly, while those without this capability can use TURN servers for data relay before initiating information exchange. WebRTC technology exhibits three primary characteristics.

Interactivity. Remote server participants can use WebRTC technology to present real-time video on smart terminals, enabling communication with hosts and enhancing audience experience.

Flexibility. WebRTC allows audiences to share and transmit information directly through browsers or terminal application interfaces without installing playback plugins, eliminating unnecessary installation procedures and simplifying usage.

Low Latency. WebRTC automatically reduces video clarity during data transmission to accelerate transfer speeds, enabling users to make autonomous program selections while facilitating continuous communication through audio file sharing without transcoding.

1.2.2 WebRTC Network Models WebRTC technology commonly employs three network models: MESH, SFU, and MCU.

MESH Model. The MESH model is a wireless network form enabling cooperative communication with strong dynamic characteristics and scalability for arbitrary device interconnection. Its technical principle involves connecting clients to interact data through P2P methods. When security protocols or firewalls block interactions, TURN servers can serve as relay stations to transparently forward data packets.

SFU Model. The SFU model uses servers to forward audio and video files by transforming itself into Peer Client mode, causing confusion among other clients regarding data transmission direction—this approach is called P2S. P2S not only provides packaging functions but also enables multi-user data forwarding, making multi-party real-time video calls possible. Clients need only connect to SFU servers and upload data to switch to Simulcast or SVC modes, offering strong adaptability without firewall interference while reducing bandwidth load and CPU usage to enhance information real-time performance.

MCU Model. While SFU architecture offers significant advantages in reducing bandwidth load and improving transmission efficiency, it has limitations regarding multi-stream downstream bandwidth issues. As user numbers increase, downstream bandwidth pressure rises sharply, exacerbating network latency. The MCU architecture addresses this problem by integrating multiple streams before forwarding, effectively alleviating bandwidth pressure. However, it also has limitations, as the need to re-encode, decode, integrate, and forward data increases latency and reduces flexibility.

2. Strategies for Enhancing TV Live Broadcasting Technology in the Media Convergence Era

2.1 Strengthening Talent Team Building

To enhance TV live broadcasting technology, it is essential to recognize the critical role of talent and strengthen team building. This requires broadening recruitment thresholds, implementing access systems, and improving compensation packages to attract professionals. For existing technical staff, training programs must be enhanced with effective training plans incorporating information technology knowledge and practical skills to elevate professional competence and ethical standards. Furthermore, performance systems, evaluation criteria, and promotion mechanisms should be improved to create a positive work environment that better serves TV live broadcasting operations.

2.2 Enhancing Internet Thinking

To achieve technological innovation, it is necessary to actively enhance internet thinking and timely innovate TV live broadcasting technology. This can be accomplished by increasing technological investment and integrating advanced technologies such as 5G and big data with information collection and data transmission to improve broadcast quality. The media convergence era presents both new challenges and opportunities for the television industry. To adapt to development trends, future progress must prioritize technological innovation to enhance TV program live broadcast quality, improve audience experience, and achieve long-term development in the media convergence era.

References

[1] Ye Hai. Design Practice and Innovative Exploration of Audio Systems for Live TV Broadcasting of Beidou-3 Satellite Launch [J]. Video Engineering, 2020(8): 37-40.

[2] Li Aimin. Discussion on the Integration Development of 5G Communication Technology and Radio and Television Technology [J]. China Media Technology, 2021(9): 62-64.

[3] Long Xinwei. Convergence Innovation of Live Reporting in the All-Media Era—Taking CCTV Live Reporting as an Example [J]. TV Research, 2020(12): 67-69.

[4] Jiang Rui. How TV Media Can Expand the Advantages of News Live Broadcasting in the 5G Era—Taking Jinhua Radio and Television Station' s "Zero Distance to the People" as an Example [J]. Media, 2020(5): 54-57.

[5] Gao Ping. Application of IP Streaming Technology in Network Live Broadcasting to Traditional Baseband Signal TV Live Broadcasting [J]. China Media Technology, 2021(2): 123-125.

[6] Tong Yun. Transformation and Upgrading of Radio and Television Public Services—Taking CCTV's Live Commerce and Host Vlog as Examples [J]. China Radio, 2020(5): 54-57.

[7] Yao Mengting. Research on the Application of Computer and Network Technology in TV News Live Broadcasting Technology [J]. Video Engineering, 2019(17): 26-27.

[8] Li Gang. Technological Innovation Assisting Large-Scale Live Programs—Application of Lighting Pre-programming Software in Guangxi TV' s New Year' s Eve Gala [J]. Film & Video Production, 2019(7): 67-69.

[9] Huang Qin. The Impact of Live Broadcasting Based on Mobile Internet on TV News Industry: Contradictions and Opportunities [J]. China Digital Cable TV, 2019(10): 1063-1065.

[10] Zhang Fu. Discussion on the Development of TV Live Broadcasting Based on Internet Transmission Signals in China [J]. Digital Design, 2019(3): 195.

[11] Chen Jie. Using Converged Media Live Broadcasting to Innovate TV Theme Report Expression—Analysis of Zhejiang Satellite TV' s Converged Media News Action "Flying Together" [J]. China Radio & TV Academic Journal, 2019(10): 123-124.

Author Introduction: Jiang Nan (1979-), female, from Huanggang, Hubei, is a Senior Supervisor and Associate Senior Engineer at the Safety Broadcast Technology Coordination Department of the Broadcast Control Center of Hubei Radio and Television Station. Her research focuses on studio program recording, radio and television live broadcasting coordination, and related project construction.

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