Post-print: Thoughts and Analysis on the Construction of 4K Ultra HD Omnimedia News Production and Broadcasting Network

Authors: Zhanfei Du

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

Abstract

The continuous advancement of modern science and technology has significantly propelled innovative progress in the broadcasting and television domain. In the context of the internet information era, traditional media is progressively transitioning towards an all-media paradigm; to strengthen market competitiveness, 4K ultra-high-definition has emerged as one of the mainstream technologies in television media development. Particularly in television news production and broadcasting, the construction of a 4K ultra-high-definition all-media news production and broadcasting network has become the primary innovation direction for television stations. In light of this, this paper primarily introduces this live broadcast system, proposes the conceptual framework and workflow for constructing the production and broadcasting network, and investigates key innovation points, providing feasible construction measures for relevant organizations, aiming to facilitate the deep convergence of traditional and new media, and to propel the broadcasting and television industry forward efficiently.

Full Text

Considerations and Analysis on the Construction of 4K Ultra HD All-Media News Production and Broadcasting Networks

Author: Du Zhanfei (Ulanqab Radio and Television Station, Ulanqab, Inner Mongolia, 012000)

Abstract: The continuous development of modern science and technology has significantly propelled innovation and progress in the radio and television industry. In the context of the internet information age, traditional media is

gradually transitioning toward an all-media model. To enhance market competitiveness, 4K Ultra HD has emerged as one of the mainstream technologies in television media development. Particularly in television news production and broadcasting, the construction of 4K Ultra HD all-media news production and broadcasting networks has become a primary direction of innovation for television stations. In view of this, this paper introduces this live broadcasting system, proposes construction concepts and workflows for such networks, examines relevant innovation points, and provides feasible construction measures for related organizations, aiming to promote the deep integration of traditional and new media and to drive the efficient advancement of the radio and television industry.

Keywords: 4K Ultra HD; All-Media; News Production and Broadcasting Network; Construction Model; Overall Process

Classification Code: TN948
Document Code: A
Article ID: 1671-0134(2022)02-149-03
DOI: 10.19483/j.cnki.11-4653/n.2022.02.046

Driven by innovative advances in internet technology, new media has become the primary vehicle for news dissemination, presenting both significant challenges and opportunities for traditional television media in their development trajectory. In recent years, the concept of all-media has been proposed to encourage deep integration between old and new media, aiming to satisfy modern audiences' needs for accessing news information, improve news dissemination efficiency, exert positive public opinion guidance, and effectively promote the healthy development and innovation of contemporary news media. The 4K Ultra HD all-media news production and broadcasting network is an advanced system established to enhance news production and broadcasting quality and provide superior news services to audiences. This network facilitates the convergence of traditional and new media, steering news media development toward modernization.

1. System Architecture of 4K Ultra HD All-Media News Production and Broadcasting Networks

The 4K Ultra HD all-media news production and broadcasting network represents a new technological system constructed by modern radio and television stations to improve program quality. Based on current all-media network construction processes, its overall architecture primarily employs private cloud technology to provide excellent services and technical support for program production, effectively assisting station personnel in news program creation, including content management, quality control, cloud platform operation, final program review, and behind-the-scenes dubbing. In practice, construction personnel should thoroughly understand the system composition, which typically

includes five main components as detailed below.

1.1 Infrastructure Service Layer (IaaS)

The foundation of the 4K Ultra HD all-media news production and broadcasting network system is the IaaS layer, or Infrastructure Service Layer. Its primary function is to provide computing services, information storage, and network resource support for upper layers. This layer generally utilizes general-purpose software and hardware products for construction and can be deployed in either private or hybrid clouds, offering certain flexibility and adaptability. In actual construction, personnel must comprehensively consider business requirements to ensure the infrastructure service layer possesses adequate elasticity and scalability, facilitating deep integration between private and public clouds and enabling centralized, unified management. Additionally, all-media production and broadcasting network construction imposes special requirements on computing and storage resources, making it feasible to employ modern virtualization technology to establish corresponding resource pools that satisfy the flexibility demands of all-media network architecture. [1]

1.2 Platform Service Layer (PaaS)

Above the IaaS layer lies the Platform Service Layer (PaaS), whose functional implementation provides various resource services for system operation and integrates technical capabilities to support efficient application software operation. In the 4K Ultra HD all-media news production and broadcasting network system, the platform service layer exhibits universal characteristics, offering operational services, interface services, and content services for the station' s production and broadcasting network system, while serving as an intermediary layer that aggregates user and publishing functions. From a system-wide perspective, the platform service layer can leverage distributed architecture to host television program content, provide public and shared services, and meet the practical requirements for horizontal expansion and single-point-of-failure elimination in all-media production and broadcasting networks. Therefore, during actual system operation, each service in the platform service layer should adopt corresponding standard open interfaces, providing openness to infrastructure service layer application providers.

1.3 Software Service Layer (SaaS)

Above the platform service layer is the software service layer, which completes various application functions based on resources and services provided by the infrastructure and platform service layers. In the 4K Ultra HD all-media news production and broadcasting network system, applications in the software service layer can be mutually isolated yet interconnected, directly facing users and optimizing interface interaction, response time, and user experience upon functional design completion. Moreover, each application in the software service layer must be constructed using services provided by the platform service layer.

The system employs distributed design to form business systems and multi-node deployment methods based on multi-instance coexistence and load balancing to fully satisfy the practical requirements for system horizontal expansion. [2] On this foundation, the software service layer generally needs to integrate business requirements to refine its functional capabilities.

1.4 Integrated Business Management System

The integrated business management module constitutes an important component of the 4K Ultra HD all-media news production and broadcasting network system. Its primary role is to achieve unified control of management modules contained within the cloud platform, such as program resources, operations, and monitoring. During system operation, this module enables centralized management and control of both private and public clouds, ensuring a unified and simplified management interface. This facilitates flexible and rapid organization of resources across the infrastructure and platform service layers, supporting efficient execution of news program adaptation, deployment and release, broadcasting operations, and data recovery.

1.5 Security Management System

The construction and operation of 4K Ultra HD all-media news production and broadcasting network systems require comprehensive security management throughout all modules and processes. Therefore, during all-media production and broadcasting network construction, a complete security management system and assurance framework should be established, starting from the physical, data, and business layers to substantially enhance the safety and reliability of news program broadcasting. Simultaneously, the establishment of the security management system must strictly comply with China' s current radio and television information security protection level standards and other regulatory requirements to ensure effective adaptation to modern cloud security environments. This approach enables the provision of targeted security strategies based on different business characteristics, such as establishing real-time early warning mechanisms according to interaction rules between private and public clouds to prevent risks in television media production and broadcasting. [3]

2. Overall Approach to 4K Ultra HD All-Media News Production and Broadcasting Network Construction

Against the backdrop of continuous development in television technology systems, the construction of 4K Ultra HD all-media news production and broadcasting networks should proceed from practical realities to determine an overall construction model and effectively streamline relevant workflows. This ensures the construction work is substantive and promotes the perfection of 4K Ultra HD television and all-media fusion channels, thereby improving television news service quality.

2.1 Construction Model

Radio and television stations constructing 4K Ultra HD all-media news production and broadcasting networks must clarify their overall conceptual model. Taking Ulanqab Radio and Television Station as an example, the network construction primarily utilizes current advanced IT cloud technologies based on distributed and microservices architecture designs. This can be implemented through two availability zones (A and B) comprising five node clusters to realize the all-media news production and broadcasting network. To ensure system stability and security during operation, Availability Zone A can serve as the news storage and production space. Based on practical conditions, an IP cluster storage approach is selected to guarantee sharing and interaction among news production, broadcasting, and media assets. This further improves news dissemination efficiency and enables real-time news release. Additionally, the all-media news production and broadcasting network can be regarded as a technical support system for the television station, with a strict and standardized tenant system formulated to rationally construct the all-media business platform, effectively leveraging cloud computing advantages to enhance system flexibility and maintenance convenience. [4] Furthermore, connecting the news media asset system with the Ultra HD post-production and broadcasting system enables direct contribution from county-level television stations to the platform, allowing materials to be uploaded and edited with one-click operations in Ultra HD non-linear editing software. Simultaneously, incorporating artificial intelligence modules into the news media asset system facilitates convenient functions such as voice recognition, facial recognition, and intelligent word conversion during news production and broadcasting, thereby improving content creation and broadcasting efficiency.

2.2 Overall Workflow

During the construction of its 4K Ultra HD all-media news production and broadcasting network, Ulanqab Radio and Television Station must follow specific workflows. Based on current practical experience, the process typically begins with gathering news clues and content, identifying news topics, and assigning production and broadcasting tasks according to traditional television production characteristics and new media dissemination features. After editing, appropriate release channels are selected to achieve news information dissemination. However, due to differences in release channels, the depth and breadth of coverage for the same topic vary significantly. To ensure complementary fusion between old and new media channels, the specific workflow is as follows:

1. News clues and content collected through various channels are centrally aggregated to form a comprehensive information collection of news events.
2. Based on this information collection, newsworthy points are selected, and news production and broadcasting tasks are assigned according to editorial topics.
3. After news reporters accept assigned tasks from the station, they select

appropriate news production tools to 进行二次加工 (reprocess) news content for different channels under the all-media framework. Upon creating finished products, they undergo a strict three-review and three-proofreading process. After approval, content can be uploaded to new media channels for release. Following content dissemination, feedback data from various channels is collected and analyzed to guide subsequent news production and creation.

4. Television channel production personnel such as station reporters or editors conduct interviews, filming, scriptwriting, program editing, and playlist editing according to assigned tasks. Programs are then submitted for supervisory review and can be broadcast after approval.

3. Innovation Points in 4K Ultra HD All-Media News Production and Broadcasting Networks

3.1 System Technology Innovation

During the construction of all-media news production and broadcasting networks, leveraging current scientific and technological developments reveals several innovation points. In Ulanqab Radio and Television Station' s 4K Ultra HD all-media news production and broadcasting network construction, specific requirements exist for the 4K Ultra HD production and broadcasting modules. For instance, ensuring the completeness of all processes and functions in news production and broadcasting—from ingest, editing, and dubbing to compositing, automatic technical review, and final studio broadcast—with smoothness and proper sequencing. Simultaneously, virtualization technology should be applied to non-linear editing stations, databases, and backend services, utilizing real-time operational optimization and upgrades of the virtual layer kernel to ensure computational logic correctness. Additionally, applying microsecond-level kernel latency and fault detection technologies can further enhance virtualization platform stability. In actual construction, developing a comprehensive and efficient data center-level disaster recovery plan can largely avoid downtime risks. [5] Beyond these measures, in constructing the 4K Ultra HD all-media news production and broadcasting network system—except for certain special facilities—innovative system technologies should be applied, such as for backend applications and resource editing. Infrastructure service layer resources can be utilized to execute resource application, deployment, and recovery tasks according to media, information, and database interface protocols provided by the platform service layer, thereby perfecting system functionality.

3.2 System Operation Innovation

Ulanqab Radio and Television Station employs a dual data center model for its news live broadcasting system operation to ensure content library uniformity. Simultaneously, the station has constructed a two-phase media convergence platform to enhance the security of all-media news production and broadcast-

ing operations, leveraging existing hardware resources to build Availability Zone B. Following the cloud architecture design objective of ensuring news business continuity and security, Zone B should serve as an independently runnable system. Additionally, the station has innovatively established a dual-active backup system. When emergency failures occur during all-media news production and broadcasting network operation, all client functions and resources can be transferred to the backup system based on broadcasting safety requirements, thereby preventing negative impacts on daily news broadcasting. In this configuration, Availability Zones A and B serve as mutual backups. To achieve consistency, an automatic policy-based asynchronous backup method can be employed. This innovative model means that under normal system operation, Zone A carries news broadcasting operations while synchronizing data to Zone B. When Zone A experiences storage or computing failures, manual or automatic switching enables Zone B to assume news operations, ensuring broadcasting continuity and stability and improving news quality. Consequently, Ulanqab Radio and Television Station can back up all data for important post-production programs to Zone B, allowing business to continue on the backup system in case of failures or cyberattacks. However, during actual operation, personnel must comprehensively consider Zone B' s current responsibility for existing new media business. To alleviate operational pressure on Zone B, primary news production and broadcasting operations should be backed up while Zone B serves as the business convergence carrier. With support from the infrastructure and platform service layers, this ensures high-quality completion of news production and broadcasting operations.

4. Construction Strategies for 4K Ultra HD All-Media News Production and Broadcasting Networks

Based on the system composition, construction models, workflows, and innovation points of current 4K Ultra HD all-media news production and broadcasting networks, radio and television stations must adopt effective strategies to deepen the integration of Ultra HD and all-media. According to the development status, trends, and demands of television news, actual projects can be constructed based on HIVE architecture, dual-active data centers, and business integration to fully realize converged media news production and adapt to multi-channel information release and dissemination needs.

4.1 Utilizing HIVE Architecture to Integrate Ultra HD and All-Media

To ensure efficient and secure construction of 4K Ultra HD all-media news production and broadcasting networks, the HIVE architecture should be employed to achieve Ultra HD and all-media integration. Prior to this, compatibility should be enhanced through large-scale Ultra HD production and broadcasting capabilities to ensure smooth Ultra HD program production and broadcasting. Typically, relevant infrastructure must be perfected, such as deploying Ultra HD high-bitrate non-linear editing workstations, Ultra HD proxy-rate editing work-

stations, cloud workstations, mobile editing stations, and professional color grading and support workstations. Two sets of Ultra HD live studio systems should be equipped to guarantee enhanced quality for Ultra HD news live broadcasting. The underlying storage resources should adopt high-capacity distributed clusters, while the network layer should employ 40G+10G architecture to ensure adequate capacity and bandwidth performance for 4K Ultra HD HDR production. When utilizing the HIVE architecture, MCH can support 4K Ultra HD production and broadcasting operations in traditional production areas, while multi-tenant capabilities in the converged media area enable media convergence among different business departments within the radio and television station.

4.2 Adopting Dual-Active Data Centers

According to innovation points in 4K Ultra HD all-media news production and broadcasting network construction, dual-active data center application can enhance news production and broadcasting performance. Therefore, in Ulanqab Radio and Television Station' s construction efforts, dual-active data centers are employed to build traditional production and all-media convergence areas for effective 4K Ultra HD all-media news production and broadcasting network operation. Utilizing bidirectional synchronization between data centers unifies content data across both areas, substantially improving program production efficiency. On the other hand, news production and broadcasting capabilities can achieve efficient backup in the converged media area to further enhance operational security from a cloud system security perspective.

4.3 Achieving Business Integration and Converged Production

Constructing 4K Ultra HD all-media news production and broadcasting networks requires business integration to achieve all-media converged production. In practice, Ulanqab Radio and Television Station personnel must first interconnect topic planning and news scripts to unify command and planning for traditional television media news production. Simple editing tools in the converged media area can be used to connect with traditional news production area non-linear editing tool timelines, ensuring collaborative production between internal and external networks. Finished post-broadcast programs and playlists should be synchronized to the converged media area in a timely manner to effectively support new media program production. On the other hand, comprehensively considering the role of the MCH system, personnel must further streamline business system workflows to strengthen the depth of all-media integration.

Conclusion

In summary, recent advances in science and technology have driven television technology from high definition to ultra-high definition, representing a transformative new era for the broadcasting industry. Constructing 4K Ultra HD

all-media news production and broadcasting networks enables complete innovation in camera technology, studio systems, and audio-video post-production processes, facilitating deep integration between television news media and new media. Therefore, when constructing such networks, radio and television stations should clarify their innovation points and adopt strategies including HIVE architecture for Ultra HD and all-media integration, dual-active data centers, and business integration to effectively promote the overall development of 4K Ultra HD television.

References: [1] Xu Peikun, Lu Yin. Construction of 4K Ultra HD All-Media News Production and Broadcasting Networks[J]. Radio & Television Technology, 2020(6): 49-51.
[2] Chen Haidong. Innovative Strategies for Radio and Television News Reporting in the All-Media Era[J]. News Research Herald, 2020(17): 162-163.
[3] He Bin, Zhang Yi. Construction of News Cloud Editing Systems for Radio and Television Stations[J]. Radio & Television Technology, 2020(1): 38-43.
[4] Zhu Hui. Application and Value of New Media Technology in Television News Production[J]. China Media Technology, 2020(2): 78-80.
[5] Qi Qige. Analysis of Program Format Innovation and Technical Innovation in Television News Programs Under Media Convergence[J]. China Media Technology, 2019(3): 69-71.

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