On the Technical Applications of the New Broadcasting System at Anhui Radio and Television Station (Postprint)

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Abstract

With the rapid development of digitalization and networking of broadcast control technology, television broadcasting systems are also continuously upgrading. The main characteristics of digital broadcasting systems are being based on interconnection standards, large-scale storage, and file-based workflows. This paper focuses on the construction of new broadcasting systems and provides a brief discussion on the technical applications of the broadcasting system at Anhui Broadcasting and Television Station.

Full Text

Preamble

Research · Technology and Art: A Brief Discussion on the Technical Application of Anhui Broadcasting Station's New Broadcast System

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Abstract: With the rapid digitalization and networking of broadcast control technology, television broadcast systems have undergone continuous upgrades. The primary characteristics of digital broadcast systems are their reliance on interconnection standards, large-scale storage, and file-based workflows. This article discusses the technical application of Anhui Broadcasting Station's new broadcast system, focusing on its construction.

Keywords: broadcast system; file-based workflow; quality assurance; interface; network security

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In today's era of rapid development in digital, network, and information technologies, broadcast control technology continues to advance alongside the growth of television operations, making broadcast system structures more rational, functional, technologically advanced, reliable, and easily upgradeable. Anhui Broadcasting Station (hereinafter referred to as "the Station") launched its new broadcast system construction using cutting-edge domestic broadcast control technologies, tailored to its business development needs, to create a secure, advanced, and efficient broadcast system. This article discusses the technical application of the Station's new broadcast system from five perspectives: the development and positioning of broadcast control technology, file-based broadcasting, establishing a file-based quality assurance system, interface specifications, and network security.

1. Development and Design Positioning of Broadcast Control Technology

With the convergence of media and technology, television broadcast models and control technologies have achieved leapfrog development. Digital broadcast systems have evolved through three generations. The first generation was hard disk-based broadcast systems. The second generation represented the 初级阶段 (initial stage) of file-based broadcast preparation using secondary storage, during which system interconnection needs emerged, particularly for direct-delivery programs. The third generation establishes relevant file format specifications, interconnection standards, fully automated file-based preparation, and simultaneous high-definition/standard-definition broadcasting. The Station's new broadcast system construction is based on this third-generation design philosophy, serving not only traditional broadcast operations but also providing extensible services for new media and online television.

The design positioning of the Station's broadcast system is as follows: The broadcast system is primarily responsible for completing all material preparation and broadcasting according to the broadcast schedule. Designed around the Station's actual business processes, it can interconnect with other subsystems through the station-wide backbone platform to achieve station-wide material preparation. Simultaneously, it ensures that broadcasting can independently complete all preparation and playout operations when not interconnected with the station-wide network. According to broadcast business requirements, it must exchange data with direct-delivery program systems such as the chief editor's office for film and television drama editing, promo production, and advertisement preparation. Expansion interfaces are reserved for future business development needs.

2. File-based Broadcast Architecture

Traditional broadcast preparation workflows required first uploading tape-based programs and then transferring them to primary and backup broadcast servers. Editing and modifying broadcast schedules relied on paper program schedules submitted by the chief editor's office—an inefficient, cumbersome traditional broadcast model that cannot adapt to today's television business development. File-based broadcasting not only reduces workload, minimizes human operation errors, and improves efficiency but also maximizes program broadcast quality. The Station's new broadcast system design is based on file-based preparation, aiming to achieve integrated station-wide production and broadcasting.

2.1 File-based Broadcast Preparation Workflow

The design of the broadcast system's file-based preparation workflow must first ensure the technical quality of program files. The Station has established broadcast program file standards: File format: MXF OP1A. Video data: High-definition (compression: MPEG2 IBP Gop=12, bitrate: 50Mbps); Standard-definition (compression: MPEG2 IBP Gop=4, bitrate: 15Mbps). Audio data is embedded within the MXF.

Second, based on the Station's broadcast business characteristics, the file-based preparation business process has been confirmed. Broadcast operations include not only traditional master control and broadcasting services but also film and television drama editing, promo and guide production, and advertisement insertion. Among these, the broadcast preparation system within the broadcast domain is a crucial pathway for preparing broadcast program files, comprising file production, upload, migration, technical review, manual re-review, backup cache, and ultimately unified delivery of broadcast program files to broadcast video servers [Figure 1: see original paper].

Broadcast program schedules can be created and edited not only based on paper rundowns but also imported through USB "ferry" technology using electronic program schedule files delivered by channel editors. Electronic rundowns significantly improve schedule editing efficiency and reduce labor costs.

2.2 Workflow for Importing External Electronic Program Guides into the Broadcast Network

As shown in [Figure 2: see original paper], the broadcast program schedule prepared by the chief editor's office or channels reserves corresponding advertisement slots. The advertising department uploads and organizes advertisement materials based on these slots, merges advertisement orders with advertisement materials into advertisement files, and submits them for broadcast. If the advertisement slots or durations change due to needs from the chief editor's office or advertising department, the two departments must coordinate to determine final advertisement slot information.

The final segment advertisement schedule has a unique segment ID that matches the broadcast program schedule ID to form the final broadcast schedule. Each advertisement entry within the segment advertisement schedule is identified using an advertisement material ID, which primarily enables automatic advertisement insertion [Figure 3: see original paper].

3. Quality Assurance System

Program material security is paramount for safe broadcasting. Throughout the broadcast preparation workflow, program file transmission and storage involve multiple stages, including front-end business systems (advertising, promo packaging, and film/TV drama editing), pre-broadcast cache, upload, and broadcast video servers. Program files must be ensured problem-free during transmission and processing from production to safe broadcasting.

3.1 MD5 Verification

Any program file entering the preparation system must undergo MD5 verification to prove file integrity before completing the preparation workflow. Design process: When program files begin migrating to the preparation cache, the system generates an MD5 code for the new file while simultaneously parsing the MD5 code carried by the original file. During transmission, the two sequences are compared. If they match, the file migrates to the pre-broadcast cache. If discrepancies exist, the file is deleted, and the original program department is notified to remake or retransmit the file.

3.2 Automatic Technical Review

The preparation system is equipped with an automatic technical review server, which reduces relevant personnel workload while ensuring workflow automation. Automatic technical review automatically audits technical specifications of incoming program files from external systems. Primary review items include static frames, black fields, and color bars in video, as well as excessively high, low, and silent audio levels. This ensures program file audiovisual technical quality while providing references for manual re-review.

3.3 Manual Review and Inspection

For programs that fail automatic technical review, the system automatically generates manual inspection tasks. Technical personnel can manually verify fault points based on automatic review results. If confirmed error-free, broadcast is permitted. If genuine file issues exist, retransmission or re-uploading is required.

3.4 Broadcast Monitoring

Broadcast monitoring is a crucial auxiliary means for constructing safe broadcasting. By monitoring the broadcast system environment and software/hardware operation status, the system determines whether conditions are normal. When equipment or signal problems occur, the system quickly locates fault positions and types, displaying real-time alarms through audio, visual, and graphic means to help technical personnel respond quickly and correctly, improving broadcast emergency response efficiency.

4. Interface Specifications for the Broadcast Domain

To ensure the broadcast system can operate normally without interconnection to the backbone platform, interfaces are established with three systems within the broadcast domain: broadcast media assets, advertisement preparation, and promo production. Interface requirements are: First, seamless integration with the full business support platform and basic network platform; second, full file-based production processes for high efficiency. Primary interface relationships are as follows:

Broadcast System and Broadcast Media Assets Interface: Broadcast media assets provide the broadcast system with available edited film/TV drama material files and metadata according to broadcast rundowns.

Broadcast System and Advertisement Preparation Interface: The advertisement preparation system provides the broadcast system with edited advertisements packaged in broadcast format as files, including files and metadata.

Broadcast System and Promo Production Interface: The promo production system is responsible for satellite channel promo production, providing finished products to the broadcast system, including files and metadata.

5. Network Security Architecture

To ensure smooth broadcast operations, a robust network environment with strict security safeguards is essential. Network security responsibilities must be implemented with clear security administrators, and documents such as information system maintenance manuals, operation specifications, and emergency plans must be formulated.

Key security measures include: (1) Implement identity authentication for hosts, networks, and security devices, set user permissions to prevent unauthorized access; identify and authenticate logins to operating systems and database systems using two authentication technologies for management users, assign different usernames to different users ensuring username uniqueness; enable login failure handling functions with session termination, illegal login attempt limits, and automatic logout measures. (2) System access control: assign permissions according to management user roles to achieve separation of privileges, granting

only minimum required permissions; set sensitive markings for important information resources; strictly control user operations on sensitive marked resources according to security policies. (3) Close unnecessary external data access ports (USB, optical drives, etc.) to prevent illegal software installation. (4) Install antivirus software, configure two or more scanning engines, regularly update virus databases; manage and update operating system patches. (5) Establish system-level or data-level disaster backup: build disaster backup to ensure data security and continuous operation of critical services, improving disaster resilience. Therefore, establish regular backup mechanisms for important data with complete daily backups copied to secure areas.

6. Conclusion

Since the launch of Anhui Broadcasting Station's new broadcast system, the entire system has operated normally and stably, completing broadcast tasks for Anhui Satellite TV's high-definition and standard-definition channels and related ground channels. The system meets relevant design requirements for security, practicality, stability, and reliability, providing robust technical support for safe broadcasting across Anhui Broadcasting Station's channels.

References

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