Analysis of Radio and Television Broadcast Control Technology and Maintenance Management Postprint

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Abstract

Against the backdrop of the broadcast television industry' s development, this article analyzes broadcast television playout control technology, focusing specifically on data storage and data migration management. It concludes by proposing three recommendations for the maintenance and management of television playout control, with the objective of enhancing the application effectiveness of playout control technology and driving industry advancement.

Full Text

Analysis of Broadcasting Control Technology and Maintenance Management

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Abstract: Against the backdrop of broadcasting industry development, this paper analyzes broadcasting control technology, with particular emphasis on data storage and data migration management. Finally, three recommendations are proposed for the maintenance and management of television broadcast control, aiming to improve the application effectiveness of control technology and promote industry development.

Keywords: broadcasting control technology; maintenance management; data storage technology; data migration management technology

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Since the 19th Party Congress, relevant departments have increasingly prioritized the broadcasting industry, augmenting investment in funding and technology to enable better service to society and the public. Central to this effort are signal transmission and reception. With significant technological development, wireless signal control—one of the most critical operations in broadcasting—has been substantially enhanced. Broadcast control faces stringent requirements and must apply advanced control technologies to achieve ideal broadcasting results. Designers increasingly adopt distributed multi-level matrix architectures in master control system design, manifested in three aspects: master control matrix, input-output matrix, and mutually mirrored broadcast control matrices.[2] Through mutual interaction, these three matrices combine into a novel independent structure that fully leverages matrix capabilities, reasonably distinguishing signals according to their characteristics and implementing effective isolation measures, thereby achieving optimal broadcast control system operation.

1. Broadcasting Control System

Broadcasting control systems have matured alongside industry development. In practice, these systems can be identified as comprising four primary components: master control, remote monitoring, storage, and sub-control. The master control system represents the most critical element, responsible for receiving signals from various sources such as satellites and broadcast stations, as well as return signals from front-end equipment.[1] Serving as a signal aggregation hub, it processes and organizes all information through integrated scheduling to ensure program broadcast quality. Sub-control systems consist of three main parts: audio-video systems, automatic broadcast control software, and switchers. Through effective sub-control system operation, all television programs can be successfully broadcast and recorded, underscoring its importance. Additionally, hard disk broadcasting systems play a vital role in broadcasting control, particularly the audio-video servers whose performance and security directly impact broadcast quality. These servers store audio and video materials, compressing and processing data through system functions to meet broadcast requirements. All signal transmission, equipment detection, and maintenance tasks within the control system are accomplished via remote monitoring systems, facilitating convenient maintenance and ensuring stable operation. Therefore, broadcast control systems are crucial to the broadcasting industry, and only through proper functioning can they drive industry development. Given this context, understanding the various functions of broadcast control systems is essential. Throughout broadcasting development, these systems have played a positive driving role, particularly in continuously improving operational stability and security. To achieve sustainable broadcasting industry development, in-depth investigation of control technology is necessary. During system operation, electronic technology' s role becomes increasingly evident, directly impacting broadcast control systems.

2. Broadcasting Control Technology

Broadcasting control technology constitutes a critical measure supporting system normal operation. The following analysis focuses on two commonly used technologies: data storage technology and data migration management technology.

2.1 Data Storage Technology

Media resources, including substantial audio-visual materials, play a crucial role in broadcast control. Due to large data volumes, a hierarchical storage management mechanism is typically implemented based on actual usage patterns, dividing all stored data into three tiers. Frequently accessed data is stored in high-speed disk arrays to ensure rapid response times. Infrequently used data is stored near-line in tape libraries, available for timely transfer to disk arrays when needed. Rarely used data employs offline storage with manual management, convertible to near-line storage through manual loading when required. Traditional storage models primarily used Direct-Attached Storage (DAS), placing hard drives in servers or connecting them via SCSI interfaces. All read/write operations depended on the server, with I/O interfaces limiting system bandwidth. If a connected server failed, data in the storage device became inaccessible, increasing management difficulty and operational risks. Consequently, technicians developed network-based technologies such as Storage Area Network (SAN) and Network-Attached Storage (NAS). SAN is a network architecture based on a centralized storage model, typically operating over fiber channel connections. Its architecture comprises four layers: storage systems, hardware connectors, management software, and file systems, enabling data exchange and transmission through scalable network topologies connected via high-speed optical channels. NAS is a network-based data storage technology that connects network storage resources directly to the network, eliminating the need for traditional storage device connections.

2.2 Data Migration Management Technology

Data migration management is a common technology in broadcasting control systems that enhances online data mobility and migration speed. Typically implemented through EMC PowerPath Migration Enabler (PPME), this tool enables data migration across multiple storage systems. PPME utilizes PowerPath technology to rapidly complete data migration with support from other foundational technologies. Generally based on array and replicated SAN environments, PPME develops broadcast data migration management solutions without consuming host resources. During operation, PPME maximizes migration efficiency through three modes, addressing application interruptions caused by migration, preventing migration-related risks, and simplifying migration procedures. In practice, PPME operates independently of PowerPath multipath technology, requiring no additional path synchronization.

3. Maintenance Management

3.1 Strengthen Management to Reduce Economic Losses

3.1.1 Improve System Maintenance Systems To ensure management efficiency, comprehensive and feasible systems are essential, as they enhance maintenance staff professionalism while preventing safety incidents. For managers, the key challenge lies in maximizing system effectiveness. Through analysis and investigation, enabling maintenance personnel to fulfill their duties with clear guidelines and providing suitable positions for technicians proves effective for motivating staff. Additionally, daily management requires attention, with managers maintaining positive interpersonal relationships and employing humane communication approaches. Requirements from superior departments regarding broadcast control technology maintenance must be promptly communicated to maintenance staff, with immediate organization of maintenance activities. When feasible, all maintenance personnel should undergo training and exchange experiences to improve management deficiencies and develop practical solutions based on actual working conditions, thereby optimizing broadcast control systems and eliminating safety hazards before they cause economic losses.

3.1.2 Implement Broadcast Duty Work

3.1.2.1 Implement Superior Department Requirements When superior departments issue new system requirements, duty personnel must implement them promptly. On one hand, feasible regulations provide work guidelines for maintenance staff; on the other hand, broadcast equipment operation and program signal transmission must be monitored during broadcast periods to prevent unresolved issues.

3.1.2.2 Strengthen Responsibility Concepts All maintenance personnel must conduct timely equipment inspections according to institutional requirements, including switch transitions and monitoring devices. GPS clocks require regular calibration, with maintenance personnel notified immediately to correct any time errors and ensure punctual program broadcasting. For critical broadcast security areas, regular patrol inspections must be conducted with dedicated 24-hour staffing. Professional personnel should maintain broadcast control equipment to ensure stable operation, including: (1) checking temperatures and connection tightness; (2) inspecting broadcast control power systems, which are critical for normal program broadcasting. Power cables in control rooms must be neatly arranged for rapid troubleshooting during failures. Additionally, security and emergency lighting equipment must be installed at power equipment locations, separated from other electrical devices.

3.2 Optimize Training Programs to Improve Staff Competence

Training programs for maintenance and management personnel can comprehensively improve their professional competence and strengthen work consciousness.

Through guidance on management and maintenance skills, broadcast control effectiveness can be ensured. All notices from superior departments should be incorporated into training programs, with maintenance training strengthened according to job requirements to ensure staff expertise meets work demands. As maintenance personnel, they must thoroughly study their professional responsibilities, truly understanding and mastering relevant technologies while continuously fostering innovative concepts to identify and resolve new problems during operations. To achieve optimal training results, exemplary learners can be selected within the organization to conduct regular exchange activities, embodying the people-oriented, quality-first philosophy in all work.[5]

In summary, broadcasting control technology is crucial for ensuring effective television program broadcasting. Maintenance and management must be properly executed to fully leverage control technology advantages and promote broadcasting industry development.

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