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## Network Upgrade Solutions for HD/SD Station-Wide Integration at County-Level Television Stations (Postprint)

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### Abstract

Addressing the serious disconnect between program production systems and broadcasting systems in county-level television stations, this paper introduces how to utilize network technology and digital technology to carry out digital and networked transformation of production and broadcasting systems. From the perspectives of the necessity for digital and networked transformation, technical solutions, design principles, and other aspects, it elaborates on the approaches for county-level television stations to achieve digitalization and networking.

### Full Text

#### Research on the Integrated Network Upgrade Plan for HD/SD Simultaneous Broadcast at County-Level Television Stations

**Abstract:** Addressing the serious disconnect between program production and broadcast systems at county-level television stations, this paper introduces how to utilize network and digital technologies to transform broadcast systems through digitalization and networking. It elaborates on the pathways for county-level TV stations to achieve digitalization and networking, covering the necessity of transformation, technical solutions, and design principles. The fundamental difference between analog and digital television lies in signal distortion and noise accumulation—while digital TV maintains performance integrity over long-distance transmission and multiple processing stages, analog TV cannot. To reduce and avoid broadcast accidents, and to overcome issues such as VCR damage from prolonged use, high maintenance costs, and inefficient manual operation, innovating broadcast systems and promoting automated, digital production-to-broadcast workflows represents both a practical necessity and future development direction.

**Keywords:** Digitalization; Networking; Design Principles; Technical Solutions; Transformation Effectiveness

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## 1. Current Situation Analysis at Yinjiang Radio and Television Station

In recent years, our Yinjiang Radio and Television Station has experienced unbalanced development between high-quality editing/production and low-efficiency broadcasting. DVCAM digital editing and non-linear editing systems have failed to deliver high efficiency and quality. In particular, while journalists use HD/SD-compatible cameras for daily interviews and external publicity topics, all external publicity materials uploaded to Guizhou Radio and Television Station require 16:9 HD format. Although our production system is also HD/SD-compatible, our station broadcasts in 4:3 SD format, resulting in meeting footage where leaders on both sides are cropped to half their bodies when aired on our station.

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## 2. Design Principles for Digitalization and Networking Transformation of Production-Broadcast Systems

The information age dominated by mobile data has propelled the digital and networked development of radio and television systems. As the saying goes, “nothing can be accomplished without norms.” In the design and reform of our broadcast system, our station strictly adheres to the following principles.

**2.1 Security** Security is paramount. To ensure stable long-term operation, high-quality hardware equipment and reliable transmission cables must be adopted.

**2.2 Advancement** Given the diversity of system models requiring strong compatibility, all audio and video channel indicators must meet industry Grade-A specifications.

**2.3 Flexibility** Our system adheres to flexibility principles in signal source selection, broadcast operations, interface visual effects, and playback modes to address various emergency situations.

**2.4 Economy** Given the high cost of all-digital equipment and our actual development status, improvements will be implemented in phases, gradually upgrading from initial gigabit Ethernet to fiber optic networks.

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### **3. Upgrade Plan for County-Level HD/SD Simultaneous Broadcast System**

In the past, county-level broadcast systems increasingly failed to meet actual broadcasting demands. In practice, we must first attach great importance to this issue, recognizing its urgency as a critical development priority. Second, thorough investigation and analysis must be conducted to construct a comprehensive broadcast system that enhances automation and intelligence capabilities, improves scientific management levels, raises work quality, and reduces broadcast accident rates. The design and implementation of the county-level TV station's HD/SD simultaneous broadcast system must prioritize solving practical problems to ensure effectiveness.

**3.1 Broadcast System Architecture Design** For broadcast system architecture design, emphasis should be placed on top-level design, drawing on successful solutions while comprehensively considering objective factors to clarify the design approach. Critical equipment must employ primary-backup redundant configurations, with careful attention to scale design to ensure safe broadcasting of two HD/SD digital channels. Simultaneously, adequate room must be reserved for future upgrades and development.

**3.2 Digital Hard Disk Broadcast System Design** Given the system's primary task of managing video servers, related VCRs, and various external signal sources, the design process must ensure the core position of the video server. In implementation, fundamental improvements to security and stability are essential to guarantee smooth program broadcasting. Hardware-level backup technology must be applied at critical points to eliminate single points of failure in the hardware system.

The fully digital HD/SD broadcast system employs a video broadcast server as its core equipment, overcoming long-standing challenges. For instance, traditional VCRs suffer from poor maintainability, high costs, and low reliability. The new system not only reduces maintenance costs but also ensures smooth program switching effects, guarantees frame-accurate picture quality, and enhances user experience.

The main components of the broadcast system include: (1) Video server system, which converts HD SDI signals and serves as the control center of the entire system; (2) Database system, responsible for recording materials, monitoring programs, and managing data elements; (3) Broadcast control system, which controls video servers, audio/video switching equipment, and ensures effective

broadcasting of various programs; (4) Audio/video dispatch system, which uses matrix methods for unified scheduling and processing of multi-source signals for playback across channels; and (5) Audio/video sub-control system, primarily for channel-specific processing, along with a clock system to coordinate time uniformity and ensure system-wide synchronization.

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#### 4. Problems and Solutions Encountered During Upgrade

Given our station's actual operational conditions, we face issues such as insufficient scale and difficulty in unified management and maintenance. While large-scale audio/video production and broadcast stations possess strong production capabilities, they also consume excessive resources. Traditional linear editing machines or standalone non-linear editors complicate centralized management and maintenance. Current large-scale network projects feature relatively complex network structures, typically employing sophisticated fiber optics and proprietary disk arrays that require substantial financial investment and highly skilled maintenance personnel. Given our county station's limited funding, we cannot afford such large-scale investment. Therefore, we have adopted a phased improvement approach based on our actual development status, gradually upgrading from initial gigabit Ethernet to fiber optic networks. After repeated comparison and consideration, and through careful deliberation by all station staff, we have finalized the system technical solution. By coupling multiple advanced technologies, we have formed a scientific and effective production workflow that also serves as a reference for production/broadcast workgroups.

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#### 5. Daily System Maintenance

The evolving era, particularly the rapid advancement of computer science and network technologies, presents both challenges and opportunities for radio and television. On one hand, we must focus on solving practical problems such as unbalanced development while accelerating technological innovation. On the other hand, achieving integrated HD/SD network upgrades at county stations is of great significance to broadcast systems. Practice yields true knowledge. During two years of operation since the upgrade, our broadcast system has encountered many bottlenecks. In solving these practical problems, we have developed a relatively comprehensive and realistic operational system that includes routine maintenance schedules, emergency protocols, and special requirements, thereby preventing broadcast accidents.

**5.1 Real-Time Hardware Monitoring** The continuous and stable operation of a system depends on the security and stability of its hardware facilities. We have developed equipment status monitoring forms and maintain detailed maintenance logs, tracking environmental conditions such as temperature and

humidity, power supply status, indicator light functionality, and host control system operation. We have installed monitoring software in our hard disk broadcast system to conduct risk assessments of all broadcast system components. Maintenance is tailored to each device's specific environmental requirements: disk arrays are particularly sensitive to operating environments and require high standards, necessitating regular cleaning operations; to prevent broadcast accidents caused by hard disk damage, we regularly check hard disk read/write status; and we frequently test technical quality indicators reflecting audio/video operation status and overall system performance to ensure system security.

**5.2 Software Maintenance and Upgrade** To ensure the security and isolation of the entire network broadcast system, all operational software in the hard disk broadcast system must be genuine licensed versions, with all input devices disabled. Technicians performing system maintenance must use specific hardware and software drivers while backing up operational software. To improve overall system stability and security, software updates must be performed promptly.

**5.3 Data Maintenance** Data storage is the core of the entire system; without the various data stored in databases, the broadcast system cannot function. The hard disk broadcast system primarily employs backup mechanisms to enhance data security and recovery capabilities. To eliminate any points of failure, we utilize primary and backup database servers along with dual broadcast and dual upload servers. As a critical component of the digital broadcast system, disk arrays occupy substantial storage space. Failure to regularly clean up unnecessary materials will slow down the entire system. We maintain detailed database system operation logs to identify and resolve issues promptly.

**5.4 Software System Maintenance** After prolonged high-speed operation, the broadcast system generates numerous fragments that occupy substantial memory, severely impacting system speed and stability. To maintain normal system operation, regular disk defragmentation and server restart procedures are required.

**5.5 Permission Settings** Throughout the operation of the broadcast system, different responsibility permissions must be established. Super administrators possess full system operation permissions, database managers have only data viewing and updating permissions, and control platform operators cannot access database data. Only internally authorized staff members have login accounts and passwords. Operational procedures must be strictly standardized, with detailed operation logs maintained and regularly inspected to identify and mitigate risks.

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