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## Architecture and Application of Intelligent Monitoring System for Broadcast Control Rooms: Postprint

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### Abstract

This paper primarily introduces the architecture of the intelligent monitoring system for the broadcast master control room at Anhui Broadcasting and Television Station, including the system design concept, overall architecture, strategies, and certain implementation details. It elaborates on the importance of the intelligent monitoring system as a critical auxiliary tool for ensuring the safe operation of television broadcasting systems.

### Full Text

## Intelligent Monitoring System Architecture and Applications for Broadcast Control Rooms

**Abstract:** This paper introduces the architecture of the intelligent monitoring system for the master broadcast control room at Anhui Radio and Television Station, including system design concepts, overall framework, strategies, and implementation details. It elaborates on the importance of intelligent monitoring systems as critical auxiliary tools for ensuring the safe operation of television broadcasting systems.

**Keywords:** intelligent monitoring platform; equipment monitoring; signal monitoring; business monitoring; power and environmental monitoring

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Intelligent monitoring serves as an auxiliary system for television broadcasting that effectively provides insight into system operational status, prevents and

promptly handles system failures, and enhances overall system management capabilities. As a system designed to ensure the safe and stable operation of broadcast control systems, high security represents a fundamental design principle. The monitoring system itself performs no control operations on any business systems, allowing each business system to operate independently of the master monitoring system. Practicality constitutes another primary consideration—the intelligent monitoring system must be capable of filtering and analyzing data reported from various subsystems to improve alarm accuracy, thereby becoming a truly effective tool for helping duty personnel accurately diagnose faults.

## 1. Construction Objectives

The objective is to establish a unified network intelligent monitoring system platform in the new central broadcast control room. Through this system, an intelligent early warning and monitoring platform will be implemented covering the entire broadcast master control system and all broadcasting operations. The monitoring scope includes IT equipment, transmission systems, and machine room environmental conditions. The intelligent monitoring platform not only monitors the signal and equipment layers but also establishes a signal quality monitoring system through signal quality detection cards. Based on business requirements, it implements comprehensive, accurate, real-time monitoring of business processes, network environments, power conditions, and machine room environments, with real-time analysis and graded classification alerts for collected information.

## 3. Functional Applications

From a functional perspective, the system is divided into three components: monitoring, client presentation, and operations management.

### 3.1 Device Monitoring Level

Due to its simplicity and universality, the SNMP (Simple Network Management Protocol) protocol is supported by equipment from many broadcast industry manufacturers. We utilize SNMP for device monitoring and management, employing both polling and trap methods in the SNMP protocol to monitor equipment operational status. For AV equipment, detection parameters primarily reference the MIB (Management Information Base) files and operational status information provided by hardware manufacturers (obtained via SNMP or other proprietary protocols). IT equipment detection parameters include hardware metrics such as CPU utilization, memory occupancy, disk usage, and chassis temperature. Network-related information collection covers data traffic per port, network protocols per port (if supported), and configuration files.

### 3.2 Signal Monitoring Level

The primary monitoring content involves key points in the upload, review, and broadcast chain, mainly using signal quality detection cards. Signal quality directly affects broadcast quality, and its evaluation criteria follow the alarm parameters of the State Administration of Radio and Television's Golden Sail Award. Main technical parameters and system indicators include SD: 625i50 and HD: 1080i50. Signal detection content encompasses frozen frames, black field, color field, color bars, audio silence, and audio level abnormalities (too high or too low).

### 4.3 System False Alarm and Missed Alarm Rate Indicators

For equipment status alarms: no software missed alarms are permitted, and the software false alarm rate must be less than 0.1%. For broadcast process alarms: no software missed alarms are permitted, and the software false alarm rate must be below 0.1%. For environmental status alarms: no software missed alarms are permitted, and the software false alarm rate must be less than 0.3%.

### 3.3 Business Monitoring Level

Business monitoring covers status information throughout the entire process from broadcast playlist reception to transmission, as well as status information during all stages of file upload, review, migration, and broadcast. The technical review platform comprises automatic technical review and manual re-inspection software. Automatic technical review analyzes every frame of video and audio signals in the examined material through software, comparing parsed data against relevant standards to identify technical issues such as black field, color bars, or audio silence, marking problematic points for manual re-inspection. For MXF files, the automatic review software can detect structural information of the MXF file, allowing manual re-inspection software to view MXF file structure error information. Since automatic technical review is mechanical and lacks human logical judgment, the manual re-inspection process requires browsing and reviewing issues identified during automatic review to confirm whether problems are genuine. The manual re-inspection software can locate problematic timecode points for entries marked as "automatic technical review failed" in the program schedule, display the image at the current timecode on a monitor, and allow manual confirmation of whether the issue constitutes an actual error, marking the material as either "manual re-inspection passed" or "manual re-inspection failed."

## 4. Power and Environmental Monitoring Level

Multiple environmental monitoring points are deployed within the central machine room to acquire UPS, precision air conditioning, and machine room temperature/humidity information. UPS monitoring provides system power-related information such as voltage, current, and power, while precision air conditioning

monitoring and temperature/humidity sensors deployed throughout the machine room provide temperature and humidity information at various system points.

#### 4.1 Screen Presentation

The system enables maintenance personnel to understand the operational status of the entire broadcast system through multiple methods (such as tree directories, system electronic diagrams, and keyword searches) for real-time queries of online equipment (currently in use and hot backup equipment) working status. It provides graded alarms for equipment warning information (presentation interface warnings, audible and visual alarms), lists a comprehensive alarm information table, and allows query retrieval of required alarms. Alarms can be displayed in multiple hierarchical methods, such as machine room -> cabinet -> board card, or machine room -> system -> module -> device. As needed, the system can perform real-time graphical display of system hardware links and signal routing with preset display ranges, and provide monitoring interface displays for different duty positions.

#### 4.2 Monitoring Subsystem Response Time Indicators

The master monitoring system has different response time requirements for different application levels. Responses are divided into two categories: real-time response and fast response. Real-time response applies to broadcast primary and backup link signals and equipment closely related to safe broadcasting and directly affecting it, using fast and reliable methods to place monitoring results and emergency prompts in prominent monitoring positions with audible and visual alarms. For alarms related to safe broadcasting and directly affecting broadcast primary and backup link signals and equipment, the real-time response time is less than 2 seconds, striving for within 1 second. Fast response applies to non-broadcast link equipment signals and equipment that do not directly affect safe broadcasting, using reliable methods to display monitoring results relatively quickly (within 5 seconds).

## 2. Overall Architecture Design

The intelligent monitoring system's overall architecture is divided into three layers: the collection service layer, the aggregation analysis service layer, and the application presentation layer. Main hardware includes database servers, data collection servers, aggregation analysis servers, signal quality detection cards, temperature and humidity sensors, 16 channel monitoring presentation workstations, and 2 master control monitoring presentation workstations.

## 5. Conclusion

The intelligent monitoring system for the new central broadcast control room at Anhui Radio and Television Station commenced construction and commissioning in July 2013, began trial operation on August 15, 2013, and officially

served the broadcast system on October 22, 2013. Since its launch in October 2013, the intelligent monitoring system has significantly reduced the workload of duty personnel and technical maintenance staff. Equipment information, fault information, personnel actions, and equipment alarm information within the broadcast system can all be queried and stored in the database. Replacing manual patrols with software patrols helps duty personnel respond quickly and handle issues correctly, improving system emergency response efficiency and enhancing broadcast security. The intelligent monitoring system demonstrates high timeliness, accuracy, and availability, strictly ensuring that duty personnel receive alarm notifications at the first moment of failure. By improving monitoring technology levels, it eliminates missed alarms, minimizes false alarms, and enables rapid fault location and analysis, becoming an effective auxiliary tool for operations and maintenance personnel to troubleshoot and handle emergencies.

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

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