

Design Philosophy and System Characteristics of the Hulunbuir Radio and Television Station HDTV OB Van (Postprint)

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Abstract

High-definition television outside broadcast vans of broadcast television stations play a crucial role in the television program recording and production process. This paper mainly explores the design principles, system configuration, and system characteristics of high-definition OB vans for broadcast television stations.

Full Text

Design Philosophy and System of Hulunbuir Radio and Television Station's High-Definition Television Broadcast Van

Abstract: High-definition television broadcast vans play a vital role in television program production and recording processes. This paper explores the design principles, system configuration, and characteristics of high-definition broadcast vans for radio and television stations.

Keywords: high-definition television broadcast van; system configuration; matrix equipment; audio equipment

1.1 Design Principles for High-Definition Television Broadcast Vans

The design quality of high-definition television broadcast vans directly affects television production outcomes. Based on analysis of compatibility between high-definition and standard-definition programs and various subsystem designs, engineers strengthened the extensibility of the broadcast van system to facilitate future upgrades [?]. The design principles for high-definition television broadcast vans primarily include the following aspects:

1.1.1 Principle of Technical Advancement

In accordance with the current state of broadcast television technology, the system design of high-definition broadcast vans must synchronize with international advanced design concepts and maximize adaptability to future technological developments and diverse program production requirements. The vehicle modification employs advanced manufacturing processes and materials.

1.1.2 Principle of Functional Completeness

Hulunbuir City is located in the northern temperate zone, characterized by long, cold winters and short, cool summers with insufficient heat and large diurnal temperature variations. Most areas of the city have an average annual temperature below 0°C. The high-definition broadcast van must demonstrate strong adaptability to these local environmental conditions. Both vehicle design and equipment selection should be stable, reliable, simple, and safe. During the design process, engineers must develop comprehensive emergency plans for the system. All hardware, software, and vehicle modifications must also comply with relevant international and domestic standards.

1.1.3 Principle of Functional Practicality

Television broadcast vans play a crucial role in live broadcasts and program relay. Organizations must complete system design according to broadcast industry signal transmission requirements, enabling the van to better satisfy functional demands for live broadcasting and recording of important programs and large-scale events. In terms of overall space design, engineers should follow a people-oriented principle. Additionally, thorough resolution of high-definition and standard-definition compatibility issues ensures reliable switching and conversion between formats.

1.1.4 Principle of Operational Flexibility

Operational flexibility of high-definition television broadcast vans encompasses three aspects: flexible system architecture, flexible system access, and flexible system operation. To facilitate system expansion and upgrades, system design and reserved wiring must be scalable.

1.1.5 Principle of Maintainability

System maintenance occupies a critical position throughout the system lifecycle. During the design phase, system solutions must fully consider the rationality and standardization of structural design while strengthening system maintainability to support future maintenance of systems and equipment.

1.2 System Configuration

1.2.1 Video System Configuration

Our station's high-definition broadcast van is designed with 10 conventional camera channels, 2 wireless microwave transmission channels, and 2 high-speed

camera channels. Camera channel functions include monitoring, return video, TALLY, and intercom. The system is configured with 6 sets of 18x standard lenses, 3 sets of 14x wide-angle lenses, 2 sets of 23x medium telephoto lenses, 2 sets of 42x telephoto lenses, and 1 set of 77x box lenses [?]. Signals from cameras, external sources, VTRs, slow-motion servers, and character generators simultaneously feed into both the production switcher and video matrix. Signal exchange between the switcher and video matrix is implemented such that most input signals to the switcher are directly connected from sources (or source distribution amplifiers), with only a small number of input signals allocated from the matrix. All switcher outputs can assign program outputs for each M/E level, with output signals definable as PGM, PVW, CLEAN, and AUX signals. Simultaneously, PGM, PVW, CLEAN OUT, AUX, and program master outputs from each M/E level of the switcher are sent to the digital video matrix for signal monitoring.

1.2.2 Audio System Configuration

The audio system employs a main-backup combined design. Both primary and backup mixing consoles are digital and can process analog and digital signals simultaneously. Audio signals from all sources are distributed and simultaneously fed into both main and backup consoles. The broadcast van's primary audio channels use digital audio transmission to ensure audio quality. According to the broadcast van's designed operating environment, the audio system must support high-definition television audio live broadcasting and recording capabilities. The application of main-backup dual-channel architecture in audio output channel design enables the van to better accomplish mono production, stereo production recording, transmission, and basic monitoring, thereby ensuring safe live broadcasting and production while enabling rapid emergency switching. VTRs, slow-motion systems, and external analog and digital audio signals are distributed into both main and backup consoles after processing. PGM outputs from main and backup consoles enable fast emergency switching.

The broadcast van's audio transmission system primarily solves problems of microphone pickup and audio signal return/communication between the van and site. Typically, to facilitate and satisfy short-distance, medium-distance, and long-distance multi-channel audio signal pickup and transmission, the system employs multi-core audio cable transmission (pickup) methods, with camera microphone channels serving as important supplements for signal transmission (pickup). To ensure synchronized alignment of video and audio signals for broadcasting/recording and monitoring/listening, the broadcast van can utilize digital audio delay functions in digital mixing consoles or "insert digital audio delay devices" in appropriate audio system segments for audio delay processing.

1.2.3 Monitoring System Configuration

The broadcast van monitoring system employs a combination of multi-viewers and large screens. The core of the monitoring system consists of a 3ME production switcher and an 80"×80" input/output video matrix. The technical

area uses dual-channel recording and monitoring equipment to complete channel signal monitoring functions, while configuring OLED master control monitors for overall technical signal monitoring. The audio area uses two 23-inch high-definition LCD monitors, one configured as a 4-way split screen with signals routed by the video matrix, and the other fixed to monitor PGM signals. The slow-motion area uses two 24-inch or larger displays, each completing slow-motion signal monitoring through multi-viewer outputs from slow-motion servers.

Common monitoring equipment in the system includes 17-inch OLED broadcast-grade technical monitors, rack-mounted dual monitors, and wide-viewing-angle 23-inch broadcast-grade monitors. For example, broadcast-grade high-definition OLED liquid crystal monitors achieve 1920×1080 resolution with RGB 10-bit OLED full HD panels, providing color depth of 1.07 billion colors and 178-degree wide viewing angles. They support multiple color gamuts including SMPTE, EBU, ITU-709, S-GUMAT, and native. They support Gamma 2.2, 2.4, and CRT gamma, and S-Log2 to ITU-709 gamma conversion modes. The new rack-mounted dual monitors feature 1:1 pixel mapping mode for SD/HD, focus assist, H/V delay, center brightness check, timecode display, multiple scanning modes, and waveform/vector scope capabilities.

2. System Characteristics of Hulunbuir Radio and Television Station' s High-Definition Television Broadcast Van

Based on the current design status of high-definition television broadcast vans, key technical standards that must be followed include: *Limits of Vehicle Dimensions (GB1589-2004)*, *Technical Specifications for Motor Vehicle Operation Safety (GB7258-2004)*, GB/T 14857-93 *Specifications for Digital Television Encoding Parameters in Studios*, and GB/T 17953-2000 *Interface for 4:2:2 Digital Component Video Signals* (equivalent to SMPTE 259M).

2.1 Practicality

The practicality of high-definition television broadcast vans relates to systems such as the internal cable system and air conditioning system. For the cable system, designers employ a solution that integrates vehicle mains power with isolation transformers and voltage regulators, providing clean power quality for the broadcast van. Online UPS systems inside the vehicle protect broadcast equipment and ensure safety and reliability during program transmission. For the air conditioning system, after calculating cooling and heating loads for the vehicle' s electrical air conditioning, designers implemented a solution using supply and return air ducts to regulate the internal environment. The broadcast van' s air conditioning system enables independent cooling and heating for equipment areas and personnel areas in each functional zone, while separately installed cabinet air conditioning in equipment areas ensures special heat dissipation effects with high airflow and low power consumption. For program transmission

channels, to improve system safety levels, the broadcast van employs a 2×1 main-backup dual-channel mirrored architecture.

2.2 Mobility and Flexibility

The mobility and flexibility characteristics of our station's high-definition broadcast van primarily manifest in four aspects. First, the internal broadcast system possesses rapid response capabilities, allowing station personnel to quickly deploy operations after parking. Second, the 12-meter vehicle interior is reasonably divided into audio, director, slow-motion, technical, and equipment areas, providing relatively complete functionality [?]. Third, regarding interior layout, designers strictly followed national standards such as *General Rules for Application of Human Body Dimension Percentiles in Product Design (GB 12985-1991)*, resulting in a broadcast system with user-friendly human-machine interfaces. Fourth, considering Hulunbuir's climate characteristics of large temperature variations, strong sunlight, and heavy snowfall, the vehicle wall composite materials employ special chemical compositions that enhance corrosion resistance and aging resistance. Additionally, the application of a centralized control system further strengthens the van's mobility and flexibility. For instance, the centralized control system enables centralized control and management of vehicle-mounted equipment, integrating operation of all monitorable and controllable devices onto a single touchscreen. This allows operators to conveniently and quickly control various vehicle equipment while concentrating information display and control in a timely and accurate manner, thereby reducing overall vehicle operation difficulty.

High-definition television broadcast vans play an important role in live field broadcasting and large-scale program recording. Currently, the performance and technical indicators of our station's high-definition broadcast van effectively meet design requirements, demonstrating system flexibility, stability, and security.

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