Analysis of Design and Production Technology for Television Station HD-SD Simulcast Playout Systems (Postprint)

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Abstract

To satisfy the broadcasting requirements of television stations transitioning from standard-definition to high-definition, HD/SD simulcast systems have emerged. This necessitates a detailed analysis of television station hard-disk broadcasting systems, accommodating the viewing needs of both new high-definition users and existing standard-definition users, and proposing system design technical requirements and objectives according to system characteristics. This article will investigate the design and production techniques of television station HD/SD simulcast systems.

Full Text

Analysis of Design and Production Techniques for High-Definition and Standard-Definition Simulcast Broadcasting Systems in Television Stations

Abstract: To meet the broadcasting requirements of television stations transitioning from standard-definition (SD) to high-definition (HD), high-definition/standard-definition simulcast broadcasting systems have emerged. These systems must accommodate both new HD viewers and existing SD audiences. This paper analyzes television station hard-disk broadcasting systems in detail, proposes technical requirements and objectives based on system characteristics, and explores the design and production techniques of HD/SD simulcast broadcasting systems.

Keywords: Television Stations; Design; HD/SD Simulcast Broadcasting Systems; Production

1.5 Configuration Flexibility

Nowadays, SD equipment is gradually becoming obsolete for both consumer electronics and professional applications, making HD technology an inevitable progression. Broadcasting systems should therefore adopt China's HD broadcasting format of 1920$\times$1080i/50Hz, with equipment requiring 4K compatibility to provide a foundation for future development. For storage, external storage solutions can be utilized, with built-in 16TB HDD storage available. Regarding channel configuration, broadcast servers can initially be equipped with only SD channels, with modifications conveniently performed through menu interfaces. SD/HD switching can be executed at any time, with HD upgrades enabled via license keys, supporting subtitle on/off functionality and up/down conversion.

1.1 No Single Point of Failure

RAID6 should be employed to protect broadcast servers, with hot-swappable fans allowing simultaneous failure of two hard drives. Jumpers are required for various core channel equipment; if damage occurs, it should not affect broadcasting and can be immediately rerouted. However, it is essential to mark critical jumper ports, with channel jumper panels positioned on the console to facilitate convenient switching by duty personnel—a point requiring special emphasis.

1.2 HD/SD Simulcast

As the industry is still in the phase of clearing unauthorized channels, some channels will be eliminated by the State Administration of Radio, Film, and Television. For auxiliary channels, seamless upgrades to server encoder/decoder formats can be implemented by temporarily adopting SD designs that can be directly modified without altering other broadcasting equipment. Additionally, HD/SD simulcast is primarily adopted by channels such as economic news and comprehensive news channels.

1.3 Compatible with Multiple Formats

Integrated software and hardware codec technology has become increasingly convenient and mature. Systems must support multiple mainstream formats including DN$\times$HD, Quicktime, MPEG-2, AVC-Intra, DV, MXF, and AMWA ASO2 to prevent repeated transcoding that degrades signal quality, thereby enhancing system openness and compatibility. The system should support FTP and back-to-back playback of multiple formats.

1.4 New Media Encoding

China has completed the transformation to HD/SD simulcast from central to provincial television stations, entering the all-media era and gaining significant popularity among netizens. To achieve integrated broadcast control, original

encoded streams are provided to news video websites and subsequently transmitted to network streaming distribution. This reduces manpower requirements and website post-encoding equipment needs. Moreover, to prevent repeated encoding by these websites, higher broadcast source quality can be ensured while preventing degradation from multiple compression cycles.

2. Production Techniques for HD/SD Simulcast Systems

While producing high-quality HD programs presents challenges, the production process itself is relatively straightforward. Compared with SD television, HD offers clearer pictures, more delicate layering, richer colors, and places higher demands on production techniques.

2.1.1 Color Correction Color correction and grading are characteristic features of HD television production. The goal is to achieve consistent tone and color between every shot. Through post-production software, color differences from multi-camera shooting, overly dark images, and inconsistencies caused by weather and natural environment changes can be corrected and overcome. This results in saturated colors, accurate tones, unified overall effects, and rich, uniform layering. It is essential to strengthen control of technical indicators during the color grading process.

2.1.2 Proxy Bitrate Editing Bandwidth, editing performance, and storage capacity are critical technical issues in networked HD production. Due to the high bitrate of HD, which far exceeds SD production, network bandwidth and storage capacity requirements increase dramatically. HD has approximately five times the pixel count of SD, with larger picture sizes, but HD special effects rendering is significantly slower than SD, placing higher demands on non-linear editing workstation processing capabilities. To reduce production costs, decrease storage and bandwidth requirements, and improve efficiency, materials are typically transcoded and down-converted, or low-bitrate proxy editing is performed using SD resolution. The rough-cut EDL (Edit Decision List) is then exported for conforming and finishing in the HD system. This is the commonly adopted proxy bitrate editing method.

2.2.1 Lenses

Previously, SD television relied on dynamic, changing images to attract viewer attention, as static images lacked sufficient clarity for prolonged viewing. HD lenses solve this problem by faithfully recording details previously overlooked by viewers. With higher picture clarity, audiences can see these details more clearly, making static images more watchable. HD production should prioritize picture structure, utilizing slow-moving or fixed shots, except in special circumstances. Moreover, the human eye is more sensitive to jitter and shake in HD images, making sturdy, stable tripods an excellent choice during shooting.

2.2.2 Skin Tone Detail Correction

HD cameras feature skin tone detail correction that can reduce sharpness in certain skin tones. However, excessive reduction can cause facial blurring when down-converted to SD, despite looking good in HD. Therefore, skin tone detail correction values must be set reasonably, determined according to the host's skin characteristics and age.

2.2.3 Composition

The golden ratio of picture elements and compositional proportions change accordingly due to differences between HD and SD aspect ratios. The increased horizontal viewing angle can create a sense of visual perspective. Special attention must be paid to the proper positioning of subjects and supporting elements, controlling appropriate ratios of sharpness and blur to achieve both balance and contrast. Composition must also accommodate the 4:3 aspect ratio, using edge-cropping methods for content that needs to be broadcast on SD channels.

2.2.4 Exposure

Picture color saturation, layering, and detail are directly affected by exposure, making accurate exposure essential for perfect images. The enhanced horizontal resolution of HD cameras provides richer layering than SD, with picture latitude closer to film stock. When shooting scenes, careful observation of the distribution range of light and dark areas is required, adjusting aperture size to determine exposure based on the trade-offs between the subject and shadow/highlight details. Under non-ideal lighting conditions, picture modification and compensation are needed through adjustments to black gamma curves, knee points, and gamma curves.

2.2.5 Lighting

The embodiment of HD layering is also very important after clarity is improved. Every effort should be made to shoot crystal-clear images under good lighting conditions, with appropriate application of various light sources. Without adequate lighting conditions, the entire picture will have poor color reproduction and may even appear gray. Therefore, to fully realize the characteristics of high-definition picture quality, good lighting conditions are essential. Consequently, lighting must be uniform, wide-ranging, and multi-layered, using soft light sources to create depth and dimensionality.

2.2.6 Camera Parameter Adjustment

To achieve desired artistic effects, HD cameras provide detailed parameter menu adjustment functions. For programs with high artistic and technical requirements, such as film and television dramas, image quality control is necessary,

with HD engineers participating in production to ensure consistent picture quality. Adjustments to back focus, picture tone, and color are made according to cinematographer requirements, monitoring shadow and highlight levels, viewing HD waveform monitors, controlling white balance, and setting camera menus to optimize image capture.

2.2.7 Focus

HD has much shallower depth of field than SD, with higher lens resolution. When using conventional SD camera operations for HD shooting, out-of-focus blur occurs more easily. Therefore, push-pull and pan-tilt movements should be minimized. When shooting dynamic subjects, wide-angle and fixed-focus lenses should be used as much as possible in HD production. During tracking shots, long focal lengths should be avoided in favor of wide-angle lenses. Aperture should be reduced while increasing scene illumination. Careful selection of ideal focus references is necessary, making good use of focus assist functions. Large-size HD monitors are required.

2.2.8 Set Design

Due to the high clarity of HD cameras, flaws in the image become very apparent, requiring more refined props, makeup, and wardrobe. Details must be more delicate in HD, whereas set details can be slightly rougher in SD. Since HD uses 16:9 composition with frequent push-pull and pan-tilt movements, backgrounds and stage design must be arranged according to 16:9 composition principles.

3. Conclusion

Television stations constitute a crucial yet currently weak link in the HD television industry chain, yet they bear the heavy responsibility of launching the entire industry, with significant investment gaps existing. Therefore, government departments must increase support, adopt effective measures, and gradually expand the coverage of HD simulcast channels. Television stations also need to accelerate the construction of HD production and broadcasting systems, strengthen HD talent cultivation from the perspective of future competition, enhance the sustainability and urgency of HD television, improve program quality of HD simulcast channels, and jointly create a bright future for China's radio and television industry.

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