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On the Postprint of NEXUS Audio Routing System Applications

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Abstract

This paper introduces the NEXUS audio routing system and, in close conjunction with the audio systems of three OB vans and a large studio at Hubei Television, specifically analyzes its application in television program production from aspects such as structural design and equipment selection.

Full Text

Abstract

This paper introduces the NEXUS audio routing system and analyzes its application in television program production through the specific case of three broadcast vehicles and one large studio hall at Hubei Television, examining structural design and equipment selection considerations.

Keywords: routing; matrix; audio system; fiber optic network

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1. Working Principles and Basic Configuration of the NEXUS Audio Routing System

The NEXUS audio routing system is a digital routing matrix. Its operation can be understood as follows: within this audio network, fiber optics connect all major equipment, transmitting audio and control signals in digital format; specialized software implements input-to-output routing configuration, along with additional functions such as audio format conversion, audio processing, and data transmission.

The NEXUS audio routing system consists of three primary components: (1) base devices that provide signal input/output and processing capabilities; (2) bidirectional fiber optic connections linking the base devices; and (3) computers that facilitate user interaction with the audio system.

Both NEXUS base devices and fiber optic transmission employ Time Division Multiplexing (TDM) technology based on channel multiplexing. This architecture fully leverages the advantages of fiber optic audio systems, including low signal loss, strong anti-interference capability, large communication capacity, and long transmission distances, successfully addressing the challenges of traditional large-scale routing systems such as complex structure, massive cable requirements, signal attenuation, and interference issues.

In large-scale routing systems involving multiple studios and control rooms, NEXUS STAR is often deployed as the system core to enhance routing capabilities, forming a fundamental star topology where all NEXUS base devices connect to the NEXUS STAR. The NEXUS STAR employs a highly optimized routing matrix for control, capable of reaching 4096×4096 scale with nearly 16 million crosspoints.

Currently, mainstream fiber optic network audio systems adopt two structural forms: single-star plus ring topology and dual-star topology. Both offer high security levels—the first provides backup through ring connections if the single star fails, while the second features dual cores for mutual backup. Naturally, both approaches are also the most expensive. Based on practical considerations, we comprehensively evaluated our station’s budget constraints, current program requirements, and development needs for the next 10–15 years. Consequently, for the individual audio systems of our three broadcast vehicles and one large studio hall, we opted for a single-star structure rather than the aforementioned dual-topology approaches.

2. Configuration of Hubei Television’s NEXUS Audio Routing System

In July 2011, Hubei Television launched its HDTV channel. To meet the production demands of high-definition programming, the station subsequently completed projects including an 8-channel HD broadcast vehicle, a 12+2+2-channel HD broadcast vehicle, a 5.1 surround sound audio vehicle, and a 2,000-square-meter studio hall. The audio systems for these three vehicles and one large studio hall all employ the NEXUS audio routing system, whose safe, reliable, convenient, and flexible characteristics effectively satisfy the production requirements of high-definition programs at various scales and will continue to demonstrate its capabilities in the upcoming 4K era.

The 8-channel HD broadcast vehicle audio system at Hubei Television utilizes a STAGETEC NEXUS interface chassis with an Auratus mixing console. The 12+2+2-channel HD broadcast vehicle audio system, the 5.1 surround sound

audio vehicle, and the 2,000-square-meter studio hall audio system all employ STAGETEC NEXUS interface chassis + NEXUS STAR central router + Crescendo mixing console as their core.

Crescendo/Auratus digital mixing consoles can be logically considered as signal insertion processing for the NEXUS audio routing system. Consequently, each mixing console can select audio signals from any physical input port of the routing matrix as its input channels, and the console's bus outputs can be assigned to any physical output port of the routing matrix. This network audio architecture enables us to conveniently meet the diverse requirements of different programs for the audio system.

3. Specific Applications of Hubei Television's NEXUS Audio Routing System

3.1 Interconnection of the 8-Channel and 12+2+2-Channel HD Broadcast Vehicles with the 5.1 Surround Sound Audio Vehicle

The 5.1 surround sound audio vehicle serves as a mobile surround sound production facility capable of complex surround sound field production and multi-track recording. With limited funding that precludes large-scale construction of a dedicated surround sound control room, the interconnection of the 5.1 surround sound audio vehicle with the 8-channel and 12+2+2-channel HD broadcast vehicles effectively meets surround sound program production requirements. The interconnection between audio vehicles and HD vehicles includes video, audio, intercom, TALLY, clock, and sync signals. The audio system interconnection between vehicles uses one 12-channel digital audio cable and six professional fiber optic cables. Deep interconnection enables switching and scheduling of audio signal routing between the two systems, complete signal sharing, and streamlined remote system logic.

In the matrix window, we can configure all inputs and outputs of the entire NEXUS routing system. Input-to-output routing operations follow three fundamental principles: one input signal can be distributed to all available outputs; one input signal can be simultaneously distributed to multiple outputs; and one output can only have one input signal.

In large-scale variety show production, television broadcast, live sound reinforcement, and stage monitoring must be adjusted separately to achieve optimal results. During the production of the 2012 Hubei Spring Festival Gala and the 2012 National Farmers' Spring Festival Gala, we implemented a collaborative model using live sound FOH + 16-channel HD vehicle + 5.1 audio vehicle. First, we split the required CD, VTR, and microphone signals using microphone and line signal distributors—one feed to the FOH mixing console, and another feed into the STAGETEC NEXUS audio fiber optic network system via a mobile NEXUS interface box on site. This was then connected to the 12+2+2 HD broadcast vehicle through single-mode camera fiber optic cable, while simul-

taneously interconnecting the HD broadcast vehicle and 5.1 surround sound audio vehicle to establish the complete digital audio network. As previously described, once audio signals are connected to the STAGETEC NEXUS audio fiber optic network system, we can route signals to required equipment through matrix configuration. Since the 5.1 surround sound audio vehicle provides a more comfortable production environment, we designated it as the primary audio production area while using the HD broadcast vehicle as the audio signal recording area.

3.2 Application in Ultra-Large-Scale Programs

With evolving audience expectations, we increasingly face opportunities to produce ultra-large-scale programs. Such productions commonly involve dozens or even hundreds of microphone channels, with primary and backup broadcast mixing consoles, primary and backup sound reinforcement consoles, and primary and backup monitor consoles being standard configuration. Provincial television stations typically lack permanently installed systems of this scale, requiring temporary construction. For instance, a large-scale gala requiring 100 microphone channels with primary and backup broadcast consoles, primary and backup sound reinforcement consoles, and a monitor console—five mixing consoles total—demands enormous temporary system construction workload. Conventional practice involves cascading two 1-to-3 signal distributors to achieve 1-to-5 distribution to the five consoles. One hundred microphone channels require nearly a thousand microphone cables after distribution, each needing testing. Since each mixing console requires different signals, substantial work is needed to allocate and schedule these inputs. Any last-minute adjustments require modifications at multiple points, creating significant workload and greatly increasing the probability of human error.

For the STAGETEC NEXUS audio fiber optic network system, rapid construction of large-scale systems presents no fundamental challenge. We simply position the mixing consoles as required, then route the 100 channels through 1-to-2 distributors to primary and backup STAGETEC NEXUS interface boxes. Each mixing console simultaneously takes signals from both primary and backup audio routing systems, while console outputs are also fed to primary and backup STAGETEC NEXUS interface boxes before distribution to primary/backup broadcast, primary/backup sound reinforcement, and monitor equipment. The architectural advantages of the STAGETEC NEXUS audio fiber optic network system are evident: not only does it save cables and connection workload, but more importantly, it enables separate adjustment of television broadcast, live sound reinforcement, and stage monitoring for optimal results in large-scale variety show production.

Through several years of practical experience, we have fully recognized the superiority of the STAGETEC NEXUS audio fiber optic network system. During routine program production, the audio systems of our three vehicles and one large studio hall can operate independently without interference. When tasked

with ultra-large-scale program production, we can fully leverage the advantages of the audio fiber optic network to redefine the functions of each mixing console, rapidly constructing a safe and reliable large-scale system that meets program production requirements. With the rapid development of Audio over IP (AoIP) technology in recent years, we must continuously enhance our knowledge, break free from traditional audio system thinking limitations, and utilize modern technologies to build more excellent audio systems for program production.

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

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