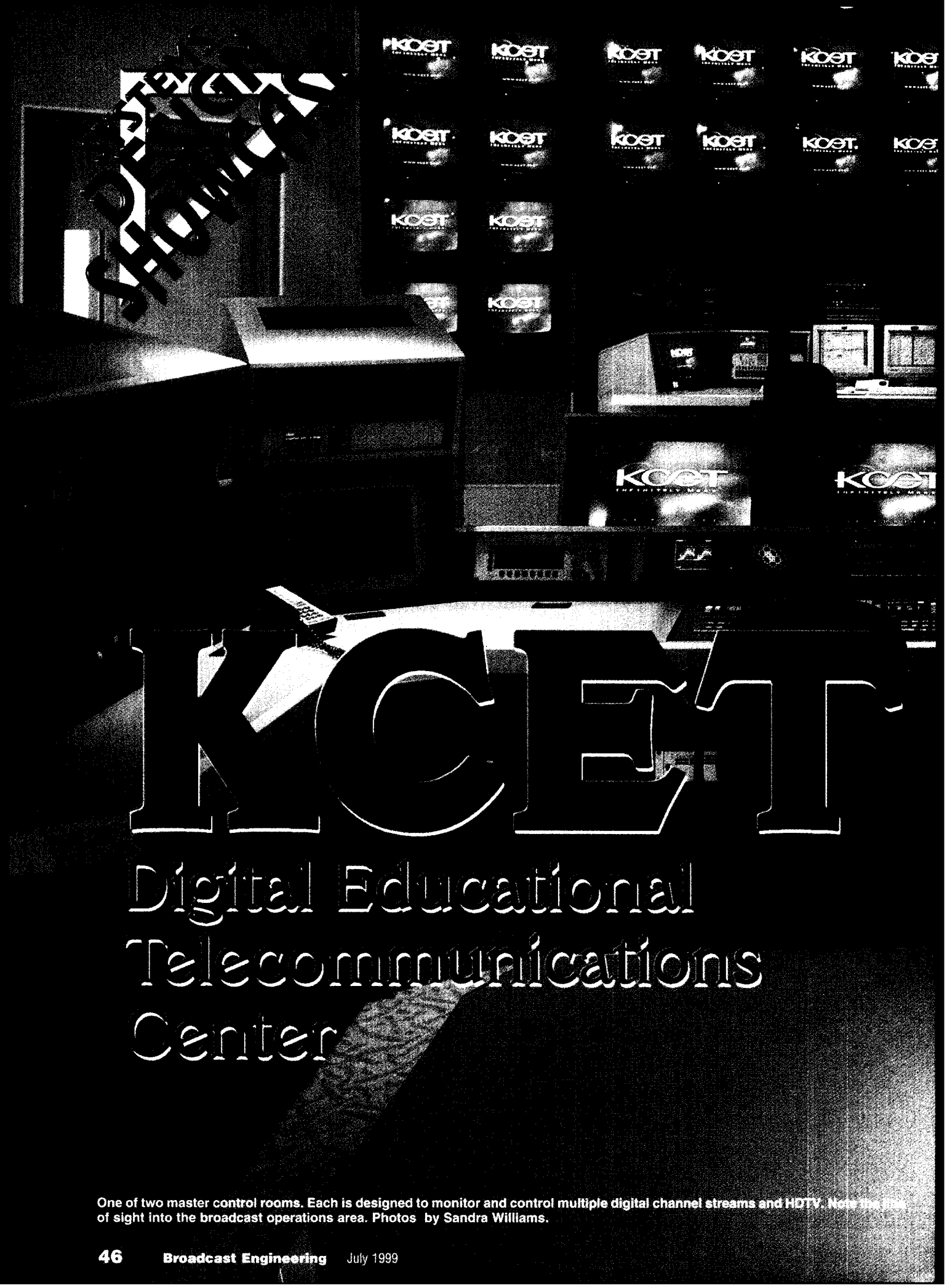

One of two master control rooms. Each is designed to monitor and control multiple digital channel streams and HDTV. Note the line of sight into the broadcast operations area. Photos by Sandra Williams.

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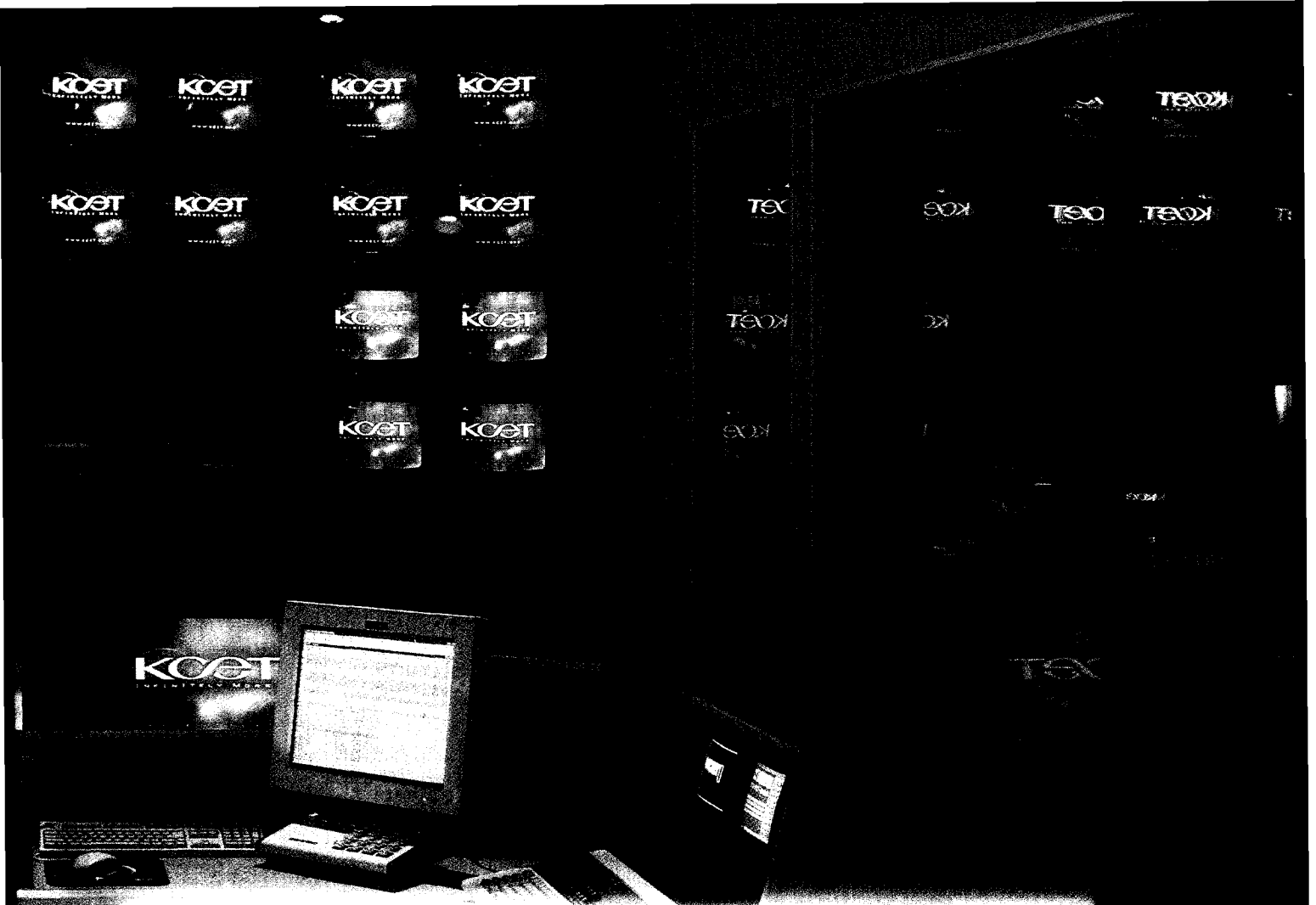

By Darrell Wenhardt

In 1989, KCET Channel 28, Los Angeles, realized that its existing master control and related on-air support facilities had succumbed to old age. The systems were housed in the old film vault section of Fleming Street Studios, one of the first film studios built in the Hollywood area in 1912. KCET needed a new facility.

The challenge was to design and build a facility that would be flexible and adaptable to technology shifts and growing operational demands, while consistently supporting programming and business operations without interruptions.

Building infrastructure

Building design began with a series of meetings with management, programming, engineering, operations and facility leaders. The meetings included the design team, the architect (AHT of Los Angeles) and broadcast consultant (CBT Systems of San Diego).

Initial data suggested that the current administrative, financial, programming and studio operation areas could remain in the existing facilities. The on-air broadcast operations and the directly related on-air support studio, editing, voice-over, maintenance engineering offices and multimedia development departments required new facilities.

CBT Systems began laying out specific technical-related operational areas, including the central equipment room, master control, on-air operations area, videotape dub and format area, online and offline editing, video production control room, audio production control room and a small production stage, Studio C.

As the architectural shell and interior layout details took shape, CBT Systems evaluated building infrastructure requirements for power, grounding, HVAC, mechanical systems, acoustics and signal distribution.

Acoustics

Sound transmission control and control room interior acoustical treatment was critical. All production control, editing and master control rooms were designed to implement full 5.1 surround sound.

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KCET

Not only did room interior noise criteria levels become critical, but sound transmission levels between walls and ceilings became even more important to isolate the additional subwoofer energy. Thus, the design goal for building partition sound transmission ratings ran STC-50 to STC-62. In-room noise criteria requirements ranged from NC-15 to NC-30.

A combination of isolated slab subfloors, floating floors, double-wall construction, floating ceiling lids and cavity absorption were employed to achieve both good in-room acoustical performance and excellent audio containment between adjacent rooms.

Cable and signal distribution

An 18-inch raised-access flooring system was designed as the main component of the facilities signal cable distribution system. The architect and consulting teams closely studied and coordinated the building permit, associated building and NEC code sections relating to raised access flooring and related cabling requirements.

The signal cable distribution and installation plan involved countless hours of thought and planning. The prior practice of piling new cable over old without a plan to reutilize the existing cable was something the station wanted to change and guard against in the new facility.

CBT Systems engineering team's was based upon Icon source panel and Icon destination panel demarcation points throughout the facilities.

All circuits entering and/or leaving the central equipment room terminated and cross-connected at coaxial and twisted-pair Icon blocks mounted in 56RU racks next to the central equipment room.

All connections to remote control rooms, technical areas and interbuilding connection points were made via trunking lines between the central equipment room and Icon blocks at the remote locations. The trunking was overbuilt, in some cases by 100 percent, to provide for first-day and future build-out cable conductivity requirements.

This system will not completely future-proof the facility, but it will provide a solid backbone of infrastructure signal cable support for many years to come.

Racks and consoles

Through the early stages of design development, KCET repeatedly stated that the goal of the new facility must be to allocate space and infrastructure resources to future growth and technology advancement. This meant more rack space and adaptable console design.

Additional square footage was allocated for equipment racks. A separate area was designed to employ 36-inch deep racks to support extra-deep file server equipment. This separate area was set aside because of the server's higher per-rack heat load, higher operating sound level and sensitivity to dust and airborne particles.

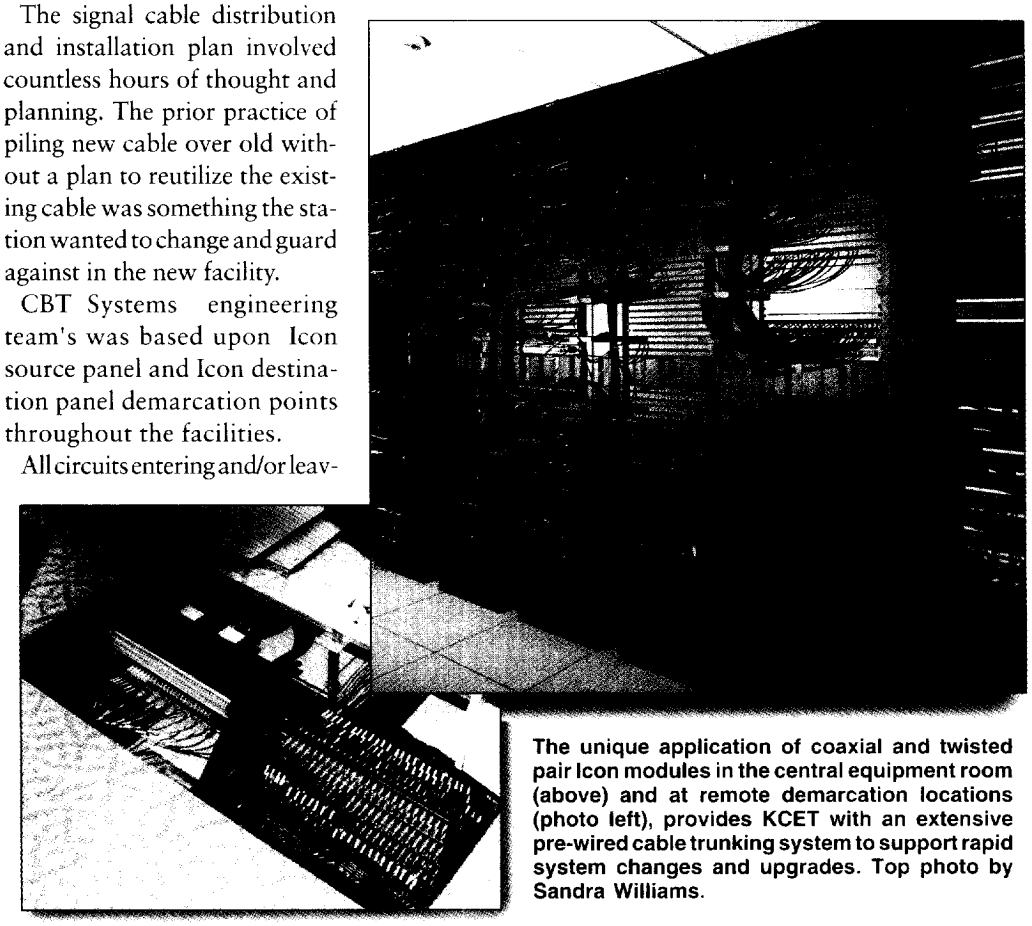
Another key set-up element included seismically rated rack-based support for all equipment racks. These massive steel frames, bolted to the concrete subfloor, are designed to support the equipment rack load during earthquake activity, not an uncommon occurrence in the Los Angeles area.

Operational consoles in each control area received a similar "future growth" and adaptability design criteria. Here the CBT Systems team developed a stamped metal-based modular console design. This approach provided a complete "erector set" console set up which will permit KCET to reconfigure individual console bays by adding height, display mounts, equipment shelves, and support arms at will as operational changes dictate.

Broadcast operations and technology

With a solid building infrastructure in place, the engineering and operations design team and CBT Systems' engineers turned their attention to technical operational requirements. A process flow review ensured that all elements of broadcast programming, from traffic program log development to interstitial material editing to multichannel on-air signal flow, were covered.

The technology approach centered on KCET's desire to develop a "video tapeless" operational philosophy. Using a 601 serial digital video and AES digital audio foundation, a system architecture that included extensive Fibre Channel video file transfer capability was developed. The system design requirement defined five technical sections: incoming program ingest, program production, program editing, program cacheing and program transmission.



The unique application of coaxial and twisted pair Icon modules in the central equipment room (above) and at remote demarcation locations (photo left), provides KCET with an extensive pre-wired cable trunking system to support rapid system changes and upgrades. Top photo by Sandra Williams.

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KCET

Program ingest, media control and editing

With these requirements in place, a network of video file servers was established to support all levels of technical and production operations without traditional videotape support. Program media flow and multichannel broadcast control was designed as a fully automated process. Louth was chosen to manage all aspects of the automation system. Program ingest and formatting, program near-line and archive storage, media transfer and routing, and multichannel broadcasting were all placed under the automation control and media tracking system.

Three program media ingest and formatting stations were created for high-quality videotape transfer. Each station is supported with a full compliment Leitch Digibus A/D conversion, digital noise reduction, audio processing and associated analog and digital signal monitoring.

Program and interstitial material editing in the new facility is handled by both full-function and limited-function nonlinear editing rooms. The full function rooms are based around Editware 351 control platforms. Because of Editware's operational familiarity to the editing staff and nonlinear control of the Tektronix Profiles, each edit room's video switching, effects and graphics is supported by Grass Valley 1200 production switchers, Pinnacle DVExtreme and Chyron MAX! graphics systems.

Audio control and processing in the edit rooms is digital. The mixing platform is Graham-Patten DESAM 400. Audio monitoring is set up for both 5.1 surround sound and four-channel discrete with a full complement of Genelec self-powered, full-range speakers and subwoofers, as well as Sony and Yamaha digital audio effects processors.

Field acquisition is currently in Sony Beta SP. To maintain tape compatibility and to begin a technological direction to implementing full MPEG signal throughput, the station selected Sony Beta SX as its new field acquisition format. Thus, each edit room is outfitted with two Beta SX Editing VCRs for material ingest.

Signal routing

KCET implemented a multiple matrix versus single matrix routing system architecture. This kept the overall crosspoint count down and left KCET with better options in the future to add specific router segments (i.e. HD). Philips' Venus was chosen as the digital and analog router and is controlled by the Jupiter switcher. A Philips' Saturn serves as the master control switcher.

Each all-digital edit room is equipped with an Editware nonlinear driver to control multiple channels of Tektronix Profile and Sony SX tape. Photo by Sandra Williams.

A hybrid analog/digital 64x64 ingest router handles all incoming satellite, microwave and fiber feeds. This unit also services the analog/digital tape format and dub area, and the analog/digital signal processing routing.

The main router is a 128x128 serial digital platform with three levels of AES audio, one level of timecode and one level machine control routing. A separate 128x96 analog video router was employed to support video monitoring and signal source ID tracking.

A 32x32 expandable to 64x64 digital transmission router with three levels of AES audio provides desired multipath and multichannel transmission capability.

Video servers

Developing a tapeless video process flow meant the heavy application of video file servers, RAID and data tape. The engineering team chose Tektronix Profile PDR 200s and Ampex DST data tape libraries.

The initial systems build-out contains nine four-channel Profiles with related 24Mb/s storage capacities ranging from five to 21 hours. The overall file server system design was implemented to support a total of 20 Profiles supporting some 68 I/O video channels, each capable of eight channels of audio.

The server architecture includes ingest server channels for incoming program material, edit servers to handle segment and program review and editing, a RAID-supported production server cache connected to one Ampex 712 data tape library, a main program cache with interface to the second data tape library, and four identical main transmission servers to support KCET's initial requirement of four fully backed up, full-time broadcast channels.

Broadcast master control

As part of its long-term programming distribution plan, KCET developed engineering and operational plans to implement two full-function master control rooms. Master Control I is designed to provide separate feeds to both the current analog Channel 28 transmitter and the new digital Channel 59 transmitter. (KCET is scheduled to begin digital broadcasting in December.)

Master Control I will also support three additional channels of regional programming and/or multichannel broadcasts over the new digital transmitter. Additionally, the system is prewired for a HD switching path to Channel 59.

Master Control II is designed to support up to 12 channels of planned regionalized feeds and local educational

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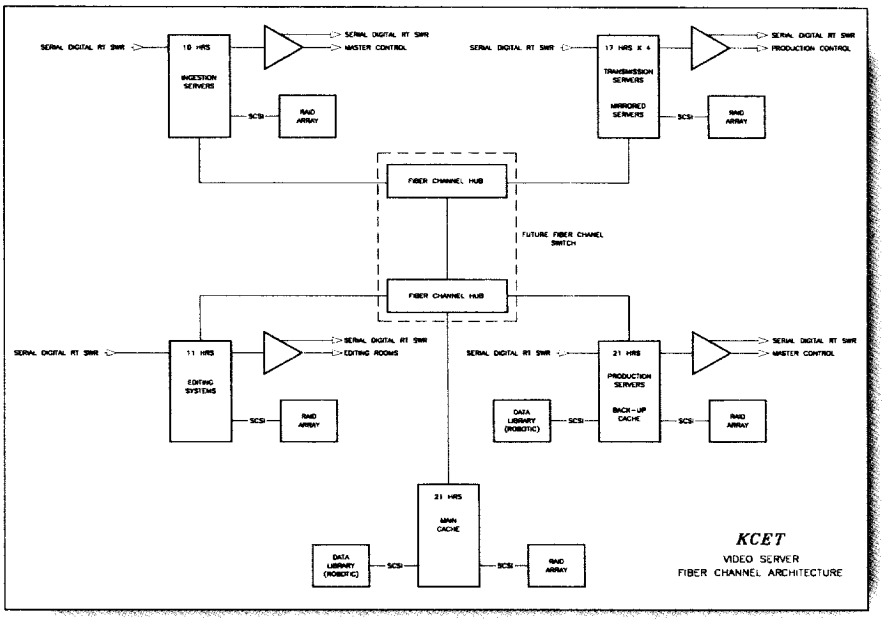

Figure 1. KCET employs a basic file server, RAID cache and data tape library architecture. Signal routing and data transfer is handled by both serial digital and a Fibre Channel network.

programming channels.

All source program and interstitial material to be broadcast on all master control channels is set up to originate from the transmission video file servers. Each channel will be programmed and controlled by the automation system. Each transmission server can store a total of 17 hours of program material. These servers are fully backed up with mirrored units. Daily storage needs outside of the 17-hour range are stored in a main program cache server capable of 21 hours of storage and in the Ampex 712 DST data tape library system.

Operational areas, Phase I, Phase II

The design team developed a two-phase systems implementation approach.

Phase I puts into place all elements necessary to bring current analog channel broadcast operations online with digital technology. These requirements led to the initial build-out of the central equipment room, the video file server room, the videotape format and dub area, the broadcast operation area, Master Control I and Edit Room I.

As broadcast programming increases at KCET, the new facility is prepared to handle the demands, having been prebuilt-out and prewired to immediately support the addition of the following operational spaces and channel capacities:

- Master Control I — Expansion to include HD.
- Master Control II – Built-out to support 12 channels of programming.
- Studio C and Production Control Room C.
- Audio control and sweetening.
- Edit Room II.
- Edit Rooms A, B and C.

Studio C, with its attendant production control room, implements new cameras capable of 16:9 digital operation. Studio C utilizes high-output compact fluorescent lighting technology.

The audio control room will be implemented to support both Studio C digital productions and to provide the overall facility with a digital audio sweetening and voice over control room. Several digital audio mixing and server-based editing platforms are currently being considered for application in this area.

Edit Rooms A, B and C will employ full nonlinear "shared" media editing platforms interfaced into the facility's file server network.

The Profile Server architectural features Fibre Channel hubs configured to facilitate upgrading to a fiber switch as system capacity demands increase.

With these additions, KCET will fulfill its initial design goal of providing an advanced digital television production and broadcast center to serve as the public television station for Southern and Central California. ■

Darrell Wenhardt is president of CBT Systems, San Diego.

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Bill Burroughs, chief engineer
Bill Christian, facilities manager
Joe Saavedra, senior engineer
Architect: AHT Los Angeles
Construction Management: Ray Wilson Company
Broadcast Consultant and Systems Integrator: CBT Systems
Darrell Wenhardt, principal consultant
Edward Webster, senior engineer
C. Stanley Ellington, senior designer
Paul Schankin, project manager

Equipment list

Louth automation system
Ampex DST-712 automated cartridge library
Aphex 320A stereo audio processor
Avalon archive manager
Chyron MAX!, MAXINE!
Cisco 200 Series catalyst, 2916XL 100BaseT Ethernet switch
RTS intercom
Denon DN-C680 CD player
Dolby SDU-4 surround decoder
Editware N-VPE351-K2 editing controller
Fostex D25 edit controller
Genelec 1030A speakers
Graham-Patten 409
Grass Valley Group 1200 Edit Switcher
Hitachi SuperScanPro 620 monitors
Ikegami color monitors
Leitch Digibus processing equipment
Leitch CSD-5300 master clock driver
Miranda ASD-251u video A/D converter
NVision audio D/A processing
Panasonic color monitor
Philips Mars digital video switcher, Saturn digital master control switcher, Jupiter control processor Venus A/D routing switcher
Pinnacle DVExtreme
RTS intercom
Tektronix test equipment and monitors, Profile video servers
Bittree patch jacks, patch panels and Icon panels
Videssence lighting
Vinten Pro-Ped camera pedestal
Wohler AMP1-A stereo audio monitor

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