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BroadcastEngineering

Building an HD system by David Phillips

Asian sportscaster ESPN-STAR has rebuilt the transmission area in its Singapore facility.

Although many HD systems have been built, success still hinges on the right decisions being taken before plans are committed to purchase orders. Over the past four to five years, there's been a huge increase in HD services; the channel count continues to increase rapidly, especially for broadcasters without bandwidth constraints and innovative business plans. There is a clear demand for HD from consumers, who expect high-quality video and audio on their viewing devices, as well as an extensive choice of programs available on demand.

Broadcasters need to invest in order to maintain or increase their audience and revenue, as well as take advantage of the new opportunities that HD creates. Usually, existing SD services, archive material and legacy devices all need to be included in the design of new HD systems.

The trend for system design is starting to move away from 1.5Gb/s (1080i) systems toward 3Gb/s (1080p) systems as broadcasters have an eye on the future for systems compatible with 3Gb/s. When equipment is not 3Gb/s capable, broadcasters generally create a roadmap to achieve 3Gb/s. This demand is aided by the decreasing costs of 3Gb/s infrastructure. Stations undertaking a significant refresh with a project tend to favor going straight for 3Gb/s, even if it's not a production requirement today, as it is likely to be more cost-effective. That being the case, it's probably better to install the basic cabling and routing infrastructure now and exchange the hardware later.

As SDI data rates have increased to achieve 1080i and 1080p formats, the physical limitations of copper cable infrastructure have affected the design of the buildings themselves, including cable tray routes and lengths. Liaison with construction partners at an early stage helps to define appropriate applications for fiber links and avoids surprises during the pressured on-site build stage.

Understanding the workflow

In addition to the detailed technical design, defining and understanding the required workflow is a key factor that must be established at the beginning. Allocating time and resource to the workshops needed to define these workflows may often be overlooked, leading to the process being rushed through. Defining the requirements at an early stage will ensure vendors provide products that best fit. A professional systems integrator must be rigorous about confirming that its suppliers can meet delivery promises. This is often done by insisting on a real-world demonstration — no smoke and mirrors — of the specific workflow, making sure there is a minimum or preferably no further product development required as a result. No one likes to be part of a science project with a deadline.

When moving to HD infrastructures, broadcasters are often looking to reduce operational overheads and automate many stages of the production environment. Automation is no longer the preserve of transmission playout systems, but is equally applicable to HD studios. Recent studio projects have included automatic assignment of facilities at the push of a button. One example is production control room changeover. This allows, within seconds, different studio control rooms to be switched to control different studios. This has many other uses, including routing in the event of equipment failure or for flexibility of operations. Another example is management of the allocation of broadcast resources in the newsroom. Technical facilities available in any overall system can be automatically allocated, configured and set up by an automation system, with the benefit of increasing operational flexibility.

Audio challenges

MediaCity UK is a large project for a purpose-built media center that will house five BBC departments.

While the high-bandwidth requirements of HD video present a challenge, audio provides an equal challenge, despite its vastly lower data rates. A greatly enhanced audio experience for end users is absolutely core to the design of HD systems. Multichannel audio has its own system design implications; phasing and processing are key, as is handling multiple languages, audio description and alternative audio mixes.

To some extent, audio infrastructures have become simpler, in part due to the prevalence of embedded audio transport and MADI trunking (console to communications [talkback or intercom], router to console etc.). AES audio is routinely used for local connectivity within control suites and apparatus rooms. However, analog audio is still used between the microphone and amplifier, console and loudspeaker, and as a method of I/O connectivity by some brands of intercom systems and RF components. The extensive use of analog audio seems consigned to history, and the previous examples can all be connected digitally depending on the model of product used.

The density of wiring frames, jackfields and termination panels is also dissipating for the reasons described, but the technology and processes required to deliver audio and the skills involved in production have increased exponentially, despite a diminishing pool of trained personnel.

Fiber infrastructure cabling is not as necessary in audio systems as it may be in video because of the relatively low bandwidth. Many products offer the alternative of copper connectivity (coax for MADI, Cat 5/6 for audio networks) for shorter run lengths, with fiber an option for longer applications.

Sound control rooms are routinely equipped with large-scale digital assignable mixing consoles, and provision for the location of Dolby 5.1 loudspeaker systems has become the norm. Careful placement of surround speakers to ITU recommendations are often compromised by the physical restrictions of the listening environment and the location of vision monitoring equipment. For an integrator, this might mean the use of elaborate ceiling truss systems to optimize the location of surround speakers and customized monitor stack assemblies for center channel positioning.

Computer networks

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A crucial aspect of any HD system is the design of the LAN and IT networking infrastructure. The increase in HD data rates in a file-based system has encouraged integrators to invest strongly in in-house IT networking expertise. Time spent in network and storage design is repaid, as the time taken for complex faultfinding is dramatically reduced. The nature of faults can sometimes be unpredictable due to incorrect network and storage design and configuration. This can damage user confidence in the critical early days of operating with a new system.

All media file movements take place over the network, from ingest to transmission, and maintaining the many workflows in between. The deployment of multichannel HD systems, using formats such as DVC-PRO100 and IMX-50, with supporting workflows, demands high throughput, high availability and low latency from the network infrastructure.

Traditional corporate LAN and network design methodologies are of limited use for deploying such networks. The capacity required of a network supporting such a multichannel HD infrastructure can be considered similar to that of a medium-sized service provider's infrastructure. 10GigE technologies are usual for such core networks, with optical WAN speeds of up to 40Gb/s deployed where facilities are split over a multiple locations. Such high capacities are required to support channels' complex workflows, where file transfers over the network must reliably operate at several times real-time speed.

The availability of such networks must also equal that of the rest of the system. High availability platforms, with features such as redundant controllers and power supplies, are used throughout, and routing and LAN protocols are tuned to provide extremely fast network reconvergence in the event of equipment or link failure.

System security

Television New Zealand (TVNZ) has recently undertaken four major projects at its Auckland base, including a digital upgrade to MCR, news production and control rooms.

Such systems' networks are not completely isolated from the outside world, and security requirements must be taken into account, with protection integrated into the complete solution. As file-based import into such systems becomes more common, and the requirement for inclusion of such features as user-generated content increases, network traffic inspection and mitigation tools are required to protect the environment from malware or computer viruses that could be contained in that media.

Similarly, a level of network security is required to prevent content and media from being stolen from the environment. Such solutions have evolved with the demands of a modern HD production facility and continue to do so to keep pace with the traffic, user and security features, and functionality required of such a solution.

Other decisions that need to be considered when building an HD system include:

- Does the output have to be in SD as well as HD? Careful planning is required if it is, especially around graphics if SD/HD simulcast is required. Some channels may be suitable for simple downconversion, but many will require full parallel SD and HD playout chains, which will inevitably have major cost implications.
- What is the policy on SD material? Is it prohibited or permitted after upconversion? How much does the client wish to spend on upconversion, given that money equals quality? Is the SD material to be converted on ingest or on playout? If all material is upconverted on ingest, this will lead to greater storage and transfer times, but it may result in a higher quality output as a better upconverter can be used. However, what quality is appropriate for the target market?
- Which codec is to be used? This can be a complex choice based on storage requirements, editing requirements, the number of audio channels and the capabilities of major subsystems. It is often better to avoid transcoding, as this improves system throughput and eases workflow issues.
- Is the chosen codec compatible with the editing platform or can it be handled via a plug-in, for instance? Again, avoiding transcoding is often desirable.
- How many audio channels need to be supported? The number of audio channels required can be a key factor as there are still vendors who support only eight channels of audio, which is unlikely to be adequate for many broadcast channels. This may also drive the choice of codec format, as not all codecs support 16 channels.
- The choice of captioning format and where in the chain it is to be inserted needs to be considered, especially where there are both HD and SD domains.
- Finally, the move to 3-D has been made easier with HD being used, as 3-D sits comfortably within an HD environment, albeit with a reduced resolution.

Most technological developments, including HD, bring great advantages to the end users, though from a system design viewpoint, increased challenges. Despite the advantages to the broadcaster and end user, the design of an HD system is not for the fainthearted.

David Phillips is managing director at TSL.