White Paper for Media Industry

Broadcast Media Management in a Data-Centric Workflow

Greg Doyle

Abstract

The television industry is again in a state of change and renewal. But this time it is not changing to simply accommodate new production formats or transmission standards (e.g., HDTV, ATSC) but is undergoing a complete change in fundamental workflow. Driven by the leveraging of information technology advances to the needs of broadcasters, the connection of previously incompatible video-centric islands of equipment in facilities is transitioning to a more cost-effective workflow that is wholly data-centric and based on open standards. In this new faster than real-time dataflow, information technologies are allowing the automation of tedious tasks and encouraging creative collaboration. Video and audio in their original form are only present at the point of original ingest and later at the point of transmission, although uniquely, multi-format copies and metadata are available at all times in all locations. In this environment, a heterogeneous filesystem allows true file sharing across the facility and enables a new level of finding and sharing recent and archival material under the control of media management software. Clever implementation of these systems allows existing video compression formats and legacy hardware to seamlessly co-exist with equipment built to new and emerging standards. This paper identifies the main components of this changed workflow and shows how it has been deployed by SGI in the real world of television. The examples are drawn from news broadcasting workflows in various sites, but this level of media management, open shared filesystems, and IT storage and networking architectures is beginning to enable similar cost efficiencies and workflow improvements across all aspects of production and broadcasting.

1.0 Background – Format Wars

In the past, we experienced the "format wars" between VTR manufacturers over incompatible tape sizes and scan formats. These wars continue even today and create a major problem in recovering increasingly valuable footage from videotape archives. The choice of the main VTR format significantly impacted the broadcaster's operational methods and workflows, influencing program and commercial distribution, satellite ingest, electronic news gathering, in-house program production, editing, and finally the playback of program material and insertion of commercials or promos. The commitment to a format was, by its nature, long-term. It bound the broadcaster to a format and manufacturer and, in some cases, limited technical and operational options available in competitive devices not supported by that manufacturer. Broadcast facilities grew up around these video "boxes" and their controlling devices, with connectivity limited to real-time video/audio routing or physical tape copying and transfers from machine to machine with resultant quality loss. Information about the content and context of the tape (i.e., metadata) was limited to tape labels, shot logs, running sheets, and, in some cases, a basic library database.

The advent of video servers, especially for commercial replay and news, greatly improved reliability and repetitive access to media. In some cases, notably news and sports, it freed the broadcaster from some of the VTR format constraints. However, in replacing VTRs for many applications, the broadcaster essentially replaced analog devices with "islands" of digital devices, which perpetuated another type of incompatibility, that of file incompatibility. Manufacturers initially released video servers with built-in Motion-JPEG codecs incompatible with the later DVCPRO and MPEG2 codecs. But worse still, most video servers with the same compression format even today produce incompatible files, due to the proprietary nature of the filesystems employed by these devices. This made it impossible to exchange files between servers from different vendors. In the end, this is inefficient, because a true end-to-end workflow could not be achieved in the facility. No reliance could be placed on the efficient integration of legacy equipment, and, just like the conversion of media between tape formats, video could only be transferred between filesystems by real-time playback and rerecord to the destination filesystem. This continued to constrain efficiency, time to air,

and quality. Work within SMPTE for several years has attempted to address this well-known issue of lack of file interoperability.

2.0 SMPTE Current and Proposed Standards

Industry pressure to achieve practical format interchange for general use with video servers has led to the development of SMPTE 360M-General Exchange Format (GXF). This current standard accommodates Motion-JPEG, DVCPRO, and MPEG with metadata. It has had some deployment in broadcast but does not take legacy hardware into account. The pro-MPEG forum has taken up similar concepts and SMPTE standards work has evolved on this proposal, which has evolved into the new Material Exchange Format (MXF) open-file standard. It seems likely this more comprehensive standard will be adopted and gain wider acceptance. Broadcasters in Europe are already asking for MXF format compatibility. SGI has delivered MXF input and playout capabilities in its SGI Media Server for broadcast video server to broadcasters in Germany, France, and the Czech Republic. This will allow the finished file to carry metadata including edit decision list information with the media starting at the production level. MXF is also better prepared to accommodate new and yet-to-be-deployed compression schemes. But again, this will only address new, compliant equipment.

What is needed is a solution that solves the problems of today without major disruption, yet allows for a smooth transition to the standards and operations of the future, accommodating them seamlessly. This is possible through the adoption of a data-centric approach with a SAN-based heterogeneous filesystem. Many of the prime objectives of MXF compliance are already achievable today, in part or whole, through the use of a proven filesystem that does not require users to conform existing equipment to new standards. Rather, this system accommodates the existing hardware platforms and their different filesystems. In addition, a data-centric approach will accommodate the new MXF standard as it is deployed.

An effective dataflow already enables significant facility-wide advantages vis-à-vis the objectives of MXF today (text in italics from the stated goals for MXF):

- **Cross-platform network interoperability:** Prior to MXF compliance, a dataflow already "*works with all main network protocols, including Ethernet, Gigabit Ethernet, Fibre Channel, GSN®, HIPPI, and ATM (OC3, OC12, and OC48). It also works with the key operating systems used in broadcast today: Microsoft® Windows®, SGI® IRIX®, Linux®, Mac OS® X.*", and *Sun™ Solaris™*.
- **Compression independence:** Prior to MXF compliance, it "*does not need to convert between compression formats; it does make managing more than one format in a single environment easier. It does handle uncompressed video*."

  Additionally, (outside MXF objectives) a dataflow actually facilitates compression transcoding or format conversion and storage with automated FTP transfers as required, e.g., proprietary graphics sent to video servers for replay. And a dataflow can easily handle uncompressed HD video rates.
- **Streaming/transfer bridging:** Prior to MXF compliance, "*it will manage the ingest of all legacy video/audio formats (A/D conversion to SDI required), including SDI and SDTI but with manual metadata entry. It already provides a capability to view incoming data during ingest/transfer as a live "E to E" SDI loop through. In addition, with ingest to modern servers, a low-resolution copy is viewable and editable at enabled desktops around the facility, with less than a 20-second latency from frame 1.*"

  With MXF compliance in future, "*it will operate seamlessly with streaming media-especially SDTI, where fully transparent interchange is achieved. Once end-to-end MXF compliance is achieved, this interchange will be bi-directional between MXF and streaming video.*

3.0 Broadcast Business Issues

For many people, personal experience and the division between the video and IT worlds have

meant that much of our thinking to date has been conditioned by a traditional "video-centric" approach. However, by looking past the day-to-day issues of managing operations between video-connected black boxes or between islands of equipment (library, production, news, master control, and presentation), we can now see more cost-effective ways of addressing some underlying business issues, using low-cost standard IT components.

These include evolving a more efficient and timely end-to-end workflow, sharing file access for collaboration regardless of location, simplifying integration of legacy and new equipment, introducing cost- and space-effective media archiving, and improving staff performance and satisfaction.

Generating revenue from valuable sound, film, and videotape archives is another prime business issue for many larger broadcasters. These archives require large amounts of valuable space, are often deployed inconveniently on multiple sites, in some cases are deteriorating rapidly, and are generally accessed only through cumbersome ad hoc content management systems.

Managing "dataflow" at faster than real time will achieve these objectives and will allow for any future standards to be more simply adopted.

Mounting competitive pressures mean that speed to air through improved workflow, program presentation quality, and revenue-generation on assets with a high focus on the best return on investment are the key benchmarks. A data-centric approach clearly gives competitive advantages and new opportunities.

4.0 The Data-Centric Approach—Distribute Data, View Video

This section describes an end-to-end workflow that is data-centric from the time of ingest until actual transmission, using as an example one of the most critical of all broadcast applications, news. However, it is important to note that the benefits apply equally to all aspects of broadcast production and operations.

The success of a data-centric approach relies on using a high-bandwidth server for simultaneous network and SDI or SDTI ingests, with high-speed connectivity providing faster than real-time file transfers between a central archive and all servers. For quality and workflow reasons, once the video is ingested and stored as a file, it is maintained digitally with all metadata, even through editing, until final distribution or play-to-air. Managing video as data also allows the adoption of consistent human interfaces across systems. This is accomplished by leveraging a combination of open systems such as HTML and Java™ combined with a growing choice of applications across all the stages of the broadcast workflow. It tends to simplify media management within the operation. It improves efficiency, personal productivity, and satisfaction. It reduces the complexity and cost of operations.

These primary broadcast workflow stages are described:

- Ingest
- Central Storage and Archiving
- Editing
- Playout

5.0 Ingest

Whether into a video-centric or data-centric model, media arrives on from a variety of sources: videotape, live feeds, satellite and microwave links, and telco circuits via FTP.

5.1 FTP Ingest and Contribution

Currently, point-to-point FTP transfers over telco circuits or facility cabling are mostly reconverted to video on receipt, typically SDI, for routing and reuse. This is a typical video-centric model where even in the presence of video servers and extensive news facilities, ever larger routing switchers and SDI video connectivity play a key role.

A data-centric approach maintains all FTP file ingests in their original form through the station, eliminating re-conversion to and from SDI, re-recording, or format conversion to maintain original quality. To deal with existing transmission methods, legacy equipment, and

formats, a provision is made to accept any SDI and SDTI signals inputs (with embedded or separate audio) and convert them to data for storage on a scalable central archive.

Regardless of the ingest method or original format, the key to simplifying ingest operations is to make the application available on the desktop with a consistently friendly HTML-based user interface, with access according to staff functions and authorizations. This allows complete freedom to arrange operational areas, irrespective of technical equipment location or operational complexity, and introduces a high level of error-free automation in these repetitive tasks.

Figure 1 shows Swedish national broadcaster – SVT's eleven news bureaus, spread around Sweden in major cities and connected via a cost-effective telco WAN.

SVT realized significant annual savings by replacing the satellite transmission of video/audio between bureaus with a completely data-centric, telco-connected alternative. All bureaus can locally ingest—i.e., convert video/audio to data files—and, through high-speed FTP transfers, send edited or raw data files to the central archive for national news production.

Operators are alerted to the receipt of a file in the central archive and are prompted to the metadata field for data entry, starting the media management process. In the time-critical news environment, the faster than real-time FTP transfers and the fact editing can proceed while the file is still being ingested, which provides significant advantages and improves ROI.

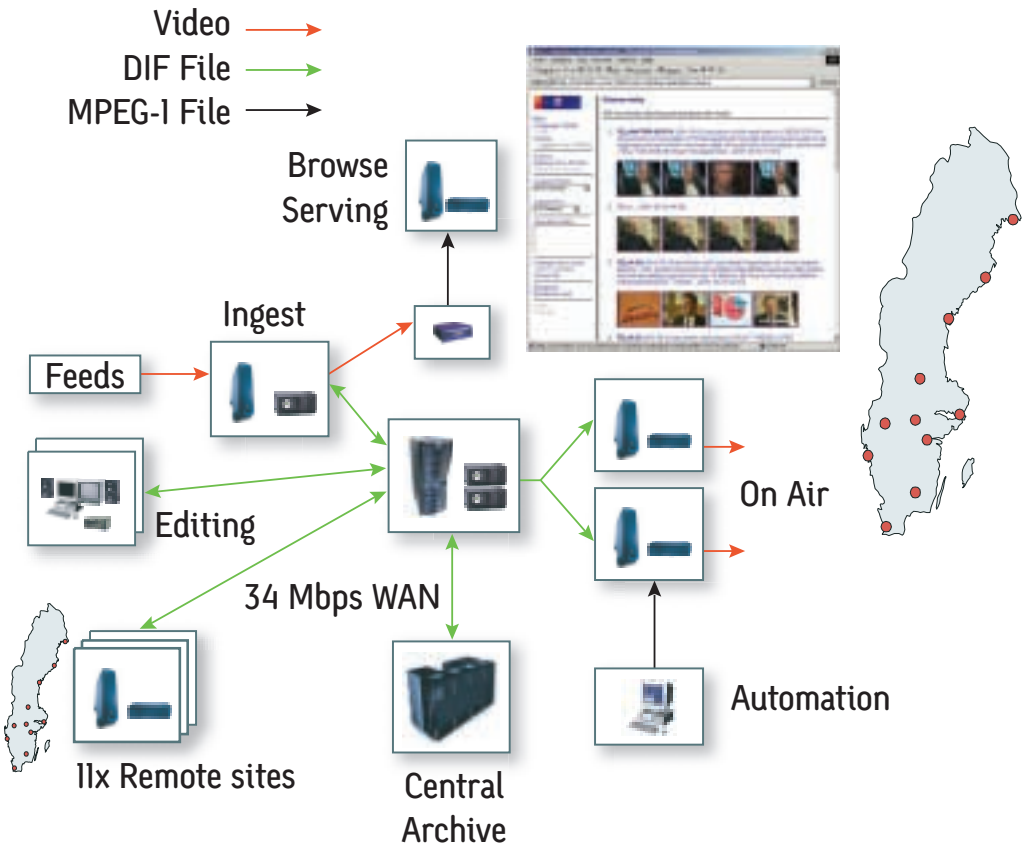

Fig. 1. System block diagram and major points on SVT wide-area-network. Contribution material is FTP'd between SGI Media Servers™ for broadcast at each site

5.2 Live Feed and Videotape Ingest

The Ardendo™ Digital Automated Record Tool (DART), which is enabled on selected desktops at SVT-Sweden, is a tool that performs unattended automated scheduled ingest and manual one-touch hot-key recording from pre-selected sources, with automated routing to user-selected server inputs. DART and its successor ARDOME provide login access and user-password-controlled permissions to access levels of the media management operation.

On the screen depicted in figure 2, the hot keys (Eurovision, Reuters, etc.) are shown at the top of the screen. Selecting these keys at authorized desktops initiates an immediate signal routing and ingest start to the server. Live sources and VTRs with RS-232 deck control can also be accommodated on these keys. The blocks (Channel A, etc.) to the left of the screen represent sources currently selected to the inputs of a respective server or servers. These are automatically rerouted when new sources are selected.

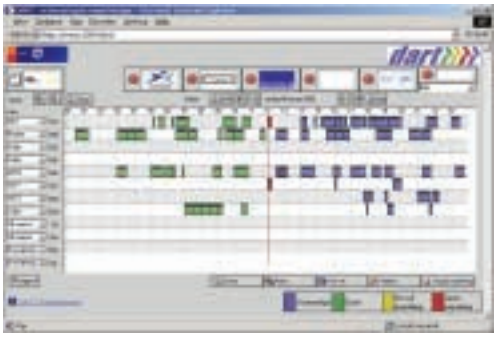

Fig. 2. The Ardendo™ Digital Automated Record Tool (DART) user interface used to control SGI Media Servers™ for broadcast at SVT and Danish Broadcasting.

Authorized desktops can also prepare schedules for automated, unattended operation and edit at the same at any time. In figure 2, the red line at center screen represents current time, while the green blocks to the left of the line represent ingests performed as scheduled or manually taken against the time line. Blue blocks represent scheduled ingests not yet performed.

To prepare for ingest, the operator invokes a new basic metadata entry to identify the new clip. Typically this would be done at the time of preparation for the scheduled automated ingest. Note that this multichannel automated ingest is not under control of the main station automation, but runs under the Ardendo™ application, which also manages all file routing from ingest to storage to play-to-air.

5.3 Newswire Ingest and MOS Protocol

The basic news service feeds ingesting to systems from ENPS, iNews, and Autocue have long been part of the broadcast news islands, providing a wire service data ingest and desktop text editing capability, with the output linked to prompter facilities. The integration of these systems with usually dedicated news video servers using MOS protocol provides a useful extension of the basic editing capability by allowing desktop browsing of the video server files and MOS links to the on-air automation. In a data-centric approach, it is now possible to extend the capability of these news systems with more extensive metadata and archive file access and, importantly, extend those facilities to all uses of the station facilities, whether located on-site or remotely.

5.4 Expanding the News System Capability

Using the same news desktop stations with an additional software application enables a more comprehensive and station-wide desktop capability, especially when linked to editing systems and graphics systems accessing content directly from the central archive storage. As typified in the case of the national news network SVT, this provides a truly comprehensive media management solution for browsing data and managing files to and from all 35 servers in the 11 cities around its LAN/WAN network. In addition, it allows access to all archived material stored online or near-line and gives a browsing and editing capability, regardless of file or user location. This capability, based on software from the Swedish supplier Ardendo with facilities linked to an Avid Technology news system and vizrt graphics, has been in use at SVT since 2001.

The improved dataflow resulting from this approach involves relatively modest capital outlay easily recovered, even in low-labor-cost economies, by the labor savings and improvements in station speed to air as well as on-air presentation and technical quality.

6.0 Central Storage and Archiving

Increased disk drive capacity and smaller form factor have resulted in a lower cost per megabyte and reduced physical size for a central digital storage system. This, with the improvements in cost and performance of networking components, has brought large IT-based storage and media management systems within reach of all operators. Full broadcast-style redundancy and unprecedented levels of scalability are easily achieved.

A data-centric broadcast storage area network (SAN) central storage archive integrates:

- A filesystem able to manage large quantities of the huge files typical of media facilities
- Media management software to provide global access to metadata and content
- Hard-disk-based online storage
- Data tape near-line storage
- Hierarchical storage management (HSM) software for bi-directional data migration
- High-bandwidth network connectivity

Note that most broadcast applications ideally require file and OS independence, due mainly to legacy equipment, so a heterogeneous filesystem is required to manage global storage and archiving needs.

6.1 Filesystems

Filesystems typically constrain the storage and movement of digital content in a broadcast facility. The filesystem is perhaps the most critical component of a digital infrastructure. A robust, 64-bit, journaled and shared filesystem is needed. This type of filesystem enables unlimited media accumulation, flexible storage options, leading-edge network bandwidth choices, true file sharing, consistent uptime, and, lastly, rapid recovery. The SGI® CXFS™ shared filesystem meets all these criteria and is beginning to transform the broadcast workflow in national and regional broadcast network environments. The CXFS filesystem can scale massively to hold 18 million terabytes of digital media. That's 2,400 years of 50Mb broadcast material.

But typical SANs operate in a homogeneous environment where the SAN must be partitioned to accommodate duplicate copies, one for each supported operating system. This wastes storage capacity, typically reducing it to one-half or one-third its size. This makes storage much more expensive, and the time needed to copy files within the SAN reduces the efficiency of the workflow

The newer, heterogeneous CXFS filesystem adds the capability of sharing the filesystem and storage directly with multiple SAN-attached client hardware and operating systems, including SGI IRIX, Windows NT®, Windows® 2000, Sun Solaris, Linux and, in the future, Mac OS X. This shared filesystem is the key that unlocks the full potential of the storage area network—permitting workflows and collaboration in a media facility that fosters speed, efficiency, creativity, and client satisfaction. Most importantly, it opens the attached client systems of the SAN to multiple vendors' solutions.

6.2 Media Management

In a heterogeneous SAN, typically only one original file needs to be stored, because this type of SAN enables true file sharing. Eliminating the need for multiple copies of files greatly simplifies the media management problem. All media, regardless of final application, can now be ingested and stored once and can be readily located via the media management system. The media management system enables tracking of the original and any low-resolution copies in the archive and around the station's WAN network. The system also enables the immediate relocation of files, as well as high-speed transfer, if required.

Local and remote desktop workstation access to metadata and viewing of thumbnail clips help users identify relevant portions of any

media, and, if required, the clip can be replayed in part or in whole at the desktop. In the past, producers, journalists, and editors had to search a videotape library system, pull likely tapes from the library, and then review log sheets and view tapes at a viewing station. With a media-management-enabled dataflow, they can now perform metadata searches via the media management system.

6.3 Example Deployment: Georgia Public Broadcasting

An example of a full digital workflow incorporating media management is being implemented at Georgia Public Broadcasting, in Atlanta, Georgia. Under the control of Harris Automation and Masstech media management system, the four-channel national program feed of the American PBS network is directly ingested as MPTS, along with the ingest of SDI contribution material from other satellites, live sources, and videotape. Provision is made to encode SMPTE 292M (HD), conforming finished programs from HD sources, encoding HD to DVB/ASI for storage and subsequent back-to-back HD replay.

SDI-based contribution material is passed via a Virage® logger under Masstech control to provide metadata and keyframes for media management and subsequent low-resolution browsing and editing over the LAN. The resulting media is stored on SGI CXFS, allowing complete integration with a nonlinear editing system based on Avid Unity™, the streaming of multiresolution copies, and the inclusion of data sources. Edited program material is stored on the SAN until it is forwarded to the redundant on-air servers under Masstech and Harris control.

On replay, Harris Automation controls an SGI® Origin® 300 video server for HDTV service and controls a redundant SGI Media Server for broadcast MPEG2 video servers to provide the additional standard-definition (SD) channels and embedded data services. The video output from these video servers is encoded to DVB/ASI for multiplexing and final transmission.

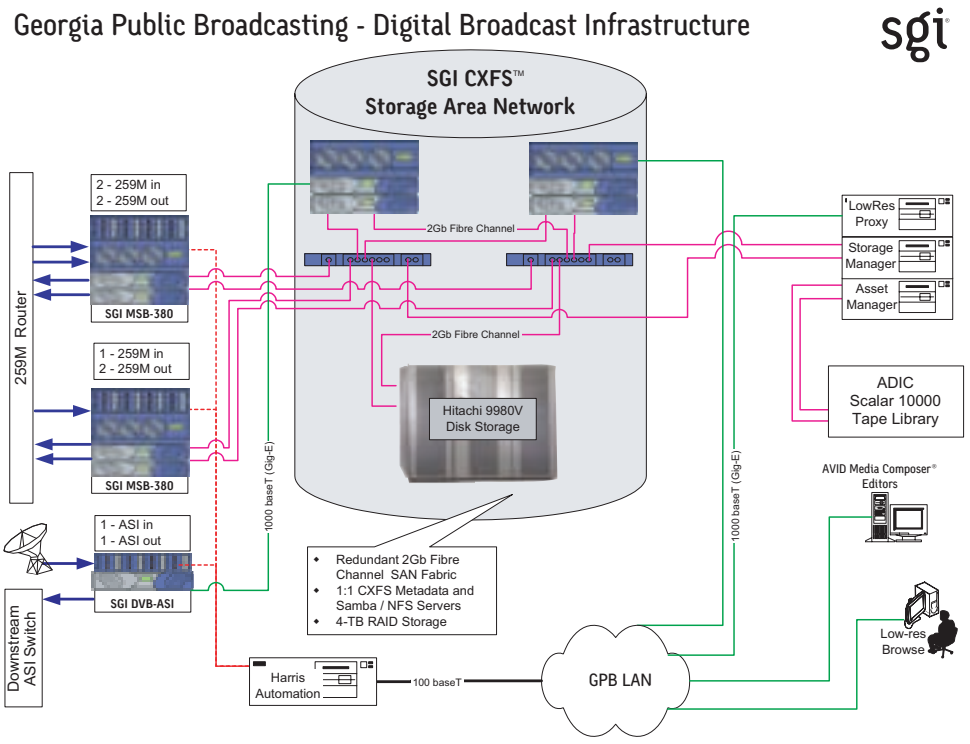

Fig. 3. SGI InfiniteStorage™ at Georgia Public Broadcasting. Video and data routing is balanced to provide optimal media management

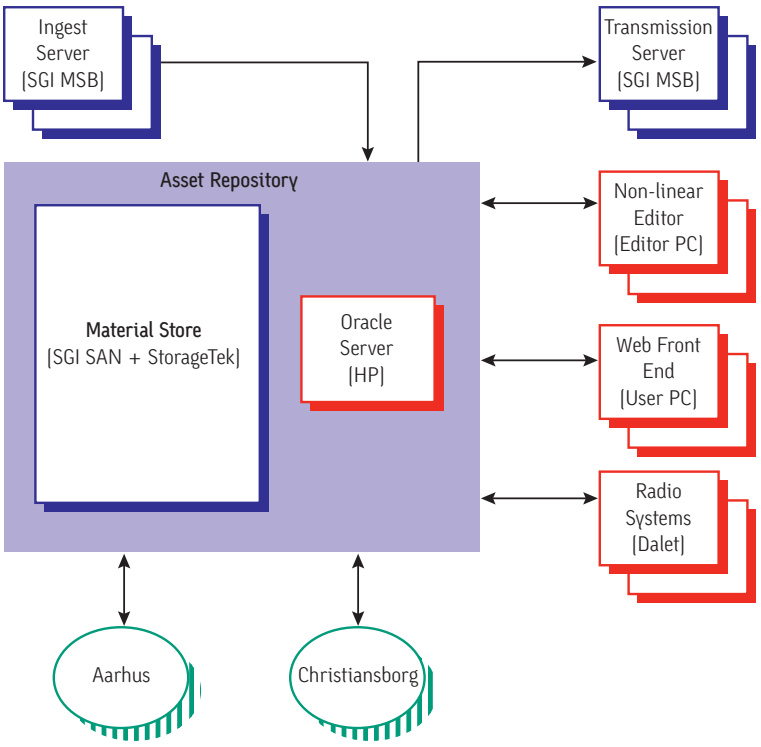

Fig 4. Shows how an SGI broadcast dataflow is to be implemented over two cities by Danish Broadcasting—for TV news, in the TV sports department, and finally in radio operations—using DALET's radio automation. The custom Web front end on the user PC provides for Ardendo and other PC-based applications.

6.4 Danish Broadcasting

A typical system with media management in a heterogeneous SAN environment is being installed at the Danish Broadcasting (DR) after the success of a trial system over 12 months in 1999 and 2000. This typifies the media management capability of the approach.

Figure 5 shows a typical configurable HTML-based desktop screen with tabs for asset metadata searches, browse/editing, monitoring, ingest control and filesystem (ingest servers, playout servers, and archive) directory/file access.

Note the availability of metadata and thumbnail clips based on scene-change detection or selected time intervals and the status bar for FTP transfer monitoring. The single line metadata header provides basic information on media capability for browsing, listening (audio clips), or document viewing, as well as the date and duration of recording. Clicking on the metadata header information provides access to all metadata fields, including wire service details. The layout and criteria for searching can be customized.

Fig. 5. A configurable HTML screen enables ingest control, media management, and browse editing at Danish Broadcasting

6.5 Hybrid Storage Strategies

Figure 6 shows the main elements of Danish Broadcasting hard disk and data tape storage infrastructure in the heterogeneous SAN, the levels of networking, and the integration of news terminals, graphics stations, and NLEs with ingest and playout video servers.

SANs are networked infrastructures designed to provide a flexible, high-performance, and highly scalable storage environment, optimized for the efficient transfer of block data, which is critically important for media tasks. They are often used in combination with other types of storage. For example, some broadcasters may prefer dedicated direct-attach storage for on-air server storage with a SAN. In this system, scalable and redundant servers linked with FailSafe™ software provide surety of continuous access to 2TB of dual-protected RAID storage, with 2Gb Fibre Channel connectivity to allow for up to 25x real-time provisioning. SAN client access is provided over a separate 1Gb network. These external RAID storage systems are modular. They can be installed in direct-attached or network-attached (NAS) architectures and later can be added to (hot scalable) and even re-configured into shared storage SAN architectures. The redundant metadata servers used in the SGI CXFS Shared SAN can also support the very large I/O speed and connectivity needed. The metadata servers can also run the hierarchical storage management (HSM) software required to seamlessly migrate the files to near-line storage.

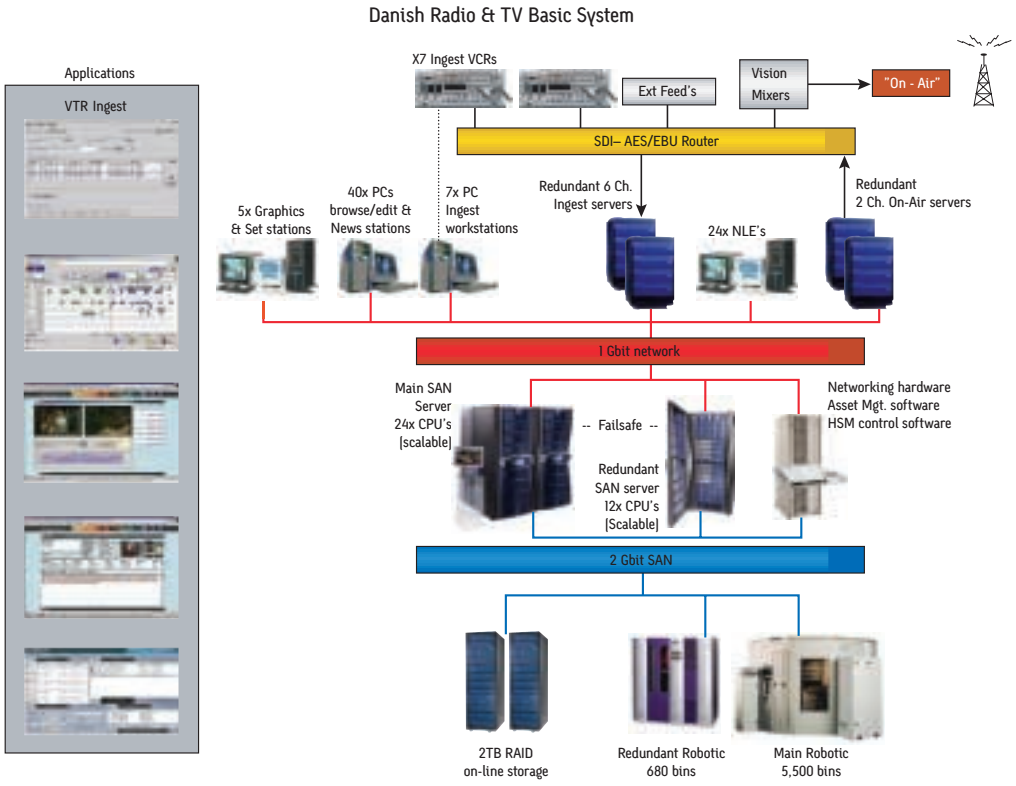

Fig. 6. Danish Radio & TV Basic System: Multiple networks are deployed to efficiently balance video distribution and control, data file sharing, and high-speed storage migration.

6.6 Data Tape Archive

In the Danish Broadcasting architecture, a robotic tape system and a backup unit are part of the SAN environment and are arranged for full redundancy. The use of data tape provides secure high-density storage and enables the broadcaster's entire media archive to be fully integrated with the production workflow under the control of the media management system. For example, 60,000 hours of content can be stored in a data robot system that consumes less than 50 square feet of building space yet offers practical access times measured in minutes. Danish Broadcasting chose StorageTek® data tape robots, but devices from ADIC, Sony, IBM (used at SVT Sweden), and Panasonic are also widely used. These choices exemplify the benefits of an open IT architecture.

A data-centric approach to access and storage offers significant ongoing cost savings and efficiencies. Archiving media in data robotics enables loss-less, faster than real-time background transfers, consistent metadata maintenance, quality preservation, and full automation. Conversely, maintaining videotape archives is costly and inefficient in space utilization, means a continuing loss of quality between videotape generations, and requires manual metadata updating. Format changes can only be made manually in a real-time replay/copy operation from the old format to the new. Initial conversion of existing videotape archives to automated data archives, while time-consuming, is a once-only manual process that can be accommodated simultaneously with the next play-to-air of an archived item or part thereof, or as a separate dedicated archive conversion project.

6.7 Hierarchical Storage Management

Broadcast facilities already generate and manage massive amounts of media, now stored mainly on videotape, especially where long-term archiving and post-production is involved. To optimize workflow throughout the facility, this needs to be transitioned cost-effectively to compressed data storage while still maintaining immediate access and full transparency.

Typically, media content is time-sensitive. While the data files are being used for current production, it is important to keep them online, but storing them indefinitely on the fastest disk drives generally isn't possible or economical. Eventually, the data needs to be moved to less expensive solutions, either slower disks or data tape.

At Danish Broadcasting, the SGI® Data Migration facility (DMF) is used within the SAN to migrate data from online disks to near-line data tape and back again—all without operator intervention and all based on migration rules that the DR dictates. While the data may move, it always remains available within a few minutes, even off data tape, and always appears online to the user, because the file information is maintained in the SAN metadata server. This is especially effective in news operations that require the archiving and reuse of content and in program production where material is being accumulated over time.

6.8 SAN Speed and Network Connectivity

It is critical to have SAN speed and network connectivity to support the high-speed delivery of media. In newer sites like Danish Broadcasting, this is accommodated in 1Gb-per-second Fibre Channel network conduits and in 2Gb-per-second Fibre Channel connections to storage. Switchable Gigabit/100BaseT is also used. FTP transfer quality is never compromised because of limited bandwidth. Only the speed of the transfer is dictated by the bandwidth of the network. As a benchmark, note that practical FTP throughput to SGI Media Server for broadcast video servers over Fibre Channel out of a CXFS shared SAN is roughly 25 times faster than real time. This means that the MSB can be provisioned with a 30-minute program (of 25Mb material) in just over one minute. A 90-second news story will transfer in less than four seconds. This makes last-minute changes literally possible.

7.0 Editing

Due to time constraints, much of the editing in a traditional news environment is based on simple processes, relying on cuts between

scenes with a facility for commentary to be added, usually in an editing booth. This basic editing process is already accommodated in common practice, based on videotape editing or by the newer browse/editing systems using proxy copies. Some of these systems provide department-based storage, but seldom data archiving.

7.1 Editing with Shared Files

Adding global media management in a shared SAN environment adds a metadata search-and-browse capability to access archived footage and graphics and extends these facilities to the field using open wide area network standards.

The integration of nonlinear editors, virtual sets, and graphics systems on the same SAN further improves collaboration and workflow, allowing more timely control and improved presentation.

These same benefits can be cost-effectively applied throughout all operational areas in the broadcast facility without compromising the integrity, work processes, layout, or autonomy of any operational area on the station.

For a dual TV and radio facility spread over two cities, this is an interesting illustration of how the open architecture provided by an IT-based system supports multiple file formats, different operating systems, and two totally different production and transmission needs.

7.2 Desktop Editing and NLEs

The desktop editing application also loaded on the journalist's PC is an evolution of the Ardendo™ EasyCut system used at SVT Sweden, which provides for asset browsing, cut editing, and four-channel audio editing. Rough-cut stories are conformed nondestructively in broadcast resolution. They are then stored for additional graphics or special effects editing and eventual play-to-air.

In case of late-breaking news or other urgent needs, the finished clip may be sent immediately from the desktop application to the on-air servers.

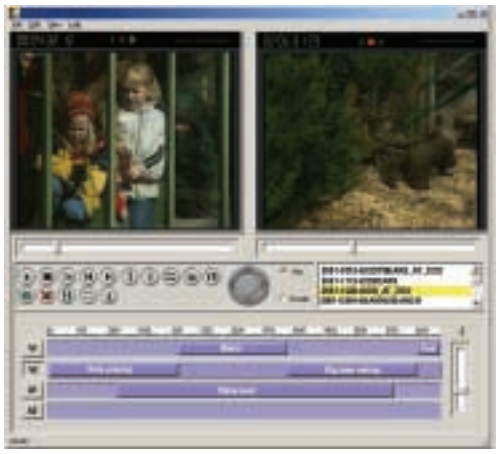

Fig. 7. The desktop editing application also loaded on the journalist's PC is an evolution of the Ardendo™ EasyCut system used at SVT Sweden.

Using the folder/file search facilities on the desktop, users locate the current clip folder for new media or, if archive material is required, they search the archive via the media management system as described and select the appropriate clips.

Browsing the current or archived media allows viewing of thumbnail storyboards; the clips can be played in real time or jogged and shuttled. The portions of the clips required are selected during replay by marking in and out points on the fly or entering time codes as preferred. Once selected, the segments are added to a virtual-clip list. These clips may be played down seamlessly at any time and trimmed as needed, adding voice-overs if required, until the final result is obtained.

The composite proxy file generated is then used to conform a high-resolution version, which is stored back to the SAN for any additional edit work prior to final review and release for playout. The Ardendo media management element manages the availability of the finished file for transfer to playout, monitoring the needs of the TV automation schedule or the news rundown list. For manual override, clicking on the "transmit" hot key initiates sending the edited high-resolution file directly to playout in urgent cases.

8.0 Playout: Third-Generation Video Servers

The current second-generation video servers, with their traditional problems of file incompatibility, restricted network interface speeds, and limited internal bandwidth and storage, have perpetuated the video-centric black-box approach. These issues have now been addressed in practical deployments in broadcast for about 12 months, based on the use of proven IT technologies. Specifically, they are addressed with either a fully redundant heterogeneous SAN or NAS with the use of newer generation servers with the required network connectivity for WAN and telco deployment, and the internal bandwidth to manage the simultaneous LAN and SDI/SDTI ingest with multichannel playout. These types of video servers are necessary not only at the playout level, but are also required at the point of ingest to avoid a weak link in the end-to-end workflow.

Increasing demands on the broadcaster from multiformat digital transmission, increasing channel count, data casting requirements, and central casting need to be met by innovation and a lowering of overall facility cost-of-ownership.

Current systems and workflows in many cases cannot cope with the new demands without increasing labor costs or compromising results in one area or another. It's time to change by adding the new multiformat, multichannel capability in the playout and distribution area with a new automation of workflow and playout, based on a transition to a data-centric environment.

9.0 Summary

Experience in advanced facilities has shown us that in this era of rebuilding, now is the time for change to an effective dataflow, a dataflow characterized by the leveraging of open standards and the latest in information technology advances. This dataflow is clearly better equipped to reliably handle today's tasks, manage the transition to digital and the new standards and operations of tomorrow, and better prepare the facility for the long term. Collaboration with colleagues and supplier partners who have the essential IT and video experience is needed to ensure the optimum return on investment.

10.0 Acknowledgements

The author gratefully acknowledges the contribution of his colleagues and supplier partners to this paper, in particular:

- Bill Buhro, Systems Architect, SGI, USA
- Gert Hansen, SGI Denmark
- John Foster, SGI Professional Services, U.K.
- Jason Danielson, SGI Director of Media Industries, Mountain View, California
- Jonas Engstrom, Ardendo, Sweden
- Mogens Rasmussen, SGI Denmark

MXF references: In particular the stated objectives of Pro-MPEG and MXF are extracted from the paper for FACTS (Australia) 2002.doc titled The Material eXchange Format, presented by Bruce Devlin of Snell & Wilcox-UK during the ABE conference in Australia in July 2002.

Corporate Office
1600 Amphitheatre Pkwy.
Mountain View, CA 94043
(650) 960-1980
www.sgi.com

North America 1(800) 800-7441
Latin America (52) 5267-1300
Europe (44) 118.925.75.00
Japan (81) 3.5488.1811
Asia Pacific (65) 6771.0290

3477 (08/01/2003) JI4250