

# WRAL TV's Transition to a High Definition File Based Newsroom

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## ABSTRACT

WRAL-TV is the first commercial station in the United States to adopt a file based High Definition (HD) newsroom. WRAL is famous for breaking new ground in HD starting 10 years ago with their first HD broadcast programming in 1996, and the first station to broadcast a local High Definition newscast in 2000. This transition to using video as files was driven by the need to consistently deliver the highest quality product to their viewers, as well as easily repurpose their HD content for products such as their 24-hour News Channel, website, and mobile devices. The selection, preparation, and deployment of WRAL-TV's newsroom production system, in partnership with BitCentral, resulted in an improved workflow, superior quality from acquisition to air, and a streamlined means of re-purposing video content.

## WRAL-TV BACKGROUND

Capitol Broadcasting Company, Inc., (CBC) is a diversified communications company that owns WRAL-TV Channel 5 in Raleigh, NC. CBC has a rich legacy and culture of innovation, including the nation's first commercial HDTV license. WRAL-TV is the only station with all photographers shooting all HD in the field with 29 DVCPro-HD cameras, representing the only all-digital, all-HD news workflow in the country. In this, and other innovations, the technology at WRAL and CBC often has been so far ahead of the pack that employees helped write instruction manuals for the new products companies had to create to accommodate their latest innovations.

A file based workflow is essential to manage the high volume requirements of WRAL.com, which is the most visited local TV Web site in the country. Since WRAL.com launched January 17, 1996, it has grown to more than 30 million page views a month from more than 1.2 million unique users. WRAL.com streams more than 500,000 on-demand video clips a month and serves thousands of live streams of its newscasts each month.

With the recent addition of the BitCentral Précis-HD newsroom production system, WRAL is the first station to adopt a full High Definition file based workflow. At WRAL-TV, and throughout CBC, the quality of the consumer's experience is paramount.

## OLD TAPE WORKFLOW

The tape workflow at WRAL-TV had been unique to the industry since launching their completely digital, full High Definition workflow in 2001. For electronic news gathering (ENG), WRAL-TV utilizes 29 sets of DVCPro-HD cameras and associated field gear.

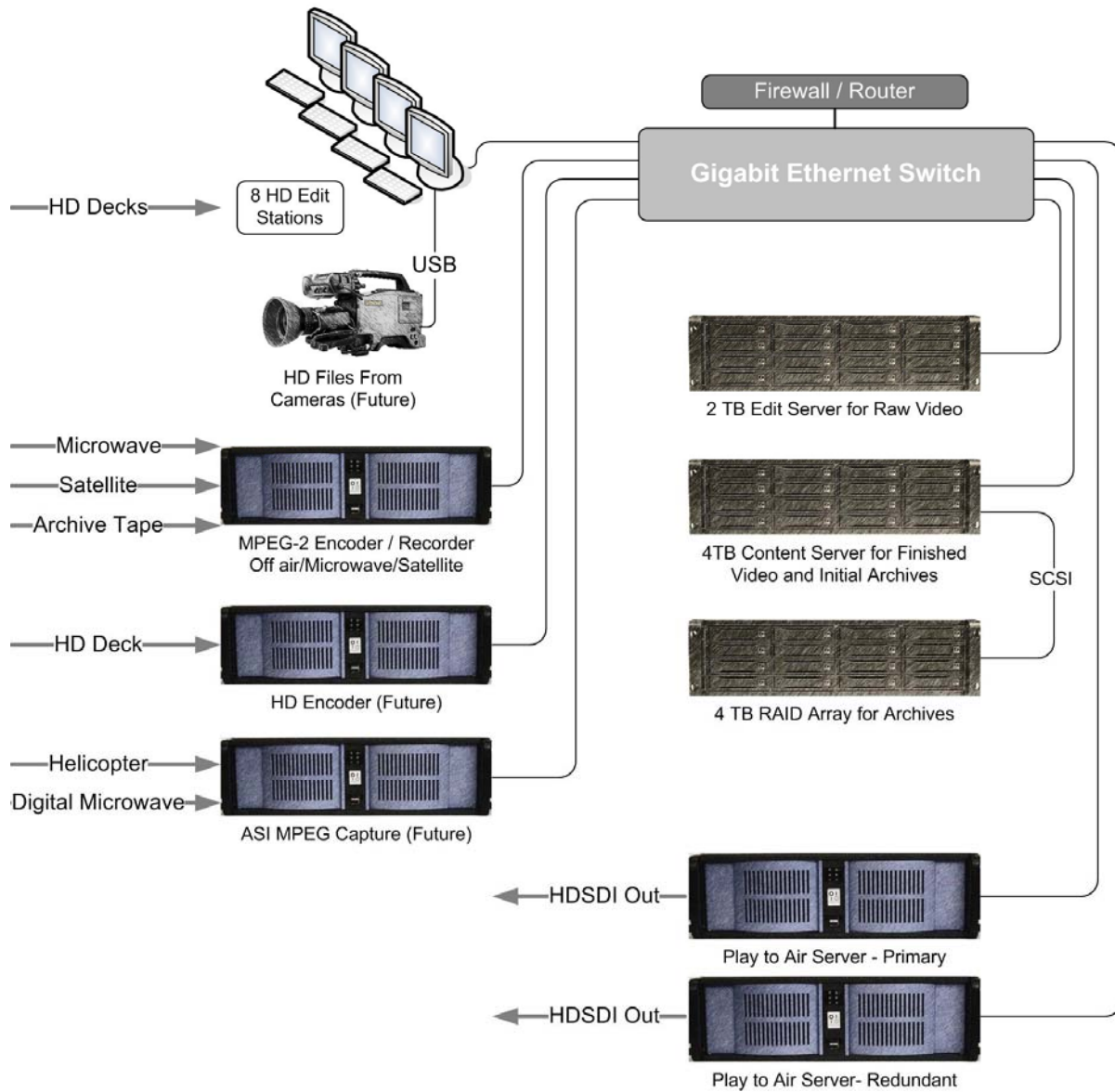
In order to preserve the all-digital, all HD workflow, ENG crews were required, in most cases, to physically bring content recorded onto DVCPro HD tapes into the station because the microwave systems on their trucks were analog. When video needed to be sent in via microwave in a tape based workflow it was down converted and remained in standard definition (SD 16x9) for that broadcast. Subsequent broadcasts would utilize the HD tapes after they arrived at the station.

Once at the station the HD tapes were edited on dual DVCPro-HD 150 decks. The edited stories were played to air on tape and archives were also tape based.



The Old WRAL Tape Playback Room

# WRAL-TV HD File Based Workflow



## FILE BASED WORKFLOW

The first phase of the transition to a file based workflow is within the station. The tape based DVCPro-HD cameras will continue to provide service to the WRAL-TV news team, and will remain incorporated into the new workflow until file based HD cameras capable of recording 1080i and suitable data rates become available.

During phase one, WRAL designed and implemented two separate dedicated local area networks (LAN) for the movement of high definition video throughout their plant. One LAN is dedicated for marketing and promotions video editing, and the other is dedicated for the new newsroom production system. For the newsroom production system LAN, the gigabit

Ethernet-based network has been run with standard CAT6 cabling. The file based HD workflow is constrained to its own LAN at WRAL because of the mission critical nature of news and the desire to minimize the effect of the transfer of HD video files across legacy networks. All equipment related to HD news production will be totally isolated from the Internet.

In addition to the networking requirements, WRAL-TV had a number of system requirements for the conversion to a file based workflow.

### **System considerations:**

- System must maintain full 1080i HDTV resolution without artifacts
- System must maintain an open architecture that allows easy re-purposing of content
- System must provide full integration with 24 hour cable news channel
- System must provide newsroom software integration module that utilizes a single point of interaction for producers, writers, directors
- System must provide online archives capable of saving all WRAL news footage and be retrieved at a moment's notice for utilization by the news staff
- All media must be located on common storage so it is available to all users on the network at all times from raw video to archives.
- Editing save times must be no longer than 1.5 times real time with full resolution 1080i HD.
- Edit stations must be format agnostic and accommodate HD and SD resolutions of MPEG-2, MPEG-4, Windows Media 9, FCP and AVI all on the same timeline without rendering.
- System must have ability to ingest simultaneously from 4 DVC Pro HD decks at 100 Mbps to common storage.
- System must have ability for up to 8 Edit stations to operate without slowing down at peak times with all content accessed from common storage.

WRAL is acquiring all their HD content with Panasonic DVCPRO HD cameras which capture at 1280 X 1080 resolution. The Panasonic HD 150 deck is connected to the Précis HD edit station via an HD-SDI interface and RS-422 machine control. The ingest stream is generated as the edit station captures content from tape using the Canopus HD AVI Codec with a resolution of 1280 X 1080/60i at 100 Mbps. Users control the ingest from within the editing interface via RS-422, and if desired, mark in and out points for a batch capture from tape.

The requirement to support four simultaneous ingest streams to common storage from the HD decks was one of the most important considerations. These four HD decks ingesting simultaneously at 100 Mbps are well within the capacity of the Gigabit Ethernet connection and the RAID array on the Précis editing server that was installed specifically for high-bandwidth HD editing. The software on the editing server sequentially writes each stream to the RAID array and eliminates contention of resources between users who are editing and those who are ingesting.

When editors are finished with an edit session and want to save their story, they click the save button on the editing interface and a screen is displayed listing the active shows. The editor selects the show they are working on and all the stories within that show are displayed. They click on the desired story and the edited video is automatically associated with that story

and ready to go to air. The edit is conformed at this time and the story is ready to go to air in about 1.5 times real time.

After a thorough evaluation and benchmarking, WRAL-TV chose to outfit the newsroom edit suites with server-class workstations powered by the new AMD Dual Core Opteron 280 Processor, Canopus Edius Pro-Broadcast, Canopus HD I/O boards, and additional software from Canopus called "SpeedEncoder". SpeedEncoder fully utilizes the processing power available on a dual core, dual processor system. During testing, BitCentral benchmarked a 40 second editing project populated with various HD AVI and SD MPEG clips, transitions, video filters, and other effects. Using SpeedEncoder, the project took approximately 63 seconds to save to an HD 37.5 Mbps MPEG-2 file on the NAS. The format WRAL-TV chose to save their video is 1080 60i Long GOP MPEG-2 at a data rate of 37.5 Mbps. The resolution was kept at the same as originated in the camera which is 1280 X 1080 60i.

Once an editor deposits their finished MPEG-2 video by saving it to the story, Précis automatically creates proxy videos and JPEG images for the browser interface and transfers the media to the redundant pair of HD play to air servers for playout. Stories can be automatically archived in long-term storage, or sent to the archive manually by the producer flagging the stories to be archived in ENPS.

The online archive system can utilize any local or network attached storage. The initial archive is 3.5 TB located on the content server. Additional archive capacity is located on three SCSI attached 4 TB SATA arrays. The content server and the 4 TB SATA arrays are 2 RU and utilize 12ea. 400 GB hard drives in a RAID 5 configuration. Additional storage can be added at any time to the Précis system by entering the network address or drive letter into the administration interface.

WRAL-TV estimates that news operations will contribute approximately 764 hours of news per year to their online archive. Based on the chosen format of MPEG-2 1080i at 37.5 Mbps, WRAL-TV specified 13.5 Terabytes of annual storage requirements across the content server and additional 4TB SATA arrays.

MPEG-2 at 37.5 Mbps was determined to provide WRAL-TV with appropriate image quality and long-term storage feasibility. In addition, online archival provides the newsroom easier and quicker access to the archived video. Keeping the archived material within the system also eliminates any additional labor or facilities needed to access the archived content.

WRAL-TV's feasibility study compared the costs of keeping the broadcast video on spinning disk or on a

robotic tape library. Using all spinning disks for storage, backed up with a small robotic library using LTO-3 Data Tape broke even at 35 TB with a larger robotic data tape-based system with SGL video library management software. The SGL software automatically matches the broadcast video to the proxy and metadata. Based on rapidly declining hard drive storage costs, WRAL-TV chose to archive on spinning disk with a data tape backup because the ROI for the larger system would have been nearly four years.

WRAL-TV previously installed a dark fiber link between the station and transmitter site so the backup LTO-3 system will be located there. This off site backup system will consist of a redundant Précis content server providing disk backup capability which is attached via SCSI ultra 320 to an Overland Neo robotic tape library with approximately 12 terabytes of internal capacity. Backups will be performed using Veritas Backup Exec from the in station archives to the disk based content server located at the transmitter site. The software will then back up from the content server to the co-located tape library. Backups will be done in 4 Terabyte volumes in order to ensure practical full backup times.

## NETWORKING REQUIREMENTS

- All on air systems at WRAL-TV must be on their own network and provides the total isolation of on air systems from potential network borne threats.
- The on air system must not see the internet or even the WRAL-TV LAN. If there are problems it is easy to detect the cause in this isolated environment.

The HD file based LAN at WRAL-TV contains the eight HD edit stations, content servers, edit servers, and redundant play-to-air servers. The Gigabit Ethernet switch used in the system needed to support Jumbo Frame and Link Aggregation. With link aggregation the throughput between the switch and edit server can go as high as 1.8 Gbps. This is faster than the Edit server can read or write data to its RAID 10 SATA array. All the equipment on the HD LAN is on its own router and has fixed IP addresses. For security purposes they are literally tied to each other by IP address. Even though the edit stations do not have access to ENPS they can view the rundowns and scripts from the Précis browser-based interface or in a user interface module developed by BitCentral that plugs into the editing software.

WRAL-TV does not plan to move any video file traffic through the router/firewall. Based upon this layout, WRAL-TV has concluded that a non proprietary gigabit network can support 8-10 edit stations editing full resolution 100 Mbps High Definition Video off common storage.

## FORMAT CONSIDERATIONS

There is always a trade off between file size and quality. The objective at WRAL-TV was to maintain excellent quality at the lowest possible file size. Since most of the components of the Précis system are non-proprietary, the video formats are mostly at the discretion of the user. There are two places in the workflow where WRAL-TV could choose formats. The first is the acquisition format on the raw video side and the second is the playout format. All raw video is managed on a specialized editing server designed to manage multiple simultaneous edit sessions. Currently WRAL-TV is capturing from tape with Edit Stations directly over a Gigabit Ethernet network to the Edit Server. The capture data rate is 100 Mbps using a DVC Pro 100 based codec. This acquisition format was chosen because it allows fast scrubbing and it was the lowest data rate codec native to Edius Professional. The Panasonic cameras capture at a resolution of 1280 X 1080i and the capture format needs to be compatible with this resolution or moray patterns will develop in the video. This is noticeable as rainbow patterns on bright edges of the video.

Out of all commonly used formats, MPEG-2 Long GOP, MPEG.2 I-Frame only, and DVC Pro HD at 100 Mbps, WRAL-TV engineers determined that MPEG-2 Long GOP offered the best picture quality at the lowest bit rate. I frame only formats produce excellent images however they are not as efficient as a long GOP format and are wasteful of bandwidth and storage. MPEG-2 at 37.5 Mbps with a 15 frame GOP structure was chosen as the highest quality and most efficient format. The next consideration was the data rate and format within Long GOP MPEG-2. The resolution WRAL-TV uses to go to air is 1280 X 1080i 60.

Data rates from 25 Mbps to 50 Mbps were evaluated to determine the point at which artifacts were no longer noticeable. The source video for the test was high motion detailed images originated in DVC Pro 100 format. The video included nature scenes with flocks of birds flying over water, hockey games with the cameras panning through the crowds and night scenes with flashing lights of emergency vehicles. All these scenes were chosen to test the worst case scenario and visually measure the encoder's performance.

The WRAL-TV engineering team scrutinized the video simultaneously on four different display technologies. The first was a 42" plasma monitor, the second was a 19" Ikegami HD CRT broadcast monitor, the third was a Dell 20.1" 16X9 1680 X 1050 Resolution LCD display that used a Black Magic HD Link which converted HD SDI to DVI and the 4<sup>th</sup> was a Samsung Consumer 32" HD CRT monitor using HD SDI converted to Component. All the formats evaluated were 1080i 60. The low data rate format at 25 Mbps

utilized an HDV codec while all other formats were MPEG-2 1080i.

The source video directly from the tape at 100 Mbps I-Frame only was the standard to compare to. Why not start with HD-CAM, D-5 or uncompressed? Anything can be proven in math, however in the real world at WRAL News everything starts on 100 Mb tape. Because ENG crews never capture in the field in these formats, any other source format was irrelevant.

The WRAL-TV Engineering and News teams found only minute differences when looking at 100Mbps video from the source tapes and 37.5 Mbps Long GOP MPEG-2 encoded from the Edius editor. They felt that the differences were not discernable enough to forgo the advantages. The audio is embedded during the MPEG-2 encode process, which simplifies file management and ensures lip sync when editing. Analog ingest of satellite feeds with resulting SD files can be mixed on the timeline. They can be set up with sidebars or cropped top and bottom depending on the subject matter.

### **RE-PURPOSING OF CONTENT**

WRAL-TV, like many other broadcasters, has been challenged to change the single-stream paradigm of local television. In addition to WRAL-TV's CBS-affiliate Channel 5, WRAL provides programming of local content for a 24-hour news channel, a 24-hour weather channel, newscasts for our sister station (a Fox affiliate), an award-winning website (WRAL.com), and a content service for mobile devices. During the NCAA basketball tournament, WRAL-TV streams all 64 games via multicast. Therefore, any new content management system installed at WRAL must assist news and other content creators in "re-purposing" original content on WRAL and CBC's multiple streams.

A key requirement to enable re-purposing of content is a non-proprietary workflow. The Broadcast HD MPEG-2 files can be automatically converted to multiple streams of video in appropriate formats for multiple delivery paths. WRAL utilizes a transcode server powered by Canopus' ProCoder software, which is integrated into the all-digital workflow.

### **CONCLUSION**

The reason WRAL is an early pioneer in HD is because of Capitol Broadcasting's belief in providing nothing but the best quality for their viewers. Because of a non-proprietary file based workflow, WRAL is able to do a lot more to extend their brand and give more to their viewers without growing the newsroom. WRAL is becoming a production engine for a variety of formats and venues, not just a television news station. The file based workflow gives the WRAL viewers both quantity and quality without adding additional resources.

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