FROM CAMERA TO THE HOME MANAGING ASPECT RATIO THROUGH THE PRODUCTION AND DISTRIBUTION PROCESS

Larry Thaler, Vice President of Distribution Technology
NBC Universal Inc, New York, NY

INTRODUCTION

As the percentage of high definition televisions in the home continues to grow, networks face increasing pressure to tailor their programming for both the SD and HD audiences. This trend has challenged broadcasters to find innovative ways of producing and distributing their content.

High on this list of challenges is aspect ratio. Programming will continue to originate and will be distributed in both SD and HD formats for years to come. Broadcasters must have a strategy that maximizes production and distribution efficiencies while maintaining the presentation quality for each home viewer, even though their screens may differ greatly.

Adding further complexity, the DTV switchover deadline is looming. What can broadcasters do to ensure consistent delivery of their programming in all markets after February 17, 2009? How could the changing distribution path affect the way programming is displayed at the home? What decisions should you be making now?

This paper will describe steps that NBC Universal has taken to prepare for this transition and makes recommendations that stations can use as the transition approaches. It highlights techniques available to every broadcaster and Production Company that can ensure all programming is optimized for both the SD and HD viewer.

"FRAMING" THE CHALLENGE

At first glance, aspect ratio challenges presented by the HD transition can be simple to understand. It's the age-old puzzle of putting a round peg into a square hole. Or, in this case, putting a 16:9 peg into a 4:3 hole (& vice versa).

When formatting an HD program for the SD audience, the choices are normally Center-Cut (and produced Center-Cut safe) or Letterboxed (giving up roughly 1/3 of the SD screen). Alternatively, when formatting an SD program for the HD audience, the material is normally pillar-boxed (which can sometimes result in home viewers stretching or zooming the content to fill the screen).

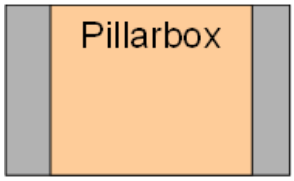

Figure 1: 4:3 Image in 16:9 Frame

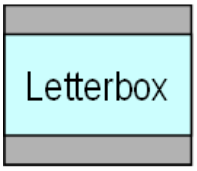

Figure 2: 16:9 Image in 4:3 Frame

There are other options such as shooting material in a compromise 14:9; however building a library in 14:9 may limit its value after the digital transition. Alternatively, material may also be produced and edited twice (in each HD and SD), but production costs make this approach prohibitive.

VARYING PRODUCTION REQUIREMENTS

There are a multitude of options, which may result in an organization attempting to simplify the process by either Center-Cutting everything, or Letterboxing everything. For NBC Universal, and at many other broadcasters, this choice is just not tenable.

NBC Universal's "Entertainment" community like many others express a strong preference for producing all content in 16:9 and down converting the SD in a letter-box format. They argue convincingly that this enables the creative community to tell their story using the entire screen and protects the production investment for the HD future.

Unlike entertainment, NBC Universal's News and Sports divisions expressed a strong desire to produce their programming "Center-Cut safe". Sports

communicates concern about the size of the ball in letterbox while News put a high priority on compatibility with 4:3 archived material and format consistency from hard to reach remote productions.

Advertisers each have their own unique opinion on the issues. Regardless of the current preferences, all of this is sure to change as the HD audience increases as well.

DYNAMIC ASPECT RATIO CONTROL

At NBC Universal, it was clear that an adaptive solution was needed. One of the tenants of GE's vaunted Six Sigma design process is to give the decision makers the tools to act on their decisions. Doing this eliminates process steps downstream, avoids mistakes and opportunities for error. A high priority for NBC is to give the program producer creative control as far upstream in the process as possible.

In February of 2005, NBC began a project to convert Saturday Night Live's facilities to High Definition with the following primary requirements:

1. To produce the show in "real HD" (i.e. full 16:9, not center-cut safe)
2. To present the show in letterbox for SD viewers.
3. To avoid increasing number of control rooms needed.
4. To share production facilities with NBC News and Sports.

NBC needed a way to permit a show producer to identify the format of the content upstream, and provide instructions to the down-converter further downstream.

The answer came in the form of AFD (Aspect Format Descriptor). NBC proposed to our vendors that we carry an AFD flag in the VANC (Vertical Ancillary Data Space) of our HD video signals in our upstream production equipment. Downstream down-converters would interpret this flag and automatically switch between 16:9 and 4:3 segments in real-time. This would produce an optimal viewing experience to both SD and HD viewers with one set of production facilities.

AFD was inserted in the 8H control room's embedder, which is used to combine the audio and video signals after the production switcher and audio console. NBC standardized on two main flags ("AFD Full 16:9" and "AFD 16:9 with 4:3 center") to identify material that should be letterboxed or center cut on down conversion.

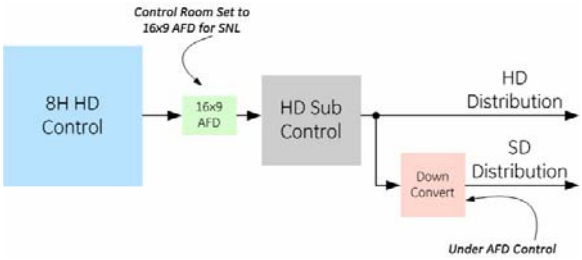

Figure 3: AFD in 8H Control Room

Thanks to support from many vendors, Saturday Night Live went on air with their first HD broadcast on October 1st 2005 with 16:9 programming and 4:3 commercials. The SD viewers saw a perfect letterbox show accompanied by full-frame commercials.

All of NBC's programming has been using AFD technology to produce the proper down-converted aspect ratio since the fall season in 2006. Our audience has been enjoying shows such as Heroes, Scrubs, SNL, Late Night, and Today and Nightly News with Brian Williams with the SD version properly formatted by the production requirements.

In 2007 SMPTE officially adopted an AFD production standard (SMPTE 2016) expanding vendor support for AFD and ensuring interoperability. The ATSC has also included AFD within its transport stream specification (ATSC A/53).

NETWORK ORIGINATION

The NBC Network currently maintains parallel SD and HD distribution from its Genesis Broadcast Operations Center (BOC) at 30 Rock. All programming and commercial playback feeds through BOC to local affiliates for 4 time zones.

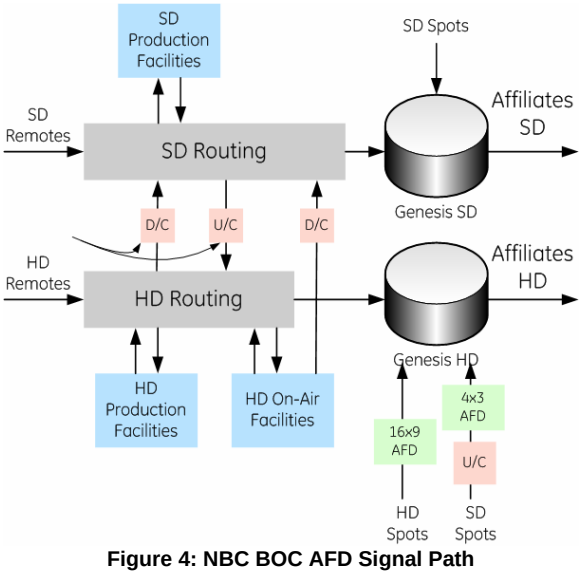

Figure 4: NBC BOC AFD Signal Path

AFD is inserted at this facility when taped material is dubbed into the video servers. With end-to-end support for AFD within Genesis, NBC automatically controls how HD originated content is presented to our SD audience.

Affiliated Stations receive NBC's programming from its Skypath™ satellite distribution system. Both SD and HD feeds are uplinked from "Master" earth stations located in NBC's New York and Burbank facilities. Just as the current Skypath™ system was originally architected to serve NBC's NTSC viewers, a major upgrade will be deployed prior to 2009 Digital Transition.

NBC's new Skypath HD™ system will be the next step in the natural evolution to a fully High Definition network. Once Skypath HD™ is deployed, NBC programming will be distributed to its broadcast affiliates exclusively in HD, simplifying the distribution process.

What makes this all possible is NBC's aforementioned HD/SD infrastructure that has seamlessly incorporated AFD. A local down-converter will generate the main NBC SD feed for its local stations – presented at the proper aspect ratio under dynamic AFD control. With almost 3 years of experience, we have faith that these devices can reliably handle all aspects of the down-conversion accurately.

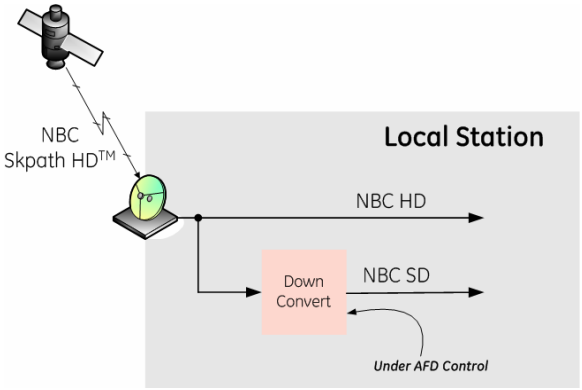

Figure 5: HD Distribution with Down-Conversion

TV STATION DISTRIBUTION PATH

While NBC's new Skypath HD™ system will continue to provide network versions in both HD and SD, many local stations will not have a direct need for the SD signal. Once NBC's signal is fed primarily in HD, the local stations' signal path will also evolve as shown below in the two figures below.

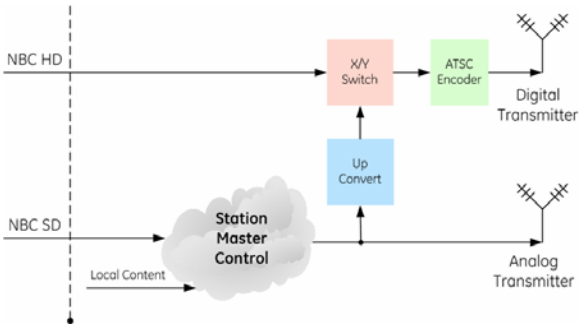

Figure 6: Common Station Signal Path (Today)

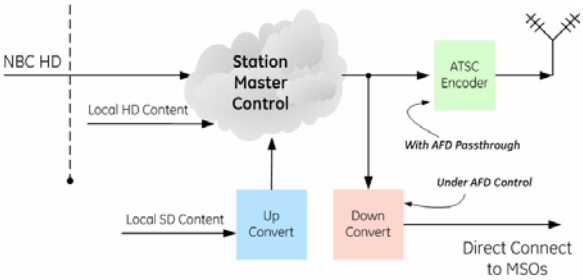

Figure 7: Common Station Signal Path (Post 2009)

Most NBC Stations are currently broadcasting HD programming and NBC Weather Plus on their DTV channels. With increasing pressures to utilize their DTV channel bandwidth for additional programming, mobile DTV, or other data services, NBC SD programming will not be available off-air in most markets.

Considering a large majority of homes on February 17, 2009 will still own standard definition 4:3 sets, NBC is has outlined the following suggested strategy to ensure consistent delivery of programming to its SD viewers.

1. *Direct Fiber Connection*. Where feasible provide direct connection of the local station SD signal to cable head-ends, satellite providers and Telco's.
2. *Propagate End-to-End AFD Support*. Work towards industry adoption of AFD support throughout the distribution path to the home. Ensure ATSC encoder is equipped with update where available to support AFD.

CABLE HEAD-END ARCHITECTURES

While direct fiber connection is the best way to control SD program delivery for cable and satellite viewers, there are large regions of the country where this is not practical. Analyzing typical cable-head architectures will help to illustrate the scenario.

For cable head-ends that redistribute off-air broadcast signals, the diagram below illustrates a typical setup today.

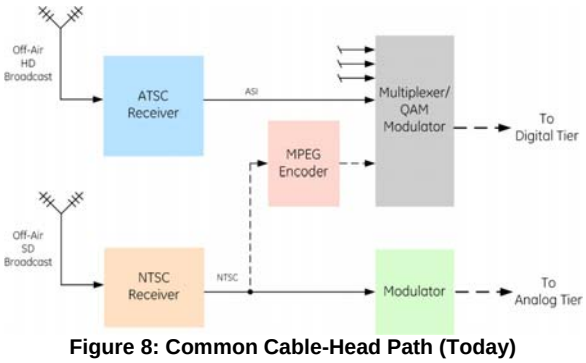

Figure 8: Common Cable-Head Path (Today)

The diagram illustrates the typical parallel redistribution path. Off Air HD Signals are demodulated to ASI and multiplexed into the cable system's digital tier. Off Air NTSC signals received and re-modulated into the cable systems analog tier.

Post February 17, 2009, many cable systems will continue to provide broadcast network signals on their analog tier (or digital SD channels), but will no longer have off-air NTSC signals available to do so.

The best solution is for a new ATSC Receiver device with the ability to down-convert and generate properly formatted SD signals as shown in the diagram below.

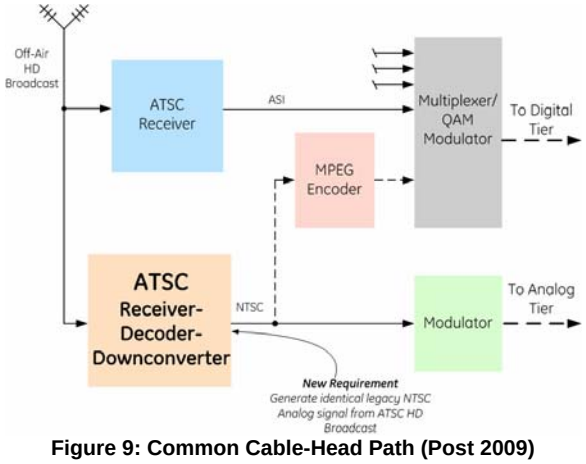

Figure 9: Common Cable-Head Path (Post 2009)

When specifying such a device, it is important to consider aspect ratio control and other elements to ensure that the NTSC signal is properly formatted including the following.

1. Down-conversion under control of AFD
2. EIA-608 Extraction and Conversion of Closed Captions
3. Conversion of XDS Data including V-Chip and Nielsen Ratings
4. Proper Dolby 5.1 Down-mix to LT/RT
5. Proper Choice of Dolby Digital Dynamic Range Profile
6. Carriage of Second Audio Program (SAP)

It is estimated that thousands of these devices will be required in the build out leading up to February 2009. This presents a huge opportunity for ATSC receiver manufacturers that are anxious to meet the industry's needs. It is up to the TV stations to clearly identify these needs when discussing this with their cable operators.

OFF-AIR VIEWERS

It is clear that there will be viewers watching transmitted signals directly over the air. These viewers will not benefit from the down-converters at the television stations or in the cable head-ends. If these viewers have ATSC tuners built into the television sets, they are most likely watching in 16:9 and will not have an aspect ratio issue. Some of the set-top boxes available have the capability to support AFD. As an industry we work towards having AFD support in the government sponsored set top boxes to help ease customers through the Digital Transition.

CONCLUSION

NBC has shown that aspect ratio can be consistently formatted and managed from the content provider, through the program chain, out to affiliate stations and to cable head ends on a day to day basis.

In the short term, we must plan our strategy so that we don't adversely affect the majority of our audience who own SD televisions sets. However, it is clear that over the long-term, more and more of the audience will be upgrading from 4:3 televisions to 16:9 widescreens. Clearly, the ultimate goal will be to maximize the HD viewing experience. This shift of perspective represents an inflection point that we need to prepare for now.

As broadcasters, we have a responsibility to smoothen the DTV transition for our audiences and to create a strategy to handle this inflection point. Full support of AFD through the chain will provide the tools needed to make this choice on our schedule, and on a station-by-station basis. Let's make sure we're ready by laying the groundwork today.

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BRIEF BIOGRAPHY OF AUTHOR

Larry Thaler is Vice President of Distribution Technology at NBC-Universal. During his 25 years with the NBC network, he has led key efforts, which have been at the junction of where traditional broadcasting meets new media. Most recently, he and his team have been responsible for the major overhaul of NBC's 30 Rock headquarters into a state of the art HD production and distribution center, the build-out of the new Cable Network Operations Center in Englewood Cliffs, NJ and the integration of new infrastructure for NBC's new Digital Media delivery platforms.

Larry received a BFA from NYU majoring in Broadcasting with a minor in Computer Science. He has spoken at several industry forums including NAB and SMPTE and is an Emmy award recipient.