Active Format Description

by Michael Dolan

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Active Format Description (AFD) is a new kind of video metadata that solves an annoying viewer problem as we transition from conventional 4:3 display devices to widescreen 16:9 displays. It provides information to ultimately assist a decoder or display to properly present video material that was encoded or transformed during production and distribution from an aspect ratio that is not the same as the display device. The aspect ratios of 4:3, 16:9 and 14:9 are addressed. The problem is not directly related to SD versus HD video formats, but more so the aspect ratios supported by the various equipment.

What's the problem? Video material comes from all kinds of sources, including feature film, traditional (SD 4:3) video cameras and now the newer digital (HD 16:9) cameras. During production and distribution, the original material is usually modified to conform to 4:3, so it is viewable on traditional (4:3) television displays. This transformation is done using various techniques that include linear scaling, anamorphic scaling, pillar-boxing and letterboxing. You are probably familiar with the leader disclaimer, "This presentation has been modified from its original form…to fit on your television screen". The transform details are not the subject of this paper, but their end results and affects on the viewer are. The transforms in the distribution often involve multiple steps at different times for different applications of the material. A worst case scenario can result in many or all of the above transforms before the program arrives at the consumer display.

Figure1: Original material (View from the 4th tee box at Seven Canyons)

Figure 2: Letterboxed and formatted for 4:3 display

An example of a fairly typical set of transforms over a digital broadcast is shown in *Figures 1 through 3*. The

original encoded material is shown in Figure 1; its letterbox transform to 4:3 is shown in *Figure 2*; and the additional pillar-box transform to 16:9 is shown in *Figure 3*.

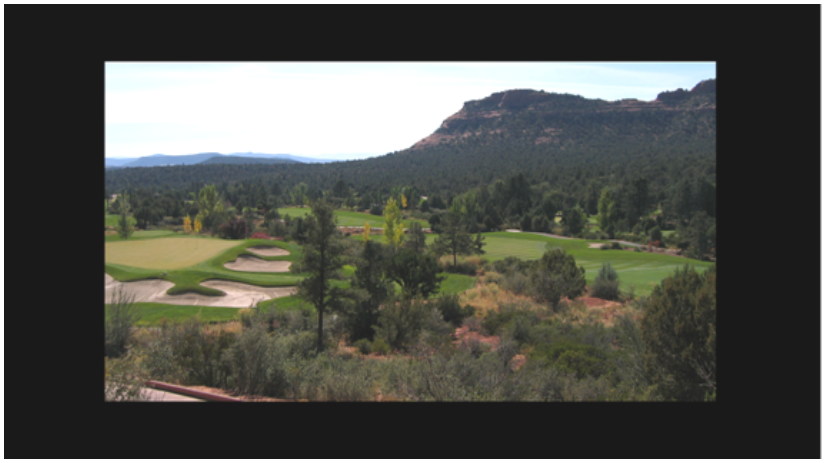

Figure 3: Pillar-boxed and formatted again for a 16:9 display

There are several transforms of *Figure 1* possible for viewing on a 4:3 display. The letterboxing shown in *Figure 2* is one common option especially for material with panoramic scenes. What the viewer wants to see, of course, is the image of *Figure 1* on their expensive 16:9 display, and not the "postage stamp" of *Figure 3*.

How does AFD work to fix this? AFD is metadata attached to the video that specifies the "active area" to be displayed. It doesn't signal the transforms (or cumulative transforms), but rather what to do about the final resulting picture. For example, when the image of *Figure 2* is transmitted, it is accompanied by an AFD value that signals that the picture actually contains a 16:9 image and it is letterboxed. The AFD descriptive test signal picture (used for display AFD reaction verification and based on CEA CEB16) is shown in *Figure 4*, which provides visual guidance on what the display should actually display (i.e. not the red fields of the picture) when testing a 16:9 display with a specific AFD value, in this case "1010".

AFD also provides the additional benefit that allows the display device to process the incoming signal to make the highest-resolution and most accurate picture possible. Furthermore, the display can take advantage of the knowledge that certain areas of video are currently unused and can implement algorithms that reduce the potential effects of uneven screen aging that occurs with prevalent letterboxing and pillar-boxing on some display technologies.

It's also worth noting that there is related metadata, known as "bar data". While this initially had a broader intent, today it forms a companion with AFD to support non-standard aspect ratios and unusual transforms. It allows the encoder to specify specific, video-format-dependent video samples to discard from the top, bottom, left and right edges of the encoded picture before display.

How and where is AFD specified? AFD, and its carriage through the distribution, is specified in a wide collection of standards in almost as many standards organizations. Work on the problem initiated in Europe within the ETSI as part of TR 101 154 V1.4.1, "Digital Video Broadcasting (DVB): Implementation Guidelines for the use of MPEG-2 Systems, Video and Audio in Satellite, Cable and Terrestrial Broadcasting Applications, Annex B", published in summer 2000. Along with that work is the UK application defined in "DTG Implementation and User Group Digital Receiver Implementation Guidelines and Recommended Receiver Reaction to Aspect Ratio Signaling in Digital Video Broadcasting".

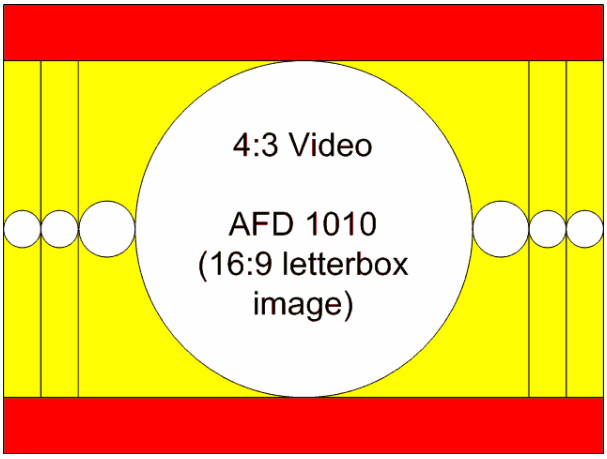

Figure 4. Example AFD Test Pattern
(Used with permission of CEA and TBT, Inc)

AFD comes to America with a collection of standards. CEA CEB16, "Active Format Description (AFD) & Bar Data Recommended Practice" published summer, 2006 extends the

ETSI and DTG work and defines a series of new AFD values. ATSC defined the carriage of AFD in terrestrial broadcast (MPEG-2 Transport) in A/53B (Annex A, Amendment 1), "Digital Television Standard (A/53)", published in summer 2002. It originally referenced the ETSI work, but now references the more US-specific CEA CEB16.

The above standards cover the emission and display behavior. The facility carriage of AFD is covered in SMPTE 2016-1, "Format for Active Format Description and Bar Data" which not only specifies the carriage of the AFD code in the facility SDI (SMPTE 259 and SMPTE 292) links, but also provides guidance to encoders and transcoders for how to set the code based on the material.

When will consumer displays make use of it? The implementation of AFD is now on the cusp following the recent specification of the facility carriage and encoding guidelines in SMPTE, filling in the distribution means for AFD. All the specifications needed to implement it are now in place. CEA, working with Television Broadcast Technology, Inc has made available test digital transport streams to enable display manufacturers to test their display equipment with a series of test patterns like Figure 4.

Consumer demand will ultimately encourage AFD to be properly set by the broadcasters and for the displays to react and provide the best possible viewer experience. But the balls are now rolling and one might expect AFD to provide a better viewer experience in the near future.