Optimizing BrightSign Video Quality

The BrightSign "compact" models are capable of producing excellent high quality High Definition video output. However, video quality can be reduced if a system isn't configured properly. This document describes what affects video quality, and how to ensure you get the best results.

Summary

1. Avoid downscaling video. For example don't display content authored for 1080i with 720p display mode. Instead, match the content authored resolution and output display mode. Another example, don't display 720p video (1280 x 720) in a zone window that is smaller (e.g. 1024 x 576). Instead, author the content to match the zone window resolution, or author it smaller so it "scales up".
2. Use a true progressive output mode i.e. neither 1080i nor 1080p60 (1080p30 is fine).
3. Pick a display with a native resolution that is the same as your output mode because a display that has a native mode of 1280x720 will scale content when displaying at 1920x1080.
4. Turn off overscan or select a monitor or mode that doesn't overscan at your chosen output mode.
5. Use progressive video content at the same frame rate as the output mode. Author your content to match your display resolution and frame rates when possible. For example, if you are using video that's 25fps, then use an output resolution that's 25, 50, or 75.
6. Use 1080p50 or 1080p60 with care; choose instead 720p or 1080p30 to avoid any de-interlacing flicker.

Introduction

For optimal video quality the amount of processing performed on the video has to be minimized both in the Brightsign and in the display to which it is connected. The types of video processing we're concerned with are:

- Scaling
    - Scaling occurs when video changes resolution, e.g. from 720p to 1080p. We can split this into upscaling where the video is increased in size and downscaling where it is reduced in size.
- Overscan
    - Overscan is upscaling, but we'll list it separately here because it's easy to forget about. Overscan is done within TVs to crop the edges from incoming video. It is an upscale of about 5%. Some TVs have 'exact scan' modes which enable the user to turn off overscan. Overscan should only apply to TV modes like 720p, 1080i, 1080p and not to VGA modes like 1370x768, but there is some inconsistency in the way that TVs and monitors deal with overscan.

Toshiba calls overscan disable 'Exact scan' and Samsung and LG call it 'Just scan'.

- Interlacing / de-interlacing
    - When video changes from progressive to interlaced or from interlaced to progressive some processing takes place.

All systems have varying levels of quality when it comes to this processing and these have a direct effect on the resulting video quality of the system.

Scaling / Overscan

Where can it happen? Imagine a video at resolution ‘a’ being played in window size ‘b’ at video mode ‘x’ to a display with a native resolution ‘y’. Scaling will occur at each point in the chain where the resolution changes. So if ‘a’ = 1280x720, ‘b’ = 1024x768, ‘x’ = 1280x720 and ‘y’ = 1920x1080 there will be 2 instances of the video being scaled in the system:

The video clip is decoded to 1280x720. Then the first scaling occurs:

1. The video is scaled down to fit in the 1024x768 window.

The whole screen is then output over HDMI / component at 1280x720

2. The display then scales up the whole screen to fit its 1920x1080 native resolution. This scaling will likely also include overscan meaning that the displayed image is only the central portion of the screen generated from the Brightsign.

To reduce the amount of scaling the video content and video window should be the same and the video mode and display native resolution should be the same - i.e. a = b and x = y. For example, a 1024x768 video clip played back full screen using video mode 1024x768x75p to a 1024x768 native resolution screen will involve no scaling. A 1080p29.97 video clip played back at video mode 1920x1080x29.97p to a 1920x1080 native resolution screen will also involve no scaling as long as the display does no overscanning. Also, a 720@60p video played back in a 1280x720 window with video mode 1360x768x60p to a 1360x768 native resolution screen will also result in no scaling.

Wherever possible, overscan should be disabled on displays as in general it provides no useful function.

All upscaling in Brightsign is very high quality, but downscaling vertically can only be done by decimation which means throwing away half of the lines. Scaling interlaced video is rarely good on any systems - the worst thing to do is to playback 1920x1080x60i video in a 1920x1078 window. This results in each field of the video being decimated (halved in height) and then scaled back up which gives a low quality output. Scaling up a

1280x720p video to a 1920x1078 window only involves upscale and is therefore much better.

Interlacing / de-interlacing

Interlacing is really a legacy of cathode ray tube TV's and should generally be avoided with LCD and Plasma displays. Whereas a CRT TV would show an interlaced signal natively by scanning alternate lines, LCD and Plasma displays must deinterlace the input prior to displaying it. Many displays, especially monitors aimed at PC's do not do a good job of deinterlacing with the results being flicker even on static images. If interlaced content must be used e.g. 1080i then the deinterlacing can be done either in the Brightsign or in the display by selecting the video mode. If a 1080i video mode is selected then the deinterlacing will be done by the display, otherwise the Brightsign will do it. In general we recommend against using interlaced content.

Which video mode is best?

As discussed above this largely depends on content, but if you can choose the format of your content then here are the video modes in recommended order:

1. 1920x1080x29.97p. This is definitely the best video mode for Brightsign, as there is no interlacing and the image resolution is the highest supported. Because it is a 'TV mode', it's best to disable overscan on the attached display. There are some reasons that it may not suit a project

    - Some 1080p monitors support frame rates below 50Hz
    - We have an open bug where 1080i content doesn't display well in this mode - we're working on resolving this. 1920x1080x29.97p content plays perfectly.

2. 1360x768x60p. This mode doesn't have as many pixels as 1920x1080x60i, but it's progressive and so has no interlaced video artifacts. Also, because it is a VGA mode most displays won't overscan it; this makes zones design easier.

3. 1920x1080x60i. This is a good mode when the video content to be played is 1080@60i. It is not as good as 1920x1080x29.97p for static images as it relies on the de-interlacing of the display which isn't always good. As with 1920x1080x29.97p it's best to disable overscan on the attached display.

4. 1920x1080x60p. This is not as good a mode as it sounds! It is 1920x1080x60i passed through our de-interlacer inside the HDMI chip. However, it is the only mode for BrightSign to talk to some 1080p PC monitors. The main visible quality issue is flicker from the de-interlacer which can be seen even on static images.

Media formats and their limits

The type of compression used for video and audio and the type of container that the compressed media is stored in has an impact on how efficiently BrightSign can play back the media. This affects video quality indirectly by putting an upper limit on the bitrate for different types of files. Here's a list of what we support:

Video compression

We support MPEG-2 and H.264 video compression pretty much equally. H.264 gives better quality output for a given bitrate. An HD clip encoded at 10Mbps H.264 will look much better than one encoded at 10Mbps MPEG-2. The files will of course be roughly the same size.

Audio compression

We support MP2, MP3 and AAC audio compression. AAC gives much better quality than MP2/MP3 at a given bitrate.

Containers

We support MPEG-2 transport streams, MPEG-1 system streams and MPEG-2 program streams. We are also adding QuickTime support (.mov files). All of the containers can have inside them any combination of our supported video and audio codecs.

BrightSign has hardware accelerated transport stream support which means that this is the most efficiently supported file format. We can playback these transport streams with bitrates of up to around 35Mbits/second.

Program streams and MPEG-1 system streams are supported with bitrates up to around 25Mbits/second. Quicktime streams have a similar limit though testing of this new feature is ongoing.

The higher the bitrate, the harder the BrightSign has to work. For full screen stand alone video, this doesn't matter too much. However, where zones are in use with images displayed in other zones with transitions, the higher the video bitrate, the less CPU is available for image transitions etc. Therefore, if video is windowed in a zone it's a good idea not to use the highest bitrate. Similarily, if networking is being used to update content, the harder the BrightSign is working playing video, the slower it will be to transfer new content by network.

The maximum bitrates quoted here are for constant bitrate encodings. Some variable bitrate encodings may average at 25Mbits/second but have peaks at 40Mits/second which can result in playback glitches.

Also, if a 35Mbit/second file is to be played, care must be taken to ensure that the storage is capable of delivering well in excess of that. For these a class 6 SD card is recommended which has a minimum transfer rate of 6Mbytes/second (48Mbits/second).

The final point is about seamless video looping. BrightSign is capable of looping transport streams containing only video seamlessly. If the content is authored appropriately then the final frame of the video will be immediately followed by the first frame. The result is a video loop where the observer can't tell at what point the video is looping.