Broadcast Pix

Application Note

Minimizing Delays for Image Magnification

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For image-magnification applications, even the slightest delay can be critical. Typically these situations involve a large-scale projected image of a live speaker who is often right in front of the video screen. Delays make the enlarged image of the speaker fall out of lip-sync with the live speaker's speech.

Most digital devices, including displays and even cameras, delay the video signal as they process it in various ways. In cameras, the greatest delays are typically created during encoding. For example, the FireWire DV output is often several frames behind the live action due to the time needed to compress the signal. The Firewire output on HDV 1080i cameras is delayed by 30 frames (!). This is because the MPEG compression scheme they use requires a group of 15 consecutive frames to compress and decompress the signal.

Displays such as HD monitors and projectors can add additional delays as they convert incoming signals into their native display formats: Most projectors need to convert interlaced signals into progressive ones and many apply additional processing such as image enhancement and noise reduction. This can add substantial delays. One of the most effective enhancement/noise-reduction algorithms – median filtering – can require a delay of several frames for best results. Most people don't realize that there can be so much delay just from monitor input to displayed image.

How can users deal with these issues? With live image-magnification, it isn't possible to delay the live audio to match the projected video, so the only solution is to keep video delays as short as possible – hopefully below a noticeable level.

Research has shown that the human threshold for perceiving audio/video latency is about 100 milliseconds, or the equivalent of three SD video frames. The Broadcast Pix Slate system has been designed to keep this delay below this threshold:

1) The SD version of our product has a latency of only a single frame (33 milliseconds for 525-line 'NTSC' systems / 40 milliseconds for 625-line 'PAL' systems) when used with synchronized and timed sources. All effects are executed in this single, consistent timeframe. Even our 2ME systems will allow you to feed one ME into the second ME, superimpose six separate DVE's and perform simultaneous aspect-ratio correction on all inputs – all within that one frame's duration. We're able to do this by processing all effects in a single pass.

2) Our HD product accommodates input signals from 720p to 1080i. However, converting all these inputs into a single consistent format for processing introduces an additional 33 milliseconds of delay for NTSC-based formats and 40 milliseconds for PAL-based formats. Converting the output into the format desired by the user (we offer a range of choices from 720p to 1080i as well as many DVI-I formats up to 1080p) requires another 33/40 milliseconds. This makes the total delay for synchronized HD inputs 99 milliseconds for NTSC-based formats (just below the threshold of perception) and 120 milliseconds for PAL-based formats (just barely over the threshold of perceptibility).

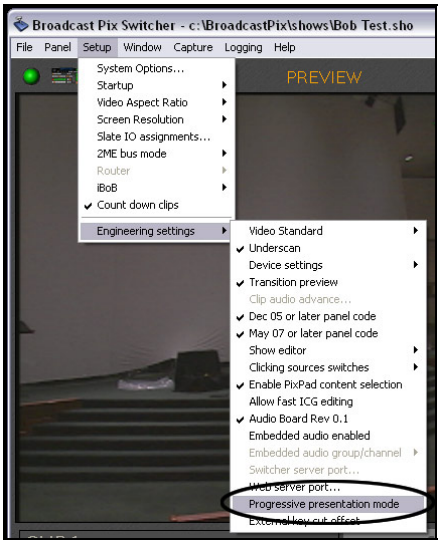
3) We have a unique low-latency 'Progressive Presentation' HD mode that streamlines the signal path through our system. It reduces the delay to 66 milliseconds for NTSC-based formats and 80 milliseconds for PAL-based formats. It requires inputs to be synchronized and timed 720p signals – this allows us to skip an interlaced-to-progressive processing step as well as a buffering delay used to synchronize the output to the reference. The output can be any progressive signal: 720p SDI or any progressive signal up to 1080p from our optional DVI output. Because the output is progressive, it also eliminates a delay at the projector – the

conversion step needed to convert an interlaced signal into the projector's native progressive display mode. This is an important benefit for image-magnification applications and this mode was built into the product with this specific use in mind.

So what does this mean to you as a user? Practical steps you can take to reduce delays:

If your system application is image magnification, our low-latency mode offers very important benefits. Steps include:

- Connecting all your sources and Broadcast Pix workstation to a genlock reference.
- Connecting the progressive output from your cameras (typically 720p) into the Broadcast Pix system.
- Making sure you take the HD signal output from the Broadcast Pix workstation (the one at the bottom of the HD input card - output D or E or the DVI output option) for your projector.
- There is normally no delay associated with 720p camera outputs, but you should make sure delay-introducing enhancement algorithms (like noise-reduction) on the projector are switched off.
- Be sure to put your Broadcast Pix Slate system into Progressive Presentation mode!



The ability of the Broadcast Pix Slate system to support the specialized needs of image magnification is due to its unique processing architecture. The custom-built Slate hardware engine is capable of processing all effects for two ME's and six key layers in a single pass as well as perform all format conversions to intermix the widest variety of signal types. By harnessing this power with a broadcast-oriented range of control panels and an intuitive monitor wall user-interface, we've created a system that is not only powerful, but also easy and efficient to use. Specialized enhancements such as our Progressive Presentation Mode and other features to support specialized applications make the Broadcast Pix Slate system not only more powerful but also more useful. Our objective has always been to exceed expectations.