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Choice of Display Light and Scene Light Based Conversion in EDIUS — An Example for Instantaneous HDR Production Workflow

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WHITE PAPER

Introduction

In the video industry, efforts are made to use High Dynamic Range (HDR) video for news and live field production where immediate content distribution is necessary. One of such is Sony's "Instant HDR" concept, and cameras which can shoot in Hybrid Log-Gamma (HLG) format are to be brought into the market.

If video is shot in HLG format directly, it can be distributed without any color grading in cases where timing is of the essence.

Then, isn't it possible for Log format cameras like S-Log or V-Log to be used in such fields? Although a Log signal needs to be converted to HLG or Perceptual Quantization (PQ) in order to be displayed on consumer TVs, the conversion itself is not difficult. Leaving live production to one side, we can play out HDR clips with a short time lag after quick editing such as cut & paste, title addition and format conversion by using EDIUS.

But to do so, some points need to be taken into account, for example, the concept of picture tone is different between Log formats and HLG. The "Conversion Base" setting in the Primary Color Correction has implications based on the difference of the source material.

This whitepaper deals with the topic.

HDR and SDR

HDR is a mechanism to record specular highlights on shiny objects and display them without clipping. For clarification purposes, the traditional video system is called as SDR (Standard Dynamic Range).

HLG and PQ are the HDR standards employed in consumer TVs. Log standards defined by many camera manufactures are also HDR systems, though they cannot be seen on consumer TVs directly.

Although many people may presume that Log is a system to widen the expression capability when color grading an SDR image, it is nothing but an HDR system. It can be taken advantage of when producing a SDR video of course, but Log clips can also be used as HDR sources.

Difference Between Log and HLG/PQ Pictures Just After Acquisition

When you display a Log file shot by a Log camera just after acquisition on a BT.709 (SDR) display, you will see an image like in Figure 1. It is an example shot by a V-Log camera.

Overall, you see a dark and grayish image. This is because the signal is displayed on an incompatible display, and the displayed image is wrong. A display compliant to its standard is needed to display a Log signal correctly.

When the Log file is displayed on a compatible display, the picture is shown like in Figure 2.

Figure 1 — Log signal displayed on a BT.709 display (an example of V-Log)

Figure 2 — Log signal displayed on a display compatible to the standard

Since a PDF and its printed or online version can never display a Log image, Figure 2 is a simulated image showing that “it will be seen like this if it is displayed on a Log display.” Though a Log is an HDR, the PDF/paper image is not an HDR. Therefore the highlight portion is clipped to flat white.

There are some very bright objects in the right half of the image, and they are displayed in monotonous white. If it is seen on a Log display, they shine brighter than the reference white without being clipped.

Except for the clipped white part, the image seems to be shown with the correct color, unlike in Figure 1. But, if you look carefully, the image has a slight lack of tone contrast, and the black looks brighter than the real objects.

On the other hand, if the same objects are shot by an HLG camera and the file is displayed on an HLG display, the image will be seen like in Figure 3.

Figure 3 — HLG signal displayed on an HLG display

Compared to Figure 2, the blacks are darker and the image looks alive!

In Figure 2, the blacks look gray and lack tone contrast. Human eyes see the image to be lacking in contrast, though the lightness of each part in Figure 2 is proportional to the corresponding part in the real scene. This is because of human perception characteristics. When the size and the absolute luminance of the objects, and the surrounding luminance are different between the real scene and the displayed image, human eyes see the image different from the real scene in spite of the "proportional tone scale." Generally on video displays, the tone scale needs to be altered as shown in Figure 3 (the contrast is intentionally increased) to make human eyes see the image to be identical to the real scene.

In contrast, with the HLG system the image looks alive and more natural. This is because a kind of tone conversion is performed inherently. The resulting image is considered to be nearer to the real objects than the image without the tone conversion. It can be thought that a kind of "standard color correction" is performed automatically. Owing to it, when a video is captured in HLG format, it can be displayed as is with a standard tone, and distributed without any processing if desired.

Then, why is such a tone conversion not performed in Log systems? Maybe that is because of an existing policy to leave everything to color graders and not to alter the tone. Thus color grading is essential in the "Log world."

Therefore, roughly speaking, while Log shooting is suitable for high-end productions where it takes a long time to perform the necessary and elaborate color grading, HLG shooting is for field production where instant access is important, like news production.

Meanwhile, if there is a camera that is compliant to the PQ standard, the picture acquired by it will be seen on a PQ display like in Figure 4.

Figure 4 — PQ signal displayed on a PQ display

The picture in the PQ system (Figure 4) also looks alive in the black parts compared to the Log system (Figure 1). But the black portion is still darker than in the HLG system (Figure 3). Let's move our interest to pure colors, red especially. They look more vivid in PQ than in HLG. Although they both have the "standard color correction," they do not look the same because their characteristics differ slightly with each other.

As it is indicated by the term "standard color correction," the tone difference can be regarded as a result of a color correction effect. This means a similar tone can be achieved by some general color-correction effects.

For example, it is practicable to perform the similar tone conversion for a Log clip as the "standard color correction" in the HLG or PQ system. When a Log clip is processed like that displayed on a Log display, it looks similar to the image displayed on the HLG or PQ display. This is the reason why I always appended a term "as is (just after acquisition)" in the above explanations. Displaying a Log clip on a Log display does not always result in an image lacking tone contrast. If the Log clip has been processed as above, the displayed image tone is adequate.

In summary, in a general Log system, if a clip just after acquisition is displayed, it appears to lack tone contrast and it needs color correction/grading before finishing. In an HLG or PQ system, the clip just after acquisition appears with standard tone because the system performs the "standard color correction" automatically.

But the difference between them is not very big and may not be noticed at first glance. In addition, the processed images in HLG and PQ systems are still different from each other. The blacks are darker in PQ than in HLG, and while the colors are mild in HLG, they look more colorful in PQ.

Signal Format Conversion on Scene Light Base

I stated above the case where a picture is shot in one of the Logs, HLG or PQ camera, and displayed on the same standard display. But in some cases one standard signal needs to be converted to another. In the case of EDIUS 8.5's Primary Color Correction, the conversion is possible by setting the ***Destination/LUT*** in the ***Color Space*** to a different type from the ***Source***. Then the signal converted to the Destination/LUT format is played out from the timeline.

In the previous section, I stated that when a picture is shot by a camera and displayed on a display as is, the picture tone differs depending on the signal standard: Log, HLG or PQ.

Then how does picture tone vary when the signal standard is converted with the Primary Color Correction? I will explain this below.

How the picture tone is changed after the conversion depends on the ***Base*** setting in the Primary Color Correction.

If the ***Base*** is set to ***Scene Light***, the source clip is assumed to have been shot by the source standard camera and left as is. Then it is converted so that the output image tone is as if it were shot by the output standard camera. Figure 5 explains the tone change.

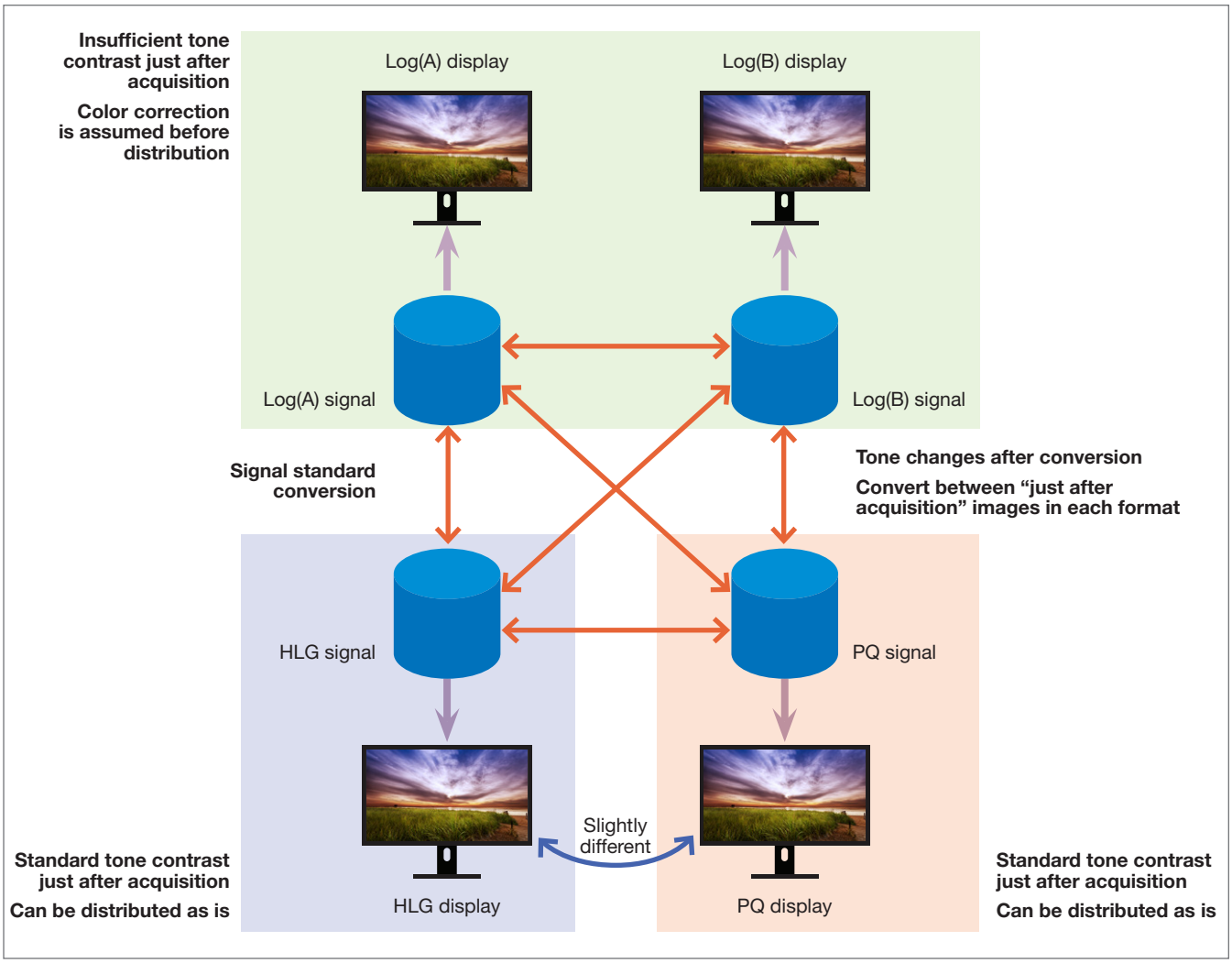

Figure 5 — Signal standard conversion on scene light base

Consequently the picture tone changes as below:

1. If converted from a Log to another Log, the tone does not change.
2. If converted from a Log to HLG or PQ, the tone changes from insufficient contrast to adequate contrast.
3. If converted from HLG or PQ to a Log, the tone changes from adequate contrast to insufficient contrast.
4. If converted from HLG to PQ or in reverse, the tone of both pictures has adequate contrast, but the tone slightly changes because of the difference between each of the format's characteristics.

Thus the conversion rule is complicated because it depends on both the characteristics of the source and destination formats.

Among the above conversion cases, the second case is useful in workflows like that shown below.

As stated earlier, when shot by an HLG camera, the clip can be distributed without color grading. To be more specific, after cut editing and title insertion only, it can be distributed quickly as shown in Figure 6. This is the same concept as the "Instant HDR" introduced by Sony.

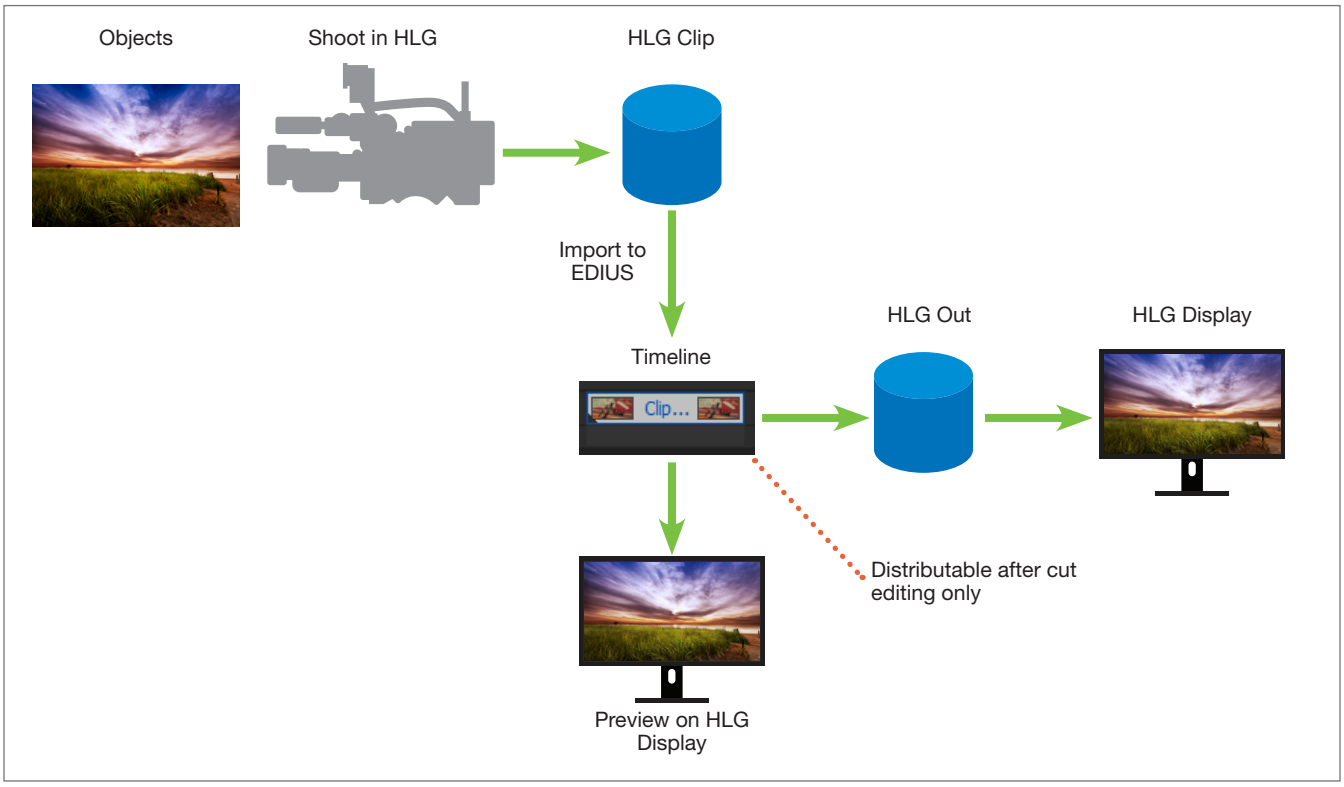

Figure 6 — HLG production workflow with excellent immediate distribution

We can achieve a similar workflow with a Log camera instead of an HLG camera. This is realized by converting the Log signal to HLG using Primary Color Correction on scene light base as shown in Figure 7.

With scene light based conversion, a Log signal shot by a Log camera is converted to an HLG signal as if it were shot by an HLG camera. Therefore the same concept of workflow is available as “Shoot with an HLG camera and distribute it without color grading.” An additional step of applying Primary Color Correction is needed of course, but it is only a simple step.

I wrote earlier that Log shooting is suitable for high-end productions where it takes a long time to perform elaborate color grading, but Log shooting is also useful for instantaneous workflows like news production by using scene light based conversion.

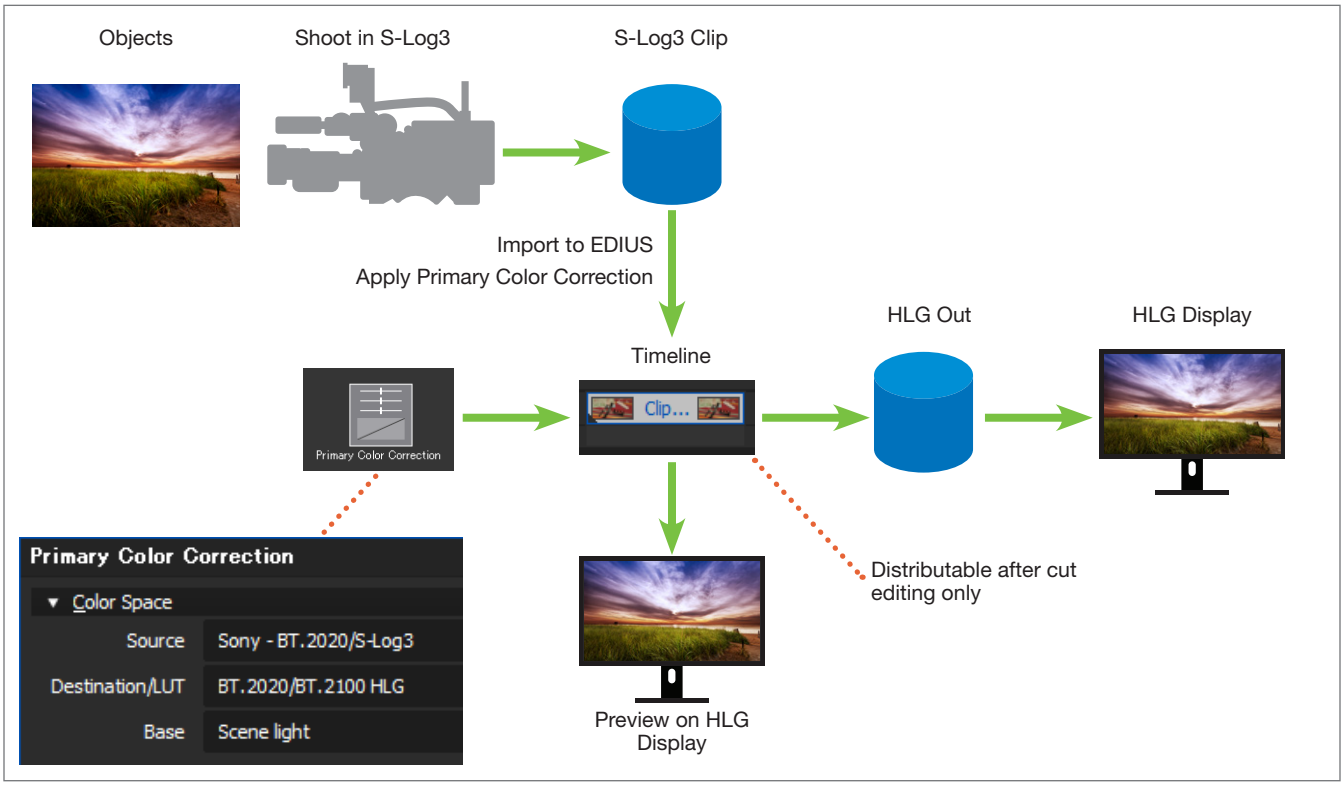

Figure 7 — Instantaneous HLG production workflow with Log camera

Signal Format Conversion on Display Light Base

In contrast, if we set the ***Base*** to ***Display light***, the picture tone is kept unchanged after a conversion from any type to any type as shown in Figure 8.

As an example, let's imagine a case where we color grade a Log clip and save it in the Log format file, and then convert it to HLG when it is distributed. If we use scene light based conversion, the picture tone of the finished clip after long color grading work will be changed unexpectedly. Remember that the picture tone is changed by scene light based conversion.

If we convert it on display light base, only the signal format is changed and the picture tone is kept unchanged. This is the expected result.

The default setting of ***Base*** is ***Display light***. Be sure not to change it from the default setting unless you use a workflow as introduced in the previous section.

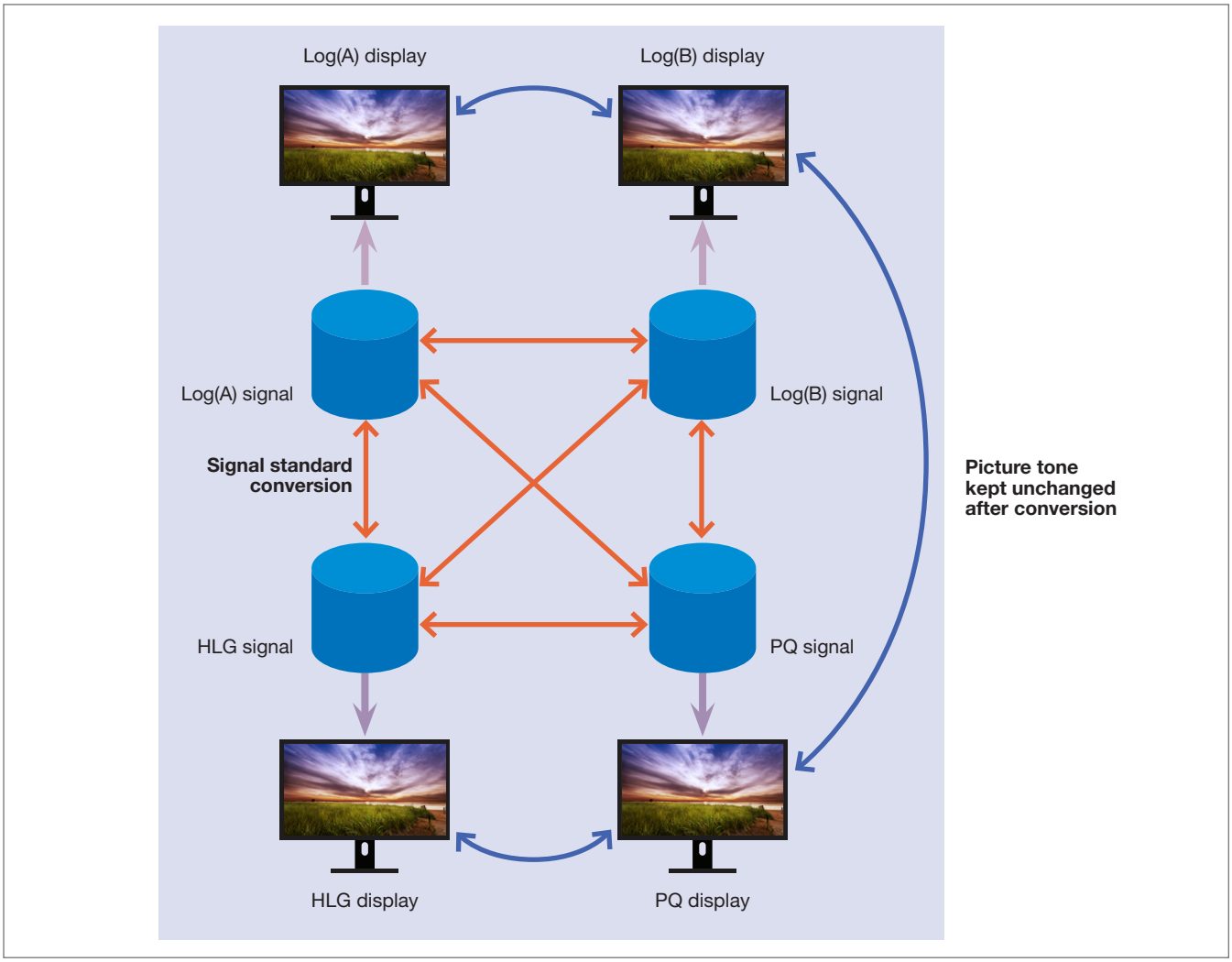

Figure 8 — Signal standard conversion on display light base

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