# InSync Technology Ltd White Paper: Best practice in handling High Dynamic Range (HDR) content

Producing content in high dynamic range (HDR) has many benefits because it enables a wider range of artistic decisions. In particular, HDR enables greater contrast ratios, such that fine variations in blacks can be accommodated at the same time as very bright whites. These improvements lead to more realistic scenes which in turn enable higher audience engagement.

HDR is particularly applicable to sports productions, where high production quality and broadcaster differentiation are needed to attract subscribers. Most 4K TVs now support HDR, as do an increasing number of mobile phones. With programme delivery moving to OTT, the use of HDR in live production is growing and many content catalogues are being remastered in HDR. This enables differentiation and the opportunity to charge a premium subscription rate in the densely crowded SVOD market.

Despite the growth of HDR content consumption, there remains a significant audience still viewing in standard dynamic range (SDR), so many broadcasters need to provide simultaneous HDR and SDR delivery. A further headache arises where there is a need for a hybrid HDR/SDR production environment. This can occur, for example, if SDR content from archive or from another location must be mixed into an HDR production.

**Creating SDR from HDR-focused production**

ITU document BT.2408-2 presents a number of use cases where HDR and SDR are both required in typical production environments. Some scenarios can be quite complex, with both HD and UHD content in use. In such instances, dynamic range mappings are needed along with conversion between resolutions (e.g., up- or downconversion) and colour space mappings (e.g., between BT.709 and BT.2020).

In a simple use case, the entire production is HDR-focused, with all on-site cameras being HDR-capable and the full production workflow being HDR-enabled. The required SDR feed is generated from the final HDR programme feed.

For such a scenario, BT.2408 recommends that the SDR output be produced via a display-referred mapping as this means that the output HDR and SDR will have the same look. However, this inevitably means that the maximum supported output level is less than the source level, so clipping or limiting will need to be applied. This process is sometimes referred to as display mapping or tone mapping (ITU BT.2390). Figure 1 illustrates display mapping where content mastered for an HDR reference display is modified to be shown on a display with a smaller dynamic range.

Clipping functions may also be modified with a hard or a soft clip, both shown in Figure 2. A hard clip means that high brightness levels not supported in the selected output format are hard-clipped to the maximum supported brightness level. A soft clip means that brightness levels close the maximum supported in the selected output format are progressively attenuated to avoid an abrupt cut-off.

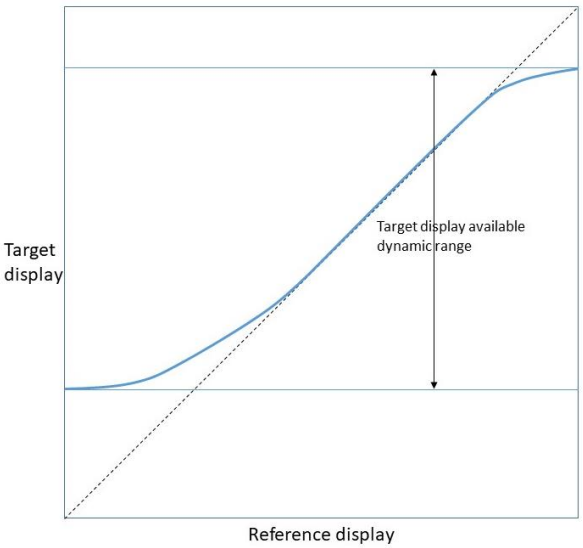


**Figure 1: Example mapping for dynamic range reduction**

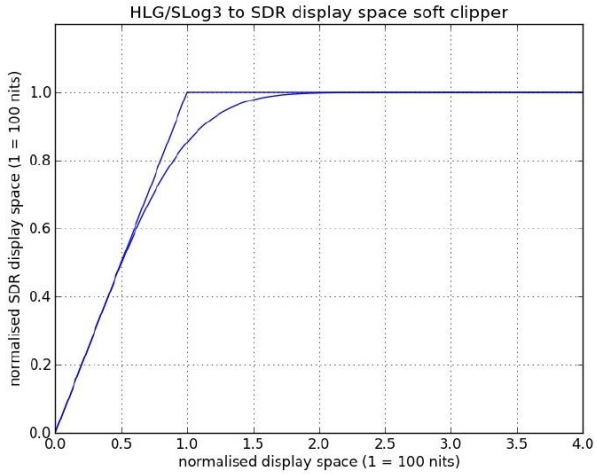


**Figure 2: Hard and soft clip examples**

Where clipping is in effect, the broadcaster may want to adjust the level at which the white clip point applies. Such adjustments modify the maximum white level at the target display, and can be used to create special mood effects. Figure 3 illustrates an example in which 100% indicates compliance with the applicable HDR or SDR standard.

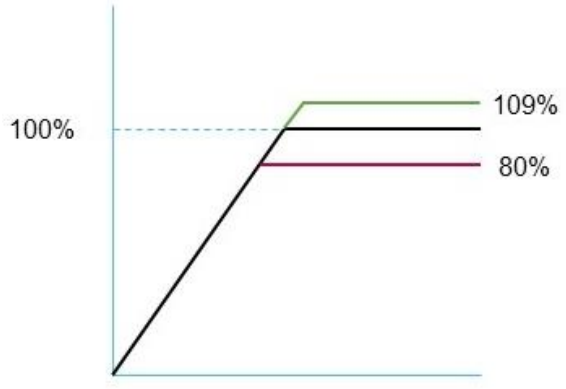


**Figure 3: Maximum white adjustments**

**Integrating SDR into an HDR production**

BT.2408-2 presents a scenario where content from an SDR camera needs to be integrated into an HDR production (e.g., using the HLG HDR standard).

SDR-to-HDR conversion may be carried out with no additional processing (i.e. the SDR content is passed into HDR format without alteration). This approach is recommended when conversion back to SDR — known as “round-tripping” — may be required downstream.

It is also possible to convert SDR to HDR with some enhancement. In this case, the broadcaster can choose to increase brightness levels of the HDR output content. This option is valuable in situations where the SDR insert highlights were originally heavily clipped by the SDR camera at acquisition.

Enhancement will increase the brightness of SDR content near peak white. Ideally, the broadcaster may adjust various parameters determining both the amount of increase in the brightness of the content which is close to peak white and the threshold above which the SDR enhancement is applied. Figure 4 shows two examples where the threshold at which the enhancement is applied and the amount of gain applied can be chosen by the user. The graph on the left shows a threshold of 0.2, whereas the graph on the right shows a threshold of 0.8, both with various gains up to 4.0.

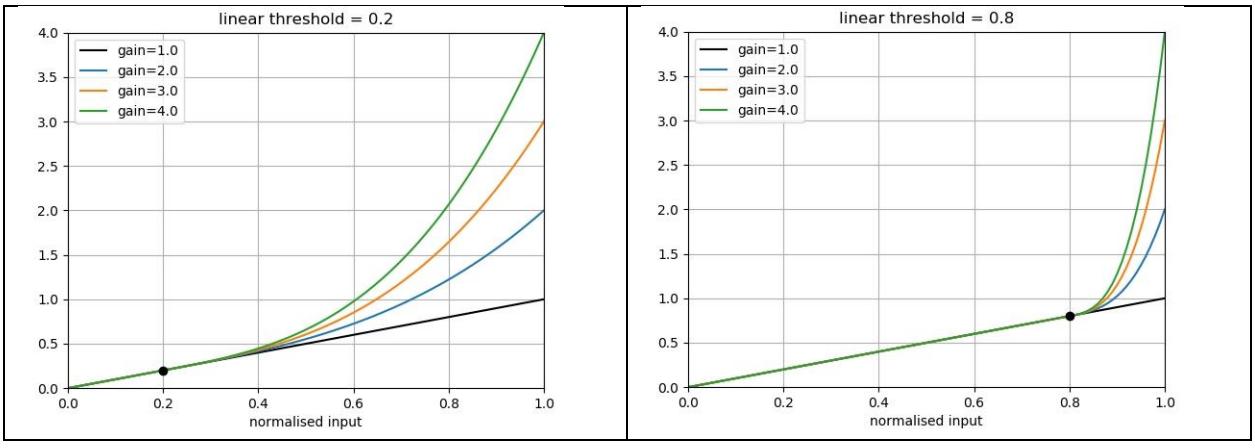


**Figure 4: SDR enhancement examples**

Sometimes, the broadcaster wants to more closely match the brightness of the HDR content. If that brightness is known, scaling can be carried out to bring up the brightness of the mapped SDR content. BT.2390 refers to the option of performing scaling and gamma adjustments in linear light space. Scaling should be performed with care lest scaled SDR content, and skin tones in particular, becomes brighter than in the HDR content.

**How InSync can help**

This white paper focuses on the simplest use cases for handling HDR in today's production environments. Many broadcasters are tackling far more complex workflows, with multiple deliverables required in a range of formats and standards.

With so many different parameters to consider when mapping between different formats, it's easy to make mistakes that lead to nonstandard content and potentially bad deliverables. HDR production is very complex and requires highly trained experts with the correct monitoring equipment to make decisions about the multiple conversion parameters.

So, what can you do if you don't have enough experts on site or you don't have an available expert to set up the HDR equipment at the moment and location you need them?

InSync Technology answers these challenges with PixFormer, the latest in the company's range of API integrated software-based conversion modules, which targets SDR/HDR conversion applications. InSync's PixFormer brings high-quality SDR-to-HDR, HDR-to-SDR, and HDR-to-HDR conversions to content processing and distribution platforms. Easy to integrate via its open API and flexible to deploy, PixFormer can run on premise or in any cloud environment. The use of CPU-only resources further illustrates the flexibility and scalability of the software.

As a software-only toolset, PixFormer can be controlled remotely by an expert, solving the problem of getting the required personnel on site. PixFormer builds on InSync's modular approach to providing high-quality image processing wherever it is required in the content supply chain. The software's range of advanced tools means that producers are always in full control of the content output, and flexible deployment options fully support remote production.

More information is available at www.insync.tv/software-solutions/pixformer.

If you would like to find out more, please contact InSync Technology enquiries@insync.tv