

# MovieLabs Specification for Next Generation Video – Version 1.0

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## Introduction

Display and distribution technologies are advancing at an accelerated pace. MovieLabs, a technology joint venture of Disney, 20<sup>th</sup> Century Fox, Paramount, Sony Pictures, Universal and Warner Bros. recognizes these trends and would like to take advantage of these developments.

This high-level specification has the following primary goals:

1. Provide consumers with entertainment content at the highest quality technology allows.
2. Preserve the artistic intent of the content creators throughout the distribution pipeline to the maximum extent possible.
3. Provide integrated, extensible and future-proof solutions.
4. Provide incentive for manufacturers of display and player devices to compete in the marketplace with clearly differentiated products.

Some notable technology trends present in the marketplace today are:

- Display resolution (from Full HD to Ultra-HD and beyond)
- Variety in display technologies (plasma, DLP, LCD, LED, OLED, laser)
- Performance and variance in color representation (gamut width, bit depth)
- Display brightness and dynamic range
- Video processing power and performance (frame rate conversion, spatial scaling, dithering, support of various formats, etc.)
- Integration of programmable processors in displays
- Overall processing power and capabilities in displays and players (graphics, networking, operating systems, applications)
- Capabilities to enhance and/or upgrade the performance of major components and features of devices in the field

Considering these goals along with the technology trends in the marketplace, MovieLabs puts forward the following specification as a basis for next generation video player devices to be available in supply chain products in 2014 and later.

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### **Use Case**

The primary use case for this specification is the delivery of scripted content (feature length motion pictures) to consumers in the form of a digital file. Such file may be distributed to a consumer electronically (i.e., via a network connection) or physically (on optical, flash memory, magnetic storage, etc.). The *transport/package file formats* used for the different distribution mechanisms may or may not be the same. However, it is desired for the *video elementary streams* to use a single format, which meets the requirements outlined in this document.

Decoding of such content would take place in a player, which supports this next generation video format. The player functionality can be realized in a separate device or may be integrated in the display directly.

For the case that the player is a separate device, the player shall interrogate the display (and the display shall provide) for information about the display's capabilities regarding the parameters listed below.

Next generation displays shall be designed to receive the original video format (encoded in CIE XYZ), so that the display can perform the optimal transform for its own image reproduction capability. But in the case that the player is connected to a legacy display that is not capable of processing the original video format, the player shall transform its input signal into an output that is appropriate for the display connected to it. For example, if color space mapping is required, such color mapping function would be performed in the player device.

## Requirements

### Resolution

Next generation video devices shall minimally support a resolution of at least 3840 x 2160 pixels (Ultra-HD).

Optionally, devices supporting the full cinema array of 4096 x 2160 pixels (full 4K) are desired. In the case where there is a small mismatch between the native resolution of the display and the resolution of the content, the player shall pass through the content at its native resolution, and the display shall display such content in the native resolution of the content regardless of the display's native resolution. Rescaling the image slightly to match the native resolution of the display is strongly discouraged.

### Frame Rate

Next generation video devices shall minimally support the following frame rates for 2D and 3D respectively<sup>1</sup>.

- 2D: 24p, 25p, 30p, 48p, 50p, 60p, (96p), (100p), (120p)
- 3D: 48p (24p per eye), 96p (48p per eye), 120p (60p per eye)

### Color Space

Content will be delivered encoded in the CIE XYZ color space, transported either in an X'Y'Z' or in a color differenced Y'DzDx format. The player device and next generation display shall have the capability to process the XYZ encoded content and convert this to realizable colors.

### Dynamic Range

Player devices shall support the processing of signals that take advantage of displays with very high peak brightness and dynamic range/contrast ratio characteristics.

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<sup>1</sup> Support for fractional (i.e., 1000/1001) frame rates is not needed.

The format shall support a peak brightness of 10,000 nits and a black luminance of 0.005 Nits, thus resulting in a target contrast ratio of 2,000,000:1 (1 nit = 1 cd/m<sup>2</sup>). The lower threshold of the encoding range shall be 0 Nits. The upper threshold of the encoding range shall be 10,000 Nits.

### **Mastering Metadata**

The content publisher may provide metadata to signal the color space of the reference display that the title was mastered on. The metadata shall consist of the chromaticities, the peak luminance and white point of the reference display that the title was mastered on. This metadata is informative and is intended to provide the creative intent of the presentation. It is expected that the display will compare the display's native gamut to the mastering display's gamut, provided as metadata. In the case where the display's gamut is greater than or equal to the mastering display's gamut, the display shall apply standard transforms, similar to SMPTE Engineering Guideline EG 432-1:2010, to convert the XYZ encoded data to display colors. In all cases it should be presumed that the mastering viewing environment is a dim surround.

Optionally, to encourage Wider Color Gamut displays and the mastering of content for them, optional metadata specifying mathematical transformations (3x3 matrix) or 3D Look-Up Tables, may be delivered with the title. The objective here is to describe the “non-standard” Wide Color Gamut Space of the Mastering display and provide a mechanism for the downstream consumer display to reproduce this accurately – in the case that the consumer display's color gamut is similar to that of the Mastering display.

This metadata is not intended to provide any direction on how the XYZ content shall be displayed on devices that have a color gamut less than that described by the metadata. It is expected that display manufacturers will either develop devices that can fully encompass the creative range and/or bring innovative transformations that can display the data as closely as intended on the limited gamut device.

### **Encoding**

#### **Transfer Function**

To allow efficient baseband video transmission and decoder implementations, high dynamic range XYZ content will be encoded into a non-linear space using a transfer function. The transfer function will be perceptually spaced, based on the Barten perceptual model, rather than on gamma.

#### **Color Sample Bit Depth**

The target for bit depth is at least 12 bits, in order to minimize banding/contouring artifacts that might occur given the wide color gamut (especially at high contrast ratios). Testing continues to validate the adequacy of this bit depth.

### **Color Sampling**

Color Sampling in the format of 4:2:0, 4:2:2 and 4:4:4 shall be supported to the extent that investigations demonstrate the benefit of higher color sampling.

MovieLabs and its member studios are studying the impact of color sampling in 4:2:2 and 4:4:4 format. 4:4:4 might yield some advantages in encoding efficiency.

### **Color Differencing**

Color Differencing shall be supported, and the MovieLabs and its members are currently evaluating schemes that would provide a true luminance and chroma sub-sampling scheme that would enable greater encoding efficiencies.

### **Baseband Video Links**

Baseband video links to displays shall support color-differenced  $Y'DzDx$  at all of the stated color subsamplings (4:4:4, 4:2:2 and 4:2:0) and  $X'Y'Z'$  at 4:4:4, and at bit depths of 12, 14 and 16 bits, with the transfer function for high dynamic range described above.

In addition to supporting any signaling needed for the above, video links shall also support signaling of the mastering metadata described above.