The HDR myth & suggested setup / notes for the AppleTV X

I am not a fan of HDR. I can kinda live with Dolby Vision, but HDR has a LOT of technical issues that can only be compensated for, not fixed. Both HDR and Dolby Vision are perceptually lossy compression schemes created to stuff at least 16 bits of luminance range into a lesser bit depth using visually lossy math. Displays today are SDR not HDR.

I would suggest calibrators do a calibration for the ATVX in 4K SDR and a second calibration for 4K Dolby Vision and avoid 4K HDR if possible.

I highly recommend 4K SDR as this matches the TV

My fierce dislike of HDR comes from a deep understanding of the technical aspects of it. I have been doing best in class calibrations and taken many best of show awards for my pictures going back 30 years. I am a SMPTE, SID and SPIE member. I am deeply into the science of displays. I have participated on steering committees for some of these standards and regularly attend various conferences by SMPTE and SID on display science. I have a deep understanding of HDR and Dolby Vision. I have post production clients with ATVXs who do current top series work and film work.

I will try and make the HDR debacle as simple as I can as it is a complex thing many do not fully understand - even people in the industry. This is a simplified description of what is going on.

A HDR display is a theoretical display device that does not exist. In theory it would have a range of brightness that our current science cannot do. I am not sure you would want one as it defines that the screen would have light literally as bright as the sun with dark scenes as dim as moonless nights. Can you imagine the transition from a dark to light scene ?. Zero doubt people will turn down the brightness, reducing the HDR display to SDR again.

You have a SDR display.

This is defined as less then 1 million to 1 measured contrast ratio. Not a manufacturer claimed contrast ratio, a real standards based measurement done in a controlled test by a qualified 3rd party. SMPTE standards going back 50 years and well established perceptual science have worked out a max brightness for human vision that is comfortable. This is not sunlit bright HDR screens.

The eye has dynamic limits it can see. If half the screen is super bright, and the other half dark, you cant see the dark as well. SO there are limits to how much contrast ratio is useful. HDR/Dolby Vision is a compression scheme to bring a wider range of brightness into the consumer living room without using more bandwidth (bits per second) by using perceptual coding and lossy compression and providing this as metadata NOT higher bitrates or bitdepth. HDR/Dolby Vision remove things the average person can't see based on all sorts of super complex modeling of what the average human can't see in order to push brighter range pictures. Just like what audio compression does for things like MP3. HDR/DV are a lossey luminance compression scheme that provides a theoretical brighter white and darker black on a display that science has yet to invent.

I dont want HDR, its not a good thing. It was pushed by the Consumer Electronics Association mfgrs as a way to sell TVs, rcvrs, even cables.

It really stands for "High Dynamic Revenue"

Your TV/projector is SDR. Its contrast ratio is not HDR. It is a SDR display. Full stop.

When they shoot content for HDR they capture SDR and "metadata" about what is bright and dark in scenes. As HDR DOES NOT HAVE MORE BITS they spread the bits they have around to cover a wider range and use perceptual coding to compress what would normally take 14 or 16 bits to cover. They then store this "meta data" that describes where the bits could go if the display is actually HDR. So HDR starts off by chopping up the luminance (brightness) pixel by pixel / scene by scene into disconnected chunks and doing perceptual compression based on a "std" human. So it puts some bits here and some there and discards data the "avg" person might not pick up on under "Normal viewing conditions". HDR does not add any new

resolution (bitdepth) to luminance. No more steps between black and white. It just spreads them out in blocks and does compression.

The SDR captured tho is very accurate and 10 bits is plenty for the eye with TONS of science and decades of research behind it. So a HDR program is SDR + HDR meta data.

Capture and post production are more complicated because how do you set the right HDR brightness and see the picture when a true HDR display does not exist for use in post ? Only tone mapped SDR displays can be used. No one has ever seen a actual HDR picture. They just hope and guess. With each tone mapped display in post being different as there are no standards.

On the display side.. If you had a true HDR display then the bits would simply land in the right place in brightness, no processing required. In fact the perceptual compression might be OK. BUUTTT,, No one has a HDR display.. And science does not know how to make one.

SO.. On the consumer display side.. The incoming SDR + HDR metadata decodes into a HDR set of bits. This chunky blocking of compressed brightness bits needs to be reduced to fit on the SDR display brightness range. This is tone mapping. So tone mapping is, at best, a guess by each mfgr on how to handle this reduction of contrast ratio and what to do with all these blocks to somehow remap and reconstruct a continuous black to white range that works on your display device. Color also needs tweaking if you play with the brightness of a pixel. Of course what was tossed out in perceptual coding is gone forever. There is no standard for tone mapping. Each mfgr does it different. No 2 pics are alike. This math is highly complex as it varies scene by scene, area by area, pixel by pixel. Lumigen has made a LOT of money off HDR doing this math. They do it really well by the way. But it is by no means perfect and some material was lost by the perceptual coding. Also its different then the director saw because every HDR display has a different set of tone maps. So a director / DP watches a display and a set of tone maps that is different then what a consumer sees. Tone maps are literally hand tweaked. Some TVs use AI and every time you run a scene thru it looks different. Dark areas just never work well because of bit starvation. They have banding most times as the crude incomplete perceptual compression then undoing of it onto a real TV does not fully model dark well and banding results along with noise.

At times, very rarely, the tone mapping can give more bits to a section

or a scene. So under IDEAL conditions, with a perfect calibration, with the right movie from the right app, with the moon in the right phase,, parts of a scene can look better then the SDR for a few seconds. Maybe. This is rare and comes at a cost to the rest of the scene VS just doing SDR. As SDR is the master, you really wont get any better then the SDR, HDR will just have darker dark scenes and brighter bright scenes. Which I personally dont want to have the sun in a outdoor scene be as bright as the real thing. I dont need sunburn from my watching beach scenes.

Tone mapping is fitting a square peg in a round hole with a hammer and every mfgr has a different hammer along with every peg and hole being different moment by moment.

BUT.. You can simply discard the HDR metadata and use the original SDR and skip a lumigen and feed that to the display directly. Set the Apple TV X to 4K SDR and turn off "match content - dynamic range" Leave "match content - frame rate" on. You then get the uncompressed unaltered SDR That the director saw and intended and its just stunning. Math/compression induced banding and noise are gone. This native SDR matches your SDR display. No need to process the image with tons of math. I have done a LOT of work on this using all the high end projectors and flat panels and the best pic comes from SDR directly into the display with a short HDMI cable. This also makes technical sense. I realize tho a lot of people with a Lumigen use it for HDMI switching and so its hard to just pull it or work around it. Any device between the ATVX and the display/sound processor will degrade the pic. So try and keep the path pure as the electrical characteristics of the HDMI coming out of the ATVX is VERY low jitter and VERY low noise and a lab grade clock. A good path is AppleTV X > Sound processor > Display.

Pass this email to your calibrator if they are of the mind that HDR is better. Many people somehow think HDR is better. Its not.

So I would have your calibrator do one for 4K HDR setting on the apple TV and then one with the setting for 4K SDR. And you can judge for yourself.

Its important for a calibrator to use test patterns from the ATVX from places like maybe youtube or his own uploaded vids or pics. The ATVX can play media off a local UPnP server. So A calibrator would bring a server like a small qnap and run calibration material off it right on the AppleTV X. Apps like Plex or VLC. Different apps use different CODECs

tho so its important to look at real content on apps like Paramont+ and Disney for example. Youtube can land high bitrate material. I have some evaul clips on youtube that are good for this kind of use.

IMPORTANT NOTES AND SETTINGS ON VARIOUS TVs

Some TVs, like LGs, have horrendous settings for SDR. To me these seem intentional in order to make SDR look bad and HDR / Dolby Vision look good. So it might be best to use 4K HDR on some TVs in order to get the best picture because of choices hard to circumvent in simple settings. Dolby Vision is ALWAYS the better setting VS HDR. Avoid HDR.

Sony OLED panels and both std projectors and laser projectors are best on 4K SDR. Sony knows what they are doing.

JVC projectors also seem best on 4K SDR

No matter what,,, you should try out the settings and see what looks best. You should get a professional calibration if possible but they need to read the above as they might force you into HDR and a lesser picture while claiming its best

HDMI CABLES MATTER TO PICTURE AND SOUND QUALITY. Experiment and see what works best in your system

HOOK Up THE ATVX via ethernet if you can. Wireless is not the best way as it generates a lot of RF noise

Power and ethernet cables matter I am also told. These can affect the RF environment.