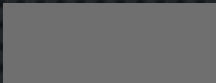


FFMPEG DEFAULTS

STATUS REPORT

SAM RICHARDS





OUTLINE

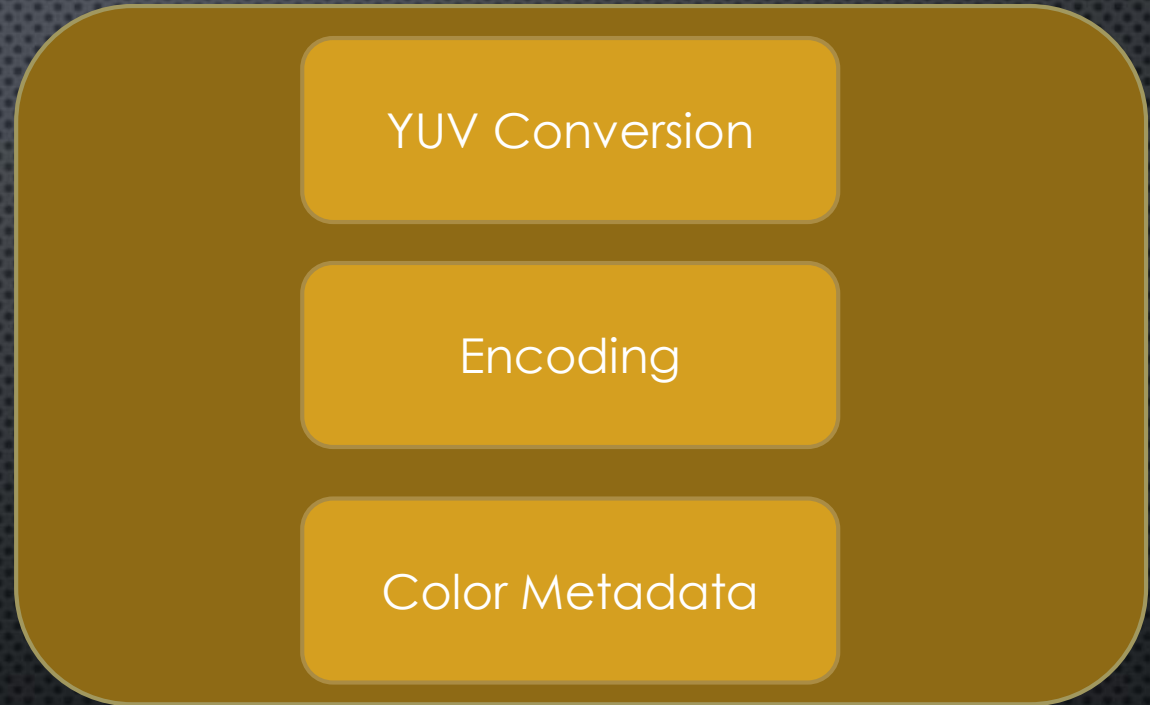
- ENCODING OUTLINE
- YCrCb/YUV CONVERSION
- MEDIA ENCODING
- MP4 COLOR METADATA

OCIO conversions done prior to
ffmpeg

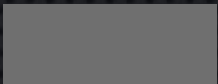
Ideally resulting mp4 matching
PNG

Nuke

Oiiotool



YUV CONVERSION



BASIC FFMPEG CONVERSION.

```
FFMPEG -R 24 -I MYFRAMES.%04D.PNG -VCODEC LIBX264 -CRF 25 -PIX_FMT YUV420P TEST.MP4
```

[YUV Encoding Comparison.](#)

YUV CONVERSION SUMMARY

- `-vf "COLORMATRIX=BT470BG:BT709"` -- BETTER THAN NOTHING, BUT NOT GREAT.
- `-vf "COLORSPACE=BT709:IAALL=BT601-6-625:FAST=1"` -- PRETTY GOOD.
- `-vf "SCALE=IN_RANGE=FULL:IN_COLOR_MATRIX=BT709:OUT_RANGE=TV:OUT_COLOR_MATRIX=BT709"` – GREAT!

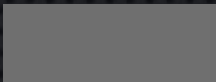
BETTER FFMPEG CONVERSION

```
FFMPEG -R 24 -I MYFRAMES.%04D.PNG -VF
```

```
"SCALE=IN_RANGE=FULL:IN_COLOR_MATRIX=BT709:OUT_RANGE=TV:OUT_COLOR_MATRIX=BT709" -VCODEC LIBX264 -CRF 25 -PIX_FMT YUV420P TEST.MP4
```

RECOMMENDED ADDING TO ALL FRAME ENCODING TO MP4 FILES.

MP4 COLOR METADATA



METADATA FOR COLORSPACE/NCLC TAGS

- -COLOR_RANGE 1 -COLORSPACE 1 -COLOR_PRIMARIES 1 -COLOR_TRC 1
- FLAGS USED FOR HINTS TO DECODER

RV SUPPORT FOR NCLC TAGS

FPS	25 (retimed to 25)
VideoTracks	1
VideoCodec	H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10
VideoPixelFormat	yuv420p
COLR/ParameterType	nclx
COLR/Primaries	ITU-R BT709 (1)
COLR/Transfer	GAMMA 2.8 (5)
COLR/Matrix	ITU-R BT709 (1)
ColorSpace/WhitePrimary	(0.3127, 0.329)
ColorSpace/RedPrimary	(0.64, 0.33)
ColorSpace/GreenPrimary	(0.3, 0.6)
ColorSpace/BluePrimary	(0.15, 0.06)
ColorSpace/ChromaPlacement	Left
ColorSpace/Range	Video Range
ColorSpace/Conversion	Rec709
ColorSpace/Gamma	2.8
ColorSpace/Transfer	Gamma 2.8
ColorSpace/Primaries	Rec709
FrameType	I Frame
Audio	No
Note	Movie Has Slow Random Access
Movie/Encoder	Lavf58.76.100
PixelAspectRatio	1

FPS	25
VideoTracks	1
VideoCodec	H.264 / AVC / MPEG-4 AVC / MPEG-4 part 10
VideoPixelFormat	yuv420p
COLR/ParameterType	nclx
COLR/Primaries	ITU-R BT709 (1)
COLR/Transfer	ITU-R BT709 (1)
COLR/Matrix	ITU-R BT709 (1)
ColorSpace/WhitePrimary	(0.3127, 0.329)
ColorSpace/RedPrimary	(0.64, 0.33)
ColorSpace/GreenPrimary	(0.3, 0.6)
ColorSpace/BluePrimary	(0.15, 0.06)
ColorSpace/ChromaPlacement	Left
ColorSpace/Range	Video Range
ColorSpace/Conversion	Rec709
ColorSpace/Transfer	Rec709
ColorSpace/Primaries	Rec709
FrameType	I Frame
Audio	No
Note	Movie Has Slow Random Access
Movie/Encoder	Lavf58.76.100
PixelAspectRatio	1

METADATA COLORSPACE FLAG

Numeric Value	String values	Description
0	rgb	
1	bt709	Typically set it to this.
2		unspecified
9	bt2020nc bt2020_ncl	ITU-R BT2020 non-constant luminance system
10	bt2020c bt2020_cl	ITU-R BT2020 constant luminance system

-colorspace 1 or -colorspace bt709

METADATA COLOR_PRIMARIES FLAG

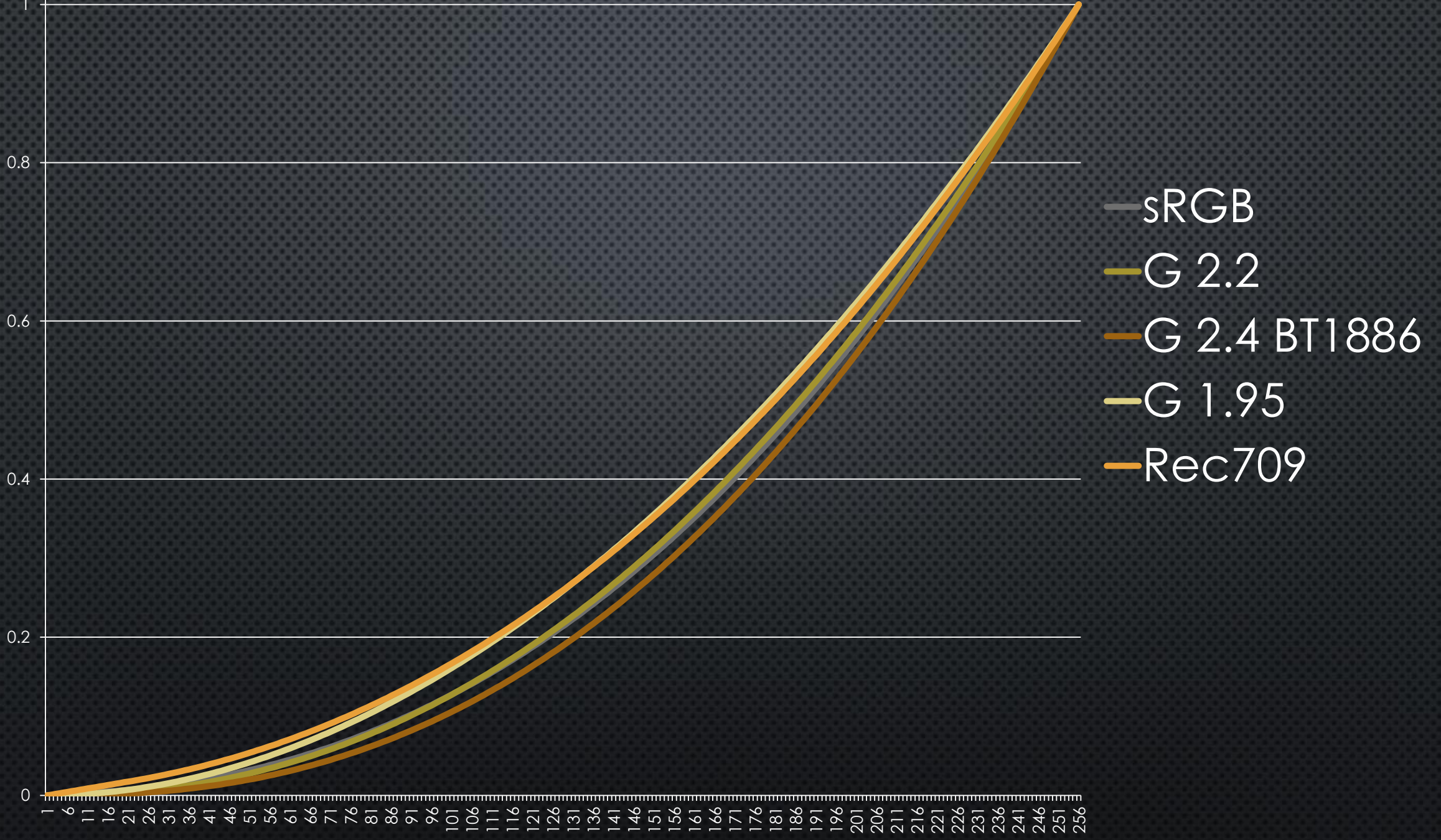
Numeric Value	String Values
1	bt709
9	bt2020

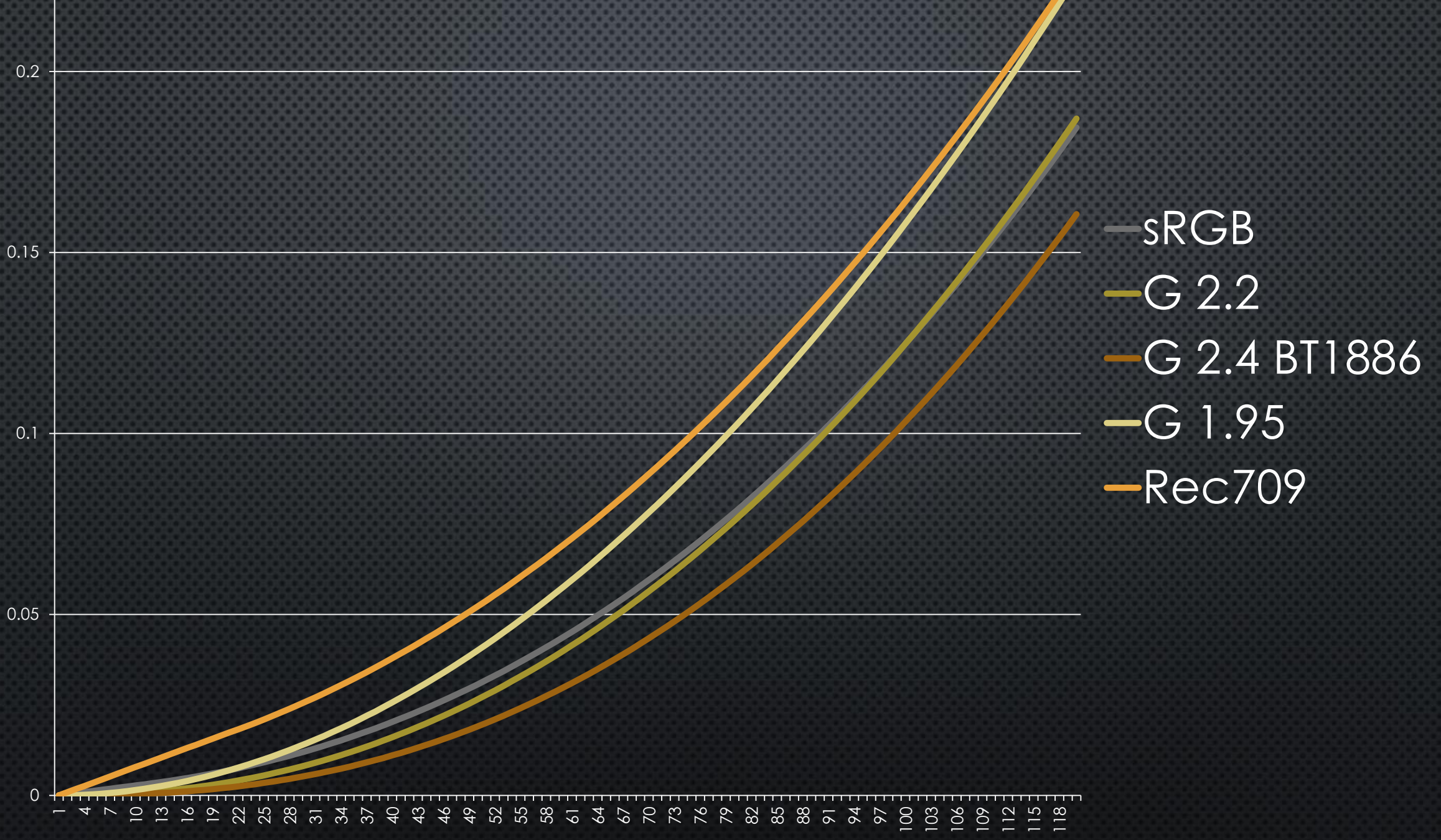
`-color_primaries 1` or `-color_primaries bt709`

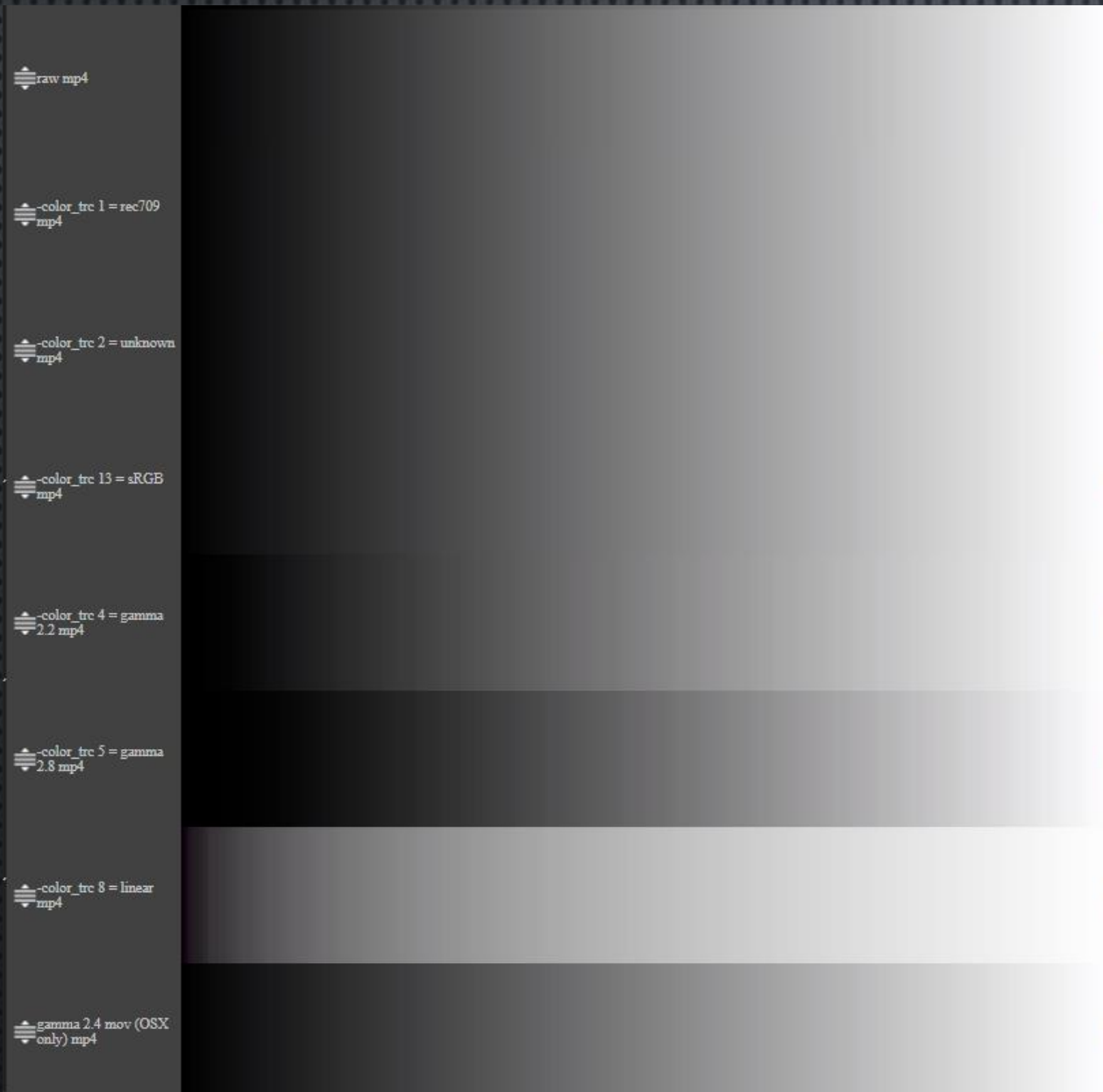
METADATA COLOR_TRC FLAG – AKA COLOR TRANSFER CHARACTERISTIC

Numeric Value	String Values	Description
1	bt709	Note this is the camera gamma i.e. ~1.95 this is NOT bt1886
2		Image characteristics are unknown or are determined by the application.
4	gamma22	
5	gamma28	
8	linear	Linear
13		sRGB

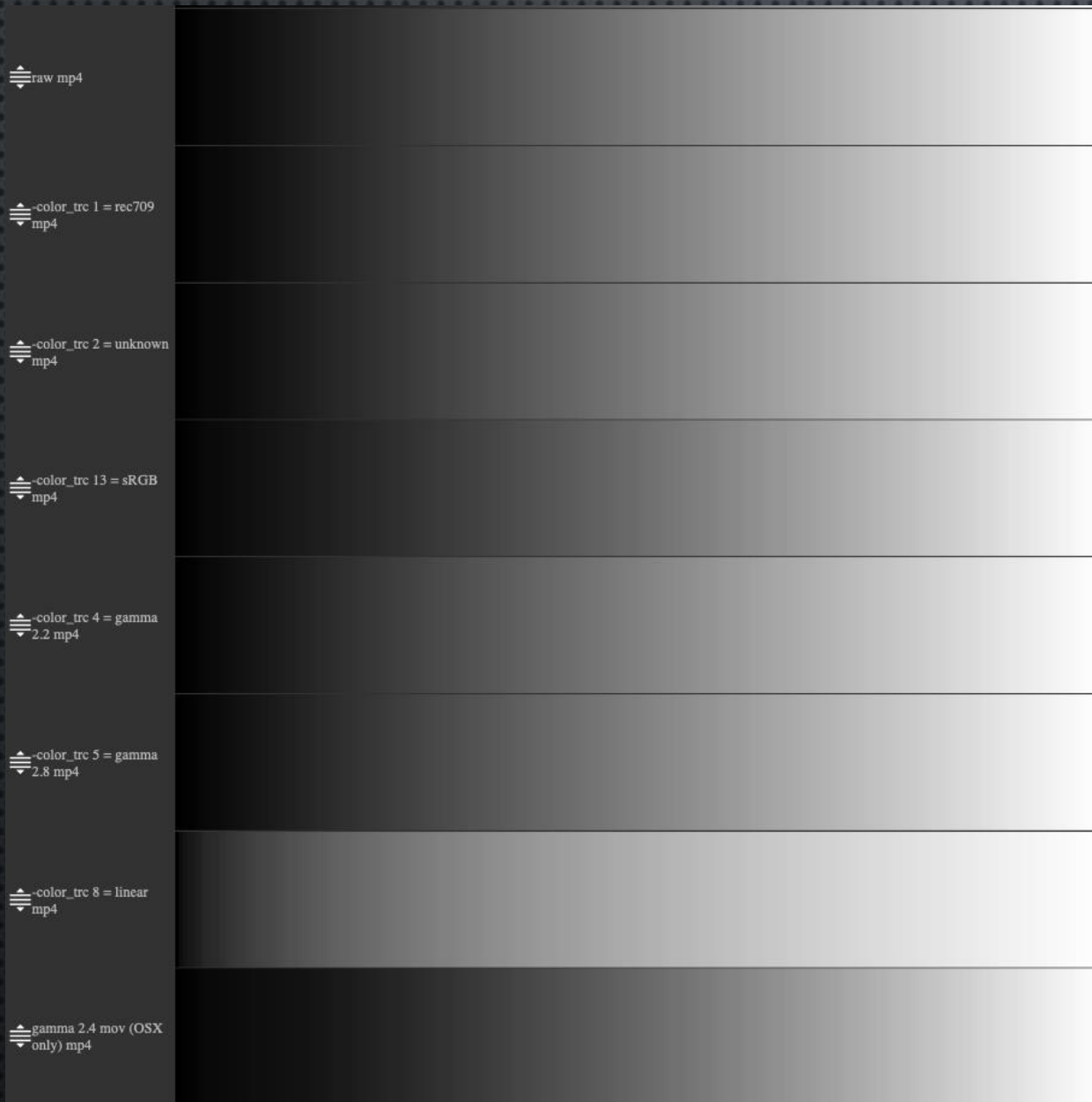
-color primaries 4





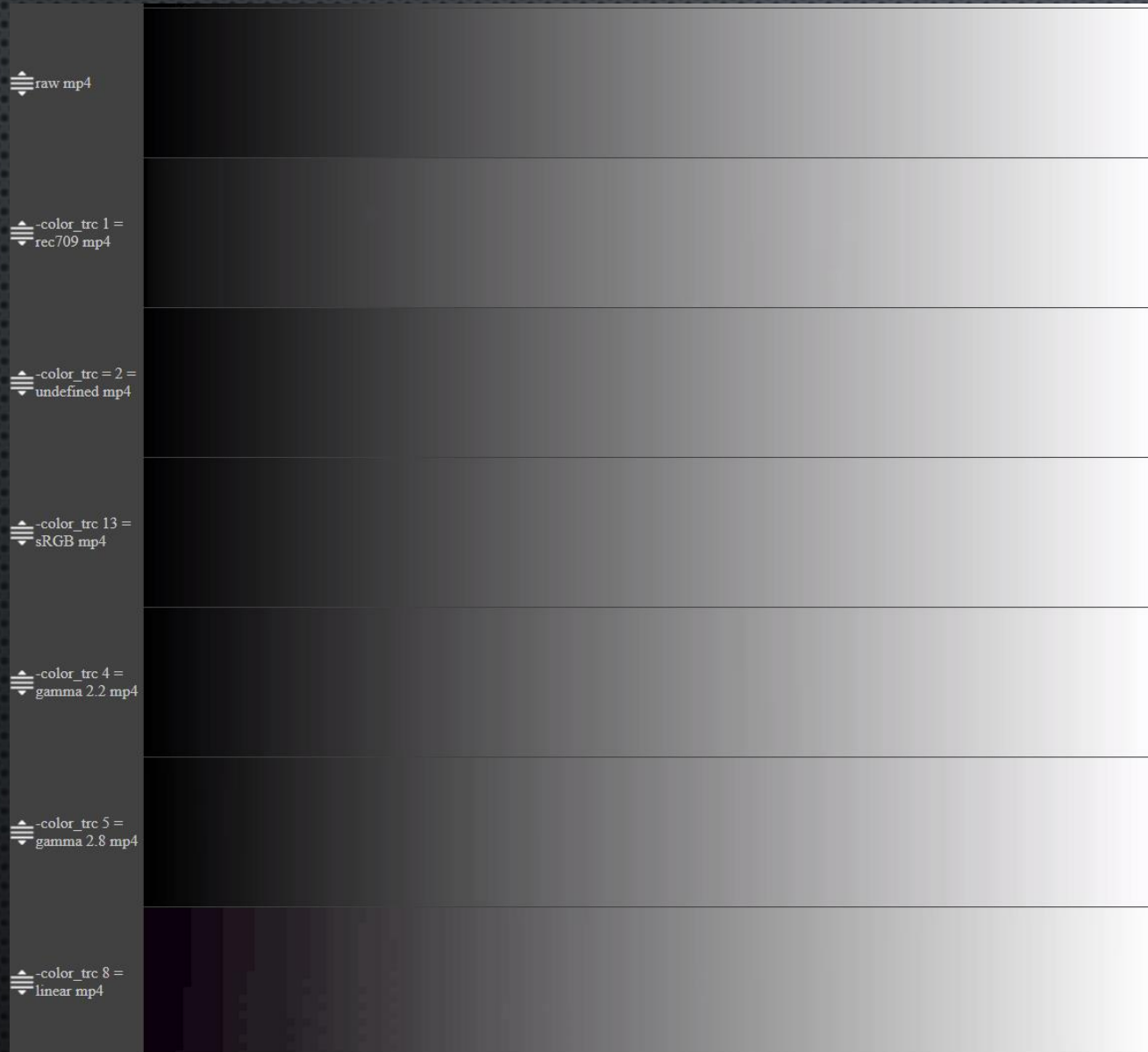


- This page is showing exactly the same media encoded with only the color_trc flag changing.
- If you look in firefox on windows, everything will look the same.
- OSX and Windows the grads will look different.
- You can drag the grads to more easily compare them.
- Quantizing is bad.
- Color shift compared to PNG file on windows.
- -color_trc 1 doesn't seem to do anything.



- This is showing the same on OSX on safari.

<https://richardssam.github.io/ffmpeg-tests/tests/greyramp-rev-ps/compare.html>



Similar to [ICC Profile tests](#), do the flags do what is expected?

Here each Grad is designed so that if the metadata flag is applied correctly, we get a gamma 2.2 curve, this may only work correctly on windows or a sRGB display.

-color_trc 1 is clearly doing something unexpected.

-color_trc 13 (if you ignore the color shift issue) gets the closest.

<https://richardssam.github.io/ffmpeg-tests/tests/greyramp-revs/compare.html>

raw mp4

-color_trc
= 2 =
undefined
mp4

-color_trc 1
= rec709
mp4

-color_trc
13 = sRGB
mp4

-color_trc 4
= gamma
2.2 mp4

-color_trc 5
= gamma
2.8 mp4

-color_trc 8
= linear
mp4

Safari on OSX produces a different result for mp4's.

raw mp4

-color_trc =
2 =
undefined
mp4

-color_trc 1
= rec709
mp4

-color_trc 13
= sRGB
mp4

-color_trc 4
= gamma 2.2
mp4

-color_trc 5
= gamma 2.8
mp4

-color_trc 8
= linear
mp4

Firefox for OSX mp4's.

raw mp4

-color_trc = 2
= undefined
mp4

-color_trc 1 =
rec709 mp4

-color_trc 13
= sRGB mp4

-color_trc 4 =
gamma 2.2
mp4

-color_trc 5 =
gamma 2.8
mp4

-color_trc 8 =
linear mp4

Firefox for Windows mp4's.

raw png

srgb png

gamma1.95
png

gamma2.2
png

gamma2.8
png

lin png

Safari on OSX produces a different result for PNG values.

raw png

srgb png

gamma1.95 png

gamma2.2 png

gamma2.8 png

lin png

Chrome for windows produces similar results with PNG files

BETTER FFMPEG CONVERSION

IF YOUR DISPLAY DEVICES ARE sRGB PROPOSE USING:

```
FFMPEG -R 24 -I MYFRAMES.%04d.PNG -VF  
"SCALE=IN_RANGE=FULL:IN_COLOR_MATRIX=BT709:OUT_RANGE=TV:OUT_COLOR_MATRIX=BT709" -  
VCODEC LIBX264 -CRF 25 -PIX_FMT YUV420P -COLOR_RANGE 1 -COLORSPACE 1 -  
COLOR_PRIMARIES 1 -COLOR_TRC 13 TEST.MP4
```

IF YOU ARE USING GAMMA 2.4 IN FIREFOX:

```
FFMPEG -R 24 -I MYFRAMES.%04d.PNG -VF  
"SCALE=IN_RANGE=FULL:IN_COLOR_MATRIX=BT709:OUT_RANGE=TV:OUT_COLOR_MATRIX=BT709" -  
VCODEC LIBX264 -CRF 25 -PIX_FMT YUV420P -COLOR_RANGE 1 -COLORSPACE 1 -  
COLOR_PRIMARIES 1 -COLOR_TRC 2 TEST.MP4
```


ALTERNATIVE FOR OSX

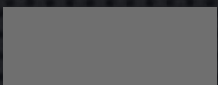
```
FFMPEG -R 24 -I MYFRAMES.%04D.PNG -VF  
"SCALE=IN_RANGE=FULL:IN_COLOR_MATRIX=BT709:OUT_RANGE=TV:OUT_COLOR_MATRIX=BT7  
09" -VCODEC LIBX264 -CRF 25 -PIX_FMT YUV420P -COLOR_RANGE 1 -COLORSPACE 1 -  
COLOR_PRIMARIES 1 -COLOR_TRC 2 -MOVFLAGS WRITE_COLR+WRITE_GAMA -MOV_GAMMA  
2.4 TEST.MOV
```

CAN EXPLICITLY SET GAMMA IN MOV FILE.

COLOR SCIENCE HELP

- THIS IS MESSED UP!
- [HTTPS://BUGS.CHROMIUM.ORG/P/CHROMIUM/ISSUES/DETAIL?ID=1262622#C16](https://bugs.chromium.org/p/chromium/issues/detail?id=1262622#c16)
- WHICH PLATFORMS ARE SEEING COLOR SHIFT?
- FIREFOX PLUGIN – DISABLING COLOR MANAGEMENT. – NOT SURE IF THIS IS AN ISSUE ON WINDOWS?
- COULD USE HELP – WITH RECOMMENDATIONS?
 - LOGIC BEHIND REC709 AND REC2020 GAMMA ~ 1.95 ?
 - WHAT DOES `-COLOR_TRC 1` ACTUALLY DEFAULT TO.
 - WHICH BROWSERS HAVE A DECENT RESPONSE ON EXTENDED GAMUT DISPLAYS (P3, REC2020, ETC) AND/OR BT1886

ENCODING



LOW QUALITY ENCODING FOR WEB REVIEW

- WHAT ARE REASONABLE BIT-RATES FOR MEDIA REVIEW FROM HOME?
- CAN WE ACHIEVE WITH JUST CRF?
- E.G. “ -VCODEC LIBX264 -**CRF 25** -PIX_FMT YUV420P -PRESET SLOWER -TUNE FILM “
- **PLAN TO EXPLORE: [HTTPS://WORKFLOW.FRAME.IO/CODEC-COMPARISON](https://workflow.frame.io/codec-comparison)**

HIGH QUALITY H264 ENCODING

- `-LIBX264RGB` - AVOIDS MESSY YUV CONVERSION, WITH LIMITED PLAYBACK, AND 8-BIT ONLY (E.G. RV), ALSO NO SUB-SAMPLING (I.E. 444 EQUIVALENT)
- `-PIX_FMT YUV444P10LE` – 10-BIT YUV, SO MORE DYNAMIC RANGE THAN `LIBX264RGB`

METADATA COLOR_RANGE FLAG

-color_range 1 is a conventional setting, meaning that lumance values are 16-235

However, it is possible to encode for full range 0-255, but you do need to change more than -color_range 2

<https://richardssam.github.io/ffmpeg-tests/tests/greyramp-fulltv/compare.html>

- Pros – it works in browsers, so you get 14% more range for “free”, less quantizing in ffmpeg process.
- Cons – some apps may not support it, may need additional work.
- Note: yuvj420p is “deprecated”, so using

- KEVIN WHEATLEY
- GATES ROBERG CLARK
- RICK SAYRE
- WENDY HEFFNER



THANKS

HELP

- REFERENCE IMAGE SEQUENCES FOR ENCODING TEST?
- RECOMMENDATIONS FOR WEB ENCODING, AND HIGH QUALITY ENCODING.
 - SUGGESTIONS FOR THE COLOR_TRC MESS?
- REPORT BUG TO GOOGLE - [HTTPS://BUGS.CHROMIUM.ORG/P/CHROMIUM/ISSUES/DETAIL?ID=1262622](https://bugs.chromium.org/p/chromium/issues/detail?id=1262622)
- CREATE TESTING MATRIX FOR:
 - COLOR_TRC SUPPORT – BROWSERS AND APPS).
 - TV/FULL RANGE SUPPORT
 - YUV444P10LE SUPPORT.
 - DISPLAY PROFILE TESTING?