Performance Evaluation
Xilinx U30

Jan Ozer
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Overview

	Xilinx U30	NVIDIA T4	x265 Medium	x265 Veryfast
Start-Up Latency	1	4	2	3
VMAF quality rank	2	4	1	3
PSNR quality rank	3	4	1	2
Subjective quality	2	4	1	3
Quality consistency	2	4	1	4
Overall	**2**	**4**	**1**	**3**

- Overall, U30 ranked second (score is an average of all tests with no weighting)
- The U30 quality rankings were relatively consistent and the U30 ranked ahead of NVIDIA and Veryfast (except for PSNR with Very fast)
- The U30's quality consistency was high which promotes QoE

- Though not reflected in the chart above, we couldn't produce a single encoding ladder using x265 Medium or Slow on our 96-core AWS C5.metal test bed
- While x265 Medium ranked first overall, it may be challenging to find an encoding station that can affordably produce a full encoding ladder using this codec/preset

Agenda

- Codecs tested: Xilinx U30, NVIDIA T4, x265 Veryfast, x265 Medium
- Clips: Crowdrun, Football, GTAV, Meridian
- Metrics: VMAF, PSNR, RD-Curves, BD-Rate Stats
- Subjective: GBT Tech
- Data rate consistency

Xilinx U30

- Test bed
- Script/capacity
- Command strings
  - Objective
  - Subjective

U30 Test Bed/ Script

u30_hevc_jan_ozer_perf2.sh

```
#!/bin/bash
if [ $# -ne 2 ]
  then
    echo "Incorrect arguments supplied"
    echo "Usage: ./"$0" <1080p60 input> <br_1080p>"
    exit 1
fi

filename=$(basename -- "$1")
filename="${filename%.*}"

out_path=/scratch/output
#/proj/ipeng/staff/umam/nobkup/00_benchmark/32_jan_ozer/u30_hevc_perf_final
#

mkdir -p $out_path

ffmpeg -f rawvideo -s 1920x1080 -r 60 -i $1 \
-filter_complex "[0:v] split[a][b]; [b]framerate=fps=30[c]; [c]multiscale_xma=outputs=3:\
out_1_width=1280:out_1_height=720:out_1_pix_fmt=vcu_nv12:\
out_2_width=960:out_2_height=540:out_2_pix_fmt=vcu_nv12:\
out_3_width=640:out_3_height=360:out_3_pix_fmt=vcu_nv12 [d][e][f];[a]split[aa][ab]" \
-map '[aa]' -c:v mpsoc_vcu_hevc -b:v 6M -max-bitrate 6M -slice-qp -1  -g 120 -qp-mode auto \
-bf 2 -lookahead_depth 20 -f mp4 -y $out_path/football_U30_1080p_6MB.mp4 \
-map '[ab]' -c:v mpsoc_vcu_hevc -r 30 -b:v 4M -max-bitrate 4M -slice-qp -1  -g 60 -qp-mode auto \
-bf 2 -lookahead_depth 20 -f mp4 -y $out_path/football_U30_1080p_4MB.mp4 \
-map '[d]' -c:v mpsoc_vcu_hevc -r 30 -b:v 2.5M -max-bitrate 2.5M -slice-qp -1  -g 60 \
-qp-mode auto -bf 2 -lookahead_depth 20 -f mp4 -y $out_path/football_U30_720p_2_5MB.mp4 \
-map '[e]' -c:v mpsoc_vcu_hevc -r 30 -b:v 1.2M -max-bitrate 1.2M -slice-qp -1  -g 60 \
-qp-mode auto -bf 2 -lookahead_depth 20 -f mp4 -y $out_path/football_U30_540p_1_2MB.mp4 \
-map '[f]' -c:v mpsoc_vcu_hevc -r 30 -b:v 0.8M -max-bitrate .8M -slice-qp -1  -g 60 \
-qp-mode auto -bf 2 -lookahead_depth 20 -f mp4 -y $out_path/football_U30_360p_800K.mp4 >
perf_output.txt 2>&1
```

- Achieved 1 full ladder on Xilinx internal test machine

U30 Start-up Latency

Preset	Latency
U30	.6 (sec)

- Recorded screen with Camtasia
- Pasted in command string
- Computed time from paste until first frame appeared
- Ran three tests and averaged time

U30 Command Strings

- Objective

```
ffmpeg -f rawvideo -s 1920x1080 -r 60 -re -i Football_1080p.yuv -vsync 0
-an  -b:v 3M -max-bitrate 3M -c:v mpsoc_vcu_hevc -slice-qp -1 -g 120
-qp-mode uniform -bf 2 -lookahead_depth 20 -spatial-aq 0 -temporal-aq 0
-rate-control-mode 0 -f mp4 -y Football_U30_tune_3MB.mp4
```

- Subjective

```
ffmpeg -f rawvideo -s 1920x1080 -r 60 -i Football_1080p.yuv -vsync 0
-an  -b:v 3M -max-bitrate 3M -c:v mpsoc_vcu_hevc  -slice-qp -1 -g 120
-qp-mode auto -bf 2  -lookahead_depth 20 -spatial-aq 0 -temporal-aq 0
-rate-control-mode 0 -f mp4 -y football_U30_viz_3MB.mp4
```

NVIDIA T4

- Test bed
- Script/capacity
- Command strings
  - Objective
  - Subjective

T4 Performance Test Script

```
ffmpeg -re -y -hwaccel cuvid -c:v h264_cuvid -i Football_1080p.mp4  \
-c:v hevc_nvenc -preset fast -qmin 0 -bf 2 -spatial_aq 1 -rc-lookahead 20 -
i_qfactor 0.75 -b_qfactor 1.1  -g 120 -keyint_min 120 -sc_threshold 0 -b:v 6M -
bufsize 6M -maxrate 12M out1/Football_NVEnc_1920_6.mp4 \
-c:v hevc_nvenc -preset fast -qmin 0 -bf 2 -spatial_aq 1 -rc-lookahead 20 -
i_qfactor 0.75 -b_qfactor 1.1 -r 30 -g 60 -keyint_min 60 -sc_threshold 0 -b:v 4M
-bufsize 4M -maxrate 8M out1/Football_NVEnc_1920_4.mp4 \
-c:v hevc_nvenc -vf scale_npp=1280:720 -preset fast -qmin 0 -bf 2 -spatial_aq 1
-rc-lookahead 20 -i_qfactor 0.75 -b_qfactor 1.1 -r 30 -g 60 -keyint_min 60 -
sc_threshold 0 -b:v 2.5M -bufsize 2.5M -maxrate 5M
out1/Football_NVEnc_720_2_5.mp4 \
-c:v hevc_nvenc -vf scale_npp=960:540 -preset fast -qmin 0 -bf 2 -spatial_aq 1 -
rc-lookahead 20 -i_qfactor 0.75 -b_qfactor 1.1 -r 30 -g 60 -keyint_min 60 -
sc_threshold 0 -b:v 1.2M -bufsize 1.2M -maxrate 2.4M
out1/Football_NVEnc_540_1_2.mp4 \
-c:v hevc_nvenc -vf scale_npp=640:360 -preset fast -qmin 0 -bf 2 -spatial_aq 1 -
rc-lookahead 20 -i_qfactor 0.75 -b_qfactor 1.1 -r 30 -g 60 -keyint_min 60 -
sc_threshold 0 -b:v .8M -bufsize .8M -maxrate 1.6M
out1/Football_NVEnc_360_800k.mp4
```

- Achieved 2 full ladders on AWS Instance

T4 Start-up Latency

Preset	Latency
T4	1.38 (sec)

- Recorded screen with Camtasia
- Pasted in command string
- Computed time from paste until first frame appeared
- Ran three tests and averaged time

Command String - Metrics

Analysis

We encoded files with and without the AQ switches noted below and PSNR and VMAF scores were higher. For this reason, we encoded files for objective metric comparisons and subjective comparisons with AQ using the command string below.

	Tune (no AQ)	Viz (with AQ)
PSNR	34.29	34.76
VMAF	81.87	83.56

```
ffmpeg -re -y -hwaccel_output_format cuda -c:v h264_cuvid -i Football_1080p.mp4 -c:v
hevc_nvenc -spatial_aq 1 -i_qfactor 0.75 -b_qfactor 1.1 -preset fast  -cbr 1 -an   -qmin 0 -
bf 2  -rc-lookahead 20  -g 120 -keyint_min 120 -sc_threshold 0 -b:v 3M -maxrate 3M -bufsize 6M
Football_NVEnc_Tune_3MB_fast.mp4
```

T4 Command Strings

- Objective

```
ffmpeg -re -y -hwaccel_output_format cuda -c:v h264_cuvid -i Football_1080p.mp4
-c:v hevc_nvenc -spatial_aq 1 -i_qfactor 0.75 -b_qfactor 1.1  -preset fast  -cbr 1
-an -qmin 0 -bf 2  -rc-lookahead 20  -g 120 -keyint_min 120 -sc_threshold 0
-b:v 3M -maxrate 3M -bufsize 6M  Football_NVEnc_Tune_3MB_fast.mp4
```

- Subjective

```
ffmpeg -re -y -hwaccel_output_format cuda -c:v h264_cuvid -i Football_1080p.mp4
-c:v hevc_nvenc -spatial_aq 1 -i_qfactor 0.75 -b_qfactor 1.1 -preset fast  -cbr 1
-an -qmin 0 -bf 2  -rc-lookahead 20 -g 120 -keyint_min 120 -sc_threshold 0
-b:v 3M  -maxrate 3M -bufsize 6M Football_NVEnc_Viz_3MB_fast.mp4
```

x265 Veryfast and Medium

- Test bed
- Script/capacity
- Command strings
  - Objective
  - Subjective

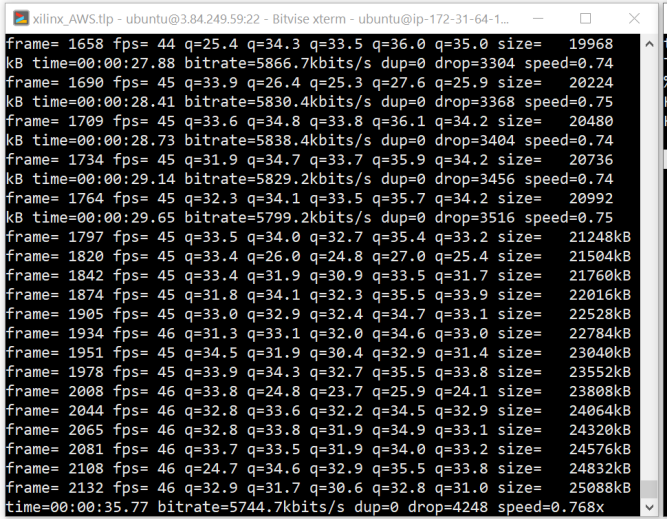
x265 Capacity/Cost

Model	vCPU	Memory (GiB)	Instance Storage (GiB)	Network Bandwidth (Gbps)	EBS Bandwidth (Mbps)
c5.metal	96	192	EBS-Only	25	19,000

- Tested on an AWS C5.metal
- Running 2nd gen Intel Xeon Scalable Processors (Cascade Lake) with a sustained all-core Turbo CPU frequency of 3.6GHz.
- On-demand pricing - $4.08/hour

x265 Veryfast

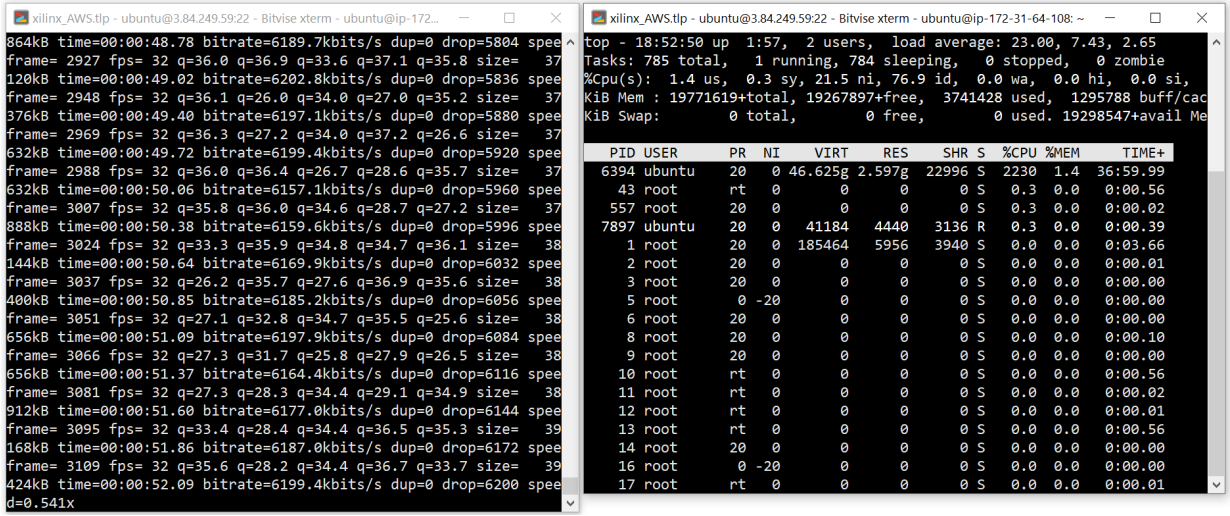
- Did not produce a single ladder




```
ffmpeg -y -re -i Football_1080p.mp4 \
-c:v libx265 -preset veryfast -x265-params keyint=120:min-keyint=120:scenecut=0:bitrate=6000:vbv-
maxrate=6000:vbv-buf-size=12000:open-gop=0 Football_1080p_6MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -preset veryfast -x265-params keyint=60:min-keyint=60:scenecut=0:bitrate=4000:vbv-
maxrate=4000:vbv-buf-size=8000:open-gop=0 Football_1080p_4MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -s 1280x720 -preset veryfast -x265-params keyint=60:minkeyint=60:scenecut=0:
bitrate=2500:vbv-maxrate=2500:vbv-buf-size=5000:open-gop=0 Football_720p_2_5MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -s 960x540 -preset veryfast -x265-params keyint=60:minkeyint=60:scenecut=0:
bitrate=1200:vbv-maxrate=1200:vbv-buf-size=2400:open-gop=0 Football_540p_1_2MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -s 640x360 -preset veryfast -x265-params keyint=60:min-keyint=60:scenecut=0
:bitrate=800:vbv-maxrate=800:vbv-buf-size=1600:open-gop=0 Football_360p_800kb_x265_veryfast.mp4
```

x265 Medium

- Did not produce a single ladder




```
ffmpeg -y -re -i Football_1080p.mp4 \
-c:v libx265 -preset veryfast -x265-params keyint=120:min-keyint=120:scenecut=0:bitrate=6000:vbv-
maxrate=6000:vbv-buf-size=12000:open-gop=0 Football_1080p_6MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -preset veryfast -x265-params keyint=60:min-keyint=60:scenecut=0:bitrate=4000:vbv-
maxrate=4000:vbv-buf-size=8000:open-gop=0 Football_1080p_4MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -s 1280x720 -preset veryfast -x265-params keyint=60:minkeyint=60:scenecut=0:
bitrate=2500:vbv-maxrate=2500:vbv-buf-size=5000:open-gop=0 Football_720p_2_5MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -s 960x540 -preset veryfast -x265-params keyint=60:minkeyint=60:scenecut=0:
bitrate=1200:vbv-maxrate=1200:vbv-buf-size=2400:open-gop=0 Football_540p_1_2MB_x265_veryfast.mp4 \
-c:v libx265 -r 30 -s 640x360 -preset veryfast -x265-params keyint=60:min-keyint=60:scenecut=0
:bitrate=800:vbv-maxrate=800:vbv-buf-size=1600:open-gop=0 Football_360p_800kb_x265_veryfast.mp4
```

x265 Start-up Latency

Preset	Latency
Veryfast	.94 (sec)
Medium	.92 (sec)

- Recorded screen with Camtasia
- Pasted in command string
- Computed time from paste until first frame appeared
- Ran three tests and averaged time

x265 Command Strings

- Objective

```
ffmpeg -y -re -i Football_1080p.mp4 -c:v libx265 -preset veryfast -tune psnr
-x265-params keyint=120:min-keyint=120:scenecut=0:bitrate=3000:vbv-
maxrate=3000:vbv-bufsize=6000:open-gop=0 Football_1080p_3MB_x265_vf_tune_buf.mp4
```

- Subjective

```
ffmpeg -y -re -i Football_1080p.mp4 -c:v libx265  -preset veryfast
-x265-params keyint=120:min-keyint=120:scenecut=0:bitrate=3000:vbv-
maxrate=3000:vbv-bufsize=6000:open-gop=0 Football_1080p_3MB_x265_vf_viz_buf.mp4
```

About The Tests

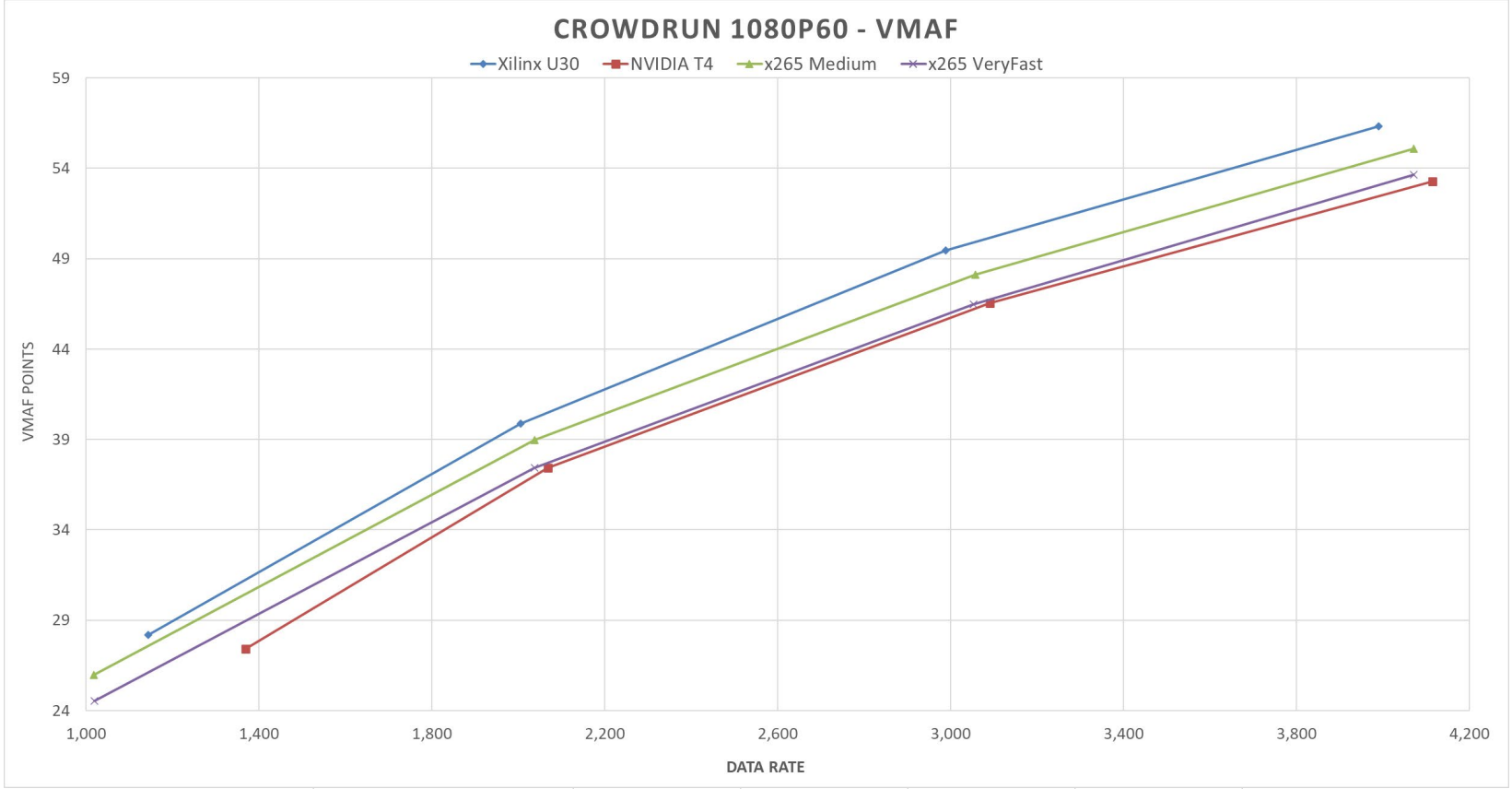
- We ran encoding trials and objective metrics on four files, three of which were 2 minutes long (Football, Meridian, GTAV) and one that was 10 seconds long (Crowdrun)
  - Objective metrics were produced using the Moscow State University Video Quality Measurement Tool
- Subjective tests were performed on ten-second segments of the three longer files and the full 10-second clip
  - Subjective tests were designed and overseen by the MPEG Test Chair Vittorio Baroncini and performed by the independent laboratory GBtech under the supervision of the Test Administrator Giacomo Baroncini
  - The tests produced the Double Stimulus Impairment Scale Mean Opinion Score according to the ITU-R Recommendation BT 500 (https://www.itu.int/rec/R-REC-BT.500-14-201910-I/en)

U30 Quality Results

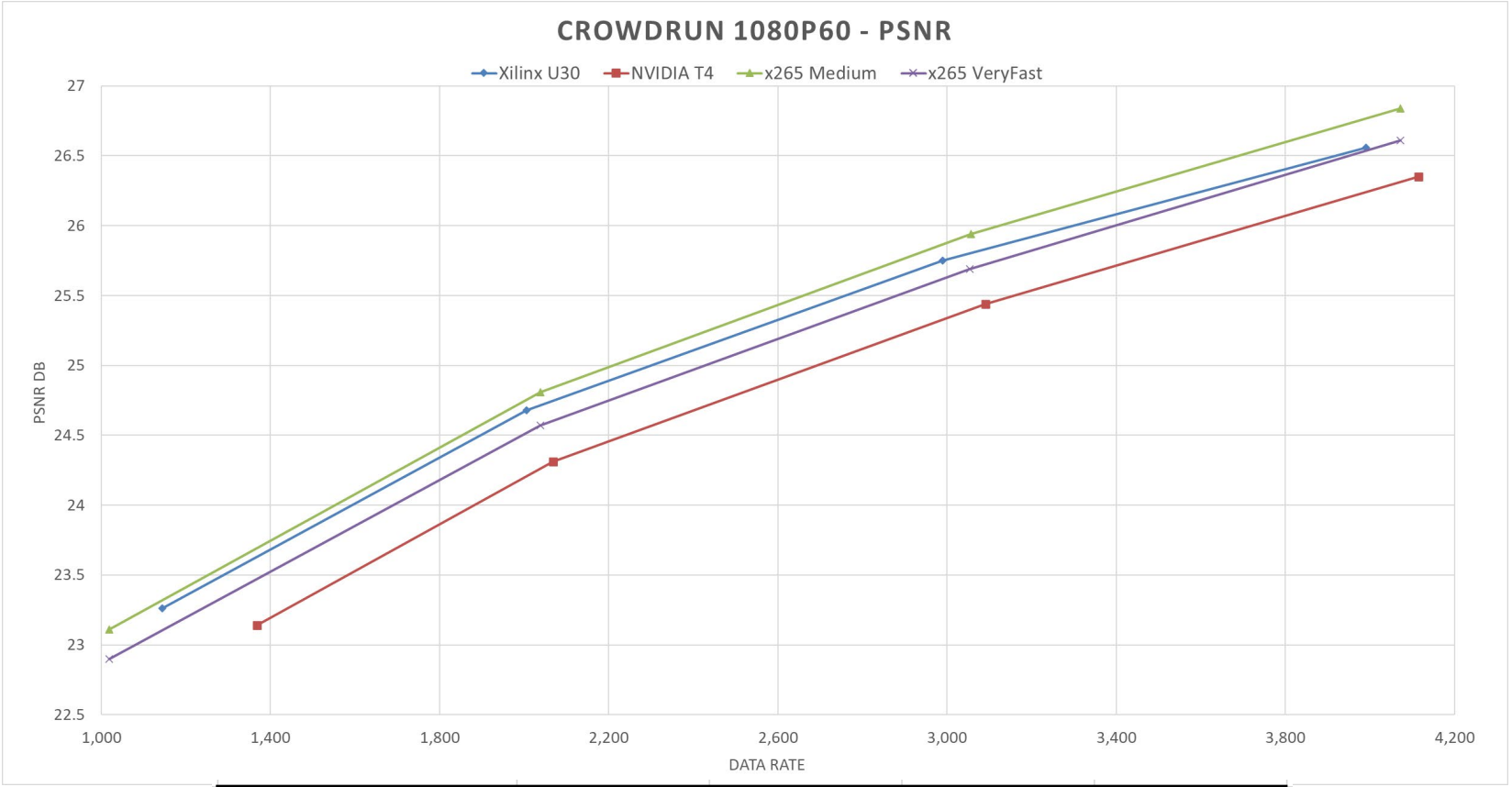
- Four videos
  - Crowdrun
  - Harmonic Football
  - GTAV
  - Netflix Meridian
  - All 1080p60
- Tested at 2-5 Mbps

Crowdrun

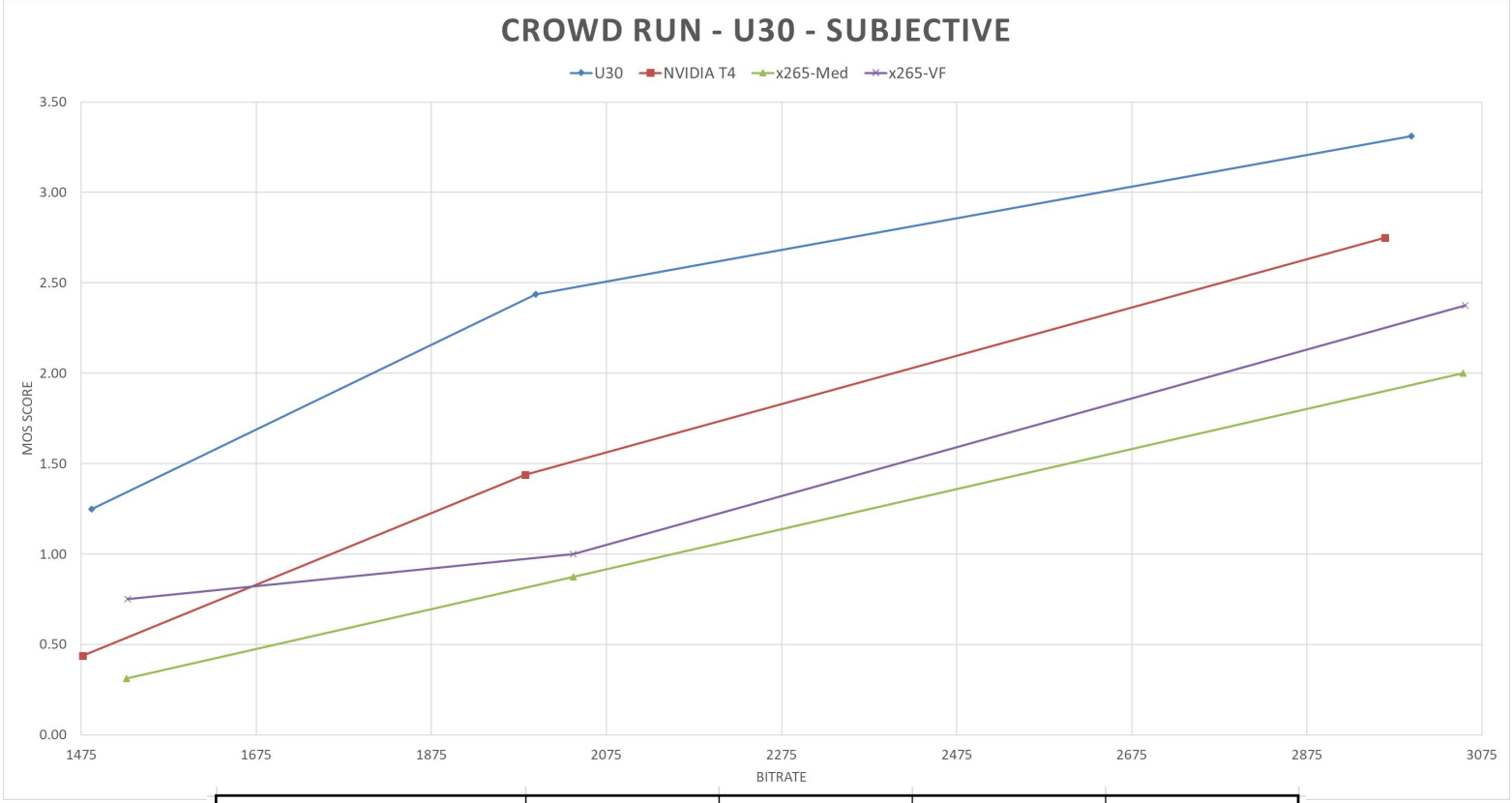
- VMAF
- PSNR
- Subjective
- Results plot (U30 vs. T4, x265 Medium, x265 Veryfast)
- Quality consistency



	VMAF - Crowdrun	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
1	Xilinx U30	X	-14.35	-5.66	-12.05
4	NVIDIA T4	16.76	X	10.63	2.98
2	x265 Medium	5.99	-9.61	X	-6.96
3	x265 VeryFast	13.70	-2.90	7.48	X

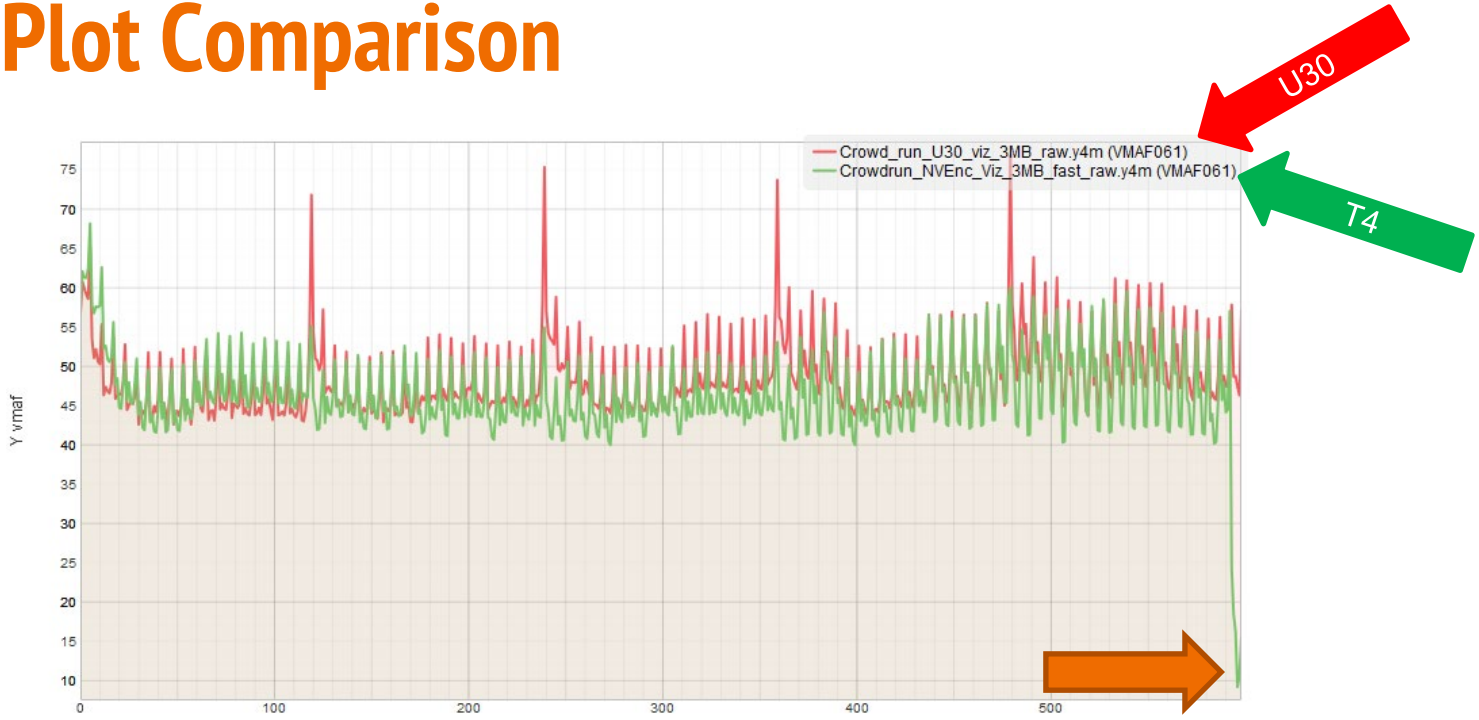


	PSNR - Crowdrun	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
2	Xilinx U30	X	-14.98	4.27	-4.50
4	NVIDIA T4	17.62	X	22.81	12.35
1	x265 Medium	-4.09	-18.57	X	-8.41
3	x265 VeryFast	4.71	-11.00	9.18	X



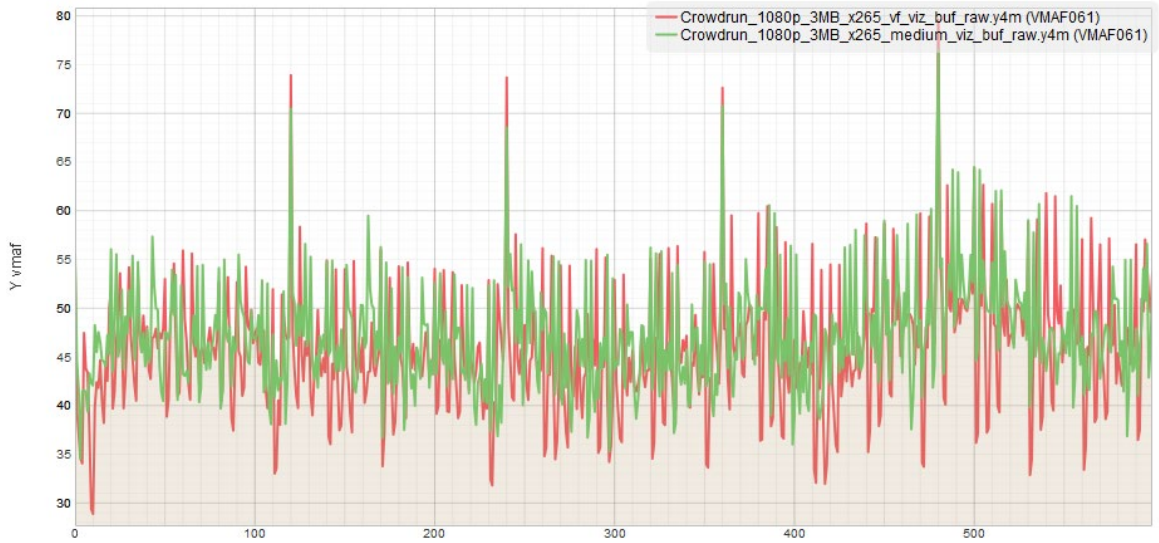
Crowdrun - Sub	Xilinx-U30	NVIDIA T4	x265-Med	x265-VF
1 Xilinx-U30	X	-24.83%	-41.37%	-39.75%
2 NVIDIA T4	33.04%	X	-19.71%	-17.57%
4 x265-Med	70.57%	24.55%	X	4.73%
3 x265-VF	65.99%	21.32%	-4.52%	X

Results Plot Comparison



- Ignore errors at the end of files (no impact on QoE

Results Plot Comparison



x265 VF

x265 Med

- x265 veryfast shows much more variability which can degrade QoE

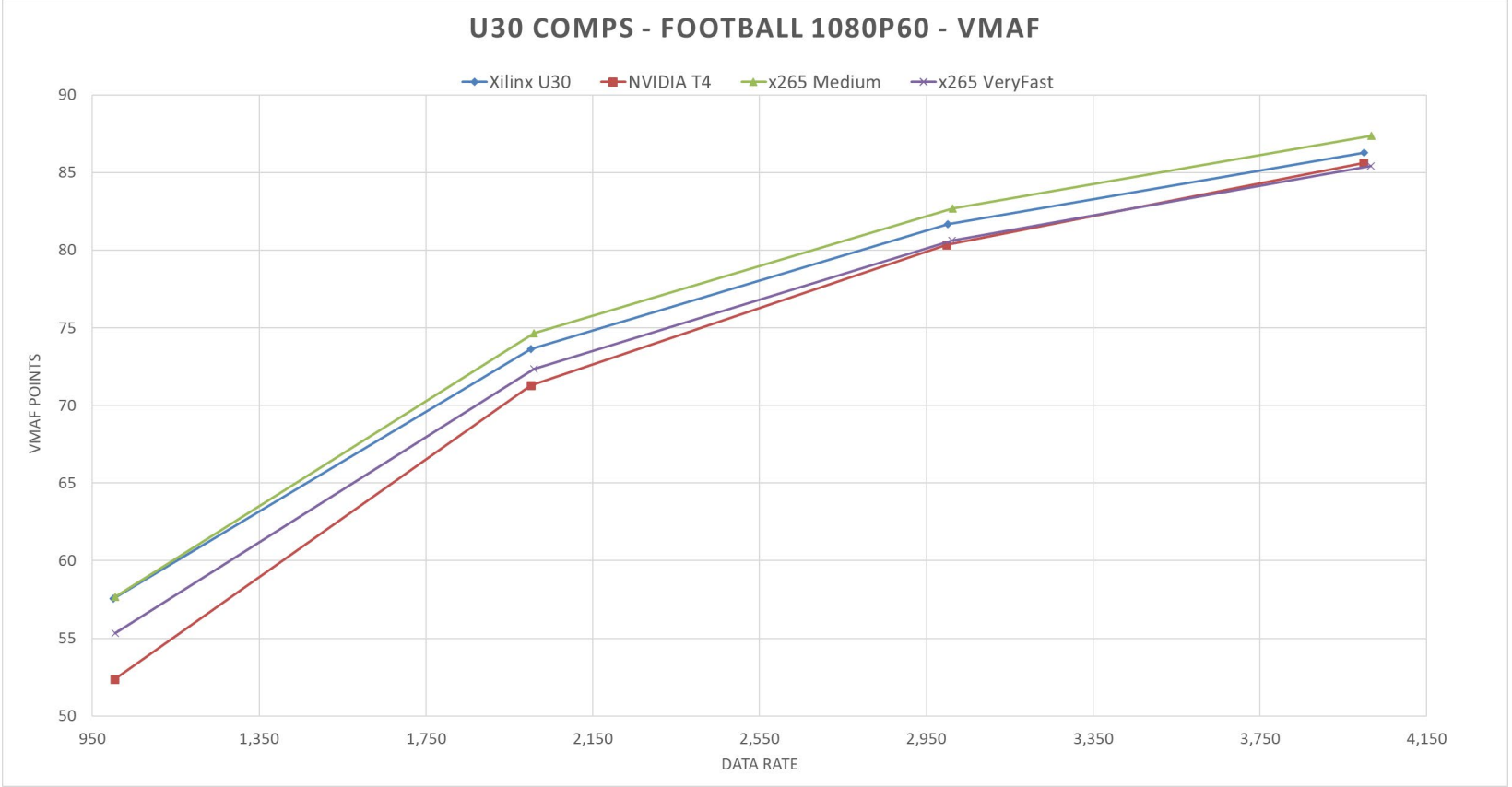
Quality Variability - Crowdrun

	U30	T4	Medium	Very Fast
Low frame VMAF	42.52	30.51	34.52	28.87
Standard Deviation	4.82	5.52	5.63	6.46
Ranking	1	2	2	4

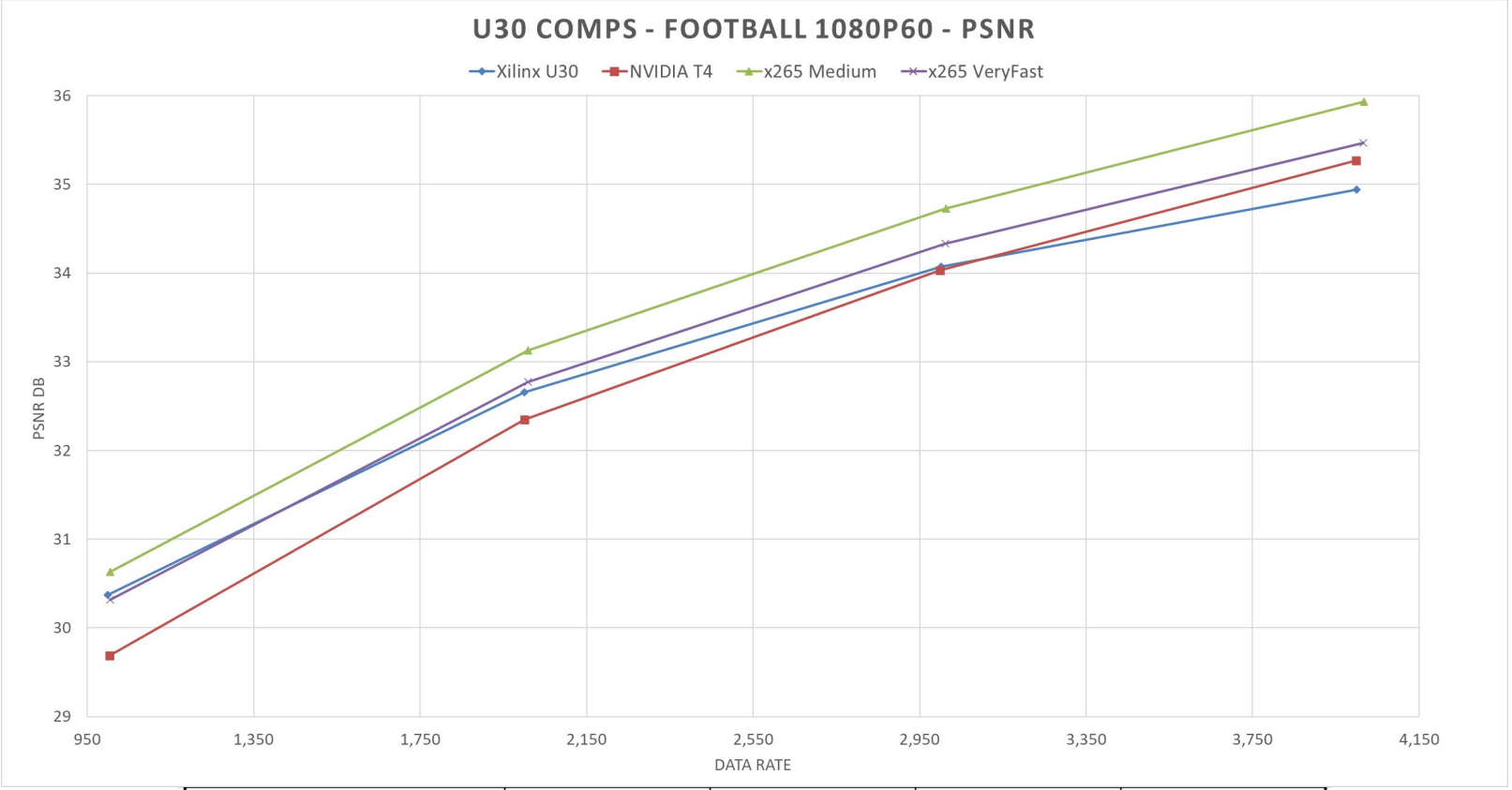
- Ranking is average rank for low-frame (higher is better) and standard deviation (lower is better)

Football

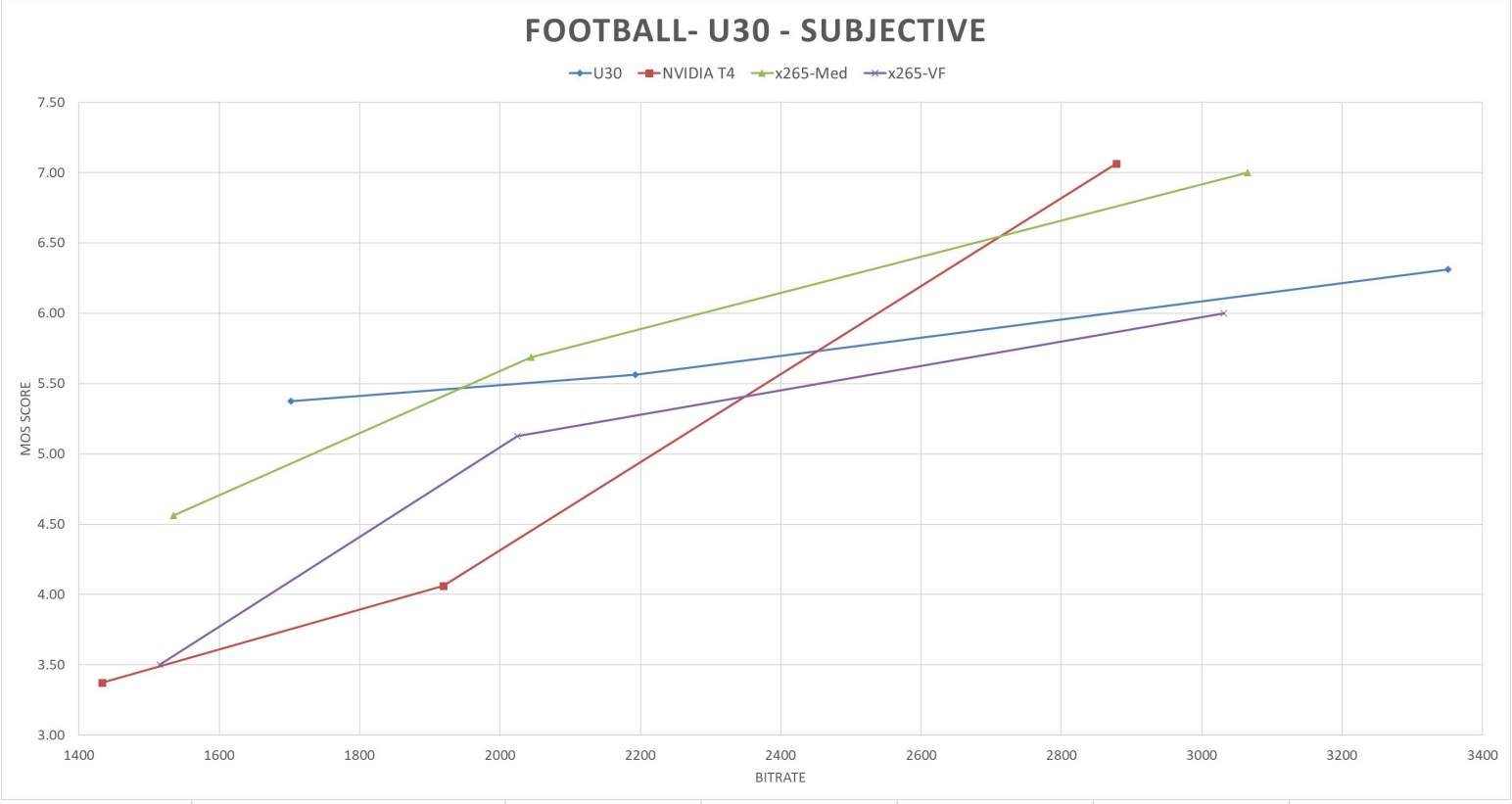
- VMAF
- PSNR
- Subjective
- Results plot (U30 vs. T4, x265 Veryfast vs. Medium)
- Quality consistency



	VMAF - Football	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
2	Xilinx U30	X	-10.09	3.83	-6.38
4	NVIDIA T4	11.23	X	15.37	4.62
1	x265 Medium	-3.69	-13.32	X	-9.75
3	x265 VeryFast	6.81	-4.42	10.80	X

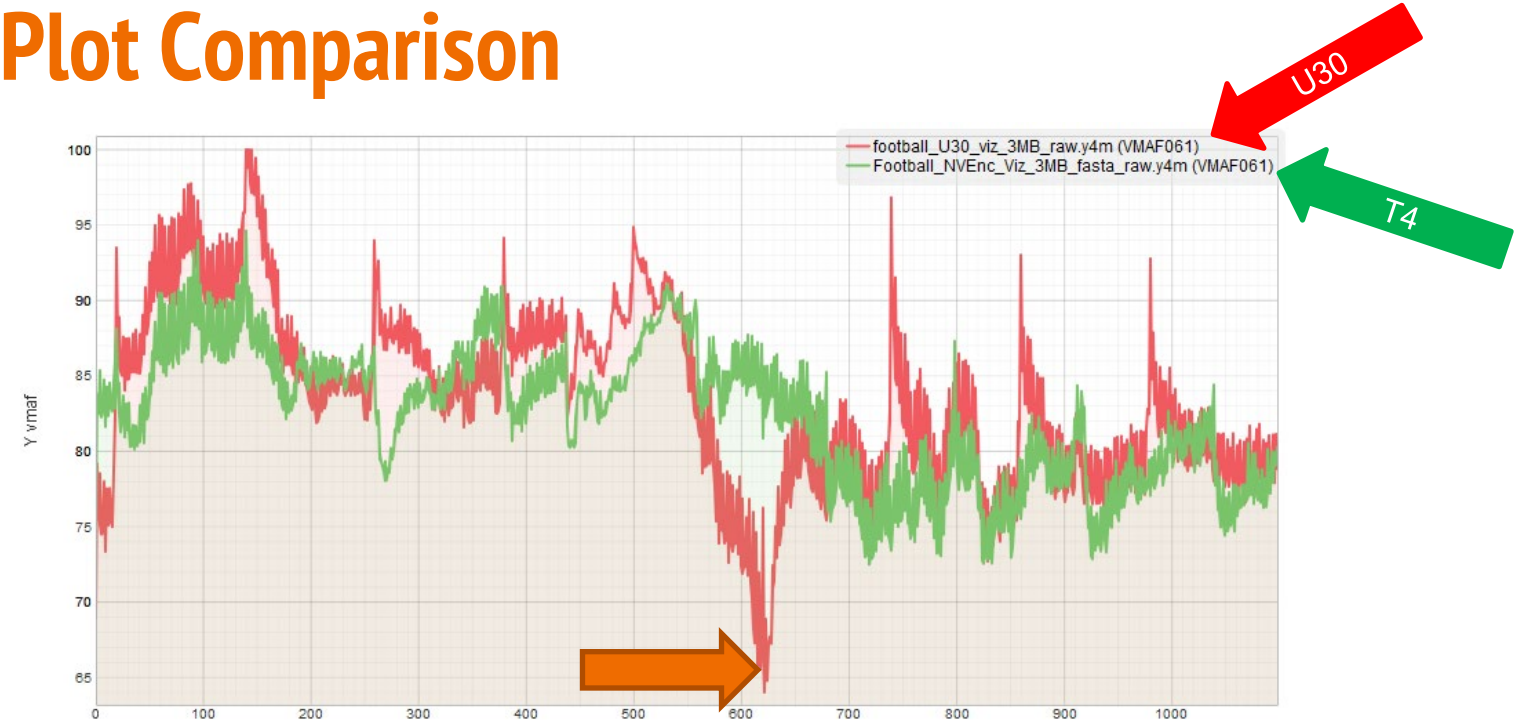


	PSNR - Football	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
3	Xilinx U30	X	-6.69	14.34	3.57
4	NVIDIA T4	7.17	X	21.38	10.67
1	x265 Medium	-12.54	-17.62	X	-9.24
2	x265 VeryFast	-3.45	-9.64	10.18	X



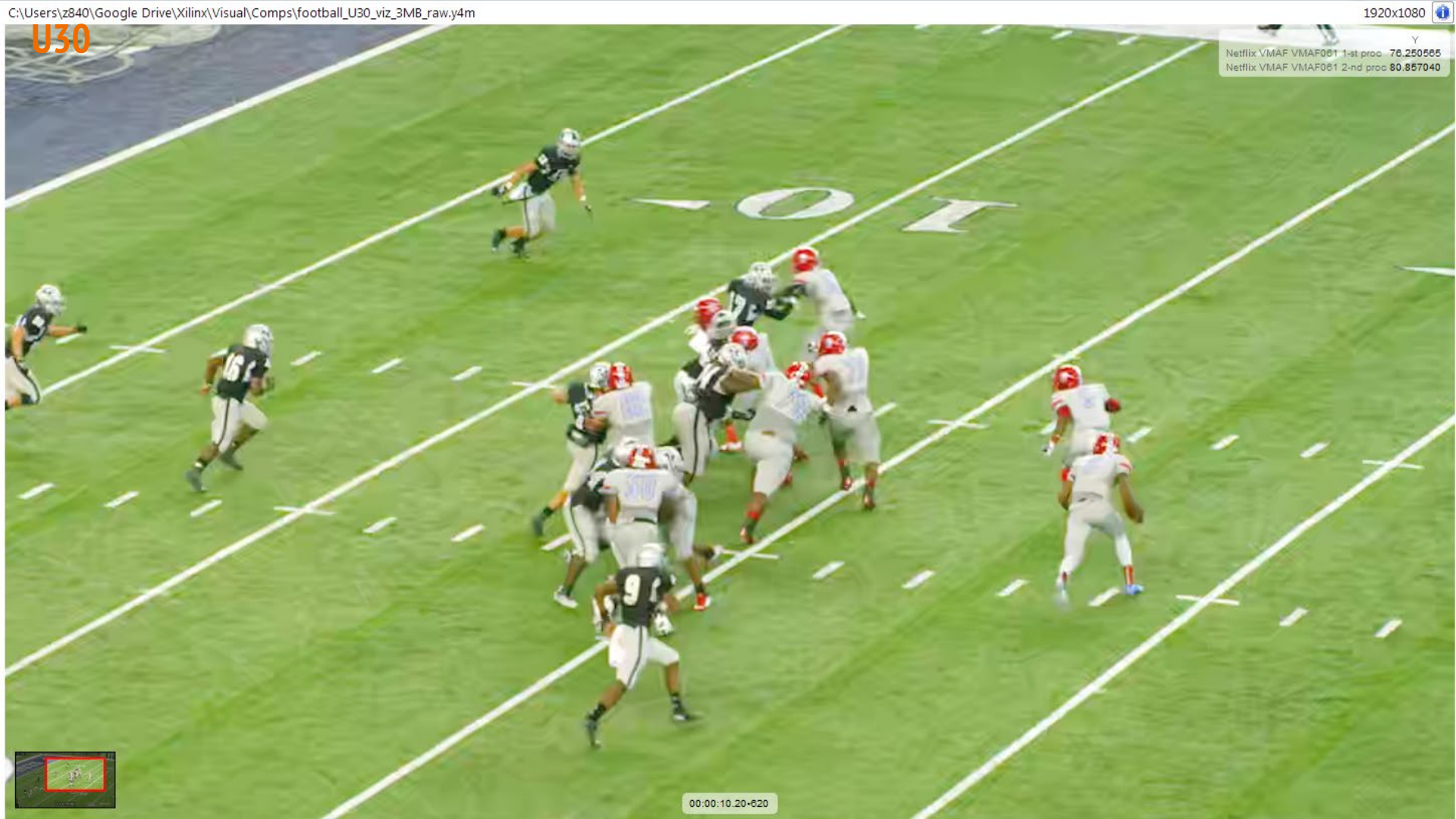
	Football - Sub	Xilinx-U30	NVIDIA T4	x265-Med	x265-VF
②	Xilinx-U30	X	-0.03%	23.90%	-6.60%
④	NVIDIA T4	0.03%	X	21.87%	13.49%
①	x265-Med	-19.29%	-17.95%	X	-16.27%
③	x265-VF	7.07%	-11.89%	19.43%	X

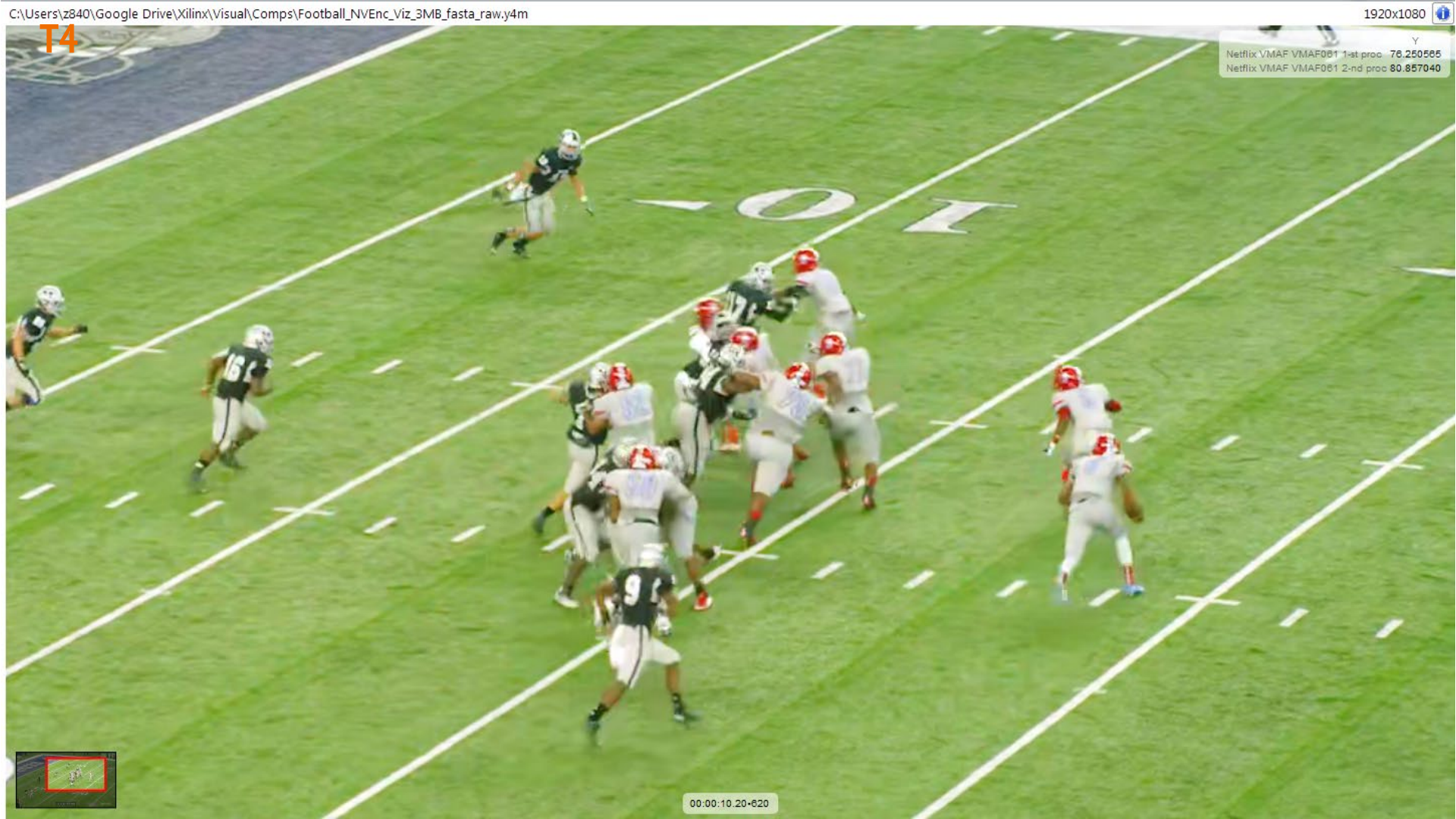
Results Plot Comparison



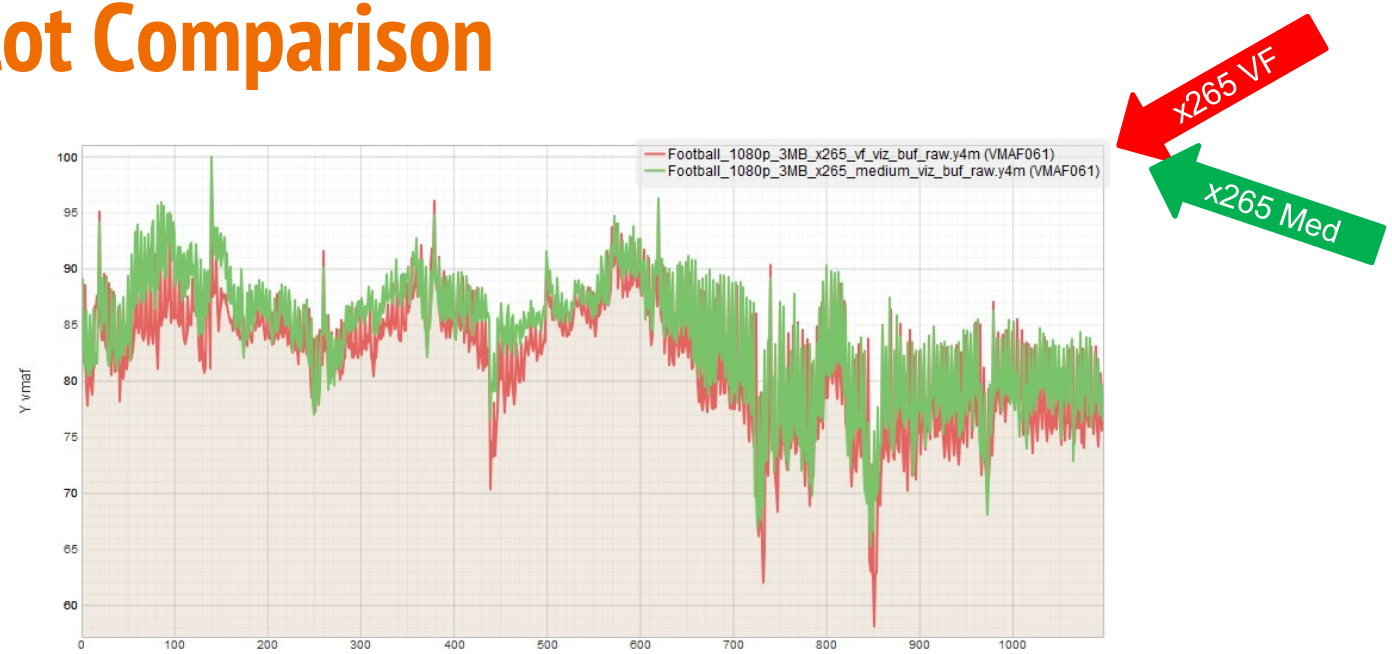
- U30 significant drop; not really visible (see following frames)


C:\Users\z840\Google Drive\Xilinx\Visual\football_1080p.mp4
1920x1080
Source
Y
Netflix VMAF VMAF061 1-st proc 76.250565
Netflix VMAF VMAF061 2-nd proc 80.857040
00:00:10.20-620


C:\Users\z840\Google Drive\Xilinx\Visual\Comps\football_U30_viz_3MB_raw.y4m
1920x1080
U30
Y
Netflix VMAF VMAF061 1-st proc 76.250565
Netflix VMAF VMAF061 2-nd proc 80.857040
00:00:10.20+620


C:\Users\z840\Google Drive\Xilinx\Visual\Comps\Football_NVEnc_Viz_3MB_fasta_raw.y4m
1920x1080
T4
Y
Netflix VMAF VMAF061 1-st proc 76.250565
Netflix VMAF VMAF061 2-nd proc 80.857040
00:00:10.20-620

Results Plot Comparison



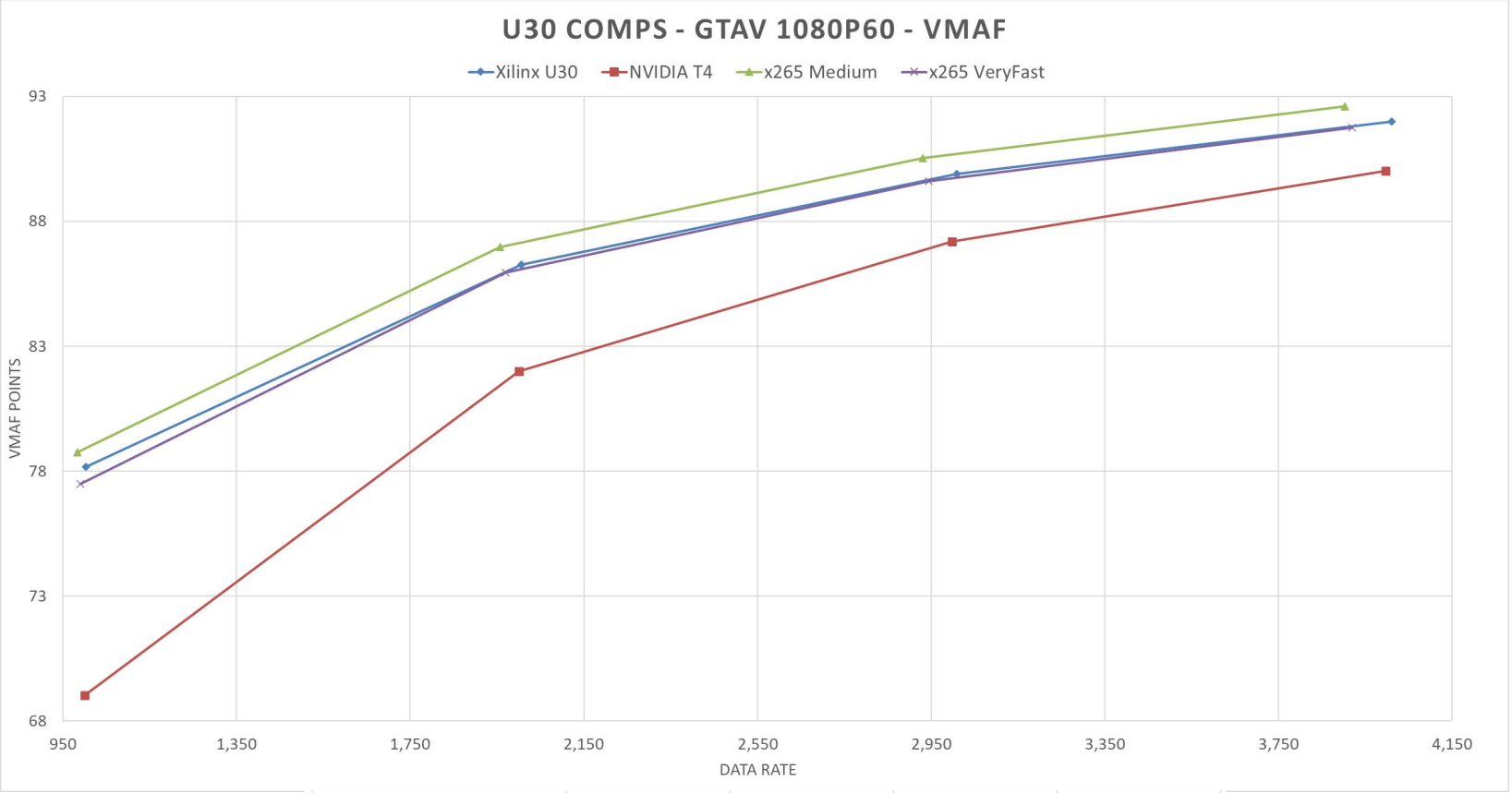
- x265 veryfast shows lower low-frame scores and more quality variability which can degrade QoE

Quality Variability - Football

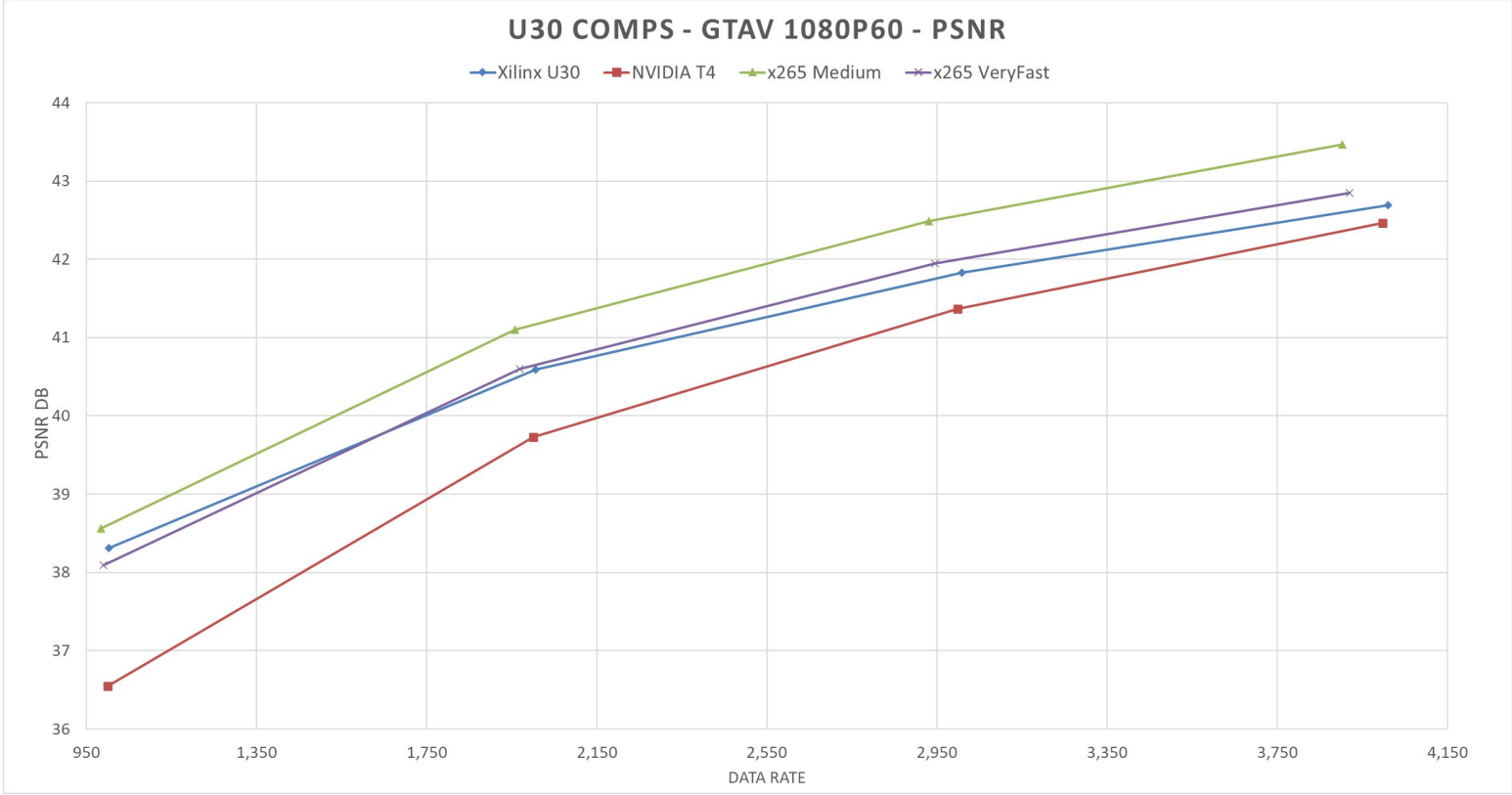
	U30	T4	Medium	Very Fast
Low frame VMAF	64.02	72.49	65.31	58.17
Standard Deviation	6.03	4.51	5.46	5.50
Ranking	4	1	2	4

GTAV

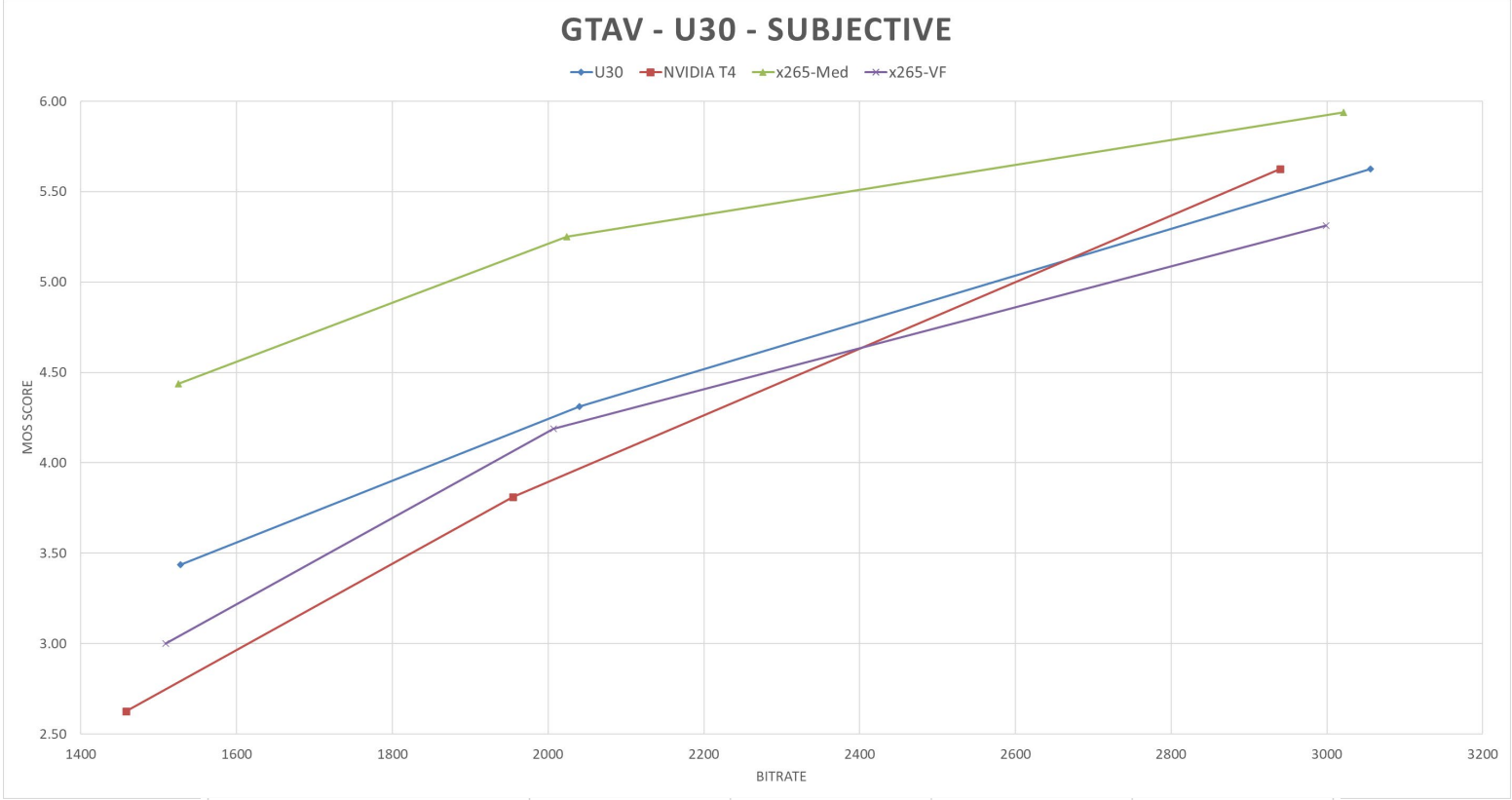
- VMAF
- PSNR
- Subjective
- Results plot (U30 vs. T4, x265 Veryfast vs. Medium)
- Quality consistency



	VMAF - GTAV	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
②	Xilinx U30	X	-29.76	9.67	-1.82
④	NVIDIA T4	42.37	X	54.79	40.41
①	x265 Medium	-8.82	-35.40	X	-10.36
③	x265 VeryFast	1.85	-28.78	11.56	X

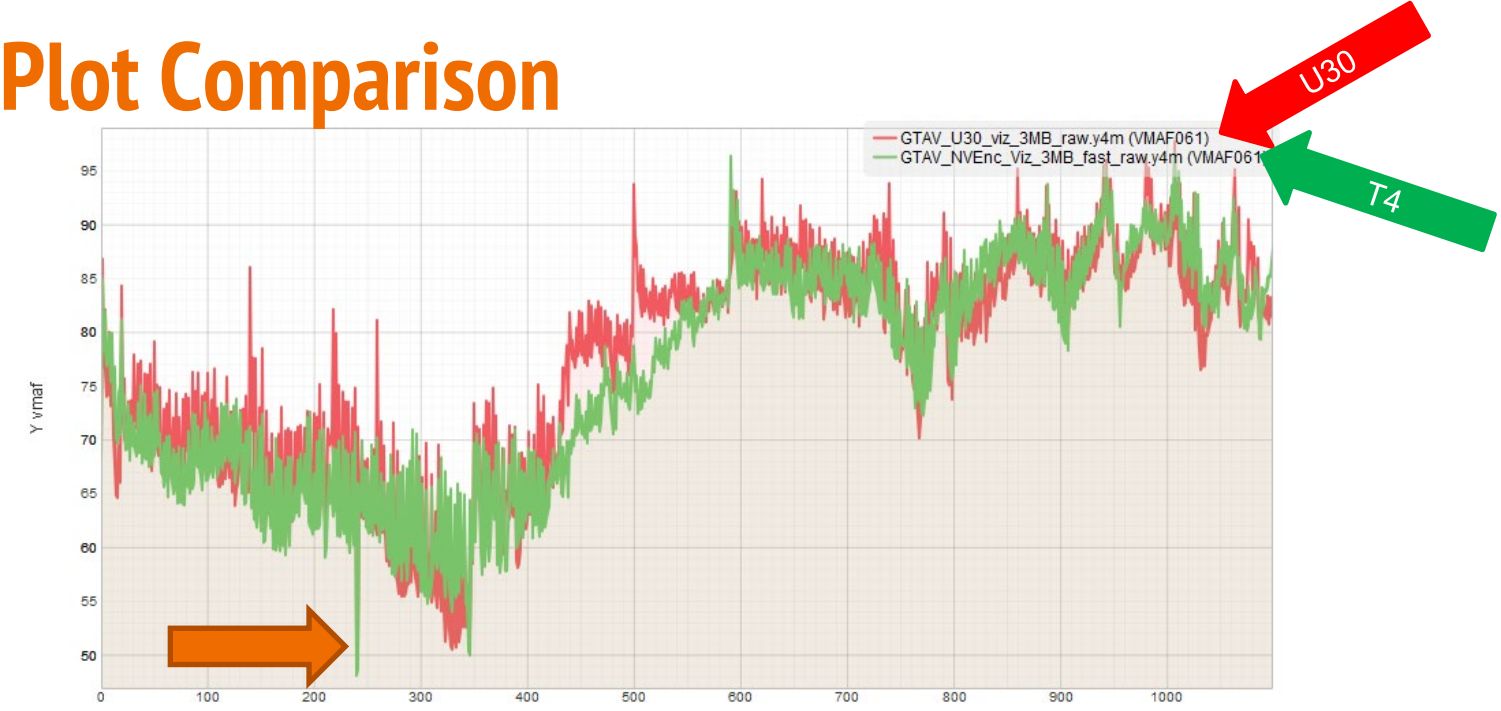


	PSNR - GTAV	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
3	Xilinx U30	X	-19.76	18.73	1.75
4	NVIDIA T4	24.62	X	45.98	26.99
1	x265 Medium	-15.78	-31.50	X	-14.10
2	x265 VeryFast	-1.72	-21.25	16.41	X



	GTAV - Sub	Xilinx-U30	NVIDIA T4	x265-Med	x265-VF
②	Xilinx-U30	X	-5.46%	36.28%	-3.88%
④	NVIDIA T4	5.78%	X	37.88%	3.89%
①	x265-Med	-26.62%	-27.47%	X	-30.79%
③	x265-VF	4.03%	-3.75%	44.48%	X

Results Plot Comparison



- T4 shows very short transient issue
  - Visible in frames
  - Both frames degraded (challenging source, low input file quality)

Source


C:\Users\z840\Google Drive\Xilinx\Visual\GTAV_1080p.mp4
1920x1080
00;00;05;41

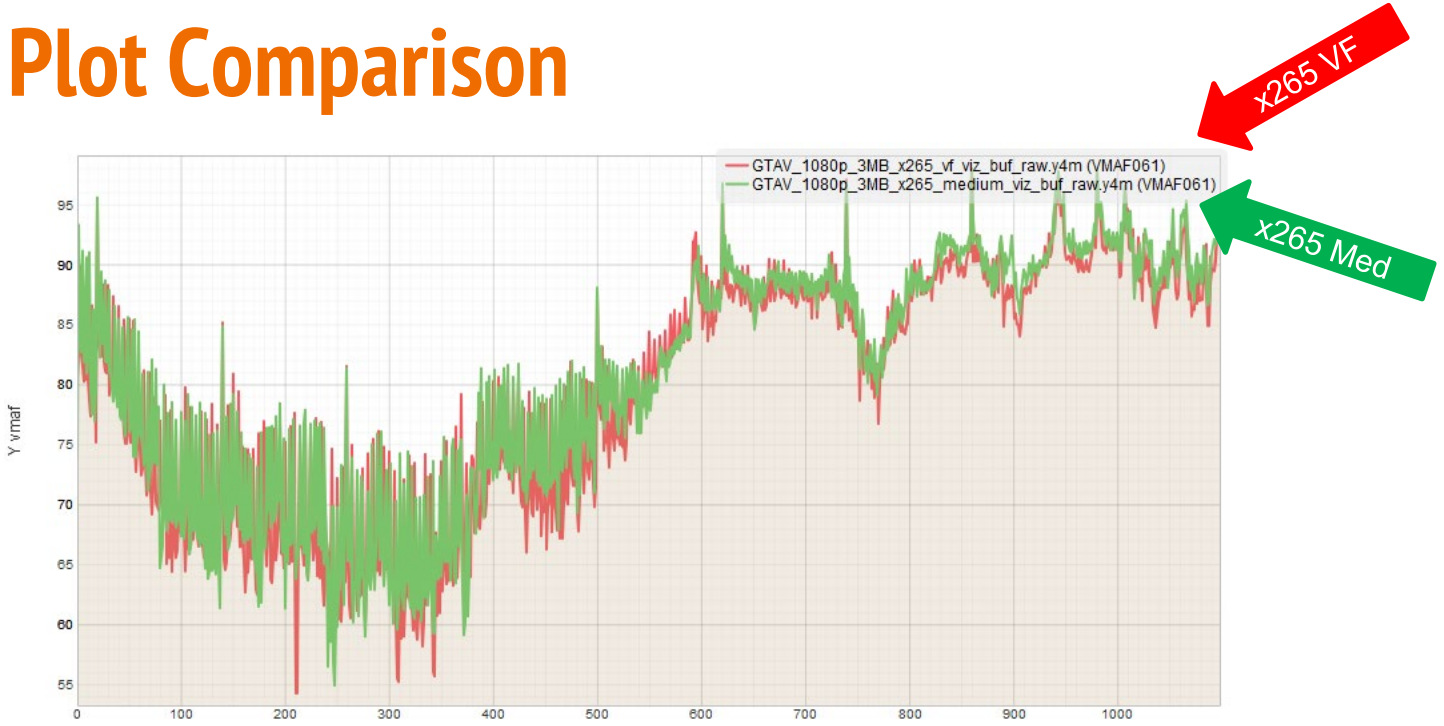
U30


C:\Users\z840\Google Drive\Xilinx\Visual\Comps\New folder\GTAV_U30_viz_3MB_raw.y4m
1920x1080
00;00;05;41

T4


C:\Users\z840\Google Drive\Xilinx\Visual\Comps\New folder\GTAV_NVEnc_Viz_3MB_fast_raw.y4m
1920x1080
Netflix VMAF VMAF061 1-st proc 51.012711
Netflix VMAF VMAF061 2-nd proc 48.701908
00;00;05;41
00:00:04.1+241
x: 305
y: 426
Y: 31
U: 130
V: 127

Results Plot Comparison



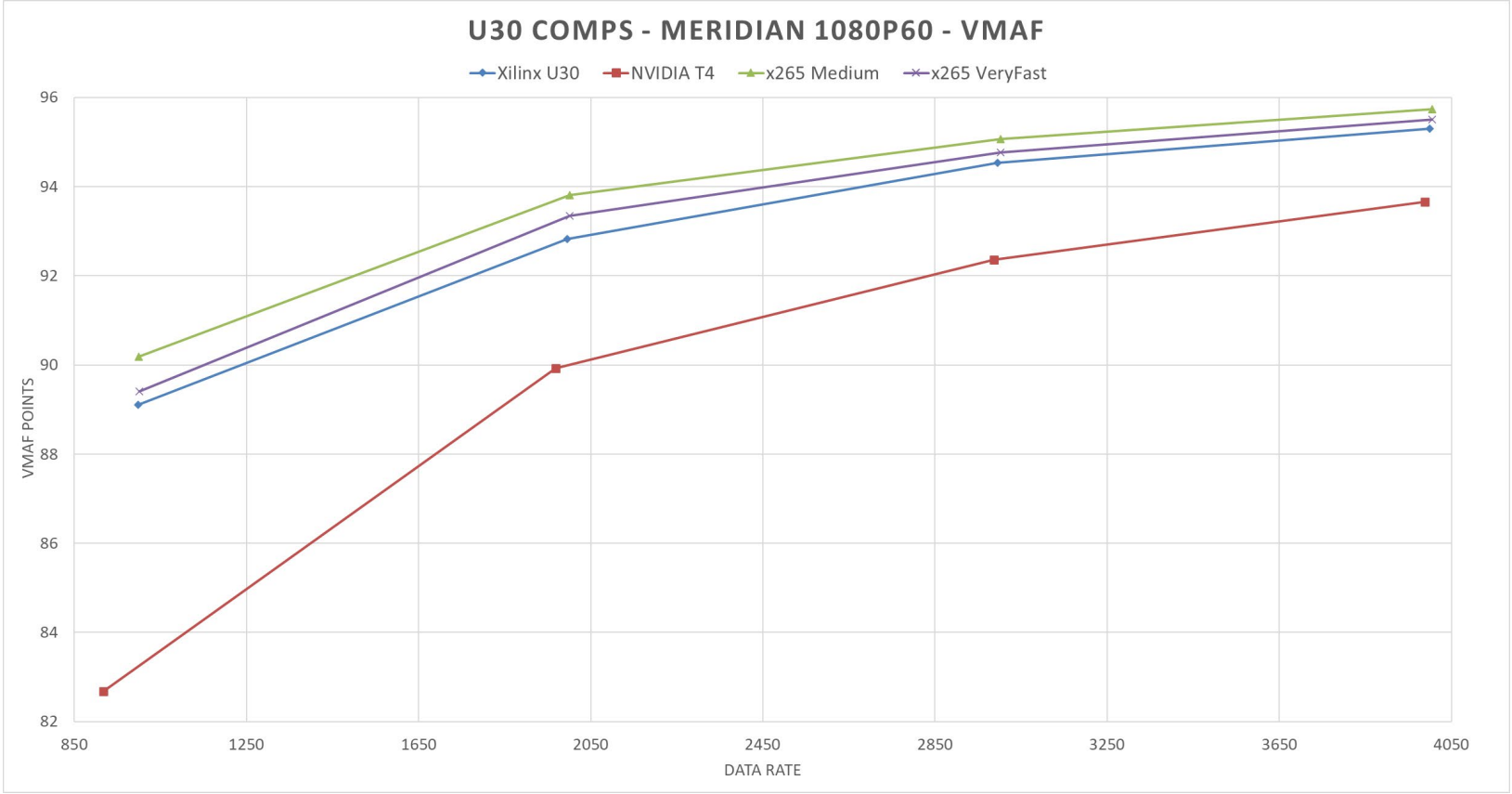
- x265 veryfast show short transient quality issues in multiple locations

Quality Variability - GTAV

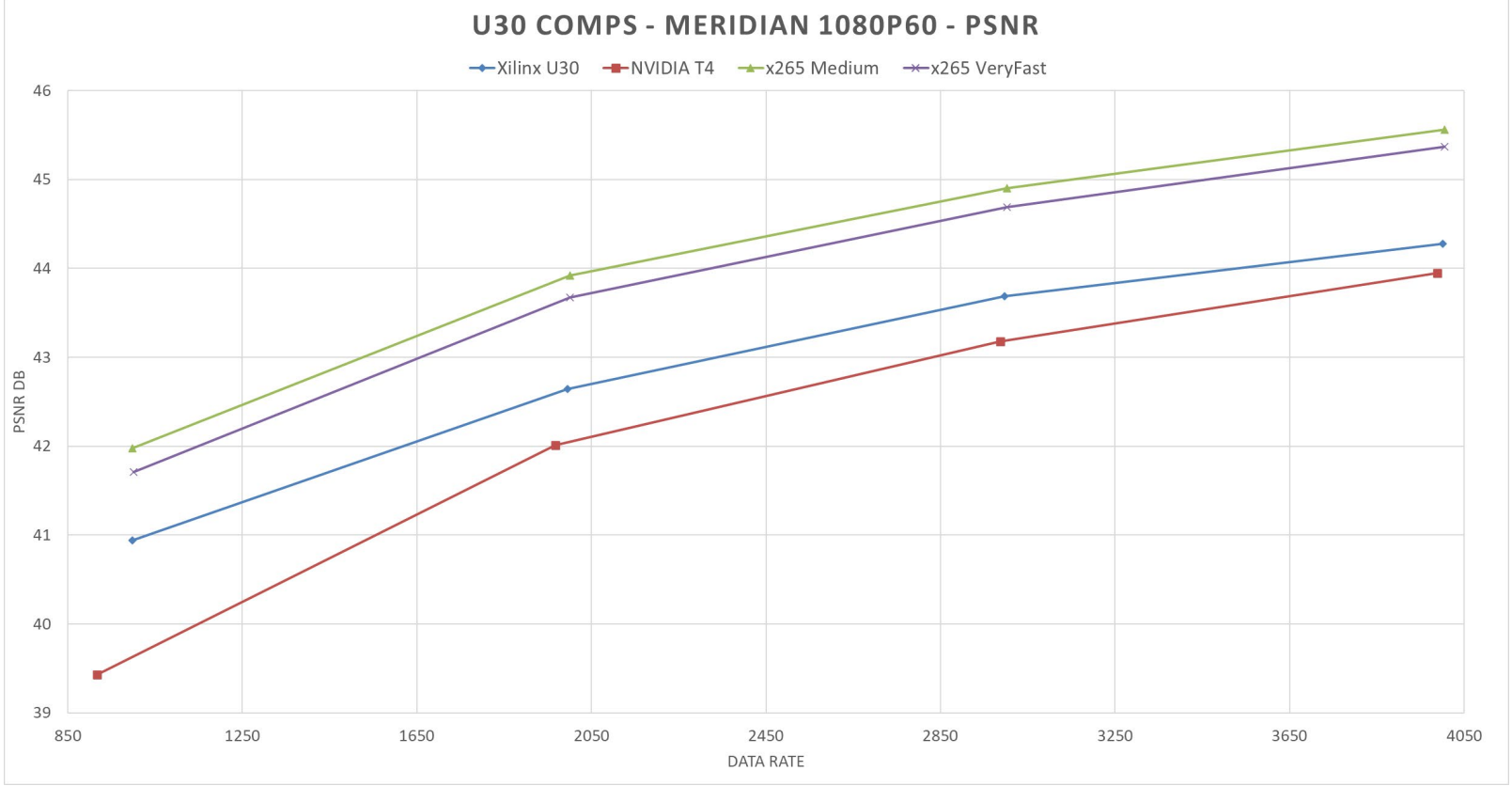
	U30	T4	Medium	Very Fast
Low frame VMAF	50.53	48.10	54.96	54.31
Standard Deviation	10.27	10.33	9.89	10.02
Ranking	3	4	1	2

Meridian

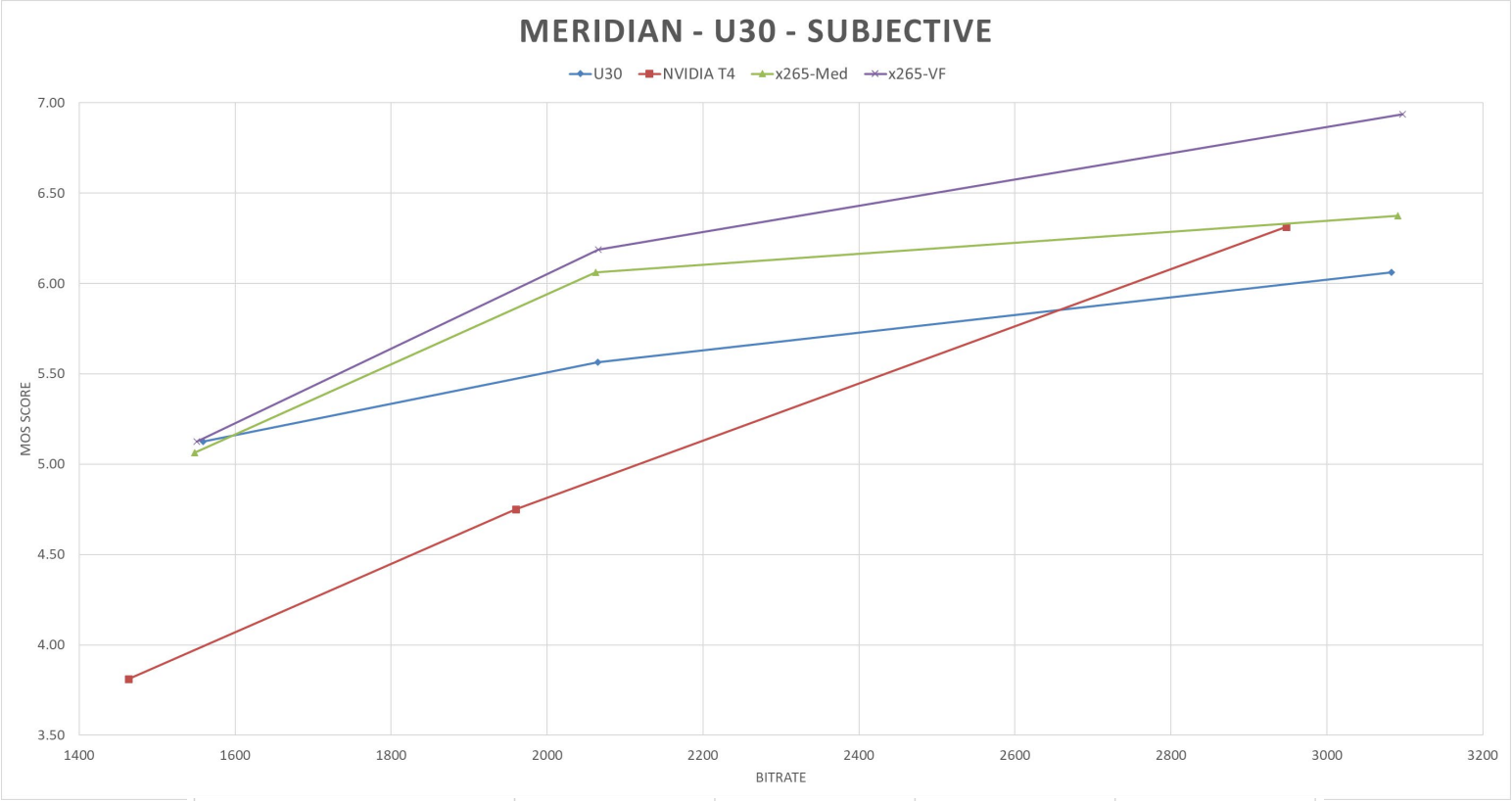
- VMAF
- PSNR
- Subjective
- Results plot (U30 vs. T4, x265 Veryfast vs. Medium)
- Quality consistency



	VMAF - Meridian	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
3	Xilinx U30	X	-37.84	25.80	11.72
4	NVIDIA T4	60.88	X	104.90	81.29
1	x265 Medium	-20.51	-51.20	X	-11.14
2	x265 VeryFast	-10.49	-44.84	12.53	X



	PSNR - Meridian	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
3	Xilinx U30	X	-19.84	62.54	46.89
4	NVIDIA T4	24.75	X	97.47	78.86
1	x265 Medium	-38.48	-49.36	X	-9.03
2	x265 VeryFast	-31.92	-44.09	9.93	X

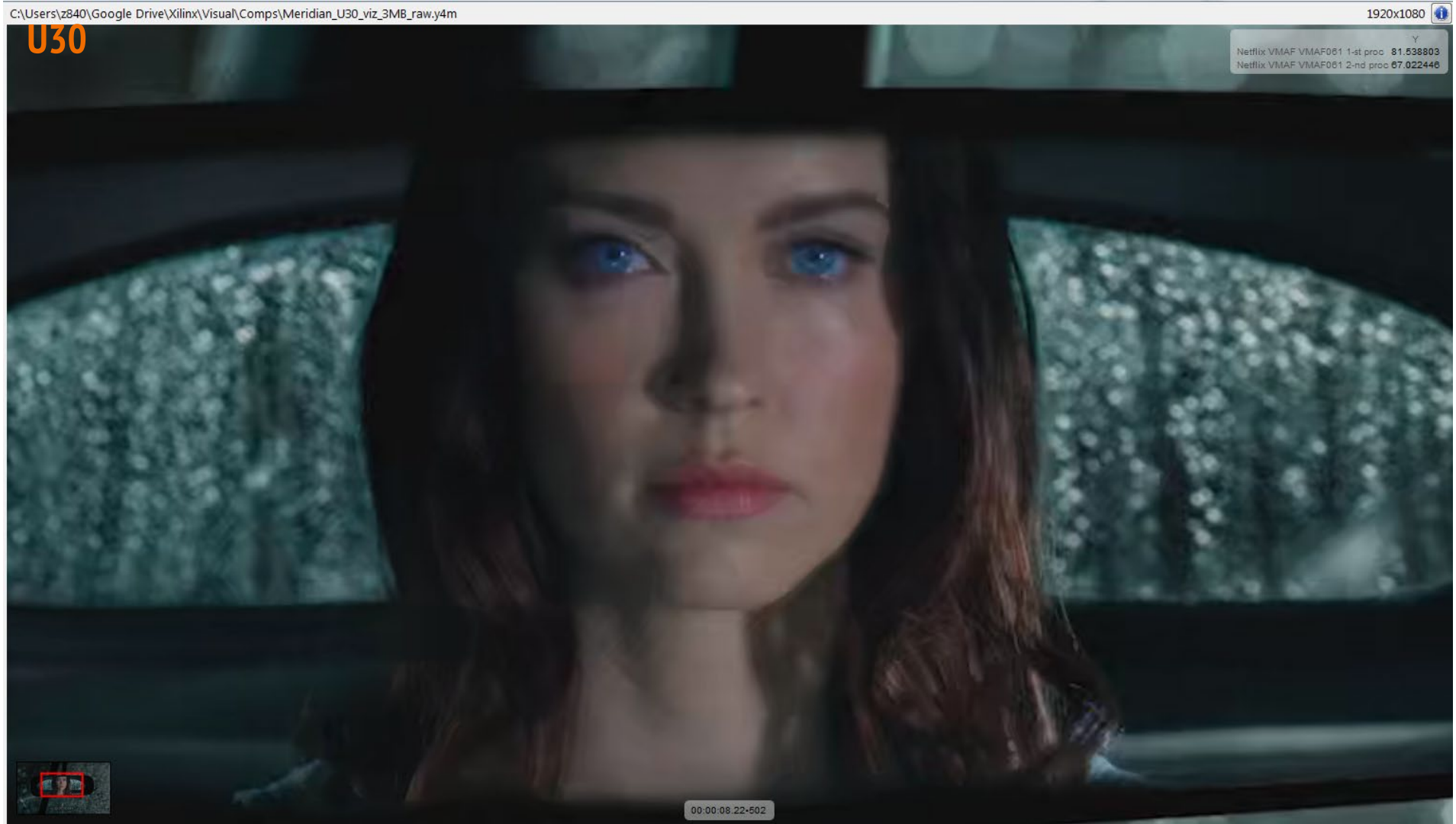


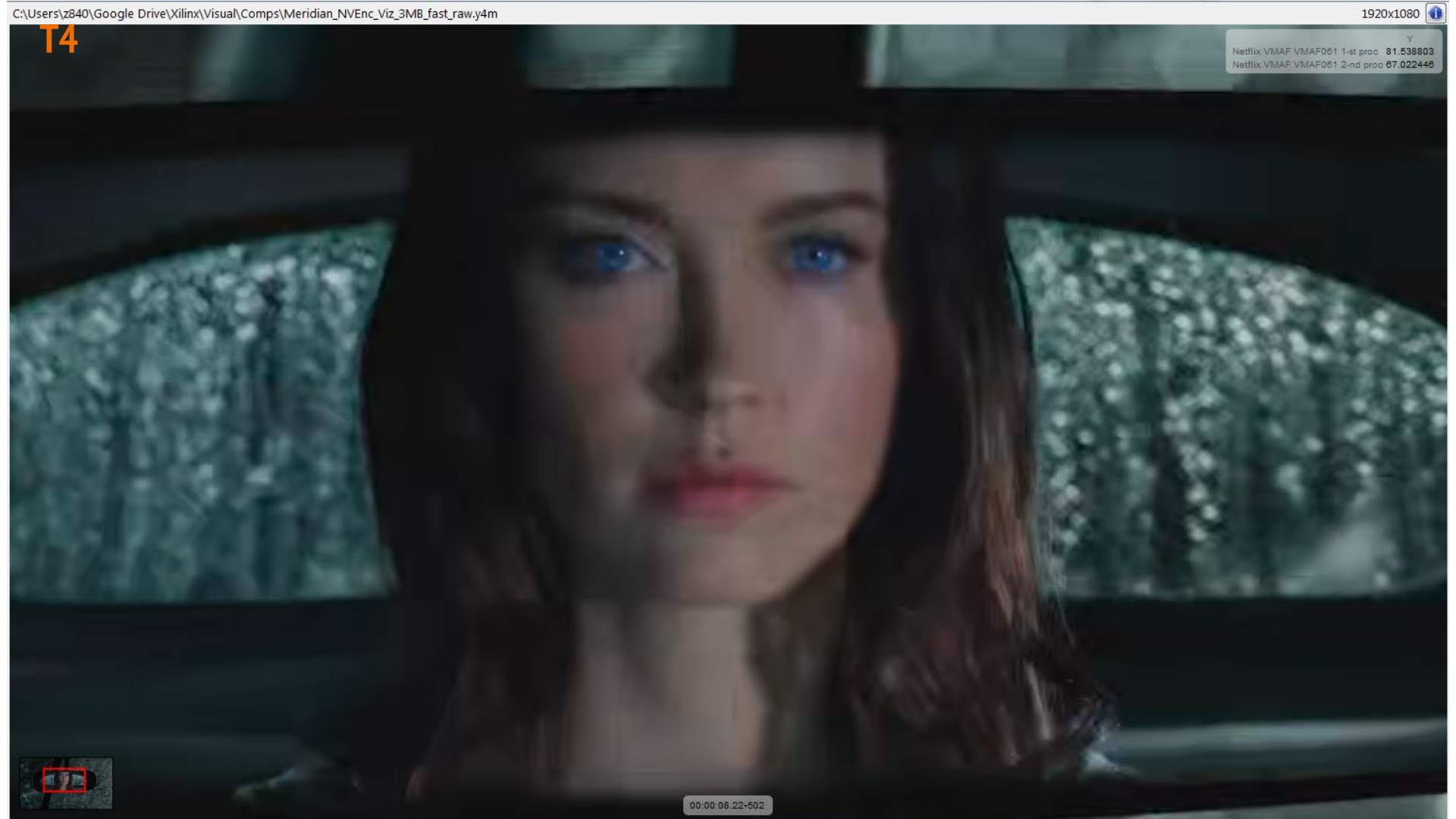
	Meridien - Sub	Xilinx-U30	NVIDIA T4	x265-Med	x265-VF
3	Xilinx-U30	X	-13.33%	24.26%	24.55%
4	NVIDIA T4	15.38%	X	38.57%	42.58%
2	x265-Med	-19.52%	-27.84%	X	4.28%
1	x265-VF	-19.71%	-29.87%	-4.10%	X

Results Plot Comparison

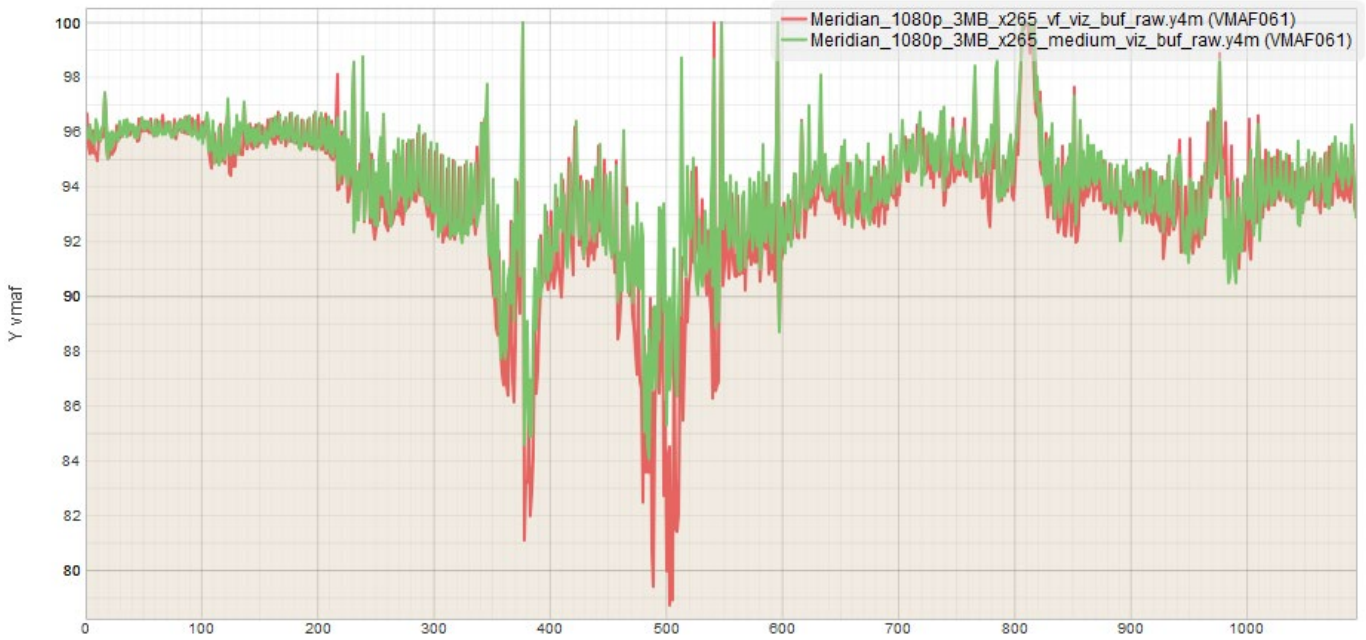
- T4 had issues with woman in rear-view mirror


E:\Xilinx\Meridian\Meridian_1080p.mp4
1920x1080
Source
Y
Netflix VMAF VMAF061 1-st proc 81.538803
Netflix VMAF VMAF061 2-nd proc 67.022446
00:00:08.22•502


C:\Users\z840\Google Drive\Xilinx\Visual\Comps\Meridian_U30_viz_3MB_raw.y4m
1920x1080
U30
Y
Netflix VMAF VMAF061 1-st proc 81.538803
Netflix VMAF VMAF061 2-nd proc 67.022446
00:00:08.22+502


C:\Users\z840\Google Drive\Xilinx\Visual\Comps\Meridian_NVEnc_Viz_3MB_fast_raw.y4m
1920x1080
T4
Y
Netflix VMAF VMAF061 1-st proc 81.538803
Netflix VMAF VMAF061 2-nd proc 67.022446
00:00:08.22+502

Results Plot Comparison



x265 VF

x265 Med

- x265 veryfast shows much more variability which can degrade QoE
  - No visible differences in low frames

Quality Variability - Meridian

	U30	T4	Medium	Very Fast
Low frame VMAF	78.27	65.22	84.08	78.73
Standard Deviation	3.49	4.89	2.22	2.86
Ranking	3	4	1	2

Overall

- VMAF
- PSNR
- Subjective
- Scorecard

VMAF Overall Score

	VMAF - Overall	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
2	Xilinx U30	X	-23.01%	8.41%	-2.13%
4	NVIDIA T4	32.81%	X	46.42%	32.33%
1	x265 Medium	-6.75%	-27.38%	X	-9.55%
3	x265 VeryFast	2.97%	-20.23%	10.59%	X

PSNR Overall Score

	PSNR - Overall	Xilinx U30	NVIDIA T4	x265 Medium	x265 VeryFast
3	Xilinx U30	X	-15.32%	24.97%	11.93%
4	NVIDIA T4	18.54%	X	46.91%	32.22%
1	x265 Medium	-17.72%	-29.26%	X	-10.19%
2	x265 VeryFast	-8.09%	-21.49%	11.43%	X

Subjective Overall Score

	Subjective - Overall	Xilinx-U30	NVIDIA T4	x265-Med	x265-VF
②	Xilinx-U30	X	-11.66%	10.77%	-6.42%
④	NVIDIA T4	13.56%	X	19.65%	10.60%
①	x265-Medium	1.29%	-12.18%	X	-9.51%
③	x265-Very Fast	14.35%	-6.05%	13.82%	X

U30 Summary

	Xilinx U30	NVIDIA T4	x265 Medium	x265 Veryfast
Start-Up Latency	1	4	2	3
VMAF quality rank	2	4	1	3
PSNR quality rank	3	4	1	2
Subjective quality	2	4	1	3
Quality consistency	2	4	1	4
Overall	**2**	**4**	**1**	**3**

- Overall ranking is based upon average of all scores with no weighting