Standard quality metadata in compressed bitstreams

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Meta

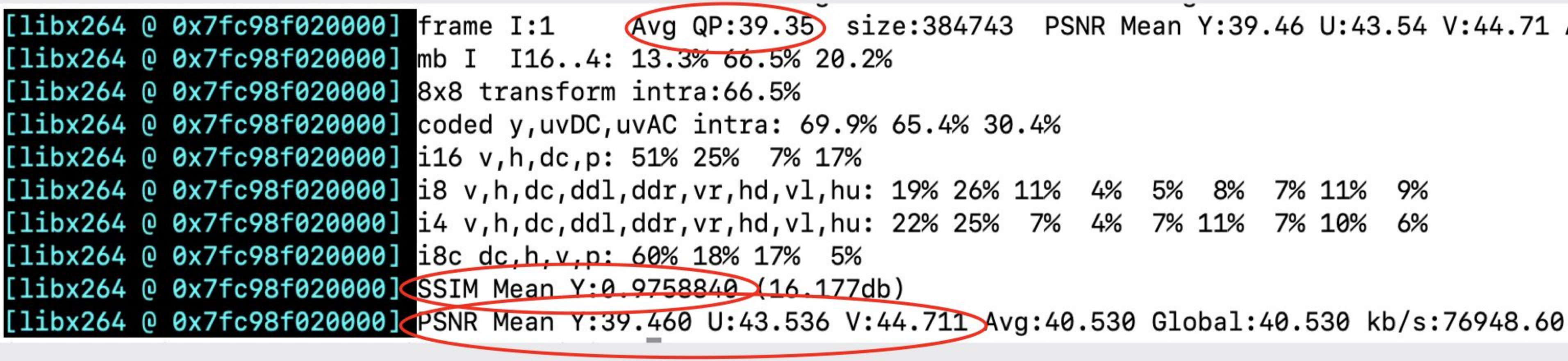
Vision

- Make large-scale video quality data available to users/service operators/researchers
- Full-reference metrics are not reproducible and only available at the source/encoder
- Some metrics are very expensive (computationally) and these pre-calculated scores, properly combined, can offer lower complexity and improved accuracy
- Such FR scores at the encoder side can supplement - and even replace - NR metric calculations at the receiver side

Current status

- Working document, tracking rationale and various discussions: https://docs.google.com/document/d/1v02cd7tFz-YozfctAy2OkKz1dGX8eHuk-1lueaxobYE/edit?usp=sharing
- Working document, on the proposed standard for T.35 signaling: https://docs.google.com/document/d/1zrUnttz4LxYbBcIsf8nYQ__13TVom6iH54ZPK6GaNws/edit?usp=sharing

Transcoding example (FFMPEG/x264)



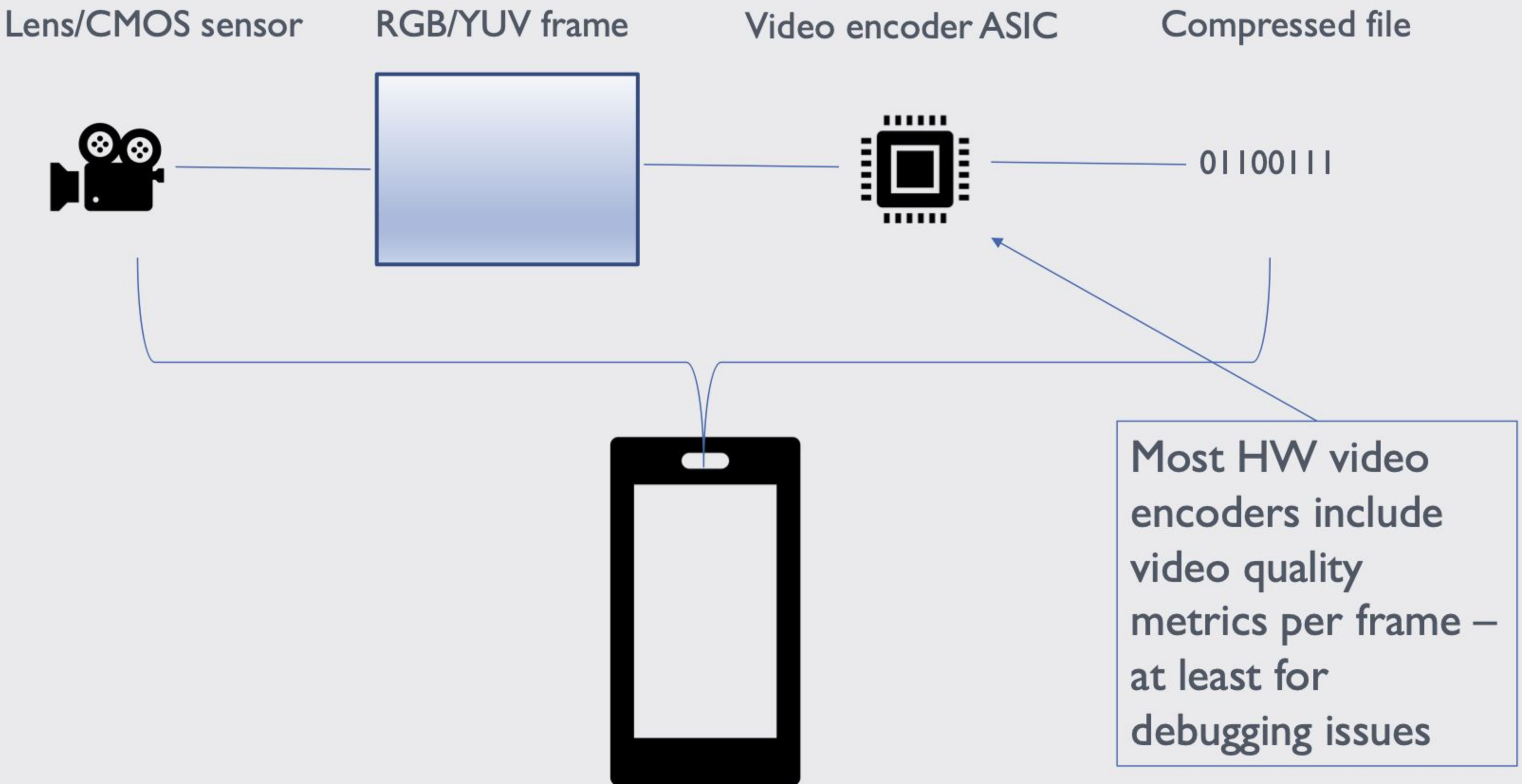
```
[libx264 @ 0x7fc98f020000] frame I:1     Avg QP:39.35  size:384743  PSNR Mean Y:39.46 U:43.54 V:44.71
[libx264 @ 0x7fc98f020000] mb I  I16..4: 13.3% 66.5% 20.2%
[libx264 @ 0x7fc98f020000] 8x8 transform intra:66.5%
[libx264 @ 0x7fc98f020000] coded y,uvDC,uvAC intra: 69.9% 65.4% 30.4%
[libx264 @ 0x7fc98f020000] i16 v,h,dc,p: 51% 25%  7% 17%
[libx264 @ 0x7fc98f020000] i8 v,h,dc,ddl,ddr,vr,hd,vl,hu: 19% 26% 11%  4%  5%  8%  7% 11%  9%
[libx264 @ 0x7fc98f020000] i4 v,h,dc,ddl,ddr,vr,hd,vl,hu: 22% 25%  7%  4%  7% 11%  7% 10%  6%
[libx264 @ 0x7fc98f020000] i8c dc,h,v,p: 60% 18% 17%  5%
[libx264 @ 0x7fc98f020000] SSIM Mean Y:0.9758840 (16.177db)
[libx264 @ 0x7fc98f020000] PSNR Mean Y:39.460 U:43.536 V:44.711 Avg:40.530 Global:40.530 kb/s:76948.60
```

Elementary video quality information about this encode is readily available

- Per frame average QP
- Per frame PSNR (Y/U/V)
- Per frame SSIM

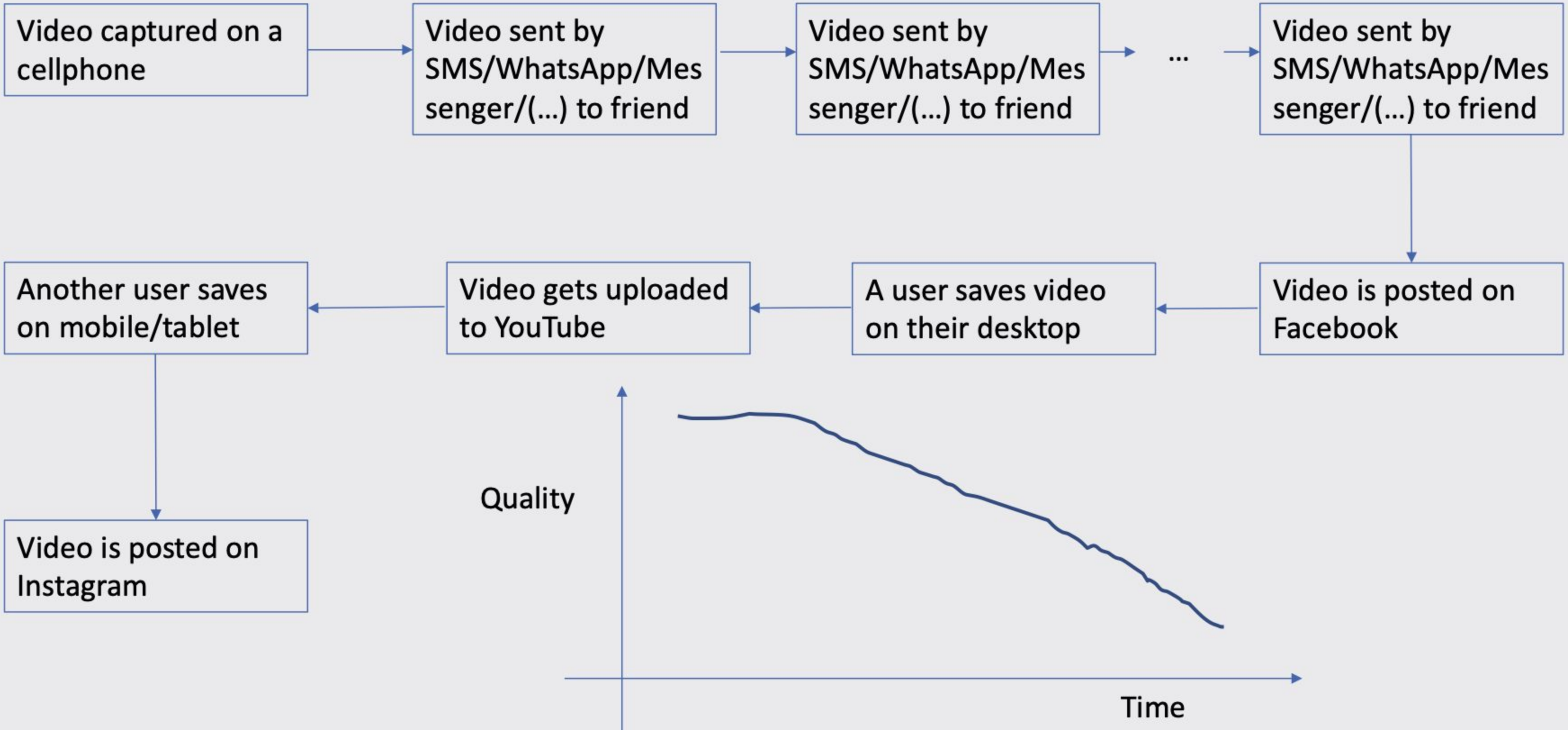
At near-zero compute overhead

How about camera capture?



Most HW video encoders include video quality metrics per frame – at least for debugging issues

The life-cycle of a UGC video



Video captured on a cellphone

Video sent by SMS/WhatsApp/Messenger/(...) to friend

Video sent by SMS/WhatsApp/Messenger/(...) to friend

...

Video sent by SMS/WhatsApp/Messenger/(...) to friend

Video is posted on Facebook

A user saves video on their desktop

Video gets uploaded to YouTube

Another user saves on mobile/tablet

Video is posted on Instagram

Challenge

- Each transcoding pipeline estimates source video quality using no-reference metrics to determine best ingestion strategy
- During transcoding, full-reference quality metrics are generated to determine best encoding settings/ABR strategy
- Estimation errors propagate and accumulate when cascading multiple transcoding pipeline
- No-reference metrics require significant compute overhead

VQEG as a T.35 “terminal provider”

ITU-T T.35 recommendation: https://www.itu.int/rec/T-REC-T.35-200002-I

Three parts: country code, terminal provider code and terminal provider oriented code in the case of terminal specific non-standard facilities. The country code identifies the country (US), the terminal provider code identifies the provider (VQEG) and the terminal provider oriented code is defined by each provider (various codes, one corresponding to each payload).

VQEG; registered in the US with ITS street address
The Manufacturer code assigned to you is:
Mfg Code - first (MSB) byte: Hex: 48
Mfg Code - second (LSB) byte: Hex: 10

T.35 messages can be incorporated through minimal header in existing and future compressed bitstreams (for example, by introducing special SEI messages in AVC)

They can be specified at both elementary video streams and system-bitstreams, using the exact same syntax

Proposal summary

3 different payloads, corresponding to 3 distinct “terminal provided oriented” codes

- Summary payload (intended to store information about the entire compressed video sequence)
- Metric instance descriptor (intended to describe the exact configuration to calculate one specific metric value)
- Metric instance value (value corresponding to one of the metric instance descriptors)

Proposal summary (cont’d)

Frequency of these payloads (suggested, for VOD applications)

- Summary payload: 1 per sequence/file
- Metric instance descriptor: N per sequence/file, capturing N quality metrics
- Metric instance value:
    - Fine granularity: N per frame
    - Medium granularity: N per GOP/independently decodable coded unit
    - Coarse granularity: N per minute
    - Summarized version: same as for “summary payload”

Frequency of these payloads (suggested, for LIVE applications)

- Consider every 10 minutes of a LIVE stream as a “sequence” and apply the corresponding frequencies listed above

Detailed proposal

- https://docs.google.com/document/d/1zrUnttz4LxYbBcIsf8nYQ__13TVom6iH54ZPK6GaNws/edit?usp=sharing

Next steps

- Have a working draft of the proposed T.35 payloads
- Share the working draft with SSOs (JVET, AOM, others?)
- Collect and incorporate feedback