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| *Title:* | **New High Throughput Profiles for HEVC** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution requests the creation of two additional HEVC High Throughput profiles with inter prediction capabilities, one without and one with screen content coding tools support.

# Introduction

Support for a High Throughput profile was added in version 2 of the HEVC video coding standard [1], apparently primarily targeting high end camera capture applications. This profile, however is limited to the use of intra only slices and mainly achieves higher throughput performance versus all other profiles through mandating the use of a CABAC alignment process prior to bypass decoding of the coeff\_sign\_flag[] and coeff\_abs\_level\_remaining[] elements (cabac\_bypass\_alignment\_enabled\_flag set to 1). Even though this is the only profile that currently allows the combination of tiles and wavefronts, there is currently no other coding tool that has been explicitly specified and mandated within this profile’s specifications that can guarantee that high throughput can be easily achieved in an implementation.

This contribution proposes to add two additional High Throughput profiles in the HEVC specification, which could be used for a plethora of video applications that may require low delay, low compression/high quality, and very high throughput. One example application includes video communication using high bandwidth digital media interfaces. Both profiles, i.e. the High Throughput 4:4:4 14 profile and the Screen-Extended High Throughput 4:4:4 14 profile, can support inter prediction coding tools, with one of the profiles also allowing the use of Screen Content Coding (SCC) tools [2]. Unlike, however, the existing High Throughput profile, it is recommended that the use of the CABAC alignment process remains optional, while, however, mandating the use of at least one of either wavefront processing (entropy\_coding\_sync\_enabled\_flag = 1) or tiles (tiles\_enabled\_flag = 1). We believe that such a constraint can better enable lower complexity high throughput implementations than the use of the CABAC alignment process on its own.

# Characteristics of the New High Throughput HEVC profiles

The following common characteristics are proposed for these two new High Throughput profiles:

* At least one of entropy\_coding\_sync\_enabled\_flag or tiles\_enabled\_flag shall be set to 1, i.e. ((entropy\_coding\_sync\_enabled\_flag == 1) || (tiles\_enabled\_flag == 1)) == 1.
* cabac\_bypass\_alignment\_enabled\_flag can be either 0 or 1.
* If ((tiles\_enabled\_flag == 1) && (entropy\_coding\_sync\_enabled\_flag == 0)) then the following additional constraints shall be obeyed:
  + Tiles shall be restricted to a maximum luma sample size of 8912896 (MaxLumaTs).
  + Tiles shall also satisfy a maximum tile luma sample rate of 534773760 samples per second (MaxLumaTr).
  + A maximum bit rate for each tile will be supported which shall be set equal to min(2 \* MaxLumaTr, MaxLumaPr) \* BitRate[i] / MaxLumaPr.
  + Active VPSs shall have vps\_base\_layer\_internal\_flag and vps\_base\_layer\_available\_flag both equal to 1 only.
  + Active SPSs for the base layer shall have separate\_colour\_plane\_flag, when present, equal to 0 only.
  + Active SPSs for the base layer shall have bit\_depth\_luma\_minus8 in the range of 0 to 6, inclusive.
  + Active SPSs for the base layer shall have bit\_depth\_chroma\_minus8 in the range of 0 to 6, inclusive.
  + All values of chroma\_format\_idc (0 to 3) as well as all range extensions coding tools shall be supported
  + When an active PPS for the base layer has tiles\_enabled\_flag equal to 1, ColumnWidthInLumaSamples[ i ] shall be greater than or equal to 256 for all values of i in the range of 0 to num\_tile\_columns\_minus1, inclusive, and RowHeightInLumaSamples[ j ] shall be greater than or equal to 64 for all values of j in the range of 0 to num\_tile\_rows\_minus1, inclusive.
  + The picture output order in bitstreams conforming to these new high throughput profiles shall be the same as the decoding order.
  + The number of times read\_bits( 1 ) is called in clauses 9.3.4.3.3 and 9.3.4.3.4 when parsing coding\_tree\_unit( ) data for any coding tree unit shall be less than or equal to 5 \* RawCtuBits / 3.
  + In bitstreams conforming to these High Throughput profile, general\_level\_idc and sub\_layer\_level\_idc[ i ] for all values of i in active SPSs for the base layer shall not be equal to 255 (which indicates level 8.5).
  + These profiles shall have similar level constraints as those specified for the High Throughput intra profile.
  + Since these profiles are limited in supporting a maximum of 14 bits, it is suggested that CpbVclFactor, CpbNalFactor, FormatCapabilityFactor, and MinCrScaleFactor shall have values of 3.5, 3.850, 5.250, and 0.5 respectively.
  + general\_lower\_bit\_rate\_constraint\_flag and sub\_layer\_lower\_bit\_rate\_constraint\_flag[i] for any sub-layer representation i, shall be equal to 1 only.

The Screen-Extended High Throughput 4:4:4 14 profile shall also support all coding tools and restrictions, as appropriate, specified for all other defined Screen-Extended profiles.

In the current HEVC specification it is specified that the maximum bitrate supported for all High Throughput profiles, assuming that the value of general\_lower\_bit\_rate\_constraint\_flag and sub\_layer\_lower\_bit\_rate\_constraint\_flag[i] is equal to 1, is 12 times higher than that of the non high throughput profiles. This would result in a maximum bit rate for the proposed profiles at level 6.2 of 33.6Gbps. This could be argued to be rather excessive for some of the applications that we may have in mind. We would therefore suggest, if possible, changing this limit specification for these new profiles. In particular, it is requested to reduce this value to half its original size for any non intra High Throughput profiles.

# Proposed Text

To be provided.

# References

1. ISO/IEC 23008:2014 Information technology -- High efficiency coding and media delivery in heterogeneous environments -- Part 2: High efficiency video coding, Second Edition
2. R. Joshi, S. Liu, G. Sullivan, G. Tech, J. Xu, and Y. Ye, “High Efficiency Video Coding (HEVC) Screen Content Coding: Draft 4”, MPEG/JCTVC document M36870/JCTVC-U1005, Warsaw, PL, Jun. 2015

# Patent rights declaration(s)

**Apple Inc does not have any current or pending patent rights relating to the technology described in this contribution.**