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Source   **Telecom ParisTech, Canon Research Centre France**
Status   **For consideration at the 115th MPEG meeting**
Title   **Merging TRIF and TSIF sample group descriptions**
Author   Jean Le Feuvre, Cyril Concolato, Franck Denoual, Frédéric Mazé

1   Introduction

During the processing of votes on 14496-15 DIS, FI16 comment asked for extending the HEVC tiling with layered HEVC support. As shown in m 38642, this is however already supported.

During the editing period, a proposal (however not backed up by any NB comment) for simplifying the tile group mechanism was made in m38225.

In this contribution, we quickly review the description of tiles in layered HEVC cases and propose a simplification of the design.

NOTE: This contribution does not recap how mapping of NALs to tiles is performed (see m38642 for that); it only focuses on how tiles dependencies are described.

2   Describing tile dependencies in layered case

2.1   Example of use in a generic case

In the current DIS text, the tools used to describe tiles are:
- TileRegionGroupEntry sample group description: provides size and position of the tile, as well as an indication on whether the tile can be decoded independently from other tiles or not.
- TileSetGroupEntry sample group description: provides the ID of tiles constituting the tile set, and the list of tiles this tile set depends on for decoding

In a layered coding context, the tiles from the enhancement layer will always have dependencies to the full picture or to some tiles in the lower layer(s), which implies:
- either that the independent_idc field of the TileRegionGroupEntry is 0, in which case dependencies of that tile are unknown at the 'trif' level,
- Or that the independent_idc field is 1 (no temporal dependencies outside of this tile in this layer), in which case dependencies to the lower layer(s) are unknown at the 'trif' level.

In either cases, in order to find the tiles dependencies for this L-HEVC tile, one needs to inspect the TileSetGroupEntry in that track and find a tile set composed of exactly that tile (cf Figure 1); the tile set will then give the proper dependencies:
- dependencies applicable for all NALUs regarding of the slice and/or NALU type

- optionally, dependencies only applicable for IRAP NALUs, in order to accommodate for cases where the higher layer uses references from the lower layer(s) only on IRAP picture, typically at the beginning of the GOP.
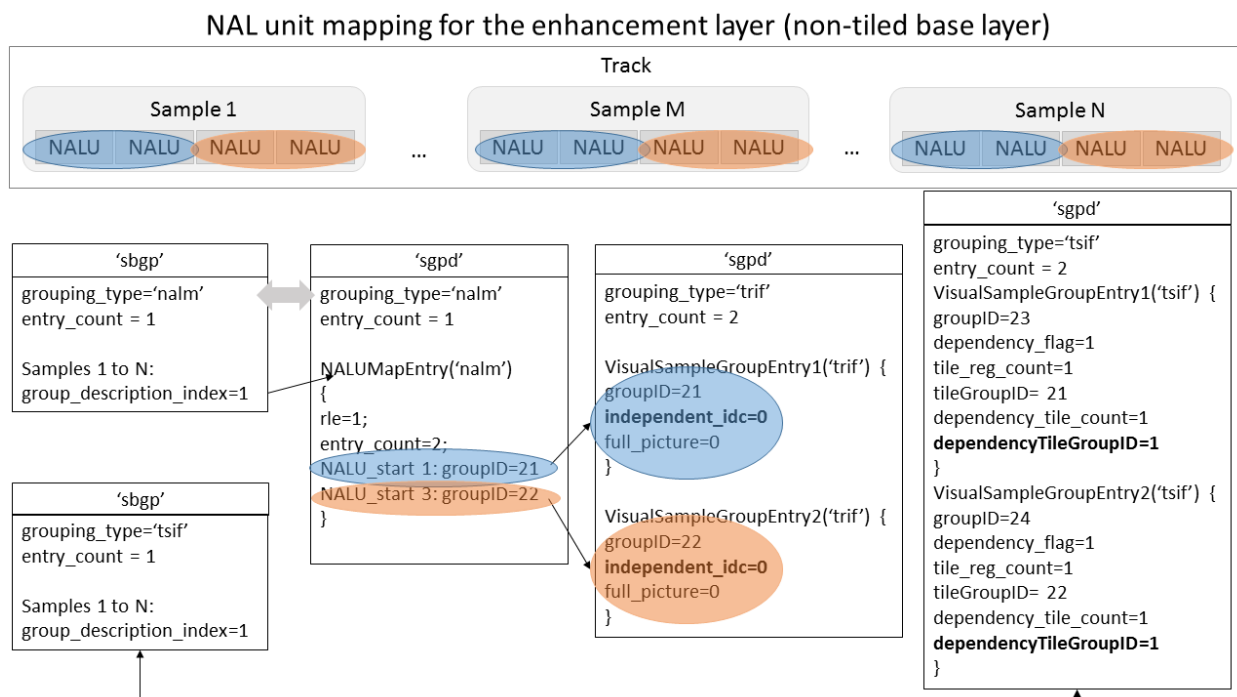

Figure 1 - Tiling in layered context

As can be seen from this discussion, describing inter-layer tiled dependencies layered HEVC is possible with the current DIS text, but requires an additional level of indirection between TileSetGroupEntry and TileRegionGroupEntry. Although these tile descriptions are usually constant and can be made default sample group description in tile tracks, this extra complexity is not very useful.

Additionally, if all tiles are stored in one track, a NALUMapEntry group will likely be present, complexifying the design of the storage.

2.2 A unified sample grouping for tiles

We propose to merge both TileRegion and TileSet sample group entries and have a single way of describing tiles and their dependencies. We propose to keep the original TileRegion name and "trif" sample group, and propose the following syntax.
Note that no new tools are introduced compared to DIS text. For the sake of simplification and as requested by FINB, the description using top-left and bottom-right indices has been removed.

Syntax:
```
class TileRegionGroupEntry() extends VisualSampleGroupEntry
('trif') {

    unsigned int(16) groupID;
    unsigned int(2)  independent_idc;
    unsigned int(1)  full_picture;
    unsigned int(1)  filtering_disabled;
```

```
   unsigned int(1)  tile_group;  // added to distinguish single tile vs. set
of tiles
   unsigned int(1)  has_dependency_list;
   unsigned int(1)  has_irap_dependency_list;
   unsigned int(1)  reserved=0;

   if (tile_group) {
      unsigned int(16) tile_count;
      for (i=1; i<= tile_count; i++)
         unsigned int(16) tileGroupID;
   } else {
      if (!full_picture) {
         unsigned int(16) horizontal_offset;
         unsigned int(16) vertical_offset;
      }
      unsigned int(16) region_width;
      unsigned int(16) region_height;
   }
   if (has_dependency_list) {
      unsigned int(16) dependency_tile_count;
      for (i=1; i<= dependency_tile_count; i++){
         unsigned int(16) dependencyTileGroupID;
      }
   }
   if (has_irap_dependency_list) {
      unsigned int(16) irap_dependency_tile_count;
      for (i=1; i<= irap_dependency_tile_count; i++){
         unsigned int(16) irap_dependencyTileGroupID;
      }
   }
}
```

Semantics:

groupID is a unique identifier for the tile region described by this group. Value 0 is reserved for special use in the 'nalm' box.

independent_idc specifies the coding dependencies between this tile region and other tile regions in the current picture and in reference pictures, whether from the same layer or not. This flag takes the following values:

- If independent_idc equals 0, the coding dependencies between this tile region and other tile regions in the same picture or previous pictures are given by the list of dependencyTileGroupID. If dependency_tile_count is 0, these dependencies are unknown.

- If independent_idc equals 1, there are no temporal dependencies between this tile region and the other tile regions with different groupID in any reference pictures in the same layer but there can be coding dependencies between this tile and the tile region with the same groupID in the reference pictures in the same layer, or with different groupID in other layers. If the associated sample this tile belongs to is a random access sample as defined for this HEVC layer, the coding dependencies between this tile region and other tile regions in lower layers are given by the list of irap_dependencyTileGroupID and dependencyTileGroupID; if the sum of irap_dependency_tile_count and dependency_tile_count is 0, these dependencies are unknown. If the associated sample this tile belongs to is not a random access sample as defined for this HEVC layer, the coding dependencies between this tile region and other tile regions in lower layers are given by the list of dependencyTileGroupID; if dependency_tile_count is 0, there are no

coding dependencies between this tile region and other tile regions in any reference picture of other layers for non random access samples.

- If independent_idc equals 2, there are no coding dependencies between this tile region and any other tiles in the reference pictures.

- Value 3 is reserved

full_picture, when set, indicates that this tile region is actually a complete picture, in which case region_width and region_height shall be set to the layer luma size, and independent_flag shall be set to 1. This allows expressing dependencies between tiles of a layer to a non-tiled layer, the later using a 'trif' sample group with *full_picture* parameter set to 1.

filtering_disable, when set, indicates that no post-decoding filtering operation on this tile region require access to pixels adjacent to this tile region, i.e. bit-exact reconstruction of the tile region is possible without decoding the adjacent tiles.

tile_group, when set to 1, indicates that this tile region is the result of visually grouping the tile regions identified by the list of tileGroupID. This allows describing non rectangular tile regions. When set to 0, this tile region describes a rectangular, dense rectangle (i.e. without holes) composed of one or several HEVC tiles.

has_dependency_list: when set to 1, indicates that a list of dependencies is present. If set to 0, dependency_tile_count is assumed to be 0.

has_irap_dependency_list: when set to 1, indicates that a list of dependencies for random access samples is present. If set to 0, irap_dependency_tile_count is assumed to be 0.

horizontal_offset and vertical_offset give respectively the horizontal and vertical offsets of the top-left pixel of the rectangular region represented by the tile region, relative to the top-left pixel of the picture, in luma samples of the base region. When tile_group is set to 1, these values are inferred to be the minimum values of horizontal_offset, vertical_offset of the tiles regions identified by the list of tileGroupID.

region_width and region_height give respectively the width and height of the rectangular region represented by the tile region, in luma samples of the base region. When tile_group is set to 1, these values are inferred to be the width and height of the region described by the union of tiles regions identified by the list of tileGroupID.

tile_count gives the number of tiles regions from which this tile region is defined.

tileGroupID indicates the tile region groupID value (as defined by a TileRegionGroupEntry) of a tile region that belongs to this tile region.

dependency_tile_count indicates the number of tile regions in the dependency list.

dependencyTileGroupID gives the identifier of a tile region (as defined by a TileRegionGroupEntry) that this tile region depends on.

irap_dependency_tile_count and irap_dependencyTileGroupID specify an additional list of tile region(s) this tile region depends on when the sample this tile region belongs to is a random access sample as defined for this HEVC layer.

For HEVC and LHEVC tile tracks as defined in this standard, the base region used in the TileRegionGroupEntry is the size of the picture to which the tile belongs.

NOTE: for LHEVC streams using spatial scalability and tiling on both the base and enhancement layers, the TileRegionGroupEntry sample descriptions of the base layer will give coordinates expressed in luma samples of the base layer, while the TileRegionGroupEntry sample descriptions of the enhancement layer will give coordinates expressed in luma samples of the enhancement layer.

2.3   Benefits

The merging of trif and tsif
- simplifies the description of inter-layer dependencies of HEVC tiles
- reduces the number of sample groups present in stbl or in traf,
- simplifies the reading and understanding of the specification

careful cleanup of section 10 will be required to remove all TileSet references.

3   Conclusion

We have proposed a slightly more elegant tile description based on the current DIS text **with no additional tools and a priori no regression,** which simplifies the specification and aligns with some NB comments and some contributions. We recommend the adoption of the proposed text in the FDIS.