Removal of cabac_zero_word to simplify error detection in CABAC
(JCTVC-D238/m18999)

Yasutomo Matsuba, Vivienne Sze

Texas Instruments Inc.

TEXAS INSTRUMENTS

cabac_zero_word

- Inserted after rbsp_trailing_bits() to achieve desired bins to bits ratio

- For error detection need to check whether bits are cabac_zero_word or macroblock_layer until next NALU (start code)
  - cabac_zero_word significant increases number of cycles in entropy decoder (already a bottleneck)

| start_code + NAL header | macroblock_layer() | rbsp_trailing_bits() | cabac_zero_word | start_code + NAL header | ... |

rbsp_slice_trailing_bits()
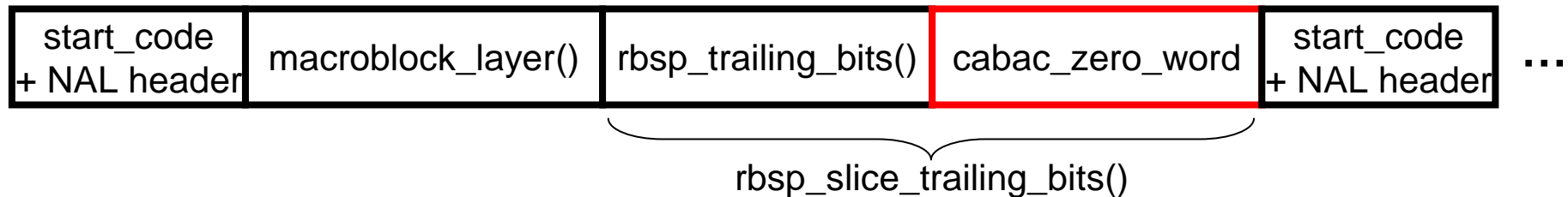
```
rbsp_slice_trailing_bits( ) {
  rbsp_trailing_bits( )
  if( entropy_coding_mode_flag )
    while( more_rbsp_trailing_data( ) )
      cabac_zero_word /* equal to 0x0000 */
}
```

Recommend remove cabac_zero_word from rbsp_slice_trailing_bits() and use alternative byte stuffing technique

TEXAS INSTRUMENTS

Byte stuffing

Let the variable k be set equal to

*Ceil((Ceil(3 * (32 * BinCountsInNALunits − RawMbBits ** PicSizeInMbs) ÷ 1024) − NumBytesInVclNALunits) ÷ 3).*

Depending on the variable k the following applies.

– *If k is less than or equal to 0, no cabac_zero_word is appended to the NAL unit.*

– *Otherwise (k is greater than 0), the 3-byte sequence 0x000003 is appended k times to the NAL unit after encapsulation, where the first two bytes 0x0000 represent a cabac_zero_word and the third byte 0x03 represents an emulation_prevention_three_byte.*

Multiplication and division have high implementation cost

TEXAS INSTRUMENTS

Byte stuffing with filler_data RBSP

- Filler_data RBSP = 0xFF (1-byte)

- Calculation of k simplified to

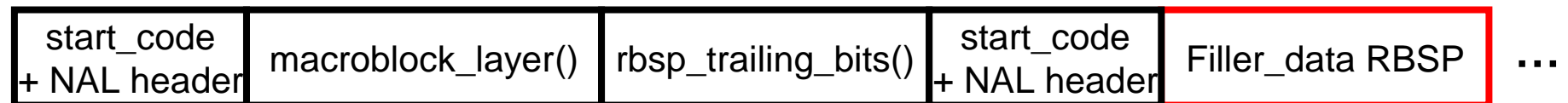*Ceil((32 * BinCountsInNALunits − RawMbBits * PicSizeInMbs) ÷ 1024) − NumBytesInVclNALunits)*

- Which can be implemented as with shifts and adds

$$a = (BinCountsInNALunits << 5) − RawMbBits * PicSizeInMbs ;$$

$$p = a >> 10;$$

$$q = ((a \& 0x3FF) == 0) ? 0 : 1;$$

$$k = (p + q) − NumBytesInVclNALunits.$$

start_code + NAL header	macroblock_layer()	rbsp_trailing_bits()	start_code + NAL header	Filler_data RBSP

...

TEXAS INSTRUMENTS

Conclusions

- Propose to remove cabac_zero_word due to cycle impact at entropy decoder, which is already a tight bottleneck

    – Reduces complexity of error detection in decoder

- Recommend using filler_data RBSP instead of cabac_zero_word to keep proper bins vs. bits ratio.

    – Simplifies encoder byte stuffing with lower implementation cost.

TEXAS INSTRUMENTS