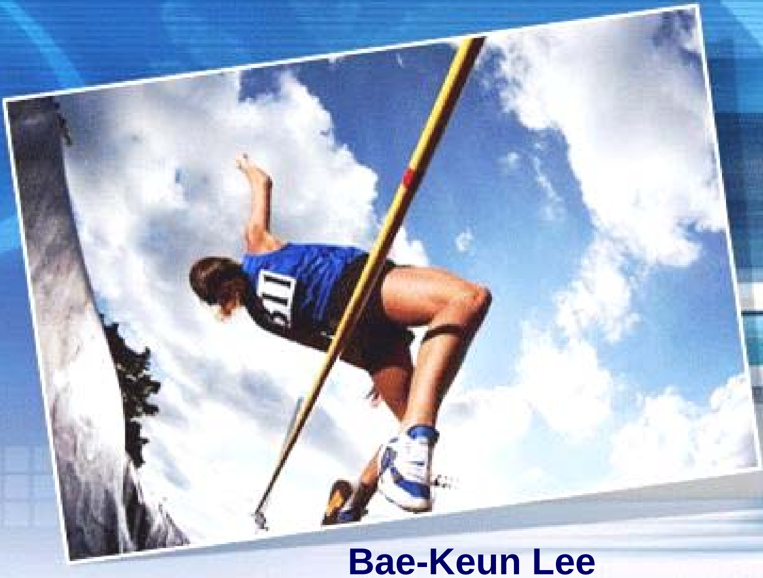
# Samsung Report CE4: Significant coefficients for PR slices [JVT-T034]



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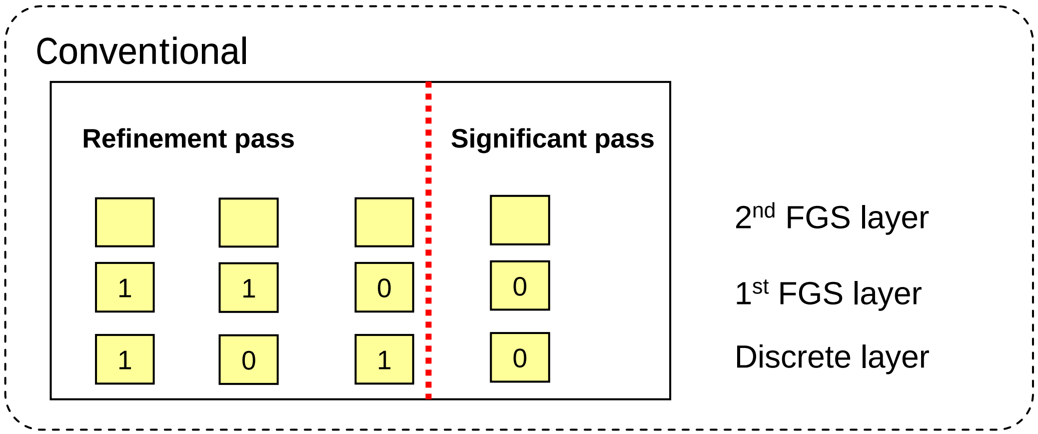
# Contents

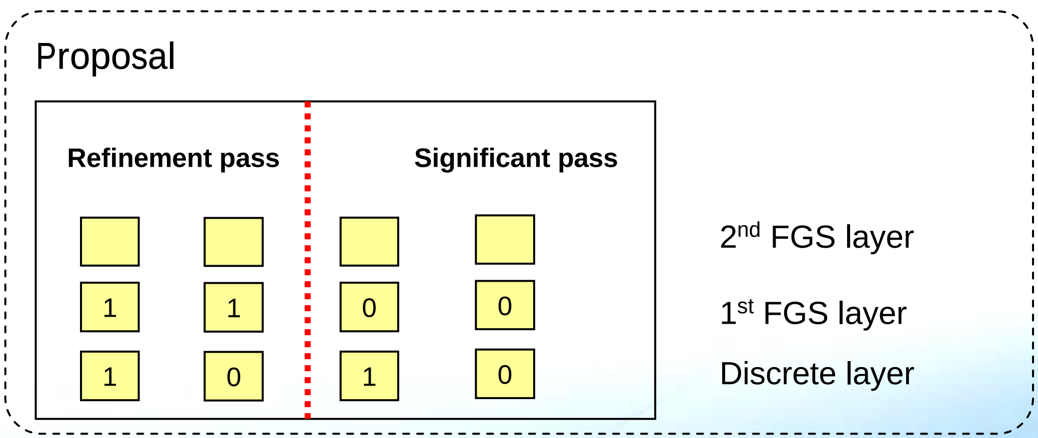
- Motivation
  - FGS coding method in JSVM6
  - Observation
- Re-defined significant coefficients for PR slice
- Experimental Results
- Conclusion

# Motivation

- FGS coding methods in JSVM6
  - Significant pass : all sub-ordinate coefficients are zero.
  - Refinement pass : any one of sub-ordinate coefficients is non-zero.

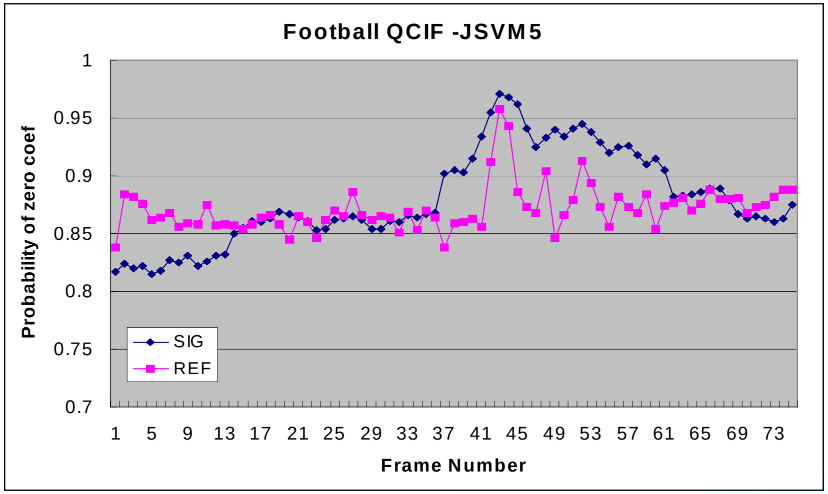


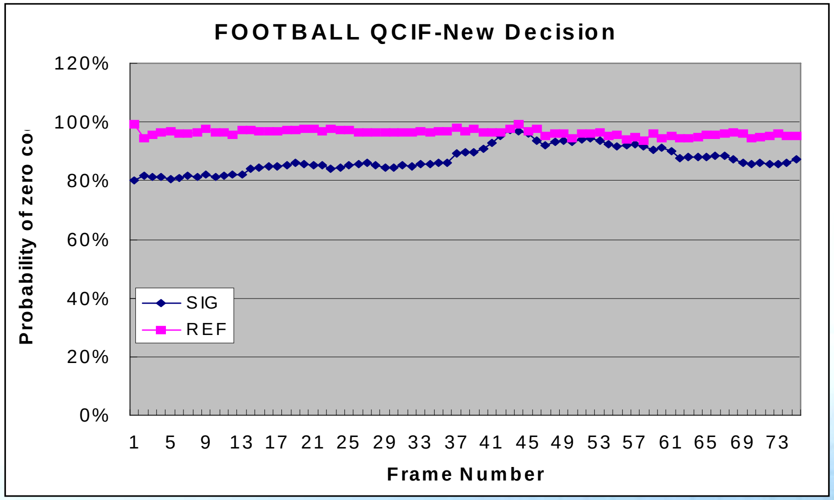

- FGS coding methods in proposal
  - See just below layer to classify significant / refinement pass.



# Motivation

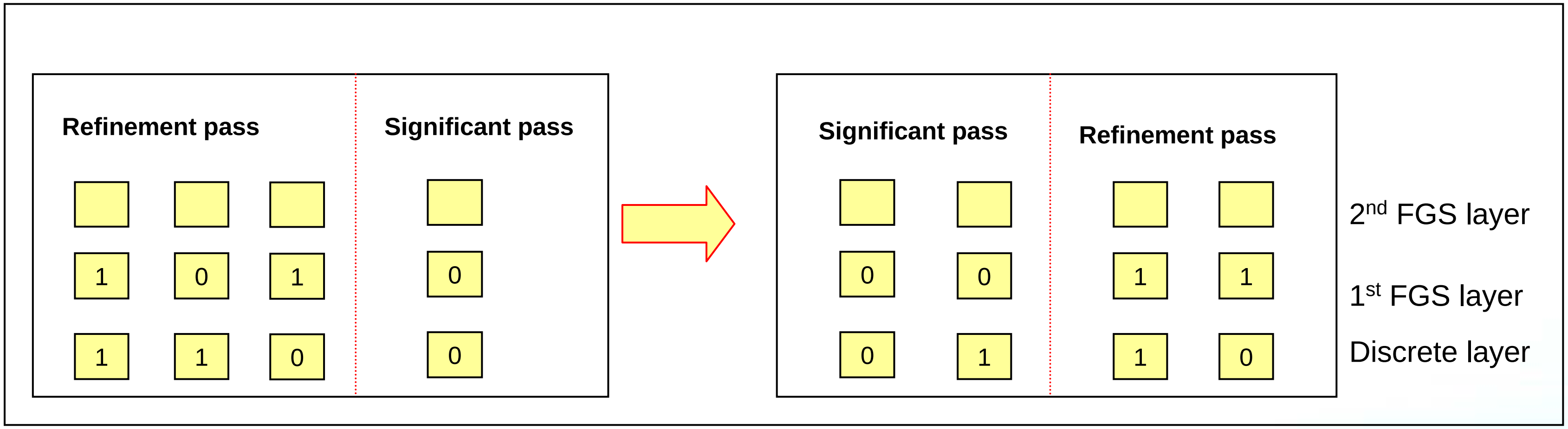
- Problems
  - The probability of zero coefficients between significant and refinement pass is apparently distinguishable, in general.
    - Two encoding pass approach is beneficial to improve coding efficiency and truncation performance.
    - This statistic is not true above second FGS layer in I/P frames. [See the left figure]
  - The probability of zero coeff between significant and refinement pass is distinguishable, after changing decision logic with look for for $F_{n-1}$'s coeff only, while encode $F_n^{th}$ FGS layer
    - If $F_{n-1}$ has non-zero coefficients, regard as refinement pass.
    - If $F_{n-1}$ has zero coefficient, regard as significant pass.
  - More stationary probability → Improve coding efficiency.



# Re-define significant coefficients for PR slices

- Re-definition of significant/refinement pass
  - Let's assume that $F_n$ is current FGS layer to be coded and $F_{n-1}$ is previous FGS layer which is already coded.
    - If $F_{n-1}$ has non-zero coefficient, then refinement pass coding.
    - If $F_{n-1}$ has zero coefficient, then significant pass coding.
  - No change in coding process of JSVM5, if $F_{n-1}$ is discrete base layer.
  - No additional memory
  - Less complexity




**Comparison with first option in JSVM5 and proposal**

# Simplification of Syntax and derivation process

- JSVM6
  - base_luma_level( mbAddr, i8x8, i4x4, scanIdx ) is specified as follows.
    - A variable i is set equal to 0.
    - A variable result is set equal to 0.
    - The return value of base_luma_level( mbAddr, i8x8, i4x4, scanIdx ) is derived as follows.
      a. The derivation process for base quality slices in subclause F.6.1 is invoked with mbAddr and baseQualityLevel equal to i as input and the output is assigned to baseQualitySlice[ i ].
      b. When the transform coefficient level LumaLevel[ 4 * i8x8 + i4x4 ][ scanIdx ] of the macroblock mbAddr is not equal to 0, the following applies
         - The variable result is set equal to LumaLevel[ 4 * i8x8 + i4x4 ][ scanIdx ].
         - The derivation process is continued with step d.
      c. When the variable i is less than ( quality_level – 1 ), the following applies.
  - The variable i is incremented by 1: i = i + 1.
  - The derivation process is continued with step a.
      a. The return value of base_luma_level( mbAddr, i8x8, i4x4, scanIdx ) is set equal to the value of the variable result .
- JVT-T034
  - The return value of base_luma_level( mbAddr, i8x8, i4x4, scanIdx ) is derived as follows.
    a. The derivation process for base quality slices in subclause F.6.1 is invoked with mbAddr and baseQualityLevel equal to i as input and the output is assigned to baseQualitySlice[ quality_level – 1 ].
    b. The return value of base_luma_level(mbAddr, i8x8, i4x4, scanIdx ) is set equal to LumaLevel[ 4 * i8x8 + i4x4 ][ scanIdx ].
- No iterative derivation process is required

# Experimental Result

- Test condition and S/W
  - Use 3 layer FGS test
  - Integrated into JSVM5.8
  - Two test condition
    - IPPP structure
    - Hierarchical B Structure
  - CABAC and CAVLC
  - Discrete base layer QP set to 40
- Summary of experimental results for first FGS coding option of JSVM5 in IPPP chain
  - QCIF sequence
    - Up to 0.62 dB gain at high bit-rates
  - CIF sequence
    - Up to 0.63 dB gain at high bit-rates
- Summary of experimental results for first FGS coding option of JSVM5 in Hierarchical B structure( GOP size =32 )
  - QCIF sequence
    - Up to 0.21 dB gain at high bit-rates
  - CIF sequence
    - Up to 0.04 dB gain at high bit-rates

# Experimental Result

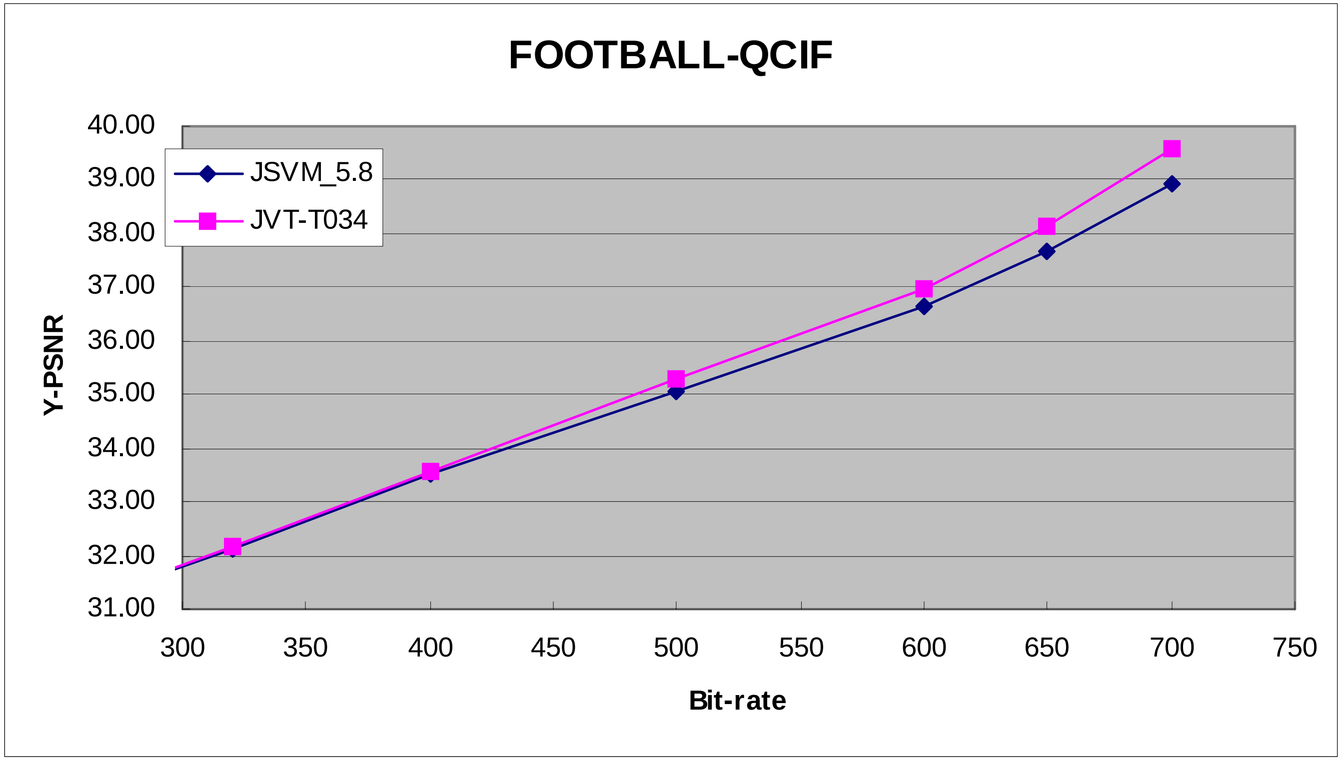
- Summary of experimental results of JSVM6 in IPPP structure [CABAC]
  - QCIF sequence
    - Up to 0.63 dB gain in third FGS layer.
    - Similar result in second FGS layer.
  - CIF sequence
    - Up to 0.61 dB gain in third FGS layer.
    - Similar result in second FGS layer.
  - 4CIF sequence
    - Up to 0.23 dB gain in third FGS layer.
    - Similar result in second FGS layer.
- Summary of experimental results of JSVM6 in IPPP structure [CAVLC]
  - Up to 0.18 dB PSNR gain at FOOTBALL-CIF
  - Up to 0.21 dB PSNR loss at FOREMAN-QCIF
  - Very similar performance at the other sequence

# Experimental Result

IPPP structure [CABAC]

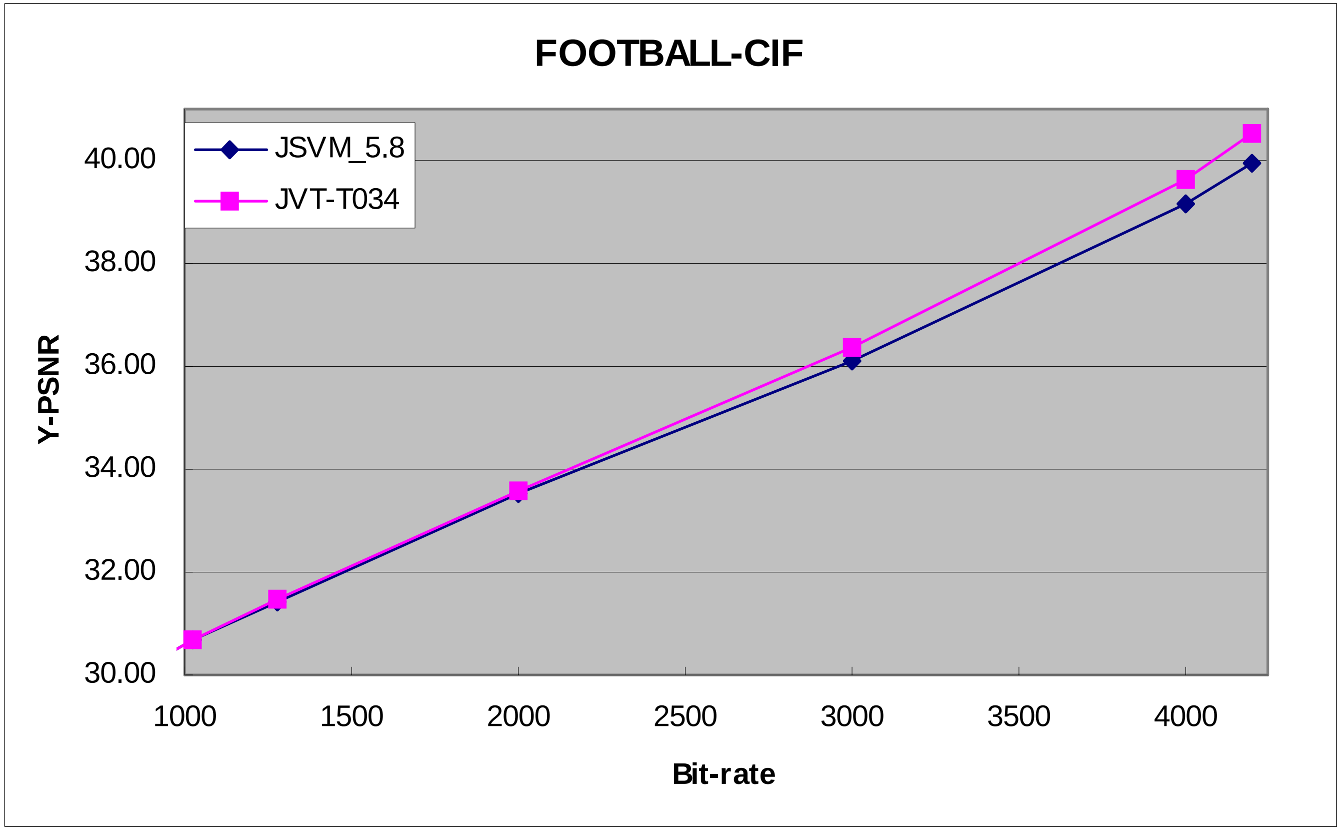
# Experimental Results

- FOOTBALL-QCIF
  - Up to 0.63 dB gain



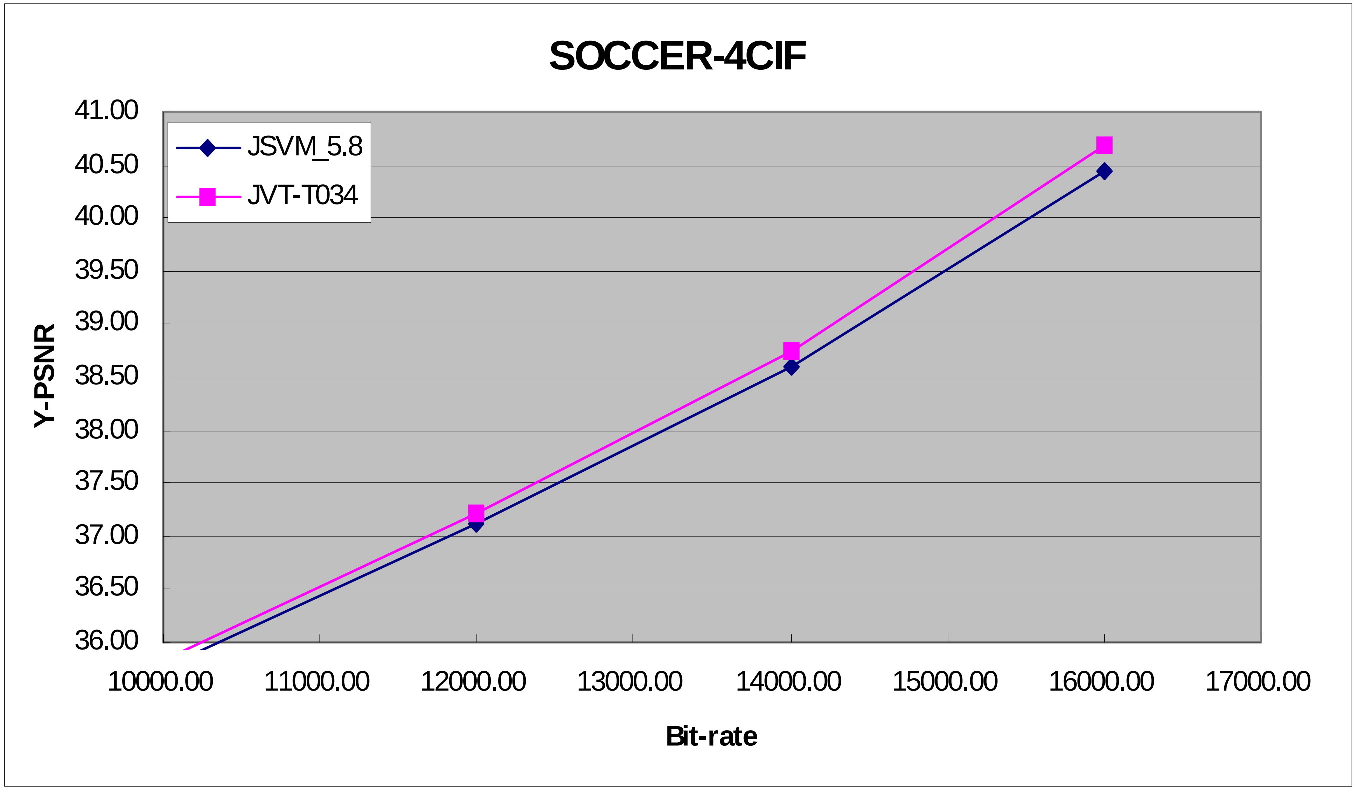
# Experimental Results

- FOOTBALL-CIF
  - Up to 0.61 dB gain



# Experimental Results

- SOCCER-4CIF
  - Up to 0.23 dB gain



# Conclusion

- Re-define significant coefficients for PR slices
  - Using only $F_{n-1}$$^{th}$ FGS layer's coefficients, when encode $F_n$$^{th}$ FGS layer.
    - If $F_{n-1}$ has non-zero coefficients, regard as refinement pass.
    - If $F_{n-1}$ has zero coefficient, regard as significant pass.
    - No change coding method, if $F_{n-1}$ is discrete base layer.
  - Better coding performance compared to JSVM6.
    - Up to 0.63 dB at QCIF, up to 0.61 dB at CIF, up to 0.23 dB at 4CIF
  - Simplified syntax and derivation process
    - No require iterative derivation process

# Conclusion

- Simplify second option in FGS coding in I/P frames.
  - Using re-defined FGS coefficients partitioning
  - One coding pass is used .
  - Encoding complexity is reduced about roughly ½ times.
  - Reduce memory – Not using discrete base layer map.
  - Similar performance in second FGS layer.
  - Better performance in third FGS layer.

- Recommend JVT to Create CE about FGS coefficient partitioning.

# Thank You!

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