

## JCTVC-O0165 Real-time SHVC software decoding with multi- threaded parallel processing

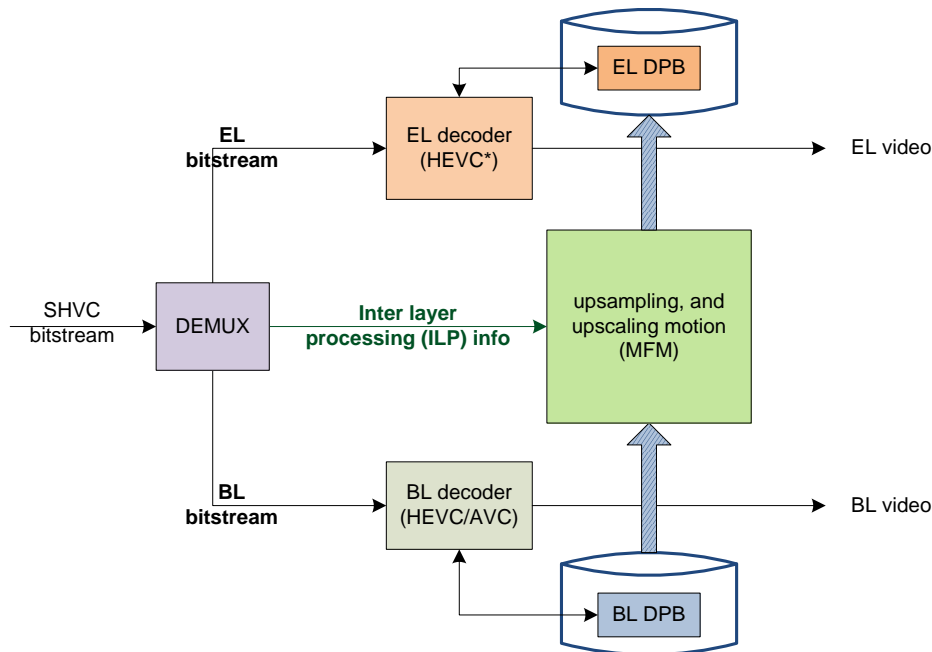


invention | collaboration | contribution

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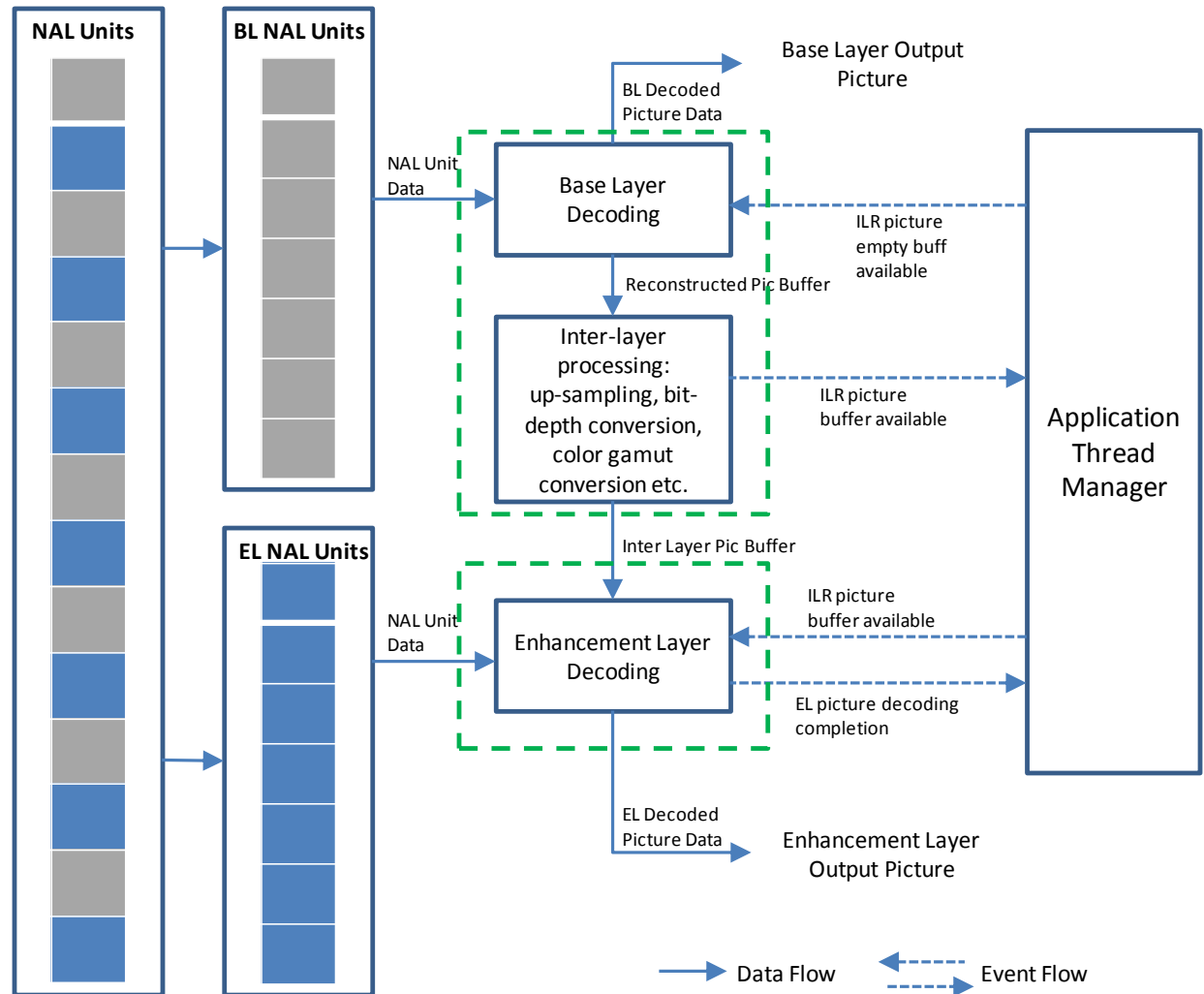
# Introduction

- Ref-Idx based SHVC is friendly for parallelized decoding implementation
- This proposal investigates SHVC real-time decoding:
  - 720p→1080p at 50fps on Intel i7 2600 @ 3.4GHz
- Our real-time SHVC decoder implementation is based on:
  - Multi-threaded layer decoding
  - Slice decoding with fine granularity pipeline design and multi-threading
  - SIMD optimizations
  - Other parallelization tools, such as WPP, tiles and multiple slices, are not used



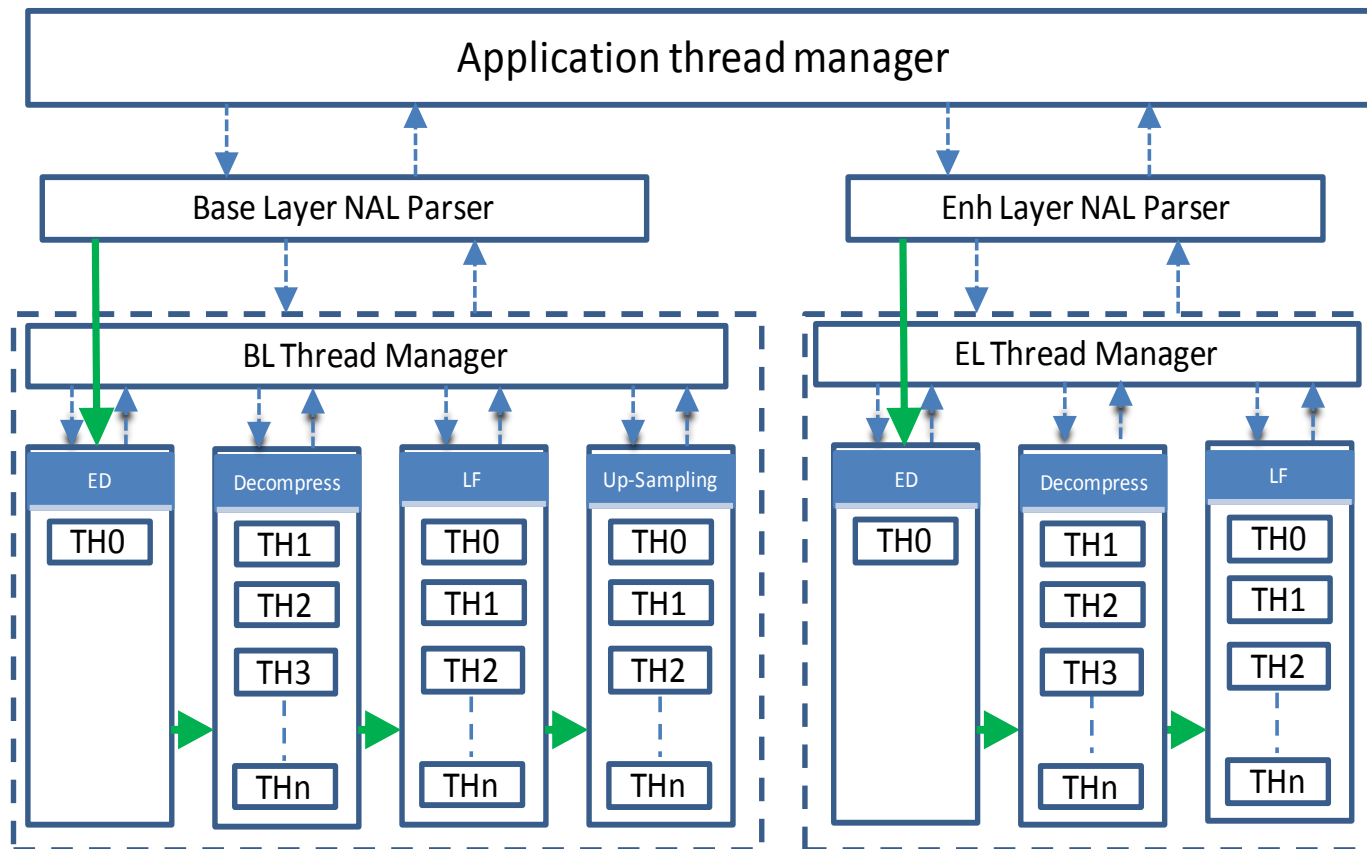
# Multi-threaded layer decoding

- Application thread manager synchronizes the BL and EL decoding
- BL decoding thread = BL decoding + inter layer processing (upsampling)
- EL decoding thread



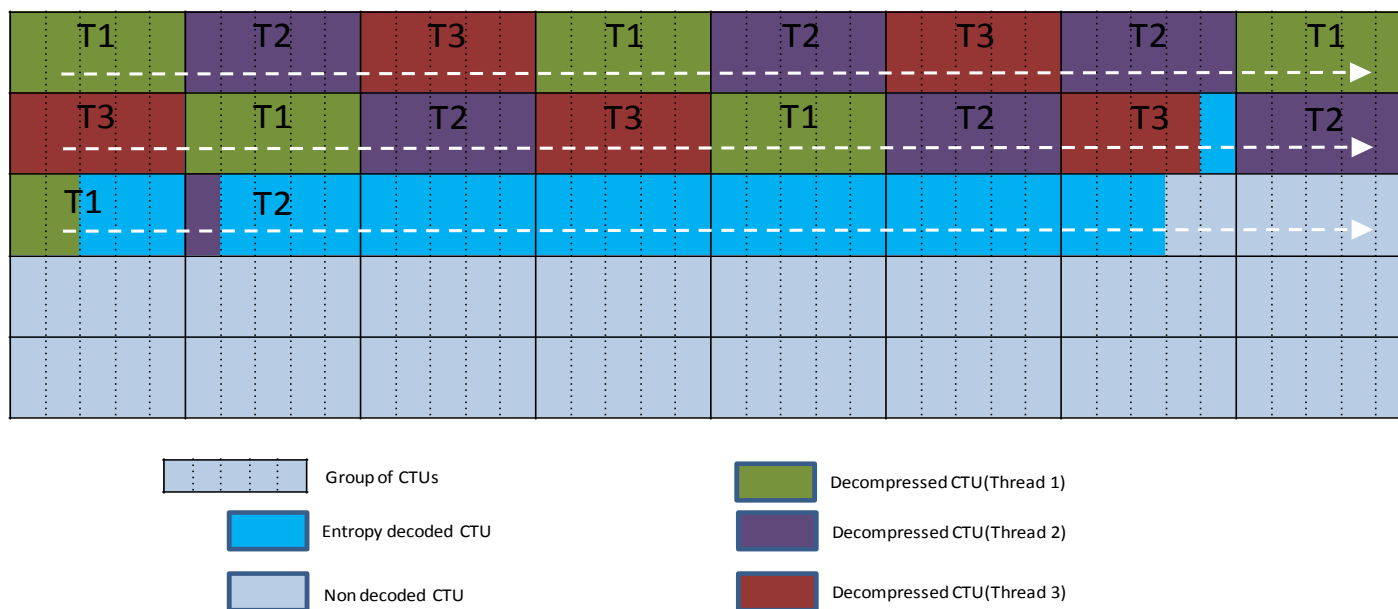
# Slice decoding with fine granularity pipeline and multi-threading

- BL thread manager schedules working threads for the following 4 stages
  - Entropy decoding
  - Decompression
  - Inloop filtering (deblocking and SAO)
  - Up-sampling and upscaling motion
- EL thread manager schedules working threads for the following 3 stages
  - Entropy decoding
  - Decompression
  - Inloop filtering (deblocking and SAO)



# Multi-threaded slice decoding

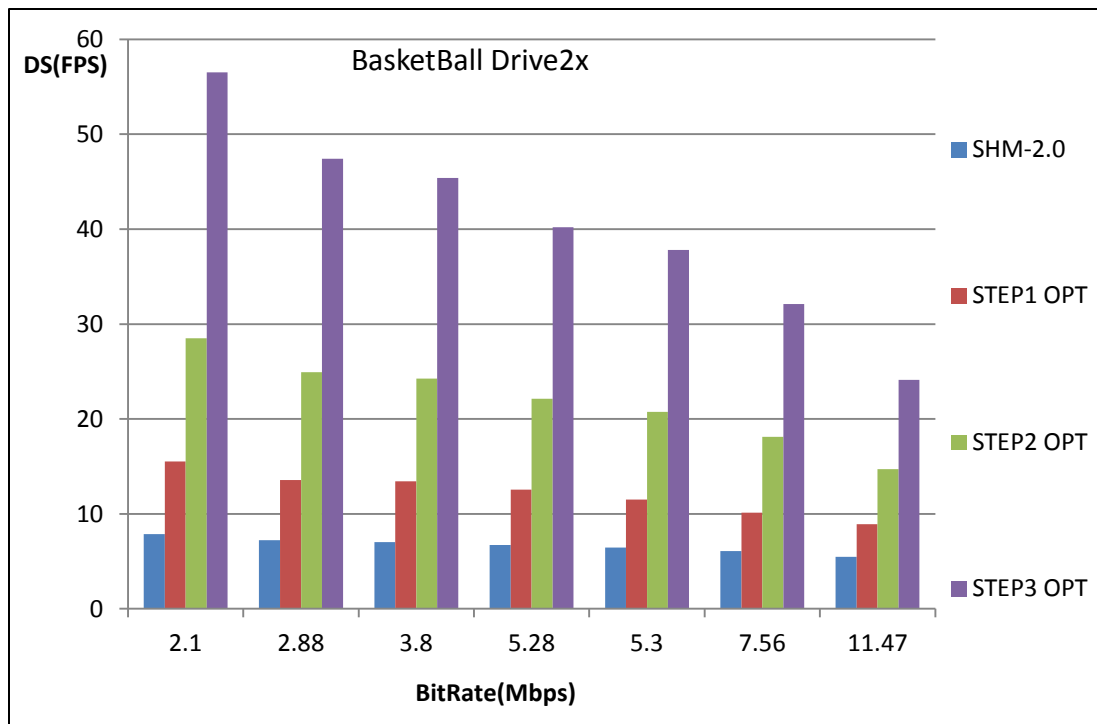
- A slice is separated into CTB groups, with each CTB group containing multiple CTBs
- 1 thread for entropy decoding, and multiple threads for decompression (MC, IQ, IT and reconstruction) based on CTB group



- SIMD optimizations for MC, IQ, IT and reconstruction

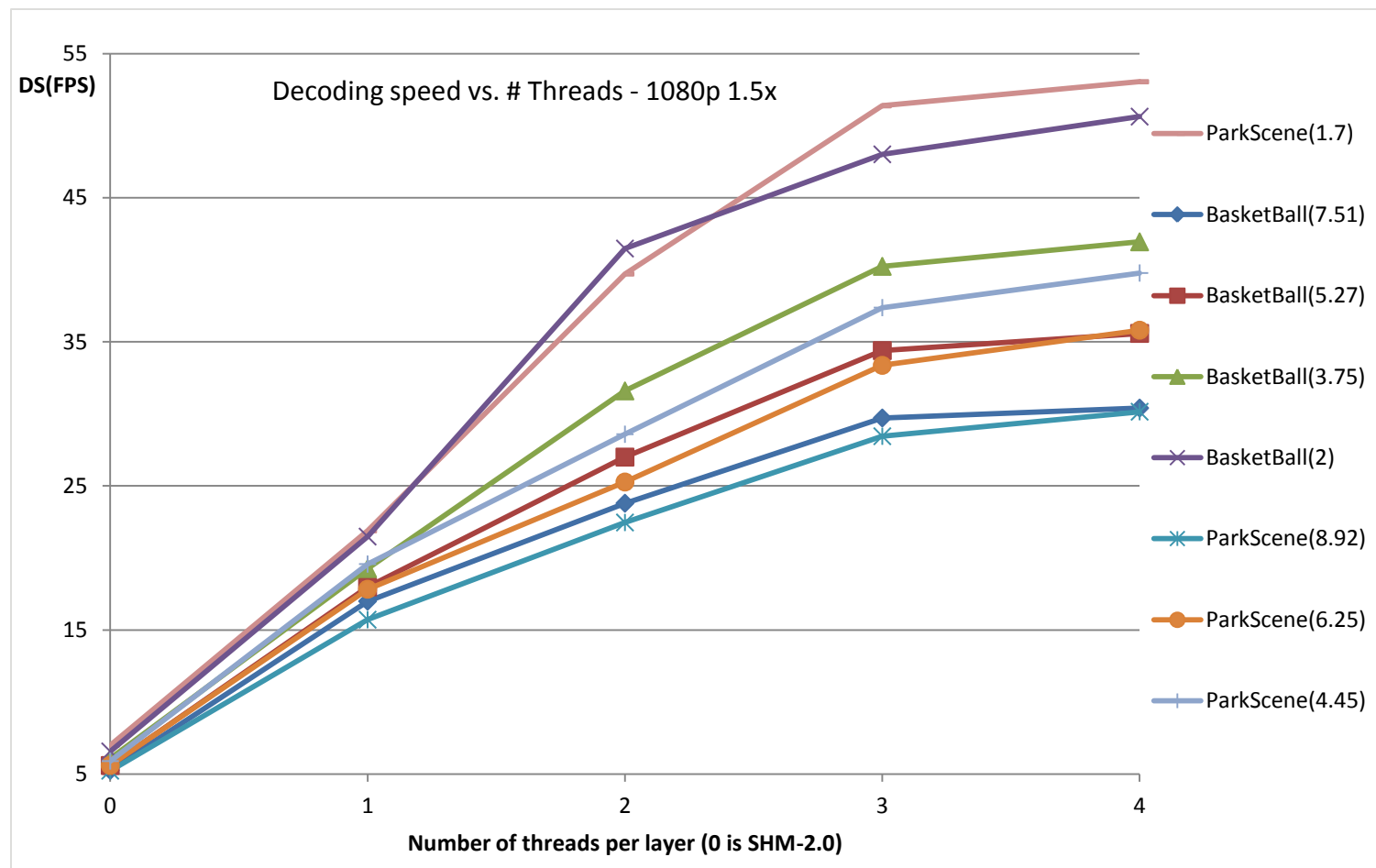
# Decoding speed with different optimizations

	Parallelization	Speedup vs SHM2.0
Step 1	Layer based multi-threading	2x
Step 2	Step 1 + SIMD	3x-4x
Step 3	Step 2 + MT slice decoding	5x-8x



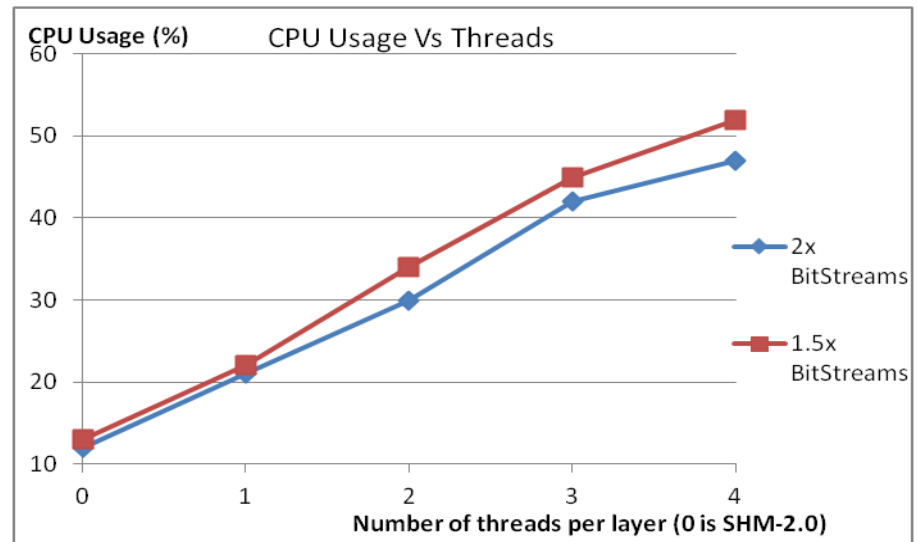
Platform: Intel Core i7 2600 processor, running at 3.4 GHz

# Decoding speed with different number of threads

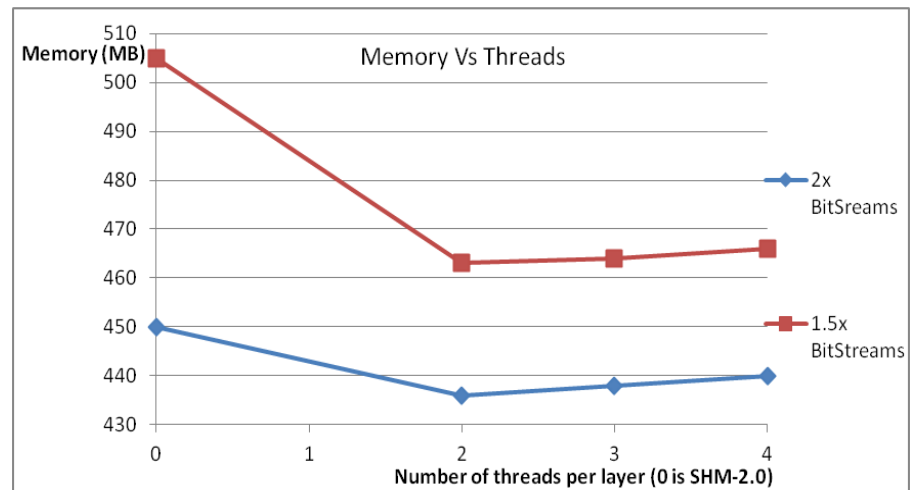


# CPU and memory usages

- Low CPU usage:  
50%~60% for 8 threads



- Memory usage is less than 470 Mbytes, lower than SHM-2.0





# Conclusions

- Reference index based SHVC design is friendly for real-time decoding implementations
- The real-time decoder in this proposal achieves up to 60fps for 1080p 2x spatial scalability, and 50fps for 1080p 1.5x spatial scalability