



# Daala-TX

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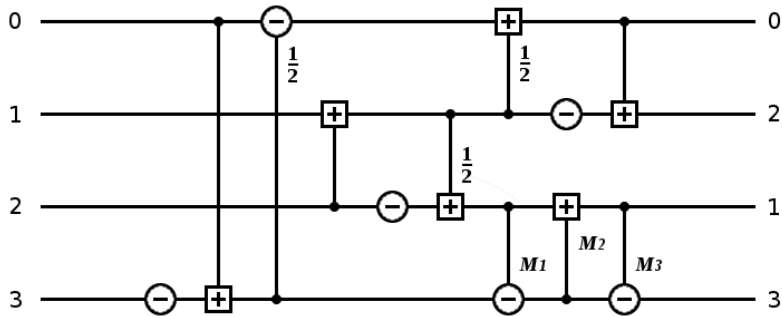
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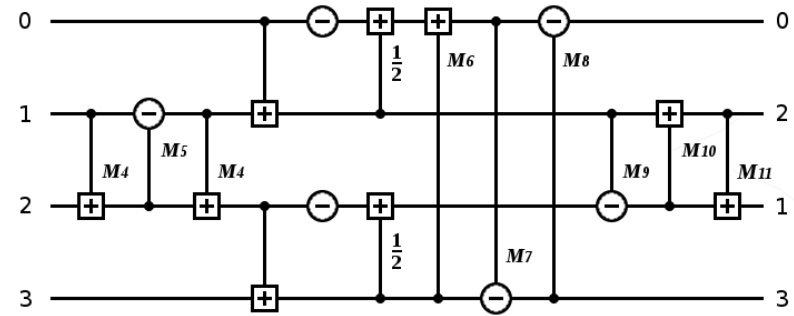


# What is Daala TX

Replaces the existing AV1 TX with the lifting implementation from Daala.



Type-II 4-point DCT



Type-IV 4-point DST



# Daala TX

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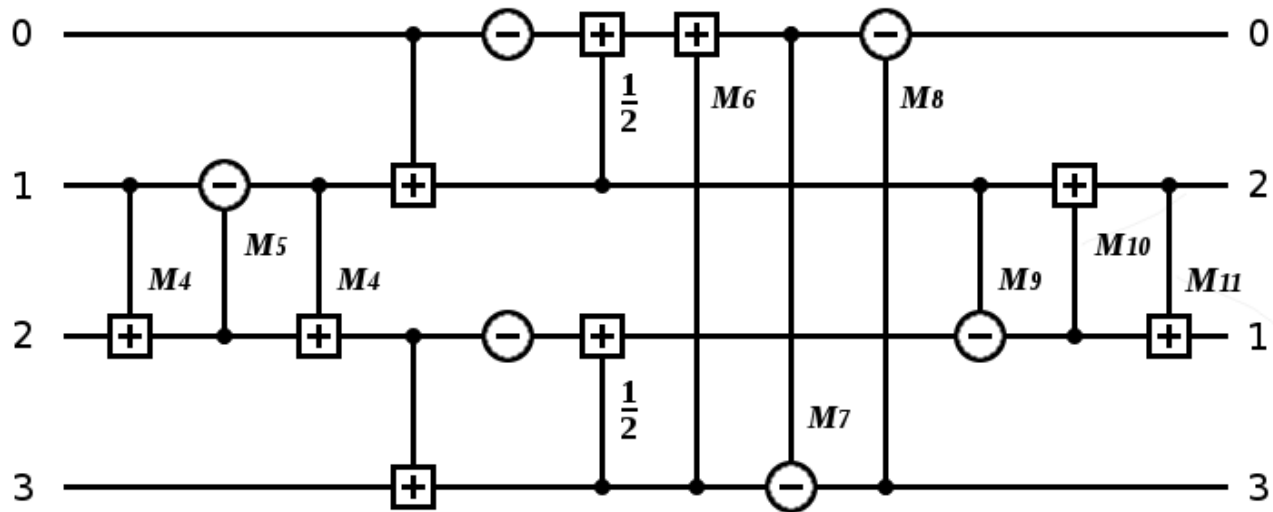
Daala TX is a better implementation in every way...

- Lower operation count, fewer multiplies
  - complete multiply/downshift/round is a single instruction (VQRDMULH in NEON, PMULHRSW in SSSE3)
  - no halving of the SIMD throughput during the rotations
- Orthonormal scaling
  - No need for different shifts at different transform sizes
  - Use same quantizers for all transform sizes and depths
- Smaller intermediaries
- Daala 'low-bitdepth' transforms wide enough for high-bitdepth
- Deeper noise floor
  - Increase coefficient shift for more gain (.5%-1%)
- Reusable / embedded design (less hardware area)
- Inherently lossless



# Arithmetic dependency depth

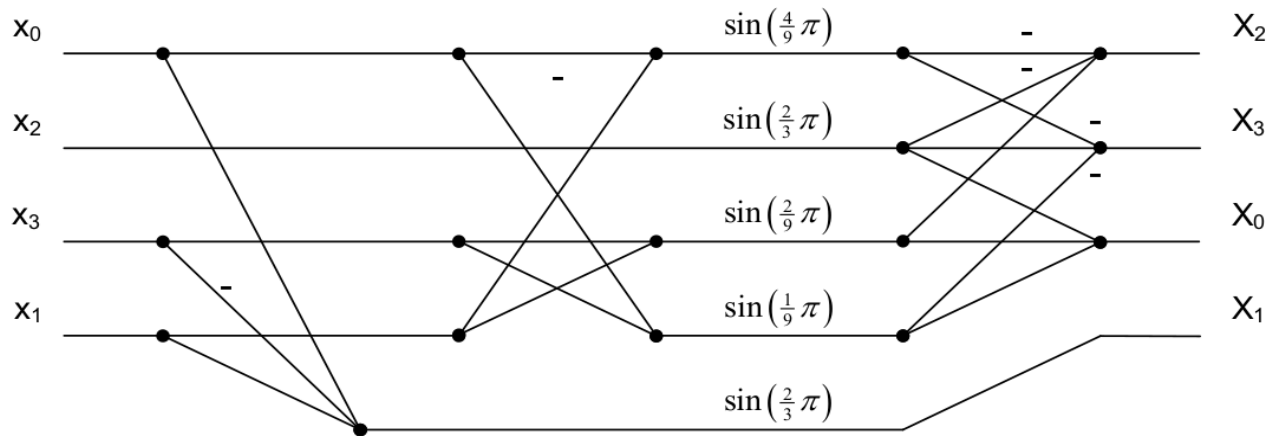
The One Disadvantage:  
Multiplies are partly serialized





# Arithmetic depth (2)

The solution: Hybrid transforms  
Use where hardware latency is critical



Factorization structure for type-VII 4-point DST

Tradeoff: Hybrid TX loses inherent invertibility/losslessness



# Daala TX: Current State

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Landed or pending review:

- All transforms in place, active in lowbitdepth path (CONFIG\_DAALA\_TX)
- Optional hybrid 4-point DST-VII (Gerrit 19021)

To do:

- High bit-depth glue code
- Move AV1 to same-quantizer for all TX sizes and depths
- Decisions (use low-latency hybrid or no?)



# Daala TX

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# Questions?