

The background is a solid green color with a repeating pattern of white line-art icons. These icons include various nautical items like anchors, lifebuoys, and seashells, as well as outdoor and travel-related items like a compass, a map, a bird, and a lightning bolt.

**MEDIATEK**

**JVET-Q0193**

# **LFNST signalling cleanup with TS checking**

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# Overall Summary

- Three methods are proposed to consider transform skip (TS) for low frequency non-separable secondary transform (LFNST) signalling
  - Method 1: If one of the components is not coded in TS mode, the LFNST index can be signalled
  - Method 2: If all components are not coded in TS mode, the LFNST index can be signalled
  - Method 3: For single tree, if luma is not coded in TS mode, the LFNST index can be signalled
- Compared to VTM7.0 CTC, the BD-rates of Method 1 and Method 2 are negligible and Method 3 has no BD-rate change

| #                 | Config. | VTM7.0 |        |       |
|-------------------|---------|--------|--------|-------|
|                   |         | Y      | Cb     | Cr    |
| Proposed method 1 | AI      | 0.00%  | 0.01%  | 0.01% |
|                   | RA      | 0.00%  | 0.00%  | 0.04% |
| Proposed method 2 | AI      | 0.00%  | -0.01% | 0.02% |
|                   | RA      | 0.01%  | 0.06%  | 0.05% |

# LFNST Signalling Issue

- LFNST is disabled when transform is skipped
- Per adoption of JVET-P0058, TS is extended to chroma components, and the TB-level TS flags for Y, Cb, and Cr are signalled, respectively
- However, when signalling the LFNST index, the TS flag for Y is considered but there is no corresponding checking for TS flags for Cb and Cr
- Moreover, it is not reasonable to consider the luma TS flag in chroma tree
  - In VVC Draft 7, the luma TS flag is checked even in chroma tree

# Method 1 – Signal LFNST Index When One of the Components Is Not TS Mode

- LFNST can be applied to any of non-TS coded colour component
  - Signal LFNST index when one of the components is not TS mode
  - Flexibility of LFNST is maintained
- For single tree, if any one of the TS flags for Y, Cb, and Cr is equal to 0, LFNST index can be signalled
- For chroma tree, if any one of the TS flags for Cb and Cr is equal to 0, the LFSNT index can be signalled
- For luma tree, if the TS flag for Y is equal to 0, the LFNST index can be signalled

## Method 2 – Signal LFNST Index When All Components Are Not TS Mode

- LFNST can be applied when all colour components are not using TS mode
  - Strictness of LFNST is achieved
- For single tree, if the TS flags for Y, Cb, and Cr are all equal to 0, LFNST index can be signalled
- For chroma tree, if the TS flags for Cb and Cr are both equal to 0, the LFSNT index can be signalled
- For luma tree, if the TS flag for Y is equal to 0, the LFNST index can be signalled

## Method 3 – Only Check Luma Component in Single Tree

- Fix of the VVC Draft 7. Only check luma component in single tree
  - In VVC Draft 7, the luma TS flag is checked even in chroma tree, while the VTM7 does not
  - Align the spec to SW
  - Same result as the VTM7.0
- For single tree, the TS flag for Y is equal to 0, LFNST index can be signalled
- For luma tree and chroma tree, no additional check is added

# Performance of Method 1

| All Intra Main10 |       |        |        |      |      | Random access Main10 |        |        |        |      |      |
|------------------|-------|--------|--------|------|------|----------------------|--------|--------|--------|------|------|
| Over VTM-7.0     |       |        |        |      |      | Over VTM-7.0         |        |        |        |      |      |
|                  | Y     | U      | V      | EncT | DecT |                      | Y      | U      | V      | EncT | DecT |
| Class A1         | 0.00% | -0.01% | 0.05%  | 100% | 99%  | Class A1             | 0.01%  | 0.04%  | -0.04% | 100% | 97%  |
| Class A2         | 0.00% | 0.00%  | 0.01%  | 100% | 98%  | Class A2             | -0.03% | 0.04%  | -0.03% | 100% | 100% |
| Class B          | 0.00% | 0.00%  | -0.06% | 100% | 99%  | Class B              | 0.00%  | -0.03% | 0.17%  | 100% | 100% |
| Class C          | 0.01% | 0.06%  | 0.06%  | 100% | 99%  | Class C              | 0.02%  | 0.00%  | 0.00%  | 99%  | 102% |
| Class E          | 0.00% | 0.00%  | 0.04%  | 100% | 100% | Class E              |        |        |        |      |      |
| <b>Overall</b>   | 0.00% | 0.01%  | 0.01%  | 100% | 99%  | <b>Overall</b>       | 0.00%  | 0.00%  | 0.04%  | 100% | 100% |
| Class D          | 0.00% | -0.02% | 0.09%  | 102% | 98%  | Class D              | -0.03% | -0.07% | 0.07%  | 100% | 101% |
| Class F          | 0.00% | -0.01% | 0.07%  | 100% | 98%  | Class F              | 0.00%  | 0.03%  | 0.03%  | 100% | 99%  |

# Performance of Method 2

| All Intra Main10 |        |        |        |      |      | Random access Main10 |        |        |        |      |      |
|------------------|--------|--------|--------|------|------|----------------------|--------|--------|--------|------|------|
| Over VTM-7.0     |        |        |        |      |      | Over VTM-7.0         |        |        |        |      |      |
|                  | Y      | U      | V      | EncT | DecT |                      | Y      | U      | V      | EncT | DecT |
| Class A1         | 0.00%  | -0.03% | 0.05%  | 100% | 100% | Class A1             | 0.00%  | -0.01% | 0.00%  | 99%  | 100% |
| Class A2         | -0.01% | -0.01% | 0.01%  | 100% | 99%  | Class A2             | -0.01% | 0.10%  | 0.08%  | 100% | 100% |
| Class B          | 0.00%  | 0.00%  | 0.00%  | 100% | 98%  | Class B              | 0.02%  | 0.06%  | 0.04%  | 99%  | 98%  |
| Class C          | 0.00%  | -0.02% | 0.05%  | 100% | 99%  | Class C              | 0.02%  | 0.07%  | 0.08%  | 99%  | 99%  |
| Class E          | 0.00%  | 0.00%  | -0.03% | 100% | 100% | Class E              |        |        |        |      |      |
| <b>Overall</b>   | 0.00%  | -0.01% | 0.02%  | 100% | 99%  | <b>Overall</b>       | 0.01%  | 0.06%  | 0.05%  | 99%  | 99%  |
| Class D          | 0.00%  | 0.03%  | -0.01% | 102% | 100% | Class D              | -0.05% | -0.22% | -0.07% | 100% | 99%  |
| Class F          | -0.01% | 0.01%  | 0.00%  | 100% | 99%  | Class F              | 0.01%  | 0.00%  | -0.04% | 99%  | 100% |

# Conclusions

- Three methods are proposed to clearly define the interaction between TS flags for Y, Cb, and Cr
  - Method 1 allows LFNST signalling if at least one component is not TS
    - Flexibility of LFNST is maintained
  - Method 2 allows LFNST signalling if all components are not TS
    - Strictness of LFNST is achieved
  - Method 3 allows LFNST signalling for single tree if Y is not TS
    - Simple clarification is provided
- Minor BD-rate changes