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| Question: | 6/21 (VCEG) | | |
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| Title: | **Report of CE-4** | | |
| Purpose: | Proposal | | |

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# Abstract

This document reports on the simulation results of CE-4.

# Technical overview of the CE

The current H.BWC, version 2, supports to use LMS prediction in the DCT-domain. If LMS-prediction is supported on a given block, no additional block-based prediction is applied on that block, or, in other words, only the zero prediction mode is used. Moreover, in the current H.BWC, if LMS prediction is supported, Huffman coding is used for the DCT coefficients.

As a first anchor for CE-4, called LMS-only anchor, the current H.BWC is configured so that only the aforementioned LMS-prediction mode is used. Moreover, the fixed blocksize 2048 is used since this blocksize was found to be most efficient for the LMS prediction of the current H.BWC.

Corresponding to this LMS-only anchor, in all tests of CE-4, only the zero-prediction in combination with LMS prediction as well as the fixed blocksize 2048 are used. However, for the entropy coding, Huffman coding is replaced by CABAC entropy coding.

In this setting, the CE tests two versions of CABAC entropy coding: First, the CABAC entropy coding from H.BWC, version 2, without any changes and, second, the CABAC entropy coding from H.BWC, version 2, but with the changes of CE 3 enabled. Moreover, the CE tests the combination of each of these CABAC versions with three versions of quantization: Uniform reconstruction scalar quantization without entropy constraint quantization at the encoder, uniform reconstruction scalar quantization with entropy constraint quantization at the encoder (rate-distortion-optimized quantization) and trellis coded quantization.

# Software versions for CE-4

To generated the results of CE-4, two software versions were used. First, software version SW-v1 was used to generate the results of CE-4-1-1, CE-4-2-1, CE-4-3-1, CE-4-4-1, CE-4-5-1 and CE-4-6-1. The software SW-v1 is the same software as the software SW-v1 used to generate the results of CE-5-1-1, CE-5-2-1 and CE-5-3-1, where different configuration-files were used for each of these CEs. Second, software version SW-v2 was used to generate the results of CE-4-1-2, CE-4-2-2, CE-4-3-2, CE-4-4-2, CE-4-5-2 and CE-4-6-2. The software SW-v2 is the same software as the software SW-v2 used to generate the results of CE-5-1-2, CE-5-2-2 and CE-5-3-2, where different configuration-files were used for each of these CEs.

# Simulation results

## Simulation results of CE-4-1-1

In this CE, the Huffman coding is replaced by the CABAC entropy coding of H.BWC, version 2 without any changes. For quantization, a uniform scalar reconstruction quantizer is used. At the encoder, simple quantization without entropy constraints is invoked.

The following results are reported over the LMS anchor in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 1,60% | 1,59% | 102% | 93% |
| INCART (ECG) | -0,41% | -0,38% | 138% | 198% |
| CHBMIT (EEG) | -1,21% | -1,18% | 110% | 193% |
| NMR55 (EEG) | -1,17% | -0,78% | 151% | 105% |
| NMR57 (EEG) | 0,62% | 0,67% | 199% | 281% |
| Ozdemir (EMG) | 0,35% | 0,44% | 117% | 109% |
| **Overall** | -0,04% | 0,06% | 136% | 163% |

The following results are reported over the LMS anchor in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 1,09% | 1,09% | 138% | 129% |
| INCART (ECG) | -31,57% | -31,59% | 159% | 302% |
| CHBMIT (EEG) | -17,56% | -17,51% | 148% | 301% |
| NMR55 (EEG) | -8,51% | -8,05% | 162% | 149% |
| NMR57 (EEG) | -22,62% | -22,52% | 254% | 514% |
| Ozdemir (EMG) | -0,01% | 0,08% | 118% | 125% |
| **Overall** | -13,20% | -13,08% | 163% | 254% |

## Simulation results of CE-4-1-2

In this CE, the Huffman coding is replaced by the CABAC entropy coding of H.BWC, version 2, where the changes to the CABAC entropy coding proposed in CE 3 are enabled. For quantization, a uniform scalar reconstruction quantizer is used. At the encoder, simple quantization without entropy constraints is invoked.

The following results are reported over the LMS anchor in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | -2,95% | -2,95% | 80% | 72% |
| INCART (ECG) | -4,00% | -3,97% | 107% | 152% |
| CHBMIT (EEG) | -4,45% | -4,43% | 85% | 148% |
| NMR55 (EEG) | -3,71% | -3,32% | 118% | 81% |
| NMR57 (EEG) | -1,77% | -1,70% | 156% | 213% |
| Ozdemir (EMG) | -0,91% | -0,82% | 91% | 83% |
| **Overall** | -2,97% | -2,87% | 106% | 125% |

The following results are reported over the LMS anchor in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | -3,43% | -3,43% | 108% | 100% |
| INCART (ECG) | -34,10% | -34,12% | 123% | 232% |
| CHBMIT (EEG) | -20,28% | -20,24% | 115% | 231% |
| NMR55 (EEG) | -10,87% | -10,40% | 126% | 115% |
| NMR57 (EEG) | -24,50% | -24,40% | 199% | 390% |
| Ozdemir (EMG) | -1,27% | -1,17% | 92% | 95% |
| **Overall** | -15,74% | -15,63% | 127% | 194% |

## Simulation results of CE-4-2-1

In this CE, the Huffman coding is replaced by the CABAC entropy coding of H.BWC, version 2 without any changes. For quantization, a uniform scalar reconstruction quantizer is used. At the encoder, entropy constraint quantization (rate-distortion optimized quantization) is invoked.

The following results are reported over the LMS anchor in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 2,94% | 2,71% | 118% | 89% |
| INCART (ECG) | 3,12% | 2,97% | 162% | 195% |
| CHBMIT (EEG) | -1,03% | -1,07% | 138% | 190% |
| NMR55 (EEG) | -0,78% | -1,02% | 175% | 104% |
| NMR57 (EEG) | 0,33% | 0,25% | 233% | 283% |
| Ozdemir (EMG) | 0,38% | 0,19% | 144% | 107% |
| **Overall** | 0,83% | 0,67% | 162% | 161% |

The following results are reported over the LMS anchor in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 2,41% | 2,19% | 160% | 123% |
| INCART (ECG) | -29,10% | -29,24% | 187% | 298% |
| CHBMIT (EEG) | -17,39% | -17,40% | 187% | 297% |
| NMR55 (EEG) | -8,16% | -8,29% | 188% | 148% |
| NMR57 (EEG) | -23,01% | -23,02% | 297% | 518% |
| Ozdemir (EMG) | 0,01% | -0,17% | 146% | 123% |
| **Overall** | -12,54% | -12,65% | 194% | 251% |

## Simulation results of CE-4-2-2

In this CE, the Huffman coding is replaced by the CABAC entropy coding of H.BWC, version 2, where the changes to the CABAC entropy coding proposed in CE 3 are enabled. For quantization, a uniform scalar reconstruction quantizer is used. At the encoder, entropy constraint quantization (rate-distortion optimized quantization) is invoked.

The following results are reported over the LMS anchor in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | -5,61% | -5,62% | 123% | 69% |
| INCART (ECG) | -3,59% | -3,66% | 162% | 152% |
| CHBMIT (EEG) | -5,71% | -5,76% | 136% | 148% |
| NMR55 (EEG) | -4,92% | -4,68% | 179% | 81% |
| NMR57 (EEG) | -3,42% | -3,35% | 214% | 216% |
| Ozdemir (EMG) | -1,73% | -1,66% | 141% | 81% |
| **Overall** | -4,16% | -4,12% | 159% | 124% |

The following results are reported over the LMS anchor in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | -6,07% | -6,09% | 166% | 96% |
| INCART (ECG) | -33,85% | -33,93% | 186% | 232% |
| CHBMIT (EEG) | -21,33% | -21,35% | 184% | 231% |
| NMR55 (EEG) | -11,99% | -11,67% | 192% | 114% |
| NMR57 (EEG) | -25,96% | -25,84% | 272% | 395% |
| Ozdemir (EMG) | -2,09% | -2,01% | 142% | 93% |
| **Overall** | -16,88% | -16,81% | 191% | 193% |

## Simulation results of CE-4-3-1

In this CE, the Huffman coding is replaced by the CABAC entropy coding of H.BWC, version 2, without any changes. For quantization, trellis coded quantization with four states is used.

The following results are reported over the LMS anchor in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 2,21% | 2,01% | 238% | 90% |
| INCART (ECG) | 3,10% | 2,91% | 312% | 196% |
| CHBMIT (EEG) | -2,88% | -2,95% | 300% | 190% |
| NMR55 (EEG) | -2,07% | -2,54% | 322% | 105% |
| NMR57 (EEG) | -0,69% | -0,88% | 495% | 282% |
| Ozdemir (EMG) | -1,89% | -2,07% | 282% | 107% |
| **Overall** | -0,37% | -0,59% | 325% | 162% |

The following results are reported over the LMS anchor in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 1,69% | 1,49% | 323% | 124% |
| INCART (ECG) | -29,09% | -29,26% | 359% | 298% |
| CHBMIT (EEG) | -18,91% | -18,95% | 406% | 297% |
| NMR55 (EEG) | -9,37% | -9,71% | 345% | 149% |
| NMR57 (EEG) | -23,82% | -23,91% | 630% | 516% |
| Ozdemir (EMG) | -2,24% | -2,42% | 285% | 123% |
| **Overall** | -13,63% | -13,79% | 391% | 251% |

## Simulation results of CE-4-3-2

In this CE, the Huffman coding is replaced by the CABAC entropy coding of H.BWC, version 2, where the changes to the CABAC entropy coding proposed in CE 3 are enabled. For quantization, trellis coded quantization with four states is used.

The following results are reported over the LMS anchor in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | -9,46% | -9,47% | 215% | 71% |
| INCART (ECG) | -7,28% | -7,32% | 272% | 152% |
| CHBMIT (EEG) | -9,90% | -9,91% | 258% | 148% |
| NMR55 (EEG) | -8,48% | -8,25% | 288% | 82% |
| NMR57 (EEG) | -7,86% | -7,80% | 388% | 193% |
| Ozdemir (EMG) | -5,04% | -4,94% | 243% | 82% |
| **Overall** | -8,00% | -7,95% | 277% | 121% |

The following results are reported over the LMS anchor in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.0** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | -9,91% | -9,91% | 291% | 99% |
| INCART (ECG) | -36,37% | -36,42% | 313% | 231% |
| CHBMIT (EEG) | -24,81% | -24,80% | 349% | 231% |
| NMR55 (EEG) | -15,28% | -14,98% | 309% | 116% |
| NMR57 (EEG) | -29,39% | -29,28% | 495% | 354% |
| Ozdemir (EMG) | -5,38% | -5,28% | 245% | 95% |
| **Overall** | -20,19% | -20,11% | 334% | 187% |

## Simulation results of CE-4-4-1

The test in this CE is the same as in CE-4-1-1, but the anchor is now H.BWC, version 2, CTC.

The following results are reported in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 34,55% | 34,50% | 4% | 175% |
| INCART (ECG) | 12,88% | 13,00% | 3% | 231% |
| CHBMIT (EEG) | 5,96% | 5,99% | 6% | 227% |
| NMR55 (EEG) | 10,89% | 14,05% | 4% | 138% |
| NMR57 (EEG) | 8,41% | 8,41% | 3% | 346% |
| Ozdemir (EMG) | 2,56% | 2,62% | 4% | 133% |
| **Overall** | 12,54% | 13,09% | 4% | 208% |

The following results are reported in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 39,35% | 39,30% | 2% | 175% |
| INCART (ECG) | 42,59% | 42,80% | 4% | 150% |
| CHBMIT (EEG) | 5,74% | 5,73% | 3% | 146% |
| NMR55 (EEG) | 10,47% | 14,15% | 4% | 173% |
| NMR57 (EEG) | 8,25% | 8,27% | 5% | 128% |
| Ozdemir (EMG) | 2,80% | 2,84% | 4% | 133% |
| **Overall** | 18,20% | 18,85% | 4% | 151% |

## Simulation results of CE-4-4-2

The test in this CE is the same as in CE-4-1-2, but the anchor is now H.BWC, version 2, CTC.

The following results are reported in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 28,53% | 28,48% | 3% | 135% |
| INCART (ECG) | 8,78% | 8,91% | 2% | 177% |
| CHBMIT (EEG) | 2,55% | 2,58% | 5% | 174% |
| NMR55 (EEG) | 8,19% | 11,30% | 3% | 106% |
| NMR57 (EEG) | 5,97% | 6,00% | 2% | 263% |
| Ozdemir (EMG) | 1,28% | 1,34% | 3% | 100% |
| **Overall** | 9,22% | 9,77% | 3% | 159% |

The following results are reported in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 33,01% | 32,96% | 2% | 127% |
| INCART (ECG) | 38,04% | 38,26% | 4% | 146% |
| CHBMIT (EEG) | 2,60% | 2,59% | 2% | 142% |
| NMR55 (EEG) | 7,90% | 11,54% | 4% | 126% |
| NMR57 (EEG) | 6,27% | 6,31% | 5% | 125% |
| Ozdemir (EMG) | 1,53% | 1,57% | 4% | 128% |
| **Overall** | 14,89% | 15,54% | 4% | 132% |

## Simulation results of CE-4-5-1

The test in this CE is the same as in CE-4-2-1, but the anchor is now H.BWC, version 2, CTC.

The following results are reported in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 38,17% | 37,78% | 4% | 167% |
| INCART (ECG) | 18,24% | 18,12% | 4% | 227% |
| CHBMIT (EEG) | 6,14% | 6,09% | 8% | 223% |
| NMR55 (EEG) | 11,23% | 13,81% | 4% | 137% |
| NMR57 (EEG) | 8,24% | 8,10% | 3% | 349% |
| Ozdemir (EMG) | 2,60% | 2,37% | 5% | 130% |
| **Overall** | 14,10% | 14,38% | 5% | 206% |

The following results are reported in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 43,38% | 43,00% | 3% | 167% |
| INCART (ECG) | 47,84% | 47,83% | 5% | 146% |
| CHBMIT (EEG) | 5,73% | 5,68% | 3% | 143% |
| NMR55 (EEG) | 10,74% | 13,94% | 5% | 169% |
| NMR57 (EEG) | 8,14% | 8,00% | 6% | 125% |
| Ozdemir (EMG) | 2,87% | 2,62% | 5% | 129% |
| **Overall** | 19,78% | 20,18% | 5% | 146% |

## Simulation results of CE-4-5-2

The test in this CE is the same as in CE-4-2-2, but the anchor is now H.BWC, version 2, CTC.

The following results are reported in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 24,82% | 24,76% | 4% | 130% |
| INCART (ECG) | 9,27% | 9,28% | 4% | 177% |
| CHBMIT (EEG) | 1,22% | 1,16% | 8% | 173% |
| NMR55 (EEG) | 6,91% | 9,85% | 5% | 106% |
| NMR57 (EEG) | 4,47% | 4,48% | 3% | 266% |
| Ozdemir (EMG) | 0,44% | 0,49% | 5% | 99% |
| **Overall** | 7,85% | 8,34% | 5% | 159% |

The following results are reported in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 29,06% | 28,99% | 3% | 125% |
| INCART (ECG) | 36,43% | 36,64% | 6% | 145% |
| CHBMIT (EEG) | 1,35% | 1,34% | 3% | 141% |
| NMR55 (EEG) | 6,90% | 10,51% | 7% | 125% |
| NMR57 (EEG) | 5,07% | 5,13% | 8% | 123% |
| Ozdemir (EMG) | 0,71% | 0,74% | 7% | 127% |
| **Overall** | 13,25% | 13,89% | 6% | 131% |

## Simulation results of CE-4-6-1

The test in this CE is the same as in CE-4-3-1, but the anchor is now H.BWC, version 2, CTC.

The following results are reported for the CTC in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 37,21% | 36,83% | 9% | 168% |
| INCART (ECG) | 18,22% | 18,06% | 7% | 228% |
| CHBMIT (EEG) | 4,16% | 4,09% | 17% | 224% |
| NMR55 (EEG) | 9,81% | 12,11% | 8% | 138% |
| NMR57 (EEG) | 7,05% | 6,81% | 6% | 347% |
| Ozdemir (EMG) | 0,25% | 0,02% | 10% | 130% |
| **Overall** | 12,78% | 12,99% | 10% | 206% |

The following results are reported for the CTC in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 42,39% | 42,04% | 6% | 168% |
| INCART (ECG) | 48,27% | 48,23% | 9% | 145% |
| CHBMIT (EEG) | 4,13% | 4,05% | 7% | 142% |
| NMR55 (EEG) | 9,11% | 11,80% | 9% | 170% |
| NMR57 (EEG) | 6,53% | 6,25% | 12% | 126% |
| Ozdemir (EMG) | 0,49% | 0,25% | 10% | 130% |
| **Overall** | 18,49% | 18,77% | 9% | 147% |

## Simulation results of CE-4-6-2

The test in this CE is the same as in CE-4-3-2, but the anchor is now H.BWC, version 2, CTC.

The following results are reported for the CTC in the case of joint channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 19,57% | 19,52% | 8% | 134% |
| INCART (ECG) | 5,22% | 5,26% | 6% | 177% |
| CHBMIT (EEG) | -3,23% | -3,24% | 15% | 173% |
| NMR55 (EEG) | 3,08% | 5,93% | 7% | 107% |
| NMR57 (EEG) | -0,10% | -0,08% | 5% | 238% |
| Ozdemir (EMG) | -2,93% | -2,87% | 9% | 100% |
| **Overall** | 3,60% | 4,09% | 8% | 155% |

The following results are reported for the CTC in the case of independent channel coding:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Lossy Compression** | | | |
|  | **Over BWC-2.1** | | | |
|  | BD-PSNR1 | BD-PSNR2 | EncT | DecT |
| MIT (ECG) | 23,69% | 23,63% | 5% | 123% |
| INCART (ECG) | 31,74% | 31,94% | 10% | 143% |
| CHBMIT (EEG) | -2,62% | -2,63% | 6% | 140% |
| NMR55 (EEG) | 3,03% | 6,44% | 10% | 123% |
| NMR57 (EEG) | 1,09% | 1,13% | 13% | 124% |
| Ozdemir (EMG) | -2,70% | -2,65% | 11% | 128% |
| **Overall** | 9,04% | 9,65% | 9% | 130% |

# Patent rights declaration(s)

**Fraunhofer HHI may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**

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