# TE1:
# Refinement Motion Compensation using Decoder-side Motion Estimation

**JCTVC-B032**

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# 1. Overview

# Overview

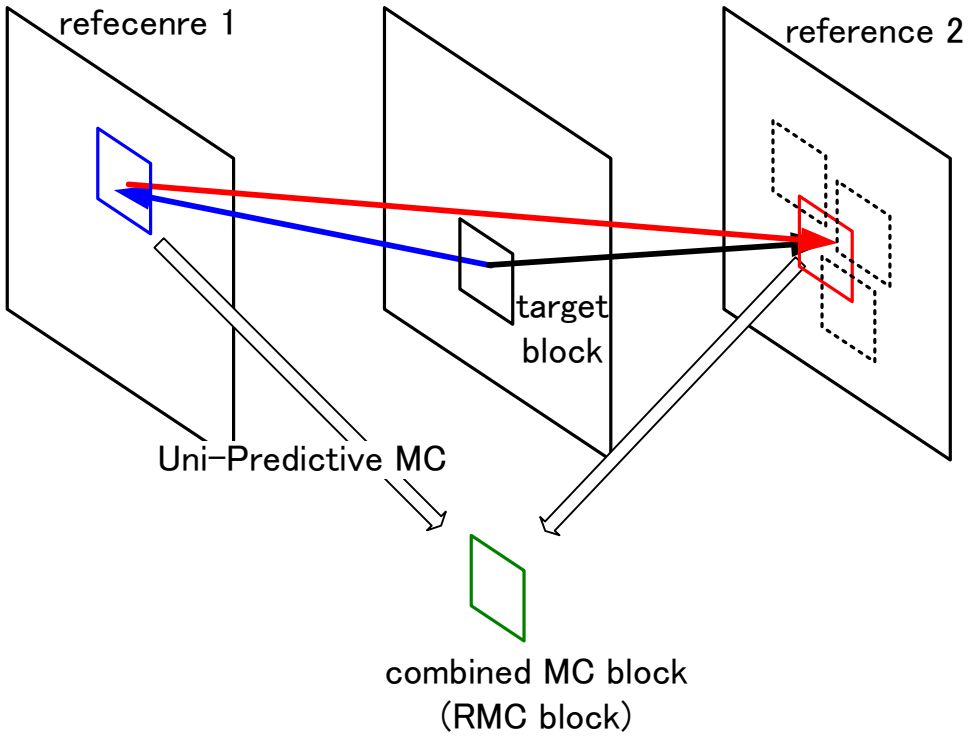
- Proposed technique
  - RMC on TE1 activity
    (Refinement Motion Compensation using Decoder-side Motion Estimation)
- About RMC
  - Inter prediction
  - Decoder-side Motion Estimation based
  - Exploit the correlation between reference pictures
- Implementation
  - Ported into TE1 codebase from JVC CfP code based on JM16.2
  - Implemented only for specific prediction modes
- BD-Bitrate
  - Average -1.97% for CS1
  - Average -1.76% for CS2 (-2.09% except for ClassA)

# 2. RMC Algorithm

# Concept of RMC

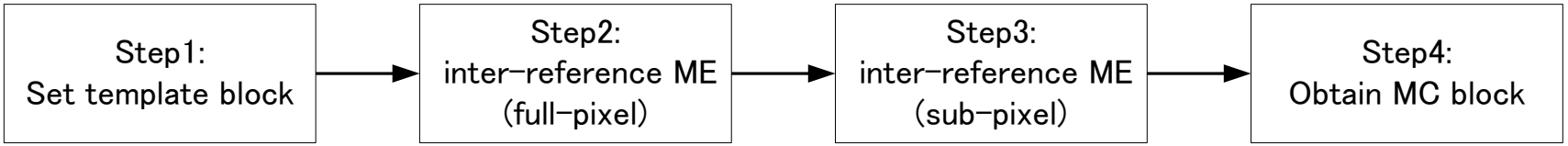
## What for ?

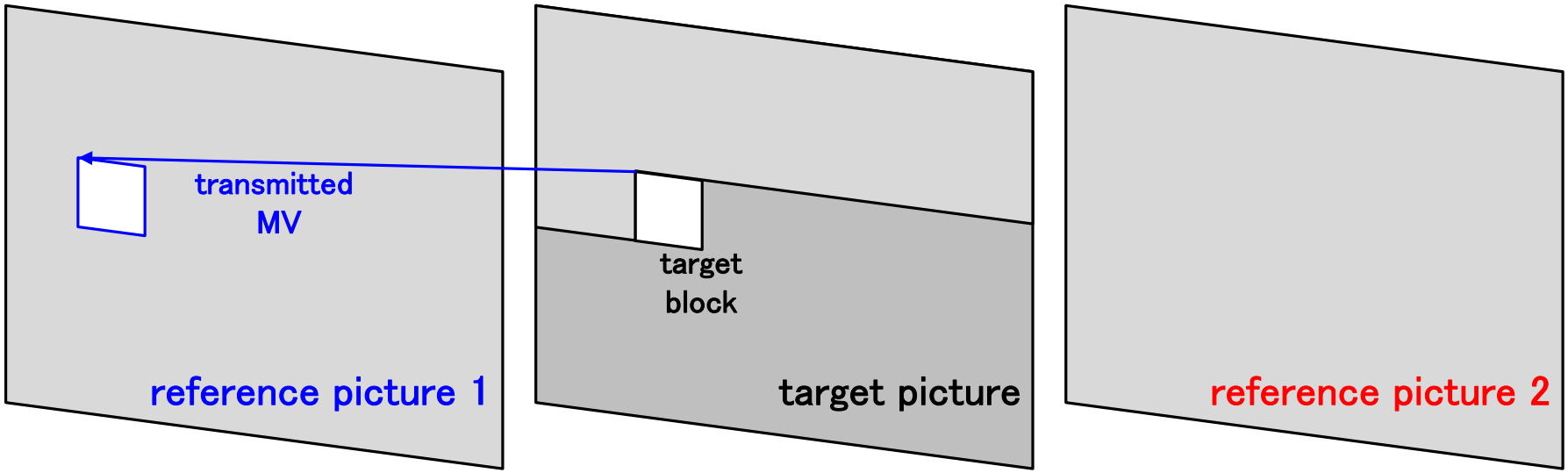
**smooth distortion and restore textures on reference picture**




Uni-predictive MC block leads other reference picture using Decoder-side Motion Estimation

# Decoding Procedure



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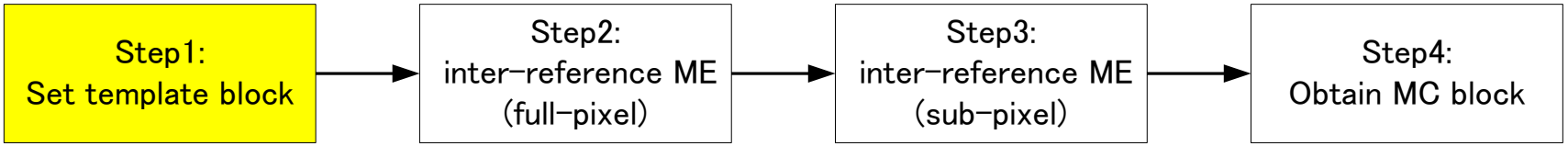


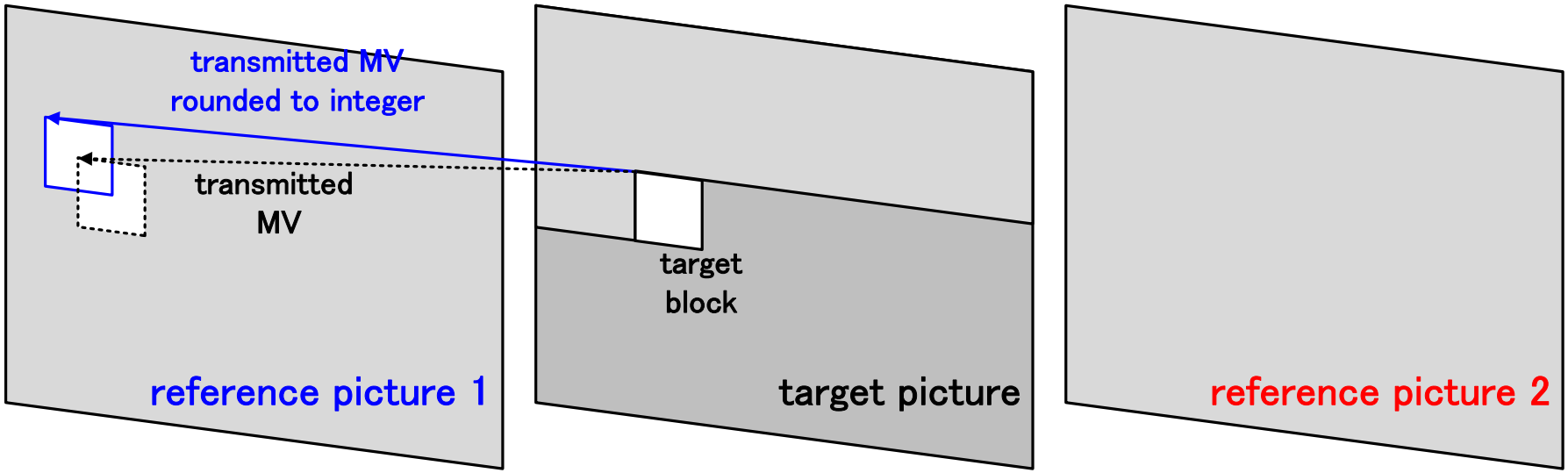

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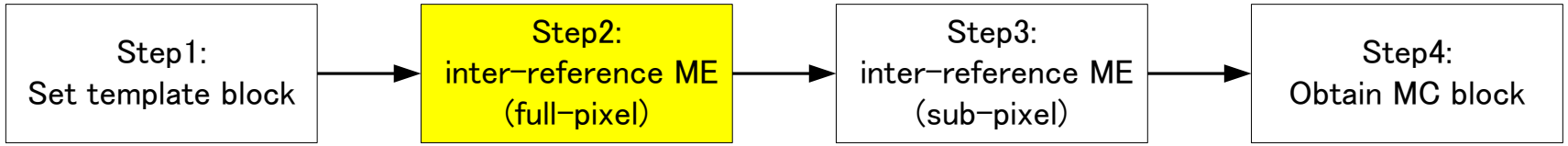


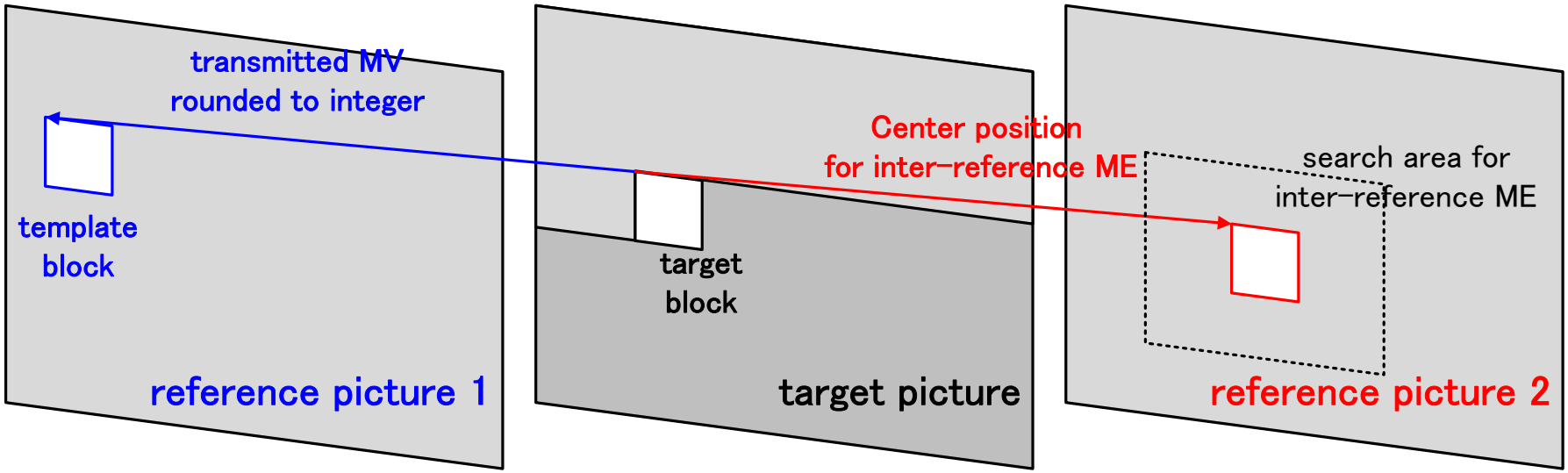

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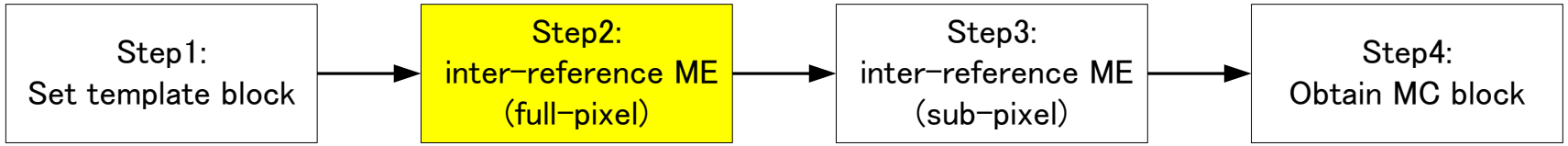


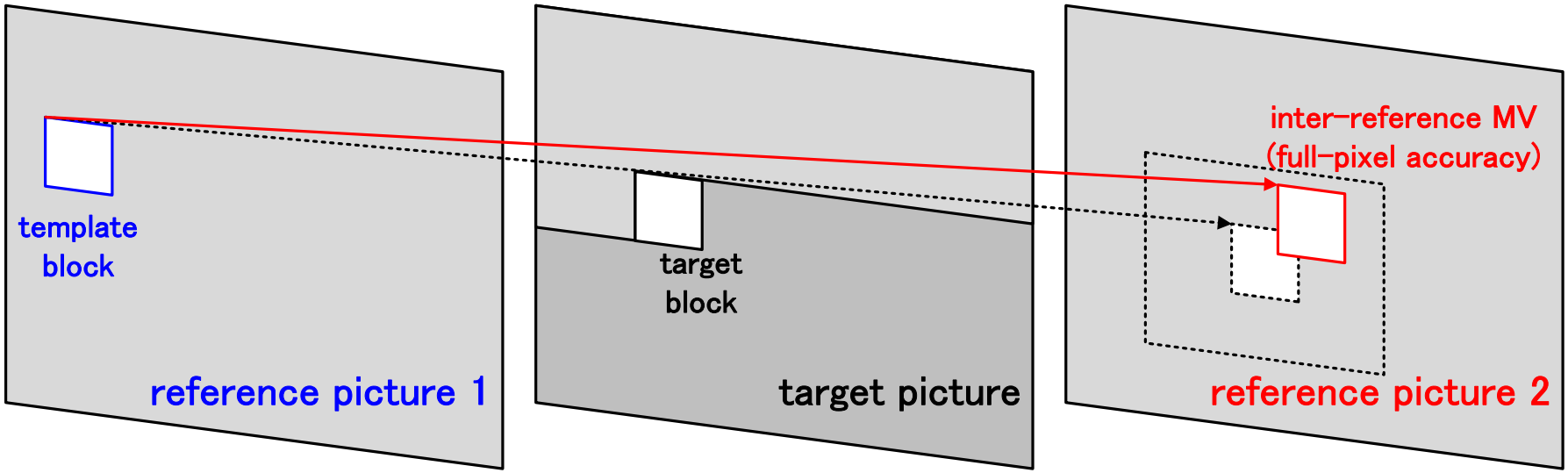

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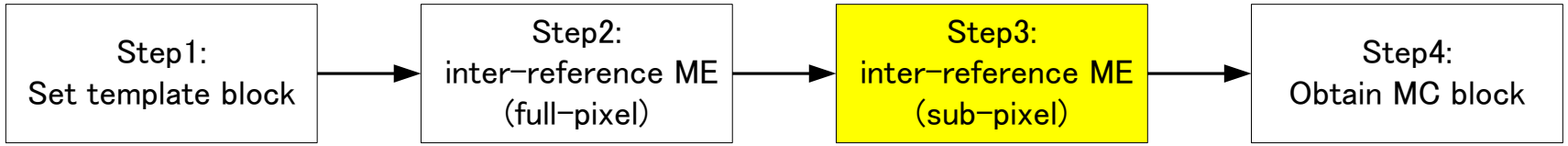


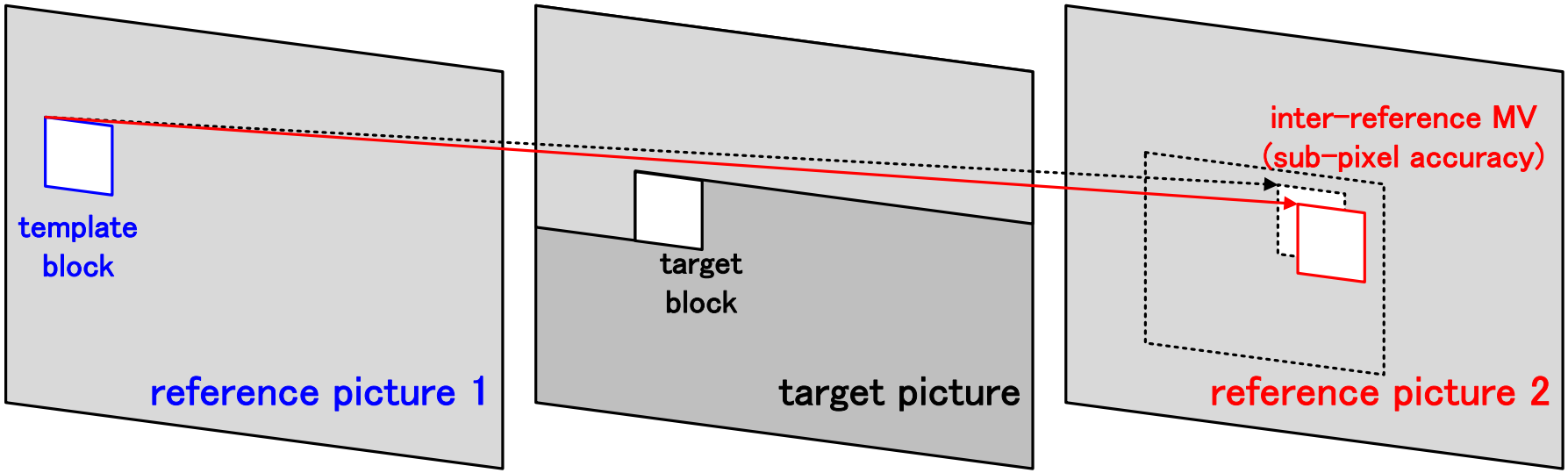

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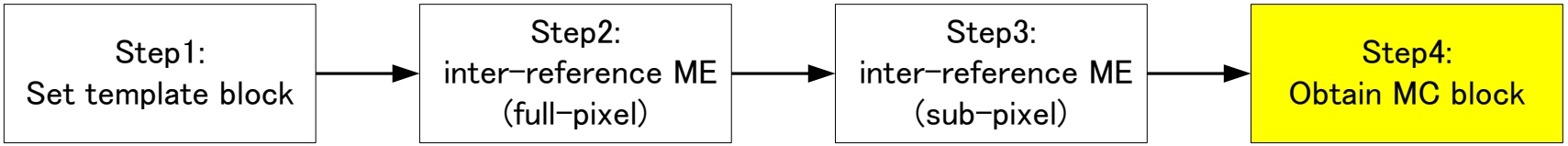


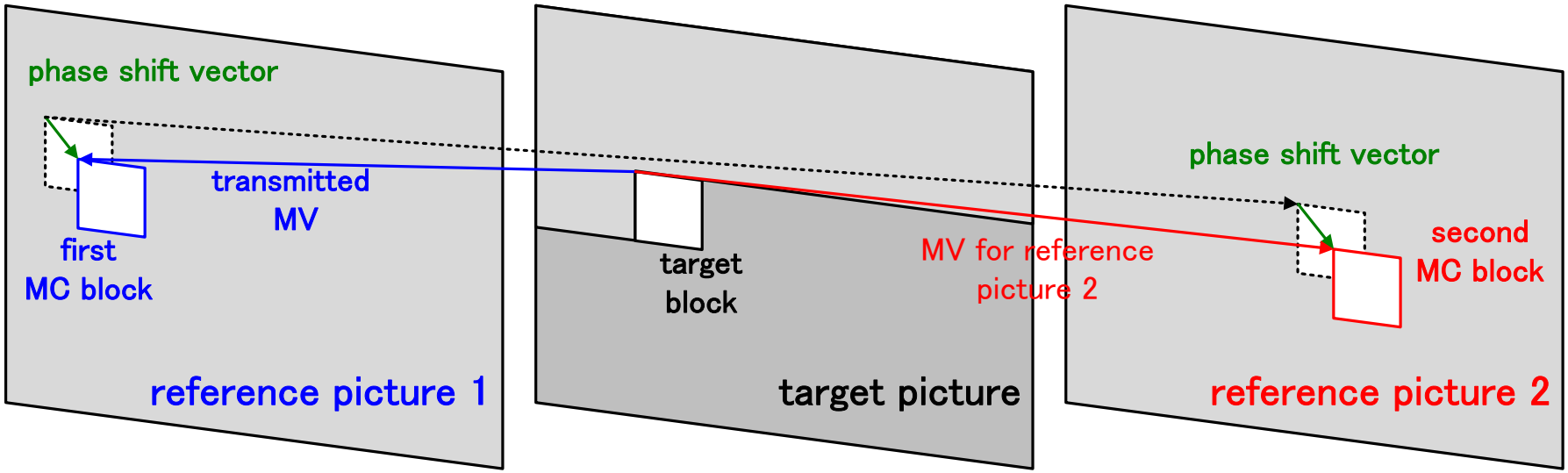

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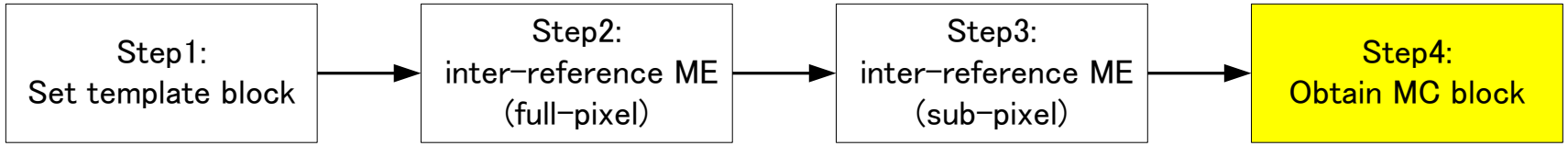


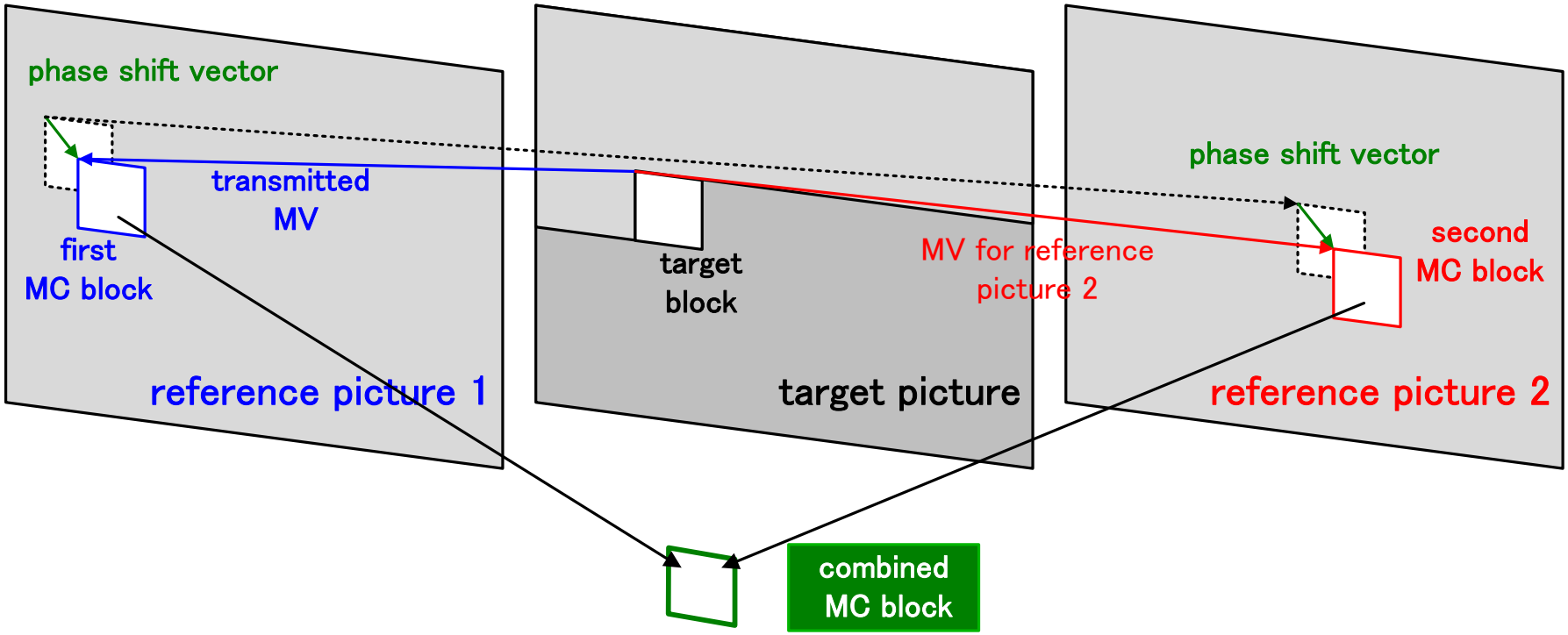

# Implementation

- Software
  - Ported into TE1 codebase from JVC CfP code based on JM16.2
- Syntax
  - The information of the RMC applicable mode is sent in Slice Header
  - The flag of enabling RMC is sent per prediction block
- Prediction Mode
  - Implemented only for specific prediction modes

| | 64x64 | 64x32 | 32x64 | 32x32 | 32x16 | 16x32 | 16x16 | 16x8 | 8x16 | 8x8 | 8x4 | 4x8 | 4x4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| no vector (direct) | | | | | | | | | | | | | |
| one vector (uni-predictive) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| two vector (bi-predictive) | | | | | | | | | | | | | |

- Decoder-side Motion Estimation Spec
  - Search Range for full-pixel ME ±3 pixels
  - Search Range for sub-pixel ME ±3/4 pixels
  - SAD (Luminance only)

# 3. Simulation Results

# Simulation Results

- BD-Bitrate
  - Average -1.97% and up to -3.14% for CS1
  - Average -1.76% and up to -11.50% for CS2 (-2.09% except for ClassA)

ClassA(CS1)

| Test Sequence | BD-PSNR | BD-bitrate |
|---|---|---|
| Traffic(S01) | 0.072 | -1.768 |
| PeopleOnStreet(S02) | 0.150 | -3.143 |
| Class Average | 0.111 | -2.456 |

ClassA(CS2)

| Test Sequence | BD-PSNR | BD-bitrate |
|---|---|---|
| Traffic(S01) | 0.013 | -0.339 |
| PeopleOnStreet(S02) | 0.014 | -0.292 |
| Class Average | 0.013 | -0.316 |

ClassB(CS1)

| Test Sequence | BD-PSNR | BD-bitrate |
|---|---|---|
| Kimono(S03) | 0.029 | -0.904 |
| ParkScene(S04) | 0.035 | -1.020 |
| Cactus(S05) | 0.065 | -2.119 |
| BasketballDrive(S06) | 0.059 | -2.016 |
| BQTerrace(S07) | 0.050 | -2.239 |
| Class Average | 0.048 | -1.660 |

ClassB(CS2)

| Test Sequence | BD-PSNR | BD-bitrate |
|---|---|---|
| Kimono(S03) | -0.011 | 0.358 |
| ParkScene(S04) | 0.001 | -0.033 |
| Cactus(S05) | 0.015 | -0.492 |
| BasketballDrive(S06) | 0.021 | -0.775 |
| BQTerrace(S07) | 0.259 | -11.503 |
| Class Average | 0.057 | -2.489 |

ClassC(CS1)

| Test Sequence | BD-PSNR | BD-bitrate |
|---|---|---|
| BasketballDrill(S08) | 0.104 | -2.664 |
| BQMall(S09) | 0.096 | -2.202 |
| PartyScene(S10) | 0.058 | -1.385 |
| RaceHorses(S11) | 0.085 | -2.155 |
| Class Average | 0,086 | -2.101 |

| Average | 0.073 | -1.965 |
|---|---|---|

ClassC(CS2)

| Test Sequence | BD-PSNR | BD-bitrate |
|---|---|---|
| BasketballDrill(S08) | 0.053 | -1.453 |
| BQMall(S09) | 0.044 | -1.027 |
| PartyScene(S10) | 0.096 | -2.343 |
| RaceHorses(S11) | 0.059 | -1.429 |
| Class Average | 0.063 | -1.563 |

| Average | 0.051 | -1.757 |
|---|---|---|
| Average without ClassA | 0.060 | -2.078 |

# Simulation Results

- Complexity
  - About 1.6 times on encoder (1.6 times except for ClassA)
  - About 2.5 times on decoder (2.5 times except for ClassA)

ClassA(CS1)

| Test Sequence | encode | decode |
|---|---|---|
| Traffic(S01) | 1.640 | 2.526 |
| PeopleOnStreet(S02) | 1.650 | 3.501 |
| Class Average | 1.645 | 3.014 |

ClassA(CS2)

| Test Sequence | encode | decode |
|---|---|---|
| Traffic(S01) | 1.594 | 1.659 |
| PeopleOnStreet(S02) | 1.622 | 1.679 |
| Class Average | 1.608 | 1.669 |

ClassB(CS1)

| Test Sequence | encode | decode |
|---|---|---|
| Kimono(S03) | 1.635 | 2.355 |
| ParkScene(S04) | 1.624 | 2.721 |
| Cactus(S05) | 1.622 | 3.009 |
| BasketballDrive(S06) | 1.723 | 2.568 |
| BQTerrace(S07) | 1.698 | 2.168 |
| Class Average | 1.660 | 2.564 |

ClassB(CS2)

| Test Sequence | encode | decode |
|---|---|---|
| Kimono(S03) | 1.645 | 1.265 |
| ParkScene(S04) | 1.634 | 1.424 |
| Cactus(S05) | 1.646 | 1.509 |
| BasketballDrive(S06) | 1.696 | 1.770 |
| BQTerrace(S07) | 1.544 | 3.710 |
| Class Average | 1.633 | 1.936 |

ClassC(CS1)

| Test Sequence | encode | decode |
|---|---|---|
| BasketballDrill(S08) | 1.695 | 3.346 |
| BQMall(S09) | 1.664 | 3.668 |
| PartyScene(S10) | 1.590 | 2.725 |
| RaceHorses(S11) | 1.673 | 4.042 |
| Class Average | 1.656 | 3.445 |

ClassC(CS2)

| Test Sequence | encode | decode |
|---|---|---|
| BasketballDrill(S08) | 1.697 | 2.176 |
| BQMall(S09) | 1.624 | 1.789 |
| PartyScene(S10) | 1.541 | 3.450 |
| RaceHorses(S11) | 1.664 | 2.086 |
| Class Average | 1.632 | 2.375 |

| | | |
|---|---|---|
| Average | 1.656 | 2.996 |

| | | |
|---|---|---|
| Average | 1.628 | 2.047 |
| Average without ClassA | 1.632 | 2.131 |

# 4. Conclusion

# Conclusion

- Proposed technique
  - RMC on TE1 activity
    (Refinement Motion Compensation using Decoder-side Motion Estimation)
- BD-Bitrate
  - Average -1.97% for CS1
  - Average -1.76% for CS2 (-2.09% except for ClassA)
- Software
  - Ported into TE1 codebase from JVC CfP code
- Future Work
  - Improve RMC algorithm under TE1 activity

JVC KENWOOD
HOLDINGS

ITU
ISO
IEC
ISO/IEC JTC1/SC29 WG11
MPEG
MOVING PICTURE EXPERTS GROUP