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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  3rd Meeting: Guangzhou, CN, 7-15 October, 2010 | Document: JCTVC-C130 |

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| *Title:* | **TE10 subtest 1: Results of intra deblocking filter testing by SKKU/SKT** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This document reports TE 10 test results of intra deblocking filter (DF) which was proposed in JCTVC-B075. The proposed method employs exactly the same DF scheme as that in the TMuC except filter strength control for intra block. It is implemented on TMuC 0.7 S/W, and its experimental results under the TE10 subtest 1 procedure show BDBR gain of 0.6% (intra only), 0.3% (random access), and 0.1% (low delay). Encoding time is increased less than 1% and decoding time is the same as the TMuC0.7. The proposed method provides improved visual quality.

Proposed intra deblocking filter

The contribution [1] provided test result by the proposed method implemented on KTA 2.6r1 S/W. According to the change of common test software to TMuC, the proposed method is re-implemented on top of TENTM DF of TMuC 0.7 software. Key modifications from TMuC 0.7 are as follows.

## Modified filtering decision

In TMuC DF, if blocks P and Q are intra coded, the boundary between them is always filtered [2]. However, in the proposed method, although P and Q are intra coded, if intra prediction modes of blocks P and Q are the same and if they don’t contain non-zero transform coefficients, the boundary between them is not filtered. It is based on the understanding that in this case, the blocks are expected to be very similar in their contents and the blocking artifact may not be conspicuous. Other filtering decision conditions are the same as the TMuC DF.

## Control of the filtering strength for intra blocks

As shown in Table 1, if the boundary between blocks P and B is decided to be filtered by the filtering decision process, the proposed method controls the strength of DF for intra coded blocks as follows.

Table 1. Control of the filtering strength

|  |  |
| --- | --- |
| Conditions | Filtering |
| P and/or Q are intra coded  *and* P and Q have different PredMode | Strong and weak filtering  with tC+2 |
| P and Q are intra coded  *and* P and Q have different IntraPredMode | Strong and weak filtering  with tC+1 |
| P and Q are intra coded  *and* P and Q have the same IntraPredMode  *and* boundary direction & prediction direction are different | Weak filtering  with tC |
| Otherwise | Weak smoothing filtering  with tC |

If block P and/or block Q are intra-coded and their prediction modes are different, the same filtering process of TMuC is performed with tC plus 2 since the boundary between P and Q may have strong blocking artifact. It is to note that one of two types of filtering (weak and strong filtering) is applied by using the same decision criterion of TMuC DF [2]. Otherwise, intra prediction modes of P and Q are considered to jointly control the strength of filtering. Different intra prediction modes of P and Q indicate that block P and block Q are predicted in different directions, thus the effects of intra prediction and quantization of blocks P and Q are expected to be non-identical. In this case, the same filtering process of TMuC is performed with tC plus 1. Otherwise, if intra prediction modes of P and Q are the same, P and Q are most likely to be in the same region. Therefore, in this case, if block boundary direction and prediction are the same, the weak filtering with tC is only applied. Otherwise, a weak smoothing filter with tC is only applied as follows:



Note that strong filtering is not applied to avoid an unintended distortion for these two cases. When directions of block boundary and prediction are the same, for example, as shown in Fig 1 (a), the two blocks P and Q are most likely to belong to different objects, and the boundary is caused by texture. Thus, weak filtering instead of the strong filtering should be helpful to avoid an unintended smoothing over the block boundary between P and Q. On the other hand, if intra prediction is performed across the given block boundary, P and Q blocks are most likely to belong to the same object, so weak smoothing might help to remove the quantization error which otherwise may be visible across the boundary.

(a) Same direction (b) Different direction

Fig 1. Example of block boundary direction and prediction direction

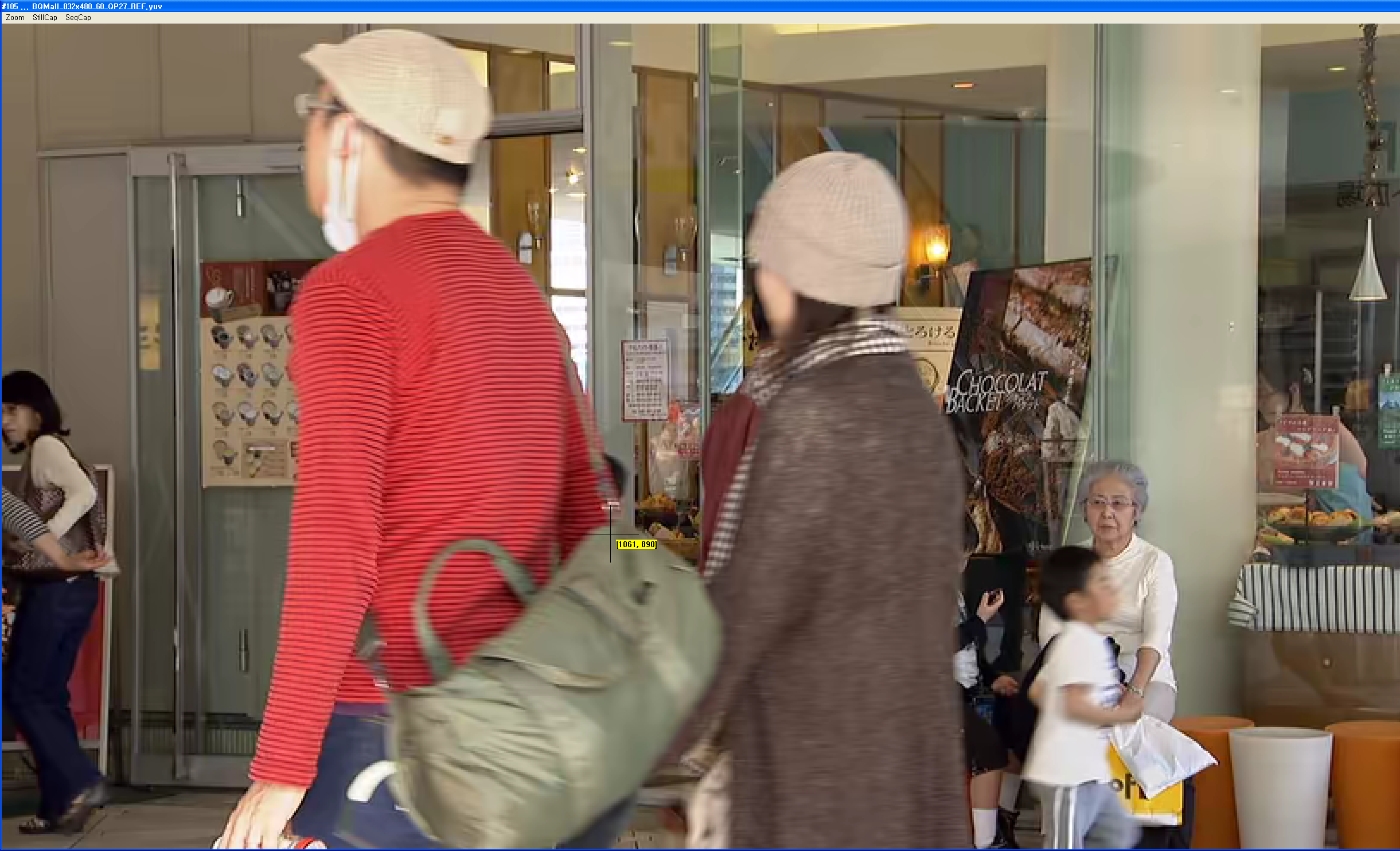
For this reason, in the proposed method, vertical and horizontal intra prediction modes are considered to check the difference between block boundary direction and prediction direction. Since DF is applied to vertical and horizontal block boundaries, in this proposal, vertical and horizontal intra prediction modes are considered to check the difference between boundary direction and prediction direction. Other filtering operations are the same as the TMuC DF.

# Experimental results

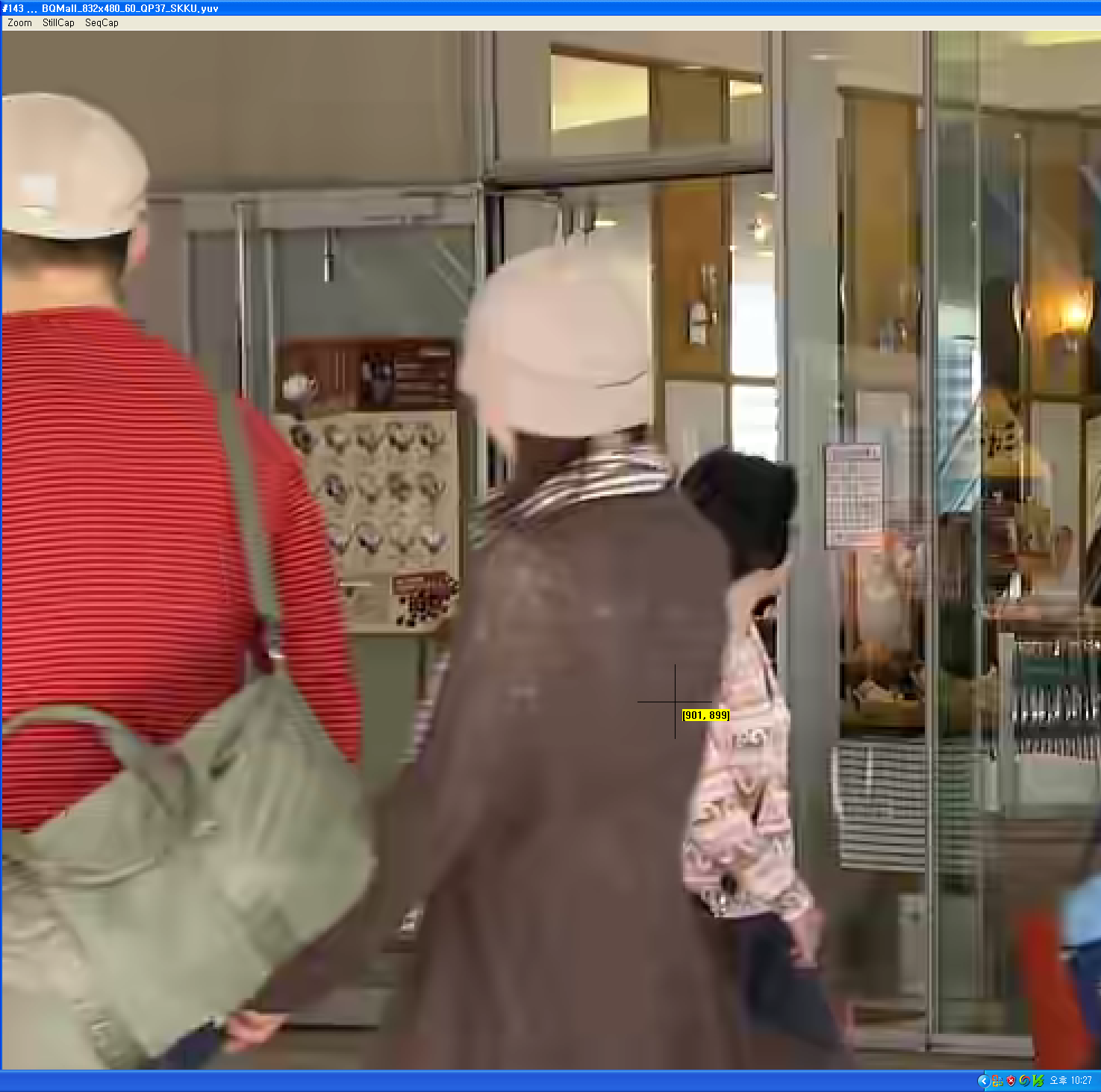
The proposed method is implemented on TMuC 0.7 software and simulated under the recommended test conditions of TE10 Subset 1 [3]. More detailed results are included in JCTVC-C130\_TE10\_Results\_SKKU.xls.

Table 2. Experimental results

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| --- | --- | --- | --- |
|  | Y BD-rate | | |
| Intra only | Random access | Low delay |
| Class A | -0.9 | -0.5 |  |
| Class B | -0.7 | -0.4 | -0.1 |
| Class C | -0.5 | -0.3 | -0.1 |
| Class D | -0.5 | -0.2 | -0.1 |
| Class E | -0.6 |  | -0.1 |
| All | -0.6 | -0.3 | -0.1 |
| Enc. Time | 101% | 101% | 100% |
| Dec. Time | 100% | 100% | 100% |



|  |  |
| --- | --- |
| (a) Anchor | (b) Proposed |
| 105th frame of BQMall\_832x480 (intra only coded with QP27) | |



|  |  |
| --- | --- |
| (a) Anchor | (b) Proposed |
| 143rd frame of BQMall\_832x480 (intra only coded with QP37) | |



|  |  |
| --- | --- |
| (a) Anchor | (b) Proposed |
| 70th frame of PartyScene\_832x480 (intra only coded with QP32) | |

# Concluding remarks

In this document, results of the proposed deblocking filter [1] implemented on TMuC are reported. The proposed method employs exactly the same DF scheme as that in the TMuC except filter strength control for intra block. However, even the small change of assigning different strength of DF for intra-coded blocks have generated positive coding gain.

# References

[1] J. Yang, K. Won, H. Yang, B. Jeon, J. Lim, J. Song “In-loop deblocking filtering for intra blocks,” Doc. of JCT-VC, B075, July, 2010.

[2] JCT-VC, “Test Model under Consideration,” Doc. of JCT-VC, B205, July, 2010.

[3] T. Yamakage, T. Chujoh, S. Lei, K. Chono, M. Karczewicz, A. Segall, T. Yamamoto, B. Jeon, J. Lim and J. Xu “Tool Experiment 10: In-loop filtering,” Doc. of JCT-VC, B310, July, 2010.

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