

**ISO/IEC JTC 1/SC 29/WG 11**

**Coding of moving pictures and audio**

**Convenorship: UNI (Italy)**

**ISO/IEC JTC 1/SC 29/WG 11 N18740**

**Document type: Approved WG 11 document**

**Title: Description of Exploration Experiment 13.13 for G-PCC: on Lossless extension to RAHT**

**Status: Draft**

**Date of document: 2019-07-24**

**Source: 3DG**

**Expected action:**

**No. of pages:**

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**INTERNATIONAL ORGANISATION FOR STANDARDISATION**

**ORGANISATION INTERNATIONALE DE NORMALISATION**

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**Gothenburg, SE – July 2019**

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| **Source:** | **3DG** |
| **Title:** | **Description of Exploration Experiment 13.13 for G-PCC: on Lossless extension to RAHT** |

**Description of Exploration Experiment 13.13 for G-PCC: on Lossless extension to RAHT**

# Abstract

This document provides a description of G-PCC Exploration Experiment (EE) 13.13 on Lossless extension to RAHT.

# Introduction

The goal of EE13.13 is to investigate the attribute lossless coding with Integer Haar Transform provided in m49627[1] in terms of coding gain and complexity.

# Information about proposed tools

## m49627: lossless attributes coding using Integer Haar Transform harmonized with RAHT

To facilitate hardware implementation, the fixed point RAHT [2][3] was introduced into G-PCC specification. However, lossless compression cannot be realized in it due to square-root and division operation. To realize lossless compression, m49627 proposes to introduce Integer Haar Transform on top of the current fixed point RAHT design.

To implement integer Haar transform on top of RAHT, the following functions were introduced into the current Fixed Point RAHT process.

* Introduce Integer Haar transform flag to turn on it
* If Interger Haar transform flag is equal to 1 then
  + set the weights to w1 = w2 = 1
  + set Aqs = 1
  + conduct shift operation to remove the floating point precision

Figure 1 shows the Fixed Point RAHT process in TMC13v6.0 and Figure 2 shows the proposed implementation of integer Haar transform on top of Fixed Point RAHT. In Figure 2, the blue sentenses are related to additional functions of this proposal.

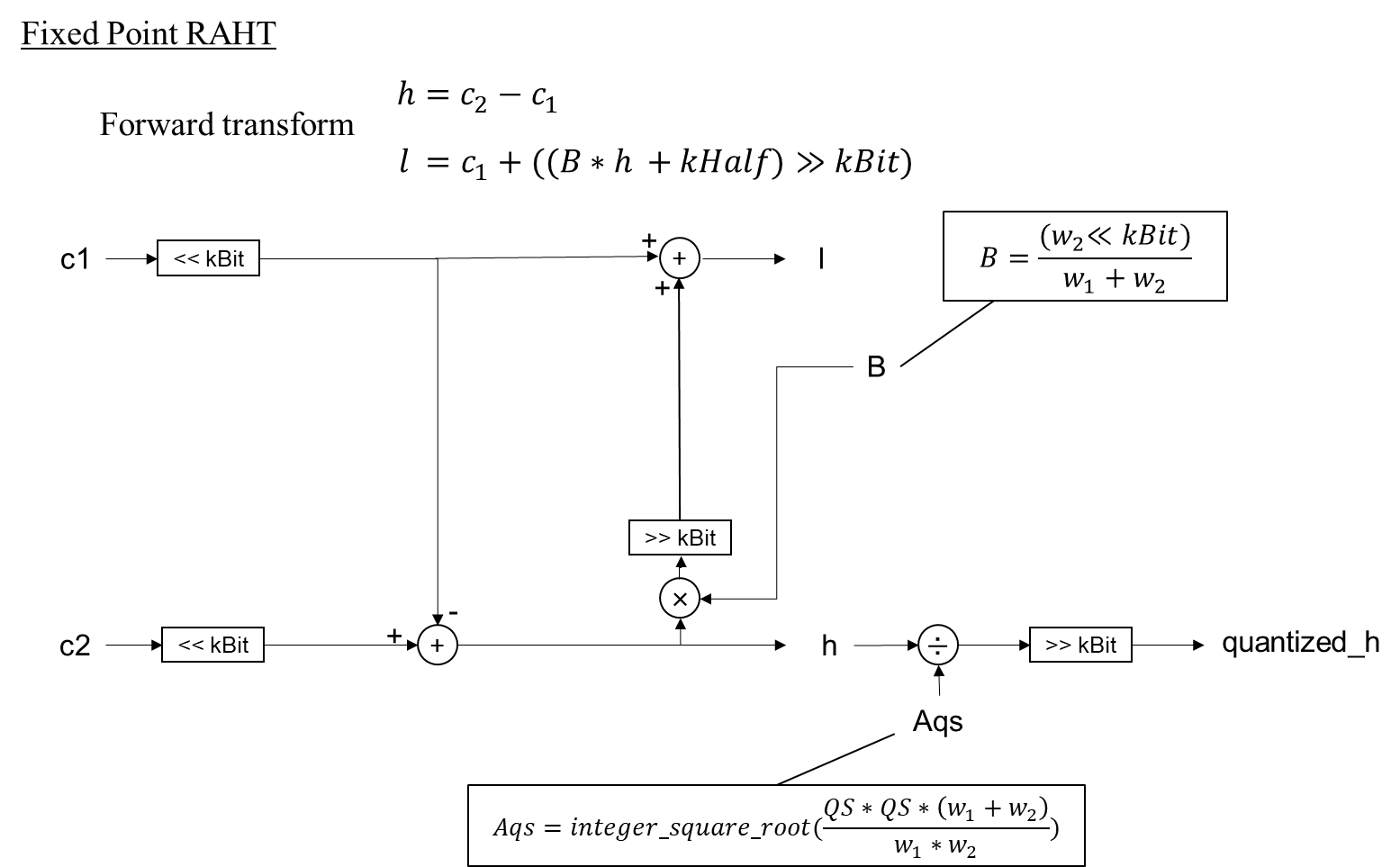
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Figure 1: Fixed Point RAHT process

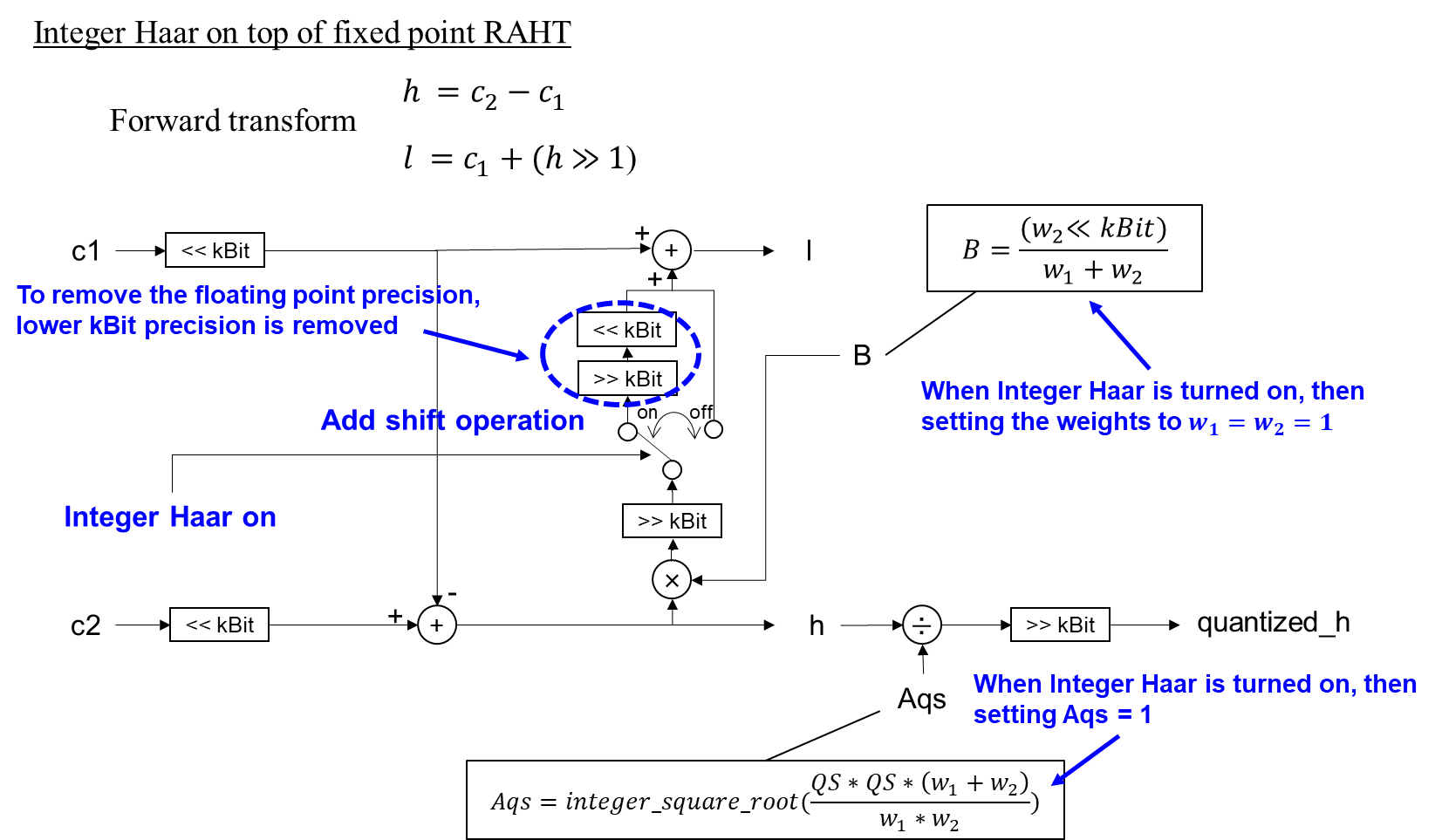
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Figure 2: Integer Haar transform on top of fixed point RAHT process

In MPEG 127th meeting, the basic design of fixed point RAHT was updated in m49380 [4]. So, the integer Haar Transform will be also implemented on top of the updated design. In detail, HaarKernel class will be implemented, in which forward and inverse transform of Integer Haar Transform proposed in m49627 are defined. Then, in case that Integer Haar Transform flag is turned on, all weight values will be set to 1 and forward and inverse transform of Integer Haar Transform will be applied instead of RAHT Transform.

# Experimental description

In this EE, the proposed attribute lossless coding method will be investigated in terms of coding gain and complexity.

## Mandates

* Evaluate and report compression performance, computation time and complexity of Integer Haar Transform based lossless coding on top of the updated RAHT design compared with Predicting Transform based lossless coding
* Study the functionality on the spatial scalability in lossless mode

## Participants

| **Name** | **Company** | **E-mail address** | **Type** |
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## Information for conducting tests

Proposed method should be evaluated in both compression efficiency as well as computation time compared with Predicting Transform based lossless coding in TMC13v7 [5] with the CTC setting.

Additionally, to compare the compression efficiency with the similar computation time, the value of “SearchRange” parameter on Predicting Transform will be adjusted and the result will be reported.

### Software

TMC13v7 shall be used for these experiments. The proposed tools shall be implemented on top of TMC13v7.

### Test configurations

Parameters and configurations for TMC13v7 software will be provided by the proponent.

### Evaluation Method

The point cloud test material will be tested under the following conditions of the CTC [6]:

* CW Lossless Geometry – Lossless Attributes

## EE13.13 Coordinators

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# Timeline:

* **2019-08-19**: Expected date for release of cross-verified TMC13 software and anchors
* **2019-09-18**: Deliver source code and results for cross check
* **2019-09-25**: Report of preliminary cross check results
* **2019-10-02**: MPEG document upload deadline

# References

1. [G-PCC] EE13.3 related proposal on lossless attributes coding using Integer Haar Transform harmonized with RAHT, ISO/IEC JTC1/SC29 WG11 Doc. m49627, Gothenburg, SE, July 2019.
2. Fixed-point version of RAHT with rate-distortion impact tests, ISO/IEC JTC1/SC29/WG11 input document m44486, Macau, China, October 2018
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4. G-PCC CE13.18 report on upsampled transform domain prediction in RAHT, ISO/IEC JTC1/SC29 WG11 Doc. m49380, Gothenburg, SE, July 2019.
5. PCC Test Model v7, ISO/IEC JTC1/SC29/WG11 Doc. N18664, Gothenburg, SE, July 2019.
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