Reference is made to the following documents:

D1 Jarek Duda: "Asymmetric numeral systems: entropy coding combining speed of Huffman coding with compression rate of arithmetic coding", , 11 November 2013 (2013-11-11), pages 1-24, XP055350053,
Retrieved from the Internet:
URL:https://arxiv.org/pdf/1311.2540.pdf
[retrieved on 2017-02-28]
cited in the application

D2 FABIAN GIESEN: "Interleaved entropy coders", ARXIV.ORG, CORNELL UNIVERSITY LIBRARY, 201 OLIN LIBRARY CORNELL UNIVERSITY ITHACA, NY 14853, 14 February 2014 (2014-02-14), XP080005632,

D3 Duda J; Converse A: "Re: New entropy coding: faster than Huffman, compression rate like arithmetic",
Google group: Codec developers, 29 December 2015 (2015-12-29), XP055349420,
Retrieved from the Internet:
URL:https://groups.google.com/a/webmproject.org/forum/#!topic/codec-devel/idezdUoV1yY
[retrieved on 2017-02-24]

D4 Mukherjee, D: "An overview of new video coding tools in VP10", FUTURE VIDEO CODING WORKSHOP 3, 21 November 2015 (2015-11-21), XP030001654,

Re Item V

1 The provisional opinion of the present Authority is that the subject-matter of the claims does not involve an inventive step in the sense of Article 33(1) and (3) PCT.

1.1 The technical problem of entropy coding transform coefficients is a standard problem in the field of video/image coding. Any relevant textbook may be consulted in case of doubt.

1.2 ANS codecs were known at the time of filing, e.g. document D1 is cited in the application. Application of ANS coding to transform coefficients is explicitly mentioned in D2, section 3, last paragraph and in D4, page 27. Therefore, the mere application of ANS to the case of transform coefficient coding cannot be an inventive contribution by itself.

1.3 According to the application, inventive idea is the use of two decoders, one for a "binary flag or bit" and one for "a token". The independent claims, but also the application as a whole, do not specify further any differences in the decoding methods applied by the two decoders.

1.4 When compared to the straightforward application of the generic stream ANS algorithm (D1, page 3), it is not clear how the invention, which allegedly uses two decoders, differ from a straightforward implementation of an ANS decoder handling all symbols. It is evident that the two decoders of claim 1 cannot perform parallel processing, because of the dependencies in the decoder state diagram (figure 6). Simply naming all binary state transitions as "Boolean ANS decoding" does not necessarily imply a different algorithm.

1.5 In other words, a straightforward application of ANS would traverse through the ANS states corresponding to the decoder states in figure 6. The states corresponding to flags (e.g. "EOB") would lead by definition to a binary state transition, since in these states the available alphabet would contain only two symbols (e.g. 'EOB' and 'not EOB'). According to the invention, the ANS states corresponding to the decoder states "EOB", "ZERO", "EXTRA BITS" and "SIGN" are processed by a "Boolean ANS decoder", while the ANS states corresponding to the decoder state "TOKEN" are processed by a "symbol ANS decoder". However, the claim fails to describe any concrete steps that would reach a technical effect beyond the straightforward application of generic stream ANS to all ANS states.

1.6 Seen from a different perspective, any ANS decoding method can be regarded as comprising two decoders, each processing a subset of the ANS states. This does not imply that the overall decoding method is different.

1.7 Therefore, it is provisionally regarded that the proposed solution does not comprise an inventive contribution over the prior art, because it is no more than a straightforward application of known coding algorithms.

1.8 It is noted that in document D3, a person appearing to be the author of D1 confirms that it is a good idea to use two different versions of the algorithm (rANS+uABS) for video compression. Nevertheless, these appear to be two different, specific algorithms, the different algorithms being suitable for different parts of the input. The present application merely mentions a "Boolean ANS decoder" and a "symbol ANS decoder", without mentioning how they differ, except for the fact that the one is "Boolean" and the other (apparently) not.

1.9 For the corresponding decoding apparatus, encoding apparatus and computer readable medium the above comments apply mutatis mutandis (claims 9, 15 and 21). Note that the normalization and state evolution steps of claim 15 are inherent to stream ANS coding.

2 The dependent claims do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:

2.1 The "entropy decoder state machine" of claims 2 and 10-11 merely models the bitstream syntax and has no effect on the algorithm as such. The bitstream as such is common general knowledge, as it was already part of previous codecs, e.g. VP8.

2.2 Claims 3 and 4 relate to the detokenizer, which is only vaguely described in the application. It seems that the function of the detokenizer relates to the assignment of probabilities, which is common general knowledge in the field of entropy coding (e.g. see [0056]). The same applies to claims 12-13

2.3 Claims 5-8, 14, 16-18 relate to ANS features that are either known from D1 or rendered obvious by it.

2.4 Claims 19-20 disclose common general knowledge in the field of video coding.

3 If it could be derived from the application as a whole that the algorithms of the "Boolean ANS" and the "symbol ANS" differed in a way that achieves a positive technical effect compared to the straightforward application of any ANS variant, then the requirements of Article 33(1) PCT would be met. In this context, the following should be noted:

3.1 According to the applicant, the technical effect is higher "flexibility", fast encoding/decoding and higher compression ([0020]-[0021]). It is not apparent how the term "flexibility" is to be interpreted, and why flexibility is an advantage in the present case. Higher compression and higher processing speed are indeed tangible technical effects. However, achieving these effects would mean that the two algorithms ("Boolean" and "symbol" ANS) are such that their combination is faster and more efficient than application of one ANS variant to the whole input. Obviously, such an effect would depend on the difference between the algorithms, which is not disclosed in the claims. The application mentions two different state evolutions functions (claim 6, [0087]), but discloses no concrete example of such functions that lead to the technical effects.

3.2 Document D2 discloses the use of many ANS encoders/decoders in parallel (section 3) processing a single, interleaved bit stream (e.g. see page 7, lines 1-5), also with application to transform coefficients in image and video coding (section 3, last paragraph). However, D2 does not disclose using *different* encoders/decoders. The parallel decoders in D2 are designed to be identical, e.g. in order to be implemented as SIMD data flows.

Re Item VI

4 Document D3 discloses information relevant to the invention. The document may be used in an objection against lack of novelty or lack of inventive step, if the priority claim of the application proves to be invalid.

Re Item VIII

5 The claims are not clear in the sense of Article 6 PCT for the following reasons:

5.1 The steps of "processing a binary flag or bit" and "processing a token" are not clear. The former implies that the binary flag is part of the input, whereas the input is the encoded bit stream. The latter includes the vague term "token", that does not have a well-known, generally accepted meaning.

5.2 Further regarding the term "token" in claim 1, it is noted that a binary flag can also be regarded as a "token", and decoding a "token" must comprise "processing a bit" from the input bitstream.

5.3 The step of sequentially producing transform coefficients does not necessarily stop when an end of block flag is reached, contrary to what is indicated in claim 1. If the value of the end of block flag is '0', then the step continues with the next coefficient.

5.4 The terms "detokenizer" (e.g. claim 3) and "tokenize" (e.g. claim 15) do not have a well-known, generally accepted meaning in the field of entropy coding. The application as a whole gives inconsistent information regarding the function of the detokenizer. Claim 4 mentions that the output of the detokenizer to the Boolean ANS decoder is a Boolean value. The description, on the other hand, states that the Boolean ANS decoder provides the Boolean value to the detokenizer, which returns a context probability. The corresponding parts for the symbol ANS decoder contain the same inconsistency.

5.5 In claim 5, the word bit has been misspelled ("but").

5.6 Claim 9 is an apparatus defined as comprising an "entropy decoder state machine". However, a state machine is a theoretical model of computation and cannot be regarded as forming a structural unit of an actual apparatus. The same applies to the encoding state machine of claim 15.

5.7 According to claim 15, the Boolean ANS encoder encodes a token comprising a bit or a binary flag and the symbol ANS encoder encodes a token comprising a symbol. There is no clear distinction between these two cases, so that the claim is vague as to what is encoded by each ANS encoder. In particular, all symbols are represented as bits, so that all "tokens" comprise a bit. The binary flags are also symbols, so that all "tokens" comprise a symbol. Consequently, every syntax element in the bitstream may be seen as a "token comprising a bit" or a "token comprising a symbol".

5.8 The step of "output computation" (e.g. claims 5, 15) is not clear (see also §6 below).

6 The following points raise doubts as to whether the invention is sufficiently disclosed in the sense of Article 5 PCT:

6.1 The disclosed embodiments include an "output computation step", which is only vaguely described in [0083] and [0091]. According to these passages, the output computation step produces "an output value (e.g., the decoded transform coefficient value associated with the token)" in the case of the decoder, and another "output value (e.g., the encoded bits for the token)" for the encoder. There is no further example of a detailed computation.

6.2 The invention is based on the existence of two different encoders/decoders using two different state evolution functions. However, the application does not disclose any example of a suitable pair of state evolution functions.