Claims

1. An audio decoder for providing a decoded audio information on the basis of an encoded audio information,
wherein the audio decoder is configured to obtain decoded spectral values on the basis of an encoded information representing the spectral values,

wherein the audio decoder is configured to jointly decode two or more most significant bits per spectral value on the basis of respective symbol codes for a set of spectral values using an arithmetic decoding,

wherein a respective symbol code represents two or more most significant bits per spectral value for one or more spectral values,

wherein the audio decoder is configured to decode one or more least significant bits associated with one or more of the spectral values in dependence on how much least significant bit information is available,
such that one or more least significant bits associated with one or more of the spectral values are decoded, while no least significant bits are decoded for one or more other spectral values for which one or more most significant bits are decoded and which comprise more bits than the one or more most significant bits; and

wherein the audio decoder is configured to provide the decoded audio information using the spectral values.

2. The audio decoder according to claim 1, wherein the audio decoder is configured to map one symbol of an arithmetically encoded representation, which represents at least two most significant bits of at least one spectral value, onto the at least two most significant bits of the at least one spectral value.

3. The audio decoder according to claim 1 or claim 2, wherein the arithmetic decoding is configured to determine bit positions of the at least two most significant bits and to allocate the at least two most significant bits determined by a symbol of the arithmetically encoded representation to the determined bit positions.

4. The audio decoder according to one of claims 1 to 3, wherein the audio decoder is configured to decode, for all spectral values for which two or more most significant

bits have been decoded and which comprise more bits than the two or more most significant bits and a least significant bit, one or more intermediate bits, bit positions of which are between the least significant bit and the two or more most significant bits.

5. The audio decoder according to one of claims 1 to 4, wherein the audio decoder is configured to decode, in a first decoding phase,

- two or more most significant bits per spectral value, and
- for all spectral values for which two or more most significant bits are decoded and which comprise more bits than the two or more most significant bits and a least significant bit, one or more intermediate bits, bit positions of which are between the least significant bit and the two or more most significant bits, and
- for all spectral values for which two or more most significant bits are decoded and for which the two or more most significant bits and any intermediate bits, as far as intermediate bits are present, indicate a non-zero value, signs; and

wherein the audio decoder is configured to selectively omit, in the first decoding phase, a decoding of a sign for spectral values for which the two or more most significant bits and any intermediate bits, as far as intermediate bits are present, indicate a zero value, and
wherein the audio decoder is configured to selectively obtain, in a second decoding phase which follows the first decoding phase, sign information for spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a zero value and for which a least significant bit information indicates a non-zero value.

6. The audio decoder according to one of claims 1 to 5, wherein the audio decoder is configured to sequentially use subsequent bits of a least-significant-bit-information bit sequence in order to obtain least significant bit values associated with the spectral values.

7. The audio decoder according to claim 6, wherein the audio decoder is configured to use a single bit of the least-significant-bit-information bitsequence for respective spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a non-zero value, where-

in the used single bit of the least-significant-bit-information bitsequence is used in order to obtain a least significant bit value; and

wherein the audio decoder is configured to use a single bit of the least-significant-bit-information bitsequence for respective spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a zero value, and for which the used single bit of the least-significant-bit-information bitsequence confirms the zero value; and

wherein the audio decoder is configured to use two subsequent bits of the least-significant-bit-information bitsequence for respective spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a zero value, and for which a first of the used bits of the least-significant-bit-information bitsequence indicates a deviation from the zero value by a least significant bit value, wherein a second of the used bits of the least-significant-bit-information bitsequence determines a sign of the respective spectral value.

8. The audio decoder according to one of claims 1 to 7, wherein the audio decoder is configured to decode least significant bits starting from a least significant bit associated with a lowest frequency spectral value and proceeding towards spectral values associated with increasingly higher frequencies,

such that spectral values are refined by least-significant-bit information in a range from a lowest frequency spectral value up to a spectral value for which a last least significant bit information is available, and such that spectral values having associated frequencies higher than a frequency associated with the spectral value for which the last least significant bit information is available remain unrefined.

9. The audio decoder according to one of claims 1 to 8, wherein the audio decoder is configured to be switchable between

- a first mode in which a decoding of spectral values in a higher frequency range is omitted in response to a signaling from the encoder and in which least significant bits are decoded for all spectral values for which one or more most signif-

icant bits are decoded and which comprise more bits than the most significant bits, and

- a second mode in which one or more least significant bits associated with one or more of the spectral values are decoded, while no least significant bits are decoded for one or more other spectral values for which one or more most significant bits are decoded and which comprise more bits than the most significant bits.

10. The audio decoder according to claim 9, wherein the audio decoder is configured to evaluate a bitstream flag which is included in the encoded audio information in order to decide whether the audio decoder operates in the first mode or in the second mode.

11. The audio decoder according to one of claims 1 to 10, wherein the audio decoder is configured to jointly decode two or more most significant bits per spectral value for at least two spectral values on the basis of respective symbol codes,

wherein a respective symbol code represents two or more most significant bits per spectral value for at least two spectral values.

12. The audio decoder according to one of claims 1 to 11, wherein the audio decoder is configured to decode spectral values according to the following algorithm:

Decode the 2 most significant bits of both coefficients $X_q(n)$ and $X_q(n+1)$ according to:

```
numbits = 1;
do {
        Get probabilities p from context c
        Decode symbol sym with arithmetic decoding and probabilities p
        Update context c
        numbits++;
} while (sym==VAL_ESC)
Xq[n] = (sym & 3) << (numbits-2);
Xq[n+1] = (sym >> 2) << (numbits-2);
```

Decode remaining bits except the least significant bit, if there are any remaining bits, according to:

```
for (b = 1; b < numbits-2; b++) {
        Decode bit0
        Xq[n] += bit0 << b
        Decode bit1
        Xq[n+1] += bit1 << b
}
```

Decode the sign of each coefficient, except if the most significant bit is zero and the remaining bits are zero according to:

```
if (Xq[n] != 0 ) {
        Decode bit0
        if (bit0 == 1) {
                Xq[n] = -Xq[n];
        }
}
if (Xq[n+1] != 0) {
        Decode bit1
        if (bit1 == 1) {
                Xq[n+1] = -Xq[n+1];
        }
}
```

Set all coefficients n >= lastnz to zero, wherein lastnz is obtained on the basis of a side information obtained from the encoded audio representation;

Finalize the arithmetic decoding and compute the number of unused bits;

if there are unused bits, decode `nlsbs` bits and store them in a data structure `lsbs[]`;
then refine the coefficients ($X_q(n)$,$X_q(n+1)$) if numbits[n]>2 using the decoded LSB bits according to:

```
k = 0;
for (n = 0; n < lastnz; n+=2) {
        if (numbits[n] > 2) {
                if (k == nlsbs) {
                        break;
                }
                bit0 = lsbs[k++];
                if (bit0 == 1) {
                        if (Xq[n] > 0) {
                                Xq[n] += 1;
                        } else if (Xq[n] < 0) {
                                Xq[n] -= 1;
                        } else {
                                if (k == nlsbs) {
                                        break;
                                }
                                bit1 = lsbs[k++];
```

```
                                    X_q[n] = 1 – 2*bit1;
                                }
                            }
                            if (k == nlsbs) {
                                break;
                            }
                            bit0 = lsbs[k++];
                            if (bit0 == 1) {
                                if (X_q[n+1] > 0) {
                                    X_q[n+1] += 1;
                                } else if (X_q[n+1] < 0) {
                                    X_q[n+1] -= 1;
                                } else {
                                    if (k == nlsbs) {
                                        break;
                                    }
                                    bit1 = lsbs[k++];
                                    X_q[n+1] = 1 – 2*bit1;
                                }
                            }
                        }
                    }
```

13. An audio encoder for providing an encoded audio information on the basis of an input audio information,

wherein the audio encoder is configured to obtain spectral values representing an audio content of the input audio information, and

wherein the audio encoder is configured to encode at least a plurality of the spectral values, in order to obtain an encoded information representing the spectral values;

wherein the audio encoder is configured to jointly encode two or more most significant bits per spectral value, to obtain respective symbol codes for a set of spectral values using an arithmetic encoding,

wherein a respective symbol code represents two or more most significant bits per spectral value for one or more spectral values,

wherein the audio encoder is configured to encode one or more least significant bits associated with one or more of the spectral values in dependence on a bit budget available,

such that one or more least significant bits associated with one or more of the spectral values are encoded, while no least significant bits are encoded for one or more other spectral values for which two or more most significant bits are encoded and which comprise more bits than the two or more most significant bits; and

wherein the audio encoder is configured to provide the encoded audio information using the encoded information representing the spectral values.

14. The audio encoder according to claim 13, wherein the arithmetic encoding is configured to determine bit positions of the at least two most significant bits and include into the arithmetically encoded representation an information describing the bit positions.

15. The audio encoder according to claim 13 or claim 14, wherein the audio encoder is configured to map at least two most significant bits of the at least one spectral value onto one symbol of an arithmetically encoded representation, which represents the at least two most significant bits of the at least one spectral value.

16. The audio encoder according to one of claims 13 to 15, wherein the audio encoder is configured to encode, for all spectral values for which two or more most significant bits are encoded and which comprise more bits than the two or more most significant bits and a least significant bit, one or more intermediate bits, bit positions of which are between the least significant bit and the two or more most significant bits.

17. The audio encoder according to one of claims 13 to 16, wherein the audio encoder is configured to encode, in a first encoding phase,

- two or more most significant bits per spectral value, and
- for all spectral values for which two or more most significant bits are encoded and which comprise more bits than the two or more most significant bits and a least significant bit, one or more intermediate bits, bit positions of which are between the least significant bit and the two or more most significant bits, and
- for all spectral values for which two or more most significant bits are encoded and for which the two or more most significant bits and any intermediate bits, as far as intermediate bits are present, indicate a non-zero value, signs; and

wherein the audio encoder is configured to selectively omit, in the first encoding phase, an encoding of a sign for spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a zero value, and

wherein the audio encoder is configured to selectively encode, in a second encoding phase, sign information for spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a zero value and for which a least significant bit information indicates a non-zero value.

18. The audio encoder according to one of claims 13 to 17, wherein the audio encoder is configured to only include a sign information into the encoded audio representation for spectral values which only differ from zero by a least significant bit if the least significant bit of such spectral values is actually encoded.

19. The audio encoder according to one of claims 13 to 18, wherein the audio encoder is configured to sequentially provide subsequent bits of a least-significant-bit-information bit sequence in order to encode least significant bit values associated with the spectral values.

20. The audio encoder according to claim 19, wherein the audio encoder is configured to provide a single bit of the least-significant-bit-information bitsequence for respective spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a non-zero value, wherein the used single bit of the least-significant-bit-information bitsequence is used in order to encode a least significant bit value; and

wherein the audio encoder is configured to provide a single bit of the least-significant-bit-information bitsequence for respective spectral values for which the two or more most significant values and any intermediate bits, as far as intermediate bits are present, indicate a zero value, and for which the provided single bit of the least-significant-bit-information bitsequence confirms the zero value; and

wherein the audio encoder is configured to provide two subsequent bits of the least-significant-bit-information bitsequence for respective spectral values for which the two or more most significant values and any intermediate bits, as far as

intermediate bits are present, indicate a zero value, and for which a first of the provided bits of the least-significant-bit-information bitsequence indicates a deviation from the zero value by a least significant bit value, wherein a second of the provided bits of the least-significant-bit-information bitsequence encodes a sign of the respective spectral value.

21. The audio encoder according to one of claims 13 to 20, wherein the audio encoder is configured to encode least significant bits starting from a least significant bit associated with a lowest frequency spectral value and proceeding towards spectral values associated with increasingly higher frequencies,

such that encoded information for refining spectral values by least-significant-bit information is provided in a range from a lowest frequency spectral value up to a spectral value for which a last least significant bit information is provided, and such that no encoded information for refining spectral values by least-significant-bit information is provided for spectral values having associated frequencies higher than a frequency associated with the spectral value for which the last least significant bit information is provided.

22. The audio encoder according to one of claims 13 to 21, wherein the audio encoder is configured to be switchable between

- a first mode in which an encoding of non-zero spectral values in a higher frequency range is omitted in case that an available bit budget is used up by an encoding of spectral values in a lower frequency range and in which least significant bits are encoded for all spectral values for which one or more most significant bits are encoded and which comprise more bits than the most significant bits, and

- a second mode in which one or more least significant bits associated with one or more of the spectral values are encoded, while no least significant bits are encoded for one or more other spectral values for which one or more most significant bits are encoded and which comprise more bits than the most significant bits.

23. The audio encoder according to claim 22, wherein the audio encoder is configured to provide a bitstream flag which is included in the encoded audio information in order to indicate whether the audio encoder operates in the first mode or in the second mode.

24. The audio encoder according to one of claims 13 to 23, wherein the audio encoder is configured to jointly encode two or more most significant bits per spectral value for at least two spectral values using respective symbol codes,

wherein a respective symbol code represents two or more most significant bits per spectral value for at least two spectral values.

25. The audio encoder according to one of claims 13 to 24, wherein the audio encoder is configured determine an actual highest-frequency non-zero spectral value and to encode at least two or more most significant bits of all non-zero spectral values or of all non-zero groups of spectral values.

26. The audio encoder according to one of claims 13 to claim 25, wherein the audio encoder is configured to encode all bits except for a least significant bit for all non-zero spectral values, and
wherein the audio encoder is configured to encode least significant bits for spectral values until a bit budget is exhausted.

27. The audio encoder according to one of claims 13 to 26, wherein the audio encoder is configured to obtain a gain information which determines quantization steps of a quantization of spectral values, and which determines a bit demand for encoding the quantized spectral values.

28. A method for providing a decoded audio information on the basis of an encoded audio information,
wherein the method comprises obtaining decoded spectral values on the basis of an encoded information representing the spectral values,

wherein the method comprises jointly decoding two or more most significant bits per spectral value on the basis of respective symbol codes for a set of spectral values using an arithmetic decoding,

wherein a respective symbol code represents two or more most significant bits per spectral value for one or more spectral values,

wherein the method comprises decoding one or more least significant bits associated with one or more of the spectral values in dependence on how much least significant bit information is available,
such that one or more least significant bits associated with one or more of the spectral values are decoded, while no least significant bits are decoded for one or more other spectral values for which one or more most significant bits are decoded and which comprise more bits than the one or more most significant bits; and

wherein the method comprises providing the decoded audio information using the spectral values.

29. A method for providing an encoded audio information on the basis of an input audio information,
wherein the method comprises obtaining spectral values representing an audio content of the input audio information, and
wherein the method comprises encoding at least a plurality of the spectral values, in order to obtain an encoded information representing the spectral values;

wherein the method comprises jointly encoding two or more most significant bits per spectral value, to obtain respective symbol codes for a set of spectral values , using an arithmetic encoding,

wherein a respective symbol code represents two or more most significant bits per spectral value for one or more spectral values,

wherein the method comprises encoding one or more least significant bits associated with one or more of the spectral values in dependence on a bit budget available,

such that one or more least significant bits associated with one or more of the spectral values are encoded, while no least significant bits are encoded for one or more other spectral values for which two or more most significant bits are encoded and which comprise more bits than the two or more most significant bits; and

wherein the method comprises providing the encoded audio information using the encoded information representing the spectral values.

30. A computer program for performing the method according to one of claims 28 to 29 when the computer program runs on a computer.