CLAIMS

1. A method performed by a decoder (100, 200, 400), said method comprises:

determining (S1), after a current picture of a bitstream has been decoded and stored in a decoded picture buffer (125, 225) a number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output, said current picture belonging to a layer other than a highest layer that is decoded by said decoder (100, 200, 400) of a multi-layer video sequence comprising multiple layers of pictures;

deriving a value *sps_max_num_reorder_pics*[*HighestTid*]from a syntax element associated with said highest layer, wherein the *HighestTid* specifies said highest layer, and the syntax element is retrieved from a sequence parameter set in the bitstream, and each layer i of said multiple layers has an associated syntax element defining a respective value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i;

outputting (S3) a picture, which is a first picture in output order of said pictures in said decoded picture buffer (125, 225) that are marked as needed for output, if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*]; and

marking (S4) said picture as not needed for output if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

2. The method according to claim 1, further comprising:

parsing (S10) a slice header of said current picture to be decoded of said multi-layer video sequence;

determining (S11) a reference picture set for said current picture based on said parsed slice header;

marking (S12) all pictures in said decoded picture buffer (125, 225) that are not present in said reference picture set as unused for reference;

outputting (S13) zero, one or many pictures, marked as needed for output, of said pictures in said decoded picture buffer (125, 225) and marking said zero, one or many pictures as not needed for output;

emptying (S14), from said decoded picture buffer (125, 225), any picture marked as unused for reference and not needed for output of said pictures in said decoded picture buffer (125, 225); and

decoding (S15) said current picture, wherein determining (S1) said number of pictures, outputting (S3) said picture and marking (S4) said picture are performed after decoding (S15) said current picture.

3. A method performed by a decoder (100, 300, 500), said method comprises:

parsing (S30) a slice header of a current picture of a bitstream to be decoded of a multi-layer video sequence comprising multiple layers of pictures, said current picture belonging to a layer other than a highest layer that is decoded by said decoder (100, 200, 400) of said multi-layer video sequence;

determining (S31) a reference picture set for said current picture based on said parsed slice header;

marking (S32) all pictures in a decoded picture buffer (125, 325) that are not present in said reference picture set as unused for reference;

outputting (S33) zero, one or many pictures, marked as needed for output, of said pictures in said decoded picture buffer (125, 325) and marking said zero, one or many pictures as not needed for output;

emptying (S34) any picture, from said decoded picture buffer (125, 325), marked as unused for reference and not needed for output of said pictures in said decoded picture buffer (125, 325);

decoding (S35) said current picture;

determining (S36) a number of pictures in said decoded picture buffer (125, 325) that are marked as needed for output;

deriving a value *sps_max_num_reorder_pics*[*HighestTid*]from a syntax element associated with said highest layer, wherein the *HighestTid* specifies said highest layer, and the syntax element is retrieved from a sequence parameter set in the bitstream, and each layer i of said multiple layers has an associated syntax element defining a respective value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i;

outputting (S38) a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (125, 325) that are marked as needed for output if said number of pictures in said decoded picture buffer (125, 325) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*]; and

marking (S39) said picture as not needed for output if said number of pictures in said decoded picture buffer (125, 325) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*], wherein determining (S36) said number of pictures, outputting (S38) said picture and marking (S39) said picture are performed after decoding (S35) said current picture.

4. The method according to claim 3, further comprising:

storing (S40) said decoded current picture in said decoded picture buffer (125, 325); and

marking (S41) said decoded current picture as needed for output or as not needed for output, wherein determining (S1, S36) said number of pictures is performed after marking (S41) said decoded current picture.

5. The method according to any of the claims 1 to 4, wherein

outputting (S3, S38) said picture comprises outputting (S3, S38) a picture in said decoded picture buffer (125, 225, 325) with a smallest value of *PicOrderCntVal* of all pictures in said decoded picture buffer (125, 225, 325) that are marked as needed for output if said number of pictures in said decoded picture buffer (125, 225, 325) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*], wherein *PicOrderCntVal* represents a picture order count value.

6. A decoder (100, 200) configured to:

determine, after a current picture of a bitstream (10) representing pictures of a multi-layer video sequence comprising multiple layers of pictures has been decoded and stored in a decoded picture buffer (125, 225), a number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output, said current picture belonging to a layer other than a highest layer that is decoded by said decoder (100, 200) of said multi-layer video sequence;

deriving a value *sps_max_num_reorder_pics*[*HighestTid*]from a syntax element associated with said highest layer, wherein the *HighestTid* specifies said highest layer, and the syntax element is retrieved from a sequence parameter set in the bitstream, and each layer i of said multiple layers has an associated syntax element defining a respective value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i;

output a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (125, 225) that are marked as needed for output if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*]; and

mark said picture as not needed for output if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

7. A decoder (100, 300) configured to:

parse a slice header of a current picture to be decoded of a bitstream (10) representing pictures of a multi-layer video sequence comprising multiple layers of pictures, said current picture belonging to a layer other than a highest layer that is decoded by said decoder (100, 300) of said multi-layer video sequence;

determine a reference picture set for said current picture based on said parsed slice header;

mark all pictures in a decoded picture buffer (125, 325) that are not present in said reference picture set as unused for reference;

output zero, one or many pictures, marked as needed for output, of said pictures in said decoded picture buffer (125, 325) and mark said zero, one or many pictures as not needed for output;

empty, from said decoded picture buffer (125, 325), any picture marked as unused for reference and not needed for output of said pictures in said decoded picture buffer (125, 325);

decode said current picture;

determine a number of pictures in said decoded picture buffer (125, 325) that are marked as needed for output;

deriving a value *sps_max_num_reorder_pics*[*HighestTid*]from a syntax element associated with said highest layer, wherein the *HighestTid* specifies said highest layer, and the syntax element is retrieved from a sequence parameter set in the bitstream, and each layer i of said multiple layers has an associated syntax element defining a respective value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i;

output a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (125, 325) that are marked as needed for output if said number of pictures in said decoded picture buffer (125, 325) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*]; and

mark said picture as not needed for output if said number of pictures in said decoded picture buffer (125, 325) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*], wherein said decoder (100, 300) is configured to determine said number of pictures, output said picture and mark said picture after decoding said current picture.

8. The decoder according to claim 6 or 7, wherein said decoder (100, 200, 300, 400, 500) is a High Efficiency Video Coding, HEVC, compliant decoder (100, 200, 300, 400, 500).

9. A method performed by an encoder (600, 700, 900), said method comprises:

determining (S60), after a current picture has been decoded and stored in a decoded picture buffer (625, 725), a number of pictures in said decoded picture buffer (625, 725) that are marked as needed for output, said current picture belonging to a layer other a highest layer that is decoded by said encoder (600, 700, 900) of a multi-layer video sequence comprising multiple layers of pictures;

selecting a value *sps_max_num_reorder_pics*[*HighestTid*] for a syntax element in a sequence parameter set , wherein *HighestTid* specifies said highest layer, each layer i of said multiple layers has an associated value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i; and

marking (S62) a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (625, 725) that are marked as needed for output as not needed for output if said number of pictures in said decoded picture buffer (625, 725) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

10. A method performed by an encoder (600, 800), said method comprises:

marking (S70) all pictures in a decoded picture buffer (625, 825) that are not present in a reference picture set for a current picture of a multi-layer video sequence comprising multiple layers of pictures as unused for reference, said current picture belonging to a layer other than a highest layer that is decoded by said encoder (600, 800) of said multi-layer video sequence;

marking (S71) zero, one or many pictures, marked as needed for output, of said pictures in said decoded picture buffer (625, 825) as not needed for output;

emptying (S72), from said decoded picture buffer (625, 825), any picture marked as unused for reference and not needed for output of said pictures in said decoded picture buffer (625, 825);

decoding (S73) said current picture;

determining (S74) a number of pictures in said decoded picture buffer (625, 825) that are marked as needed for output;

selecting (S50) a value *sps_max_num_reorder_pics*[*HighestTid*] for a syntax element in a sequence parameter set, wherein *HighestTid* specifies said highest layer, each layer i of said multiple layers has an associated value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i; and

marking (S76) a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (625, 825) that are marked as needed for output as not needed for output if said number of pictures in said decoded picture buffer (625, 825) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*], wherein determining (S74) said number of pictures, and marking (S76) said picture are performed after decoding (S73) said current picture.

11. An encoder (600, 700) configured to:

determine, after a current picture has been decoded and stored in a decoded picture buffer (625, 725), a number of pictures in said decoded picture buffer (625, 725) that are marked as needed for output, said current picture belonging to a layer other a highest layer that is decoded by said encoder (600, 700) of a multi-layer video sequence comprising multiple layers of pictures;

select a value *sps_max_num_reorder_pics*[*HighestTid*] for a syntax element in a sequence parameter set, wherein *HighestTid* specifies said highest layer, each layer i of said multiple layers has an associated value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i; and

mark a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (625, 725) that are marked as needed for output as not needed for output if said number of pictures in said decoded picture buffer (625, 725) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

12. An encoder (600, 800) configured to:

mark all pictures in a decoded picture buffer (625, 825) that are not present in a reference picture set for a current picture of a multi-layer video sequence comprising multiple layers of pictures as unused for reference, said current picture belonging to a layer other than a highest layer that is decoded by said encoder (600, 800) of said multi-layer video sequence;

mark zero, one or many pictures, marked as needed for output, of said pictures in said decoded picture buffer (625, 825) as not needed for output;

empty, from said decoded picture buffer (625, 825), any picture marked as unused for reference and not needed for output of said pictures in said decoded picture buffer (625, 825);

decode said current picture;

determine a number of pictures in said decoded picture buffer (625, 825) that are marked as needed for output;

select a value *sps_max_num_reorder_pics*[*HighestTid*] for a syntax element in a sequence parameter set, wherein *HighestTid* specifies said highest layer, each layer i of said multiple layers has an associated value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i; and

mark a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (625, 825) that are marked as needed for output as not needed for output if said number of pictures in said decoded picture buffer (625, 825) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*], wherein said encoder (600, 800) is configured to determine said number of pictures, mark said picture are performed after decoding said current picture.

13. The encoder according to claim 11 or 12, wherein said encoder (600, 700, 800, 900, 1000) is a High Efficiency Video Coding, HEVC, compliant encoder (600, 700, 800, 900, 1000).

14. A mobile terminal (1100) comprising a decoder (100, 200, 300, 400, 500) according to any of the claims 6-8 and/or an encoder (600, 700, 800, 900, 1000) according to any of the claims 11-13.

15. A network node (2) comprising a decoder (100, 200, 300, 400, 500) according to any of the claims 8 to 19 and/or an encoder (600, 700, 800, 900, 1000) according to any of the claims 11-13.

Claims

1. A method performed by a decoder (100,200,400), said method comprises:

determining (S1), after a current picture of a bitstream has been decoded and stored in a decoded picture buffer (125, 225) a number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output, said current picture belonging to a layer other than a highest layer that is decoded by said decoder (100, 200, 400) of a multi-layer video sequence comprising multiple layers of pictures;

deriving a value *sps_max_num_reorder_pics*[*HighestTid*]from a syntax element associated with said highest layer, wherein the *HighestTid* specifies said highest layer, and the syntax element is retrieved from a sequence parameter set in the bitstream, and each layer i of said multiple layers has an associated syntax element defining a respective value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i;

outputting (S3) a picture, which is a first picture in output order of said pictures in said decoded picture buffer (125, 225) that are marked as needed for output, if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*]; and

marking (S4) said picture as not needed for output if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

2. The method according to claim 1, further comprising:

parsing (S10) a slice header of said current picture to be decoded of said multi-layer video sequence;

determining (S11) a reference picture set for said current picture based on said parsed slice header;

marking (S12) all pictures in said decoded picture buffer (125, 225) that are not present in said reference picture set as unused for reference;

outputting (S13) zero, one or many pictures, marked as needed for output, of said pictures in said decoded picture buffer (125, 225) and marking said zero, one or many pictures as not needed for output;

emptying (S14), from said decoded picture buffer (125, 225), any picture marked as unused for reference and not needed for output of said pictures in said decoded picture buffer (125, 225); and

decoding (S15) said current picture, wherein determining (S1) said number of pictures, outputting (S3) said picture and marking (S4) said picture are performed after decoding (S15) said current picture.

3. A decoder (100,200) configured to:

determine, after a current picture of a bitstream (10) representing pictures of a multi-layer video sequence comprising multiple layers of pictures has been decoded and stored in a decoded picture buffer (125, 225), a number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output, said current picture belonging to a layer other than a highest layer that is decoded by said decoder (100,200) of said multilayer video sequence;

derive a value *sps_max_num_reorder_pics*[*HighestTid*]from a syntax element associated with said highest layer, wherein the *HighestTid* specifies said highest layer, and the syntax element is retrieved from a sequence parameter set in the bitstream, and each layer i of said multiple layers has an associated syntax element defining a respective value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i;

output a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (125, 225) that are marked as needed for output if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*]; and

mark said picture as not needed for output if said number of pictures in said decoded picture buffer (125, 225) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

4. The decoder according to claim 3, wherein said decoder (100, 200, 300, 400, 500) is a High Efficiency Video Coding, HEVC, compliant decoder (100, 200, 300, 400, 500).

5. A method performed by an encoder (600, 700, 900), said method comprises:

determining (S60), after a current picture has been decoded and stored in a decoded picture buffer (625, 725), a number of pictures in said decoded picture buffer (625, 725) that

are marked as needed for output, said current picture belonging to a layer other a highest layer that is decoded by said encoder (600, 700, 900) of a multilayer video sequence comprising multiple layers of pictures;

selecting a value *sps_max_num_reorder_pics*[*HighestTid*] for a syntax element in a sequence parameter set, wherein *HighestTid* specifies said highest layer, each layer i of said multiple layers has an associated value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i; and

marking (S62) a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (625, 725) that are marked as needed for output as not needed for output if said number of pictures in said decoded picture buffer (625, 725) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

6. An encoder (600, 700) configured to:

determine, after a current picture has been decoded and stored in a decoded picture buffer (625, 725), a number of pictures in said decoded picture buffer (625, 725) that are marked as needed for output, said current picture belonging to a layer other a highest layer that is decoded by said encoder (600, 700) of a multi-layer video sequence comprising multiple layers of pictures;

select a value *sps_max_num_reorder_pics*[*HighestTid*] for a syntax element in a sequence parameter set, wherein *HighestTid* specifies said highest layer, each layer i of said multiple layers has an associated value *sps_max_num_reorder_pics*[i], and said value *sps_max_num_reorder_pics*[i] indicates a maximum allowed number of pictures that can precede any picture in said multi-layer video sequence in decoding order and follow that picture in output order when *HighestTid* is equal to i; and

mark a picture, which is a first picture in output order, of said pictures in said decoded picture buffer (625, 725) that are marked as needed for output as not needed for output if said number of pictures in said decoded picture buffer (625, 725) that are marked as needed for output is greater than said value *sps_max_num_reorder_pics*[*HighestTid*].

7. The encoder according to claim 6, wherein said encoder (600, 700, 800, 900, 1000) is a High Efficiency Video Coding, HEVC, compliant encoder (600, 700, 800, 900, 1000).

8. A mobile terminal (1100) comprising a decoder (100, 200, 300, 400, 500) according to any of the claims 3-4 and/or an encoder (600, 700, 800, 900, 1000) according to any of the claims 6-7.

9. A network node (2) comprising a decoder (100, 200, 300, 400, 500) according to any of the claims 3-4 and/or an encoder (600, 700, 800, 900, 1000) according to any of the claims 6-7.