

Claims

1. Decoder configured to

5 receive raw byte sequence payload describing a picture in slices, WPP substreams or tiles and coded using CABAC from an encoder in tranches of the slices, WPP substreams or tiles;

10 entropy decoding the tranches with continuing CABAC probability adaptation across tranche boundaries; and

decode the raw byte sequence payload to obtain the picture.

15 2. Decoder according to claim 1, wherein the raw byte sequence describes the picture in slices, and the decoder is configured to, in decoding the raw byte sequence payload, decode each slice separately without use of data of other slices.

20 3. Decoder according to claim 1 or 2, wherein the raw byte sequence payload describes the picture in tiles and the decoder is configured to, in decoding the raw byte sequence payload, perform entropy decoding and transform decoding of the tiles independently from each other.

25 4. Decoder according to any of the previous claims, wherein the raw byte sequence payload describes the picture in WPP substreams and the decoder is configured to, in decoding the raw byte sequence payload, use wavefront parallel processing of the WPP substream.

30 5. Decoder according to any of the previous claims, wherein the tranches are packetized using slice headers, and the decoder is configured to, in receiving the tranches, be responsive, upon receiving a new slice, to a flag in the slice header of the new slice, a slice_type of the new slice or a NAL unit type of a NAL unit containing the new slice so as to either interrupt the CABAC probability adaptation by resetting CABAC probabilities or to continue the CABAC probability adaptation.

35 6. Decoder according to any of the previous claims, wherein the raw byte sequence payload describes the picture in WPP substreams or tiles, which are further subdivided into the tranches.

7. Decoder according to claim 6, wherein the decoder is configured to, in receiving the tranches, deinterleave the tranches by identifying, for each tranche, as to which WPP substream or tile, the respective tranche belongs to.
- 5 8. Decoder according to any of the previous claims, wherein the tranches are packetized into packets in manner so that each packet comprises one tranche of each WPP substream or tile of the picture, or a subset of the WPP substreams or tiles of the picture, arranged in an order defined among the WPP substreams or tiles, each packet comprising a header comprising revealing the positions and/or lengths of the tranches packed into the respective packet, or markers separating the tranches within the respective packet from each other, wherein the decoder is configured to, in receiving the raw byte sequence payload, use the information comprised by the headers or the markers so as to access the tranches within the packets.
- 10 9. Decoder according to claim 8, wherein packets comprising first – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP substreams or tiles of the picture, comprise a low delay feature indicator, and packets comprising second or subsequent – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP substreams or tiles of the picture, comprise a continuation indicator.
- 15 10. Decoder according to claim 8 or 9, wherein the packets are NAL units or slices.
- 20 11. Transport demultiplexer comprising
- 25 a multiplex buffer;
- 30 slice buffers for being pulled by a multi-threaded decoder allowing parallel decoding of a picture in WPP substreams or tiles;
- 35 a transport buffer configured to collect data belonging to a TS packet of a predetermined elementary stream of a video bitstream, and forward the data to the multiplex buffer;
- wherein the transport demultiplexer is configured to evaluate NAL unit headers of NAL units of a NAL unit sequence packetized into the TS packets at an output of

the multiplex buffer, drop substream markers inserted into the NAL unit sequence with storing the substream marker data carried within the substream makers and store data of slices of substreams or tiles within NAL units following substream markers a data field of which identifies an equal WPP substream or tile in one slice buffer, and data of slices of WPP substreams or tiles within NAL units following substream markers a data field of which identify different WPP substreams or tiles in different slice buffers.

12. Transport demultiplexer according to claim 11, wherein the substream markers are substream marker NAL units having a NAL unit type different from NAL units within which the data of the slices of the substreams or tiles is.
13. Transport demultiplexer according to claim 11 or 12, further comprising
a demultiplexer configured to receive the video bitstream and split TS packets of the video bitstream into different elementary streams according to PIDs contained within TS headers of the TS packets so that each elementary stream is composed of TS packets of a PID different from PIDs of TS packets of other elementary streams.
14. Transport demultiplexer configured to receive a video bitstream comprising raw byte sequence payload describing a picture in slices, WPP substreams or tiles and coded using CABAC, the video bitstream being decomposed into tranches of the slices, WPP substreams or tiles with continuing CABAC probability adaptation across tranche boundaries, wherein the each tranche comprises information identifying, for each tranche, as to which WPP substream or tile, the respective tranche belongs to, and to associate the tranches to the slices, WPP substreams or tiles using the information.
15. Transport demultiplexer according to claim 14, wherein, for each tranche, the information comprised by the respective tranche comprises an address of a starting position within the picture, starting from which the respective tranche continuously covers a portion of the slice, WPP substream or tile which the respective tranche belongs to.
16. Transport demultiplexer according to claim 14 or 15, wherein the transport demultiplexer is configured to sort, for each slice, WPP substream or tile, the tranches thereof using a decoding order number in packet headers of packets into which the tranches are packed.

17. System comprising a transport demultiplexer according to any of claims 11 to 13, and the multi-threaded decoder, wherein the multi-threaded decoder is embodied according to claim 5.
- 5 18. Encoder configured to
- forming, by encoding a picture, a raw byte sequence payload so as to describe the picture in slices, WPP substreams or tiles with entropy encoding the raw byte sequence using CABAC, transmitting the raw byte sequence in tranches, and continuing CABAC probability adaptation in the entropy encoding across tranche boundaries.
- 10 19. Encoder according to claim 18, wherein the encoder is configured to from the raw byte sequence such that the tranches match a maximum transfer unit size.
- 15 20. Video bitstream transmitting a sequence of NAL units comprising NAL unit headers, the sequence of NAL units having inserted therein substream markers, wherein NAL units carrying data of slices of an equal one of substreams or tiles, follow substream markers a data field of which identifies the equal substream or tile, and data of slices of different substreams or tiles follow different substream markers a data field of which identify the different substreams or tiles.
- 20 21. Video bitstream comprising raw byte sequence payload describing a picture in slices, WPP substreams or tiles and coded using CABAC, the video bitstream being decomposed into tranches of the slices, WPP substreams or tiles with continuing CABAC probability adaptation across tranche boundaries, wherein each tranche includes an explicit indication of its rank among the tranches into which the slice, WPP substream or tile the respective tranche belongs to, is sequentially decomposed.
- 25 30 22. Video bitstream according to claim 21, wherein the tranches are packetized into packets in manner so that each packet comprises one tranche of each WPP substream or tile of the picture, or a subset of the WPP substreams or tiles of the picture, arranged in an order defined among the WPP substreams or tiles, each packet comprising a header comprising revealing the positions and/or lengths of the tranches packed into the respective packet, or markers separating the tranches within the respective packet from each other.
- 35

23. Video bitstream according to claim 21 or 22, wherein packets comprising first – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP substreams or tiles of the picture, comprise a low delay feature indicator, and packets comprising second or subsequent – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP substreams or tiles of the picture, comprise a continuation indicator.
24. Video bitstream according to any of claims 21 to 23, wherein the packets are NAL units or slices.
25. Method for decoding comprising
- receiving raw byte sequence payload describing a picture in slices, WPP substreams or tiles and coded using CABAC from an encoder in tranches of the slices, WPP substreams or tiles;
- entropy decoding the tranches with continuing CABAC probability adaptation across tranche boundaries; and
- decoding the raw byte sequence payload to obtain the picture.
26. Method for transport demultiplexing using a multiplex buffer, slice buffers for being pulled by a multi-threaded decoder allowing parallel decoding of a picture in WPP substreams or tiles, and a transport buffer configured to collect data belonging to a TS packet of a predetermined elementary stream of a video bitstream, and forward the data to the multiplex buffer, the method comprising
- evaluating NAL unit headers of NAL units of a NAL unit sequence packetized into the TS packets at an output of the multiplex buffer,
- dropping substream marker NAL units with storing the substream marker data carried within the substream maker NAL units and
- storing data of slices of substreams or tiles within NAL units following substream marker NAL units a data field of which identifies an equal WPP substream or tile in one slice buffer, and data of slices of WPP substreams or tiles within NAL units

following substream marker NAL units a data field of which identify different WPP substreams or tiles in different slice buffers.

- 5 27. Method for transport demultiplexing comprising receiving a video bitstream comprising raw byte sequence payload describing a picture in slices, WPP substreams or tiles and coded using CABAC, the video bitstream being decomposed into tranches of the slices, WPP substreams or tiles with continuing CABAC probability adaptation across tranche boundaries, wherein the each tranche comprises information identifying, for each tranche, as to which WPP substream or tile, the respective tranche belongs to, and associating the tranches to the slices, WPP substreams or tiles using the information.
- 10
28. Method for encoding comprising
- 15 forming, by encoding a picture, a raw byte sequence payload so as to describe the picture in slices, WPP substreams or tiles with entropy encoding the raw byte sequence using CABAC, transmitting the raw byte sequence in tranches, and continuing CABAC probability adaptation in the entropy encoding across tranche boundaries.
- 20
29. A computer program having a program code for performing, when running on a computer, a method according to any of claims 25 to 28.
- 25

Claims

1. Decoder configured to

5 receive raw byte sequence payload describing a picture in WPP substreams with one WPP substream per LCU row of the picture and coded using CABAC from an encoder in tranches into which the WPP substreams are segmented thereby having tranche boundaries introduced therein;

10 entropy decoding the tranches with continuing CABAC probability adaptation across the tranche boundaries introduced within the WPP substreams; and

decode the raw byte sequence payload to obtain the picture.

15 2. Decoder according to any of the previous claims, wherein the tranches are packetized using slice headers, and the decoder is configured to, in receiving the tranches, be responsive, upon receiving a new slice, to a flag in the slice header of the new slice, a slice_type of the new slice or a NAL unit type of a NAL unit containing the new slice so as to either interrupt the CABAC probability adaptation
20 by resetting CABAC probabilities or to continue the CABAC probability adaptation.

3. Decoder according to claim 1 or 2, wherein the decoder is configured to, in receiving the tranches, deinterleave the tranches by identifying, for each tranche, as
25 to which WPP substream the respective tranche belongs to.

4. Decoder according to any of the previous claims, wherein the tranches are packetized into packets in manner so that each packet comprises one tranche of each WPP substream of the picture, or a subset of the WPP substreams of the picture, arranged in an order defined among the WPP substreams, each packet
30 comprising a header comprising revealing the positions and/or lengths of the tranches packed into the respective packet, or markers separating the tranches within the respective packet from each other, wherein the decoder is configured to, in receiving the raw byte sequence payload, use the information comprised by the headers or the markers so as to access the tranches within the packets.
35

5. Decoder according to claim 4, wherein packets comprising first – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP

substreams or tiles of the picture, comprise a low delay feature indicator, and packets comprising second or subsequent – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP substreams or tiles of the picture, comprise a continuation indicator.

5

6. Decoder according to claim 4 or 5, wherein the packets are NAL units or slices.

7. Decoder configured to

10

receive raw byte sequence payload describing a picture in WPP substreams and coded using CABAC from an encoder in tranches into which the WPP substreams are segmented thereby having tranche boundaries introduced therein;

15

entropy decoding the tranches with continuing CABAC probability adaptation across the tranche boundaries introduced within the WPP substreams by adopting, in starting entropy decoding one tranche of the WPP substream, the CABAC probabilities at the end of entropy decoding another tranche of the WPP substream; and

20

decode the raw byte sequence payload to obtain the picture.

8. Encoder configured to

25

forming, by encoding a picture, a raw byte sequence payload so as to describe the picture in WPP substreams with one WPP substream per LCU row of the picture with entropy encoding the raw byte sequence using CABAC, transmitting the raw byte sequence in tranches into which the WPP substreams are segmented thereby having tranche boundaries introduced therein, and continuing CABAC probability adaptation in the entropy encoding across the tranche boundaries introduced within the WPP substreams.

30

9. Encoder according to claim 8, wherein the encoder is configured to from the raw byte sequence such that the tranches match a maximum transfer unit size.

35

10. Video bitstream comprising raw byte sequence payload describing a picture in WPP substreams with one WPP substream per LCU row of the picture and coded using CABAC, the video bitstream being decomposed into tranches of the WPP substreams into which the WPP substreams are segmented thereby having tranche

boundaries introduced therein, with continuing CABAC probability adaptation across the tranche boundaries introduced within the WPP substreams, wherein each tranche includes an explicit indication of its rank among the tranches into which the WPP substream the respective tranche belongs to, is sequentially decomposed.

5

11. Video bitstream according to claim 10, wherein the tranches are packetized into packets in manner so that each packet comprises one tranche of each WPP substream or tile of the picture, or a subset of the WPP substreams or tiles of the picture, arranged in an order defined among the WPP substreams or tiles, each packet comprising a header comprising revealing the positions and/or lengths of the tranches packed into the respective packet, or markers separating the tranches within the respective packet from each other.

10

12. Video bitstream according to claim 10 or 11, wherein packets comprising first – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP substreams or tiles of the picture, comprise a low delay feature indicator, and packets comprising second or subsequent – in accordance with the order defined among the WPP substreams or tiles - tranches of the WPP substreams or tiles of the picture, comprise a continuation indicator.

15

20

13. Video bitstream according to any of claims 10 to 12, wherein the packets are NAL units or slices.

14. Method for decoding comprising

25

receiving raw byte sequence payload describing a picture in WPP substreams with one WPP substream per LCU row of the picture and coded using CABAC from an encoder in tranches of the WPP substreams into which the WPP substreams are segmented thereby having tranche boundaries introduced therein,;

30

entropy decoding the tranches with continuing CABAC probability adaptation across the tranche boundaries introduced within the WPP substreams; and

decoding the raw byte sequence payload to obtain the picture.

35

15. Method for transport demultiplexing comprising receiving a video bitstream comprising raw byte sequence payload describing a picture in WPP substreams with one WPP substream per LCU row of the picture and coded using CABAC, the

video bitstream being decomposed into tranches of the WPP substreams into which the WPP substreams are segmented thereby having tranche boundaries introduced therein with continuing CABAC probability adaptation across the tranche boundaries introduced within the WPP substreams, wherein the each tranche comprises information identifying, for each tranche, as to which WPP substream or tile, the respective tranche belongs to, and associating the tranches to the slices, WPP substreams or tiles using the information.

16. Method for encoding comprising

forming, by encoding a picture, a raw byte sequence payload so as to describe the picture in WPP substreams with one WPP substream per LCU row of the picture with entropy encoding the raw byte sequence using CABAC, transmitting the raw byte sequence in tranches into which the WPP substreams are segmented thereby having tranche boundaries introduced therein, and continuing CABAC probability adaptation in the entropy encoding across the tranche boundaries introduced within the WPP substreams.

17. A computer program having a program code for performing, when running on a computer, a method according to any of claims 13 to 16.

18. Transport demultiplexer comprising

a multiplex buffer;

slice buffers for being pulled by a multi-threaded decoder allowing parallel decoding of a picture in WPP substreams or tiles;

a transport buffer configured to collect data belonging to a TS packet of a predetermined elementary stream of a video bitstream, and forward the data to the multiplex buffer;

wherein the transport demultiplexer is configured to evaluate NAL unit headers of NAL units of a NAL unit sequence packetized into the TS packets at an output of the multiplex buffer, drop substream markers inserted into the NAL unit sequence with storing the substream marker data carried within the substream makers and store data of slices of substreams or tiles within NAL units following substream markers a data field of which identifies an equal WPP substream or tile in one slice

buffer, and data of slices of WPP substreams or tiles within NAL units following substream markers a data field of which identify different WPP substreams or tiles in different slice buffers.

- 5 19. Transport demultiplexer according to claim 18, wherein the substream markers are substream marker NAL units having a NAL unit type different from NAL units within which the data of the slices of the substreams or tiles is.
- 10 20. Transport demultiplexer according to claim 18 or 19, further comprising
 a demultiplexer configured to receive the video bitstream and split TS packets of the video bitstream into different elementary streams according to PIDs contained within TS headers of the TS packets so that each elementary stream is composed of TS packets of a PID different from PIDs of TS packets of other elementary streams.
- 15 21. Transport demultiplexer configured to receive a video bitstream comprising raw byte sequence payload describing a picture in slices, WPP substreams or tiles and coded using CABAC, the video bitstream being decomposed into tranches of the slices, WPP substreams or tiles with continuing CABAC probability adaptation across tranche boundaries, wherein the each tranche comprises information identifying, for each tranche, as to which WPP substream or tile, the respective tranche belongs to, and to associate the tranches to the slices, WPP substreams or tiles using the information.
- 20 22. Transport demultiplexer according to claim 21, wherein, for each tranche, the information comprised by the respective tranche comprises an address of a starting position within the picture, starting from which the respective tranche continuously covers a portion of the slice, WPP substream or tile which the respective tranche belongs to.
- 25 23. Transport demultiplexer according to claim 21 or 22, wherein the transport demultiplexer is configured to sort, for each slice, WPP substream or tile, the tranches thereof using a decoding order number in packet headers of packets into which the tranches are packed.
- 30 24. System comprising a transport demultiplexer according to any of claims 19 to 20, and the multi-threaded decoder, wherein the multi-threaded decoder is embodied according to claim 5.
- 35

25. Video bitstream transmitting a sequence of NAL units comprising NAL unit headers, the sequence of NAL units having inserted therein substream markers, wherein NAL units carrying data of slices of an equal one of substreams or tiles, follow substream markers a data field of which identifies the equal substream or tile, and data of slices of different substreams or tiles follow different substream markers a data field of which identify the different substreams or tiles.
26. Method for transport demultiplexing using a multiplex buffer, slice buffers for being pulled by a multi-threaded decoder allowing parallel decoding of a picture in WPP substreams or tiles, and a transport buffer configured to collect data belonging to a TS packet of a predetermined elementary stream of a video bitstream, and forward the data to the multiplex buffer, the method comprising
- evaluating NAL unit headers of NAL units of a NAL unit sequence packetized into the TS packets at an output of the multiplex buffer,
- dropping substream marker NAL units with storing the substream marker data carried within the substream maker NAL units and
- storing data of slices of substreams or tiles within NAL units following substream marker NAL units a data field of which identifies an equal WPP substream or tile in one slice buffer, and data of slices of WPP substreams or tiles within NAL units following substream marker NAL units a data field of which identify different WPP substreams or tiles in different slice buffers.
27. A computer program having a program code for performing, when running on a computer, a method according to claim 26.