

WHAT IS CLAIMED IS:

1. A method of coding video data, the method comprising:
storing one or more decoding units of video data in a coded picture buffer (CPB);
obtaining a respective buffer removal time for the one or more decoding units;
removing the decoding units from the CPB in accordance with the obtained buffer removal time for each of the decoding units;
determining whether the CPB operates at access unit level or sub-picture level;
and
coding video data corresponding to the removed decoding units,
wherein, if the CPB operates at access unit level, coding the video data comprises coding access units comprised in the decoding units; and
wherein, if the CPB operates at sub-picture level, coding the video data comprises coding subsets of access units comprised in the decoding units.
2. The method of claim 1, wherein determining whether the CPB operates at access unit level or sub-picture level comprises:
determining that the CPB operates at access unit level if a sub-picture coded picture buffer preferred flag has a value of zero or if a sub-picture coded picture buffer parameters present flag has a value of zero; and
determining that the CPB operates at sub-picture level if both the sub-picture coded picture buffer preferred flag has a value of one and the sub-picture coded picture buffer parameters present flag has a value of one.
3. The method of claim 2, further comprising receiving the value for the sub-picture coded picture buffer preferred flag.
4. The method of claim 2, further comprising setting a value of zero for the sub-picture coded picture buffer preferred flag if a value for the sub-picture coded picture buffer preferred flag is not received.

5. The method of claim 2, further comprising receiving the value for the sub-picture coded picture buffer parameters present flag.
6. The method of claim 1, further comprising:
receiving the one or more decoding units of video data in a continuous decoding order,
wherein storing the one or more decoding units of video data in the CPB comprises storing the one or more decoding units of video data in the continuous decoding order in the CPB.
7. The method of claim 1, wherein obtaining the respective buffer removal time for the one or more decoding units comprises receiving a respective signaled value indicative of the respective buffer removal time for at least one of the decoding units.
8. The method of claim 7, wherein the signaled value indicative of the buffer removal time for the at least one of the decoding units comprises a signaled value indicative of a number of network abstraction layer (NAL) units comprised by the at least one of the decoding units.
9. The method of claim 1, wherein the one or more decoding units comprise respective sub-pictures, the method further comprising receiving a signaled value indicative of a byte alignment of at least one sub-picture within a larger set of the video data.

10. A device for coding video data, the device comprising a video coder configured to:

store one or more decoding units of video data in a coded picture buffer (CPB);
obtain a respective buffer removal time for the one or more decoding units;
remove the decoding units from the CPB in accordance with the obtained buffer removal time for each of the decoding units;

determine whether the CPB operates at access unit level or sub-picture level; and
code video data corresponding to the removed decoding units.

wherein, if the CPB operates at access unit level, to code the video data, the video coder is further configured to code access units comprised in the decoding units;
and

wherein, if the CPB operates at sub-picture level, to code the video data, the video coder is further configured to code subsets of access units comprised in the decoding units.

11. The device of claim 10, wherein, to determine whether the CPB operates at access unit level or sub-picture level, the video coder is further configured to:

determine that the CPB operates at access unit level if a sub-picture coded picture buffer preferred flag has a value of zero or if a sub-picture coded picture buffer parameters present flag has a value of zero; and

determine that the CPB operates at sub-picture level if both the sub-picture coded picture buffer preferred flag has a value of one and the sub-picture coded picture buffer parameters present flag has a value of one.

12. The device of claim 11, wherein the video coder is further configured to receive the value for the sub-picture coded picture buffer preferred flag.

13. The device of claim 11, wherein the video coder is further configured to set a value of zero for the sub-picture coded picture buffer preferred flag if a value for the sub-picture coded picture buffer preferred flag is not received.

14. The device of claim 11, wherein the video coder is further configured to receive the value for the sub-picture coded picture buffer parameters present flag.
15. The device of claim 10, wherein the video coder is further configured to:
receive the one or more decoding units of video data in a continuous decoding order,
wherein storing the one or more decoding units of video data in the CPB comprises storing the one or more decoding units of video data in the continuous decoding order in the CPB.
16. The device of claim 10, wherein obtaining the respective buffer removal time for the one or more decoding units comprises receiving a respective signaled value indicative of the respective buffer removal time for at least one of the decoding units.
17. The device of claim 16, wherein the signaled value indicative of the buffer removal time for the at least one of the decoding units comprises a signaled value indicative of a number of network abstraction layer (NAL) units comprised by the at least one of the decoding units.
18. The device of claim 10, wherein the one or more decoding units comprise respective sub-pictures, and the video coder is further configured to receiving a signaled value indicative of a byte alignment of at least one sub-picture within a larger set of the video data.
19. The device of claim 10, wherein the device comprises at least one of:
one or more integrated circuits;
one or more microprocessors; and
a wireless communication device that includes the video coder.

20. An apparatus for coding video data, the apparatus comprising:
means for storing one or more decoding units of video data in a coded picture buffer (CPB);
means for obtaining a respective buffer removal time for the one or more decoding units;
means for removing the decoding units from the CPB in accordance with the obtained buffer removal time for each of the decoding units;
means for determining whether the CPB operates at access unit level or sub-picture level; and
means for coding video data corresponding to the removed decoding units, wherein, if the CPB operates at access unit level, the means for coding the video data comprises means for coding access units comprised in the decoding units; and wherein, if the CPB operates at sub-picture level, the means for coding the video data comprises means for coding subsets of access units comprised in the decoding units.
21. The apparatus of claim 20, wherein the means for determining whether the CPB operates at access unit level or sub-picture level comprises:
means for determining that the CPB operates at access unit level if a sub-picture coded picture buffer preferred flag has a value of zero or if a sub-picture coded picture buffer parameters present flag has a value of zero; and
means for determining that the CPB operates at sub-picture level if both the sub-picture coded picture buffer preferred flag has a value of one and the sub-picture coded picture buffer parameters present flag has a value of one.
22. The apparatus of claim 21, further comprising means for receiving the value for the sub-picture coded picture buffer preferred flag.
23. The apparatus of claim 21, further comprising means for setting a value of zero for the sub-picture coded picture buffer preferred flag if a value for the sub-picture coded picture buffer preferred flag is not received.

24. The apparatus of claim 21, further comprising means for receiving the value for the sub-picture coded picture buffer parameters present flag.
25. The apparatus of claim 20, further comprising:
means for receiving the one or more decoding units of video data in a continuous decoding order,
wherein the means for storing the one or more decoding units of video data in the CPB comprises means for storing the one or more decoding units of video data in the continuous decoding order in the CPB.
26. The apparatus of claim 20, wherein the means for obtaining the respective buffer removal time for the one or more decoding units comprises means for receiving a respective signaled value indicative of the respective buffer removal time for at least one of the decoding units.
27. The apparatus of claim 26, wherein the signaled value indicative of the buffer removal time for the at least one of the decoding units comprises a signaled value indicative of a number of network abstraction layer (NAL) units comprised by the at least one of the decoding units.
28. The apparatus of claim 20, wherein the one or more decoding units comprise respective sub-pictures, the apparatus further comprising means for receiving a signaled value indicative of a byte alignment of at least one sub-picture within a larger set of the video data.
29. The apparatus of claim 20, wherein the apparatus comprises at least one of:
one or more integrated circuits;
one or more microprocessors; and
a wireless communication device that includes a video coding device.

30. A computer program product comprising a computer-readable storage medium comprising instructions stored thereon that, if executed, cause a processor to:

- store one or more decoding units of video data in a coded picture buffer (CPB);
- obtain a respective buffer removal time for the one or more decoding units;
- remove the decoding units from the CPB in accordance with the obtained buffer removal time for each of the decoding units;
- determine whether the CPB operates at access unit level or sub-picture level; and
- code video data corresponding to the removed decoding units,

wherein, if the CPB operates at access unit level, coding the video data comprises coding access units comprised in the decoding units; and

wherein, if the CPB operates at sub-picture level, coding the video data comprises coding subsets of access units comprised in the decoding units.

31. The computer program product of claim 30, wherein determining whether the CPB operates at access unit level or sub-picture level comprises:

- determining that the CPB operates at access unit level if a sub-picture coded picture buffer preferred flag has a value of zero or if a sub-picture coded picture buffer parameters present flag has a value of zero; and

- determining that the CPB operates at sub-picture level if both the sub-picture coded picture buffer preferred flag has a value of one and the sub-picture coded picture buffer parameters present flag has a value of one.

32. The computer program product of claim 31, wherein the instructions further cause the processor to receive the value for the sub-picture coded picture buffer preferred flag.

33. The computer program product of claim 31, wherein the instructions further cause the processor to set a value of zero for the sub-picture coded picture buffer preferred flag if a value for the sub-picture coded picture buffer preferred flag is not received.

34. The computer program product of claim 31, wherein the instructions further cause the processor to receive the value for the sub-picture coded picture buffer parameters present flag.

35. The computer program product of claim 30, wherein the instructions further cause the processor to:

receive the one or more decoding units of video data in a continuous decoding order,

wherein storing the one or more decoding units of video data in the CPB comprises storing the one or more decoding units of video data in the continuous decoding order in the CPB.

36. The computer program product of claim 30, wherein obtaining the respective buffer removal time for the one or more decoding units comprises receiving a respective signaled value indicative of the respective buffer removal time for at least one of the decoding units.

37. The computer program product of claim 36, wherein the signaled value indicative of the buffer removal time for the at least one of the decoding units comprises a signaled value indicative of a number of network abstraction layer (NAL) units comprised by the at least one of the decoding units.

38. The computer program product of claim 30, wherein the one or more decoding units comprise respective sub-pictures, the method further comprising receiving a signaled value indicative of a byte alignment of at least one sub-picture within a larger set of the video data.

CLAIMS

Claim 1: A method of coding video data, the method comprising:

determining a value of at least one flag based on a sub-picture coded picture buffer preferred flag and a sub-picture coded picture buffer parameters present flag, the value of the sub-picture coded picture buffer preferred flag being one of externally-specified or set to zero when not externally-specified and the sub-picture coded picture buffer parameters present flag being indicative of whether parameters needed for coding subsets of access units are present;

determining, based on the value of the at least one flag, whether a coded picture buffer (CPB) operates at an access unit level or at a sub-picture level; and

based on a determination that the CPB operates at the access unit level:

determining that decoding units stored in the CPB comprise access units,

removing, from the CPB, a decoding unit comprising a respective access unit, and

coding the removed decoding unit that comprises the

respective access unit; or

based on a determination that the CPB operates at the sub-picture level:

determining that decoding units stored in the CPB comprise subsets of access units,

removing, from the CPB, a decoding unit comprising a subset of a respective access unit, and

coding the removed decoding unit that comprises the subset of the respective access unit.

Claim 2: The method of claim 1, further comprising determining the value for the sub-picture coded picture buffer preferred flag.

Claim 3: The method of claim 1, further comprising setting the value of the sub-picture coded picture buffer preferred flag to zero (0) based on the value for the sub-picture coded picture buffer preferred flag not being externally-specified.

Claim 4: The method of claim 1, further comprising determining the value for the sub-picture coded picture buffer parameters present flag.

Claim 5: The method of claim 1,
setting the value of the at least one flag to one (1) based on the sub-picture coded picture buffer preferred flag and the sub-picture coded picture buffer parameters present flag being set to respective values of one (1),
wherein the value of one (1) for the at least one flag indicates that the CPB operates at the sub-picture level.

Claim 6: The method of claim 1,
setting the value of the at least one flag to zero (0) based on at least one of the sub-picture coded picture buffer preferred flag or the sub-picture coded picture buffer parameters present flag being set to a value of zero (0),
wherein the value of zero (0) for the at least one flag indicates that the CPB operates at the access unit level.

Claim 7: A device for coding video data, the device comprising:

a memory configured to store at least a portion of the video data; and
a video coder for processing the portion of the video data, the video coder being

configured to:

determine a value of at least one flag based on a sub-picture coded picture buffer preferred flag and a sub-picture coded picture buffer parameters present flag, the value of the sub-picture coded picture buffer preferred flag being one of externally-specified or set to zero when not externally-specified and the sub-picture coded picture buffer parameters present flag being indicative of whether parameters needed for coding subsets of access units are present;

determine, based on the value of the at least one flag, whether a coded picture buffer (CPB) operates at an access unit level or at a sub-picture level; and

based on a determination that the CPB operates at the access unit level:

determine that decoding units stored in the CPB comprise access units,
remove, from the CPB, a decoding unit comprising a respective access unit, and
code the removed decoding unit that comprises the respective access unit; or

based on a determination that the CPB operates at the sub-picture level:

determine that decoding units stored in the CPB comprise subsets of access units,
remove, from the CPB, a decoding unit comprising a subset of a respective access unit,

and

code the removed decoding unit that comprises the subset of the respective access unit.

Claim 8: The device of claim 7, wherein the video coder is further configured to determine the value for the sub-picture coded picture buffer preferred flag.

Claim 9: The device of claim 7, wherein the video coder is further configured to set the value of the sub-picture coded picture buffer preferred flag to zero (0) based on the value for the sub-picture coded picture buffer preferred flag not being externally-specified.

Claim 10: The device of claim 7, wherein the video coder is further configured to determine the value for the sub-picture coded picture buffer parameters present flag.

Claim 11: The device of claim 7, wherein the video coder is further configured to set the value of the at least one flag to one (1) based on the sub-picture coded picture buffer preferred flag and the sub-picture coded picture buffer parameters present flag being set to respective values of one (1), and wherein the value of one (1) for the at least one flag indicates that the CPB operates at the sub-picture level.

Claim 12: The device of claim 7, wherein the video coder is further configured to set the value of the at least one flag is set equal to zero (0) based on at least one of the sub-picture coded picture buffer preferred flag or the sub-picture coded picture buffer parameters present flag being set to a value of zero (0), and wherein the value of zero (0) for the at least one flag indicates that the CPB operates at the access unit level.

Claim 13: The device of claim 7, wherein the device comprises at least one of:

- one or more integrated circuits;
- one or more microprocessors;
- one or more digital signal processors (DSPs);
- one or more field programmable gate arrays (FPGAs);
- a desktop computer;
- a laptop computer;
- a tablet computer;
- a phone;
- a television;
- a camera;
- a display device;
- a digital media player;
- a video game console;
- a video game device;
- a video streaming device; or
- a wireless communication device.

Claim 14: An apparatus for coding video data, the apparatus comprising:

means for determining a value of at least one flag based on a sub-picture coded picture buffer preferred flag and a sub-picture coded picture buffer parameters present flag, the value of the sub-picture coded picture buffer preferred flag being one of externally-specified or set to zero when not externally-specified and the sub-picture coded picture buffer parameters present flag being indicative of whether parameters needed for coding subsets of access units are present;

means for determining, based on the value of the at least one flag, whether a coded picture buffer (CPB) operates at an access unit level or at a sub-picture level;

means for determining, based on a determination that the CPB operates at the access unit level, that decoding units stored in the CPB comprise access units;

means for removing from the CPB, based on the determination that the CPB operates at the access unit level, a decoding unit comprising a respective access unit;

means for coding, based on the determination that the CPB operates at the access unit level, removed decoding unit that comprises the respective access unit;

means for determining that decoding units stored in the CPB comprise subsets of access units;

means for removing from the CPB, based on a determination that the CPB operates at the sub-picture level, a decoding unit comprising a subset of a respective access unit; and

means for coding, based on the determination that the CPB operates at the sub-picture level, the removed decoding unit that comprises the subset of the respective access unit.

Claim 15: The apparatus of claim 14, further comprising means for determining the value for the sub-picture coded picture buffer preferred flag.

Claim 16: The apparatus of claim 14, further comprising means for setting the value of the sub-picture coded picture buffer preferred flag to zero (0) based on the value for the sub-picture coded picture buffer preferred flag not being externally-specified.

Claim 17: The apparatus of claim 14, further comprising means for determining the value for the sub-picture coded picture buffer parameters present flag.

Claim 18: The apparatus of claim 14,

further comprising means for setting the value of the at least one flag to one (1) based on the sub-picture coded picture buffer preferred flag and the sub-picture coded picture buffer parameters present flag being set to respective values of one (1),

wherein the value of one (1) for the at least one flag indicates that the CPB operates at the sub-picture level.

Claim 19: The apparatus of claim 14,

further comprising means for setting the value of the at least one flag is set equal to zero (0) based on at least one of the sub-picture coded picture buffer preferred flag or the sub-picture coded picture buffer parameters present flag being set to a value of zero (0),

wherein the value of zero (0) for the at least one flag indicates that the CPB operates at the access unit level.

Claim 20: The apparatus of claim 14, wherein the apparatus comprises at least one of:

- one or more integrated circuits;
- one or more microprocessors;
- one or more digital signal processors (DSPs);
- one or more field programmable gate arrays (FPGAs);
- a desktop computer;
- a laptop computer;
- a tablet computer;
- a phone;
- a television;
- a camera;
- a display device;
- a digital media player;
- a video game console;
- a video game device;
- a video streaming device; or
- a wireless communication device.

Claim 21: A computer program product comprising a non-transitory computer-readable storage medium comprising instructions stored thereon that, if executed, cause one or more processors of a video coding device to:

determine a value of at least one flag based on a sub-picture coded picture buffer preferred flag and a sub-picture coded picture buffer parameters present flag, the value of the sub-picture coded picture buffer preferred flag being one of externally-specified or set to zero when not externally-specified and the sub-picture coded picture buffer parameters present flag being indicative of whether parameters needed for coding subsets of access units are present;

determine, based on the value of the at least one flag, whether a coded picture buffer (CPB) operates at an access unit level or at a sub-picture level; and

based on a determination that the CPB operates at the access unit level:

determine that decoding units stored in the CPB comprise access units,

remove, from the CPB, a decoding unit comprising a respective access unit, and

code the removed decoding unit that comprises the respective access unit; or

based on a determination that the CPB operates at the sub-picture level:

determine that decoding units stored in the CPB comprise subsets of access units,

remove, from the CPB, a decoding unit comprising a subset of a respective access

unit, and

code the decoding unit that comprises the subset of the respective access unit.

Claim 22: The computer program product of claim 21, wherein the instructions further cause the one or more processors to determine the value for the sub-picture coded picture buffer preferred flag.

Claim 23: The computer program product of claim 21, wherein the instructions further cause the one or more processors to set the value of the sub-picture coded picture buffer preferred flag to zero (0) based on the value for the sub-picture coded picture buffer preferred flag not being received externally-specified.

Claim 24: The computer program product of claim 21, wherein the instructions further cause the one or more processors to determine the value for the sub-picture coded picture buffer parameters present flag.

Claim 25: The computer program product of claim 21,
wherein the instructions further cause the one or more processors to set the value of the at least one flag to one (1) based on the sub-picture coded picture buffer preferred flag and the sub-picture coded picture buffer parameters present flag being set to respective values of one (1), and
wherein the value of one (1) for the at least one flag indicates that the CPB operates at the sub-picture level.

Claim 26: The computer program product of claim 21,
wherein the instructions further cause the one or more processors to set the value of the at least one flag to zero (0) based on at least one of the sub-picture coded picture buffer preferred flag or the sub-picture coded picture buffer parameters present flag being set to a value of zero (0), and
wherein the value of zero (0) for the at least one flag indicates that the CPB operates at the access unit level.

Claim 27: The device of claim 7, further comprising a camera configured to capture at least a portion of the video data.

Claim 28: The device of claim 7, further comprising a display configured to output at least a portion of the video data.

Claim 29: The apparatus of claim 14, further comprising means for capturing at least a portion of the video data.

Claim 30: The apparatus of claim 14, further comprising means for outputting at least a portion of the video data for display.