Amended Set of Claims 1 to 46

1. A method for decoding video data, the method comprising:

decoding a duration between coded picture buffer (CPB) removal time of a first decoding unit (DU) in an access unit (AU) and CPB removal time of a second DU, wherein the first DU comprises a non-video coding layer (VCL) network abstraction layer (NAL) unit with nal_unit_type equal to UNSPEC0, EOS_NUT, EOB_NUT, in the range of RSV_NVCL44 to RSV_NVCL47 or in the range of UNSPEC48 to UNSPEC63;

determining a removal time of the first DU based at least in part on the decoded duration; and

decoding video data of the first DU based at least in part on the removal time.

2. The method of claim 1, wherein the second DU is subsequent to the first DU in decoding order and in the same AU as the first DU.

3. The method of claim 2, wherein the second DU is immediately subsequent to the first DU in the AU in decoding order.

4. The method of claim 2, wherein the second DU is a last DU in the AU in decoding order.

5. The method of claim 1, further comprising:

decoding one or more sub-picture level CPB parameters, wherein determining the removal time of the first DU comprises determining the removal time of the first DU based at least in part on the decoded duration and the sub-picture level CPB parameters.

6. The method of claim 5, wherein decoding one or more sub-picture level CPB parameters comprises:

decoding a sub-picture timing supplemental enhancement information (SEI) message that is associated with the first DU.

7. The method of claim 6, wherein the second DU is a last DU in the AU in decoding order, and wherein decoding the sub-picture SEI message comprises:

decoding the duration between a removal time of the last DU and the removal time of the first DU in the sub-picture timing SEI message.

8. The method of claim 5, further comprising:

decoding a sequence level flag to determine presence of the sub-picture level CPB parameters either in picture timing SEI messages or in sub-picture timing SEI messages.

9. The method of claim 1, wherein the AU has a TemporalId equal to 0, the method further comprising:

decoding at least one of a buffering period supplemental enhancement information (SEI) message or a recovery point SEI message associated with the AU.

10. The method of claim 1, further comprising:

deriving at least one of a CPB arrival time and a CPB nominal removal time for the AU at both an access unit level and a sub-picture level regardless of a value of a syntax element that defines whether the first DU is the AU.

11. A video decoding device comprising a video decoder configured to:

decode a duration between coded picture buffer (CPB) removal time of a first decoding unit (DU) in an access unit (AU) and CPB removal time of a second DU, wherein the first DU comprises a non-video coding layer (VCL) network abstraction layer (NAL) unit with nal_unit_type equal to UNSPEC0, EOS_NUT, EOB_NUT, in the range of RSV_NVCL44 to RSV_NVCL47 or in the range of UNSPEC48 to UNSPEC63;

determine a removal time of the first DU based at least in part on the decoded duration; and

decode video data of the first DU based at least in part on the removal time.

12. The video decoding device of claim 11, wherein the second DU is subsequent to the first DU in decoding order and in the same AU as the first DU.

13. The video decoding device of claim 12, wherein the second DU is immediately subsequent to the first DU in the AU in decoding order.

14. The video decoding device of claim 12, wherein the second DU is a last DU in the AU in decoding order.

15. The video decoding device of claim 11, wherein the video decoder is further configured to decode one or more sub-picture level CPB parameters, wherein determine the removal time of the first DU comprises determine the removal time of the first DU based at least in part on the decoded duration and the sub-picture level CPB parameters.

16. The video decoding device of claim 15, wherein the video decoder is further configured to decode one or more sub-picture level CPB parameters by decoding a sub-picture timing supplemental enhancement information (SEI) message that is associated with the first DU.

17. The video decoding device of claim 16, wherein the second DU is a last DU in the AU in decoding order, and wherein decode the sub-picture SEI message comprises decode the duration between a removal time of the last DU and the removal time of the first DU in the sub-picture timing SEI message.

18. The video decoding device of claim 15, wherein the video decoder is further configured to decode a sequence level flag to determine presence of the sub-picture level CPB parameters either in picture timing SEI messages or in sub-picture timing SEI messages.

19. The video decoding device of claim 11, wherein the AU has a TemporalId equal to 0, wherein the video decoder is further configured to decode at least one of a buffering period supplemental enhancement information (SEI) message or a recovery point SEI message associated with the AU.

20. The video decoding device of claim 11, wherein the video decoder is further configured to derive at least one of a CPB arrival time and a CPB nominal removal time for the AU at both an access unit level and a sub-picture level regardless of a value of a syntax element that defines whether the first DU is the AU.

21. A computer-readable storage medium having stored thereon instructions that, when executed, cause a processor of a device for decoding video data to:

decode a duration between coded picture buffer (CPB) removal time of a first decoding unit (DU) in an access unit (AU) and CPB removal time of a second DU, wherein the first DU comprises a non-video coding layer (VCL) network abstraction layer (NAL) unit with nal_unit_type equal to UNSPEC0, EOS_NUT, EOB_NUT, in the range of RSV_NVCL44 to RSV_NVCL47 or in the range of UNSPEC48 to UNSPEC63;

determine a removal time of the first DU based at least in part on the decoded duration; and

decode video data of the first DU based at least in part on the removal time.

22. The computer-readable storage medium of claim 21, wherein the second DU is in the same AU as the first DU and wherein the second DU is one of immediately subsequent to the first DU in decoding order or a last DU in the AU in decoding order.

23. A video decoding device comprising:

means for decoding a duration between coded picture buffer (CPB) removal time of a first decoding unit (DU) in an access unit (AU) and CPB removal time of a second DU, wherein the first DU comprises a non-video coding layer (VCL) network abstraction layer (NAL) unit with nal_unit_type equal to UNSPEC0, EOS_NUT, EOB_NUT, in the range of RSV_NVCL44 to RSV_NVCL47 or in the range of UNSPEC48 to UNSPEC63;

means for determining a removal time of the first DU based at least in part on the decoded duration; and

means for decoding video data of the first DU based at least in part on the removal time.

24. The video decoding device of claim 23, wherein the second DU is in the same AU as the first DU and wherein the second DU is one of immediately subsequent to the first DU in decoding order or a last DU in the AU in decoding order.

25. A method for encoding video data, the method comprising:

determining, for an AU including a first DU, a CPB removal time of a second DU, wherein the second DU is subsequent to the first DU in decoding order and in the same AU as the first DU, and wherein the first DU comprises a non-video coding layer (VCL) network abstraction layer (NAL) unit with nal_unit_type equal to UNSPEC0, EOS_NUT, EOB_NUT, in the range of RSV_NVCL44 to RSV_NVCL47 or in the range of UNSPEC48 to UNSPEC63;

determining a duration between CPB removal time of the first DU and the determined CPB removal time of the second DU; and

encoding the determined duration.

26. (Cancelled)

27. The method of claim 25, wherein the second DU is immediately subsequent to the first DU in the AU in decoding order.

28. The method of claim 25, wherein the second DU is a last DU in the AU in decoding order.

29. The method of claim 25, wherein encoding video data of the first DU based at least in part on the determined duration further comprises encoding the determined duration in one or more sub-picture level CPB parameters.

30. The method of claim 29, wherein encoding one or more sub-picture level CPB parameters comprises:

encoding a sub-picture timing supplemental enhancement information (SEI) message that is associated with the first DU.

31. The method of claim 30, wherein the second DU is a last DU in the AU in decoding order, and wherein encoding the sub-picture SEI message comprises:

encoding the duration between a removal time of the last DU and the removal time of the first DU in the sub-picture timing SEI message.

32. The method of claim 29, further comprising:

encoding a sequence level flag to indicate presence of the sub-picture level CPB parameters either in picture timing SEI messages or in sub-picture timing SEI messages.

33. The method of claim of claim 25, wherein the AU has a TemporalId equal to 0, the method further comprising:

encoding at least one of a buffering period supplemental enhancement information (SEI) message or a recovery point SEI message associated with the AU.

34. The method of claim 25, further comprising:

deriving at least one of a CPB arrival time and a CPB nominal removal time for the AU at both an access unit level and a sub-picture level regardless of a value of a syntax element that defines whether the first DU is the AU.

35. A video encoding device comprising a video encoder configured to:

determine, for an AU including a first DU, a CPB removal time of a second DU, wherein the second DU is subsequent to the first DU in decoding order and in the same AU as the first DU, and wherein the first DU comprises a non-video coding layer (VCL) network abstraction layer (NAL) unit with nal_unit_type equal to UNSPEC0, EOS_NUT, EOB_NUT, in the range of RSV_NVCL44 to RSV_NVCL47 or in the range of UNSPEC48 to UNSPEC63;

determine a duration between CPB removal time of the first DU and the determined CPB removal time of the second DU; and

encode video data of the first DU based at least in part on the determined duration.

36. (Cancelled)

37. The video encoding device of claim 35, wherein the second DU is immediately subsequent to the first DU in the AU in decoding order.

38. The video encoding device of claim 35, wherein the second DU is a last DU in the AU in decoding order.

39. The video encoding device of claim 35, wherein encode video data of the first DU based at least in part on the determined duration further comprises encode the determined duration in one or more sub-picture level CPB parameters.

40. The video encoding device of claim 39, wherein the video encoder is further configured to encode one or more sub-picture level CPB parameters by encoding a sub-picture timing supplemental enhancement information (SEI) message that is associated with the first DU.

41. The video encoding device of claim 40, wherein the second DU is a last DU in the AU in decoding order, and wherein encode the sub-picture SEI message comprises encode the duration between a removal time of the last DU and the removal time of the first DU in the sub-picture timing SEI message.

42. The video encoding device of claim 39, the video encoder is further configured to encode a sequence level flag to indicate presence of the sub-picture level CPB parameters either in picture timing SEI messages or in sub-picture timing SEI messages.

43. The video encoding device of claim 35, wherein the AU has a TemporalId equal to 0, the video encoder further configured to encode at least one of a buffering period supplemental enhancement information (SEI) message or a recovery point SEI message associated with the AU.

44. The video encoding device of claim 35, the video encoder is further configured to derive at least one of a CPB arrival time and a CPB nominal removal time for the AU at both an access unit level and a sub-picture level regardless of a value of a syntax element that defines whether the first DU is the AU.

45. A computer-readable storage medium having stored thereon instructions that, when executed, cause a processor of a device for encoding video data to:

determine, for an AU including a first DU, a CPB removal time of a second DU, wherein the second DU is subsequent to the first DU in decoding order and in the same AU as the first DU, and wherein the first DU comprises a non-video coding layer (VCL) network abstraction layer (NAL) unit with nal_unit_type equal to UNSPEC0, EOS_NUT, EOB_NUT, in the range of RSV_NVCL44 to RSV_NVCL47 or in the range of UNSPEC48 to UNSPEC63;

determine a duration between CPB removal time of the first DU and the determined CPB removal time of the second DU; and

encode video data of the first DU based at least in part on the determined duration.

46. The computer-readable storage medium of claim 45, wherein the second DU is in the same AU as the first DU and wherein the second DU is one of immediately subsequent to the first DU in decoding order or a last DU in the AU in decoding order.

CLAIMS

1. A method for decoding video data, the method comprising:

receiving, by a video decoder, a bitstream that comprises a series of Network Abstraction Layer (NAL) units, the series of NAL units including a non-Video Coding Layer (VCL) NAL unit;

based on the non-VCL NAL unit having a nal_unit_type equal to EOS_NUT, EOB_NUT, in the range of RSV-NVCL45 to RSV_NVCL47 or in the range of UNSPEC56 to UNSPEC63, associating, by the video decoder, the non-VCL NAL unit with a most recent VCL NAL unit preceding the non-VCL NAL unit in decoding order,

wherein a decoding unit (DU) consists of one or more VCL NAL units and non-VCL NAL units associated with the one or more VCL NAL units, the one or more VCL NAL units and the non-VCL NAL units associated with the one or more VCL NAL units being in the series of NAL units; and

at a determined Coded Picture Buffer (CPB) removal time of the DU, removing, by the video decoder, video data associated with the DU from the CPB and decoding the video data associated with the DU.

2. The method of claim 1, wherein all non-VCL NAL units associated with a VCL NAL unit are included in the same DU as the VCL NAL unit.

3. The method of claim 1, wherein a Hypothetical Reference Decoder (HRD) includes the CPB, and the HRD is assumed to decode the video data associated with the DU instantaneously.

4. A video decoding device comprising:

a coded picture buffer (CPB); and

a video decoder configured to:

receive a bitstream that comprises a series of Network Abstraction Layer (NAL) units, the series of NAL units including a non-Video Coding Layer (VCL) NAL unit;

based on the non-VCL NAL unit having a nal_unit_type equal to EOS_NUT, EOB_NUT, in the range of RSV_NVCL45 to RSV_NVCL47 or in the range of

UNSPEC56 to UNSPEC63, associate the non-VCL NAL unit with a most recent VCL NAL unit preceding the non-VCL NAL unit in decoding order,

wherein a decoding unit (DU) consists of one or more VCL NAL units and non-VCL NAL units associated with the one or more VCL NAL units, the one or more VCL NAL units and the non-VCL NAL units associated with the one or more VCL NAL units being in the series of NAL units; and

at a determined CPB removal time of the DU, remove video data associated with the DU from the CPB and decode the video data associated with the DU.

5. The video decoding device of claim 4, wherein all non-VCL NAL units associated with a VCL NAL unit are included in the same DU as the VCL NAL unit.

6. The video decoding device of claim 4, wherein a Hypothetical Reference Decoder (HRD) includes the CPB, and the HRD is assumed to decode the video data associated with the DU instantaneously.

7. A non-transitory computer-readable storage medium having stored thereon instructions that, when executed, cause a processor of a device for decoding video data to:

receive a bitstream that comprises a series of Network Abstraction Layer (NAL) units, the series of NAL units including a non-Video Coding Layer (VCL) NAL unit;

based on the non-VCL NAL unit having a nal_unit_type equal to EOS_NUT, EOB_NUT, in the range of RSV_NVCL45 to RSV_NVCL47 or in the range of UNSPEC56 to UNSPEC63, associate the non-VCL NAL unit with a most recent VCL NAL unit preceding the non-VCL NAL unit in decoding order,

wherein a decoding unit (DU) consists of one or more VCL NAL units and non-VCL NAL units associated with the one or more VCL NAL units, the one or more VCL NAL units and the non-VCL NAL units associated with the one or more VCL NAL units being in the series of NAL units; and

at the determined Coded Picture Buffer (CPB) removal time of the DU, remove video data associated with the DU from the CPB and decode the video data associated with the DU.

8. The non-transitory computer-readable storage medium of claim 7, wherein all non-VCL NAL units associated with a VCL NAL unit are included in the same DU as the VCL NAL unit.

9. The non-transitory computer-readable storage medium of claim 7, wherein a Hypothetical Reference Decoder (HRD) includes the CPB, and the HRD is assumed to decode the video data associated with the DU instantaneously.

10. A video decoding device comprising:

means for receiving a bitstream that comprises a series of Network Abstraction Layer (NAL) units, the series of NAL units including a non-Video Coding Layer (VCL) NAL unit;

means for associating, based on the non-VCL NAL unit having a nal_unit_type equal to EOS_NUT, EOB_NUT, in the range of RSV_NVCL45 to RSV_NVCL47 or in the range of UNSPEC56 to UNSPEC63, the non-VCL NAL unit with a most recent VCL NAL unit preceding the non-VCL NAL unit in decoding order,

wherein a decoding unit (DU) consists of one or more VCL NAL units and non-VCL NAL units associated with the one or more VCL NAL units, the one or more VCL NAL units and the non-VCL NAL units associated with the one or more VCL NAL units being in the series of NAL units; and

means for removing, at a determined Coded Picture Buffer (CPB) removal time of the DU, video data associated with the DU from the CPB and decoding, at the determined CPB removal time of the DU, the video data associated with the DU.

11. The video decoding device of claim 10, wherein all non-VCL NAL units associated with a VCL NAL unit are included in the same DU as the VCL NAL unit.

12. The video decoding device of claim 10, wherein a Hypothetical Reference Decoder (HRD) includes the CPB, and the HRD is assumed to decode the video data associated with the DU instantaneously.