Amended Set of Claims 1 to 44

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

receiving a bitstream comprising one or more pictures of a coded video sequence (CVS);

decoding a first picture of the one or more pictures according to a decoding order associated with the CVS, wherein the first picture is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; ~~and~~

decoding at least one of the one or more pictures, other than the first picture, following the first picture according to the decoding order, based on the decoded first picture;

identify at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

decoding the at least one of the one or more pictures, wherein decoding each of the at least one of the one or more pictures includes:

identifying one or more reference pictures used to encode the respective picture;

determining whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generating a virtual reference picture; and

decoding the respective picture based on the corresponding one or more generated virtual reference pictures.

2. Cancelled.

3. The method of claim 2, wherein generating the virtual reference picture comprises generating a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the CVS.

4. The method of claim 1, further comprising:

identifying at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

avoiding outputting one or more of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

5. The method of claim 1, further comprising:

identifying at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

avoiding using one or more of the at least one of the one or more pictures as a reference picture for decoding at least one of the one or more pictures, other than the first picture, that follows the first picture according to the decoding order and according to a display order associated with the CVS.

6. The method of claim 1, wherein the first picture comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is coded using intra-prediction coding and is decodedable without reference to any other pictures, and for which one or more pictures included within a CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

7. The method of claim 1, wherein the IDR picture comprises a picture that is coded using intra-prediction coding and is decodedable without reference to any other pictures, and for which all other pictures included within a CVS along with the IDR picture that follow the IDR picture according to a decoding order associated with the CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

8. The method of claim 1, further comprising:

decoding a first set of coded picture buffer (CPB) initial delay parameters, and when the one or more pictures do not include at least one leading picture associated with the first picture, decoding one of a second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS.

9. The method of claim 8, wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture.

10. The method of claim 8, wherein a CPB removal time of each picture following the first picture in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.

11. A method of encoding video data, the method comprising:

generating a bitstream comprising one or more pictures of a coded video sequence (CVS), wherein a first picture of the one or more pictures according to a decoding order associated with the CVS is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture,

wherein generating the bitstream comprises avoiding including at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS, ~~and~~

wherein the first picture is decodable, and wherein at least one of the one or more pictures, other than the first picture, following the first picture according to the decoding order, is decodable based on the first picture; and

wherein encoding further includes a decoding process that comprises:

identify at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

decoding the at least one of the one or more pictures, wherein decoding each of the at least one of the one or more pictures includes:

identifying one or more reference pictures used to encode the respective picture;

determining whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generating a virtual reference picture; and

decoding the respective picture based on the corresponding one or more generated virtual reference pictures.

12. An apparatus configured to decode video data, the apparatus comprising a video decoder configured to:

receive a bitstream comprising one or more pictures of a coded video sequence (CVS);

decode a first picture of the one or more pictures according to a decoding order associated with the CVS, wherein the first picture is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; ~~and~~

decode at least one of the one or more pictures, other than the first picture, following the first picture according to the decoding order, based on the decoded first picture;

identify at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

decode the at least one of the one or more pictures, wherein to decode each of the at least one of the one or more pictures, the video decoder is configured to:

identify one or more reference pictures used to encode the respective picture;

determine whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generate a virtual reference picture; and

decode the respective picture based on the corresponding one or more generated virtual reference pictures.

13. Cancelled.

14. The apparatus of claim 13, wherein to generate the virtual reference picture, the video decoder is configured to generate a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the CVS.

15. The apparatus of claim 12, wherein the video decoder is further configured to:

identify at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

avoid outputting one or more of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

16. The apparatus of claim 12, wherein the video decoder is further configured to:

identify at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

avoid using one or more of the at least one of the one or more pictures as a reference picture for decoding at least one of the one or more pictures, other than the first picture, that follows the first picture according to the decoding order and according to a display order associated with the CVS.

Received at the EPO on Aug 30, 2013 23:39:36. Page 36 of 45

17. The apparatus of claim 12, wherein the first picture comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is coded using intra-prediction coding and is decodable without reference to any other pictures, and for which one or more pictures included within a CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

18. The apparatus of claim 12, wherein the IDR picture comprises a picture that is coded using intra-prediction coding and is decodable without reference to any other pictures, and for which all other pictures included within a CVS along with the IDR picture that follow the IDR picture according to a decoding order associated with the CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

19. The apparatus of claim 12, wherein the video decoder is further configured to:

decode a first set of coded picture buffer (CPB) initial delay parameters, and, when the one or more pictures do not include at least one leading picture associated with the first picture, decode one of a second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS.

20. The apparatus of claim 19, wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture.

21. The apparatus of claim 19, wherein a CPB removal time of each picture following the first picture in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.

22. The apparatus of claim 12, wherein the apparatus comprises at least one of:

an integrated circuit;

a microprocessor; and

a wireless communication device that includes the video decoder.

23. An apparatus configured to encode video data, the apparatus comprising a video encoder configured to:

generate a bitstream comprising one or more pictures of a coded video sequence (CVS), wherein a first picture of the one or more pictures according to a decoding order associated with the CVS is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture,

wherein to generate the bitstream, the video encoder is configured to avoid including at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS, ~~and~~

wherein the first picture is decodable, and wherein at least one of the one or more pictures, other than the first picture, following the first picture according to the decoding order, is decodable based on the first picture; and

wherein encoding further includes a decoding process that comprises:

identify at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

decoding the at least one of the one or more pictures, wherein decoding each of the at least one of the one or more pictures includes:

identifying one or more reference pictures used to encode the respective picture;

determining whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generating a virtual reference picture; and

decoding the respective picture based on the corresponding one or more generated virtual reference pictures.

24. The apparatus of claim 23, wherein the apparatus comprises at least one of:

an integrated circuit;

a microprocessor; and

a wireless communication device that includes the video encoder.

25. A device for decoding video data, the device comprising:

means for receiving a bitstream comprising one or more pictures of a coded video sequence (CVS);

means for decoding a first picture of the one or more pictures according to a decoding order associated with the CVS, wherein the first picture is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; and

means for decoding at least one of the one or more pictures, other than the first picture, following the first picture according to the decoding order, based on the decoded first picture;

means for identifying at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

means for decoding the at least one of the one or more pictures, wherein the means for decoding each of the at least one of the one or more pictures includes:

means for identifying one or more reference pictures used to encode the respective picture;

means for determining whether any of the identified one or more reference pictures is unavailable to be decoded;

means for, for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generating a virtual reference picture; and

means for decoding the respective picture based on the corresponding one or more generated virtual reference pictures.

26. Cancelled.

27. The device of claim 26, wherein the means for generating the virtual reference picture comprises means for generating a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the CVS.

28. The device of claim 25, further comprising:

means for identifying at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

means for avoiding outputting one or more of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

29. The device of claim 25, further comprising:

means for identifying at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

means for avoiding using one or more of the at least one of the one or more pictures as a reference picture for decoding at least one of the one or more pictures, other than the first picture, that follows the first picture according to the decoding order and according to a display order associated with the CVS.

30. The device of claim 25, wherein the first picture comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is coded using intra-prediction coding and is decodable without reference to any other pictures, and for which one or more pictures included within a CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

31. The device of claim 25, wherein the IDR picture comprises a picture that is coded using intra-prediction coding and is decodable without reference to any other pictures, and for which all other pictures included within a CVS along with the IDR picture that follow the IDR picture according to a decoding order associated with the CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

32. The device of claim 25, further comprising:

means for decoding a first set of coded picture buffer (CPB) initial delay parameters, and, when the one or more pictures do not include at least one leading picture associated with the first picture, decoding one of a second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS.

33. The device of claim 32, wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture.

34. The device of claim 32, wherein a CPB removal time of each picture following the first picture in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.

35. A computer-readable storage medium storing instructions that, when executed, cause one or more processors to decode video data, wherein the instructions cause the one or more processors to:

receive a bitstream comprising one or more pictures of a coded video sequence (CVS);

decode a first picture of the one or more pictures according to a decoding order associated with the CVS, wherein the first picture is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; and

decode at least one of the one or more pictures, other than the first picture, following the first picture according to the decoding order, based on the decoded first picture;

identify at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

decode the at least one of the one or more pictures, wherein the instructions that cause the one or more processors to decode each of the at least one of the one or more pictures include instructions that cause the one or more processors to:

identify one or more reference pictures used to encode the respective picture;

determine whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generate a virtual reference picture; and

decode the respective picture based on the corresponding one or more generated virtual reference pictures.

36. Cancelled.

37. The computer-readable storage medium of claim 36, wherein the instructions that cause the one or more processors to generate the virtual reference picture comprise instructions that cause the one or more processors to generate a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the CVS.

38. The computer-readable storage medium of claim 35, further comprising instructions that cause the one or more processors to:

determine at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

avoid outputting one or more of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

39. The computer-readable storage medium of claim 35, further comprising instructions that cause the one or more processors to:

determine at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

avoid using one or more of the at least one of the one or more pictures as a reference picture for decoding at least one of the one or more pictures, other than the first picture, that follows the first picture according to the decoding order and according to a display order associated with the CVS.

40. The computer-readable storage medium of claim 35, wherein the first picture comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is coded using intra-prediction coding and is decodable without reference to any other pictures, and for which one or more pictures included within a CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

41. The computer-readable storage medium of claim 35, wherein the IDR picture comprises a picture that is coded using intra-prediction coding and is decodable without reference to any other pictures, and for which all other pictures included within a CVS along with the IDR picture that follow the IDR picture according to a decoding order associated with the CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

42. The computer-readable storage medium of claim 35, further comprising instructions that cause the one or more processors to:

decode a first set of coded picture buffer (CPB) initial delay parameters, and, when the one or more pictures do not include at least one leading picture associated with the first picture, decode one of a second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS.

43. The computer-readable storage medium of claim 42, wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture.

44. The computer-readable storage medium of claim 42, wherein a CPB removal time of each picture following the first picture in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.

CLAIMS

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

receiving a bitstream comprising one or more coded video sequences (CVSs), each CVS comprising one or more pictures, wherein a first picture in decoding order in a first CVS of the one or more CVSs is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; and

decoding the bitstream at least in part by parsing two sets of coded picture buffer (CPB) initial delay parameters and by selecting one of the two sets of CPB initial delay parameters for a derivation of CPB timing parameters.

Claim 2: The method of claim 1, further comprising:

identifying at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture of the first CVS, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the first CVS; and

decoding the at least one of the one or more pictures, wherein decoding each of the at least one of the one or more pictures includes:

identifying one or more reference pictures used to encode the at least one of the one or more pictures;

determining whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generating a virtual reference picture; and

decoding the at least one of the one or more pictures based on the corresponding one or more generated virtual reference pictures.

Claim 3: The method of claim 2, wherein generating the virtual reference picture comprises generating a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the first CVS.

Claim 4: The method of claim 1, further comprising:

identifying at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture of the first CVS, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture of the first CVS according to a display order associated with the first CVS; and

avoiding outputting any of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

Claim 5: The method of claim 1, further comprising:

identifying at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture of the first CVS according to a display order associated with the first CVS; and

avoiding using one or more of the at least one of the one or more pictures as a reference picture for decoding at least one of the one or more pictures, other than the first picture of the first CVS, that follows the first picture of the first CVS according to the decoding order and according to a display order associated with the first CVS.

Claim 6: The method of claim 1, wherein the first picture of the first CVS comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is encoded using intra-prediction coding and is decodable without reference to any other pictures, and for which one or more pictures included within the first CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the first CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

Claim 7: The method of claim 1, wherein the IDR picture comprises a picture that is encoded using intra-prediction coding and is decodable without reference to any other pictures, and for which all other pictures included within a respective CVS of the one or more CVSs along with the IDR picture that follow the IDR picture according to a decoding order associated with the respective CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

Claim 8: The method of claim 1, wherein the two sets of CPB initial delay parameters includes a first set of CPB initial delay parameters and a second set of CPB initial delay parameters, and wherein selecting the one of the two sets of the CPB initial delay parameters comprises:

decoding the first set of CPB initial delay parameters, and, when the one or more pictures do not include at least one leading picture associated with the first picture, decoding the second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture according to a display order associated with the first CVS.

Claim 9: The method of claim 8, wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture of the first CVS.

Claim 10: The method of claim 8, wherein a CPB removal time of each picture following the first picture of the first CVS in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.

Claim 11: A method of encoding video data, the method comprising:

generating a bitstream comprising one or more coded video sequences (CVSs), each CVS comprising one or more pictures, wherein a first picture in a decoding order of the one or more pictures associated with a first CVS of the one or more CVSs is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture, and

wherein the bitstream comprises two sets of coded picture buffer (CPB) initial delay parameters from which CPB timing parameters are derivable.

Claim 12: An apparatus configured to decode video data, the apparatus comprising a video decoder configured to:

receive a bitstream comprising one or more coded video sequences (CVSs), each CVS comprising one or more pictures, wherein a first picture in decoding order in a first CVS of the one or more CVSs is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; and

decode the bitstream at least in part by parsing two sets of coded picture buffer (CPB) initial delay parameters and by selecting one of the two sets of CPB initial delay parameters for a derivation of CPB timing parameters.

Claim 13: The apparatus of claim 12, wherein the video decoder is further configured to:

identify at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture according to a display order associated with the first CVS; and

decode the at least one of the one or more pictures, wherein to decode each of the at least one of the one or more pictures, the video decoder is configured to:

identify one or more reference pictures used to encode the at least one of the one or more pictures;

determine whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generate a virtual reference picture; and

decode the at least one of the one or more pictures based on the corresponding one or more generated virtual reference pictures.

Claim 14: The apparatus of claim 13, wherein to generate the virtual reference picture, the video decoder is configured to generate a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the first CVS.

Claim 15: The apparatus of claim 12, wherein the video decoder is further configured to:

identify at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture of the first CVS according to a display order associated with the CVS; and

avoid outputting any of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

Claim 16: The apparatus of claim 12, wherein the video decoder is further configured to:

identify at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture of the first CVS, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture of the first CVS according to a display order associated with the first CVS; and

avoid using any of the at least one of the one or more pictures as a

reference picture for decoding at least one of the one or more pictures, other than the first picture, that follows the first picture according to the decoding order and according to a display order associated with the CVS.

Claim 17: The apparatus of claim 12, wherein the first picture of the first CVS comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is encoded using intra-prediction coding and is decodable without reference to any other pictures, and for which one or more pictures included within the first CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the first CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

Claim 18: The apparatus of claim 12, wherein the IDR picture comprises a picture that is encoded using intra-prediction coding and is decodable without reference to any other pictures, and for which all other pictures included within a respective CVS of the one or more CVSs along with the IDR picture that follow the IDR picture according to a decoding order associated with the respective CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

Claim 19: The apparatus of claim 12, wherein the two sets of CPB initial delay parameters includes a first set of CPB initial delay parameters and a second set of CPB initial delay parameters, and wherein, to select the one of the two sets of the CPB initial delay parameters, the video decoder is configured to:

decode the first set of CPB initial delay parameters, and, when the one or more pictures do not include at least one leading picture associated with the first picture, decode the second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture according to a display order associated with the first CVS.

Claim 20: The apparatus of claim 19, wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture of the first CVS.

Claim 21: The apparatus of claim 19, wherein a CPB removal time of each picture following the first picture of the first CVS in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.

Claim 22: The apparatus of claim 12, wherein the apparatus comprises at least one of:

an integrated circuit;

a microprocessor; or

a wireless communication device that includes the video decoder.

Claim 23: An apparatus configured to encode video data, the apparatus comprising a video encoder configured to:

generate a bitstream comprising one or more coded video sequences (CVSs), each CVS comprising one or more pictures, wherein a first picture in a decoding order of the one or more pictures associated with a first CVS of the one or more CVSs is a

random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture, and

wherein the bitstream comprises two sets of coded picture buffer (CPB) initial delay parameters from which CPB timing parameters are derivable.

Claim 24: The apparatus of claim 23, wherein the apparatus comprises at least one of:

an integrated circuit;

a microprocessor; or

a wireless communication device that includes the video encoder.

Claim 25: A device for decoding video data, the device comprising:

means for receiving a bitstream comprising one or more coded video sequences (CVSs), each CVS comprising one or more pictures,

wherein a first picture in decoding order in a first CVS of the one or more CVSs is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; and

means for decoding the bitstream at least in part by parsing two sets of coded picture buffer (CPB) initial delay parameters and by selecting one of the two sets of CPB initial delay parameters for a derivation of CPB timing parameters.

Claim 26: The device of claim 25, further comprising:

means for identifying at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture of the first CVS, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

means for decoding the at least one of the one or more pictures, wherein the means for decoding each of the at least one of the one or more pictures includes:

means for identifying one or more reference pictures used to encode the at least one of the one or more pictures;

means for determining whether any of the identified one or more reference pictures is unavailable to be decoded;

means for, for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generating a virtual reference picture; and

means for decoding the at least one of the one or more pictures based on the corresponding one or more generated virtual reference pictures.

Claim 27: The device of claim 26, wherein the means for generating the virtual reference picture comprises means for generating a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the first CVS.

Claim 28: The device of claim 25, further comprising:

means for identifying at least one of the one or more pictures, other than the first picture, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

means for avoiding outputting one or more of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

Claim 29: The device of claim 25, further comprising:

means for identifying at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture of the first CVS, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture of the first CVS according to a display order associated with the first CVS; and

means for avoiding using any of the at least one of the one or more pictures as a reference picture for decoding at least one of the one or more pictures, other than the first picture, that follows the first picture according to the decoding order and according to a display order associated with the CVS.

Claim 30: The device of claim 25, wherein the first picture of the first CVS comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is encoded using intra-prediction coding and is decodable without

reference to any other pictures, and for which one or more pictures included within the first CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the first CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

Claim 31: The device of claim 25, wherein the IDR picture comprises a picture that is encoded using intra-prediction coding and is decodable without reference to any other pictures, and for which all other pictures included within a respective CVS of the one or more CVSs along with the IDR picture that follow the IDR picture according to a decoding order associated with the respective CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

Claim 32: The device of claim 25, wherein the two sets of CPB initial delay parameters includes a first set of CPB initial delay parameters and a second set of CPB initial delay parameters, and wherein the means for selecting the one of the two sets of the CPB initial delay parameters comprises:

means for decoding the first set of CPB initial delay parameters, and, when the one or more pictures do not include at least one leading picture associated with the first picture, decoding the second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture according to a display order associated with the first CVS.

Claim 33: The device of claim 32, wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture of the first CVS.

Claim 34: The device of claim 32, wherein a CPB removal time of each picture following the first picture of the first CVS in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.

Claim 35: A computer-readable storage medium storing instructions that, when executed, cause one or more processors to decode video data, wherein the instructions cause the one or more processors to:

receive a bitstream comprising one or more coded video sequences (CVSs), each CVS comprising one or more pictures,

wherein a first picture in decoding order in a first CVS of the

one or more CVSs is a random access point (RAP) picture that is not an instantaneous decoding refresh (IDR) picture; and

decode the bitstream at least in part by parsing two sets of coded picture buffer (CPB) initial delay parameters and by selecting one of the two sets of CPB initial delay parameters for a derivation of CPB timing parameters.

Claim 36: The computer-readable storage medium of claim 35, further comprising instructions that cause the one or more processors to:

identify at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture of the first CVS, wherein the leading picture comprises a picture that follows the first picture according to the decoding order and precedes the first picture according to a display order associated with the CVS; and

decode the at least one of the one or more pictures, wherein the instructions that cause the one or more processors to decode each of the at least one of the one or more pictures include instructions that cause the one or more processors to:

identify one or more reference pictures used to encode the at least one of the one or more pictures;

determine whether any of the identified one or more reference pictures is unavailable to be decoded;

for each of the identified one or more reference pictures that is determined to be unavailable to be decoded, generate a virtual reference picture; and

decode the at least one of the one or more pictures based on the corresponding one or more generated virtual reference pictures.

Claim 37: The computer-readable storage medium of claim 36,
wherein the instructions that cause the one or more processors to generate the virtual reference picture comprise instructions that cause the one or more processors to generate a picture that includes one or more pixel values that each correspond to a middle of a range of pixel values associated with the first CVS.

Claim 38: The computer-readable storage medium of claim 35,
further comprising instructions that cause the one or more processors to:

determine at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture of the first CVS, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture according to a display order associated with the first CVS; and

avoid outputting any of the at least one of the one or more pictures for which an output flag indicates that the respective picture is to be output.

Claim 39: The computer-readable storage medium of claim 35,
further comprising instructions that cause the one or more processors to:

determine at least one of the one or more pictures, other than the first picture of the first CVS, that corresponds to a leading picture associated with the first picture, wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture of the first CVS according to a display order associated with the first CVS; and

avoid using one or more of the at least one of the one or more pictures as a reference picture for decoding at least one of the one or more pictures, other than the first picture of the first CVS, that follows the first picture of the first CVS according to the decoding order and according to a display order associated with the first CVS.

Claim 40: The computer-readable storage medium of claim 35,
wherein the first picture of the first CVS comprises a clean random access (CRA) picture, wherein the CRA picture comprises a picture that is encoded using intra-prediction

coding and is decodable without reference to any other pictures, and for which one or more pictures included within the first CVS along with the CRA picture that follow the CRA picture according to a decoding order associated with the first CVS may be decoded with reference to one or more pictures that precede the CRA picture according to the decoding order.

Claim 41: The computer-readable storage medium of claim 35,
wherein the IDR picture comprises a picture that is encoded using intra-prediction coding and is decodable without reference to any other pictures, and for which all other pictures included within a respective CVS of the one or more CVSs along with the IDR picture that follow the IDR picture according to a decoding order associated with the respective CVS are decoded without reference to any pictures that precede the IDR picture according to the decoding order.

Claim 42: The computer-readable storage medium of claim 35,
wherein the two sets of CPB initial delay parameters includes a first set of CPB initial delay parameters and a second set of CPB initial delay parameters, and wherein the instructions that cause the one or more processors to select the one of the two sets of the CPB initial delay parameters comprise instructions that cause the one or more processors to:

decode the first set of CPB initial delay parameters, and, when the one or more pictures do not include at least one leading picture associated with the first picture, decode the second set of CPB initial delay parameters, wherein the second set is different than the first set, and a set of CPB delay offset parameters,

wherein the leading picture comprises a picture that follows the first picture of the first CVS according to the decoding order and precedes the first picture according to a display order associated with the first CVS.

Claim 43: The computer-readable storage medium of claim 42,
wherein one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters are included in one of a supplemental enhancement information (SEI) message, a picture buffering period SEI message, and a slice header, associated with the first picture of the first CVS.

Claim 44: The computer-readable storage medium of claim 42,
wherein a CPB removal time of each picture following the first picture of the first CVS in the decoding order is shifted earlier as indicated by one or more of the first and second sets of CPB initial delay parameters and the set of CPB delay offset parameters.