CLAIMS

1. A method of decoding an encoded representation (60) of a picture (10) of a video stream (1) of multiple pictures (10, 40, 42, 50), said method comprises:

retrieving (S30) buffer description information defining at least one reference picture (40, 42) from said encoded representation (60) of said picture (10); and

determining (S31), based on said buffer description information, at least one picture identifier identifying a respective reference picture (40, 42) of said at least one reference picture (40, 42) as decoding reference for said picture (10); and

updating (S32) a decoded picture buffer (530, 650) based on said at least one picture identifier.

2. The method according to claim 1, wherein updating (S32) said decoded picture buffer (530, 650) comprises updating (S32) said decoded picture buffer (530, 650) to comprise said respective reference picture (40, 42) identified by said at least one picture identifier.

3. The method according to claim 1 or 2, wherein

retrieving (S30) said buffer description information comprises retrieving (S30) said buffer description information defining multiple reference pictures (40, 42) from said encoded representation (60) of said picture (10);

determining (S31) said at least one picture identifier comprises determining (S31), based on said buffer description information, i) at least one picture identifier identifying a respective reference picture (40, 42) of said multiple reference pictures (40, 42) as decoding reference for said picture (10) and ii) at least one picture identifier identifying a respective reference picture (42) of said multiple reference pictures (40, 42) as decoding reference for a subsequent, according to a decoding order, picture (50) of said video stream (1).

4. The method according to any of the claims 1 to 3, further comprising decoding (S33) said picture (10) based on said encoded representation (60) of said picture (10) and at least one reference picture (40, 42) present in said decoded picture buffer (530, 650), wherein decoding said picture (10) is performed after updating said decoded picture buffer (530, 650).

5. The method according to any of the claims 1 to 4, wherein updating (S32) said decoded picture buffer (530, 650) comprises marking (S70) all reference pictures present in said decoded picture buffer (530, 650) and not being associated with any of said at least one picture identifier determined based on said buffer description information as unused for reference.

6. The method according to any of the claims 1 to 5, wherein updating (S32) said decoded picture buffer (530, 650) comprises marking (S70) a reference picture present in said decoded picture buffer (530, 650) and associated with a picture identifier of said at least one picture identifier determined based on said buffer description information as used for reference, preferably as used for short-term reference or used for long-term reference.

7. The method according to claim 5 or 6, wherein marking any reference picture is performed prior to decoding said picture (10).

8. The method according to any of the claims 1 to 7, further comprising outputting (S71) zero or more pictures from said decoded picture buffer (530, 650) for display prior to decoding said picture (10).

9. The method according to any of the claims 1 to 8, wherein retrieving (S30) said buffer description information comprises retrieving said buffer description information from a slice header (65) of said encoded representation (60) of said picture (10).

10. The method according to any of the claims 1 to 9, wherein determining (S31) said at least one picture identifier comprises:

retrieving (S40), based on said buffer description information, a respective delta identifier; and

calculating (S41) said at least one picture identifier identifying said at least one reference picture (40, 42) based on a picture identifier identifying said picture (10) and said respective delta identifier.

11. The method according to any of the claims 1 to 10, wherein retrieving (S30) said buffer description information comprises:

retrieving (S51), from said encoded representation (60) of said picture (10), said buffer description information identifying a buffer description defining said at least one reference picture (40, 42); and

identifying (S52), based on said buffer description information, said buffer description from a data structure comprising multiple predefined buffer descriptions each defining at least one reference picture (40, 42).

12. The method according to claim 11, further comprising retrieving (S50) said data structure from a picture parameter set (67) or a sequence parameter set (68) associated with an encoded representation of said video stream (1).

13. The method according to claim 11 or 12, wherein said buffer description information comprises an identifier identifying said buffer description and information defining at least one reference picture (40, 42), and determining (S31) said at least one picture identifier comprises:

determining (S60), based on said buffer description, a first set of at least one reference picture (40, 42) identifying a respective reference picture; and

determining (S61), based on said information defining at least one picture identifier, a second set of at least one picture identifier identifying a respective reference picture; and

forming (S62) a joint set of picture identifiers based on said first set and said second set.

14. The method according to claim 13, further comprising:

comparing (S63) a total number of picture identifiers in said joint set with a maximum number of reference pictures; and

removing (S64), if said total number of picture identifiers exceeds said maximum number of reference pictures and from said joint set, one or more picture identifiers included in said first set but not in said second set until said total number of picture identifiers in said joint set does not exceed said maximum number of reference pictures.

15. The method according to any of the claims 1 to 14, wherein updating (S32) said decoded picture buffer (530, 650) comprises removing (S70), from said decoded picture buffer (530, 650), all reference pictures present in said decoded picture buffer (530, 650) and not being associated with any of said at least one picture identifier determined from said buffer description information.

16. The method according to any of the claims 1 to 15, further comprising:

comparing (S72) said determined at least one picture identifier with picture identifiers associated with reference pictures present in said decoded picture buffer (530, 650); and

determining (S73) a given picture as non-existing if a picture identifier identifying said given picture is found among said determined at least one picture identifier but said given picture is not present in said decoded picture buffer (530, 650).

17. The method according to any of the claims 1 to 16, further comprising performing (S60) reference picture list initialization based on said buffer description information.

18. The method according to any of the claims 1 to 17, wherein determining (S31) said at least one picture identifier comprises determining (S31), based on said buffer description information, at least one picture order count, POC, value identifying said respective reference picture (40, 42) as decoding reference for said picture (10).

19. The method according to claim 18, wherein determining (S31) said at least one POC value comprises determining (S31), based on said buffer description information, said at least one picture order count, POC, value and at least one additional identifier identifying said respective reference picture (40, 42) as decoding reference for said picture (10).

20. The method according to any of the claims 1 to 19, wherein said video stream (1) is a scalable video stream with pictures (10, 40, 42, 50) grouped into multiple layers, and retrieving (S30) said buffer description information comprises retrieving (S30) said buffer description information defining said at least one picture identifier and layer information identifying a respective layer of said multiple layers to which said respective reference picture (40, 42) belongs.

21. A decoder (400) configured to decode an encoded representation (60) of a picture (10) of a video stream (1) of multiple pictures (10, 40, 42, 50), said decoder (400) comprises:

a data retriever (410) configured to retrieve buffer description information defining at least one reference picture (40, 42) from said encoded representation (60) of said picture (10);

a picture identifier determiner (420) configured to determine, based on said buffer description information, at least one picture identifier identifying a respective reference picture (40, 42) of said at least one reference picture (40, 42) as decoding reference for said picture (10); and

a buffer manager (430) configured to update a decoded picture buffer (530) based on said at least one picture identifier.

22. The decoder according to claim 21, wherein said buffer manager (430) is configured to update said decoded picture buffer (530) to comprise said respective reference picture (40, 42) identified by said at least one picture identifier.

23. The decoder according to claim 21 or 22, wherein

said data retriever (410) is configured to retrieve said buffer description information defining multiple reference pictures (40, 42) from said encoded representation (60) of said picture (10); and

said picture identifier determiner (420) is configured to determine, based on said buffer description information, i) at least one picture identifier identifying a respective reference picture (40, 42) of said multiple reference pictures (40, 42) as decoding reference for said picture (10) and ii) at least one picture identifier identifying a respective reference picture (42) of said multiple reference pictures (40, 42) as decoding reference for a subsequent, according to a decoding order, picture (50) of said video stream (1).

24. The decoder according to any of the claims 21 to 23, wherein said decoder (400) is configured to decode, after said buffer manager (430) has updated said decoded picture buffer (530), said picture (10) based on said encoded representation (60) of said picture (10) and at least one reference picture (40, 42) present in said decoded picture buffer (530).

25. The decoder according to any of the claims 21 to 24, wherein said buffer manager (430) is configured to mark all reference pictures present in said decoded picture buffer (530) and not being associated with any of said at least one picture identifier determined based on said buffer description information as unused for reference.

26. The decoder according to any of the claims 21 to 25, wherein said buffer manager (430) is configured to mark a reference picture present in said decoded picture buffer (530, 650) and associated with a picture identifier of said at least one picture identifier determined based on said buffer description information as used for reference, preferably as used for short-term reference or used for long-term reference.

27. The decoder according to claim 25 or 26, wherein said buffer manager (430) is configured to mark any reference picture prior to said decoder (400) decodes said picture (10).

28. The decoder according to any of the claims 21 to 27, further comprising an outputting section (450) configured to output zero or more pictures from said decoded picture buffer (530) for display prior to said decoder (400) decodes said picture (10).

29. The decoder according to any of the claims 21 to 28, wherein said data retriever (410) is configured to retrieve said buffer description information from a slice header (65) of said encoded representation (60) of said picture (10).

30. The decoder according to any of the claims 21 to 29, wherein said picture identifier determiner (420) is configured to i) retrieve, based on said buffer description information, a respective delta identifier, and ii) calculate said at least one picture identifier identifying said at least one reference picture (40, 42) based on a picture identifier identifying said picture (10) and said respective delta identifier.

31. The decoder according to any of the claims 21 to 30, wherein said data retriever (410) is configured to retrieve, from said encoded representation (60) of said picture (10), said buffer description information identifying a buffer description defining said at least one reference picture (40, 42), said decoder (400) further comprises a buffer description identifier (480) configured to identify, based on said buffer description information, said buffer description from a data structure comprising multiple predefined buffer descriptions each defining at least one reference picture (40, 42).

32. The decoder according to claim 31, wherein said data retriever (410) is configured to retrieve said data structure from a picture parameter set (67) or a sequence parameter set (68) associated with an encoded representation of said video stream (1).

33. The decoder according to claim 31 or 32, wherein said buffer description information comprises an identifier identifying said buffer description and information defining at least one reference picture (40, 42), said picture identifier determiner (420) is configured to I) determine, based on said buffer description, a first set of at least one picture identifier identifying a respective reference picture, and II) determine, based on said information defining at least one reference picture (40, 42), a second set of at least one picture identifier identifying a respective reference picture, and iii) form a joint set of picture identifiers based on said first set and said second set.

34. The decoder according to claim 33, further comprising a number comparator (440) configured to compare a total number of picture identifiers in said joint set with a maximum number of reference pictures, wherein said picture identifier determiner (420) is configured to remove, if said total number of picture identifiers exceeds said maximum number of reference pictures and from said joint set, one or

more picture identifiers included in said first set but not in said second set until said total number of picture identifiers in said joint set does not exceed said maximum number of reference pictures.

35. The decoder according to any of the claims 21 to 34, wherein said buffer manager (430) is configured to remove, from said decoded picture buffer (530), all reference pictures stored in said decoded picture buffer (530) and not being associated with any of said at least one picture identifier determined from said buffer description information.

36. The decoder according to any of the claims 21 to 35, further comprising an identifier comparator (460) configured to compare said determined at least one picture identifier with picture identifiers associated with reference pictures present in said decoded picture buffer (530), wherein said picture identifier determiner (420) is configured to determine a given picture as non-existing if a picture identifier identifying said given picture is found among said determined at least one picture identifier but said given picture is not present in said decoded picture buffer (530).

37. The decoder according to any of the claims 21 to 36, further comprising a list manager (470) configured to perform reference picture list initialization based on said buffer description information.

38. A receiver (500) comprising:

an input section (510) configured to receive encoded representations (60) of multiple pictures (10, 40, 42, 50) of a video stream (1);

a decoder (400) according to any of the claims 21 to 37 configured to decode said encoded representations (60) of said multiple pictures (10, 40, 42, 50); and

an output section (520) configured to output decoded pictures of said video stream (1).

39. A decoder (600) comprising:

an input section (610) configured to receive encoded representations (60) of multiple pictures (10, 40, 42, 50) of a video stream (1);

a processor (630) configured to process code means of a computer program stored in a memory (640), said code means causes, when run on said processor (630), said processor (630) to:

retrieve buffer description information defining at least one reference picture (40, 42) from an encoded representation (60) of a picture (10);

determine, based on said buffer description information, at least one picture identifier identifying a respective reference picture (40, 42) of said at least one reference picture (40, 42) as decoding reference for said picture (10); and

update a decoded picture buffer (650) based on said at least one picture identifier; and

an output section (620) configured to output decoded pictures of said video stream (1).

40. A method of encoding a picture (10) of a video stream (1) of multiple pictures (10, 40, 42, 50), said method comprises:

determining (S1), for said picture (10), at least one reference picture (40, 42) of said multiple pictures (10, 40, 42, 50) as encoding reference for said picture (10);

providing (S2), for each reference picture (40, 42) of said at least one reference picture (40, 42), a picture identifier identifying said reference picture (40, 42);

generating (S3), based on said at least one picture identifier, buffer description information defining said at least one reference picture (40, 42); and

inserting (S4) said buffer description information in an encoded representation (60) of said picture (10).

41. The method according to claim 40, wherein determining (S1) said at least one reference picture (40, 42) comprises determining (S1), for said picture (10), any reference picture (40, 42) of said multiple pictures (10, 40, 42, 50) as encoding reference for said picture (10) and any reference picture (42) of said multiple pictures (10, 40, 42, 50) as encoding reference for a subsequent, according to a decoding order, picture (50) of said video stream (1).

42. The method according to claim 40 or 41, wherein said picture (10) comprises at least one slice (20, 22) and wherein

determining (S1) said at least one reference picture (40, 42) comprises determining, for at least one slice (20, 22) of said picture (10), at least one reference picture (40, 42) of said multiple pictures (10, 40, 42, 50); and

inserting (S4) said buffer description information comprises inserting, for each slice (20, 22) of said picture (10), said buffer description information in a respective slice header (65) of said encoded representation (60) of said picture (60).

43. The method according to any of the claims 40 to 42, further comprising calculating (S10), for each picture identifier of said at least one picture identifier, a difference between said picture identifier

identifying a reference picture of said at least one reference picture (40, 42) and a picture identifier identifying said picture (10), wherein generating (S3) said buffer description information comprises generating, based on said at least one difference, said buffer description information defining said at least one picture identifier relative to said picture identifier identifying said picture (10).

44. The method according to any of the claims 40 to 43, further comprising generating (S20) a data structure comprising multiple predefined buffer descriptions each defining at least one reference picture (40, 42), wherein generating (S3) said buffer description information comprises:

selecting (S23), based on said at least one picture identifier, a buffer description of said data structure; and

generating (S24) said buffer description information comprising an identifier of said selected buffer description.

45. The method according to claim 44, further comprising:

inserting (S21) said data structure in a picture parameter set (67) or a sequence parameter set (68) associated with an encoded representation of said video stream (1); and

inserting (S22) an identifier of said picture parameter set (67) or of said sequence parameter set (68) in a slice header (65) of said encoded representation (60) of said picture (10) as part of said buffer description information.

46. The method according to claim 44 or 45, wherein generating (S3) said buffer description information comprises generating said buffer description information comprising said identifier of said selected buffer description and comprising information defining a reference picture of said at least one reference picture (40, 42).

47. The method according to any of the claims 40 to 46, wherein determining (S1) said at least one reference picture (40, 42) comprises determining, for said picture (10), said at least one reference picture (40, 42) by maximizing compression efficiency of said encoded representation (60) of said picture (10) while complying to at least one side constraint selected from i) a predefined maximum number of reference pictures (40, 42) and ii) generating a decodable encoded representation of said video stream (1) also when at least one encoded representation of a picture is removed from said encoded representation of said video stream (1).

48. An encoder (100) configured to encode a picture (10) of a video stream (1) of multiple pictures (10, 40, 42, 50), said encoder (100) comprises:

a reference picture determiner (110) configured to determine, for said picture (10), at least one reference picture (40, 42) of said multiple pictures (40, 42, 50) as encoding reference for said picture (10);

a picture identifier provider (120) configured to provide, for each reference picture (40, 42) of said at least one reference picture (40, 42), a picture identifier identifying said reference picture (40, 42);

a buffer description information generator (130) configured to generate, based on said at least one picture identifier, buffer description information defining said at least one reference picture (40, 42); and

a data inserter (140) configured to insert said buffer description information in an encoded representation (60) of said picture (10).

49. The encoder according to claim 48, wherein said reference picture determiner (110) is configured to determine, for said picture (10), any reference picture (40, 42) of said multiple pictures (10, 40, 42, 50) as encoding reference for said picture (10) and any reference picture (42) of said multiple pictures (10, 40, 42, 50) as encoding reference for a subsequent, according to a decoding order, picture (50).

50. The encoder according to claim 48 or 49, wherein said picture (10) comprises at least one slice (20, 22) and wherein

said reference picture determiner (110) is configured to determine, for at least one slice (20, 22) of said picture (10), at least one reference picture (40, 42) of said multiple pictures (10, 40, 42, 50); and

said data inserter (140) is configured to insert, for each slice (20, 22) of said picture (10), said buffer description information in a respective slice header (65) of said encoded representation (60) of said picture (10).

51. The encoder according to any of the claims 48 to 50, further comprising an identifier calculator (150) configured to calculate, for each picture identifier of said at least one picture identifier, a difference between said picture identifier identifying a reference picture of said at least one reference picture (40, 42) and a picture identifier identifying said picture (10), wherein said buffer description information generator (130) is configured to generate, based on said at least one difference, said buffer

description information defining said at least one picture identifier relative to said picture identifier identifying said picture (10).

52. The encoder according to any of the claims 48 to 51, further comprising a data structure generator (160) configured to generate a data structure comprising multiple predefined buffer descriptions each defining at least one picture identifier, wherein said buffer description information generator (130) is configured to i) select, based on said at least one picture identifier, a buffer description of said data structure, and ii) generate said buffer description information comprising an identifier of said selected buffer description.

53. The encoder according to claim 52, wherein said data inserter (140) is configured to i) insert said data structure in a picture parameter set (67) or a sequence parameter set (68) associated with an encoded representation of said video stream (1), and ii) insert an identifier of said picture parameter set (67) or of said sequence parameter set (68) in a slice header (65) of said encoded representation (60) of said picture (10) as part of said buffer description information.

54. The encoder according to claim 52 or 53, wherein said buffer description information generator (130) is configured to generate said buffer description information comprising said identifier of said selected buffer description and comprising information defining a reference picture of said at least one reference picture (40, 42).

55. A transmitter (200) comprising:

an input section (210) configured to receive multiple pictures (10, 40, 42, 50) of a video stream (1);

an encoder (100) according to any of the claims 48 to 54 configured to encode said multiple pictures (10, 40, 42, 50) to generate respective encoded representations (60) of said multiple pictures (10, 40, 42, 50); and

an output section (220) configured to output said respective encoded representations (60) of said multiple pictures (10, 40, 42, 50).

56. An encoder (300) comprising:

an input section (310) configured to receive multiple pictures (10, 40, 42, 50) of a video stream (1);

a processor (330) configured to process code means of a computer program stored in a memory (340), said code means causes, when run on said processor (330), said processor (330) to:

determine, for a picture (10) of said video stream (1), at least one reference picture (40, 42) of said multiple pictures (10, 40, 42, 50) as encoding reference for said picture (10);

provide, for each reference picture (40, 42) of said at least one reference picture (40, 42), a picture identifier identifying said reference picture (40, 42);

generate, based on said at least one picture identifier, buffer description information defining said at least one reference picture (40, 42); and

insert said buffer description information in an encoded representation (60) of said picture (1); and

an output section (320) configured to output encoded representations (60) of pictures (10).

CLAIMS

1. A method of decoding an encoded representation (60) of a picture (10) of a video stream (1) of multiple pictures (10, 40, 42, 50), said method comprising:

retrieving (S30) buffer description information defining at least one reference picture (40, 42) from a data structure included in said encoded representation (60) of said picture (10);

determining (S31), based on said buffer description information, at least one picture identifier identifying a reference picture (40, 42) among said at least one reference picture (40, 42) as decoding reference for said picture (10); and

updating (S32) a decoded picture buffer (530, 650) based on said at least one picture identifier by marking (S70) all reference pictures present in said decoded picture buffer (530, 650) and not being associated with any of said at least one picture identifier determined based on said buffer description information as unused for reference, characterized in that

said buffer description information defines said at least one reference picture (40,42) in an absolute and explicit way by means of said encoded representation (60) of said picture (10) which contains in said data structure the information about which reference picture to use for reference during decoding, independently of the encoded representation of previous pictures in the video stream.

2. The method according to claim 1, wherein updating (S32) said decoded picture buffer (530, 650) comprises updating (S32) said decoded picture buffer (530, 650) to comprise said respective reference picture (40, 42) identified by said at least one picture identifier.

3. The method according to claim 1 or 2, wherein

retrieving (S30) said buffer description information comprises retrieving (S30) said buffer description information defining multiple reference pictures (40, 42) from said encoded representation (60) of said picture (10);

determining (S31) said at least one picture identifier comprises determining (S31), based on said buffer description information, i) at least one picture identifier identifying a reference picture (40, 42) among said multiple reference pictures (40, 42) as decoding reference for said picture

(10) and ii) at least one picture identifier identifying a reference picture (42) among said multiple reference pictures (40, 42) as decoding reference for a subsequent, according to a decoding order, picture (50) of said video stream (1).

4. A decoder (400) configured to decode an encoded representation (60) of a picture (10) of a video stream (1) of multiple pictures (10, 40, 42, 50), said decoder (400) comprises:

a data retriever (410) configured to retrieve buffer description information defining at least one reference picture (40, 42) from a data structure in said encoded representation (60) of said picture (10);

a picture identifier determiner (420) configured to determine, based on said buffer description information, at least one picture identifier identifying a reference picture (40, 42) among said at least one reference picture (40, 42) as decoding reference for said picture (10); and

a buffer manager (430) configured to update a decoded picture buffer (530) based on said at least one picture identifier by marking all reference pictures present in said decoded picture buffer (530) and not being associated with any of said at least one picture identifier determined based on said buffer description information as unused for reference; characterized in that

said buffer description information defines said at least one reference picture (40,42) in an absolute and explicit way by means of said encoded representation (60) of said picture (10) which contains in said data structure the information about which reference picture to use for reference during decoding, independently of the encoded representation of previous pictures in the video stream.

5. The decoder according to claim 4, wherein said buffer manager (430) is configured to update said decoded picture buffer (530) to comprise said respective reference picture (40, 42) identified by said at least one picture identifier.

6. The decoder according to claim 4 or 5, wherein

said data retriever (410) is configured to retrieve said buffer description information defining multiple reference pictures (40, 42) from said encoded representation (60) of said picture (10); and

said picture identifier determiner (420) is configured to determine, based on said buffer description information, i) at least one picture identifier identifying a reference picture (40, 42) among said multiple reference pictures (40, 42) as decoding reference for said picture (10) and ii) at least one picture identifier identifying a reference picture (42) among said multiple reference pictures (40, 42) as decoding reference for a subsequent, according to a decoding order, picture (50) of said video stream (1).

7. A receiver (500) comprising:

an input section (510) configured to receive encoded representations (60) of multiple pictures (10, 40, 42, 50) of a video stream (1);

a decoder (400) according to any of the claims 4-6 configured to decode said encoded representations (60) of said multiple pictures (10, 40, 42, 50); and

an output section (520) configured to output decoded pictures of said video stream (1).