

CLAIMS

What is claimed is:

1. A method of decoding implemented by a video decoder, comprising:
receiving, by the video decoder, a bitstream having a plurality of layers and a video parameter set (VPS), wherein the VPS includes a direct reference layer flag, wherein the direct reference layer flag equal to a first value specifies that a second layer is not a direct reference layer for a first layer, and wherein the direct reference layer flag equal to a second value specifies that the second layer is the direct reference layer for the first layer;
deriving, by the video decoder, a reference layer flag by:
initially setting the reference layer flag to the first value; and
updating the reference layer flag to the second value when the direct reference layer flag has the second value; and
decoding, by the video decoder, a picture from the first layer in accordance with the reference layer flag to obtain a decoded picture.
2. The method of claim 1, wherein the reference layer flag is designated LayerUsedAsRefLayerFlag[i] or LayerUsedAsRefLayerFlag[j].
3. The method of any of claims 1 to 2, wherein the direct reference layer flag is designated vps_direct_ref_layer_flag.
4. The method of any of claims 1 to 3, wherein the first value is zero and the second value is one.
5. The method of any of claims 1 to 4, wherein the first layer has an index value of [i] and the second layer has an index value of [j].
6. The method of any of claims 1 to 5, wherein the index value of [i] is in a range of zero to vps_max_layers_minus1.

7. The method of any of claims 1 to 6, wherein `vps_max_layers_minus1` plus 1 specifies a number of layers specified by the VPS.
8. The method of any of claims 1 to 7, further comprising displaying the decoded picture on a display of an electronic device.
9. A method of encoding implemented by a video encoder, the method comprising:
setting, by the video encoder, a direct reference layer flag equal to a first value to specify that a second layer is not a direct reference layer for a first layer, and to a second value to specify that the second layer is the direct reference layer for the first layer, wherein the direct reference layer flag is configured for use in derivation of a reference layer flag;
generating, by the video encoder, a video parameter set (VPS) including the direct reference layer flag;
encoding, by the video encoder, the VPS into a video bitstream; and
storing, by the video encoder, the video bitstream for communication toward a video decoder.
10. The method of claim 9, wherein the direct reference layer flag is designated `vps_direct_ref_layer_flag`, and wherein the first value is zero and the second value is one.
11. The method of any of claims 9 to 10, wherein the first layer has an index value of `[ i ]` and the second layer has an index value of `[ j ]`.
12. The method of any of claims 10 to 11, wherein the index value of `[ i ]` is in a range of zero to `vps_max_layers_minus1`, wherein `vps_max_layers_minus1` plus 1 specifies a number of layers specified by the VPS, which is a maximum allowed number of layers in each coded video sequence (CVS) referring to the VPS.
13. The method of any of claims 10 to 12, further comprising deriving the reference layer flag and performing, by a hypothetical reference decoder (HRD) of the video encoder, a

conformance test on the video bitstream using the reference layer flag, wherein the reference layer flag is derived by:

initially setting the reference layer flag to the first value; and

updating the reference layer flag to the second value when the direct reference layer flag has the second value.

14. The method of any of claims 10 to 13, further comprising transmitting the bitstream toward a video decoder.

15. A decoding device, comprising:

a receiver configured to receive a bitstream having a plurality of layers and a video parameter set (VPS), wherein the VPS includes a direct reference layer flag, wherein the direct reference layer flag equal to a first value specifies that a second layer is not a direct reference layer for a first layer, and wherein the direct reference layer flag equal to a second value specifies that the second layer is the direct reference layer for the first layer; and

a memory containing instructions;

a processor coupled to the memory, the processor configured to implement the instructions to cause the decoding device to:

derive a reference layer flag to the first value by:

initially setting the reference layer flag to the first value; and

updating the reference layer flag to the second value when the direct reference layer flag has the second value; and

decode a picture from the first layer in accordance with the reference layer flag to obtain a decoded picture.

16. The decoding device of claim 15, wherein the reference layer flag is designated `LayerUsedAsRefLayerFlag[ i ]` or `LayerUsedAsRefLayerFlag[ j ]`.

17. The decoding device of any of claims 15 to 16, wherein the direct reference layer flag is designated `vps_direct_ref_layer_flag`.

18. The decoding device of any of claims 15 to 17, wherein the first value is zero and the second value is one.
19. The decoding device of any of claims 15 to 18, wherein the sequence parameter set (SPS) is referred to by the only one layer in the output layer set (OLS).
20. The decoding device of any of claims 15 to 19, further comprising a display configured to display the picture as decoded.
21. An encoding device, comprising:
a memory containing instructions;
a processor coupled to the memory, the processor configured to implement the instructions to cause the encoding device to:
 set a direct reference layer flag equal to a first value to specify that a second layer is not a direct reference layer for a first layer, and to a second value to specify that the second layer is the direct reference layer for the first layer, wherein the direct reference layer flag is configured for use in derivation of a reference layer flag;
 generate a video parameter set (VPS) including the direct reference layer flag;
 encode the VPS into a video bitstream; and
a transmitter coupled to the processor, the transmitter configured to transmit the video bitstream toward a video decoder.
22. The encoding device of claim 21, wherein the direct reference layer flag is designated `vps_direct_ref_layer_flag`, and wherein the first value is zero and the second value is one.
23. The encoding device of any of claims 21 to 22, wherein the first layer has an index value of `[ i ]` and the second layer has an index value of `[ j ]`, wherein the index value of `[ i ]` is in a range of zero to `vps_max_layers_minus1`.

24. The encoding device of any of claims 23 to 25, wherein $\text{vps_max_layers_minus1} + 1$ specifies a number of layers specified by the VPS, which is a maximum allowed number of layers in each coded video sequence (CVS) referring to the VPS.
25. A coding apparatus, comprising:
a receiver configured to receive a picture to encode or to receive a bitstream to decode;
a transmitter coupled to the receiver, the transmitter configured to transmit the bitstream to a decoder or to transmit a decoded image to a display;
a memory coupled to at least one of the receiver or the transmitter, the memory configured to store instructions; and
a processor coupled to the memory, the processor configured to execute the instructions stored in the memory to perform the method in any of claims 1 to 8 and any of claims 9 to 14.
26. The coding apparatus of claim 25, further comprising a display configured to display a decoded picture.
27. A system, comprising:
an encoder; and
a decoder in communication with the encoder, wherein the encoder or the decoder includes the decoding device, the encoding device, or the coding apparatus of any of claims 15 to 26.
28. A means for coding, comprising:
receiving means configured to receive a picture to encode or to receive a bitstream to decode;
transmission means coupled to the receiving means, the transmission means configured to transmit the bitstream to a decoding means or to transmit a decoded image to a display means;
storage means coupled to at least one of the receiving means or the transmission means, the storage means configured to store instructions; and
processing means coupled to the storage means, the processing means configured to execute the instructions stored in the storage means to perform the method in any of claims 1 to 8 and any of claims 9 to 14.