~~**WHAT IS CLAIMED IS:**~~

CLAIMS

1.~~——~~ A device for decoding encoded point cloud data to reconstruct a point cloud, the device comprising:

a memory configured to store the encoded point cloud data~~:~~

; and one or more processors, implemented in circuitry, and configured to:

for a point of ~~a~~the point cloud~~,~~ determine a first attribute value for a first color component based on a first predicted value and a first residual value;

receive, in the encoded point cloud data, a syntax element indicating a scalar value, wherein the scalar value is an integer value; apply a scaling factor to the first residual value to determine a predicted second residual value, wherein the scaling factor has ~~one or both of~~ a non-integer value ~~or an absolute value greater than one;~~

, and wherein to apply the scaling factor to the first residual value, the one or more processors are further configured to: perform a multiplication by the scalar value; and perform a right shift operation, wherein a result of a combination of the multiplication by the scalar value and the right shift operation is equal to the scaling factor; for the point of the point cloud, receive a second residual value in the encoded point cloud data;

determine a final second residual value based on the predicted second residual value and the received second residual value; and~~——~~

for the point of the point cloud, determine a second attribute value for a second color component based on a second predicted value and the final second residual value.

~~2. The device of claim 1, wherein the one or more processors are further configured to receive, in the encoded point cloud data, a syntax element for determining a scalar value, wherein the scalar value is an integer value, and wherein to apply the scaling factor, the one or more processors are further configured to perform a multiplication by the scalar value and perform a bit shift operation.~~

2. The device of claim 1, wherein the right shift operation comprises a right shift by 2.

3.~~——~~ The device of claim ~~2, wherein to perform the bit shift operation, the one or more processors are further configured to perform a right shift by 2.~~

~~4.~~ ~~The device of claim 2~~1, wherein the syntax element ~~for determining the scalar value~~ indicates a difference value corresponding to a difference between the scalar value and a previously determined scalar value.

~~5.~~ 4. The device of claim ~~4~~3, wherein the syntax element ~~for determining the scalar value~~ comprises a variable length syntax element indicating the difference value.

~~6.~~ 5. The device of claim ~~4~~3, wherein the point cloud comprises a point cloud for a first level of detail and the previously determined scalar value is for a second level of detail that is different than the first level of detail.

~~7.~~ 6. The device of claim ~~2~~1, wherein to receive the syntax element ~~for determining the scalar value~~, the one or more processors are further configured to receive the syntax element ~~for determining the scalar value~~ in an attribute slice header syntax structure.

~~8.~~ 7. The device of claim 1, wherein the one or more processors are further configured to determine the second predicted value for the point of the point cloud based on values for one or more different points of the point cloud.

~~9.~~ 8. The device of claim 1, wherein the point cloud comprises a point cloud for a first level of detail, and wherein to determine the scaling factor, the one or more processors are further configured to determine the scaling factor based on a scaling factor for a second level of detail that is different than the first level of detail.

~~10.~~ 9. The device of claim 1, wherein the first color component comprises a first chroma color component and the second color component comprises a second chroma color component.

~~11.~~ 10. The device of claim ~~10~~9, wherein the one or more processors are further configured to for the point of the point cloud, determine a third attribute value for a third color component, wherein the third color component comprises a luma color component.

~~12.~~ 11. The device of claim 1, wherein the one or more processors are further configured to reconstruct the point cloud.

~~13.~~ 12. The device of claim ~~12~~11, wherein the one or more processors are further configured to generate a map of an interior of a building based on the reconstructed point cloud.

~~14.~~ 13. The device of claim ~~12~~11, wherein the one or more processors are further configured to perform an autonomous navigation operation based on the reconstructed point cloud.

~~15.~~ 14. The device of claim ~~12~~11, wherein the one or more processors are further configured to generate computer graphics based on the reconstructed point cloud.

~~16.~~ 15. The device of claim ~~12~~11, wherein the one or more processors are configured to:

determine a position of a virtual object based on the reconstructed point cloud; and

generate an extended reality (XR) visualization in which the virtual object is at the determined position.

~~17.~~ 16. The device of claim ~~12~~11, further comprising a display to present imagery based on the reconstructed point cloud.

~~18.~~ 17. The device of claim 1, wherein the device is one of a mobile phone or tablet computer.

~~19.~~ 18. The device of claim 1, wherein the device is a vehicle.

~~20.~~ 19. The device of claim 1, wherein the device is an extended reality device.

~~21.~~ 20. A method of decoding encoded point cloud data to reconstruct a point cloud, the method comprising:

for a point of ~~a~~the point cloud, determining a first attribute value for a first color component based on a first predicted value and a first residual value;

receiving, in the encoded point cloud data, a syntax element indicating a scalar value, wherein the scalar value is an integer value; applying a scaling factor to the first residual value to determine a predicted second residual value, wherein the scaling factor has ~~one or both of a non-integer value or an absolute value greater than one;~~

a non-integer value, wherein applying the scaling factor to the first residual value comprises: performing a multiplication by the scalar value; and performing a right shift operation, wherein a result of a combination of the multiplication by the scalar value and the right shift operation is

equal to the scaling factor; for the point of the point cloud, receiving a second residual value in the encoded point cloud data;

determining a final second residual value based on the predicted second residual value and the received second residual value; and—

for the point of the point cloud, determining a second attribute value for a second color component based on a second predicted value and the final second residual value.

~~22.~~ 21. The method of claim ~~21, further comprising receiving, in the encoded point cloud data, a syntax element for determining a scalar value~~20, wherein the ~~scalar value is an integer value, and wherein applying the scaling factor comprises performing a multiplication by the scalar value and performing a bit~~right shift operation comprises a right shift by 2.

~~23.~~ 22. The method of claim ~~22, wherein performing the bit shift operation comprises performing a right shift by 2.~~

~~24. The method of claim 22~~20, wherein the syntax element ~~for determining the scalar value~~ indicates a difference value corresponding to a difference between the scalar value and a previously determined scalar value.

~~25.~~ 23. The method of claim ~~24~~22, wherein the syntax element ~~for determining the scalar value~~ comprises a variable length syntax element indicating the difference value.

~~26.~~ 24. The method of claim ~~24~~22, wherein the point cloud comprises a point cloud for a first level of detail and the previously determined scalar value is for a second level of detail that is different than the first level of detail.

~~27.~~ 25. The method of claim ~~22~~20, wherein receiving the syntax element ~~for determining the scalar value~~ comprises receiving the syntax element ~~for determining the scalar value~~ in an attribute slice header syntax structure.

~~28.~~ 26. The method of claim ~~21~~20, further comprising determining the second predicted value for the point of the point cloud based on values for one or more different points of the point cloud.

~~29.~~ 27. The method of claim ~~21~~20, wherein determining the scaling factor comprises determining the scaling factor based on a scaling factor for a second level of detail.

~~30.~~ 28. The method of claim ~~21~~20, wherein the first color component comprises a first chroma color component and the second color component comprises a second chroma color component.

~~31.~~ 29. The method of claim ~~30~~28, further comprising for the point of the point cloud, determining a third attribute value for a third color component, wherein the third color component comprises a luma color component.

~~32.~~ 30. A device for encoding point cloud data, the device comprising:

a memory configured to store the encoded point cloud data:

one or more processors, implemented in circuitry, and configured to:

for a point of a point cloud, determine a first attribute value for a first color component;

encode the first attribute value for the first color component as a first predicted value and a first residual value;

for the point of the point cloud, determine a second attribute value for a second color component;

determine a second predicted value for the second attribute value for the second color component;

determine a second residual value for the second attribute value for the second color component;

apply a scaling factor to the first residual value to determine a predicted second residual value, wherein the scaling factor has ~~one or both of a non-integer value or an absolute value greater than one; and~~a non-integer value, wherein to apply the scaling factor to the first residual value, the one or more processors are further configured to: perform a multiplication by a scalar value; and perform a right shift operation, wherein a result of a combination of the multiplication by the scalar value and the right shift operation is equal to the scaling factor; and generate, for inclusion in encoded point cloud data, a syntax element indicating the scalar value.

~~generate, for inclusion in the encoded point cloud data, a syntax element representing a difference between the second residual value and the predicted second residual value.~~

~~33. The device of claim 32, wherein the one or more processors are further configured to generate, for inclusion in the encoded point cloud data, a syntax element for determining a scalar~~

~~value, wherein the scalar value is an integer value, and wherein applying the scaling factor comprises performing a multiplication by the scalar value and performing a bit shift operation.~~

~~34. The device of claim 33~~31. The device of claim 30, wherein to perform the bit shift operation, the one or more processors are further configured to perform a right shift by 2.

~~35.~~ 32. The device of claim ~~33~~30, wherein the syntax element ~~for determining the scalar value~~ indicates a difference value corresponding to a difference between the scalar value and a previously determined scalar value.

~~36.~~ 33. The device of claim ~~35~~32, wherein the syntax element ~~for determining the scalar value~~ comprises a variable length syntax element indicating the difference value.

~~37.~~ 34. The device of claim ~~33~~32, wherein the point cloud comprises a point cloud for a first level of detail and the previously determined scalar value is for a second level of detail that is different than the first level of detail.

~~38.~~ 35. The device of claim ~~33~~30, wherein to generate the syntax element ~~for determining the scalar value~~, the one or more processors are further configured to include the syntax element for determining the scalar value in an attribute slice header syntax structure.

~~39.~~ 36. The device of claim ~~32~~30, wherein the one or more processors are further configured to determine the second predicted value for the point of the point cloud based on values for one or more different points of the point cloud.

~~40.~~ 37. The device of claim ~~32~~30, wherein the point cloud comprises a point cloud for a first level of detail, and wherein to determine the scaling factor, the one or more processors are further configured to determine the scaling factor based on a scaling factor for a second level of detail that is different than the first level of detail.

~~41.~~ 38. The device of claim ~~32~~30, wherein the first color component comprises a first chroma color component and the second color component comprises a second chroma color component.

~~42.~~ 39. The device of claim ~~41~~38, wherein the one or more processors are further configured to for the point of the point cloud, determine a third attribute value for a third color component, wherein the third color component comprises a luma color component.

~~43.~~ 40. The device of claim ~~32~~30, further comprising a sensor to generate the encoded point cloud data.

~~44.~~ 41. A method of encoding point cloud data, the method comprising:

for a point of a point cloud, determining a first attribute value for a first color component;

encoding the first attribute value for the first color component as a first predicted value and a first residual value;

for the point of the point cloud, determining a second attribute value for a second color component;

determining a second predicted value for the second attribute value for the second color component;

determining a second residual value for the second attribute value for the second color component;

applying a scaling factor to the first residual value to determine a predicted second residual value, wherein the scaling factor has ~~one or both of a non-integer value or an absolute value greater than one; and~~a non-integer value, wherein applying the scaling factor to the first residual value comprises: performing a multiplication by a scalar value; and performing a right shift operation, wherein a result of a combination of the multiplication by the scalar value and the right shift operation is equal to the scaling factor; and generating, for inclusion in encoded point cloud data, a syntax indicating the scalar value.

~~generating, for inclusion in the encoded point cloud data, a syntax element representing a difference between the second residual value and the predicted second residual value.~~

~~45.~~ 42. The method of claim ~~44, further comprising generating, for inclusion in the encoded point cloud data, a syntax element for determining a scalar value~~41, wherein the ~~scalar value is an integer value, and wherein applying the scaling factor comprises performing a multiplication by the scalar value and performing a bit~~right shift operation comprises a right shift by 2.

~~46.~~ 43. The method of claim ~~45, wherein performing the bit shift operation comprises performing a right shift by 2.~~

~~47. The method of claim 45~~41, wherein the syntax element ~~for determining the scalar value~~ indicates a difference value corresponding to a difference between the scalar value and a previously determined scalar value.

~~48.~~ 44. The method of claim ~~47~~43, wherein the syntax element ~~for determining the scalar value~~ comprises a variable length syntax element indicating the difference value.

~~49.~~ 45. The method of claim ~~45~~43, wherein the point cloud comprises a point cloud for a first level of detail and the previously determined scalar value is for a second level of detail that is different than the first level of detail.

~~50.~~ 46. The method of claim ~~45~~41, wherein generating the syntax element ~~for determining the scalar value~~ comprises including the syntax element for determining the scalar value in an attribute slice header syntax structure.

~~51.~~ 47. The method of claim ~~44~~41, further comprising determining the second predicted value for the point of the point cloud based on values for one or more different points of the point cloud.~~—~~

~~52.~~ 48. The method of claim ~~44~~41, wherein determining the scaling factor comprises determining the scaling factor based on a scaling factor for a second level of detail.

~~53.~~ 49. The method of claim ~~44~~41, wherein the first color component comprises a first chroma color component and the second color component comprises a second chroma color component.

~~54.~~ 50. The method of claim ~~53~~49, further comprising for the point of the point cloud, determining a third attribute value for a third color component, wherein the third color component comprises a luma color component.

~~55.~~ 51. A computer-readable storage medium storing instructions that when executed by one or more processors cause the one or more processors to:

for a point of a point cloud of encoded point cloud data, determine a first attribute value for a first color component based on a first predicted value and a first residual value;

receive, in the encoded point cloud data, a syntax element indicating a scalar value, wherein the scalar value is an integer value; apply a scaling factor to the first residual value to determine a predicted second residual value, wherein the scaling factor has ~~one or both of~~ a non-integer value ~~or an absolute value greater than one;~~, and wherein to apply the scaling factor to the first residual value, the instructions cause the one or more processors to: perform a multiplication by the scalar value; and perform a right shift operation, wherein a result of a combination of the multiplication by the scalar value and the right shift operation is equal to the scaling factor; for the point of the point cloud, receive a second residual value in the encoded point cloud data;

determine a final second residual value based on the predicted second residual value and the received second residual value; and~~—~~

for the point of the point cloud, determine a second attribute value for a second color component based on a second predicted value and the final second residual value.

~~56.~~ 52. A computer-readable storage medium storing instructions that when executed by one or more processors cause the one or more processors to:

for a point of a point cloud, determine a first attribute value for a first color component;

encode the first attribute value for the first color component as a first predicted value and a first residual value;

for the point of the point cloud, determine a second attribute value for a second color component;

determine a second predicted value for the second attribute value for the second color component;

determine a second residual value for the second attribute value for the second color component;

apply a scaling factor to the first residual value to determine a predicted second residual value, wherein the scaling factor has ~~one or both of~~ a non-integer value ~~or an absolute value greater than one; and~~, wherein to apply the scaling factor to the first residual value, the one or more processors are further configured to: perform a multiplication by a scalar value; and perform a right shift operation, wherein a result of a combination of the multiplication by the scalar value and the right shift operation is equal to the scaling factor; and generate, for inclusion in ~~the~~ encoded point cloud data, a syntax element ~~representing a difference between the second residual value and the predicted second residual value.~~indicating the scalar value.