

m53495

Definition of node size restriction

Kyohei Unno, Ryosuke Watanabe, Kei Kawamura
KDDI Corp. (KDDI Research, Inc.)

■ Problem statement

- In the current spec, valid ranges of node size syntax elements are not defined.
- It shall be defined as a standard to define what is a compliant bitstream.

■ Proposal

- Add two syntax elements to GPS to define valid ranges
- Add valid range definition to semantics of node size syntax elements

- In the current spec, node size syntax elements are decoded by $ue(v)$ or $se(v)$.
- However, valid ranges of those SEs are not defined.
 - Especially, node size y and node size z can have a minus value.

	Descriptor
geometry_slice_header() {	
...	
if (gps_implicit_geom_partition_flag) {	
gsh_log2_max_nodsize_x	ue(v)
gsh_log2_max_nodsize_y_minus_x	se(v)
gsh_log2_max_nodsize_z_minus_y	se(v)
} else {	
gsh_log2_max_nodsize	ue(v)
}	
...	
}	

gsh_log2_max_nodsize_x specifies the bounding box size in the x dimension, i.e., $MaxNodeSizeXLog2$ that is used in the decoding process as follows.

$$MaxNodeSizeXLog2 = gsh_log2_max_nodsize_x$$

$$MaxNodeSizeX = 1 \ll MaxNodeSizeXLog2$$

gsh_log2_max_nodsize_y_minus_x specifies the bounding box size in the y dimension, i.e., $MaxNodeSizeYLog2$ that is used in the decoding process as follows:

$$MaxNodeSizeYLog2 = gsh_log2_max_nodsize_y_minus_x + MaxNodeSizeXLog2.$$

$$MaxNodeSizeY = 1 \ll MaxNodeSizeYLog2.$$

- The valid ranges of SEs shall be defined as a standard to define what is a compliant bitstream.

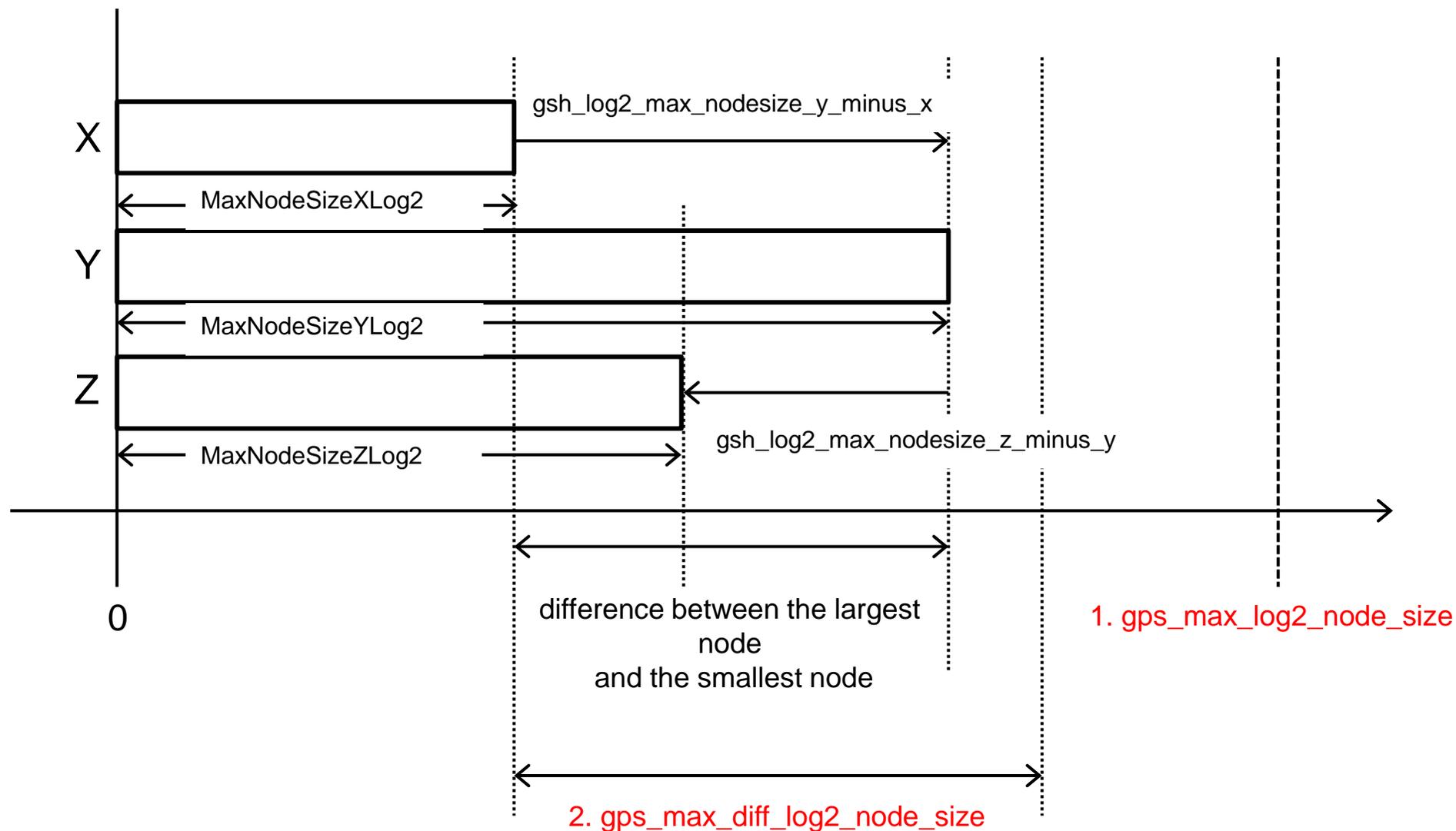
■ Add two SEs to Geometry Parameter Set

1. **gps_max_log2_node_size** specifies the maximum value of node size.
2. **gps_max_diff_log2_node_size** specifies the maximum difference between the largest node size (x, y or z) and the smallest node size (x, y or z).
 - To restrict too slimline or too flat node shape depending on profiles or levels of the standard.

	Descriptor
geometry_parameter_set() {	
...	ue(v)
gps_max_log2_node_size	ue(v)
gps_implicit_geom_partition_flag	u(1)
if(gps_implicit_geom_partition_flag) {	
gps_max_diff_log2_node_size	ue(v)
gps_max_num_implicit_qtbt_before_ot	ue(v)
gps_min_size_implicit_qtbt	ue(v)
}	
...	
}	

■ Add valid range definition to semantics of node size SEs

Relationship between proposed SEs and valid ranges



■ **gsh_log2_max_nodysize, gsh_log2_max_nodysize_x**

1. $0 \leq \text{gsh_log2_max_nodysize}(_x) \leq \text{gps_max_log2_nodysize}$

■ **gsh_log2_max_nodysize_y_minus_x**

1. $0 \leq \text{MaxNodesizeYLog2} \leq \text{gps_max_log2_nodysize}$
2. $-\text{gps_max_diff_log2_nodysize} \leq \text{gsh_log2_max_nodysize_y_minus_x} \leq \text{gps_max_diff_log2_nodysize}$

$$\Leftrightarrow \text{Max}(\text{MaxNodeSizeXLog2}, \text{gps_max_diff_log2_node_size}) \leq \text{gsh_log2_max_nodysize_y_minus_x} \leq \text{Min}(\text{gps_max_diff_log2_node_size}, \text{gps_max_log2_node_size} \text{ MaxNodeSizeXLog2})$$

■ **gsh_log2_max_nodysize_z_minus_y**

1. $0 \leq \text{MaxNodesizeZLog2} \leq \text{gps_max_log2_nodysize}$
2. a $-\text{gps_max_diff_log2_nodysize} \leq \text{gsh_log2_max_nodysize_z_minus_y} \leq \text{gps_max_diff_log2_nodysize}$
2. b $-\text{gps_max_diff_log2_nodysize} \leq \text{MaxNodesizeZLog2} - \text{MaxNodesizeXLog2} \leq \text{gps_max_diff_log2_nodysize}$

Suggested semantics changes

gsh_log2_max_nodsize_x specifies the bounding box size in the x dimension, i.e., `MaxNodeSizeXLog2` that is used in the decoding process as follows.

$$\text{MaxNodeSizeXLog2} = \text{gsh_log2_max_nodsize_x}$$

$$\text{MaxNodeSizeX} = 1 \ll \text{MaxNodeSizeXLog2}$$

The value of `gsh_log2_max_nodsize_x` shall be in the range of 0 to `gps_max_log2_node_size`.

gsh_log2_max_nodsize_y_minus_x specifies the bounding box size in the y dimension, i.e., `MaxNodeSizeYLog2` that is used in the decoding process as follows:

$$\text{MaxNodeSizeYLog2} = \text{gsh_log2_max_nodsize_y_minus_x} + \text{MaxNodeSizeXLog2}.$$

$$\text{MaxNodeSizeY} = 1 \ll \text{MaxNodeSizeYLog2}.$$

The value of `gsh_log2_max_nodsize_y_minus_x` shall be in the range of $\text{Max}(-\text{MaxNodeSizeXLog2}, -\text{gps_max_diff_log2_node_size})$ to $\text{Min}(\text{gps_max_diff_log2_node_size}, \text{gps_max_log2_node_size} - \text{MaxNodeSizeXLog2})$.

gsh_log2_max_nodsize_z_minus_y specifies the bounding box size in the z dimension, i.e., `MaxNodeSizeZLog2` that is used in the decoding process as follows.

$$\text{MaxNodeSizeZLog2} = \text{gsh_log2_max_nodsize_z_minus_y} + \text{MaxNodeSizeYLog2}$$

$$\text{MaxNodeSizeZ} = 1 \ll \text{MaxNodeSizeZLog2}$$

The value of `gsh_log2_max_nodsize_z_minus_y` shall be in the range of $\text{Max}(-\text{MaxNodeSizeYLog2}, \text{Max}(-\text{gps_max_diff_log2_node_size}, -\text{gps_max_diff_log2_node_size} - \text{gsh_log2_max_nodsize_y_minus_x}))$ to $\text{Min}(\text{gps_max_diff_log2_node_size}, \text{Min}(\text{gps_max_log2_node_size} - \text{gsh_log2_max_nodsize_y_minus_x}, \text{gps_max_log2_node_size} - \text{MaxNodeSizeYLog2}))$.

If `gps_implicit_geom_partition_flag` equals to 1, `gsh_log2_max_nodsize` is derived as follows.

$$\text{gsh_log2_max_nodsize} = \max\{\text{MaxNodeSizeXLog2}, \text{MaxNodeSizeYLog2}, \text{MaxNodeSizeZLog2}\}$$

gsh_log2_max_nodsize specifies the size of the root geometry octree node when `gps_implicit_geom_partition_flag` is equal to 0. The variables `MaxNodeSize`, and `MaxGeometryOctreeDepth` are derived as follows.

$$\text{MaxNodeSize} = 1 \ll \text{gsh_log2_max_nodsize}$$

$$\text{MaxGeometryOctreeDepth} = \text{gsh_log2_max_nodsize} - \text{log2_trisoup_node_size}$$

The value of `gsh_log2_max_nodsize` shall be in the range of 0 to `gps_max_log2_node_size`.

■ Problem statement

- In the current spec, valid ranges of node size syntax elements are not defined.
- It shall be defined as a standard to define what is a compliant bitstream.

■ Proposal

- Add two syntax elements to GPS to define valid ranges
 1. `gps_max_log2_node_size` specifies the maximum value of node size.
 2. `gps_max_diff_log2_node_size` specifies the maximum difference between the largest node size (x, y or z) and the smallest node size (x, y or z).
- Add valid range definition to semantics of node size syntax elements

■ It is recommended to adopt the proposal to the next draft.