
**Information technology — Coding of
audio-visual objects —**

Part 11:

Scene description and application engine

AMENDMENT 6

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(standards.iteh.ai) *Technologies de l'information — Codage des objets audiovisuels —
Partie 11: Description de scène et moteur d'application*

ISO/IEC 14496-11:2005/Amd 6:2009

AMENDEMENT 6
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Foreword

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Information technology — Coding of audio-visual objects —

Part 11: Scene description and application engine

AMENDMENT 6

After 8.13, add the following new subclause:

8.14 Scene Partitioning

8.14.1 Overview

In 3D streaming applications, a server often holds a compressed binary representation of the whole scene data. At the time a client connects, it receives a coarse version of the environment that suits more or less its actual location and requested precision. For the rest of the navigation, refinement data will be sent according to the observer trajectory within the scene.

At this stage, two scenarios are possible. The first one is called *server-driven scenario*; in this case, the server is assumed to be able to cope with the necessary computations for deciding exactly what refinements the client needs. Usually, the client has already sent his position and some hints of what he already has in his cache. According to this information, the server extracts a subset of the compressed binary representation, using some kind of MPEG-21 gBSD file.

The second possible scenario is the so-called client-based one. In this case, it is the client task to compute and request the necessary refinement data. In a perfect world, the server would have enough capability to constantly remain in server-driven mode. But in practical applications, when the number of clients grows, often reaching several thousands of terminals, the server can not cope anymore and has to cast to the most effective clients the task of identifying the needed refinements.

Another important thing to note, also raised after our practical implementations, is that this becomes general rule when dealing with peer-to-peer applications, i.e. when terminals can arbitrarily be considered as servers as well.

While the client-driven mode reduces the amount of information to send to the server (namely the hints on the cache content), one noticeable difference is that the client does not know exactly what could or should be sent in function of his position and orientation. What was known on the server side in the server-driven mode is unknown by the client in the client-driven mode.

The schema is based on an extensible syntax, such as the AFX backchannel. The purpose of this framework is to be able to any space partitioning conception, including the most general ones, as well as the most specific. The partitioning types considered so far are:

- 1) *BSP*: this had already been proposed at the Fairfax meeting, but the activity had not followed up at that time by lack of support and efficient design of the node. However, the technology itself has proved to be useful for adaptive transmission and rendering of large scenes, and applies to the most arbitrary scenes, independently on the tools used to compress the objects.
- 2) *Cells / Portals*: another widely used representation for selective transmission / rendering of large interior scenes is the Cell / Portal paradigm. This representation is a graph in which the nodes figure the various rooms in the building and the edges denote the possible visibility from one room to another.

- 3) *PVS (Potentially Visible Sets)*: also very widely used for exterior scenes, the purpose of PVS is the same as Cells and Portals with the difference that areas are not related to other visible areas but instead linked to the set of objects that are visible from this area.
- 4) *WaveletSubdivisionSurfaces*: this is a specific partitioning design, suited to the accommodation of geometric wavelet coefficients. This is based on bounding volumes that are strongly dependent on the shape of the base mesh.
- 5) *FootPrints*: this is the specific design that was originally demonstrated and that showed significant gain in both bandwidth and reconstruction time.

Generic tools, such as BSP, Cells and Portals and PVS are supposed to handle portions of scenes independently of the encoding scheme. This can be used for VRML scenes, or with objects for which the partitioning does not have to have finer granularity than the object itself, namely because its encoding does not provide multiresolution.

8.14.2 Node interface

```
PROTO SpacePartition [ #%NDT=SFWorldNode,SF3DNode %COD=N
  eventIn      MF3DNode  addChildren
  eventIn      MF3DNode  removeChildren
  exposedField MF3DNode  children      []
  exposedField SFUrl    SPStream NULL
] {}
```

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8.14.2.1 Semantics and functionality (standards.iteh.ai)

children: this is the target node. The partitioning information may apply to the children nodes and to its descent.

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SPStream: this is the stream containing the Scene Partitioning information. [ISO/IEC 14496-11:2005/Amd.6:2009](https://standards.iteh.ai/catalog/standards/sist/78bdb0d9-1d90-4016-)

NOTE The partitioning nodes obey the following criteria:

- Each partitioning node is attached to a rendered node;
- The partitioning node influences the descent of the rendered node it is attached to;
- The partitioning nodes combine themselves according to the hierarchy of the scene graph;

Figure AMD6.1 shows an example illustrating these points.

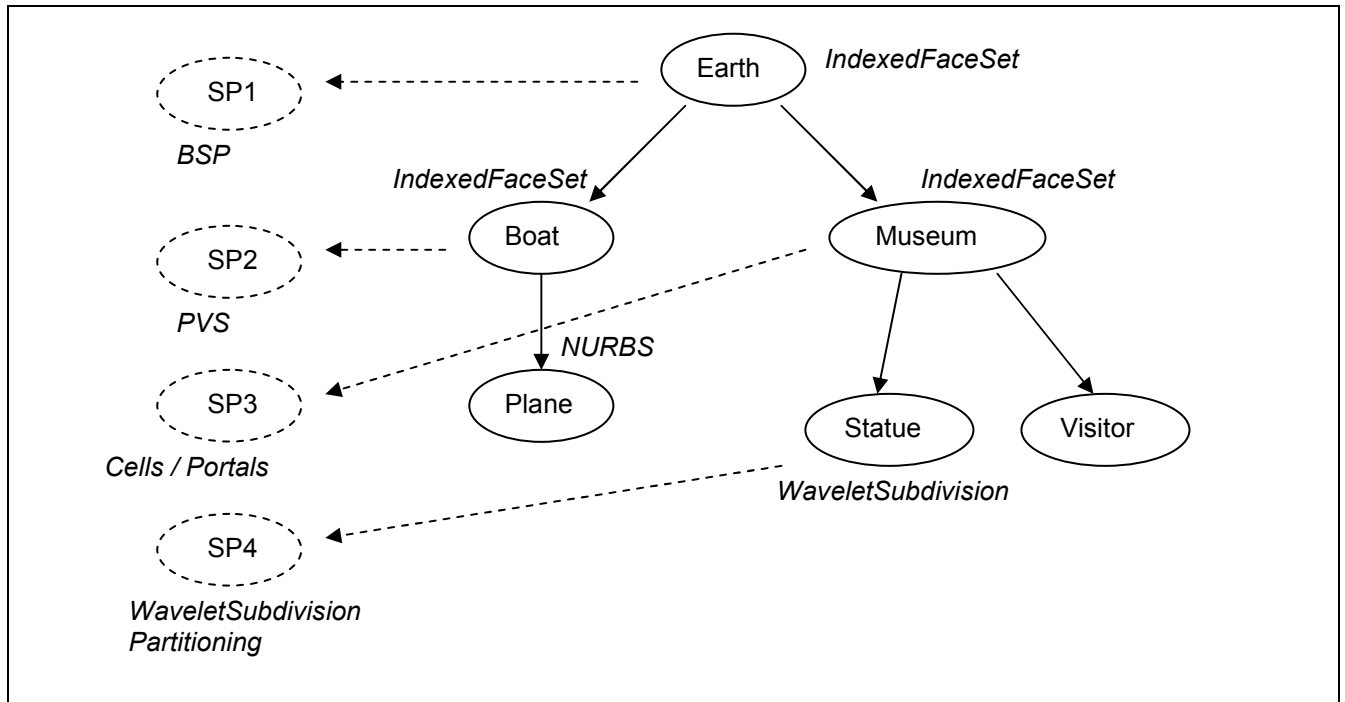


Figure AMD6.1 — example of organization of space partitioning nodes within a scene graph

In this example, one can see various space partitioning nodes (the SPs) occurring at various depth in the scene hierarchy. The type of each SP node is suited to the type of the object it is linked to. For example IndexedFaceSets representing the Earth and the Boat are partitioned using BSP and PVS. The museum, which is an interior subscene, is partitioned with Cells and Portals. The statue inside the museum, represented by WaveletSubdivision Surfaces, is partitioned with the according declination of the node. Each SP node is dependent on every other SP node upper in the hierarchy. For instance the rendering of the statue is subject to adaptation lead by SP4, but is constrained by the visibility induced by SP3 and SP1, that are linked to parent nodes.

8.14.3 Scene Partitioning stream definition

8.14.3.1 SpacePartitionDecoderConfig

8.14.3.1.1 Syntax

```

class SpacePartitionDecoderConfig {
    int (8) DSItag;
    int (8) type;
    switch(type) {
        0: BSPDecoderConfig;
        1: CellPortalDecoderConfig;
        2: PVSDecoderConfig;
        3: SPFootprintDecoderConfig;
        4: WaveletDecoderConfig;
    }
}
  
```

8.14.3.1.2 Semantics

DSItag: Space Partition tag (0x0C)

type: space partition type

8.14.3.2 BSPDecoderConfig

8.14.3.2.1 Syntax

```
class BSPDecoderConfig {
    int(6) indexNbBits;
    int(6) coefNbBits;
    int(6) objCountNbBits;
    int(1) is3D;
}
```

8.14.3.2.2 Semantics

indexNbBits: number of bits used to encode BSP plane IDs

coefNbBits: number of bits used to encode BSP plane coefficients

objCountNbBits: number of bits used to encode the number of objects

is3D: identifier of the 2D (value 0) or 3D (value 1).

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8.14.3.3 CellPortalDecoderConfig

8.14.3.3.1 Syntax

```
class CellPortalDecoderConfig {
    int(6) cellCountNbBits;
    int(6) totalCountNbBits;
    int(6) cellGeomNbBits;
    int(1) is3D;
}
```

8.14.3.3.2 Semantics

cellCountNbBits: number of bits used to encode number of cells in the stream

totalCountNbBits: number of bits used to encode total number of cells as well as cell IDs

cellGeomNbBits: number of bits used to encode cell geometry parameters

is3D: identifier of the 2D (value 0) or 3D (value 1).

8.14.3.4 PVSDecoderConfig

8.14.3.4.1 Syntax

```
class PVSDecoderConfig {
    int(6) cellCountNbBits;
    int(6) objCountNbBits;
    int(6) pvsGeomNbBits;
}
```

8.14.3.4.2 Semantics

cellCountNbBits: number of bits used to encode the total number of cells

objCountNbBits: number of bits used to encode the total number of objects

8.14.3.5 SPFootprintDecoderConfig

8.14.3.5.1 Syntax

```
class SPFootprintDecoderConfig {
    int(8) type;
    unsigned int(5) rootChildrenRadiusNbBits;
    unsigned int(5) nbChildrenNbBits;
    unsigned int(5) nbSubTreesNbBits;
    float(32) acquisitionPrecision;
    float(32) minMetricError;
    float(32) maxMetricErrorEncodingFunction;
    unsigned int(16) nbRootChildren;
    unsigned int(5) indexNbBits;
    unsigned int(5) nbNodesInSubTreeNbBits;
    unsigned int(5) nbNodesOnFirstLevelOfSubTreeNbBits;
    unsigned int(5) nbSubTreesChildrenNbBits;
    unsigned int(5) nbNodesOnLastLevelNbBits;
    unsigned int(5) networkType;
    switch(networkType) {
        0: // no additional information;
        1: int(5) subTreeSizeNbBits;
           Int(5) geometryNodesSizeNbBits;
    }
}
```

8.14.3.5.2 Semantics

type: type of the description structure

rootChildrenRadiusNbBits: number of bits used to decode the radius of the children (i.e. the bounding sphere)

nbChildrenNbBits: number of bits used to decode the number of hierarchical description node's children

nbSubTreesNbBits: number of bits used to decode number of sub-trees in a packet.

acquisitionPrecision: precision used during data acquisition.

minMetricError: smallest metric error that is greater than 0.

maxMetricErrorEncodingFunction: maximum metric error used in the encoding function.

nbRootChildren: number of children nodes for current node.

indexNbBits: number of bits used to decode description node indices.

nbNodesInSubTreeNbBits: number of bits to used to decode the number of sub-tree nodes.

nbNodesOnFirstLevelOfSubTreeNbBits: number of bits used to decode the number of nodes included in the first level sub-tree.

NbSubTreesChildrenNbBits: number of bits used to decode the number of current sub-tree childrens.

nbNodesOnLastLevelNbBits: number of bits used to decode the number of nodes in the sub-tree first level.

networkType: communication type.

Type 0: client - server

Type 1: P2P

-subTreeSizeNbBits: number of bits used to decode the sub-tree size.

-geometryNodeSizeNbBits: number of bits used to decode the geometry size.

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8.14.3.6 WaveletDecoderConfig

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8.14.3.6.1 Syntax

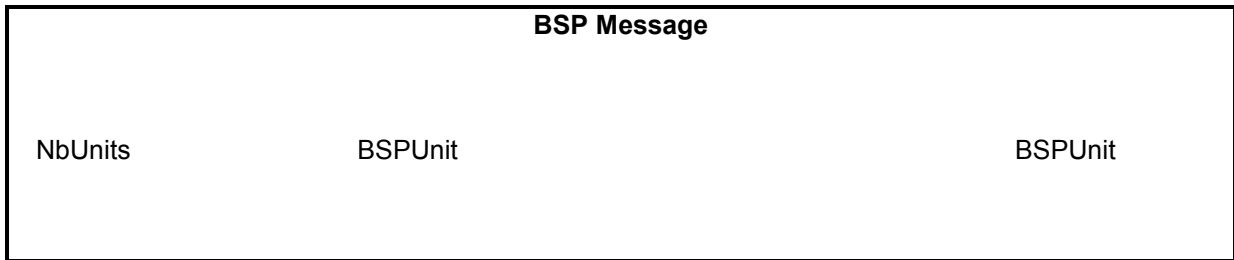
```
class WaveletDecoderConfig {
    int(6) unitCountNbBits;
    int(6) faceCountNbBits;
    int(6) geomNbBits;
}
```

8.14.3.6.2 SpacePartitionNodeMessage

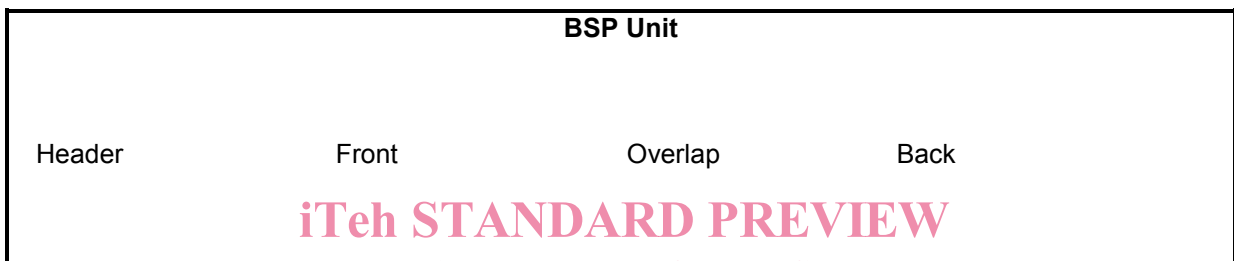
```
class SpacePartitionNodeMessage {
    switch(SpacePartitionDecoderConfig.type) {
        0: BSPNodeMessage;
        1: CellPortalNodeMessage;
        2: PVSNodeMessage;
        3: FootprintMessage;
        4: WaveletMessage;
    }
}
```

8.14.3.7 BSPNodeMessage

8.14.3.7.1 Overview



NbUnits : number of BSP Units defined below



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