

REAL 3D PRO-1000

Professional Series



MultiGen Database Development Manual



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MULTIGEN DATABASE GENERATION REQUIREMENTS

This document is designed to illustrate the ideal database hierarchy and necessary keywords required in MultiGen flight files for the REAL 3D PRO-1000 Application Program Interface (API) and Gemini OpenGVSTM software. The database hierarchy is required to properly set up the levels-of-detail (LODs) for hardware load management acceleration and to maximize the culling structure. The keywords are used as flags for the API and OpenGVSTM to set various mode words including LOD control.

REAL 3D PRO-1000 specific keywords can be declared in a flight file in two ways. First is by using syntax specific entries typed into the comment fields on the MultiGen attribute pages. The second method is to utilize the REAL 3D extended flight file fields created by REAL 3D for MultiGen II Pro for Windows NT™. The extended fields will contain text boxes to input values, but will not require syntax specific entries.

SETTING FLAGS USING COMMENTS

Flags can be set by placing comments in the group, object, LOD, and polygon attribute comment fields. In order for the API or OpenGVSTM to read an attribute, the keyword “#real3d” must be placed before the flags in each comment field. Sibling nodes will inherit the parent’s attributes. Flags can also be set using the extended flight file fields generated by REAL 3D (See Setting Flags Using REAL 3D Extensions).

#real3d – Must start the line in the comment field of any “flt” file feature that will contain keywords used by the PRO–1000. Attributes after this keyword will be read by the API or OpenGVSTM.

lod_model=on – This flag indicates that the child beads below this group node should be treated as model replacement LODs. The children under this group node will need to contain the *lod=x* keyword described below. Valid on Group nodes only.



lod_index=x – This sets the index number to be used from the blend table. This can be set on group, object, or LOD nodes. The *lod_index* can be redefined for any of the children. Also, when a parent node is deleted due to blending, all of its children are also deleted. The *lod_index* takes an integer value ranging from 0–127 (default is 0).

lod=x – This flag sets the replacement model number (LOD) for an LOD node. This node must be a child of a group node flagged with the *lod_model=on* keyword. The value assigned to the *lod* can only be 0, 1, 2, or 3. This can be set on group, object, or LOD nodes.

volume_clamp=on – This will clamp the size of the object and may only be placed on object nodes. The size is determined from the discard value set in the LOD index table (described in the LODs for MultiGen section). The last entry line will determine when the object will be clamped. This can only be set at the object level.

np_scale=x.x – This flag controls how a texture will be sampled. The argument is a real number. If the value is less than 1, then the texture will be undersampled. If the value is greater than 1, the texture will be oversampled. The keyword can be defined at the polygon level. If defined at the polygon, that polygon alone will have its *np* value multiplied. The value can also be set in the texture attributes on Series II (See Texture Attributes; PRO-1000 Additions). Setting the *np_scale* on the texture will cause all polygons using this texture to have their *np* values multiplied by the indicated amount. If the keyword is defined on a texture attributes page and then again on a polygon using the texture, the polygon *np_scale* value will be a multiplier to the *np_scale* indicated in the texture attributes (ie., total *np_scale* = texture *np_scale* * poly *np_scale* = 2.0 * 0.5 = 1.0). If no *np_scale* is given the default is 1.0.

edge_on_blend=on – This flag is set on the polygon node and enables polygons to blend out as the viewpoint gets edge on to the polygon.

u_mirror=on – This keyword is placed on the polygon node. This will mirror the texture in the *u* direction. This flag may also be set in the texture attributes page on the Series II tool (See Texture Attributes; PRO-1000 Additions). If this flag is set on the texture attribute, the mirror will occur on all polygons using the texture. If the flag is set on both the texture attribute and the polygon, no mirroring will occur.

v_mirror=on – This keyword is placed on the polygon node. This will mirror the texture in the *v* direction. This flag may also be set in the texture attributes page on the Series II tool



(See Texture Attributes; PRO-1000 Additions). If this flag is set on the texture attribute, the mirror will occur on all polygons using the texture. If the flag is set on both the texture attribute and the polygon, no mirroring will occur.

NOTE

Both `u_mirror` and `v_mirror` can be used on the same texture or polygon, if that is desired.

`u_smooth=on` – This keyword is placed on the polygon node. It will blend the edge pixels of a wrapping texture to avoid hard lines in the *u* direction. This flag may also be set in the texture attributes on the Series II tool (See Texture Attributes; PRO-1000 Additions). If this flag is set on the texture attribute, the smoothing will occur on all polygons using the texture. If the flag is set on both the texture attribute and the polygon, no smoothing will occur.

`v_smooth=on` – This keyword is placed on the polygon node. It will blend the edge pixels of a wrapping texture to avoid hard lines in the *v* direction. This flag may also be set in the texture attributes on the Series II tool (See Texture Attributes; PRO-1000 Additions). If this flag is set on the texture attribute, the smoothing will occur on all polygons using the texture. If the flag is set on both the texture attribute and the polygon, no smoothing will occur.

NOTE

Both `u_smooth` and `v_smooth` can be used on the same texture or polygon, if that is desired.

SETTING FLAGS USING REAL 3D EXTENSIONS

If you are using MultiGen II Pro NT from REAL 3D, the following extended flight fields will be available to you with the installation of the optional extensions package. To view these fields the user simply needs to expand the bubble labeled “REAL 3D Pro-1000” on the attribute pages of nodes that Real 3D has elected to extend. These extended fields are used in a direct replacement of having to remember syntax specific comments as described in Setting Flags Using Comments. When properly installed, the user should be able to see the following displays in the attribute pages. These fields are currently supported only through REAL 3D’s PRO-1000 API and not through OpenGVS.



GROUP NODE ATTRIBUTE EXTENSIONS

Group Attributes : g1

IDg1

☐ Global Attribute Modify

☐ Keep

Group

g4

Prev

Current

Group

g1

g5

Group

g2

<

Rel. Priority0

Special 10

Animation

☒ None ☐ Forward ☐ Fwd/Bwd

Significance0

Special 20

Replicate0

Layer0

Bounding Volume

☒ None ☐ Box ☐ Sphere ☐ Cylinder

☒ Attribute Extensions

☒ Real 3D Pro-1000

LOD Model

0

LOD Index

-1

Blend LOD

0

Comment or attribute extensions

Close

Help



LOD NODE ATTRIBUTE EXTENSIONS

LOD Attributes : 11

ID11

☐ Global Attribute Modify

☐ Keep

Group

g4

Group

Current

g5

Object

l1

o1

Down

<

0

0

Switch in10000000.00000

Transition Distance

Switch out0.000000

0.000000

☐ Use Previous Range

Special 10

☐ Additive LODs Below

Special 20

Center

x0.000000

Calculate Center

y0.000000

☐ Freeze Center

z0.000000

☒ Attribute Extensions

☒ Real 3D Pro-1000

LOD Index

-1

LOD Number

-1

Comment or attribute extensions

Close

Help



OBJECT NODE ATTRIBUTE EXTENSIONS

Object Attributes : o1

IDo1

☐ Global Attribute Modify

☐ Keep

Group

g4

LOD

Current

Next

11

o1

Down

Rel. Priority0

Special 10

Transparency1.000000

Special 20

Significance28

☐ Shadow

☐ Non-illuminated

☐ Flat Shaded

Inhibit display at☐ Day☐ Dusk☐ Night

☒ Attribute Extensions

☒ Real 3D Pro-1000

LOD Index1

Volume Clamp0

Comment or attribute extensions

Close

Help



POLYGON NODE ATTRIBUTE EXTENSIONS

Face Attributes : p6

Face ID p6

☐ Global Attribute Modify

☐ Keep

Group

SuperFace

g2

Face

Current

Next

p5

p6

SideFace

Vertex

/V1

☒ Attribute Extensions

☒ Real 3D Pro-1000

Edge on Blend

0

Number of Sides

3

Line Width

0.010000

Texture Sample Bias

1.000000

U Mirror

0

V Mirror

0

U Smooth

0

V Smooth

0

Comment or attribute extensions

Close

Help

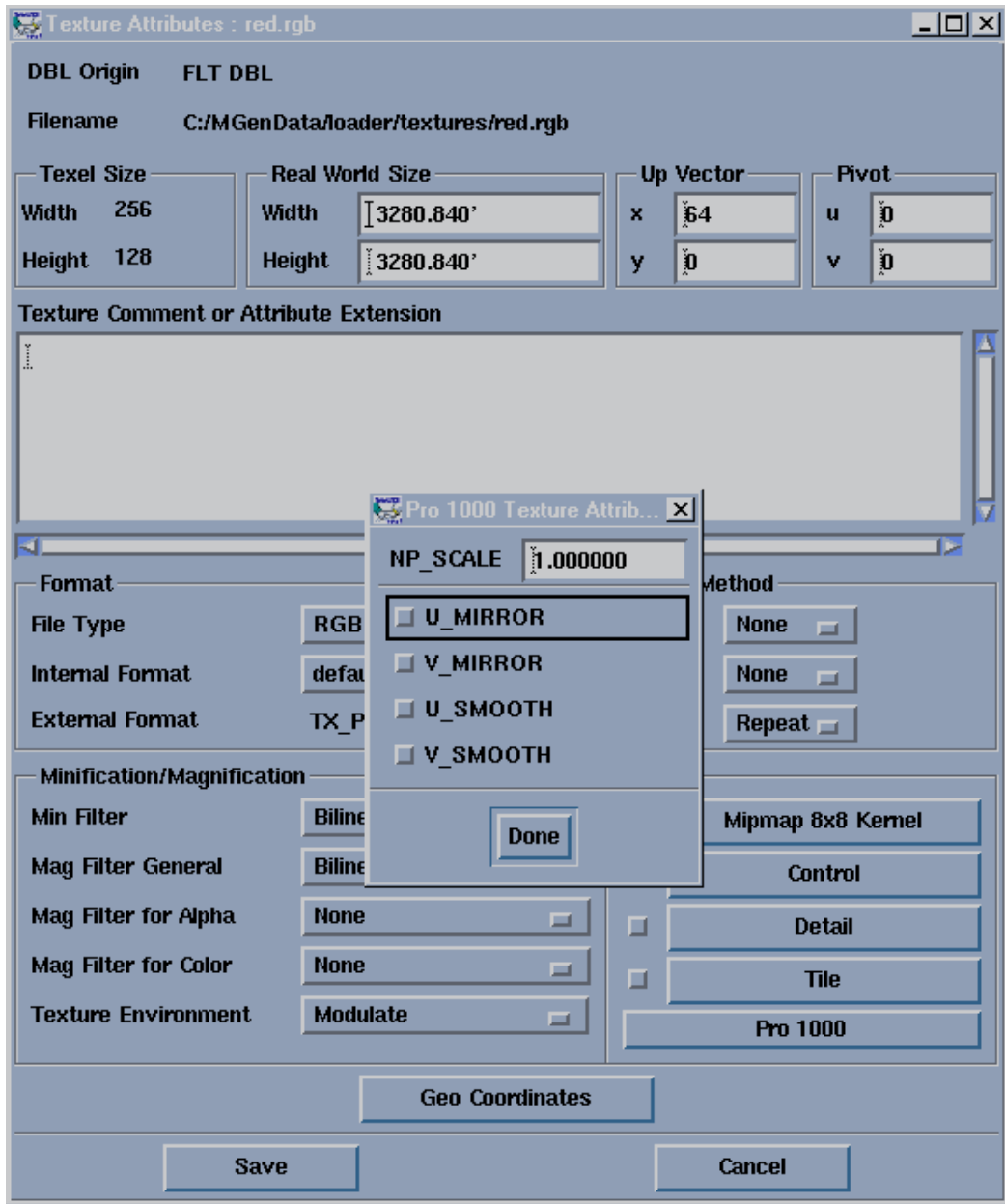


TEXTURE ATTRIBUTES: PRO-1000 ADDITIONS

MultiGen has added PRO-1000 specific keywords to their attributes page on Series II. To access these fields, go to the texture palette and modify the attributes (Ctrl + Equal) for the desired texture. Select the “PRO-1000” button to reveal another dialog box containing np_scale, u & v mirror , and u & v smooth. Values and flags placed in these fields will be globally applied to all polygons using the texture. (See Setting Flags Using Comments for a detailed breakdown of field definitions and interaction with similar polygon comments/extensions).



TEXTURE ATTRIBUTES: PRO-1000 ADDITIONS





LEVELS-OF-DETAIL (LODS) FOR MULTIGEN

There can be up to four LOD nodes defined under the group node that has been flagged with the *lod_model* keyword. If the REAL 3D extensions are being used, the “LOD” field will only exist on the LOD node. However, if comments are being used instead of the REAL 3D extended flight files, then the “lod=” syntax can be placed on either the Group, LOD, or Object nodes underneath the parent group that was flagged with “lod_model”.

Each of these LOD nodes must contain the *lod* keyword and an integer value that the LOD represents (0 is most detailed and 3 is the least detailed). Keep in mind that the PRO-1000 will blend completely from one node to the next in numerical order. All four LODs need not be defined. The software will fill in the missing LODs with the previous one until a new LOD is defined. See *lod.flt* or *another_lod.flt* for an example.

The “switch in” and “switch out” distances indicated in the LOD node attributes **are not used** by the PRO-1000 hardware if the lod keywords are used. The hardware reads a blend table that is set up by the user and transitions to each model based on its index number. For example: The group node of a model has an *lod_index* 27 set. The hardware will look up the blending parameters for that ID. A sample blend table entry may look something like this:

```
RLOD 27
  100 150
  200 250
  300 350
  500 525
```

The function call in the API for setting this data is:

```
void SetRangeBlendParameters ( 27 , 0 , 100 , 150 );
```

and so on, for all of the blend table entries.

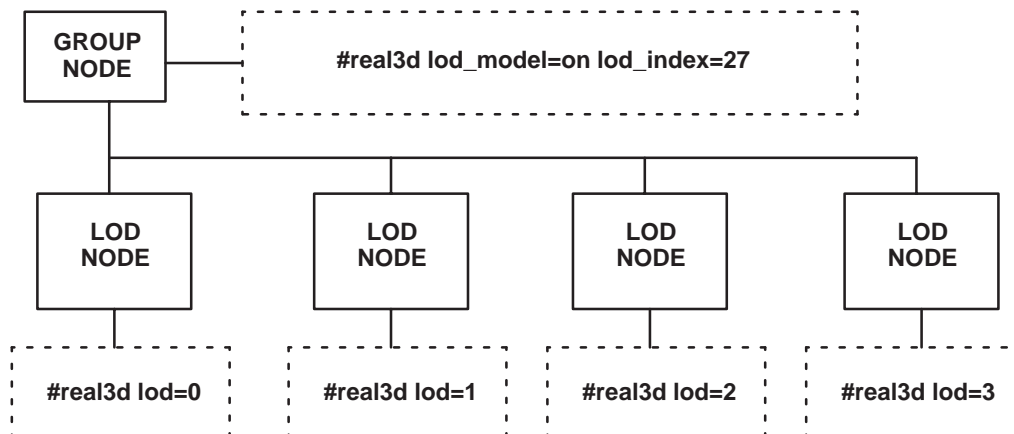


The first set of numbers states that the model will start blending from LOD 0 to LOD 1 at a distance of 100 units. It will finish blending to LOD 1 at 150 units. LOD 1 will start blending to LOD 2 at a distance of 200 units, and finish at 250 units. LOD 2 will start blending to LOD 3 at a distance of 300 units, and finish at 350 units. LOD 3 will start blending out of the scene at 500 units, and will be deleted at 525 units.

Another method of blending is to have the models blend by subtended angle instead of range. The blend table entry format can look very similar, but the values will be angles instead of range, therefore these values need to be set differently. The function call on the API for reading this data is:

```
void SetSizeBlendParameters (long feature_type, long  
    lod_number, float start_angle,  
    float delete_angle);
```

As many models as you desire can reference the same *lod_index* value. There are a total of 127 index values, so use them as you see fit. Mixing blend types is not allowable. The entire blend table assigned to a viewport has to be either range or size. Your MultiGen workstation's "switch in" and "switch out" distances are similar to the range-based principle. For previewing your scenes on the work station, it is recommended that you set the "switch in" and "switch out" distances of the LOD nodes to similar values called by your *lod_index*.



NOTE: Solid boxes are actual nodes in the hierarchy. Dashed boxes can be comment-field input or REAL 3D flight file extensions. If comments are being used instead of REAL 3D extensions, then these could be groups, objects, or LOD nodes.

Figure 1. LOD Example in MultiGen

SWITCH IN/SWITCH OUT

Software rendering of MultiGen's LOD nodes is permitted if the user does not desire to implement the REAL 3D keywords for load management. Please keep in mind that since the load management will occur in the software and will not be hardware accelerated, some performance impact may be noticed depending on the user's application and host computer.

MICROTEXTURE IN MULTIGEN

Microtexture is defined in MultiGen by using the detail texture attribute for a polygon. The texture palette number from MultiGen needs to be placed in the detail texture field in the polygon attribute page. Up to eight different textures can be used as microtexture maps.

The microtexture maps themselves need to be 128x128 pixels in size and need to be of the .rgb or .int type. No alpha channels are allowed on microtexture maps. The base map to which the microtexture is applied can be of any legal size or type (.rgb, .rgba, .int, .inta). One more note on microtexture is that it is an additive process. If microtexture is applied



to a base map that has an alpha channel, the microtexture will be blended into the translucent areas of the base texture.

DATABASE CONSTRUCTION

The hierarchy structure of the entire database can be no more than 14 levels deep. This includes the structure of any external references (and subsequent external references) called by the main flight file. When reading in a flight database, the software will collapse all hierarchy after the 14th level to be on the 14th level. If this is undesirable, the user may want to take the time to remove all unnecessary culling depth from the database.

The PRO-1000 is a fully Z-buffered machine, so Binary Separation Planes (BSP's) and drawing order do not make a difference. If the PRO-1000 API reads in a database with BSP data, those polygons will be ignored. Please make active use of sub-polygons for proper drawing of coplaner polygons. Sub-polygons in MultiGen will set stenciling bits for the PRO-1000 to determine drawing priority of coplaner polygons.

Another method for setting stenciling bits for drawing priority is through the use of the Layer field in group attributes. Two major rules need to be met for group layering to work. First, all of the polygons contained in all of the groups to be layered must be coplaner. Second, the area of the base layer (layer 0) must encompass the area of all of the subsequent sub layers (layer 1,...,n). See *layers.flt* as an example.

TRANSLUCENCY ON THE PRO-1000 SERIES

For maximum image quality and performance frugal use of translucency is encouraged on the PRO-1000 Series of image generators. This includes all types of MultiGen alpha found in textures, polygons, and materials. The best kind of alpha to use is contour texture translucency where the alpha channel is either 0 or 255. Enabling this type of texture translucency will allow texture anti-aliasing to continue. Ensure that materials assigned to polygons have their alpha values set to 1.0 if translucency is not needed on those polygons. Also, the REAL 3D PRO-1000 API MultiGen Loader will check all textures with alpha channels assigned to ensure that they are not totally opaque. If they are the software will discard the alpha channel.

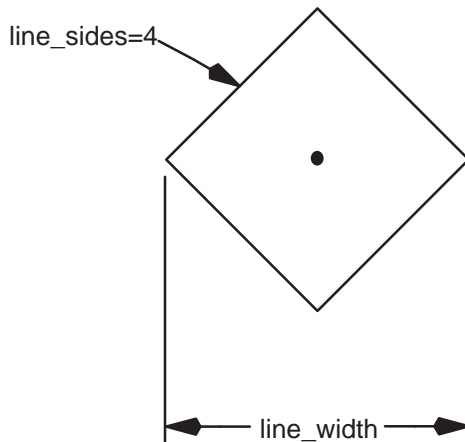


2-D LINES (WIREFRAME) IN MULTIGEN

Polygons that are flagged as wireframe in Multigen can be processed for the PRO, but can not be flown as 2-D lines. Instead, the line will be simulated with polygons in the form of a rod with n sides and a line width (diameter). Two keywords are to be used to describe the 2-D line.

line_sides=x – This will define the number of sides for the rod. Keyword is to be placed on the polygon flagged as wireframe.

line_width=x.x – This width is twice the distance from the line center to a vertex of a polygon comprising the line side. Keyword is to be placed on the polygon flagged as a wireframe.



Comment Field on Polygon Attribute Page:
#real3d line_sides=4 line_width=0.25

Figure 2. Wire Model Diagram



APPENDIX A – SUPPORTED MULTIGEN FIELDS

The following section contains attribute fields that are read by the REAL 3D PRO-1000 API. If fields other than these are set in MultiGen, they will be ignored by the API. The file should load and be displayed by the PRO in a similar fashion as if the tool had the unrecognized field set to the system default. For example, the API does not currently recognize “Relative Priority” on the polygon attributes. If the database displayed on the tool has a relative priority set to help determine the drawing order, the displayed database through the PRO would look as if all the polygons had a relative priority of zero.

GROUP NODES:

Animations

- None
- Forward
- Forward/Backward

Layer

- Layer will be supported in future release.

Replicate

- Replications and Instances are both recognized.

LOD NODES:

Switch In/Switch Out

- Load management will occur in software using these values if no REAL 3D comments or extensions are found for setting up hardware load management.



POLYGON NODES:

Polygon Fields

- Color
- Transparency
- Texture
- Detail Texture
- Material

Template

- Fixed/No Alpha
- Fixed/Alpha
- Z Axis/Alpha (a.k.a. billboards) will be supported in future release.

Polygon Drawing

- Normal
- Wireframe Closed
(requires further arguments. See 2-D Lines In MultiGen).
- Wireframe Unclosed
(requires further arguments. See 2-D Lines In MultiGen).
- Vertices as Lights

Light Directionality

- Omni-directional
- Uni-directional
- Bi-directional

Polygon Flags

- Both Sides Visible
- Draw Textured Face White



EXTERNAL REFERENCE NODES:

Palette Overrides

- Color
- Material
- Texture

DOF NODES:

The only values that are read by the REAL 3D PRO-1000 API are the MIN and MAX limits for which an articulated part can traverse. This will enable the software to calculate the proper culling radius. The PRO-1000 API can allow the articulated part to move in an unrestricted manner regardless of the limits set in the DOF node. However the written application should restrict the motion to the limits approximated in the DOF node, otherwise popping of the articulated part may occur.

Also, DOF nodes may be positioned as required since the API will read the set location of the DOF node. However, DOF nodes ***may not be rotated***. The XYZ axis of the DOF node must correspond to the XYZ axis of the world coordinates in order for the parts to behave properly.