

# 3Dlabs<sup>®</sup>

## Software Release Note

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*Windows NT 4.0*

*Display & OpenGL Drivers for  
GLINT<sup>®</sup> & PERMEDIA<sup>®</sup>*

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### **OpenGL Extension Appendices**

This note collects together appendices for various OpenGL extensions supported by the Windows NT 4.0 Display Driver and OpenGL Installable Client Driver for the GLINT and PERMEDIA graphics boards.

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## APPENDIX A

# OpenGL Overlay Planes Support

### Introduction

Overlay planes provide a method by which OpenGL applications can render over screen areas in a non-destructive way. A typical use of such functionality would be to draw dialog boxes above a rendered 3d scene. There would be no need to save and restore from a bitmap or re-render the scene when the dialog is cleared as the standard, main-plane, rendering remains intact. Overlay planes are used by many high end OpenGL applications as they are a common feature on Silicon Graphics hardware.

Overlay planes are not provided as a standard part of OpenGL in the way that stencil or depth buffers are. On Windows NT Microsoft define a standard overlay plane specification as part of the WGL interface. This interface is used by Windows NT OpenGL applications which require overlay functionality, notably Softimage.

### Implementation

The Microsoft overlays standard provides for up to 15 levels of underlay and 15 levels of overlay in addition to the main rendering plane. Each level of underlay or overlay, referred to as a layer plane, has it's own layer plane descriptor structure. This structure is similar to the standard pixel format descriptor and allows each layer to define it's own device capabilities independent of the main plane or other layer planes. This allows a double buffered, rgb main plane to coexist with single buffered, color index overlay plane etc. Each layer defines a color which is defined to be transparent and allows rendering in lower planes to show through. Functions are provided for creating rendering contexts in layer planes, manipulating the palettes of color index layers and swapping layer planes independently of the main plane if the graphics device supports this capability.

3Dlabs drivers support OpenGL overlays on Racer based boards only. On such boards overlays are provided in 32bpp truecolor display modes. In standard truecolor modes each 32bit pixel is split into 8 bits of red, green, blue and alpha. Overlays are provided by replacing the alpha component with 8 bits of overlay. Thus a single 8 bit color index overlay is provided in addition to a 24 bit rgb main plane.

The overlay plane is single buffered if the main plane is single buffered and double buffered if the main plane is double buffered. Independent swaps of the main and overlay planes are supported when blit double buffered. When full-screen double buffered, such as when an OpenGL application takes up the entire display, independent swaps are not supported.

To provide access to OpenGL overlays in 32bpp modes extra pixel formats are exported, in addition to the standard pixel formats. These extra pixel formats are defined to have an 8 bit overlay plane but no alpha. As soon as any OpenGL application chooses a pixel format of one type or the other all the pixel formats that are exported are changed to only support that mode. For instance, if the first pixel format chosen includes overlays all the remaining pixel formats exported will be changed to export overlays but not alpha and vice versa. When all OpenGL windows are closed the system reverts to exporting a choice of pixel formats. The driver must work in this way as setting overlay mode is a global change and alpha and overlay planes cannot be supported simultaneously.

When overlay planes are used an additional registry variable must be set, otherwise icon corruption may be seen,

`DisableOffScreenBitmaps`

This variable should be created as a DWORD value in the same place as the other GLINT variables (described in the section, Registry Variables) and set to a value of one. A reboot is necessary for this change to take affect

If the Softimage rendering package (which requires overlay plane functionality) is used we recommend that one of the SupportSoftimage registry variables are set. Full details on these variables are given earlier in the section describing all of the registry variables. This will optimize the OpenGL drivers for use with the package.

Readers are referred to Appendix A in the 3Dlabs OpenGL Extensions document for further information about the use of OpenGL overlay planes.

## APPENDIX B

# OpenGL Overlay Planes Extension for Windows NT

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### Overview

Overlay and underlay planes are used in many high-end 3-D graphics applications. This extension allows such applications to use the hardware overlay and underlay planes in Windows NT 3.51.

In Windows NT, the pixel formats describe the pixel configurations of a graphics device. Each pixel format includes a description of the depth and other characteristics of the main color buffers and also tells what additional buffers (depth, accumulation, stencil, auxiliary) are associated with the main plane. The pixel format is hereby extended to include information about the overlay and underlay buffers that are available through the pixel format.

A layer plane has at least a front-left color buffer, and may optionally include right and/or back color buffers. It may share depth, accumulation, and stencil buffers with the main plane.

A layer plane specific rendering context is used to render into the layer buffers. GDI drawing is not available in layer planes.

The layer color buffers are managed as part of a normal window similar to the main color buffers. Each window has its own layer color buffers. Multiple windows with overlay and/or underlay planes can be displayed at the same time. The extension requires no additional window management and modifications to the existing clip change notification mechanism of the DDI. This reduces complexity and allows the extension to be supported in Windows NT 3.51 with minimal changes. The extension does not support free floating overlay windows that can move over any window in the main drawing plane. Such free floating windows would require additional overlay window management or access serialization in applications. The extension also does not support hardware pop-up plane that has no transparent color because it would obscure underlying planes in the window at all times.

Each layer plane in a window has an associated palette. The palette of a color-index layer plane can be set by the application, while the palette of an RGBA color plane is fixed. It is the responsibility of the application to realize the palette when the window is in the foreground. In addition, it has a transparent pixel color or index that allows the underlying planes to show through the layer plane.

The state of a rendering context can be copied to another rendering context in a different layer plane. Display lists can also be shared by rendering contexts in different layer planes.

### New Procedures and Functions

BOOL wglDescribeLayerPlane(hdc, iPixelFormat, iLayerPlane, nBytes, plpd)

HDC hdc;

int iPixelFormat;

int iLayerPlane;

UINT nBytes;

LPLAYERPLANEDESCRIPTOR plpd;

int wglSetLayerPaletteEntries(hdc, iLayerPlane, iStart, cEntries, pcr)

HDC hdc;

int iLayerPlane;

int iStart;

int cEntries;

CONST COLORREF \*pcr;

int wglGetLayerPaletteEntries(hdc, iLayerPlane, iStart, cEntries, pcr)

HDC hdc;

```
int      iLayerPlane;
int      iStart;
int      cEntries;
COLORREF *pcr;
```

```
BOOL     wglRealizeLayerPalette(hdc, iLayerPlane, bRealize)
HDC      hdc;
int      iLayerPlane;
BOOL     bRealize;
```

```
BOOL     wglSwapLayerBuffers(hdc, fuPlanes)
HDC      hdc;
UINT     fuPlanes;
```

```
HGLRC    wglCreateLayerContext(hdc, iLayerPlane)
HDC      hdc;
int      iLayerPlane;
```

```
BOOL     wglCopyContext (hglrcSrc, hglrcDst, mask)
HGLRC    hglrcSrc;
HGLRC    hglrcDst;
UINT     mask;
```

## New Tokens and Data Structures

```
typedef struct tagLAYERPLANEDESCRIPTOR { // lpd
    WORD      nSize;
    WORD      nVersion;
    DWORD     dwFlags;
    BYTE      iPixelFormat;
    BYTE      cColorBits;
    BYTE      cRedBits;
    BYTE      cRedShift;
    BYTE      cGreenBits;
    BYTE      cGreenShift;
    BYTE      cBlueBits;
    BYTE      cBlueShift;
    BYTE      cAlphaBits;
    BYTE      cAlphaShift;
    BYTE      cAccumBits;
    BYTE      cAccumRedBits;
    BYTE      cAccumGreenBits;
```

```

BYTE      cAccumBlueBits;
BYTE      cAccumAlphaBits;
BYTE      cDepthBits;
BYTE      cStencilBits;
BYTE      cAuxBuffers;
BYTE      iLayerPlane;
BYTE      bReserved;

COLORREF   crTransparent;
} LAYERPLANEDESCRIPTOR;

```

Accepted by the dwFlags field of LAYERPLANEDESCRIPTOR:

```

LPD_SUPPORT_OPENGL
LPD_SUPPORT_GDI
LPD_DOUBLEBUFFER
LPD_STEREO
LPD_SWAP_EXCHANGE
LPD_SWAP_COPY
LPD_TRANSPARENT
LPD_SHARE_DEPTH
LPD_SHARE_STENCIL
LPD_SHARE_ACCUM

```

Accepted by the iPixelFormat field of LAYERPLANEDESCRIPTOR:

```

LPD_TYPE_RGBA
LPD_TYPE_COLORINDEX

```

Accepted by the dwFlags field of PIXELFORMATDESCRIPTOR:

```

PFD_SWAP_LAYER_BUFFERS

```

Accepted by the fuPlanes parameter of wglSwapLayerBuffers:

```

WGL_SWAP_MAIN_PLANE
WGL_SWAP_OVERLAYi, where i is between 1 and 15.
WGL_SWAP_UNDERLAYi, where i is between 1 and 15.

```

## Pixel Format Descriptor

A pixel format identifies a particular buffer configuration of a graphics device, and is described by the pixel format descriptor. The pixel format descriptor is extended to include the number of overlay and underlay planes in the pixel format. Two pixel formats that have identical main planes but different layer planes are now two distinct pixel formats. Previously, they were both identified in a single pixel format when overlay was not supported.

Each pixel format can include up to 15 overlay planes and up to 15 underlay planes. All pixel formats must include the main color plane.

If a pixel format includes an underlay plane, the pixel format must provide a transparent pixel color or index, depending on the pixel type, that allows the pixels of the underlying plane to show through the main color plane. All other layer planes except the lowest numbered underlay plane must provide a transparent pixel color or index, depending on the pixel type of the overlay or underlay plane.

A window can be set up to use a particular pixel format. All planes identified in the pixel format, including the overlay and underlay planes, are part of the regular window. Applications can create multiple windows each with a different layer plane configuration. These windows can be displayed at the same time. There is no additional management for these windows other than the normal window management. The layer planes share the same main window region and are updated at the same time as the main window. Free floating overlay windows that can move over any window in the main drawing plane are not supported.

The depth, accumulation and stencil buffers may be shared by all layer planes in a window.

## Changes to PIXELFORMATDESCRIPTOR

dwFlags	Add the following flag
	<b>PFD_SWAP_LAYER_BUFFERS</b>
	Indicates whether the device can swap individual layer planes other than all layer planes as a group if the pixel format includes double-buffered overlay or underlay planes. If this flag is not set, the wglSwapLayerBuffers function is not supported.
iLayerType	Ignored.
bReserved	Count of up to 15 overlay planes (bit 0-3) and up to 15 underlay planes (bit 4-7)
dwLayerMask	Ignored.
dwVisibleMask	Specifies the transparent color or index if there is an underlay plane. If the pixel type is RGBA, it is a transparent RGB color. If the pixel type is color index, it is a transparent index.
dwDamageMask	Ignored.

## Examining Layer Planes of a Pixel Format

The wglDescribeLayerPlane function obtains information about the layer planes of a given pixel format.

### wglDescribeLayerPlane

```

BOOL wglDescribeLayerPlane(hdc, iPixelFormat, iLayerPlane, nBytes, plpd)
HDC   hdc;
int    iPixelFormat;
int    iLayerPlane;
UINT   nBytes;
LPLAYERPLANEDESCRIPTOR plpd;
```

The wglDescribeLayerPlane function obtains information about an overlay or underlay plane of a given pixel format of the device associated with hdc. The function sets the members of the LAYERPLANEDESCRIPTOR structure pointed to by plpd with that layer plane information.

#### Parameters

hdc

Specifies the device context.

iPixelFormat

Specifies the pixel format whose layer plane is of interest.

iLayerPlane

Identifies the overlay or underlay plane of interest. The value 1 identifies the first overlay plane over the main plane, 2 the second overlay plane over the first overlay plane and the main plane, and so on. The value -1 identifies the first

underlay plane under the main plane, -2 the second underlay plane under the first underlay plane and the main plane, and so on. The number of overlay and underlay planes is given in the bReserved field of the pixel format descriptor.

#### nBytes

Specifies the size, in bytes, of the structure pointed to by plpd. The function stores data to that structure; it stores no more than nBytes bytes. Set this value to sizeof(LAYERPLANEDESCRIPTOR).

#### plpd

Pointer to a LAYERPLANEDESCRIPTOR structure whose members the function sets with layer plane data. The function stores the number of bytes copied to the structure in the structure's nSize field.

#### Return Value

If the function succeeds, the return value is TRUE and the function sets the members of the LAYERPLANEDESCRIPTOR structure pointed to by plpd according to the specified layer plane of the given pixel format. If the function fails, the return value is FALSE. Call GetLastError for extended error information.

#### Comments

The layer planes are ordered by the plane number. Higher numbered planes overlay lower numbered planes.

#### See Also

DescribePixelFormat, wglCreateLayerContext, PIXELFORMATDESCRIPTOR, LAYERPLANEDESCRIPTOR

### Layer Plane Descriptor

```
typedef struct tagLAYERPLANEDESCRIPTOR { // lpd
```

```
    WORD    nSize;
    WORD    nVersion;
    DWORD   dwFlags;
    BYTE    iPixelFormat;
    BYTE    cColorBits;
    BYTE    cRedBits;
    BYTE    cRedShift;
    BYTE    cGreenBits;
    BYTE    cGreenShift;
    BYTE    cBlueBits;
    BYTE    cBlueShift;
    BYTE    cAlphaBits;
    BYTE    cAlphaShift;
    BYTE    cAccumBits;
    BYTE    cAccumRedBits;
    BYTE    cAccumGreenBits;
    BYTE    cAccumBlueBits;
    BYTE    cAccumAlphaBits;
```



```

BYTE      cDepthBits;
BYTE      cStencilBits;
BYTE      cAuxBuffers;
BYTE      iLayerPlane;
BYTE      bReserved;

COLORREF   crTransparent;
} LAYERPLANEDESCRIPTOR;

```

The LAYERPLANEDESCRIPTOR structure describes a layer plane of a pixel format.

### Members

#### nSize

Specifies the size of this data structure. This value should be set to sizeof(LAYERPLANEDESCRIPTOR).

#### nVersion

Specifies the version of this data structure. This value should be set to 1.

#### dwFlags

A set of flags that specify the properties of the layer plane.

##### LPD\_SUPPORT\_OPENGL

The layer plane supports OpenGL drawing.

##### LPD\_SUPPORT\_GDI

The layer plane supports GDI drawing. This flag is not supported in the current implementation.

##### LPD\_DOUBLEBUFFER

The layer plane is double-buffered. A layer plane may be double-buffered even if the main plane is single-buffered and vice versa.

##### LPD\_STEREO

The layer plane is stereoscopic. A layer plane may be stereoscopic even if the main plane is monoscopic and vice versa.

##### LPD\_SWAP\_EXCHANGE

In a double-buffered layer plane, swapping the color buffers causes the back buffer and the front buffer contents to be exchanged. Following the swap, the back buffer contains the front buffer content before the swap. This flag is only a hint and may not be provided by the driver.

##### LPD\_SWAP\_COPY

In a double-buffered layer plane, swapping the color buffers causes the back buffer content to be copied to the front buffer. The back buffer content is not affected by the swap. This flag is only a hint and may not be provided by the driver.

##### LPD\_TRANSPARENT

There is a transparent color or index value, as given in the crTransparent field of this structure, that allows underlying layer pixels to show through this layer. A transparent color or index exists for all layer planes except the lowest numbered underlay plane.

##### LPD\_SHARE\_DEPTH

The layer plane shares the depth buffer with the main plane.

##### LPD\_SHARE\_STENCIL

The layer plane shares the stencil buffer with the main plane.

##### LPD\_SHARE\_ACCUM

The layer plane shares the accumulation buffer with the main plane.

**iPixelFormat**

Specifies the type of pixel data. The following types are defined:

Value	Meaning
LPD_TYPE_RGBA	RGBA pixels. Each pixel has four components: red, green, blue, and alpha.
LPD_TYPE_COLORINDEX	Color index pixels. Each pixel uses a color index value.

**cColorBits**

Specifies the number of color bitplanes in each color buffer in the layer plane. For RGBA pixel types, it is the size of the color buffer excluding the alpha bitplanes. For color index pixels, it is the size of the color index buffer.

**cRedBits**

Specifies the number of red bitplanes in each RGBA color buffer.

**cRedShift**

Specifies the shift count for red bitplanes in each RGBA color buffer.

**cGreenBits**

Specifies the number of green bitplanes in each RGBA color buffer.

**cGreenShift**

Specifies the shift count for green bitplanes in each RGBA color buffer.

**cBlueBits**

Specifies the number of blue bitplanes in each RGBA color buffer.

**cBlueShift**

Specifies the shift count for blue bitplanes in each RGBA color buffer.

**cAlphaBits**

Specifies the number of alpha bitplanes in each RGBA color buffer.

**cAlphaShift**

Specifies the shift count for alpha bitplanes in each RGBA color buffer.

**cAccumBits**

Not used. Must be zero.

**cAccumRedBits**

Not used. Must be zero.

**cAccumGreenBits**

Not used. Must be zero.

**cAccumBlueBits**

Not used. Must be zero.

**cAccumAlphaBits**

Not used. Must be zero.

**cDepthBits**

Not used. Must be zero.

**cStencilBits**

Not used. Must be zero.

**cAuxBuffers**

Specifies the number of auxiliary buffers.

**iLayerPlane**

Specifies the layer plane number. The value 1 identifies the first overlay plane over the main plane, 2 the second overlay plane over the first overlay plane and the main plane, and so on. The value -1 identifies the first underlay plane under the main plane, -2 the second underlay plane under the first underlay plane and the main plane, and so on.

bReserved

Not used. Must be zero.

crTransparent

Specifies the transparent color or index value if the LPD\_TRANSPARENT flag is set. Typically, this value is 0.

## Managing Layer Palette Entries

Each color-index layer plane in a window has an associated palette that can be set with `wglSetLayerPaletteEntries`. Initially, the layer palette contains white colors. The palette entries can be retrieved by calling `wglGetLayerPaletteEntries`. They are mapped into the physical palette in `wglRealizeLayerPalette`. The palette of the main plane is managed by GDI.

Although a RGBA layer plane does not have a settable palette, its palette must be initialized in `wglRealizeLayerPalette`.

## wglSetLayerPaletteEntries

```
int      wglSetLayerPaletteEntries(hdc, iLayerPlane, iStart, cEntries, pcr)
HDC      hdc;
int      iLayerPlane;
int      iStart;
int      cEntries;
CONST COLORREF *pcr;
```

The `wglSetLayerPaletteEntries` function sets the palette entries in a given color-index layer plane of the window referenced by `hdc`.

### Parameters

`hdc`

Specifies a device context of the window whose layer's palette is to be modified.

`iLayerPlane`

Identifies the overlay or underlay plane of interest. The value 1 identifies the first overlay plane over the main plane, 2 the second overlay plane over the first overlay plane and the main plane, and so on. The value -1 identifies the first underlay plane under the main plane, -2 the second underlay plane under the first underlay plane and the main plane, and so on. The number of overlay and underlay planes is given in the `bReserved` field of the pixel format descriptor.

`iStart`

Specifies the first palette entry to be set.

`cEntries`

Specifies the number of palette entries to be set.

`pcr`

Points to the first member of an array of `cEntries` `COLORREF` structures containing the RGB values.

### Return Value

If the function succeeds, the return value is the number of entries that were set in the palette in the layer plane of the window. If the function fails or no pixel format has been selected, the return value is zero. To get extended error information, call `GetLastError`.

### Comments

Each color-index layer plane in a window has a palette whose size is determined by the number of color bitplanes. If there are  $n$  bitplanes in the layer plane, the size of its palette is  $2^n$ . The palette entry corresponding to the transparent index, if it exists, cannot be modified. The layer palette is realized in `wglRealizeLayerPalette`.

Initially, the layer palette contains white colors.

The `wglSetLayerPaletteEntries` function does not set the palette entries of the main plane. Use GDI palette functions to update the main plane palette.

**See Also**

wglRealizeLayerPalette, wglGetLayerPaletteEntries, wglDescribeLayerPlane, LAYERPLANEDESCRIPTOR

**wglGetLayerPaletteEntries**

```
int      wglGetLayerPaletteEntries(hdc, iLayerPlane, iStart, cEntries, pcr)
HDC      hdc;
int      iLayerPlane;
int      iStart;
int      cEntries;
COLORREF *pcr;
```

The wglGetLayerPaletteEntries function retrieves the palette entries from a given color-index layer plane of the window referenced by hdc.

**Parameters**

hdc

Specifies a device context of the window whose layer's palette is to be retrieved.

iLayerPlane

Identifies the overlay or underlay plane of interest. The value 1 identifies the first overlay plane over the main plane, 2 the second overlay plane over the first overlay plane and the main plane, and so on. The value -1 identifies the first underlay plane under the main plane, -2 the second underlay plane under the first underlay plane and the main plane, and so on. The number of overlay and underlay planes is given in the bReserved field of the pixel format descriptor.

iStart

Specifies the first palette entry to be retrieved.

cEntries

Specifies the number of palette entries to be retrieved.

pcr

Points to an array of COLORREF structures to receive the palette RGB values. The array must contain at least as many structures as specified by the cEntries parameter.

**Return Value**

If the function succeeds, the return value is the number of palette colors retrieved from the layer plane of the window. If the function fails or no pixel format has been selected, the return value is zero. To get extended error information, call GetLastError.

**Comments**

The RGB value of the palette entry corresponding to the transparent index, if it exists, is undefined.

Initially, the layer palette contains white colors.

The wglGetLayerPaletteEntries function does not retrieve the palette entries of the main plane. Use GDI palette functions to retrieve the main plane palette.

**See Also**

wglSetLayerPaletteEntries

**wglRealizeLayerPalette**

```
BOOL     wglRealizeLayerPalette(hdc, iLayerPlane, bRealize)
HDC      hdc;
int      iLayerPlane;
BOOL     bRealize;
```

The `wglRealizeLayerPalette` function maps palette entries from a given color-index layer plane into the physical palette or initializes the palette of a RGBA layer plane.

#### Parameters

`hdc`

Specifies a device context of the window whose layer's palette is to be realized into the physical palette.

`iLayerPlane`

Identifies the overlay or underlay plane of interest. The value 1 identifies the first overlay plane over the main plane, 2 the second overlay plane over the first overlay plane and the main plane, and so on. The value -1 identifies the first underlay plane under the main plane, -2 the second underlay plane under the first underlay plane and the main plane, and so on. The number of overlay and underlay planes is given in the `bReserved` field of the pixel format descriptor.

`bRealize`

Indicates whether the palette is to be realized in the physical palette. If `bRealize` is `TRUE`, the palette entries are mapped into the physical palette where available. If `bRealize` is `FALSE`, the palette entries for the layer plane of the window are no longer needed and may be released for use by a different foreground window.

#### Return Value

If the function succeeds, the return value is `TRUE`. The function returns success even if `bRealize` is `TRUE` and the physical palette is unavailable at the time. If the function fails or no pixel format has been selected, the return value is `FALSE`. To get extended error information, call `GetLastError`.

#### Comments

The physical palette for a layer plane is a shared resource among windows with layer planes. If more than one window realizes a palette for a given physical layer plane, only one palette is realized at a time. The layer palette of a foreground window is always realized when `wglRealizeLayerPalette` is called.

When a window's layer palette is realized, its palette entries are always mapped 1-1 into the physical palette. Unlike GDI logical palettes, the system makes no attempt to map other windows' layer palettes to the current physical palette.

Whenever a window becomes foreground, it should call `wglRealizeLayerPalette` to re-realize its layer palettes even if the pixel type of the layer plane is `RGBA`.

The `wglRealizeLayerPalette` function does not realize the palette entries of the main plane. Use GDI palette functions to realize the main plane palette.

#### See Also

`wglSetLayerPaletteEntries`

## Swapping Layer Plane Buffers

The layer plane color buffers are swapped in `wglSwapLayerBuffers`.

### `wglSwapLayerBuffers`

`BOOL wglSwapLayerBuffers(hdc, fuPlanes)`

`HDC hdc;`

`UINT fuPlanes;`

The `wglSwapLayerBuffers` function swaps the front and back buffers in the overlay, underlay, and main planes of the window referenced by the specified device context.

#### Parameters

`hdc`

Specifies a device context of the window whose layer planes are of interest.

`fuPlanes`

Specifies the overlay, underlay, and main planes whose front and back buffers are to be swapped. The number of overlay and underlay planes is given in the `bReserved` field of the pixel format descriptor. This parameter is a bitwise combination of the following values:

Value	Description
<code>WGL_SWAP_MAIN_PLANE</code>	Swaps the front and back buffers of the main plane.
<code>WGL_SWAP_OVERLAY<sub>i</sub></code>	Swaps the front and back buffers of the overlay plane <i>i</i> , where <i>i</i> is between 1 and 15. <code>WGL_SWAP_OVERLAY1</code> identifies the first overlay plane over the main plane, <code>WGL_SWAP_OVERLAY2</code> the second overlay plane over the first overlay plane and the main plane, and so on.
<code>WGL_SWAP_UNDERLAY<sub>i</sub></code>	Swaps the front and back buffers of the underlay plane <i>i</i> , where <i>i</i> is between 1 and 15. <code>WGL_SWAP_UNDERLAY1</code> identifies the first underlay plane under the main plane, <code>WGL_SWAP_UNDERLAY2</code> the second underlay plane under the first underlay plane and the main plane, and so on.

### Return Value

If the function succeeds, the return value is `TRUE`. If the function fails, the return value is `FALSE`. Call `GetLastError` for extended error information.

### Comments

If the layer plane does not include a back buffer, then this call has no effect on that layer plane. The state of the back buffer content following the swap is given in the corresponding layer plane descriptor of the layer plane or the pixel format descriptor of the main plane.

The `wglSwapLayerBuffers` function swaps the front and back buffers in the specified layer planes simultaneously.

Not all devices support swapping layer planes individually other than all layer planes as a group. This is indicated by the `PFD_SWAP_LAYER_BUFFERS` flag in the pixel format descriptor.

A multithreaded application should flush the drawing commands in any other threads drawing to the same window before calling the `wglSwapLayerBuffers` function.

### See Also

`SwapBuffers`, `LAYERPLANEDESCRIPTOR`, `PIXELFORMATDESCRIPTOR`

## SwapBuffers

Add to Comments

If the window includes double-buffered overlay and underlay planes, `SwapBuffers` swaps the front and back buffers of all planes simultaneously. Use the `wglSwapLayerBuffers` function to swap individual layer plane buffers.

## Rendering in Layer Planes

A layer plane specific rendering context is used to render into the layer buffers. GDI drawing is not available in layer planes.

### wglCreateLayerContext

`HGLRC wglCreateLayerContext(hdc, iLayerPlane)`

`HDC`    `hdc`;

`int`     `iLayerPlane`;

The `wglCreateLayerContext` function creates a new OpenGL rendering context. The rendering context is suitable for drawing to the specified layer plane on the device referenced by `hdc`. The rendering context has the same pixel format as the device context.

**Parameters****hdc**

Handle to a device context. The function creates an OpenGL rendering context suitable for the device the device context references.

**iLayerPlane**

Identifies the layer plane to which the rendering context is bound. The value 0 identifies the main plane. The value 1 identifies the first overlay plane over the main plane, 2 the second overlay plane over the first overlay plane and the main plane, and so on. The value -1 identifies the first underlay plane under the main plane, -2 the second underlay plane under the first underlay plane and the main plane, and so on. The number of overlay and underlay planes is given in the bReserved field of the pixel format descriptor.

**Return Value**

If the function succeeds, the return value is a valid handle to an OpenGL rendering context. If the function fails, the return value is NULL. Call GetLastError for extended error information.

**Comments**

A rendering context, or GLRC, is a port through which all OpenGL commands pass. Every thread that makes OpenGL calls needs to have a current OpenGL rendering context.

A rendering context is not the same as a device context. A device context contains information pertinent to GDI, and a rendering context contains information pertinent to OpenGL.

An application should set the device context's pixel format before creating a rendering context. See the SetPixelFormat function.

A rendering context can only be used in the specified plane of a window with the same pixel format.

To use OpenGL, an application creates a rendering context, selects it as a thread's current rendering context, then calls OpenGL functions. When the application is finished with the rendering context, it disposes of it by calling wglDeleteContext. Here's a code example:

```
// The following code fragment shows how to render to overlay plane 1.
```

```
// This assumes that the pixel format of hdc includes overlay plane 1.
```

```
HDC  hdc;  
HGLRC hglrc;
```

```
// create a rendering context for overlay plane 1
```

```
hglrc = wglCreateLayerContext (hdc, 1);
```

```
// make it the calling thread's current rendering context  
wglMakeCurrent (hdc, hglrc);
```

```
// call OpenGL APIs as desired ...  
.  
.  
.
```

```
// when the rendering context is no longer needed ...
```

```
// make the rendering context not current
```

```
wglMakeCurrent (NULL, NULL) ;
```

```
// delete the rendering context
```

```
wglDeleteContext (hglrc);
```

**See Also**

SetPixelFormat, wglCreateContext, wglDeleteContext, wglGetCurrentContext, wglGetCurrentDC, wglMakeCurrent

## Synchronizing Rendering State in Layer Planes

The rendering state of a rendering context can be copied to another rendering context in wglCopyContext. Rendering contexts can also share display lists in the existing wglShareLists function.

### wglCopyContext

BOOL wglCopyContext (hglrcSrc, hglrcDst, mask)

HGLRC hglrcSrc;

HGLRC hglrcDst;

UINT mask;

The wglCopyContext function copies selected groups of rendering state from one OpenGL rendering context to another.

**Parameters**

hglrcSrc

Specifies the source OpenGL rendering context.

hglrcDst

Specifies the destination OpenGL rendering context.

mask

Specifies which groups of hglrcSrc rendering state are to be copied to hglrcDst. It contains the bitwise OR of the same symbolic names that are passed to the OpenGL command glPushAttrib. The value GL\_ALL\_ATTRIB\_BITS can be used to copy the maximum possible groups of rendering state.

**Return Value**

If the function succeeds, the return value is TRUE. If the function fails, the return value is FALSE. To get extended error information, call GetLastError.

**Comments**

The wglCopyContext function allows an application to synchronize rendering state of two OpenGL rendering contexts.

You can only copy rendering state between two rendering contexts within the same process. In addition, the rendering contexts must be provided by the same OpenGL implementation. For example, you can always copy rendering state between two rendering contexts of a given pixel format in the same process.

Not all values for OpenGL state can be copied. For example, pixel pack and unpack state, render mode state, and select and feedback state are not copied. The state that can be copied is exactly the state that is manipulated by the OpenGL command glPushAttrib.

The destination rendering context hglrcDst should not be current to any thread when calling wglCopyContext.



**See Also**

glPushAttrib, wglCreateLayerContext, wglCreateContext, wglShareLists

## APPENDIX C

### OpenGL Paletted Texture Extension Support

This appendix describes the programming steps required for OpenGL applications to take advantage of the support in the GLINT 500TX for palette textures. The implementation is based upon the extension recently proposed by Microsoft (refer to Appendix C for further details).

In the example code for downloading a 4-bit indexed texture below, note the following:

Extensions to OpenGL (in this case the functions `glColorTableEXT`, `glGetColorTableEXT` etc..) are not directly exported by the OpenGL dynamic link library. Instead the name of the required function ( for example “`glGetColorTableEXT`” ) is passed as a string to the Win32 function `wglGetProcAddress` which returns a suitable function pointer . The function is invoked by dereferencing this pointer with the appropriate arguments.

The GLINT 500TX only supports 1, 2 and 4-bit indexed textures with an on-chip texture LUT of 16 entries of RGBA (with each component in the table stored to 8-bits precision).

The PERMEDIA only supports 4-bit indexed textures with an on-chip texture LUT of 16 entries of RGB (the alpha component is unused. Each component in the table is stored to 5-bits precision, the bottom 3-bits are ignored internally ).

When downloading the palette texture by calling `glTexImage1D` or `glTexImage2D`, the format parameter must be set to `GL_COLOR_INDEX` and the components parameter to `GL_COLOR_INDEX4_EXT` (in the case of a 4-bit texture). There is no way at present of presenting the texel indices pre-packed to the OpenGL call (i.e. each index occupies a full data type, e.g. a byte if `GL_UNSIGNED_BYTE` is specified for the type parameter even though two 4-bit indices could be packed per byte). **However** the texel indices are stored packed after downloading into the local buffer memory.

```
// Add these defines to gl.h
#define GL_COLOR_INDEX1_EXT           0x80E2
#define GL_COLOR_INDEX2_EXT           0x80E3
#define GL_COLOR_INDEX4_EXT           0x80E4

#define GL_COLOR_TABLE_FORMAT_EXT      0x80D8
#define GL_COLOR_TABLE_WIDTH_EXT       0x80D9
#define GL_COLOR_RED_SIZE_EXT          0x80DA
#define GL_COLOR_GREEN_SIZE_EXT        0x80DB
#define GL_COLOR_BLUE_SIZE_EXT         0x80DC
#define GL_COLOR_ALPHA_SIZE_EXT        0x80DD
```

```
#define GL_COLOR_LUMINANCE_SIZE_EXT          0x80DE
#define GL_COLOR_INTENSITY_SIZE_EXT         0x80DF

typedef void (APIENTRY * PFNGLCOLORTABLEEXTPROC) ( GLenum target,
                                                    GLenum internalformat,
                                                    GLsizei width,
                                                    GLenum format,
                                                    GLenum type,
                                                    const void *data );

typedef void (APIENTRY * PFNGLCOLORSUBTABLEEXTPROC) ( GLenum target,
                                                       GLsizei start,
                                                       GLsizei count,
                                                       GLenum format,
                                                       GLenum type,
                                                       const void *data );

typedef void (APIENTRY * PFNGLGETCOLORTABLEEXTPROC) ( GLenum target,
                                                       GLenum format,
                                                       GLenum type,
                                                       const void *data );

typedef void (APIENTRY * PFNGLGETCOLORTABLEPARAMETERIVEXTPROC) ( GLenum target,
                                                                    GLenum pname,
                                                                    int *params );

typedef void (APIENTRY * PFNGLGETCOLORTABLEPARAMETERFVEXTPROC) ( GLenum target,
                                                                    GLenum pname,
                                                                    float *params );

// define a suitable struct for each entry in the texture lut
typedef struct { GLubyte r, g, b, a; } ubLutEntry;

// allocate a variable to hold the table of lut entries
// note the maximum number of entries on the TX500 is 16
ubLutEntry texLUT[16];

// initialise the lut
// e.g. from black
texLUT[0].r = 0; texLUT[0].g = 0; texLUT[0].b = 0; texLUT[0].a = 255;
texLUT[1] ...
texLUT[14] ...
// to white etc..
```

```
texLUT[15].r = 255; texLUT[15].g = 255; texLUT[15].b = 255; texLUT[15].a = 255;

// declare a suitable function pointer for updating the texture lut
PFNGLCOLORTABLEEXTPROC fp_glColorTableEXT;

// bind the function pointer by passing the name of the function as a string
fp_glColorTableEXT = (PFNGLCOLORTABLEEXTPROC) wglGetProcAddress( "glColorTableEXT" );

// download the lut by dereferencing the function pointer
(*fp_glColorTableEXT)(GL_TEXTURE_2D, GL_RGBA, 16, GL_RGBA, GL_UNSIGNED_BYTE, texLUT);

...

// initialise the texture image data
imageWidth  = 256;
imageHeight = 128;

// allocate a byte per texel index
imageBuffer = (GLubyte*) malloc(imageWidth * imageHeight);

...

// in this example download a 4-bit indexed texture
// (but note that each 4-bit (or 2 or 1 bit) index occupies a full byte
// when passed to OpenGL
// but ends up packed 2 (or 4 or 8) to a byte in the TX local buffer)

glPixelStorei(GL_UNPACK_ALIGNMENT, 1);
glTexImage2D( GL_TEXTURE_2D, 0,
              GL_COLOR_INDEX4_EXT,
              imageWidth,      // must be power of 2 (+ 2*border)
              imageHeight,     // must be power of 2 (+ 2*border)
              0,               // no border in this example
              GL_COLOR_INDEX,  // must be color index format
              GL_UNSIGNED_BYTE, // byte per index
              imageBuffer );

...

// now repeated calls to glColorTableEXT followed by a flush will
// instantly update the texture colors without a download
// e.g change all blacks in the texture to yellow:
texLUT[0].r = 255; texLUT[0].g = 255; texLUT[0].b = 0;
```

```
(*fp_glColorTableEXT)(GL_TEXTURE_2D, GL_RGBA, 16, GL_RGBA, GL_UNSIGNED_BYTE, texLUT);  
glFlush();
```

This is an example routine for querying the extensions available using glGetString:

```
int checkPaletteTextureEXTAvailable( void )  
{  
    char seps[]    = " ,";  
    char *token;  
    static char extStr[128];  
    const GLubyte *pExtStr;  
  
    pExtStr = glGetString( GL_EXTENSIONS );  
    strcpy(extStr, pExtStr );  
  
    token = strtok( extStr, seps );  
    while( token != NULL ) {  
        // While there are tokens in "string"  
        if (strcmp( token, "GL_EXT_paletted_texture" ) == 0)  
            return TRUE;  
  
        // Get next token:  
        token = strtok( NULL, seps );  
    }  
  
    return FALSE;  
}
```

## Restrictions

None

## APPENDIX D

### Windows NT OpenGL Group

#### OpenGL Paletted Texture Extension

**Author:** *Drew Bliss (Microsoft Corp)*

*Version 0.8 March 1, 1996*

#### Name

EXT\_paletted\_texture

#### Name Strings

GL\_EXT\_paletted\_texture

#### Dependencies

GL\_EXT\_paletted\_texture shares routines and enumerants with GL\_SGI\_color\_table with the minor modification that EXT replaces SGI. In all other ways these calls should function in the same manner and the enumerant values should be identical. The portions of GL\_SGI\_color\_table that are used are:

ColorTableSGI, GetColorTableSGI, GetColorTableParameterivSGI, GetColorTableParameterfvSGI.

COLOR\_TABLE\_FORMAT\_SGI, COLOR\_TABLE\_WIDTH\_SGI, COLOR\_TABLE\_RED\_SIZE\_SGI,  
COLOR\_TABLE\_GREEN\_SIZE\_SGI, COLOR\_TABLE\_BLUE\_SIZE\_SGI, COLOR\_TABLE\_ALPHA\_SIZE\_SGI,  
COLOR\_TABLE\_LUMINANCE\_SIZE\_SGI, COLOR\_TABLE\_INTENSITY\_SIZE\_SGI.

Portions of GL\_SGI\_color\_table which are not used in GL\_EXT\_paletted\_texture are:

CopyColorTableSGI, ColorTableParameterivSGI, ColorTableParameterfvSGI.

COLOR_TABLE_SGI,	POST_CONVOLUTION_COLOR_TABLE_SGI,
POST_COLOR_MATRIX_COLOR_TABLE_SGI,	PROXY_COLOR_TABLE_SGI,
PROXY_POST_CONVOLUTION_COLOR_TABLE_SGI,	
PROXY_POST_COLOR_MATRIX_COLOR_TABLE_SGI,	COLOR_TABLE_SCALE_SGI,
COLOR_TABLE_BIAS_SGI,	

#### Overview

EXT\_paletted\_texture defines new texture formats and new calls to support the use of paletted textures in OpenGL. A paletted texture is defined by giving both a palette of colors and a set of image data which is composed of indices into the palette. The paletted texture cannot function properly without both pieces of information so it increases the work required to define a texture. This is offset by the fact that the overall amount of texture data can be reduced dramatically by factoring redundant information out of the logical view of the texture and placing it in the palette.

Paletted textures provide several advantages over full-color textures:

As mentioned above, the amount of data required to define a texture can be greatly reduced over what would be needed for full-color specification. For example, consider a source texture that has only 256 distinct colors in a 256 by 256 pixel grid. Full-color representation requires three bytes per pixel, taking 192K of texture data. By putting the distinct colors in a palette only eight bits are required per pixel, reducing the 192K to 64K plus 768 bytes for the palette. Now add an alpha channel to the texture. The full-color representation increases by 64K while the paletted version would only increase by 256 bytes. This reduction in space required is particularly important for hardware accelerators where texture space is limited.

Paletted textures allow easy reuse of texture data for images which require many similar but slightly different colored objects. Consider a driving simulation with heavy traffic on the road. Many of the cars will be similar but with different color schemes. If full-color textures are used a separate texture would be needed for each color scheme, while paletted textures allow the same basic index data to be reused for each car, with a different palette to change the final colors.

Paletted textures also allow use of all the palette tricks developed for paletted displays. Simple animation can be done, along with strobing, glowing and other palette-cycling effects. All of these techniques can enhance the visual richness of a scene with very little data.

#### New Procedures and Functions

```
void ColorTableEXT(
```

```
    enum target,  
    enum internalFormat,  
    sizei width,  
    enum format,  
    enum type,  
    const void *data);
```

```
void ColorSubTableEXT(
```

```
    enum target,  
    sizei start,  
    sizei count,  
    enum format,  
    enum type,  
    const void *data);
```

```
void GetColorTableEXT(
```

```
    enum target,  
    enum format,  
    enum type,  
    void *data);
```

```
void GetColorTableParameterivEXT(
```

```
    enum target,  
    enum pname,
```

```
int *params);
```

```
void GetColorTableParameterfvEXT(
```

```
    enum target,
```

```
    enum pname,
```

```
    float *params);
```

#### New Tokens

Accepted by the *internalformat* parameter of TexImage1D, and TexImage2D:

COLOR_INDEX1_EXT	0x80E2
COLOR_INDEX2_EXT	0x80E3
COLOR_INDEX4_EXT	0x80E4
COLOR_INDEX8_EXT	0x80E5
COLOR_INDEX12_EXT	0x80E6
COLOR_INDEX16_EXT	0x80E7

Accepted by the *pname* parameter of GetColorTableParameterivEXT and GetColorTableParameterfvEXT:

COLOR_TABLE_FORMAT_EXT	0x80D8
COLOR_TABLE_WIDTH_EXT	0x80D9
COLOR_TABLE_RED_SIZE_EXT	0x80DA
COLOR_TABLE_GREEN_SIZE_EXT	0x80DB
COLOR_TABLE_BLUE_SIZE_EXT	0x80DC
COLOR_TABLE_ALPHA_SIZE_EXT	0x80DD
COLOR_TABLE_LUMINANCE_SIZE_EXT	0x80DE
COLOR_TABLE_INTENSITY_SIZE_EXT	0x80DF

#### Additions to Chapter 2 of the GL Specification (OpenGL Operation)

None

#### Additions to Chapter 3 of the GL Specification (Rasterization)

Section 3.6.4, ‘Pixel Transfer Operations,’ subsection ‘Color Index Lookup,’ point two is modified from ‘The groups will be loaded as an image into texture memory’ to ‘The groups will be loaded as an image into texture memory and the *internalformat* parameter is not one of the color index formats from table 3.8.’

Section 3.8, ‘Texturing,’ subsection ‘Texture Image Specification’ is modified as follows:

The portion of the first paragraph discussing interpretation of *format*, *type* and *data* is split from the portion discussing *target*, *width* and *height*. The *target*, *width* and *height* section now ends with the sentence ‘Arguments *width* and *height* specify the image’s width and height.’



The *format*, *type* and *data* section is moved under a subheader ‘Direct Color Texture Formats’ and begins with ‘If *internalformat* is not one of the color index formats from table 3.8,’ and continues with the existing text through the *internalformat* discussion.

After that section, a new section ‘Paletted Texture Formats’ has the text:

If *format* is given as **COLOR\_INDEX** then the image data is composed of integer values representing indices into a table of colors rather than colors themselves. If *internalformat* is given as one of the color index formats from table 3.8 then the texture will be stored internally as indices rather than undergoing index-to-RGBA mapping as would previously have occurred. In this case the only valid values for *type* are **BYTE**, **UNSIGNED\_BYTE**, **SHORT**, **UNSIGNED\_SHORT**, **INT** and **UNSIGNED\_INT**.

The image data is unpacked from memory exactly as for a DrawPixels command with *format* of **COLOR\_INDEX** for a context in color index mode. The data is then stored in an internal format derived from *internalformat*. In this case the only legal values of *internalformat* are **COLOR\_INDEX1\_EXT**, **COLOR\_INDEX2\_EXT**, **COLOR\_INDEX4\_EXT**, **COLOR\_INDEX8\_EXT**, **COLOR\_INDEX12\_EXT** and **COLOR\_INDEX16\_EXT** and the internal component resolution is picked according to the index resolution specified by *internalformat*. Any excess precision in the data is silently truncated to fit in the internal component precision.

An application can determine whether a particular implementation supports a particular paletted format (or any paletted formats at all) by attempting to use the paletted format with a proxy *target*.

Table 3.8 should be augmented with a column titled ‘Index bits.’ All existing formats have zero index bits. The following formats are added with zeroes in all existing columns:

Name	Index bits
COLOR_INDEX1_EXT	1
COLOR_INDEX2_EXT	2
COLOR_INDEX4_EXT	4
COLOR_INDEX8_EXT	8
COLOR_INDEX12_EXT	12
COLOR_INDEX16_EXT	16

At the end of the discussion of *level* the following text should be added:

All mipmapping levels share the same palette. If levels are created with different precision indices then their internal formats will not match and the texture will be inconsistent, as discussed above.

In the discussion of *internalformat* for CopyTexImage, at end of the sentence specifying that 1, 2, 3 and 4 are illegal there should also be a mention that paletted *internalformat* values are illegal.

At the end of the *width*, *height*, *format*, *type* and *data* section under TexSubImage there should be an additional sentence:

If the target texture has an color index internal format then *format* may only be **COLOR\_INDEX**.

After the Alternate Image Specification Commands section, a new ‘Palette Specification Commands’ section should be added.

Paletted textures require palette information to translate indices into full colors. The command

```
void ColorTableEXT(enum target, enum internalformat, sizei width, enum format,
    enum type, const void *data);
```

is used to specify the format and size of the palette for paletted textures. *target* specifies which texture is to have its palette changed and may be one of **TEXTURE\_1D**, **TEXTURE\_2D**, **PROXY\_TEXTURE\_1D** or **PROXY\_TEXTURE\_2D**. *internalformat* specifies the desired format and resolution of the palette when in its internal form. *internalformat* can be any of the values legal for **TexImage** *internalformat* although implementations are not required to support palettes of all possible formats. *width* controls the size of the palette and must be a power of two greater than or equal to one. *format* and *type* specify the number of components and type of the data given by *data*. *format* can be any of the formats legal for **DrawPixels** although implementations are not required to support all possible formats. *type* can be any of the types legal for **DrawPixels** except **GL\_BITMAP**.

Data is taken from memory and converted just as if each palette entry were a single pixel of a 1D texture. Pixel unpacking and transfer modes apply just as with texture data. After unpacking and conversion the data is translated into a internal format that matches the given format as closely as possible. An implementation does not, however, have a responsibility to support more than one precision for the base formats.

If the palette's width is greater than the range of the color indices in the texture data then some of the palettes entries will be unused. If the palette's width is less than the range of the color indices in the texture data then the most-significant bits of the texture data are ignored and only the appropriate number of bits of the index are used when accessing the palette.

Specifying a proxy *target* causes the proxy texture's palette to be resized and its parameters set but no data is transferred or accessed.

Portions of the current palette can be replaced with

```
void ColorSubTableEXT(enum target, sizei start, sizei count, enum format,
    enum type, const void *data);
```

*target* can be any of the non-proxy values legal for **ColorTableEXT**. *start* and *count* control which entries of the palette are changed out of the range allowed by the internal format used for the palette indices. *count* is silently clamped so that all modified entries all within the legal range. *format* and *type* can be any of the values legal for **ColorTableEXT**. The data is treated as a 1D texture just as in **ColorTableEXT**.

In the 'Texture State and Proxy State' section the palette data should be added in as a third category of texture state. After the discussion of properties, the following should be added:

Next there is the texture palette. All textures have a palette, even if their internal format is not color index. A texture's palette is initially one RGBA element with all four components set to 1.0.

The sentence mentioning that proxies do not have image data or properties should be extended with 'or palettes.'

Additions to Chapter 4 of the GL Specification (Per-Fragment Operations and the Framebuffer)

None

Additions to Chapter 5 of the GL Specification (Special Functions)

None

Additions to Chapter 6 of the GL Specification (State and State Requests)

In the section on **GetTexImage**, the sentence saying 'The components are assigned among R, G, B and A according to' should be changed to be

If the internal format of the texture is not a color index format then the components are assigned among R, G, B, and A according to Table 6.1. Specifying **COLOR\_INDEX** for *format* in this case will generate the error **INVALID\_ENUM**. If the internal format of the texture is color index then the components are handled in one of two ways depending on the value of *format*. If *format* is not **COLOR\_INDEX**, the texture's indices are passed through the texture's palette and the resulting components are assigned among R, G, B, and A according to Table 6.1. If *format* is **COLOR\_INDEX** then the data is treated as single components and processed through the color index pixel transfer modes rather than RGBA. Components are taken starting...

Following the `GetTexImage` section there should be a new section:

**GetColorTableEXT** is used to get the current texture palette.

```
void GetColorTableEXT(enum target, enum format, enum type, void *data);
```

**GetColorTableEXT** retrieves the texture palette of the texture given by *target*. *target* can be any of the non-proxy targets valid for **ColorTableEXT**. *format* and *type* are interpreted just as for **ColorTableEXT**. All textures have a palette by default so **GetColorTableEXT** will always be able to return data even if the internal format of the texture is not a color index format.

Palette parameters can be retrieved using

```
void GetColorTableParameterivEXT(enum target, enum pname, int *params);
```

```
void GetColorTableParameterfvEXT(enum target, enum pname, float *params);
```

*target* specifies the texture being queried and *pname* controls which parameter value is returned. Data is returned in the memory pointed to by *params*.

Querying **COLOR\_TABLE\_FORMAT\_EXT** returns the internal format requested by the most recent **ColorTableEXT** call or the default. **COLOR\_TABLE\_WIDTH\_EXT** returns the width of the current palette. **COLOR\_TABLE\_RED\_SIZE\_EXT**, **COLOR\_TABLE\_GREEN\_SIZE\_EXT**, **COLOR\_TABLE\_BLUE\_SIZE\_EXT** and **COLOR\_TABLE\_ALPHA\_SIZE\_EXT** return the actual size of the components used to store the palette data internally, not the size requested when the palette was defined.

#### Revision History

Original draft, revision 0.5, December 20, 1995 (drewb)

Created

Minor revisions and clarifications, revision 0.6, January 2, 1996 (drewb)

Replaced all request-for-comment blocks with final text based on implementation.

Minor revisions and clarifications, revision 0.7, February 5, 1996 (drewb)

Specified the state of the palette color information when existing data is replaced by new data.

Clarified behavior of `TexPalette` on inconsistent textures.

Major changes due to ARB review, revision 0.8, March 1, 1996 (drewb)

Switched from using `TexPaletteEXT` and `GetTexPaletteEXT` to using SGI's `ColorTableEXT` routines. Added `ColorSubTableEXT` so equivalent functionality is available.

Allowed proxies in all targets.

Changed `PALETTE?_EXT` values to `COLOR_INDEX?_EXT`. Added support for one and two bit palettes. Removed `PALETTE_INDEX_EXT` in favor of `COLOR_INDEX`.

Decoupled palette size from texture data type. Palette size is controlled only by `ColorTableEXT`.

## APPENDIX E

### Windows NT OpenGL Group

## OpenGL EXT\_BGRA Extension Specification

#### Name

EXT\_bgra

#### Name Strings

GL\_EXT\_bgra

#### Dependencies

EXT\_abgr affects the definition of this extension

EXT\_cmyka affects the definition of this extension

EXT\_color\_table affects the definition of this extension

EXT\_color\_subtable affects the definition of this extension

#### Overview

EXT\_bgra extends the list of host-memory color formats. Specifically, it provides formats which match the memory layout of Windows DIBs so that applications can use the same data in both Windows API calls and OpenGL pixel API calls.

#### New Procedures and Functions

None

#### New Tokens

Accepted by the <format> parameter of DrawPixels, GetTexImage,

ReadPixels, TexImage1D, TexImage2D, ColorTableEXT and ColorSubTableEXT:

BGR_EXT	0x80E0
BGRA_EXT	0x80E1

#### Additions to Chapter 2 of the GL Specification (OpenGL Operation)

None.

#### Additions to Chapter 3 of the GL Specification (Rasterization)

Two entries are added to table 3.5 (DrawPixels and ReadPixels formats). The new table is:

Name	Type	Elements	Target Buffer
------	------	----------	---------------

COLOR_INDEX	Index	Color Index	Color
STENCIL_INDEX	Index	Stencil value	Stencil
DEPTH_COMPONENT	Component	Depth value	Depth
RED	Component	R	Color
GREEN	Component	G	Color
BLUE	Component	B	Color
ALPHA	Component	A	Color
RGB	Component	R, G, B	Color
RGBA	Component	R, G, B, A	Color
LUMINANCE	Component	Luminance value	Color
LUMINANCE_ALPHA	Component	Luminance value, A	Color
ABGR_EXT	Component	A, B, G, R	Color
CMYK_EXT	Component	Cyan value, Magenta value, Yellow value, Black value	Color
CMYKA_EXT	Component	Cyan value, Magenta value, Yellow value, Black value, A	Color
BGR_EXT	Component	B, G, R	Color
BGRA_EXT	Component	B, G, R, A	Color

**Table 3.5:** DrawPixels and ReadPixels formats. The third column gives a description of and the number and order of elements in a group.

#### Additions to Chapter 4 of the GL Specification (Per-Fragment Operations and the Framebuffer)

The new format is added to the discussion of Obtaining Pixels from the Framebuffer. It should read " If the <format> is one of RED, GREEN, BLUE, ALPHA, RGB, RGBA, ABGR\_EXT, BGR\_EXT, BGRA\_EXT, LUMINANCE, LUMINANCE\_ALPHA, CMYK\_EXT, or CMYKA\_EXT, and the GL is in color index mode, then the color index is obtained."

The new format is added to the discussion of Index Lookup. It should read "If <format> is one of RED, GREEN, BLUE, ALPHA, RGB, RGBA, ABGR\_EXT, BGR\_EXT, BGRA\_EXT, LUMINANCE, LUMINANCE\_ALPHA, CMYK\_EXT, or CMYKA\_EXT, then the index is used to reference 4 tables of color components:

PIXEL\_MAP\_I\_TO\_R, PIXEL\_MAP\_I\_TO\_G, PIXEL\_MAP\_I\_TO\_B, and  
PIXEL\_MAP\_I\_TO\_A."

**Additions to Chapter 5 of the GL Specification (Special Functions)**

None.

**Additions to Chapter 6 of the GL Specification (State and State Requests)**

None.

**Dependencies on EXT\_abgr**

If EXT\_abgr is not implemented, then references to ABGR\_EXT in this specification are void.

**Dependencies on EXT\_cmyka**

If EXT\_cmyka is not implemented, then references to CMYK\_EXT and CMYKA\_EXT in this specification are void.

**Dependencies on EXT\_color\_table**

If EXT\_color\_table is not implemented, then references to ColorTableEXT in this specification are void.

**Dependencies on EXT\_color\_subtable**

If EXT\_color\_subtable is not implemented, then references to ColorSubTableEXT in this specification are void.

**Revision History**  
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## APPENDIX F

### OpenGL Texture Object Extension Support

This appendix describes the programming steps required of OpenGL applications that need to switch between textures without resorting to display lists (in order to avoid downloading the texture data each time `glTexImage1D/2D` is invoked). The implementation is based upon the texture object extension of version 1.0 and adopted as standard in version 1.1 (refer to Appendix F for further details).

Unlike display list textures which depend on the texture parameter state of the default immediate mode 1D and 2D texture targets, texture objects maintain their own separate copy of all texture state (such as wrap modes, min/mag filters etc. including for palette textures, the colour lut). By selecting a texture object to be the current texture (referred to as 'binding'), all subsequent OpenGL commands such as `glTexImage1/2D` and `glTexParameter` will affect the state of that texture object only, until a different texture object is made the new target. The following code fragment should make this process clear.

```
// declare suitable function pointers for calling the texture object routines
typedef void (APIENTRY * PFNGLBINDTEXTUREEXTPROC) (GLenum target, GLuint texture);
typedef void (APIENTRY * PFNGLGENTEXTURESEXTPROC) (GLsizei n, GLuint *textures);
typedef void (APIENTRY * PFNGLDELTEXTURESEXTPROC) (GLsizei n, GLuint *textures);

PFNGLBINDTEXTUREEXTPROC    fpglBindTextureEXT;
PFNGLGENTEXTURESEXTPROC    fpglGenTexturesEXT;
PFNGLDELTEXTURESEXTPROC    fpglDeleteTexturesEXT;

// bind the function pointer by passing the name of the function as a string
fpglBindTextureEXT = (PFNGLBINDTEXTUREEXTPROC) wglGetProcAddress("glBindTextureEXT");
fpglGenTexturesEXT = (PFNGLGENTEXTURESEXTPROC) wglGetProcAddress("glGenTexturesEXT");
fpglDeleteTexturesEXT =
    (PFNGLDELTEXTURESEXTPROC) glGetProcAddress("glDeleteTexturesEXT");

// texture objects are given unique handles (their name or identifier)
// here we have a 4-bit palette texture, a large non-palette texture (512x256)
// and a small texture (64x64)
GLuint palTexObj;
GLuint largeTexObj;
GLuint smallTexObj;

// obtain a free texture object handle
fpglGenTexturesEXT( 1, &palTexObj );

// make this the current texture target
```

```
// Note the first time we bind to a object handle, OpenGL creates a new texture
// parameter state record in an internal table. Assuming valid texel data
// has been downloaded for this object, subsequent binds will use this texture
// for rendering
fpglBindTextureEXT(GL_TEXTURE_2D, palTexObj);

// download the texels for this object
glTexImage2D( GL_TEXTURE_2D, 0, GL_COLOR_INDEX4_EXT, palTexObjWidth,
              palTexObjHeight, 0, GL_COLOR_INDEX, GL_UNSIGNED_BYTE,
              palTexObjImageBuffer );

// and the palette lut
fpglColorTableEXT( GL_TEXTURE_2D, GL_RGBA, 16, GL_RGBA, GL_UNSIGNED_BYTE,
                  palTexObjLUT );

// set filter modes
glTexParameterf(GL_TEXTURE_2D, GL_TEXTURE_MAG_FILTER, GL_NEAREST);
glTexParameterf(GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER, GL_NEAREST);

// setup the large texture (3 component)
fpglGenTexturesEXT( 1, &largeTexObj );
fpglBindTextureEXT(GL_TEXTURE_2D, largeTexObj);

glTexImage2D( GL_TEXTURE_2D, 0, 3, largeTexObjWidth, largeTexObjHeight,
              0, GL_RGB, GL_UNSIGNED_BYTE,
              largeTexObjImageBuffer );

glTexParameterf(GL_TEXTURE_2D, GL_TEXTURE_MAG_FILTER, GL_LINEAR);
glTexParameterf(GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER, GL_LINEAR);

// setup the small texture (4 component with alpha)
fpglGenTexturesEXT( 1, &smallTexObj );
fpglBindTextureEXT(GL_TEXTURE_2D, smallTexObj);

glTexImage2D( GL_TEXTURE_2D, 0, 4, smallTexObjWidth, smallTexObjHeight,
              0, GL_RGBA, GL_UNSIGNED_BYTE,
              smallTexObjImageBuffer );

glTexParameterf(GL_TEXTURE_2D, GL_TEXTURE_MAG_FILTER, GL_NEAREST);
glTexParameterf(GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER, GL_NEAREST);

// and so on, you get the idea

// now lets switch between textures for rendering
glEnable(GL_TEXTURE_2D);
```



```
fpglBindTextureEXT(GL_TEXTURE_2D, palTexObj);
// all textured primitives will now use the palette texture object
// with nearest-neighbour filtering
myDrawDisplay();

fpglBindTextureEXT(GL_TEXTURE_2D, largeTexObj);
// all textured primitives will now use the large texture object
// with linear filtering
myDrawDisplay();

fpglBindTextureEXT(GL_TEXTURE_2D, smallTexObj);
// all textured primitives will now use the small texture object
// and now back to nearest-neighbour filtering
myDrawDisplay();

// etc.

// free up texture memory when finished
fpglDeleteTexturesEXT( 1, &palTexObj );
fpglDeleteTexturesEXT( 1, &largeTexObj );
fpglDeleteTexturesEXT( 1, &smallTexObj );
```

## APPENDIX G

# OpenGL Texture Object Extension Specification

**Name**

EXT\_texture\_object

**Name Strings**

GL\_EXT\_texture\_object

**Version**

\$Date: 1995/06/17 03:38:44 \$ \$Revision: 1.26 \$

**Number**

20

**Dependencies**

EXT\_texture3D affects the definition of this extension

**Overview**

This extension introduces named texture objects. The only way to name a texture in GL 1.0 is by defining it as a single display list. Because display lists cannot be edited, these objects are static. Yet it is important to be able to change the images and parameters of a texture.

**Issues**

Should the dimensions of a texture object be static once they are changed from zero? This might simplify the management of texture memory. What about other properties of a texture object?

No.

**Reasoning**

Previous proposals overloaded the <target> parameter of many Tex commands with texture object names, as well as the original enumerated values. This proposal eliminated such overloading, choosing instead to require an application to bind a texture object, and then operate on it through the binding reference. If this constraint ultimately proves to be unacceptable, we can always extend the extension with additional binding points for editing and querying only, but if we expect to do this, we might choose to bite the bullet and overload the <target> parameters now.

Commands to directly set the priority of a texture object and to query the resident status of a texture object are included. I feel that binding a texture object would be an unacceptable burden for these management operations. These commands also allow queries and operations on lists of texture objects, which should improve efficiency.

GenTexturesEXT does not return a success/failure boolean because it should never fail in practice.

**New Procedures and Functions**

```

void GenTexturesEXT(sizei n, uint* textures);

void DeleteTexturesEXT(sizei n, const uint* textures);

void BindTextureEXT(enum target, uint texture);

void PrioritizeTexturesEXT(sizei n, const uint* textures, const clampf* priorities);

boolean AreTexturesResidentEXT(sizei n, const uint* textures, boolean* residences);

boolean IsTextureEXT(uint texture);

```

**New Tokens**

Accepted by the <pname> parameters of TexParameteri, TexParameterf, TexParameteriv, TexParameterfv, GetTexParameteriv, and GetTexParameterfv:

```
TEXTURE_PRIORITY_EXT          0x8066
```

Accepted by the <pname> parameters of GetTexParameteriv and GetTexParameterfv:

```
TEXTURE_RESIDENT_EXT         0x8067
```

Accepted by the <pname> parameters of GetBooleanv, GetIntegerv, GetFloatv, and GetDoublev:

```
TEXTURE_1D_BINDING_EXT       0x8068
TEXTURE_2D_BINDING_EXT       0x8069
TEXTURE_3D_BINDING_EXT       0x806A
```

**Additions to Chapter 2 of the 1.0 Specification (OpenGL Operation)**

None

**Additions to Chapter 3 of the 1.0 Specification (Rasterization)**

Add the following discussion to section 3.8 (Texturing). In addition to the default textures TEXTURE\_1D, TEXTURE\_2D, and TEXTURE\_3D\_EXT, it is possible to create named 1, 2, and 3-dimensional texture objects. The name space for texture objects is the unsigned integers, with zero reserved by the GL.

A texture object is created by binding an unused name to `TEXTURE_1D`, `TEXTURE_2D`, or `TEXTURE_3D_EXT`. This binding is accomplished by calling `BindTextureEXT` with `<target>` set to `TEXTURE_1D`, `TEXTURE_2D`, or `TEXTURE_3D_EXT`, and `<texture>` set to the name of the new texture object.

When a texture object is bound to a target, the previous binding for that target is automatically broken.

When a texture object is first bound it takes the dimensionality of its target. Thus, a texture object first bound to `TEXTURE_1D` is 1-dimensional; a texture object first bound to `TEXTURE_2D` is 2-dimensional, and a texture object first bound to `TEXTURE_3D_EXT` is 3-dimensional. The state of a 1-dimensional texture object immediately after it is first bound is equivalent to the state of the default `TEXTURE_1D` at GL initialization. Likewise, the state of a 2-dimensional or 3-dimensional texture object immediately after it is first bound is equivalent to the state of the default `TEXTURE_2D` or `TEXTURE_3D_EXT` at GL initialization. Subsequent bindings of a texture object have no effect on its state. The error `INVALID_OPERATION` is generated if an attempt is made to bind a texture object to a target of different dimensionality.

While a texture object is bound, GL operations on the target to which it is bound affect the bound texture object, and queries of the target to which it is bound return state from the bound texture object. If texture mapping of the dimensionality of the target to which a texture object is bound is active, the bound texture object is used.

By default when an OpenGL context is created, `TEXTURE_1D`, `TEXTURE_2D`, and `TEXTURE_3D_EXT` have 1, 2, and 3-dimensional textures associated with them. In order that access to these default textures not be lost, this extension treats them as though their names were all zero. Thus the default 1-dimensional texture is operated on, queried, and applied as `TEXTURE_1D` while zero is bound to `TEXTURE_1D`. Likewise, the default 2-dimensional texture is operated on, queried, and applied as `TEXTURE_2D` while zero is bound to `TEXTURE_2D`, and the default 3-dimensional texture is operated on, queried, and applied as `TEXTURE_3D_EXT` while zero is bound to `TEXTURE_3D_EXT`.

Texture objects are deleted by calling `DeleteTexturesEXT` with `<textures>` pointing to a list of `<n>` names of texture object to be deleted. After a texture object is deleted, it has no contents or dimensionality, and its name is freed. If a texture object that is currently bound is deleted, the binding reverts to zero. `DeleteTexturesEXT` ignores names that do not correspond to textures objects, including zero.

`GenTexturesEXT` returns `<n>` texture object names in `<textures>`. These names are chosen in an unspecified manner, the only condition being that only names that were not in use immediately prior to the call to `GenTexturesEXT` are considered. Names returned by `GenTexturesEXT` are marked as used (so that they are not returned by subsequent calls to `GenTexturesEXT`), but they are associated with a texture object only after they are first bound (just as if the name were unused).

An implementation may choose to establish a working set of texture objects on which binding operations are performed with higher performance. A texture object that is currently being treated as a part of the working set is said to be resident. `AreTexturesResidentEXT` returns `TRUE` if all of the `<n>` texture objects named in `<textures>` are resident, `FALSE` otherwise. If `FALSE` is returned, the residence of each texture object is returned in `<residences>`. Otherwise the contents of the `<residences>` array are not changed. If any of the names in `<textures>` is not the name of a texture object, `FALSE` is returned, the error `INVALID_VALUE` is generated, and the contents of `<residences>` are indeterminate. The resident status of a single bound texture object can also be queried by calling `GetTexParameteriv` or `GetTexParameterfv` with `<target>` set to the target to which the texture object is bound, and `<pname>` set to `TEXTURE_RESIDENT_EXT`. This is the only way that the resident status of a default texture can be queried.

Applications guide the OpenGL implementation in determining which texture objects should be resident by specifying a priority for each texture object. `PrioritizeTexturesEXT` sets the priorities of the `<n>` texture objects in `<textures>` to the values in `<priorities>`. Each priority value is clamped to the range `[0.0, 1.0]` before it is assigned. Zero indicates the lowest priority, and hence the least likelihood of being resident. One indicates the highest priority, and hence the greatest likelihood of being resident. The priority of a single bound texture object can also be changed by calling `TexParameteri`, `TexParameterf`, `TexParameteriv`, or `TexParameterfv` with `<target>` set to the target to which the texture object is bound, `<pname>` set to `TEXTURE_PRIORITY_EXT`, and `<param>` or `<params>` specifying the new priority value (which is clamped to `[0.0,1.0]` before being assigned). This is the only way that the priority of a default texture can be specified. (`PrioritizeTexturesEXT` silently ignores attempts to prioritize nontextures, and texture zero.)

#### Additions to Chapter 4 of the 1.0 Specification (Per-Fragment Operations and the Frame Buffer)

None

#### Additions to Chapter 5 of the 1.0 Specification (Special Functions)

`BindTextureEXT` and `PrioritizeTexturesEXT` are included in display lists.

All other commands defined by this extension are not included in display lists.

#### Additions to Chapter 6 of the 1.0 Specification (State and State Requests)

`IsTextureEXT` returns `TRUE` if `<texture>` is the name of a valid texture object. If `<texture>` is zero, or is a non-zero value that is not the name of a texture object, or if an error condition occurs, `IsTextureEXT` returns `FALSE`.

Because the query values of `TEXTURE_1D`, `TEXTURE_2D`, and `TEXTURE_3D_EXT` are already defined as booleans indicating whether these textures are enabled or disabled, another mechanism is required to query the binding associated with each of these texture targets. The name of the texture object currently bound to `TEXTURE_1D` is returned in `<params>` when `GetIntegerv` is called with `<pname>` set to `TEXTURE_1D_BINDING_EXT`. If no texture object is currently bound to `TEXTURE_1D`, zero is returned. Likewise, the name of the texture object bound to `TEXTURE_2D` or `TEXTURE_3D_EXT` is returned in `<params>` when `GetIntegerv` is called with `<pname>` set to `TEXTURE_2D_BINDING_EXT` or `TEXTURE_3D_BINDING_EXT`. If no texture object is currently bound to `TEXTURE_2D` or to `TEXTURE_3D_EXT`, zero is returned.

A texture object comprises the image arrays, priority, border color, filter modes, and wrap modes that are associated with that object. More explicitly, the state list

`TEXTURE`,  
`TEXTURE_PRIORITY_EXT`  
`TEXTURE_RED_SIZE`,  
`TEXTURE_GREEN_SIZE`,  
`TEXTURE_BLUE_SIZE`,  
`TEXTURE_ALPHA_SIZE`,  
`TEXTURE_LUMINANCE_SIZE`,  
`TEXTURE_INTENSITY_SIZE`,  
`TEXTURE_WIDTH`,  
`TEXTURE_HEIGHT`,  
`TEXTURE_DEPTH_EXT`,  
`TEXTURE_BORDER`,  
`TEXTURE_COMPONENTS`,

TEXTURE\_BORDER\_COLOR,  
TEXTURE\_MIN\_FILTER,  
TEXTURE\_MAG\_FILTER,  
TEXTURE\_WRAP\_S,  
TEXTURE\_WRAP\_T,  
TEXTURE\_WRAP\_R\_EXT

composes a single texture object.

When PushAttrib is called with TEXTURE\_BIT enabled, the priorities, border colors, filter modes, and wrap modes of the currently bound texture objects are pushed, as well as the current texture bindings and enables. When an attribute set that includes texture information is popped, the bindings and enables are first restored to their pushed values, then the bound texture objects have their priorities, border colors, filter modes, and wrap modes restored to their pushed values.

### Dependencies on EXT\_texture3D

If EXT\_texture3D is not supported, then all references to 3D textures in this specification are invalid.

### Errors

INVALID\_VALUE is generated if GenTexturesEXT parameter <n> is negative.

INVALID\_VALUE is generated if DeleteTexturesEXT parameter <n> is negative.

INVALID\_ENUM is generated if BindTextureEXT parameter <target> is not TEXTURE\_1D, TEXTURE\_2D, or TEXTURE\_3D\_EXT.

INVALID\_OPERATION is generated if BindTextureEXT parameter <target> is TEXTURE\_1D, and parameter <texture> is the name of a 2-dimensional or 3-dimensional texture object.

INVALID\_OPERATION is generated if BindTextureEXT parameter <target> is TEXTURE\_2D, and parameter <texture> is the name of a 1-dimensional or 3-dimensional texture object.

INVALID\_OPERATION is generated if BindTextureEXT parameter <target> is TEXTURE\_3D\_EXT, and parameter <texture> is the name of a 1-dimensional or 2-dimensional texture object.

INVALID\_VALUE is generated if PrioritizeTexturesEXT parameter <n> negative.

INVALID\_VALUE is generated if AreTexturesResidentEXT parameter <n> is negative.

INVALID\_VALUE is generated by AreTexturesResidentEXT if any of the names in <textures> is zero, or is not the name of a texture.

INVALID\_OPERATION is generated if any of the commands defined in this extension is executed between the execution of Begin and the corresponding execution of End.

New State

Get Value Attribute	Get Command	Type	Initial Value
TEXTURE_1D texture/enable	IsEnabled	B	FALSE
TEXTURE_2D texture/enable	IsEnabled	B	FALSE
TEXTURE_3D_EXT texture/enable	IsEnabled	B	FALSE
TEXTURE_1D_BINDING_EXT texture	GetIntegerv	Z+	0
TEXTURE_2D_BINDING_EXT texture	GetIntegerv	Z+	0
TEXTURE_3D_BINDING_EXT texture	GetIntegerv	Z+	0
TEXTURE_PRIORITY_EXT texture	GetTexParameterfv	n x Z+	1
TEXTURE_RESIDENT_EXT -	AreTexturesResidentEXT	n x B	unknown
TEXTURE -	GetTexImage	n x levels x I	null
TEXTURE_RED_SIZE_EXT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_GREEN_SIZE_EXT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_BLUE_SIZE_EXT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_ALPHA_SIZE_EXT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_LUMINANCE_SIZE_EXT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_INTENSITY_SIZE_EXT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_WIDTH -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_HEIGHT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_DEPTH_EXT -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_4DSIZE_SGIS -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_BORDER -	GetTexLevelParameteriv	n x levels x Z+	0
TEXTURE_COMPONENTS (1D and 2D) -	GetTexLevelParameteriv	n x levels x Z42	1

TEXTURE_COMPONENTS (3D and 4D)	GetTexLevelParameteriv	n x levels x Z38	LUMINANCE
-			
TEXTURE_BORDER_COLOR texture	GetTexParameteriv	n x C	0, 0, 0, 0
TEXTURE_MIN_FILTER NEAREST_MIPMAP_LINEAR texture	GetTexParameteriv	n x Z7	
TEXTURE_MAG_FILTER texture	GetTexParameteriv	n x Z3	LINEAR
TEXTURE_WRAP_S texture	GetTexParameteriv	n x Z2	REPEAT
TEXTURE_WRAP_T texture	GetTexParameteriv	n x Z2	REPEAT
TEXTURE_WRAP_R_EXT texture	GetTexParameteriv	n x Z2	REPEAT
TEXTURE_WRAP_Q_SGIS texture	GetTexParameteriv	n x Z2	REPEAT

**New Implementation Dependent State**

None



## APPENDIX H

# 3Dlabs OpenGL Driver State Extension Specification

### Name

3DLabs\_Driver\_State

### Overview

These driver extensions are accessed through a generic enable/disable function using the routines below (allowing for future expansion). There are currently two 3Dlabs specific driver extensions.

#### 1) FORCE\_POSITIVE\_NORMALS\_3DLABS

When lighting is being used and negative scaling factors are applied to the modeling matrix it can produce undesirable effects with respect to the lighting operation when the objective of the negative scale factors is that of mirroring an object about an axis. This extension is to allow reasonable visual results to be obtained when viewing a model exported by Autocad, along with its own matrix.

The operation of the extension is simple - and when the extension is enabled will cause the normalisation of normals to flip any negative normal component. This state is held on a per rendering context basis.

### Name Strings

GL\_3DLabs\_Driver\_State (this is the string that should be exported)

### Dependencies

None

### Procedures and Functions

int DriverStateSet3Dlabs (int target, int value);

Where target is one of:

FORCE\_POSITIVE\_NORMALS\_3DLABS

and value should either be GL\_FALSE (for off) or GL\_TRUE (for on).

The DriverGetState3Dlabs function will return the current value of the parameter.

GL\_TRUE will be returned if the call succeeded. GL\_FALSE will be returned if the call failed because the 'target' value was not recognised.

int DriverStateGet3Dlabs(int target);

The returned value will be the current value of the 'target' piece of state.

## Mechanism for using the extensions.

The extension's presence can be detected by searching the supported extensions string for named string. If the string is present, then the user can locate the two extension functions by calling the `wglGetProcAddress()` routine to get a pointer to the function.

```
// Declarations of function pointers..
int  (APIENTRY *MyDriverSetState) (int, int);
int  (APIENTRY *MyDriverGetState) (int);

// Get the addresses of the functions
MyDriverSetState = (void *) wglGetProcAddress("glDriverSetState3Dlabs");
MyDriverGetState = (void *) wglGetProcAddress("glDriverGetState3Dlabs");

// Switch into the mode to force the normals to be positive - assuming that the pointers
// are not NULL.
MyDriverSetState (FORCE_POSITIVE_NORMALS_3DLABS, GL_TRUE);

// Switch out of the state.
MyDriverSetState (FORCE_POSITIVE_NORMALS_3DLABS, GL_FALSE);
```

## Values

```
#define FORCE_POSITIVE_NORMALS_3DLABS    0x01
#define RESERVED                        0x02
```

## APPENDIX I

# OpenGL Shared Texture Palette Extension Specification

When paletted textures are in use, it is possible, using this extension, to download and lock a single palette into the chip. This speeds up texture switches considerably especially when 8 bit paletted textures are supported ( as with GLINT MX and Permedia2 ). The desired global palette should be downloaded and then the extension used to lock the palette by passing GL\_SHARED\_TEXTURE\_PALETTE\_EXT to glEnable. The palette is then unlocked through glDisable. This state is held on a per rendering context basis.

### Name

EXT\_shared\_texture\_palette

### Name Strings

GL\_EXT\_shared\_texture\_palette

### Version

\$Date: 1997/09/10 23:23:04 \$ \$Revision: 1.2 \$

### Number

141

### Dependencies

EXT\_paletted\_texture is required.

### Overview

EXT\_shared\_texture\_palette defines a shared texture palette which may be used in place of the texture object palettes provided by EXT\_paletted\_texture. This is useful for rapidly changing a palette common to many textures, rather than having to reload the new palette for each texture. The extension acts as a switch, causing all lookups that would normally be done on the texture's palette to instead use the shared palette.

### Issues

- \* Do we want to use a new <target> to ColorTable to specify the shared palette, or can we just infer the new target from the corresponding Enable?
- \* A future extension of larger scope might define a "texture palette object" and bind these objects to texture objects dynamically, rather than making palettes part of the texture object state as the current EXT\_paletted\_texture spec does.
- \* Should there be separate shared palettes for 1D, 2D, and 3D

textures?

Probably not; palette lookups have nothing to do with the dimensionality of the texture. If multiple shared palettes are needed, we should define palette objects.

- \* There's no proxy mechanism for checking if a shared palette can be defined with the requested parameters. Will it suffice to assume that if a texture palette can be defined, so can a shared palette with the same parameters?
- \* The changes to the spec are based on changes already made for EXT\_paletted\_texture, which means that all three documents must be referred to. This is quite difficult to read.
- \* The changes to section 3.8.6, defining how shared palettes are enabled and disabled, might be better placed in section 3.8.1. However, the underlying EXT\_paletted\_texture does not appear to modify these sections to define exactly how palette lookups are done, and it's not clear where to put the changes.

## **New Procedures and Functions**

None

## **New Tokens**

Accepted by the <pname> parameters of GetBooleanv, GetIntegerv, GetFloatv, GetDoublev, IsEnabled, Enable, Disable, ColorTableEXT, ColorSubTableEXT, GetColorTableEXT, GetColorTableParameterivEXT, and GetColorTableParameterfEXT:

SHARED\_TEXTURE\_PALETTE\_EXT                      0x81FB

## **Additions to Chapter 2 of the 1.1 Specification (OpenGL Operation)**

None

## **Additions to Chapter 3 of the 1.1 Specification (Rasterization)**

Section 3.8, 'Texturing,' subsection 'Texture Image Specification' is modified as follows:

In the Palette Specification Commands section, the sentence beginning 'target specifies which texture is to' should be changed to:

target specifies the texture palette or shared palette to be changed, and may be one of TEXTURE\_1D, TEXTURE\_2D, PROXY\_TEXTURE\_1D, PROXY\_TEXTURE\_2D, TEXTURE\_3D\_EXT, PROXY\_TEXTURE\_3D\_EXT, or SHARED\_TEXTURE\_PALETTE\_EXT.

In the 'Texture State and Proxy State' section, the sentence beginning 'A texture's palette is initially...' should be changed

to:

There is also a shared palette not associated with any texture, which may override a texture palette. All palettes are initially...

Section 3.8.6, 'Texture Application' is modified by appending the following:

Use of the shared texture palette is enabled or disabled using the generic Enable or Disable commands, respectively, with the symbolic constant SHARED\_TEXTURE\_PALETTE\_EXT.

The required state is one bit indicating whether the shared palette is enabled or disabled. In the initial state, the shared palettes is disabled.

#### **Additions to Chapter 4 of the 1.1 Specification (Per-Fragment Operations and the Frame buffer)**

#### **Additions to Chapter 5 of the 1.1 Specification (Special Functions)**

#### **Additions to Chapter 6 of the 1.1 Specification (State and State Requests)**

In the section on GetTexImage, the sentence beginning 'If format is not COLOR\_INDEX...' should be changed to:

If format is not COLOR\_INDEX, the texture's indices are passed through the texture's palette, or the shared palette if one is enabled, and the resulting components are assigned among R, G, B, and A according to Table 6.1.

In the GetColorTable section, the first sentence of the second paragraph should be changed to read:

GetColorTableEXT retrieves the texture palette or shared palette given by target.

The first sentence of the third paragraph should be changed to read:

Palette parameters can be retrieved using  
 void GetColorTableParameterivEXT(enum target, enum pname, int \*params);  
 void GetColorTableParameterfvEXT(enum target, enum pname, float \*params);  
 target specifies the texture palette or shared palette being queried and pname controls which parameter value is returned.

#### **Additions to the GLX Specification**

None

#### **New State**

Get Value	Get Command	Type	Initial Value	Attribute
-----	-----	---	-----	-----
SHARED_TEXTURE_PALETTE_EXT				

IsEnabled	B	False	texture/enable
-----------	---	-------	----------------

**New Implementation Dependent State**

None

## APPENDIX J

### GL\_KTX\_buffer\_region

#### Introduction

This extension was specified and implemented as an optimisation for 3D Studio MAX 2. It can be freely used within other applications that could benefit from it. The extension allows areas of frame, depth and stencil buffer to be stored away and later repaired. 3D Studio MAX 2 uses the extension to optimise display when a single object is being edited within a complex scene.

#### Specification

##### GLuint glNewBufferRegion(GLenum type)

This function creates a new buffer region and returns a handle to it. The type parameter can be one of GL\_KTX\_FRONT\_REGION, GL\_KTX\_BACK\_REGION, GL\_KTX\_Z\_REGION or GL\_KTX\_STENCIL\_REGION. Note that the storage of this region data is implementation specific and the pixel data is not available to the client

##### void glDeleteBufferRegion(GLuint region)

This function deletes a buffer region and any associated buffer data.

##### void glReadBufferRegion(GLuint region, GLint x, GLint y, GLsizei width, GLsizei height)

This function reads buffer data into a given region handle. The type of data read depends on the type of the region handle being used. All coordinates are window based and attempts to read areas that are clipped by the window bounds fail.

##### void glDrawBufferRegion(GLuint region, GLint x, GLint y, GLsizei width, GLsizei height, GLint xoffset, GLint yoffset)

This copies a rectangular region of data back to a display buffer. In other words, it moves previously saved data from the specified region back to its originating buffer. The type of data drawn depends on the type of the region handle being used. The rectangle specified by x, y, width, and height will always lie completely within the rectangle specified by previous calls to glReadBufferRegion. This rectangle is to be placed back into the display buffer at the location specified by xDest and yDest. Attempts to draw sub-regions outside the area of the last buffer region read will fail.

##### GLuint BufferRegionEnabled( void )

Returns whether or not this driver can currently handle buffer region calls in an efficient manner.

#### Notes:

Buffer region data is stored per window. Any context associated with the window can access the buffer regions for that window. Buffer regions are cleaned up on deletion of the window.

```
#define GL_KTX_FRONT_REGION      0
#define GL_KTX_BACK_REGION      1
#define GL_KTX_Z_REGION          2
```

#define GL\_KTX\_STENCIL\_REGION 3