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Scale9Grid User Guide

This document describes the details of using Scale9Grid functionality in Scaleform to create resizable windows, panels and buttons.

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1. Introduction: Scale9Grid in Flash and Scaleform

Scale9Grid is used in Flash® to specify component-style scaling for movie clips. Scale9Grid allows developers to create movie clip symbols and user interface components that resize intelligently to make use of the provided screen real estate, instead of scaling linearly which is commonly done with graphics and design elements.

In Flash terminology, Scale9Grid is also known as 9-slice scaling. When 9-slice scaling is enabled, the movie clip is conceptually divided into nine sections with a grid-like overlay, such that each one of the nine areas is scaled independently. To maintain the visual integrity of the movie clip, corners are not scaled, while the remaining areas of the image are scaled (as opposed to being stretched).

In the Flash Studio, 9-slice scaling is available as a checkbox in the movie clip "Symbol properties" dialog box. In addition, MovieClip.scale9Grid and Button.scale9Grid properties are also exposed in ActionScript to give programmatic control over piecewise scaling. For more information on the use of Scale9Grid in Flash, please refer to the Flash Studio documentation.

The Adobe Flash player has certain restrictions on Scale9Grid that make it relatively difficult to use in many practical situations. For example, the standard Flash player does not support images slicing and fails to process Scale9Grid with free rotation or other arbitrary transformations. Scaleform supports Scale9Grid in a more consistent manner, while keeping good compatibility with Flash. The Scale9Grid features of both Adobe Flash and Scaleform are briefly described in the following table.

Scale9Grid Features	**Adobe Flash Player**	**Scaleform**
Transformations	X/Y Scale only	Arbitrary transformations
Bitmaps	Average scaling based on the bounding box	Automatic tiling according to the Scale9Grid
Gradients and image fill	Average scaling based on the bounding box	Average scaling based on the bounding box
Sub-symbols (nested movie clips, buttons, graphics)	Not supported	Supported
Nested Scale9Grids	Not supported	Not supported
Transformations of the enclosing symbol	Supported	Supported
Text	Scaled as usual	Scaled as usual

Scaleform preserves the backward compatibility with Flash, which means that the Scale9Grid functionality that works in Flash will behave the same way in Scaleform. However, the features that are not supported in Flash may behave differently, but in a more practical manner. For example, support for sub-symbols (nested movie clips) is vitally important for creating interactively resizable windows. The differences between the two player implementations are covered in detail throughout this document.

To provide developers with a hands-on example of Scale9Grid, this document refers to a number of sample FLA/SWF files. These files are available from the Downloads section of Scaleform Developer Center website.

2. Transformations

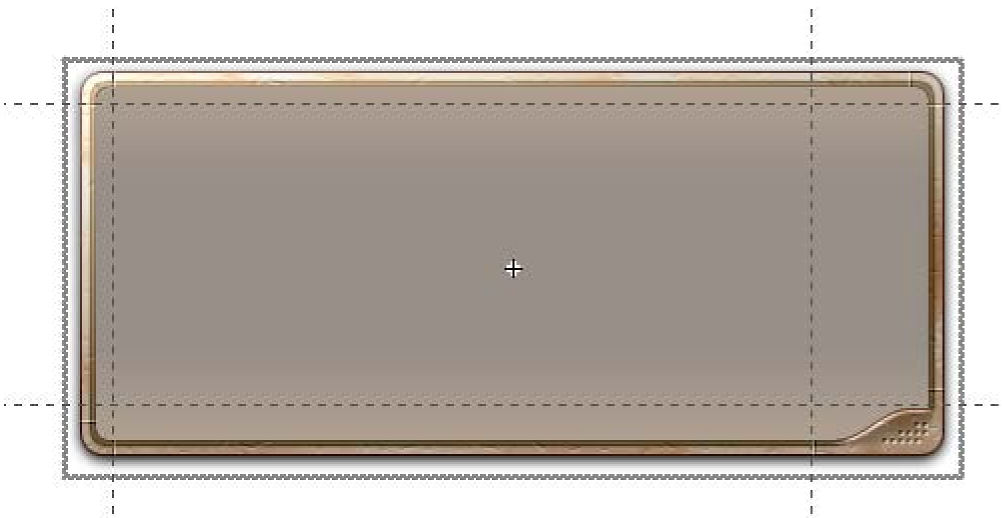
Unlike Flash, Scaleform supports arbitrary transformations of the movie clip with applied Scale9Grid. Whereas, in Flash the referenced movie clip cannot be rotated or skewed. However, it is possible to include the resulting movie clip in a sprite and then use a rotation or skew that enclosing sprite. Transformations of the enclosing sprite works identically in both, Flash and Scaleform. Transforming the higher level symbols makes it possible to draw different looking shapes with the same Scale9Grid, as in the following example.

3. Processing Bitmaps

Although gradient and bitmap shape fill styles are transformed identically in Flash and Scaleform, separate standalone bitmaps are processed differently. In Flash, when a standalone bitmap is placed in a 9-slice scaled movie clip, the player ignores any of the Scale9Grid settings unless the bitmap is explicitly cut into nine pieces by the user. Whereas, the Scaleform player automatically slices the bitmap so it is scaled correctly with Scale9Grid. This behavior greatly simplifies development and allows creation of resizable buttons and windows without manual image cutting by the artist. Furthermore, automatic slicing eliminates the antialiasing seams that are possible when stitching content rendered with EdgeAA. The behavior of automatic slicing is explained in more detail in the following example.

Suppose the artist creates a bitmap that represents a window background similar to the image below:

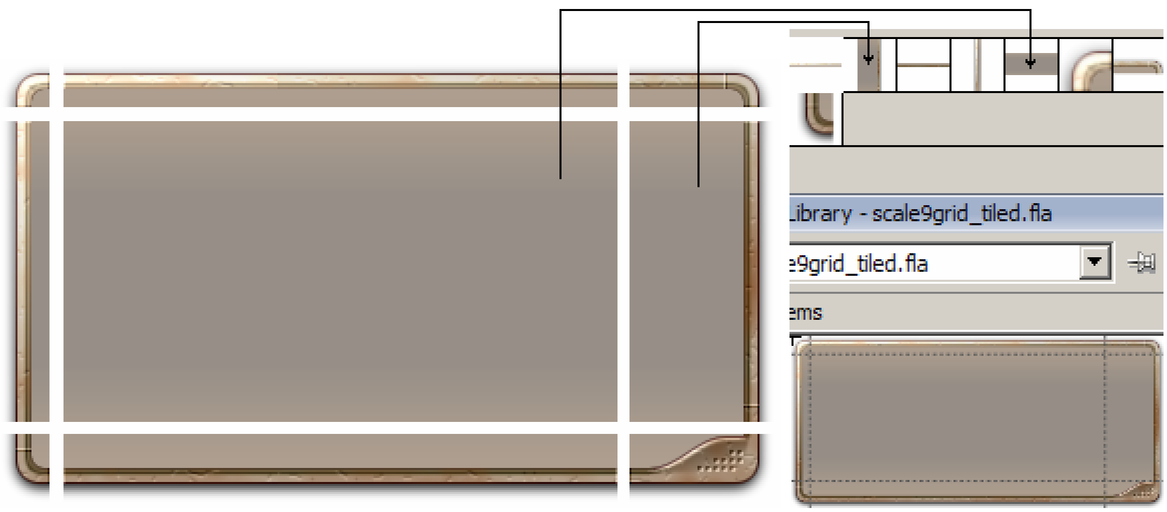
Then the artist applies Scale9Grid so that the shape of the corners can be preserved when scaling. The most obvious way to set this up is to create a movie clip and apply Scale9Grid to it as follows:



However, it will not work in Flash as expected. If you scale the resulting movie clip, it will look as if no Scale9Grid was applied:

In Scaleform this will work as expected, preserving the shapes of the corners:

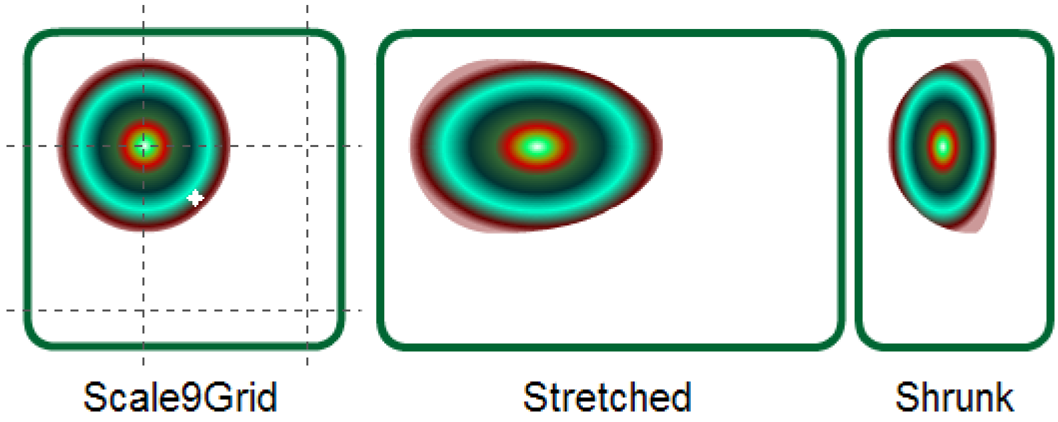
Adobe Flash calculates the average scale for the image on the basis of its bounding box. This means that it is still possible to make 9-slice scaling work with bitmaps, but it requires nine separate image pieces that correspond exactly with the Scale9Grid tiles:



Scaleform does this operation automatically when playing the Flash file.

However, if the image is arbitrarily rotated or skewed, Scaleform will process it identically to Flash. An example of such "manually tiled" window is illustrated by files scale9grid_tiled.fla and scale9grid_tiled.swf.

Shapes with bitmap and gradient fill styles are displayed identically in Flash and Scaleform. Note that both gradient and bitmap fills fail to preserve the Scale9Grid transformation. In effect, the transformation is only applied to the vector shape outline, but not to the fill style content. For example:

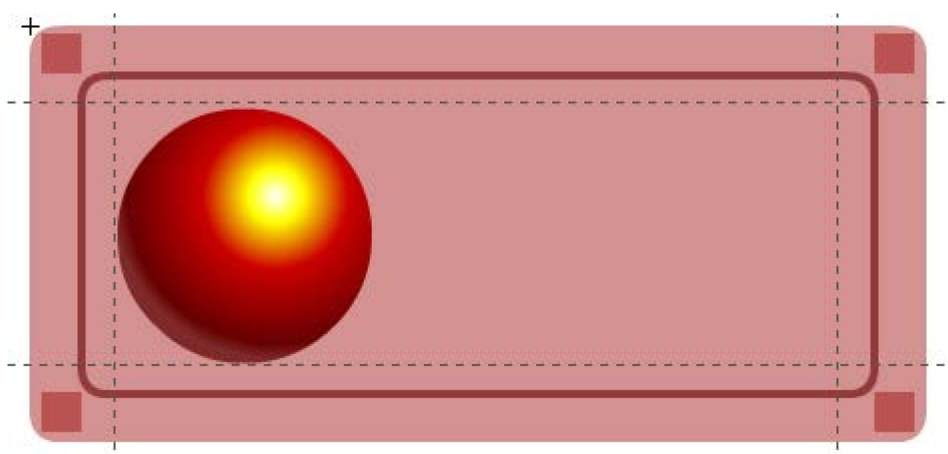


4. Interactive Windows

This section provides examples of interactively resizable windows and describes the ActionScript source code required to make them work with user input.

4.1 Flash Compatible Example

The following example demonstrates how to create a Flash compatible version of an interactively resizable window. The example relies on the scale9grid_window1.fla and scale9grid_window1.swf sample files. Suppose we created the following movie clip in the Flash Studio.



The idea is to resize the window by dragging the little squares in the corners and move it by dragging any other part of its surface. The major problem here is that Flash and its ActionScript do not provide any mechanism for hit-testing that would distinguish between the different shapes and layers inside the movie clip. Furthermore, the 9-slice scaling does not work for nested movie clips in Flash. This contradiction makes it hard to program the resizing logic. As a work-around for hit-testing shapes, programmers have to explicitly check the coordinates. The example below illustrates the ActionScript program associated with the given movie clip.

```
import flash.geom.Rectangle;

var bounds:Object = this.getBounds(this);
for (var i in bounds) trace(i+" --> "+bounds[i]);
this.XMin = bounds.xMin;
this.YMin = bounds.yMin;
this.XMax = bounds.xMax;
this.YMax = bounds.yMax;
this.MinW = 120;
this.MinH = 100;
this.OldX = this._x;
this.OldY = this._y;
this.OldW = this._width;
this.OldH = this._height;
this.OldMouseX = 0;
this.OldMouseY = 0;
this.XMode = 0;
this.YMode = 0;


this.onPress = function()
{
      this.OldX = this._x;
      this.OldY = this._y;
      this.OldW = this._width;
      this.OldH = this._height;
      this.OldMouseX = _root._xmouse;
      this.OldMouseY = _root._ymouse;
      this.XMode = 0;
      this.YMode = 0;

      var kx = (this.XMax - this.XMin) / this._width;
      var ky = (this.YMax - this.YMin) / this._height;
      var x1 = this.XMin + 6  * kx;   // Left
      var y1 = this.YMin + 4  * ky;   // Top
      var x2 = this.XMax - 26 * kx;   // Right
      var y2 = this.YMax - 25 * ky;   // Bottom
      var w  = 20 * kx;
      var h  = 20 * ky;
      var xms = this._xmouse;
      var yms = this._ymouse;

      if (xms >= x1 && xms <= x1+w)
```

```
	{
		if (yms >= y1 && yms <= y1+h)
		{
			this.XMode = -1;
			this.YMode = -1;
		}
		else
		if (yms >= y2 && yms <= y2+h)
		{
			this.XMode = -1;
			this.YMode =  1;
		}
	}
	else
	if (xms >= x2 && xms <= x2+w)
	{
		if (yms >= y1 && yms <= y1+h)
		{
			this.XMode =  1;
			this.YMode = -1;
		}
		else
		if (yms >= y2 && yms <= y2+h)
		{
			this.XMode =  1;
			this.YMode =  1;
		}
	}

	if (XMode == 0 && YMode == 0)
	{
		this.startDrag();
	}
}


this.onRelease = function()
{
	this.XMode = 0;
	this.YMode = 0;
	this.stopDrag();
}

this.onReleaseOutside = function()
{
	this.XMode = 0;
	this.YMode = 0;
	this.stopDrag();
}
```

```
this.onMouseMove = function()
{
      var dx = _root._xmouse - OldMouseX;
      var dy = _root._ymouse - OldMouseY;

      if (this.XMode == -1)
      {
            this._x     = this.OldX + dx;
            this._width = this.OldW - dx;
            if (this._width < this.MinW || _root._xmouse > this.OldX + this.OldW)
            {
                  this._x     = this.OldX + this.OldW - this.MinW;
                  this._width = this.MinW;
            }
      }
      if (this.XMode == 1)
      {
            this._width = this.OldW + dx;
            if (this._width < this.MinW || _root._xmouse < this.OldX)
                this._width = this.MinW;
      }
      if (this.YMode == -1)
      {
            this._y      = this.OldY + dy;
            this._height = this.OldH - dy;
            if (this._height < this.MinH || _root._ymouse > this.OldY + this.OldH)
            {
                  this._y      = this.OldY + this.OldH - this.MinH;
                  this._height = this.MinH;
            }
      }
      if (this.YMode == 1)
      {
            this._height = this.OldH + dy;
            if (this._height < this.MinH || _root._ymouse < this.OldY)
                this._height = this.MinH;
      }
}
```

As you can see, the logic is rather complex. We need to have the initial bounding box of the movie clip and other variables. The important values that control movement are `XMode` and `YMode`. The mode value of '`-1`' means we are dragging the left or the top window border, respectively. The value of '`1`' means we are dragging the right or the bottom one.

The main hit-test logic is contained in the `onPress()` function. First, we have to calculate the scaling coefficients `kx` and `ky`, because the mouse coordinates do not automatically preserve the Scale9Grid transformation logic:

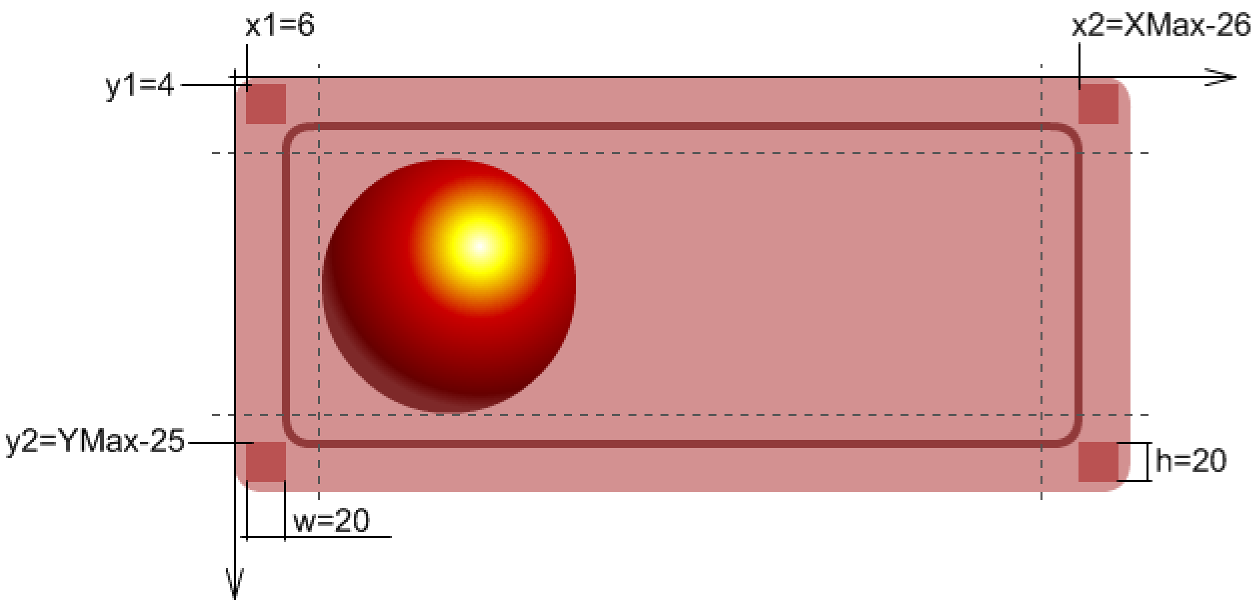
```
var kx = (this.XMax - this.XMin) / this._width;
var ky = (this.YMax - this.YMin) / this._height;
```

Then we calculate the hit-test rectangles (actually, squares in our case) which are:

Left-Top:	x1, y1, x1+w, y1+h
Right-Top:	x2, y1, x2+w, y1+h
Left-Bottom:	x1, y2, x1+w, y2+h
Right-Bottom:	x2, y2, x2+w, y2+h

```
var x1 = this.XMin + 6  * kx;   // Left
var y1 = this.YMin + 4  * ky;   // Top
var x2 = this.XMax - 26 * kx;   // Right
var y2 = this.YMax - 25 * ky;   // Bottom
var w  = 20 * kx;
var h  = 20 * ky;
```

Note the constant values 6, 4, 26, 25, and 20. They are actually the coordinates that must exactly correspond with the respective shapes in the movie clip. In fact, the squares in the corners are not necessary and can be removed. This is the major disadvantage of the method: when changing the shapes you have to modify the ActionScript code accordingly. The following picture explains the meaning of the used constants.



In the next step we programmatically verify the coordinates and assign the respective resizing modes.

```
var xms = this._xmouse;
var yms = this._ymouse;
if (xms >= x1 && xms <= x1+w)
{
      ... and so on
```

Needless to say, the more complex shapes in the corners would require more complex logic. For example, the following corners would need to check for 2 rectangles each:

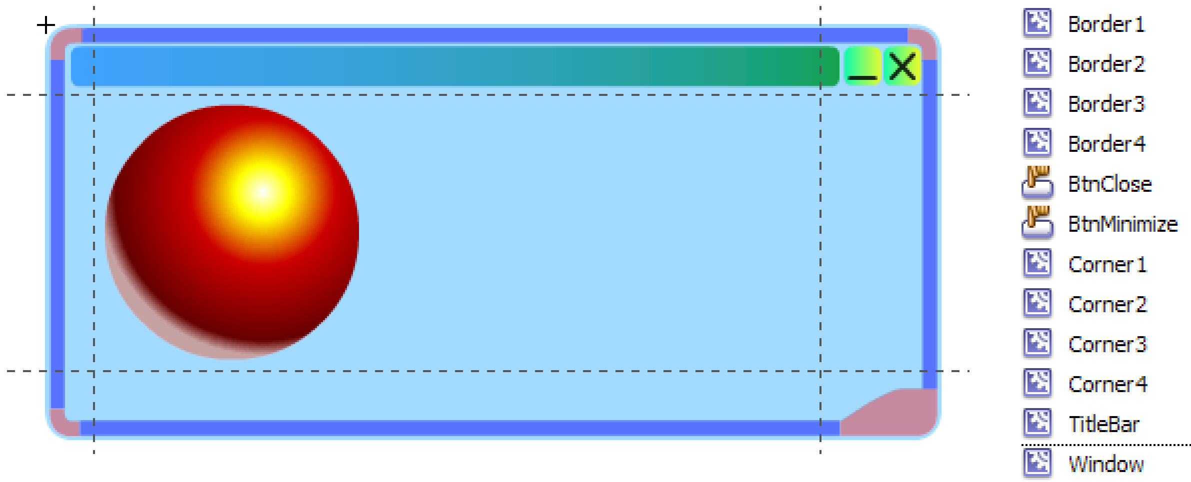
Checking for rounded corners or any other irregular shapes becomes very complex. Furthermore, this example does not handle resizing borders.

The rest of the ActionScript logic deals with changing the window coordinates and size while respecting the minimal width and height restrictions.

Note that a window with an image background requires manual tiling to be fully compatible with Flash.

4.2 Advanced Scaleform Example

An example that works in Scaleform, but not in Flash is more advanced. It relies on the fact that Scaleform transforms nested movie clips correctly, which means you can use the mouse hit-test functionality for arbitrary, irregular shapes. It is included in files scale9grid_window2.fla and scale9grid_window2.swf. The graphics for this example are more complex, providing advanced functionality based on the generalized ActionScript code that does not use hard-coded coordinates and can be easily reused.



The sample Flash file consists of separate movie clips and buttons, such as Border1 to Border4 (blue), Corner1 to Corner4 (pink), TitleBar, and so on. Since Scaleform adjusts the nested movie clips correctly based on Scale9Grid, all you have to do is assign functions to the movie clips. The ActionScript becomes simple and obvious. Note that the `OnResize()` function is the same as in the previous example.

```
import flash.geom.Rectangle;
//trace(this.scale9Grid);
this.MinW = 100;
this.MinH = 100;
this.XMode = 0;
this.YMode = 0;
this.OldX = this._x;
this.OldY = this._y;
this.OldW = this._width;
this.OldH = this._height;
this.OldMouseX = 0;
this.OldMouseY = 0;

function AssignResizeFunction(mc:MovieClip, xMode:Number, yMode:Number)
{
      mc.onPress          = function() { this._parent.StartResize(xMode, yMode);
      mc.onRelease        = function() { this._parent.StopResize(); }
      mc.onReleaseOutside = function() { this._parent.StopResize();    }
      mc.onMouseMove      = function() { this._parent.OnResize(); }
}

AssignResizeFunction(this.Border1,  0, -1);
AssignResizeFunction(this.Border2,  1,  0);
AssignResizeFunction(this.Border3,  0,  1);
AssignResizeFunction(this.Border4, -1,  0);
AssignResizeFunction(this.Corner1, -1, -1);
AssignResizeFunction(this.Corner2,  1, -1);
AssignResizeFunction(this.Corner3,  1,  1);
```

```
AssignResizeFunction(this.Corner4, -1,  1);
this.TitleBar.onPress          = function() { this._parent.startDrag(); }
this.TitleBar.onRelease        = function() { this._parent.stopDrag(); }
this.TitleBar.onReleaseOutside = function() { this._parent.stopDrag(); }

function StartResize(xMode:Number, yMode:Number)
{
      this.XMode = xMode;
      this.YMode = yMode;
      this.OldX = this._x;
      this.OldY = this._y;
      this.OldW = this._width;
      this.OldH = this._height;
      this.OldMouseX = _root._xmouse;
      this.OldMouseY = _root._ymouse;
}

function StopResize()
{
      this.XMode = 0;
      this.YMode = 0;
}

function OnResize()
{
      var dx = _root._xmouse - OldMouseX;
      var dy = _root._ymouse - OldMouseY;

      if (this.XMode == -1)
      {
            this._x     = this.OldX + dx;
            this._width = this.OldW - dx;
            if (this._width < this.MinW || _root._xmouse > this.OldX + this.OldW)
            {
                  this._x     = this.OldX + this.OldW - this.MinW;
                  this._width = this.MinW;
            }
      }
      if (this.XMode == 1)
      {
            this._width = this.OldW + dx;
            if (this._width < this.MinW || _root._xmouse < this.OldX)
                this._width = this.MinW;
      }
      if (this.YMode == -1)
      {
            this._y      = this.OldY + dy;
            this._height = this.OldH - dy;
            if (this._height < this.MinH || _root._ymouse > this.OldY + this.OldH)
```

```
        {
              this._y      = this.OldY + this.OldH - this.MinH;
              this._height = this.MinH;
        }
  }
  if (this.YMode == 1)
  {
        this._height = this.OldH + dy;
        if (this._height < this.MinH || _root._ymouse < this.OldY)
            this._height = this.MinH;
  }
}
```

This method has two disadvantages. First, it becomes incompatible with the Adobe Flash player. The second problem is it has many movie clips in it, which generates extra draw primitives and consumes extra memory. This is the price you pay for the simple and general solution. If extra draw primitives are critical, it is possible to combine both methods and replace the borders and corners with a single shape that represents the frame of the window. In which case it is necessary to add extra logic to the ActionScript code, but it should be less complex and less "fragile" than in the first example. The major advantage is that you can use arbitrary shapes for the hit-testing movie clip with irregular borders and corners. Shape and motion tweens will also work.

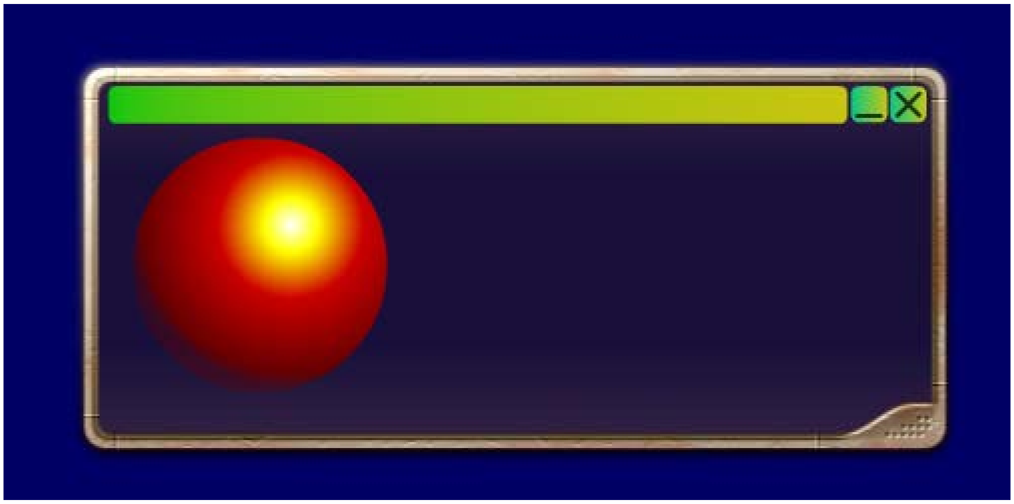
It is important to mention that the Flash Studio has a potential bug when generating SWF files with Scale9Grids. You can reproduce it with scale9grid_window2.fla. If you select the "TitleBar" layer and draw a small rectangle in the center of the window, the Scale9Grid will be incorrect. It appears that the Flash Studio does not tolerate nested movie clips and other graphics in the same layer. In a few cases it even fails to restore the correct Scale9Grid after removing this rectangle. The "Save and Compact" operation may help. If the problem persists, it is possible to restore the Scale9Grid from the ActionScript. You just trace it while it is correct:

```
trace(this.scale9Grid);
```

If the bug appears and cannot be eliminated, you can restore it using the following code:

```
this.scale9Grid = new Rectangle(24, 35, 363, 138);
```

For an example of a bitmap based background, see scale9grid_window3.fla and scale9grid_window3.swf. In this file the movie clips for the corners and borders are made fully transparent, because their only purpose is to support the hit-test functionality. They just replicate the shapes of the corners in the background image.



As mentioned earlier in the document, in Scaleform you can use a single image as the background, while in Flash you have to slice and tile it manually. In addition, the corner and border movie clip trick will not work in Adobe Flash Player, since it does not preserve the hit-test transformations correctly. Similarly, rotation and skewing of a Scale9Grid clip will not work correctly in the standard Flash Player. However, with Scaleform we tried to make creation of resizable windows as simple and efficient as possible, while also making sure scale9grid supports transformations correctly.