



High Performance Graphics in Android

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- **Why?**
- **Preparations**
- **Graphics in Android**
- **Move It!**
- **The Future**
- **Q&A**

Why?

Once upon a time...

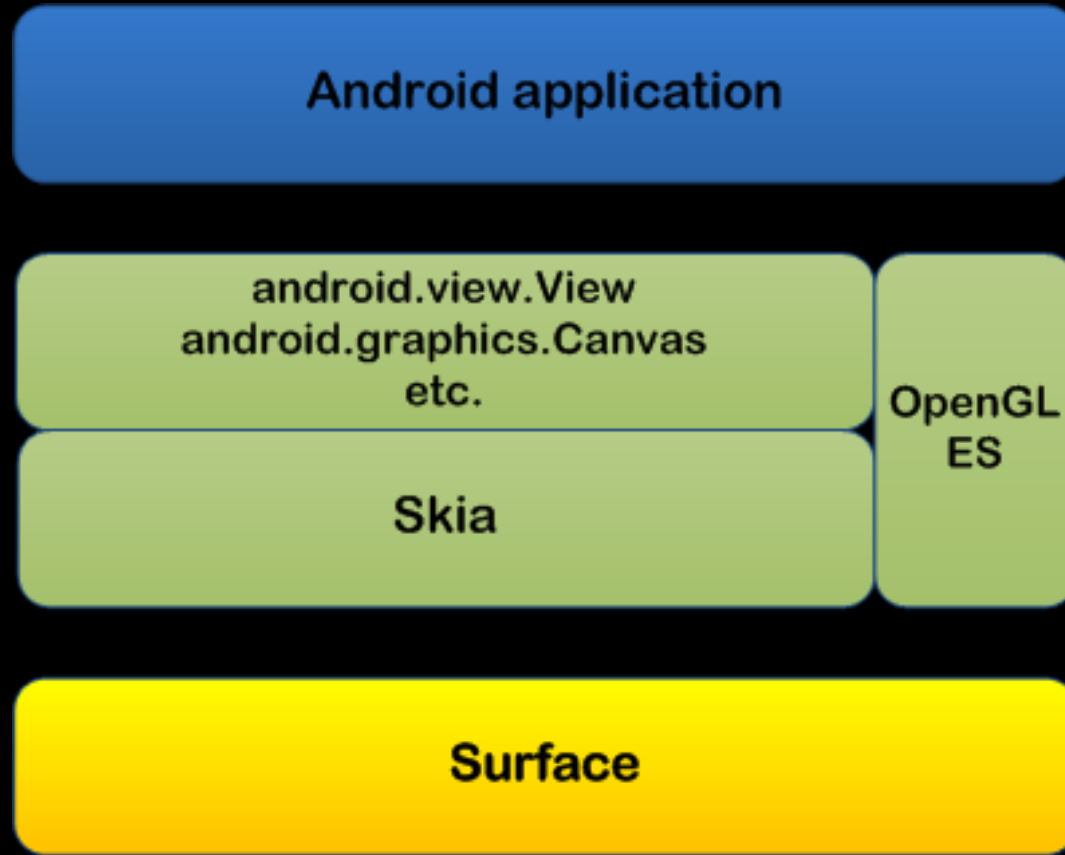


**Do NOT hack
anymore!**

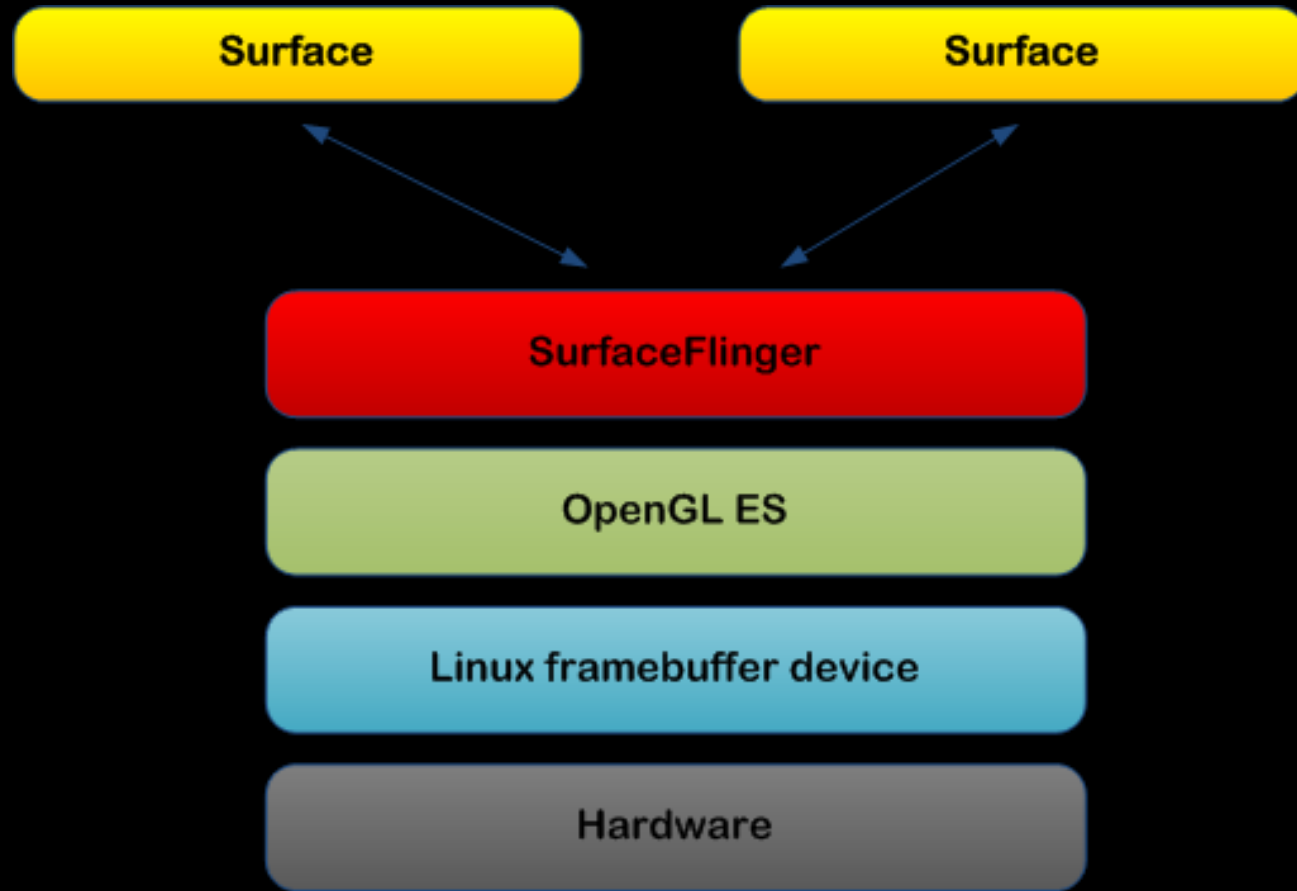
Lesson One

Be A Good Student !

Graphics in Android



Graphics in Android



- frameworks/base/libs/surfaceflinger/DisplayHardware/DisplayHardware.cpp

```
void DisplayHardware::init(uint32_t dpy)
{
    mNativeWindow = new FramebufferNativeWindow();
    framebuffer_device_t const * fbDev = mNativeWindow->getDevice();
    .....

    /*
    * Create our main surface
    */

    surface = eglCreateWindowSurface(display, config,
                                     mNativeWindow.get(), NULL);
    .....
}
```

- hardware/libhardware/modules/gralloc/framebuffer.cpp

```

int mapFramebufferLocked(struct private_module_t* module)
{
    // already initialized...
    if (module->framebuffer) {
        return 0;
    }

    char const * const device_template[] = {
        "/dev/graphics/fb%u",
        "/dev/fb%u",
        0 };

    int fd = -1;
    int i=0;
    char name[64];

    while ((fd== -1) && device_template[i]) {
        snprintf(name, 64, device_template[i], 0);
        fd = open(name, O_RDWR, 0);
        i++;
    }
    .....
}

```

- **Animation Framework**
- **Canvas**
- **OpenGL ES**

Android Animation Framework

- **android.view.animation**

Classes	Description
AlphaAnimation	An animation that controls the alpha level of an object.
RotateAnimation	An animation that controls the rotation of an object.
ScaleAnimation	An animation that controls the scale of an object.
TranslateAnimation	An animation that controls the position of an object.
AnimationDrawable	An object used to create frame-by-frame animations (android.graphics.drawable)

Wait...Wait.....

**What is the factors of
animation?**

Android Animation Framework

- **android.view.animation**

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Classic Game

The Rabbit and The Turtle

- Code snippets

```
Animation anim = new TranslateAnimation(  
    Animation.RELATIVE_TO_SELF, 0.0f,  
    Animation.RELATIVE_TO_SELF, 10.0f,  
    Animation.RELATIVE_TO_SELF, 0.0f,  
    Animation.RELATIVE_TO_SELF, 0.0f  
);  
anim.setDuration(3000);  
findViewById(R.id.ImageView01_turtle).startAnimation(anim);  
findViewById(R.id.ImageView02_rabbit).startAnimation(anim);
```

**What is the key of the
“Lazy” animations?**

Interpolator

Android Animation Framework

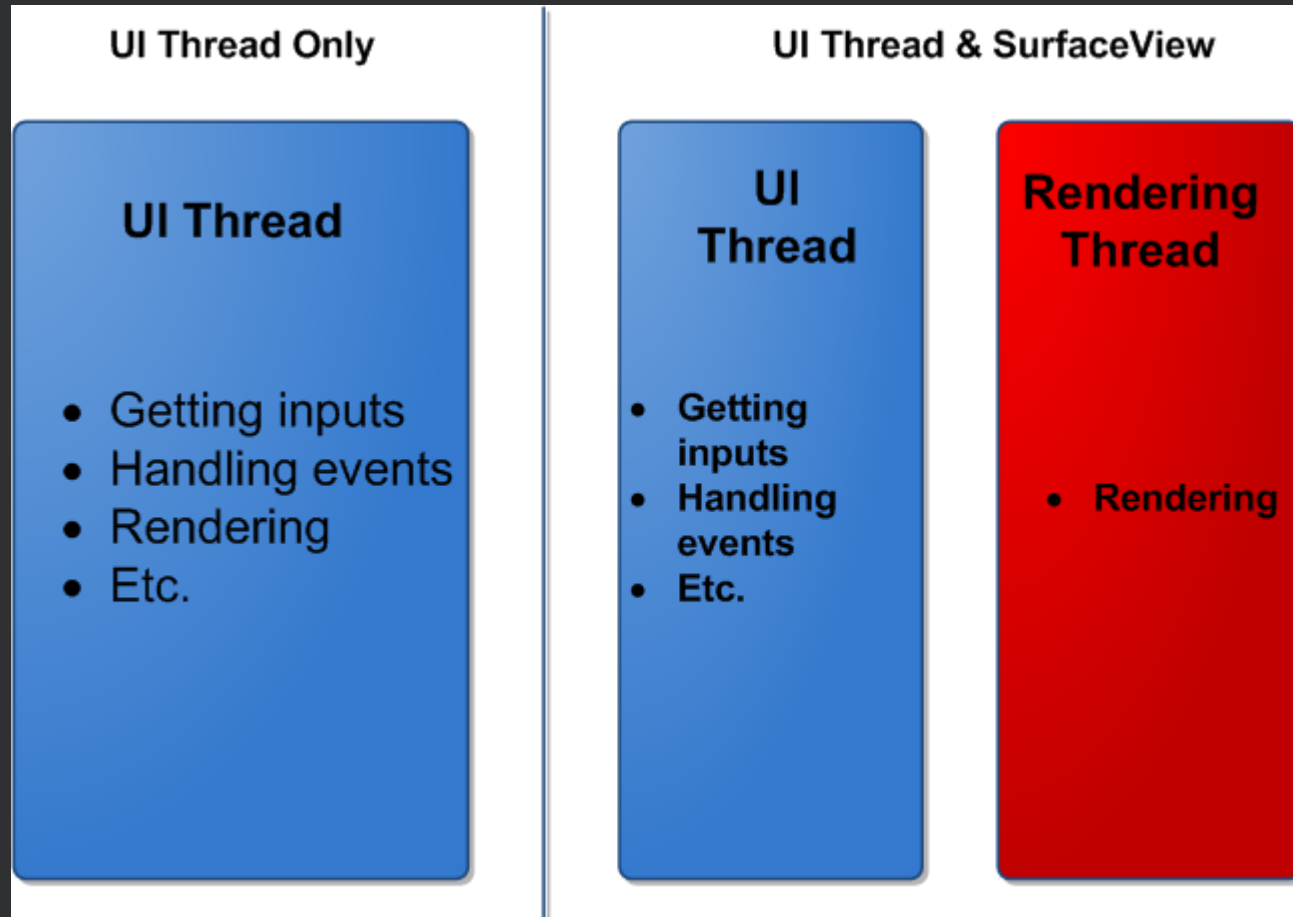
- **Interpolators (android.view.animation)**

Classes	Description
AccelerateDecelerateInterpolator	
AccelerateInterpolator	
AnticipateInterpolator *	
AnticipateOvershootInterpolator *	
BounceInterpolator *	
CycleInterpolator	
DecelerateInterpolator	
LinearInterpolator	
OvershootInterpolator *	

Can we improve it?

- **Canvas**
- **OpenGL ES**
 - Basic Vertex Quads
 - VBO Extension
 - Draw Texture Extension

Not enough!!!



- Code snippets – Part I

```

public class testSurfaceView extends SurfaceView implements
    SurfaceHolder.Callback, Runnable {

    private SurfaceHolder holder;
    .....
    public testSurfaceView(Context context) {
        super(context);
        init(context);
    }

    private init(Context context) {
        holder = getHolder();
        holder.addCallback(this);
        holder.setFixedSize(getWidth(), getHeight());
        .....
    }

    @Override
    public void surfaceChanged(SurfaceHolder holder, int format,
        int width, int height) {
        .....
    }

```

- Code snippets – Part II

.....

@Override

```
public void surfaceCreated(SurfaceHolder holder) {  
    thread = new Thread(this);  
    thread.start();  
}
```

@Override

```
public void surfaceDestroyed(SurfaceHolder holder) {  
    thread = null;  
}
```

@Override

```
public void run() {  
    // Rendering here!  
}
```

```
}
```

**Don't forget...
our old friend...**

- **DirectFB** is a thin library that provides hardware graphics acceleration, input device handling and abstraction, integrated windowing system with support for translucent windows and multiple display layers, not only on top of the Linux Framebuffer Device.
- Latest stable version: **1.4.3 (update to 2009/12/12)**
- License: **LGPL**



df_andi is back !!!

Results on Google Ion

Drawing methods	10 Tuxes	200 Tuxes
Canvas (SurfaceView)	42.52fps	13.35fps
OpenGL ES - Basic Vertex Quads	53.18fps	10.97fps
OpenGL ES - VBO Extension	57.80fps	21.23fps
OpenGL ES - Draw Texture Extension	57.81fps	42.93fps

- **RenderScript**
 - **Android 2.0 above**
 - **framework/base/graphics/java/android/**renderscript****
 - **RSSurfaceView.java**
 - Compiled on devices!!!
 - Using **acc** (libacc)
 - No ***#include***
 - No ***malloc()***
 - No ***free()***

- Code snippets

```
int main(int launchID) {  
    int z;  
    int x = Sprite->x;  
    int y = Sprite->y;  
    struct path_s * p = (struct path_s *)path;  
  
    z = x * 2 + y;  
    .....  
  
    return 1;  
}
```



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Thank you !

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