Material Animations

and other related stories

Agenda

- How Android draws
- Why 60 fps?
- Shadows
- Animations
- Activity Transitions
- Performance tools #perfmatters

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novoda

Est. 2008

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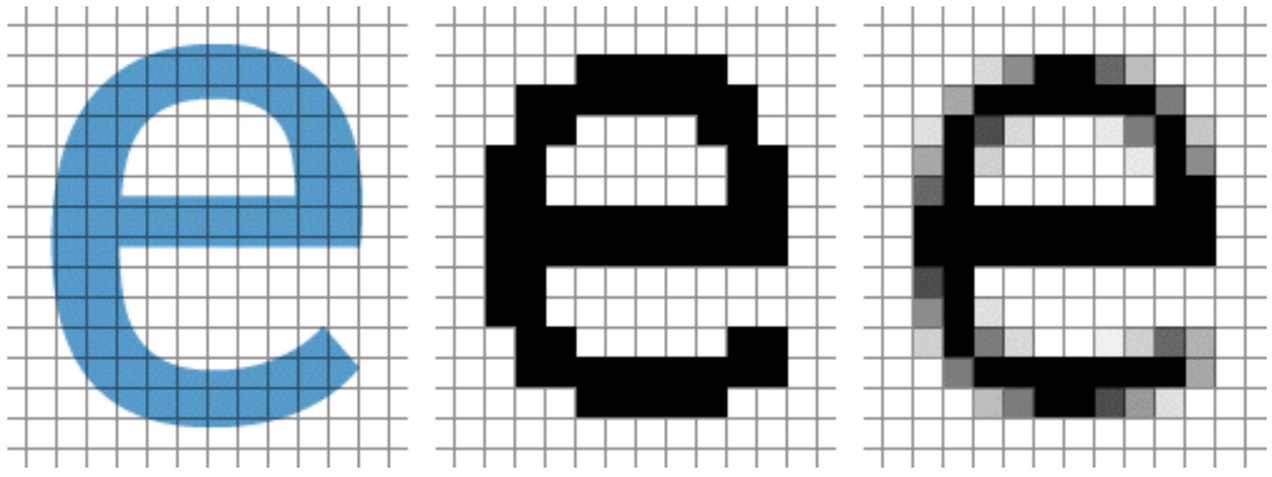
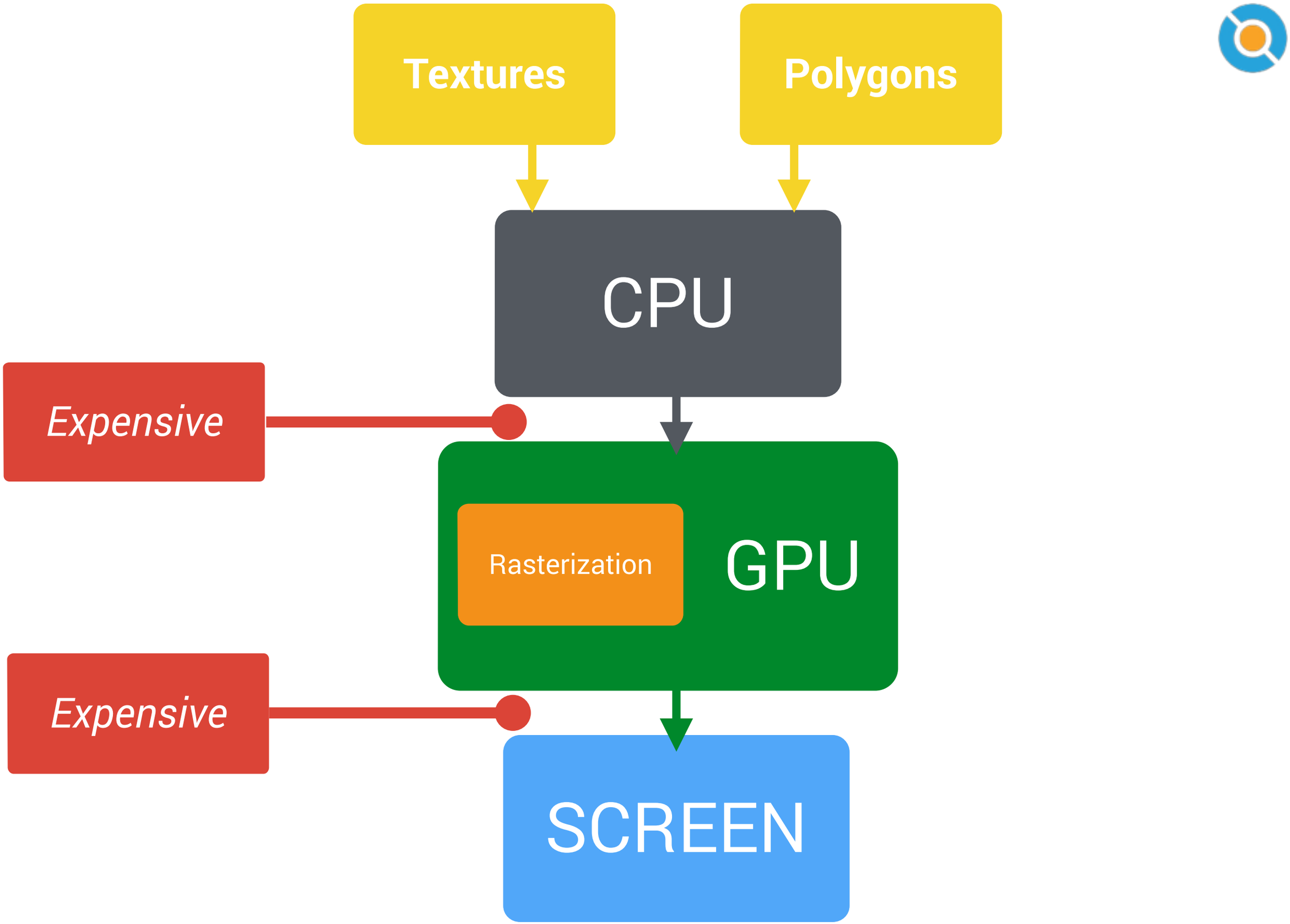
Android
2014

Scrum
Allian

How Android draws

Rasterization




Textures
Polygons
CPU
Expensive
Rasterization
GPU
Expensive
SCREEN

Why 60 fps?

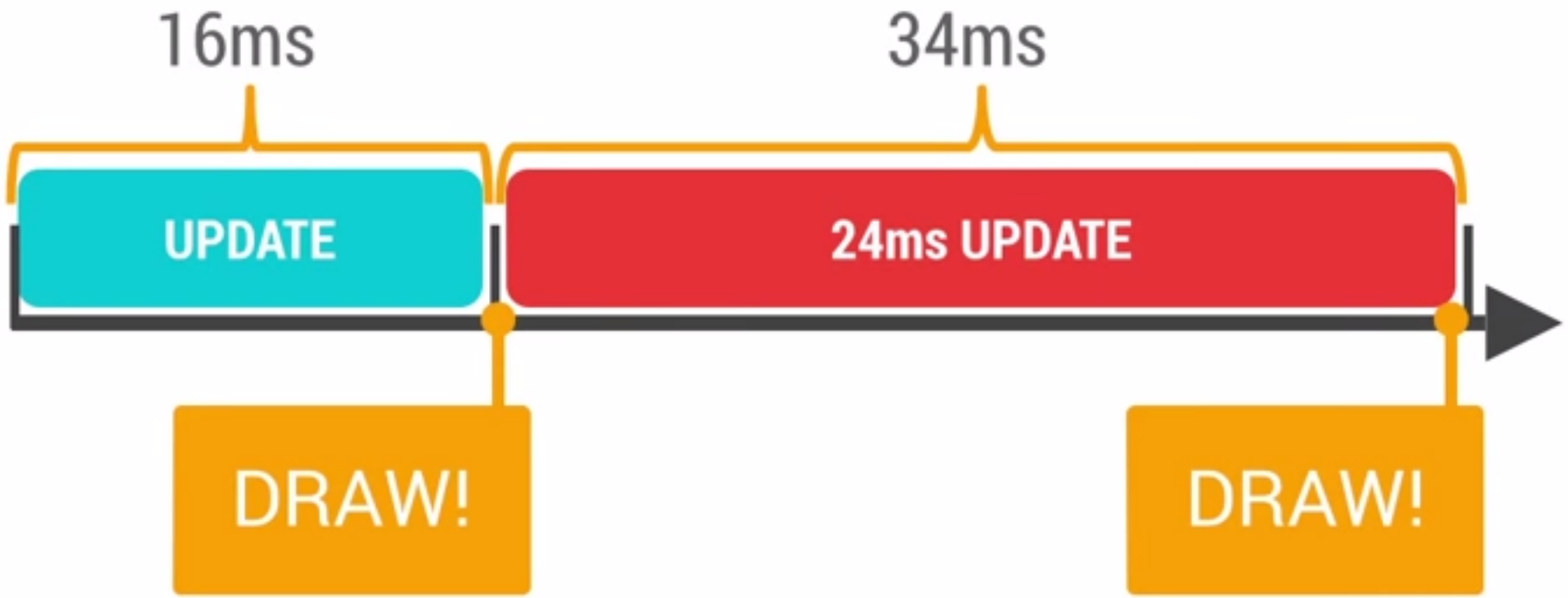
Normal speed

30fps

60fps

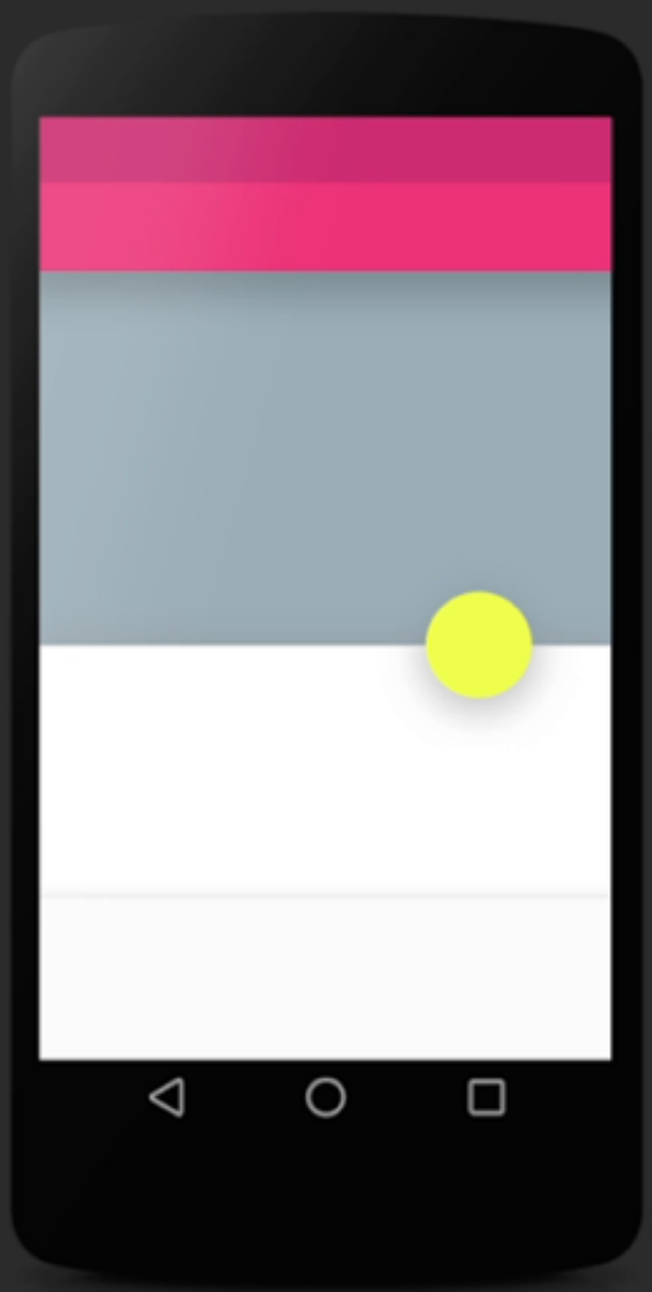
http://www.techverticals.com/wp-content/uploads/2012/04/24fps-vs-30fps-vs-60fps.jpg

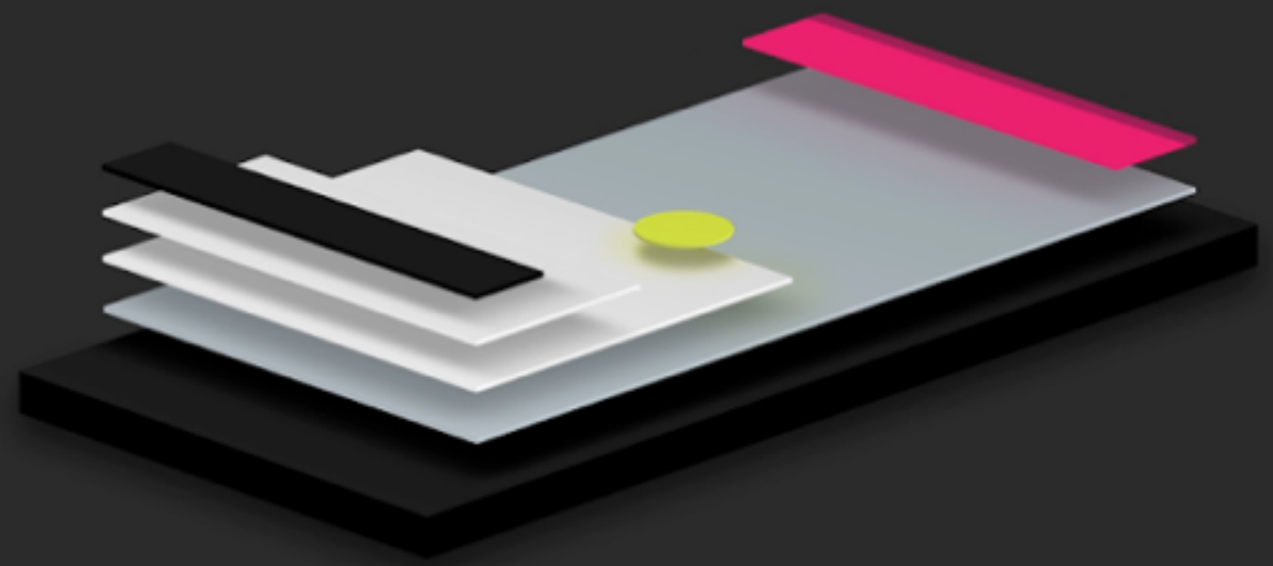
Design vs Performance



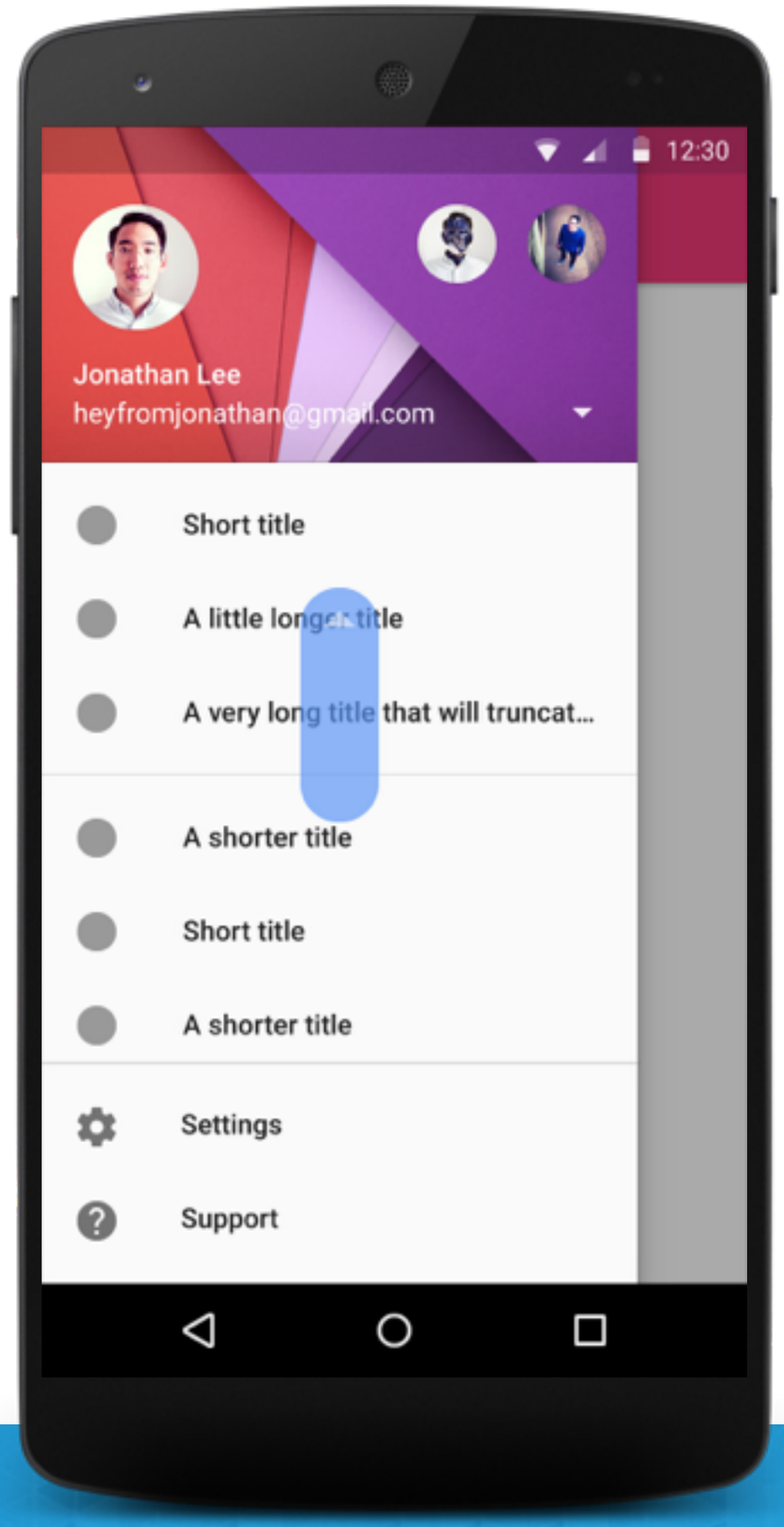
1000ms / 60 frames = 16.666 ms / frame

Overdraw



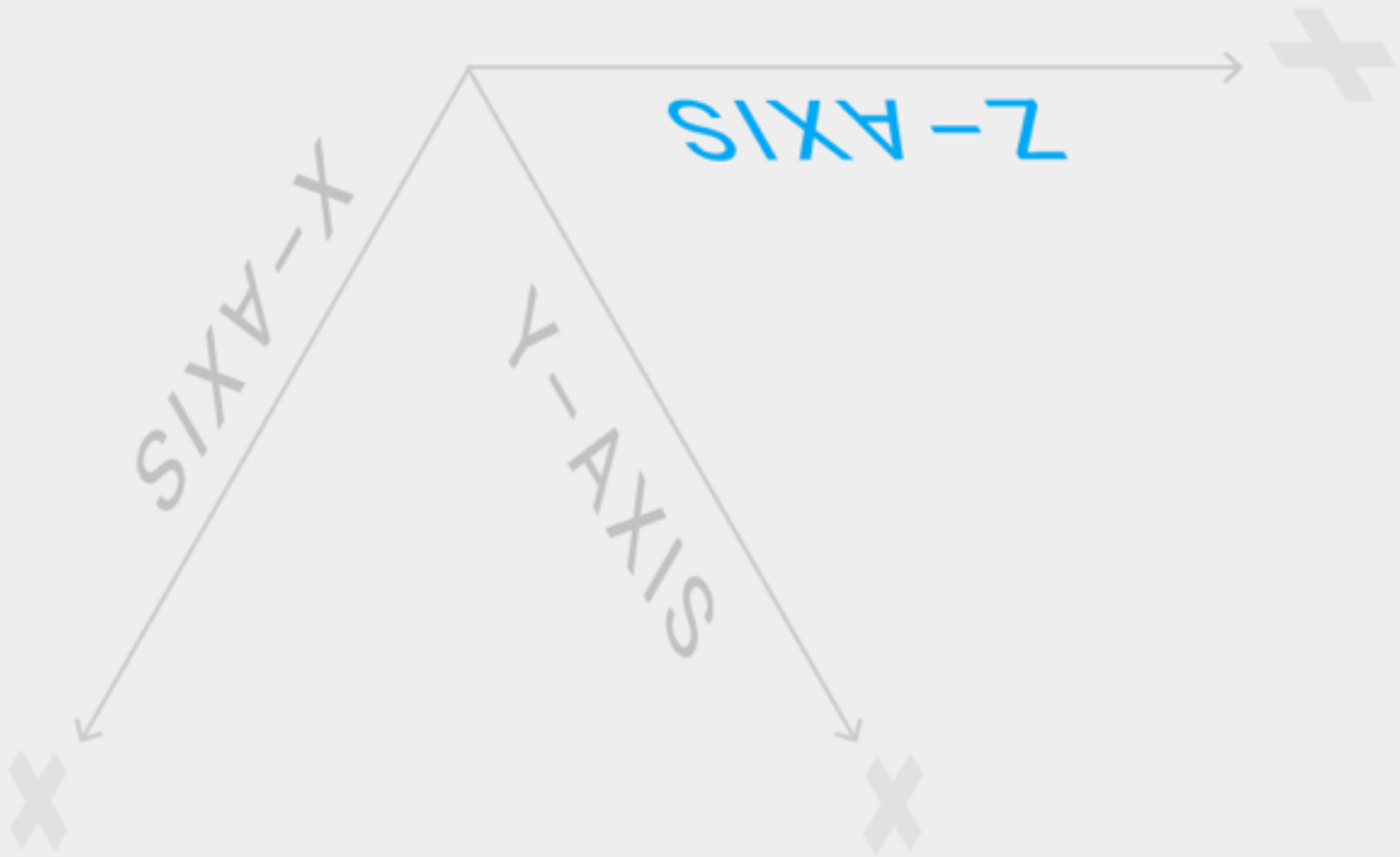


Overdraw


12:30
Jonathan Lee
heyfromjonathan@gmail.com
Short title
A little longer title
A very long title that will truncat...
A shorter title
Short title
A shorter title
Settings
Support

Shadows

- Views with elevation casts showdown onto background
- Orthographic projection
- Animated like other View properties

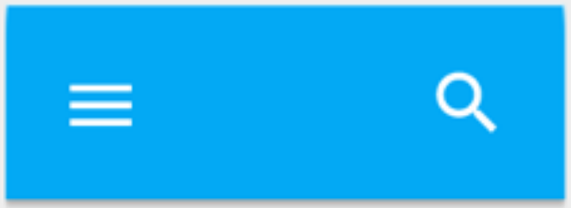

Z- AXIS
X-AXIS
Y-AXIS

Shadows

Z = Elevation + TranslationZ

Elevation

App bar



4dp

Floating action button

8dp

Card

2dp

Outline

res/layout/fragment_sample.xml

```
<ImageView
   …
   android:background=“@drawable/myrect“/>
```

res/drawable/myrect.xml

```
<shape android:shape=”rectangle”>
  <solid android:color=”#42000000” />
  <corners android:radius=”5dp” />
</shape>
```

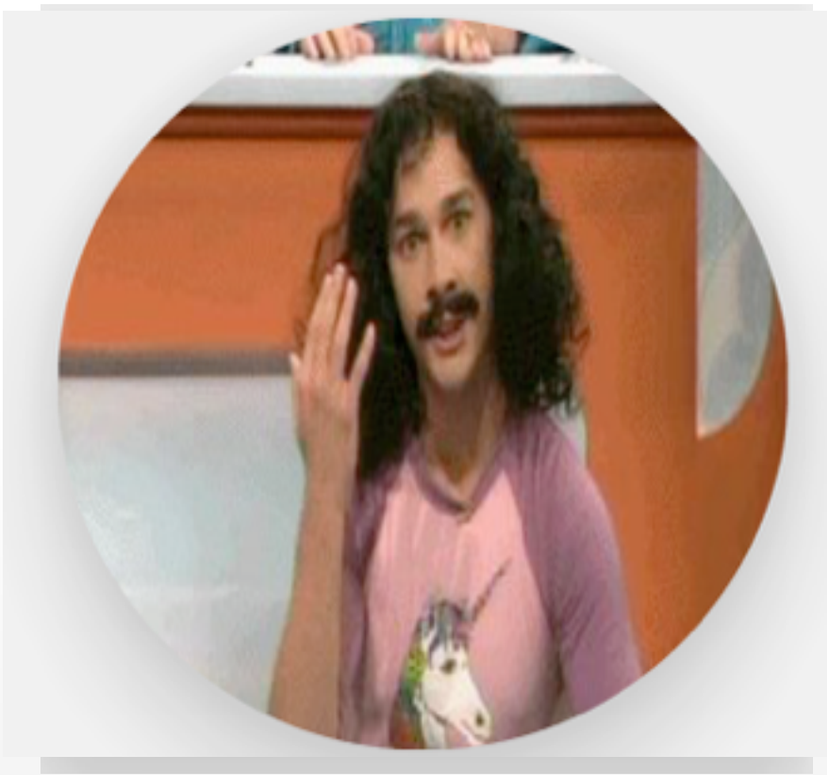
OvalOutlineProvider.java

```
static class OvalOutlineProvider
        extends ViewOutlineProvider{

    @Override
    public void getOutline(View view, Outline outline) {
        outline.setOval(0, 0,
          view.getWidth(),
          view.getHeight(),
          10);
    }
}
```

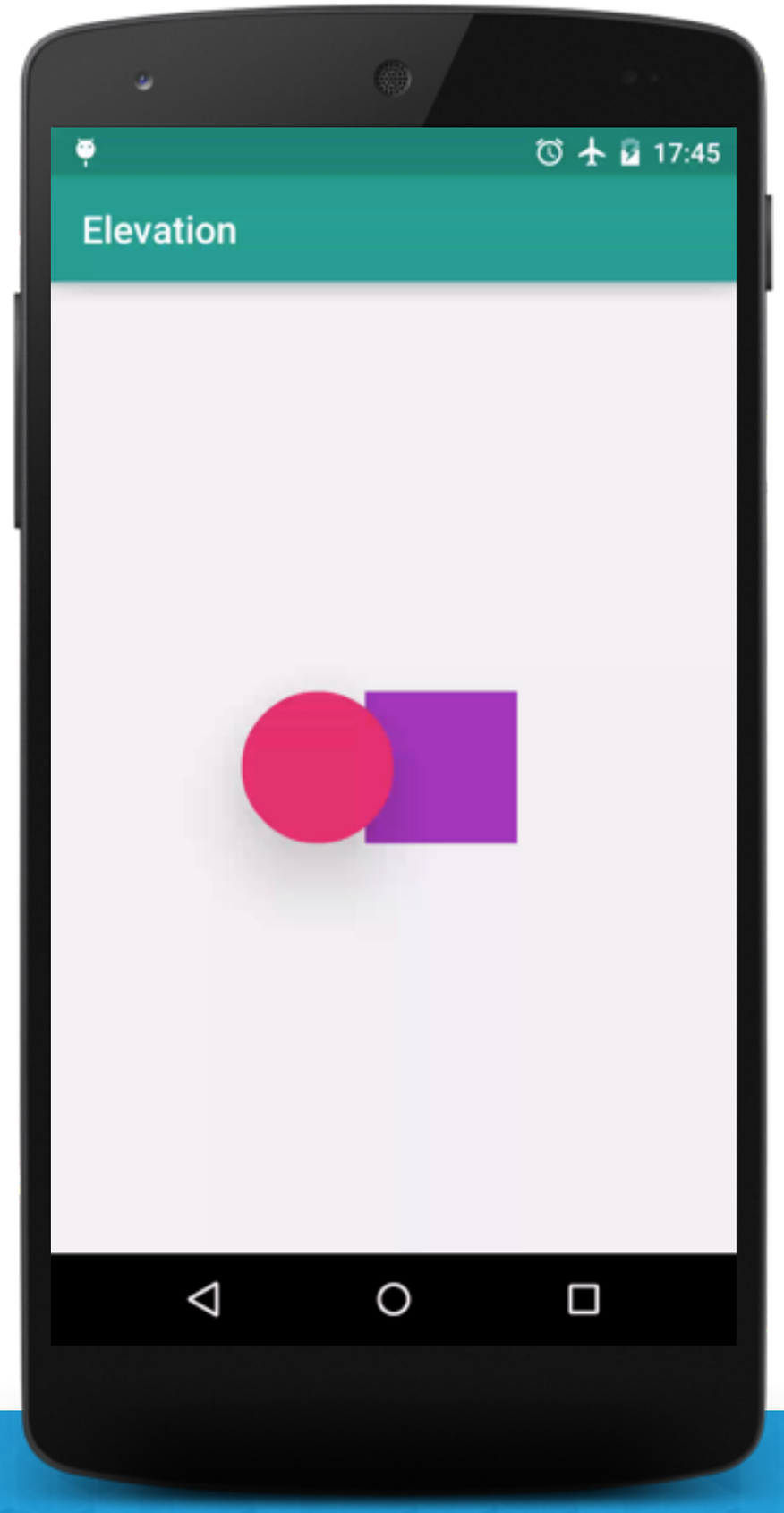
Define your own one

MyFragment.java

```
view.setClipToOutline(true);

view.setOutlineProvider(new
RoundRectOutlineProvider());
```



Basic elevation



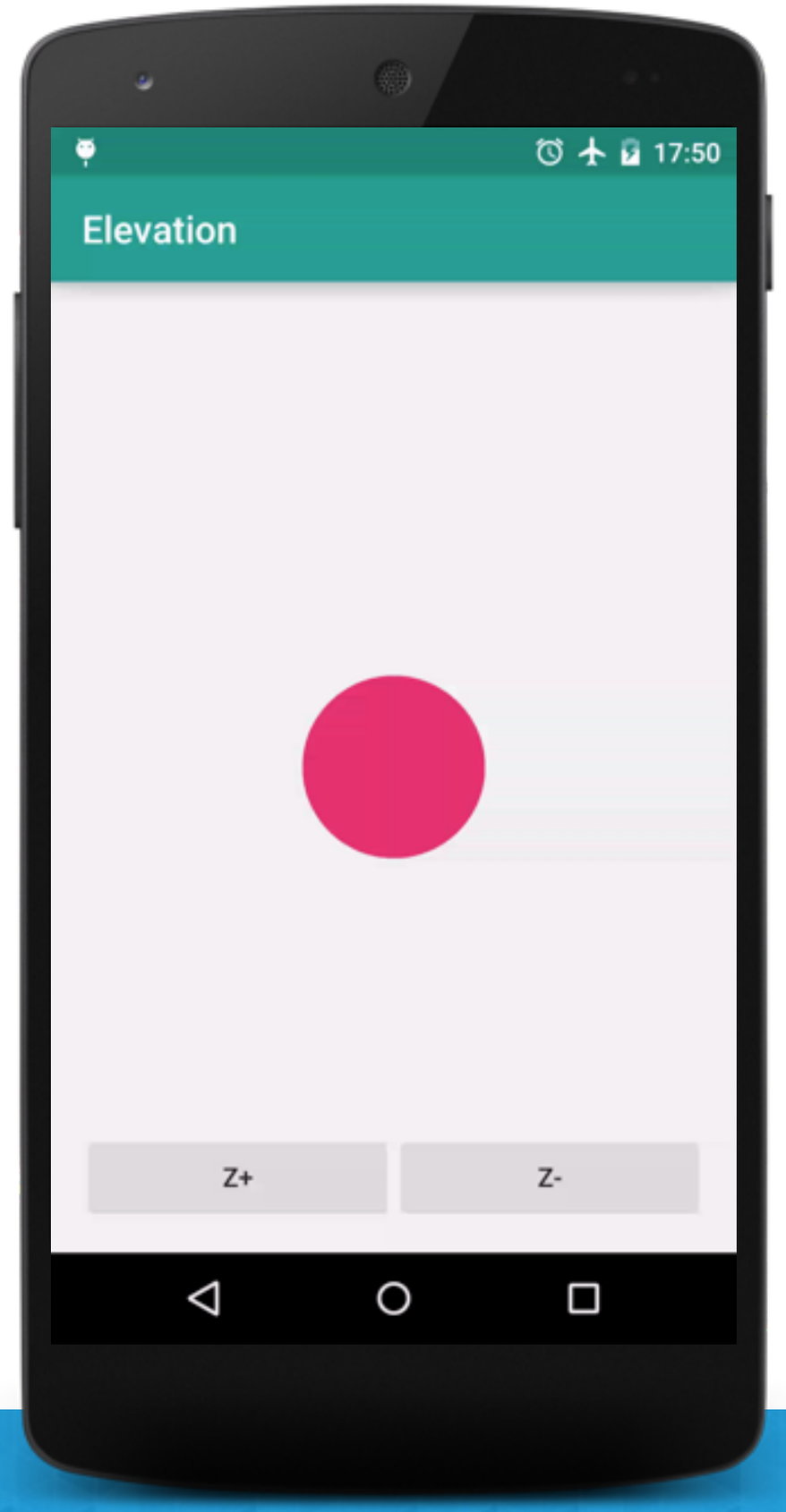
res/layout/elevation_basic.xml

```
<FrameLayout
  xmlns:tools="http://schemas.android.com/tools"
  android:layout_width="match_parent"
  android:layout_height="match_parent">
  <View
    android:id="@+id/floating_shape"
    android:layout_width="80dp"
    android:layout_height="80dp"
    android:layout_marginRight="40dp"
    android:background="@drawable/shape"
    android:elevation="30dp"
    android:layout_gravity="center"/>
  <View
    android:id="@+id/floating_shape_2"
    android:layout_width="80dp"
    android:layout_height="80dp"
    android:layout_marginLeft="25dp"
    android:background="@drawable/shape2"
    android:layout_gravity="center"/>
</FrameLayout>
```

ElevationBasicFragment.java

```
shape2.setOnTouchListener(new View.OnTouchListener() {
    @Override
    public boolean onTouch(View view, MotionEvent motionEvent) {
        int action = motionEvent.getActionMasked();
        switch (action) {
            case MotionEvent.ACTION_DOWN:
                view.animate().setDuration(100)
                  .scaleX(1.2f).scaleY(1.3f).translationZ(120);
                break;
            case MotionEvent.ACTION_UP:
                view.animate().setDuration(100)
                  .scaleX(1).scaleY(1).translationZ(0);
                break;
            default:
                return false;
        }
        return true;
    }
});
```

Drag elevation



res/layout/elevation_drag.xml

```
<FrameLayout
  xmlns:tools="http://schemas.android.com/tools"
  android:layout_width="match_parent"
  android:layout_height="match_parent">
  <View
    android:id="@+id/floating_shape"
    android:layout_width="80dp"
    android:layout_height="80dp"
    android:layout_marginRight="40dp"
    android:background="@drawable/shape"
    android:elevation="30dp"
    android:layout_gravity="center"/>
  <View
    android:id="@+id/floating_shape_2"
    android:layout_width="80dp"
    android:layout_height="80dp"
    android:layout_marginLeft="25dp"
    android:background="@drawable/shape2"
    android:layout_gravity="center"/>
</FrameLayout>
```

ElevationDragFragment.java

```
/* Raise the circle in z when the "z+" button is clicked. */
rootView.findViewById(R.id.raise_bt).setOnClickListener(new
View.OnClickListener() {
    @Override
    public void onClick(View v) {
        mElevation += mElevationStep;
        floatingShape.setElevation(mElevation);
    }
});
```

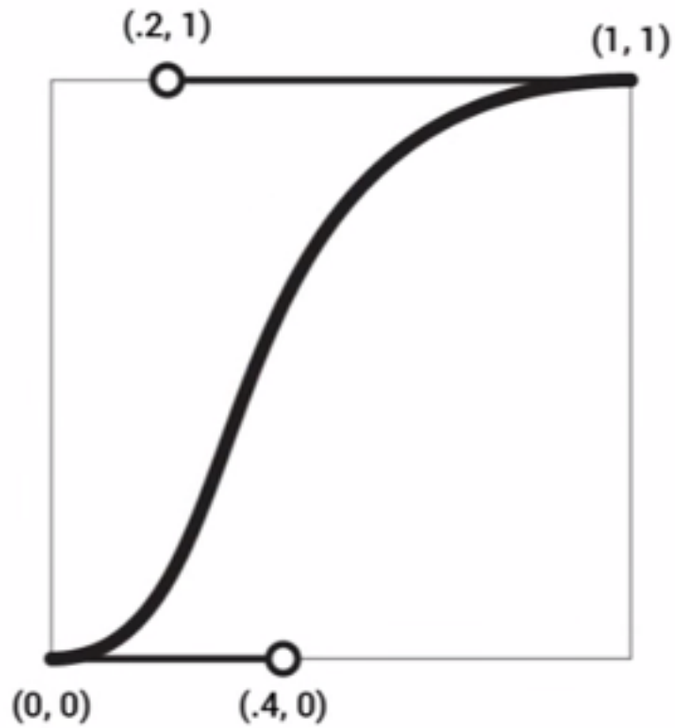
```
/* Lower the circle in z when the "z-" button is clicked. */
rootView.findViewById(R.id.lower_bt).setOnClickListener(new
View.OnClickListener() {
    @Override
    public void onClick(View v) {
        mElevation -= mElevationStep;
        // Don't allow for negative values of Z.
        if (mElevation < 0) {
            mElevation = 0;
        }
    }
});
```

ElevationDragFragment.java

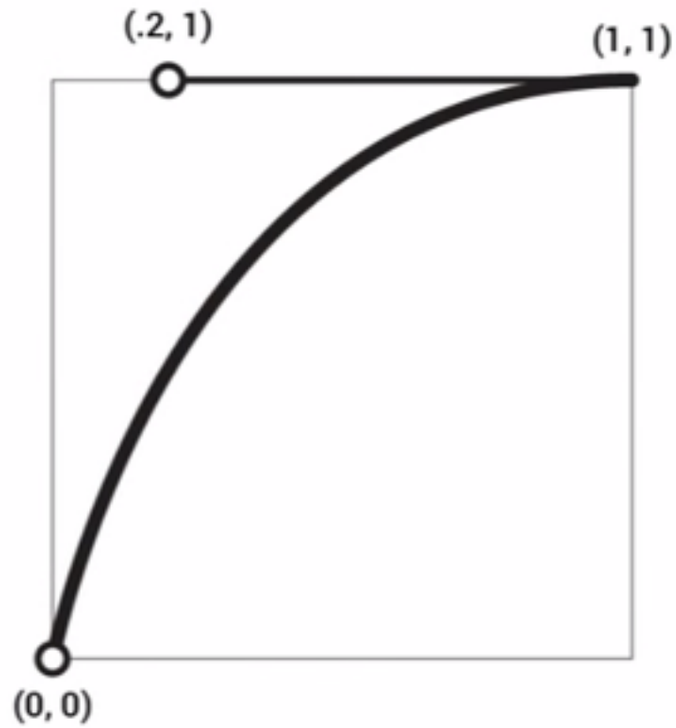
```
dragLayout.setDragFrameController(new
    DragFrameLayout.DragFrameLayoutController() {

    @Override
    public void onDragDrop(boolean captured) {
         /* Animate the translation of the {@link View}.
           Note that the translation
         is being modified, not the elevation. */
         floatingShape.animate()
                 .translationZ(captured ? 50 : 0)
                 .scaleX(1.2f)
                 .scaleY(1.3f)
                 .setDuration(100);
         Log.d(TAG, captured ? "Drag" : "Drop");
    }
});
```

Animations

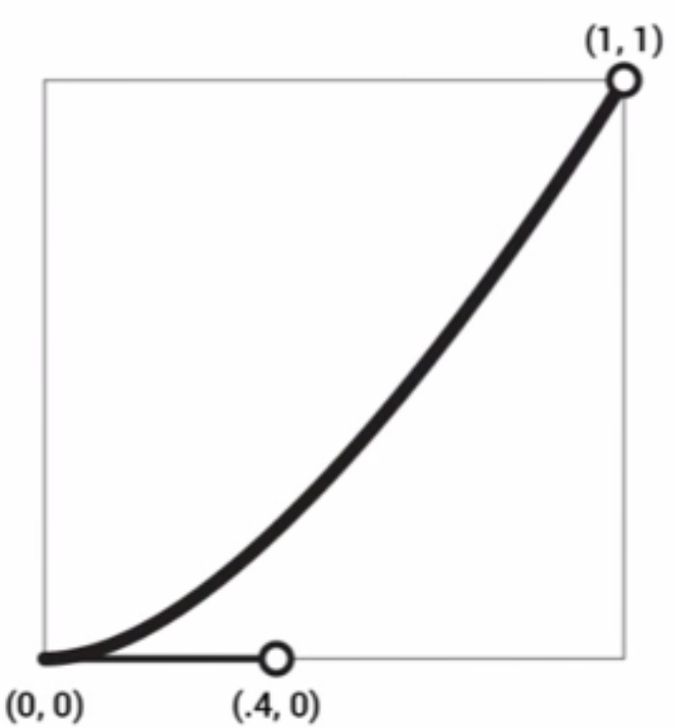
Animation curves



@interpolator/fast_out_slow_in

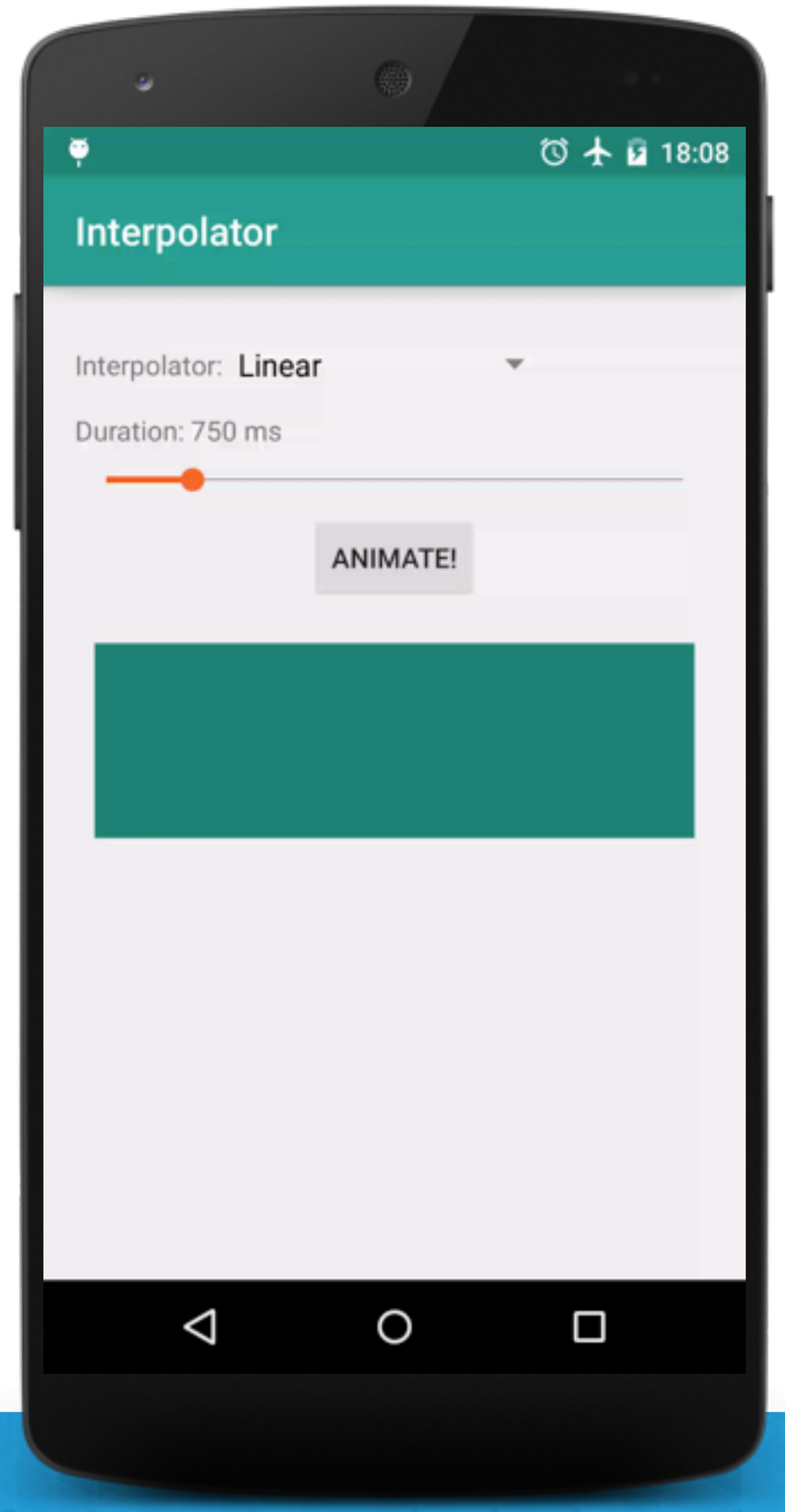


@interpolator/linear_out_slow_in



@interpolator/fast_out_linear_in

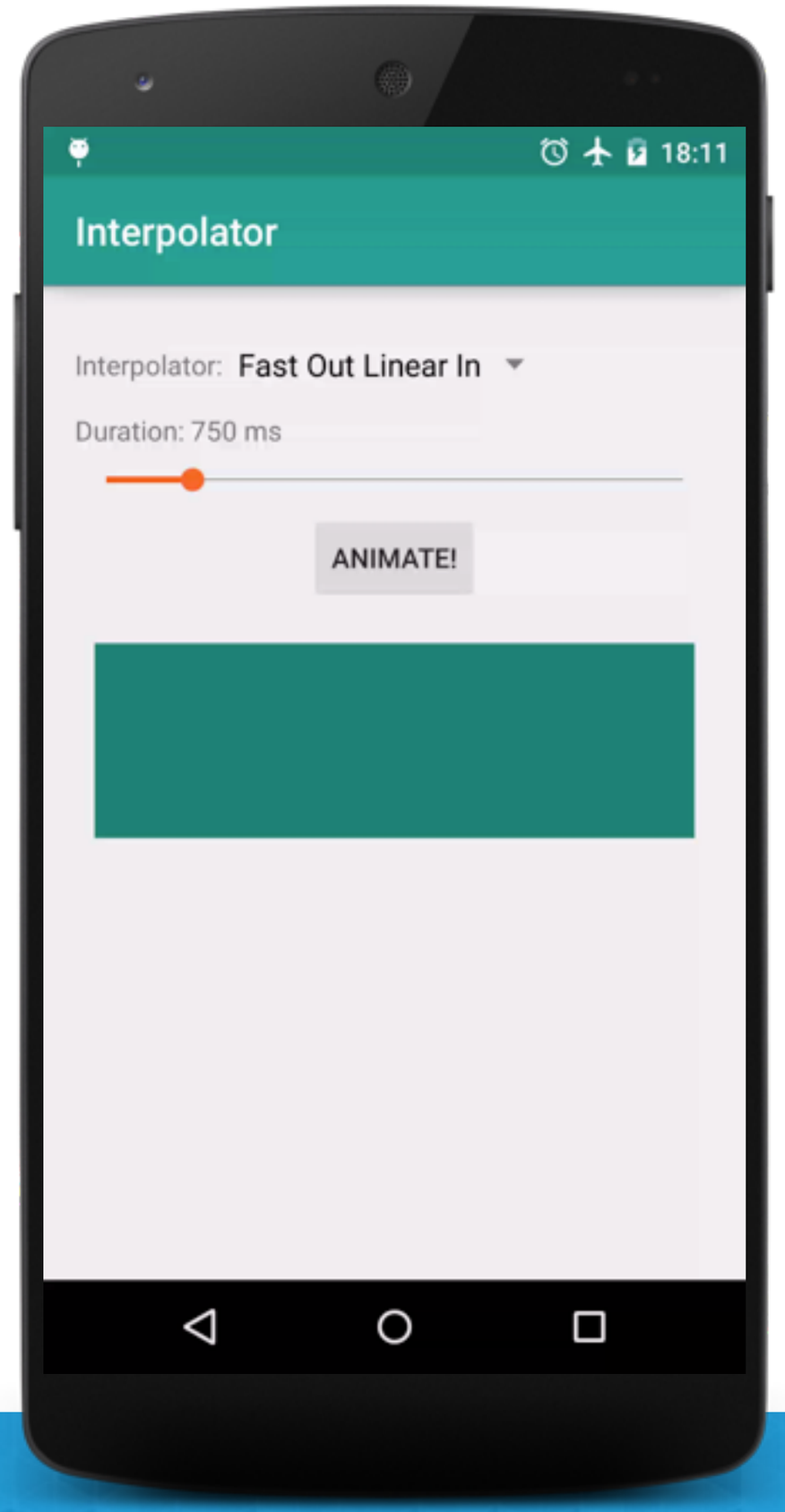
Path Interpolator



res/interpolator/linear.xml

```
<linearInterpolator />
```

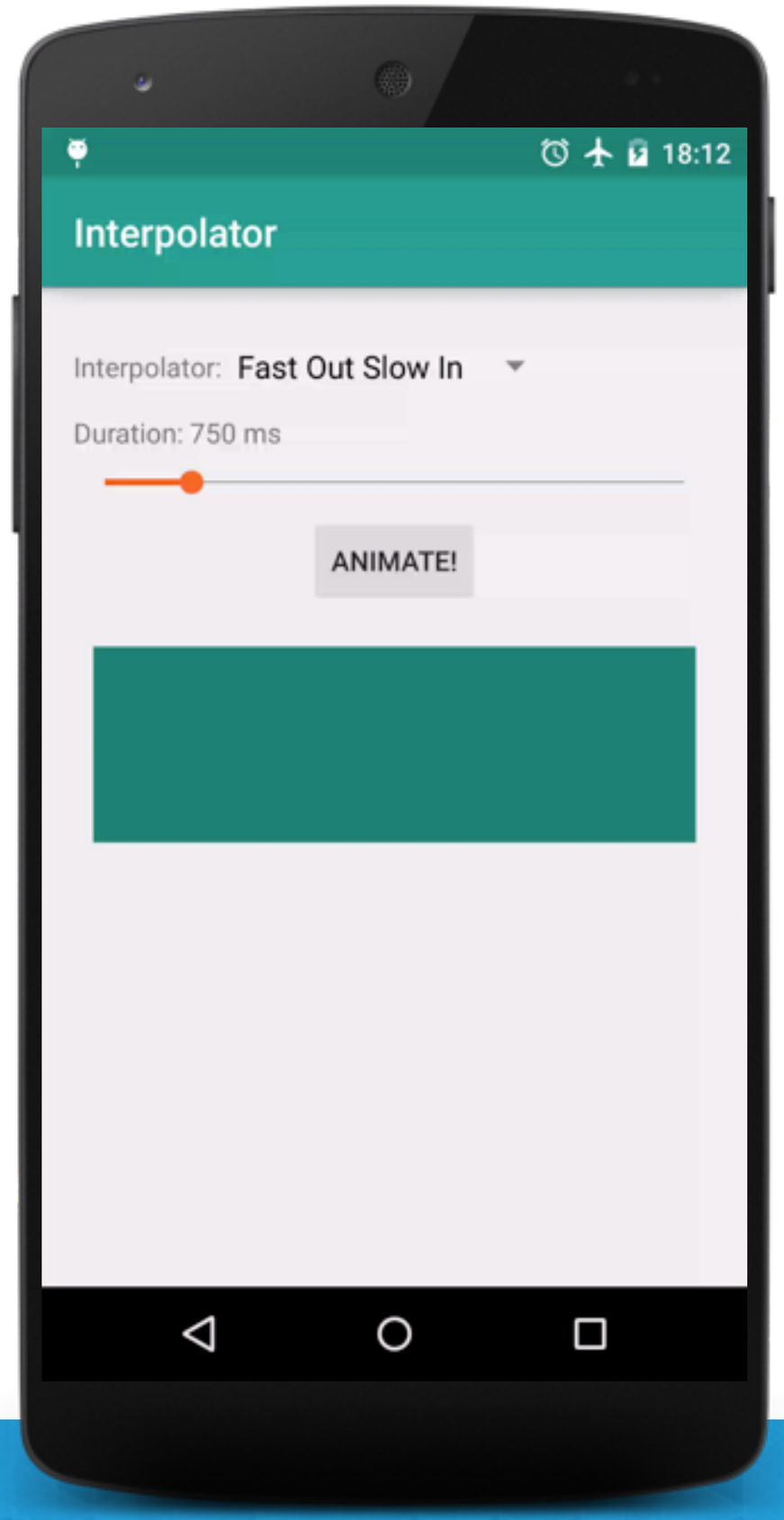
Path Interpolator



res/interpolator/fast_out_linear_in.xml

```
<pathInterpolator
    android:controlX1="0.4"
    android:controlY1="0"
    android:controlX2="1"
    android:controlY2="1"/>
```

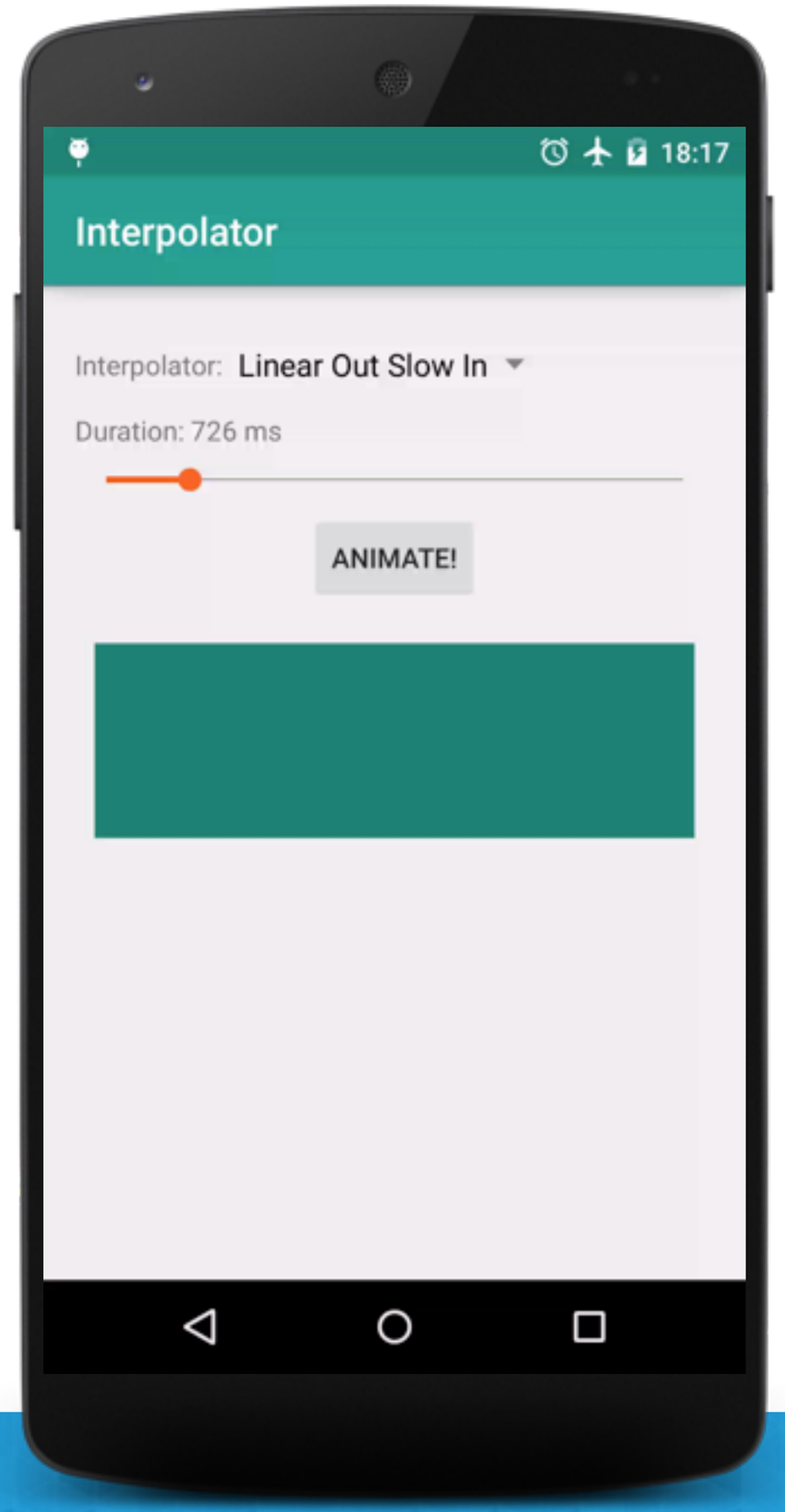
Path Interpolator



res/interpolator/fast_out_slow_in.xml

```
<pathInterpolator
    android:controlX1="0"
    android:controlY1="0"
    android:controlX2="0.2"
    android:controlY2="1"/>
```

Path Interpolator



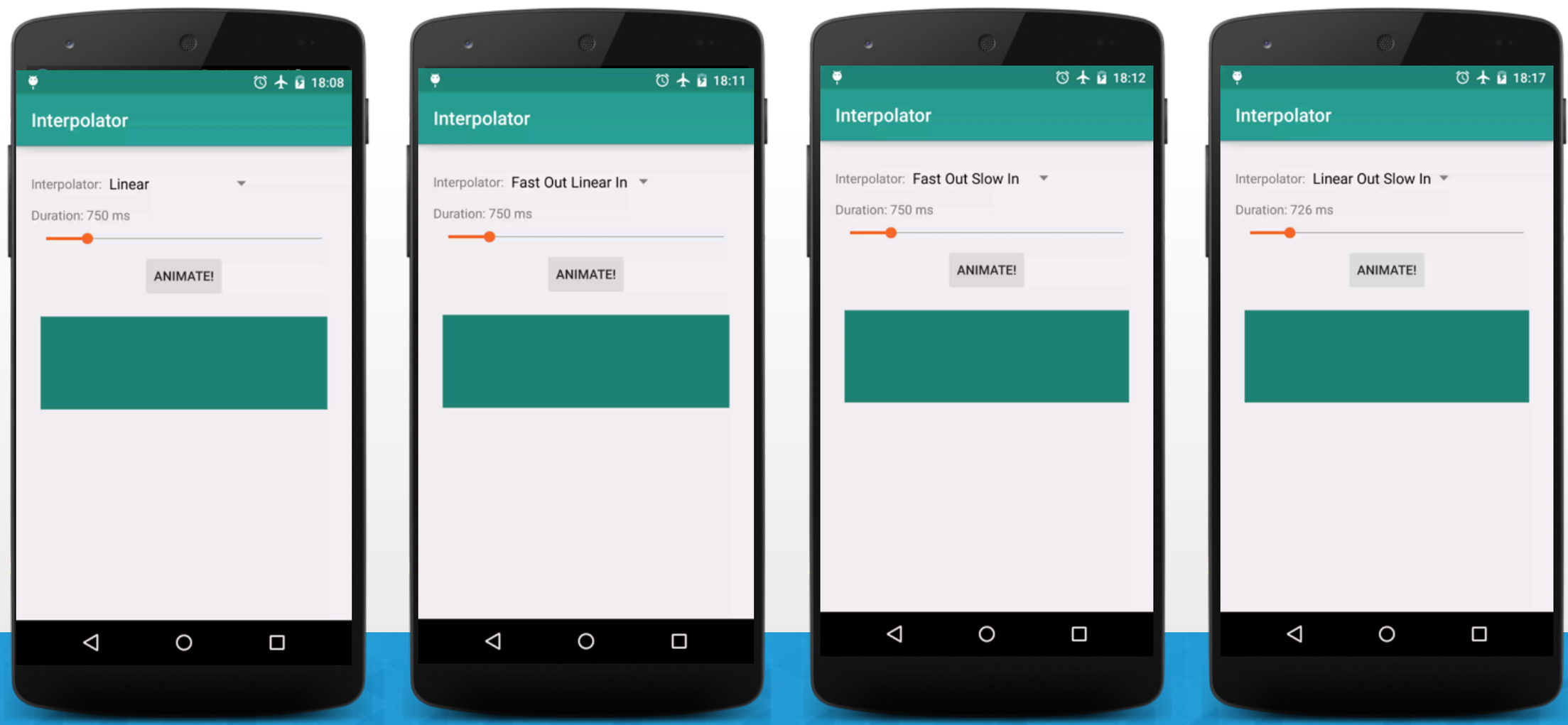
res/interpolator/linear_out_slow_in.xml

```
<pathInterpolator
    android:controlX1="0"
    android:controlY1="0"
    android:controlX2="0.2"
    android:controlY2="1"/>
```

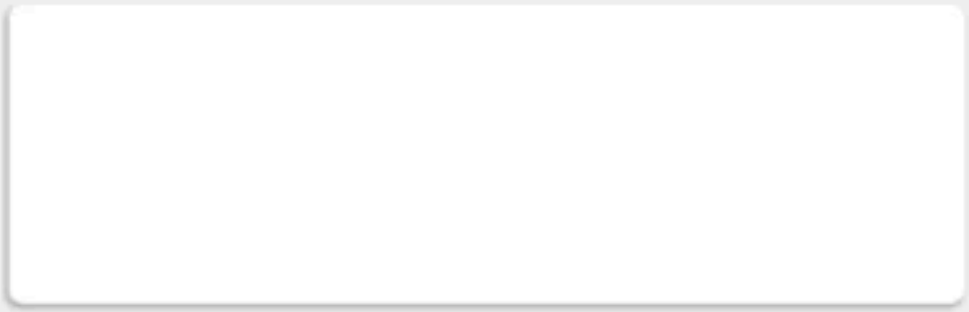
InterpolatorFragment.java

```
// Path for 'in' animation: growing from 20% to 100%
mPathIn = new Path();
mPathIn.moveTo(0.2f, 0.2f);
mPathIn.lineTo(1f, 1f);

// Path for 'out' animation: shrinking from 100% to 20%
mPathOut = new Path();
mPathOut.moveTo(1f, 1f);
mPathOut.lineTo(0.2f, 0.2f);
ObjectAnimator animator =
    ObjectAnimator.ofFloat(mView, View.SCALE_X, View.SCALE_Y, path);



// Set the duration and interpolator for this animation
animator.setDuration(duration);
animator.setInterpolator(interpolator);

animator.start();
```

The Interpolator party!



Touch feedback

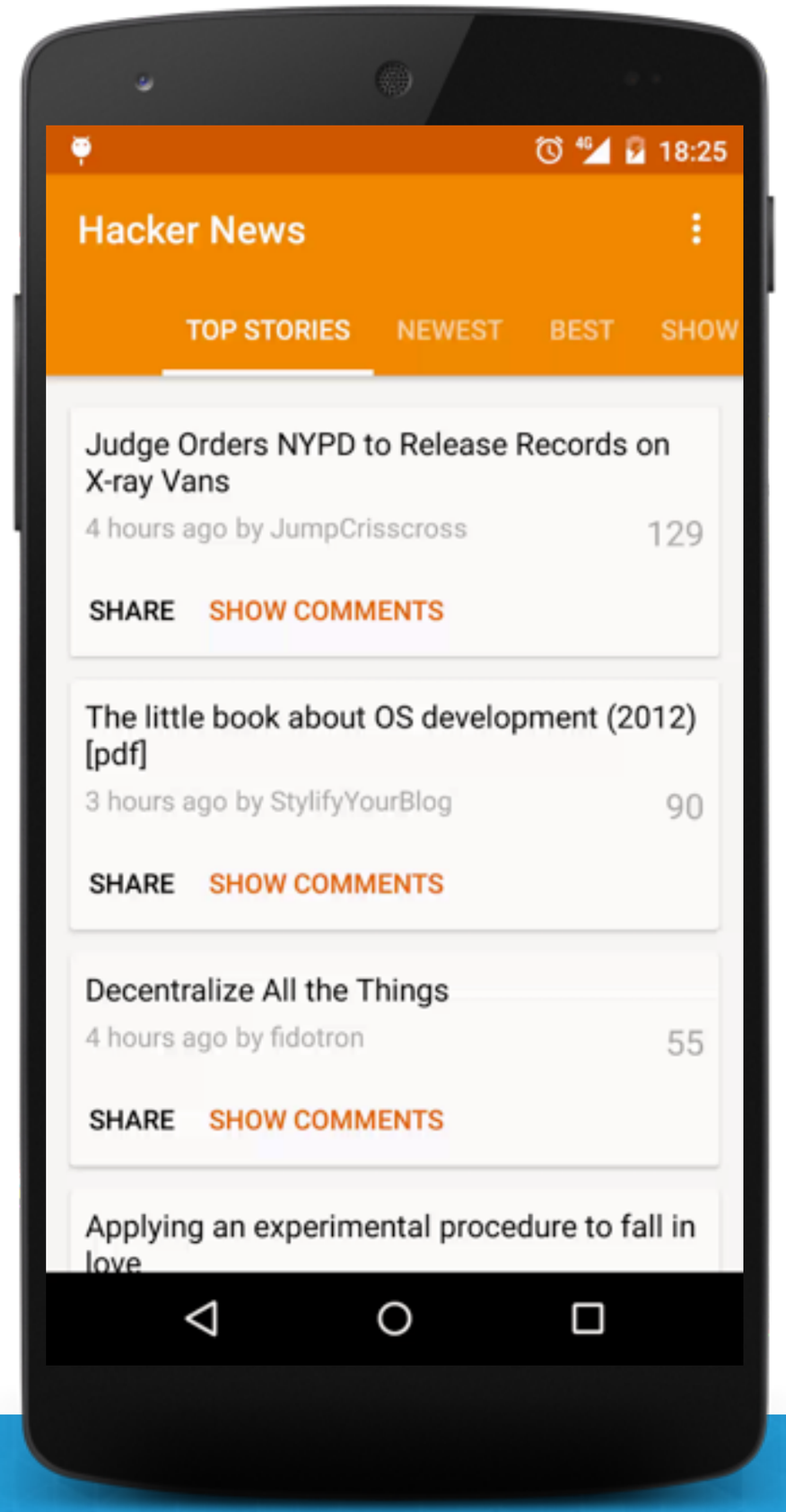


res/drawable/mystatedrawable.xml

```
<selector xmlns:android=“…”/>

   <item android:state_pressed="true">
    <objectAnimator
      android:propertyName="translationZ"
      android:duration="100"
      android:valueTo="5dp" />
   </item>

   <item android:state_pressed="false">
    <objectAnimator
      android:propertyName="translationZ"
      android:duration="100"
      android:valueTo="0" />
   </item>

</selector>
```

Touch feedback

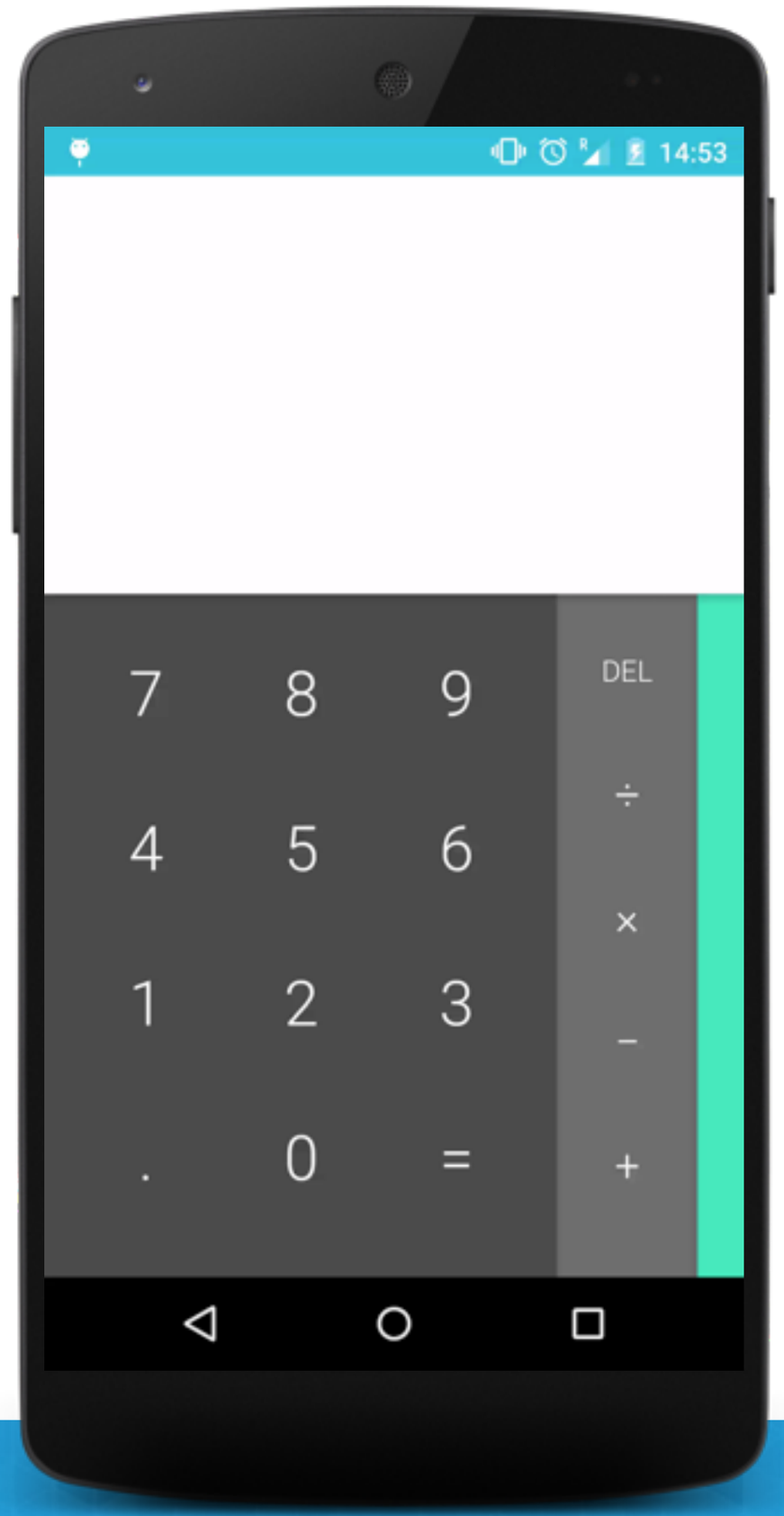
Render Thread



Reveal effect

MyActivity.java

```
Animator anim =
ViewAnimationUtils.
    createCircularReveal(
        myView,
        centerX,
        centerY,
        startRadius,
        finalRadius);

anim.start();
```



MyActivity.java

```
final View myView = findViewById(R.id.my_view);

Animator anim =
    ViewAnimationUtils.createCircularReveal(myView,
    cx,
    cy,
    initialRadius,
    0);

anim.addListener(new AnimatorListenerAdapter() {
    @Override
    public void onAnimationEnd(Animator animation) {
        super.onAnimationEnd(animation);
        myView.setVisibility(View.INVISIBLE);
    }
});

anim.start();
```

Activity transitions

- Window Transitions animate windows
- Activity transitions animate window components
- Animate when launching one activity from another
- Shared elements are transferred via ActivityOptions
- Based on the Transitions API released with KitKat

Enable transitions

MainActivity.java

```
getWindow().
   requestFeature(Window.FEATURE_CONTENT_TRANSITIONS);
```

res/values/theme.xml

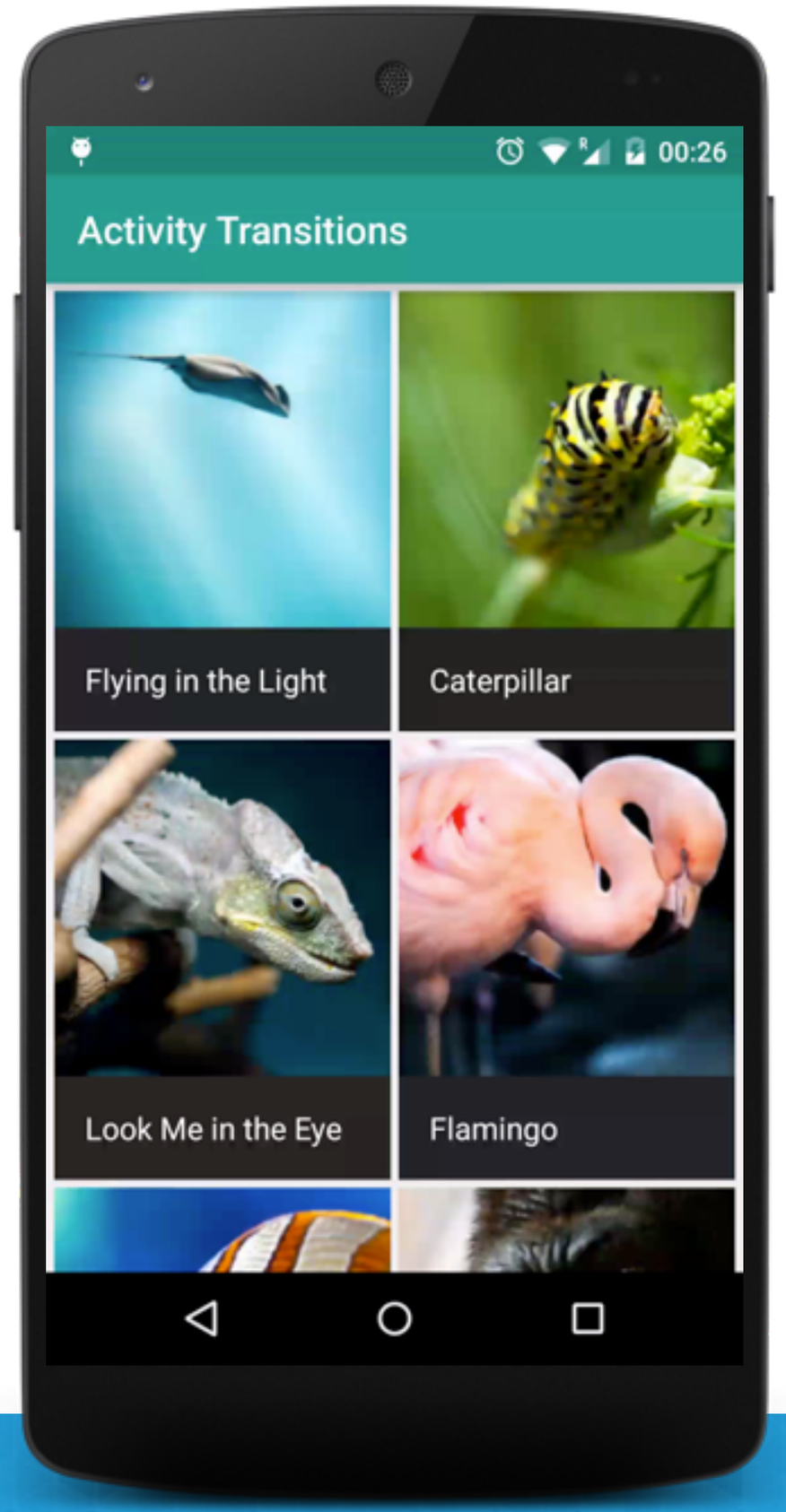
```
<style name="BaseAppTheme" parent="android:Theme.Material">
 <!-- enable window content transitions -->
 <item name="android:windowContentTransitions">true</item>
</style>
```

Activity transition

res/values/theme.xml

```
<style name="BaseAppTheme" parent="android:Theme.Material">

  <!-- specify enter and exit transitions -->
  <item name="android:windowEnterTransition">
          @transition/explode</item>
  <item name="android:windowExitTransition">
          @transition/explode</item>
</style>
```

Example


00:26
Activity Transitions
Flying in the Light
Caterpillar
Look Me in the Eye
Flamingo

Activity A

res/layout/grid_item.xml

```
<LinearLayout
  android:layout_width="match_parent"
  android:layout_height="wrap_content"
  android:orientation="vertical">

  <ImageView
    android:id="@+id/imageview_item"
    android:layout_width="match_parent"
    android:layout_height="match_parent"/>

  <TextView
    android:id="@+id/textview_name"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:background="?android:attr/colorPrimary"/>

</LinearLayout>
```

Activity B

res/layout/detail.xml

```
<LinearLayout
  android:layout_width="match_parent"
  android:layout_height="wrap_content"
  android:orientation="vertical">

  <ImageView
    android:id="@+id/imageview_header"
    android:layout_width="match_parent"
    android:layout_height="match_parent"/>

  <TextView
    android:id="@+id/textview_title"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:theme="@android:style/Theme.Material"/>

</LinearLayout>
```

TransitionActivity.java

```
ActivityOptionsCompat activityOptions =
   ActivityOptionsCompat.makeSceneTransitionAnimation(
        this,
           new Pair<View,
            String>(view.findViewById(R.id.imageview_item),
              DetailActivity.VIEW_NAME_HEADER_IMAGE),
           new Pair<View,
            String>(view.findViewById(R.id.textview_name),
              DetailActivity.VIEW_NAME_HEADER_TITLE));

// Now we can start the Activity, providing the
activity options as a bundle
ActivityCompat.startActivity(this, intent,
activityOptions.toBundle());
```

DetailActivity.java

```
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_transition_details);

    /**
     * Set the name of the view's which will be transition
to, using the static values above.
     * This could be done in the layout XML, but exposing it
via static variables allows easy
     * querying from other Activities
     */
    ViewCompat.setTransitionName(mHeaderImageView,
        VIEW_NAME_HEADER_IMAGE);
    ViewCompat.setTransitionName(mHeaderTitle,
        VIEW_NAME_HEADER_TITLE);

}
```

Shared element transition

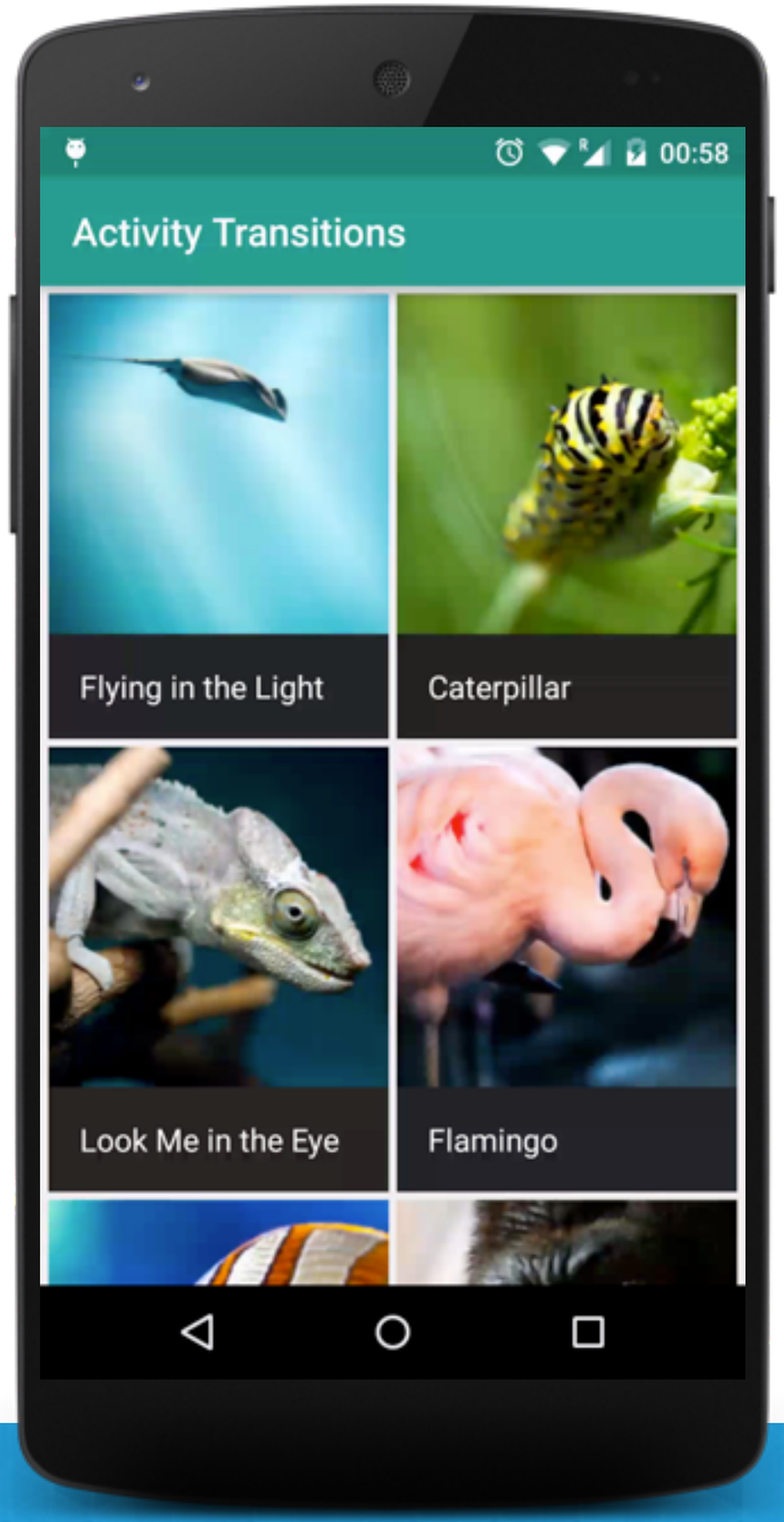
res/layout/fragment_sample.xml

```
<ImageView
   android:layout_width="200dp"
   android:layout_height="200dp"
   android:id="@+id/robotoView"
   android:layout_centerVertical="true"
   android:layout_centerHorizontal="true"
   android:background="@drawable/magic"
   android:transitionName="@transition/my_transition"/>
```

res/transition/grid_detail_transition.xml

```
<transitionSet xmlns:android="…">
  <changeBounds/>
  <changeImageTransform/>
</transitionSet>
```

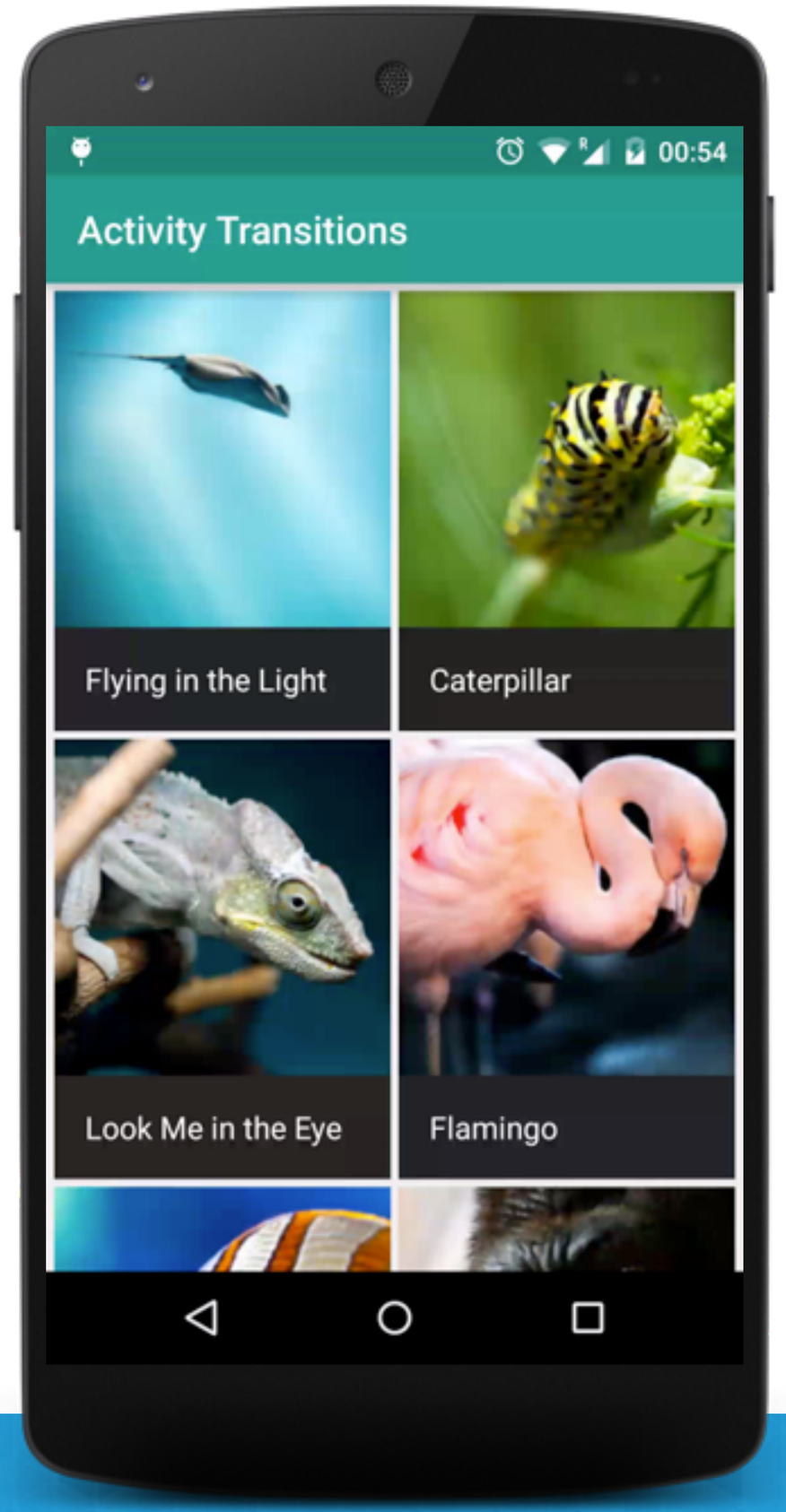
Sync Transitions and animations



DetailActivity.java

```
getWindow().getEnterTransition().addListener(new
    Transition.TransitionListener() {
     @Override
    public void onTransitionEnd(Transition transition) {
                 mFab.animate()
                         .translationY(0)
                         .setInterpolator(new
                             OvershootInterpolator(1.f))
                         .setStartDelay(300)
                         .setDuration(400)
                         .start();
        }
});
```

Animate before transition



Animate before transition

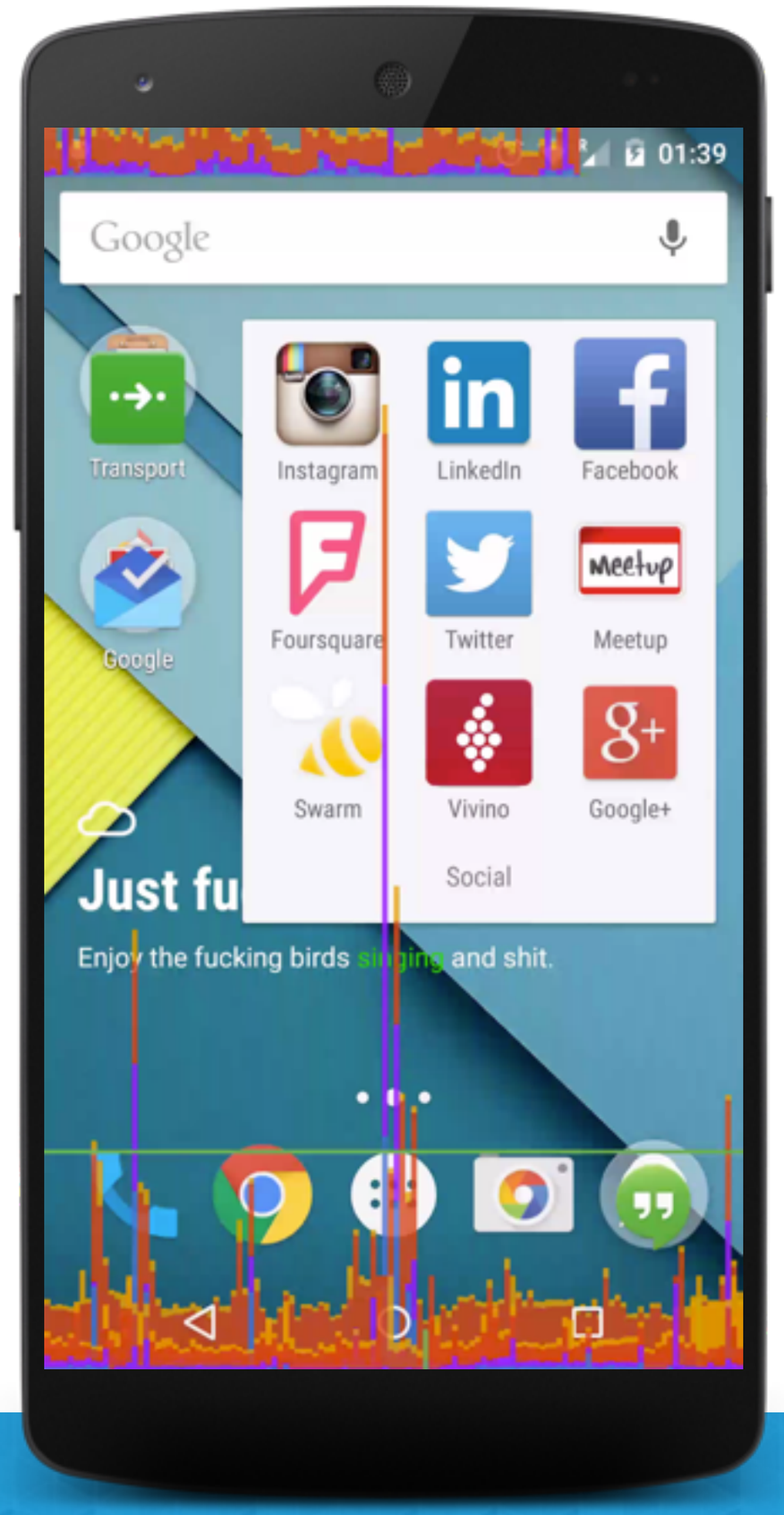
DetailActivity.java

```
@Override
public void onBackPressed() {
    mFab.animate()
            .translationYBy(2 * 56)
            .setInterpolator(new
                OvershootInterpolator(1.f))
            .setDuration(400)
            .withEndAction(new Runnable() {
                @Override
                public void run() {
                    finishAfterTransition();
                }
            });
}
```

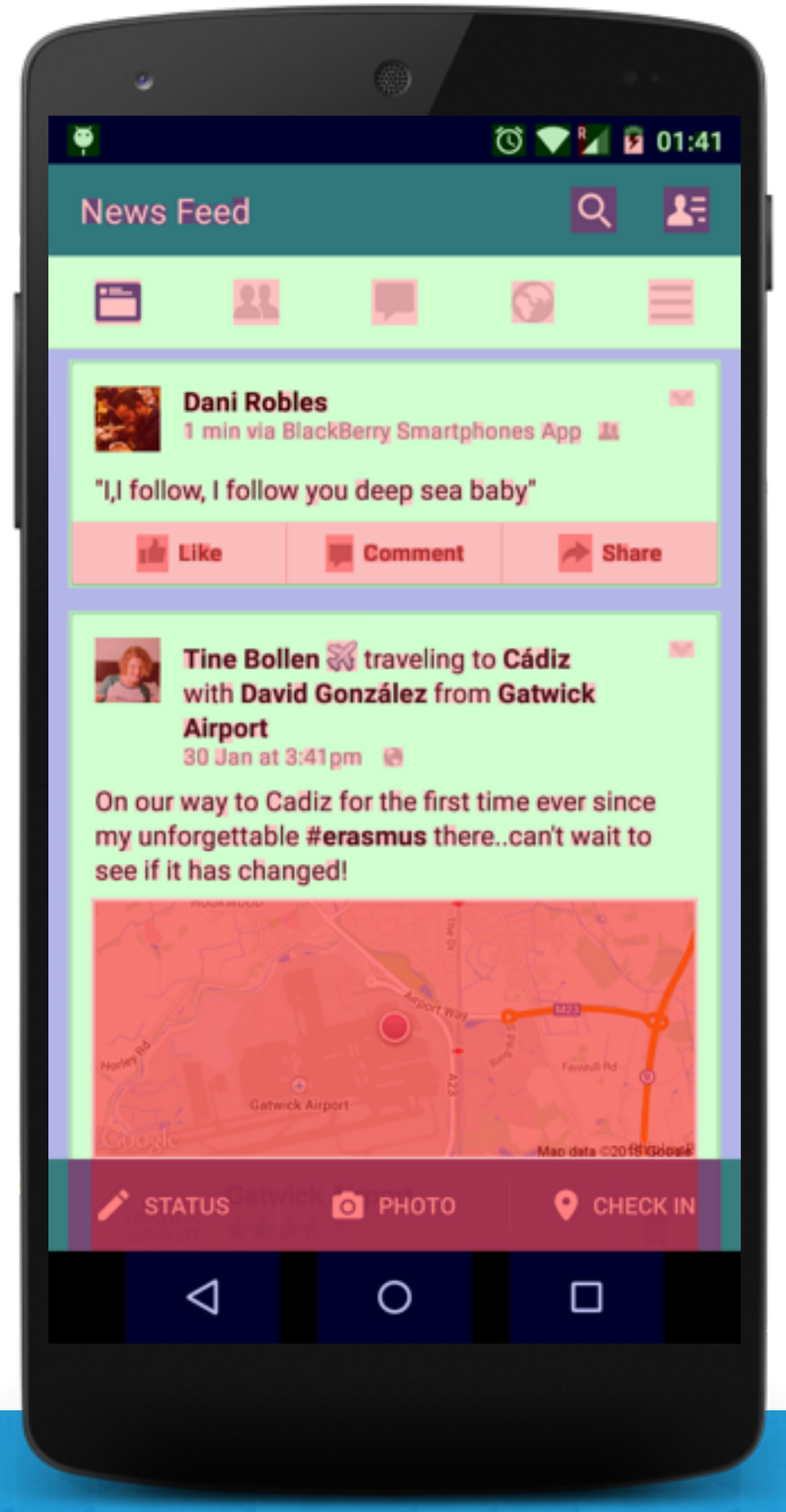
Performance tools

Join the **Android Performance Patterns G+ Community** to continue the discussion
goo.gl/g7mxml

Profile GPU Rendering



Show GPU Overdraw

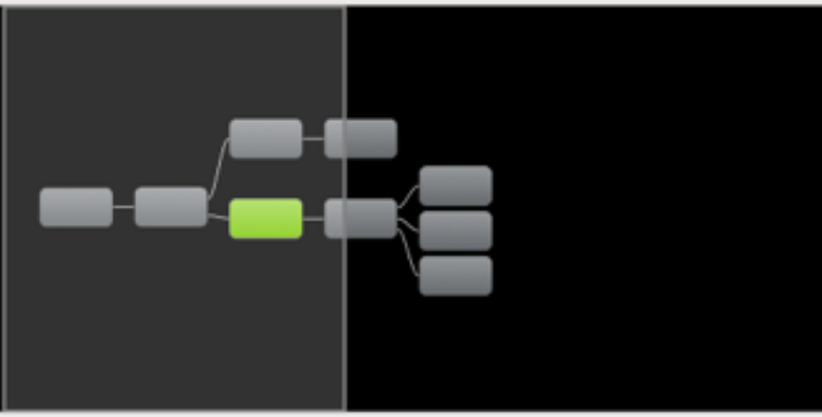


Hierarchy Viewer

le Tree View Help

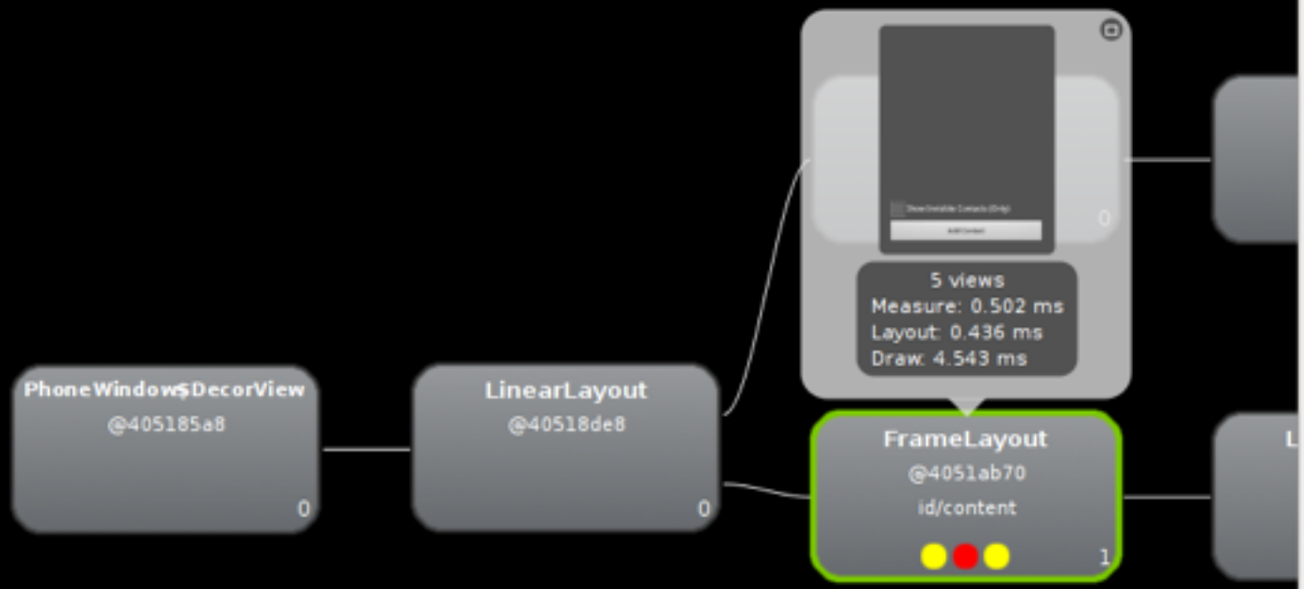
Save as PNG | Capture Layers | Load View Hierarchy | Display | Request Layout

Tree Overview pane

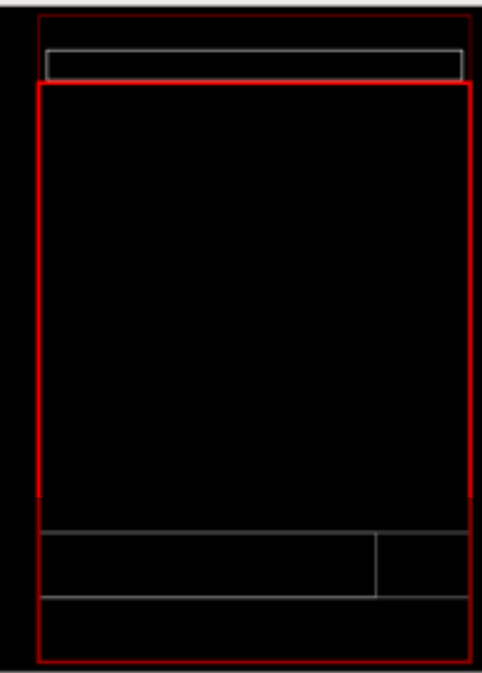


Property	Value
Drawing	
Focus	
Layout	
Measurement	
Miscellaneous	
Padding	
Scrolling	

Property View pane



Show Extras | Load All Views



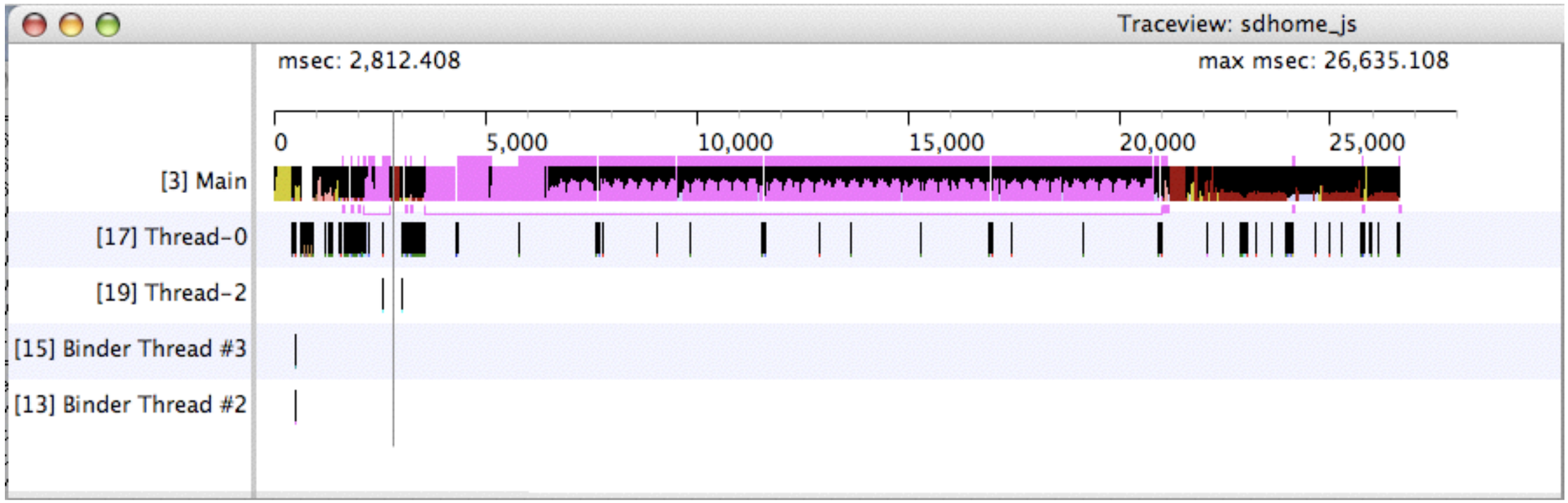
Layout View pane

Tree View pane

Filter by class or id: | 20% | 200%

Hierarchy Viewer

Traceview


Traceview: sdhome_js
msec: 2,812.408
max msec: 26,635.108
0
5,000
10,000
15,000
20,000
25,000
[3] Main
[17] Thread-0
[19] Thread-2
[15] Binder Thread #3
[13] Binder Thread #2

Fork me!

MaterialAnimations

Examples of animations and transitions

http://github.com/malmstein/MaterialAnimations

Thank you!
Questions?

@dggonzalez

+DavidGonzalezMalmstein

malmstein