Deep Dive Into Android

State Restoration

TWITTER

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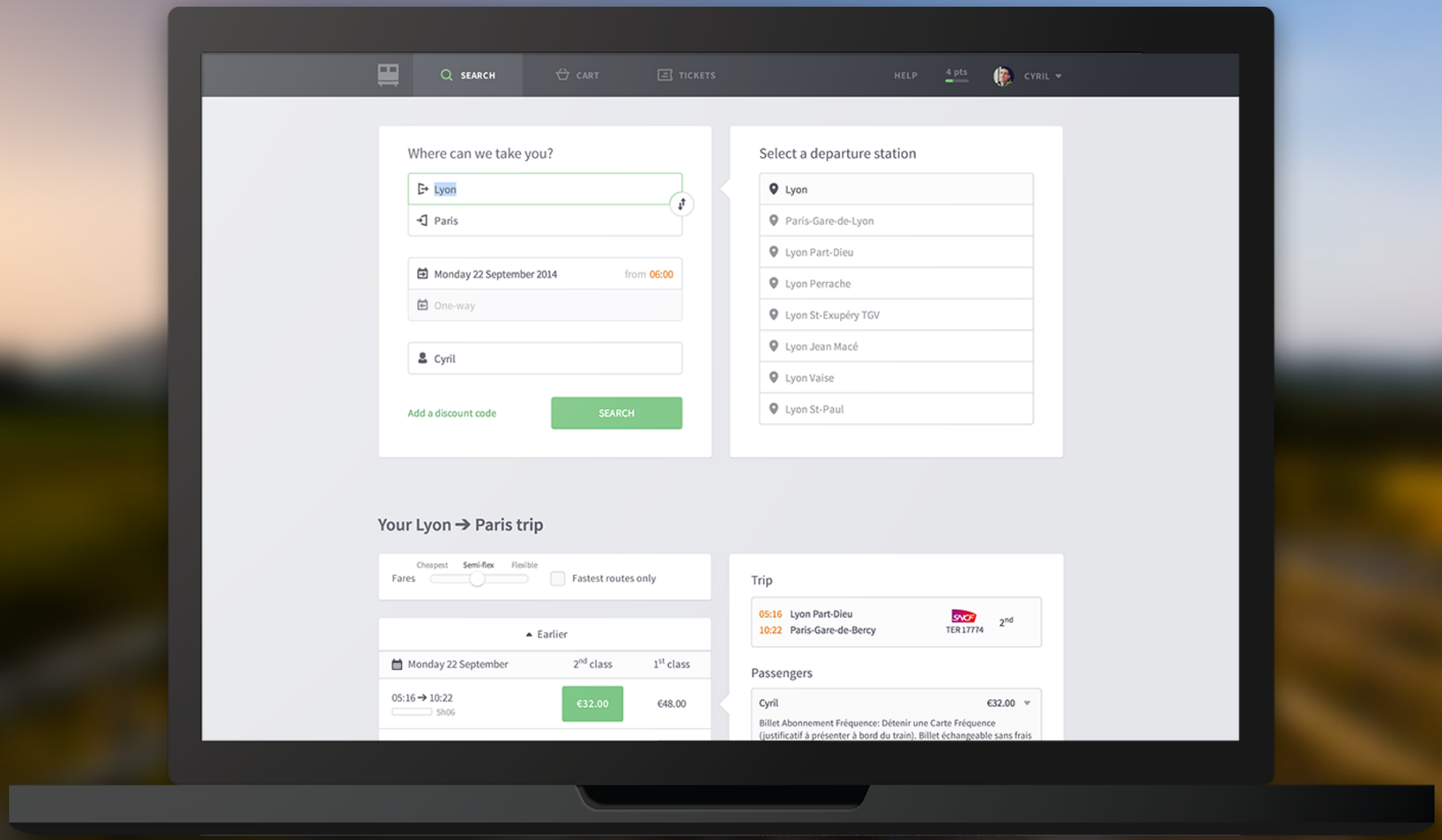
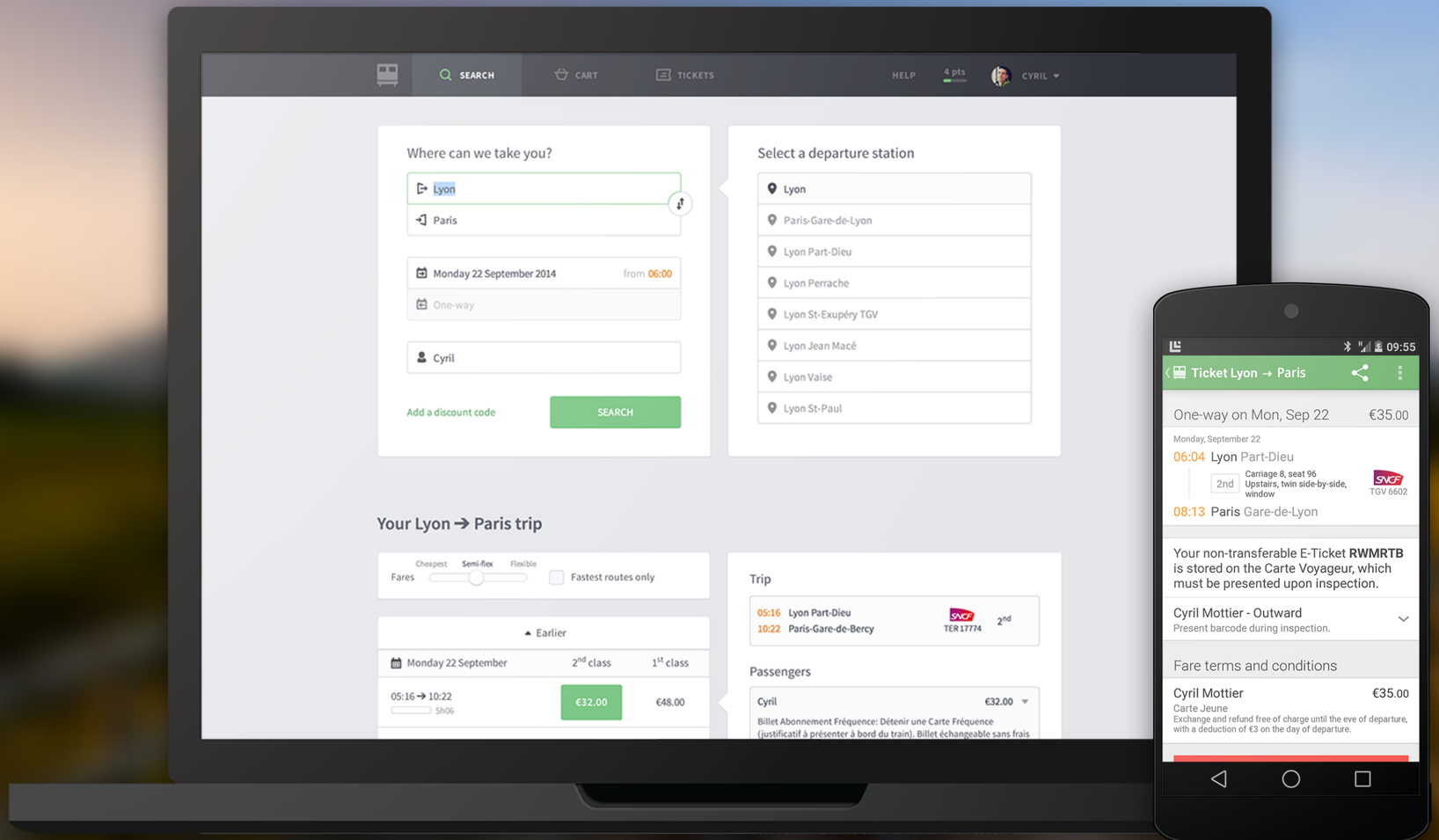
capitaine train

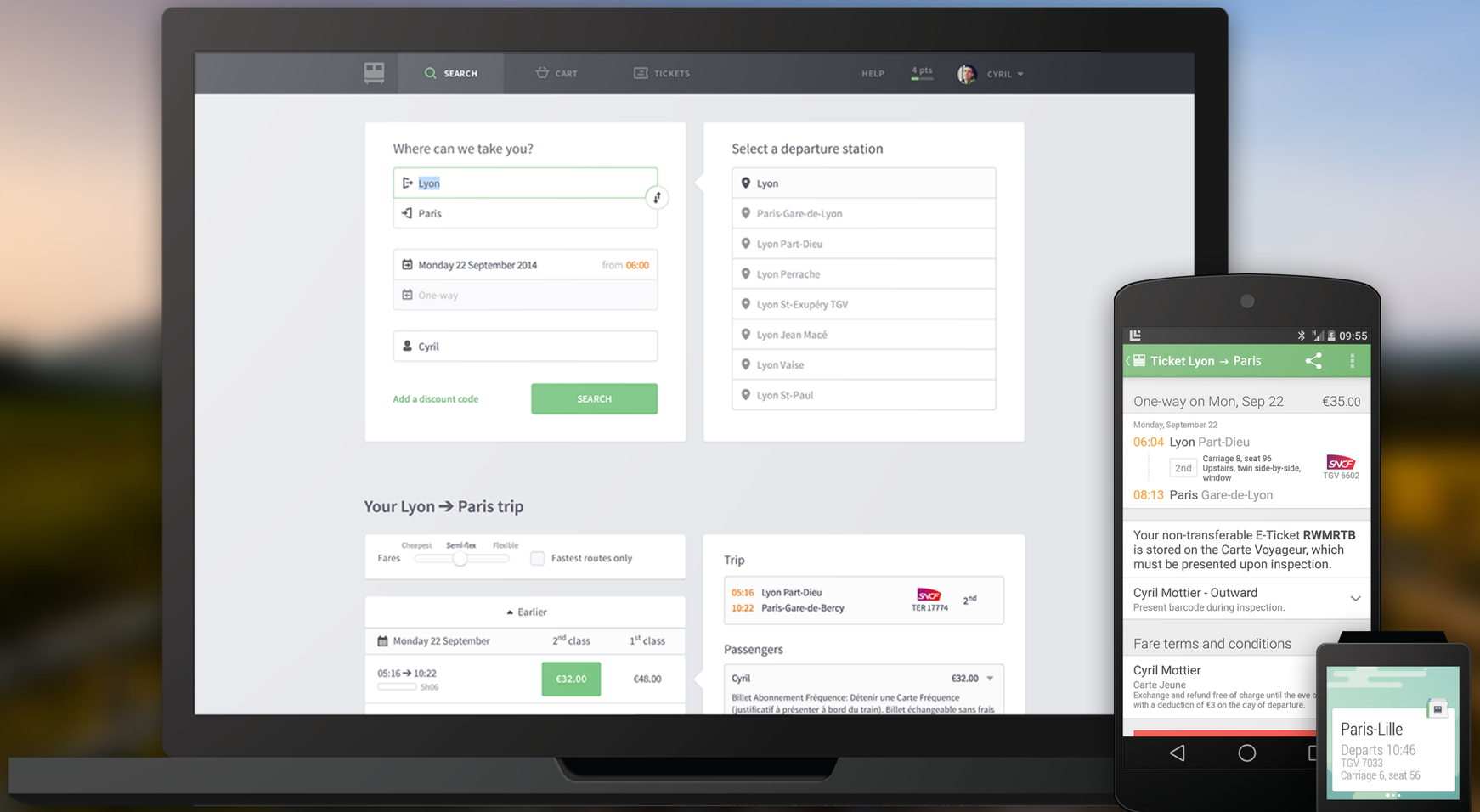
capitaine train



capitaine train



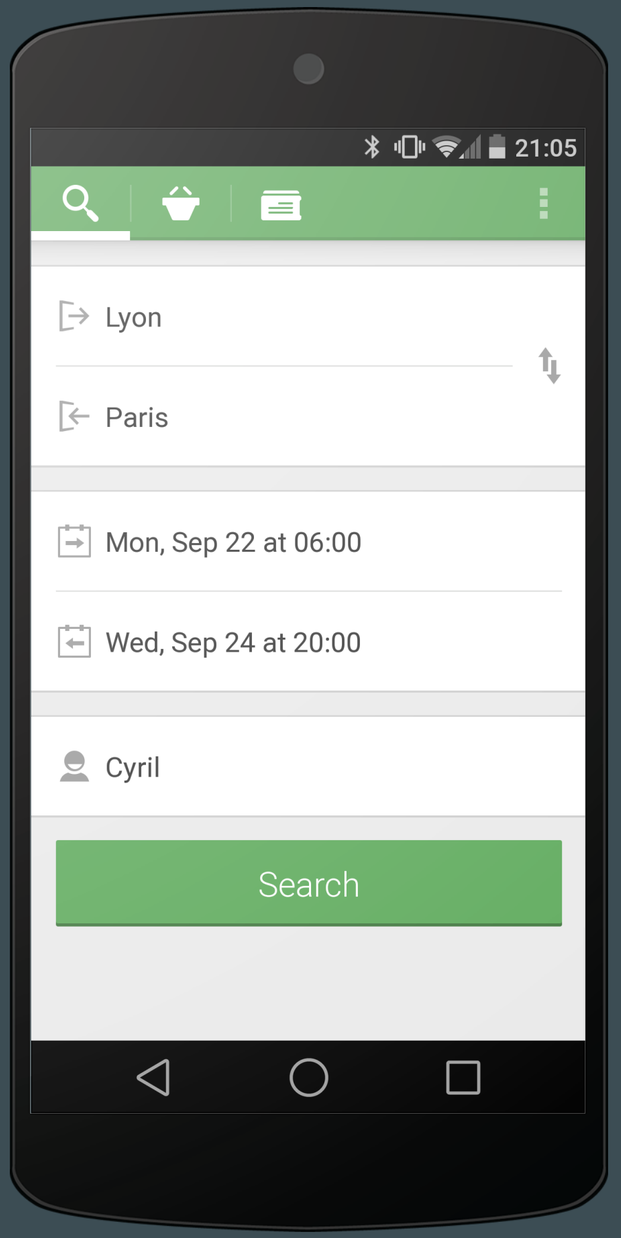
capitaine train



The story of a newbie **Android developer**

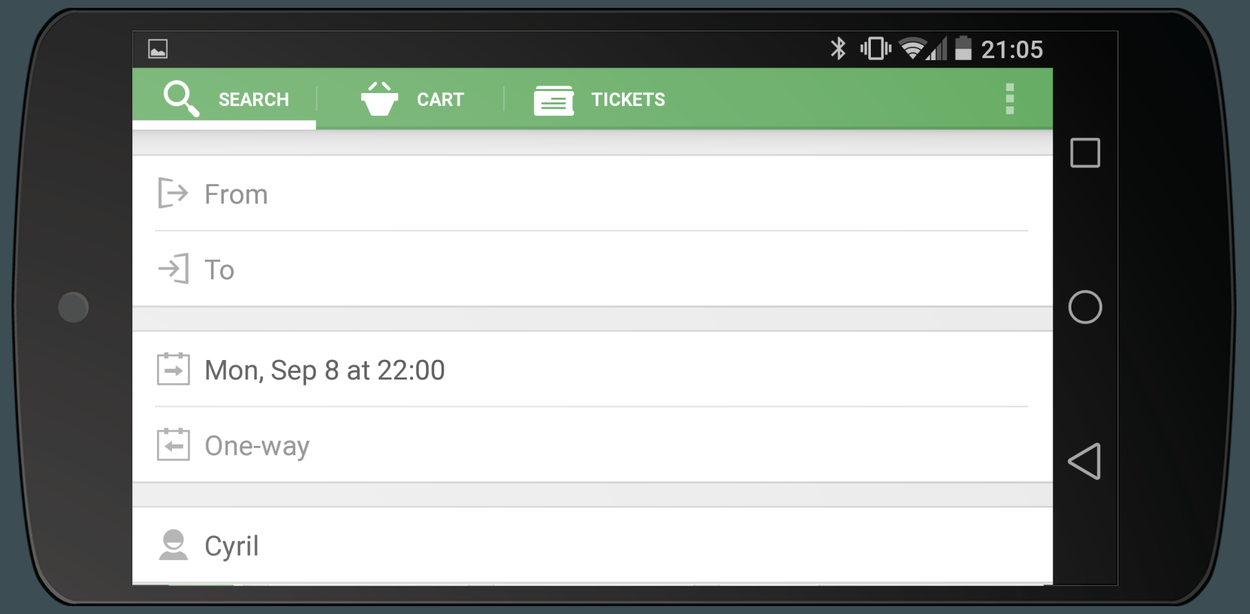
Kevin has just developed his first

Android app



He discovers an annoying bug:

Fields are cleared on rotate



3 options

3 options

Don’t care

3 options

Don’t care | Block orientation

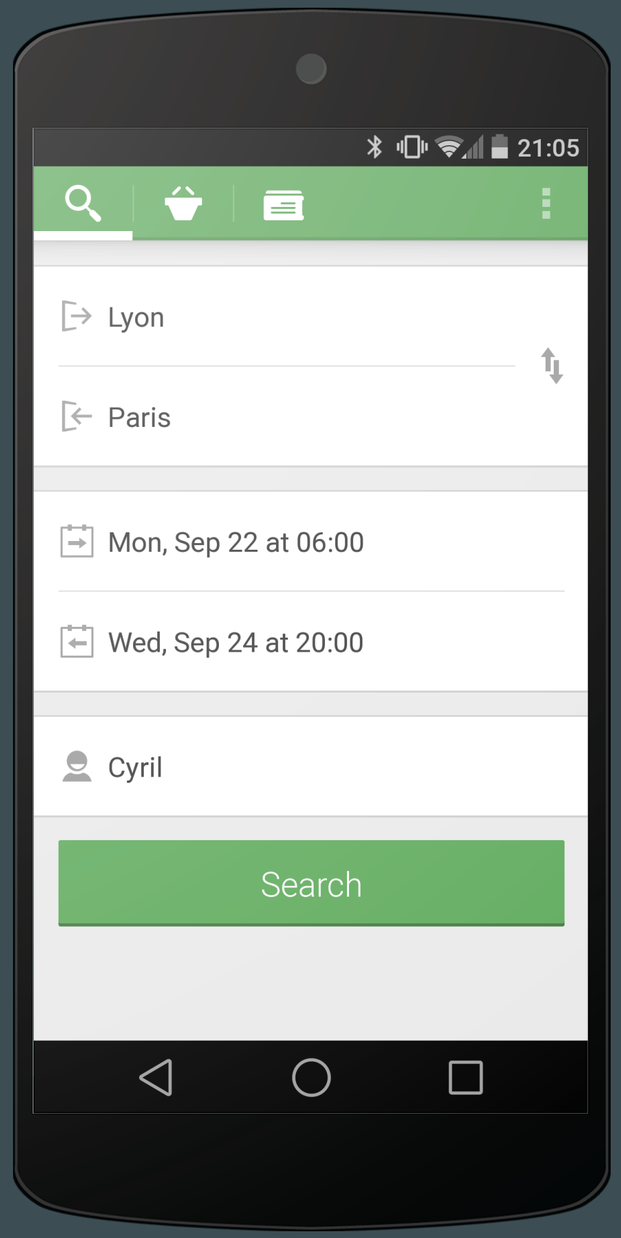
3 options

Don’t care | Block orientation | Use configChanges

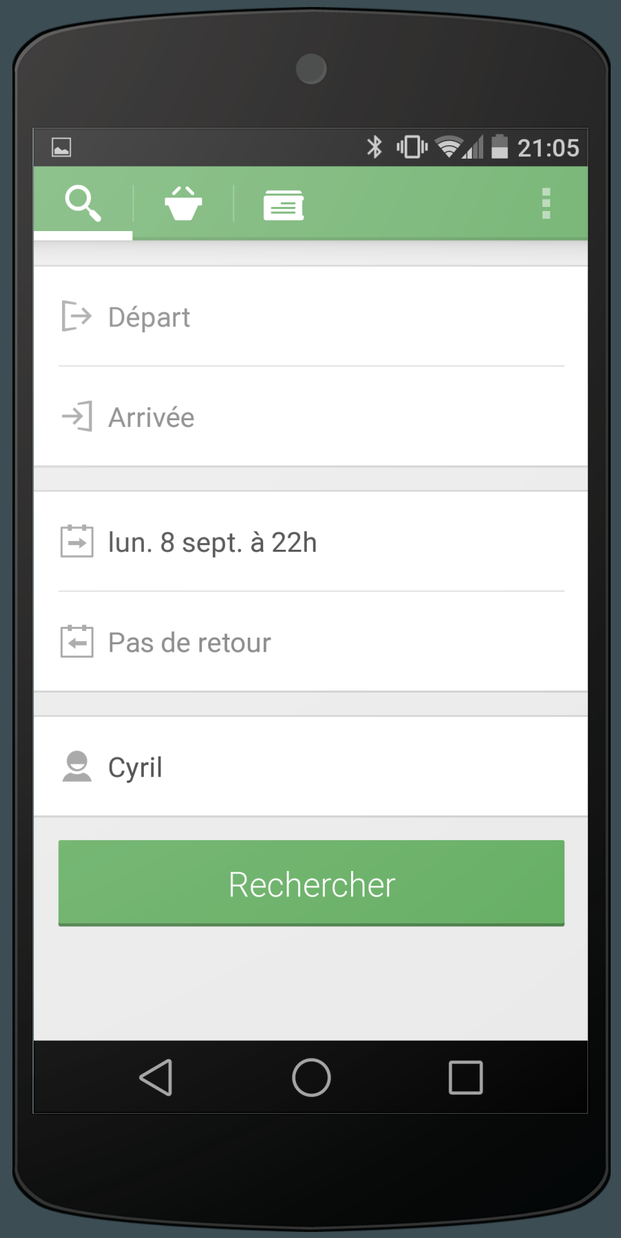
Hint: all options are 👎

```
1 <activity
2     android:name=".HomeActivity"
3     android:configChanges="orientation">
4
5     <!-- Some sweet IntentFilters. -->
6
7 </activity>
```

Kevin’s satisfied



Still having issues on…



Still having issues on…

language changes

```
1 <activity
2     android:name=".HomeActivity"
3     android:configChanges="orientation|locale">
4
5     <!-- Some annoying IntentFilters. -->
6
7 </activity>
```

Angry Kevin is

ANGRY!

```
1 <activity
2     android:name=".HomeActivity"
3     android:configChanges="orientation|locale|
          mcc|mnc|touchscreen|keyboard|
          keyboardHidden|navigation|uiMode|
          screenLayout|fontScale|screenSize|
          smallestScreenSize">
4
5     <!-- Some fuc**** IntentFilters. Arrggh! -->
6
7 </activity>
```

The nightmare continues…

Still having issues when moving the app to the background

God save the **STATE**

State restoration
key components

The container

`Parcel`

The container

`Parcel`

The content

Primitives types

Primitives arrays

`Parcelable`

```
1 parcel.writeInt(1);
2 parcel.writeLong(2L);
3 parcel.writeFloat(3F);
4 parcel.writeString("Hi!");
```

The content

Primitives types

Primitives arrays

`Parcelable`

```
1 parcel.writeIntArray(new int[]{1, 2, 3});
2 parcel.writeLongArray(new long[]{1L, 2L, 3L});
3 parcel.writeDoubleArray(new double[]{1, 2, 3});
4 parcel.writeStringArray(new String[]{
5         "Hi", "Droidcon", "guys!"
6 });
```

The content

Primitives types

Primitives arrays

Parcelable

```java
public final class Suggestion implements Parcelable {

    public final String id;
    public final String name;
    public final int type;

    public Suggestion(String id, String name, int type) {
        this.id = Objects.requireNonNull(id);
        this.name = Objects.requireNonNull(name);
        this.type = type;
    }

}
```

```java
    @Override
    public int describeContents() {
        return 0;
    }

    @Override
    public void writeToParcel(Parcel dest, int flags) {
        dest.writeString(id);
        dest.writeString(name);
        dest.writeInt(type);
    }

    public static final Parcelable.Creator<Suggestion> CREATOR =
            new Parcelable.Creator<Suggestion>() {
        public Suggestion createFromParcel(Parcel in) {
            return new Suggestion(in.readString(), //
                    in.readString(), //
                    in.readInt());
        }

        public Suggestion[] newArray(int size) {
            return new Suggestion[size];
        }
    };
```

Parcelable.Creator

The base creator interface

Parcelable.ClassLoaderCreator

A creator with the ClassLoader passed on read.

ParcelableCompat & ParcelableCompatCreatorCallbacks

Compatibility stuff

Bundle

A key-value map & type-safe Parcelable

`Parcel`

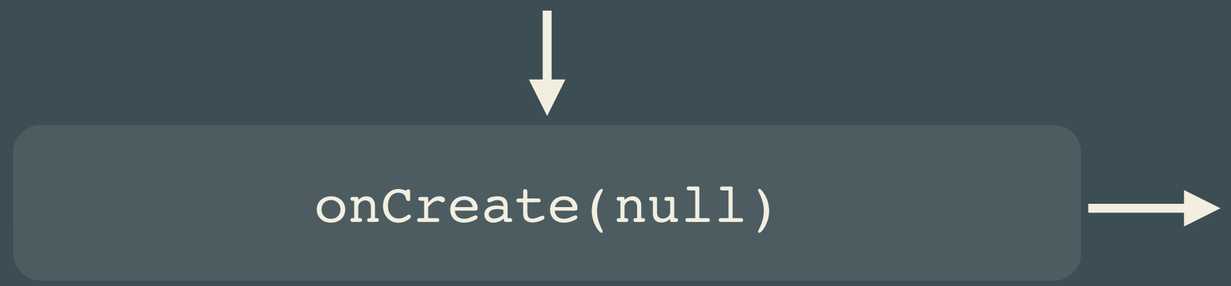
internally uses reflection

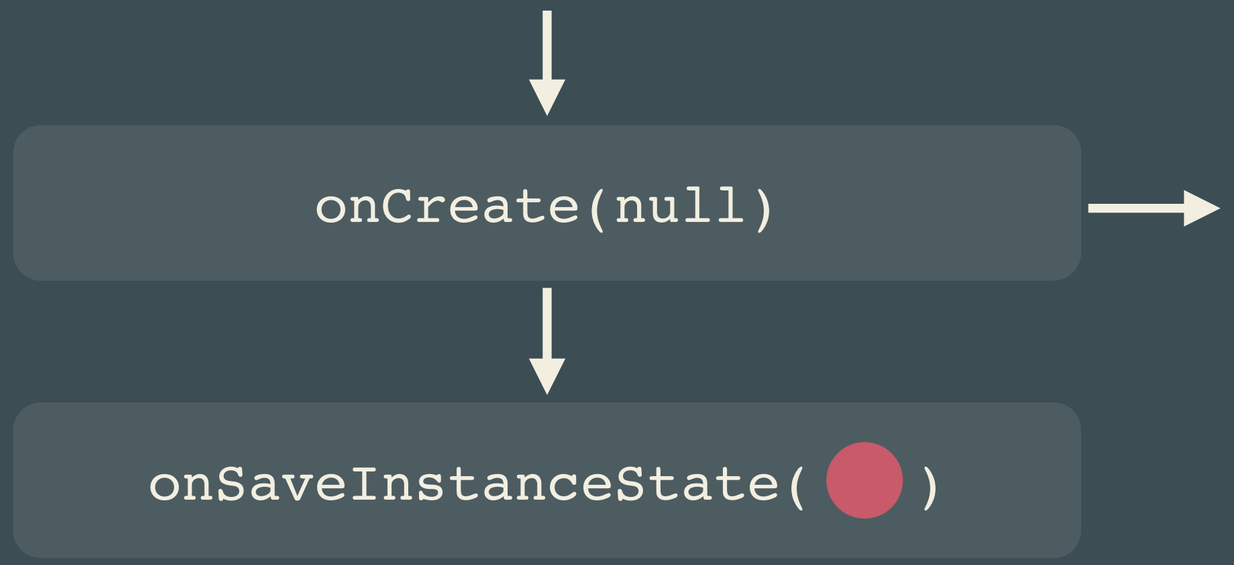
(required to get the CREATOR instance)

…i.e. beware Proguard

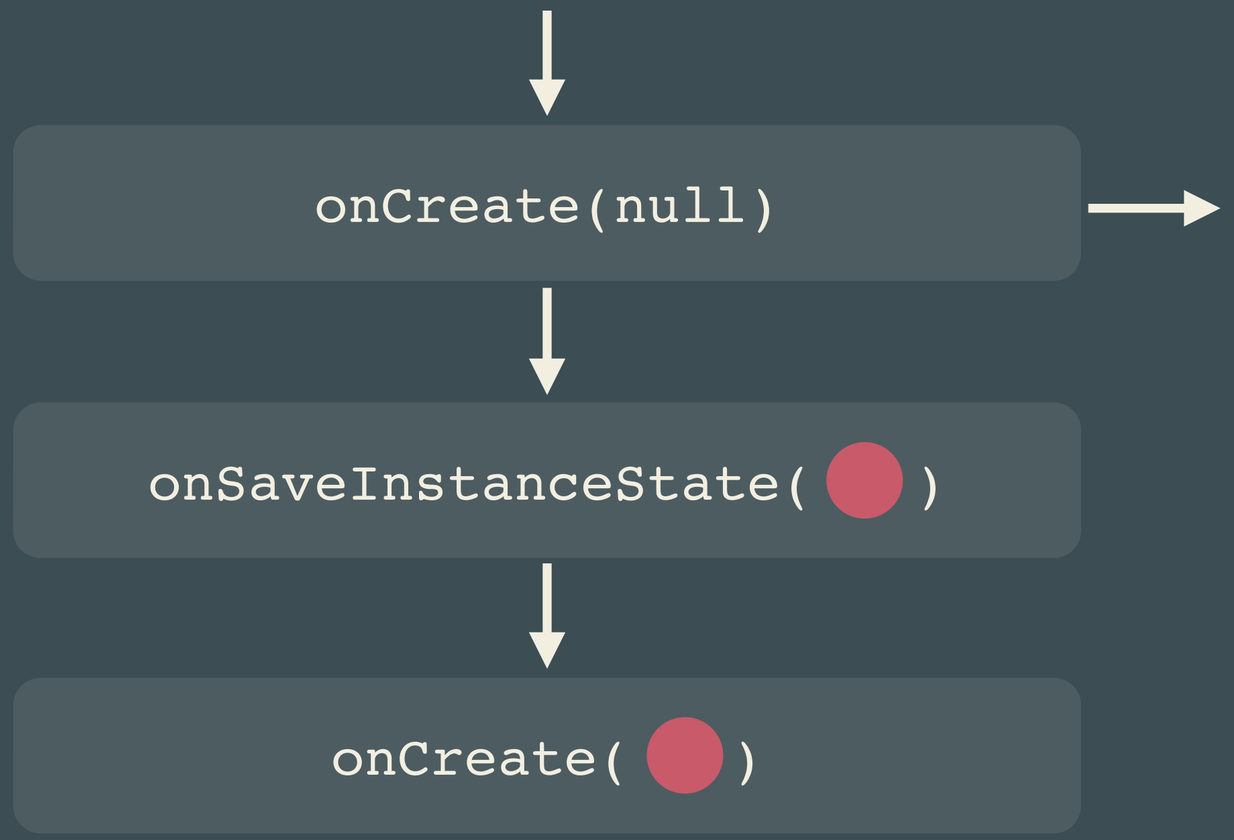
Activity level
state restoration

```
onCreate(null)
```

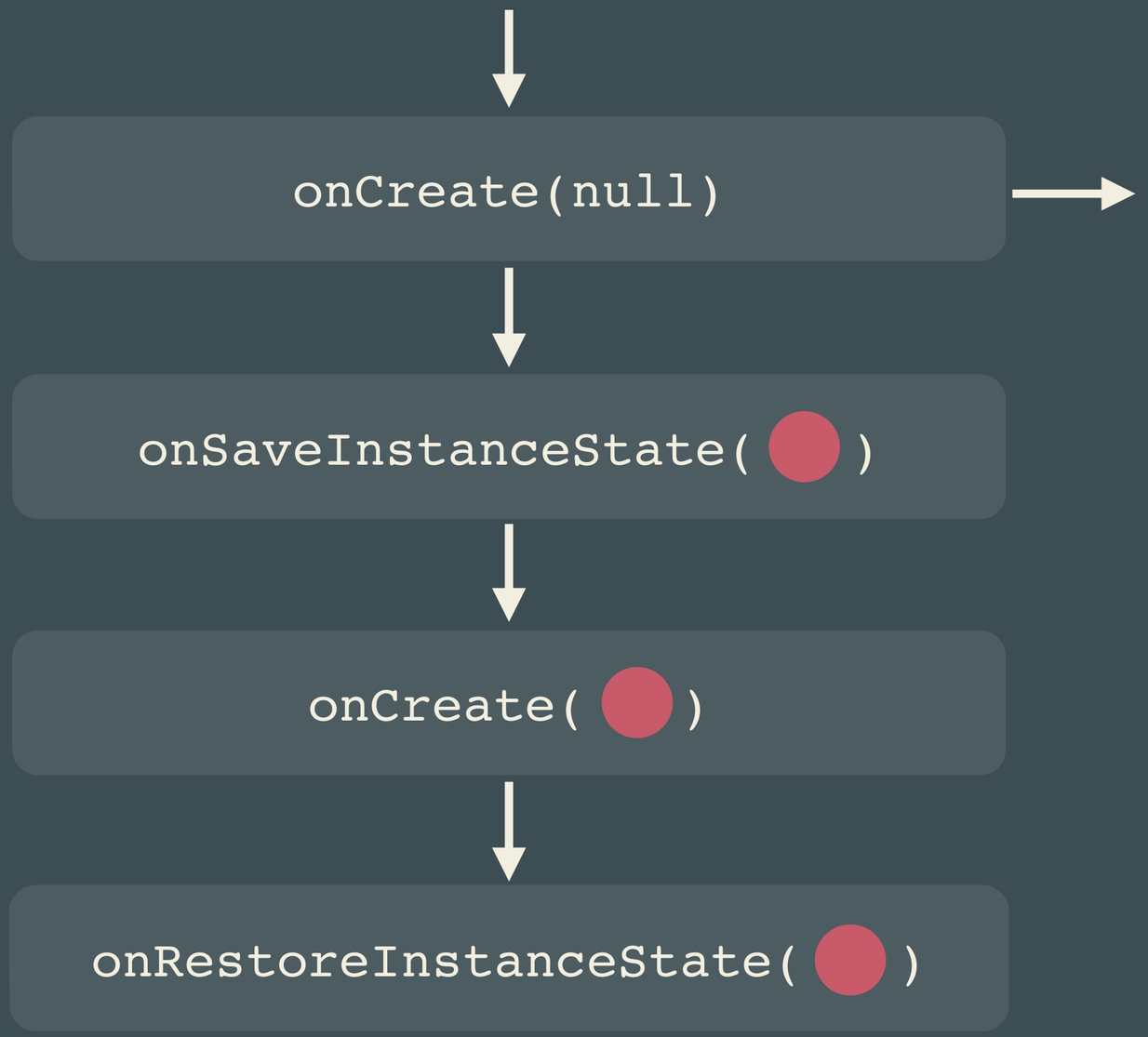

onCreate(null)



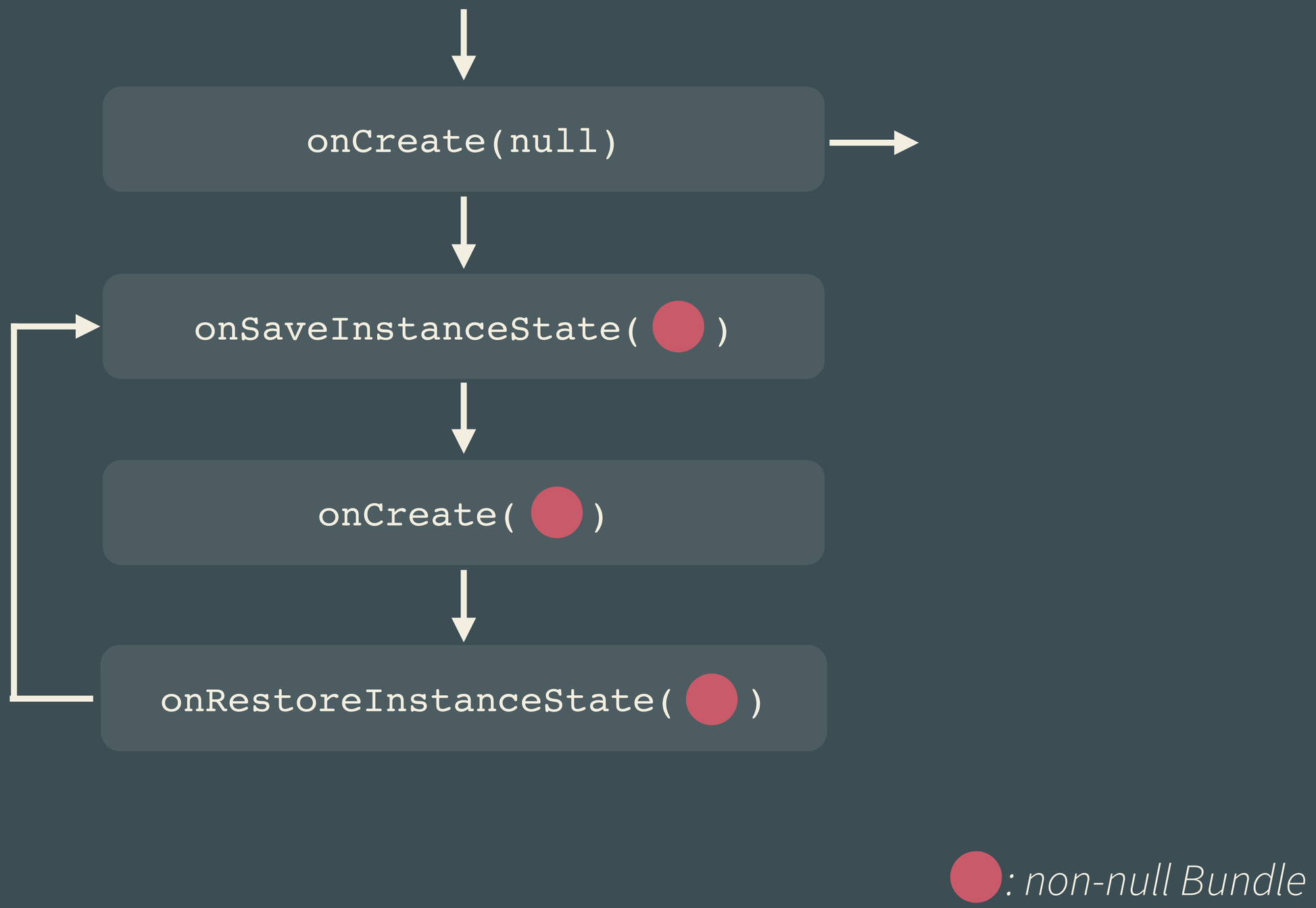
: *non-null Bundle*

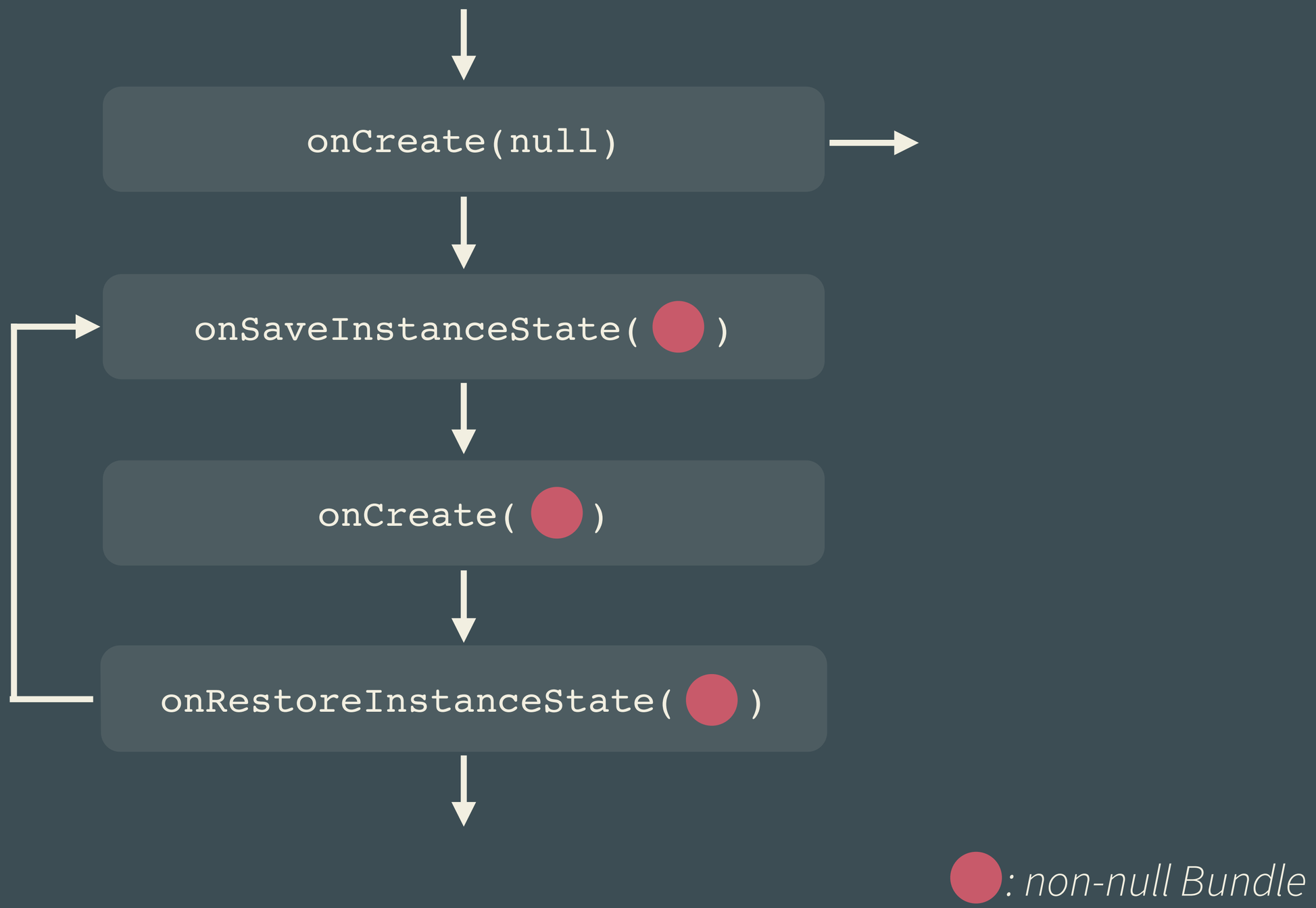


: *non-null Bundle*



: *non-null Bundle*


onCreate(null)
onSaveInstanceState( )
onCreate( )
onRestoreInstanceState( )
: non-null Bundle


onCreate(null)
onSaveInstanceState( )
onCreate( )
onRestoreInstanceState( )
: non-null Bundle

What to save?

Non persistent or non reconstructible info

```java
public class SearchActivity extends Activity {

    private static final String STATE_OUTWARD = "state:outward";

    private DateComponents mOutward;

    @Override
    protected void onCreate(Bundle inState) {
        super.onCreate(inState);

        if (inState != null) {
            DateComponents components = inState.getParcelable(STATE_OUTWARD);
            if (components != null) {
                setOutward(components);
            }
        }
    }

    @Override
    protected void onSaveInstanceState(Bundle outState) {
        super.onSaveInstanceState(outState);
        outState.putParcelable(STATE_OUTWARD, mOutward);
    }
}
```

onSaveInstanceState saves

Window

onSaveInstanceState saves

Window | Fragments

onSaveInstanceState saves

Window | Fragments | Dialogs

Always call the

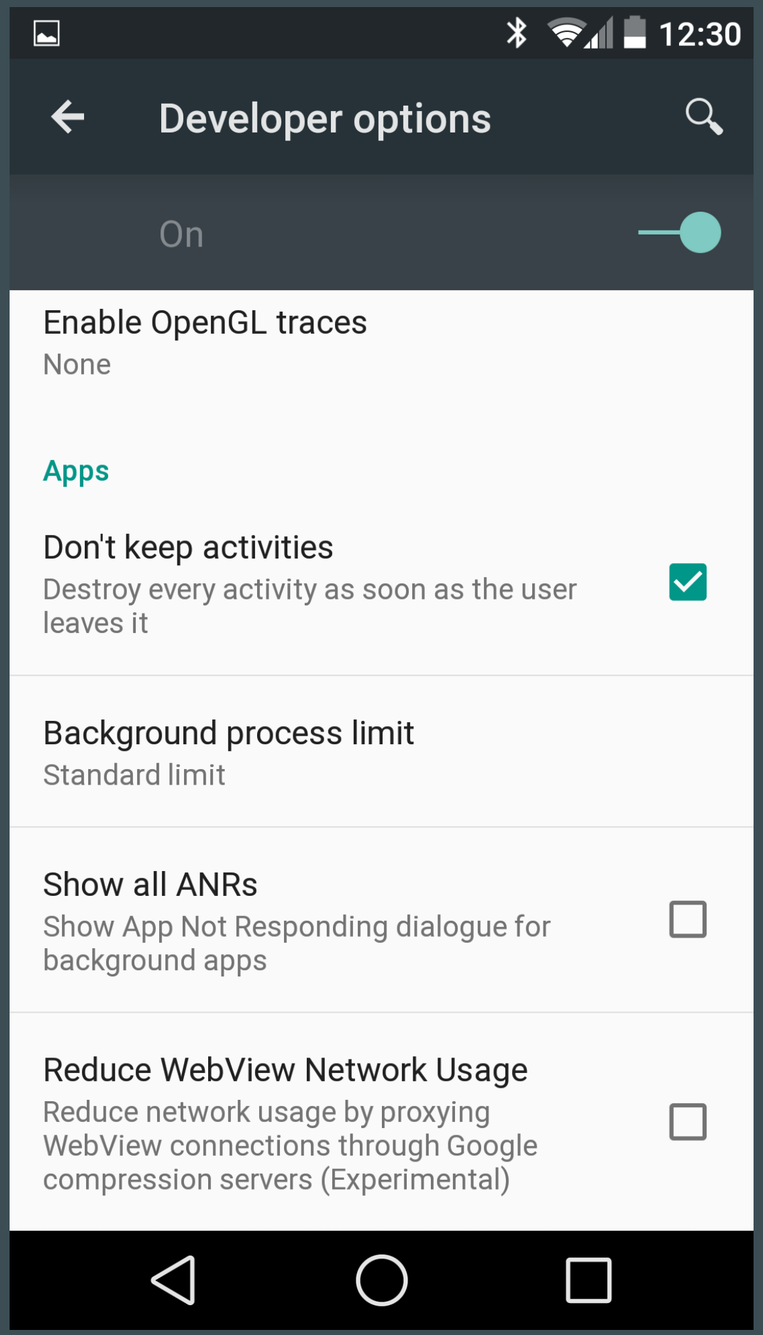
SUPER METHODS

Android has no guards on save-related methods

`android:stateNotNeeded`

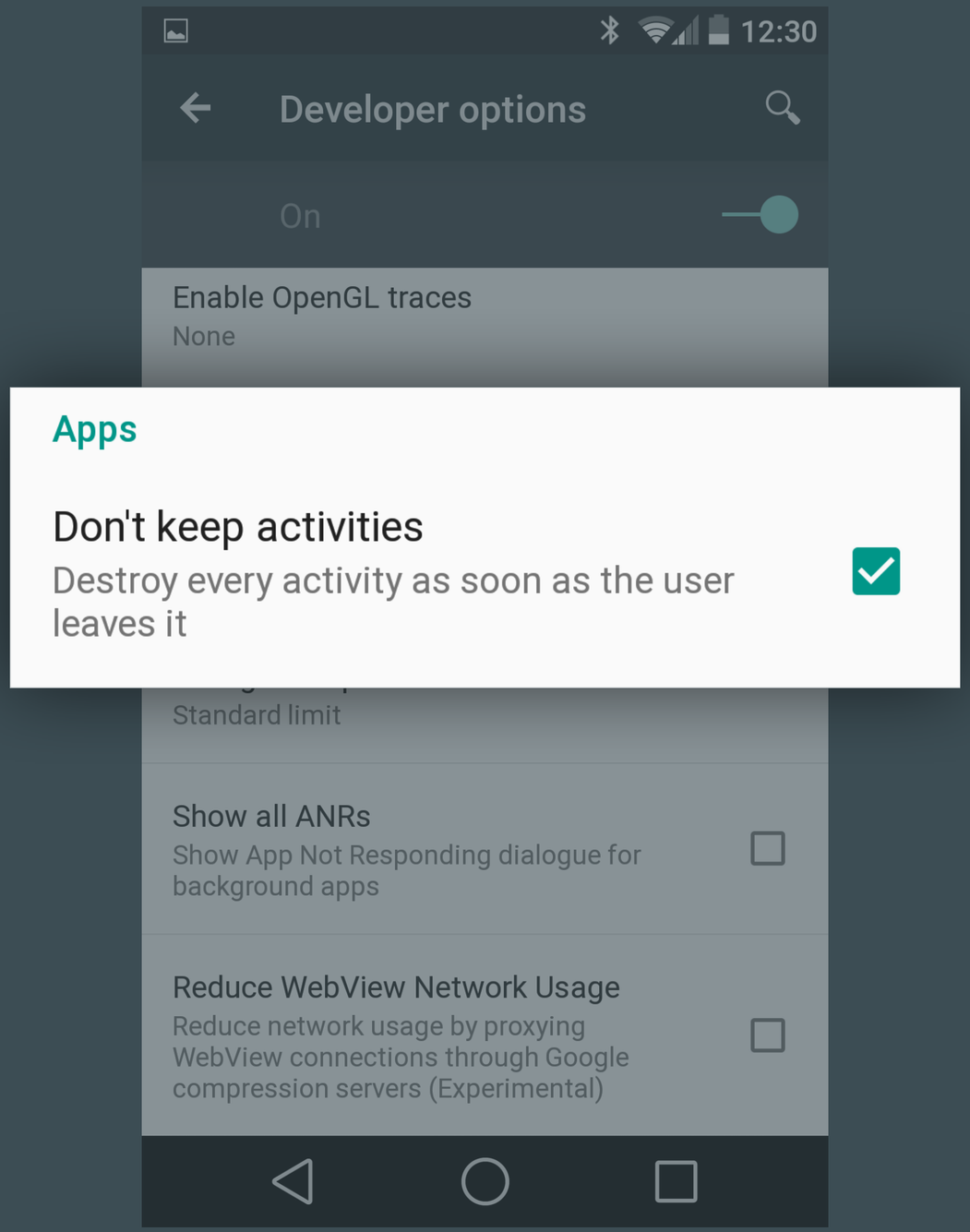
For restart-on-crash apps only

(i.e. launcher app)



Developer options

Don’t keep activities



Developer options

Don’t keep activities

View level

state restoration

Android saves UI state

AUTOMAGICALLY

Android saves UI state

AUTOMAGICALLY

(aka “It just works!™”)

Android saves UI state

AUTOMAGICALLY

(aka “It just works!™”)

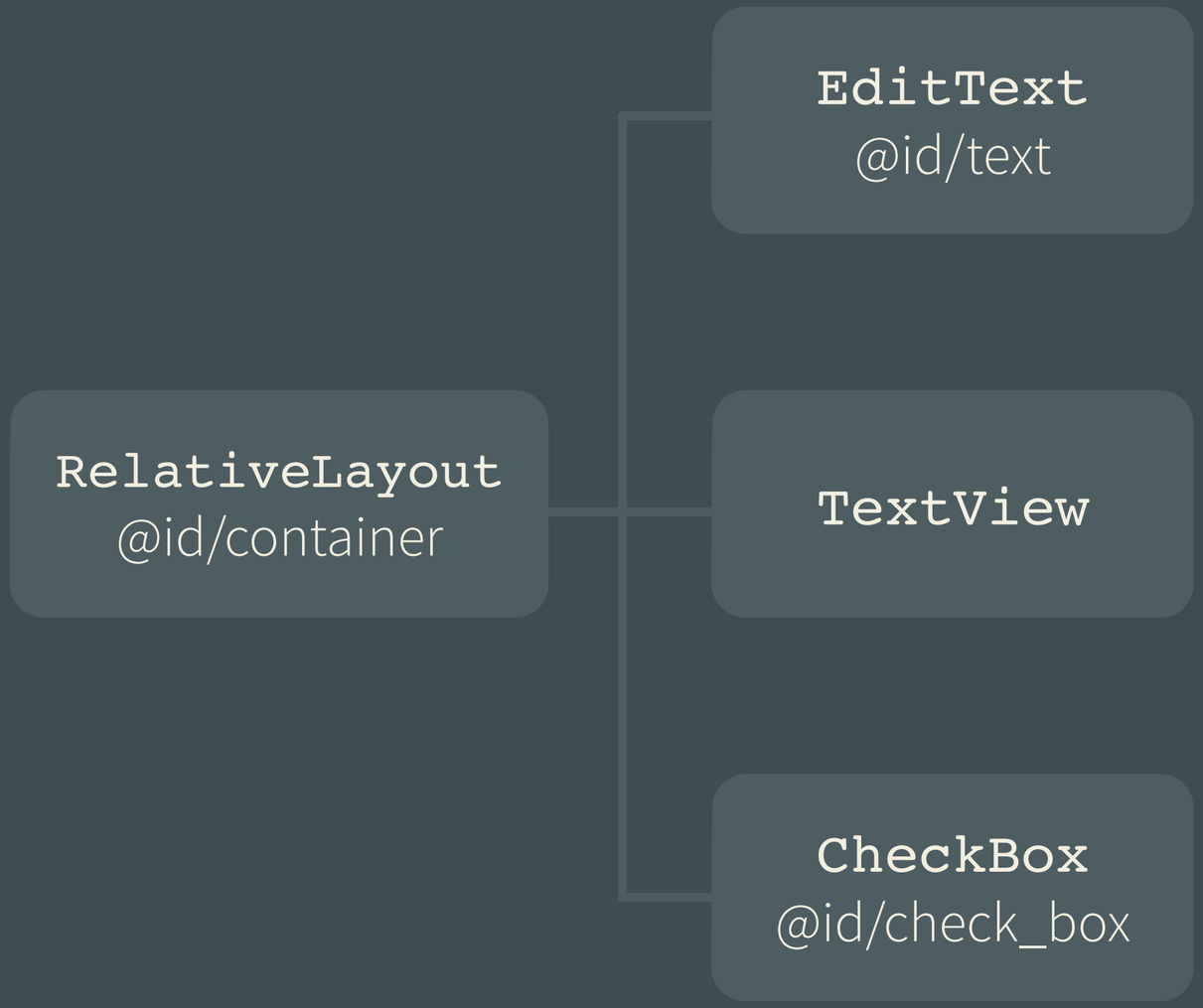
…except in some cases

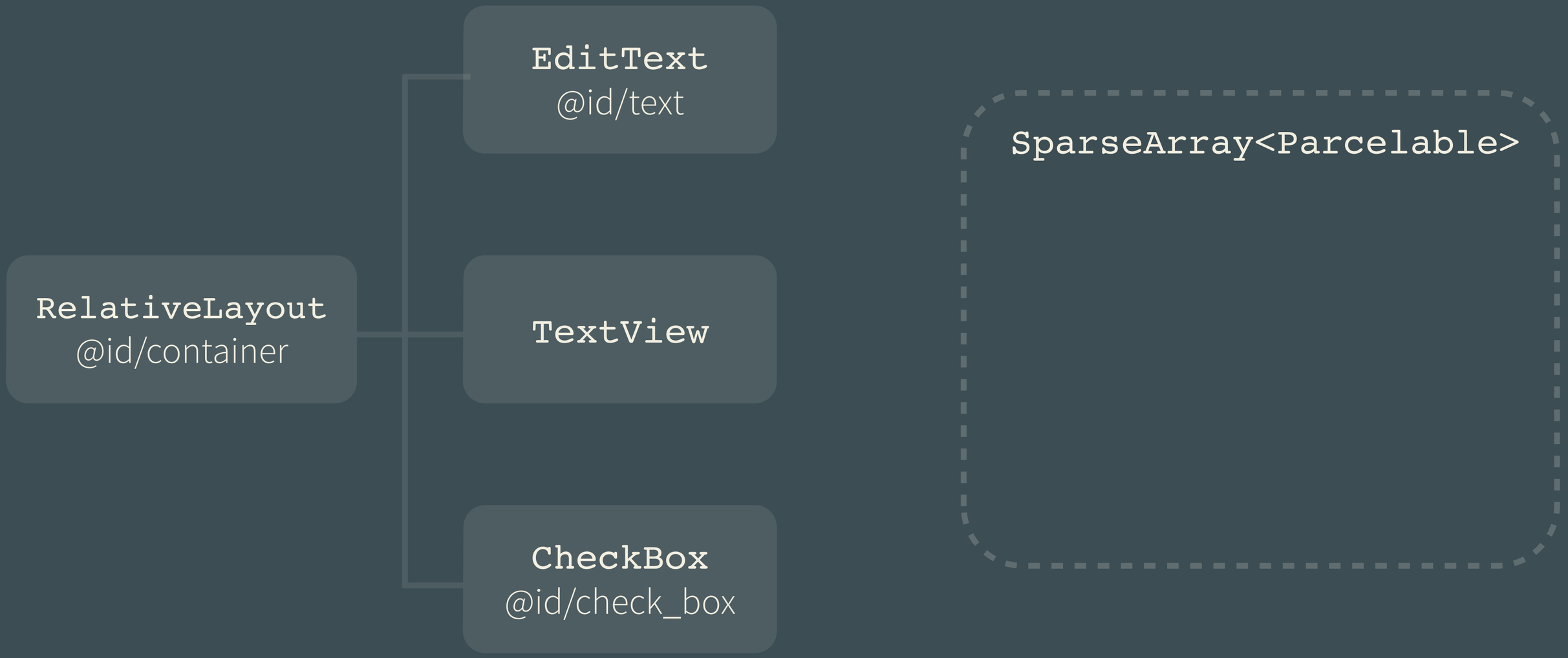
Works out-of-the-box if Views

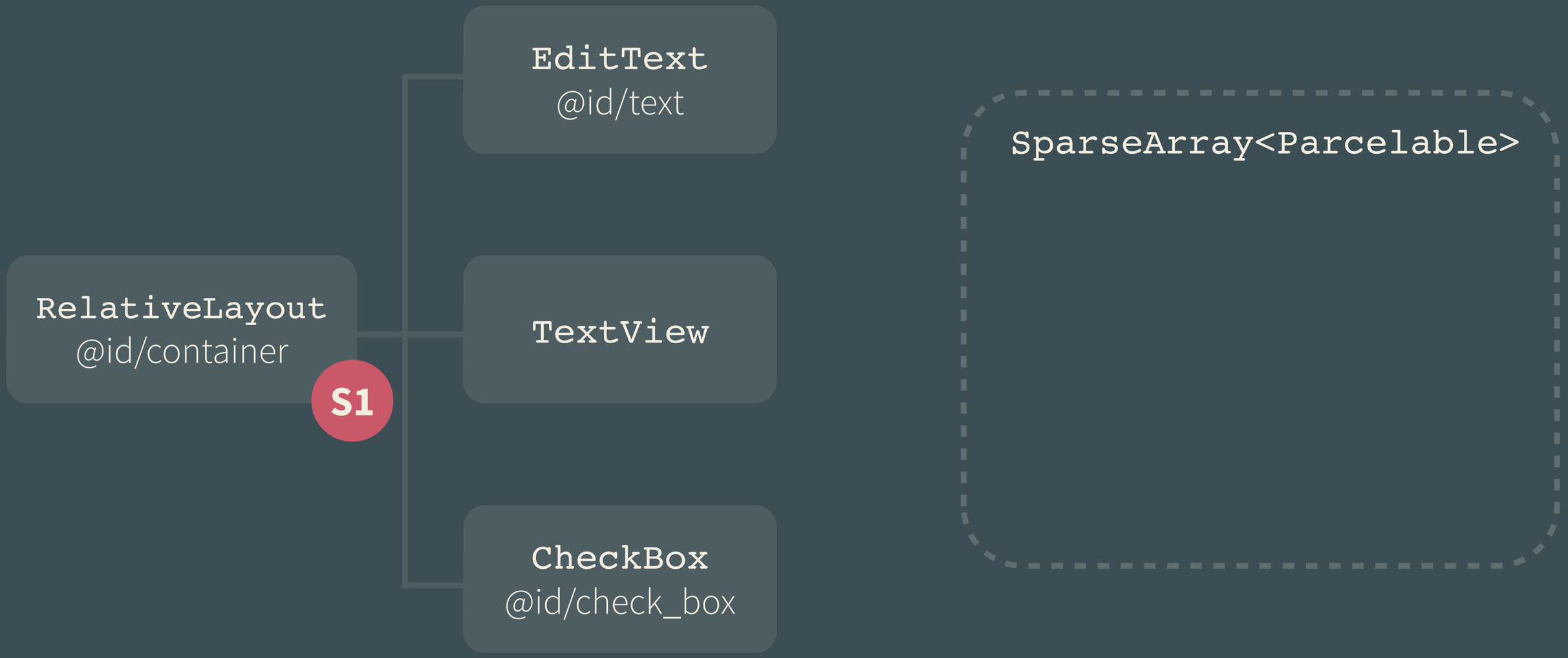
1. **Have an ID**
2. **Are “save” enabled**
3. **Come from the framework**

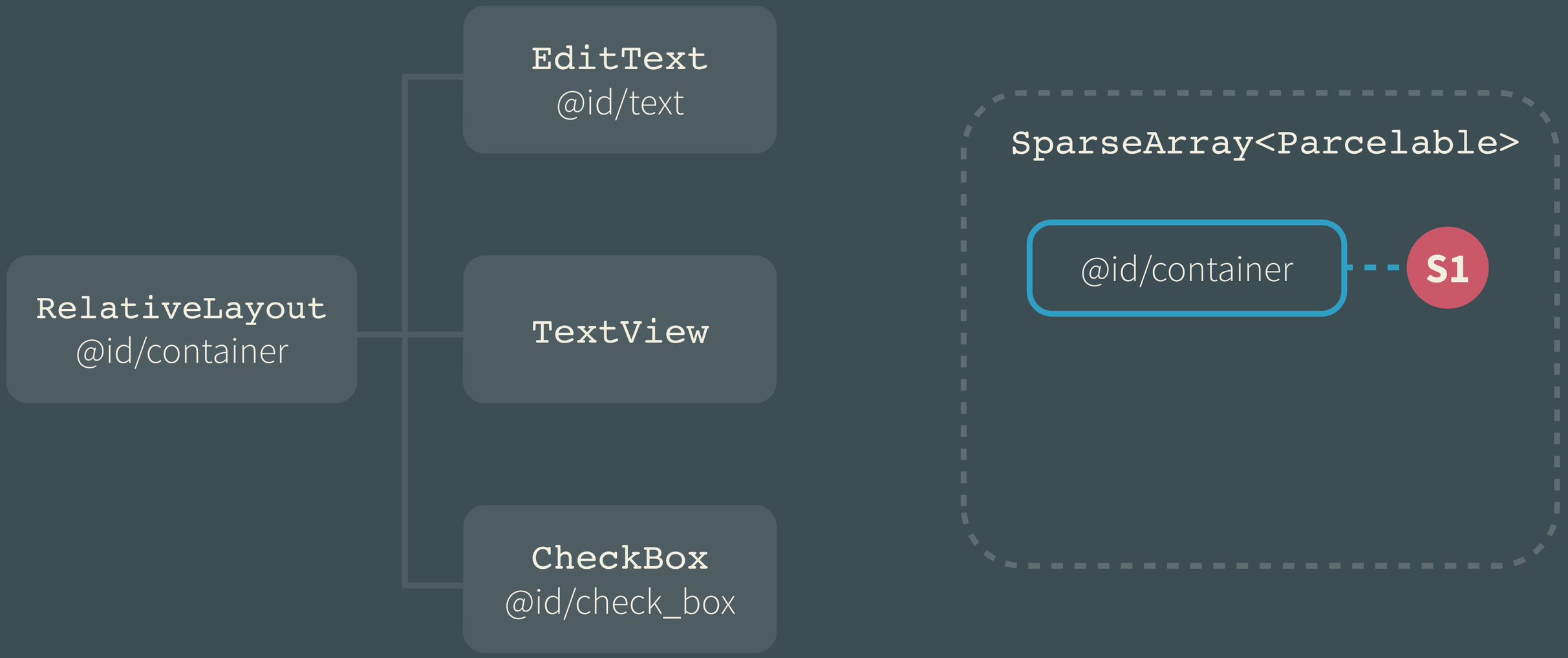
It always begins with a call to

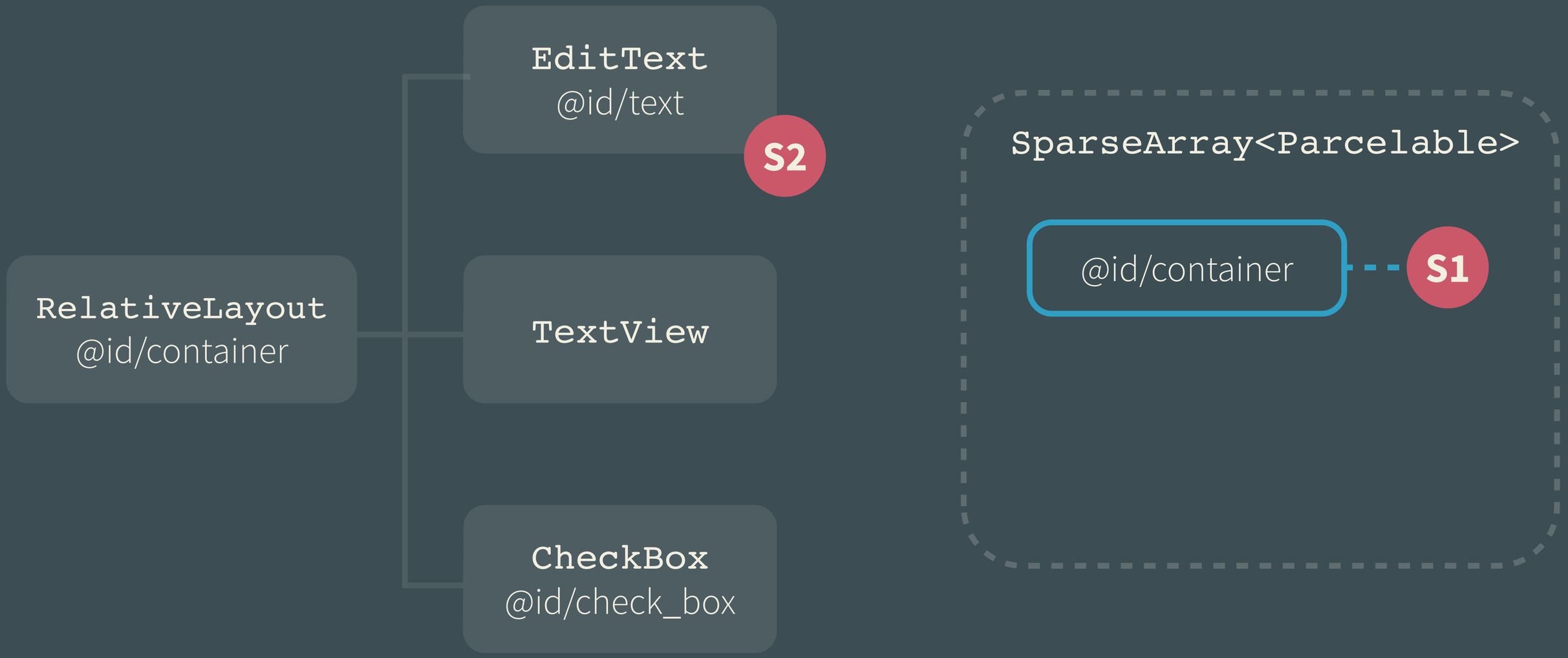
`saveHierarchyState()`

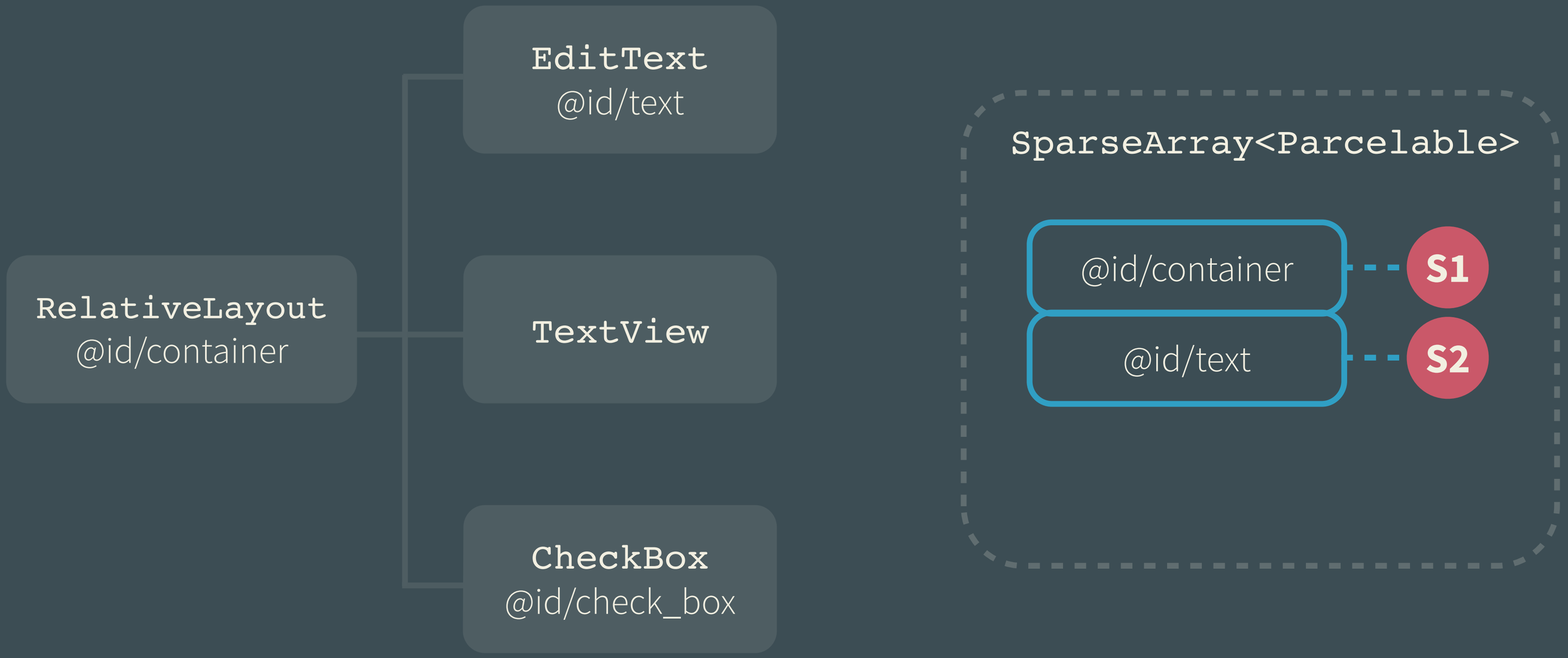

RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box

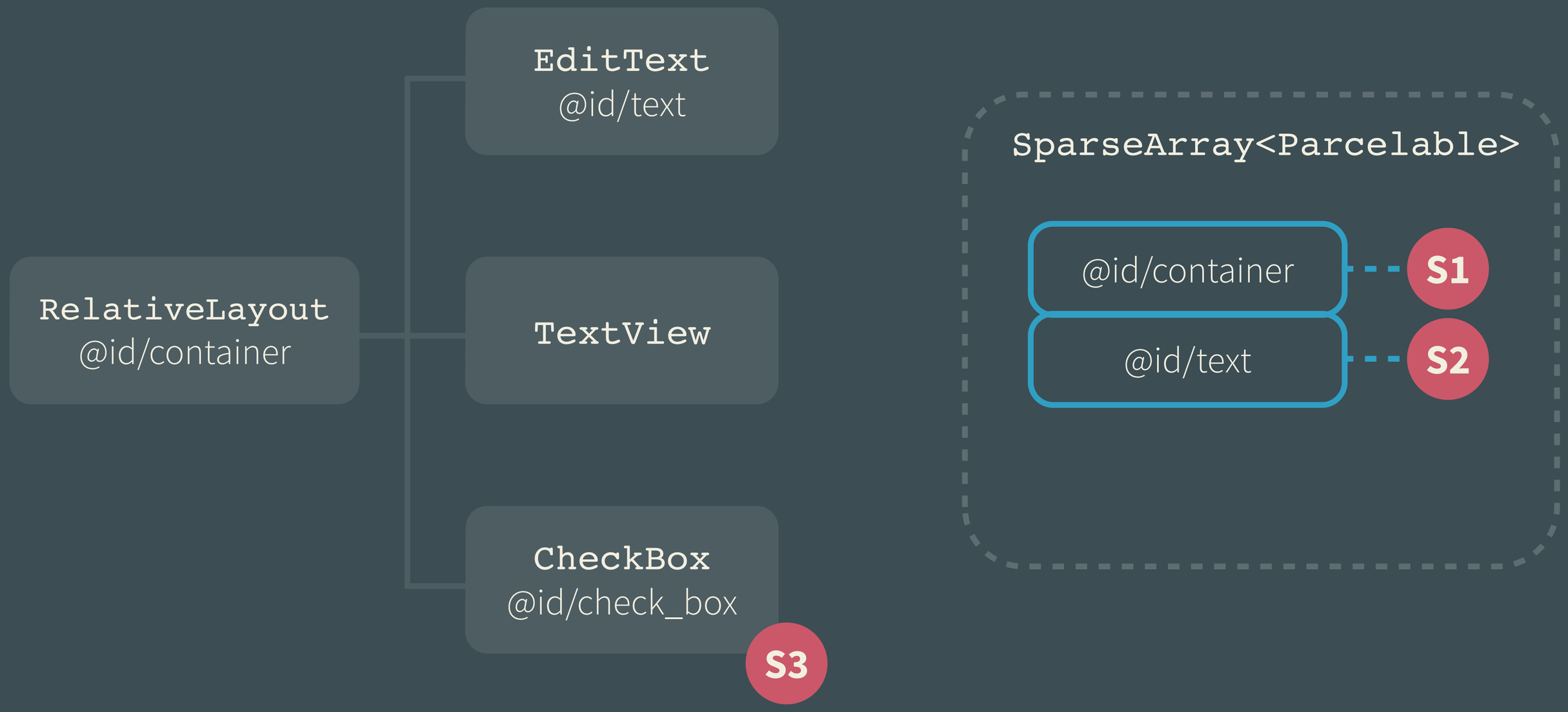

RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>

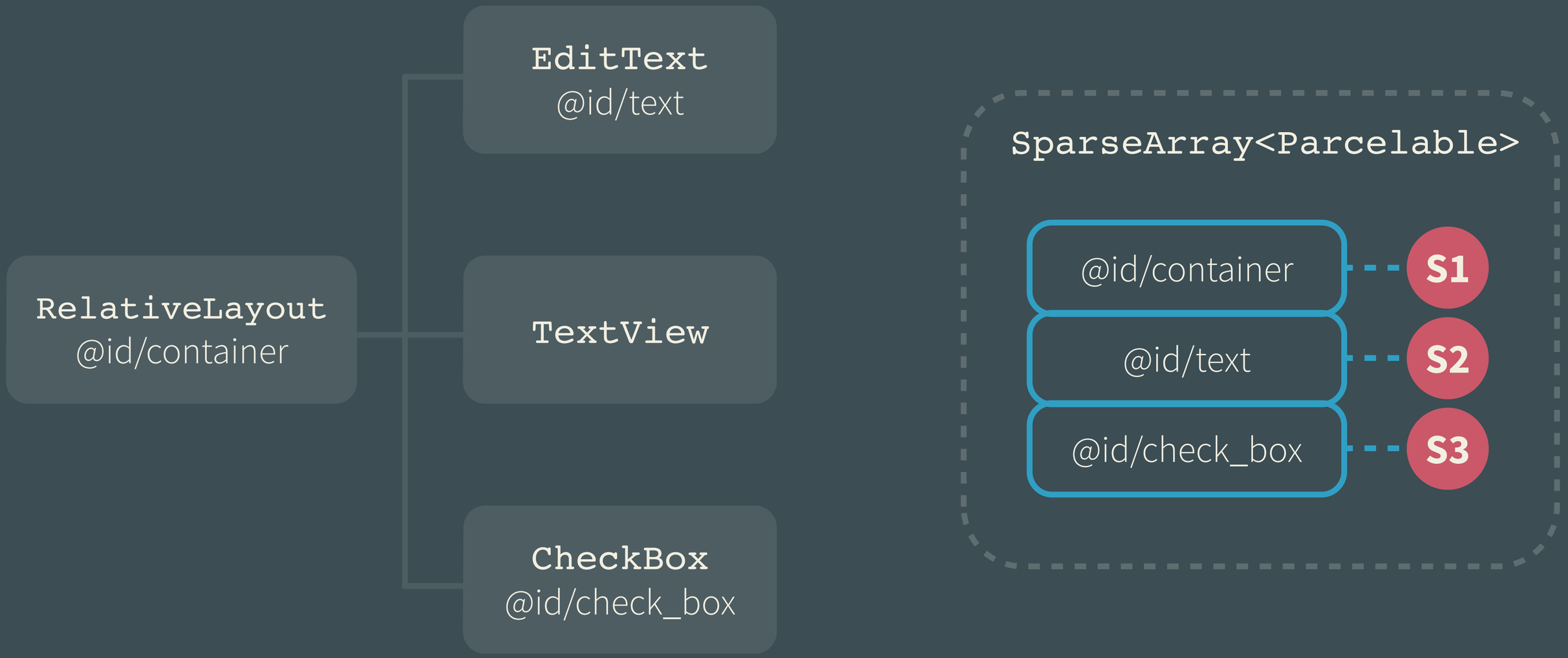

EditText
@id/text
RelativeLayout
@id/container
S1
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>


RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1


EditText
@id/text
S2
RelativeLayout
@id/container
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1


RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1
@id/text
S2


RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
S3
SparseArray<Parcelable>
@id/container
S1
@id/text
S2

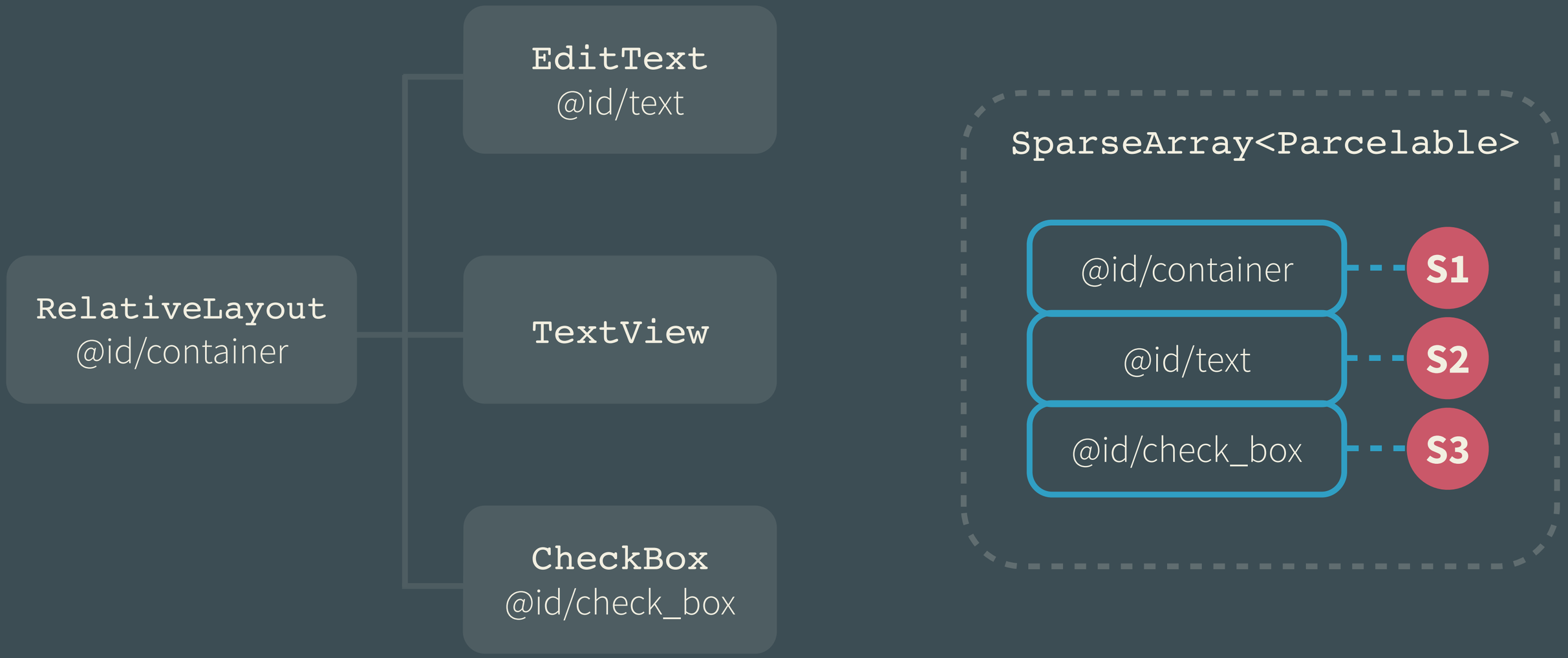

RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1
@id/text
S2
@id/check_box
S3

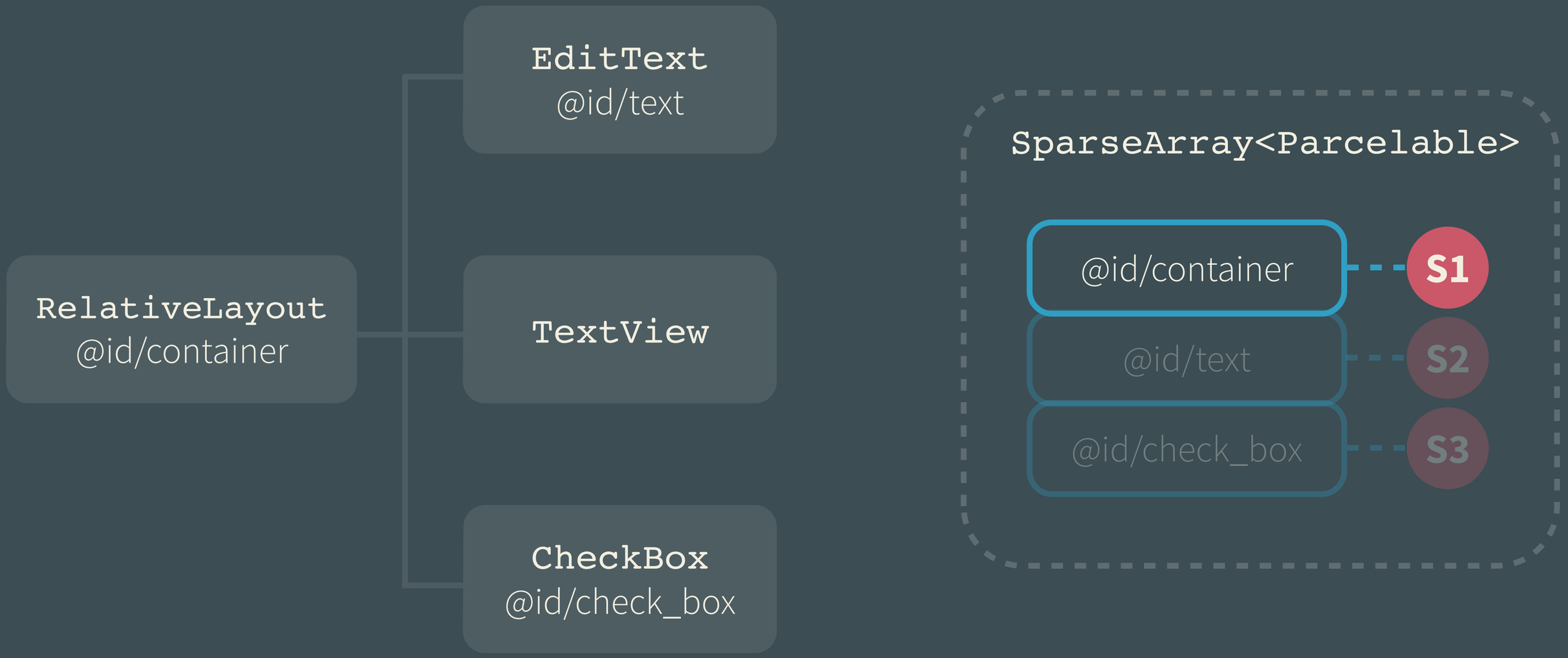
Controlling save

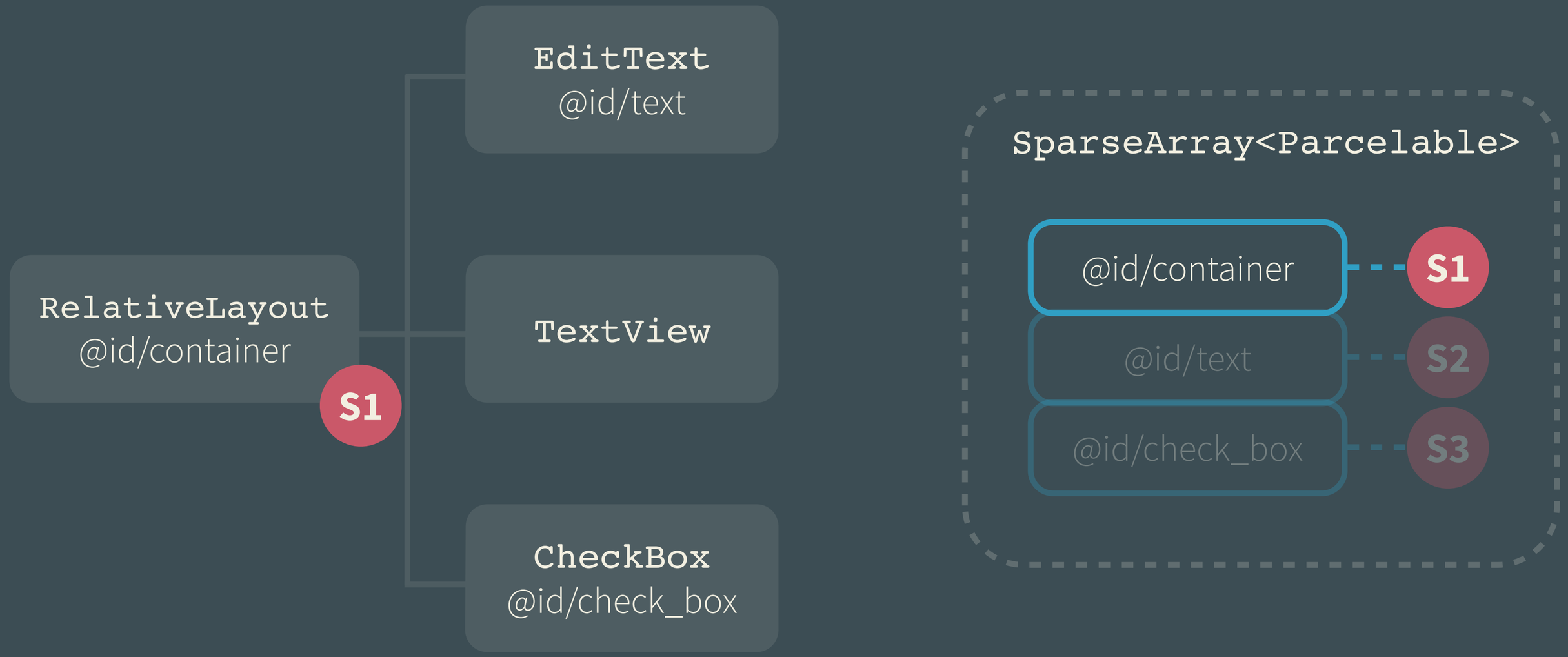
```
setSaveEnabled(boolean)

setSaveFromParentEnabled(boolean)
```

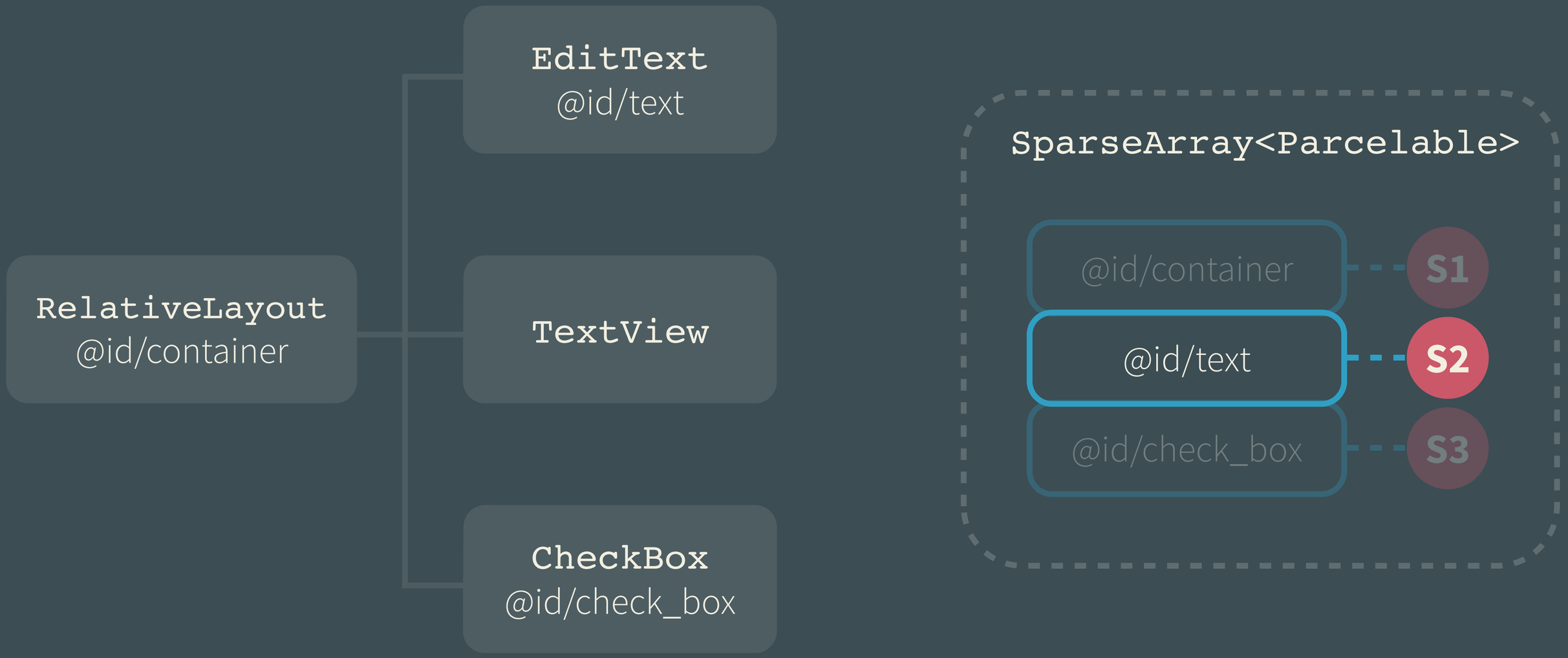
It always ends with a call to

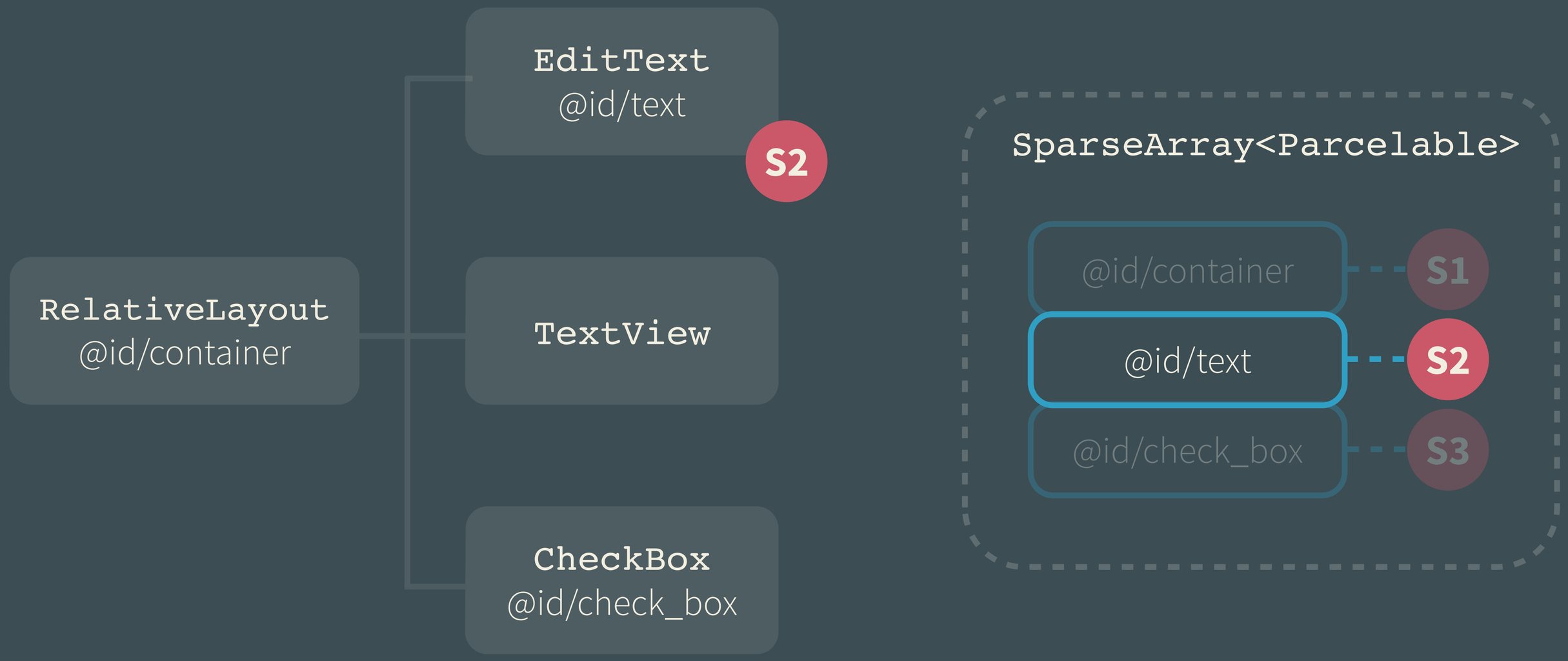
`restoreHierarchyState()`

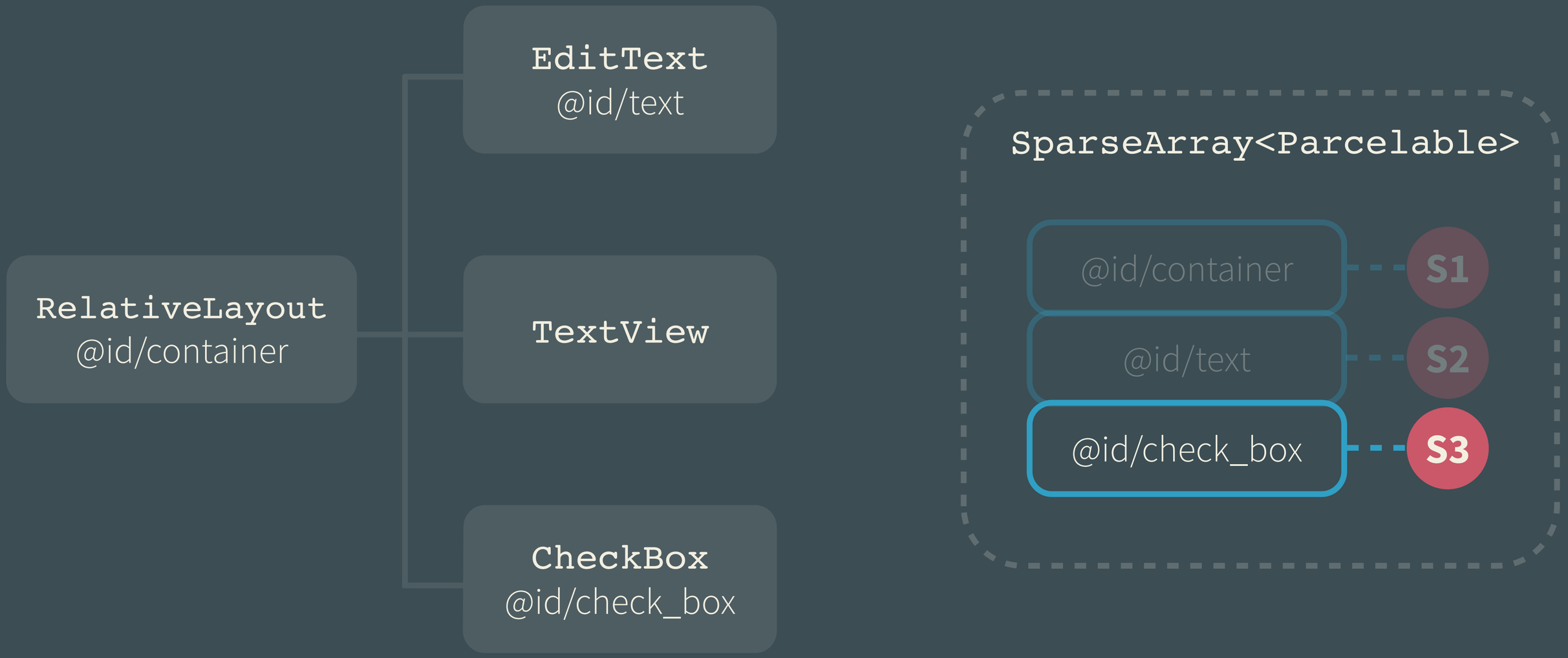

RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
@id/text
@id/check_box
S1
S2
S3

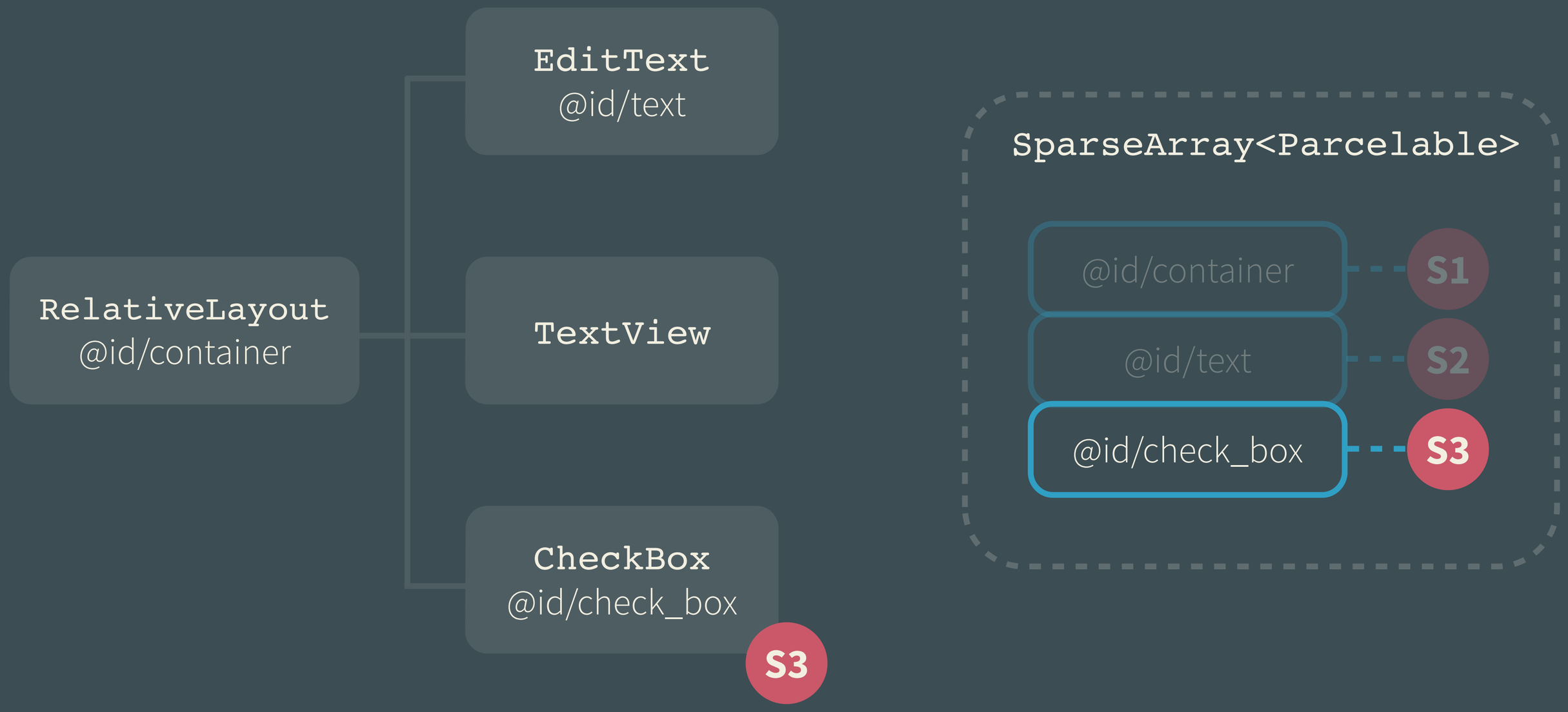

RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
@id/text
@id/check_box
S1
S2
S3


RelativeLayout
@id/container
S1
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1
@id/text
S2
@id/check_box
S3


RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1
@id/text
S2
@id/check_box
S3


RelativeLayout
@id/container
EditText
@id/text
S2
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1
@id/text
S2
@id/check_box
S3


RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
SparseArray<Parcelable>
@id/container
S1
@id/text
S2
@id/check_box
S3

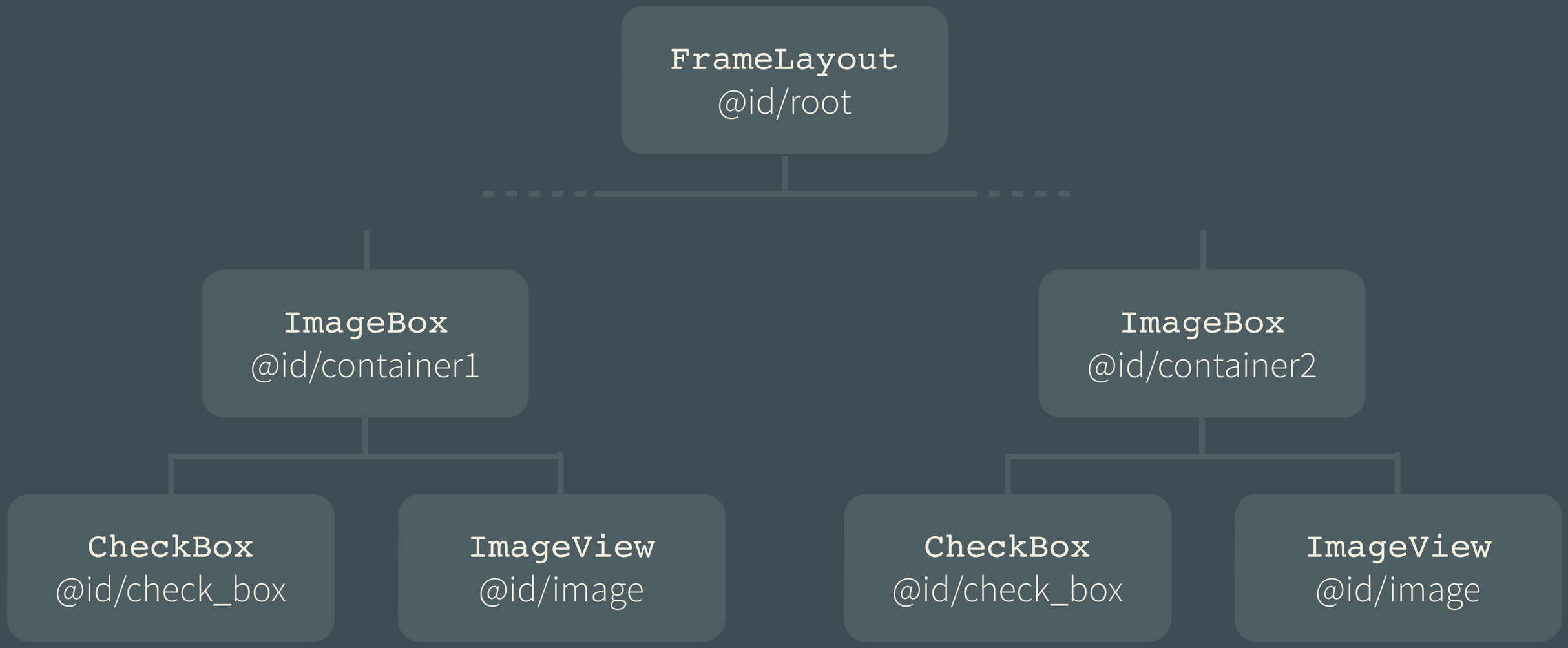

RelativeLayout
@id/container
EditText
@id/text
TextView
CheckBox
@id/check_box
S3
SparseArray<Parcelable>
@id/container
S1
@id/text
S2
@id/check_box
S3

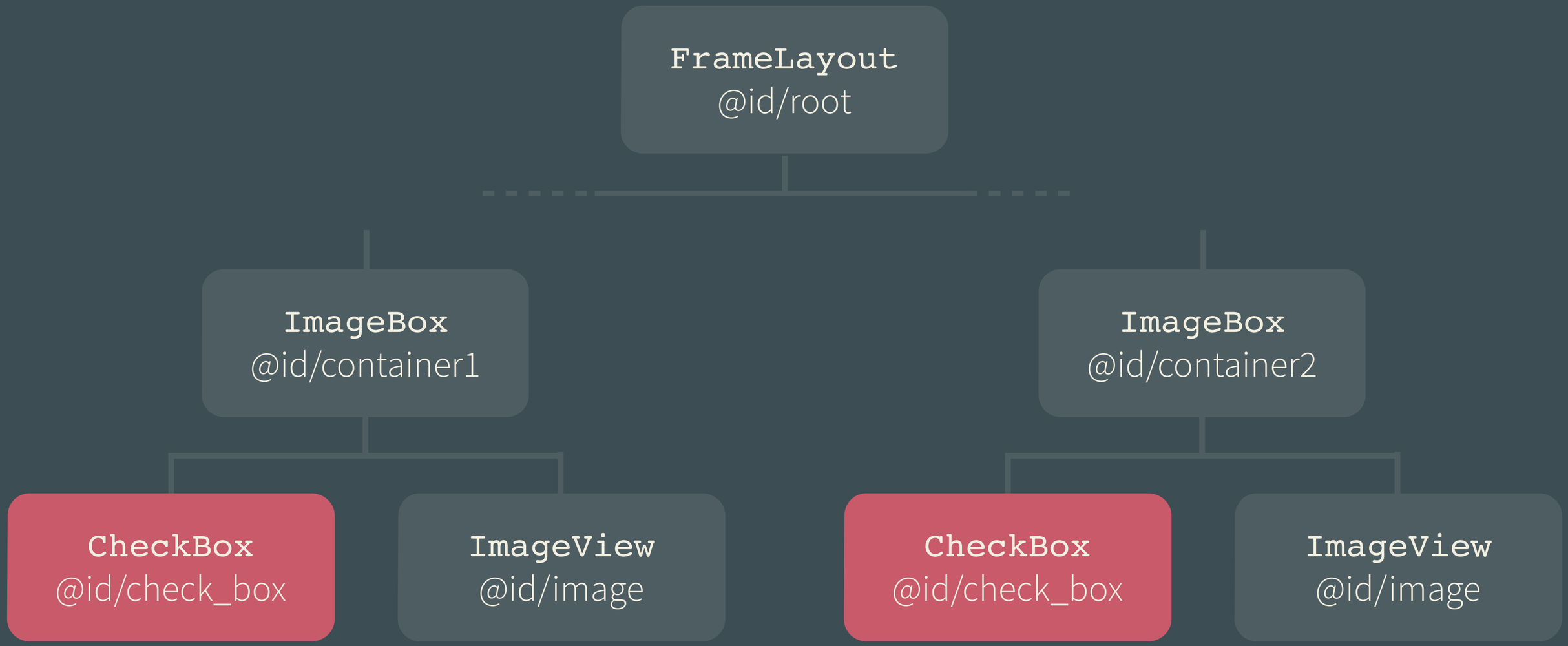
Ensure your Views' IDs are

unique & constant

```java
static class SavedState extends BaseSavedState {
    int checked;

    SavedState(Parcelable superState) { super(superState); }

    private SavedState(Parcel in) {
        super(in);
        checked = in.readInt();
    }

    @Override
    public void writeToParcel(Parcel out, int flags) {
        super.writeToParcel(out, flags);
        out.writeInt(checked);
    }

    public static final Parcelable.Creator<SavedState> CREATOR =
            new Parcelable.Creator<SavedState>() {
        public SavedState createFromParcel(Parcel in) {
            return new SavedState(in);
        }
        public SavedState[] newArray(int size) {
            return new SavedState[size];
        }
    };
}
```

```java
@Override
public Parcelable onSaveInstanceState() {
    final Parcelable superState = super.onSaveInstanceState();
    SavedState ss = new SavedState(superState);
    ss.checked = isChecked() ? 1 : 0;
    return ss;
}

@Override
public void onRestoreInstanceState(Parcelable state) {
    SavedState ss = (SavedState) state;
    super.onRestoreInstanceState(ss.getSuperState());
    setChecked(ss.checked == 1);
}
```


FrameLayout
@id/root
ImageBox
@id/container1
ImageBox
@id/container2
CheckBox
@id/check_box
ImageView
@id/image
CheckBox
@id/check_box
ImageView
@id/image



Custom views with children with same IDs

```java
static class SavedState extends BaseSavedState {

    SparseArray childrenStates;

    SavedState(Parcelable superState) { super(superState); }

    private SavedState(Parcel in, ClassLoader loader) {
        super(in);
        childrenStates = in.readSparseArray(loader);
    }

    @Override
    public void writeToParcel(Parcel out, int flags) {
        super.writeToParcel(out, flags);
        out.writeSparseArray(childrenStates);
    }

    public static final Creator<SavedState> CREATOR = ParcelableCompat.
        newCreator(new ParcelableCompatCreatorCallbacks<SavedState>() {
            @Override
            public SavedState createFromParcel(Parcel source, ClassLoader loader) {
                return new SavedState(source, loader);
            }
            @Override
            public SavedState[] newArray(int size) {
                return new SavedState[size];
            }
        });
}
```

```java
@Override
public Parcelable onSaveInstanceState() {
    final Parcelable superState = super.onSaveInstanceState();
    SavedState ss = new SavedState(superState);
    ss.childrenStates = new SparseArray<Parcelable>();
    for (int i = 0; i < getChildCount(); i++) {
        getChildAt(i).saveHierarchyState(ss.childrenStates);
    }
    return ss;
}

@Override
public void onRestoreInstanceState(Parcelable state) {
    SavedState ss = (SavedState) state;
    super.onRestoreInstanceState(ss.getSuperState());
    for (int i = 0; i < getChildCount(); i++) {
        getChildAt(i).restoreHierarchyState(ss.childrenStates);
    }
}
```

That has solved nothing!

Still need to block save/restore dispatch

```
1 @Override
2 protected void dispatchSaveInstanceState(SparseArray<Parcelable> container) {
3     dispatchFreezeSelfOnly(container);
4 }
5
6 @Override
7 protected void dispatchRestoreInstanceState(SparseArray<Parcelable> container) {
8     dispatchThawSelfOnly(container);
9 }
```

Fragment level
state restoration

Very similar to Activities

state restoration lifecycle.

(Fragments are tied to Activity after all)

Fragment blocks Activity save mechanism

with framework

`setSaveFromParentEnabled(false)`

with support library

`NoSaveStateFrameLayout`

2 distinct states

Fragment + View

common case

View only

detach, addToBackStack, etc.

Leveraging save/restore

Can to be used to create smooth transitions between your Activities:

- Save the state S_A of A
- Start B with no animations passing S_A
- Apply S_A to B
- Transition between A and B was smooth

Summarizing
in three rules

Always save the state

An Android app must survive configuration changes & low memory conditions.

Only save essential info

Only save info that is non persistent or can not be reconstructed later.

Use correct levels

Save instance states at the appropriate component level: Activity, Fragment or View.

Thank you!

@cyrilmottier

cyrilmottier.com

Resources

Dressed for Iceland • *Cécile Bernard*
Moelwynion, Eryri, Cymru • *Marc Poppleton*
Happy, Confused, Wink, Sad, Angry • *Megan Sheehan*
Floppy-Disk • *Alex Auda Samora*

Fonts

Source Sans Pro
Courier