Sample Code:
https://github.com/devunwired/custom-touch-examples

Mastering the Android Touch System

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Who Is This Guy?

- Android developer since 2009
  - ROM customization for Embedded applications
- Recovering Spark Chaser
  - Embedded M2M Monitoring systems
  - P2P Radio Links
- Co-Author of Android Recipes from Apress

Topics Covered

- Touch System Overview
- Touch Event Framework
- Custom Touch Handling
- System Provided Touch Handlers
- System Provided Gesture Handlers

How Android Handles Touches

- Each user touch event is wrapped up as a MotionEvent
- Describes user's current action
  - ACTION_DOWN
  - ACTION_UP
  - ACTION_MOVE
  - ACTION_POINTER_DOWN
  - ACTION_POINTER_UP
  - ACTION_CANCEL
- Event metadata included
  - Touch location
  - Number of pointers (fingers)
  - Event time
- A “gesture” is defined as beginning with ACTION_DOWN and ending with ACTION_UP.

How Android Handles Touches

- Events start at the Activity with dispatchTouchEvent()
- Events flow top down through views
  - Parents (ViewGroups) dispatch events to their children
  - Can intercept events at any time
- Events flow down the chain (and back up) until consumed
  - Views must declare interest by consuming ACTION_DOWN
  - Further events not delivered for efficiency
- Any unconsumed events end at the Activity with onTouchEvent()
- Optional External OnTouchListener can intercept touches on any View/ViewGroup

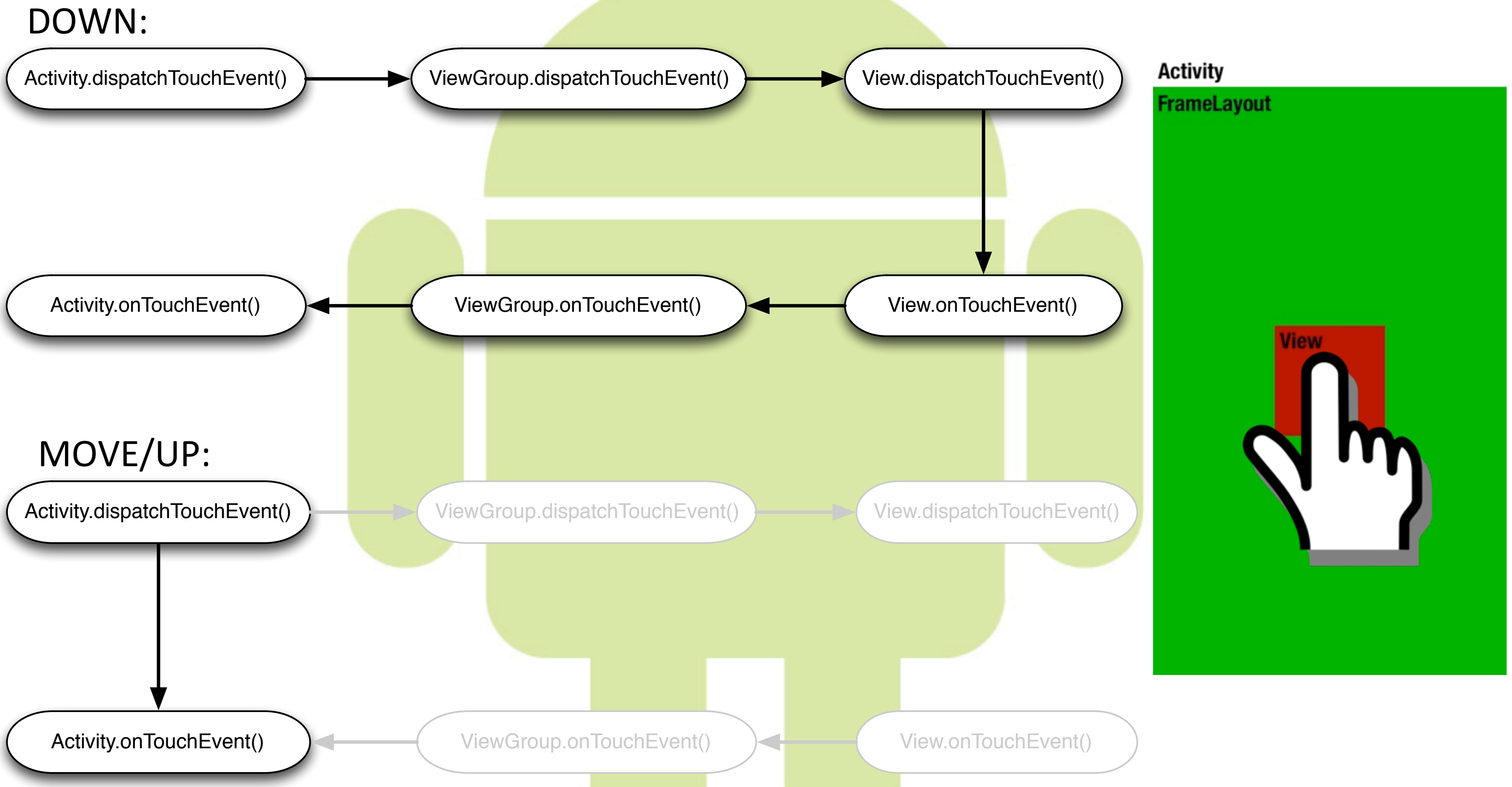
How Android Handles Touches

- Activity.dispatchTouchEvent()
  - Always first to be called
  - Sends event to root view attached to Window
  - onTouchEvent()
    - Called if no views consume the event
    - Always last to be called
- View.dispatchTouchEvent()
  - Sends event to listener first, if exists
    - View.OnTouchListener.onTouch()
  - If not consumed, processes the touch itself
    - View.onTouchEvent()

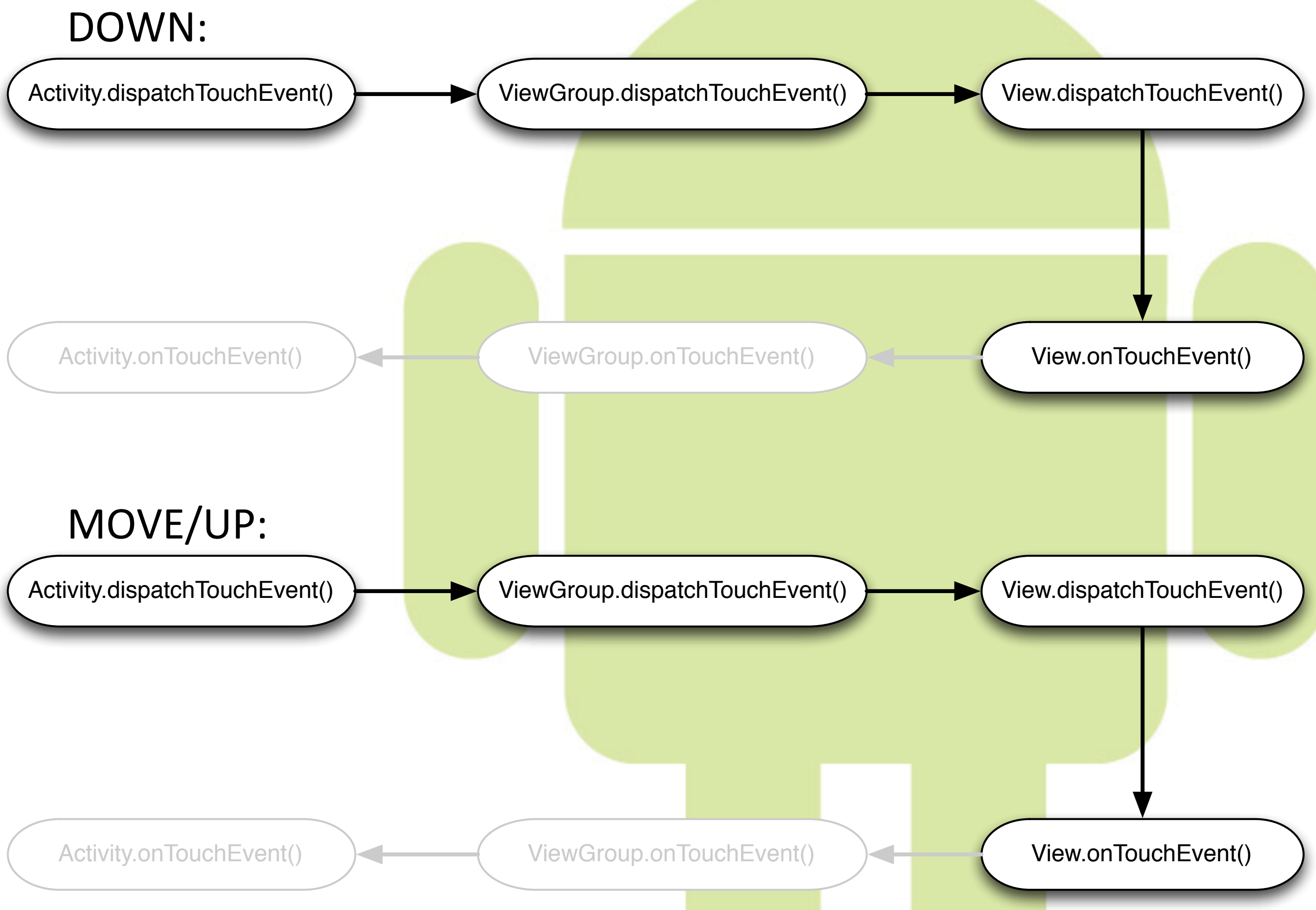
How Android Handles Touches

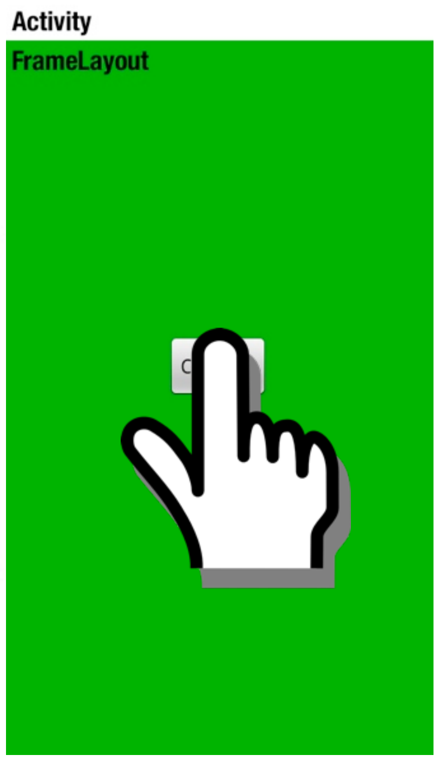
- ViewGroup.dispatchTouchEvent()
  - onInterceptTouchEvent()
    - Check if it should supersede children
    - Passes ACTION_CANCEL to active child
    - Return true once consumes all subsequent events
  - For each child view, in reverse order they were added
    - If touch is relevant (inside view), child.dispatchTouchEvent()
    - If not handled by previous, dispatch to next view
  - If no children handle event, listener gets a chance
    - OnTouchListener.onTouch()
  - If no listener, or not handled
    - onTouchEvent()
- Intercepted events jump over child step

Ignorant View Example

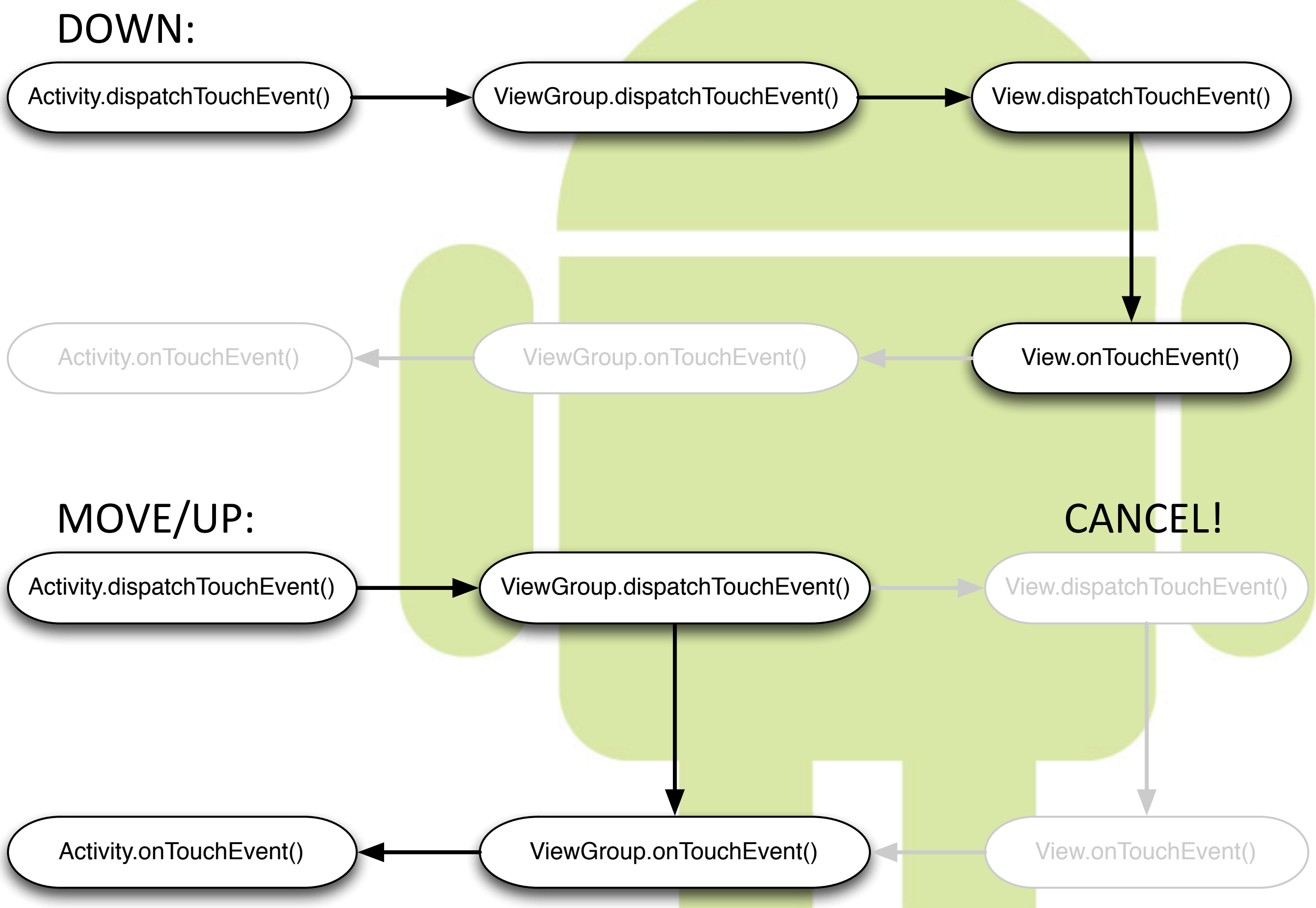

DOWN:
Activity.dispatchTouchEvent()
ViewGroup.dispatchTouchEvent()
View.dispatchTouchEvent()
Activity.onTouchEvent()
ViewGroup.onTouchEvent()
View.onTouchEvent()
MOVE/UP:
Activity.dispatchTouchEvent()
ViewGroup.dispatchTouchEvent()
View.dispatchTouchEvent()
Activity.onTouchEvent()
ViewGroup.onTouchEvent()
View.onTouchEvent()
Activity
FrameLayout
View

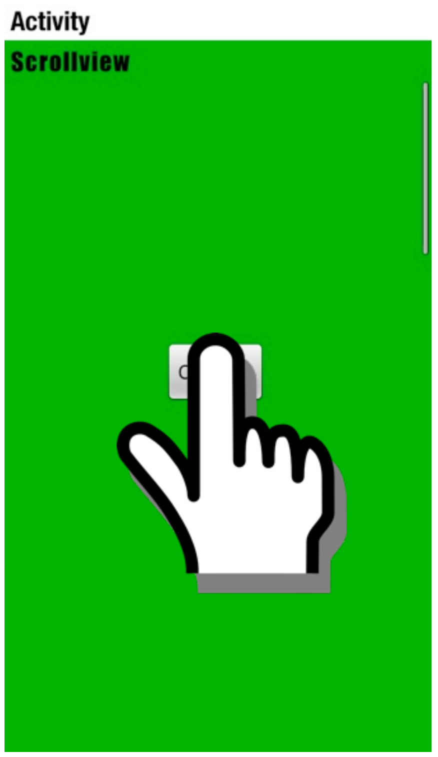
Interested View Example


DOWN:
Activity.dispatchTouchEvent()
ViewGroup.dispatchTouchEvent()
View.dispatchTouchEvent()
Activity.onTouchEvent()
ViewGroup.onTouchEvent()
View.onTouchEvent()
MOVE/UP:
Activity.dispatchTouchEvent()
ViewGroup.dispatchTouchEvent()
View.dispatchTouchEvent()
Activity.onTouchEvent()
ViewGroup.onTouchEvent()
View.onTouchEvent()



Intercept Example


DOWN:
Activity.dispatchTouchEvent()
ViewGroup.dispatchTouchEvent()
View.dispatchTouchEvent()
Activity.onTouchEvent()
ViewGroup.onTouchEvent()
View.onTouchEvent()
MOVE/UP:
CANCEL!
Activity.dispatchTouchEvent()
ViewGroup.dispatchTouchEvent()
View.dispatchTouchEvent()
Activity.onTouchEvent()
ViewGroup.onTouchEvent()
View.onTouchEvent()



Custom Touch Handling

- Handling touch events
  - Subclass to override onTouchEvent()
  - Provide an OnTouchListener
- Consuming events
  - Return true with ACTION_DOWN to show interest
    - Even if you aren't interested in ACTION_DOWN, return true
  - For other events, returning true simply stops further processing
- Useful constants available in ViewConfiguration
  - getScaledTouchSlop()
    - Distance move events might vary before they should be considered a drag
  - getScaledMinimumFlingVelocity()
    - Speed at which the system considers a drag to be a fling
  - getLongPressTimeout()
    - Time the system waits to consider an event a long-press
  - Display values scaled for each device's density

Custom Touch Handling

- Forwarding touch events
  - Call target's dispatchTouchEvent()
  - Avoid calling target's onTouchEvent() directly
- Stealing touch events (ViewGroup)
  - Subclass to override onInterceptTouchEvent()
  - Return true when you want to take over
    - All subsequent events for the current gesture will come to your onTouchEvent() directly
    - onInterceptTouchEvent() will no longer be called for each event (one-shot redirect)
  - Any current target will receive ACTION_CANCEL

Custom Touch Handling Warnings

- Call through to super whenever possible
  - View.onTouchEvent() does a LOT of state management (pressed, checked, etc.) that you will lose if you capture every touch
- Protect ACTION_MOVE with slop checks
  - Fingers are fat and twitchy
- Always Handle ACTION_CANCEL
  - Container views with action (like scrolling) will steal events and you will likely need to reset state
  - Remember after CANCEL, you will get nothing else
- Don't intercept events until you're ready to take them all.
  - Intercept cannot be reversed until the next gesture.

Multi-Touch Handling

- MotionEvent.getPointerCount()
  - How many pointers are currently on the screen?
- Use the ACTION_POINTER_DOWN and ACTION_POINTER_UP events to detect secondary pointers
  - MotionEvent.getActionMasked()
  - MotionEvent.getActionIndex()
- Use MotionEvent methods that take a pointer index parameter to get data for a specific pointer
  - Methods with no parameter always return data for the FIRST pointer

Batching

- For efficiency, ACTION_MOVE events can be batched together in a single MotionEvent
- Latest (current) event is always returned by standard methods
  - getX(), getY(), getEventTime()
- Event occurring between this ACTION_MOVE and the last are found with historical methods
  - getHistoricalX(), getHistoricalY(), getHistoricalEventTime()
  - getHistoricalSize() returns number of batched events
- Can reconstruct all events as they occurred in time for maximum precision

System Touch Handlers

- Don't jump right to custom touch handling if you don't have to…
- OnClickListener
- OnLongClickListener
- OnTouchListener
  - Monitor individual MotionEvents without a subclass
  - Can consume touches from a listener
  - Can pre-empt view's handling
- OnScrollListener / View.onScrollChanged()
  - View with existing scroll functionality has scrolled

System Touch Handlers

- For more complex touch interaction
- GestureDetector
  - onDown(), onSingleTapUp(), onDoubleTap()
  - onLongPress()
  - onScroll() (user dragging finger)
  - onFling() (user released drag with velocity
- ScaleGestureDetector
  - onScaleBegin(), onScale(), onScaleEnd()
- Handled via OnTouchListener or onTouchEvent()
- Disadvantages
  - Consume UP events and exposes no interface for CANCEL events
  - May require added touch handling if these cases need special handling (e.g. resetting a View's appearance)

Touch Delegate

- Specialized object to assist in forwarding touches from a parent view to its child
- Allows for the touch area of a specific view to be different than its actual bounds
- Called in onTouchEvent() of attached View
  - Events have to make it that far without being consumed by a child or listener
- TouchDelegate is designed to be set on the PARENT and passed the CHILD view that touches should be forwarded to, i.e.

```
ViewGroup parent;
View child;
Rect touchArea;
parent.setTouchDelegate( new TouchDelegate(touchArea, child) );
```

Demo Samples

Once Again...

- Dave Smith
- Twitter: @devunwired
- Blog: http://wiresareobsolete.com
- Samples:
  - https://github.com/devunwired/custom-touch-examples