android Bootcamp 2019

Multi-Display and Foldables

March 14, 2019

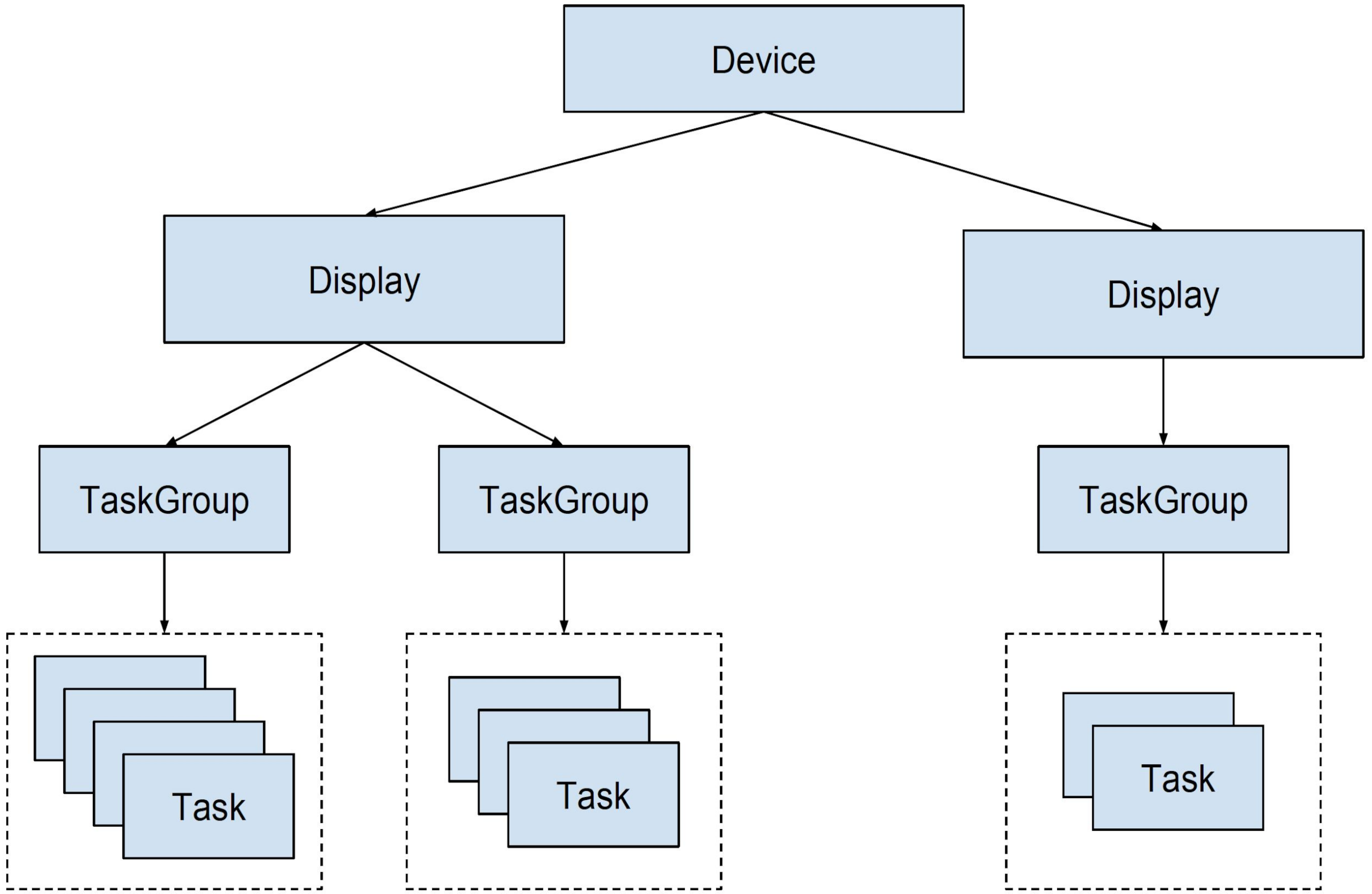
Agenda

- Multi-display
    - Previous releases
    - Target platforms
    - Changes and features
- Foldables

Multi-display

android

Multi-display in O



Multi-display in O

```
// Get target display
DisplayManager dm = (DisplayManager) getSystemService(DISPLAY_SERVICE);
Display[] displays = dm.getDisplays();

// Launch activity on target display
ActivityOptions options = ActivityOptions.makeBasic();
options.setLaunchDisplayId(displayId);
startActivity(intent, options.toBundle());
```

android

Target platforms in Q

- Android Automotive (a.k.a. Auto Embedded)
- Multi-display and foldable devices
- Desktop mode
- ARC++

Android Auto Embedded

Multi-screen devices

android

Desktop mode and ARC++

Main goals in Q

- Fixing fundamental issues and limitations (input, IME, focus handling, etc.)
- Reducing fragmentation by providing default implementation
- Building a flexible system to support new projects and use cases

Project parts

- Default-display-only limitations in core framework
- IME on external displays
- Per-display focus and multi-IME
- Support for 3+ hardware displays
- Generic display identification and input routing
- SystemUI components
- Multi-zone audio
- Emulator support
- and much more...

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Separating display policies

PhoneWindowManager
PhoneWindowManager
DisplayPolicy
DisplayRotation

PhoneWindowManager

- Display policies
- Input events

DisplayPolicy

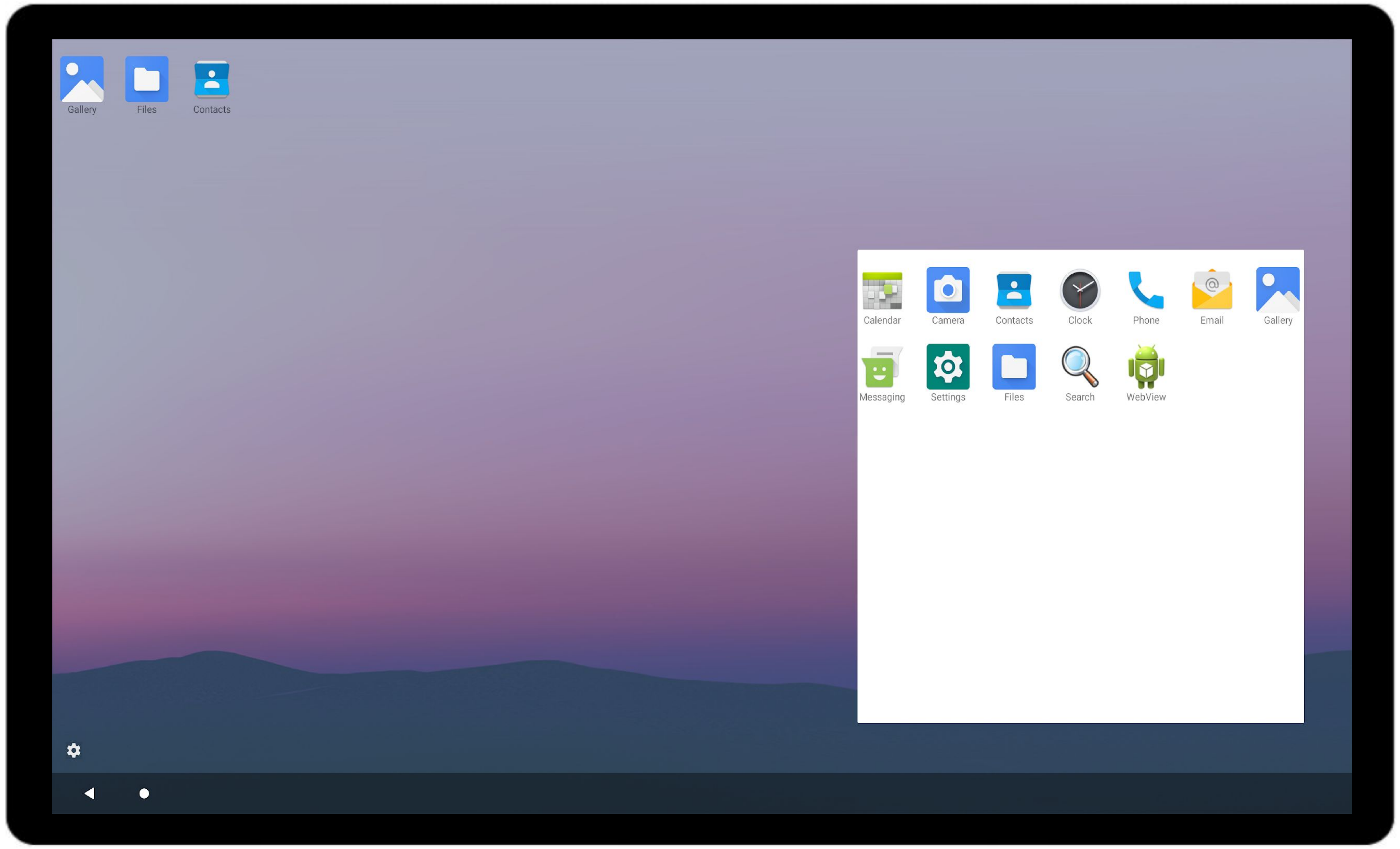
- State
- System decor
- Window layout

Display settings

DisplayWindowSettings

- Windowing mode
- System decorations support
- User rotation

System decorations



System decorations - launcher

```
<activity
    ...
    android:launchMode=~~"singleInstance"~~/~~"singleTask"~~>
        <intent-filter>
            <category android:name="android.intent.category.SECONDARY_HOME" />
            ...
        </intent-filter>
</activity>

// System default
com.android.internal.R.string.config_secondaryHomeComponent
```

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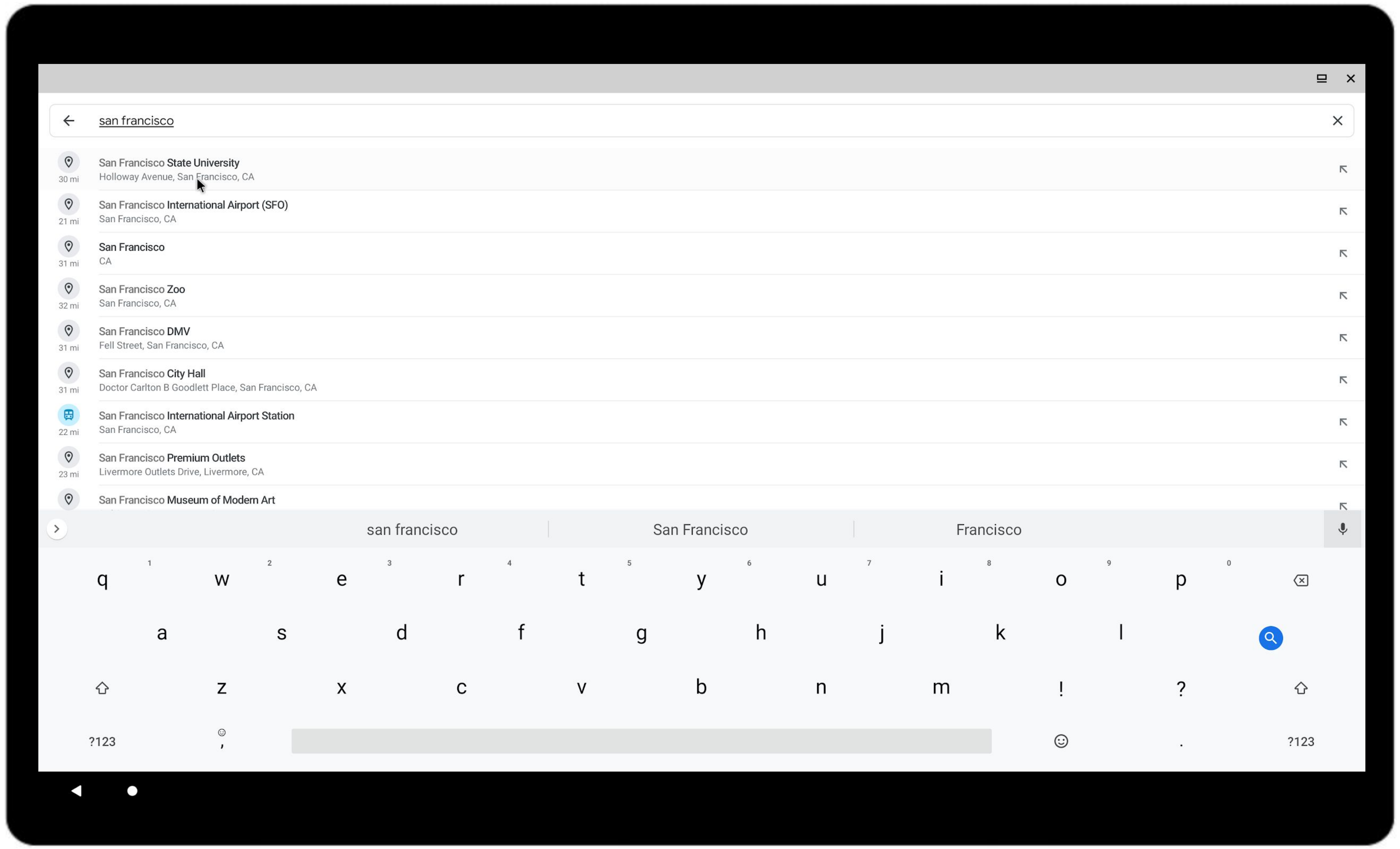
System decorations - IME


san francisco

San Francisco State University
Holloway Avenue, San Francisco, CA
30 mi

San Francisco International Airport (SFO)
San Francisco, CA
21 mi

San Francisco
CA
31 mi

San Francisco Zoo
San Francisco, CA
32 mi

San Francisco DMV
Fell Street, San Francisco, CA
31 mi

San Francisco City Hall
Doctor Carlton B Goodlett Place, San Francisco, CA
31 mi

San Francisco International Airport Station
San Francisco, CA
22 mi

San Francisco Premium Outlets
Livermore Outlets Drive, Livermore, CA
23 mi

San Francisco Museum of Modern Art

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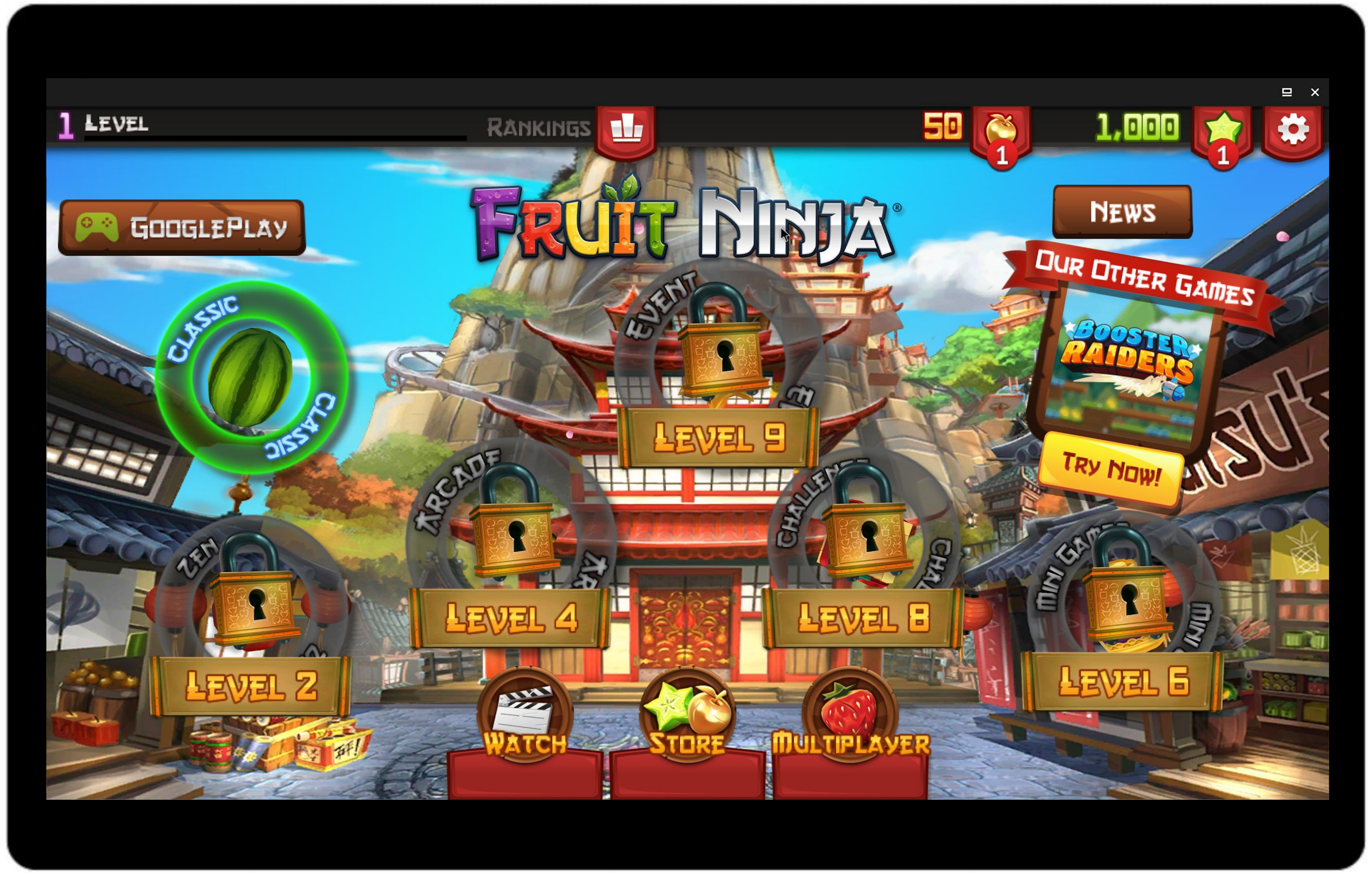
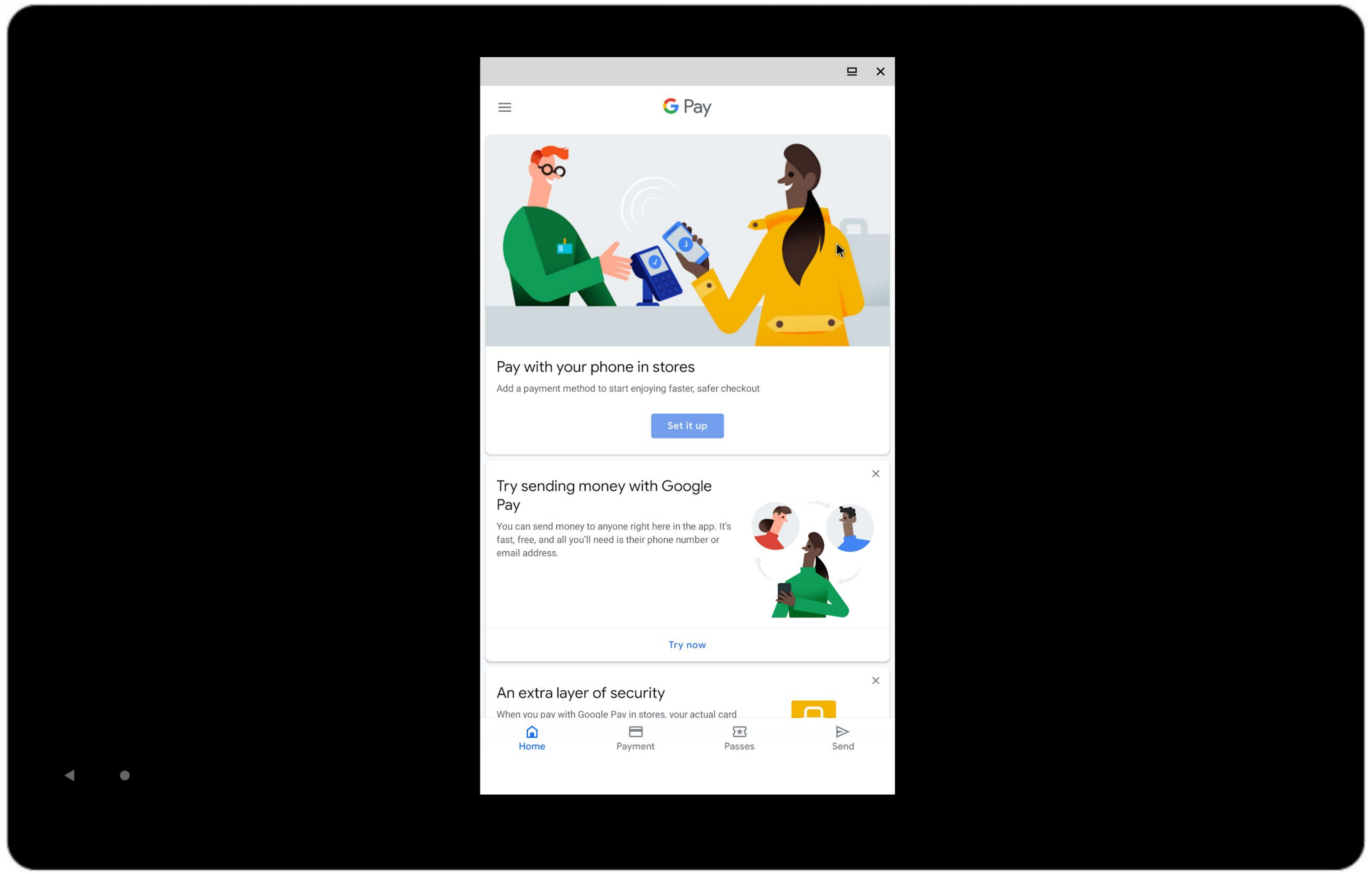
Activities





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Add a payment method to start enjoying faster, safer checkout

Set it up

Try sending money with Google Pay

You can send money to anyone right here in the app. It's fast, free, and all you'll need is their phone number or email address.

Try now

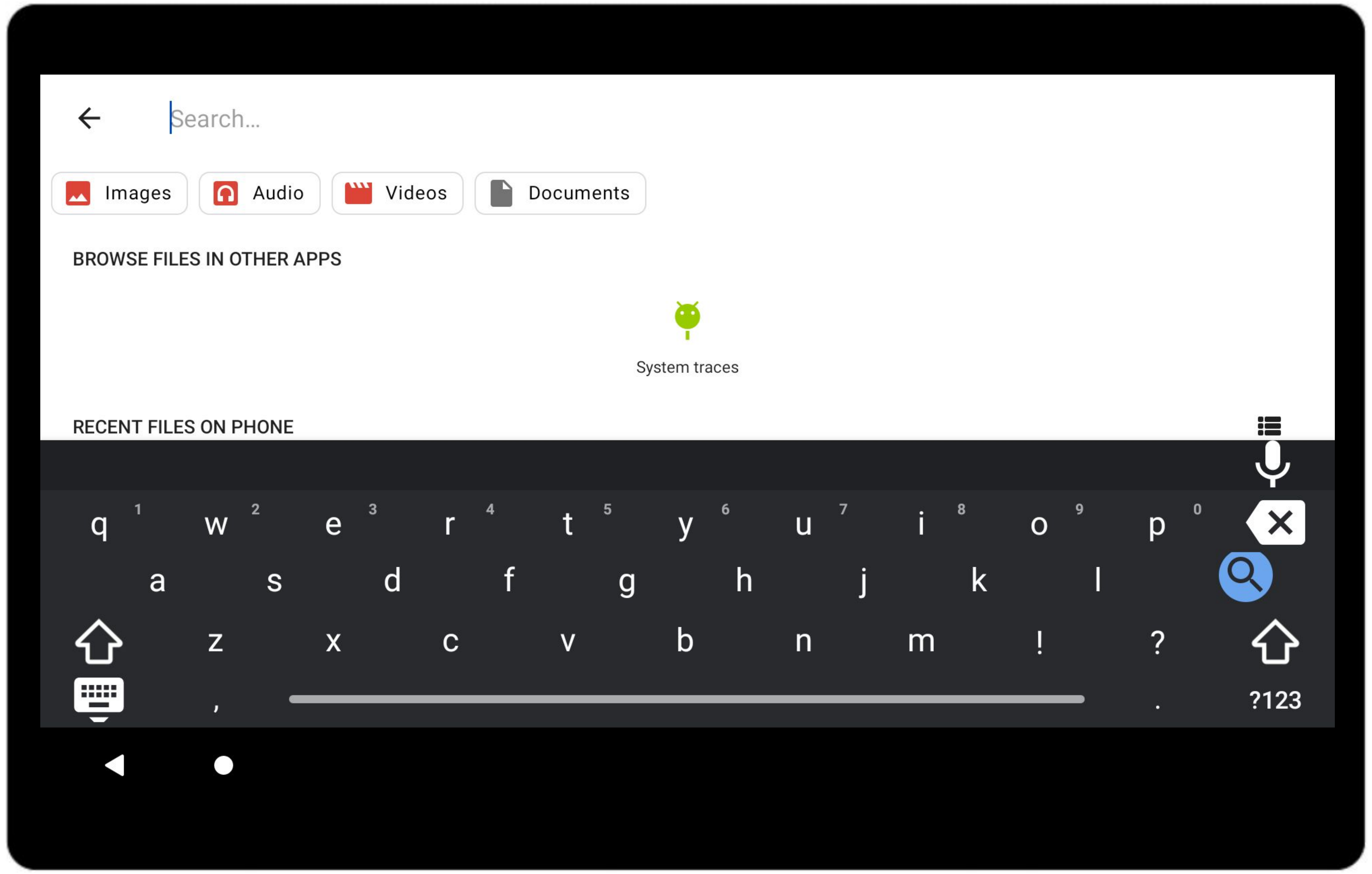
An extra layer of security

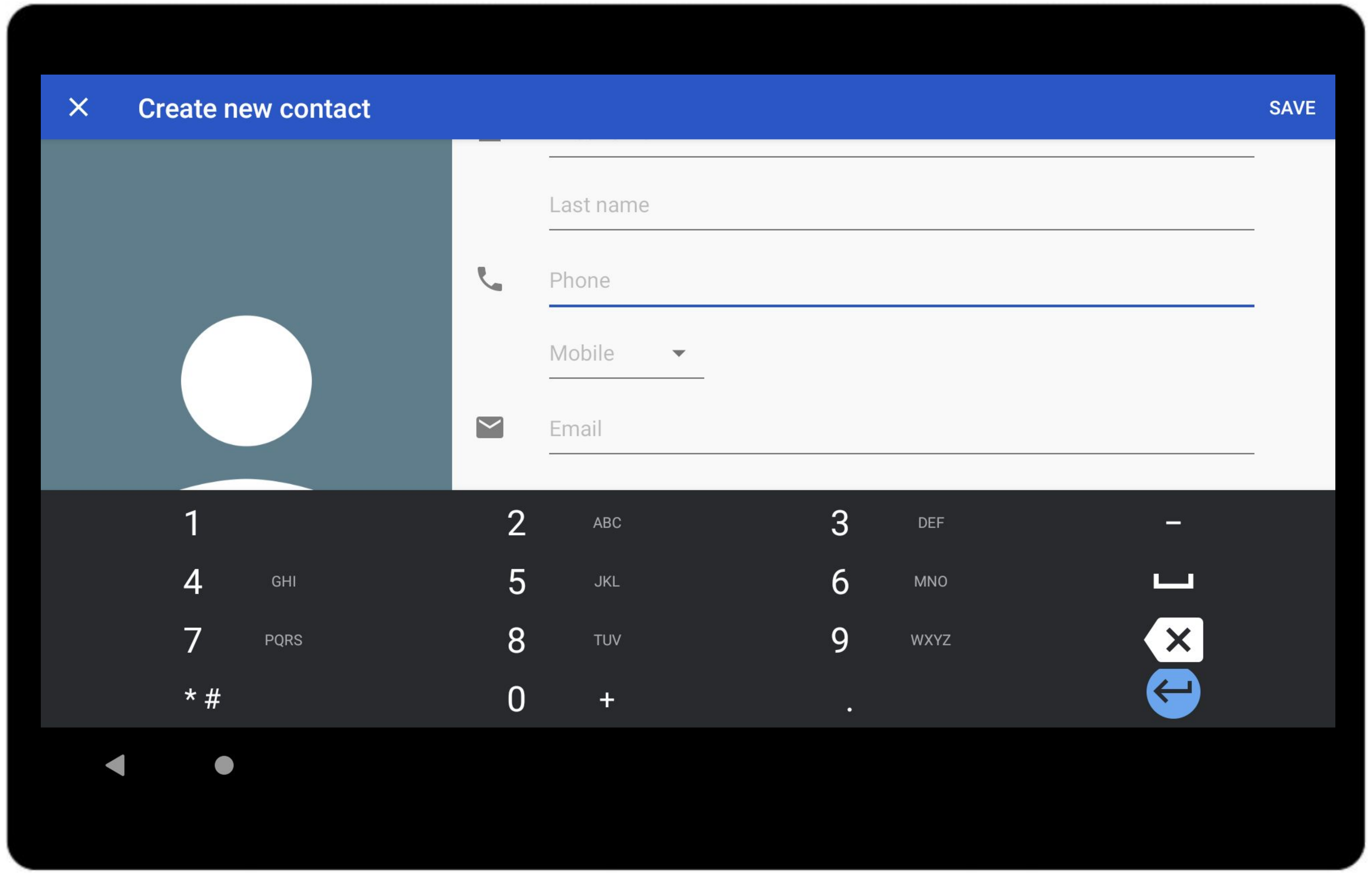
When you pay with Google Pay in stores, your actual card

Multiple screens

- Support for 3+ hardware displays
- Stable display identifiers (by port)
- Display-input association

Multi-focus and multi-IME

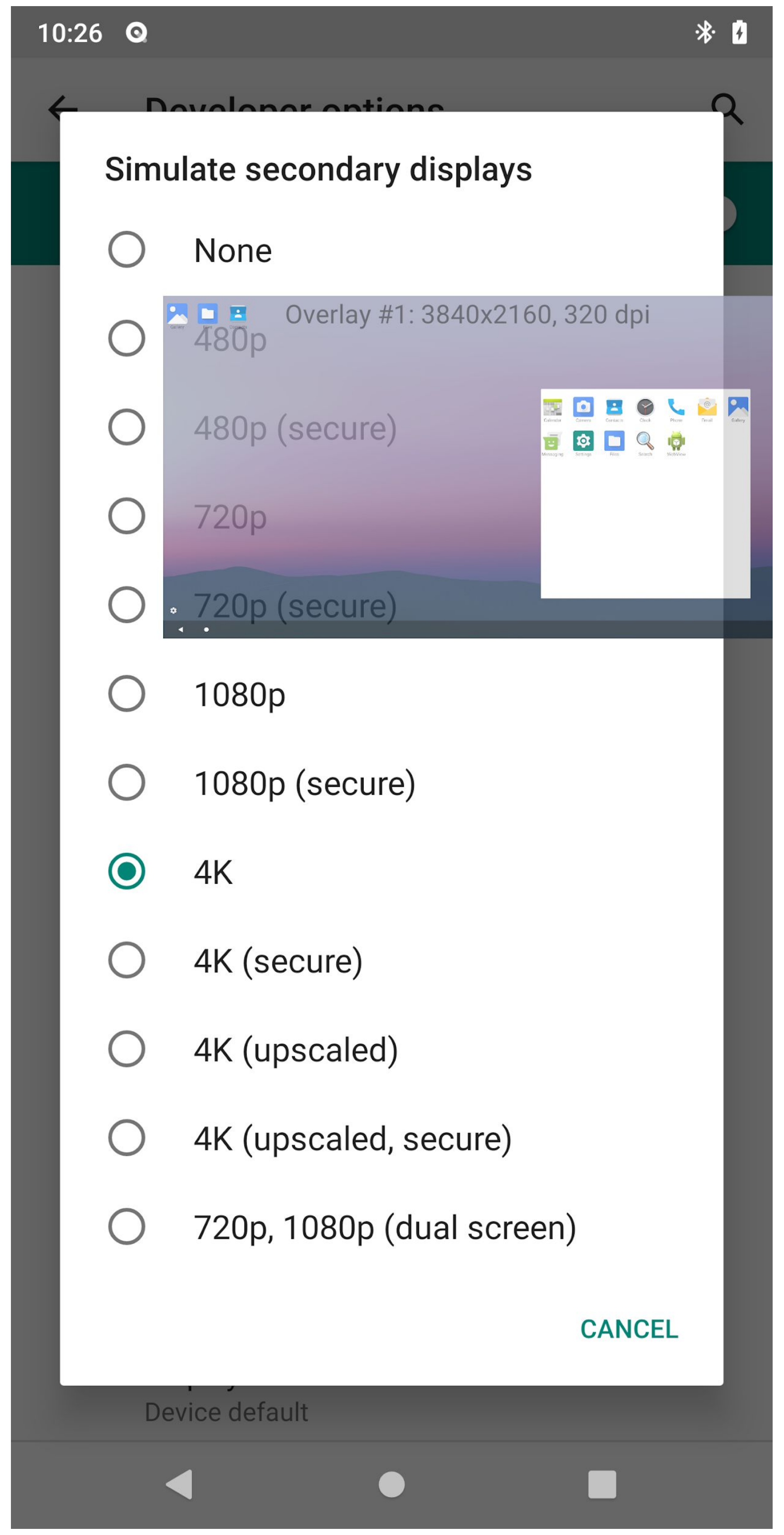




Fixes

- Focus handling
- Activity launches
- Animations
- System insets and immersive mode
- Toasts
- Drag and drop
- Mouse pointer
- Shell commands
- ...

Dev environment



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Developer options

Simulate secondary displays

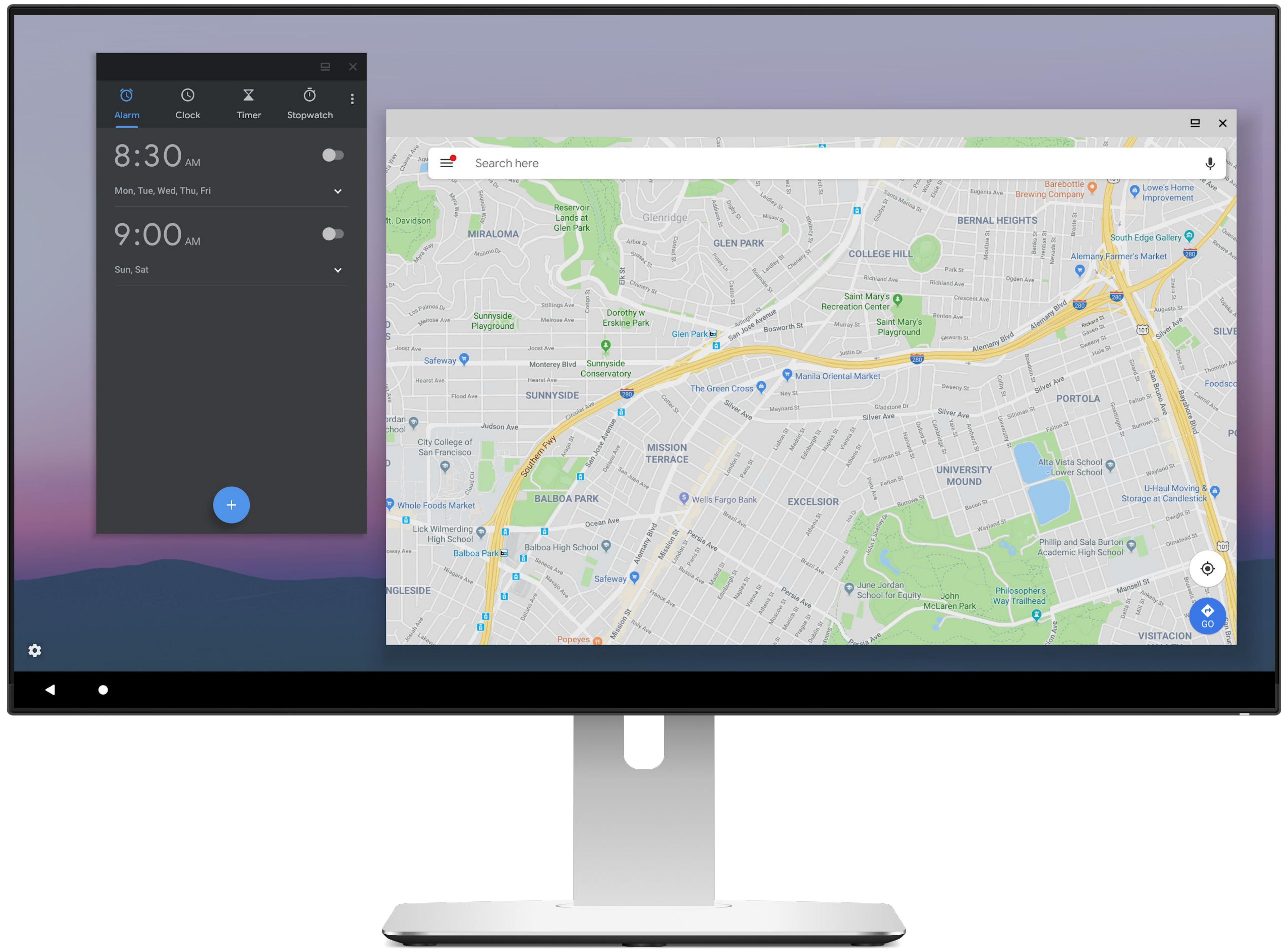
- None
- 480p
- 480p (secure)
- 720p
- 720p (secure)
- 1080p
- 1080p (secure)
- [✓ 4K]
- 4K (secure)
- 4K (upscaled)
- 4K (upscaled, secure)
- 720p, 1080p (dual screen)

Overlay #1: 3840x2160, 320 dpi

CANCEL

Device default

Simulated display



External display

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Goals in Q

Solid foundations for OEMs

Consistent developer experience

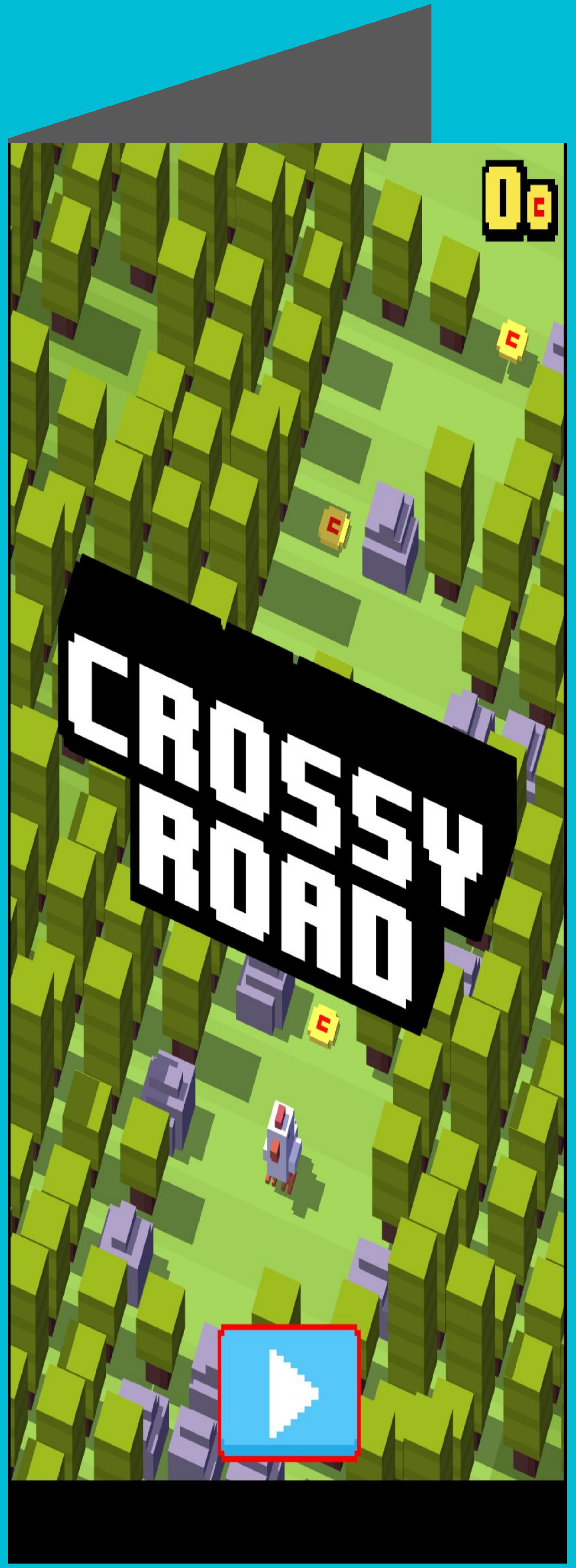
Changes in Q

- Platform changes
  - App continuity for non-resizable activities
  - Multi-resume
  - Support for 1:1 aspect ratio
  - HALs
- Developer experience
  - Foldable AOSP emulator
- UX guidelines

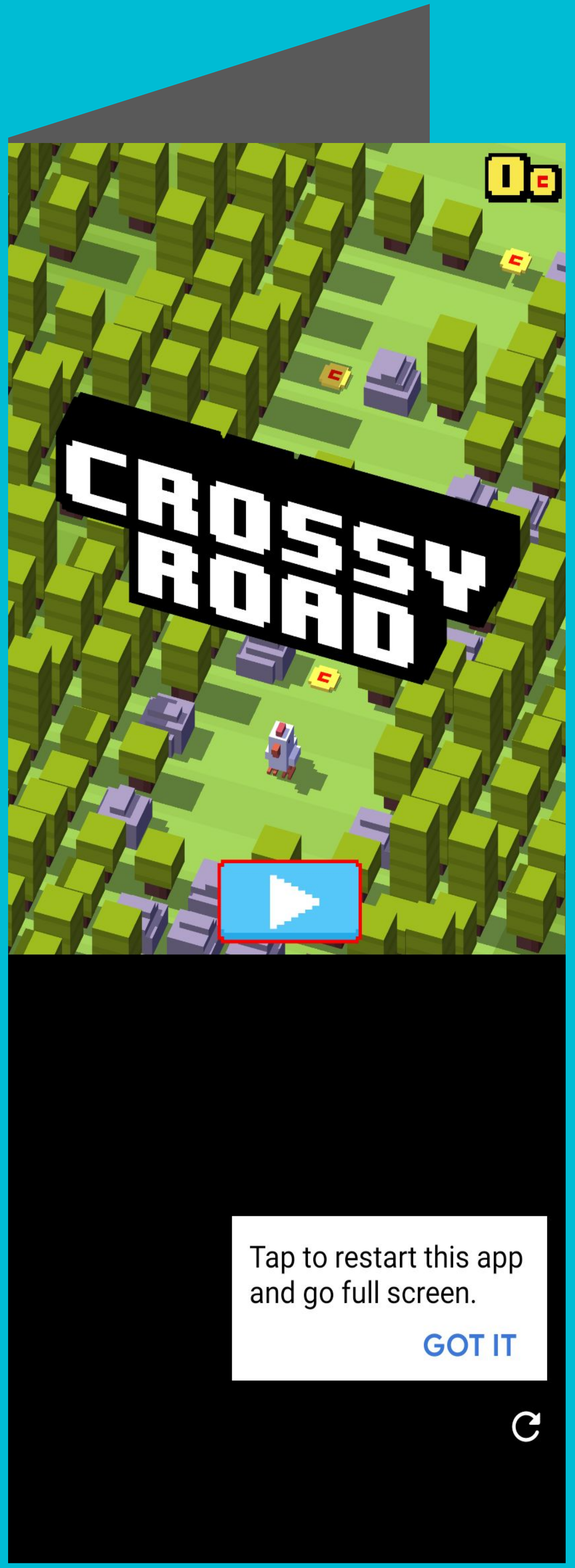
App continuity

Non-resizable activities present **challenges** for new form factors, because some don't properly resize.

New in Q: Some activities are **rescaled** when the display size or density changes, to avoid crashes, distortions and state loss.



Distorted by changing aspect ratio (P)



Scaled down, same aspect ratio (Q)

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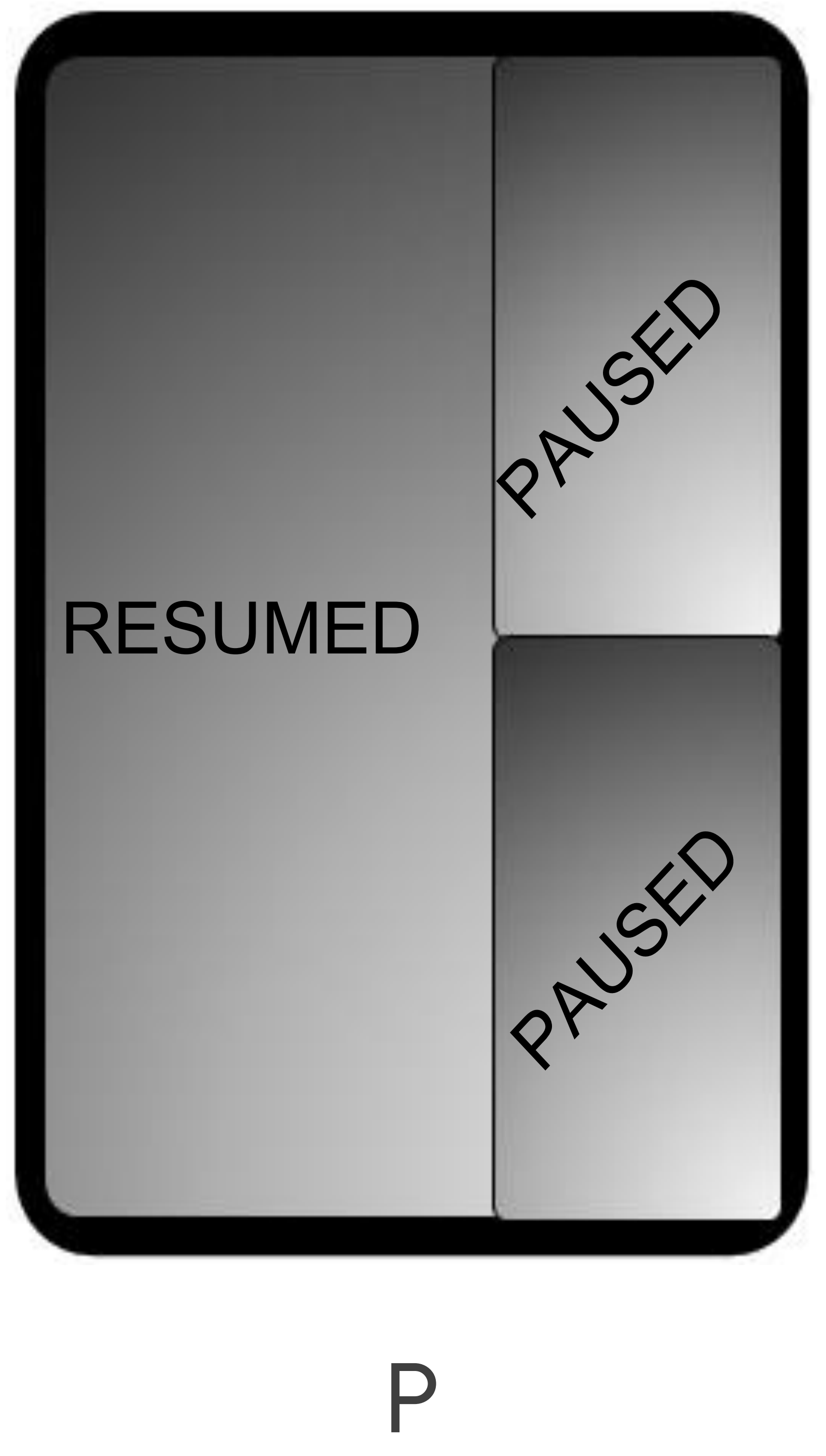
Multi-resume

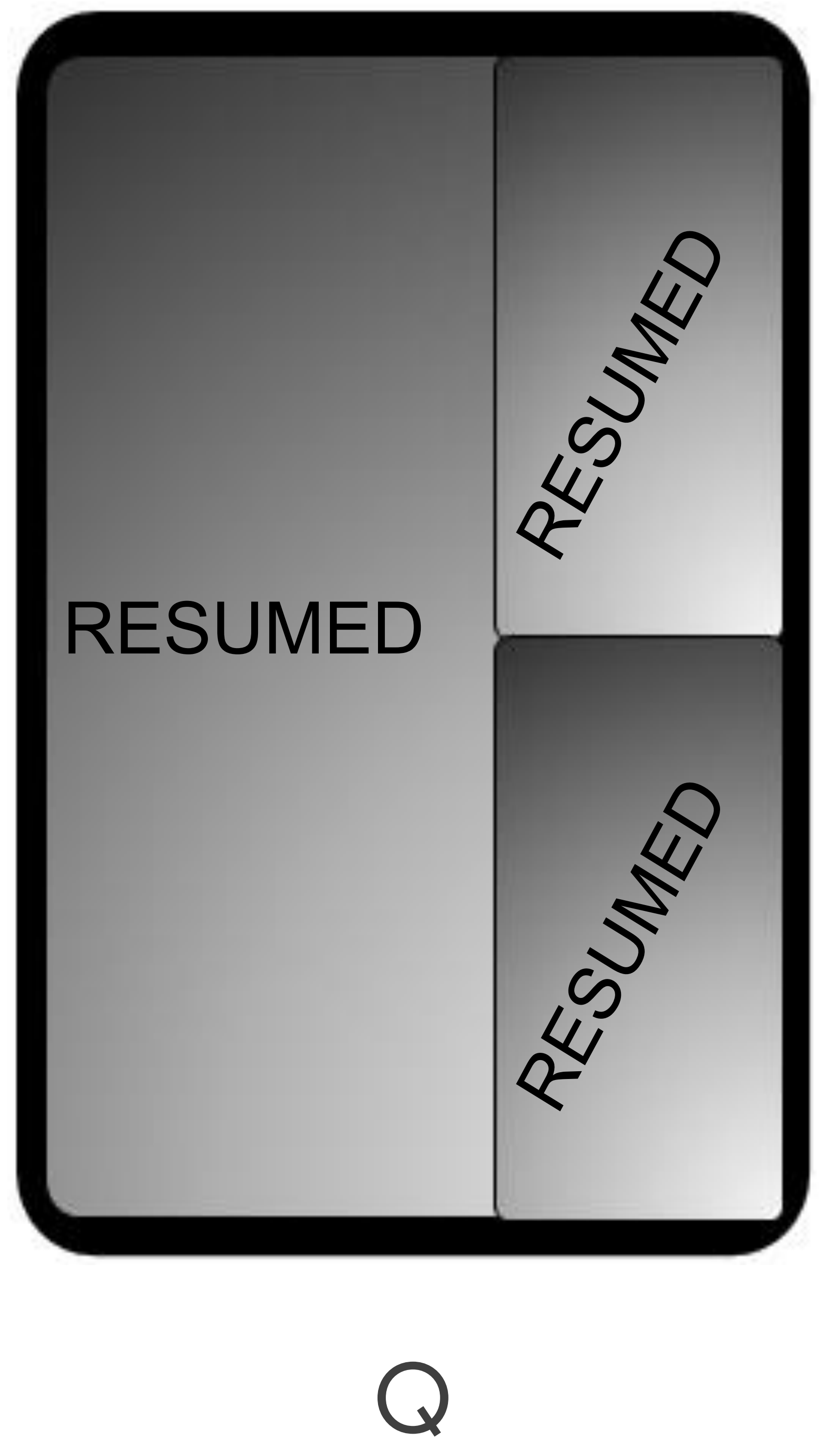
Before Q: At most one activity is resumed at any time

New in Q: In multi-window, all top focusable activities in visible stacks are now in the RESUMED state.

Activity can be resting in the PAUSED state if:

- There is a transparent activity on top
- It's not currently focusable (e.g., PiP)





Multi-resume FAQ

Why?
To improve app compatibility in multi-window modes on large-screen devices.

How does the system manage resources?
Based on the z-order, higher priority is given to activities that the user interacted with last.

What if several apps try to use camera simultaneously?
Apps should handle a camera loss event and unavailable state gracefully.

What if an app *really* needs to know that it's the topmost in the system?

1. Let us know about the use case.
2. `Activity#onTopResumedActivityChanged(boolean onTop)`

How is "top-resumed" different from "focused"?
An activity can be top-resumed, but not have focus. For example, if the notification shade is expanded.

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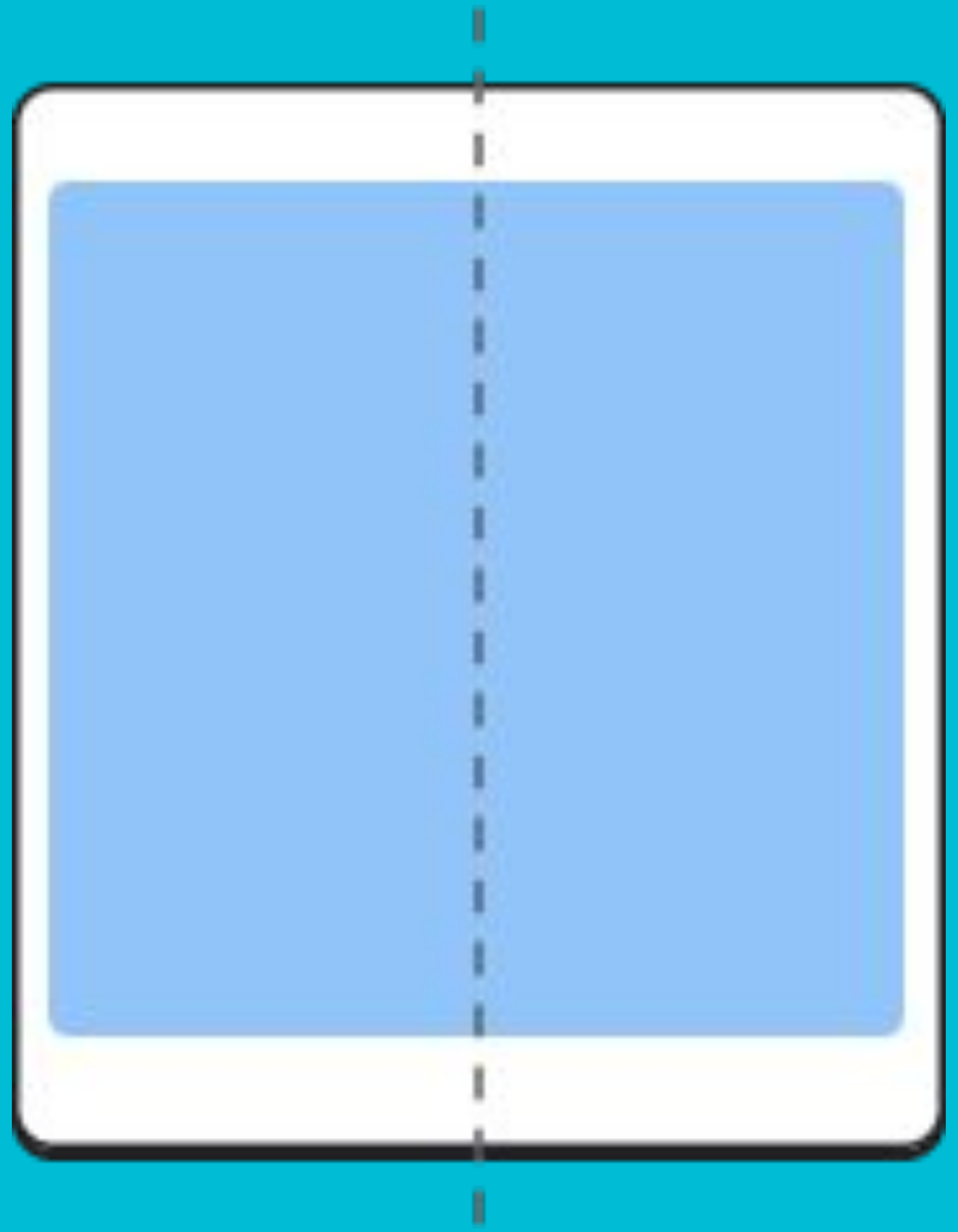
Support for 1:1

New in Q: Aspect ratios down to 1:1 are allowed

New minAspectRatio attribute lets the app declare the minimum aspect ratio it supports

Support for **orientation-locked** devices



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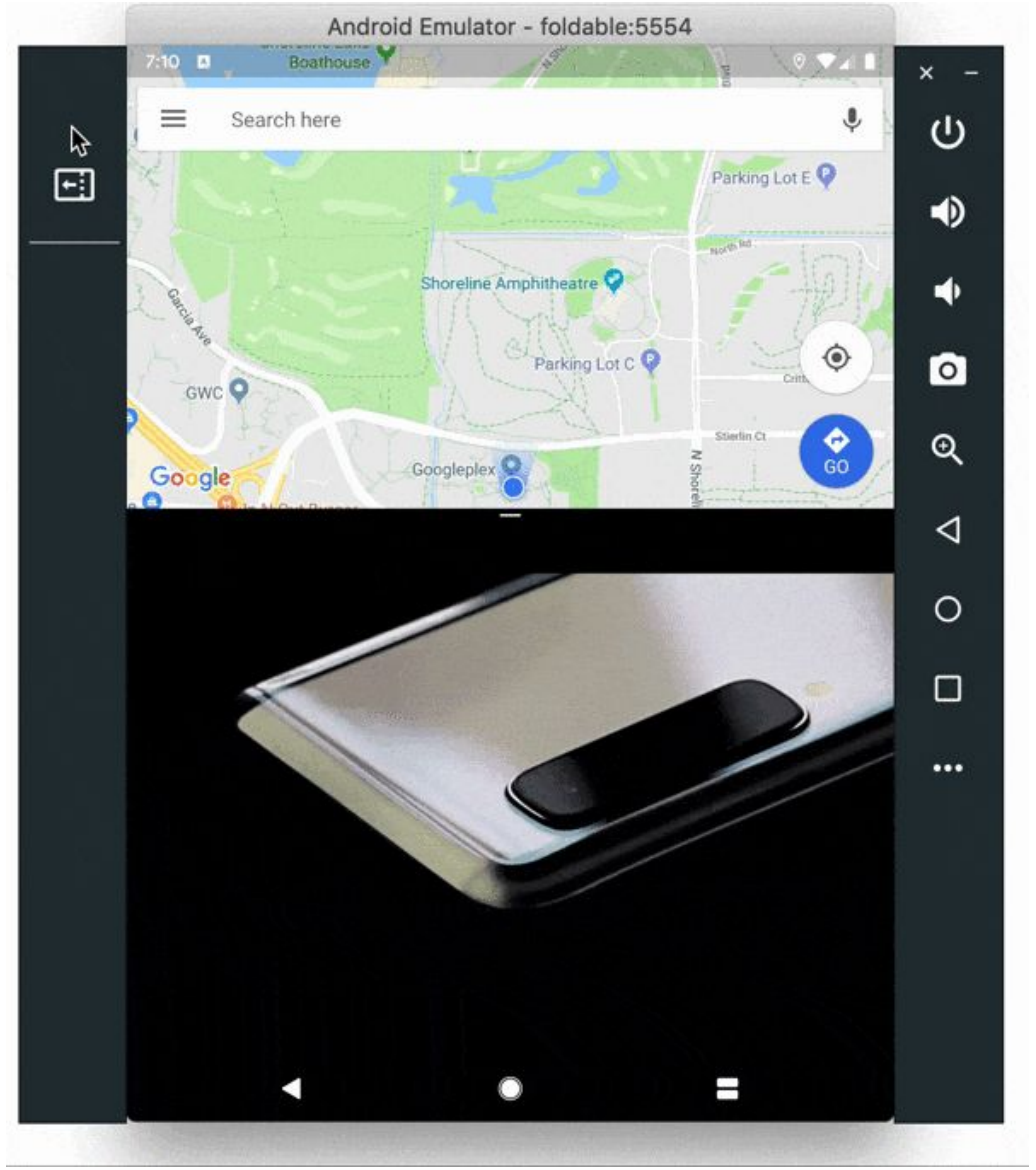
Foldable emulator



New in Q: The AOSP emulator supports emulation of folding devices

Allows developers to **test their apps** in folding scenarios

Lower barrier for app developments

Vanilla Android without special modes and focusing generic app logics

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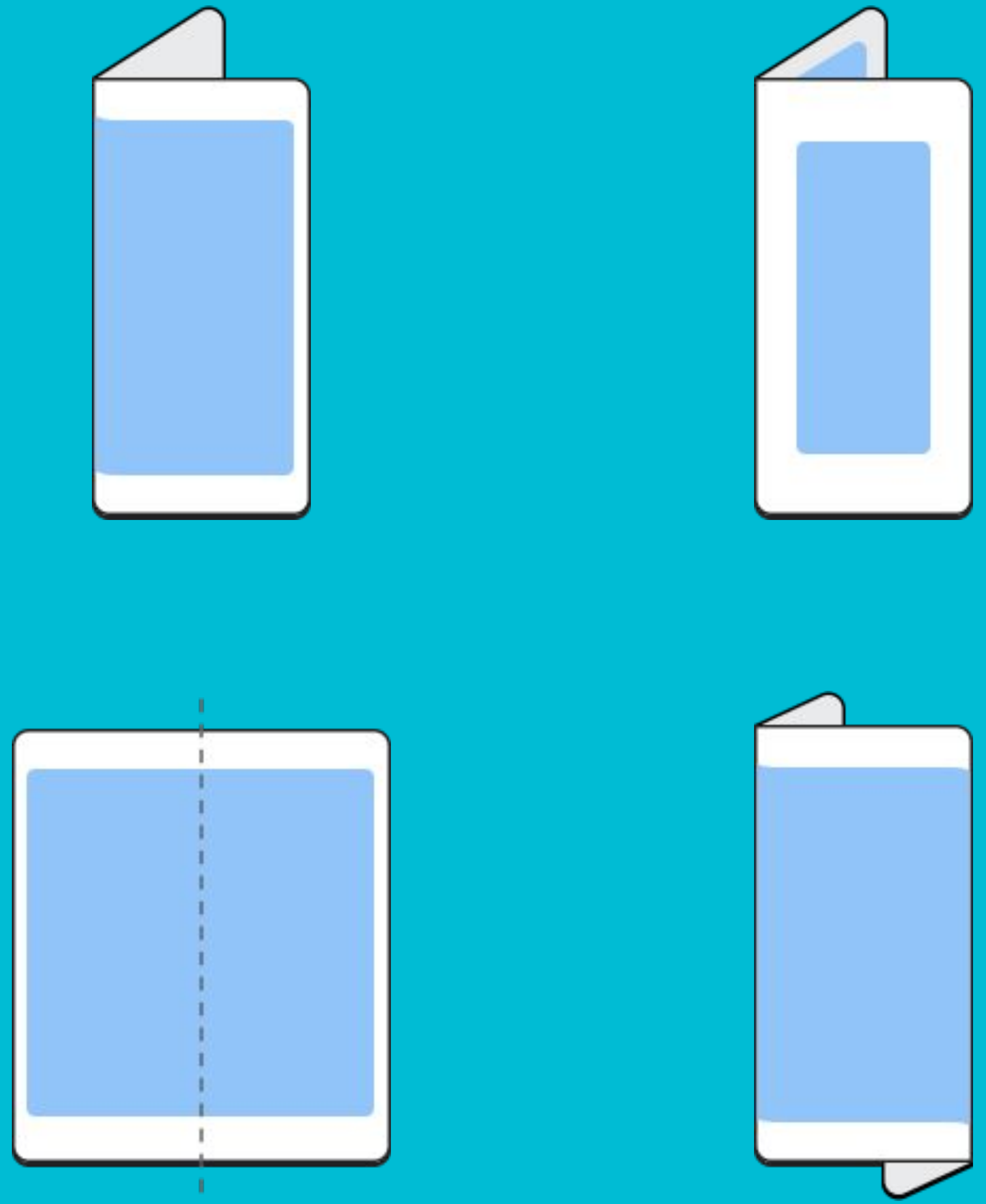
UX guidelines

New in Q: Our UX team is developing guidelines for the best experience on foldable devices

Reach out if you're planning a foldable device!



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Tl;dr

Summary

Android now with multi-display and foldables!

Next steps

Let us know what you’d like to see in R!

If you’re planning to build a foldable or multi-display device, please work with us!

THANK YOU