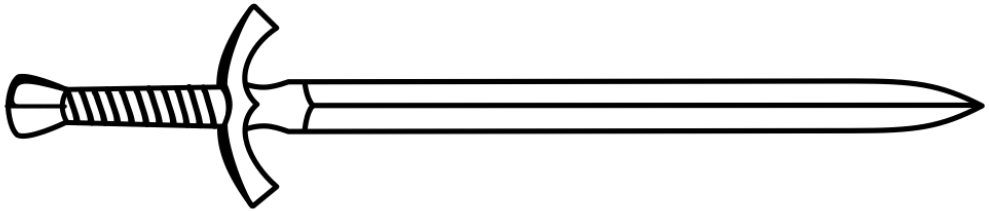
Balancing Speed and Reliability

The Double-Edged Sword of Third-Party Libraries



Ty Smith
tysmith.me
Uber

April 23, 2020
11:22am PST

Uber Incident Manager
More tools
My Incidents
2
Title
Google Maps Causing Crashes In All Mobile Apps
Level & Scope
L5
HIGH

Gergely Orosz Paid
@GergelyOrosz

Holy moly yesterday a Google Maps backend update killed most mobile apps, worldwide for hours.

Here's what we know (thread):

💥Most Android apps using Google Maps crashing
⚠️ Most iOS apps using Google Maps often crashing
🍔🚙🛒 Most gig economy apps were unusable

(1/3)

1:54 AM · Apr 24, 2020

34 Retweets **12** Quotes **132** Likes **8** Bookmarks

Justin Stanley 👨‍🔧
@JStheoriginal

🤯 @googlemaps just started crashing in every single app that uses it (including the Google Maps app).

1:08 PM · Apr 23, 2020

48 Retweets **23** Quotes **120** Likes **1** Bookmark

Ty Smith Verified
@tsmith

Google Maps SDK is crashing for everyone in pretty much all apps. Hope you didn't need to go anywhere.

1:20 PM · Apr 23, 2020

View Tweet analytics

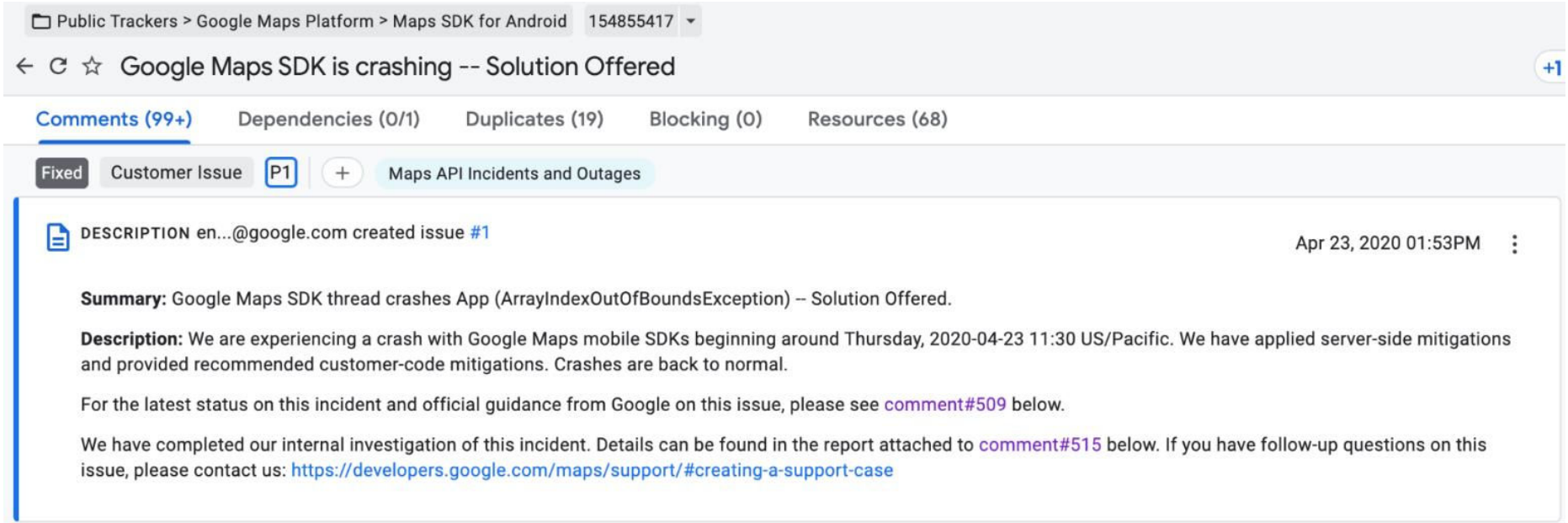
76 Retweets **18** Quotes **338** Likes **2** Bookmarks

koush Verified
@koush

Google Maps SDK is crashing in the tens of thousands of apps that use it, on iOS and Android. And I gotta say, this is honestly the best time for this sort of thing to happen, because no one can go anywhere anyways. issuetracker.google.com/issues/1548554...

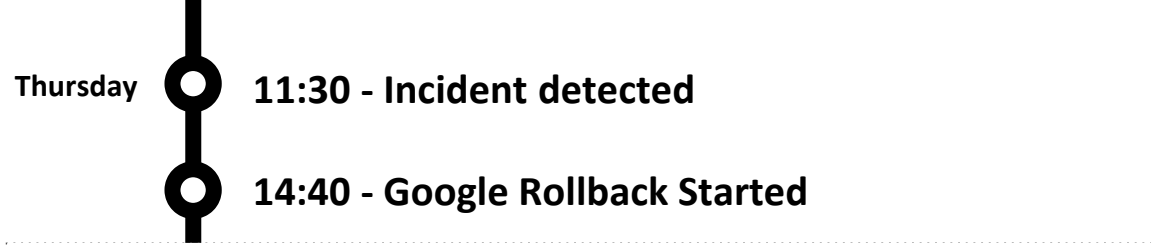
6:12 PM · Apr 23, 2020

5 Retweets **37** Likes **3** Bookmarks



issuetracker.google.com/issues/154855417

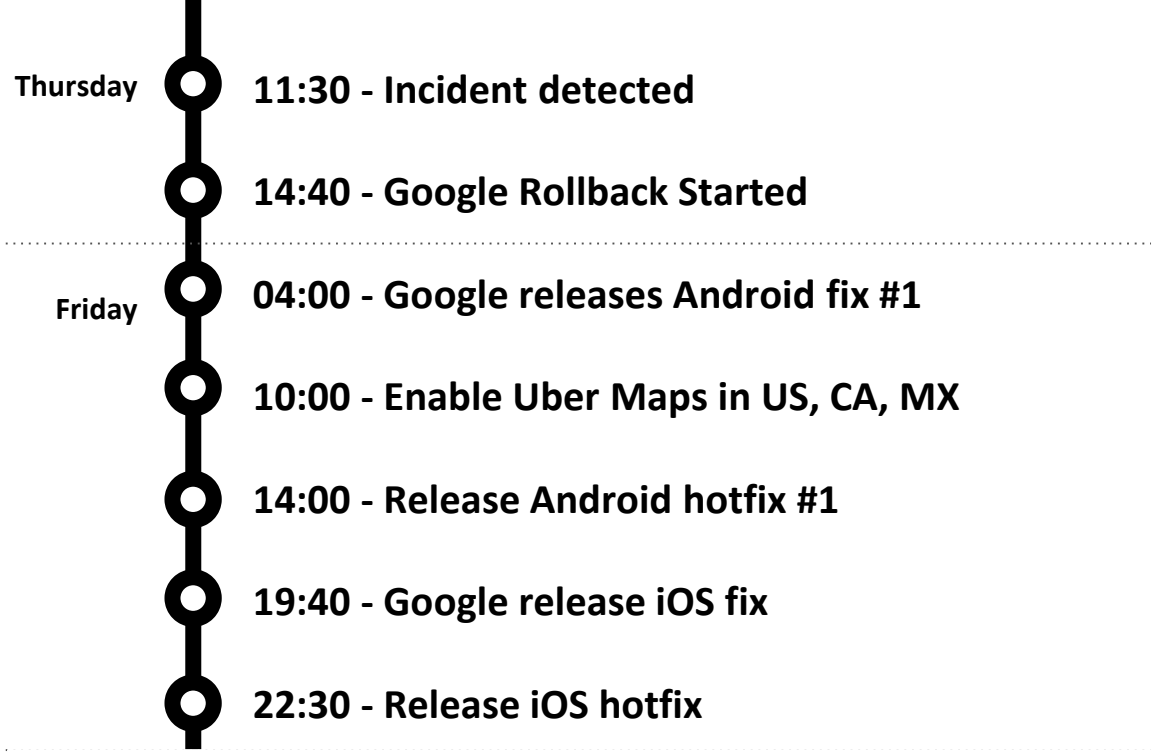
Outage Timeline



4 day outage

- Several rotating incident commanders
- Teams from every org

Outage Timeline



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Outage Timeline

4 day outage

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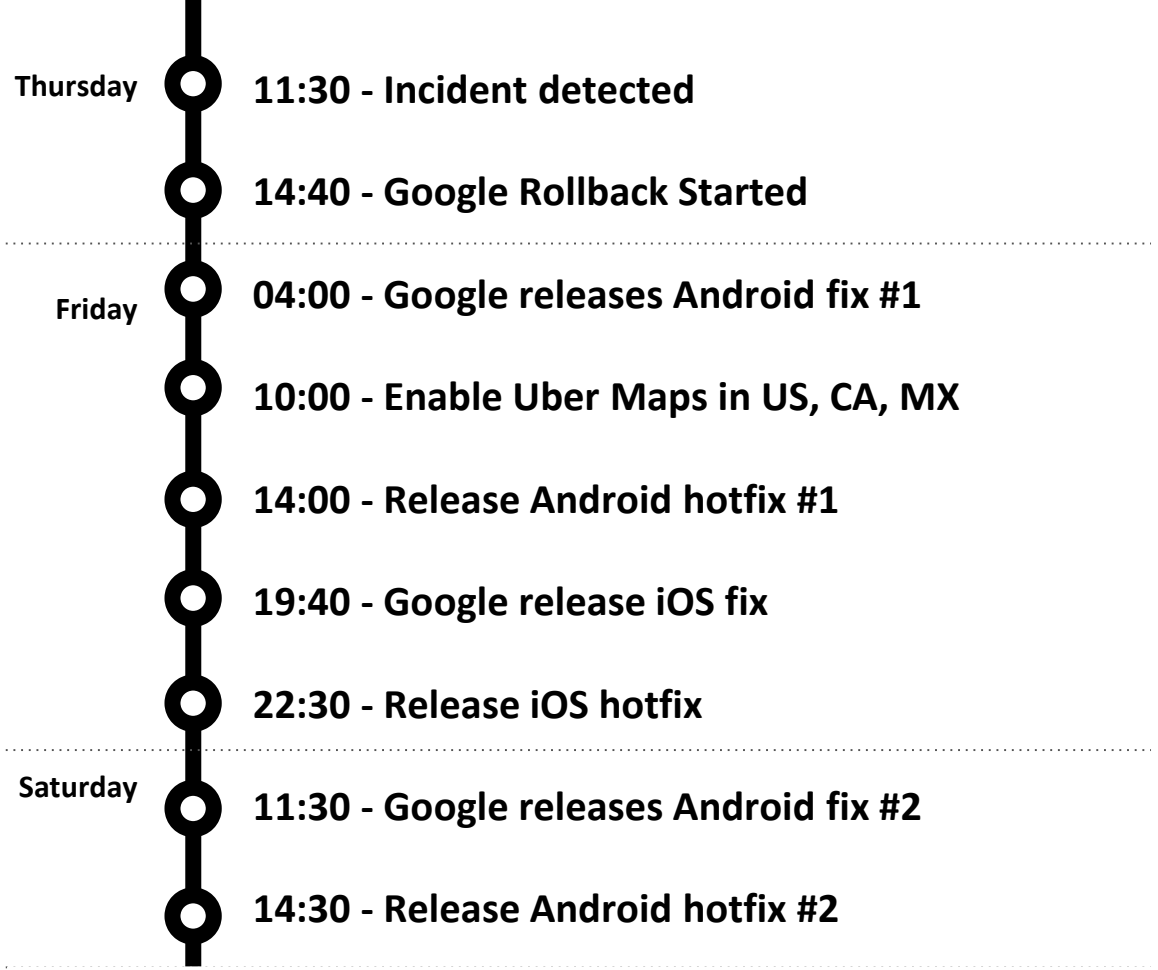

Outage Timeline

4 day outage

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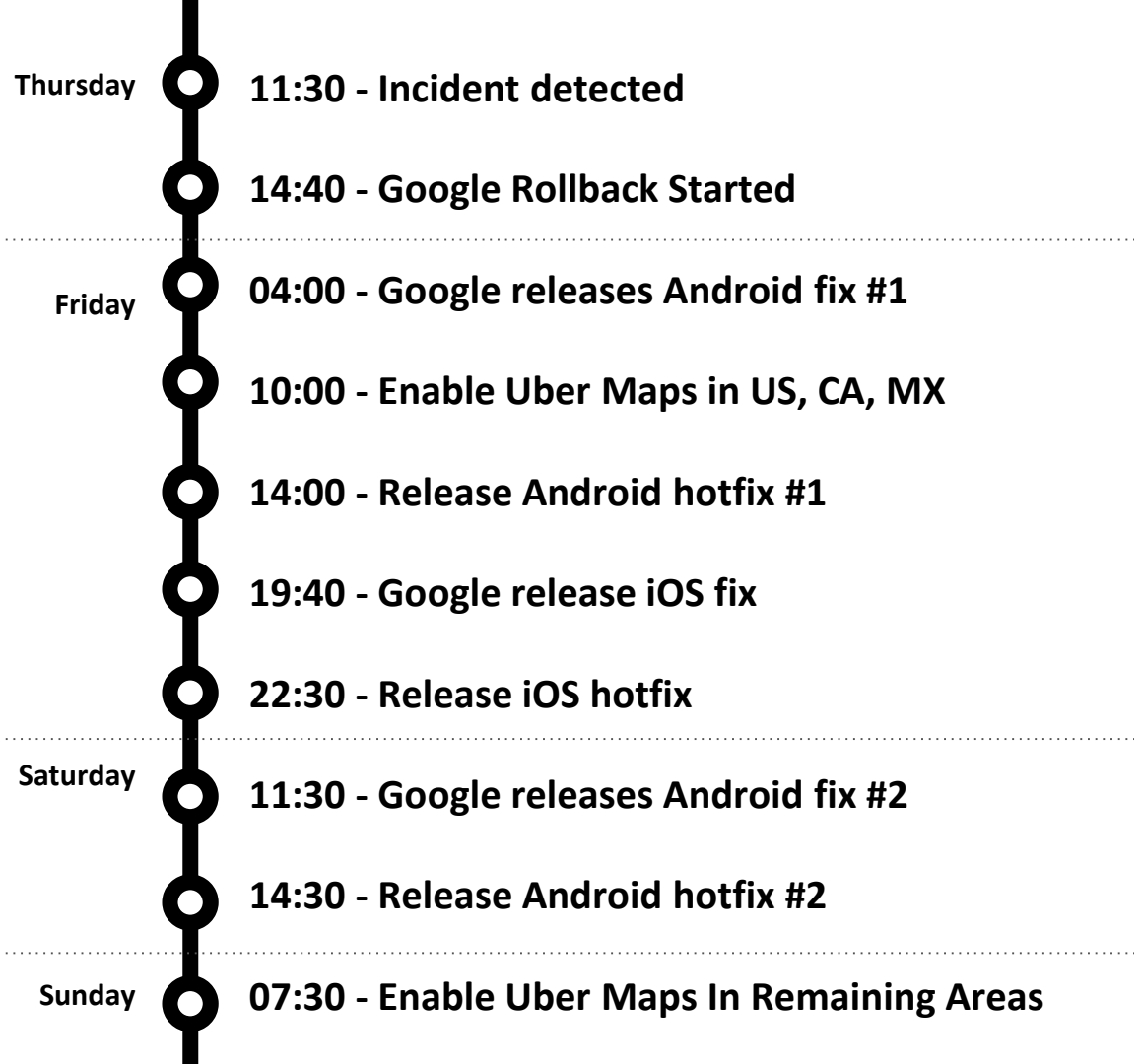
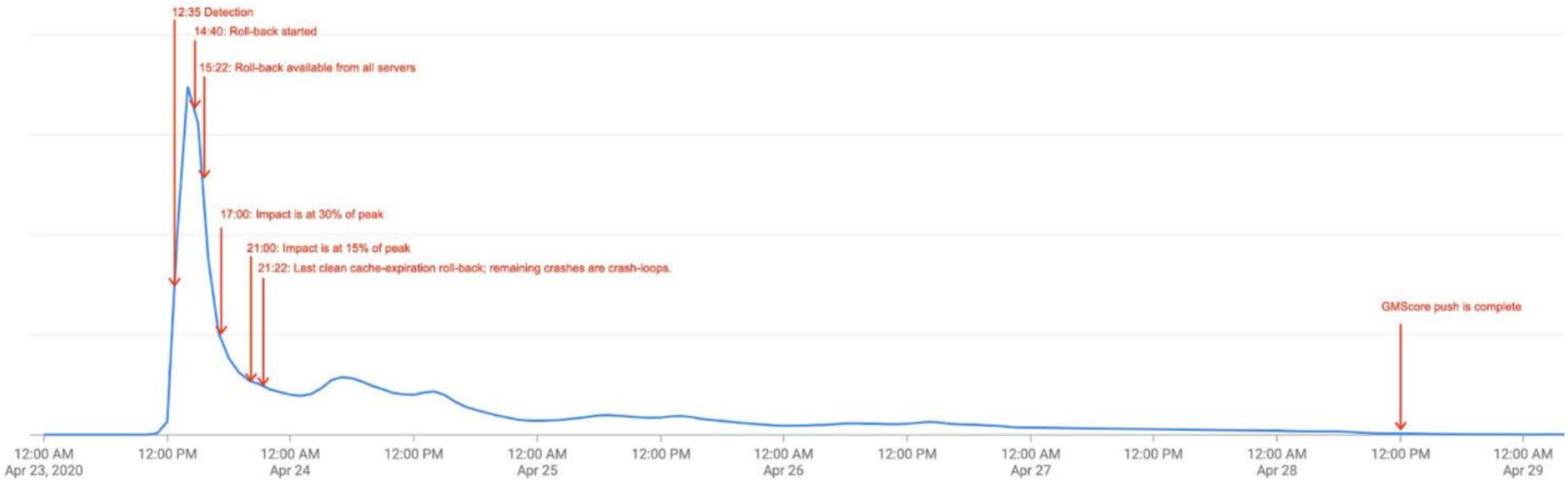




issuetracker.google.com/issues/154855417#comment515

Impact

- Largest mobile outage in Uber’s history
- Millions of users blocked
- Millions of $ lost
- Thousands of hours of lost employee productivity

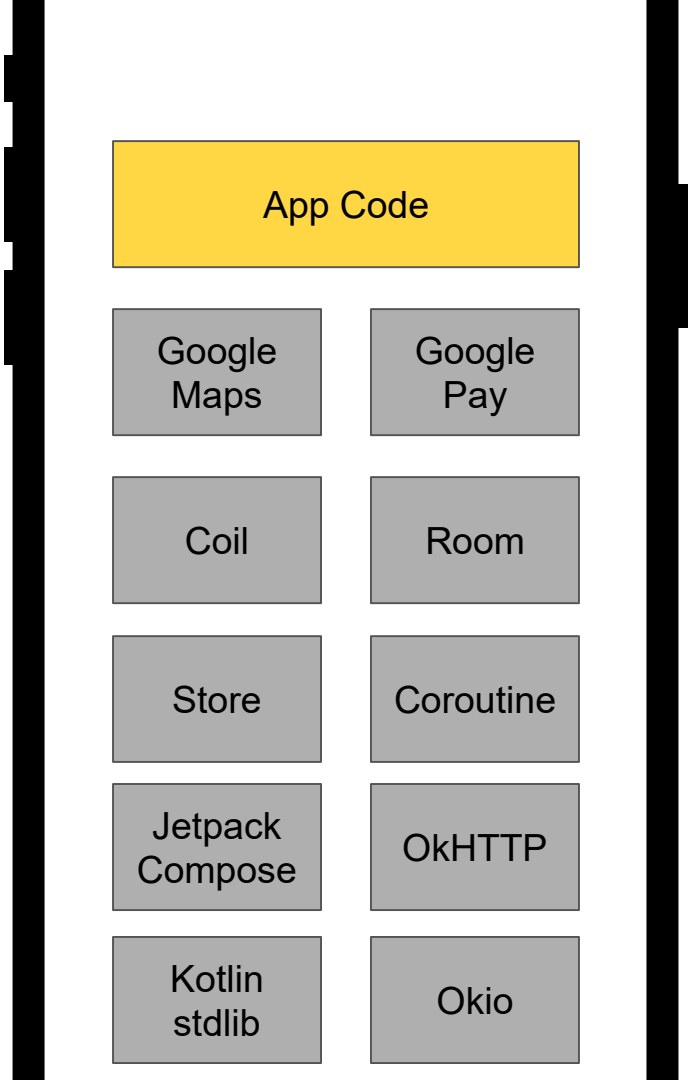
Aftermath

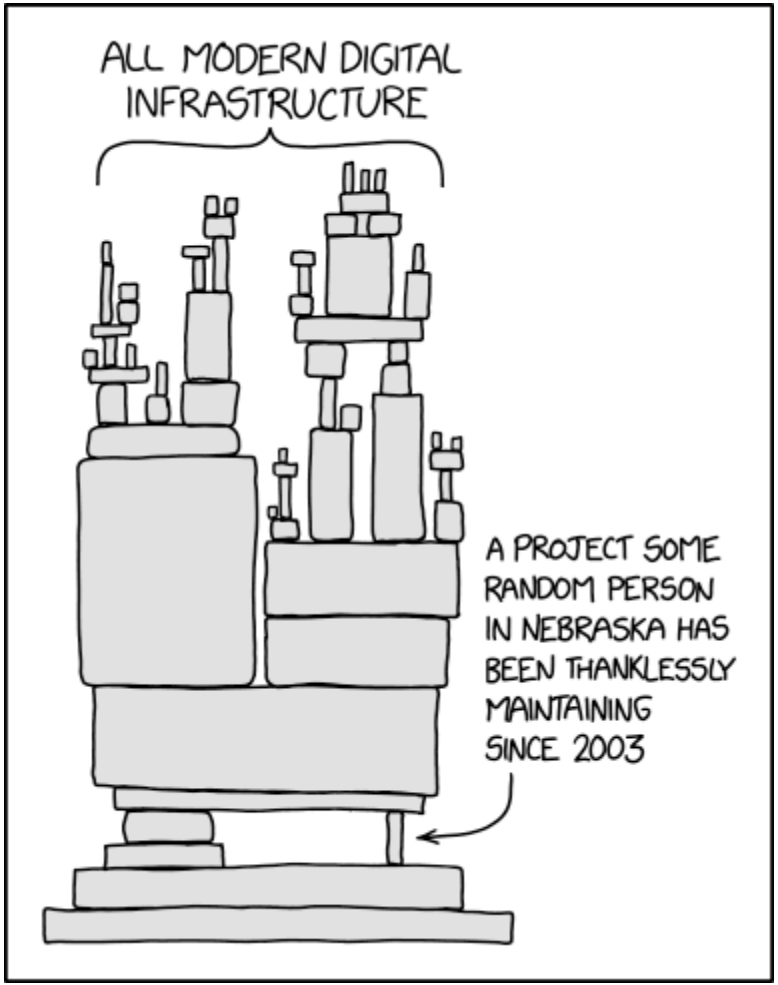
- Executive review of postmortem
- New Intercompany legal agreements
- Improved library governance process
- Improved crash protection
- Improved crash recovery

Third Party Code

Third Party Code

- ✅ Modern platform
- ✅ Available Features
- ✅ Faster development
- ✅ Free maintenance and updates


App Code
Google Maps
Google Pay
Coil
Room
Store
Coroutine
Jetpack Compose
OkHTTP
Kotlin stdlib
Okio

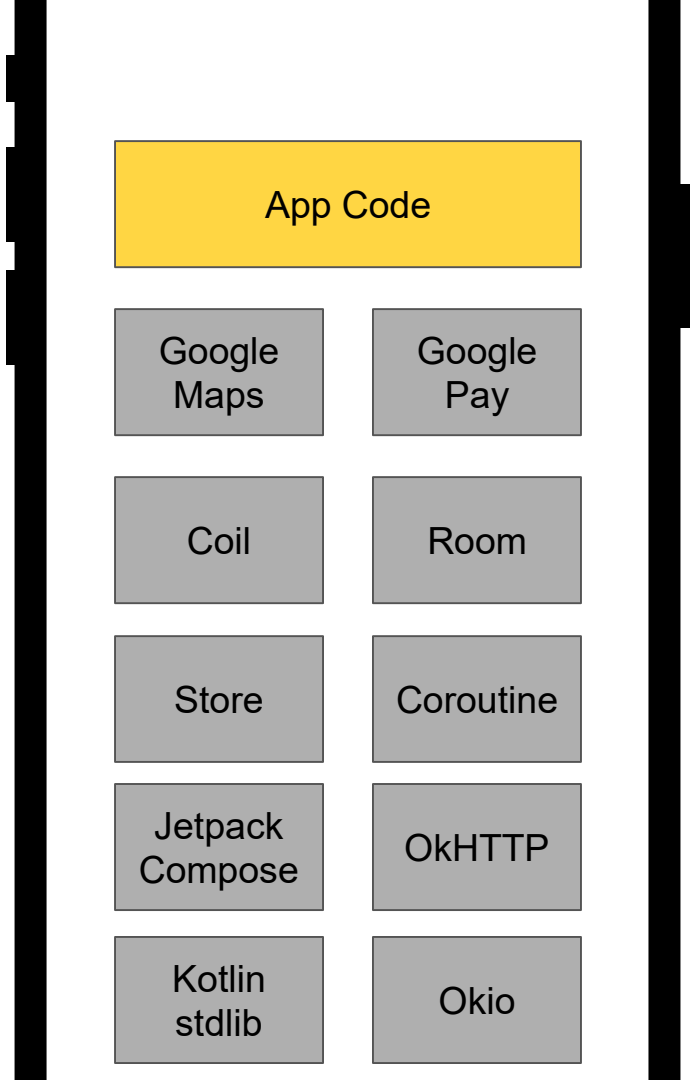


xkcd.com/2347

Third Party Code

- ✅ Faster development
- ✅ Available features
- ✅ Modern platform
- ✅ Free maintenance and updates

- ❌ Crashes
- ❌ Security Vulnerabilities
- ❌ Government Compliance
- ❌ Legal Risk
- ❌ Implicit Permissioning
- ❌ Performance Degradation
- ❌ Memory Leaks
- ❌ Transitive Dependency Conflicts
- ❌ Less control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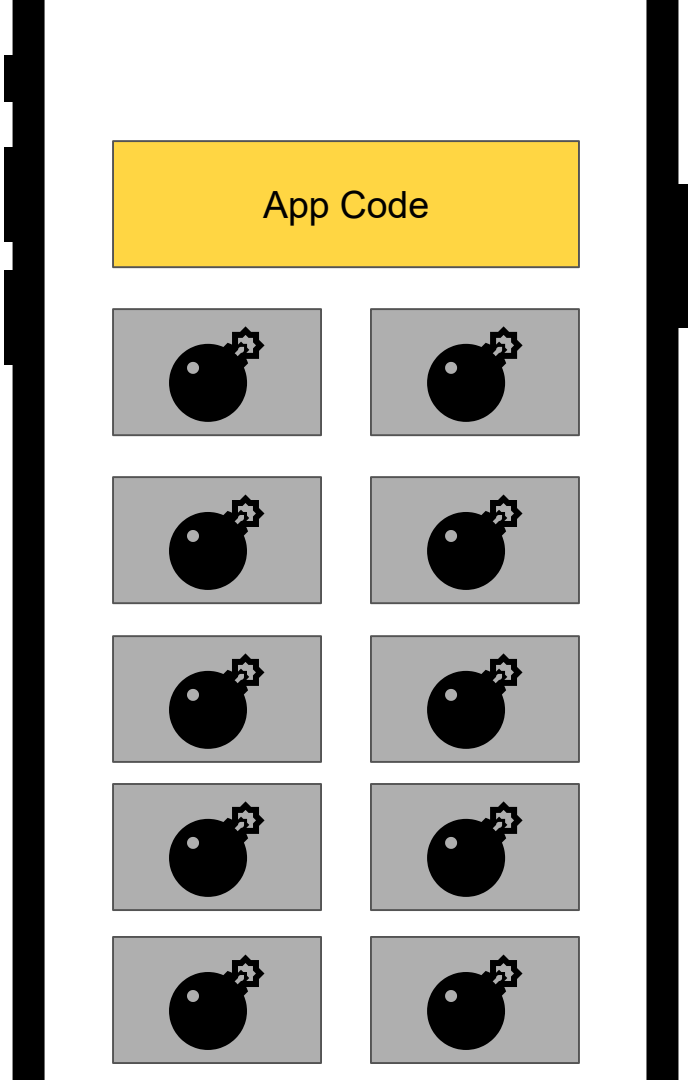
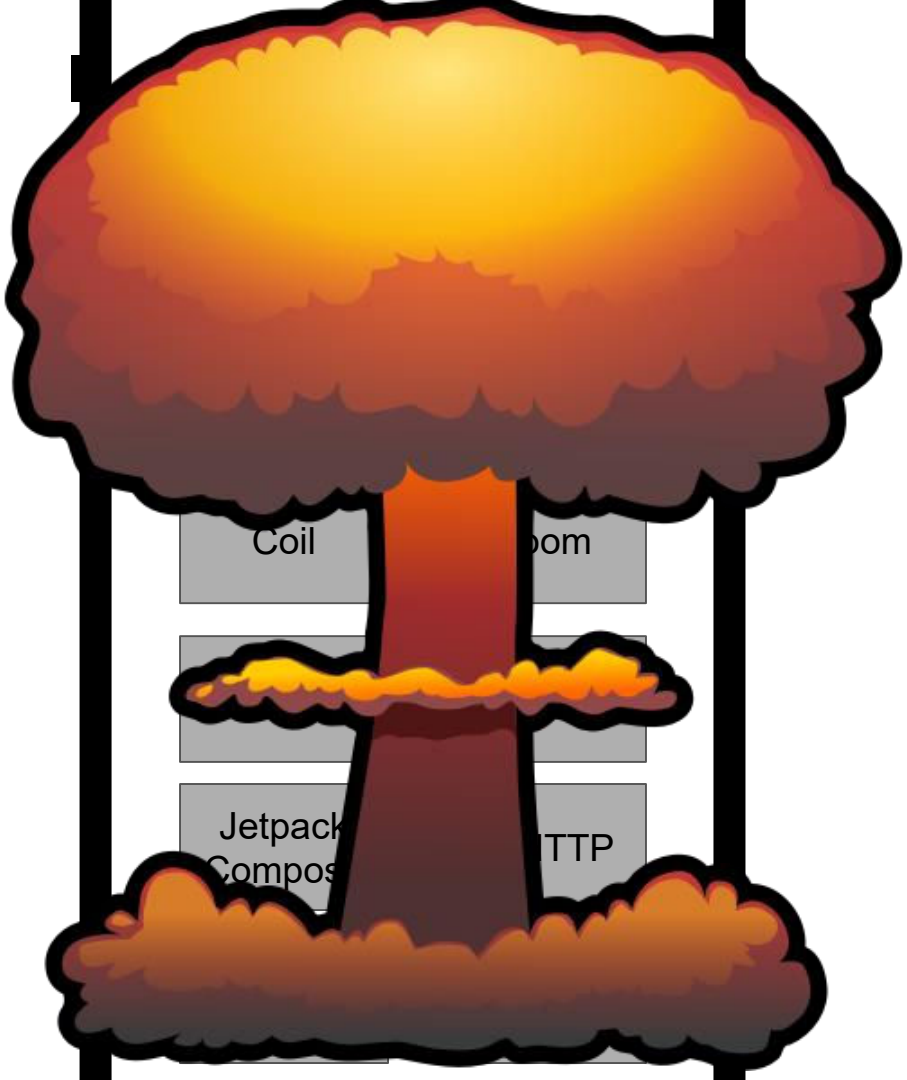

App Code


Coil
om
Jetpack
Compos
TTP

-> Library Governance
-> Reliability Defense
-> Crash Recovery

Library Governance

“The process of managing and controlling the use of software libraries, including acquisition, deployment, use, and maintenance.” - Bard

Seed startup

No policy. Use what's the fastest.

Small scale-up

Tech lead or sr eng best judgement. Bias towards speed.

Medium Sized Co

Bespoke. "If you want to add a new library, come talk to Mobile Platform"

Large Enterprise

Well defined set of criteria and a responsible team for approval.

- Define business priorities
- Define library requirements
- Define governance body
- Define review process
- Define exception process
- Define upgrade process

- Speed to market
- Developer velocity & staffing
- App quality and reliability
- Long term foundation & scale

Transportation as reliable as running water

1. App quality and reliability
2. Long term foundation/scale
3. Speed to market
4. Developer velocity & staffing

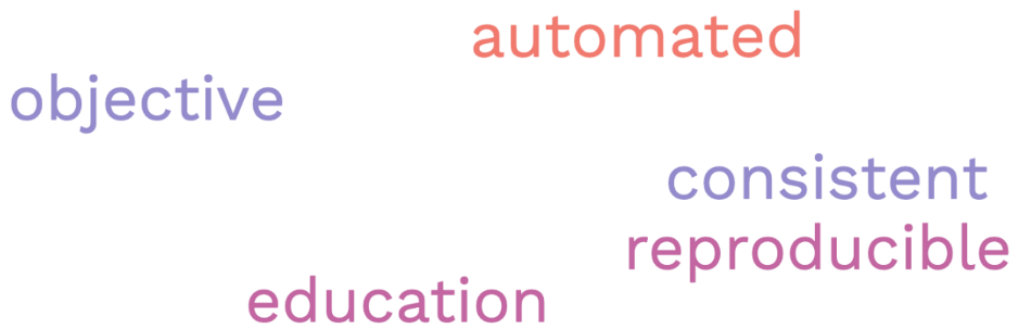
A non-exhaustive list

Third Party Library Requirements

- License
- Secure
- Private
- Stable
- Mature
- Maintained

- Small
- Industry Standard
- Testable
- High Quality
- Owned internally
- Category (Platform/Feature)

Governance Body


automated
objective
consistent
reproducible
education

- Greenkeeping
- Similar risk as new libraries
- Intentional Updates
- Organizational Cost

Examples

Coil ✅

- ✅ Appropriate license (Apache 2.0)
- ✅ Compelling Business Use- case
- ✅ No additional permissions needed
- ✅ Low binary size impact < 50kb
- ✅ Low method count < 200
- ✅ Transitive Deps all in use or reasonable.
- ✅ Standard for Compose image loading
- ✅ Reasonable API that can be flagged

- ✅ No known vulnerabilities
- ✅ Highly used by peer companies
- ✅ Good tests
- ✅ Stable
- ✅ No outside servers or dynamic behavior
- ✅ Regularly maintained
- ✅ No unexpected network or battery effect
- ✅ Reasonable memory profile

Facebook Auth SDK

- ✅ Compelling Business Use-case
- ✅ Security Checks Pass
- ✅ Well Tested

- ❌ Proprietary License
- ❌ Outside infrastructure and APIs
- ❌ Complex Client Side Code
- ❌ Web alternative is feasible

App suddenly crashing on startup in production due to FBSDKRestrictiveDataFilterManager.m #1427

Closed | 4 of 5 tasks | **nicklocking** opened this issue on Jul 9, 2020 · 130 comments

Twilio Video SDK ❌

- ✅ Compelling Business Use-case

- ❎ Closed source
- ❎ High Binary Size > 5 mb
- ❎ Alternative costly

Twilio Video SDK

- ☑ Closed source -> **Met with Twilio & Organized clean-room analysis**
- ☑ High Binary Size > 5mb -> **Dynamic Feature Module + Feature Flag**

Defense

Life of a commit

Week 1

Active Development

Week 2

1. Build Train Release
2. Release Testing
3. Employee rollout 0 -> 100%
4. Beta rollout 0 -> 100%

Week 3

Prod rollout 0 -> 100%
40% adoption

Week 4

65% adoption

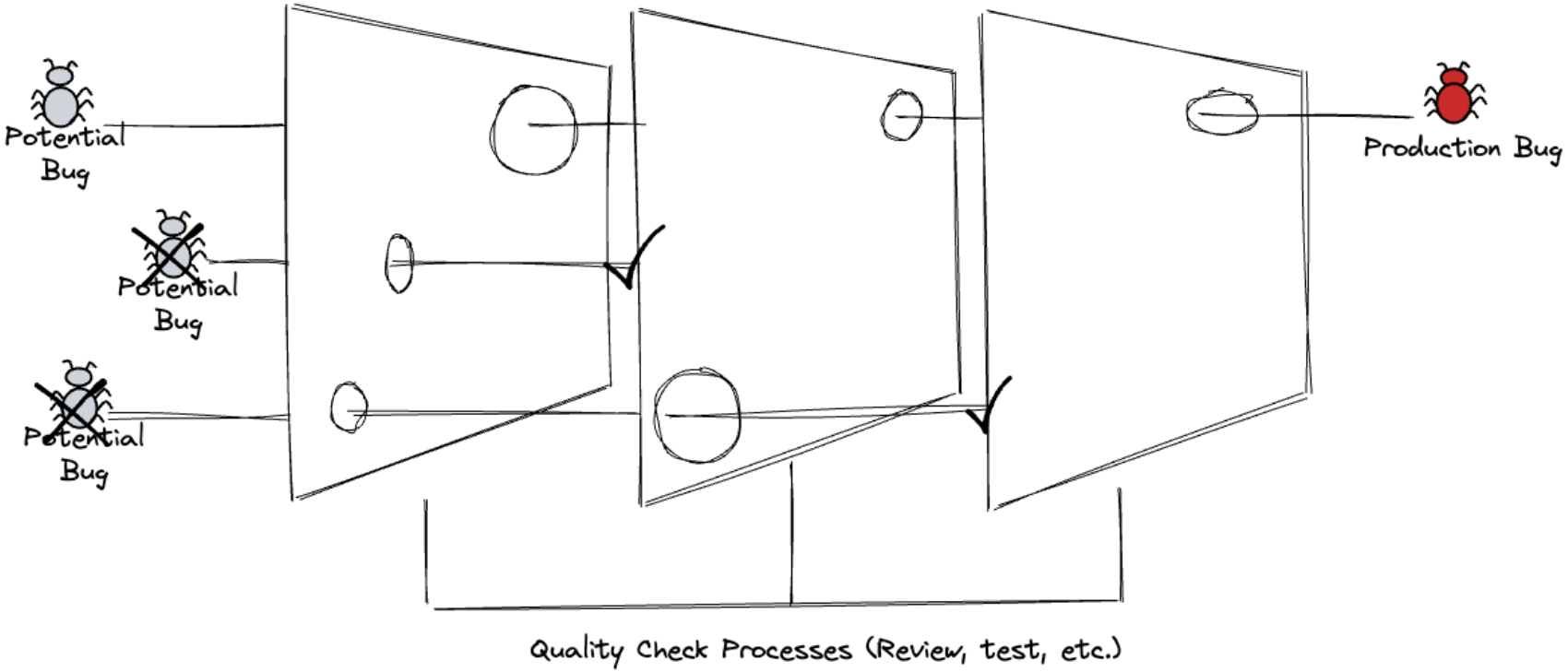
Week 5

80% adoption

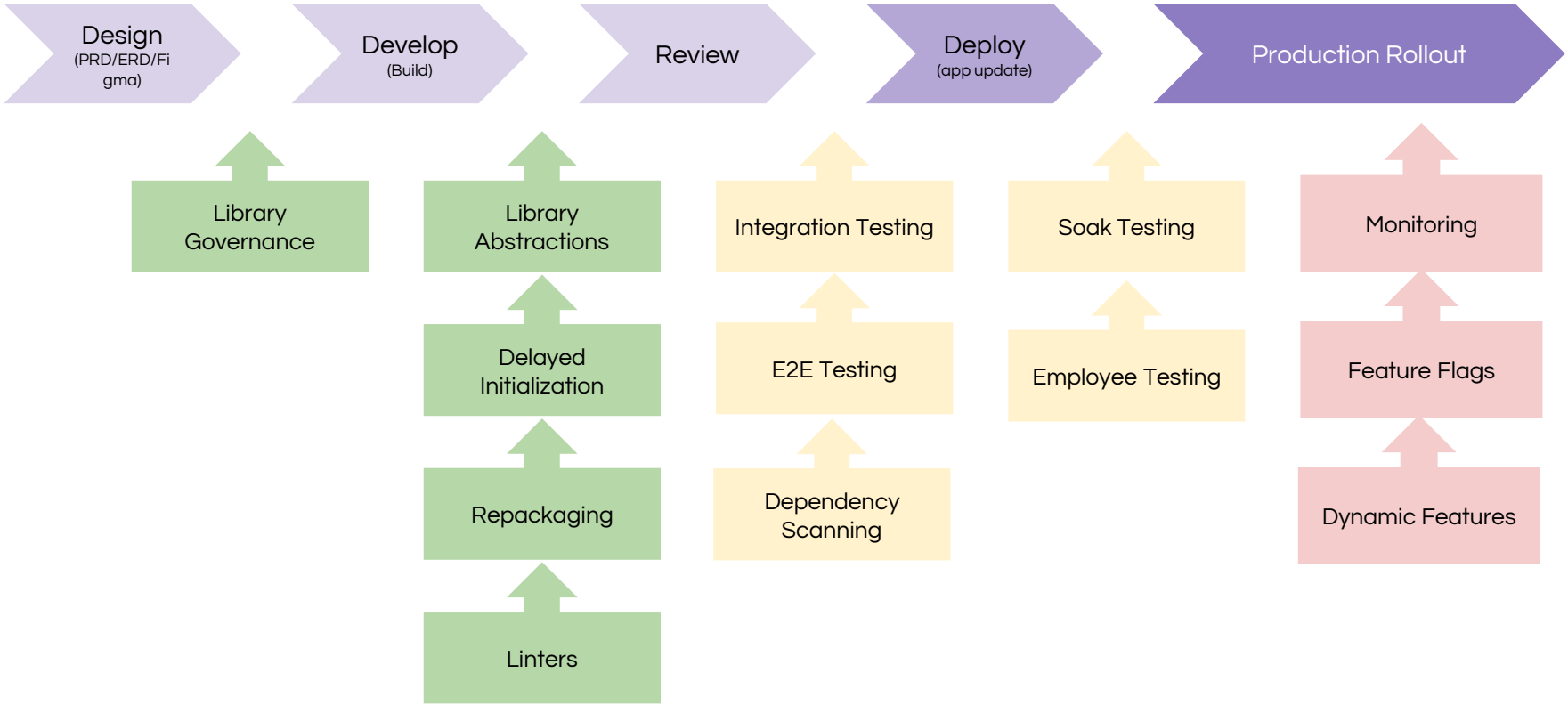
Week 6

90% adoption

Preventing Bugs



Defense Gates



Feature Flags

```
class MainActivity {

  fun useSdk() {
    Sdk.doSomething()
  }
}
```

Feature Flags

```
class MainActivity {

  fun useSdk() {
    val useSdk = FeatureFlags.get("UseSdk")

    if(useSdk) {
      Sdk.doSomething()
    } else {
      // Fallback Experience
    }
  }
}
```

Delayed Initialization

```
class MyApp : Application() {
  override fun onCreate() {
    super.onCreate()
    Sdk.init()
    // Continue App setup...
  }
}
```

Delayed Initialization

```
class MyApp : Application() {
  override fun onCreate() {
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    FeatureFlags.get("UseSDK")

    if(useSdk) {
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    }

    // Continue App setup...
  }
}
```

Delayed Initialization

E/UncaughtException: android.os.NetworkOnMainThreadException

at android.os.StrictMode$AndroidBlockGuardPolicy.onNetwork(StrictMode.java:1303)
at com.android.org.conscrypt.Platform.blockGuardOnNetwork(Platform.java:300)
at com.myapp.FeatureFlags.get(FeatureFlags.kt:35)
at com.myapp.MyApp.onCreate(MyApp.kt:10)
…

Delayed Initialization

```
class MyApp : Application() {
  override fun onCreate() {
    super.onCreate()

    FeatureFlags.get("UseSDK", Dispatcher.IO) { useSdk ->

      if(useSdk) {
        Sdk.init()
      }
    }

    // Continue App setup...
  }
}
```

Delayed Initialization

```
class SdkFeatureActivity : Activity() {
  override fun onCreate() {
    super.onCreate()

    FeatureFlags.get("UseSDK", Dispatcher.IO) { useSdk ->

      if(useSdk) {
        Sdk.init()
      }
    }

    // Continue Activity setup...
  }
}
```

Delayed Initialization

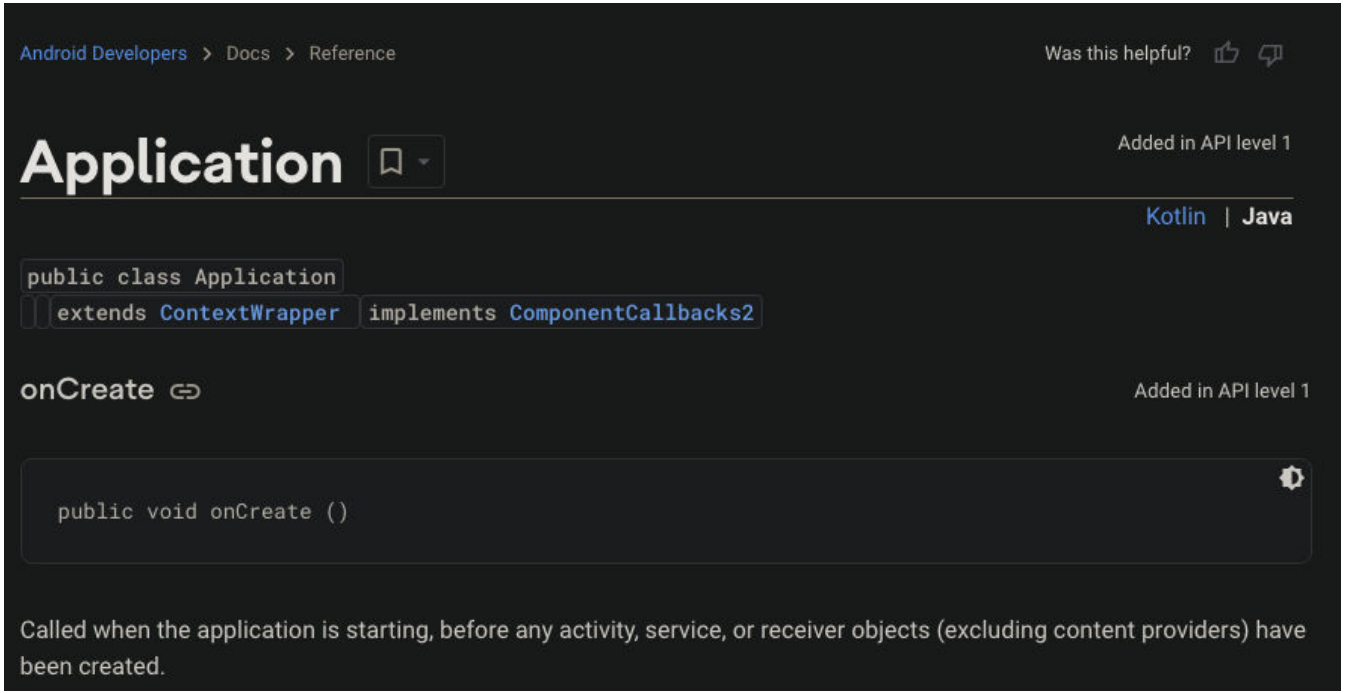
```
dependencies {
  implementation 'com.google.android.gms:play-services-ads:X.Y.Z'
}
```

Delayed Initialization

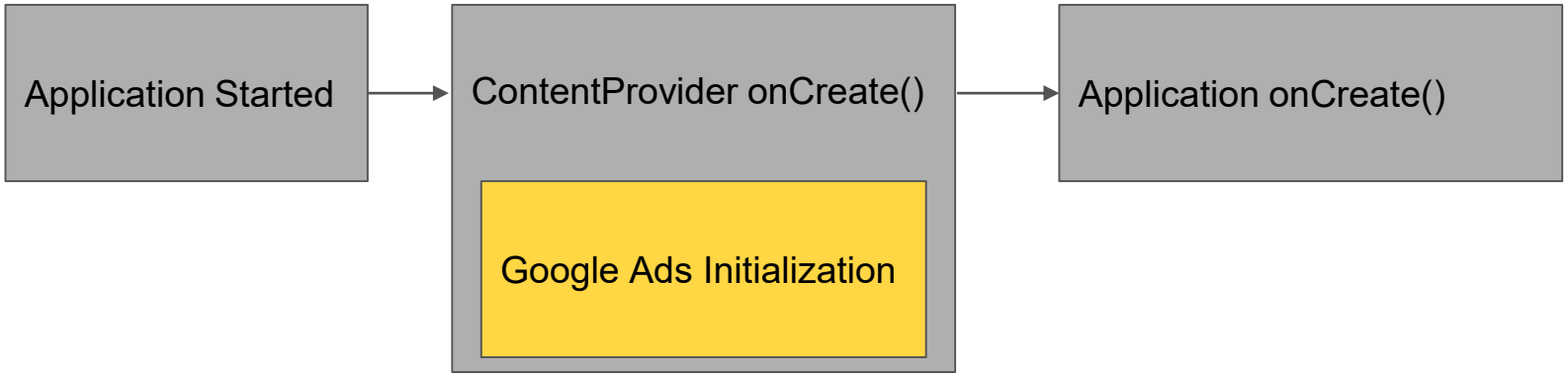
```
<provider
    android:name="com.google.android.gms.ads.MobileAdsInitProvider"
    android:authorities="${applicationId}.mobileadsinitprovider"
    android:exported="false"
    tools:node="merge">

</provider>
```

Delayed Initialization



Delayed Initialization



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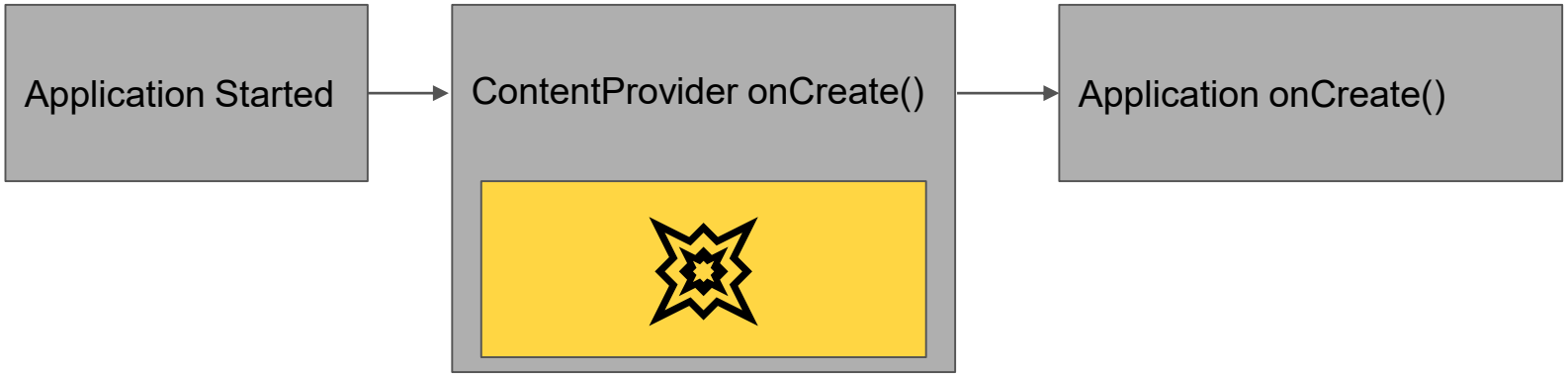


Delayed Initialization

```
<provider
    android:name="com.google.android.gms.ads.MobileAdsInitProvider"
    android:authorities="${applicationId}.mobileadsinitprovider"
    tools:node="remove" />
```

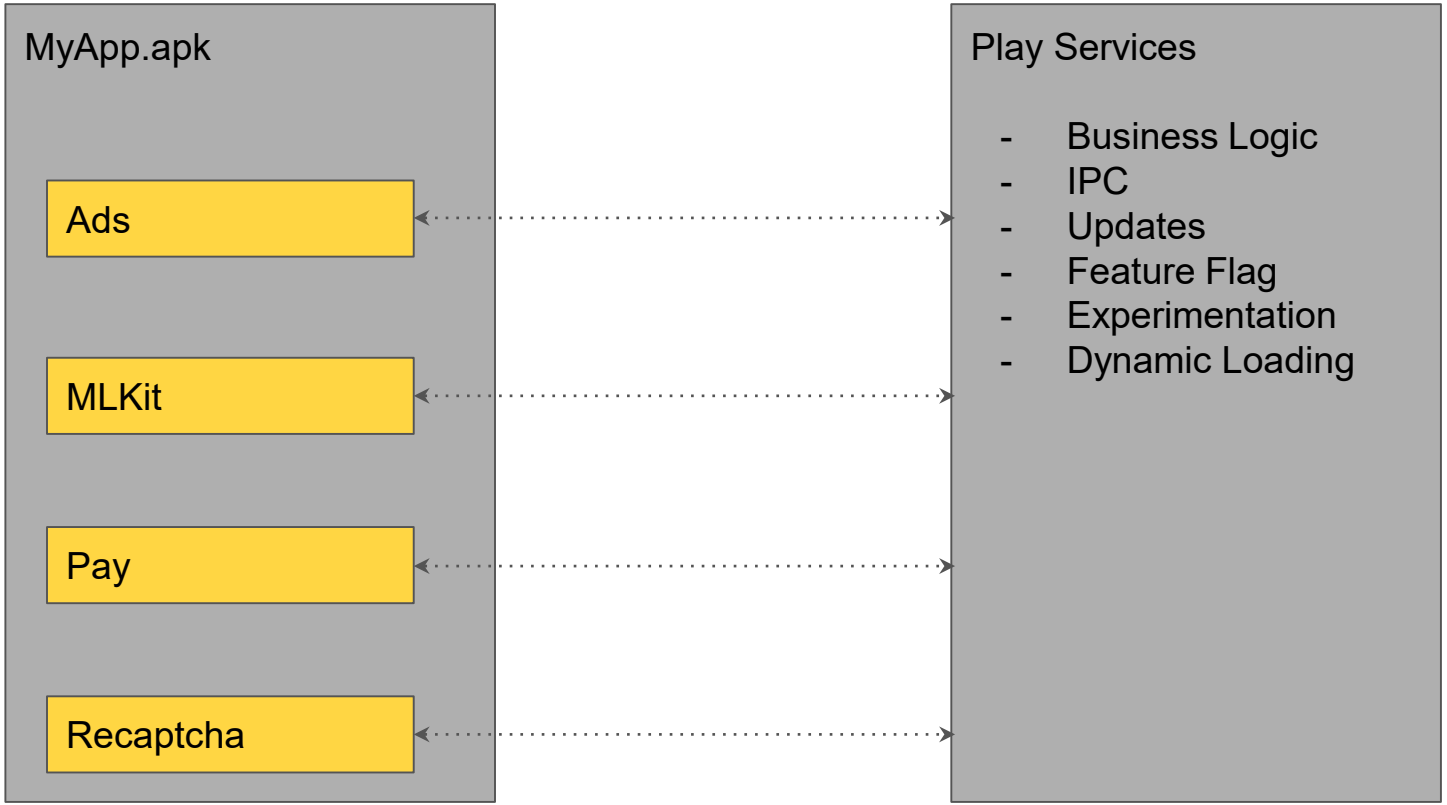
Bundled Code

- Broadcast Receivers
- Intent Filters
- Content Providers
- Native Callbacks
- AIDLs

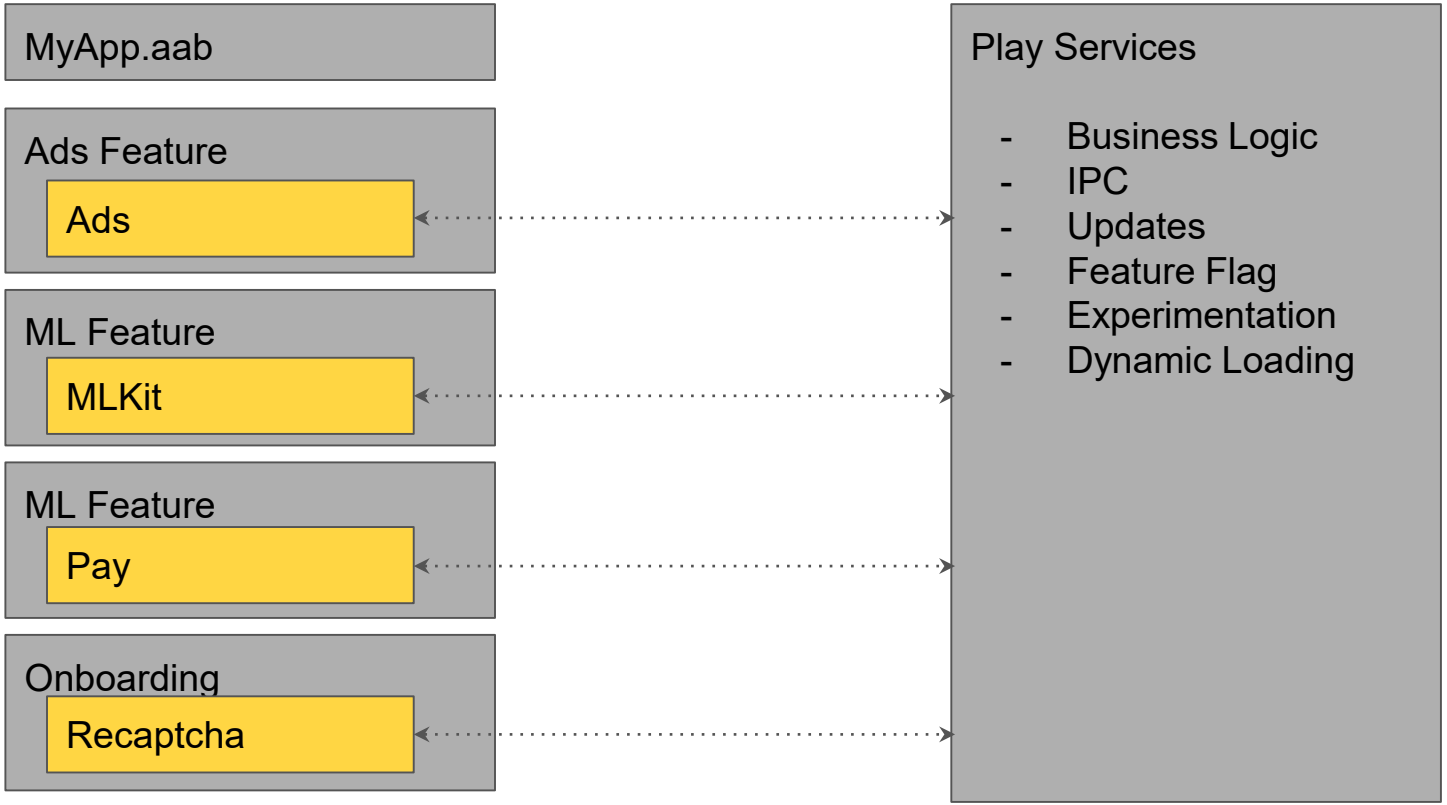
Play Services

- Opaque
- System level permissions
- Dynamic behavior outside app’s release cadence
- XP and feature flags in your app

Play Services



Play Services + Dynamic Features

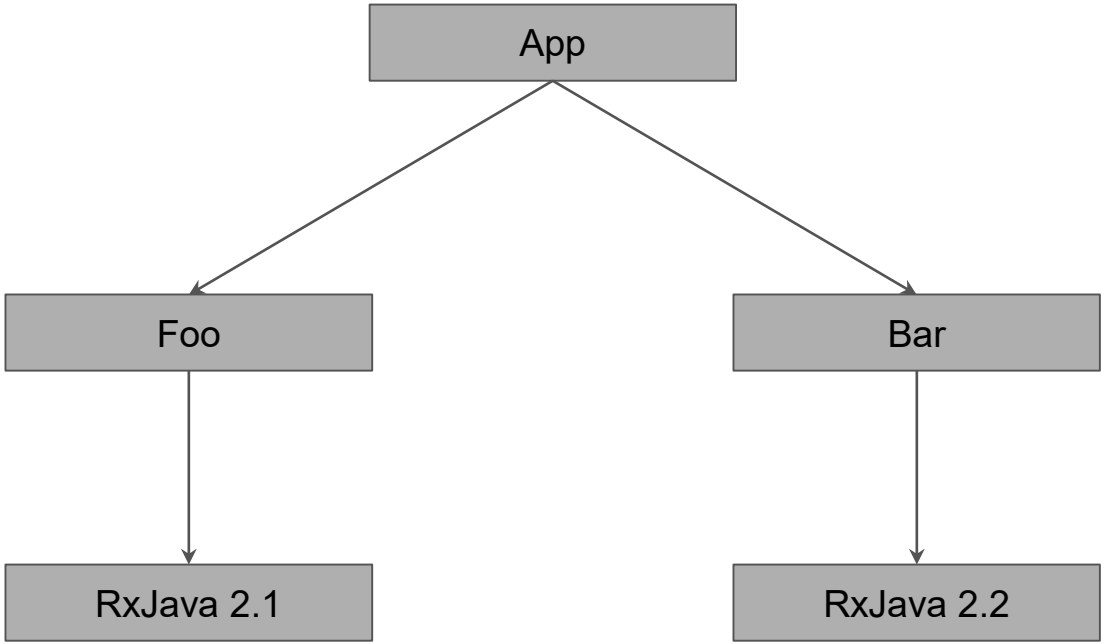


Dynamic Features

```
val installSDK = FeatureFlags.get("InstallSDK")
val initSdk = FeatureFlags.get("InitSDK")

if (installSdk) {
  SplitInstallManagerFactory.create(context)
    .startInstall(request)
    .addOnSuccessListener {
      if(initSdk) {
        Sdk.init()
      }
    }
  .addOnFailureListener { exception ->  ... }
}
```

Transitive Dependency Conflicts



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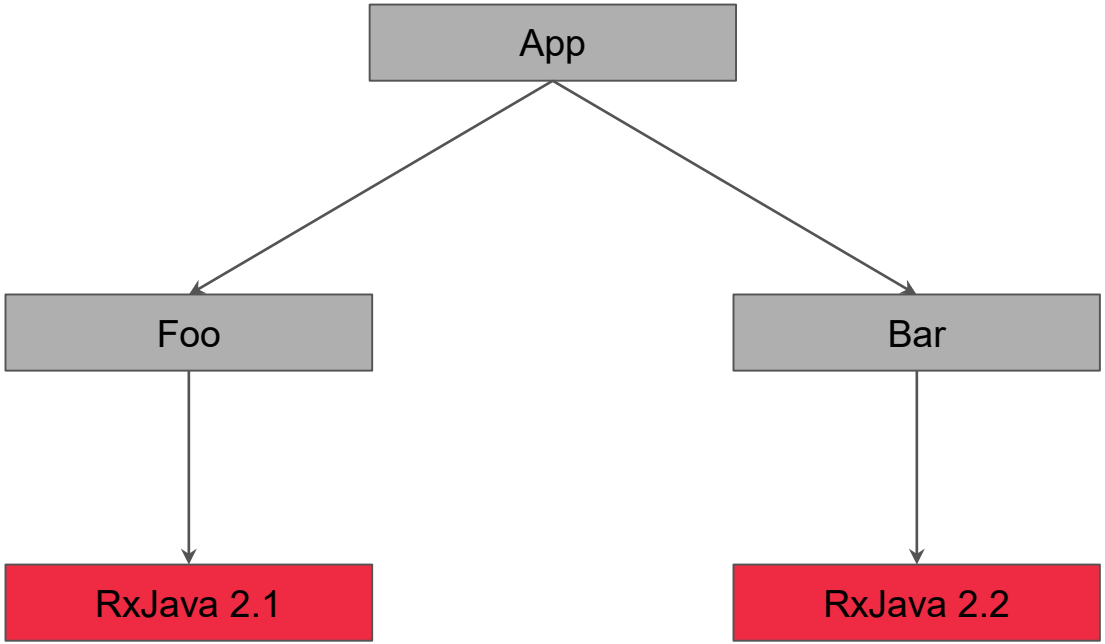

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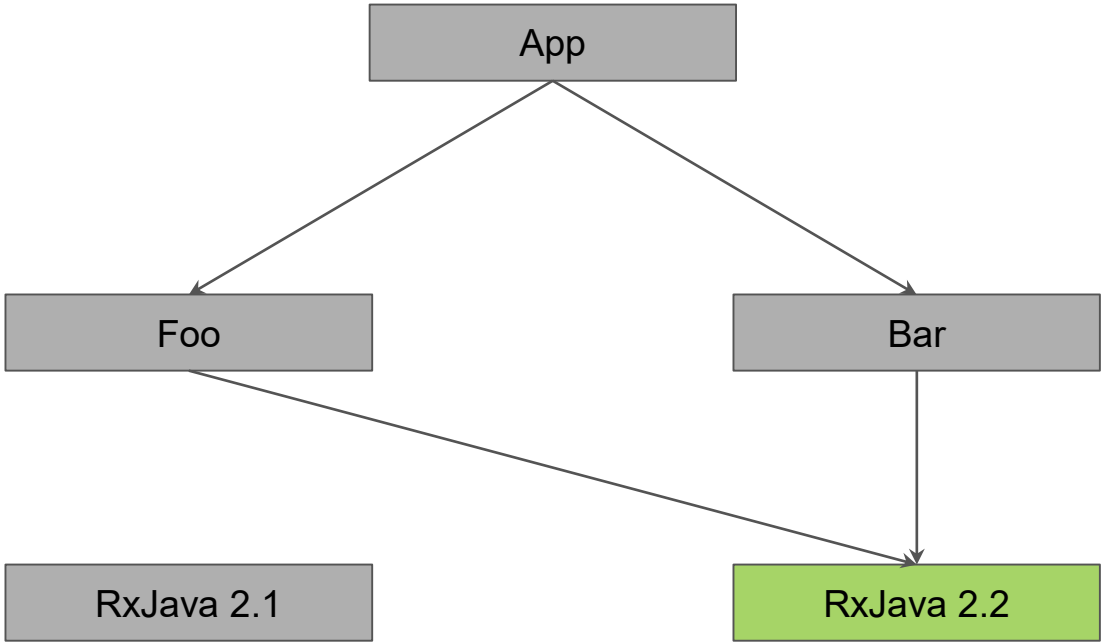

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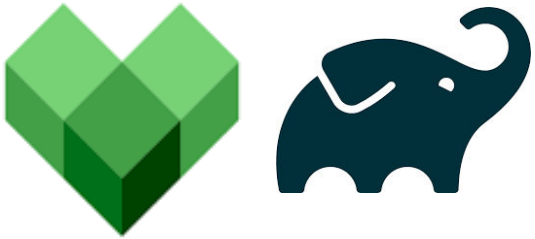

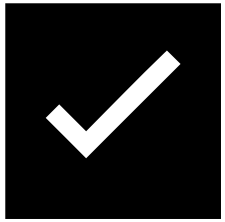

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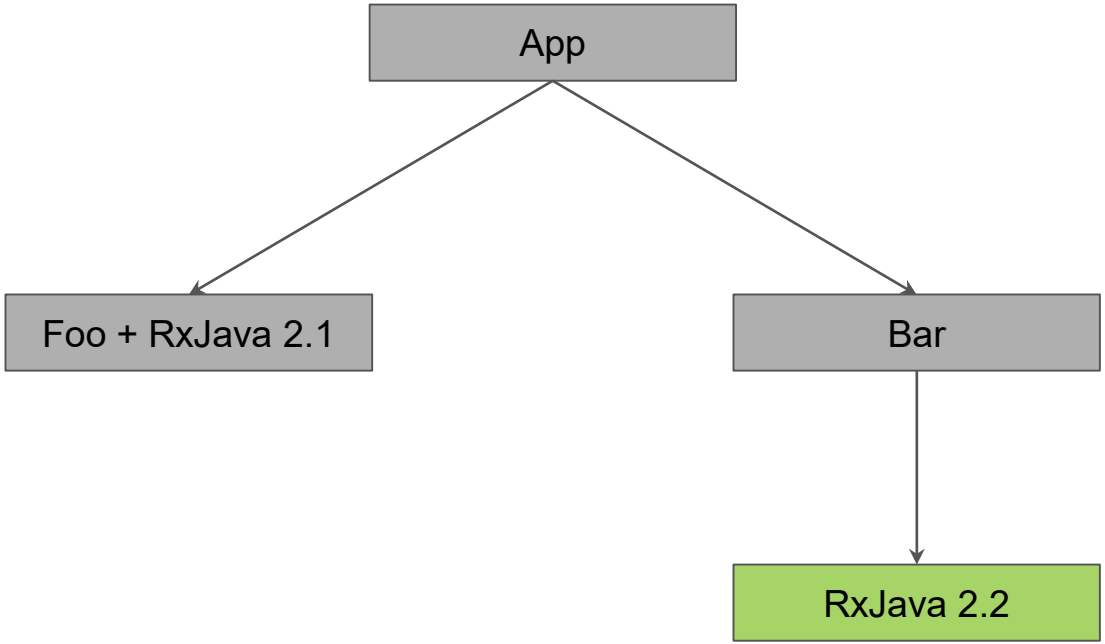


Jar Shading

```
dependencies {

  compile jarjar.repackage {
    from io.reactivex.rxjava2:rxjava:2.1.0'

    classRename "io.reactivex.rxjava2.**" "com.uber.internal.rxjava2.@1"
  }
}
```

Jar Shading

Use as last resort, prioritize updating all code to single version first!

- ✅ Dependency Stability
- ✅ Support multiple versions

- ❌ Increased App Size
- ❌ Nested Dep Complexity
- ❌ Maintenance

github.com/uber-research/java-dependency-validator

Library Abstractions

- Local Abstractions
  - Useful for local utilities with unstable APIs
  - Can enable better testability and feature flagging
  - Replace heavy SDKs with small client REST APIs

- Server Abstractions
  - Use server side integration instead of client side

Linters

- Ban known dangerous APIs
- Shift runtime exceptions left into build time exceptions

Linters

```
val image = service.getCoolPromoImage()
Picasso.load(image).into(view)
```

E/UncaughtException: java.lang.IllegalArgumentException Path must not be empty.

…

Linters

```
class Picasso {
  fun load(path: String?): RequestCreator {
    ...
    require(path.isNotBlank()) { "Path must not be empty." }
    return load(Uri.parse(path))
  }
}
```

Linters

```
fun Picasso.loadSafely(url: String?): RequestCreator {
  if (url != null && url.isEmpty()) {
    Lumber.monitor("picasso").e("empty strings are not allowed by picasso")
    return this.load(null as String?)
  }
  return this.load(url)
}
```

Linters

```
/**
  * Methods that should not be used at all.
  *
  */
 @JvmStatic
    val methods =
        mapOf(
            "com.squareup.picasso.Picasso.load(kotlin.String?)" to
                "Empty strings can trigger crashes, use the loadSafely extension.",
        )
```

Crash Recovery

Incident

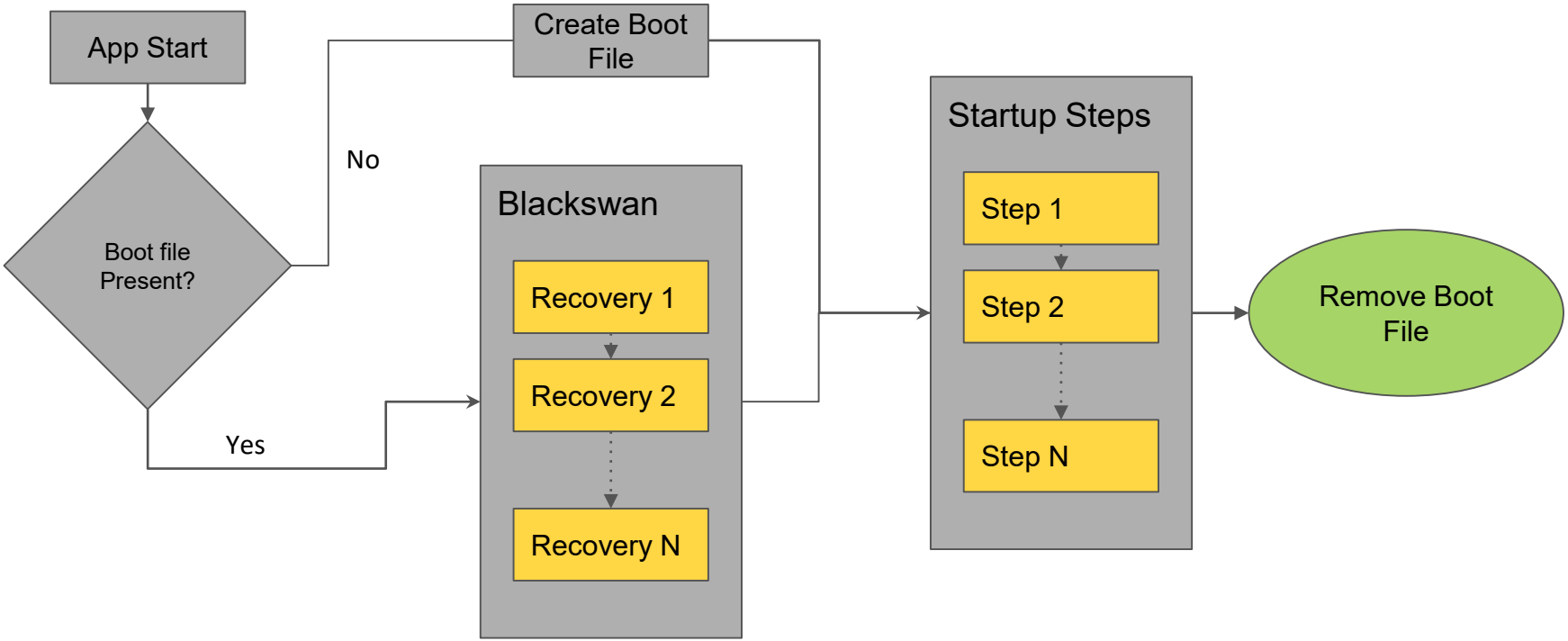
Golden Path

- On-call alert
- Triage bug
- Rollback feature flag
- Monitor
- Post-mortem

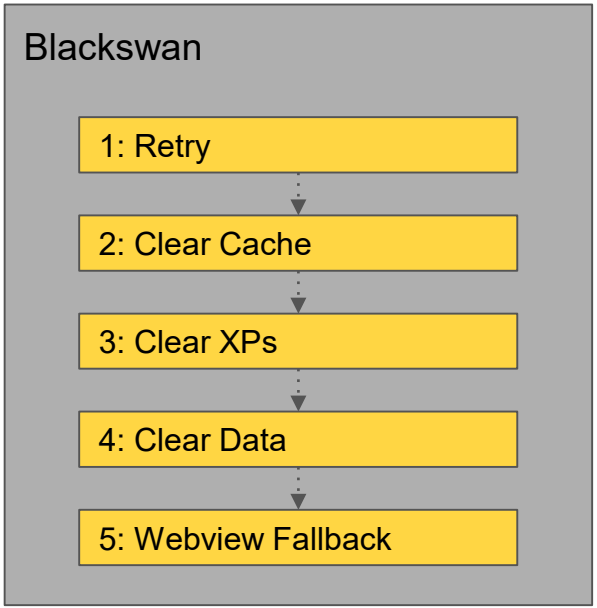
What if that doesn’t work…

- Automated Crash Recovery
- Push Based Recovery
- Multiprocess Agent
- Hotfixes and Force Upgrade

Automated Crash Recovery



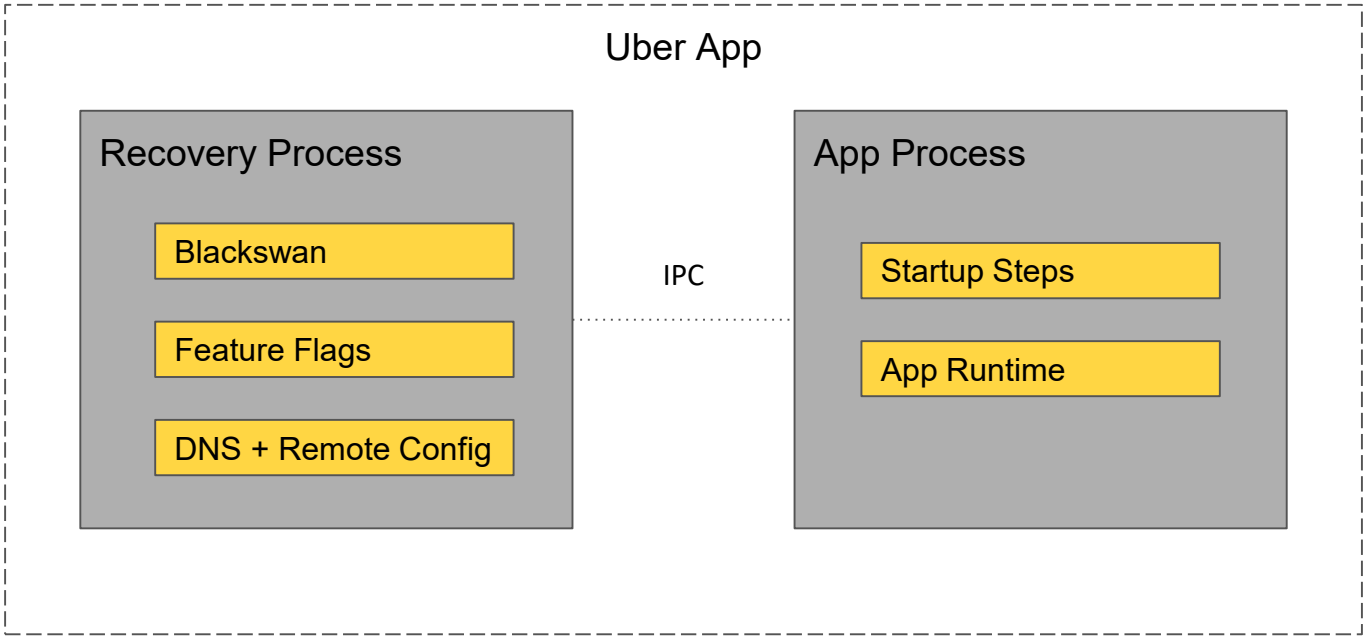
Automated Crash Recovery



Server Based Rules

- Pushed Feature Flags
- Blackswan Custom Recovery Actions
- DNS + Firebase Remote Config

Multiprocess Agent



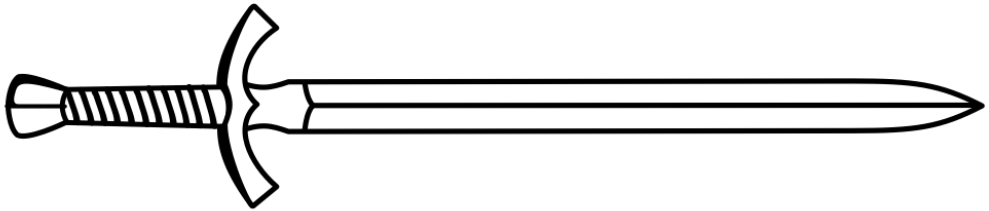
Hotfixes and Force Upgrades

- Realtime mitigations are much faster
- Hotfix introduces additional risk
- Force upgrades cause user attrition

-> Library Governance
-> Reliability Defense
-> Crash Recovery

Balancing Speed and Reliability

The Double-Edged Sword of Third-Party Libraries



Ty Smith
tysmith.me
Uber