The Cost of Modularization

Android Worldwide
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Tuesday, 2022 October 25

About me and Astro

- Mobile engineering manager at Astro
- Astro is a quick commerce startup in Indonesia 🇮🇩
- We deliver groceries to customers in less than 30 minutes 🚀

About Modularization

- Breaking down one module into multiple Gradle modules
- Module = Project and Multimodule = Multi projects

Why Modularization?

- Faster build time
- Encourage reusability
- Clear ownership

Why Not?

- You have to spend more time & effort to pay the cost

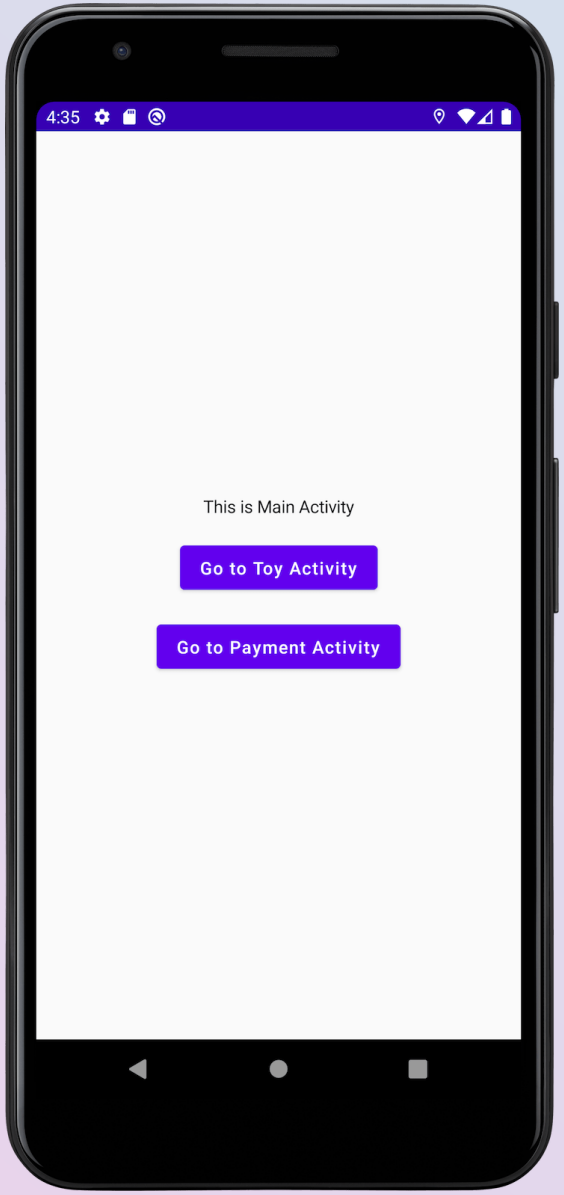
Companion Project: Toys App

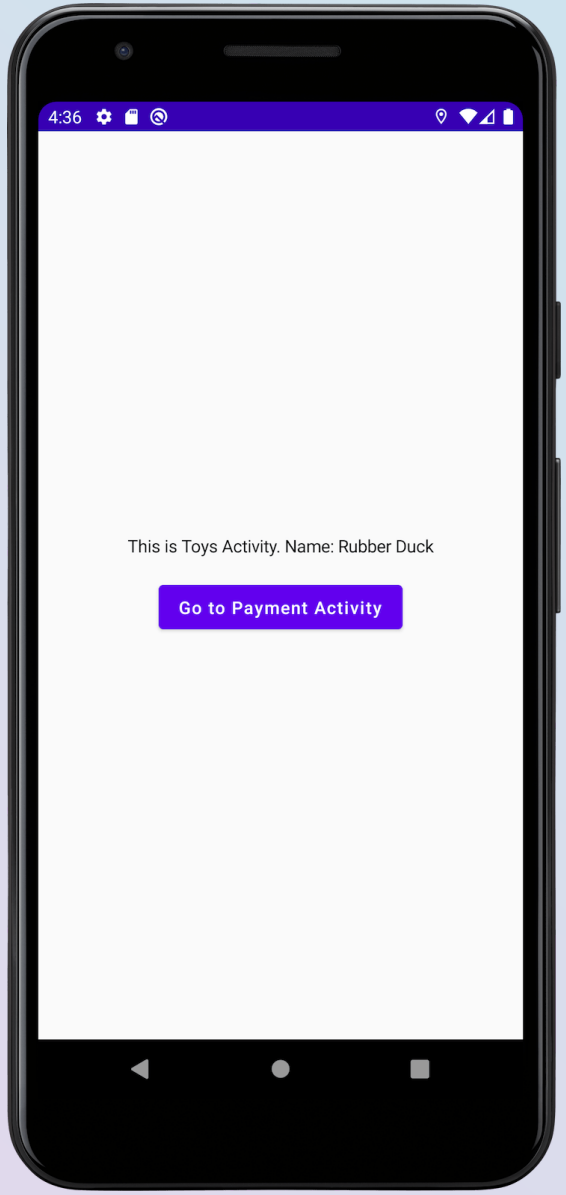
Screens

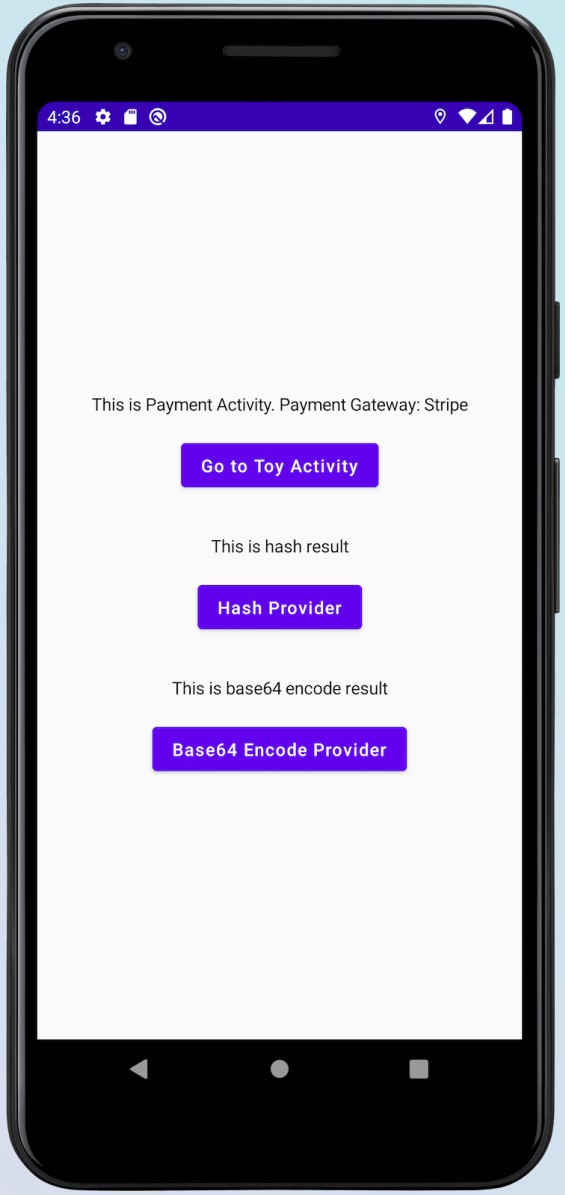
- Main screen
- Toys screen
- Payment screen

Code repository

- GitHub - ToysApp


4:35
This is Main Activity
Go to Toy Activity
Go to Payment Activity


4:36
This is Toys Activity. Name: Rubber Duck
Go to Payment Activity


4:36
This is Payment Activity. Payment Gateway: Stripe
Go to Toy Activity
This is hash result
Hash Provider
This is base64 encode result
Base64 Encode Provider

The Cost of Modularization

- Situation
- Problem
- Solution
- Example

Cost 1: Organizing Modules

Situation

- You want to breakdown your module into multimodule

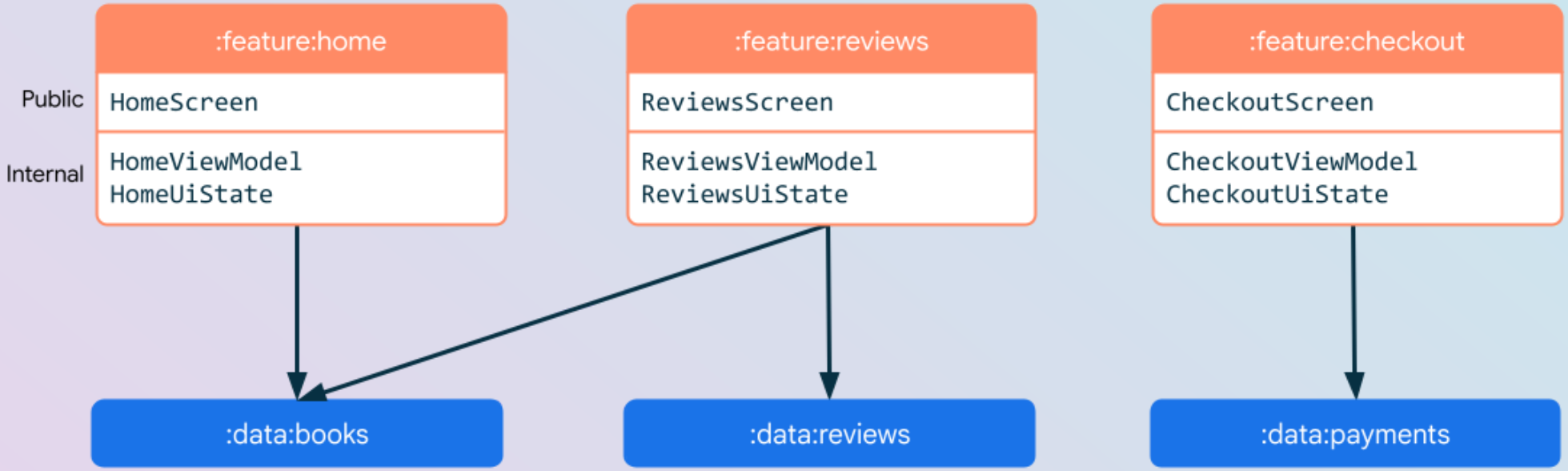
Problems

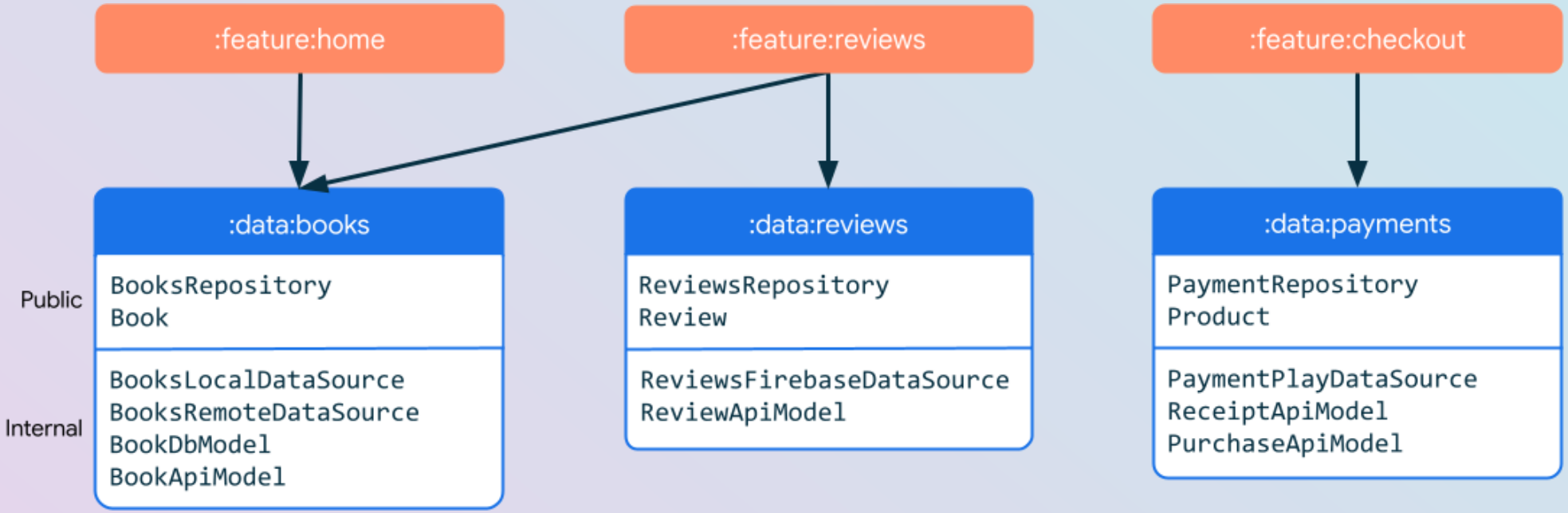
- Unclear boundary
- Too many modules
- Not enough modules

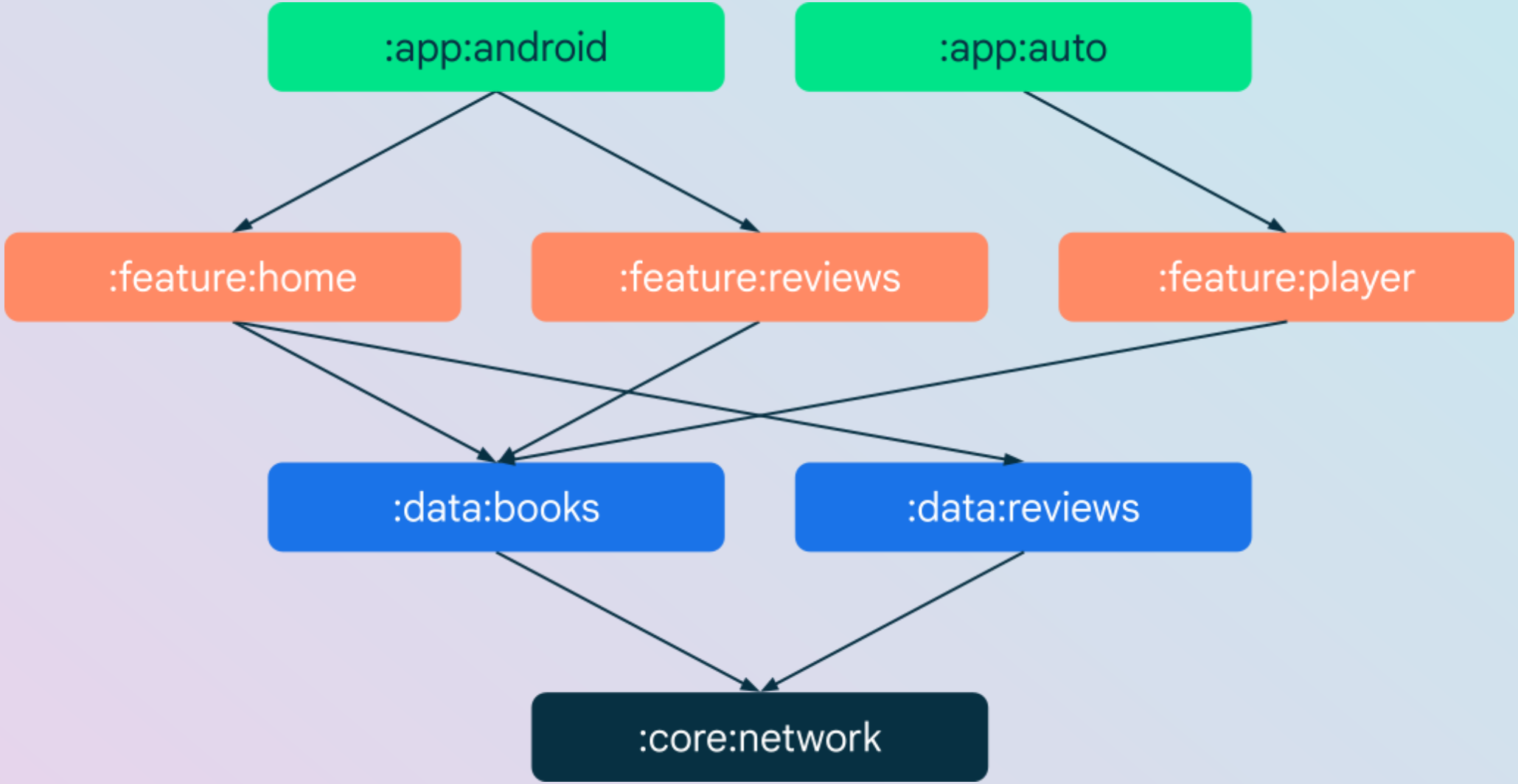
Solution

- Decide the app architecture and module convention with your team(s)
  - App architecture/Data Flow (MVVM, MVP, MVI, etc.)
  - Module convention (App, feature, library, etc.)
    - What's included & not included in the module
    - The relationship between modules

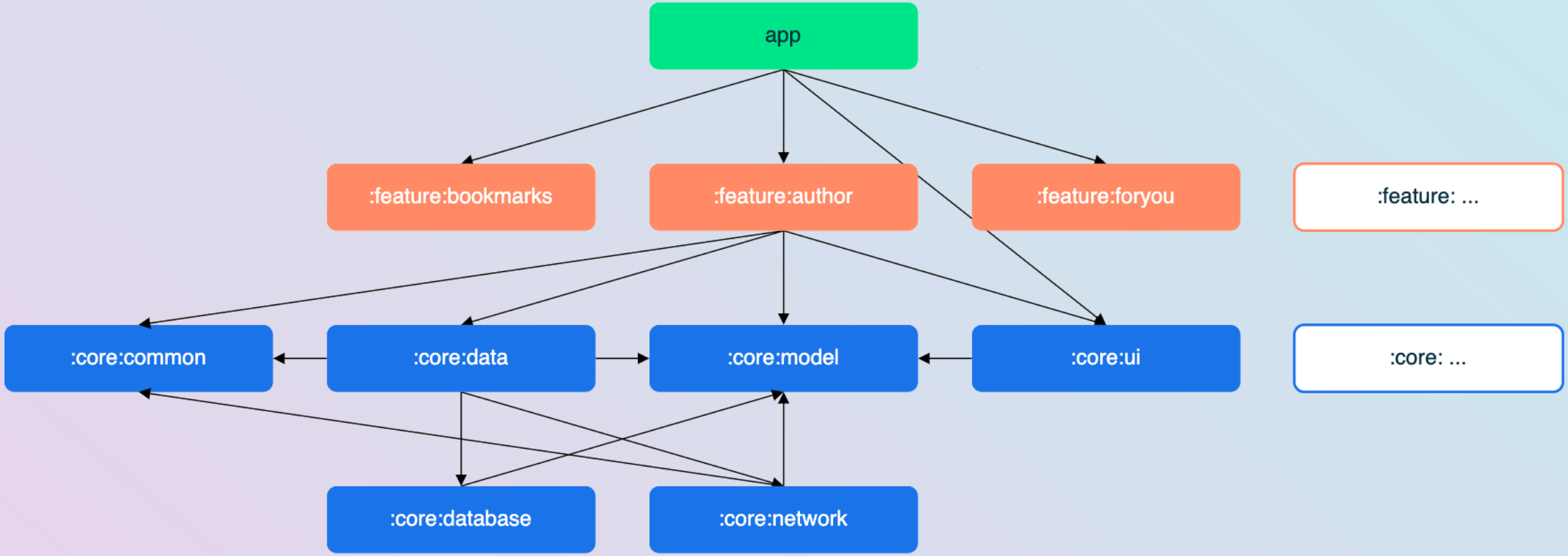
Example 1 : Android Developer Documentation


:feature:home
Public
HomeScreen
Internal
HomeViewModel
HomeUiState
:feature:reviews
ReviewsScreen
ReviewsViewModel
ReviewsUiState
:feature:checkout
CheckoutScreen
CheckoutViewModel
CheckoutUiState
:data:books
:data:reviews
:data:payments

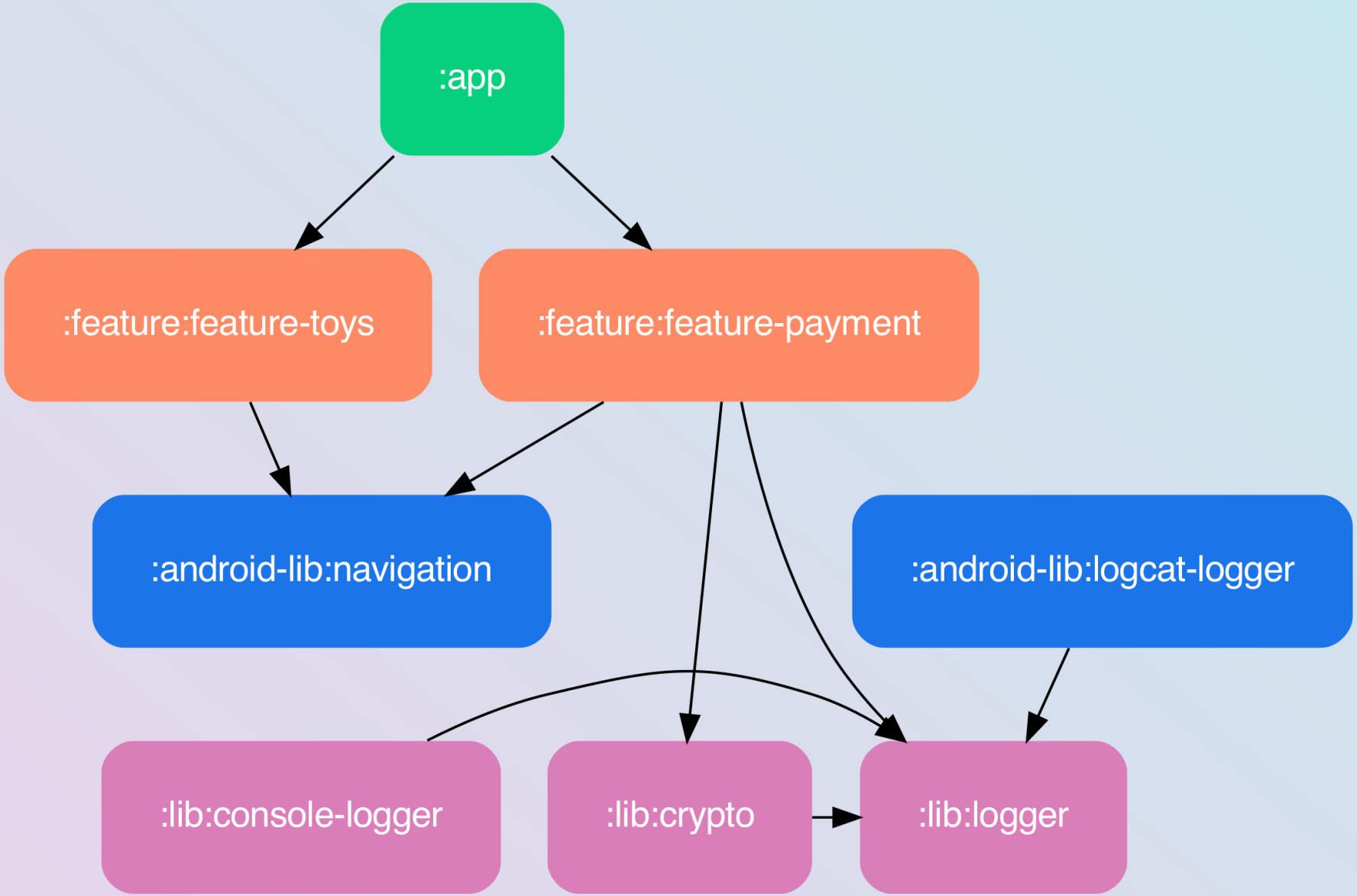

:feature:home
:feature:reviews
:feature:checkout
:data:books
Public
BooksRepository
Book
Internal
BooksLocalDataSource
BooksRemoteDataSource
BookDbModel
BookApiModel
:data:reviews
ReviewsRepository
Review
ReviewsFirebaseDataSource
ReviewApiModel
:data:payments
PaymentRepository
Product
PaymentPlayDataSource
ReceiptApiModel
PurchaseApiModel


:app:android
:app:auto
:feature:home
:feature:reviews
:feature:player
:data:books
:data:reviews
:core:network

Example 2: Now in Android


app
:feature:bookmarks
:feature:author
:feature:foryou
:feature: ...
:core:common
:core:data
:core:model
:core:ui
:core: ...
:core:database
:core:network

Example 3: Toys App


:app
:feature:feature-toys
:feature:feature-payment
:android-lib:navigation
:android-lib:logcat-logger
:lib:console-logger
:lib:crypto
:lib:logger

Cost 2: Enforcing Module Convention

Situation

- You want to create a new module

Problems

- The module should follow the module convention
- Update of a module should be reflected to all module
- Make sure a module can only depend on a certain module type

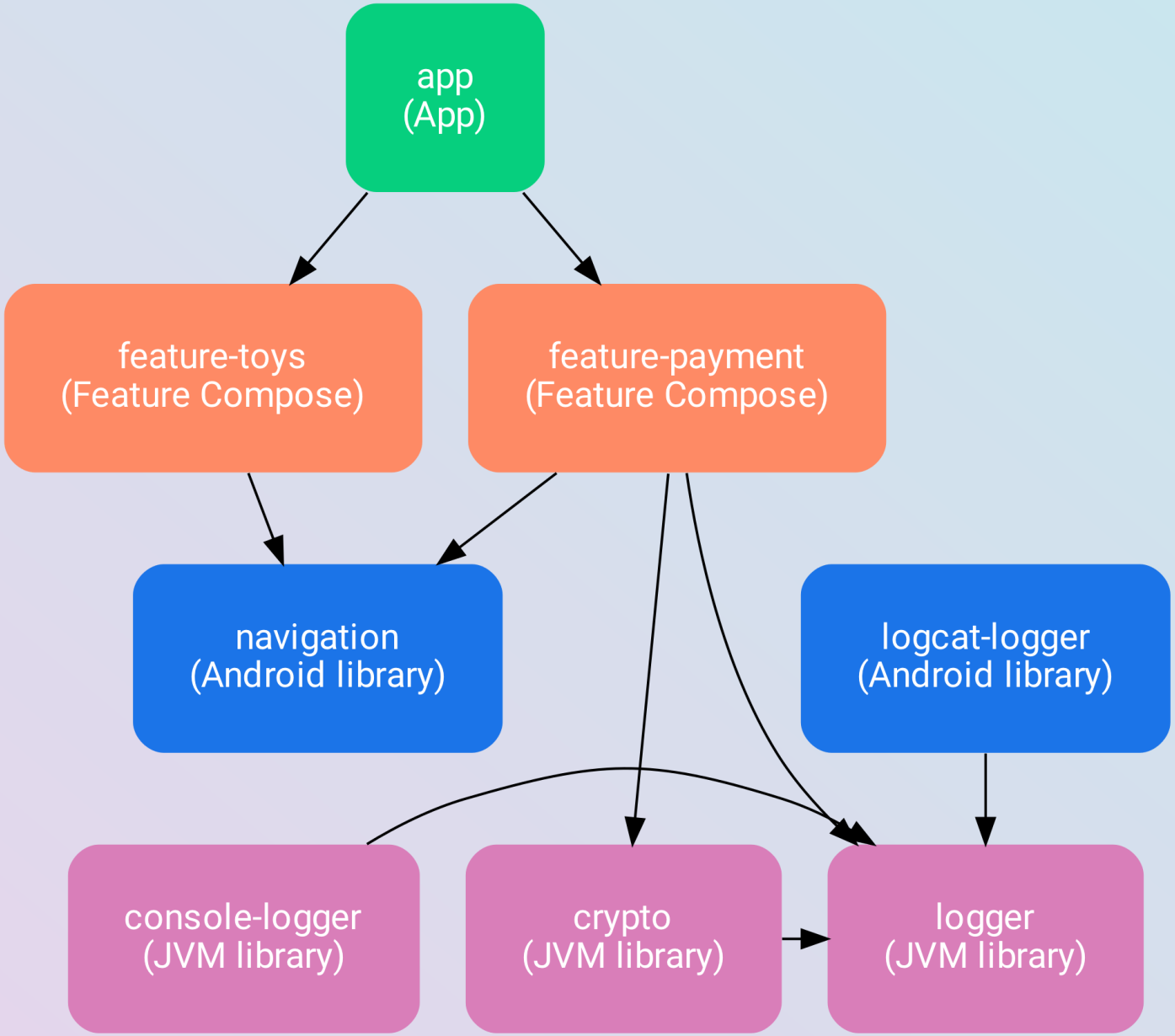
Solutions

- Use Gradle plugin for module convention
  - The plugin contains module configuration (Common settings, dependencies, plugins, etc.)
- Use Module Graph Assert plugin for asserting module relationship

Gradle plugins for module convention

```
// Create a Gradle project, i.e build-logic, to store plugins

// ToysApp/build-logic/convention/src/main/kotlin
class YourConventionPlugin: Plugin<Project> {
    override fun apply(target: Project) {
        // Your configuration here
    }
}

// ToysApp/build-logic/convention/build.gradle.kts
gradlePlugin {
    plugins {
        register("androidFeatureCompose") {
            id = "com.example.toysapp.convention.android.feature.compose"
            implementationClass = "AndroidFeatureComposeConventionPlugin"
        }
    }
}
```

Example: Feature Module using Compose


app
(App)
feature-toys
(Feature Compose)
feature-payment
(Feature Compose)
navigation
(Android library)
logcat-logger
(Android library)
console-logger
(JVM library)
crypto
(JVM library)
logger
(JVM library)

```
// Feature module - build.gradle.kts
plugins {
    id("com.android.library")
    id("org.jetbrains.kotlin.android")
}

android {
    defaultConfig {
        minSdkVersion(24)
        targetSdkVersion(31)
        testInstrumentationRunner = "androidx.test.runner.AndroidJUnitRunner"
        consumerProguardFiles("consumer-rules.pro")
        vectorDrawables {
            useSupportLibrary = true
        }
    }
    buildFeatures {
        compose = true
    }
    composeOptions {
        kotlinCompilerExtensionVersion = "1.3.2"
    }
}

dependencies {
    testImplementation("junit:junit:4.13.2")
    androidTestImplementation("androidx.test.ext:junit:1.1.3")
    androidTestImplementation("androidx.test.espresso:espresso-core:3.4.0")
}
```

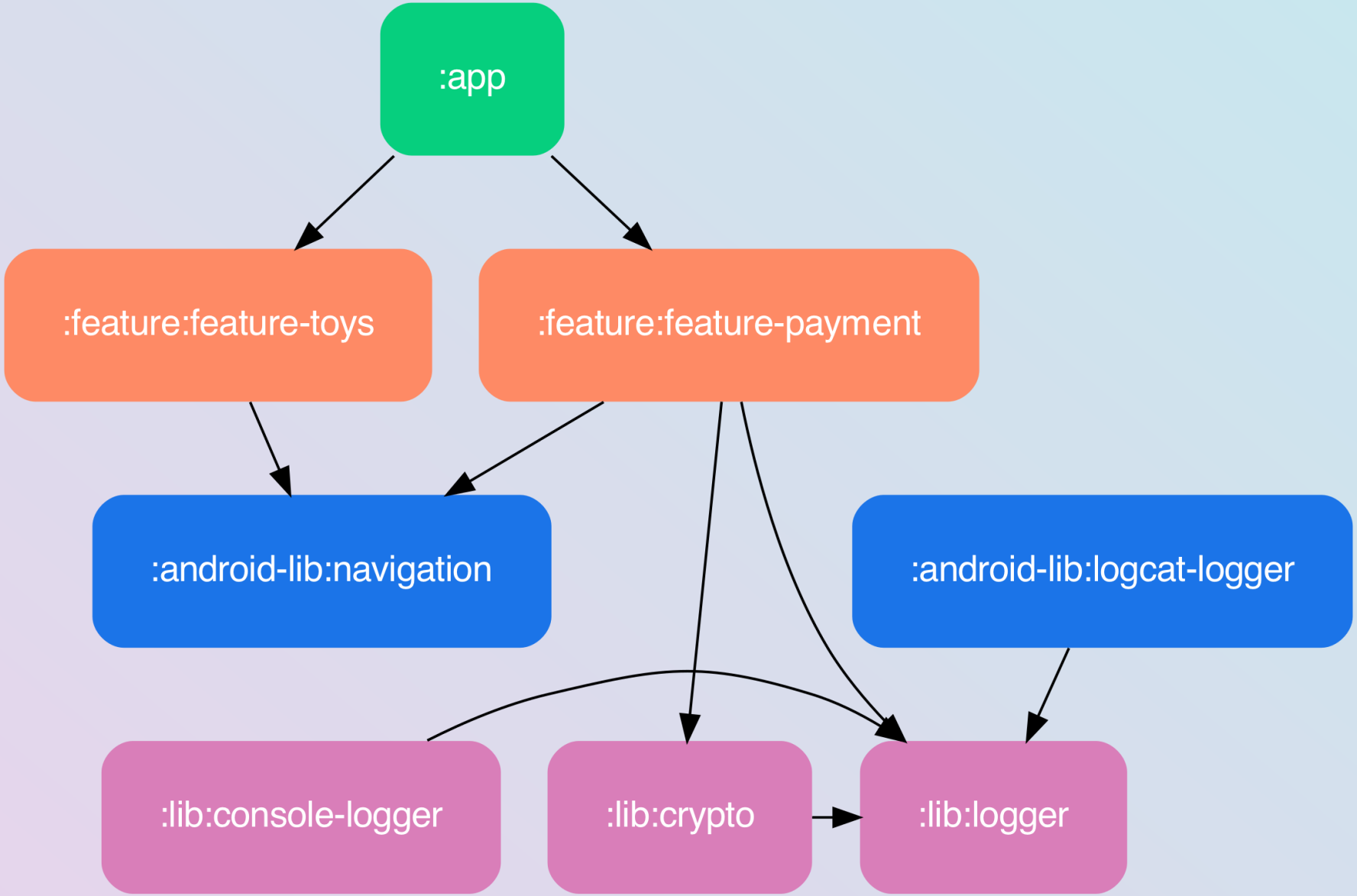
```kotlin
// ToysApp/build-logic/convention/src/main/kotlin
class AndroidFeatureComposeConventionPlugin : Plugin<Project> {

    override fun apply(target: Project) {
        target.extensions.configure<LibraryExtension> {
            defaultConfig {
                minSdk = 24
                targetSdk = 31
                testInstrumentationRunner = "androidx.test.runner.AndroidJUnitRunner"
                consumerProguardFiles("consumer-rules.pro")
                vectorDrawables {
                    useSupportLibrary = true
                }
            }
            buildFeatures {
                compose = true
            }
            composeOptions {
                kotlinCompilerExtensionVersion = "1.3.2"
            }
        }
```

```
// Feature module - build.gradle.kts
plugins {
    id("com.android.library")
    id("org.jetbrains.kotlin.android")
}

android {

}

dependencies {
    testImplementation("junit:junit:4.13.2")
    androidTestImplementation("androidx.test.ext:junit:1.1.3")
    androidTestImplementation("androidx.test.espresso:espresso-core:3.4.0")
}
```

```kotlin
// ToysApp/build-logic/convention/src/main/kotlin
class AndroidFeatureComposeConventionPlugin : Plugin<Project> {

    override fun apply(target: Project) {
        with(target) {
            with(pluginManager) {
                apply("com.android.library")
                apply("org.jetbrains.kotlin.android")
            }

            extensions.configure<LibraryExtension> {
                // ..Configure defaultConfig & Compose
            }

            dependencies {
                add("testImplementation", "junit:junit:4.13.2")
                add("androidTestImplementation", "androidx.test.ext:junit:1.1.3")
                add("androidTestImplementation", "androidx.test.espresso:espresso-core:3.4.0")
            }
        }
    }
}
```

```
// Feature module - build.gradle.kts
plugins {
    id("com.example.toysapp.convention.android.feature.compose")
}

android {

}

dependencies {

}
```

Example: Enforcing Module Relationship

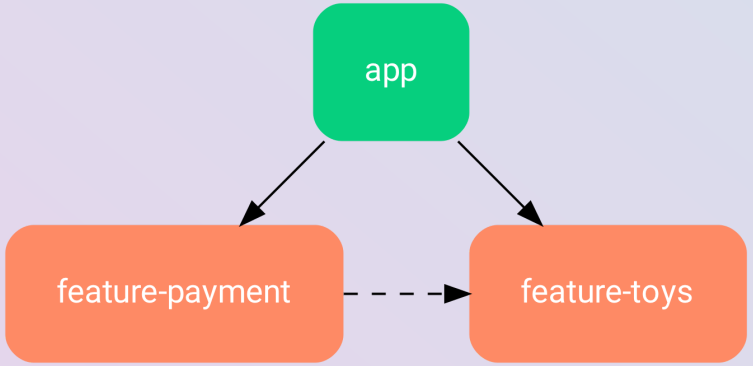

:app
:feature:feature-toys
:feature:feature-payment
:android-lib:navigation
:android-lib:logcat-logger
:lib:console-logger
:lib:crypto
:lib:logger

Setup the plugins

```
// ToysApp/build.gradle.kts
plugins {
    id("com.jraska.module.graph.assertion") version "2.3.0"
}

// ToysApp/build-logic/convention/src/main/kotlin
class AndroidApplicationConventionPlugin : Plugin<Project> {
    override fun apply(target: Project) {
        with(target) {
            with(pluginManager) {
                apply("com.android.application")
                apply("org.jetbrains.kotlin.android")
                apply("com.jraska.module.graph.assertion")
            }
        }
    }
}
```

Setup the rule

```
// ToysApp/app/build.gradle.kts
moduleGraphAssert {
    maxHeight = 3
    allowed = arrayOf(
        ":app -> :feature:.*"
        ":feature:.* -> :lib:.*",
        ":feature:.* -> :android-lib:.*",
        ":.* -> :lib:.*",
        ":.* -> :android-lib:.*",
    )
    restricted = arrayOf(
        ":feature:.* -X> :feature:.*",
        ":android-lib:.* -X> :feature:.*",
        ":lib:.* -X> :feature:.*"
    )
}
```




```
// Feature module - Payment
dependencies {
    implementation(projects.feature.featureToys) // will fail
    implementation(projects.androidLib.navigation)
}
```

```
$ ./gradlew assertModuleGraph
FAILURE: Build failed with an exception.

* What went wrong:
Execution failed for task ':app:assertAllowedModuleDependencies'.

> [':feature:feature-payment' -> ':feature:feature-toys'] not allowed
by any of [':.* -> :lib:.*', ':.* -> :android-lib:.*',
':feature:.* -> :lib:.*', ':feature:.* -> :android-lib:.*',
':app -> :feature:.*']
```

```
$ ./gradlew assertModuleGraph
BUILD SUCCESSFUL in 2s


// Alternatively will run compile, test, lint, and assertModuleGraph
$ ./gradlew check


// Bonus: Create module graph (Graphviz dot file)
$ ./gradlew generateModulesGraphvizText
```

Cost 3: Dependency Management

Situation

- Your module needs to add an external library
- Your module needs to add another module

Problems

- Duplicated dependencies
- Typo

Solutions

- Version catalog
  - `ToysApp/gradle/libs.versions.toml`
- Typesafe project accessor

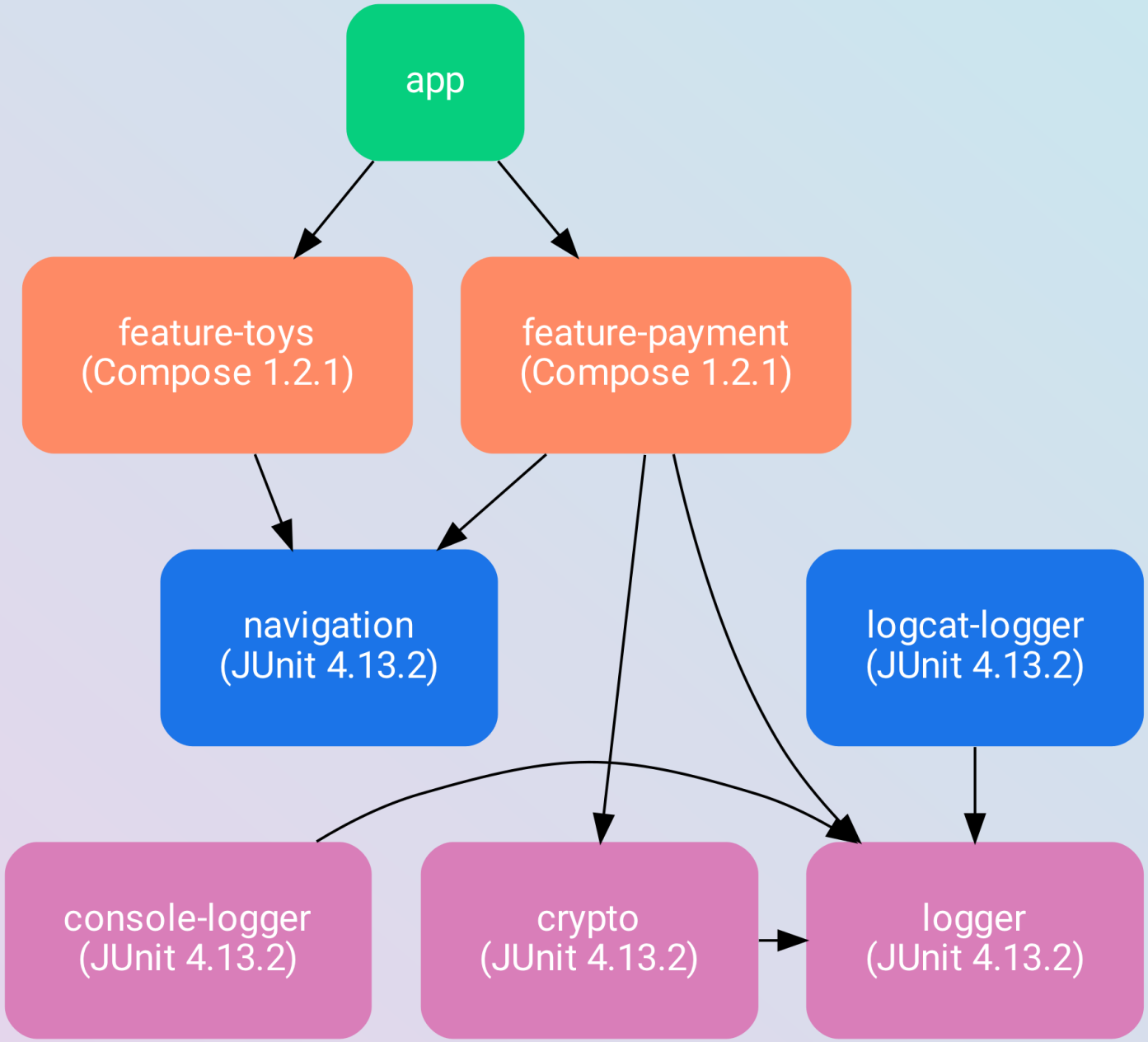
```
// ToysApp/settings.gradle.kts
enableFeaturePreview("TYPESAFE_PROJECT_ACCESSORS")
```

Version Catalog - Libraries & Bundles

```
// ToysApp/gradle/libs.versions.toml
[versions]
compose = "1.2.1"

[libraries]
compose-ui = { module = "androidx.compose.ui:ui", version.ref = "compose" }
compose-tooling = { module = "androidx.compose.ui:ui-tooling", version.ref = "compose" }
koin-android-compose = "io.insert-koin:koin-androidx-compose:3.2.1"

[bundles]
compose = ["compose-ui", "compose-tooling", "compose-activity", "compose-material"]
```

Version Catalog - Usages

```
dependencies {
    implementation(libs.koin.android.compose)
    implementation(libs.bundles.compose)
    testImplementation(libs.junit)
}
```


app
feature-toys
(Compose 1.2.1)
feature-payment
(Compose 1.2.1)
navigation
(JUnit 4.13.2)
logcat-logger
(JUnit 4.13.2)
console-logger
(JUnit 4.13.2)
crypto
(JUnit 4.13.2)
logger
(JUnit 4.13.2)

Typesafe Project Accessor

```
// Before
dependencies {
    implementation(project(":feature:feature-payment"))
    implementation(project(":lib:crypto"))
    implementation(project(":android-lib:navigation"))
}

// After
dependencies {
    implementation(projects.feature.featurePayment)
    implementation(projects.lib.crypto)
    implementation(projects.androidLib.navigation)
}
```

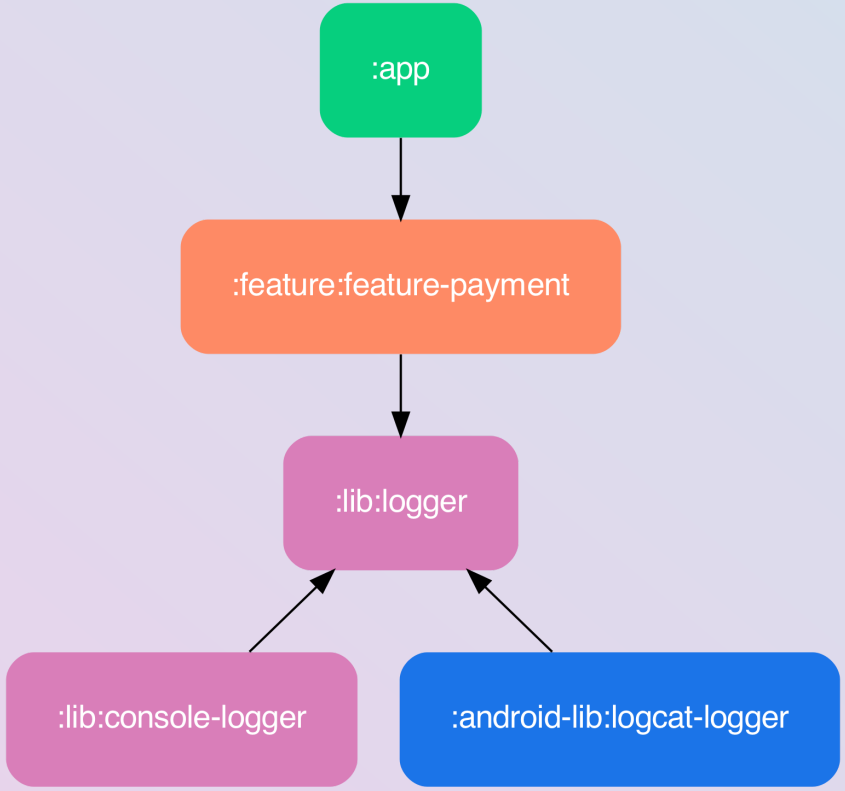
Cost 4: Dependency Injection

Situation

- Your class needs an instance of a class/interface

Problems

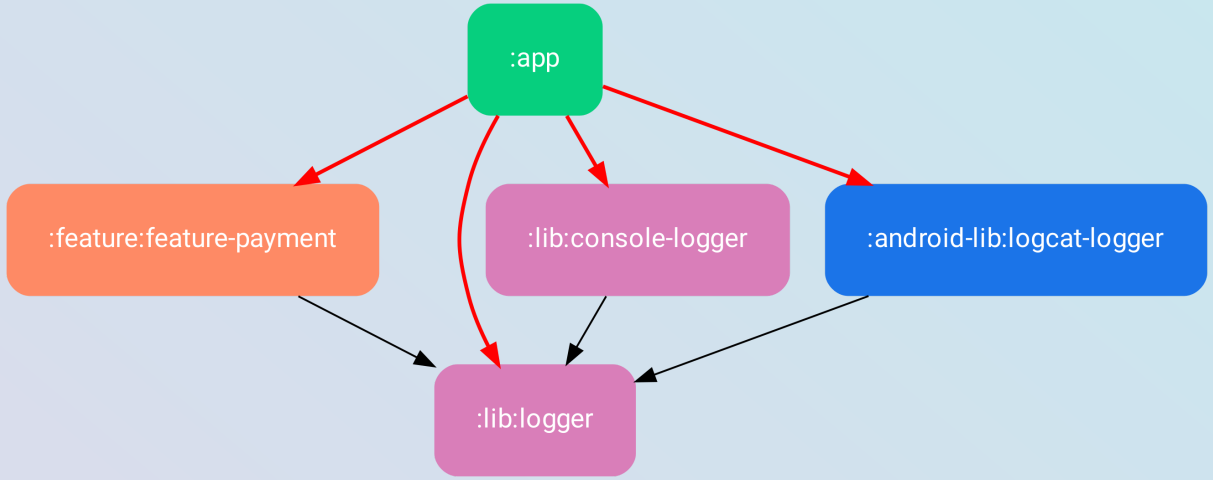
- The implementation class/interface is in another module

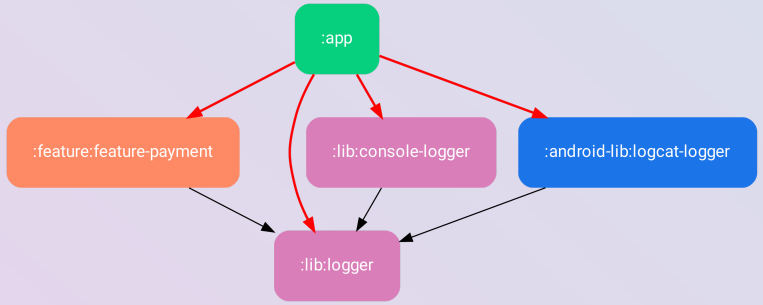



```
// Feature module - Payment
class PaymentActivity : ComponentActivity() {

    // ConsoleLogger or LogcatLogger is in another module
    private val logger: Logger by inject()
```

Solution (Koin DI)

- Pattern: App module for declaring dependencies
- App module has reference to all modules
  - Create `Koin module` in the App module
  - Or create `Koin module` in the feature/library module






```kotlin
// App module - AppModule.kt
val appModule = module {
    single<Logger> {
        ConsoleLogger()
    }
}

// App module - MainApplication.kt
override fun onCreate() {
    startKoin {
        modules(appModule)
        // or Koin module from feature module
        modules(featurePaymentModule)
    }
}

// Feature module - Payment
class PaymentActivity : ComponentActivity() {

    // ConsoleLogger is provided by AppModule
    private val logger: Logger by inject()
```

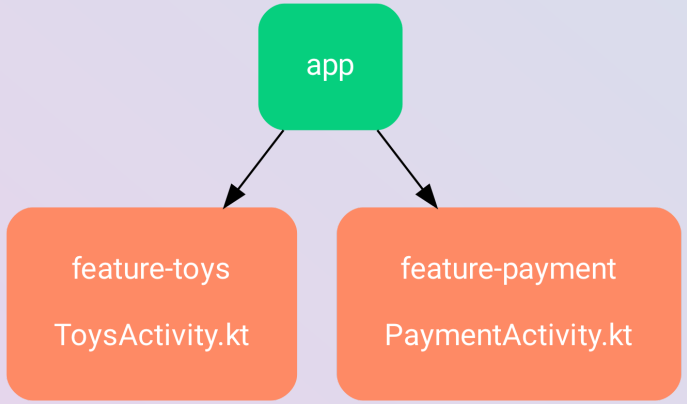
Cost 5: Navigation

Situation

- Your Activity needs to call another Activity, and vice-versa

Problems

- The Activity is in another module
- If you add the module, you'll have a cyclic dependency



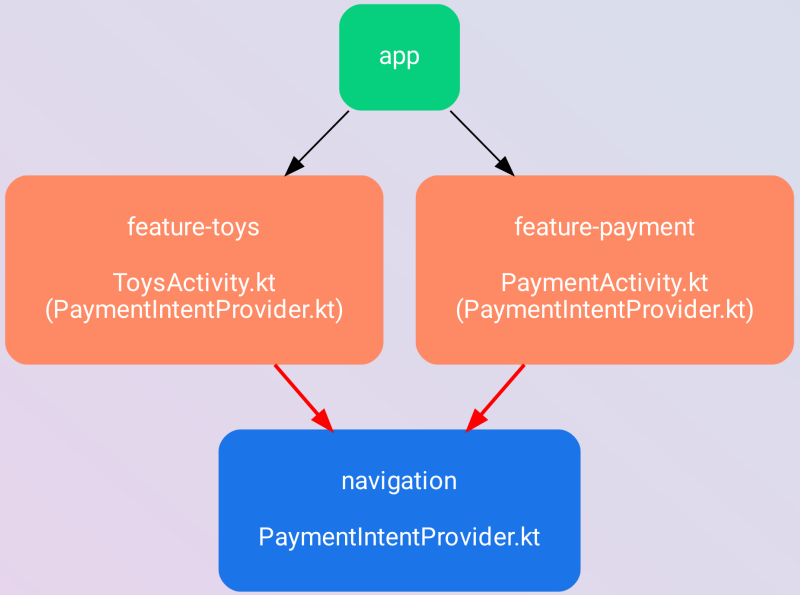

```
// Feature module – Toys
class ToysActivity : ComponentActivity() {

    private fun launchPaymentActivity() {
        // PaymentActivity doesn't exist in this module!
        val intent = Intent(context, PaymentActivity::class.java)
        startActivity(intent);
    }
```

Solution

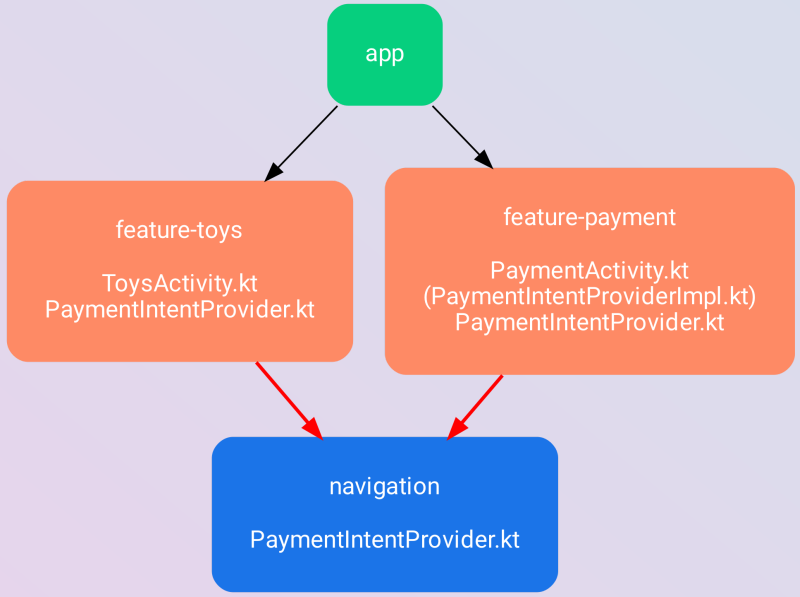
- Pattern: Intent Provider
  - Also known as mediator module

Pattern: Intent Provider

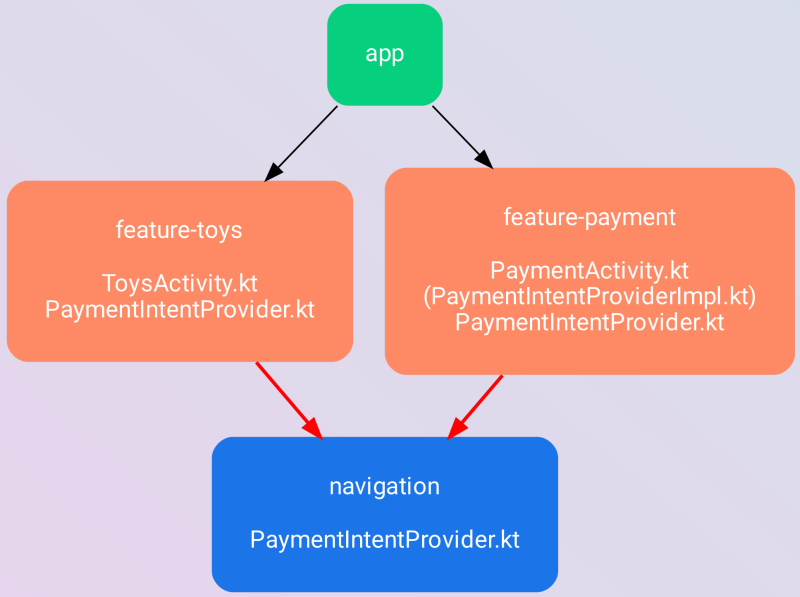
```
// Android basics
val intent = Intent(context, PaymentActivity::class.java)
startActivity(intent);

val intent = // intent creation is done somewhere..
startActivity(intent);

val intent = intentProvider.getPaymentIntent(context, "argument")
startActivity(intent)
```




```kotlin
// Android Library Module - Navigation
interface PaymentIntentProvider {

    fun getPaymentIntent(
        context: Context,
        paymentGateway: String
    ): Intent
}
```




```kotlin
// Feature Module – Payment
class PaymentIntentProviderImpl : PaymentIntentProvider {

    override fun getPaymentIntent(
        context: Context,
        paymentGateway: String
    ): Intent {
        val activity = PaymentActivity::class.java
        val intent = Intent(context, activity)
        intent.putExtra("key_argument", paymentGateway)
        return intent
    }
}
```




```
// App Module
val appModule = module {
    scope<ToysActivity> {
        scoped<PaymentIntentProvider> {
            PaymentIntentProviderImpl()
        }
    }

// Feature Module – Toys
class ToysActivity : ComponentActivity() {

    val provider: PaymentIntentProvider by inject()

    fun launchPaymentActivity() {
        val intent = provider.getPaymentIntent(this, "Google Pay")
        startActivity(intent)
    }
```

Other solutions

- Implicit Intent with a package name
  - `intent-filter/action` in `AndroidManifest.xml`
- For single-activity architecture using Jetpack Navigation
  - Use deep link (String in Navigation Graph)
  - `android-app://example.com/toys_fragment`

When should you do modularization?

When you and your team have time and effort to pay the cost

The cost

1. Organizing modules
2. Enforcing module convention
3. Dependency management
4. Dependency injection
5. Navigation

Thank you!